Midtown Corridor Improvements
Denali Street Area – Benson Boulevard to Tudor Road (16-28)

DRAFT Traffic Analysis Report

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Prepared for
R&M

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Abbreviations

ADT	Average Daily Traffic
AADT	Annual Average Daily Traffic
AASHTO	American Association of State Highway and Transportation Officials
AKDOL&WF	Alaska Department of Labor and Workforce Development
AMATS	Anchorage Metropolitan Area Transportation Solutions
ATM	Alaska Traffic Manual
BCI	Bicycle Compatibility Index
CAR	Critical Accident Rate
CCS	Continuous Count Station
DCM	*Design Criteria Manual*
DHV	Design Hourly Volume
DOT&PF	Alaska Department of Transportation and Public Facilities
FHWA	Federal Highway Administration
HCM	Highway Capacity Manual
HSIP	Highway Safety Improvement Program
ISD	Intersection Sight Distance
ITE	Institute of Transportation Engineers
KE	Kinney Engineering, LLC
LOS	Level of Service
MUTCD	*Manual on Uniform Traffic Control Devices*
MOA	Municipality of Anchorage
MTP	Metropolitan Transportation Plan
NCHRP	National Cooperative Highway Research Program
PDO	Property Damage Only
PGDHS	A Policy on the Geometric Design of Highways and Streets
PHF	Peak Hour Factor
ROW	Right of Way
SSD	Stopping Sight Distance
TMV	Turning Movement Volume
TWLTL	Two-Way Left Turn Lane
TWSC	Two Way Stop Control
vpd	Vehicles per Day
vph	Vehicles per Hour
v/c	Volume to Capacity

Executive Summary

The *Midtown Corridor Improvements* project considers alternatives to upgrade Denali Street from Northern Lights Boulevard to Tudor Road and 36th Avenue from A Street to Old Seward Highway to a Complete Streets model, which aims to accommodate all users and all modes of transportation. Kinney Engineering, LLC (KE) has been retained as a subcontractor to R&M Consultants to perform traffic analysis within the study area, shown in **Figure** 2. This report identifies concerns within the study area and analyzes possible solutions.

Identified concerns within the study include the following:

- The following intersections and road segments within the study area have crash rates statistically higher than the statewide average crash rates:
  - 36th Avenue and C Street
  - Denali Street and Benson Boulevard
  - Denali Street and 40th Avenue
  - Denali Street between Northern Lights Boulevard and Benson Boulevard
  - Denali Street between 40th Avenue and Tudor Road
- A high number of pedestrians (>20 an hour) were observed crossing the unsignalized intersections of 36th Avenue and Barrow Street and Denali Street and 40th Avenue. The current level of service (LOS) for these pedestrian crossings is very poor.
- There are no dedicated bike lanes in the study area and the existing sidewalks are uncomfortable when shared by bicyclists and pedestrians.
- Since October 2017, bus stops in the study area are no longer serviced, amplifying the need for alternative modes of access (i.e. pedestrian and bicyclist connectivity) for people who do not have/use personal vehicles.
- Vegetation blocks sight distance for turning movements from minor streets onto major streets at several locations.

As further discussed in the Introduction below, adhering to a Complete Streets methodology was at the forefront when analyzing pedestrian, bicyclist, and vehicular traffic within the study area. The following recommendations are included in this report:

- Install a roundabout at 40th Avenue and Denali Street to mitigate the high crash rate, reduce vehicle travel speeds, and vastly improve pedestrian crossing LOS.
- Reduce the number of lanes along Denali Street and reallocate space for bike lanes.
- Install bike lanes along Denali Street in both northbound and southbound directions to provide continuous connectivity.
- Trim vegetation within the study area to increase sight distance.

1 Introduction

SECTION HIGHLIGHTS

- The study area includes Denali Street and 36th Avenue in Midtown Anchorage.
- The study considers how to enhance pedestrian and bicycle safety and connectivity.
- This report focuses on existing and future crash experiences and multi-modal operations, comparing the results for the existing geometry to the results with the proposed Complete Streets elements.

In 2017, Mayor Ethan Berkowitz stated, "Anchorage moves in a lot of ways and we want to make sure whether you are walking or riding, you can do it safely." [Mayor's Corner Press Release, "Municipality Continues Work on Important Bike and Pedestrian Improvements," February 10, 2017, web link.]

Also in 2017, Mayor Berkowitz launched the Vision Zero Initiative, which aims to reduce traffic fatalities and serious injuries. In addition, Anchorage Metropolitan Area Transportation Solutions (AMATS) is currently considering adoption of a Complete Streets policy. Complete Streets are designed and operated to be inclusive of all users, from pedestrians to bicyclists to motorists to transit riders. The draft AMATS Complete Streets policy indicates that it "will focus on developing a connected, integrated transportation network that serves all users." The design of Complete Streets roadways will be different depending on the context and purpose of each roadway.

The scope for this project states that it "will examine the feasibility of enhancing pedestrian and bicycle safety and improving accessibility in this midtown corridor." This traffic analysis identifies opportunities and concerns within the study area and suggests possible methods for improving the "completeness" of 36th Avenue from A Street to the Old Seward Highway and Denali Street from Northern Lights Boulevard to Tudor Road. Figure 1 shows the project vicinity, while the study area and fifteen intersections chosen for analysis are depicted in **Figure** 2. The study area intersects a concurrent project, *W. 32nd Ave & E. 33rd Ave Upgrades,* at the intersection of Denali Street and Calais Drive/33rd Avenue. The concurrent project has a similar aim and proposes the installation of east/west bike lanes.

Denali Street runs north-south and intersects 36th Avenue which runs east-west. North of 36th Avenue, Denali Street has 5 lanes with sidewalks on both sides. South of 36th Avenue, Denali Street reduces to 4 lanes with sidewalks. Within the study area, 36th Avenue has 4 lanes with left turn lanes and sidewalks on both sides. Neither road has shoulders or separated bicycle facilities, and both are classified as Class II minor arterials by the Municipality of Anchorage (MOA).

This traffic analysis report examines the existing conditions of the study corridors in terms of safety (crash experience) and multimodal operations, with a focus on vehicular movements and pedestrian experience. This report analyzes the impacts of a proposed lane reduction along Denali Street and the installation of north/south bike facilities. Furthermore, it provides an analysis of the effects of these proposed Complete Streets elements on future crash experience and multi-modal operations.

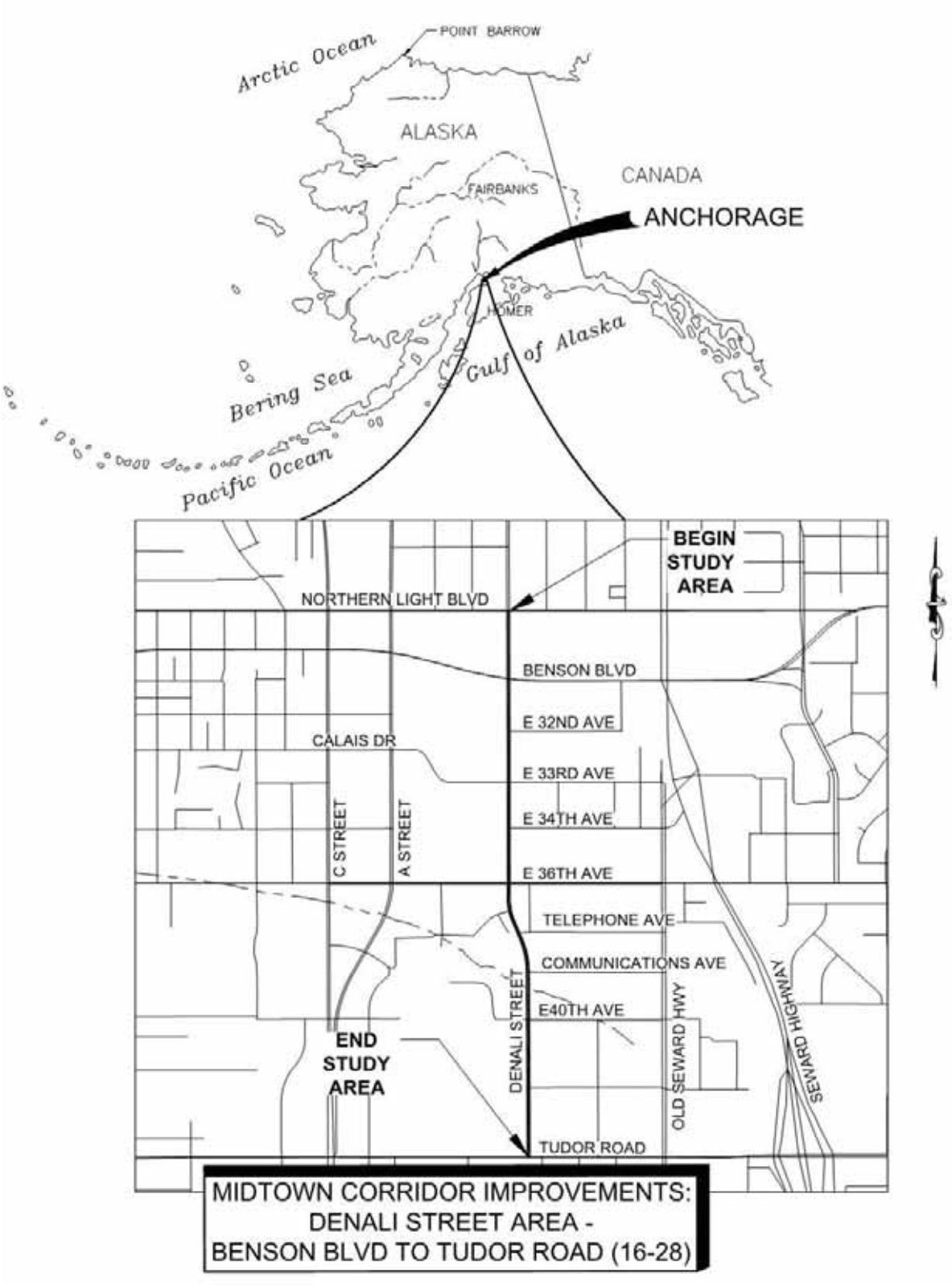


Figure 1. Project Vicinity Map

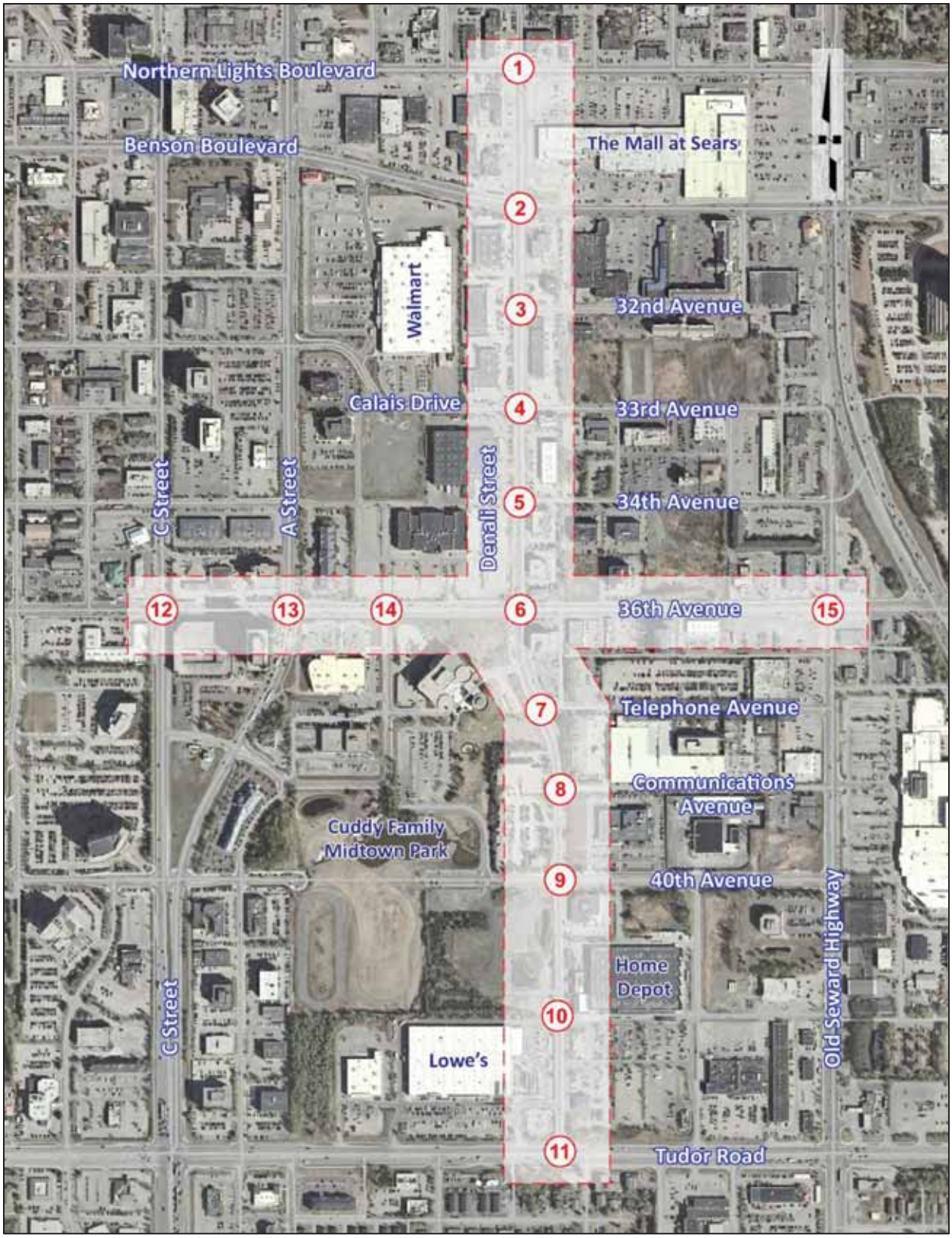


Figure 2. Study Area and Study Intersections

1.1 Area Studies, Plans and Projects

Several planning documents with desired and proposed features affecting facilities in the project area were considered during the analysis process. Additionally, some developments within the study area are currently being planned or constructed.

1.1.1 Conceptual Design Memorandum: Midtown Pedestrian and Bicycle Facilities – Denali Street & E 36th Avenue Corridors (October 12, 2016)

The MOA's *Conceptual Design Memorandum* describes the existing issues along Denali Street and 36th Avenue with respect to pedestrians and cyclists. The current issues include narrow sidewalks, light poles in the sidewalks, no bike lanes, no temporary snow storage, and non-ADA-compliant transit facilities. The memo divides the roads into different segments based on their existing layout and functionality and then proposes improvements to these segments as follows:

- Denali Street – 36th Avenue to Tudor Road
  - Convert the existing 4-lane road to a 3-lane road
  - Add 5-foot bicycle lanes
  - Construct separated pathways
  - Upgrade lighting and transit facilities

- Denali Street – 36th Avenue to Benson Boulevard
  - Convert the existing 5-lane road into fewer lanes
  - Add 5-foot bicycle lanes
  - Separate or widen sidewalks to 8 feet
  - Upgrade lighting and transit facilities
  - Purchase right of way at Denali Street and 36th Avenue to accommodate improvements

- 36th Avenue – A Street to Denali Street
  - Convert the existing 5-lane road into fewer lanes
  - Add 5-foot bicycle lanes
  - Separate or widen sidewalks to 8 feet
  - Separate pathway on library parcel
  - Construct pedestrian and cyclist plaza at the library and connect to sidewalks and the Cuddy Family Park
  - Upgrade lighting and transit facilities

- 36th Avenue – Denali Street to Old Seward Highway
  - Convert the existing 5-lane road into fewer lanes
  - Add 5-foot bicycle lanes
  - Separate or widen sidewalks to 8 feet
  - Upgrade lighting and transit facilities

This traffic analysis and KE's accompanying "Traffic Signals and Illumination Report" review the delineated issues and concerns in more detail and consider the feasibility of the proposed improvements. New recommendations are also suggested.

1.1.2 Anchorage Bicycle Plan: Bicycles as a Mode of Transportation

The 2010 AMATS *Anchorage Bicycle Plan* describes the existing conditions and delineates goals for bicycling networks in and around Anchorage. It presents the following overall goal: Double the amount of utility bicycling trips while reducing the number of cyclist crashes by one-third.

While neither Denali Street nor 36th Avenue are listed as part of the core bicycle network, the *Anchorage Bicycle Plan* states that Midtown Anchorage accounts for 32% of all bicycle destinations. The plan rates corridors within Anchorage on a Bicycle Compatibility Index (BCI) from A to F, with BCI A being bicycle-friendly and BCI F being not bicycle-friendly. The minimal acceptable level for a designated route within the bicycle network is BCI C. Under existing conditions 36th Avenue performs at BCI E, Denali Street between Northern Lights Boulevard and 36th Avenue rates at BCI E, and Denali Street between 36th Avenue and Tudor Road rates at BCI D.

The *Anchorage Bicycle Plan* also describes minimum standards for different types of bicycle infrastructure. For bicycle lanes next to high traffic volume roads, the plan suggests a 5-foot width; wider widths encourage vehicles to encroach the bicycle lanes at intersections. For paved shoulder bikeways on roads with speed limits less than 50 mph, the plan recommends a 4-foot width. For separated pathways, the plan suggests a width of 8 to 10 feet with 3-foot lateral clearance, as recommended in the American Association of State Highway and Transportation Officials (AASHTO) *Guide for the Development of Bicycle Facilities*.
This traffic analysis suggests improvements within the study area to improve accessibility for bicyclists and better connect the Midtown area to the rest of Anchorage's bicycle network. The analysis also considers which bicycle treatments are most appropriate and how these treatments affect all facility users.

1.1.3 Anchorage Pedestrian Plan: Making Anchorage a Better, Safer Place to Walk

The 2007 AMATS *Anchorage Pedestrian Plan* describes the comprehensive pedestrian facility plan within Anchorage. The overall objective is to double the number of pedestrian trips made by Anchorage residents while reducing the number of pedestrian-vehicle crashes. General improvements promoted by the plan include upgrading curb ramps to be ADA-compliant, removing obstructions in the sidewalks, lighting walkways to create safer routes, and signing walking routes for better designation and identification.

Guidance within the *Anchorage Pedestrian Plan* states that sidewalks should be a minimum of 5 feet wide and separated from the road by a minimum of 7 feet. Sidewalks that abut the road or curb should be wider than 5 feet. The October 2016 conceptual design memo includes adding separated pathways/sidewalks or adding 8-foot-wide sidewalks when they are located next to the road. Additionally, the plan recommends removing obstructions such as light/electric poles from the walkway and upgrading lighting so it does not reduce the effective width of the walkway.

The study area is located in Midtown, which according to the *Anchorage Pedestrian Plan*, generates a greater number of pedestrian trips than most other areas in Anchorage. Survey results published in the plan identify hazards and missing links within the study area. Identified hazards include:

- Non-stop traffic between office place (Office Depot) and Lowe's

- Vehicles crossing Denali Street between Lowe's and The Home Depot

Identified missing links include:

- No crossing on Denali Street between Lowe's and The Home Depot
- No pedestrian facilities on 34th Avenue behind Century 16

The *Anchorage Pedestrian Plan* has highlighted pedestrian improvement projects and ordered their priority. The following are projects within or adjacent to the study area listed with their priority number:

- Crossings on Benson Boulevard and Northern Lights Boulevard, Seward Highway to Denali Street, 85
- Denali Street to A Street – pedestrian corridor on 34th Avenue behind Century 16 Theater, 157
- Commercial District – bounded by Denali Street, Seward Highway, 36th Avenue, and Benson Boulevard is missing sidewalks, 161

This traffic analysis and KE's accompanying "Traffic Signals and Illumination Report" consider upgrades to lighting and pedestrian facilities within the study area. The analysis does not specifically address hazards, missing links, or maintenance issues identified in the *Anchorage Pedestrian Plan.*

1.1.4 Anchorage Talks Transit Choices, Outreach, and Future Alternatives

In October 2017, People Mover, Anchorage's transit system, shifted to a lower coverage higher frequency model, affecting users within the project area. The *Anchorage Talks Transit* publication describes and includes background information for the changes. Within the project area, the old bus transit system included bus routes 2, 36, and 60. Multiple transit stops were located along 36th Avenue between A Street and the Old Seward Highway and along Denali Street between 40th Avenue and Benson Boulevard.

The new Anchorage bus transit system eliminated most bus stops along 36th Avenue and Denali Street. Under the new system, bus stops are located on the outskirts of the study area along Northern Lights Boulevard, Benson Boulevard, A Street, C Street, and Tudor Road.

The decrease in transit access to the study area may lead to an increase in pedestrian and bicycle volumes as pedestrians and cyclists may use 36th Avenue and Denali Street to access businesses, new bus stops, and transfer routes. This possibility emphasizes the need for adequate pedestrian and bike facilities within the study area.

1.1.5 Interim 2035 Metropolitan Transportation Plan

One of the priorities stated in the *Interim 2035 Metropolitan Transportation Plan (MTP)* is to "calm traffic and improve opportunities for modes other than automobiles."

This plan does not list specific improvement in the immediate project area; however multiple projects are proposed at the fringes of or near the project area, as shown in Table 1.

Table 1: MTP Projects near the Midtown Corridor Improvements Project

MTP Project Number	*Project Location*	*Description of Project*	*Priority**
104	36th Avenue/Seward Highway Interchange – Tudor Road to 33rd Avenue	Construct new interchange with separated pathways	Short Term
108	36th Avenue Access Management – Spenard Road to Denali Street	Construct access management treatments	Short Term
209	A Street/ C Street Couplet Restripe – Tudor Road to 9th Avenue	Restripe to provide 4 lanes in each direction	Long Term
510	Midtown East-West Routes Study Area C	Investigate feasibility of constructing bicycle facility through midtown	Short Term
515	C Street – O'Malley Road to 10th Avenue	Construct bicycle lanes	Short Term
526	Northern Lights Boulevard – Seward Highway to Minnesota Drive	Construct separated sidewalks	Short Term
537	Benson/Northern Lights Blvd – Arlington Drive to Latouche Street	Construct bicycle lanes (pending project 510)	Short Term
602	Tudor Rd – Elmore Rd to Minnesota Drive	Upgrade separated pathway	Long Term
616	A Street – West Side, Benson Boulevard to 36th Avenue	Construct missing sidewalk	Long Term
623	Tudor Road – Minnesota Drive to Old Seward Highway	Add paved shoulder bikeway	Long Term

* Short Term projects are anticipated to begin in 2011 – 2023
Long Term projects are anticipated to begin in 2024 – 2035

The traffic analysis recommends solutions that are inclusive of all facility users, including bicyclists.

1.1.6 Official Street and Highways Plan: Maps, Policies, and Standards

The 2014 MOA *Official Streets and Highways Plan* lists both Denali Street and 36th Avenue as Class II minor arterial roads. According to this plan, the first function of arterials is to move large volumes of vehicles and goods. Minor arterials should have two to four moving lanes and paved shoulders for emergency parking. Minor arterials should also connect neighborhoods by providing for safe pedestrian access facilities. In addition, Class II minor arterial roads should have a minimum right of way (ROW) width of 80 feet if they are outside of the Central Business District area. It was noted that road sections within the study area have ROW widths as narrow as 65 feet, 15 feet less than the recommended minimum width.

This plan further describes how a road can be classified based on street typology. Typically, the project sponsor will designate the street typology at the project initiation stage. Denali Street and 36th Avenue are most likely defined as commercial typology. This typology is defined by wider travel lanes, medians, sidewalks, bicycle facilities, and landscaping. The project conceptual design memo recommends improvements consistent with this street typology.

The proposed Complete Streets improvements appear to fall within the recommendations for minor arterials in a commercial area.

1.1.7 ZJ Loussac Public Library Facility Master Plan Report

The 2013 *ZJ Loussac Public Library Facility Master Plan Report* proposes constructing a pedestrian and bicycle plaza on library grounds with connections to adjacent sidewalks and Cuddy Family Park. The October 2016 conceptual design memorandum confirms the desire to have better connectivity to the park. The report provides a proposed plan for the library grounds, which includes new library access, outdoor gathering areas, and pathways. The plan proposes to reconfigure the existing vehicle access between the library parking and Denali Street, which includes an additional driveway on Denali Street within the study area. Recently, the library's entrance reconstruction was completed; however, not all the other proposed elements were completed.

The traffic analysis proposes modifying the intersection of Denali Street and 36th Avenue, which would encroach on library property. The modifications would improve access to the library, which is in line with the goals of the library master plan report.

1.1.8 Seward Highway: Midtown Traffic Congestion Relief

DOT&PF is currently conducting a study to provide solutions to resolve traffic congestion on the Seward Highway between 20th Avenue and Tudor Road. A change in the configuration of the intersection of the Seward Highway and 36th Avenue could potentially increase or decrease volumes in study area.

Since the "Seward Highway: Midtown Traffic Congestion Relief" study is just beginning, this traffic analysis cannot incorporate findings or recommendations from the study. However, if recommendations from this traffic analysis are implemented, the two projects should be developed collaboratively to ensure the development of a well-integrated road network.

1.1.9 W. 32nd Ave & E. 33rd Ave Upgrades: Arctic Boulevard to Old Seward Highway

The MOA is conducting a concurrent study looking at alternatives to improve multimodal transportation by incorporating a Complete Streets methodology along W. 32nd Avenue, Calais Drive, and E. 33rd Avenue from Arctic Boulevard to Old Seward Highway. The project is focusing on creating continuous east/west pedestrian and bicycle facilities while upgrading infrastructure, safety, and traffic operations and decreasing traffic congestion.

The MOA's two projects meet at the intersection of Denali Street and 33rd Avenue/Calais Drive and are collaborating together.

2 Crash Analysis

Crash data for five years from 2010 to 2014 was collected from the MOA. Pedestrian, cyclist, and vehicle crashes were differentiated and analyzed to determine which intersections and segments within the study area are crash hotspots.

From 2010 to 2014, 644 total crashes were recorded in the study area. Crash rates were computed and compared to statewide averages for similar locations, as published in the 2017 Alaska Highway Safety Improvement Program (HSIP) manual, and calculated critical accident rates (CAR). The CAR is a calculated threshold that indicates the likelihood that the crash rate is above average due to characteristics of the location, and not purely by chance.

Table 2 shows the results of the intersection crash rate analysis. At intersections, crash rates are calculated in terms of crashes per million entering vehicles. Three intersections have intersection crash rates that are statistically above the state average crash rates: 36th Avenue at C Street, Denali Street at Benson Boulevard, and Denali Street at 40th Avenue.

SECTION HIGHLIGHTS

- Bicycle and pedestrian crashes occur throughout the project area; however, they occur more frequently on the project area edges.
- The unsignalized intersection of 40th Avenue with Denali Street and the segment from 40th to Tudor Road have a high number of angle-type crashes; a fatal crash occurred at the intersection in 2014.
- The signalized intersection of Benson Boulevard with Denali Street and the segment from Benson to Northern Lights Boulevards have a higher than average crash rate; a fatal crash involving a pedestrian occurred in the segment in 2012.
- The signalized intersection of 36th Avenue with C Street also has a higher than average crash rate; there were three major injury crashes, including one pedestrian crash, during the study period.

Table 3 summarizes the results of the crash analysis for segments. Two segments with crash rates statistically above the state average rate were identified: Denali Street from Northern Lights Boulevard to Benson Boulevard and Denali Street from 40th Avenue to Tudor Road. A fatal crash occurred on the Northern Lights Boulevard to Benson Boulevard segment and an incapacitating injury crash occurred on the 40th Avenue to Tudor Road segment during the analysis period.

Table 4 summarizes the crashes by type and severity. Two fatal crashes were recorded at intersections in the study area. A fatal crash involving a pedestrian occurred on Denali Street between Northern Lights Boulevard and Benson Boulevard in March 2012. A northbound vehicle driving at night failed to see a pedestrian in dark clothing who was in the roadway. The pedestrian was struck and killed. The second fatal crash occurred in October 2014 at the intersection of Denali Street and 40th Avenue. A westbound vehicle failed to stop at the stop sign, striking a northbound vehicle in the intersection. A passenger in the northbound vehicle died.

Table 2. Summary of Crash Rates at Intersections along 36th Avenue and Denali Street

Intersection		*Total Crashes*	*Crash Rate*	*State Average Crash Rate*	*Critical Accident Rate (CAR)*
Denali Street	Northern Lights	50	0.93	1.01	1.25
	Benson Boulevard	85	1.37	1.01	1.23
	32nd Avenue	12	0.46	0.57	0.83
	33rd Avenue/Calais Drive	26	1.03	1.47	1.89
	34th Avenue	20	0.81	0.57	0.84
	40th Avenue	30	1.74	0.57	0.89
	36th Avenue	74	1.42	1.47	1.76
	Telephone Avenue	12	0.57	0.47	0.73
	Tudor Road	46	0.63	1.01	1.21
36th Avenue	C Street	76	1.28	1.01	1.23
	A Street	78	0.99	1.01	1.2
	Barrow Street	15	0.34	0.57	0.77
	Old Seward Highway	72	1.37	1.47	1.76

XX Crash rate above State Average Crash Rate
XX Crash rate above State Average Crash Rate and CAR

Table 3. Summary of Crash Rates along 36th Avenue and Denali Street Segments

Road	*Segment Extents*	*Total Crashes*	*Crash Rate*	*State Average Crash Rate*	*Critical Accident Rate (CAR)*
Denali Street	Fireweed Lane to Northern Lights Boulevard	0	-	1.25	3.30
	Northern Lights to Benson Boulevard	7	3.03	1.25	2.68
	Benson Boulevard to 33rd Avenue	3	0.73	1.25	2.28
	33rd Avenue to 36th Avenue	4	0.95	1.25	2.27
	36th Avenue to Telephone Avenue	2	1.16	1.25	2.94
	Telephone Avenue to 40th Avenue	1	0.42	1.25	2.65
	40th Avenue to Tudor Road	16	4.48	1.9	3.24
36th Avenue	C Street to A Street	2	0.61	1.25	2.42
	A Street to Denali Street	5	0.68	1.25	1.99
	Denali Street to Old Seward Highway	5	0.58	1.25	1.93

XX Crash rate above State Average Crash Rate and CAR

Table 4. Summary of Crashes by Severity

	PDO	*Minor*	*Major*	*Fatal*	*Total*
Bicycle	2	11	2	0	15
Head on/Left Turn	56	31	1	0	88
Pedestrian	1	12	4	1	18
Rear End/Backing	151	57	3	0	211
Right Angle	109	92	6	1	208
Sideswipe	64	15	0	0	79
Struck Object	23	2	0	0	25
Unknown	1	0	0	0	1
Total	*407*	*220*	*16*	***2***	***645***

The crashes that occurred in the study area are visually summarized in Figure 3 and Figure 4.

Additional details on crash types and severity at each intersection and segment can be found in Appendix A: Crash Data.

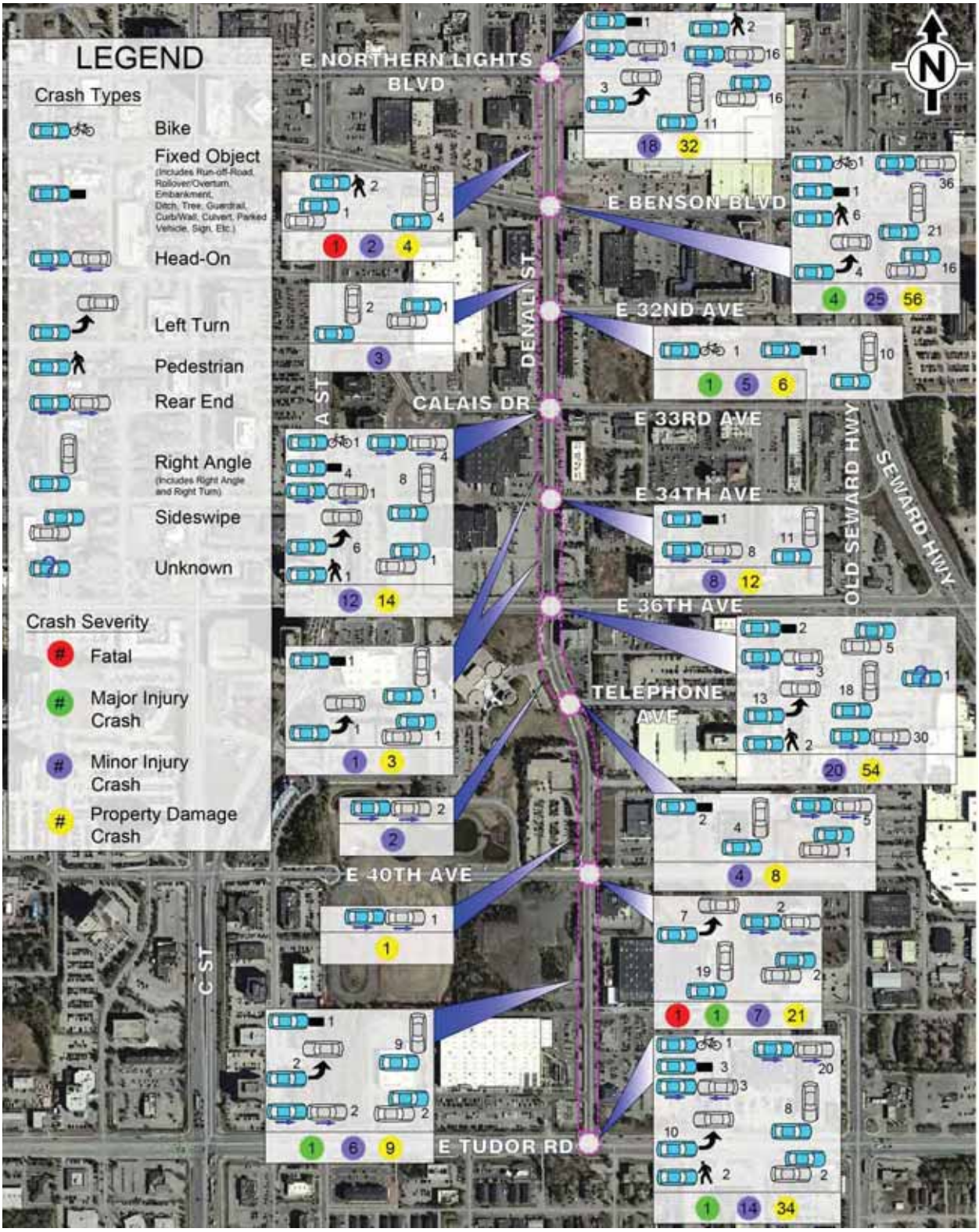


Figure 3. Crash Severity and Type for Denali Street (2010 to 2014)

Figure 4. Crash Severity and Type for 36th Avenue (2010 to 2014)

The following paragraphs describe the crashes at the intersections and segments with a statistically higher than average crash rate.

2.1 Benson Boulevard and Denali Street

At the intersection of Benson Boulevard with Denali Street, there were four major injury crashes, including two pedestrian crashes, one rear-end crash, and one angle crash. This intersection also had six pedestrian crashes, more than at any other location in the study area. Four of the pedestrian crashes occurred when the pedestrian was crossing Benson Boulevard and the other two occurred when the pedestrian was crossing Denali Street. Two of the crashes listed "pedestrian error" as a contributor to the crash, and three of the crashes occurred at night during winter time.

The dominant vehicle crash types at Benson Boulevard and Denali Street are rear-end crashes (36 total crashes) and angle crashes (21 total crashes). Figure 5 depicts the number of rear-end and right-angle crashes versus time of day. The majority of rear-end crashes occurred around the noon and PM peak hours. The right-angle crashes were more evenly spread throughout the day, with a higher crash occurrence between 2-3:00 PM and 4-5:00 PM.

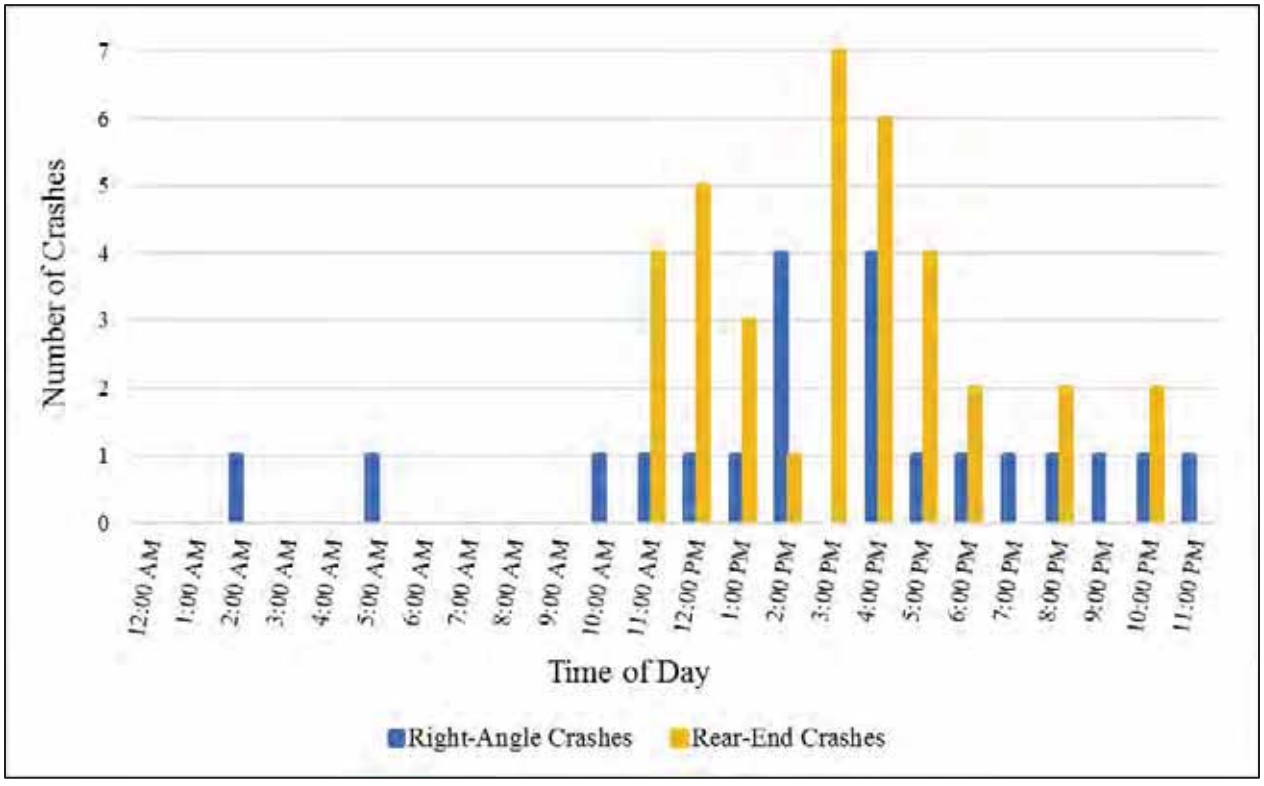


Figure 5. Number of Crashes vs. Time of Day – Benson Boulevard and Denali Street

Figure 6 shows the contributing human circumstances recorded on the police crash reports for each right-angle and rear-end crash. Some type of driver error, from red light violations to driver inattention, was reported in 67% of the crashes.

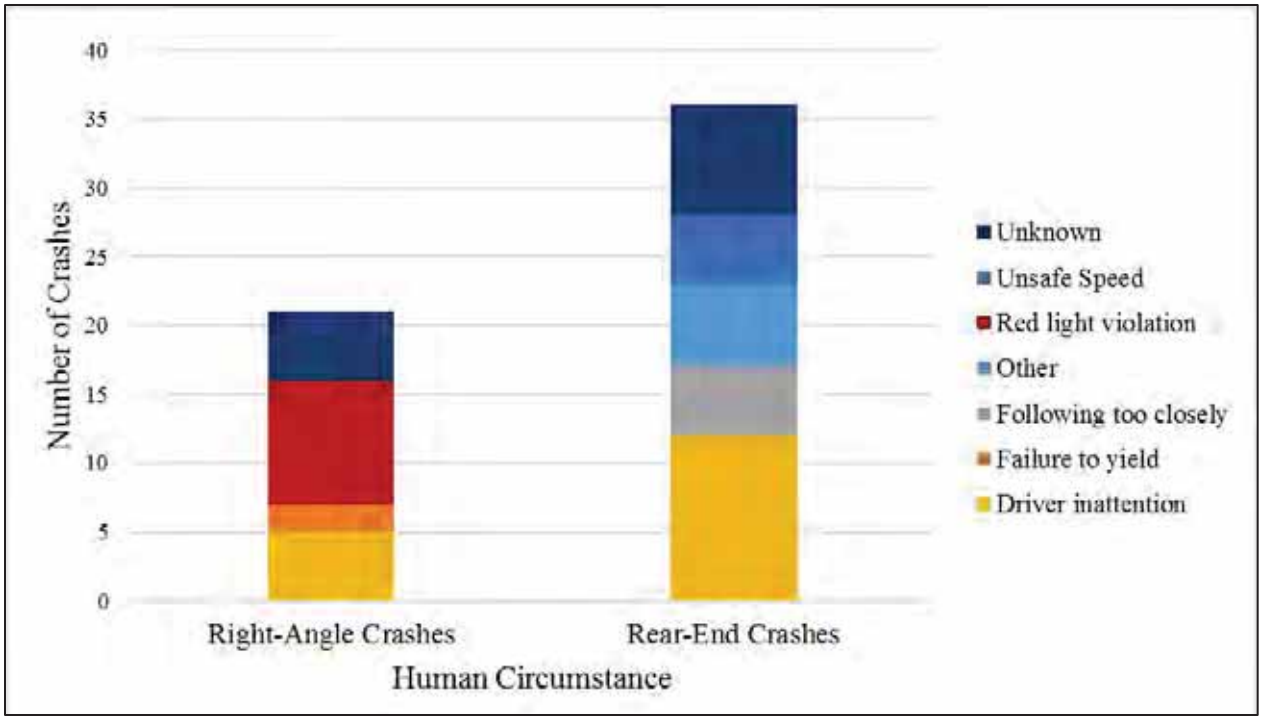


Figure 6. Number of Crashes vs. Human Circumstances – Benson Boulevard and Denali Street

As shown in Figure 7, many of the rear-end and right-angle crashes occurred between October and March, with snow, ice, frost, and/or wet road conditions listed. Seventy-eight percent (28 of the 36) of rear-end crashes and 62% (13 of the 21) of right-angle crashes occurred during these winter months.

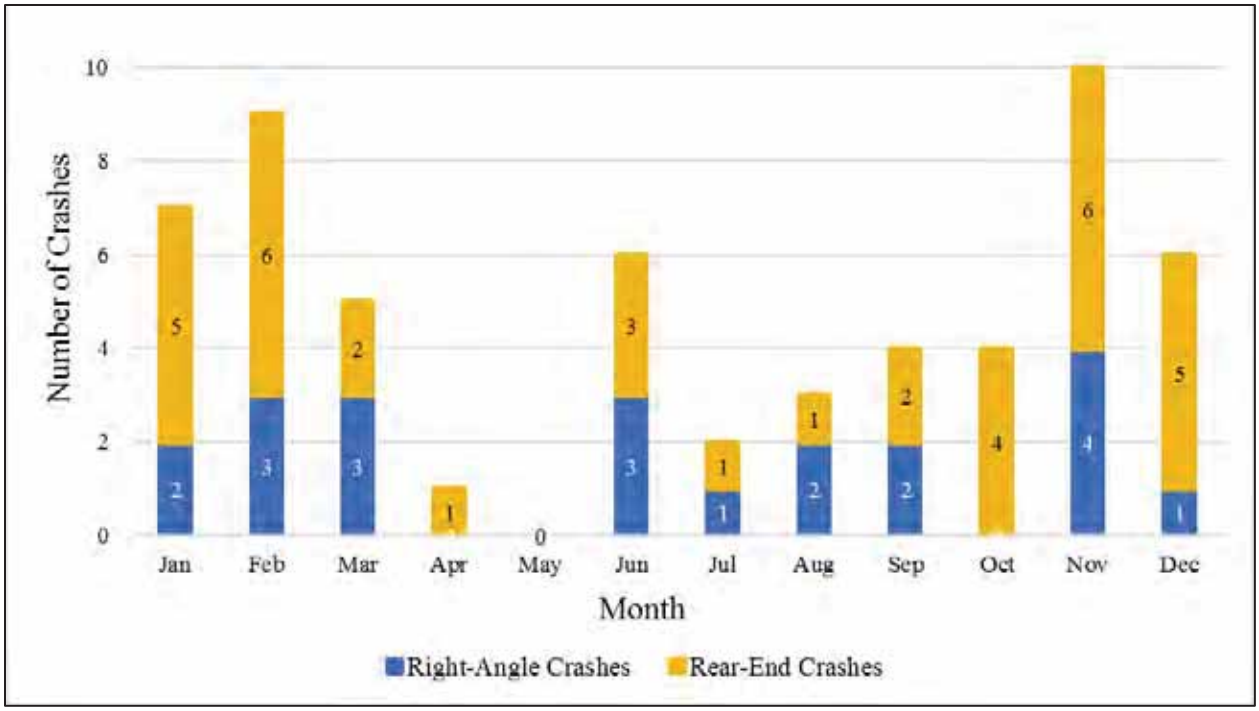


Figure 7. Number of Rear-End and Right-Angle Crashes vs. Month – Benson Boulevard and Denali Street

Continuous Count Stations (CCSs) are located throughout the Alaska Department of Transportation and Public Facilities (DOT&PF) Central Region and record year-round traffic volume data which show historical traffic trends. While there are no CCSs on Denali Street or Benson Boulevard within the study area, there is a CCS located nearby on Northern Lights Boulevard. Figure 8 compares historical data from this CCS with all analyzed crash data at the intersection of Benson Boulevard and Denali Street. Even though traffic volume decreases during the winter months, the occurrence of crashes between October and March increases, suggesting that winter weather, winter maintenance, and dark conditions may contribute to the high occurrence of crashes at this intersection.

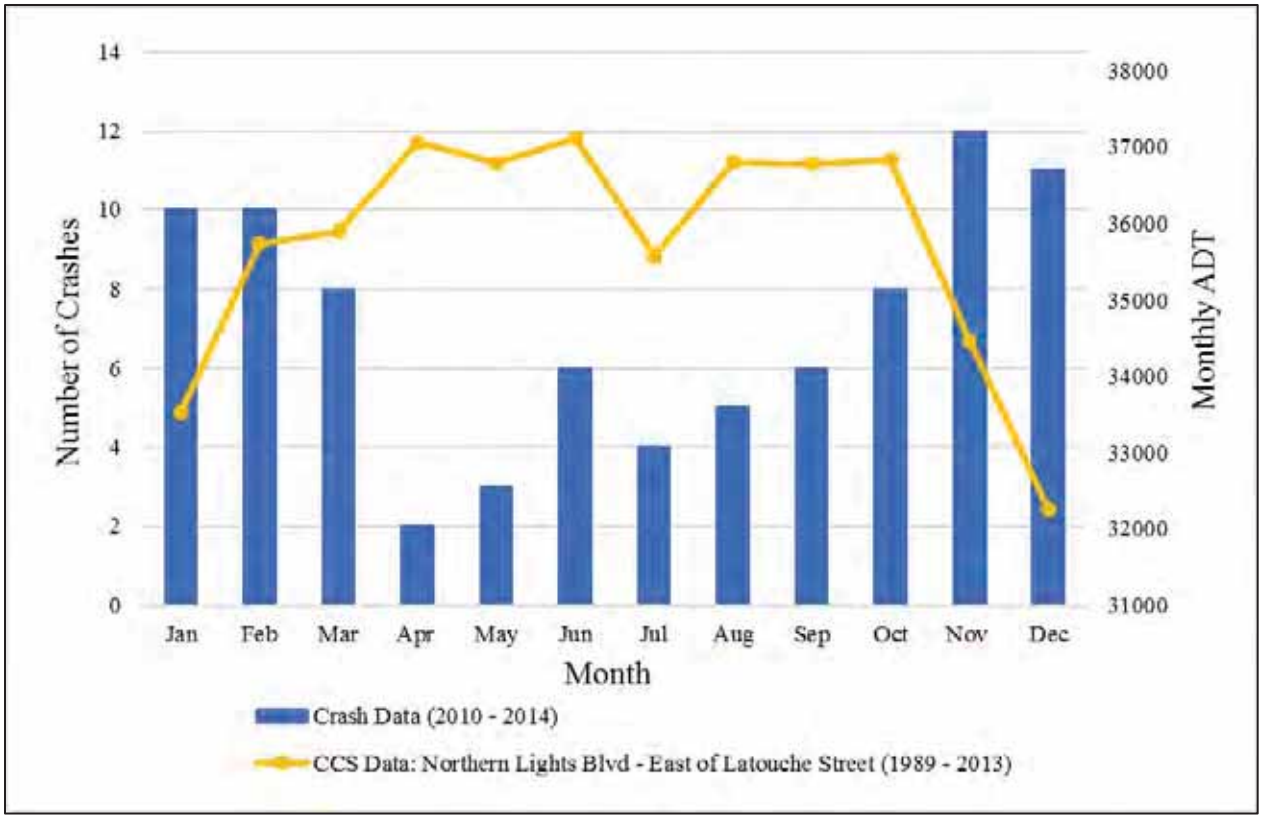


Figure 8. CSS Data Compared to Crashes at Benson Boulevard and Denali Street

2.2 Segment of Denali Street from Northern Lights to Benson Boulevard

As previously described, there was one fatal crash on this segment. There were no major injury crashes during the study period. The predominant crash type was angle crashes (4 out of the 7 total crashes). These crashes were likely related to vehicles entering or exiting Denali Street at the driveway approaches.

2.3 40th Avenue and Denali Street

At the intersection of 40th Avenue with Denali Street, there was one major injury crash, in addition to the fatal crash already mentioned. There were 19 angle crashes and 7 left turn crashes. These crashes may be indicative that the side street vehicles either have difficulty recognizing acceptable gaps in oncoming traffic or that they fail to see the stop sign and do not realize that they are approaching an intersection with a more major street.

2.4 Segment of Denali Street from 40th Avenue to Tudor Road

Between 40th Avenue and Tudor Road on Denali Street, there was one major injury crash – a right angle crash at the Lowe's driveway. Right angle and left turn crashes accounted for 11 of the 16 total crashes.

2.5 C Street and 36th Avenue

At the intersection of 36th Avenue with C Street, there were three major injury crashes, including one pedestrian crash, one rear-end crash, and one right-angle crash. The predominate crash types were angle (31 crashes) and rear-end (27 crashes). Figure 9 depicts the number of rear-end and right-angle crashes versus time of day. While fewer crashes occurred in the early morning hours, most of the crashes were spread throughout the day with no apparent correlation between crash

frequency and peak traffic hours. The highest hourly number of right-angle crashes occurred between 10-11:00 AM, and the highest number of rear-end crashes occurred from 1-2:00 PM.

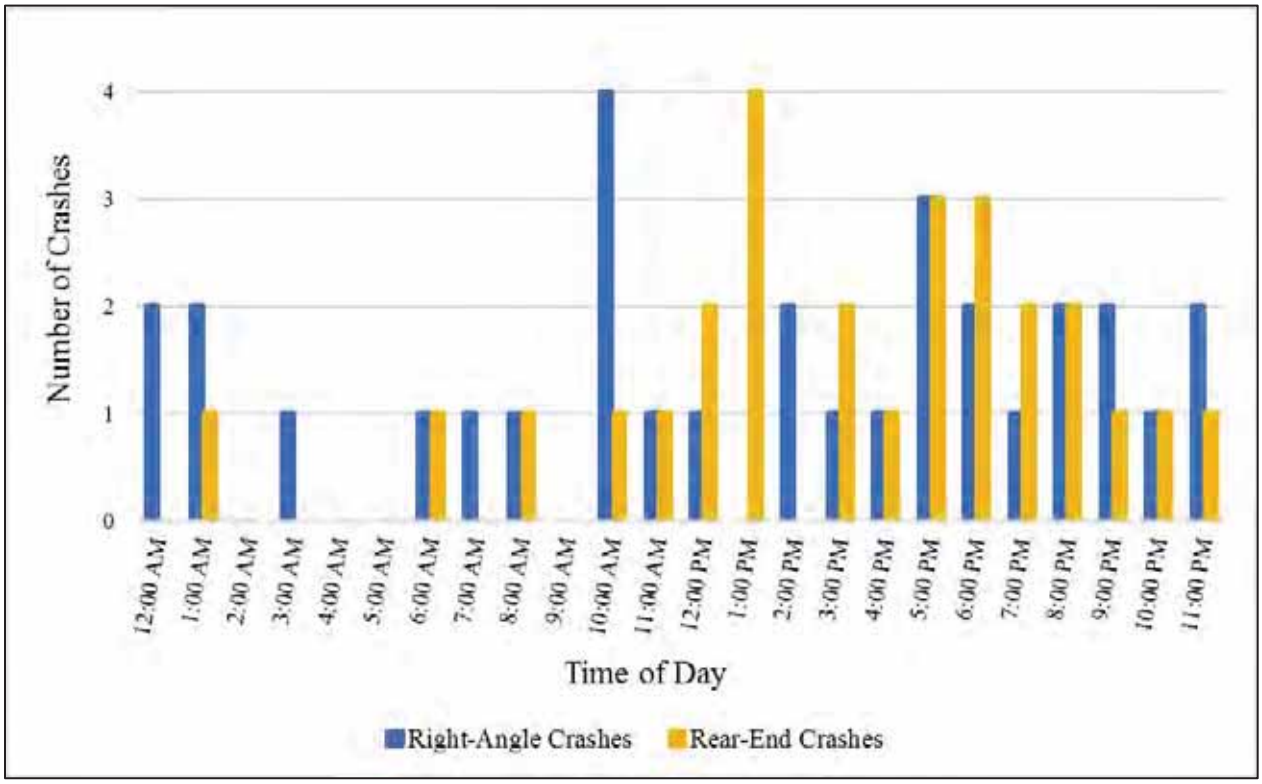


Figure 9. Number of Crashes vs. Time of Day – 36th Avenue and C Street

Figure 10 shows the contributing human circumstances recorded for right-angle and rear-end crashes. Some type of driver error, from unsafe speeds to driving under the influence, was reported for 66% of the crashes.

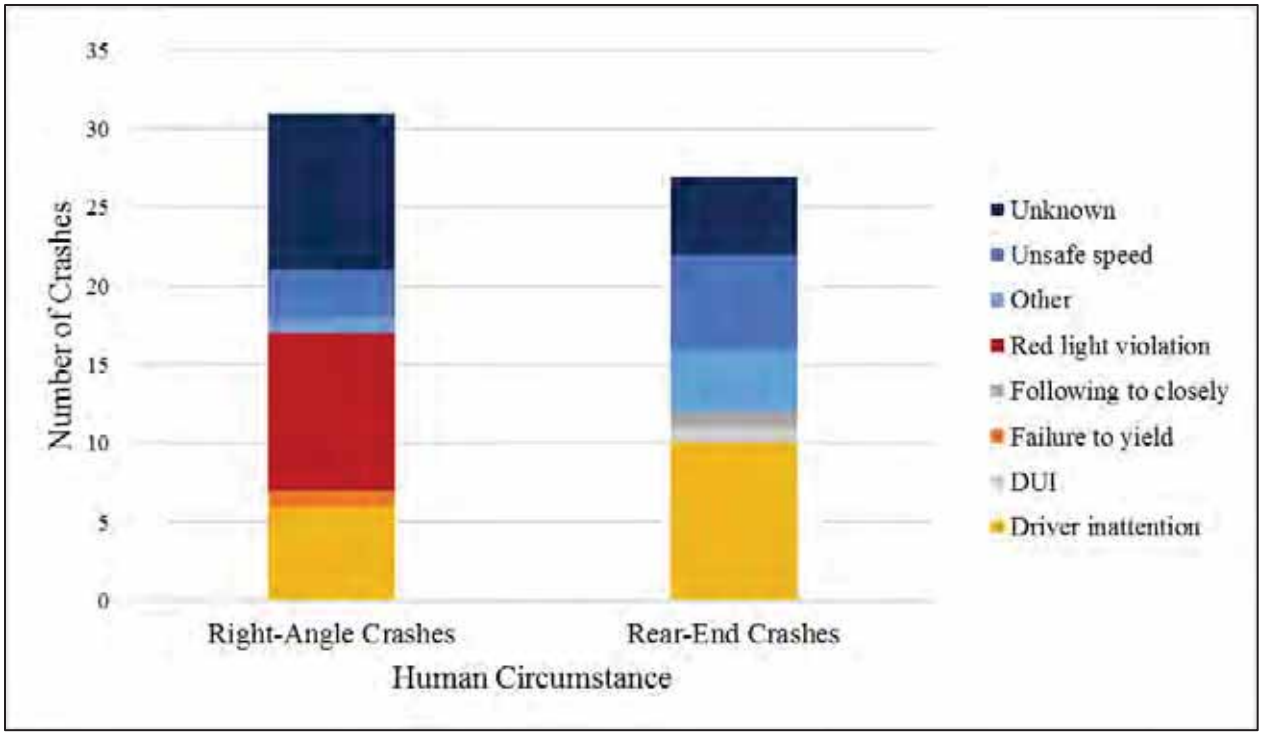


Figure 10. Number of Crashes vs. Human Circumstances – 36th Avenue and C Street

Eighty-one percent (25 out of 31) of the right-angle crashes and 67% (18 out of 27) of the rear end crashes occurred between October and March. Most of these crashes listed ice, slush, frost and/or snow as the road condition.

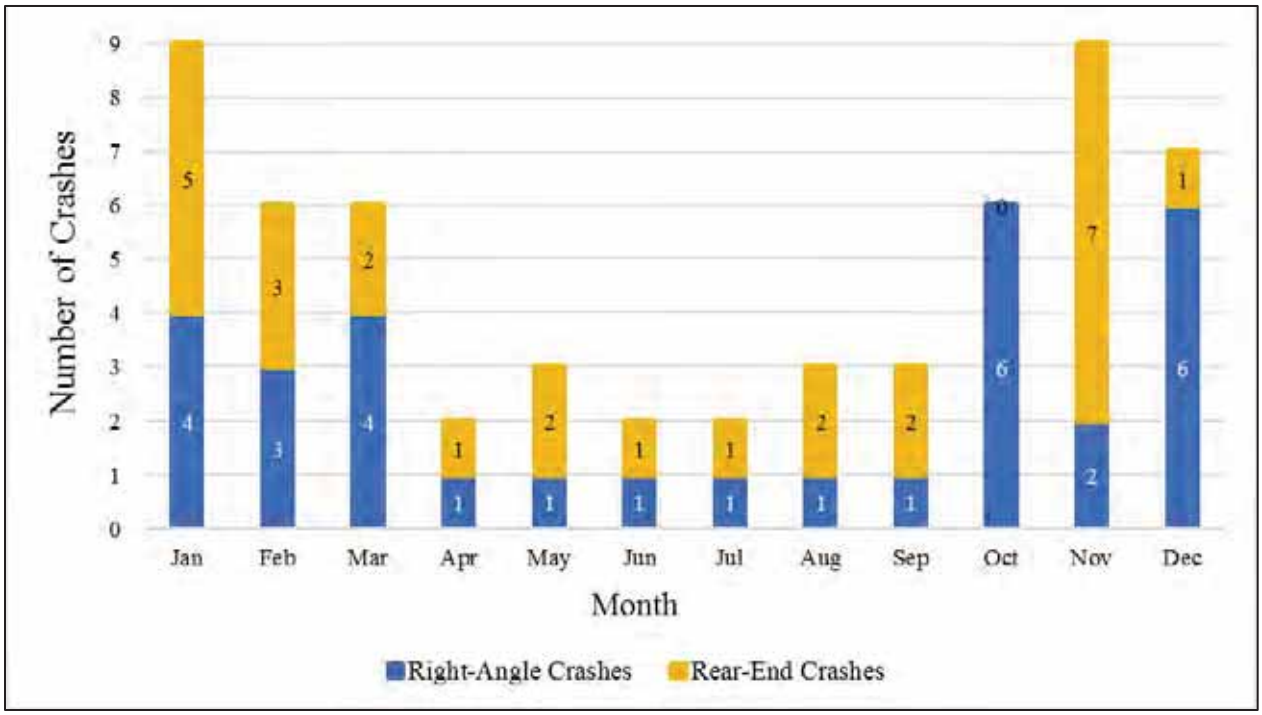


Figure 11. Number of Rear-End and Right-Angle Crashes vs. Month – 36th Avenue and C Street

While no CCSs are located within the study area on C Street or 36th Avenue, there is a CCS on C Street north of 20th Avenue. Figure 12 compares historical data from this CCS with all analyzed crash data at the intersection of C Street and 36th Avenue. Like the intersection of Benson Boulevard and Denali Street, even though traffic volume decreases during the winter months, the occurrence of crashes between October and March increases. Winter weather and driving conditions, paired with poor driving techniques, likely contribute to the high occurrence of crashes at this intersection.

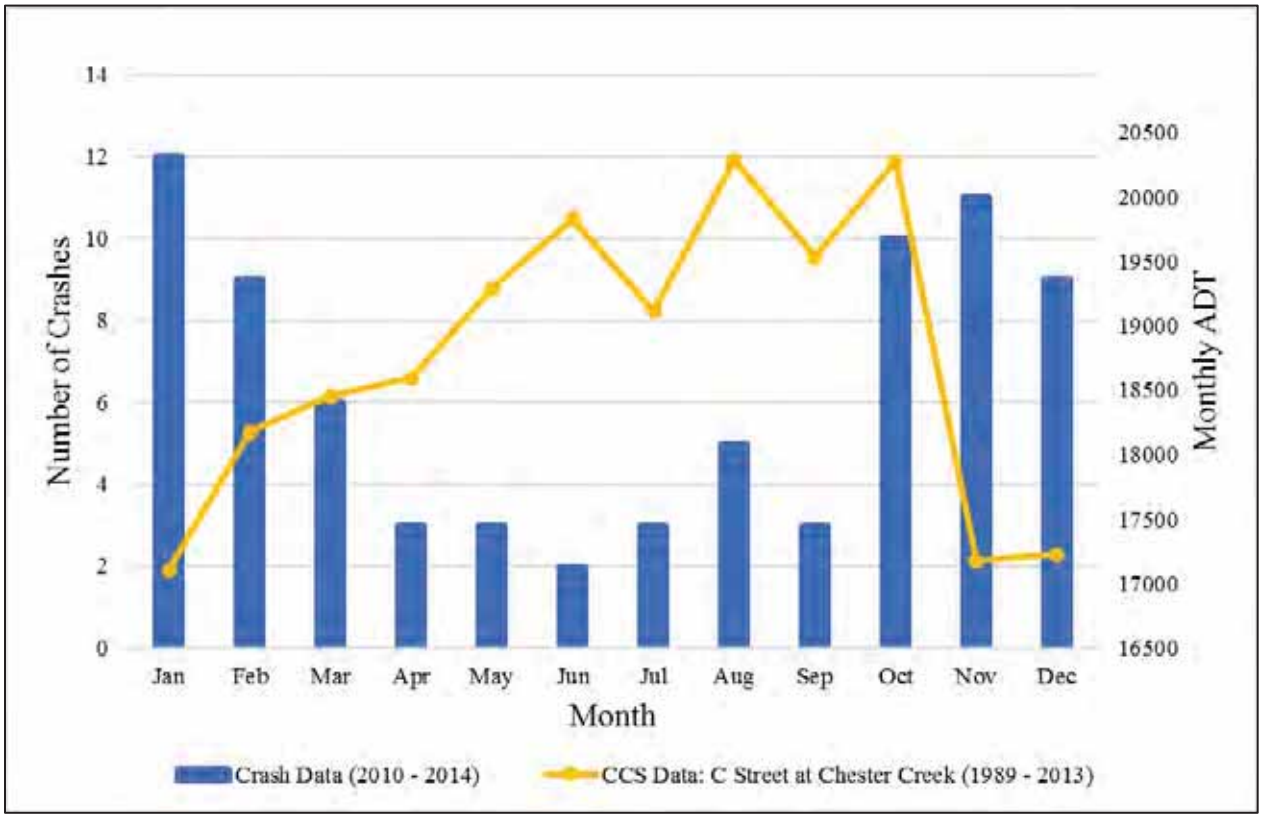


Figure 12. CSS Data Compared to Crashes at C Street and 36th Avenue

3 Existing Operational Parameters

3.1 Roadway Elements

Denali Street and 36th Avenue are both classified as Type II Minor Arterial roads by the MOA. According to the 2014 Chapter 1 Draft of MOA's *Design Criteria Manual* (DCM) a minor arterial moves traffic parallel to and connects traffic to major arterials and connects major arterials to lower classification roadways. In general, minor arterial roadways carry between 10,000 and 20,000 vehicles a day. 2013 base year average annual daily traffic (AADT) values indicate that the only segments in the study area carrying volumes lower than 10,000 vehicles a day are Denali Street between Fireweed Lane and Northern Lights Boulevard and Denali Street between 40th Avenue and Tudor Road.

The DOT classification of roads in the study area varies slightly from the MOA classification. The Alaska DOT&PF Statewide Functional Classification Map classifies 36th Avenue as a principal arterial and Denali Street as a minor arterial between Northern Lights Boulevard and Tudor Road. Between Fireweed Lane and Northern Lights Boulevard, Denali Street is classified as a minor collector. The primary function of arterials is mobility, with the aim to move traffic quickly and safely. Collectors link arterials to local roads and provide more access than arterials. In general, the higher the classification, the more limited the access.

SECTION HIGHLIGHTS

- There are 8,000 to 14,000 vehicles per day along Denali Street between Tudor Road and Northern Lights Boulevard, depending on the segment.
- There are 3,600 vehicles per day along Denali Street north of Northern Lights
- There are 16,000 to 18,000 vehicles per day along 36th Avenue, depending on the segment.
- Measured intersection sight distance is less that desired sight distance at several locations. In most cases, trimming of trees and bushes would resolve this.
- 85th percentile speeds for vehicles traveling along Denali Street are close to 40 mph, while the posted speed limit is only 35 mph.
- 85th percentile speeds for vehicles traveling along 36th Avenue are consistent with the 40 mph posted speed limit.
- Non-motorized users most frequently travel along the corridor and cross roadways at the signalized intersections.
- At Barrow Street and at 40th Avenue, more than 20 people were observed crossing the major street in one hour.
- Since October 2017, all bus stops within the study area are no longer serviced.

North of 36th Avenue, Denali Street is a 5-lane road with two lanes of travel in each direction, a two-way left turn lane (TWLTL), and a posted speed limit of 35 mph. It has 5-foot sidewalks on both sides of the street to accommodate both pedestrians and bicyclists but offers no exclusive bicycle facilities and no shoulders. There are many driveways along each side of Denali Street with access to retail, restaurants, and other services. Just north of 36th Avenue, the base year AADT is 12,200 vehicles per day (vpd), decreasing to around 10,400 vpd between Benson Boulevard and Northern Lights Boulevard. Between Fireweed Lane and Northern Lights Boulevard the base year AADT is about 3,600 vpd.

South of 36th Avenue Denali Street is a mostly undivided 4-lane road with a posted speed limit of 35 mph. However, a raised median extends from 36th Avenue to Telephone Avenue and from Telephone Avenue to Communications Avenue. There is a single southbound left turn lane at Denali Street and Telephone Avenue. The greater length of Denali Street between 36th Avenue and Tudor has 5-foot sidewalks on both sides. On the west side of Denali Street between Communications Avenue and 36th Avenue, the sidewalk widens to 10 feet and separates from the roadway north of Sharrock Way. Near Tudor Road there are two home-improvement box stores, Lowe's and Home Depot. Just south of 36th Avenue, the AADT is 9,600 vpd, decreasing to around 8,300 vpd closer to Tudor Road.

Between A Street and Denali Street, 36th Avenue is a 4-lane road with a raised median, an eastbound left turn lane, and a posted speed limit of 40 mph. Due to the eastbound left turn lane, the raised median narrows in width from 11 feet at A Street to 3 feet at Barrow Street. Both sides of the road have 5-foot sidewalks. The Natural Pantry grocery store and the library, both located on the south side of 36th Avenue, generate pedestrian and cyclist traffic. AADT along the road segment is about 18,300 vpd.

Between Denali Street and the Old Seward Highway, 36th Avenue is a 4-lane road with a raised median, left-turn lanes at access points, and a posted speed limit of 40 mph. Due to the left turn lanes, the raised median varies in width from 3 feet to 12 feet. There is an 8-foot sidewalk on the north side of the road and a 5-foot sidewalk on the south side. McDonalds, New Sagaya, and bus stops along the segment all draw pedestrians. Base year AADT along the road segment is 16,000 vpd.

3.2 Speed Studies

Speed studies were performed at five locations within the study area. At each location, speed data was collected separately for each direction of travel. Two performance metrics were analyzed for each location: the pace and the 85th percentile speed. The pace is the 10-mph range in which the largest proportion of traffic travels. The 85th percentile speed is the speed 85 percent of drivers travel at or below, or, conversely, the speed 15 percent of drivers exceed.

The speed studies performed on Denali Street and 36th Avenue are summarized in Table 5 and Table 6, respectively. The studies show that speeds on 36th Avenue are generally consistent with the 40-mph speed limit. However, on Denali Street, the 85th percentile speeds often exceed the posted speed limit of 35 mph. The largest discrepancy (6 mph) between 85th percentile speed and speed limit was observed between 40th Avenue and Tudor Road in the northbound direction. The 85th percentile speed on this segment was 41 mph.

These vehicle speed values are used to calculate desired intersection sight distance and to evaluate the compatibility of different bicycle facilities.

Table 5. Summary of Speed Studies on Denali Street

Denali Street	*Northbound*		*Southbound*		*Posted Speed Limit (mph)*
	10 mph Pace	*85th % Speed (mph)*	*10 mph Pace*	*85th % Speed (mph)*	
Benson Boulevard to 36th Avenue	32 to 41	38	31 to 40	39	35
At Communications Avenue	29 to 38	36	31 to 40	35	35
40th Avenue to Tudor Road	32 to 41	41	31 to 40	39	35

Table 6. Summary of Speed Studies on 36th Avenue

36th Avenue	*Eastbound*		*Westbound*		*Posted Speed Limit (mph)*
	10 mph Pace	*85th % Speed (mph)*	*10 mph Pace*	*85th % Speed (mph)*	
At ZJ Loussac Public Library	32 to 41	39	32 to 40	38	40
At McDonald's	34 to 43	41	34 to 43	42	40

3.3 Stopping Sight Distance

Stopping sight distance (SSD) is the distance a vehicle travels in the time it takes a driver to see an object in the road ahead and bring the vehicle to a complete stop. Because the roads have few horizontal or vertical curves, it is assumed that SSD is met along Denali Street and 36th Avenue. Therefore, SSD was not measured.

3.4 Intersection Sight Distance

Intersection sight distance (ISD) is the distance required for vehicles on a minor road to safely enter the traffic stream on the major road. Intersection sight distance is determined by two factors: the speed limit of the major road and the required time gap for a vehicle to enter the traffic stream. As the width of road which must be crossed to enter the traffic stream increases, so does the time gap.

Left turning vehicles cross a greater width of road than vehicles making right turns, and therefore require a greater intersection sight distance. AASHTO's *Policy on the Geometric Design of Highways and Streets* (PGDHS) states that at most intersections, if both right turning vehicles and left turning vehicles have sufficient ISD then vehicles traveling through the intersection will have sufficient ISD.

In addition to calculated desired ISDs, Table 7 gives measured ISDs. Highlighted cells indicate movements where the measured ISD is less than desired ISD. At these locations drivers on the side streets may have trouble seeing far enough down the road to feel comfortable. Some locations have sight distances blocked by bushes and trees; trimming the bushes and trees may increase ISD to the desired levels. At a few locations, sight distance is limited by queued

vehicles. However, if a queue has formed, a vehicle will not be able to make the desired turn, so the limited sight distance is not an issue.

Table 7. Calculated Intersection Sight Distances at Two-Way Stop Controlled Intersections

Intersection	*Looking to the Left (Minor Road onto Major Road)*			*Looking to the Right (Minor Road onto Major Road)*		
	Measured ISD (feet)	*Desired ISD (feet)*	*Obstruction*	*Measured ISD (feet)*	*Desired ISD (feet)*	*Obstruction*
32nd Avenue and Denali Street	>375	375	-	337	475	Bush
34th Avenue Eastbound and Denali Street	>375	375	-	>475	475	Queued Vehicles
34th Avenue Westbound and Denali Street	279	375	Business Sign	308	475	Tree
Telephone Avenue and Denali Street	>335	335	-	360	465	Queued Vehicles
40th Avenue Eastbound and Denali Street	>375	375	-	415	485	Bushes and Tall Grass
40th Avenue Westbound and Denali Street	>375	375	-	>485	485	-
Home Depot Driveway and Denali Street	278	375	Trees	238	485	Trees
Lowe's Driveway and Denali Street	267	375	Trees	273	485	Trees
Barrow Street and 36th Avenue	>375	375	-	>400	500	-

3.5 Existing Pedestrian and Vehicular Operations

3.5.1 Pedestrian and Cyclist Counts

Turning movement counts (TMCs) provided by the MOA and KE for intersections within the study area included combined pedestrian and bicyclist counts. Counts were collected between 2010 and 2017 for 2-hour periods during peak vehicular traffic hours: 7:00 AM to 9:00 PM, 11:00 AM to 1:00 PM, and 4:00 PM to 6:00 PM. Within each period, counts were performed at 15-minute intervals. The study periods do not necessarily correspond to peak pedestrian travel periods.

The highest non-motorized user volumes (greater than 70 users/hour) were counted at the intersections of 36th Avenue with A Street/C Street couplet, Denali Street with the Northern Lights/Benson couplet, and Denali Street with 33rd Avenue. A significant number of pedestrians were also observed crossing at the intersection of Denali Street and 36th Avenue.

The highest number of observed pedestrian and cyclist crossings at unsignalized intersections occurred at two intersections during the PM peak hour. At the intersection of 36th Avenue and Barrow Street, 25 non-motorized users crossed the major street (36th Avenue). At the

intersection of Denali Street and 40th Avenue, 20 non-motorized users crossed Denali Street. At all other unsignalized crossings, hourly pedestrian volumes were 20 pedestrians or less per hour.

Figure 13 through Figure 18 depict the pedestrian and cyclist intersection movements in the study area for the noon and PM peak hours. Note that unsignalized intersections are demarcated with red stop signs.

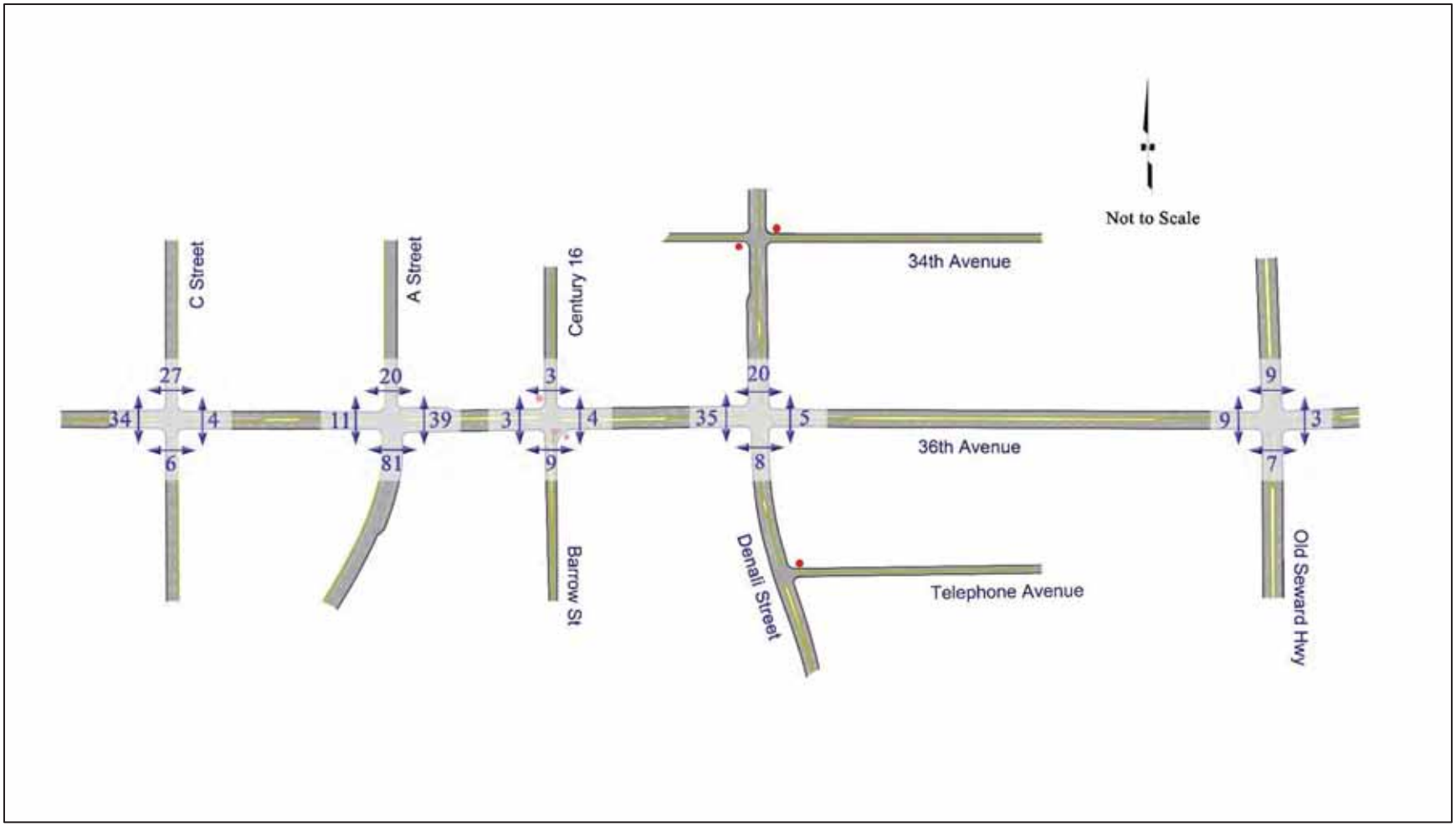


Figure 13. Pedestrian Movements on 36th Avenue, Noon Peak Hour

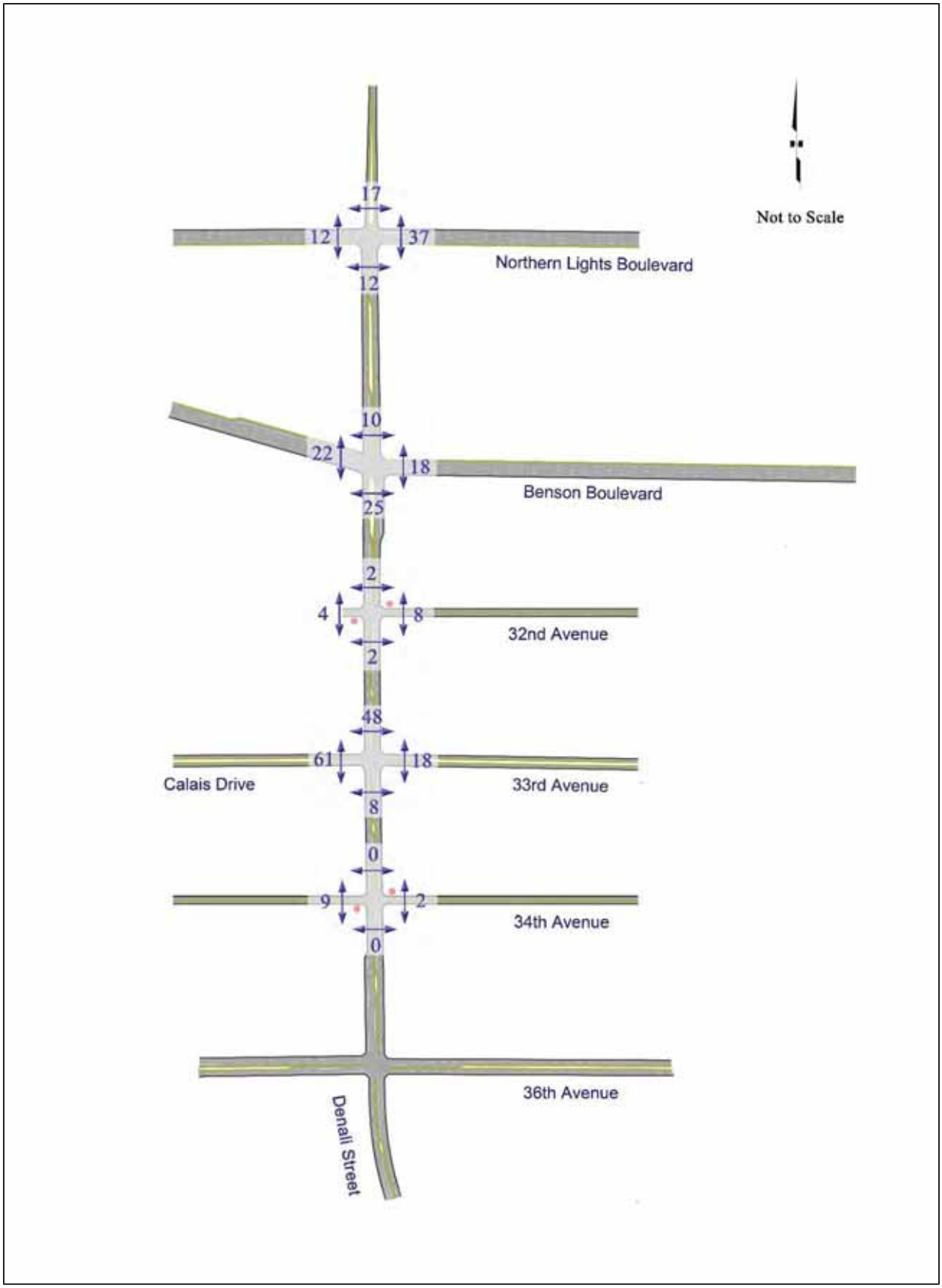


Figure 14. Pedestrian Movements on North Denali Street, Noon Peak Hour

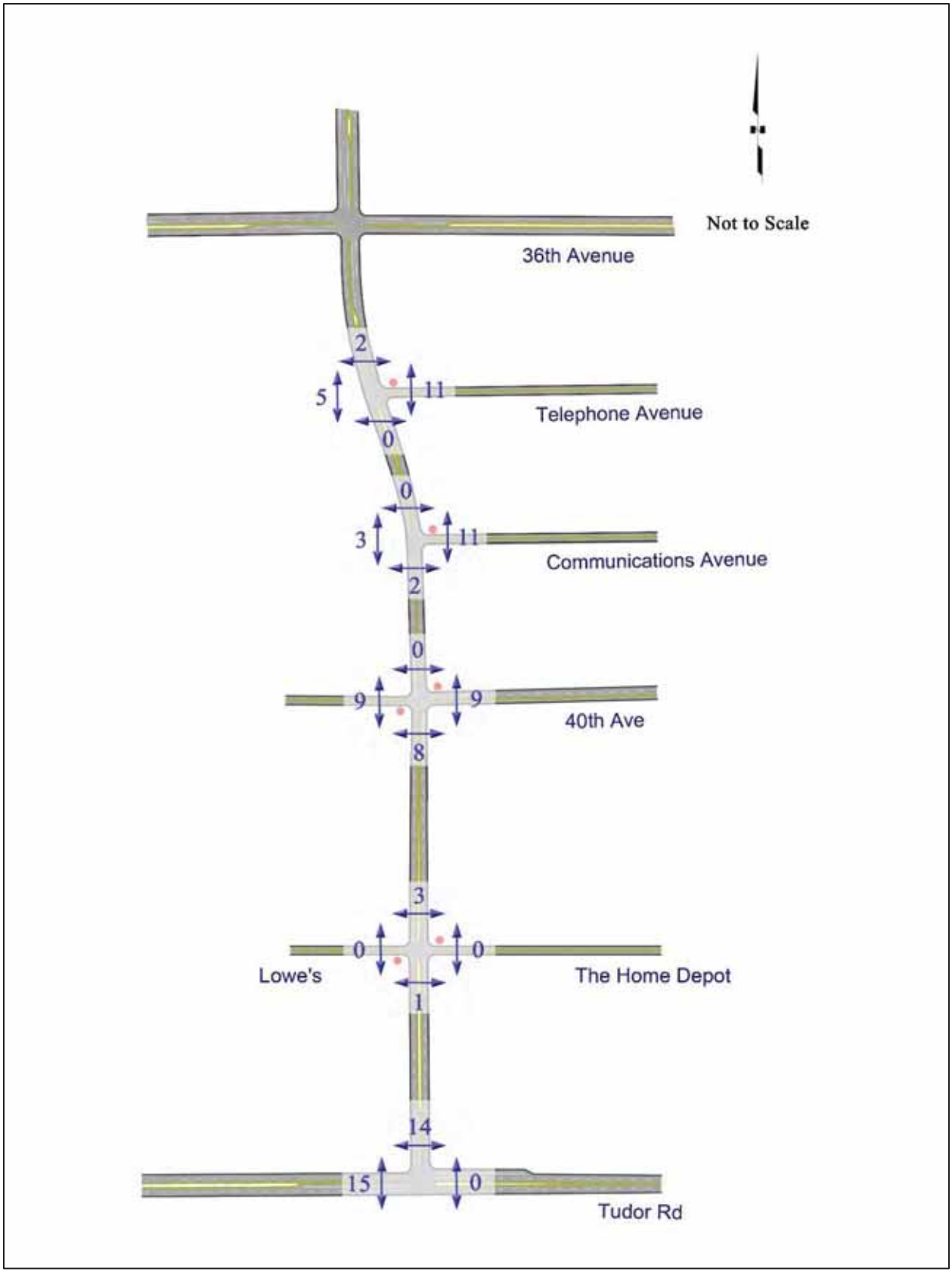


Figure 15. Pedestrian Movements on South Denali Street, Noon Peak Hour

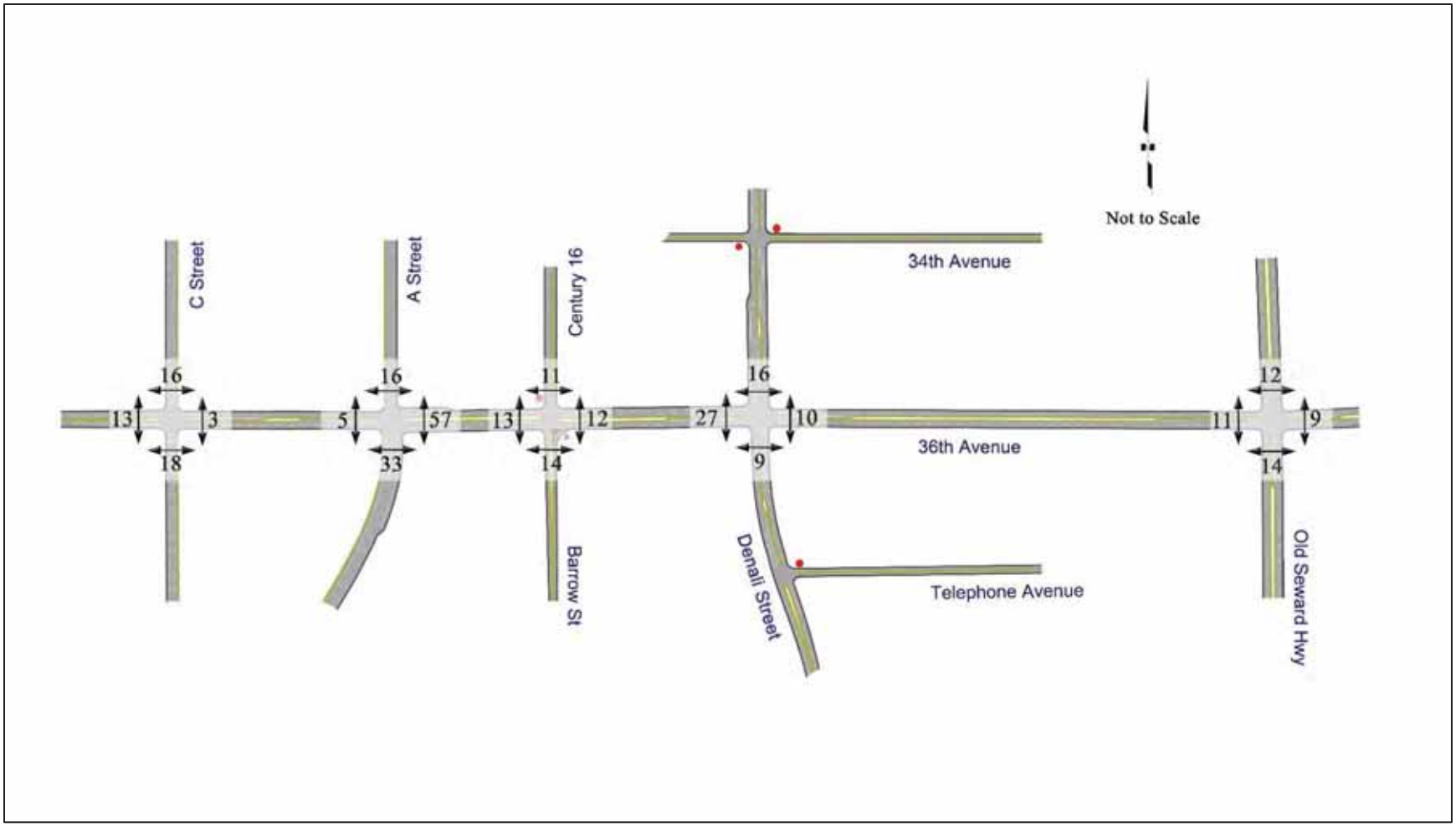


Figure 16. Pedestrian Movements on 36th Avenue, PM Peak Hour

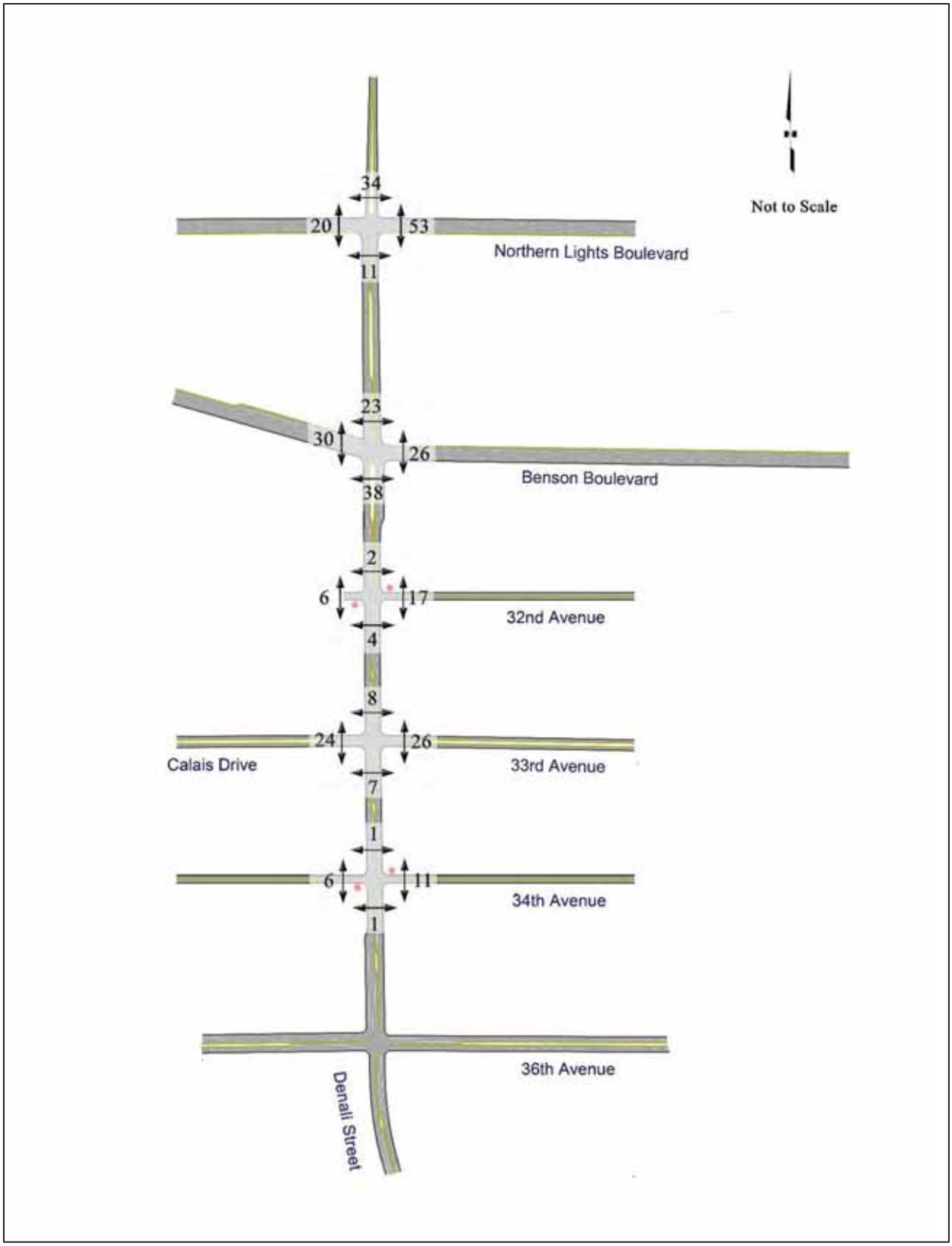


Figure 17. Pedestrian Movements on North Denali Street, PM Peak Hour

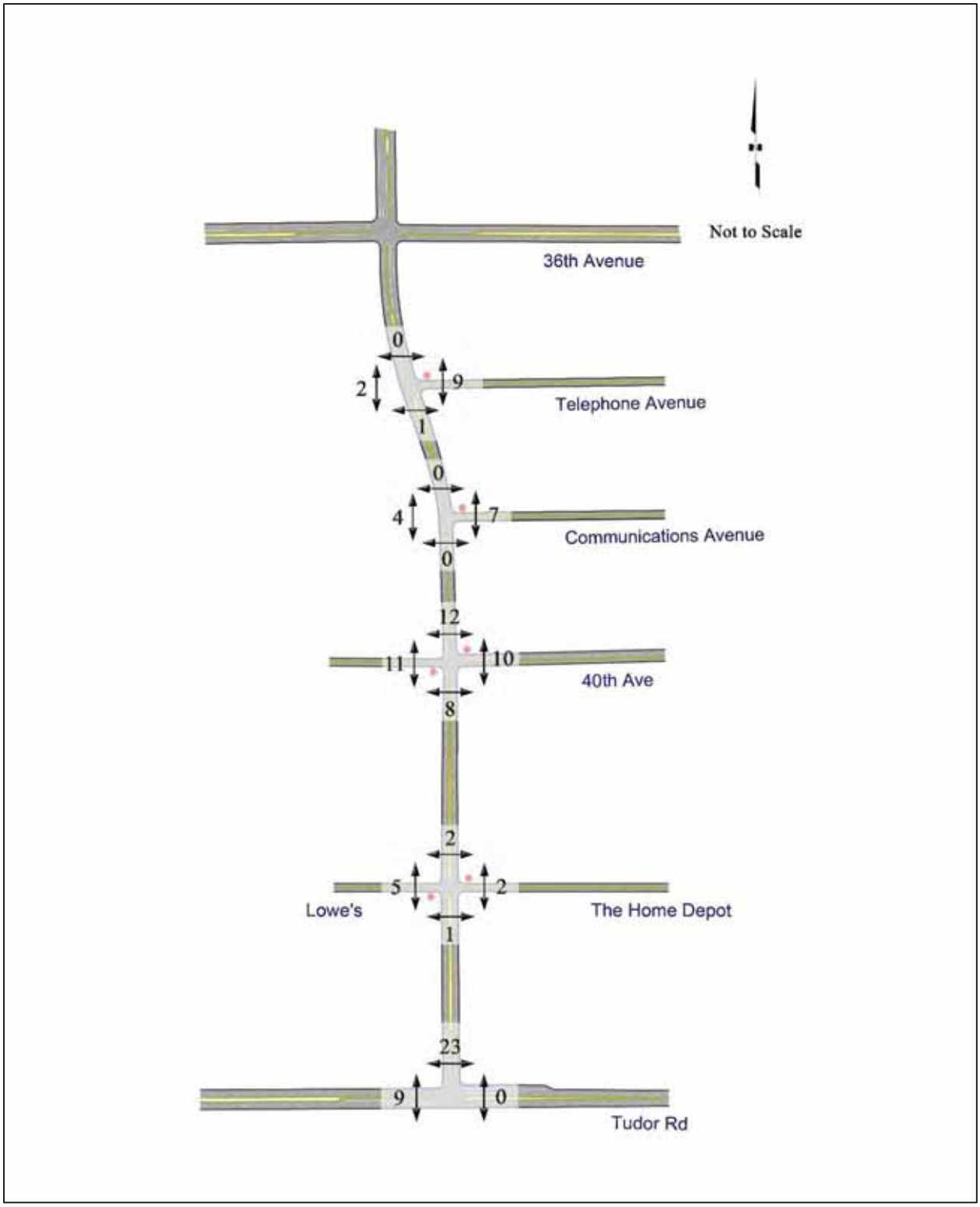


Figure 18. Pedestrian Movements on South Denali Street, PM Peak Hour

In addition to collected counts, pedestrian and cyclist travel behavior was also observed by KE along segments of 36th Avenue and Denali Street within the study area. These observations were conducted on Wednesday, July 13, 2017 and Thursday, July 14, 2017 for about an hour at each location. The observations were made between 11:45 AM and 6:00 PM. The observations do not necessarily correspond to peak pedestrian travel periods, but still offer insight into pedestrian and cyclist behavior in the study area.

Table 8 is a summary of observed midblock pedestrian and cyclist crossing volumes. The highest number of pedestrians and cyclists, 35, were observed crossing the segment of Denali Street between Communications Avenue and Tudor Road. This segment includes 40th Avenue, which has a marked crosswalk on the north side of the intersection. Of the 35 observed segment crossings, 25 occurred near 40th Avenue but only 6 utilized the crosswalk. Only 5 pedestrians and cyclists were observed crossing 36th Avenue between A Street and Denali Street during these observations, possibly because these observations were made in the mid-afternoon, rather than during the PM peak.

Table 8. Summary of Major Road Crossing Pedestrians and Cyclists along Segments

Crossing Major Street	*Segment*	*Date and Day of Week*	*Hour of Observation*	*Pedestrians*	*Cyclists*	*Total*
Denali Street	Benson Boulevard to 33rd Avenue	7/13/2017 Thursday	3:30 PM - 4:30 PM	4	4	8
Denali Street	33rd Avenue to 36th Avenue	7/13/2017 Thursday	3:30 PM - 4:30 PM	4	3	7
Denali Street	36th Avenue to Communications Drive	7/12/2017 Wednesday	3:30 PM - 4:30 PM	5	1	1
Denali Street	Communications Drive to Tudor Road	7/12/2017 Wednesday	3:30 PM - 4:30 PM	28	7	35
36th Avenue	A Street to Denali Street	7/13/2017 Thursday	11:45 AM - 12:45 PM	4	1	5
36th Avenue	Denali Street to Old Seward Highway	7/12/2017 Wednesday	4:55 PM - 5:55 PM	6	1	7

During observations, a majority of non-motorized users traveling along 36th Avenue and Denali Street used the sidewalks and crossed at designated crossings. However, at signalized crossings, multiple cases of crossing against a signal were noted. Cyclists observed on both Denali Street and 36th Avenue typically chose to travel on sidewalks and crosswalks, often creating conflicts when attempting to pass or overtake other facility users. A wheelchair user would similarly have difficulty passing other users due to narrow sidewalks. Where available, pedestrians and cyclists often elected to cut through parking lots.

The following specific observations were also noted:

- Northbound vehicles turning right onto Benson Boulevard from Denali Street appeared to be hurried and impatient when waiting for pedestrians and cyclists to cross.
- Pedestrian and cyclists traffic was generated at 32nd Avenue.
- At Denali Street and 40th Avenue, pedestrian and cyclists often seemed hesitant to cross.
- Around lunchtime the Natural Pantry draws a high number of pedestrians and cyclists (Barrow Street and 36th Avenue).
- McDonald's on 36th Avenue west of Old Seward Highway is frequented by pedestrians and cyclists.

Figure 19 depicts the number of pedestrians and cyclists that were observed traveling longitudinally along Denali Street and along 36th Avenue. Pedestrians and cyclists are differentiated. Maps showing all travel behavior observations are included in Appendix B: Pedestrian and Bicycle Observations. These maps do not differentiate between pedestrians and cyclists.

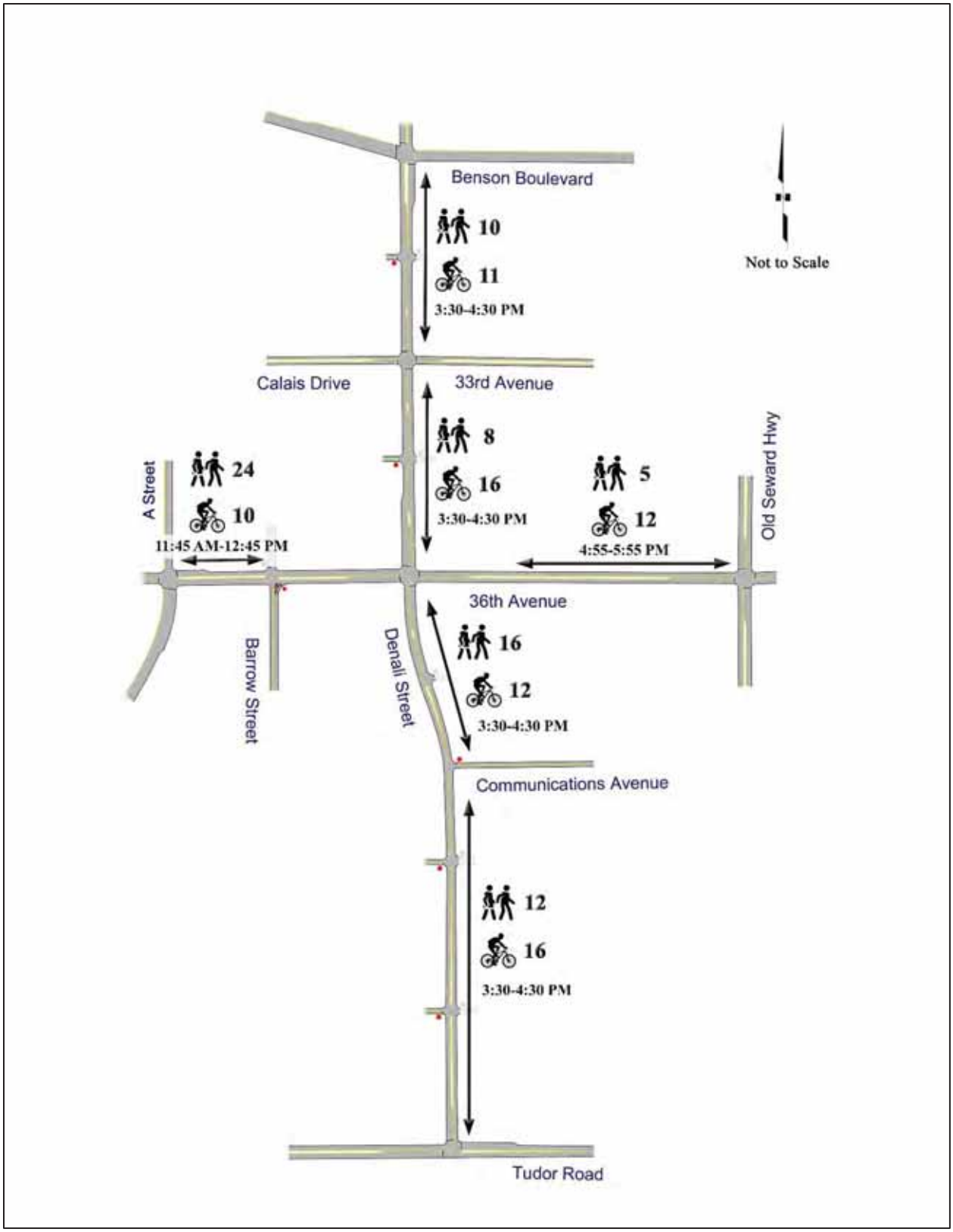


Figure 19. Longitudinal Pedestrian and Cyclist Movements

3.5.2 Historical Vehicular AADT

Figure 20 shows historical AADTs along Denali Street between 2005 and 2015. Overall, AADTs on Denali Street decreased during the 10 years analyzed. However, the data shows an increase in volume in 2014 before a sharp decrease in 2015. Figure 21 shows historic AADTs along 36th Avenue between Arctic Boulevard and Seward Highway. Between 2005 and 2013, overall traffic numbers decreased before an increase in volume was observed in 2014. Traffic on Denali Street decreased by about 1.9% a year and traffic on 36th Avenue decreased by about 2.3% per year.

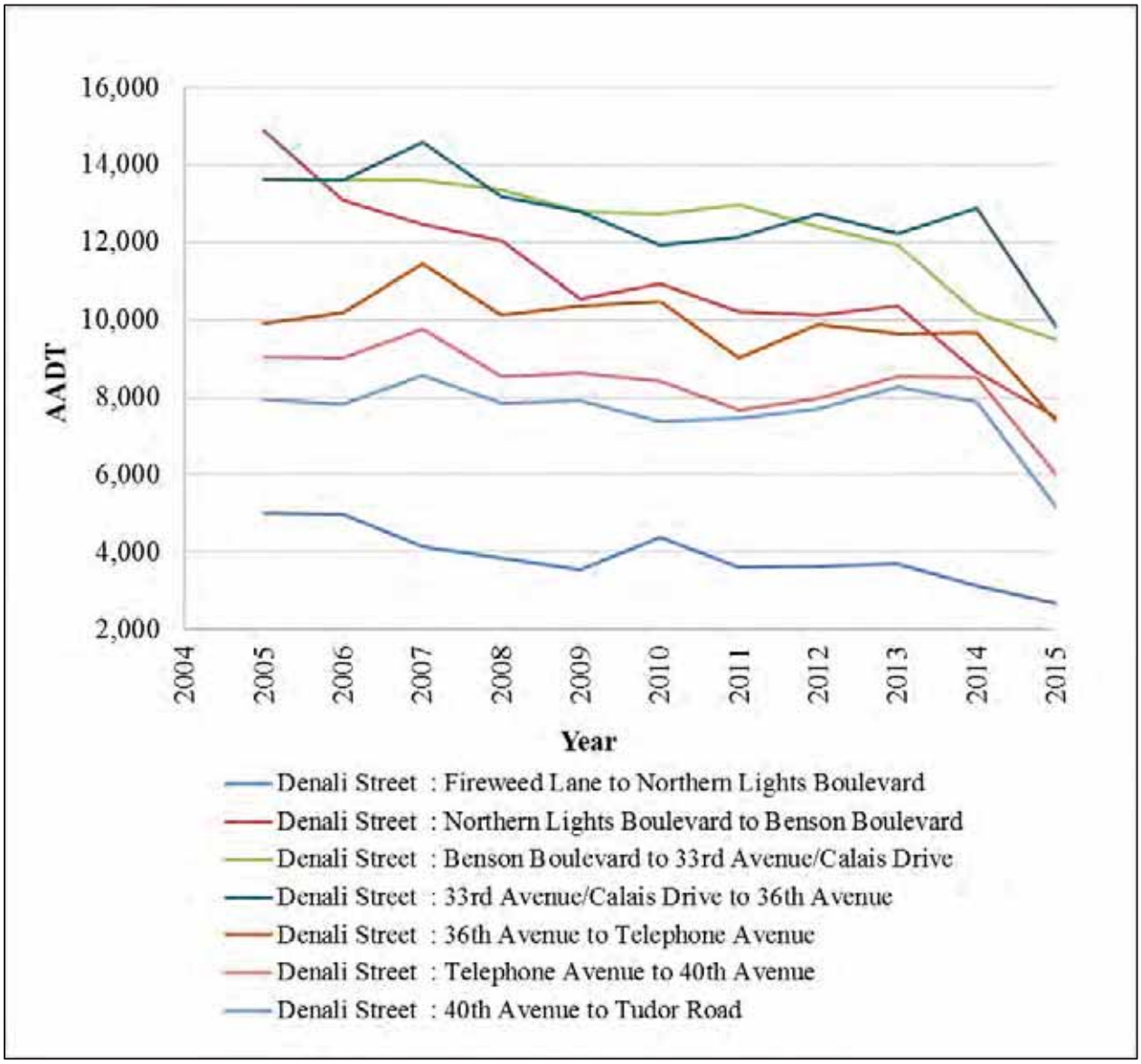


Figure 20. Historical AADTs (2005 – 2014) on Denali Street

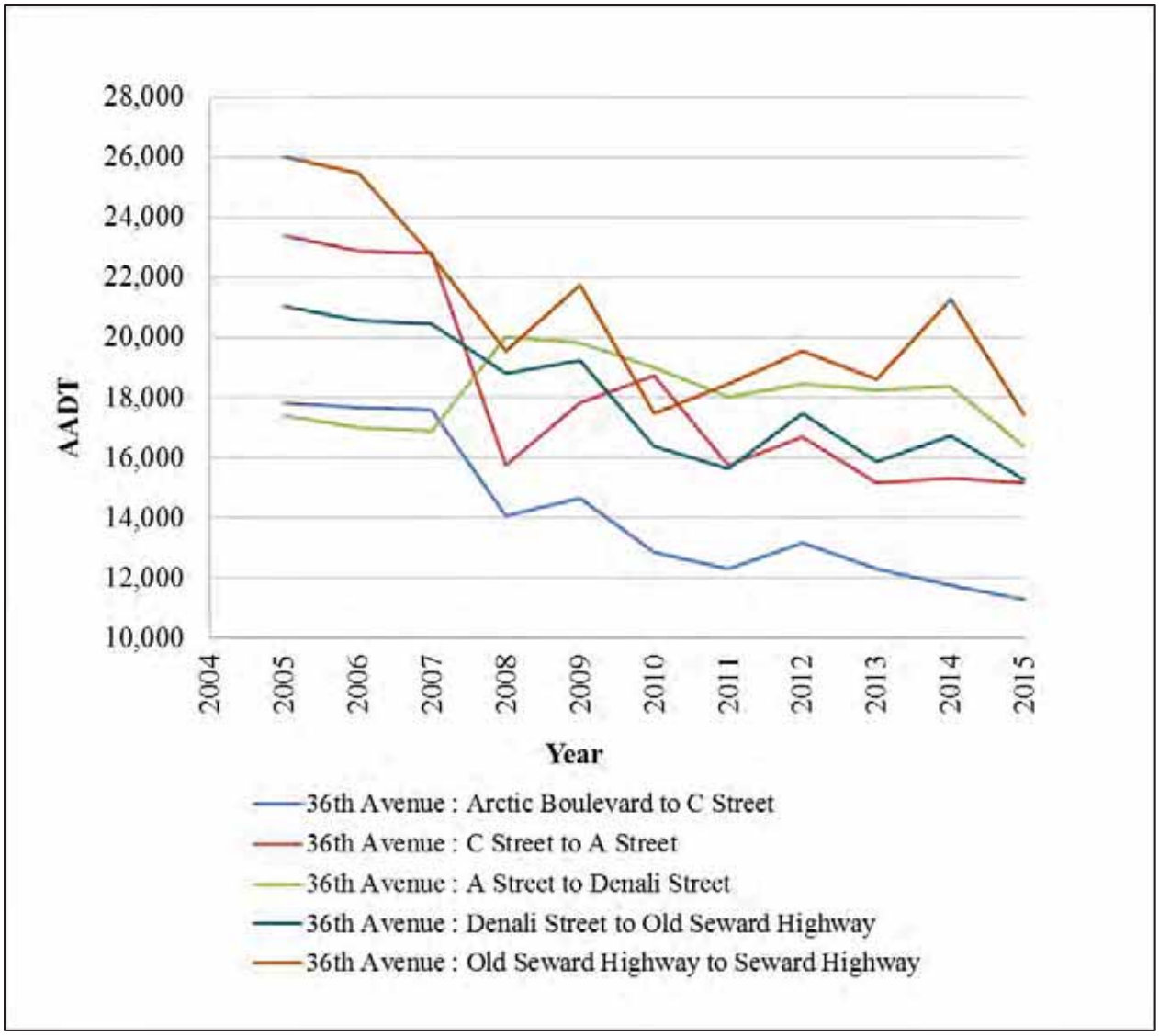


Figure 21. Historical AADTs (2005 – 2014) on 36th Avenue

3.5.3 Existing Turning Movement Volumes

TMCs were performed manually during the AM peak, midday peak, and PM peak. Municipal counts were taken between 2010 and 2014. KE counts were taken in 2017.

At the intersection of Denali Street and 36th Avenue, TMCs collected in 2012 were increased proportionally to intersection volumes from a 2014 MOA study. TMCs were then balanced outwards from the Denali Street and 36th Avenue intersection. Balanced TMCs for peak traffic hours (AM, Midday, and PM) are shown in Appendix C: Existing Turning Movement Volumes, Figure 58 through Figure 66.

3.5.4 Peak Hour Factors

A peak hour factor (PHF) is a measure of fluctuation of traffic demand in the hour of analysis. It is found by dividing the hourly volume into 15-minute periods. The hourly volume is then divided by the volume occurring in the peak 15-minute period and multiplied by 4. PHFs range from 0.25 (all traffic arrives in one 15-minute period and no additional traffic arrives for the rest of the hour) to 1.0 (equal number of vehicles arrive during each 15-minute period). A high peak hour factor indicates there may be congestion and delay at an intersection.

Intersection PHF was calculated and used for capacity analysis at each intersection in the study area, as depicted in Table 9.

Table 9. Peak Hour Factors

Intersection	*Peak Hour Factor*		
	AM Peak	*Midday Peak*	*PM Peak*
Denali Street and Northern Lights Boulevard	0.83	0.94	0.95
Denali Street and Benson Boulevard	0.82	0.97	0.91
Denali Street and 32nd Avenue	0.75	0.96	0.86
Denali Street and 33rd Avenue	0.79	0.98	0.89
Denali Street and 34th Avenue	0.81	0.91	0.94
Denali Street and 36th Avenue	0.90	0.95	0.90
Denali Street and Telephone Avenue	0.78	0.93	0.90
Denali Street and Communications Avenue	0.87	0.89	0.83
Denali Street and 40th Avenue	0.93	0.97	0.86
Denali Street and Box Store Driveways	0.78	0.91	0.89
Denali Street and Tudor Road	0.79	0.97	0.96
36th Avenue and C Street	0.79	0.91	0.95
36th Avenue and A Street	0.85	0.94	0.91
36th Avenue and Barrow Street	0.81	0.99	0.91
36th Avenue and Old Seward Highway	0.78	0.93	0.96

3.5.5 Heavy Vehicle Percentages

Heavy vehicles are defined in the *Highway Capacity Manual* (HCM) 2010 as being any vehicle with more than four tires touching the ground. The percentage of heavy vehicles in a fleet affects vehicular operations and affects the comfort of pedestrians and cyclists. Average heavy vehicle percentages at each peak hour were determined using KE's manual counts. Heavy vehicles were found to compose approximately 4% of the fleet during the AM peak and 2% during the midday and PM peaks.

3.6 Transit System

Before October 2017, six bus routes, including a commuter route between Eagle River and Anchorage, operated in the study area or intersected with roads in the study area.

The six routes were:

- Route 2 – Lake Otis
- Route 3 – Northern Lights
- Route 36 – 36th Avenue/West Anchorage
- Route 60 – Old Seward
- Route 75 – Tudor
- Route 102 – Eagle River Chugiak

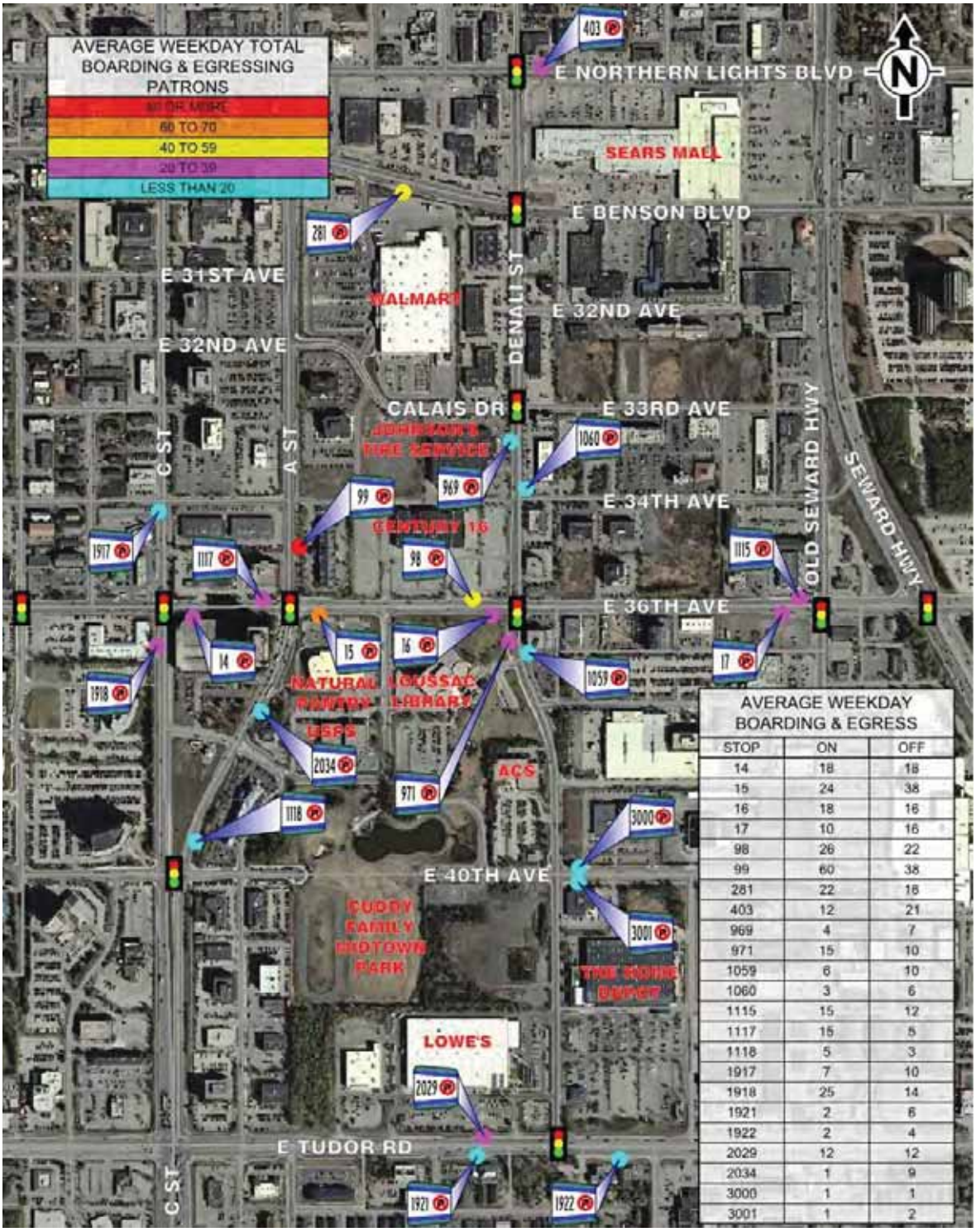
Generally, the routes had a frequency of one bus every 60 minutes throughout the day and one bus every 30 minutes during designated hours. Route 102 between Eagle River and Anchorage ran every 30 minutes during limited hours of operation – 3:20 PM to 6:00 PM outbound and 6:30 PM to 8:00 PM inbound.

The number of transit patrons boarding and egressing at each bus stop in the project area was provided by People Mover, Anchorage's public transportation agency. Figure 22 presents the number of transit patrons that boarded and egressed at the bus stops shown on an average weekday prior to October 2017. Stop 99 northeast of the 36th Avenue and A Street intersection experienced the greatest average volume within the study area, with approximately 98 patrons per weekday. In general, the highest number of transit patrons boarded or egressed near the intersections of A Street and Denali Street with 36th Avenue, using Stops 15, 16, 98, 99, 971, 1059, and 1117. Additionally, the volume of patrons moving east-west along 36th Avenue was generally greater than the volume of patrons moving north-south along Denali Street. Route 2, Route 36, and Route 103 serve 36th Avenue, while Route 60 was the only route along Denali Street.

A new bus system was implemented in Anchorage in October 2017. The system function changed to a lower coverage-higher frequency model. Additionally, hours of operation were extended. The six existing routes within the study area were replaced by two routes that run along the boundary of the study area, including along the Northern Lights Boulevard/Benson Boulevard couplet, the A Street/C Street couplet, and Tudor Road. The commuter route between Eagle River and Anchorage no longer directly services the area. Comparison maps between the old and new bus systems are located in Appendix D: Transit System.

The following routes service the study area under the new bus system:

- Route 10 – Northern Lights runs along the Northern Lights Boulevard and Benson Boulevard couplet, intersecting Denali Street, C Street, and A Street. It is considered a frequent route, with a peak frequency of one bus every 15 minutes.
- Route 25 – Tudor is a standard route with a peak frequency of one bus every 20 to 60 minutes. It runs along the southern extent of the project area, Tudor Road, and the western extent, the A Street/C Street couplet.



AVERAGE WEEKDAY BOARDING & EGRESS		
STOP	ON	OFF
14	18	18
15	24	38
16	18	16
17	10	16
98	26	22
99	60	38
281	22	18
403	12	21
969	4	7
971	15	10
1059	6	10
1060	3	6
1115	15	12
1117	15	5
1118	5	3
1917	7	10
1918	25	14
1921	2	6
1922	2	4
2029	12	12
2034	1	9
3000	1	1
3001	1	2

Figure 22. Average Daily Transit Board and Egress Volumes Prior to October 2017

Table 10 shows frequencies for Route 10 and Route 25. Each route runs at peak frequency from 6:00 AM until 8:30 PM at which point the frequency on both routes is reduced to one bus every 30 minutes and then reduced further at 10:00 PM to one bus every hour.

Table 10. New Bus System Bus Frequencies near Project Area

Time of Day	*Route 10 – Northern Lights* Frequency (one bus per every)	*Route 25 – Tudor* Frequency (one bus per every)
6:00 AM to 8:30 PM	15 Minutes	20 minutes
8:30 PM to 10:00 PM	30 Minutes	30 Minutes
10:00 PM to 12:00 AM	60 Minutes	60 Minutes

Figure 23 shows the bus stops located nearest to the study area. For patrons on route 25, the bus stops closest to 36th Avenue are bus stop 2034 or bus stop 99 on A Street, and bus stop 1918 on C Street. For patrons on Route 10, bus stop 403 on Northern Lights Boulevard or bus stop 281 on Benson Boulevard bring patrons closest to Denali Street.

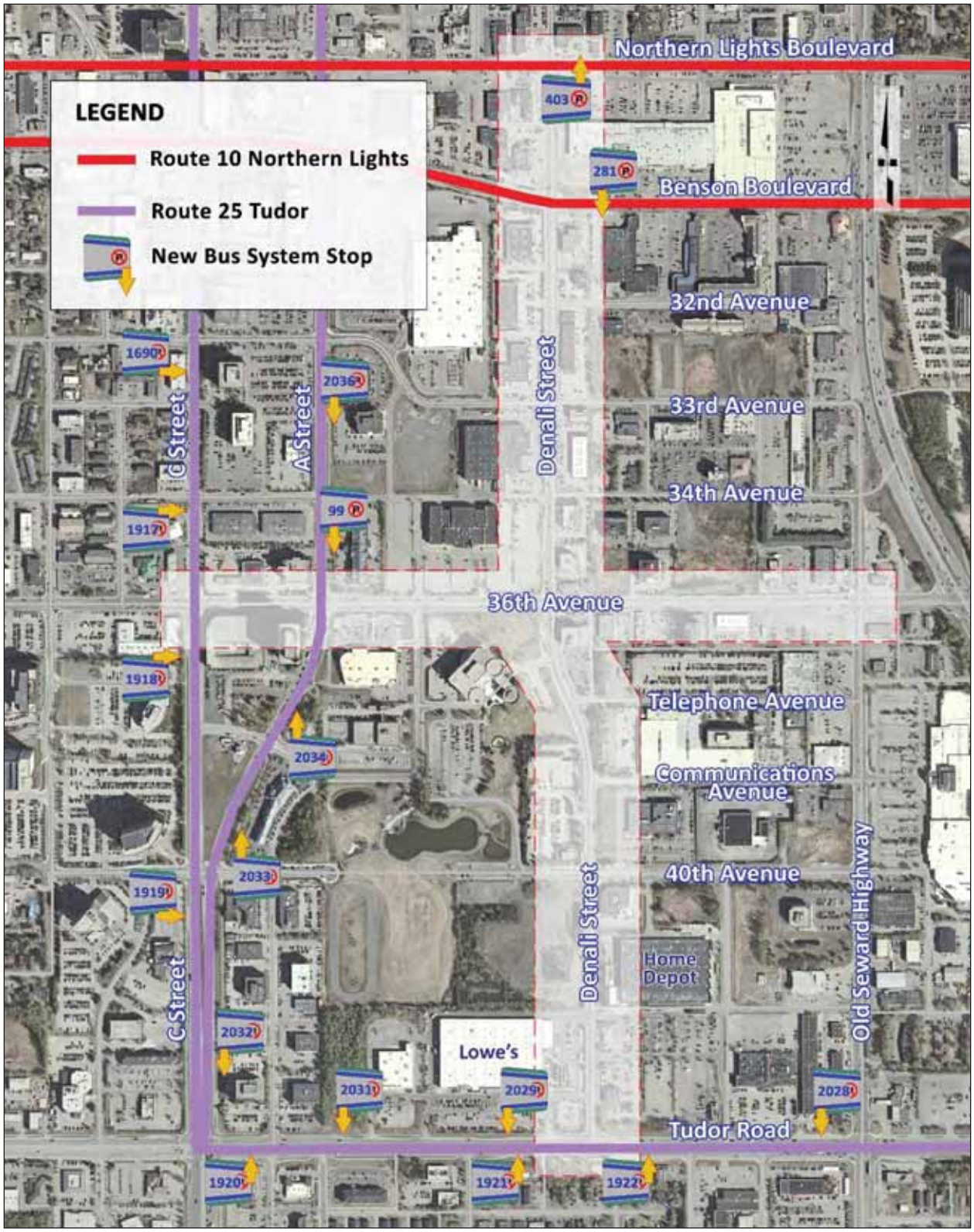


Figure 23. Bus Stops Near the Study Area – New Bus System

4 Future Pedestrian and Vehicular Operations

4.1 Pedestrian and Cyclist Count Projections

For the purposes of this report, non-motorized user counts were not projected into the future. There are several reasons for this:

- Pedestrian and cyclist volume projection methods are not as well-developed as projection methods for vehicular volumes.
- Operational parameters for non-motorized users do not depend upon pedestrian and cyclist volumes, except in locations of very high pedestrian or cyclist concentrations, such as in highly urbanized cities.
- The unsignalized locations with the highest number of crossings under existing conditions are likely to be the locations the highest number of crossings going forward. Since improvements to these locations are already warranted, it is unnecessary to consider what would happen if these volumes were to increase.

SECTION HIGHLIGHTS

- To find future study area traffic volumes, trip generation was used to calculate traffic volumes for all properties in the study area that are currently undeveloped.
- The forecasted 2045 vehicle volumes include growing the existing volumes at 0.5% per year and adding traffic from all properties that are currently undeveloped.
- Between 14,000 and 18,000 vehicles per day are forecasted to travel along Denali Street, depending on the segment.
- Between 19,000 and 24,000 vehicles per day are forecasted to travel along 36th Avenue, depending on the segment.

4.2 Vehicular AADT Projections

Three main factors are expected to affect traffic volumes within the study area over the design life of this project:

- *City-wide shifts in traffic volumes*. KE reviewed Anchorage population, employment, and traffic trends to estimate a background growth rate for the study area.
- *New development.* KE forecasted traffic volumes for currently undeveloped lots within the study area by assigning development types to these lots and using the Institute of Transportation (ITE) *Trip Generation Manual* to estimate additional traffic caused by these developments within the study area network.
- *Changes to the roadway network/infrastructure*. DOT&PF is currently conducting a study of the Seward Highway from Tudor Road to 20th Avenue, which will likely recommend grade separation alternatives, such as interchanges, for the existing at-grade intersections along the Seward Highway. Proposed changes could affect traffic volumes along both 36th Avenue and Denali Street. An analysis of the effects of the Seward Highway are outside of the scope of this Midtown project, and therefore will not be addressed in this report.

4.2.1 City-wide Volume Shifts

KE compared historical traffic volume data for the Anchorage area to socioeconomic variables such as population and employment to determine if a regression equation could express a relationship between traffic volumes and this data. Figure 24 shows the recent trends in traffic volumes, population, and employment for the Anchorage area.

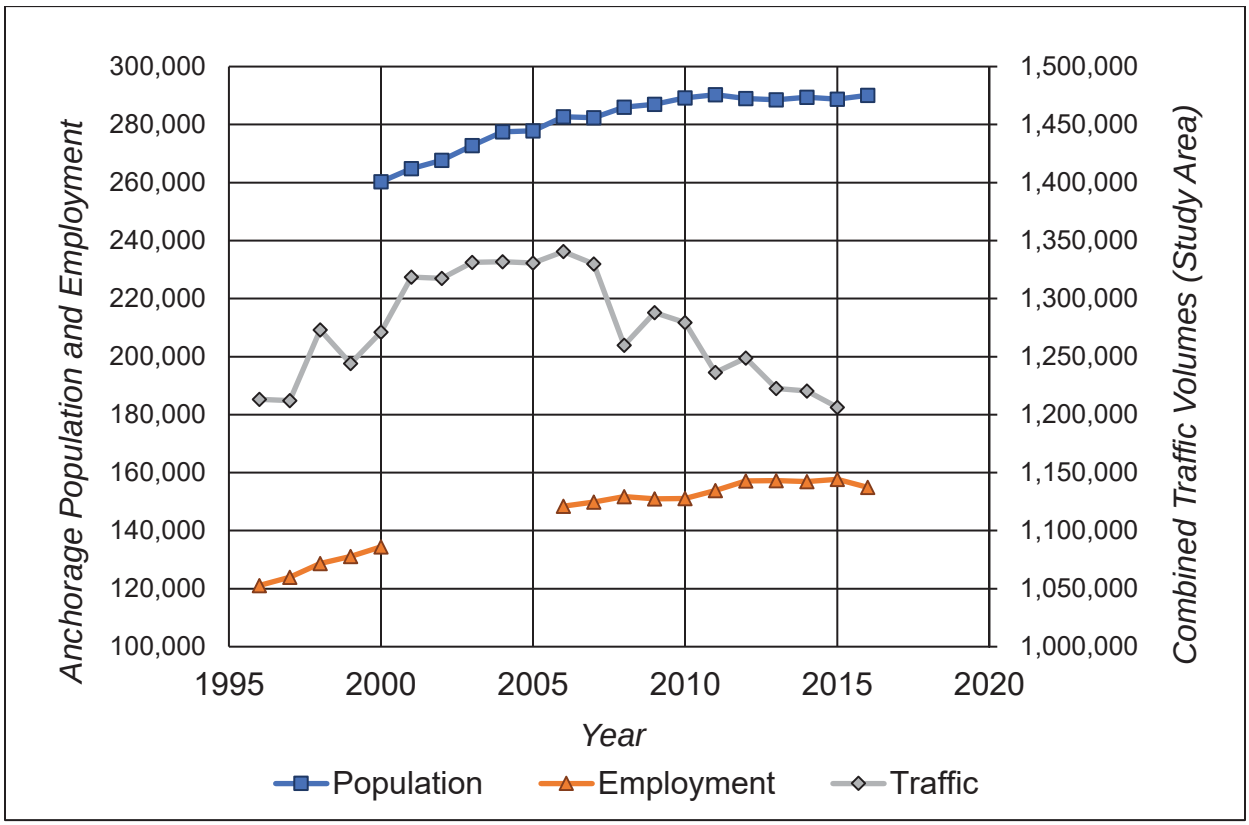


Figure 24. Comparison of Historical Socioeconomic Data with Historical Traffic Volumes

While population and employment rose slightly up until about 2011 and have been relatively flat since then, the traffic volumes peaked in 2006 and steadily dropped since then, so that 2015 volumes are equivalent to 1996 volumes. This traffic volume pattern is consistent with nation-wide trends for this time period. Thus, regression equations did not show good correlation between the two trends. Prior to 2006, population and traffic volumes tended to track well (R-squared value of 0.8). Using a regression equation comparing population and traffic volumes between 2000 and 2006, future traffic volumes can be forecasted using the Alaska Department of Labor and Workforce Development (ADOL&WD) publication A*laska Population Projections, 2015 to 2045,* Research and Analysis Section, published in April 2016. Table 11 shows the data from the Department of Labor projections.

Table 11. Anchorage Municipality Population Projections (ADOL&WD)

Anchorage Municipality Population Projections		
Year	Population	Growth Rate
2015	298,908	0.7%
2020	309,692	0.6%
2025	318,629	0.4%
2030	325,533	0.3%
2035	330,821	0.3%
2040	335,148	0.2%
2045	339,171	-

Overall Growth Rate		
Year	Population	Annual Growth Rate
2015	298,908	0.4%
2045	339,171	

Using a regression equation method for the time period between 2000 and 2006, the traffic volume growth rate would be forecasted to be about 1% per year. While the 1% growth rate represents historical trends prior to 2006, the historical record since 2006 indicates that something about traffic volumes fundamentally changed after 2006 and that change has continued up to the most recent year that data is available (2015). Note that nation-wide traffic volumes began rising in 2014 and have been steadily rising throughout the last three years. Thus, it seems likely that Anchorage volumes will also begin to rise at some point in the design life for this project.

Based on these observations, a rounded value of 0.5% annual growth rate was applied to the background traffic for initial forecasts of design year volumes. A 0.5% annual growth rate recognizes that growth is likely to happen within the design life of the project, but also considers recent trends that indicate that prior historical growth rates may not be realized.

4.2.2 New Development

Undeveloped parcels were identified in the study area and are depicted in Figure 25.

To project future traffic volumes from the undeveloped parcels, assumptions about future developments were made. The zoning for each parcel was determined using the Property Information Web Mapping Application made available by MOA Maps. Existing establishments nearby were considered prior to assigning each parcel with an assumed land use classification from the *Trip Generation Manual*, as shown in Table 12. Traffic generated by each of these assumed developments was forecasted using the *Trip Generation Manual*.

Figure 25. Currently Undeveloped Parcels

Table 12. Assumed Land Use Classification

Parcel Number	*Land Use*	*Establishments Nearby*	*Assumed Land Use Classification*
1	Commercial	Aleutian Housing Authority, Novus Glass	710 – General Office Building
2	Commercial	Parking Lot	710 – General Office Building
3	Commercial	Parking Lot	320 – Motel
4	Commercial	TownePlace Suites	320 – Motel
5	Commercial	TownePlace Suites & Alaska Rock Gym	710 – General Office Building
6	Commercial	Parking Lot/ Remax Dynamic Properties	715 – Single Tenant Office Building
7	Commercial	Remax, Walmart, and Johnson's Tire Service	820 – Shopping Center*
8	Commercial	Teamsters Local 959 and Keller Williams	710 – General Office Building
9	Commercial	Keller Williams, Extended Stay, McDonalds	750 – Office Park
10	Commercial	Bureau of Vital Statistics	714 – Corporate Headquarters Building
11	Commercial	Cuddy Park, Lowe's, and Post Office	232 – High Rise Residential Condos
			826 – Specialty Retail Center
12 - 21	Commercial	Aleut Corporation	710 – General Office Building
22	Residential	Office Depot	221 – Low-Rise Apartment

*After analysis was complete, KE learned that a 154-room hotel is currently being constructed by Staybridge Suites Inn on Parcel 7 (200 Calais Drive). The assumed land use is 310 - Hotel. As per the *Trip Generation Manual*, local data should be collected to estimate the number of trips generated by such a hotel. It is likely that the traffic generated by a shopping center would be higher than the traffic generated by a 154-room hotel. Hence, KE's projection of future traffic generated by Parcel 7 likely overestimates traffic and presents a worst-case scenario.

4.2.3 Forecasted Full Build-Out 2045 AADTs

2045 was conservatively chosen as the design year for this project under the assumption that if the project is implemented, construction would begin around 2025. To forecast 2045 design year AADTs, historical AADTs were first analyzed. As shown in Section 3.5.2, AADTs on Denali Street and 36th Avenue have been gradually decreasing overall. Traffic volumes in 2014 and 2015 show a departure from historical trends prior to 2013, especially along Denali Street. Because there are unexplainable and drastic fluctuations in the traffic volumes from 2014 and

2015, 2013 volumes were chosen as base year volumes. Existing 2013 AADTs were grown to 2045 volumes using the proposed 0.5% annual growth rate.

The volumes were used to prepare preliminary turning movement volume (TMV) forecasts using *NHCRP 765 Analytical Travel Forecasting Approaches for Project-Level Planning and Design* methodology. Traffic volumes from the assumed developments were overlain on these projected volumes by assuming vehicles enter and exit the traffic study area at the driveway locations depicted with yellow arrows in Figure 25 and in accordance with observed percentages of directional traffic flow. Turning movements from the development were overlain at the intersections based on the existing turning movement percentages. The final step in preparing the 2045 turning movement counts was to balance adjacent intersections, so that all vehicles leaving one intersection flowed into the next one. TMVs were then used to back calculate final 2045 design year AADTs, as shown in Table 13. These combined 2045 AADTs represent an average annual growth rate of 0.9%.

Table 13. Future Year 2045 AADT

Street	*Segment From*	*Segment To*	*AADT Base Year 2013*	*AADT Future Year 2045*
Denali Street	Fireweed Lane	Northern Lights Boulevard	3,700	5,000
	Northern Lights Boulevard	Benson Boulevard	10,500	14,000
	Benson Boulevard	Calais Drive/33rd Avenue	12,000	17,500
	Calais Drive/33rd Avenue	36th Avenue	12,000	17,500
	36th Avenue	Telephone Avenue	9,500	15,500
	Telephone Avenue	40th Avenue	8,500	14,000
	40th Avenue	Tudor Road	8,500	13,500
36th Avenue	Arctic Boulevard	C Street	12,500	15,000
	C Street	A Street	15,000	17,000
	A Street	Denali Street	18,500	26,500
	Denali Street	Old Seward Highway	16,000	21,000
	Old Seward Highway	New Seward Highway	18,500	23,500

4.3 Future Turning Movement Volumes

Balanced projected 2045 turning movement volumes can be found in Appendix E: Future Turning Movement Volumes, Figure 69 through Figure 77.

4.4 Peak Hour Factors and Heavy Vehicle Percentages

Existing peak hour factors and heavy vehicle percentages were applied to future volumes for capacity analysis. See Sections 3.5.4 and 3.5.5.

4.5 Future Transit System

Transit volume data provided by People Mover offers no information regarding origins and destinations for transit users. Without this information, it is hard to estimate how the October 2017 change in transit access to the study area may increase or decrease pedestrian and cyclist volumes in the future. Additionally, at an August 9, 2017 agency meeting, a People Mover representative stated that People Mover may try to reinstate transit stops along 36th Avenue. This uncertainty makes pedestrian and cyclist traffic that is linked to transit access even more difficult to forecast. The *Anchorage Pedestrian Plan* (2007) states, "Walking is the basic element of transportation…When provided with access to sidewalks, trails and other walkable features, residents are 28 to 55 percent more likely to choose walking over other modes of transportation." Thus, improvements to the pedestrian and cyclist facilities within the study area would likely attract more facility users regardless of how transit activity may fluctuate. Improvements to the facilities are also an integral part of implementing a Complete Streets model.

5 Existing and 2045 No Build Intersection Operations

5.1 Pedestrian Delay

Pedestrian delay for signalized and unsignalized intersections within the study area were determined using the HCM 2010 methodology.

5.1.1 Pedestrian Crossings at Signalized Intersections

The HCM 2010 methodology provides a step-by-step procedure to determine delay for pedestrians crossing signalized intersections. For each pedestrian crossing analyzed, the delay calculation considers intersection cycle length and effective walk time for the applicable phase.

The HCM 2010 states:

"The pedestrian delay computed…can be used to make some judgement about pedestrian compliance. In general, pedestrians become impatient when they experience delays in excess of 30 s/p [seconds per pedestrian], and there is a high likelihood of their not complying with the signal indication. In contrast, pedestrians are very likely to comply with the signal indication if their expected delay is less than 10 s/p" (Page 19-84).

SECTION HIGHLIGHTS

- Pedestrian delay at signalized intersections is often greater than 30 seconds/pedestrian.
- Pedestrian delay at unsignalized intersections is calculated as greater than 45 seconds/pedestrian; however, observations show that gaps created by the signals provide less delay.
- Pedestrians use medians to make two-stage crossings where available.
- The goal for urban arterial roadways is LOS C or D.
- Vehicle LOS is generally LOS D or better at signalized intersections, except at the Old Seward Highway intersection where it is LOS E in the PM peak.
- At unsignalized intersections, left turns often experience LOS F in the peak hours, meaning that they wait for long periods of time and may sometimes choose to turn right and take a less direct route to avoid waiting longer.

Table 19 and Table 20 delineate the average pedestrian delay by movement under the no build condition for the governing peak hour for existing and future volumes respectively. The governing peak hour was selected based on the longest calculated delay. Delay values greater than 30 seconds are highlighted and indicate delays that may result in pedestrians not complying with the signal indication. Since cycle lengths do not change between the existing and future condition, the pedestrian value changes minimally between these two conditions.

Calculated delay values for all peak hours for existing and future volumes are available in Appendix F: Average Pedestrian Delay at Signalized Intersections – No-Build Condition.

Table 14. Average Pedestrian Delay at the Midday Peak Hour – Existing Volumes

Intersection	*Average Pedestrian Delay by Movement (sec)*			
	EB	*WB*	*NB*	*SB*
Northern Lights Boulevard and Denali Street	16	16	59	59
Benson Boulevard and Denali Street	19	19	59	59
33rd Avenue and Denali Street	59	59	8	9
36th Avenue and Denali Street	26	31	59	59
Tudor Road and Denali Street	-	22	-	59
C Street and 36th Avenue	59	59	20	20
A Street and 36th Avenue	59	59	26	26
Old Seward Highway and 36th Avenue	29	29	59	59

Table 15. Average Pedestrian Delay at the Midday Peak Hour – Future Volumes

Intersection	*Average Pedestrian Delay by Movement (sec)*			
	EB	*WB*	*NB*	*SB*
Northern Lights Boulevard and Denali Street	17	17	59	59
Benson Boulevard and Denali Street	21	21	59	59
33rd Avenue and Denali Street	59	59	8	9
36th Avenue and Denali Street	29	34	59	59
Tudor Road and Denali Street	-	33	-	59
C Street and 36th Avenue	59	59	21	21
A Street and 36th Avenue	59	59	26	26
Old Seward Highway and 36th Avenue	32	31	59	59

5.1.2 Pedestrian Crossings at Unsignalized Intersections

The HCM 2010 methodology to determine LOS for pedestrians crossing at two-way stop-controlled intersections or midblock is determined solely based on the length of delay a pedestrian is expected to experience at the crossing. Table 16, taken from HCM 2010, summarizes the relationship between pedestrian LOS, delay, and the amount of risk a pedestrian is willing to take to cross a roadway after a given amount of delay.

Table 16. Pedestrian LOS – Unsignalized Intersections

Average Delay (sec/pedestrian)	*LOS*	*Comments*
0-5	A	Usually no conflicting traffic
5-10	B	Occasionally, some delay due to conflicting traffic
10-20	C	Delay noticeable to pedestrians, but not inconveniencing
20-30	D	Delay noticeable and irritating, increased likelihood of risk taking
30-45	E	Delay approaches tolerance level, risk-taking behavior likely
>45	F	Delay exceeds tolerance level, high likelihood of pedestrian risk taking

The HCM 2010 describes average pedestrian gap delay, or the average time pedestrians must wait before crossing, as a function of critical headway and vehicular flow rate. Critical headway is defined as the time between conflicting vehicles below which a pedestrian will not have time to cross the street. When the gap between vehicles is above the critical headway, a crossing opportunity for the pedestrian is available. Pedestrian delay is also affected by the rate at which vehicular traffic yields to pedestrian traffic. For the analysis of unmarked crossings, the yield rate was assumed to be zero, meaning cars do not yield for pedestrians.

Given existing traffic volumes, Table 17 presents pedestrian crossing delay and LOS for unmarked and unsignalized crossing locations along 36th Avenue at the peak hour associated with longest calculated delays. Where two crossing distances are given, there is a median at least 6-feet wide that pedestrians can use for a refuge and the delay represents the combined delay of crossing each direction of travel separately.

Table 17. Existing Average Pedestrian Delay and LOS for Unmarked Crossings of 36th Avenue, PM Peak Hour

Unmarked Crossing Location on 36th Avenue	*Analyzed Crossing Width (feet)*	*Average Pedestrian Delay (sec)*	*Pedestrian LOS*
C Street to A Street	58	> 45	F
A Street to Barrow Street	20/33*	> 45	F
Barrow Street and 36th Avenue	58	> 45	F
Barrow Street to Denali Street	22/33*	> 45	F
Denali Street to Old Seward Highway	22/33*	> 45	F

*Eastbound/Westbound

Using the HCM 2010 Methodology, all the unsignalized crossings of 36th Avenue have a very unfavorable LOS. Field observations indicate that the actual average pedestrian delay is significantly less than the calculated pedestrian delay. This discrepancy may be due in part to the

fact that the HCM 2010 methodology assumes that vehicles arrive at the crossing location randomly and does not take the platooning characteristics of the corridor into account. Additionally, within the study area, 36th Avenue has a median that varies in width from 4 feet to over 6 feet. As per AASHTO's *Guide for the Development of Pedestrian Facilities,* a median must be a minimum of 6 feet wide to safely provide refuge for pedestrians and allow them to cross in two stages. However, along 36th Avenue, pedestrians were observed utilizing 4-foot segments of the median as a refuge.

Given existing traffic volumes, Table 18 presents the existing pedestrian LOS for unmarked and unsignalized crossing locations along Denali Street at the governing peak hours. The governing peak hour represents the time period associated with longest calculated delays.

Table 18. Existing Average Pedestrian Delay and LOS for Unmarked Crossings of Denali Street, PM Peak Hour

Unmarked Crossing Location on Denali Street	*Analyzed Crossing Width (feet)*	*Average Pedestrian Delay (sec)*	*Pedestrian LOS*
Northern Lights Boulevard to Benson Boulevard	56	> 45	F
Benson Boulevard to 32nd Avenue	64	> 45	F
32nd Avenue and Denali Street	65	> 45	F
32nd Avenue to 33rd Avenue/Calais Drive	58	> 45	F
33rd Avenue to 34th Avenue	58	> 45	F
34th Avenue and Denali Street	58	> 45	F
34th Avenue to 36th Avenue	68	> 45	F
36th Avenue to Telephone Avenue	30/31*	30-45	E
Telephone Avenue and Denali Street	62	> 45	F
Telephone Avenue to Communications Avenue	24/24*	10-20	C
Denali Street and Communications Avenue	52	> 45	F
Communications Avenue to 40th Avenue	48	> 45	F
Denali Street and 40th Avenue (Unmarked Leg)	62	> 45	F
40th Avenue to Box Stores	46	> 45	F
Denali Street and Box Stores	52	> 45	F
Box Stores to Tudor Road	52	> 45	F

*Southbound/Northbound

Between Northern Lights Boulevard and Tudor Road, Denali Street is mostly undivided, although there is a two way left turn lane (TWLTL) between Northern Lights and 36th Avenue and a narrow median between 36th Avenue and Communications Avenue. Field observations confirmed that both the TWLTL and the narrow median are used as pedestrian refuges, although both are exposed to traffic. Similarly to 36th Avenue, the calculated LOS fails for nearly all crossing locations along Denali Street, although during field observations the pedestrian delays appeared much shorter and pedestrians crossed Denali Street frequently.

Pedestrian crossing delay and LOS given future volumes were also calculated as per the HCM 2010. Delays greater than 45 seconds (LOS F) were calculated for all unsignalized crossing locations along both 36th Avenue and Denali Street, with one exception. The Denali Street crossing between Telephone Avenue and Communications Avenue worsened to 40 seconds of delay (LOS E).

5.1.2.1 Marked Pedestrian Crossing at 40th Avenue

The north approach of 40th Avenue at the intersection of 40th Avenue and Denali Street is currently striped with a crosswalk. Engineering study results published in HCM 2010 suggest that on a 35-mph road, around 20% of motorized vehicles will yield to pedestrians at a marked crosswalk.

Analysis using HCM 2010 methodologies predicted that pedestrian delay at 40th Avenue, using a 20% yield rate, is about three minutes per pedestrian. During field observations, drivers did not appear to yield to pedestrians, but crossing delay appeared to be shorter than 3 minutes per pedestrian.

5.1.2.2 Pedestrian Gap Studies

To more accurately characterize pedestrian activity in the study area, gap studies were conducted during the midday and PM peak hour at the two unsignalized locations where the highest number of pedestrians crossing were observed: the intersections of 36th Avenue and Barrow Street and Denali Street and 40th Avenue. Since field observations indicate that many able-bodied pedestrians walk very quickly when crossing at unsignalized intersections, the critical gap and resulting gaps per minute were calculated using walking speeds of 3.5 ft/sec and 6.0 ft/sec, as shown in Figure 26 through Figure 29.

As per the *Manual on Uniform Traffic Control Devices (MUTCD),* standard walking speed is 3.5 ft/sec, which represents the 15th percentile walking speed. For school crossings, the MUTCD Section 4C.06 recommends considering a traffic control signal when the number of adequate gaps in the traffic stream is less that the number of minutes in the same period. This recommendation has become a rule of thumb: one or more gaps per minute is considered acceptable. If pedestrians walk at 6.0 ft/sec, the intersection of Denali Street and 40th Avenue has an acceptable number of gaps per minute. However, if pedestrians walk at 3.5 ft/sec, the gap study confirms that the pedestrian LOS is still F. In other words, able-bodied walkers can easily navigate the intersection, but other users would likely have a difficult time making a safe crossing.

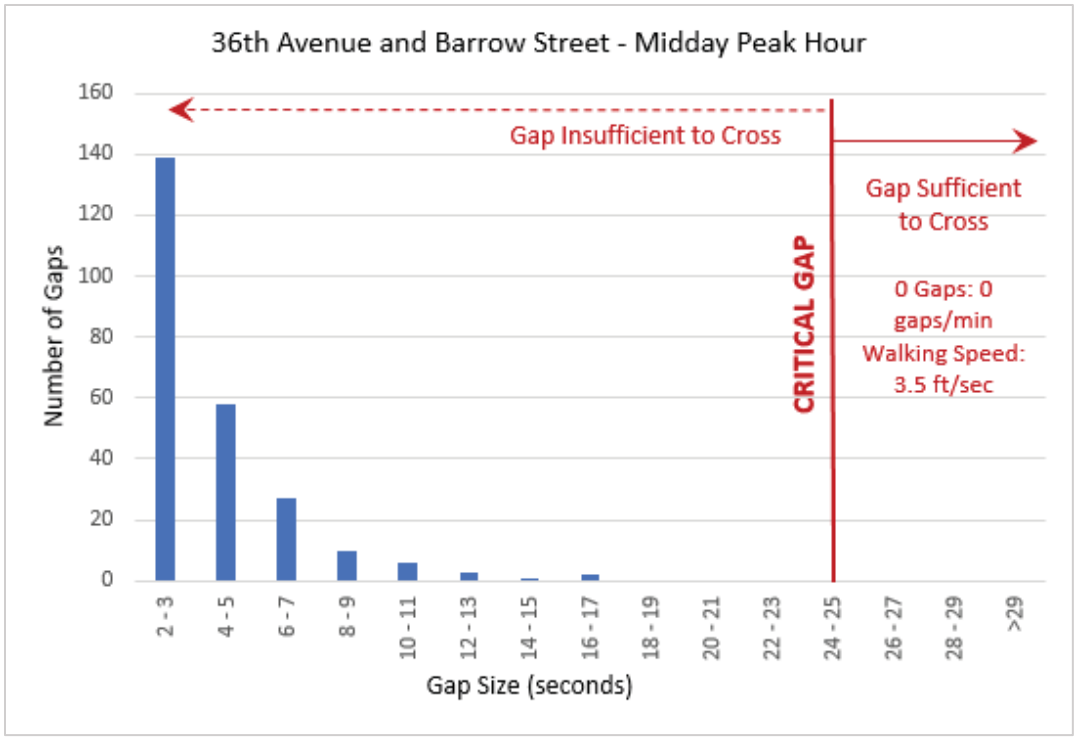


Figure 26. 36th Avenue and Barrow Street (3.5 ft/sec)

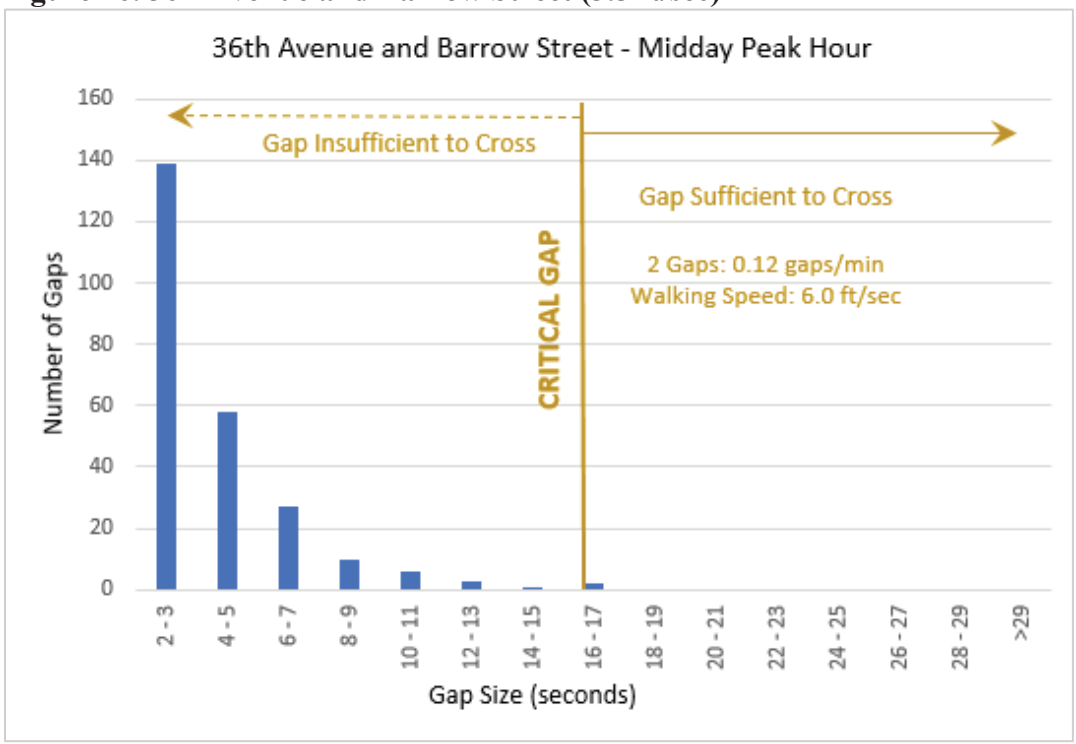


Figure 27. 36th Avenue and Barrow Street (6.0 ft/sec)

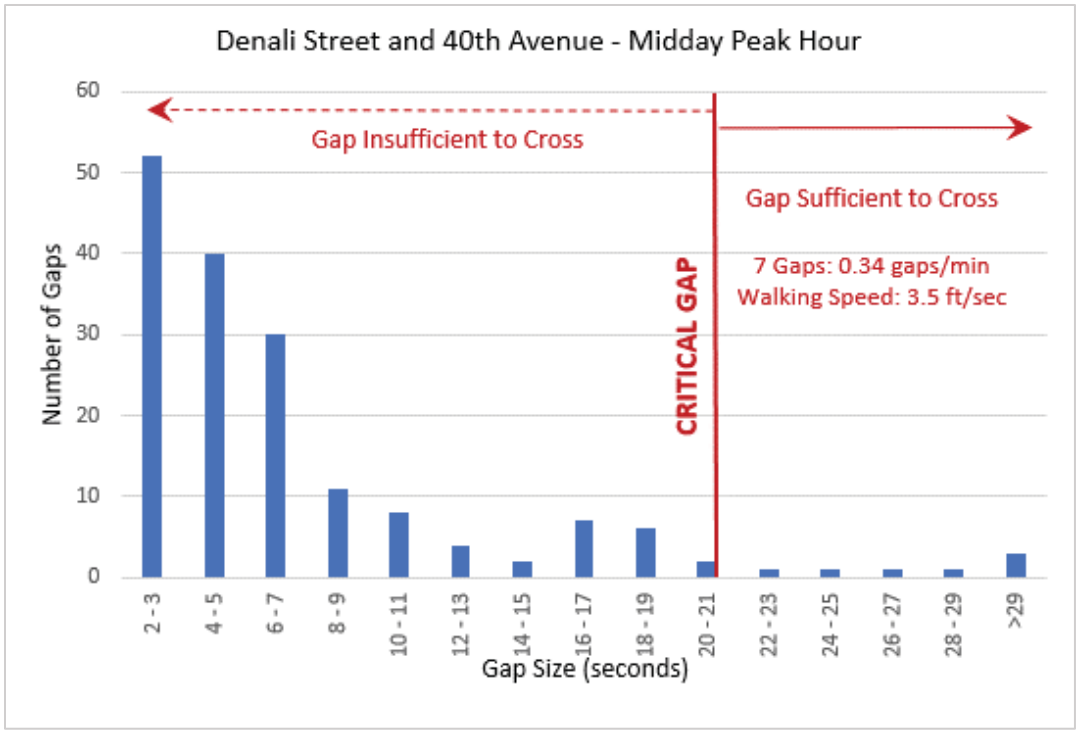


Figure 28. Denali Street and 40th Avenue (3.5 ft/sec)

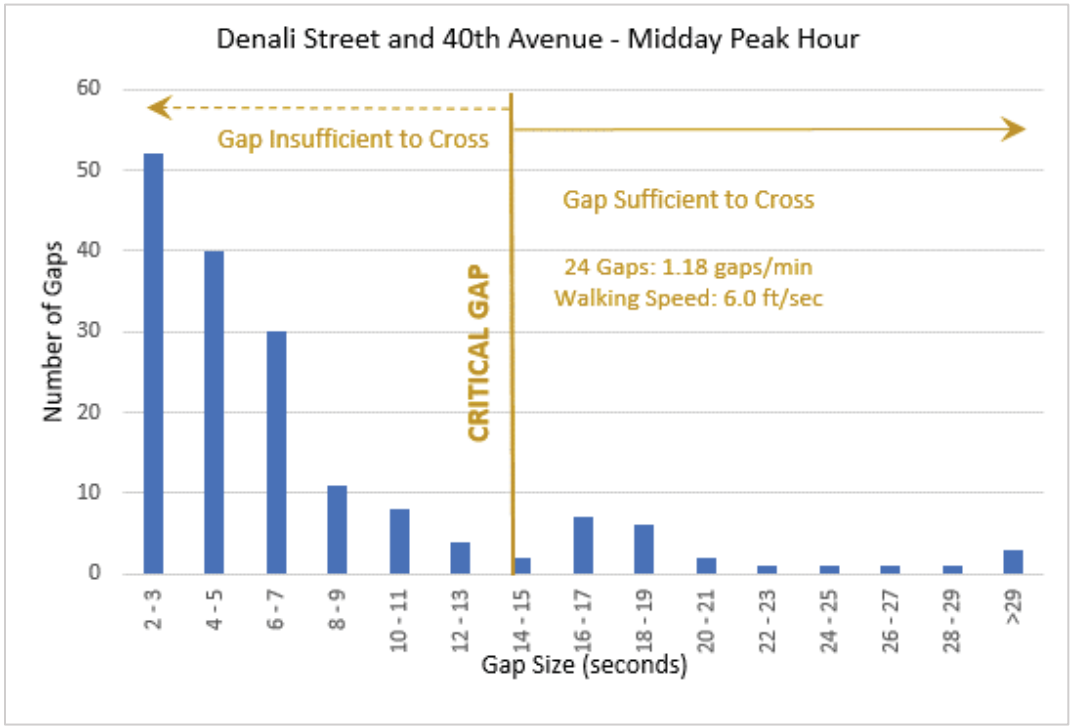


Figure 29. Denali Street and 40th Avenue (6.0 ft/sec)

5.2 Vehicle Delay and LOS

Table 19 below is adapted from AASHTO's PGDHS and presents the minimum desirable LOS on a roadway based on classification and terrain type. Both Denali Street and 36th Avenue are classified by MOA as Type II Minor Arterials. As they are located in an urban area, the minimum desired LOS is a C or D.

Table 19. AASHTO Appropriate Level of Service for Area and Terrain Type

Functional class	Appropriate LOS for specified combinations of area and terrain type			
	Rural level	Rural rolling	Rural mountainous	Urban and Suburban
Freeway	B	B	C	C or D
Arterial	B	B	C	C or D
Collector	C	C	D	D
Local	D	D	D	D

Source AASHTO PGHDS 2011 Table 2-5

Capacity analyses for most intersections within the study area were conducted using the 2010 HCM methodology. However, this methodology does not support exclusive pedestrian phases. For this reason, the intersection of Denali Street and Tudor Road was analyzed using the HCM 2000 methodology. Vehicular LOS, delay, and volume-to-capacity (v/c) ratio were calculated for both signalized and unsignalized intersections along 36th Avenue and Denali Street within the study area.

Figure 30 and Figure 31 give overall intersection LOS and delay for the midday and PM Peak hours under existing volumes and future volumes, respectively.

Detailed information about the LOS, delay, and volume to capacity (v/c) ratio for each intersection movement can be found in Appendix G: Intersection Operation Details.

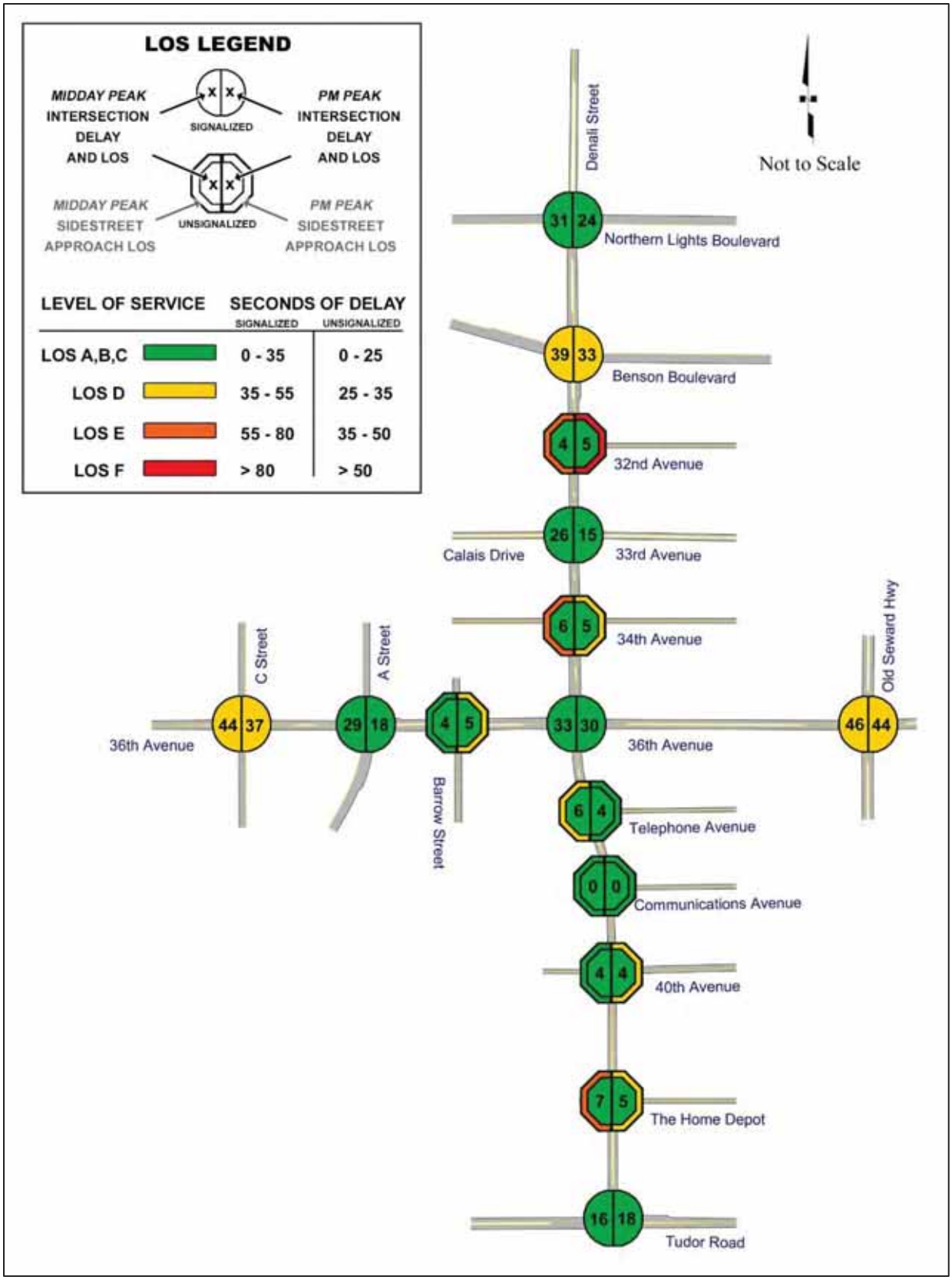


Figure 30. LOS for Existing Volumes and Existing Configuration – Midday and PM Peaks

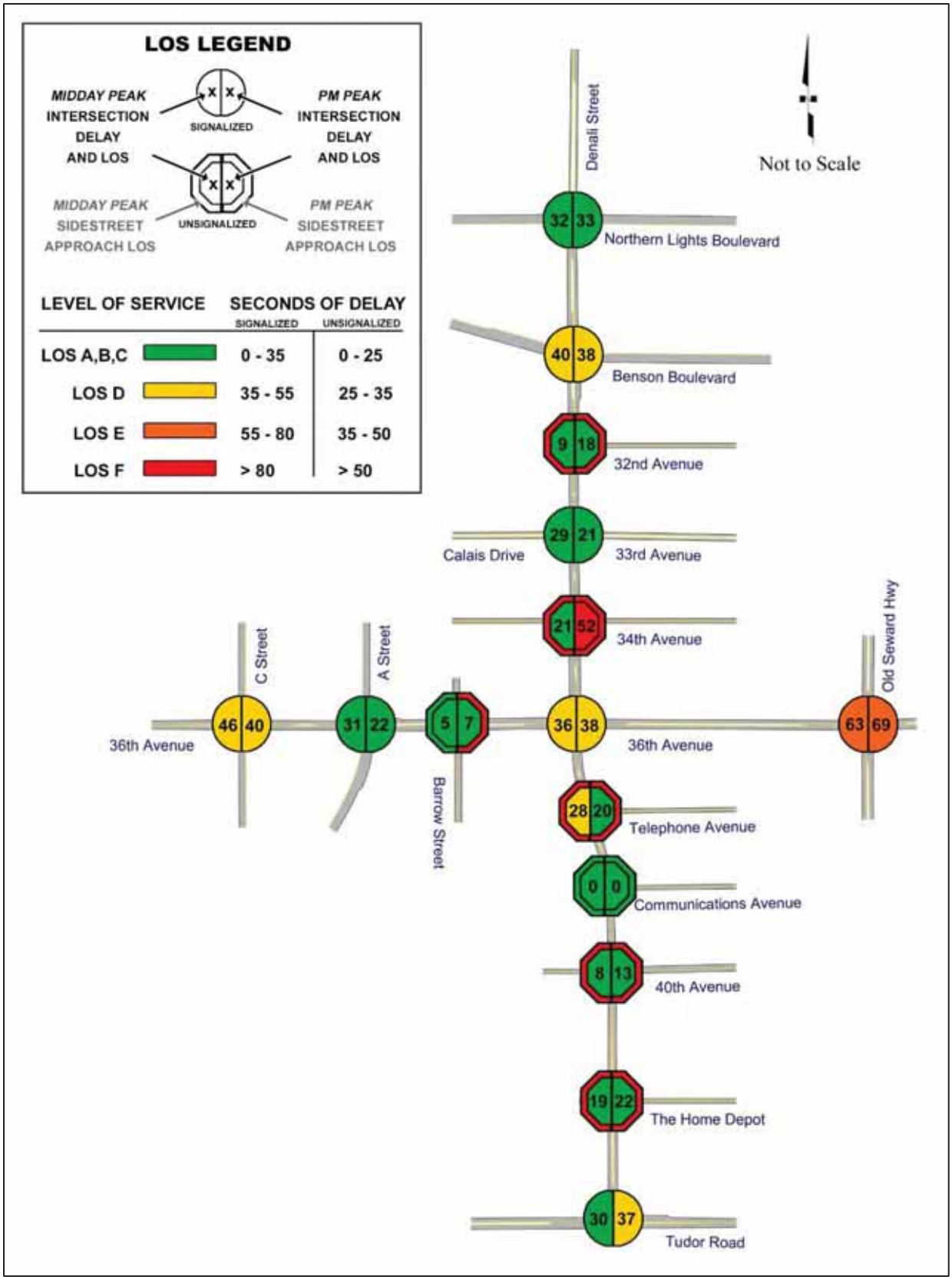


Figure 31. LOS for Future Volumes and Existing Configuration – Midday and PM Peaks

6 Guidance on Complete Streets Elements

At a charrette held on Thursday, December 14, 2017, the project team discussed the existing and forecasted future conditions and selected Complete Streets alternatives to examine in more detail. This Traffic Analysis Report looks at the effect of these alternatives on signal timing, as well as non-motorized and motorized delay and LOS.

As described in the following sections, the existing and forecasted volumes limit the feasibility of lane reductions on 36th Avenue. Based on considerations of feasibility, the project team did not pursue lane reductions on 36th Avenue, but rather chose to evaluate the effect of lane reductions on Denali Street.

SECTION HIGHLIGHTS

- A variety of sources were consulted to determine the types of Complete Streets Design Elements that could be considered.
- Based on existing and forecasted volumes, no changes to the lane configuration on 36th Avenue were proposed.
- Based on existing and forecasted volumes, reorganizing the lanes on Denali Street to include one through lane in each direction, a two-way-left-turn lane, and bike lanes is proposed for evaluation.

6.1 Lane Reorganization Treatment

Based on average daily traffic (ADT) and AADT, several agencies offer guidance about the feasiblity of reducing the traffic lanes from four lanes to three, so that the right-of-way can be reassigned to other uses. Table 20 shows criteria from the City of Seattle and from the Genesee County Metropolitan Planning Commission in Flint, MI. While guidance from both agencies indicates that a lane reduction is feasible on a road with an ADT of 10,000 or less, they vary in terms of what upper threshold would be acceptable for a three-lane roadway.

Table 20. Example Lane Reduction Feasibility Based on ADT

Agency	*Feasible*	*May be Feasible*	*Not Feasible*
City of Seattle	≤10,000 vpd	10,000 vpd to 25,000 vpd	>25,000 vpd
Genesee County Metropolitan Planning Commission	≤10,000 vpd	10,000 vpd to 20,000 vpd	>20,000 vpd

Table 21 depicts Federal Highway Administration (FHWA) guidelines for determining whether or not a roadway is a good candidate for conversion to a three-lane roadway based on traffic volumes.

Table 21. Candidate Guidelines from FHWA for Conversion to 3-Lane

Volume	*Candidacy*	*Recommended Analysis*
Less than 10,000 ADT	Great Candidates	Capacity will most likely not be affected
10,000 – 15,000 ADT	Often Good Candidates	Intersection analysis; signal retiming
15,000 – 20,000 ADT	Sometimes Good Candidates	Corridor analysis
More than 20,000 ADT	Possible Candidate	Feasibility study

The Highway Safety Information System summary "Evaluation of Lane Reduction 'Road Diet' Measures on Crashes" identifies an AADT of 20,000 vpd as the upper threshold when considering a roadway for a lane reduction. It states that "for road diets above approximately 20,000 vehicles, there is an increased likelihood that traffic congestion will increase to the point of diverting traffic to alternative routes."

Instead of evaluating the feasibility for lane reductions based on AADT, the City of Chicago prefers to use the design hourly volume (DHV). The City of Chicago considers a roadway with a DHV of 1,000 vehicles per hour (vph) or less a candidate for a lane reduction.

For reference, Table 22 provides the existing year and projected 2045 AADTs along Denali Street and along 36th Avenue within the study area. On Denali Street, the existing and future AADTs are all below the 20,000 vpd threshold for considering a three-lane cross-section. Since most of the AADTs in the future are above 10,000 vpd, an intersection analysis is suggested. On 36th Avenue, critical segments are projected to have AADTs above 20,000 in the future.

Table 22. AADTs within the Project Area

Street	*Segment From*	*Segment To*	*AADT Base Year 2013*	*AADT Future Year 2045*
Denali Street	Fireweed Lane	Northern Lights Boulevard	3,700	5,000
	Northern Lights Boulevard	Benson Boulevard	10,500	14,000
	Benson Boulevard	Calais Drive/33rd Avenue	12,000	17,500
	Calais Drive/33rd Avenue	36th Avenue	12,000	17,500
	36th Avenue	Telephone Avenue	9,500	15,500
	Telephone Avenue	40th Avenue	8,500	14,000
	40th Avenue	Tudor Road	8,500	13,500
36th Avenue	Arctic Boulevard	C Street	12,500	15,000
	C Street	A Street	15,000	17,000
	A Street	Denali Street	18,500	26,500
	Denali Street	Old Seward Highway	16,000	21,000
	Old Seward Highway	New Seward Highway	18,500	23,500

Table 23 compares two-way peak hour traffic volumes within the study area. Traffic volumes within the study area are highest at midday.

Table 23. Comparison of Peak Hour 2-way Volumes

Road Segment	*AM Peak*	*Midday Peak*	*PM Peak*
36th Avenue West of Denali Street	1,320 vph	2,105 vph	1,955 vph
36th Avenue East of Denali Street	1,285 vph	1,905 vph	1,885 vph
Denali Street North of 36th Avenue	565 vph	1,365 vph	1,385 vph
Denali Street South of 36th Avenue	430 vph	1,185 vph	1,050 vph

Given the existing and projected AADTs and DHVs on 36th Avenue, it is not desirable to convert 36th Avenue to a three-lane road. However, a three-lane option could be considered for Denali Street or portions of Denali Street. South of 36th Avenue, Denali Street is projected to have AADTs of 15,000 or less through the design year. FHWA considers roadways with these volumes to be "often good" candidates with a need for an intersection analysis. North of 36th Avenue, the AADTs are higher, falling between 15,000 and 20,000 AADT. FHWA considers roadways with these volumes to be "sometimes good" candidates with a need for a corridor analysis. It is important to note that future year AADTs assume a full build out of all

undeveloped parcels and an annual growth rate of 0.5%. This is intended to represent a worst-case traffic scenario.

Based on these considerations, the effects of a lane reduction scenario for Denali Street from Northern Lights Boulevard to Tudor Road are analyzed. However, no changes to the lane configuration are proposed for 36th Avenue.

6.2 Unsignalized Crossing Treatments

The *Alaska Traffic Manual* (ATM) provides guidance in determining if pedestrian crosswalks should be marked and whether additional traffic control devices may be installed at a midblock or unmarked crossing. Table 3B-101 in the ATM provides guidance on whether or not marked crossings are appropriate based on vehicle speed and volume, number of lanes, and the presence or absence of a median. Tables 4A-101 and 102 provide guidance on whether or not additional devices should be provided, and what level of device is appropriate.

The ATM uses a threshold pedestrian volume of 20 pedestrians in a one-hour period, recurring regularly from day to day, for consideration of any kind of marking or device. Pedestrian counts typically include bicycle counts if the bicyclist is crossing as a pedestrian. Table 24 summarizes combined pedestrian and cyclist counts (taken in conjunction with vehicular turning movement counts) crossing the major road at unsignalized intersections in the study area at varying peak hours. Twenty or more pedestrians and cyclists were counted crossing the major road at two intersections: 20 pedestrians and cyclists were counted crossing Denali Street at 40th Avenue, and 25 pedestrians and cyclists were counted crossing 36th Avenue at Barrow Street.

Table 24. Summary of Major Road Crossing Pedestrians and Cyclists at Unsignalized Intersections

Crossing Major Street	*At Minor Street*	*Date*	*Day of Week*	*Hour of Peak Crossing*	*Observed Pedestrians*
Denali Street	32nd Avenue	6/20/2017	Tuesday	4:15 - 5:15 PM	6
Denali Street	34th Avenue	6/27/2017	Tuesday	7:15 - 8:15 AM	7
Denali Street	Telephone Avenue	6/21/2017	Wednesday	12:00 - 1:00 PM	2
Denali Street	Communications Avenue	7/13/2017	Thursday	12:00 - 1:00 PM	2
Denali Street	40th Avenue	6/28/2017	Wednesday	4:00 - 5:00 PM	20
36th Avenue	Barrow Street	6/22/2017	Thursday	4:00 - 5:00 PM	25

In addition to the observed crossings at the intersection of Denali Street and 40th Avenue, a high number of pedestrians were observed crossing the segment of Denali Street between Communications Avenue and Tudor Road, as discussed in Section 3.5.1. Twenty-five pedestrians were observed crossing the segment near or at 40th Avenue.

Based on the volume of pedestrian crossings, two unsignalized intersections are recommended to be considered for a crossing treatment: the intersection of 36th Avenue at Barrow Street and the

intersection of 40th Avenue at Denali Street. Table 25 and Table 26 provide the ATM Table 3B-101 recommendations for the existing condition and the proposed Complete Streets condition, respectively. As noted in the tables, a marked crosswalk is not recommended for the Barrow Street location. The 40th Avenue location is marginal under existing conditions and under a three-lane alternative. Note that a marked crossing exists at the 40th Avenue location.

Table 25. Marked Crossing Recommendations from ATM for Existing Conditions

	Vehicle ADT	*Speed Limit (mph)*	*Number of Lanes*	*Median*	*Recommendation from Table 3B-101*
36th Avenue at Barrow Street	> 15,000	40	≥4	Yes	Do not install a crosswalk
Denali Street at 40th Avenue	< 9,000	35	≥4	No	Marginal Candidate

Table 26. Marked Crossing Recommendations from ATM for Proposed Conditions

	Vehicle ADT	*Speed Limit (mph)*	*Number of Lanes*	*Median*	*Recommendation from Table 3B-101*
36th Avenue at Barrow Street	> 15,000	40	≥4	Yes	Do not install a crosswalk
Denali Street at 40th Avenue	> 12,000 to 15,000	35	3	No	Marginal Candidate

The ATM also indicates that the proximity of signalized crossing opportunities should be considered. The Barrow Street crossing is only 450 feet away from the signal at A Street and 600 feet away from the signal at Denali Street. The 40th Avenue crossing is 1,300 feet from the nearest signal.

The ATM also provides guidance on what traffic control devices may be installed at locations where pedestrians are crossing. Depending on traffic and roadway conditions, a traffic control device can increase safety and decrease crossing delay for pedestrians and cyclists. Traffic control alternatives are grouped into three categories:

- Non-electrical (NE) devices such as signs, striping, and median refuges
- Electrical warning (EW) devices such as beacons, lighting, lighted sign borders, in-pavement lights, etc.
- Electrical regulatory (ER) devices such as pedestrian hybrid beacons and signals

The consideration of a traffic control device is contingent on either the presence of a school crossing or 20 or more pedestrians using the crossing within an hour on a regularly reoccurring basis. The selection of the device also takes into account number of lanes, presence of a median or pedestrian refuge, AADT, and speed or speed limit.

Table 27 and Table 28 give recommendations for traffic control devices at the crossings for the existing conditions and for the proposed Complete Streets condition, respectively, as found in Table 4A-101 in the *ATM.*

Table 27. Crossing Traffic Control Device Recommendations from ATM for Existing Conditions

	Vehicle ADT	*Speed Limit (mph)*	*Number of Lanes*	*Median*	*Recommendation from Table 4A-101*
36th Avenue at Barrow Street	> 15,000	40	≥4	Yes	Electrical Regulatory
Denali Street at 40th Avenue	> 4,500 to 9,000	35	≥4	No	Electrical Warning

Table 28. Crossing Traffic Control Device Recommendations from ATM for Proposed Conditions

	Vehicle ADT	*Speed Limit (mph)*	*Number of Lanes*	*Median*	*Recommendation from Table 4A-101*
36th Avenue at Barrow Street	> 15,000	40	≥4	Yes	Electrical Regulatory
Denali Street at 40th Avenue	> 12,000 to 15,000	35	3	No	Electrical Warning

Although an electrical regulatory device is indicated for the Barrow Street crossing, a regulatory device (either a signal or a pedestrian hybrid beacon) is not recommended as it would disrupt the signal progression along 36th Avenue. Since analyzed crash data does not indicate safety concerns at this location, no pedestrian crossing improvements are recommended.

Under a three-lane alternative and two-way-stop control at the Denali Street and 40th Avenue crossing, active electrical warning beacons are recommended to enhance the existing crosswalk markings. Consideration is also being given to a roundabout at this location, which would reduce the number of lanes crossed to two and provide a median refuge for every crossing.

6.3 Bicycle Facility Considerations

Table 29 offers guidance from the AASHTO *Guide for the Development of Bicycle Facilities* as to what type of bicycle facilities may be appropriate based on vehicle speeds and volumes. In place of design speed, the greater of posted speed limit and observed 85th percentile speed can be considered when selecting the type of bicycle facility.

36th Avenue has limited ROW, high volumes, and is a poor candidate for a lane reduction. Due to these constraints, the only feasible bikeway that could be implemented is a shared use path adjacent to the roadway. A lane reduction may be feasible along Denali Street, and Table 29

indicates that shared lanes, shared use paths, or bicycle lanes may be appropriate bikeway treatments.

Denali Street between Northern Lights Boulevard and Fireweed Lane was not originally included in the study area. However, if bike lanes are installed on Denali Street, the connection between Northern Lights Boulevard and the Chester Creek Trail should be considered. Currently, the segment of Denali Street between Northern Lights Boulevard and Fireweed Lane and is three-lane, with one lane in each direction and a two-way-left-turn lane. Base year and projected 2045 AADT values are under 5,000 vpd and the speed limit is 35 mph.

Table 29 indicates that shared lanes (wide outside lane) or marked shared lanes could be used on Denali Street between Northern Lights Boulevard and Fireweed Lane. Shared lanes with a wide outside lane are best for speeds greater than 25 mph, AADTs greater than 3,000 vpd, and arterials and collectors. Marked shared lanes, or sharrows, are best used for speeds under 35 mph, variable AADTs, and collectors or minor arterials. Based on this analysis, shared lanes with wide outside lanes would provide adequate bicycle facilities for this segment. Between 2010 and 2014, the period used for crash analysis, no crashes were recorded on Denali Street between Northern Lights Boulevard and Fireweed Lane. From a safety perspective, there is no need to modify the existing roadway configuration further indicating that shared lanes are an appropriate treatment.

Considering the location of the proposed bicycle facilities on Denali Street in relation to connecting and parallel bicycle facilities is an important part of creating a cohesive Complete Streets network. Bicycle facilities on Denali Street should easily connect to existing east-west routes, including the separated shared-use path on Tudor Road, the bicycle facilities currently being proposed by the W. 32nd Ave & E. 33rd Ave Upgrades project, and the Chester Creek Trail. Connection to the Chester Creek Trail could be made via a short jog along Fireweed Lane between Denali and Eagle Streets.

The nearest parallel bicycle facility to the west of Denali Street is the A Street/C Street pathway. From Klatt Street north to 40th Avenue where the A Street/C Street couplet begins, the mostly separated pathway runs on either side of C Street. From 40th Avenue north to 36th Avenue, the pathway is separated and runs on either side of the A and C Street couplet. North of 36th Avenue, the pathway along A Street remains mostly separated until 9th Avenue and offers a connection to the Chester Creek Trail north of 23rd Avenue. Meanwhile, the pathway on C Street north of 36th Avenue becomes an attached sidewalk which continues across the C Street Bridge towards Government Hill. The sidewalk is quite narrow and uncomfortable, especially for mixed pedestrians and bicyclists.

East of Denali Street, any north-south facility is discontinuous. Between Tudor Road and 36th Avenue, bicyclists have the option of traveling on the sidewalk on Old Seward Highway or on MacInnes Street. Old Seward Highway is a higher-speed, higher-volume roadway compared to Denali Street and is ¼ mile east of Denali Street. MacInnes Street is more than ¾ of a mile from Denali Street and requires crossing the Seward Highway at Tudor Road or 36th Avenue. North of 36th Avenue, there is a separated pathway on the east side of the Seward Highway that becomes a

sidewalk between Benson Boulevard and Northern Lights Boulevard, then separates from the roadway north of Northern Lights Boulevard and connects to the Chester Creek Trail.

While parallel north-south facilities exist, this report considers the effect of the installation of bike lanes on Denali Street from Tudor Road to Northern Lights Boulevard and possibly beyond to Fireweed Lane. Bicycle lanes on Denali Street would provide a continuous bicycle corridor on a lower-volume, lower-speed roadway than existing north-south connections and would improve non-motorized access to an area not currently served by the transit system.

Table 29. Summary of Bicycle Facility Type Based on Roadway Speed
(adopted from AASHTO Guide for the Development of Bicycle Facilities (2012) Table 2-3)

Type of Bikeway	*Motor Vehicle Design Speed*	*Traffic Volume (vpd)*	*Classification or Intended Use*	*Possible Candidate along Denali Street*
Shared Lanes (no special provisions)	Speeds vary based on location (rural or urban).	<1000	Rural roads or local streets	
Shared Lanes (wide outside lane)	Variable. Use as the speed differential between cyclist and motorists increases - generally any road where design speed is more than 25 mph.	>3000	Arterials and collectors (major traffic movements)	Fireweed Lane to Northern Lights Boulevard
Marked Shared Lanes	Variable. Use where the speed limit is 35 mph or less.	Variable	Collectors or minor arterials	
Paved Shoulders	Variable. Typical posted rural highway speeds (generally 40-55 mph).	Variable	Rural roadways, inter-city highways	
Bicycle Lanes	Generally, any road where the design speed is more than 25 mph.	Variable	Arterials and collectors (major traffic movements)	All Segments
Bicycle Boulevards	Use where the speed differential between motorists and cyclists is typically 15 mph or less. Generally, posted speed limits of 25 mph or less.	<3000	Residential roadways	
Shared Use Path: independent right-of-way	N/A	N/A	Provides separated pathway for non-motorized users	All Segments
Shared Use Path: Adjacent to Roadways (i.e. sidepath)	The adjacent roadway has high-speed motor vehicle traffic such that cyclists might be discouraged form riding on the roadway.	Very high motor vehicle traffic volumes	Provides separated pathway for non-motorized users	Northern Lights to Benson Boulevard

6.4 Bicycle Treatments at Intersections

The National Association of City Transportation Officials (NACTO) *Urban Bikeway Design Guide* presents alternatives that can be implemented to create Complete Streets that are inclusive of bicyclists. Guidance is given for which alternatives are permitted under the MUTCD. The guide states that "Designs for intersections with bicycle facilities should reduce conflict between bicyclists (and other vulnerable road users) and vehicles by heightening the level of visibility, denoting a clear right-of-way, and facilitating eye contact and awareness with competing modes" (p. 47).

Two possible treatments for carrying bicycle lanes through the intersections are considered in this report:

- Treat bicycles as pedestrians. Bike lanes end prior to the intersection and transition to shared use pathways, either at driveways or at ramps built for that purpose.
- Treat bicycles as motor vehicles. As depicted in Figure 32, bike lanes are carried up to the intersection, falling between the through lane and the right turn lane, if a right turn lane exists.

From https://nacto.org/wp-content/uploads/gallery/bikewaysatturnlanes_3d/through-bike-lane-plan.jpg
Figure 32. Through Bike Lanes

If bike lanes are carried to the intersection, bicycle detection would be necessary. In-pavement loops can be used for bicycle detection but are often problematic since a bike must be perfectly positioned in order to be detected. The Municipality of Anchorage is currently overseeing a test on the practicality and effectiveness of radar detection for bicycles. Depending on the results from the pilot study, bicycle radar detection within the study area may be a possibility. Note that the presence of bike lanes at an intersection would increase pedestrian crossing distance.

However, because a lane reduction is proposed on Denali Street, proposed pedestrian crossings would not be longer than existing.

Bicycle boxes, which are boxes marked on the roadway between the pedestrian crosswalk and the vehicle stop bar as shown in Figure 33, are also considered. Bike boxes are used to facilitate left turns by bicyclists. Left turning bicyclists coming up to the intersection while the light is red can enter the bike box and position themselves in front of the left turning vehicles.

Bike boxes are especially useful at locations where:

- There is a high volume of bicycles, especially if
  - Many bicyclists are making left turns
  - Many vehicles are making right turns
- A left turn is required to follow a designated bike route

Bike boxes are allowed by the MUTCD only under interim approval; agencies desiring to use bike boxes must request interim approval from the FHWA and follow the guidelines for in the FHWA Interim Approval document (IA-18; https://mutcd.fhwa.dot.gov/resources/interim_approval/ia18/index.htm).

From https://nacto.org/wp-content/uploads/gallery/bikebox_street/bikebox_top_alt.jpg
Figure 33. Bicycle Boxes

7 Evaluation of Complete Streets Design Alternatives

Based on the guidance for Complete Streets elements and on the results of the project team charrette, the following alternatives are considered in this report:

- Lane reduction along Denali Street
  - from four-lane to three-lane cross section from Tudor Road to 36th Avenue.
  - Five-lane to three-lane cross section from 36th Avenue to Benson Boulevard.
  - Five-lane to four-lane cross section (two northbound through lanes, one left turn lane, and one southbound through lane) from Benson Boulevard to Northern Lights Boulevard.
- Installation of bike lanes along Denali Street
  - With bicyclists brought onto sidewalks and treated as pedestrians at signalized intersections
  - Or with bike lanes carried through signalized intersections
  - With bike boxes at Calais Drive/33rd Avenue
- Installation of a roundabout at the intersection of 40th Avenue at Denali Street

SECTION HIGHLIGHTS

- Under the proposed lane reconfiguration, pedestrian delay would not change very much, but there would be improved longitudinal facilities for pedestrians and bicyclists.
- A lane reduction on Denali Street is feasible, with additional auxiliary lanes at signalized intersections as needed.
- The intersection impacted the most is 36th Avenue at Denali Street, which would experience LOS E in the PM peak hour under the full-build-out 2045 forecasted volumes.
- Unsignalized intersections will experience increased delay and would benefit from a robust internal network that allowed a variety of access options.
- A roundabout at the intersection of Denali Street with 40th Avenue would reduce angle and severe crashes, decrease pedestrian crossing delay, reduce vehicle speeds on Denali Street, and provide minimal delay for all vehicles.

7.1 Signal Timing Changes

Changes in roadway width, and therefore the physical size of the intersection, affect signal timing parameters such as all-red time, pedestrian walk time, and pedestrian clearance time. Thus, to understand how the proposed changes would affect vehicular LOS and delay, it was necessary to estimate how these values would change under the different scenarios. Since some of the guidelines for calculating these timing parameters have changed in the most recent MUTCD, these parameters were calculated for the existing condition as well as for the proposed conditions.

The calculated values for each intersection are presented in Appendix H: Clearance Intervals . It was found that there is little difference in yellow and all-red times across the different conditions

and that pedestrian clearance time nearly always decreased by a few seconds under the proposed treatments.

For each intersection, the existing signal timing was maintained if at all possible. In some cases, the clearance times increased to the point that the existing split time was not adequate. In these instances, the existing split timing was adjusted to accommodate the movement that needed more time; however, the intersection cycle lengths and offsets were held constant.

Because the signal timing varied little between conditions, the condition with the bike lanes carried through the intersection was found to be equivalent to the condition with the bicyclists brought onto the sidewalk and treated as pedestrians at the intersection. Thus, the following analysis only presents the results for when the bike lanes are carried through the intersection.

7.2 Design Pedestrian and Vehicular Delay and LOS

7.2.1 Pedestrian Delay and LOS

7.2.1.1 Pedestrian Crossing at Signalized Intersections

The Complete Streets design alternative only varies lane configuration along Denali Street. Thus, pedestrian delay was only calculated for signalized intersections along Denali Street as per the HCM 2010. Table 30 and Table 31 show average pedestrian delay at the governing peak hour for the Complete Streets configuration for existing and future volumes, respectively. Note that calculated delay values for the alternative are comparable to delay values under the existing condition, as presented in Section 5.1. This indicates that the Complete Streets alternative would have minimal impact on pedestrian delay.

Calculated delay values for all peak hours under the Complete Streets configuration are available in Appendix I: Average Pedestrian Delay at Signalized Intersections – Complete Streets Configuration.

Table 30. Average Pedestrian Delay at the Midday Peak Hour – Existing Volumes

Signalized Intersection	*Average Pedestrian Delay by Movement (sec)*			
	EB	WB	NB	SB
Northern Lights Boulevard and Denali Street	18	18	59	59
Benson Boulevard and Denali Street	19	19	59	59
33rd Avenue and Denali Street	59	59	8	9
36th Avenue and Denali Street – with EB/WB Channelized Rights	34	36	59	59
36th Avenue and Denali Street – with EB/WB Rights (No Channelization)	35	36	59	59
Tudor Road and Denali Street	-	23	-	59

Table 31. Average Pedestrian Delay at the Midday Peak Hour – Future Volumes

Signalized Intersection	*Average Pedestrian Delay by Movement (sec)*			
	EB	WB	NB	SB
Northern Lights Boulevard and Denali Street	18	18	59	59
Benson Boulevard and Denali Street	21	21	59	59
33rd Avenue and Denali Street	59	59	9	11
36th Avenue and Denali Street – with EB/WB Channelized Rights	38	39	59	59
36th Avenue and Denali Street – with EB/WB Rights (No Channelization)	38	39	59	59
Tudor Road and Denali Street	-	34	-	59

7.2.1.2 Pedestrian Crossings at Unsignalized Intersections

A single lane roundabout is proposed at the intersection of Denali Street and 40th Avenue. As described in Section 5.1.2, under existing conditions (two-way-stop-control), the calculated pedestrian LOS at this location is F for both existing and future volumes. Table 32 and Table 33 show that the proposed roundabout at 40th Avenue would significantly improve pedestrian delay and LOS for both existing and conservatively estimated future volumes.

Table 32. Pedestrian Delay and LOS at 40th Avenue Roundabout – Existing Volumes

Peak Hour	*Intersection Leg*	*Analyzed Crossing Width (feet)*	*Control Delay (sec)*	*LOS*
PM Peak	North Leg	18/18*	12	C
	South Leg	18/18*	11	C

*Southbound/Northbound

Table 33. Pedestrian Delay and LOS at 40th Avenue Roundabout – Future Volumes

Peak Hour	*Intersection Leg*	*Analyzed Crossing Width (feet)*	*Control Delay (sec)*	*LOS*
PM Peak	North Leg	18/18*	23	D
	South Leg	18/18*	23	D

*Southbound/Northbound

7.2.2 Vehicle Delay and LOS

To quantify the effect of the proposed complete street elements on vehicle delay at the signalized and unsignalized intersections in the study area, the LOS and delay for each intersection were calculated. Existing and 2045 full-build-out volumes were considered, as depicted in Figure 34 and Figure 35. These figures can be compared to Figure 30 and Figure 31, which illustrate LOS and delay for existing and full-build-out volumes under existing conditions.

The analysis shows that the unsignalized intersections along Denali Street will experience more delay under the Complete Streets alternative than under the existing condition, especially as the area becomes fully built-out. This is because putting all of the through traffic in one lane reduces the number of gaps large enough for a side-street vehicle to enter and cross the lanes, even though the needed gap size is slightly reduced by the lane reduction. Connectivity of these side streets, to possibly allow alternate routes, is discussed in Section 7.3.

At the signalized intersections, the existing vehicle LOS and delay is held mostly constant except at the intersection of Denali Street with 36th Avenue, where the intersection has more difficulty handling the increased traffic due to full build-out in the 2045 forecast. At this intersection, the future year LOS drops to LOS E under the Complete Streets alternative.

The LOS, delay, and other parameters by movement at each intersection under each alternative for the AM, Midday, and PM peak periods are shown in Appendix J: Intersection Operation Details – Complete Streets Configuration. Changes proposed for each of the intersections under the complete streets alternative are detailed in Section 7.3.

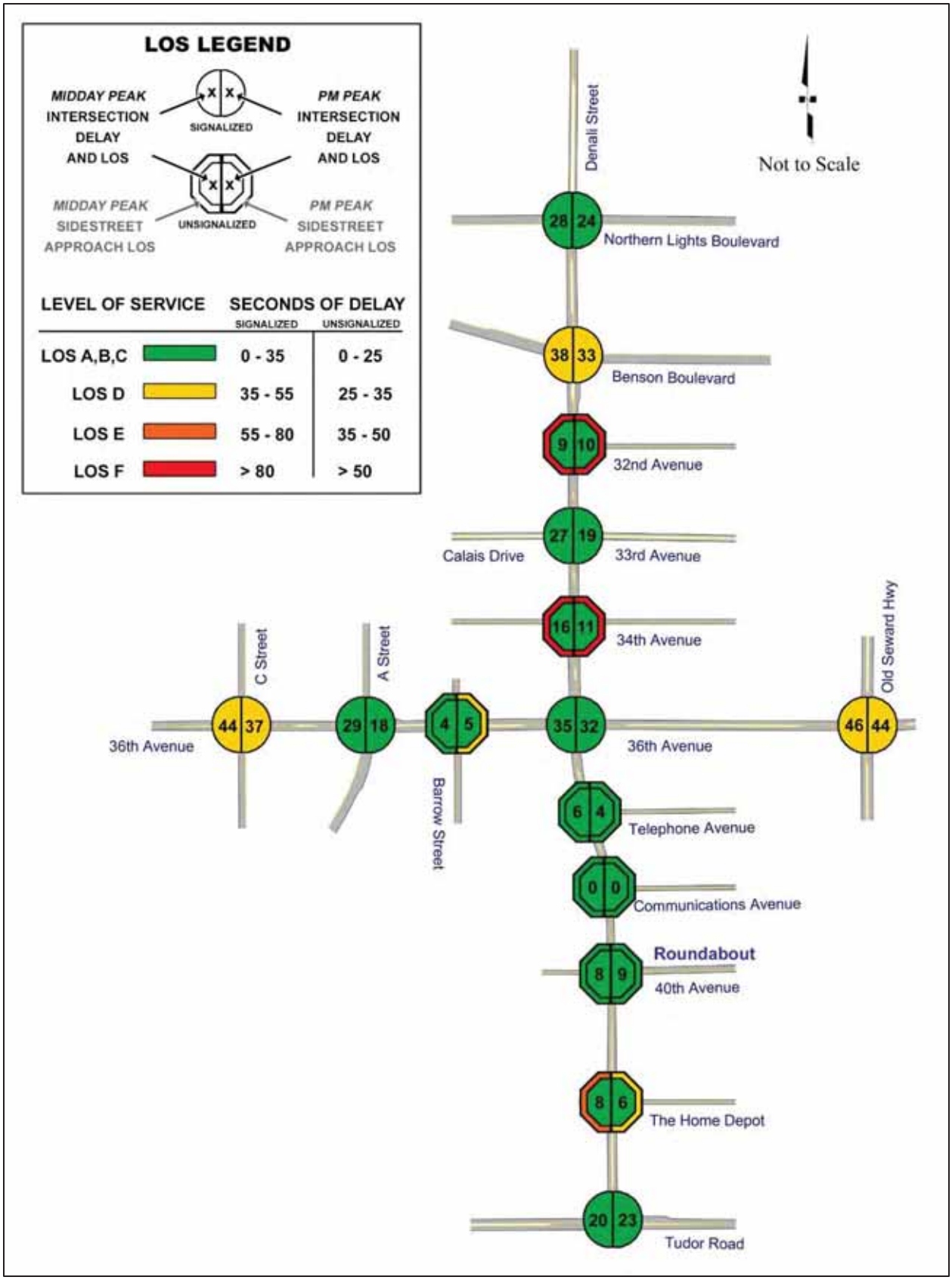


Figure 34. LOS and Delay – Existing Volumes and Complete Streets Configuration

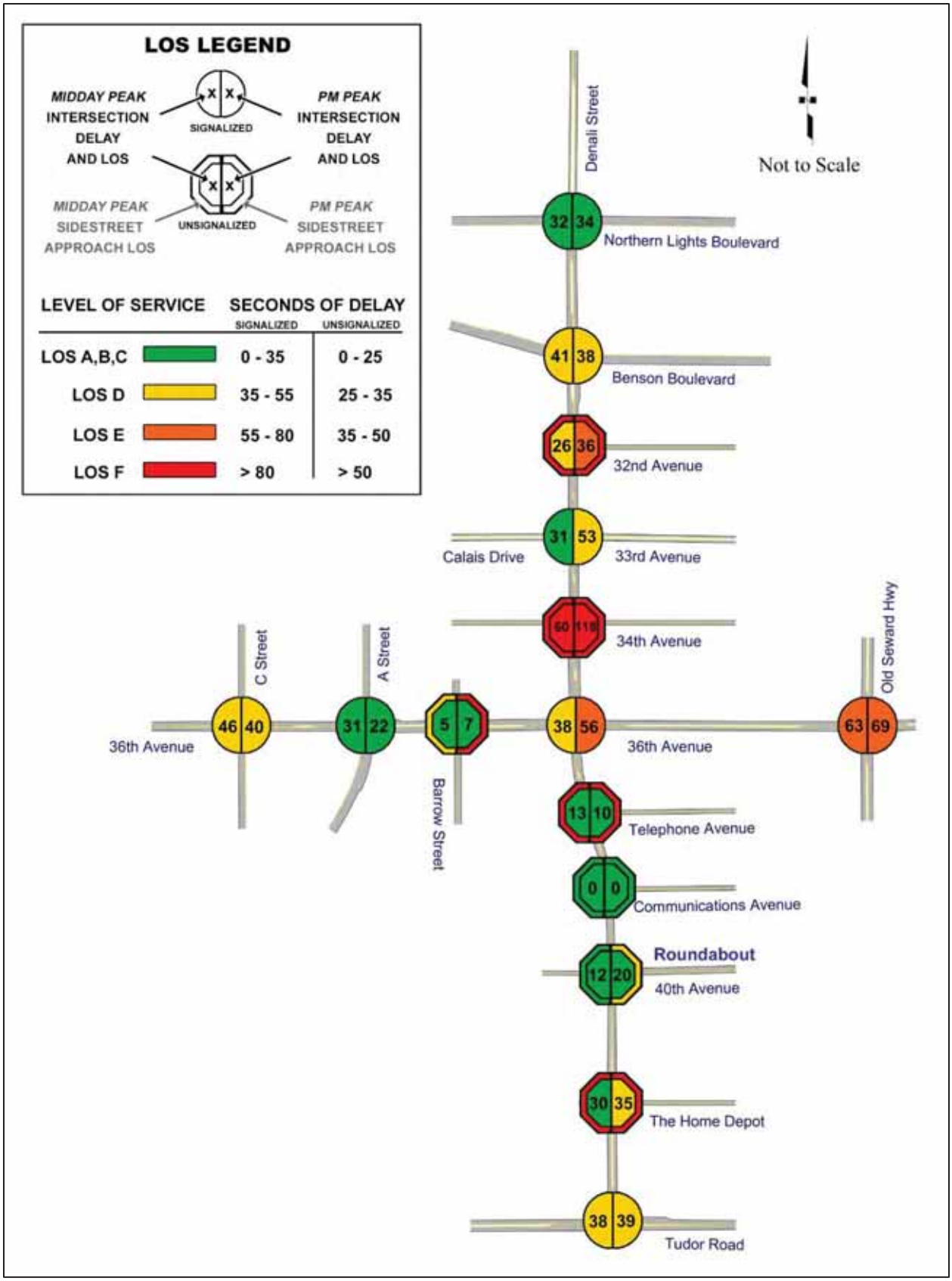


Figure 35. LOS and Delay – Future Volumes and Complete Streets Configuration

7.2.3 Effect of Bike Boxes on Signalized Intersections

NACTO's *Urban Bikeway Design Guide* describes the benefits of placing bike boxes at signalized intersections. Bike boxes are typically 10 to 16 feet deep and provide a safe and visible space for bicyclists to get ahead of traffic during the red signal phase. Bike boxes are especially useful when there are bicyclist left turns or right or left-turning conflicts between bicyclists and motorists.

The effect of bike boxes under future volumes was considered at four of the signalized intersections on Denali Street within the study area. For analysis, it was assumed that a 10-foot-deep bike box would be installed on each northbound and/or southbound intersection leg that has a left turn lane, as described below:

- Denali Street and Northern Lights Boulevard – bike box on northbound leg
- Denali Street and Benson Boulevard – bike box on southbound leg
- Denali Street and 33rd Avenue/Calais Drive – bike boxes on northbound and southbound legs
- Denali Street and 36th Avenue – bike boxes on northbound and southbound legs.

Bike boxes at the intersection of Denali Street and Tudor Road were not considered since the proposed bike lanes do not continue to the south side of Tudor Road.

Red clearance intervals for each intersection were re-calculated to reflect the inclusion of bike boxes. Table 34 describes computed increases in red time.

Table 34. Increases in Red Clearance Intervals

Intersection	*Movement*	*Increase in Red Time*
Denali Street and Northern Lights Boulevard	-	No changes
Denali Street and Benson Boulevard	SBL	+ 0.2 sec
	NBT	+ 0.2 sec
	SBT	+ 0.2 sec
Denali Street and Calais Drive/33rd Avenue	-	No changes
Denali Street and 36th Avenue – For both EB/WB Channelized Rights and EB/WB Rights (No Channelization)	SBL	+ 0.4 sec
	NBT	+ 0.4 sec
	NBL	+ 0.4 sec
	SBT	+ 0.4 sec

Using Synchro Trafficware, capacity analyses for the four intersections, both with and without bike boxes, were conducted and the results were compared. In general, the additional crossing width from the bike boxes does not cause the overall intersection LOS or the LOS for individual turning movements to deteriorate. Denali Street and Benson Boulevard is the only exception: at the midday peak hour, the northbound through movement changes from LOS D to LOS E. However, the overall intersection capacity remains at LOS D.

Note that no increases in red time are calculated at the intersection of Denali Street and Calais Drive/33rd Avenue. Existing timings are adequate to allow for additional crossing distances resulting from the inclusion of bike boxes.

While turning movement counts for bicycles are not available on the study corridor, the intersection of Denali Street with Calais Drive/33rd Avenue is considered the most desirable location for the installation of bike boxes, as bicycles would presumably transfer from the east/west bicycle facilities currently being considered by the W. 32nd Ave & E. 33rd Ave Upgrades project and the proposed north/south bicycle facilities on Denali Street. Bike boxes could be considered at the other intersections; however, the east-west cross streets at those locations do not have on-street bike facilities.

7.3 Summary of Results and Recommendations

Lane reduction alternatives were analyzed along Denali Street within the study area. The analysis focused primarily on signalized intersections, as intersection operations typically govern the flow of traffic through an urban roadway system. The analyses considered existing and future turning movement volumes for the highest peak hour periods: midday and PM. To determine delay and level of service at each intersection, 6-foot bike lanes were assumed.

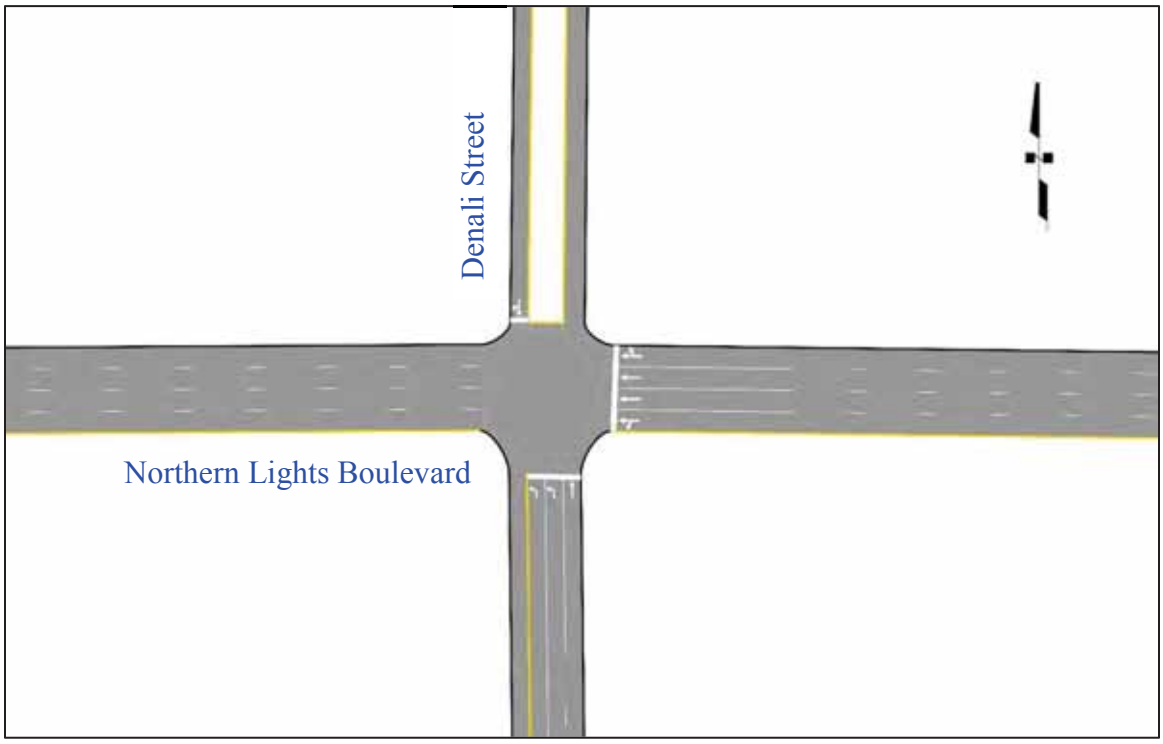
7.3.1 Intersections and Segments

A reduction of Denali Street to a three-lane configuration (one lane in each direction and one two-way-left-turn lane) was first considered. However, capacity analyses showed that a reduction of this type would result in unfavorable LOS at most signalized intersections during peak traffic hours. The only signalized intersection that was considered to have acceptable LOS with future volumes and a 2-lane approach in each direction was the intersection of Denali Street and Calais Drive/33rd Avenue, as shown in Figure 40. To increase overall intersection LOS and individual turning movement LOS to more acceptable levels, turning lanes were reintroduced at the other four signalized intersections.

The impacts of the lane reduction alternative on signalized intersections, unsignalized intersections, and road segments along Denali Street within the study area are discussed below.

7.3.1.1 Northern Lights Boulevard at Denali Street

Figure 36 shows a sketch of the proposed configuration for this intersection. This is essentially the same configuration as existing, except there is only one receiving lane southbound.



[Figure is taken directly from Synchro. Bike lanes are not shown, but the analysis assumes 6-foot bike lanes are brought to the intersection on both the north and south approaches.]

Figure 36. Denali Street and Northern Lights Lane Reduction

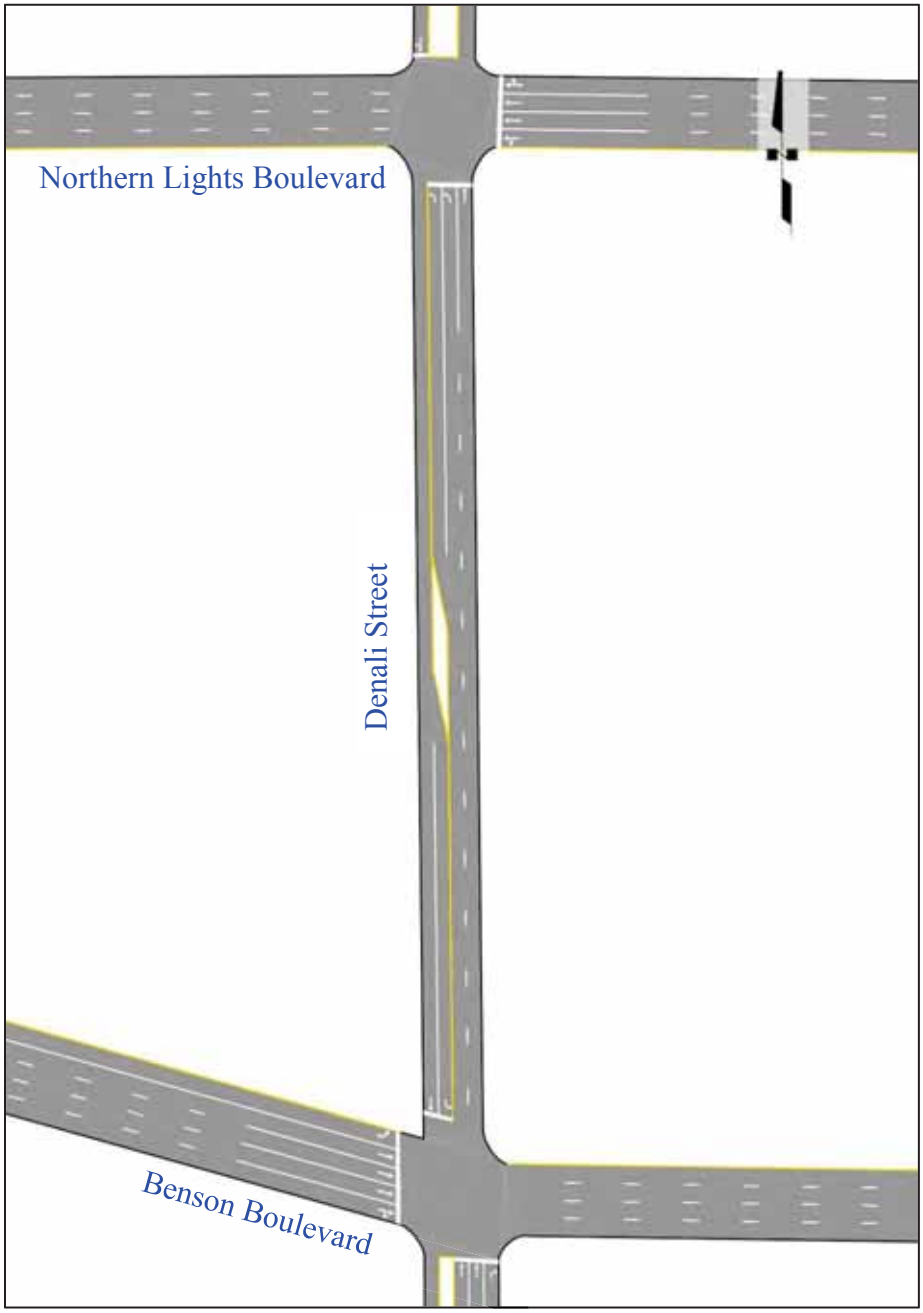
Turn lane length analysis for existing and future turning movement volumes were performed for the northbound left turn lane on Denali Street at Northern Lights Boulevard, as shown in Table 35. Essentially, the northbound left turn at Northern Lights Boulevard and the southbound left turn lane at Benson Boulevard will need to be installed back-to-back.

Table 35. Turn Lane Lengths on Denali Street and Northern Lights Boulevard

TMVs	*Auxiliary Lane Movement*	*95th % Auxiliary Lane Queue (ft)*	*95th % Adjacent Lane Queue (ft)*	*Existing Auxiliary Lane Length (ft)*	*Minimum Auxiliary Lane Length (ft)*	*Desirable Auxiliary Lane Length (ft)*	*Recommended Auxiliary Lane Length (ft)*
Existing	NBL	131	134	200	150	150	150
Future	NBL	238	262	200	250	250	250

7.3.1.2 Northern Lights Boulevard to Benson Boulevard

Figure 37 shows a sketch of the proposed lane configuration on the segment of Denali Street between Northern Lights Boulevard and Benson Boulevard. To provide an acceptable intersection LOS, two northbound left-turn lanes were required at Northern Lights Boulevard and two northbound through-lanes were needed at Benson Boulevard.



[Figure is taken directly from Synchro. Bike lanes are not shown, but the analysis assumes 6-foot bike lanes in north and southbound directions.]

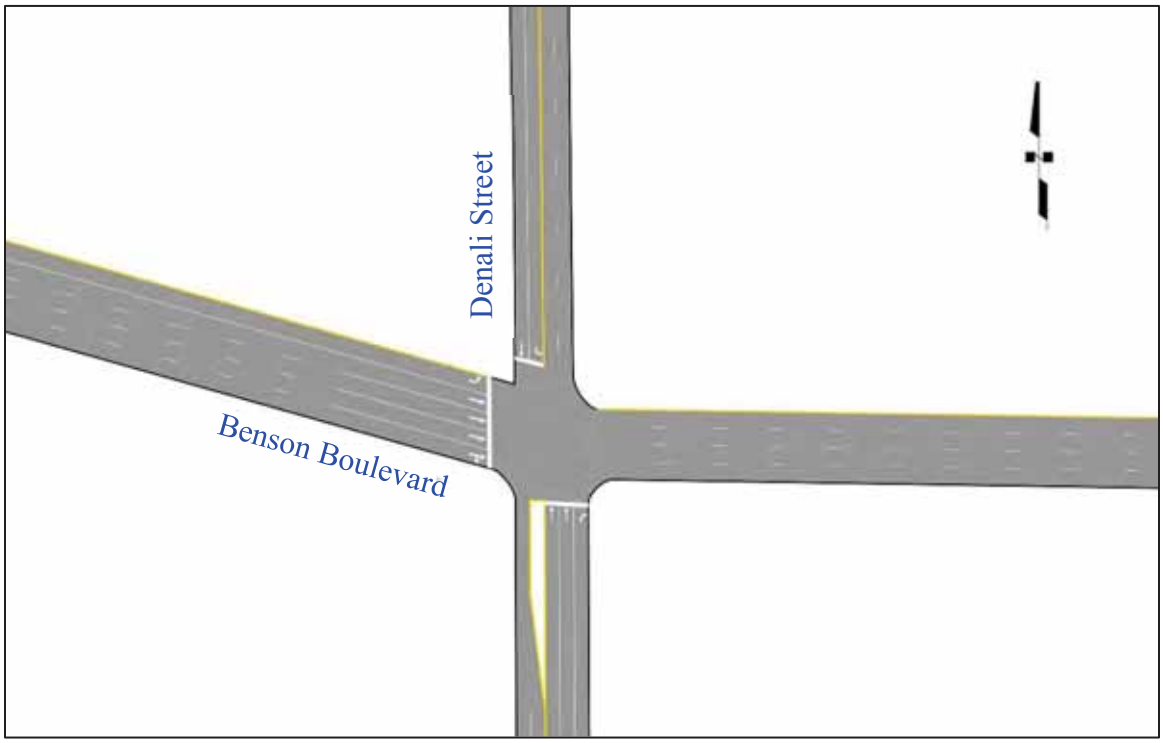
Figure 37. Lane Reduction between Northern Lights Boulevard and Benson Boulevard

7.3.1.3 Benson Boulevard at Denali Street

As discussed in Section 2: Crash Analysis, the intersection of Benson Boulevard and Denali Street had the highest occurrence of crashes of any intersection in the study area for the crash period analyzed (2010 – 2014). The intersection also has a crash rate statistically above the state average crash rate.

There are no obvious geometric adjustments, signal changes, or pedestrian upgrades to the intersection that would mitigate the occurrence of crashes. Non-geometric improvements at the intersection could be considered. For example, high friction surfacing may improve traction and reduce the number of crashes especially during wet road conditions, as discussed in the study *Evaluation of Pavement Safety Performance.* Three-inch yellow retroreflective sheeting added to signal backplates may reduce crashes by making traffic signals more conspicuous during the winter darkness and weather. A study entitled *Safety Impact of Increased Traffic Signal Backboards Conspicuity* indicates that the yellow retroreflective sheeting may decrease the occurrence of crashes by up to 15%.

Figure 38 shows a sketch of the proposed configuration for this intersection. The southbound through lanes are reduced to one lane; however, intersection operations suffer considerably if a northbound through lane is eliminated. Therefore, the analysis assumes that the northbound approach widens to accommodate two through lanes and one right-turn lane. (This represents an overall lane reduction of one southbound lane.)



[Figure is taken directly from Synchro. Bike lanes are not shown, but the analysis assumes 6-foot bike lanes are brought to the intersection on both the north and south approaches.]

Figure 38. Denali Street and Benson Boulevard Lane Reduction

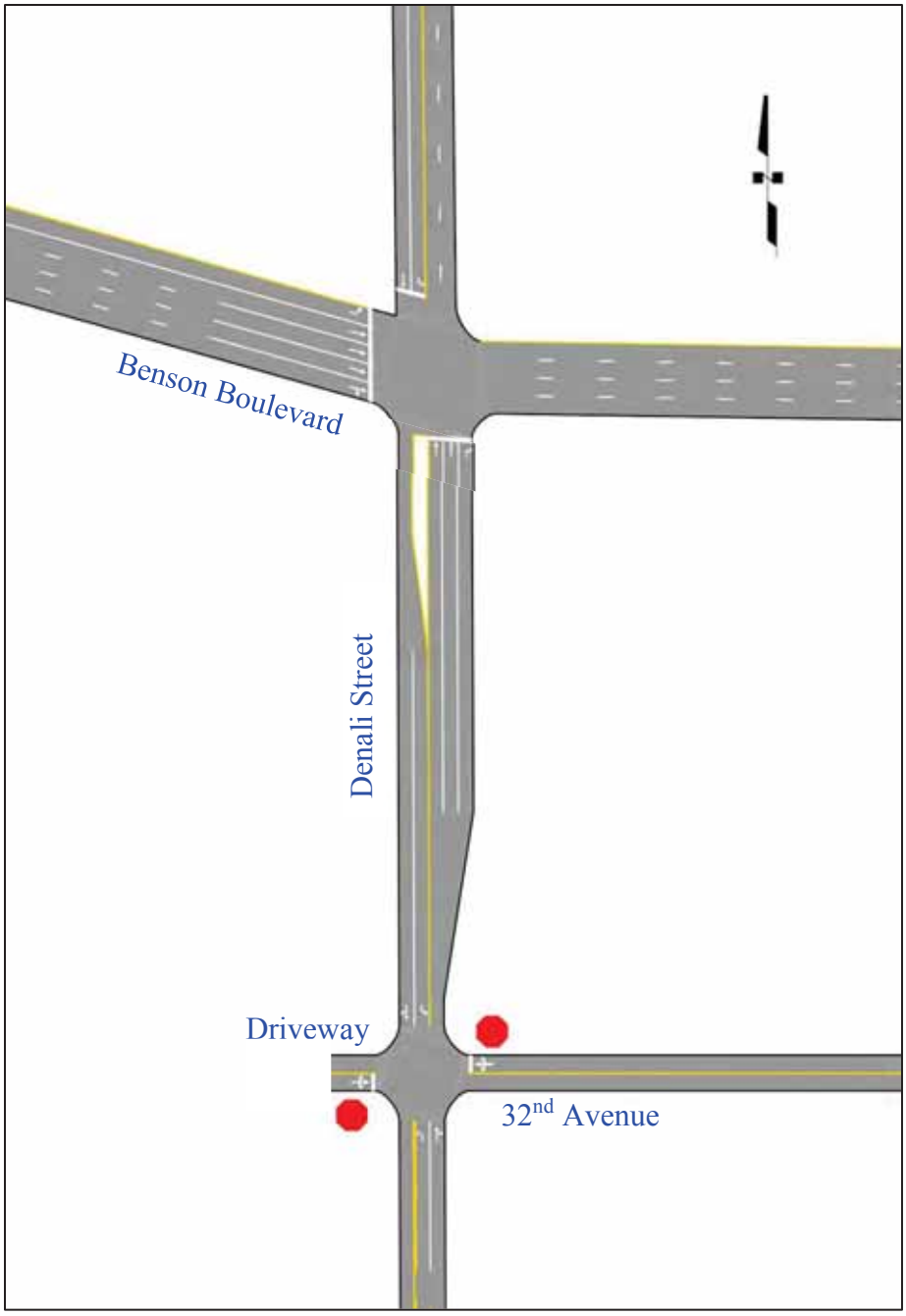
Turn lane length analysis was performed for the northbound right turn and southbound left turn lanes on Denali Street at Benson Boulevard, as shown in Table 36. The northbound left turn at Northern Lights and the southbound left turn lane at Benson will need to be installed back-to-back. The northbound right turn lane will need to be extended an additional 100 feet.

Table 36. Turn Lane Lengths – Denali Street and Benson Boulevard

TMVs	*Auxiliary Lane Movement*	*95th % Auxiliary Lane Queue (ft)*	*95% Adjacent Lane Queue (ft)*	*Existing Auxiliary Lane Length (ft)*	*Minimum Auxiliary Lane Length (ft)*	*Desirable Auxiliary Lane Length (ft)*	*Recommended Auxiliary Lane Length (ft)*
Existing	NBR	218	226	200	225	225	225
	SBL	62	175	210	150	175	175
Future	NBR	302	246	200	300	300	300
	SBL	51	208	210	150	200	200

7.3.1.4 Benson Boulevard to 32nd Avenue

Figure 39 shows a sketch of the proposed road configuration between Benson Boulevard and 32nd Avenue. Since two northbound-through lanes were required at Benson Boulevard, the northbound lanes between Benson Boulevard and 32nd Avenue are only reduced to one lane at the intersection with 32nd Avenue. In the southbound direction, the two existing lanes are reduced to one lane.



[Figure is taken directly from Synchro. Bike lanes are not shown, but the analysis assumes 6-foot bike lanes in north and southbound directions.]

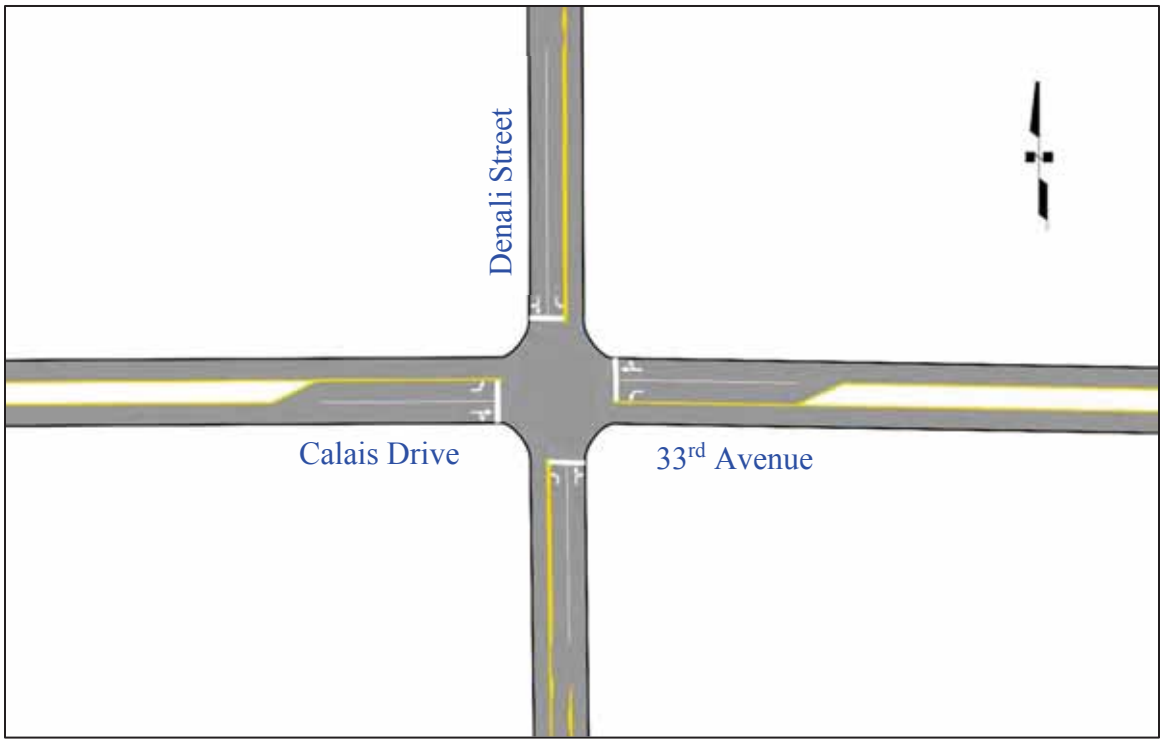
Figure 39. Lane Reduction between Benson Boulevard and 32nd Avenue

7.3.1.5 32nd Avenue at Denali Street

At this unsignalized intersection, vehicles on the side street approaches will experience LOS F during the peak hours under all alternatives. There is no existing roadway connection that would allow vehicles on 32nd Avenue to access the signal at 33rd Avenue. The only alternative route to exit 32nd Avenue leads north on Gambell Street to Benson Boulevard. Vehicles turning onto Denali Street from the driveway across from 32nd Avenue would have the option of traveling through the strip mall parking lot south to Calais Drive or north to Benson Boulevard.

7.3.1.6 Calais Drive/33rd Avenue at Denali Street

Figure 40 shows a sketch of the proposed configuration for this intersection. This intersection would operate well under the full lane-reduction alternative (one through-and-right lane and one left-turn lane on each approach).



[Figure is taken directly from Synchro. Bike lanes are not shown, but the analysis assumes 6-foot bike lanes are brought to the intersection on both the north and south approaches.]

Figure 40. Denali Street and Calais Drive/33rd Avenue Lane Reduction

Turn lane length analysis was performed for the northbound and southbound left turn lanes on Denali Street at Calais Drive/33rd Avenue, as shown in Table 37. While the through lane queues (corresponding to the column entitled 95% Adjacent Lane Queue in Table 37) are long (500 to 650 feet), the auxiliary lanes are recommended to only extend the minimum lane lengths to allow access to driveways. It is expected that some left turn vehicles will use the two-way-left-turn lanes as extensions of the turn lanes. Note that 34th Avenue is located about 400 feet south of Calais Drive/33rd Avenue, while 32nd Avenue is located about 415 feet north. During peak hours, queues from Calais Drive/33rd Avenue may extend beyond 34th Avenue and 32nd Avenue.

Table 37. Turn Lane Lengths – Denali Street and 33rd Avenue/Calais Drive

TMVs	*Auxiliary Lane Movement*	*95th % Auxiliary Lane Queue (ft)*	*95% Adjacent Lane Queue (ft)*	*Existing Auxiliary Lane Length (ft)*	*Minimum Auxiliary Lane Length (ft)*	*Desirable Auxiliary Lane Length (ft)*	*Recommended Auxiliary Lane Length (ft)*
Existing	NBL	30	500	100	150	500	150
	SBL	12	401	137	150	400	150
Future	NBL	47	645	100	150	650	150
	SBL	16	439	137	150	450	150

7.3.1.7 32nd Avenue to 34th Avenue

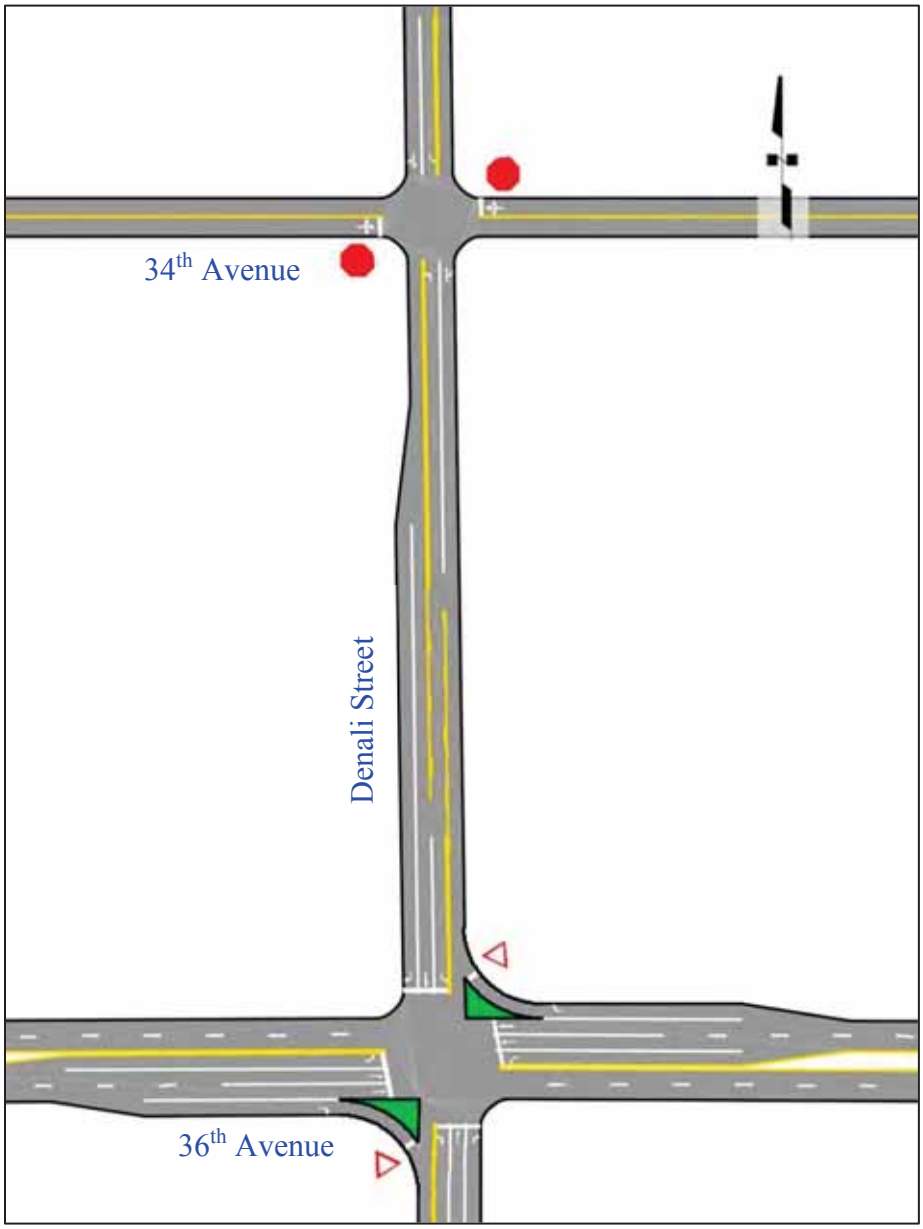
Between 32nd Avenue and 34th Avenue, a traditional three-lane configuration, with one lane in each direction and a two-way-left-turn lane, is proposed as analysis indicates that capacity would be adequate.

7.3.1.8 34th Avenue at Denali Street

At this unsignalized intersection, vehicles on the side street approaches will experience LOS F during the peak hours under all alternatives. Vehicles on 34th Avenue east of Denali Street could access the signal at 33rd Avenue/Calais Drive via either Eagle Street or Fairbanks Street. Vehicles on 34th Avenue west of Denali Street could only access the signal at 33rd Avenue/Calais Drive by traveling north through parking lots. Alternately, they could drive south through parking lots to access 36th Avenue.

7.3.1.9 34th Avenue to 36th Avenue

Figure 41 shows a sketch of the proposed road configuration between 34th Avenue and 36th Avenue. In the northbound direction, the two existing through lanes are reduced to one lane. However, a reduction to one lane in the southbound direction paired with the elimination of the right-turn lane results in a very poor LOS. To improve the intersection LOS, a southbound right-turn lane is necessary. The existing two-way-left-turn lane remains in the proposed configuration.

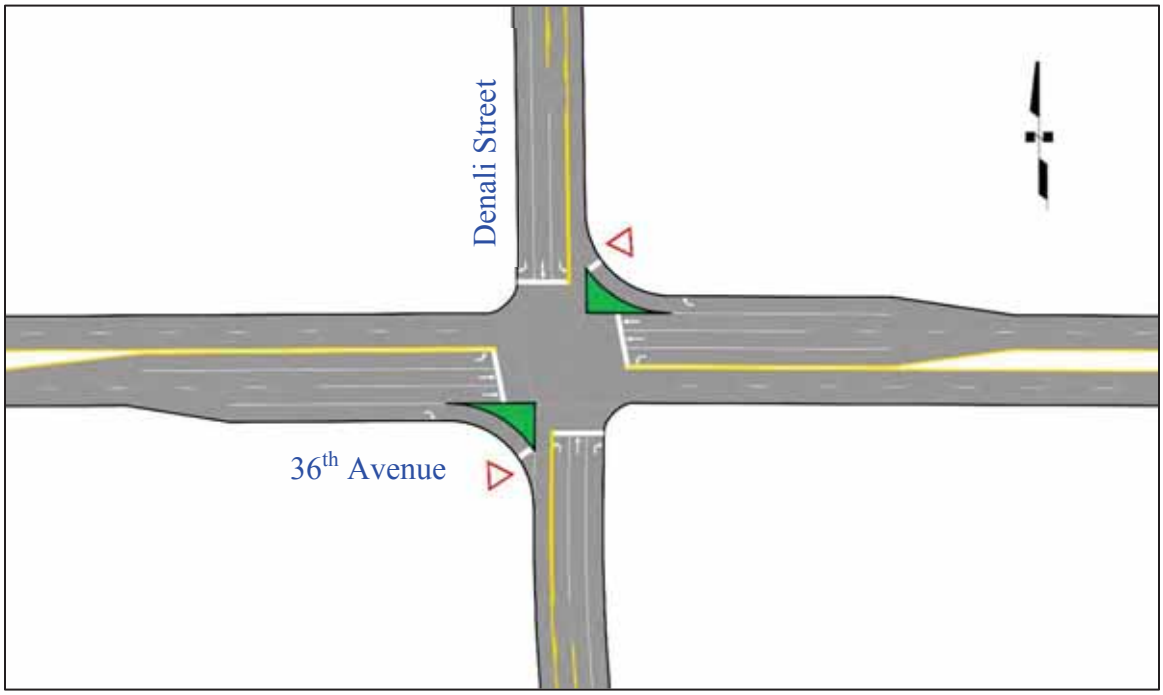


[Figure is taken directly from Synchro. Bike lanes are not shown, but the analysis assumes 6-foot bike lanes in north and southbound directions.]

Figure 41. Lane Reduction between 34th Avenue and 36th Avenue

7.3.1.10 36th Avenue at Denali Street

Figure 42 shows a sketch of the proposed configuration for this intersection. As previously mentioned, this intersection struggles to accommodate the full build-out 2045 volumes with the northbound/southbound lane reduction. To provide some additional capacity, the installation of eastbound and westbound channelized right turns is recommended. Channelized right turns would add capacity to the eastbound and westbound movements over the existing condition (shared through-right lanes) while maintaining the existing crossing distance for pedestrians.



[Figure is taken directly from Synchro. Bike lanes are not shown, but the analysis assumes 6-foot bike lanes are brought to the intersection on both the north and south approaches.]

Figure 42. Denali Street and 36th Avenue Lane Reduction

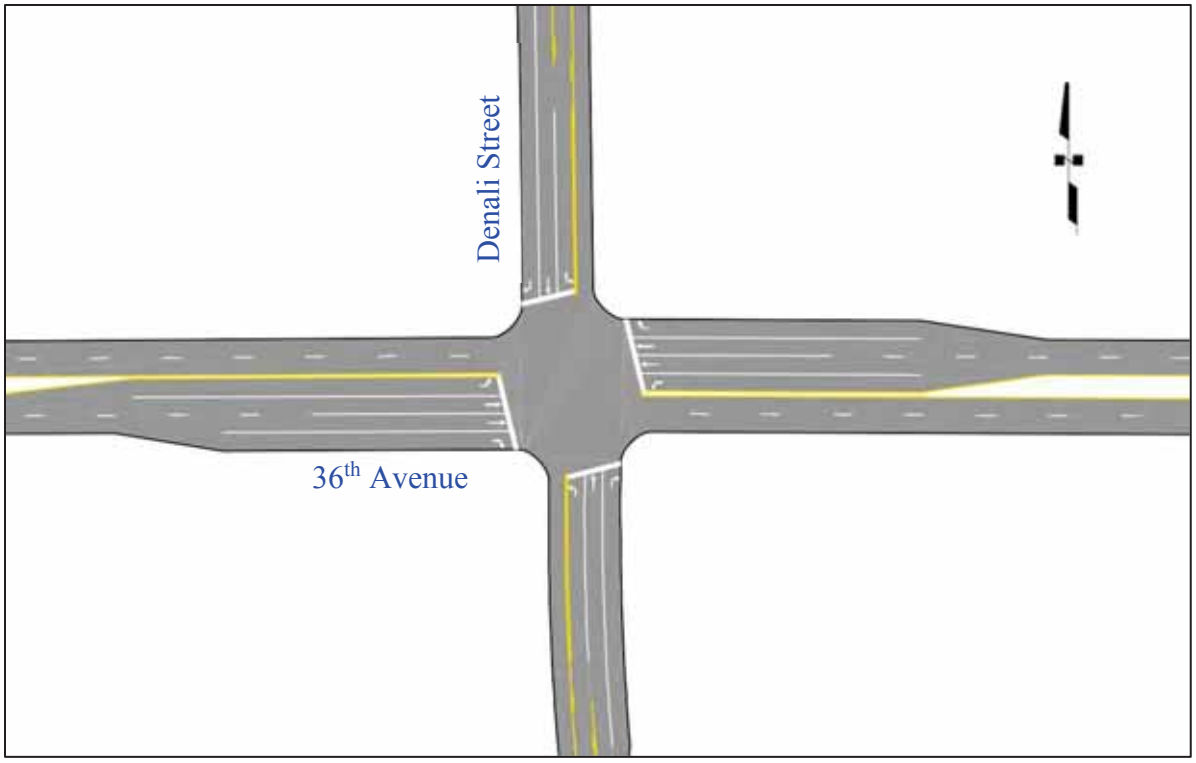
Turn lane length analysis was performed for the auxiliary lanes at the intersection of Denali Street at 36th Avenue, as shown in Table 38. While the through lane queues are significantly longer in many instances, the minimum or existing lane lengths are recommended due to geometric considerations. Telephone Avenue is located about 400 feet south of 36th Avenue. Note that at peak hours, the northbound through lane (95% adjacent) queue would likely block Telephone Avenue.

Table 38. Turn Lane Lengths – Denali Street and 36th Avenue

TMVs	*Auxiliary Lane Movement*	*95th % Auxiliary Lane Queue (ft)*	*95% Adjacent Lane Queue (ft)*	*Existing Auxiliary Lane Length (ft)*	*Minimum Auxiliary Lane Length (ft)*	*Desirable Auxiliary Lane Length (ft)*	*Recommended Auxiliary Lane Length (ft)*
Existing	NBL	129	353	186	150	350	350
	SBL	114	379	210	150	375	375
	SBR	77	379	307	150	375	375
	WBL	69	322	142	200	325	325
	WBR	39	322	n/a	175	325	325
	EBL	120	406	200	250	400	400
	EBR	51	406	n/a	175	400	400
Future	NBL	235	516	186	250	525	400
	SBL	144	483	210	150	475	400
	SBR	81	483	307	150	475	400
	WBL	119	335	142	250	375	375
	WBR	40	335	n/a	175	325	325
	EBL	134	429	200	250	425	400
	EBR	50	429	n/a	175	425	400

Due to space and ROW constraints at the intersection of Denali Street and 36th Avenue, the addition of unchannelized right turns as an alternative to channelized right turns was also considered. Figure 43 shows a sketch of the lane configuration at the intersection with the addition of right turns with no channelization.

Turn lane analysis reveals that queue lengths do not change appreciably between the channelized and unchannelized right turn configurations.



[Figure is taken directly from Synchro. Bike lanes are not shown, but the analysis assumes 6-foot bike lanes are brought to the intersection on both the north and south approaches.]

Figure 43. Denali Street and 36th Avenue Lane Reduction – Unchannelized Right Turns

Given conservative future volume forecasts, Figure 44 compares the estimated annual capacity of the intersection under various configurations. While a traditional lane reduction would likely deteriorate the overall intersection LOS to E by around 2037, the addition of right turn lanes in the eastbound and westbound direction would reduce delay to that the intersection LOS does not approach E until 2045. Figure 45 and Figure 46 show that the eastbound turn lane has a much greater impact than the westbound turn lane on improving LOS. Channelization of the right turn lanes improves the LOS for eastbound and westbound movements over the unchannelized configuration. However, the northbound and southbound timings in the unchannelized configuration must be increased to accommodate for longer pedestrian crossings of the unchannelized right turn lanes, resulting in longer green times for northbound and southbound movements. Due to the shorter northbound/southbound pedestrian crossing distances in the channelized configuration, signal timings for the channelized configuration prioritize eastbound and westbound movements while northbound and southbound movements experience more delay. Thus, the overall intersection LOS for the unchannelized configuration is slightly higher than the overall intersection LOS for the channelized configuration.

It is important to note that if a high LOS for eastbound/westbound traffic movement remains a priority, the channelization of the right turns would be desirable. If right turns are channelized, diversion of some northbound/southbound through traffic to other roads in future years may occur, perhaps in conjunction with the *Seward Highway: Midtown Traffic Congestion Relief* project. If traffic does not use alternate routes for northbound/southbound through travel, the LOS for these movements will likely deteriorate to LOS E between 2023 – 2027 and to LOS F between 2036 – 2042.

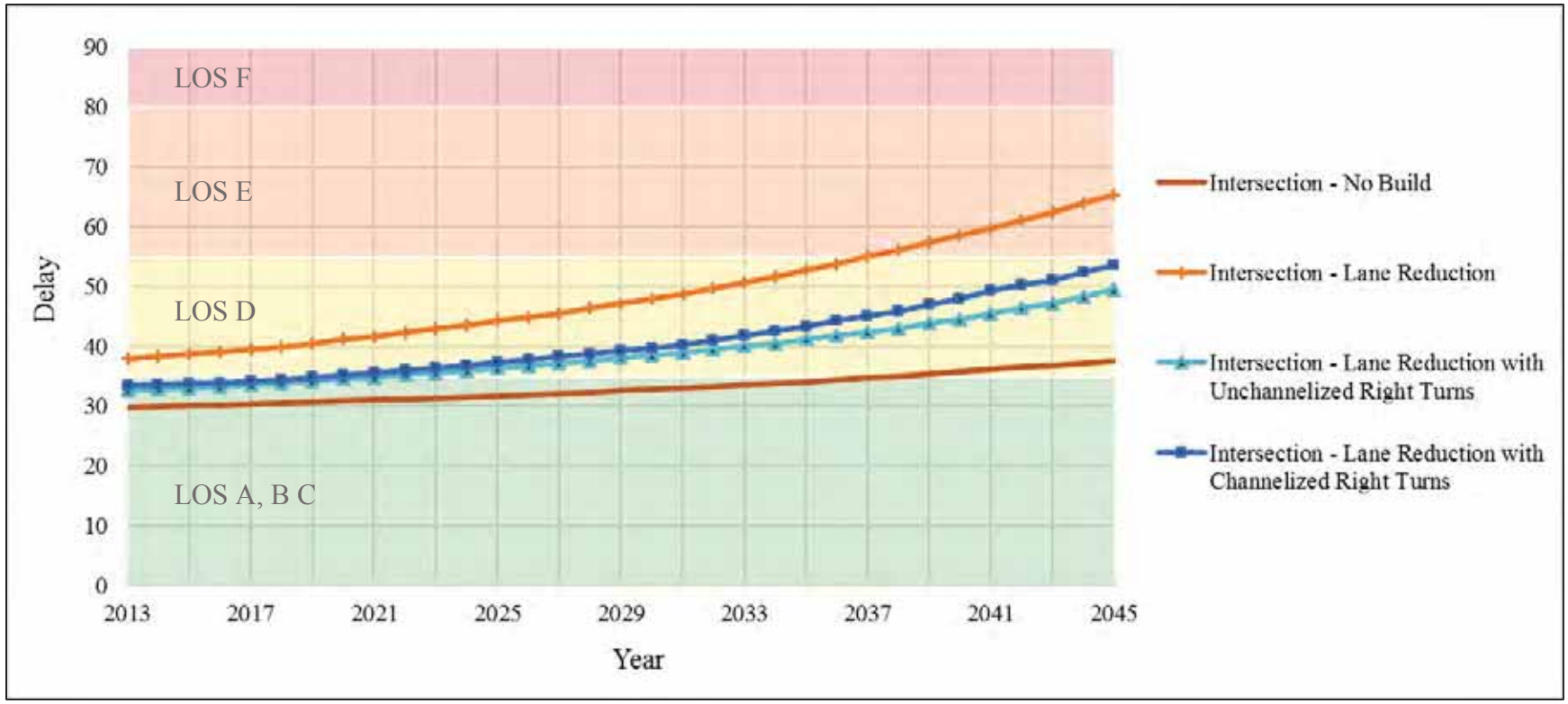


Figure 44. Overall Intersection LOS Comparison

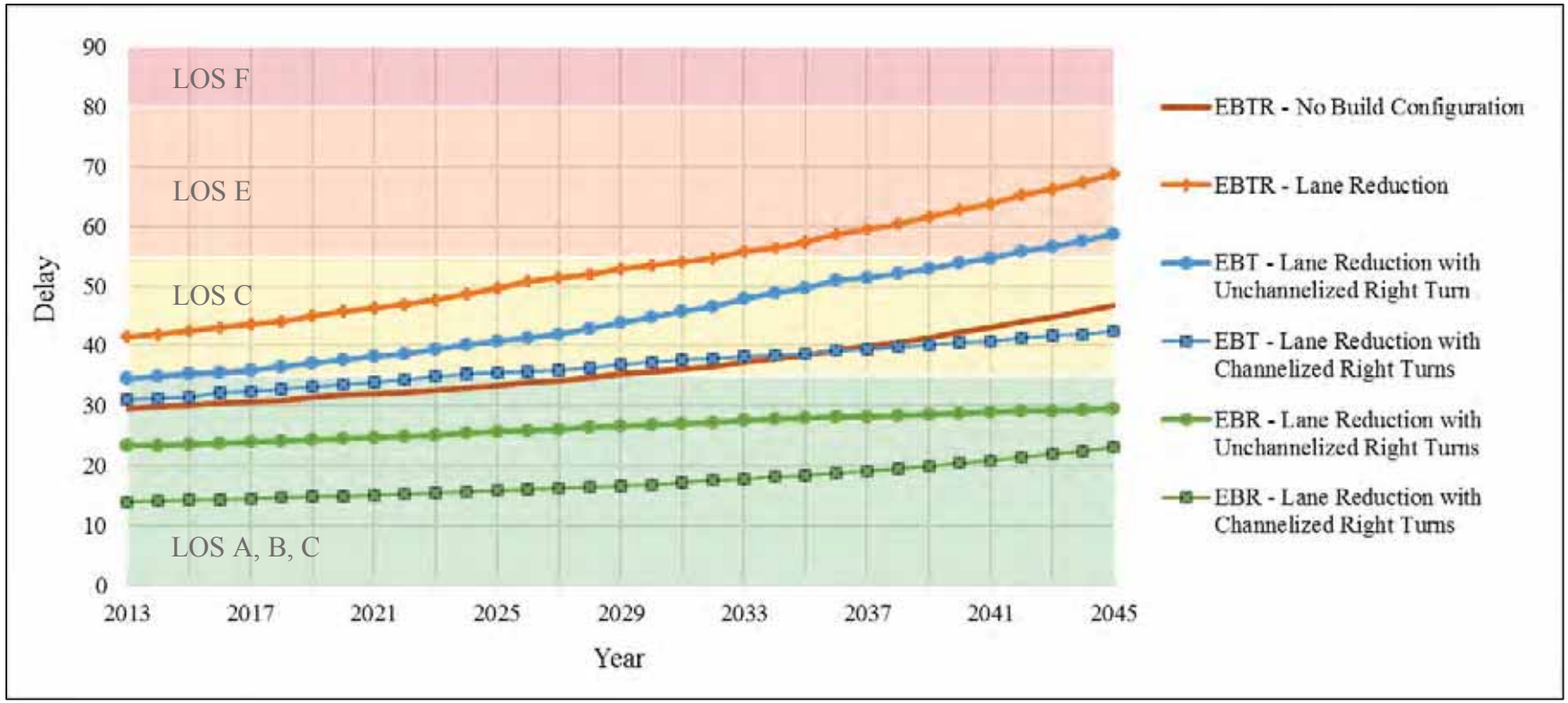


Figure 45. Eastbound Through and Right Movements LOS Comparison

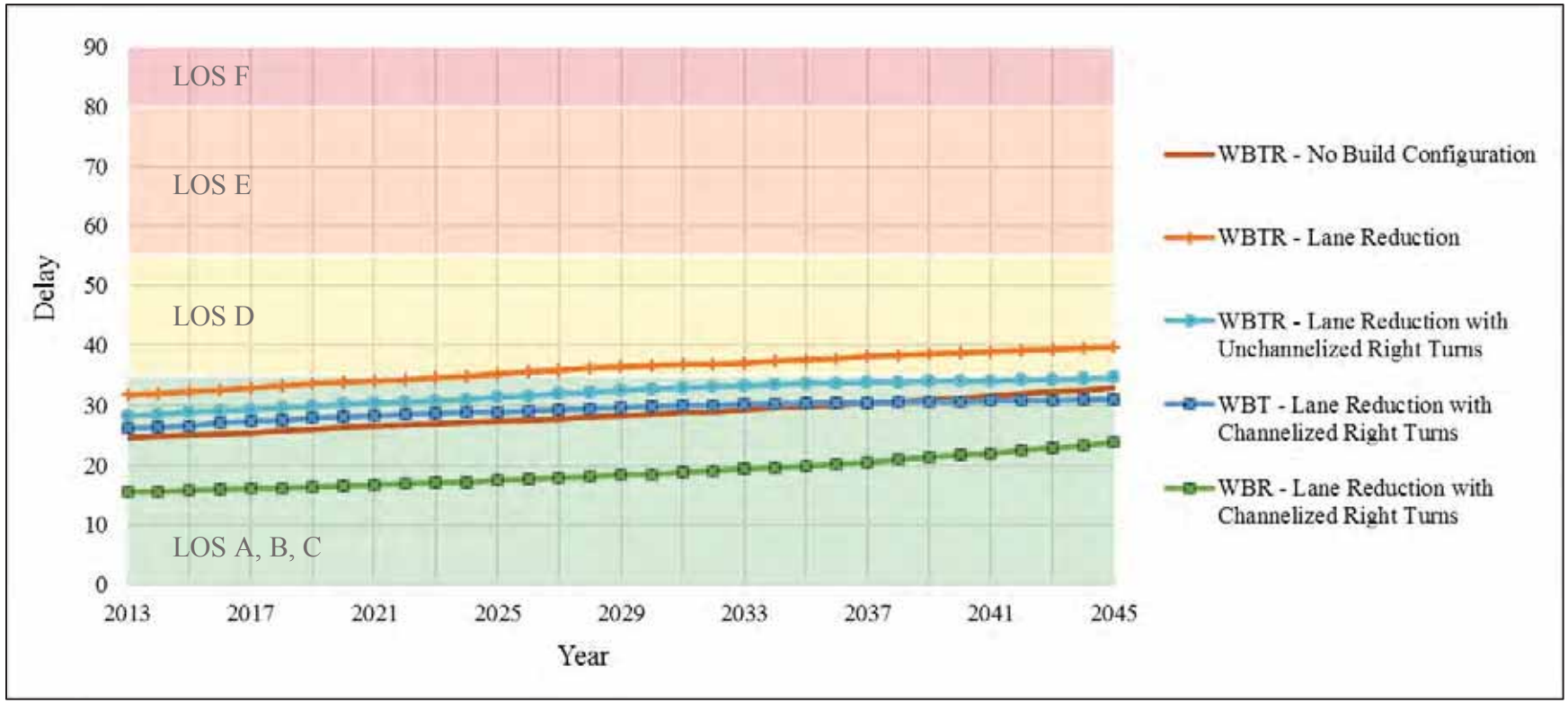
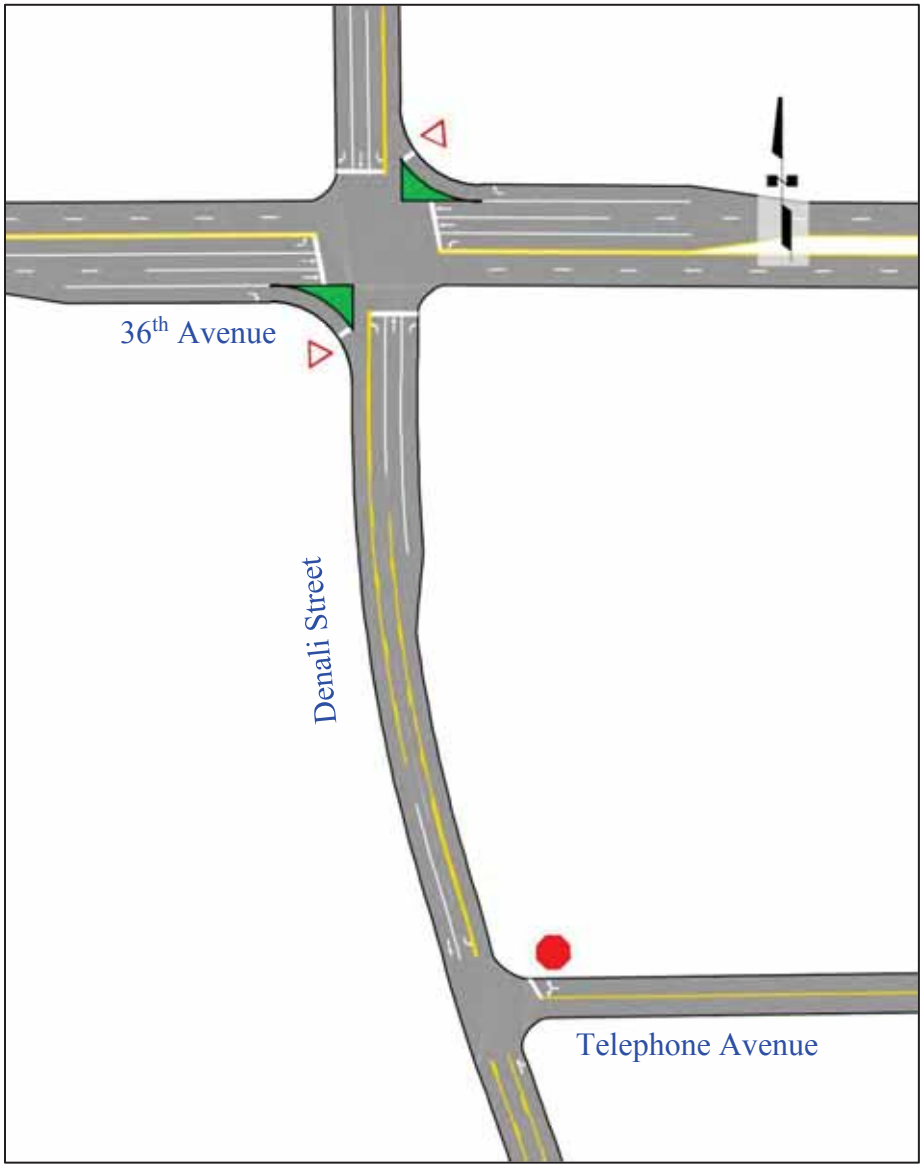


Figure 46. Westbound Through and Right Movement LOS Comparison

7.3.1.11 36th Avenue to Telephone Avenue

Figure 47 shows a sketch of the proposed roadway configuration between 36th Avenue and Telephone Avenue. In the northbound direction, reducing the two existing through lanes to one through lane and eliminating the right-turn lane results in very poor LOS. To improve LOS, the northbound right-turn lane is required. In the southbound direction, a reduction of the two existing through lanes to one through lane is acceptable.



[Figure is taken directly from Synchro. Bike lanes are not shown, but the analysis assumes 6-foot bike lanes in north and southbound directions.]

Figure 47. Lane Reduction between 36th Avenue and Telephone Avenue

7.3.1.12 Telephone Avenue at Denali Street

At this unsignalized intersection, vehicles on the side street approach will experience LOS E or F during the peak hours under all alternatives. The only alternative route leads to an unsignalized intersection on the Old Seward Highway. This unsignalized intersection prohibits northbound left-turns.

7.3.1.13 40th Avenue at Denali Street

At the intersection of 40th Avenue with Denali Street, the high number of pedestrian crossings is coupled with a crash rate statistically above the statewide average and CAR. Additionally, the 85th percentile speed on Denali Street at this location is 6 mph above the speed limit. Increasing safety and calming traffic were considered when analyzing solutions for this intersection.

Chapter 3 of FHWA's *Roundabouts: An Informational Guide* offers guidance when considering installation of a roundabout. Figure 48, taken from the document shows the relationship between capacity and major street traffic proportion. Roundabouts improve capacity over two-way-stop-control (TWSC) intersections when the minor street volume is more than 10% of the total intersection volume and double capacity over TWSC intersections when major and minor street traffic volumes are equal. AADT forecasts for the 2045 design year project that 40th Avenue will experience 15% of the total intersection volume. A roundabout at 40th Avenue and Denali Street would thus provide more capacity than a TWSC intersection at the same location.

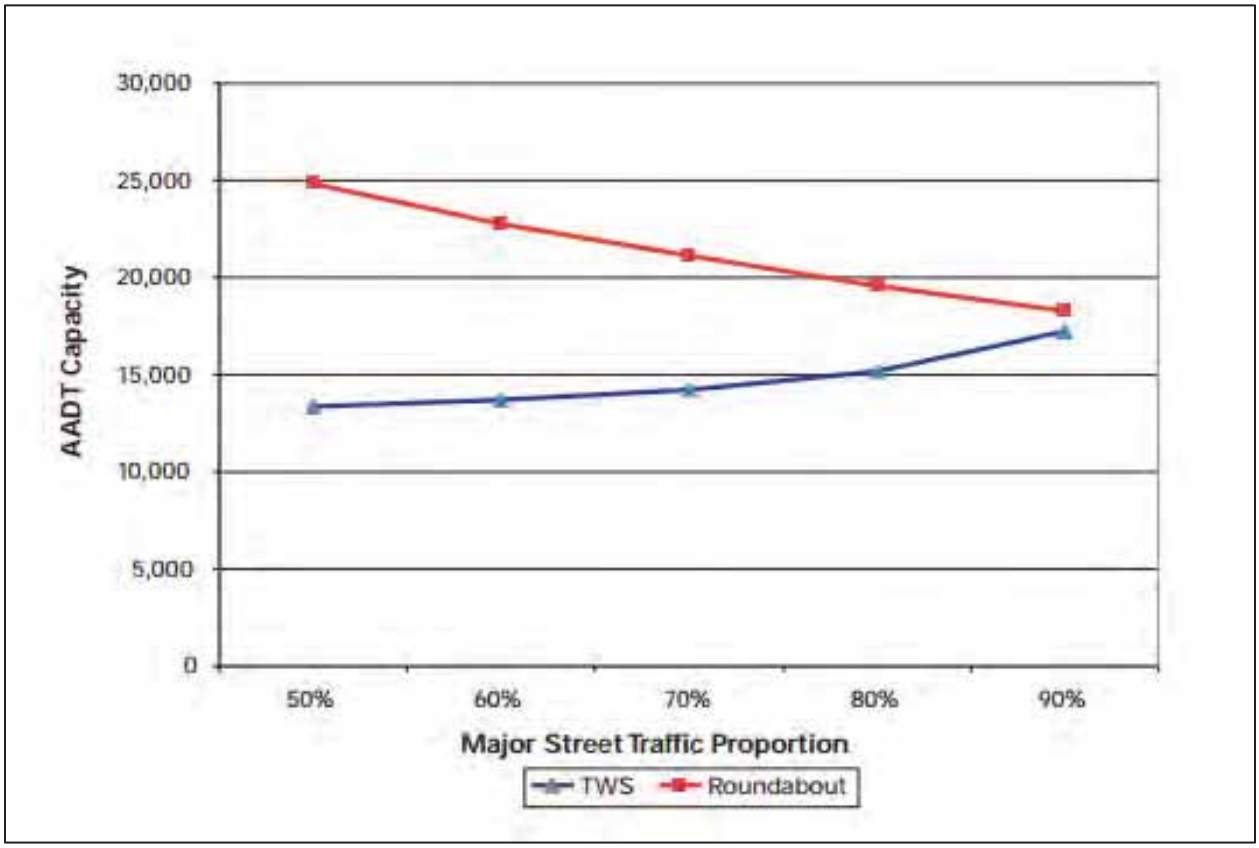


Figure 48. AADT Capacity vs. Major Street Traffic Proportion

In addition to improving intersection capacity, a single lane roundabout would effectively help reduce crashes, calm traffic, and provide very satisfactory pedestrian crossings. Figure 49 provides an example of a single lane roundabout similar to one that could be used at Denali Street and 40th Avenue. Depending on their comfort level, cyclists could either stay in the traffic lane or they could use the pedestrian facilities.

Capacity analysis for the proposed roundabout was conducted using Synchro Trafficware which relies on HCM methodologies. Levels of service for existing and future volumes were found to be acceptable (LOS C or better).

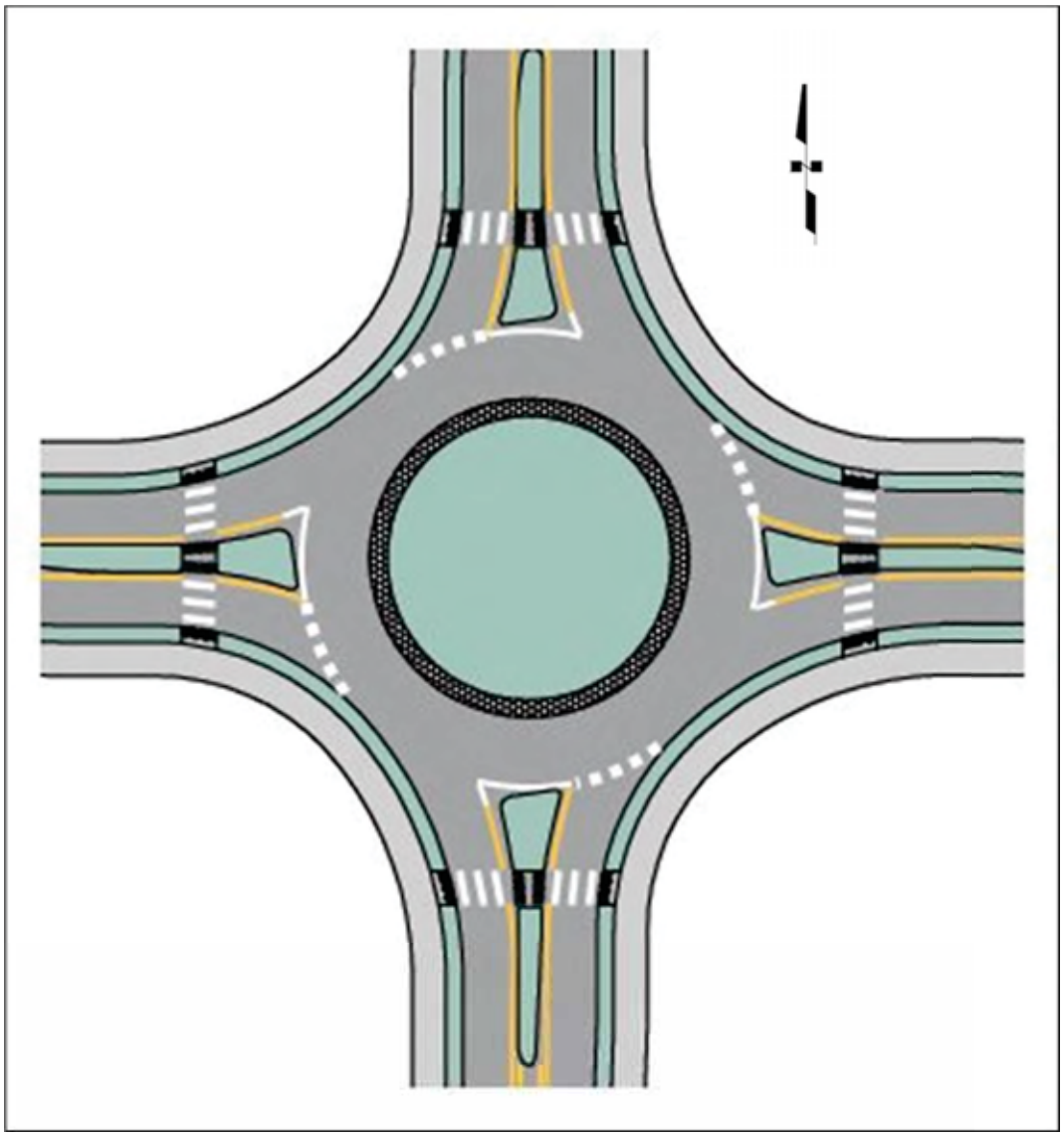


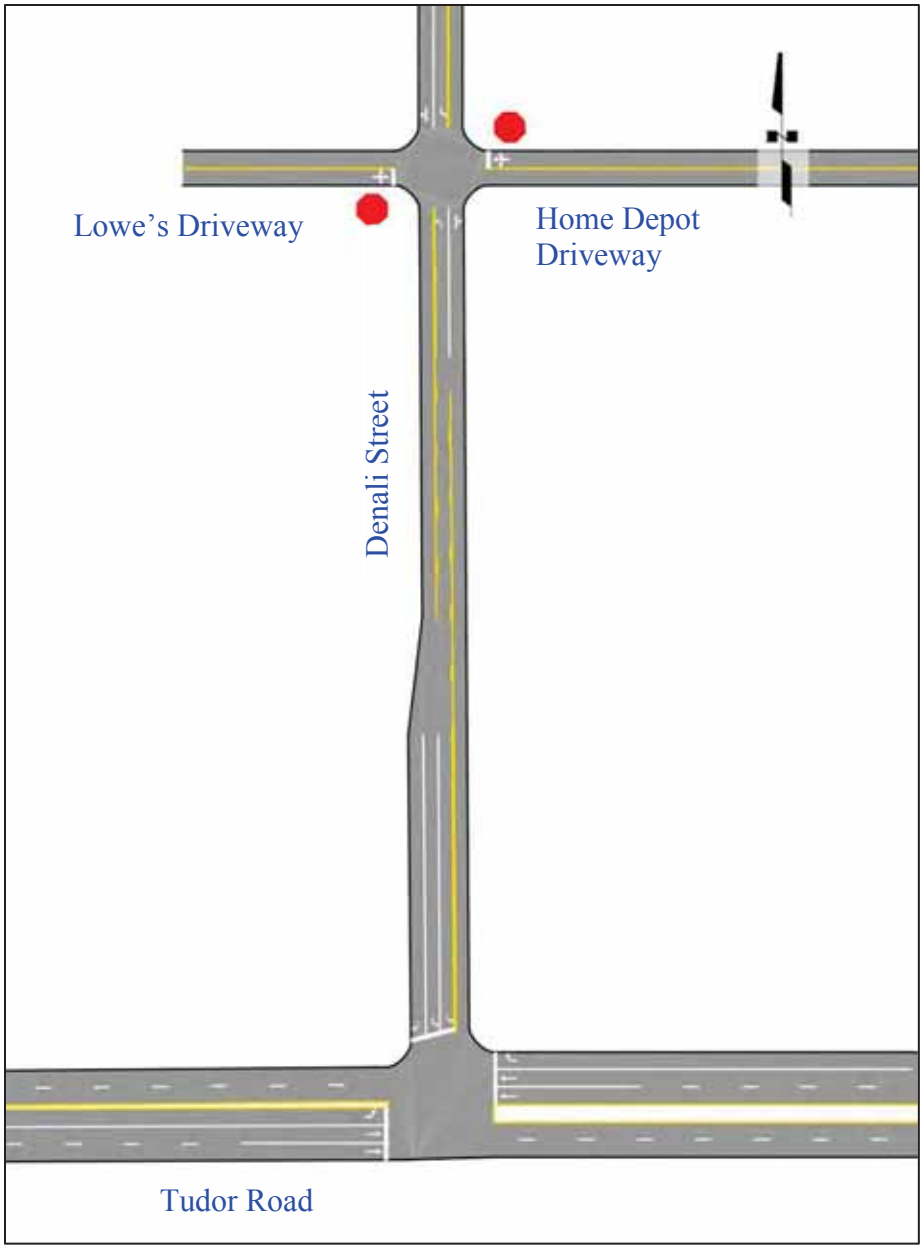
Photo retrieved from https://safety.fhwa.dot.gov/intersection/innovative/roundabouts/fhwasa10006/
Figure 49. Single Lane Roundabout

7.3.1.14 Telephone Avenue to Box Store Driveways

Between Telephone Avenue and the driveways to Home Depot and Lowe's, a reduction to a traditional 3-lane configuration is proposed. Capacity analysis indicates that a road configuration with one lane in each direction and a two-way-left-turn lane will provide an acceptable LOS.

7.3.1.15 Box Store Driveways to Tudor Road

Figure 50 shows the proposed road configuration between the Lowe's and Home Depot driveways and Tudor Road. By the box stores, the road segment is reduced to a traditional 3-lane configuration. However, to maintain an acceptable LOS at the intersection with Tudor Road, two southbound left-turn lanes and one southbound right-turn lane are needed.

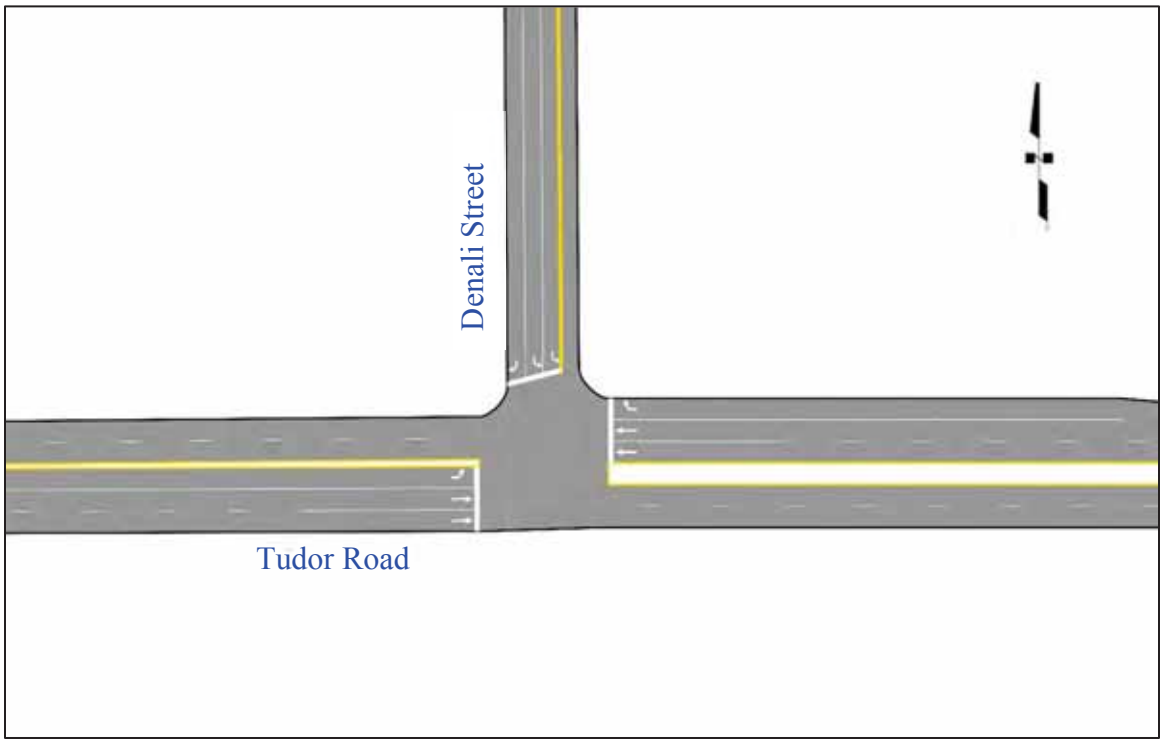


[Figure is taken directly from Synchro. Bike lanes are not shown, but the analysis assumes 6-foot bike lanes in north and southbound directions.]

Figure 50. Lane Reduction between Box Store Driveways and Tudor Road

7.3.1.16 Tudor Road at Denali Street

Figure 51 shows a sketch of the lane configuration for this intersection. No geometric changes are proposed.



[Figure is taken directly from Synchro. Bike lanes are not shown, but the analysis assumes 6-foot bike lanes are brought to the intersection on both the north and south approaches.]

Figure 51. Denali Street and Tudor Road Lane Reduction

Turn lane length analysis was performed for the southbound auxiliary lanes at the intersection of Denali Street at Tudor Road, as shown in Table 39. It is recommended that the turn lanes be lengthened.

Table 39. Turn Lane Lengths – Denali Street and Tudor Road

TMVs	*Auxiliary Lane Movement*	*95th % Auxiliary Lane Queue (ft)*	*95th % Adjacent Lane Queue (ft)*	*Existing Auxiliary Lane Length (ft)*	*Minimum Auxiliary Lane Length (ft)*	*Desirable Auxiliary Lane Length (ft)*	*Recommended Auxiliary Lane Length (ft)*
Existing	SBL	100	-	140	150	150	150
	SBR	44	-	140	150	150	150
Future	SBL	182	-	140	200	200	200
	SBR	94	-	140	150	150	150

7.3.1.17 36th Avenue at Barrow Street

While lane reductions along 36th Avenue were not analyzed, a pedestrian crossing at 36th Avenue and Barrow Street was considered due to the high pedestrian crossing volumes observed (>20 in one hour).

Based on the ATM guidance on pedestrian crossing treatments, an electrical regulatory device would be an appropriate treatment at 36th Avenue and Barrow Street; however, Barrow Street is relatively close to the signal at A Street, making it an unlikely candidate for this type of device.

8 References

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Appendices

Appendix A: Crash Data

Table 40 through Table 61 list crashes by location within the study area for the years 2010 – 2014. Crashes involving pedestrians or bicyclists are highlighted in blue. Segments or intersections with crash rates that are statistically above the average for similar facilities are highlighted in yellow. Two fatal crashes occurred in the study area: one pedestrian crash between Northern Lights and Benson Boulevard, and one right angle crash at the intersection of 40th Avenue and Denali Street.

Table 40. Crashes at Intersection of Denali Street and Northern Lights

Crash Type	Fatal	Major	Minor	PDO	Total
Head on/Left Turn			1	3	4
Struck Object				1	1
Pedestrian			2		2
Rear End/Backing			6	10	16
Sideswipe			3	13	16
Right Angle			6	5	11
Total	0	0	18	32	50

Table 41. Crashes on Denali Street: Segment from Northern Lights to Benson Boulevard

Crash Type	Fatal	Major	Minor	PDO	Total
Pedestrian	1		1		2
Sideswipe				1	1
Right Angle			1	3	4
Total	1		2	4	7

Table 42. Crashes at Intersection of Denali Street and Benson Boulevard

Crash Type	Fatal	Major	Minor	PDO	Total
Bicycle			1		1
Left Turn			1	3	4
Struck Object				1	1
Pedestrian		2	4		6
Rear End/Backing		1	7	28	36
Sideswipe			5	11	16
Right Angle		1	7	13	21
Total	0	4	25	56	85

Table 43. Crashes on Denali Street: Segment from Benson Boulevard to Calais/33rd Avenue

Crash Type	Fatal	Major	Minor	PDO	Total
Sideswipe			1		1
Right Angle			2		2
Total			3		3

Table 44. Crashes at Intersection of Denali Street and 32nd Avenue

Crash Type	Fatal	Major	Minor	PDO	Total
Bicycle		1			1
Struck Object				1	1
Right Angle			5	5	10
Total		1	5	6	12

Table 45. Crashes at Intersection of Denali Street and Calais/33rd Avenue

Crash Type	Fatal	Major	Minor	PDO	Total
Bicycle			1		1
Head on				1	1
Left Turn			4	2	6
Struck Object				4	4
Pedestrian			1		1
Rear End/Backing			1	3	4
Sideswipe				1	1
Right Angle			5	3	8
Total			12	14	26

Table 46. Crashes on Denali Street: Segment from Calais/33rd Avenue to 36th Avenue

Crash Type	Fatal	Major	Minor	PDO	Total
Left Turn				1	1
Struck Object			1		1
Sideswipe				1	1
Right Angle				1	1
Total			1	3	4

Table 47. Crashes at Intersection of Denali Street and 34th Avenue

Crash Type	Fatal	Major	Minor	PDO	Total
Struck Object				1	1
Rear End/Backing			3	5	8
Right Angle			5	6	11
Total			8	12	20

Table 48. Crashes at Intersection of Denali Street and 36th Avenue

Crash Type	Fatal	Major	Minor	PDO	Total
Unknown				1	1
Head on				3	3
Left Turn			5	8	13
Struck Object				2	2
Pedestrian			1	1	2
Rear End/Backing			9	21	30
Sideswipe				5	5
Right Angle			5	13	18
Total			20	54	74

Table 49. Crashes on Denali Street: Segment from 36th Avenue to Telephone Avenue

Crash Type	Fatal	Major	Minor	PDO	Total
Rear End/Backing			2		2
Total			2		2

Table 50. Crashes at Intersection of Denali Street and Telephone Avenue

Crash Type	Fatal	Major	Minor	PDO	Total
Struck Object				2	2
Rear End/Backing			1	4	5
Sideswipe				1	1
Right Angle			3	1	4
Total			4	8	12

Table 51. Crashes on Denali Street: Segment from Telephone Avenue to 40th Avenue

Crash Type	Fatal	Major	Minor	PDO	Total
Rear End/Backing				1	1
Total				1	1

Table 52. Crashes at Intersection of Denali Street and 40th Avenue

Crash Type	Fatal	Major	Minor	PDO	Total
Left Turn			2	5	7
Rear End/Backing				2	2
Sideswipe				2	2
Right Angle	1	1	5	12	19
Total	1	1	7	21	30

Table 53. Crashes on Denali Street: Segment from 40th Avenue to Tudor Road

Crash Type	Fatal	Major	Minor	PDO	Total
Left Turn				2	2
Struck Object				1	1
Rear End/Backing			1	1	2
Sideswipe			1	1	2
Right Angle		1	4	4	9
Total		1	6	9	16

Table 54. Crashes at Intersection of Denali Street and Tudor Road

Crash Type	Fatal	Major	Minor	PDO	Total
Bicycle				1	1
Head on			1	2	3
Left Turn			5	5	10
Struck Object				3	3
Pedestrian		1	1		2
Rear End/Backing			6	14	20
Sideswipe				2	2
Right Angle			1	7	8
Total		1	14	34	49

Table 55. Crashes at Intersection of 36th Avenue and C Street

Crash Type	Fatal	Major	Minor	PDO	Total
Bicycle			1		1
Left Turn			2	2	4
Struck Object				1	1
Pedestrian		1	1		2
Rear End/Backing		1	8	18	27
Sideswipe			2	8	10
Right Angle		1	22	8	31
Total		3	36	37	76

Table 56. Crashes on 36th Avenue: Segment from C Street to A Street

Crash Type	Fatal	Major	Minor	PDO	Total
Struck Object				1	1
Pedestrian			1		1
Total			1	1	2

Table 57. Crashes at Intersection of 36th Avenue and A Street

Crash Type	Fatal	Major	Minor	PDO	Total
Bicycle		1	3		4
Left Turn			5	5	10
Struck Object				1	1
Rear End/Backing		1	4	17	22
Sideswipe			1	8	9
Right Angle		1	16	15	32
Total		3	29	46	78

Table 58. Crashes on 36th Avenue: Segment from A Street to Denali Street

Crash Type	Fatal	Major	Minor	PDO	Total
Struck Object			1		1
Rear End/Backing			2	1	3
Sideswipe				1	1
Total			3	2	5

Table 59. Crashes at Intersection of 36th Avenue and Barrow Street

Crash Type	Fatal	Major	Minor	PDO	Total
Left Turn				2	2
Struck Object				1	1
Rear End/Backing			2	3	5
Right Angle			1	6	7
Total			3	12	15

Table 60. Crashes on 36th Avenue: Segment from Denali Street to Old Seward Highway

Crash Type	Fatal	Major	Minor	PDO	Total
Bicycle			1		1
Struck Object				2	2
Rear End/Backing				1	1
Sideswipe			1	1	2
Total			2	4	6

Table 61. Crashes at Intersection of 36th Avenue and Old Seward Highway

Crash Type	Fatal	Major	Minor	PDO	Total
Bicycle			4	1	5
Head on			1	1	2
Left Turn		1	4	11	16
Struck Object				1	1
Rear End/Backing			5	22	26
Sideswipe			1	8	9
Right Angle		1	4	7	12
Total		2	19	51	72

Appendix B: Pedestrian and Bicycle Observations

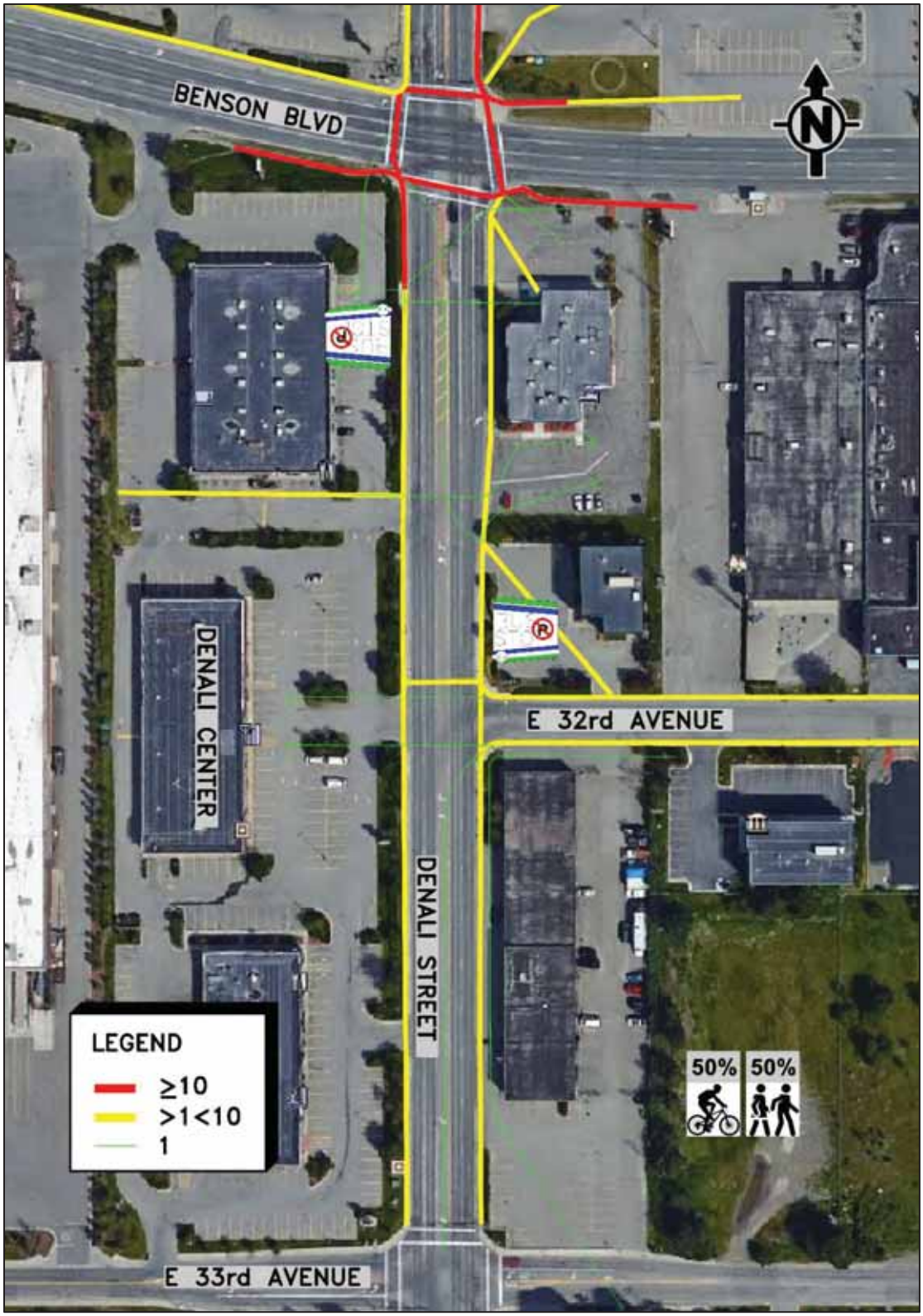


Figure 52. Ped/Bike Movements on Denali St – Benson Blvd to 33rd Ave (3:30 – 4:30 PM)

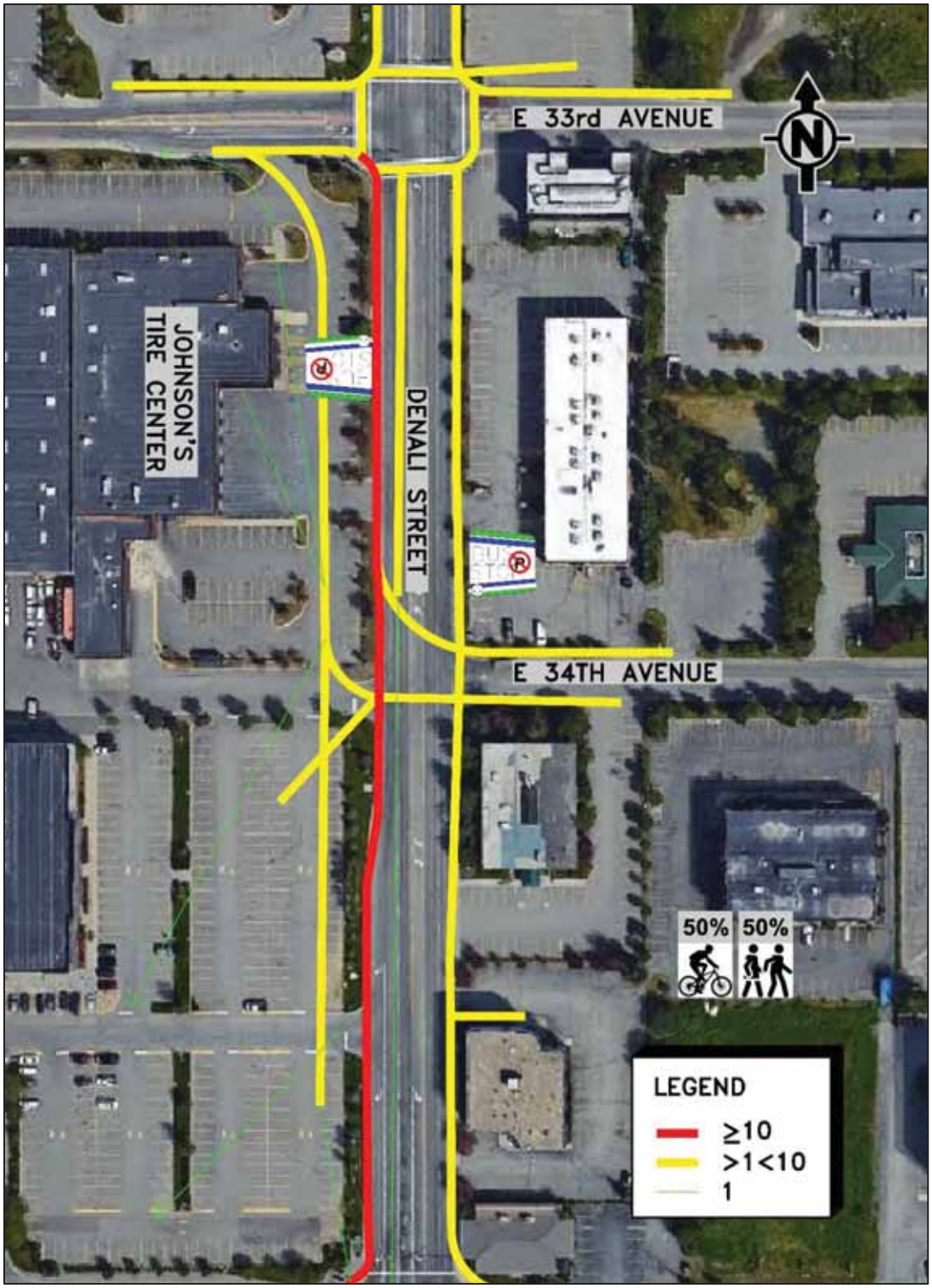


Figure 53. Ped/ Bike Movements on Denali St – 33rd Ave to 36th Ave (3:30 – 4:30 PM)

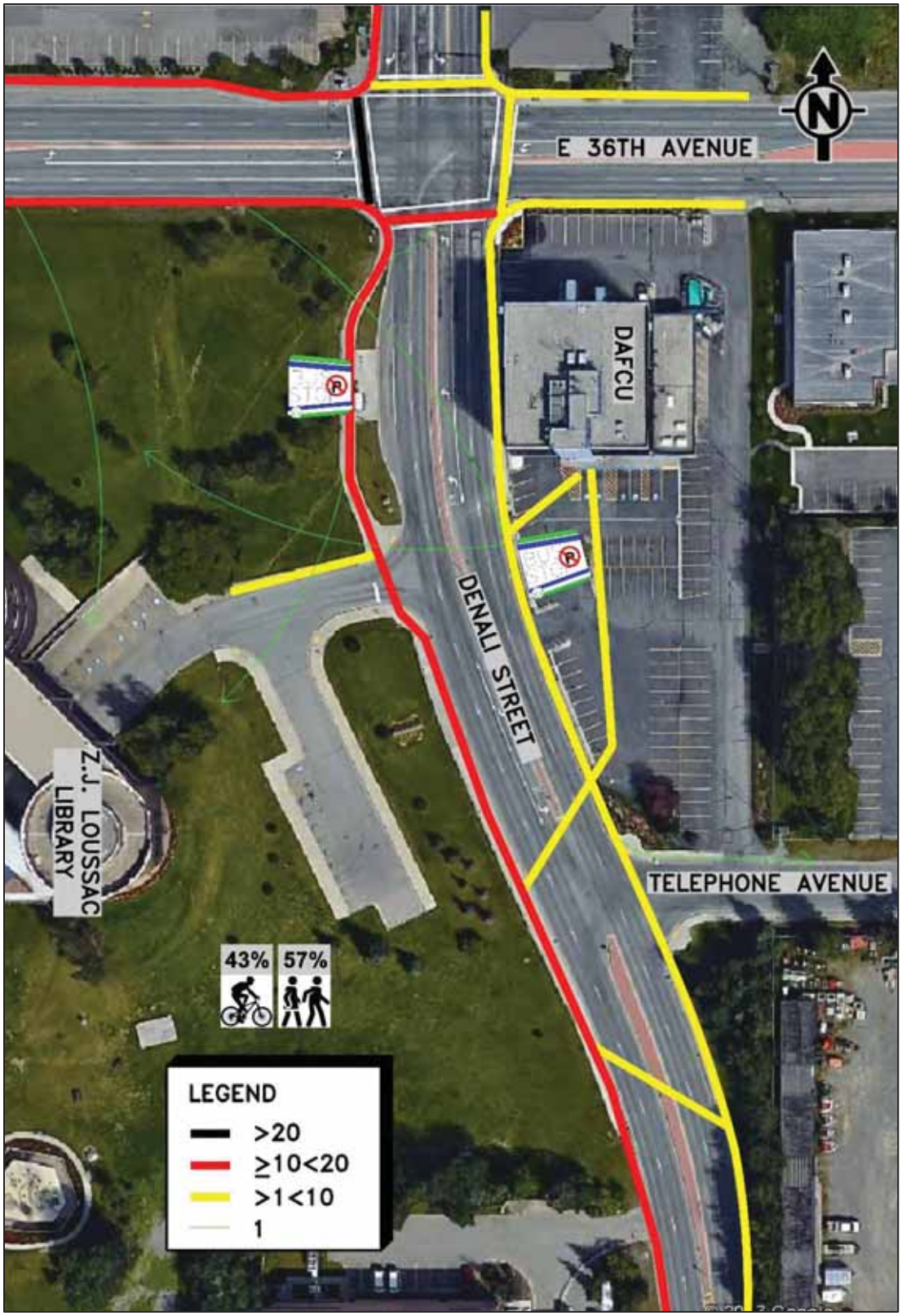


Figure 54. Ped/Bike Movements on Denali St – 36th Ave to Communications (3:30 – 4:30 PM)

Figure 55. Ped/Bike Movements on Denali St – Communications to Tudor Rd (3:30 – 4:30 PM)

Figure 56. Ped/Bike Movements on 36th Ave – A St and Denali St (11:45 AM – 12:45 PM)

Figure 57. Ped/Bike Movements on 36th Avenue – Kuukpik Bldg to Old Seward Hwy (4:55 – 5:55 PM)

Appendix C: Existing Turning Movement Volumes

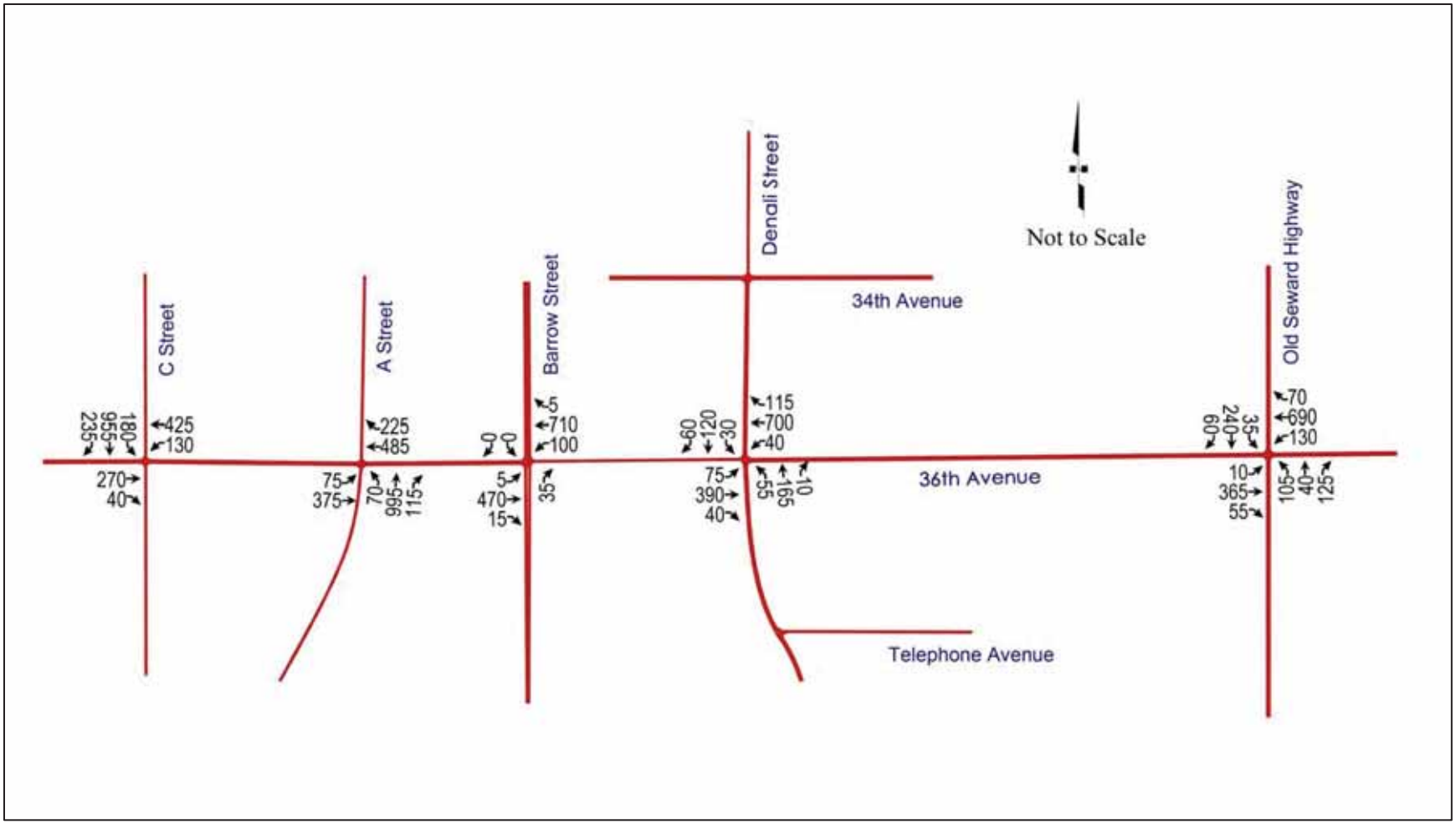


Figure 58. TMVs on 36th Avenue during the AM Peak Hour

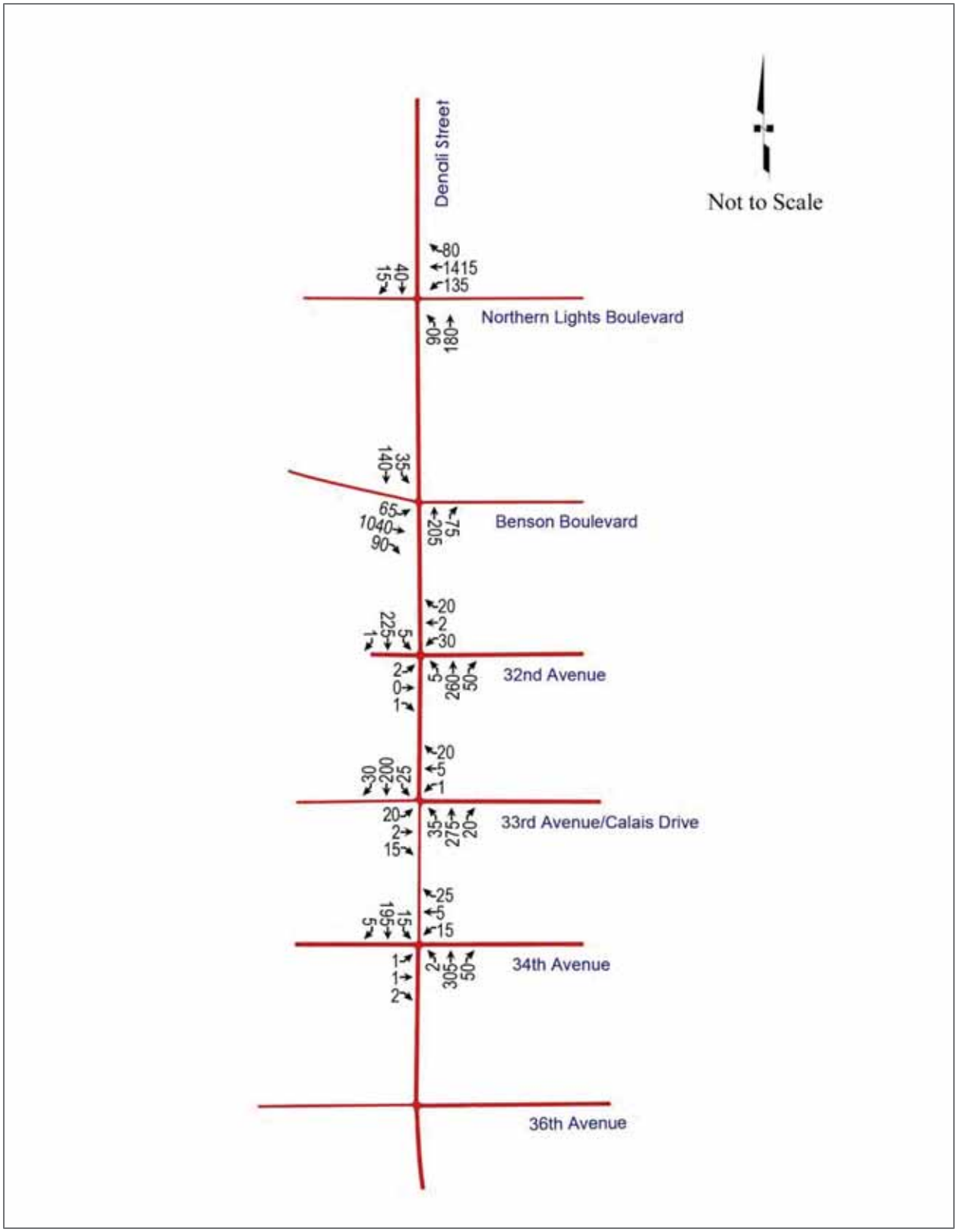


Figure 59. TMVs on North Denali Street during the AM Peak Hour

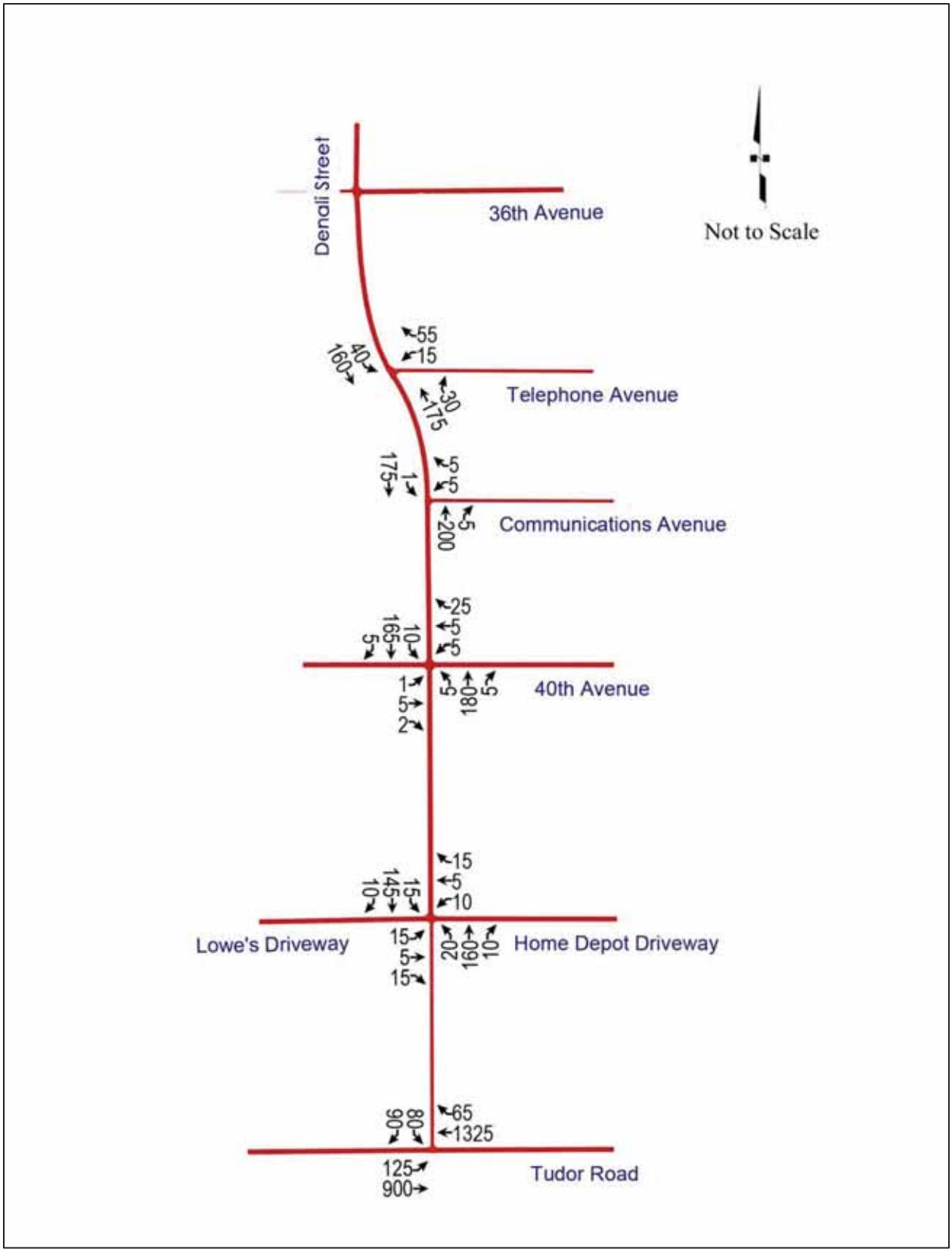


Figure 60. TMVs on South Denali Street during the AM Peak Hour

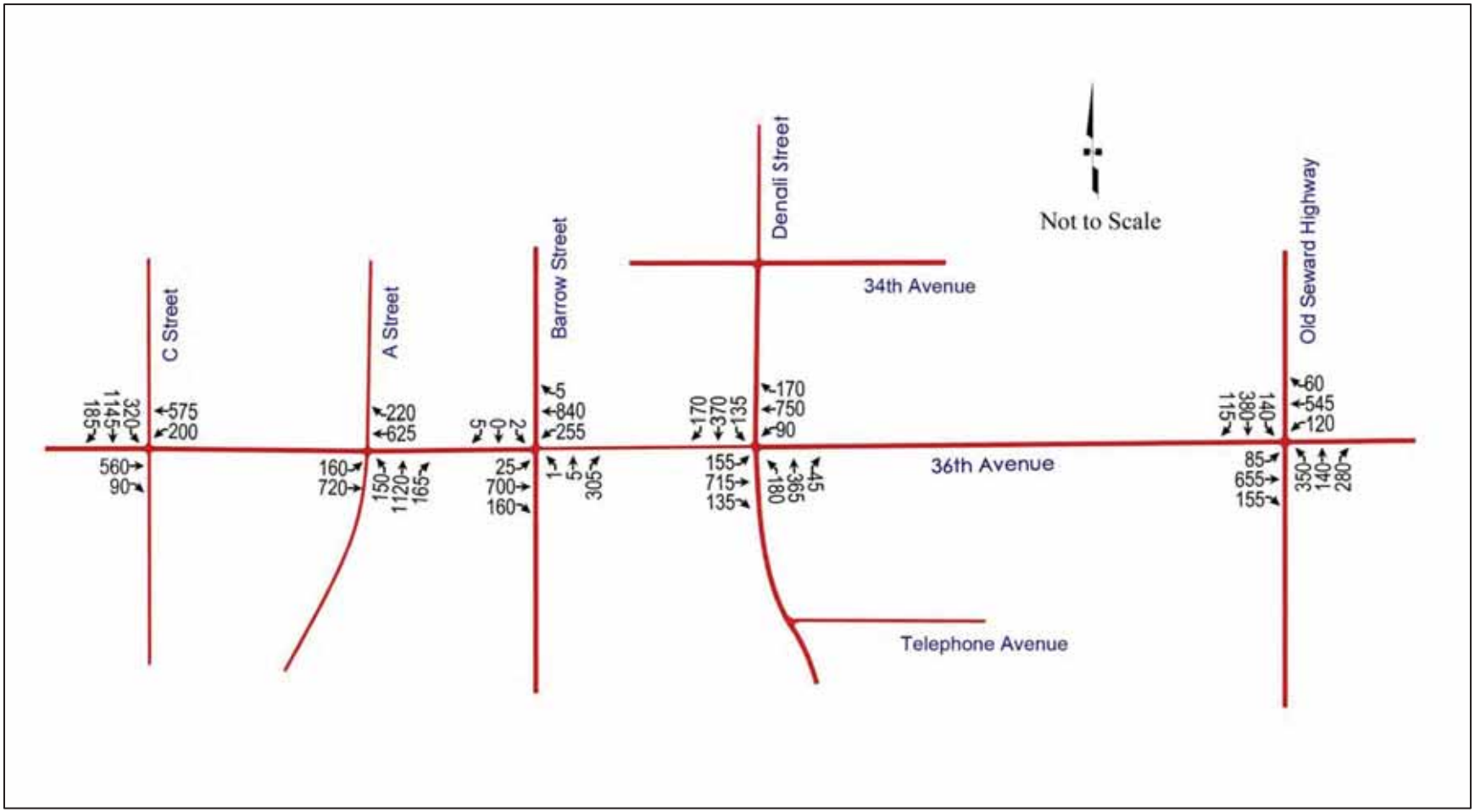


Figure 61. TMVs on 36th Avenue during the Midday Peak Hour

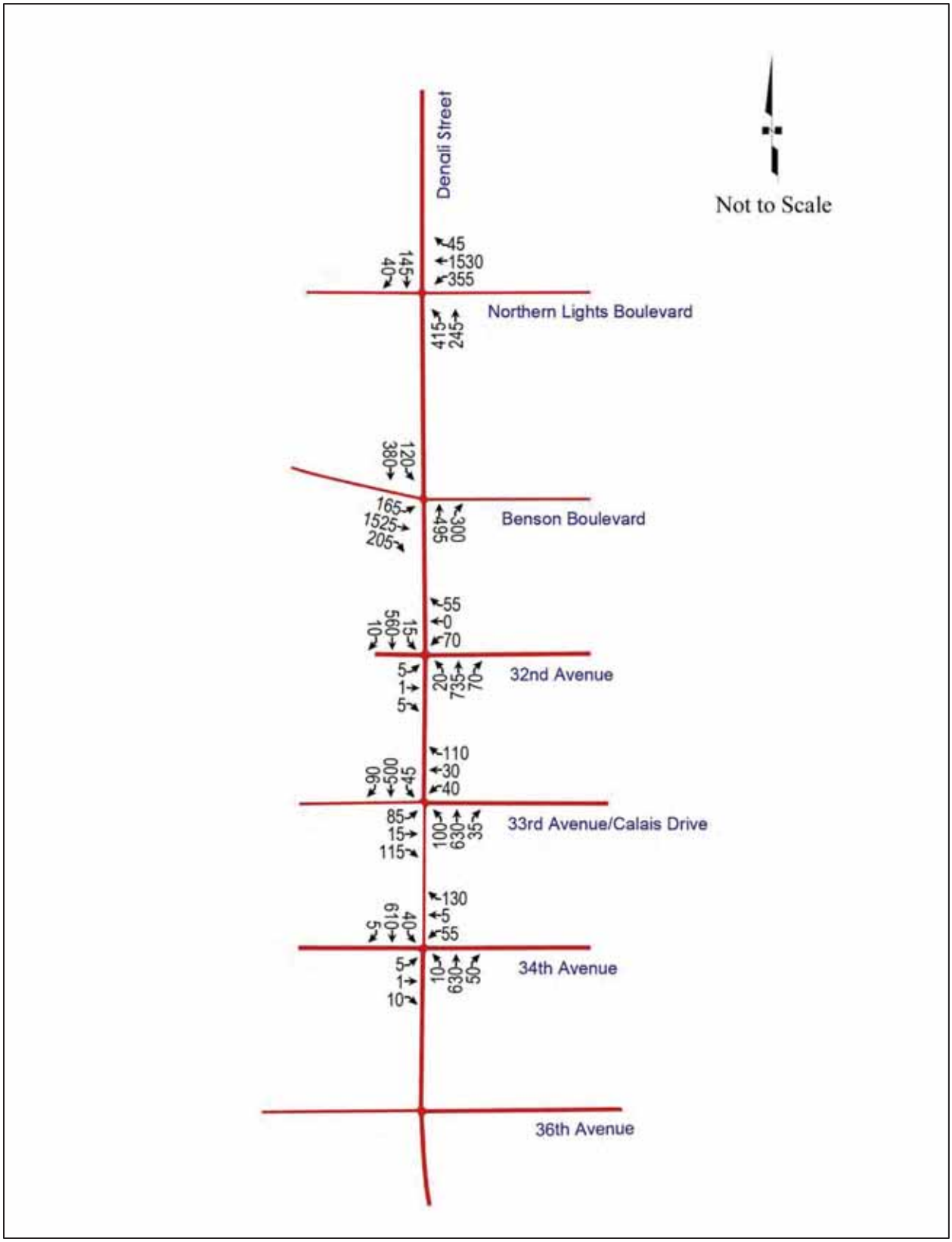


Figure 62. TMVs on North Denali Street during the Midday Peak Hour

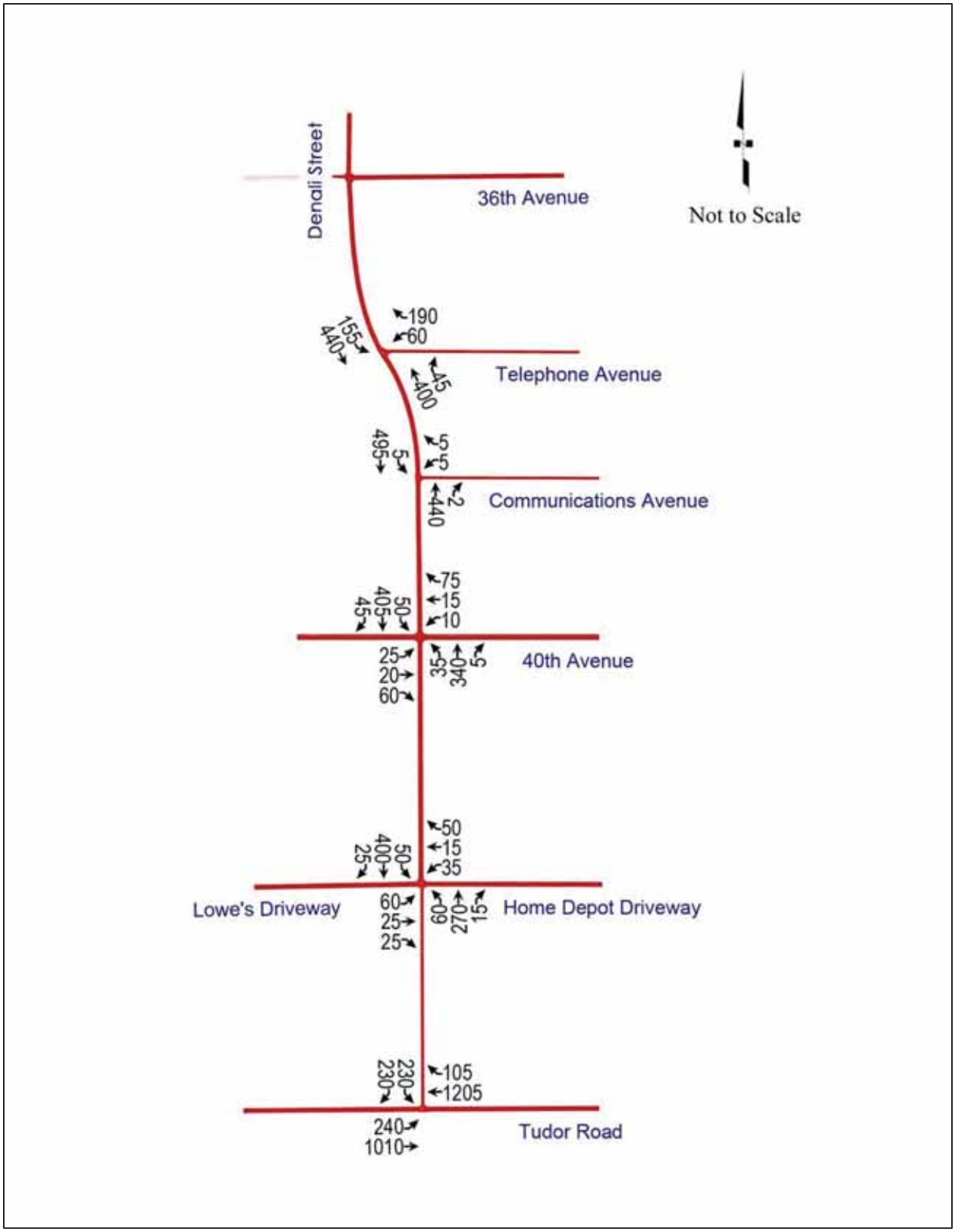


Figure 63. TMVs on South Denali Street during the Midday Peak Hour

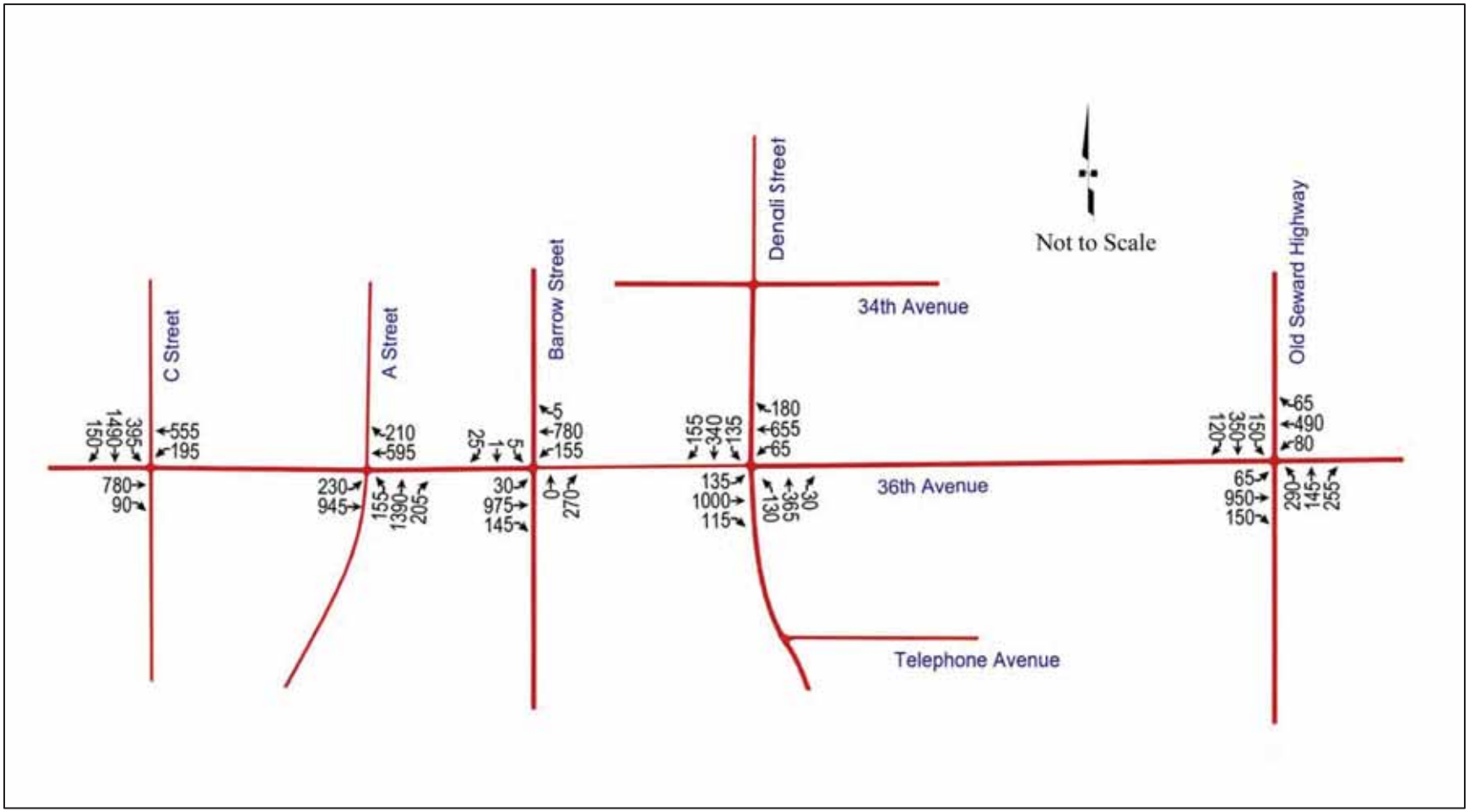


Figure 64. TMVs on 36th Avenue during the PM Peak Hour

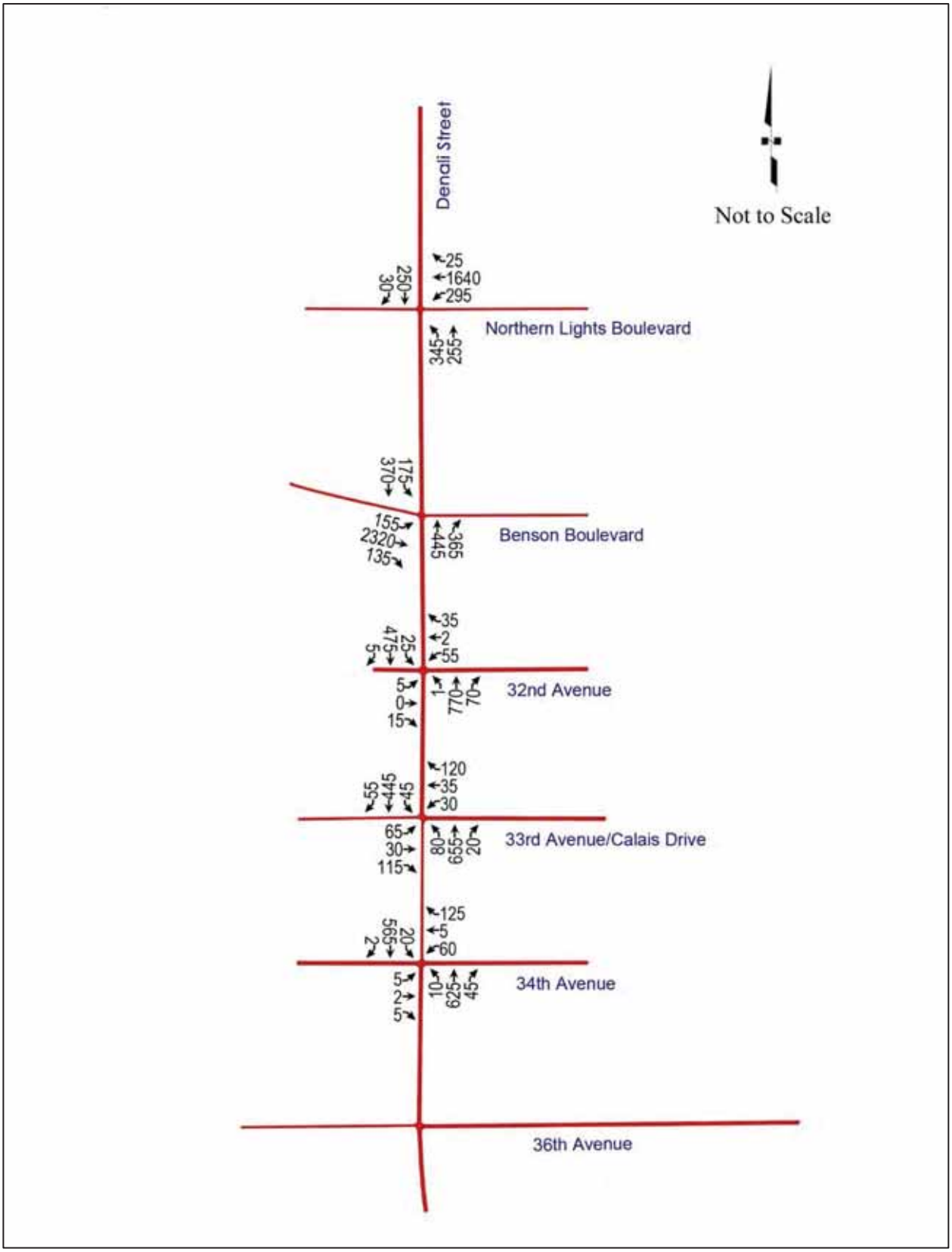


Figure 65. TMVs on North Denali Street during the PM Peak Hour

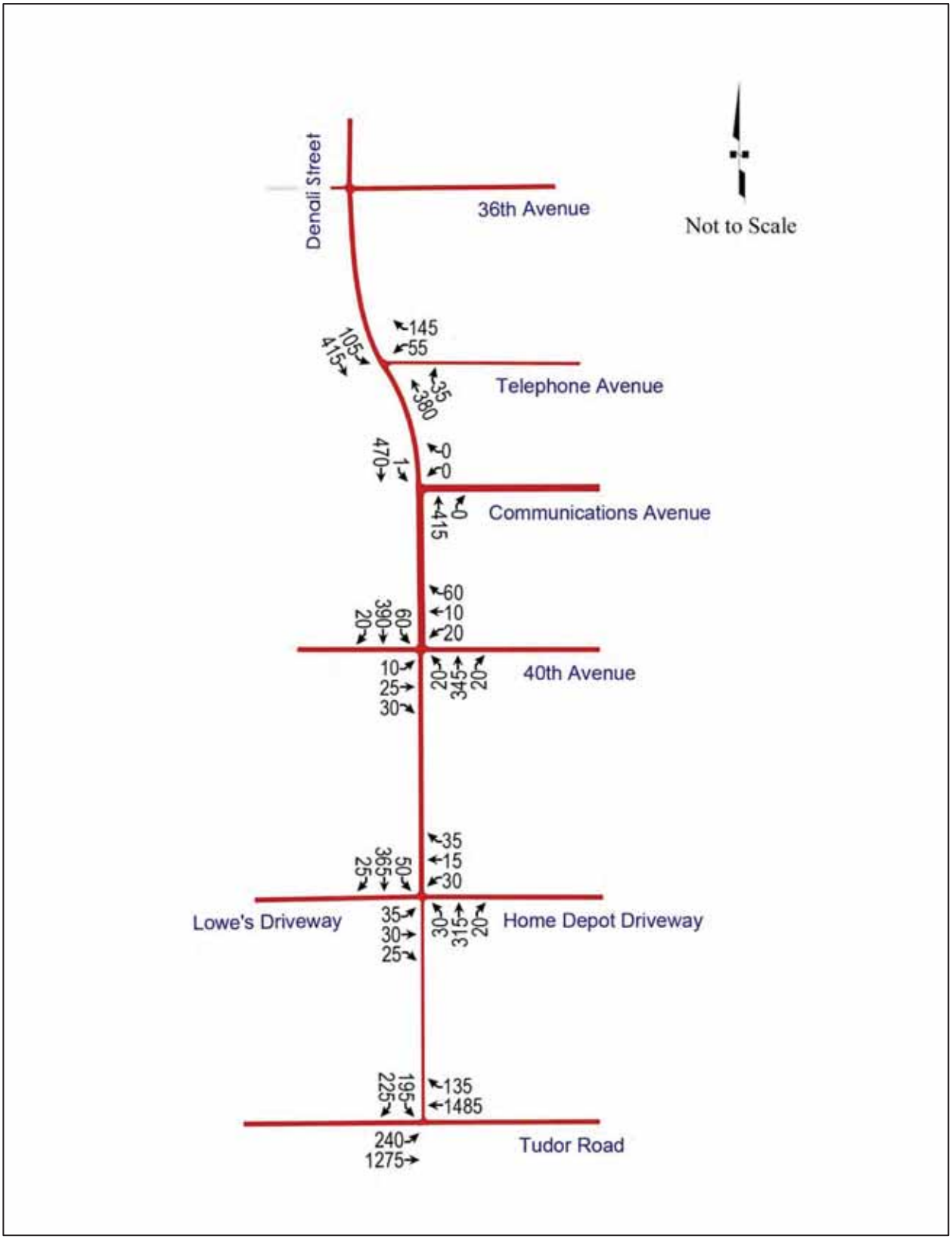
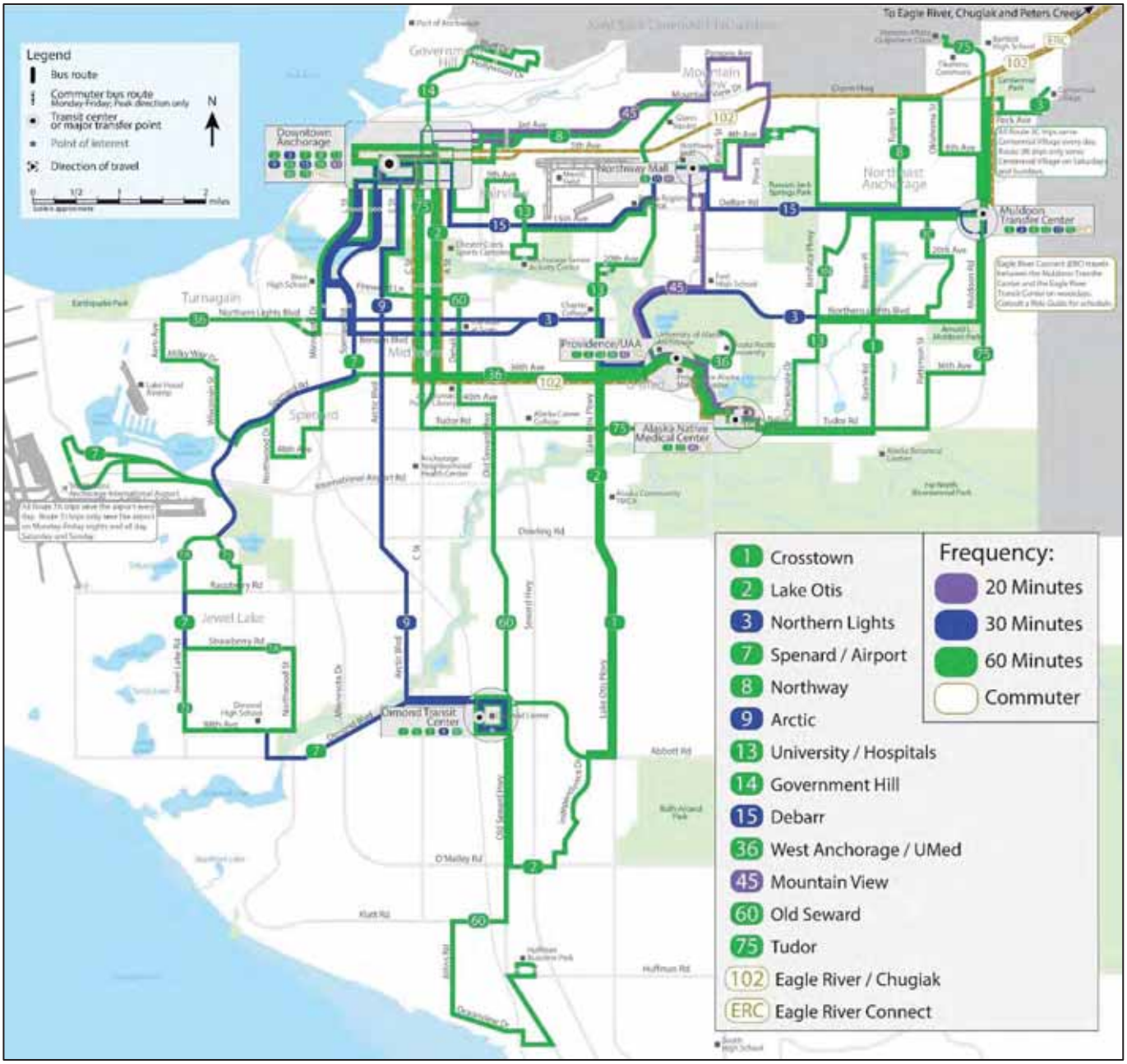


Figure 66. TMVs on South Denali Street during the PM Peak Hour

Appendix D: Transit System



Map from www.muni.org

Figure 67. Bus System Prior to October 2017

Map from www.muni.org

Figure 68. Bus System after October 2017

Appendix E: Future Turning Movement Volumes

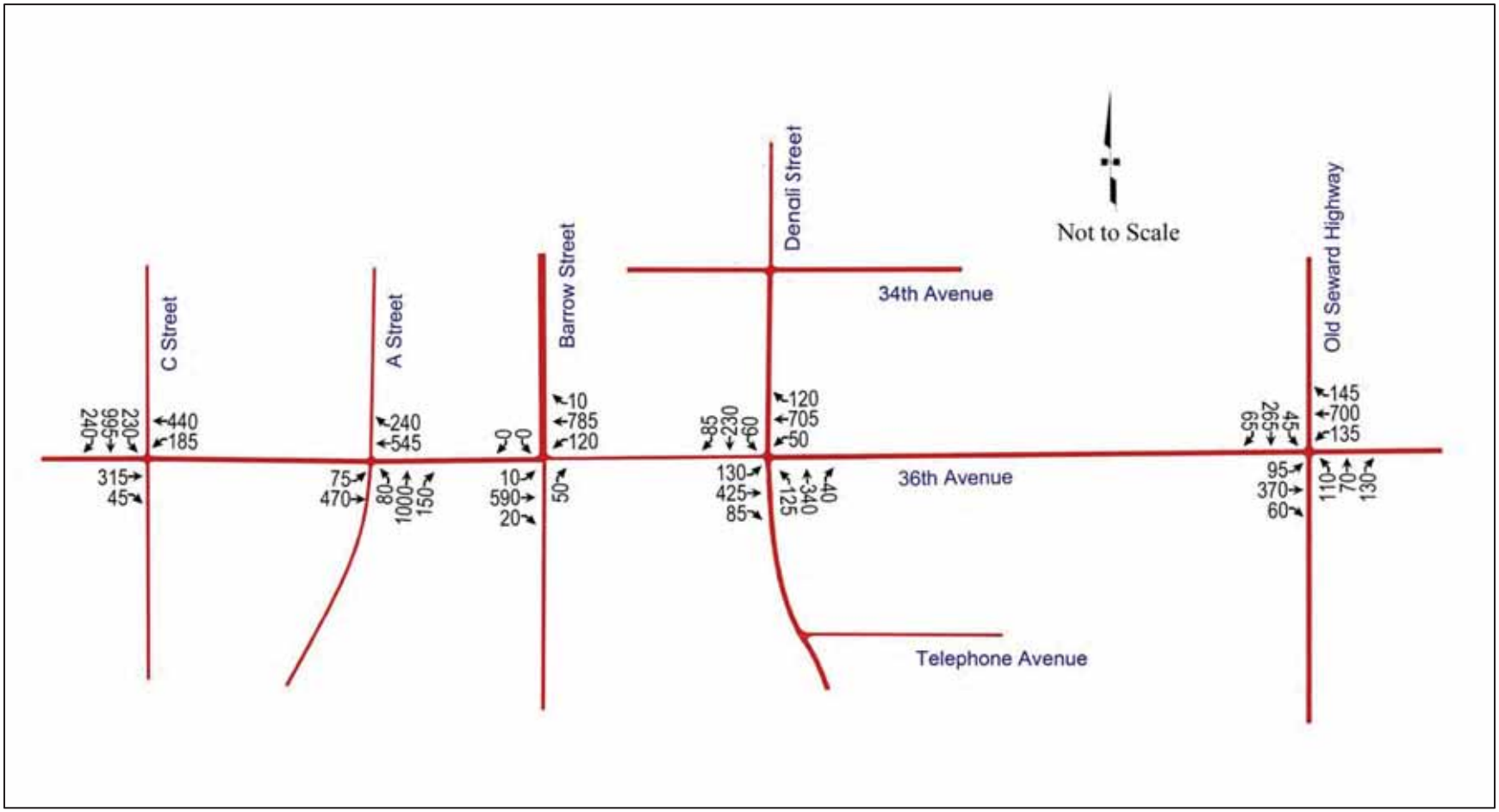


Figure 69. 2045 Projected TMVs on 36th Avenue during the AM Peak Hour

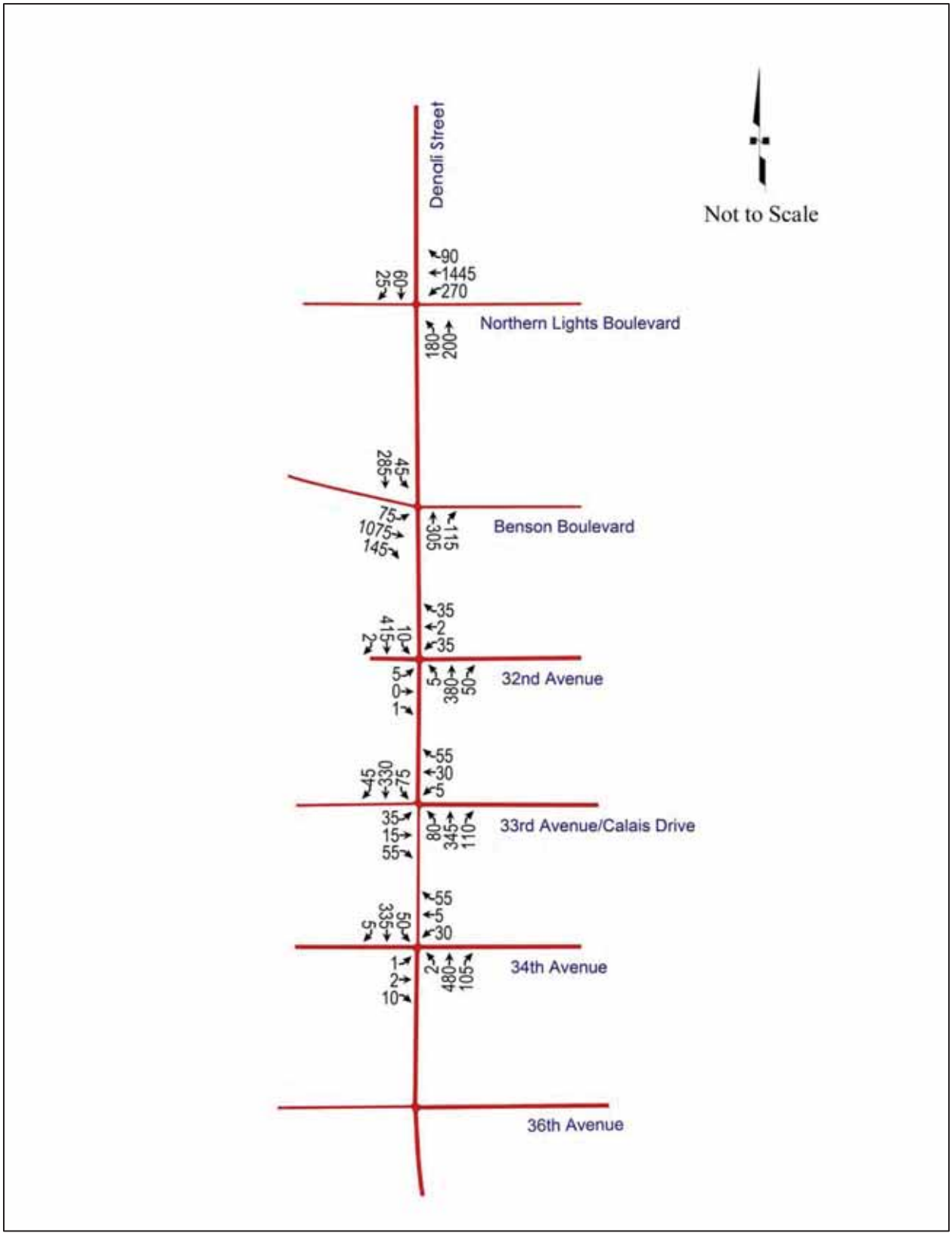


Figure 70. 2045 Projected TMVs on North Denali Street during the AM Peak Hour

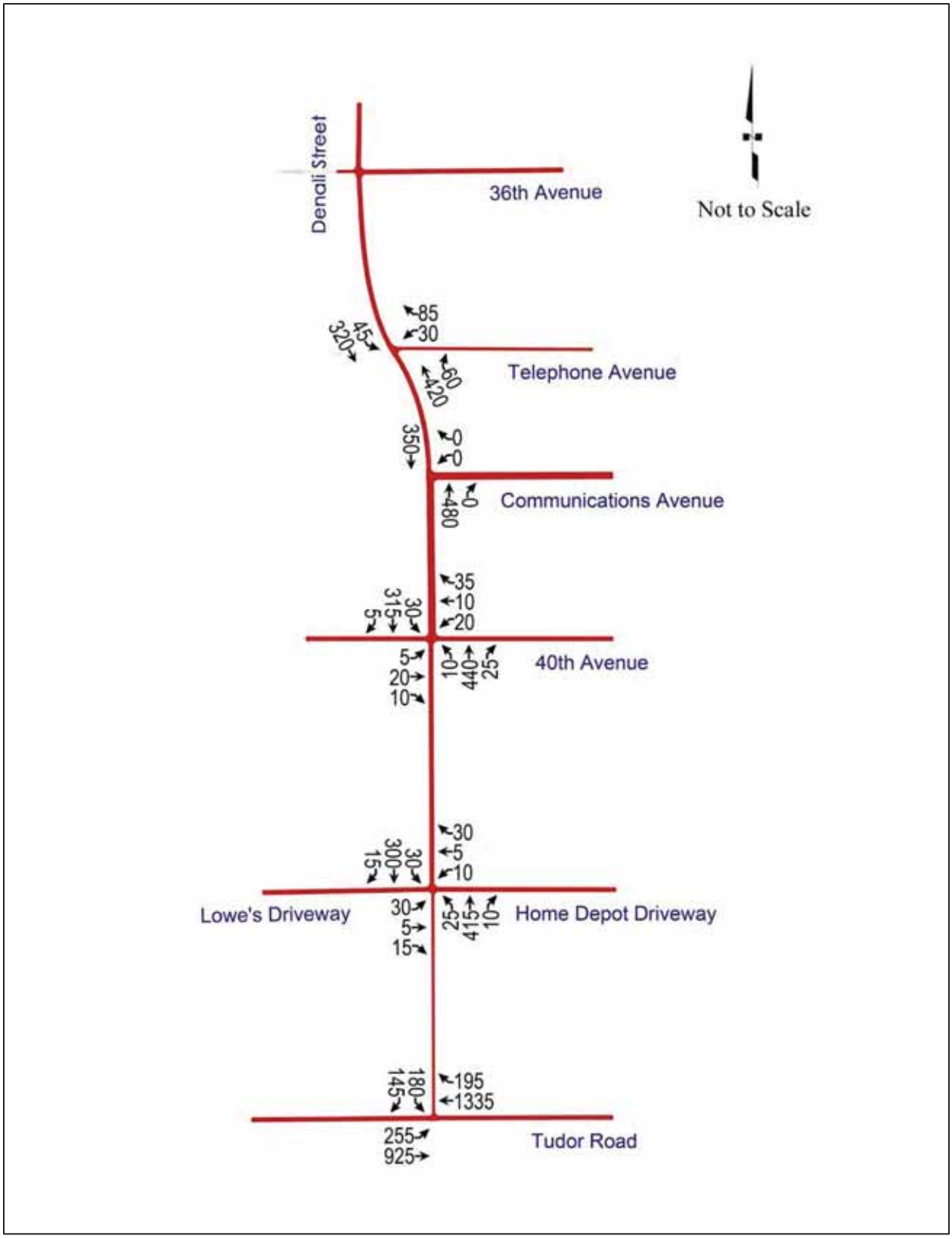


Figure 71. 2045 Projected TMVs on South Denali during the AM Peak Hour

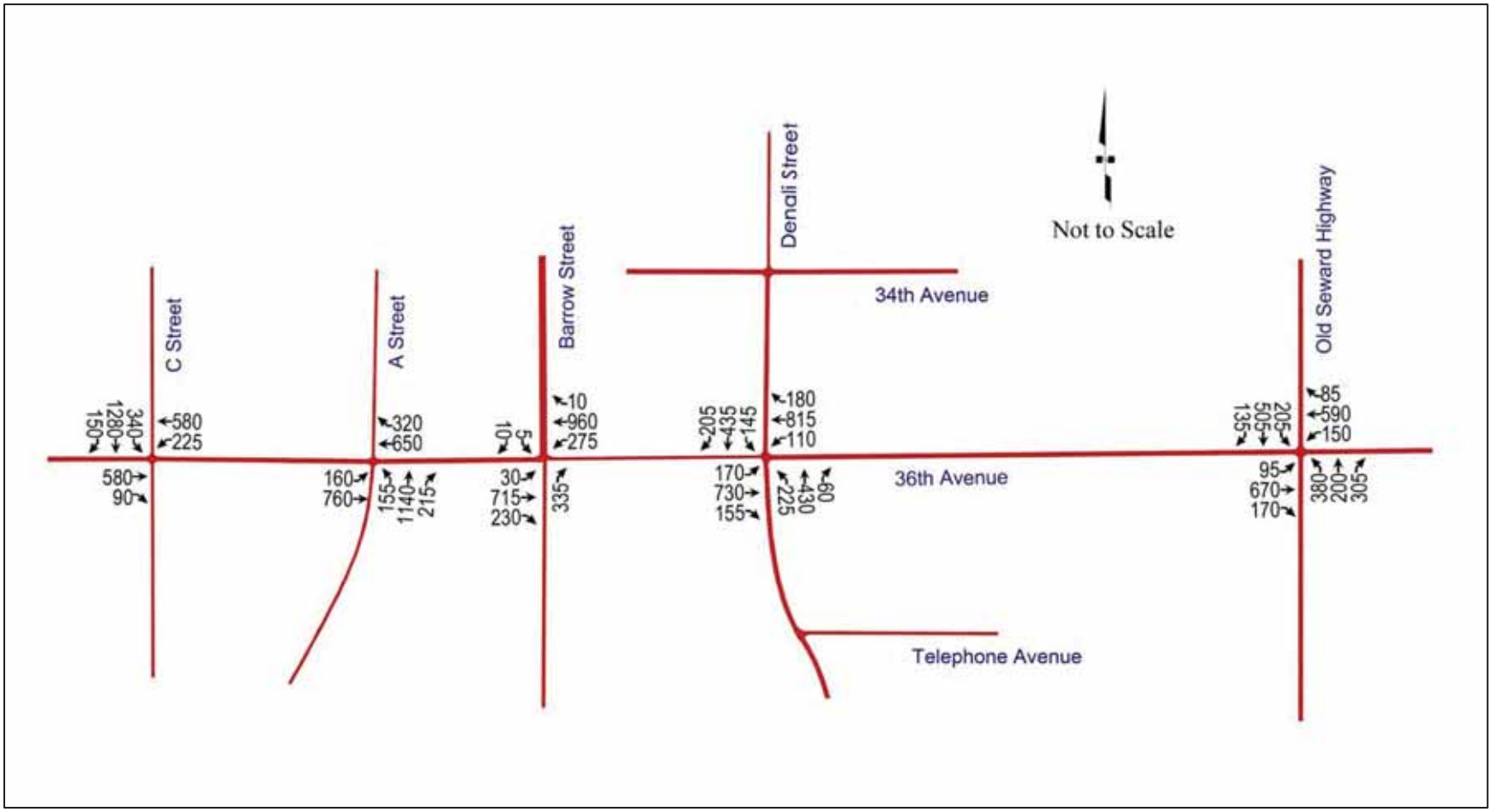


Figure 72. 2045 Projected TMVs on 36th Avenue during the Midday Peak Hour

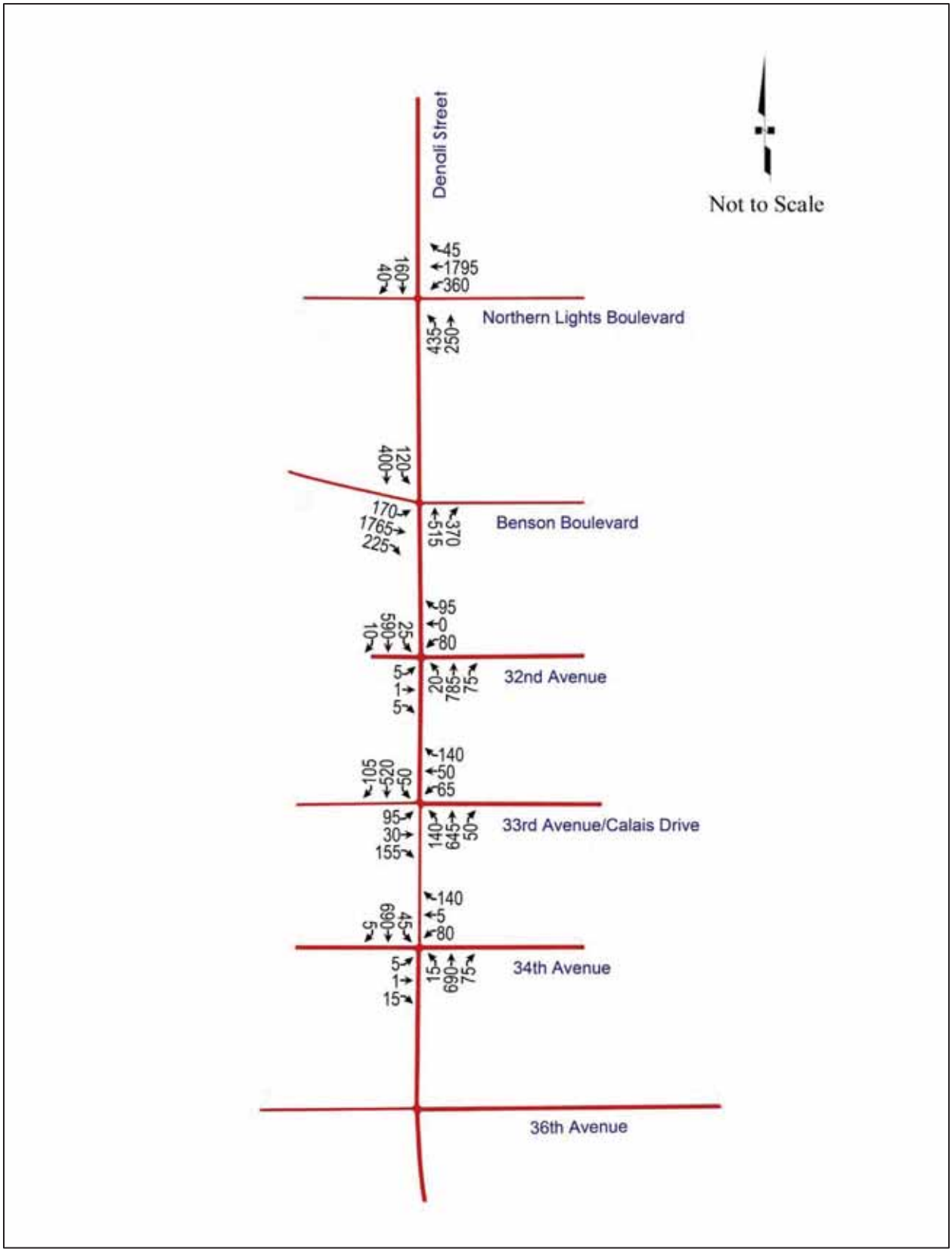


Figure 73. 2045 Projected TMVs on North Denali Street during the Midday Peak Hour

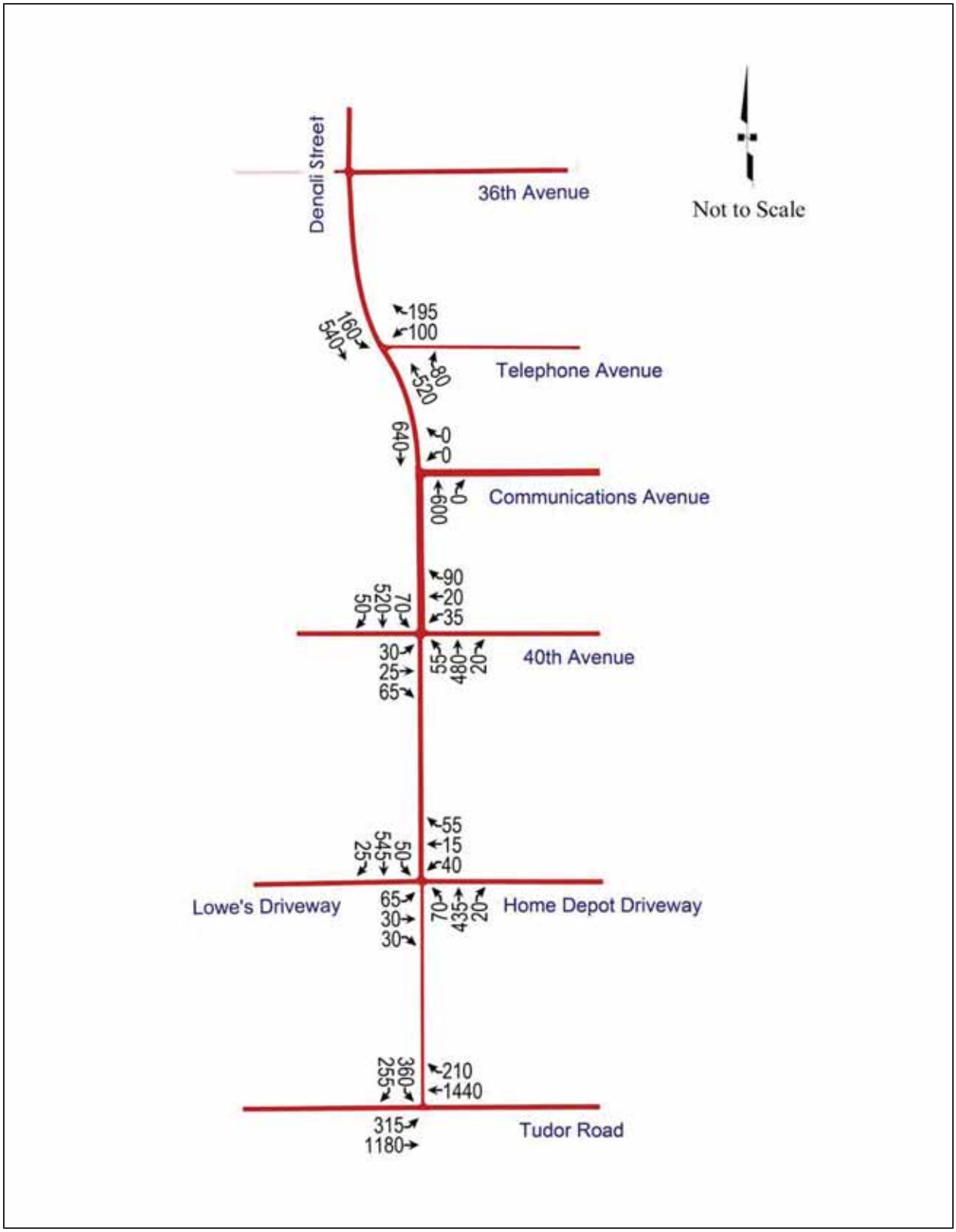


Figure 74. 2045 Projected TMVs on South Denali during the Midday Peak Hour

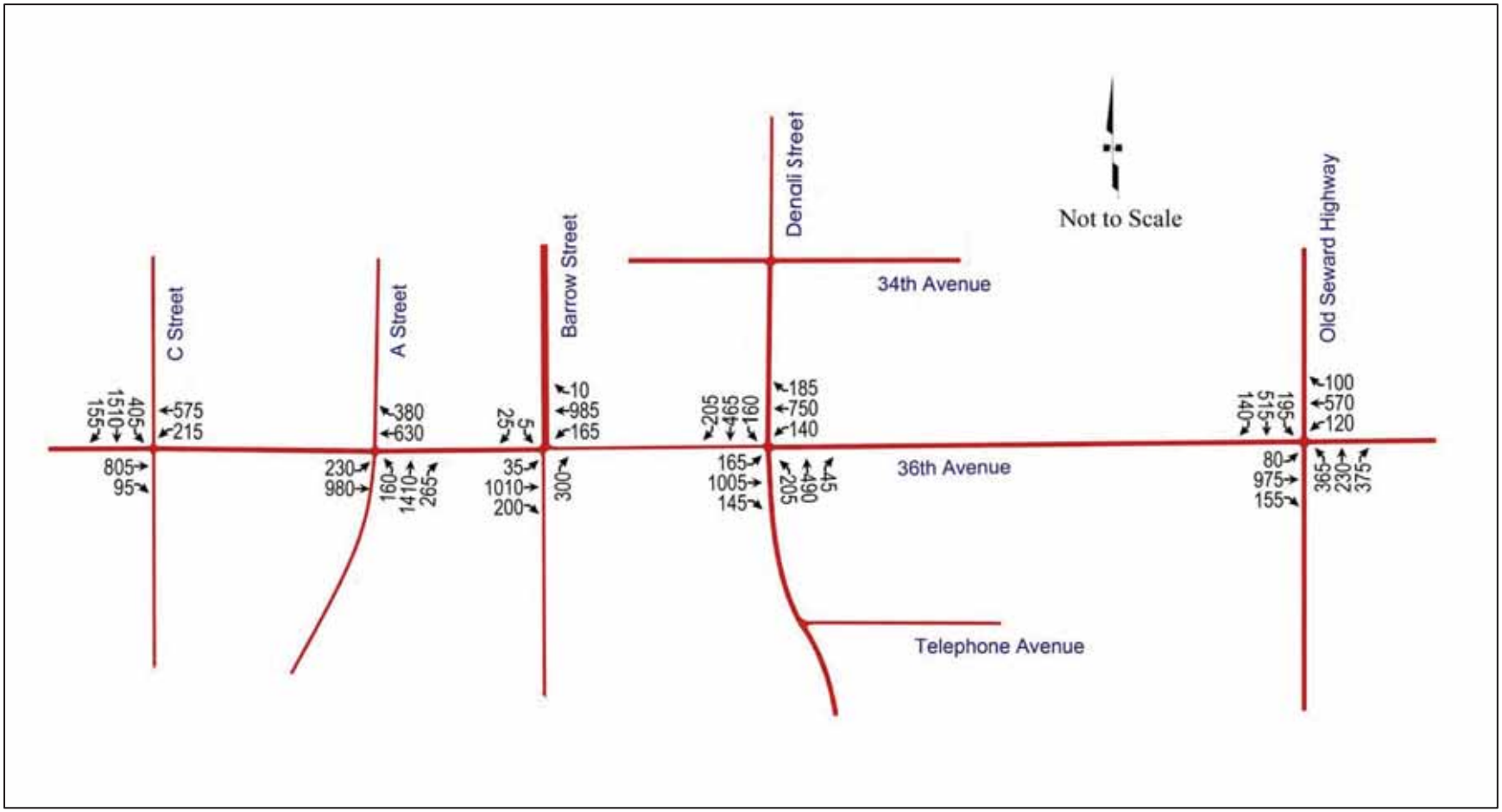


Figure 75. 2045 Projected TMVs on 36th Avenue during the PM Peak Hour

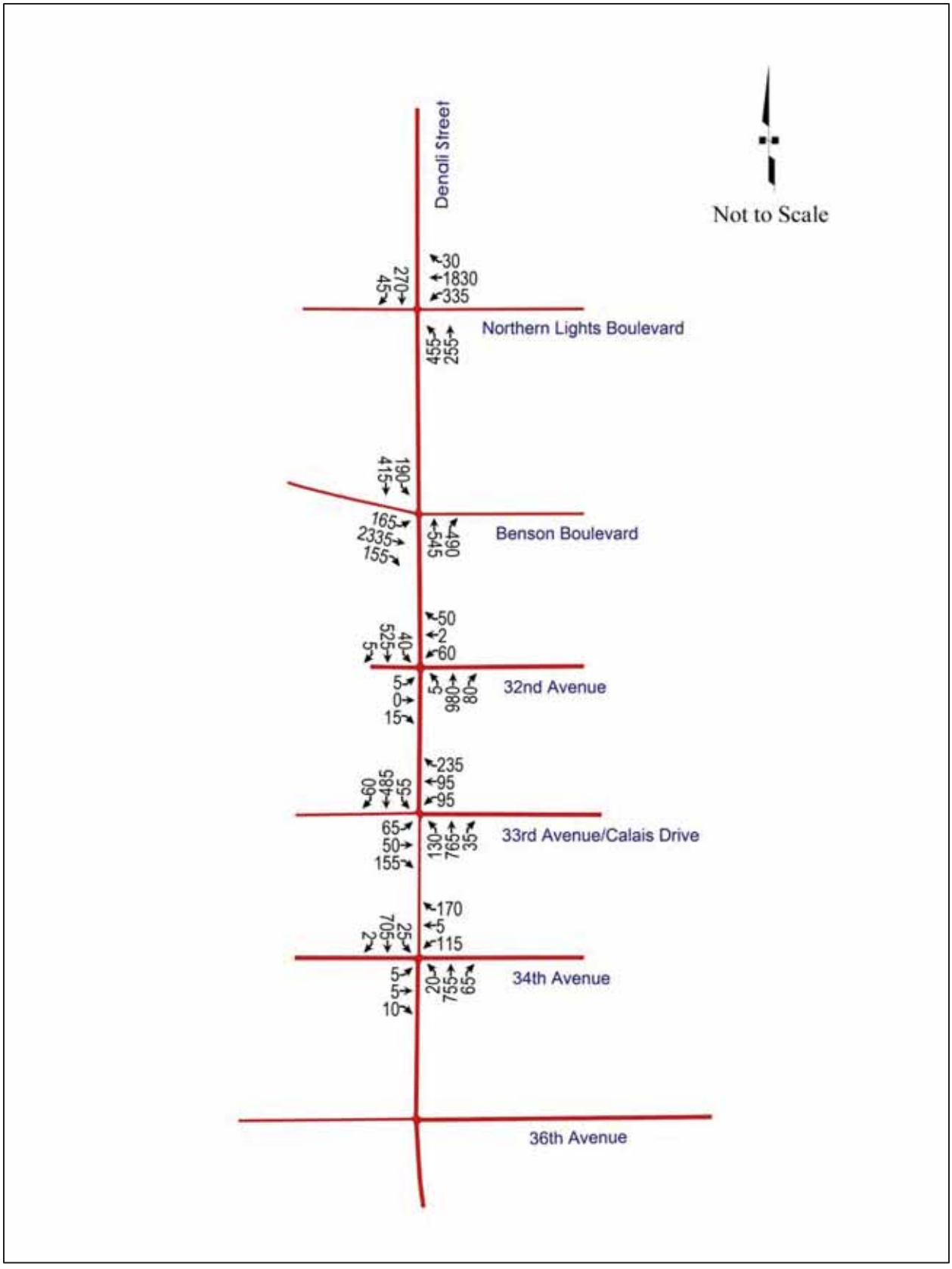


Figure 76. 2045 Projected TMVs on North Denali Street during the PM Peak Hour

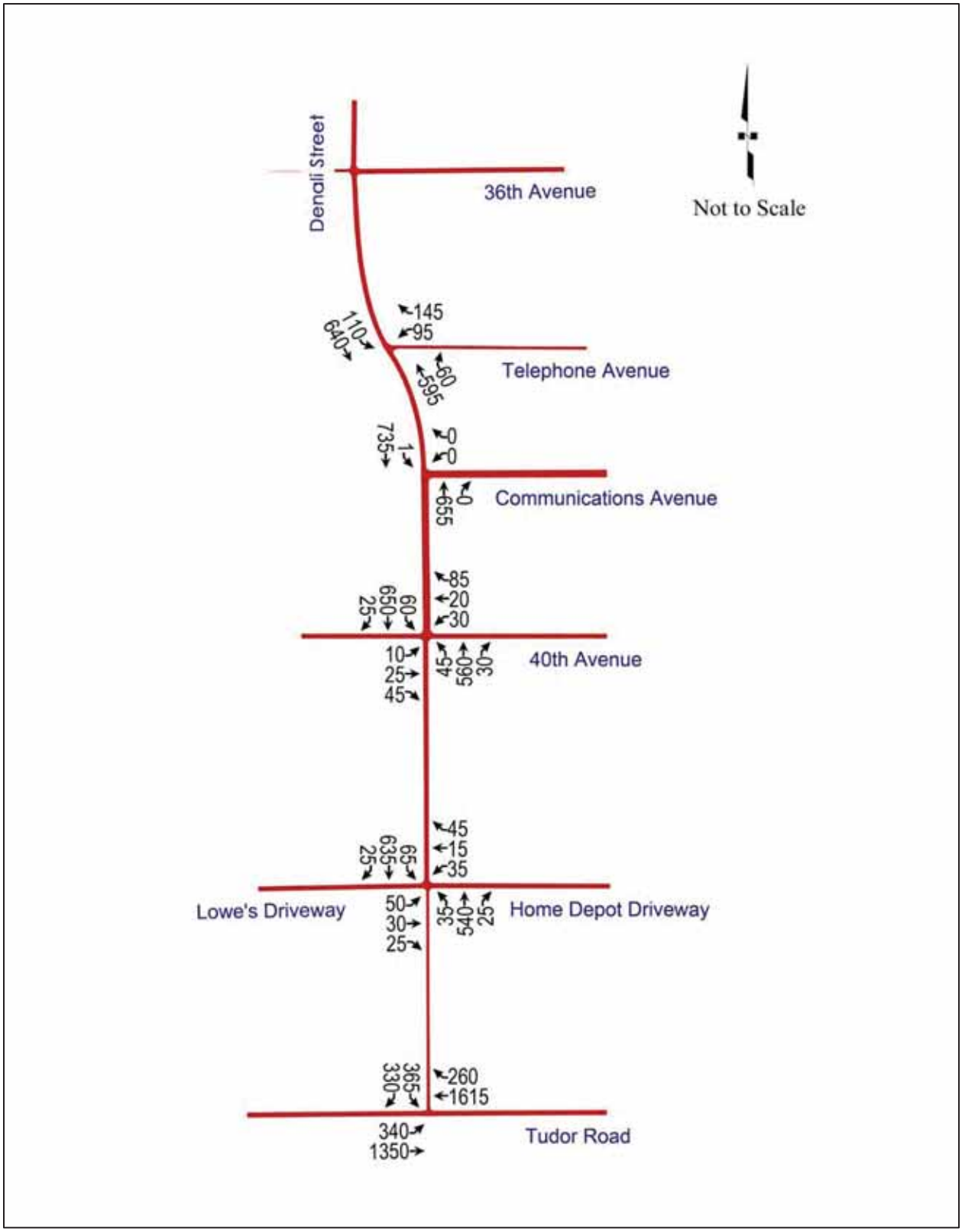


Figure 77. 2045 Projected TMVs on South Denali Street during the PM Peak Hour

Appendix F: Average Pedestrian Delay at Signalized Intersections – No-Build Condition

Note that delay values greater than 30 seconds are highlighted. A delay greater that 30 seconds results in a high likelihood of pedestrian noncompliance with signal indications.

Table 62. Average Pedestrian Delay at the AM Peak Hour – Existing Volumes

Signalized Intersection	*Average Pedestrian Delay by Movement (sec)*			
	EB	*WB*	*NB*	*SB*
Northern Lights Boulevard and Denali Street	12	12	30	30
Benson Boulevard and Denali Street	15	15	30	30
33rd Avenue and Denali Street	30	30	9	11
36th Avenue and Denali Street	19	22	42	42
Tudor Road and Denali Street	-	15	-	69
C Street and 36th Avenue	30	30	14	14
A Street and 36th Avenue	30	30	22	22
Old Seward Highway and 36th Avenue	20	17	69	69

Table 63. Average Pedestrian Delay at the Midday Peak Hour – Existing Volumes

Signalized Intersection	*Average Pedestrian Delay by Movement (sec)*			
	EB	*WB*	*NB*	*SB*
Northern Lights Boulevard and Denali Street	16	16	59	59
Benson Boulevard and Denali Street	19	19	59	59
33rd Avenue and Denali Street	59	59	8	9
36th Avenue and Denali Street	26	31	59	59
Tudor Road and Denali Street	-	22	-	59
C Street and 36th Avenue	59	59	20	20
A Street and 36th Avenue	59	59	26	26
Old Seward Highway and 36th Avenue	29	29	59	59

Table 64. Average Pedestrian Delay at the PM Peak Hour – Existing Volumes

Signalized Intersection	*Average Pedestrian Delay by Movement (sec)*			
	EB	*WB*	*NB*	*SB*
Northern Lights Boulevard and Denali Street	17	17	30	30
Benson Boulevard and Denali Street	22	22	30	30
33rd Avenue and Denali Street	30	30	11	13
36th Avenue and Denali Street	24	28	42	42
Tudor Road and Denali Street	-	21	-	69
C Street and 36th Avenue	30	30	19	19
A Street and 36th Avenue	30	30	23	23
Old Seward Highway and 36th Avenue	26	26	69	69

Table 65. Average Pedestrian Delay at the AM Peak Hour – Existing Volumes

Signalized Intersection	*Average Pedestrian Delay by Movement (sec)*			
	EB	*WB*	*NB*	*SB*
Northern Lights Boulevard and Denali Street	12	12	30	30
Benson Boulevard and Denali Street	16	16	30	30
33rd Avenue and Denali Street	30	30	10	12
36th Avenue and Denali Street	23	27	42	42
Tudor Road and Denali Street	-	29	-	69
C Street and 36th Avenue	30	30	16	16
A Street and 36th Avenue	30	30	22	22
Old Seward Highway and 36th Avenue	22	21	69	69

Table 66. Average Pedestrian Delay at the Midday Peak Hour – Existing Volumes

Signalized Intersection	*Average Pedestrian Delay by Movement (sec)*			
	EB	WB	NB	SB
Northern Lights Boulevard and Denali Street	17	17	59	59
Benson Boulevard and Denali Street	21	21	59	59
33rd Avenue and Denali Street	59	59	8	9
36th Avenue and Denali Street	29	34	59	59
Tudor Road and Denali Street	-	33	-	59
C Street and 36th Avenue	59	59	21	21
A Street and 36th Avenue	59	59	26	26
Old Seward Highway and 36th Avenue	32	31	59	59

Table 67. Average Pedestrian Delay at the PM Peak Hour – Existing Volumes

Signalized Intersection	*Average Pedestrian Delay by Movement (sec)*			
	EB	WB	NB	SB
Northern Lights Boulevard and Denali Street	18	18	30	30
Benson Boulevard and Denali Street	25	25	30	30
33rd Avenue and Denali Street	30	30	12	15
36th Avenue and Denali Street	29	32	42	42
Tudor Road and Denali Street	-	29	-	69
C Street and 36th Avenue	30	30	20	20
A Street and 36th Avenue	30	30	23	23
Old Seward Highway and 36th Avenue	31	29	69	69

Appendix G: Intersection Operation Details – Existing Configuration

Table 68. AM Peak Signalized Intersection Operations on Denali Street (Existing Volumes and Existing Configuration)

AM		*Eastbound*			*Westbound*			*Northbound*			*Southbound*		
		Left	*Through*	*Right*	*Left*	*Through*	*Right*	*Left*	*Through*	*Right*	*Left*	*Through*	*Right*
Northern Lights Boulevard & Denali Street	LOS	-	-	-	B	A	B	C	C	-	-	C	
	Delay (sec/veh)	-	-	-	11	10	11	34	30	-	-	33	
	v/c Ratio	-	-	-	0.5	0.5	0.5	0.2	0.4	-	-	0.3	
	Queue Length (ft)	-	-	-	-	192	-	38	105	-	-	34	
Benson Boulevard & Denali Street	LOS	B	B	B	-	-	-	-	C	C	C	C	-
	Delay (sec/veh)	14	17	19	-	-	-	-	35	34	25	28	-
	v/c Ratio	0.1	0.5	0.5	-	-	-	-	0.5	0.4	0.2	0.2	-
	Queue Length (ft)	34	118	-	-	-	-	-	60	34	m10	16	-
33rd Avenue/ Calais Drive & Denali Street	LOS	C	C		C	C		A	A	A	A	A	A
	Delay (sec/veh)	33	32		32	33		3	6	6	4	6	6
	v/c Ratio	0.1	0.1		0.0	0.2		0.1	0.2	0.2	0.0	0.1	0.1
	Queue Length (ft)	17	10		2	13		166	65	-	13	53	-
36th Avenue & Denali Street	LOS	A	B	B	A	B	B	**D**	**D**	**D**	**D**	**D**	**D**
	Delay (sec/veh)	9	11	11	8	14	14	**36**	**41**	**41**	**36**	**42**	**44**
	v/c Ratio	0.2	0.2	0.2	0.1	0.5	0.5	**0.2**	**0.4**	**0.4**	**0.1**	**0.3**	**0.3**
	Queue Length (ft)	43	130		26	288		**42**	**64**		**26**	**49**	**0**
Tudor Road & Denali Street *	LOS	A	A	-	-	A	A	-	-	-	**E**	-	**E**
	Delay (sec/veh)	4	2	-	-	7	4	-	-	-	**72**	-	**60**
	v/c Ratio	0.4	0.3	-	-	0.5	0.1	-	-	-	**0.4**	-	**0.1**
	Queue Length (ft)	20	72	-	-	277	13	-	-	-	**58**	-	**40**

* Analysis Done with HCM 2000

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

Table 69. AM Peak Signalized Intersection Operations on 36th Avenue (Existing Volumes and Existing Configuration)

AM		*Eastbound*			*Westbound*			*Northbound*			*Southbound*		
		Left	*Through*	*Right*	*Left*	*Through*	*Right*	*Left*	*Through*	*Right*	*Left*	*Through*	*Right*
C Street & 36th Avenue	LOS	-	C	C	C	B	-	-	-	-	C	C	C
	Delay (sec/veh)	-	32	33	32	13	-	-	-	-	34	29	30
	v/c Ratio	-	0.6	0.7	0.7	0.5	-	-	-	-	0.9	0.8	0.8
	Queue Length (ft)	-	83		19	26	-	-	-	-	-	189	-
A Street & 36th Avenue	LOS	C	A	-	-	C	C	B	B	B	-	-	-
	Delay (sec/veh)	27	2	-	-	25	28	13	17	14	-	-	-
	v/c Ratio	0.3	0.3	-	-	0.5	0.6	0.1	0.5	0.2	-	-	-
	Queue Length (ft)	m24	51	-	-	131	92	36	139	20	-	-	-
Old Seward Highway & 36th Avenue	LOS	B	B	B	B	A	A	**D**	**D**	**E**	**D**	**E**	**E**
	Delay (sec/veh)	11	17	17	11	2	2	**49**	**52**	**58**	**53**	**65**	**66**
	v/c Ratio	0.0	0.3	0.3	0.3	0.5	0.5	**0.6**	**0.1**	**0.5**	**0.2**	**0.7**	**0.7**
	Queue Length (ft)	10	149		74	262		**110**	**32**		**45**	**166**	

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

Note that the signalized intersection operations on 36th Avenue (with the exception of the intersection of Denali Street and 36th Avenue) do not change between the no build and the complete streets configuration.

Table 70. AM Peak Unsignalized Intersection Operations (Existing Volumes and Existing Configuration)

AM		*Eastbound*			*Westbound*			*Northbound*			*Southbound*		
		Left	*Through*	*Right*	*Left*	*Through*	*Right*	*Left*	*Through*	*Right*	*Left*	*Through*	*Right*
32nd Avenue & Denali Street	LOS	B			B			A	-		A	-	
	Delay (sec/veh)	12			14			8	-		8	-	
	v/c Ratio	0.0			0.1			0.0	-		0.0	-	
34th Avenue & Denali Street	LOS	B			B			A	-		A	-	
	Delay (sec/veh)	12			13			8	-		8	-	
	v/c Ratio	0.0			0.1			0.0	-		0.0	-	
Telephone Avenue & Denali Street	LOS	-			B			-	-		A	-	
	Delay (sec/veh)	-			10			-	-		8	-	
	v/c Ratio	-			0.1			-	-		0.0	-	
Communications Avenue & Denali Street	LOS	-			B			-	-		A	A	-
	Delay (sec/veh)	-			10			-	-		8	0	-
	v/c Ratio	-			0.0			-	-		0.0	-	-
40th Avenue & Denali Street	LOS	B			B		A	A	A	-	A	A	-
	Delay (sec/veh)	11			12		9	8	0	-	8	0	-
	v/c Ratio	0.0			0.0		0.0	0.0	-	-	0.0	-	-
Driveways & Denali Street	LOS	B			B			A	A	-	A	A	-
	Delay (sec/veh)	12			11			8	0	-	8	0	-
	v/c Ratio	0.1			0.1			0.0	-	-	0.0	-	-
Barrow Street & 36th Avenue	LOS	A	-	-	A	-	-	-		B	A	-	A
	Delay (sec/veh)	10	-	-	9	-	-	-		11	0	-	0
	v/c Ratio	0.0	-	-	0.1	-	-	-		0.1	-	-	

Table 71. Midday Peak Signalized Intersection Operations on Denali Street (Existing Volumes and Existing Configuration)

MIDDAY		*Eastbound*			*Westbound*			*Northbound*			*Southbound*		
		Left	*Through*	*Right*	*Left*	*Through*	*Right*	*Left*	*Through*	*Right*	*Left*	*Through*	*Right*
Northern Lights Boulevard & Denali Street	LOS	-	-	-	B	B	B	**E**	**D**	-	-	**E**	
	Delay (sec/veh)	-	-	-	18	16	17	**71**	**50**	-	-	**63**	
	v/c Ratio	-	-	-	0.5	0.5	0.5	**0.8**	**0.4**	-	-	**0.8**	
	Queue Length (ft)	-	-	-	-	323	-	**219**	**260**	-	-	**195**	
Benson Boulevard & Denali Street	LOS	C	C	C	-	-	-	-	**E**	**E**	**D**	**D**	-
	Delay (sec/veh)	21	27	29	-	-	-	-	**58**	**72**	**38**	**47**	-
	v/c Ratio	0.2	0.6	0.6	-	-	-	-	**0.6**	**0.9**	**0.5**	**0.3**	-
	Queue Length (ft)	101	274	-	-	-	-	-	**211**	**193**	**60**	**72**	-
33rd Avenue/ Calais Drive & Denali Street	LOS	**E**	**D**		**E**	**D**		A	C	C	A	A	A
	Delay (sec/veh)	**61**	**51**		**57**	**51**		7	27	27	8	10	10
	v/c Ratio	**0.5**	**0.5**		**0.2**	**0.5**		0.2	0.3	0.3	0.1	0.3	0.3
	Queue Length (ft)	**#118**	**56**		**56**	**70**		m19	165	-	7	118	-
36th Avenue & Denali Street	LOS	**D**	C	C	C	B	B	**D**	**D**	**D**	**D**	**E**	C
	Delay (sec/veh)	**37**	25	25	31	19	20	**40**	**50**	**50**	**43**	**62**	30
	v/c Ratio	**0.3**	0.5	0.5	0.4	0.8	0.8	**0.6**	**0.6**	**0.6**	**0.5**	**0.6**	0.6
	Queue Length (ft)	**105**	286	-	m55	m380	-	**161**	**197**	**-**	**122**	**175**	78
Tudor Road & Denali Street *	LOS	B	A	-	-	B	A	-	-	-	**E**	-	**D**
	Delay (sec/veh)	11	4	-	-	14	9	-	-	-	**61**	-	**41**
	v/c Ratio	0.6	0.4	-	-	0.6	0.1	-	-	-	**0.6**	-	**0.2**
	Queue Length (ft)	88	128	-	-	367	23	-	-	-	**118**	-	**45**

* Analysis Done with HCM 2000

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

Table 72. Midday Peak Signalized Intersection Operations on 36th Avenue (Existing Volumes Existing Configuration)

MIDDAY		*Eastbound*			*Westbound*			*Northbound*			*Southbound*		
		Left	*Through*	*Right*	*Left*	*Through*	*Right*	*Left*	*Through*	*Right*	*Left*	*Through*	*Right*
C Street & 36th Avenue	LOS	-	**E**	**E**	**E**	**D**	-	-	-	-	C	C	C
	Delay (sec/veh)	-	**74.2**	**75.0**	**75.7**	**48.4**	-	-	-	-	28.5	26.4	26.7
	v/c Ratio	-	**0.9**	**0.9**	**0.8**	**0.5**	-	-	-	-	0.7	0.6	0.6
	Queue Length (ft)	-	**#361**	**-**	**#222**	**272**	-	-	-	-	-	389	-
A Street & 36th Avenue	LOS	**D**	A	-	-	**E**	**E**	B	C	C	-	-	-
	Delay (sec/veh)	**49**	5	-	-	**58**	**57**	20	24	21	-	-	-
	v/c Ratio	**0.6**	0.5	-	-	**0.6**	**0.5**	0.2	0.5	0.2	-	-	-
	Queue Length (ft)	**m89**	m219	-	-	**303**	**186**	99	236	81	-	-	-
Old Seward Highway & 36th Avenue	LOS	C	C	C	C	**D**	**D**	**E**	**D**	**D**	**D**	**E**	**E**
	Delay (sec/veh)	20	31	31	22	**44**	**44**	**70**	**41**	**52**	**40**	**66**	**68**
	v/c Ratio	0.2	0.6	0.6	0.4	**0.4**	**0.4**	**1.0**	**0.3**	**0.7**	**0.5**	**0.8**	**0.8**
	Queue Length (ft)	88	391	-	77	**227**	**-**	**#409**	**84**	**-**	**112**	**239**	**-**

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

Note that the signalized intersection operations on 36th Avenue (with the exception of the intersection of Denali Street and 36th Avenue) do not change between the no build and the complete streets configuration.

Table 73. Midday Peak Unsignalized Intersection Operations (Existing Volumes and Existing Configuration)

MIDDAY		*Eastbound*			*Westbound*			*Northbound*			*Southbound*		
		Left	*Through*	*Right*	*Left*	*Through*	*Right*	*Left*	*Through*	*Right*	*Left*	*Through*	*Right*
32nd Avenue & Denali Street	LOS	C			**E**			A	-		A	-	
	Delay (sec/veh)	22			**48**			9	-		10	-	
	v/c Ratio	0.1			**0.6**			0.0	-		0.0	-	
34th Avenue & Denali Street	LOS	C			**E**			A	-		A	-	
	Delay (sec/veh)	22			**43**			9	-		9	-	
	v/c Ratio	0.1			**0.7**			0.0	-		0.1	-	
Telephone Avenue & Denali Street	LOS	-			**D**			-	-		A	-	
	Delay (sec/veh)	-			**27**			-	-		9	-	
	v/c Ratio	-			**0.6**			-	-		0.2	-	
Communications Avenue & Denali Street	LOS	-			B			-	-		A	A	-
	Delay (sec/veh)	-			13			-	-		8	0	-
	v/c Ratio	-			0.0			-	-		0.0	-	-
40th Avenue & Denali Street	LOS	C			C		A	A	A	-	A	A	-
	Delay (sec/veh)	19			24		10	9	0	-	8	0	-
	v/c Ratio	0.3			0.1		0.1	0.0	-	-	0.0	-	-
Driveways & Denali Street	LOS	**E**			C			A	A	-	A	A	-
	Delay (sec/veh)	**37**			21			9	0	-	8	0	-
	v/c Ratio	**0.5**			0.3			0.1	-	-	0.0	-	-
Barrow Street & 36th Avenue	LOS	A	-	-	B	-	-	-		C	-	-	B
	Delay (sec/veh)	10	-	-	12	-	-	-		19	-	-	11
	v/c Ratio	0.0	-	-	0.3	-	-	-		0.6	-	-	0.0

Table 74. PM Peak Signalized Intersection Operations on Denali Street (Existing Volumes and Existing Configuration)

PM		Eastbound			Westbound			Northbound			Southbound		
		Left	Through	Right	Left	Through	Right	Left	Through	Right	Left	Through	Right
Northern Lights Boulevard & Denali Street	LOS	-	-	-	C	B	B	**D**	C	-	-	C	
	Delay (sec/veh)	-	-	-	21	17	19	**44**	25	-	-	31	
	v/c Ratio	-	-	-	0.7	0.6	0.6	**0.8**	0.4	-	-	0.7	
	Queue Length (ft)	-	-	-	-	237	-	**#129**	130	-	-	165	
Benson Boulevard & Denali Street	LOS	B	C	**D**	-	-	-	-	C	**D**	B	C	-
	Delay (sec/veh)	15	34	**47**	-	-	-	-	22	**39**	18	22	-
	v/c Ratio	0.2	1.0	**1.0**	-	-	-	-	0.5	**0.9**	0.5	0.3	-
	Queue Length (ft)	74	#389	**-**	-	-	-	-	103	**#153**	m58	57	-
33rd Avenue/ Calais Drive & Denali Street	LOS	C	C		C	C		A	B	B	A	B	B
	Delay (sec/veh)	32	27		31	28		7	12	12	7	11	11
	v/c Ratio	0.3	0.5		0.1	0.5		0.2	0.4	0.4	0.1	0.3	0.3
	Queue Length (ft)	46	40		25	43		32	164	-	m14	m77	-
36th Avenue & Denali Street	LOS	B	C	C	B	C	C	C	**D**	**D**	C	**D**	**D**
	Delay (sec/veh)	16	29	29	18	25	25	29	**38**	**39**	29	**38**	**40**
	v/c Ratio	0.4	0.8	0.8	0.3	0.6	0.6	0.4	**0.6**	**0.6**	0.5	**0.5**	**0.5**
	Queue Length (ft)	71	#486	-	38	286	-	85	**144**	**-**	88	**125**	**41**
Tudor Road & Denali Street *	LOS	**C**	A	-	-	B	A	-	-	-	**E**		**D**
	Delay (sec/veh)	**29**	4	-	-	17	10	-	-	-	**71**		**47**
	v/c Ratio	**0.6**	0.5	-	-	0.7	0.1	-	-	-	**0.6**		**0.2**
	Queue Length (ft)	**143**	174	-	-	542	34	-	-	-	**117**		**49**

* Analysis Done with HCM 2000

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

Table 75. PM Peak Signalized Intersection Operations on 36th Avenue (Existing Volumes and Existing Configuration)

PM		*Eastbound*			*Westbound*			*Northbound*			*Southbound*		
		Left	*Through*	*Right*	*Left*	*Through*	*Right*	*Left*	*Through*	*Right*	*Left*	*Through*	*Right*
C Street & 36th Avenue	LOS	-	**D**	**D**	**D**	A	-	-	-	-	**D**	C	**D**
	Delay (sec/veh)	-	**49**	**49**	**35**	3	-	-	-	-	**49**	35	**35**
	v/c Ratio	-	**1.0**	**1.0**	**0.8**	0.4	-	-	-	-	**1.0**	0.9	**0.9**
	Queue Length (ft)	-	**#305**	**-**	**m#71**	90	-	-	-	-	**-**	#400	**-**
A Street & 36th Avenue	LOS	C	A	-	-	C	C	B	C	B	-	-	-
	Delay (sec/veh)	26	1	-	-	29	29	15	21	17	-	-	-
	v/c Ratio	0.7	0.6	-	-	0.7	0.5	0.2	0.7	0.4	-	-	-
	Queue Length (ft)	m64	m231	-	-	170	86	75	222	65	-	-	-
Old Seward Highway & 36th Avenue	LOS	B	C	C	C	C	C	**E**	**D**	**E**	**D**	**E**	**E**
	Delay (sec/veh)	18	30	30	23	33	33	**59**	**51**	**62**	**48**	**74**	**78**
	v/c Ratio	0.2	0.6	0.7	0.3	0.3	0.3	**0.9**	**0.4**	**0.7**	**0.5**	**0.8**	**0.8**
	Queue Length (ft)	46	507	-	55	197	-	**#325**	**97**	**-**	**133**	**248**	**-**

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

Note that the signalized intersection operations on 36th Avenue (with the exception of the intersection of Denali Street and 36th Avenue) do not change between the no build and the complete streets configuration.

Table 76. PM Peak Unsignalized Intersection Operations (Existing Volumes and Existing Configuration)

PM		*Eastbound*			*Westbound*			*Northbound*			*Southbound*		
		Left	*Through*	*Right*	*Left*	*Through*	*Right*	*Left*	*Through*	*Right*	*Left*	*Through*	*Right*
32nd Avenue & Denali Street	LOS	C			**F**			A	-		B	-	
	Delay (sec/veh)	15			**67**			9	-		10	-	
	v/c Ratio	0.1			**0.7**			0.0	-		0.0	-	
34th Avenue & Denali Street	LOS	C			**D**			A	-		A	-	
	Delay (sec/veh)	23			**34**			9	-		9	-	
	v/c Ratio	0.1			**0.6**			0.0	-		0.0	-	
Telephone Avenue & Denali Street	LOS	-			C			-	-		A	-	
	Delay (sec/veh)	-			20			-	-		9	-	
	v/c Ratio	-			0.5			-	-		0.1	-	
Communications Avenue & Denali Street	LOS	-			A			-	-		A	A	
	Delay (sec/veh)	-			0			-	-		8	0	-
	v/c Ratio	-			-			-	-		0.0	-	
40th Avenue & Denali Street	LOS	C			**D**		B	A	A		A	A	
	Delay (sec/veh)	22			**29**		10	9	0	-	9	0	-
	v/c Ratio	0.3			**0.2**		0.1	0.0	-		0.1	-	
Driveways & Denali Street	LOS	**D**			C			A	A	-	A	A	-
	Delay (sec/veh)	**26**			20			8	0	-	8	0	-
	v/c Ratio	**0.5**			0.3			0.1	-	-	0.0	-	-
Barrow Street & 36th Avenue	LOS	A	-	-	B	-	-	-		**D**	-	-	B
	Delay (sec/veh)	10	-	-	15	-	-	-		**34**	-	-	12
	v/c Ratio	0.0	-	-	0.3	-	-	-		**0.7**	-	-	0.1

Table 77. AM Peak Signalized Intersection Operations on Denali Street (Future Volumes and Existing Operations)

AM		*Eastbound*			*Westbound*			*Northbound*			*Southbound*		
		Left	*Through*	*Right*	*Left*	*Through*	*Right*	*Left*	*Through*	*Right*	*Left*	*Through*	*Right*
Northern Lights Boulevard & Denali Street	LOS	-	-	-	B	B	B	**D**	C	-	-	C	
	Delay (sec/veh)	-	-	-	12	10	11	**36**	30	-	-	34	
	v/c Ratio	-	-	-	0.6	0.5	0.5	**0.5**	0.5	-	-	0.5	
	Queue Length (ft)	-	-	-	-	223	-	**56**	112	-	-	48	
Benson Boulevard & Denali Street	LOS	B	B	C	-	-	-	-	C	C	C	C	-
	Delay (sec/veh)	14	18	20	-	-	-	-	35	35	24	29	-
	v/c Ratio	0.1	0.6	0.6	-	-	-	-	0.6	0.5	0.2	0.4	-
	Queue Length (ft)	38	126	-	-	-	-	-	78	28	m18	47	-
33rd Avenue/ Calais Drive & Denali Street	LOS	C	C		C	C		A	A	A	A	A	A
	Delay (sec/veh)	34	31		32	32		4	8	8	4	8	8
	v/c Ratio	0.2	0.4		0.0	0.4		0.1	0.3	0.3	0.1	0.2	0.2
	Queue Length (ft)	26	22		7	29		31	98	-	31	74	-
36th Avenue & Denali Street	LOS	B	B	B	B	B	B	C	**D**	**D**	C	**D**	**D**
	Delay (sec/veh)	12	15	15	10	19	19	31	**40**	**40**	34	**42**	**42**
	v/c Ratio	0.4	0.3	0.3	0.1	0.5	0.5	0.4	**0.6**	**0.6**	0.3	**0.5**	**0.4**
	Queue Length (ft)	69	154	-	31	288	-	83	**137**	**-**	45	**86**	**0**
Tudor Road & Denali Street *	LOS	C	A	-	-	C	B	-	-	-	**E**	-	D
	Delay (sec/veh)	34	6	-	-	21	13	-	-	-	**58**	-	53
	v/c Ratio	0.7	0.4	-	-	0.7	0.1	-	-	-	**0.3**	-	0.1
	Queue Length (ft)	192	202	-	-	559	50	-	-	-	**92**	-	35

* Analysis Done with HCM 2000

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

Table 78. AM Peak Signalized Intersection Operations on 36th Avenue (Future Volumes and Existing Configuration)

AM		*Eastbound*			*Westbound*			*Northbound*			*Southbound*		
		Left	*Through*	*Right*	*Left*	*Through*	*Right*	*Left*	*Through*	*Right*	*Left*	*Through*	*Right*
C Street & 36th Avenue	LOS	-	C	C	C	A	-	-	-	-	**D**	C	**D**
	Delay (sec/veh)	-	27	27	34	9	-	-	-	-	**41**	33	34
	v/c Ratio	-	0.8	0.8	0.8	0.5	-	-	-	-	**1.0**	0.9	**0.9**
	Queue Length (ft)	-	97	-	78	82	-	-	-	-	**-**	237	**-**
A Street & 36th Avenue	LOS	C	B	-	-	C	C	B	B	B	-	-	-
	Delay (sec/veh)	31	10	-	-	26	29	13	17	15	-	-	-
	v/c Ratio	0.3	0.4	-	-	0.6	0.6	0.1	0.6	0.3	-	-	-
	Queue Length (ft)	m3	153	-	-	148	101	40	140	22	-	-	-
Old Seward Highway & 36th Avenue	LOS	B	B	B	B	A	A	**D**	**D**	**E**	**D**	**E**	**E**
	Delay (sec/veh)	12	18	18	11	2	2	**49**	**53**	**58**	**51**	**67**	**68**
	v/c Ratio	0.3	0.3	0.3	0.3	0.5	0.5	**0.6**	**0.3**	**0.5**	**0.2**	**0.7**	**0.8**
	Queue Length (ft)	58	158	-	80	337	-	**113**	**44**	**-**	**53**	**180**	**-**

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

Note that the signalized intersection operations on 36th Avenue (with the exception of the intersection of Denali Street and 36th Avenue) do not change between the no build and the complete streets configuration.

Table 79. AM Peak Unsignalized Intersection Operations (Future Volumes and Existing Configuration)

AM		*Eastbound*			*Westbound*			*Northbound*			*Southbound*		
		Left	*Through*	*Right*	*Left*	*Through*	*Right*	*Left*	*Through*	*Right*	*Left*	*Through*	*Right*
32nd Avenue & Denali Street	LOS	C			C			A	-		A	-	
	Delay (sec/veh)	23			19			9	-		9	-	
	v/c Ratio	0.0			0.3			0.0	-		0.0	-	
34th Avenue & Denali Street	LOS	B			C			A	-		A	-	
	Delay (sec/veh)	14			23			8	-		10	-	
	v/c Ratio	0.0			0.4			0.0	-		0.1	-	
Telephone Avenue & Denali Street	LOS	-			C			-	-		A	-	
	Delay (sec/veh)	-			17			-	-		9	-	
	v/c Ratio	-			0.3			-	-		0.1	-	
Communications Avenue & Denali Street	LOS	-			A			-	-		A	-	-
	Delay (sec/veh)	-			0			-	-		0	-	-
	v/c Ratio	-			-			-	-		-	-	-
40th Avenue & Denali Street	LOS	C			C		B	A	A	-	A	A	-
	Delay (sec/veh)	18			21		10	8	0	-	9	0	-
	v/c Ratio	0.1			0.1		0.1	0.0	-	-	0.0	-	-
Driveways & Denali Street	LOS	C			C			A	A	-	A	A	-
	Delay (sec/veh)	22			16			8	0	-	9	0	-
	v/c Ratio	0.2			0.1			0.0	-	-	0.0	-	-
Barrow Street & 36th Avenue	LOS	B	-	-	A	-	-	-		B	A	A	-
	Delay (sec/veh)	10	-	-	10	-	-	-		12	0	0	-
	v/c Ratio	0.0	-	-	0.2	-	-	-		0.1	-	-	-

Table 80. Midday Peak Signalized Intersection Operations on Denali Street (Future Volumes and Existing Configuration)

MIDDAY		*Eastbound*			*Westbound*			*Northbound*			*Southbound*		
		Left	*Through*	*Right*	*Left*	*Through*	*Right*	*Left*	*Through*	*Right*	*Left*	*Through*	*Right*
Northern Lights Boulevard & Denali Street	LOS	-	-	-	C	B	B	**E**	**D**	-	-	**E**	
	Delay (sec/veh)	-	-	-	21	18	19	**73**	**50**	-	-	**65**	
	v/c Ratio	-	-	-	0.6	0.6	0.6	**0.9**	**0.4**	-	-	**0.8**	
	Queue Length (ft)	-	-	-	-	393	-	**#238**	**262**	-	-	**212**	
Benson Boulevard & Denali Street	LOS	C	C	C	-	-	-	-	**D**	**F**	**C**	**D**	-
	Delay (sec/veh)	21	29	32	-	-	-	-	**55**	**79**	**34**	**44**	-
	v/c Ratio	0.2	0.7	0.7	-	-	-	-	**0.6**	**0.9**	**0.5**	**0.3**	-
	Queue Length (ft)	111	357	-	-	-	-	-	**212**	**245**	**m49**	**76**	-
33rd Avenue/ Calais Drive & Denali Street	LOS	**E**	**D**		**E**	**D**		A	C	C	B	B	B
	Delay (sec/veh)	**61**	**49**		**59**	**49**		9	30	30	10	13	13
	v/c Ratio	**0.5**	**0.6**		**0.4**	**0.6**		0.3	0.3	0.3	0.1	0.3	0.3
	Queue Length (ft)	**#15**	**75**		**88**	**118**		m36	185	-	m9	152	-
36th Avenue & Denali Street	LOS	**D**	C	C	C	C	C	**D**	**D**	**D**	**D**	**E**	**D**
	Delay (sec/veh)	**43**	29	29	32	20	21	**44**	**50**	**50**	**42**	**63**	**37**
	v/c Ratio	**0.4**	0.6	0.6	0.5	0.8	0.8	**0.7**	**0.7**	**0.7**	**0.5**	**0.7**	**0.7**
	Queue Length (ft)	**138**	373	-	m70	m403	-	**m#210**	**231**	**-**	**121**	**200**	**77**
Tudor Road & Denali Street *	LOS	**D**	A	-	-	**D**	C	-	-	-	**E**	-	C
	Delay (sec/veh)	**40**	6	-	-	**41**	21	-	-	-	**60**	-	25
	v/c Ratio	**0.7**	0.5	-	-	**0.9**	0.2	-	-	-	**0.7**	-	0.2
	Queue Length (ft)	**270**	208	-	-	**#614**	55	-	-	-	**170**	-	39

* Analysis Done with HCM 2000

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

Table 81. Midday Peak Signalized Intersection Operations on 36th Avenue (Future Volumes and Existing Configuration)

MIDDAY		*Eastbound*			*Westbound*			*Northbound*			*Southbound*		
		Left	*Through*	*Right*	*Left*	*Through*	*Right*	*Left*	*Through*	*Right*	*Left*	*Through*	*Right*
C Street & 36th Avenue	LOS	-	**E**	**E**	**F**	**D**	-	-	-	-	C	C	C
	Delay (sec/veh)	-	**76**	**76**	**81**	**47**	-	-	-	-	31	28	28
	v/c Ratio	-	**0.9**	**0.9**	**0.9**	**0.5**	-	-	-	-	0.8	0.7	0.7
	Queue Length (ft)	-	**#378**	**-**	**#269**	**274**	-	-	-	-	-	436	-
A Street & 36th Avenue	LOS	**D**	A	-	-	**E**	**E**	B	C	C	-	-	-
	Delay (sec/veh)	**50**	5	-	-	**59**	**68**	20	24	22	-	-	-
	v/c Ratio	**0.6**	0.5	-	-	**0.7**	**0.7**	0.2	0.5	0.3	-	-	-
	Queue Length (ft)	**m82**	m223	-	-	**324**	**m290**	102	242	114	-	-	-
Old Seward Highway & 36th Avenue	LOS	C	**D**	**D**	C	**D**	**D**	**F**	**D**	**E**	**D**	**F**	**F**
	Delay (sec/veh)	23	**44**	**44**	26	**47**	**47**	**128**	**43**	**58**	**45**	**96**	**98**
	v/c Ratio	0.3	**0.6**	**0.6**	0.5	**0.5**	**0.5**	**1.1**	**0.5**	**0.8**	**0.7**	**1.0**	**1.0**
	Queue Length (ft)	m83	**406**	**-**	94	**260**	**-**	**#478**	**134**	**-**	**160**	**#363**	**-**

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

Note that the signalized intersection operations on 36th Avenue (with the exception of the intersection of Denali Street and 36th Avenue) do not change between the no build and the complete streets configuration.

Table 82. Midday Peak Unsignalized Intersection Operations (Future Volumes and Existing Configuration)

MIDDAY		*Eastbound*			*Westbound*			*Northbound*			*Southbound*		
		Left	*Through*	*Right*	*Left*	*Through*	*Right*	*Left*	*Through*	*Right*	*Left*	*Through*	*Right*
32nd Avenue & Denali Street	LOS	**D**			**F**			A	-		B	-	
	Delay (sec/veh)	**25**			**86**			9	-		10	-	
	v/c Ratio	**0.1**			**0.9**			0.0	-		0.0	-	
34th Avenue & Denali Street	LOS	C			**F**			A	-		A	-	
	Delay (sec/veh)	25			**163**			9	-		10	-	
	v/c Ratio	0.1			**1.2**			0.0	-		0.1	-	
Telephone Avenue & Denali Street	LOS	-			**F**			-	-		A	-	
	Delay (sec/veh)	-			**145**			-	-		10	-	
	v/c Ratio	-			**1.2**			-	-		0.2	-	
Communications Avenue & Denali Street	LOS	-			A			-	-		A	-	-
	Delay (sec/veh)	-			0.0			-	-		0.0	-	-
	v/c Ratio	-			-			-	-		0.0	-	-
40th Avenue & Denali Street	LOS	**F**			**F**		B	A	A	-	A	A	-
	Delay (sec/veh)	**45**			**63**		11	9	0	-	9	0	-
	v/c Ratio	**0.6**			**0.5**		0.1	0.1	-	-	0.1	-	-
Driveways & Denali Street	LOS	**F**			**E**			A	A	-	A	A	-
	Delay (sec/veh)	**149**			**50**			9	0	-	9	0	-
	v/c Ratio	**1.0**			**0.6**			0.1	-	-	0.1	-	-
Barrow Street & 36th Avenue	LOS	B	-	-	B	-	-	-		**D**	A	-	B
	Delay (sec/veh)	10	-	-	13	-	-	-		**24**	0	-	12
	v/c Ratio	0.0	-	-	0.4	-	-	-		**0.7**	-	-	0.0

Table 83. PM Peak Signalized Intersection Operations on Denali Street (Future Volumes and Existing Configuration)

PM		*Eastbound*			*Westbound*			*Northbound*			*Southbound*		
		Left	*Through*	*Right*	*Left*	*Through*	*Right*	*Left*	*Through*	*Right*	*Left*	*Through*	*Right*
Northern Lights Boulevard & Denali Street	LOS	-	-	-	C	C	C	**F**	C			C	
	Delay (sec/veh)	-	-	-	26	20	22	**88**	24	-	-	33	
	v/c Ratio	-	-	-	0.7	0.6	0.6	**0.8**	0.4	-	-	0.7	
	Queue Length (ft)					281		**#190**	139			#191	
Benson Boulevard & Denali Street	LOS	B	**D**	**D**	-	-	-	-	B	**F**	B	C	-
	Delay (sec/veh)	15	**37**	**51**	-	-	-	-	11	**85**	17	22	-
	v/c Ratio	0.2	**1.0**	**1.0**	-	-	-	-	0.5	**1.1**	0.6	0.3	-
	Queue Length (ft)	78	**#399**	**-**	-	-	-	-	135	**#300**	m55	m61	-
33rd Avenue/ Calais Drive & Denali Street	LOS	C	C		C	C		B	B	B	B	B	B
	Delay (sec/veh)	33	22		28	27		11	20	20	12	18	18
	v/c Ratio	0.3	0.4		0.3	0.7		0.3	0.6	0.6	0.2	0.4	0.4
	Queue Length (ft)	#66	52		68	125		48	203	-	m15	m83	-
36th Avenue & Denali Street	LOS	C	**D**	**D**	C	C	C	C	**D**	**D**	C	**D**	**D**
	Delay (sec/veh)	22	**46**	**47**	24	32	33	33	**40**	**40**	28	**38**	**40**
	v/c Ratio	0.6	**0.9**	**0.9**	0.6	0.8	0.8	0.7	**0.7**	**0.7**	0.6	**0.6**	**0.6**
	Queue Length (ft)	#14	**#513**		#115	#363		#145	**200**		#110	**173**	**46**
Tudor Road & Denali Street *	LOS	**F**	B	-	-	**D**	C	-	-	-	**E**	-	**D**
	Delay (sec/veh)	**85**	10	-	-	**46**	22	-	-	-	**58**	-	**44**
	v/c Ratio	**0.9**	0.6	-	-	**0.9**	0.2	-	-	-	**0.6**	-	**0.3**
	Queue Length (ft)	**#51**	349	-	-	**737**	72	-	-	-	**180**	-	**89**

* Analysis Done with HCM 2000

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

Table 84. PM Peak Signalized Intersection Operations on 36th Avenue (Future Volumes and Existing Configuration)

PM		Eastbound			Westbound			Northbound			Southbound		
		Left	Through	Right	Left	Through	Right	Left	Through	Right	Left	Through	Right
C Street & 36th Avenue	LOS	-	**E**	**E**	**D**	A	-	-	-	-	**D**	**D**	**D**
	Delay (sec/veh)	-	**57**	**57**	**37**	3	-	-	-	-	**53**	**37**	**37**
	v/c Ratio	-	**1.0**	**1.0**	**0.8**	0.4	-	-	-	-	**1.0**	**0.9**	**0.9**
	Queue Length (ft)	-	**#320**	**-**	**m#9**	96	-	-	-	-	**-**	**#411**	**-**
A Street & 36th Avenue	LOS	C	A	-	-	C	E	B	C	B	-	-	-
	Delay (sec/veh)	26	1	-	-	30	**65**	16	22	19	-	-	-
	v/c Ratio	0.7	0.7	-	-	0.7	1.0	0.2	0.7	0.5	-	-	-
	Queue Length (ft)	m6	m239	-	-	182	#249	78	227	95	-	-	-
Old Seward Highway & 36th Avenue	LOS	C	**D**	**D**	C	**D**	**D**	**F**	**D**	**F**	**E**	**F**	**F**
	Delay (sec/veh)	21	**35**	**35**	29	**38**	**38**	**140**	**53**	**111**	**65**	**113**	**116**
	v/c Ratio	0.2	**0.7**	**0.7**	0.5	**0.4**	**0.4**	**1.1**	**0.6**	**1.0**	**0.8**	**1.0**	**1.0**
	Queue Length (ft)	55	**#579**	**-**	92	**245**	**-**	**#502**	**224**	**-**	**171**	**412**	**-**

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

Note that the signalized intersection operations on 36th Avenue (with the exception of the intersection of Denali Street and 36th Avenue) do not change between the no build and the complete streets configuration.

Table 85. PM Peak Unsignalized Intersection Operations (Future Volumes and Existing Configuration)

PM		*Eastbound*			*Westbound*			*Northbound*			*Southbound*		
		Left	*Through*	*Right*	*Left*	*Through*	*Right*	*Left*	*Through*	*Right*	*Left*	*Through*	*Right*
32nd Avenue & Denali Street	LOS	C			**F**			A	-		B	-	
	Delay (sec/veh)	20			**281**			9	-		12	-	
	v/c Ratio	0.1			**1.3**			0.0	-		0.1	-	
34th Avenue & Denali Street	LOS	**E**			**F**			A	-		A	-	
	Delay (sec/veh)	**35**			**336**			9	-		10	-	
	v/c Ratio	**0.2**			**1.6**			0.0	-		0.0	-	
Telephone Avenue & Denali Street	LOS	-			**F**			-	-		A	-	
	Delay (sec/veh)	-			**130**			-	-		10	-	
	v/c Ratio	-			**1.1**			-	-		0.1	-	
Communications Avenue & Denali Street	LOS	-			A			-	-		A	A	-
	Delay (sec/veh)	-			-			-	-		9.4	0.0	-
	v/c Ratio	-			-			-	-		0.0	-	-
40th Avenue & Denali Street	LOS	**F**			**F**		B	A	A	-	A	A	-
	Delay (sec/veh)	**92**			**213**		12	10	0	-	9	1	-
	v/c Ratio	**0.8**			**1.0**		0.2	0.1	-	-	0.1	-	-
Driveways & Denali Street	LOS	**F**			**F**			A	A	-	A	A	-
	Delay (sec/veh)	**221**			**91**			9	0	-	9	0	-
	v/c Ratio	**1.2**			**0.8**			0.0	-	-	0.1	-	-
Barrow Street & 36th Avenue	LOS	B	-	-	C	-	-	-		**F**	**F**	-	B
	Delay (sec/veh)	11	-	-	16	-	-	-		**53**	**156**	-	13
	v/c Ratio	0.1	-	-	0.4	-	-	-		**0.9**	**0.2**	-	0.1