TRAFFIC IMPACT AND ACCESS STUDY

PROPOSED NEEDHAM MEWS RESIDENTIAL COMMUNITY
NEEDHAM, MASSACHUSETTS

Prepared for:

GREENDALE AVENUE VENTURE LLC
Burlington, MA

May 2013

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EXECUTIVE SUMMARY

Vanasse & Associates, Inc. (VAI) has conducted a Traffic Impact and Access Study (TIAS) in order to determine the potential impacts on the transportation infrastructure associated with the proposed construction of a 300-unit residential apartment community to be located at 692 and 744 Greendale Avenue in Needham, Massachusetts (hereafter referred to as the "Project"). At present, the Project site contains two residential homes and areas of open and wooded space. One of the residential homes will be demolished as part of the Project, while the other will be maintained for a period of time and then eventually removed. Traffic volumes associated with both homes are relatively minor and are reflected in the analyses presented herein. Access to the Project site will be provided by way of two (2) new full-access driveways that will intersect the east side of Greendale Avenue approximately 290 and 815 feet south of Bird Street, respectively.

This study was prepared in consultation with the Town of Needham and the Massachusetts Department of Transportation (MassDOT); was performed in accordance with the Commonwealth of Massachusetts Executive Office of Energy and Environmental Affairs (EEA)/MassDOT Guidelines for Environmental Impact Report/Environmental Impact Statement Traffic Impact Assessments (TIAs); and was conducted pursuant to the standards of the Traffic Engineering and Transportation Planning professions for the preparation of such reports.

Based on a review of the findings of this assessment, it has been concluded that the additional traffic that may be associated with the Project along Greendale Avenue will be more than off-set by the projected reduction in traffic that is expected to occur as a result of the planned construction of the Kendrick Street interchange as a part of the MassDOT Add-A-Lane project. As such, sufficient capacity will be afforded by the transportation infrastructure to accommodate the Project.

EXISTING CONDITIONS

A comprehensive field inventory of existing conditions within the study area was conducted in March 2013. The field investigation consisted of an inventory of existing roadway geometrics; pedestrian and bicycle facilities; public transportation services; traffic volumes; and operating characteristics; as well as posted speed limits and land use information within the study area. The study area for the Project was selected to contain the major roadways providing access to the Project site including Greendale Avenue, Kendrick Street and Great Plain Avenue, as well as the intersections of Kendrick Street at Hunting Road, Greendale Avenue at Bird Street, and Greendale Avenue at Great Plain Avenue.

Existing Traffic Volumes

In order to determine existing traffic-volume demands and flow patterns within the study area, automatic traffic recorder (ATR) counts, manual turning movement counts (TMCs) and vehicle classification counts were completed in March 2013 while public schools were in regular session. The ATR counts were conducted on Greendale Avenue in the vicinity of the Project site in order to record weekday daily traffic conditions over an extended period, with weekday morning (7:00 to 9:00 AM) and evening (4:00 to 6:00 PM) peak-period manual TMCs performed at the study intersections. These time periods were selected for analysis purposes, as they are representative of the peak traffic volume hours for both the Project and the adjacent roadway network. The March traffic volumes were found to be representative of an above average-month condition and were not adjusted downward in order to provide a conservative (above-average) analysis condition.

Greendale Avenue in the vicinity of the Project site was found to accommodate approximately 9,350 vehicles on an average weekday (two-way, 24-hour volume), with approximately 1,022 vehicles per hour (vph) during the weekday morning peak-hour and 1,065 vph during the weekday evening peak-hour.

A review of the peak period traffic counts indicates that the weekday morning peak-hour generally occurs between 7:45 and 8:45 AM, with the weekday evening peak-hour generally occurring between 5:00 and 6:00 PM.

Pedestrian and Bicycle Facilities

A comprehensive field inventory of pedestrian and bicycle facilities within the study area was undertaken in March 2013. The field inventory consisted of a review of the location of sidewalks and pedestrian crossing locations along the study roadways and at the study intersections, as well as the location of existing and planned future bicycle facilities. Sidewalks are provided continuously along at least one, if not both sides of the study area roadways within the study area. Marked crosswalks are provided at the signalized study intersections, with pedestrian traffic signal equipment and phasing provided.

Greendale Avenue provides sufficient width (combined travel lane and shoulder) to support bicycle travel in a shared travelled-way configuration and is designated by signs as the "Needham Bikeway". The Bay Colony Rail Trail Association is working with the Towns of Needham, Dover and Medfield to convert the unused Bay Colony rail trail, a 7-mile trail that begins at the Needham Junction station and continues southwest through the Towns of Dover and Medfield, to a multi-use trail. This project is currently in the planning phase. It should also be noted that as part of the MassDOT I-95/Route 128 Add-A-Lane project, bicycle lanes will be constructed along Kendrick Street.

Public Transportation

Public transportation services are not directly provided to the Project site; however, the Massachusetts Bay Transportation Authority (MBTA) provides commuter rail service to the Town of Needham via the Needham Line with a stop at the Hersey Station located at the intersection of Great Plain Avenue and Broad Meadow Road, less than one-mile from the Project site. The Needham Line provides commuter rail service between South Station in Boston and Needham Heights Station in Needham on weekdays between approximately 6:00 AM and

11:00 PM; service is not provided on weekends. The MBTA commuter rail fare (one-way) from Hersey Station (Zone 2) to South Station in Boston is $6.00, or $189.00 for a monthly pass.

Spot Speed Measurements

Vehicle travel speed measurements were performed on Greendale Avenue in the vicinity of the Project site over a continuous 48-hour period on two consecutive weekdays in conjunction with the ATR counts. Based on these measurements, it was determined that the mean (average) vehicle travel speed along Greendale Avenue in the vicinity of the Project is approximately 43 miles per hour (mph). The average measured 85th percentile vehicle travel speed, or the speed at which 85 percent of the observed vehicles traveled at or below, was found to be approximately 48 mph, or 8 mph above the posted speed limit (40 mph). The 85th percentile speed is used as the basis of engineering design and in the evaluation of sight distances, and is often used in establishing posted speed limits.

Motor Vehicle Crash Data

Motor vehicle crash information for the study intersections was provided by the MassDOT Highway Division Safety Management/Traffic Operations Unit for the most recent three-year period available (2008 through 2010, inclusive) in order to examine motor vehicle crash trends occurring within the study area. Based on a review of the MassDOT data, the study area intersections experienced an average of three (3) or fewer reported motor vehicle crashes per year over the three-year review period and were found to have a motor vehicle crash rate below the MassDOT average for a signalized or unsignalized intersection, as appropriate, for the MassDOT Highway Division District in which the intersections are located (District 6). No fatal motor vehicle crashes were reported within the study area over the three-year review period. As such, ***the MassDOT data did not indicate a discernible safety deficiency with respect to the immediate study area.***

FUTURE CONDITIONS

Traffic volumes in the study area were projected to the year 2018, which reflects a five-year planning horizon consistent with State traffic study guidelines. Independent of the Project, traffic volumes on the roadway network in the year 2018 under No-Build conditions include all existing traffic and new traffic resulting from background traffic growth. Anticipated Project-generated traffic volumes superimposed upon the 2018 No-Build traffic volumes reflect 2018 Build traffic volume conditions with the Project.

Specific Development by Others

The Planning Department of the Town of Needham was contacted in order to determine if there were any projects planned within the study area that would have an impact on future traffic volumes at the study intersection. Based on these discussions, the following projects were identified:

- ***Proposed Greendale Village 40B Residential Development, Needham, Massachusetts.*** This proposed project is currently under review and consists of the construction of 20 single-family homes to be located at 894 and 906 Greendale Avenue in Needham, Massachusetts.

- ***Center 128 Commercial Development, Needham, Massachusetts.*** This approved redevelopment project consists of the construction of 740,000 square feet (sf) of office space and a 128-room hotel at 360-410 1st Avenue, 66 B Street and 37 A Street in Needham, Massachusetts.

No other developments were identified at this time that are expected to result in an increase in traffic within the study area beyond the background traffic growth rate.

General Background Traffic Growth

Traffic-volume data compiled by MassDOT from permanent count stations and historic traffic counts in the area were reviewed in order to determine general background traffic growth trends. Based on a review of this data, it was determined that traffic volumes within the study area have declined by an average of approximately 3.9 percent over the past several years. In order to provide a conservative (high) analysis scenario and a prudent planning condition for the Project, a higher than average 1.0 percent per year compounded annual background traffic growth rate was used in order to account for future traffic growth and presently unforeseen development within the study area.

Roadway Improvement Projects

MassDOT and the Town of Needham were contacted in order to determine if there were any planned roadway improvement projects expected to be completed within the study area. Based on these discussions, the following roadway improvement project was identified:

- ***I-95/Route 128 Add-A-Lane Project.*** This project is currently under construction and entails widening approximately 14 miles of I-95/Route 128 from Randolph to Wellesley to provide four travel lanes in each direction and reconstruct twelve interchanges. The final phase of the contract includes reconstructing approximately 3.25 miles of I-95/Route 128 from just south of Kendrick Street in Needham to just north of Route 9 in Wellesley to include the following enhancements to this segment of the I-95/Route 128 corridor: an additional 12-foot wide travel lane and 10-foot wide shoulder in each direction; a new Kendrick Street interchange; and new collector and distributor roads between Highland Avenue and Kendrick Street. As part of the I-95/Route 128 Add-A-Lane project, traffic signal timing improvements will be implemented at the intersection of Kendrick Street and Hunting Road. Construction is scheduled to begin in the winter of 2013/2014, with completion expected by 2018.

The final phase of the I-95/Route 128 Add-A-Lane project is expected to improve access to the commercial development areas along Kendrick Street and Highland Avenue and reduce commuter traffic along local roadways such as Greendale Avenue and Hunting Road. The projected traffic volume reductions along Greendale Avenue associated with the I-95/Route 128 Add-A-Lane project and the planned traffic signal timing modifications at the Kendrick Street/Hunting Road intersection were included in the future conditions traffic volume projections and analyses (No-Build and Build).

No-Build Traffic Volumes

The 2018 No-Build condition peak-hour traffic-volumes were developed by: i) applying the 1.0 percent per year compounded annual background traffic growth rate to the 2013 Existing peak-hour traffic volumes; ii) adjusting traffic volumes along Greendale Avenue and at

intersecting roadways to reflect the I-95/Route 128 Add-A-Lane project; and iii) superimposing the peak hour traffic volumes associated with the identified specific development projects by others.

Project-Generated Traffic

As proposed, the Project will entail the construction of a 300-unit residential apartment community. In order to develop the traffic characteristics of the Project, trip-generation statistics published by the Institute of Transportation Engineers (ITE)[1] for a similar land use as that proposed were used. ITE Land Use Code (LUC) 220, *Apartment*, with the independent variable of number of dwelling units equal to 300, was used to develop the traffic characteristics of the Project.

Using the aforementioned methodology, the Project is expected to generate approximately 1,942 vehicle trips on an average weekday (two-way, 24-hour volume, or 971 vehicles entering and 971 exiting), with approximately 151 vehicle trips (30 vehicles entering and 121 exiting) expected during the weekday morning peak-hour and 183 vehicle trips (119 vehicles entering and 64 exiting) expected during the weekday evening peak-hour.

Trip Distribution and Assignment

The directional distribution of generated trips to and from the Project site was determined based on a review of Journey-to-Work data obtained from the U.S. Census for persons residing in the Town of Needham and then refined based on existing traffic patterns within the study area during the commuter peak periods. This methodology is reflective of the residential nature of the Project and the surrounding land use. In general, 45 percent of Project-related traffic was assigned to/from the north on Hunting Road, with 30 percent assigned to/from the east along Kendrick Street; 5 percent to/from the west on Kendrick Street; 10 percent to/from the east on Great Plain Avenue; 5 percent to/from the west on Great Plain Avenue; and 5 percent to/from the south on Greendale Avenue.

Build Condition Traffic-Volume Networks

The 2018 Build condition traffic volumes consist of the 2018 No-Build traffic volumes with the anticipated Project-generated traffic added to them. The Project was shown to result in traffic-volume increases outside of the immediate study area that is the subject of this assessment ranging from 0.8 to 9.6 percent during the peak periods when compared to 2018 No-Build conditions.

TRAFFIC OPERATIONS ANALYSIS

In order to assess the impact of the Project on the roadway network, traffic operations and vehicle queue analyses were performed at the study intersections under 2013 Existing, 2018 No-Build and 2018 Build conditions. This analysis has indicated that the Project will have a measurable but minor impact (increase) on motorist delays and vehicle queuing over Existing or anticipated future conditions without the Project (No-Build). Overall operating conditions at the signalized intersection of Kendrick Street at Hunting Road were shown to remain at LOS C during both the weekday morning and evening peak hours with the addition of project-related

[1] *Trip Generation*, 9th Edition; Institute of Transportation Engineers; Washington, DC; 2012.

traffic, with minor increases in vehicle queuing noted (0 to 3 vehicles). Operating conditions at the signalized intersection of Great Plain Avenue at Greendale Avenue were shown to be constrained (defined as a level-of-service of "F") during the weekday morning peak-hour independent of the Project, conditions that were minimally impacted as a result of the addition of Project-related traffic (projected increase in vehicle queuing of 0 to 1 vehicle over No-Build conditions).

Similarly, motorists exiting Bird Street at its intersection with Greendale Avenue (unsignalized) were also found to experience delay during the weekday morning peak-hour independent of the Project due to the relatively large volume of conflicting traffic on Greendale Avenue (existing condition). The addition of Project-related traffic was shown to minimally increase vehicle queuing at the intersection (0 to 2 vehicles). All movements at the Project site driveway intersections with Greendale Avenue were shown to operate at a level-of-service of "C" or better during the peak periods with minimal vehicle queuing (0 to 2 vehicles).

SIGHT DISTANCE EVALUATION

Sight distance measurements were performed at the Project site driveway intersections with Greendale Avenue in accordance with American Association of State Highway and Transportation Officials (AASHTO)[2] and MassDOT standards. Based on these measurements, it was determined that the available sight lines exceed the recommended minimum sight distance requirements for a 50 mph approach speed along Greendale Avenue, consistent with the measured 85th percentile vehicle travel speed (48 mph) and 10 mph above the posted speed limit (40 mph).

RECOMMENDATIONS

A detailed transportation improvement program has been developed that is designed to provide safe and efficient access to the Project site and address any deficiencies identified at off-site locations evaluated in conjunction with this study. The following improvements have been recommended as a part of this evaluation, and, where applicable, will be completed in conjunction with the Project subject to receipt of all necessary rights, permits, and approvals.

Project Access

Access to the Project site will be provided by way of two (2) new driveways that will intersect Greendale Avenue approximately 290 and 815 feet south of Bird Street, respectively. The following recommendations are offered with respect to the design and operation of the Project site driveways:

- The Project site driveways should be a minimum of 24-feet in width and accommodate two-way travel, with vehicles exiting the Project site placed under STOP-sign control.

- If centerline pavement markings are provided along the driveways serving the Project site or internal to the development, they should consist of a double-yellow line in

[2] *A Policy on Geometric Design of Highway and Streets*, 6th Edition; American Association of State Highway and Transportation Officials (AASHTO); Washington D.C.; 2011.

accordance with the centerline pavement marking standards of the *Manual on Uniform Traffic Control Devices* (MUTCD).[3]

- All signs and other pavement markings to be installed within the Project site shall conform to the applicable standards of the MUTCD.

- Sidewalks should be provided within the Project site linking the proposed buildings and other amenities.

- Marked crosswalks and wheelchair ramps should be provided at pedestrian crossings within the Project site.

- Signs or landscaping along the Project driveways internal to the Project site and at their intersections with Greendale Avenue should be designed and maintained so as not to restrict lines of sight.

- If school bus service will not be provided within the Project site, a bus stop and an associated waiting area should be provided at the Project site driveway intersection with Greendale Avenue or at an appropriate location designated by the Town.

Off-Site

Kendrick Street at Hunting Road

As a part of the MassDOT I-95/Route 128 Add-A-Lane project, traffic signal timing improvements are planned at the Kendrick Street/Hunting Road intersection. The addition of Project-related traffic to this signalized intersection was not shown to result in a significant impact in operating conditions over No-Build conditions, with the overall operating conditions shown to be maintained at level-of-service of "C" during the peak periods. Recognizing the importance of this intersection in providing access to the Project and the residences and businesses in the area, if the planned traffic signal timing improvements are not completed as a part of the MassDOT I-95/Route 128 Add-A-Lane project prior to the issuance of a Certificate of Occupancy for the Project, the Project proponent will design and implement an optimal traffic signal timing and phasing plan for the intersection.

Great Plain Avenue at Greendale Avenue

The addition of Project-related traffic to this signalized intersection was shown to result in a slight increase in motorist delay (approximately 6 seconds) over No-Build conditions; however, overall operating conditions were shown to be maintained at level-of-service "D" or better during the peak periods. That said, operating conditions for specific movements at the intersection during the weekday morning peak-hour were shown to be at or over capacity (defined as a level-of-service "E" or "F" respectively). As such, and recognizing the importance of this intersection in providing access to the Project and the residences and businesses in the area, the Project proponent will design and implement an optimal traffic signal timing and phasing plan for the intersection prior to the issuance of a Certificate of Occupancy for the Project. With the implementation of the recommended improvements, overall operating conditions at the intersection were shown to improve to a level-of-service of "C" during both peak periods.

[3] *Manual on Uniform Traffic Control Devices (MUTCD)*; Federal Highway Administration; Washington, D.C.; 2009.

Greendale Avenue at Bird Street

An analysis of operating conditions at this unsignalized intersection indicates that motorists exiting Bird Street experience excessive delay during one or both peak periods independent of the Project due to the relatively large volume of conflicting traffic on Greendale Avenue. It was also noted that the addition of Project-related resulted in a minimal increase in vehicle queuing at the intersection over No-Build conditions (0 to 2 vehicles). Given: i) the limited impact of the Project at the intersection; ii) the absence of an inherent safety deficiency as indicated by the MassDOT motor vehicle crash data; and iii) the significant reduction in conflicting traffic along Greendale Avenue that will occur as a result of the planned construction of the new Kendrick Street interchange as a part of the MassDOT I-95/Route 128 Add-A-Lane project; no improvements appear to be required at this intersection to accommodate the Project. However, it is recommended that a STOP-sign be installed on the Bird Street approach to Greendale Avenue independent of the Project in order to formalize the assignment of the vehicular right-of-way at the intersection.

With implementation of the above recommendations, safe and efficient access will be provided to the Project site and the Project can be constructed with minimal impact on the roadway system.

INTRODUCTION

Vanasse & Associates, Inc. (VAI) has conducted a Traffic Impact and Access Study (TIAS) in order to determine the potential impacts on the transportation infrastructure associated with the proposed residential apartment community to be located at 692 and 744 Greendale Avenue in Needham, Massachusetts (hereafter referred to as the "Project"). This study evaluates the following specific areas as they relate to the Project: i) access requirements; ii) potential off-site improvements; and iii) safety considerations; and identifies and analyzes existing traffic conditions and future traffic conditions, both with and without the Project, along Greendale Avenue, Kendrick Street, Hunting Road and Great Plain Avenue, as well as at the intersections of Kendrick Street at Hunting Road; Greendale Avenue at Bird Street; and Greendale Avenue at Great Plain Avenue.

Based on a review of the findings of this assessment, it has been concluded that the additional traffic that may be associated with the Project along Greendale Avenue will be more than off-set by the projected reduction in traffic that is expected to occur as a result of the planned construction of the Kendrick Street interchange as a part of the MassDOT Add-A-Lane project. As such, sufficient capacity will be afforded by the transportation infrastructure to accommodate the Project.

PROJECT DESCRIPTION

As proposed, the Project will entail the construction of a 300-unit residential apartment community to be located at 692 and 744 Greendale Avenue in Needham, Massachusetts. The Project site consists of approximately 6 ± acres of land bounded by residential properties and Hardy Street (an ancient town way) to the north; the Greendale Avenue Worship Center and residential properties to the south; Route 128 to the east; and Greendale Avenue to the west. Figure 1 depicts the Project site location in relation to the existing roadway network.

At present the Project site encompasses two residential homes and areas of open and wooded space. One of the residential homes will be demolished as part of the Project, while the other will remain for a period of time and will then eventually be removed. Traffic volumes associated with both homes are relatively minor and are reflected in the analyses presented herein. Access to the Project site will be provided by way of two (2) new full-access driveways that will intersect the east side of Greendale Avenue approximately 290 and 815 feet south of Bird Street, respectively.

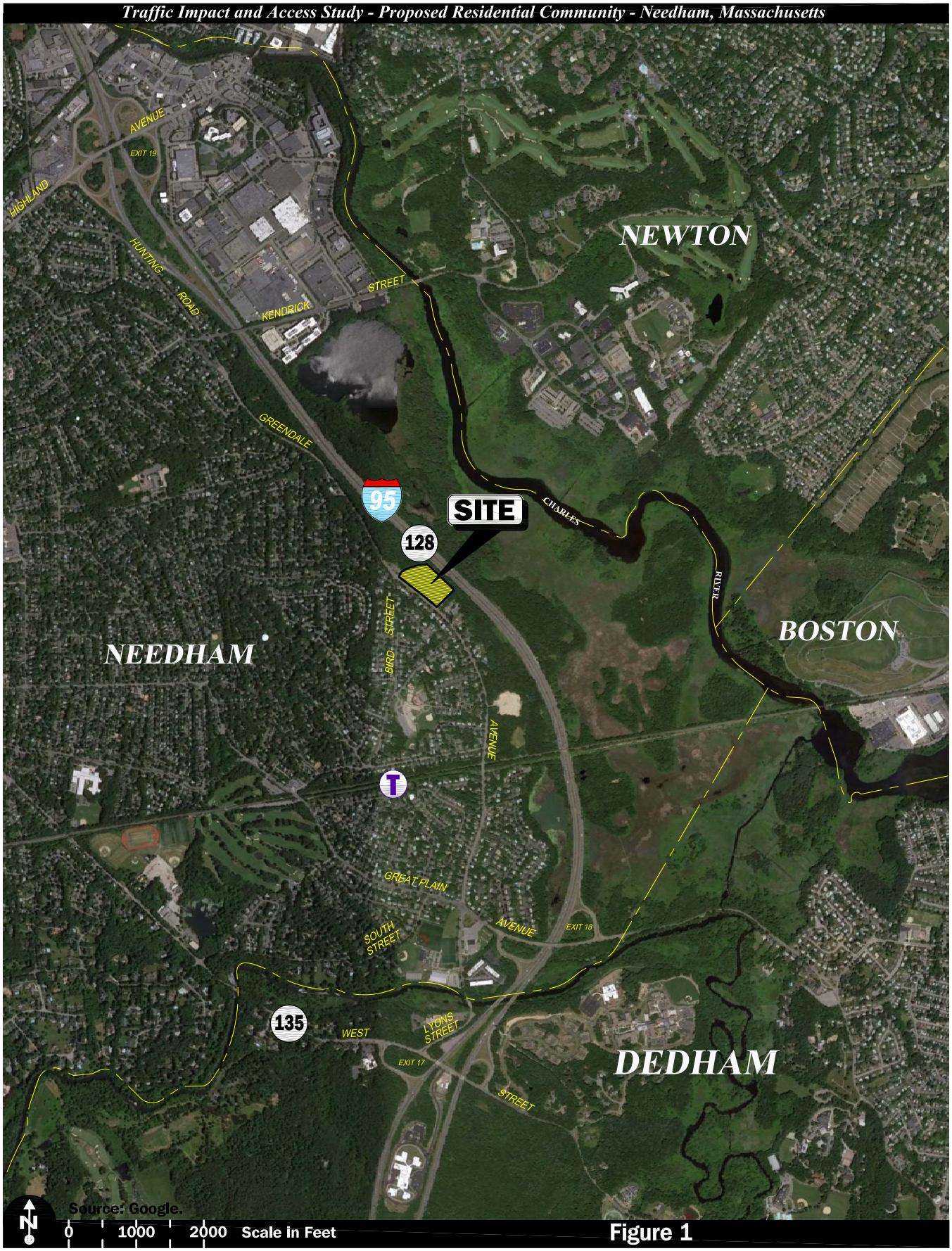

Figure 1

Site Location Map

Vanasse & Associates, Inc.
Transportation Engineers & Planners

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The Project will require the issuance of a State Highway Access Permit from the Massachusetts Department of Transportation (MassDOT) given that the Project site abuts I-95/Route 128, a State Highway under the jurisdiction of MassDOT.

STUDY METHODOLOGY

This study was prepared in consultation with MassDOT and the Town of Needham; was performed in accordance with the Commonwealth of Massachusetts Executive Office of Energy and Environmental Affairs (EEA)/MassDOT Guidelines for Environmental Impact Report/Environmental Impact Statement Traffic Impact Assessments (TIAs), and the standards of the Traffic Engineering and Transportation Planning professions for the preparation of such reports; and was conducted in three distinct stages.

The first stage involved an assessment of existing conditions in the study area and included an inventory of roadway geometrics; pedestrian and bicycle facilities; public transportation services; observations of traffic flow; and collection of daily and peak period traffic counts.

In the second stage of the study, future traffic conditions were projected and analyzed. Specific travel demand forecasts for the Project were assessed along with future traffic demands due to expected traffic growth independent of the Project. A five-year time horizon was selected for analyses consistent with state guidelines for the preparation of TIAs. The traffic analysis conducted in stage two identifies existing or projected future roadway capacity, traffic safety, and site access issues.

The third stage of the study presents and evaluates measures to address traffic and safety issues, if any, identified in stage two of the study.

EXISTING CONDITIONS

A comprehensive field inventory of existing conditions within the study area was conducted in March 2013. The field investigation consisted of an inventory of existing roadway geometrics; pedestrian and bicycle facilities; public transportation services; traffic volumes; and operating characteristics; as well as posted speed limits and land use information within the study area. The study area for the Project was selected to contain the major roadways providing access to the Project site including Greendale Avenue, Kendrick Street and Great Plain Avenue, as well as the intersections of Kendrick Street at Hunting Road, Greendale Avenue at Bird Street, and Greendale Avenue at Great Plain Avenue.

The following describes the study area roadways and intersections.

Roadways

Great Plain Avenue

Great Plain Avenue is a two-lane, urban minor arterial roadway that traverses the study area in a general east-west direction and is under local jurisdiction with the exception of the segment of roadway between Greendale Avenue and the Dedham town line where it is under state jurisdiction. Within the study area, Great Plain Avenue provides two 14 to 15-foot wide travel lanes separated by a double-yellow centerline with 4 to 8-foot wide marked shoulders provided. A 4-foot wide sidewalk is provided along both sides of Great Plain Avenue within the study area, with illumination provided by way of street lights mounted on wood poles. The posted speed limit along Great Plain Avenue within the study area is 30 miles per hour (mph). Land use along Great Plain Avenue within the study area consists of St. Sebastian's School campus and residential properties.

Greendale Avenue

Greendale Avenue is a two-lane, urban minor arterial roadway under local jurisdiction that traverses the study area in a general north-south direction. Within the study area, Greendale Avenue provides two 12 to 14-foot wide travel lanes separated by a double-yellow centerline with 5 to 7-foot wide marked shoulders provided. A 4 to 5-foot wide sidewalk is provided along both sides of Greendale Avenue south of Grosvenor Road and along the west side north of Grosvenor Road, with illumination provided by way of street lights mounted on wood poles. The posted speed limit along Greendale Avenue varies between 35 and 40 mph. Trucks

exceeding a 2½-ton capacity are restricted from Greendale Avenue. Land use along Greendale Avenue within the study area consists of the Project site, residential properties, a worship center, a memory care center, the St. Sebastian's School campus, and areas of open and wooded space.

Kendrick Street

Kendrick Street is a two to four-lane, urban minor arterial roadway that traverses the study area in a general east-west direction and is under local jurisdiction with the exception of the segment of roadway over I-95/Route 128 where it is under state jurisdiction. Within the study area, Kendrick Street provides two 12-foot wide travel lanes separated by a double-yellow centerline with no marked shoulders provided. A sidewalk is generally provided along both sides of Kendrick Street between Hunting Road and I-95/Route 128, and along the north side west of Hunting Road, with illumination provided by way of street lights mounted on wood poles. Land use along Kendrick Street within the study area consists of residential properties and areas of open and wooded space. Kendrick Street provides access to the New England Business Center to the east of I-95/Route 128, a large commercial center in the Town of Needham.

Intersections

Kendrick Street at Hunting Road

Hunting Road intersects Kendrick Street from the north and south to form this four-legged intersection under traffic signal control. The Kendrick Street eastbound approach consists of two 12-foot wide general-purpose travel lanes with no marked shoulder provided. The Kendrick Street westbound approach consists of a 12-foot wide left-turn lane and a 12-foot wide shared through/right-turn lane with no marked shoulder provided. The directions of travel along Kendrick Street are separated by a double-yellow centerline. The Hunting Road northbound approach consists of a 12-foot wide shared left-turn/through travel lane. Right turns from the Hunting Road northbound approach to Kendrick Street exit Hunting Road prior to the intersection by way of a channelized, right-turn slip-ramp under YIELD-sign control. The Hunting Road southbound approach consists of an 11-foot wide left-turn lane and a 12-foot wide shared through/right-turn lane with a 1-foot wide marked shoulder provided. The directions of travel along Hunting Road are separated by a double-yellow centerline. Illumination is provided by way of street lights mounted on wood poles. Sidewalks are provided along the west side of Hunting Road and along the north side of Kendrick Street west of Hunting Road, and along both sides east of Hunting Road to the I-95/Route 128 overpass. Crosswalks are provided across the north and west legs of the intersection. Land use in the vicinity of the intersection consists of residential properties. The traffic signal operates in a four-phase, fully-actuated mode, with lagging westbound and southbound phases provided, and an exclusive pedestrian phase provided upon pushbutton activation.

Greendale Avenue at Bird Street

Bird Street intersects Greendale Avenue from the west to form this three-legged, unsignalzied intersection under stop control. The Greendale Avenue north and southbound approaches consist of a 13 to 14-foot wide general-purpose travel lane with 5 to 7-foot wide marked shoulders provided. The directions of travel along Greendale Avenue are separated by a double-yellow centerline. Bird Street is a 24-foot wide roadway that accommodates two-way travel with no marked centerline or shoulders provided and vehicles approaching Greendale Avenue under stop control; however, a STOP-sign is not currently provided. Illumination is provided by way of

street lights mounted on wood poles. Sidewalks are provided along the west side of Greendale Avenue and along the north side of Bird Street. Land use in the vicinity of the intersection consists of the Project site and residential properties.

Greendale Avenue at Great Plain Avenue

Greendale Avenue intersects Great Plain Avenue from the north and south to form this four-legged, intersection under traffic signal control. The Great Plain Avenue east and westbound approaches consist of a 14 to 15-foot wide general-purpose travel lane with 6 to 8-foot wide marked shoulders provided. The directions of travel along Great Plain Avenue are separated by a double-yellow centerline. The Greendale Avenue north and southbound approaches consist of a 13 to 14-foot wide general-purpose travel lane with 6 to 7-foot wide marked shoulders provided. The directions of travel along Greendale Avenue are separated by a double-yellow centerline. Right-turns from the Greendale Avenue north and southbound approaches to Great Plain Avenue are separated from the left-turn/through movements by a channelized island. Illumination is provided by way of street lights mounted on wood poles. Sidewalks are provided along both sides of the intersecting roadways, with crosswalks provided across all legs of the intersection. Land use in the vicinity of the intersection consists of residential properties and the St. Sebastian's School campus. The traffic signal operates in a two-phase, fully-actuated mode, with an exclusive pedestrian phase provided upon pushbutton activation.

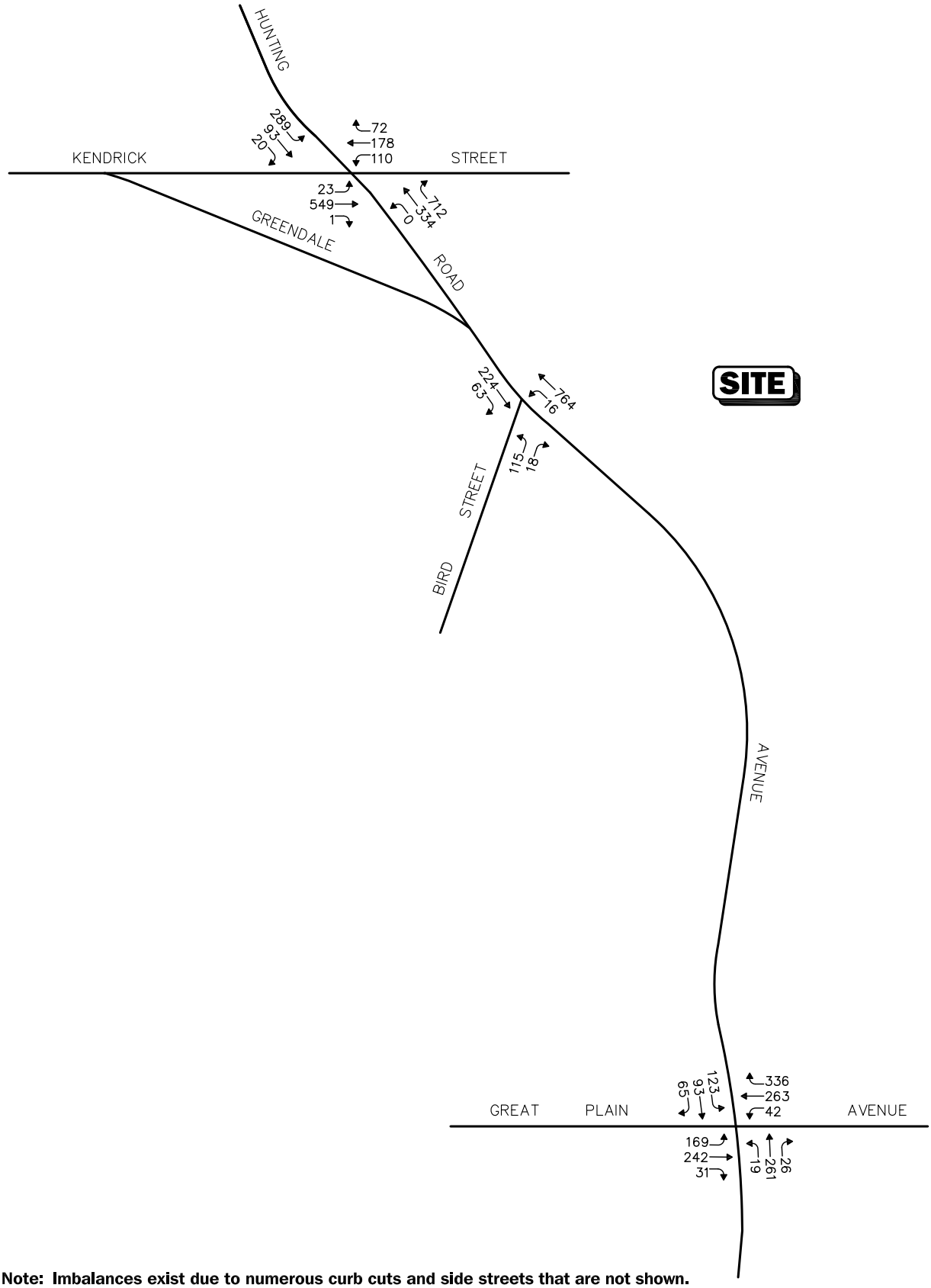
EXISTING TRAFFIC VOLUMES

In order to determine existing traffic-volume demands and flow patterns within the study area, automatic traffic recorder (ATR) counts, manual turning movement counts (TMCs) and vehicle classification counts were completed in March 2013 while public schools were in regular session. The ATR counts were conducted on Greendale Avenue in the vicinity of the Project site in order to record weekday daily traffic conditions over an extended period, with weekday morning (7:00 to 9:00 AM) and evening (4:00 to 6:00 PM) peak-period manual TMCs performed at the study intersections. These time periods were selected for analysis purposes as they are representative of the peak traffic volume hours for both the Project and the adjacent roadway network.

Traffic Volume Adjustments

In order to evaluate the potential for seasonal fluctuation of traffic volumes within the study area, MassDOT weekday seasonal factors for Group 6 roadways (urban arterials, collectors and rural arterials, the MassDOT functional classification for Greendale Avenue) were reviewed.[4] Based on a review of this data, it was determined that traffic volumes for the month of March are approximately 3.1 percent above average-month conditions and, therefore, were not adjusted downward in order to provide a conservative (above-average) analysis condition. The 2013 Existing weekday morning and evening peak-hour traffic volumes are summarized in Table 1 and graphically depicted on Figures 2 and 3, respectively.

[4]MassDOT Traffic Volumes for the Commonwealth of Massachusetts; 2007 Weekday Seasonal Factors, Group 6 – Urban Arterials, Collectors and Rural Arterials.



Note: Imbalances exist due to numerous curb cuts and side streets that are not shown.

Not To Scale

Figure 2

2013 Existing
Weekday Morning
Peak Hour Traffic Volumes

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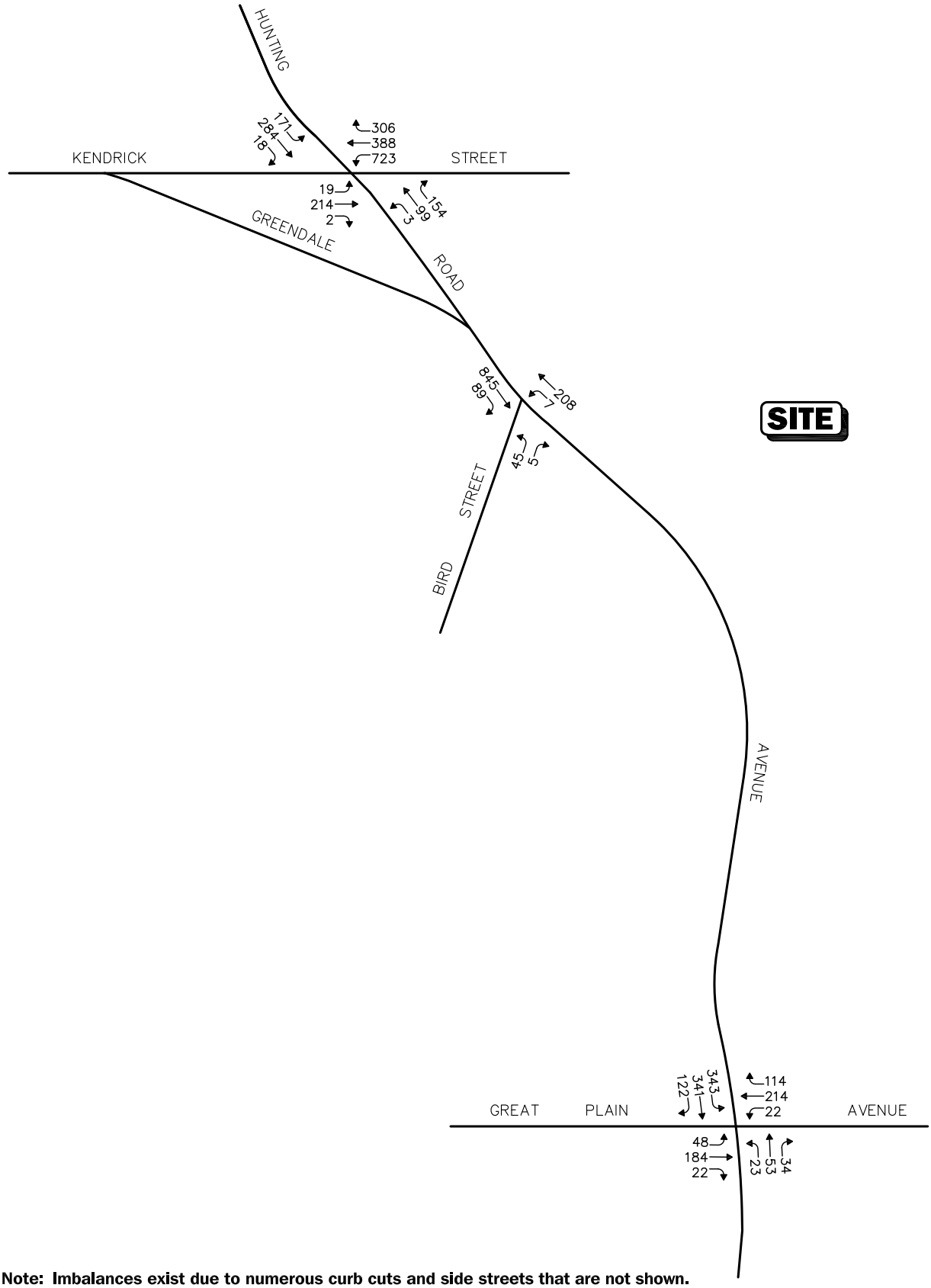

Note: Imbalances exist due to numerous curb cuts and side streets that are not shown.

Not To Scale

Figure 3

Vanasse & Associates, Inc.
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2013 Existing
Weekday Evening
Peak Hour Traffic Volumes

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Table 1
2013 EXISTING TRAFFIC VOLUMES

Location	AWT[a]	Weekday Morning Peak Hour			Weekday Evening Peak Hour		
		VPH[b]	K Factor[c]	Directional Distribution[d]	VPH	K Factor	Directional Distribution
Greendale Avenue, south of Bird Street	9,350	1,022	10.9	76.3% NB	1,065	11.4	79.8% SB

[a]Average weekday traffic in vehicles per day.
[b]Vehicles per hour.
[c]Percent of daily traffic occurring during the peak-hour.
[d]Percent traveling in peak direction.
NB = northbound; SB = southbound.

As can be seen in Table 1, Greendale Avenue in the vicinity of the Project site was found to accommodate approximately 9,350 vehicles on an average weekday (two-way, 24-hour volume), with approximately 1,022 vehicles per hour (vph) during the weekday morning peak-hour and 1,065 vph during the weekday evening peak-hour.

A review of the peak period traffic counts indicates that the weekday morning peak-hour generally occurs between 7:45 and 8:45 AM, with the weekday evening peak-hour generally occurring between 5:00 and 6:00 PM.

PEDESTRIAN AND BICYCLE FACILITIES

A comprehensive field inventory of pedestrian and bicycle facilities within the study area was undertaken in March 2013. The field inventory consisted of a review of the location of sidewalks and pedestrian crossing locations along the study roadways and at the study intersections, as well as the location of existing and planned future bicycle facilities. Sidewalks are provided continuously along at least one, if not both sides of the study area roadways within the study area. Marked crosswalks are provided at the signalized study intersections, with pedestrian traffic signal equipment and phasing provided.

Greendale Avenue provides sufficient width (combined travel lane and shoulder) to support bicycle travel in a shared travelled-way configuration and is designated by signs as the "Needham Bikeway". The Bay Colony Rail Trail Association is working with the Towns of Needham, Dover and Medfield to convert the unused Bay Colony rail trail, a 7-mile trail that begins at the Needham Junction station and continues southwest through the Towns of Dover and Medfield, to a multi-use trail. This project is currently in the planning phase. It should also be noted that as part of the MassDOT I-95/Route 128 Add-A-Lane project, bicycle lanes will be constructed along Kendrick Street.

PUBLIC TRANSPORTATION

Public transportation services are not directly provided to the Project site; however, the Massachusetts Bay Transportation Authority (MBTA) provides commuter rail service to the Town of Needham via the Needham Line with a stop at the Hersey Station located at the intersection of Great Plain Avenue and Broad Meadow Road, less than one-mile from the Project

site. The Needham Line provides commuter rail service between South Station in Boston and Needham Heights Station in Needham on weekdays between approximately 6:00 AM and 11:00 PM; service is not provided on weekends. The MBTA commuter rail fare (one-way) from Hersey Station (Zone 2) to South Station in Boston is $6.00, or $189.00 for a monthly pass. The MBTA commuter rail schedule and fare information are provided in the Appendix.

SPOT SPEED MEASUREMENTS

Vehicle travel speed measurements were performed on Greendale Avenue in the vicinity of the Project site over a continuous 48-hour period on two consecutive weekdays in conjunction with the ATR counts. Table 2 summarizes the vehicle travel speed measurements.

Table 2
VEHICLE TRAVEL SPEED MEASUREMENTS

	Greendale Avenue	
	Northbound	Southbound
Mean Travel Speed (mph)	41	44
85th Percentile Speed (mph)	48	49
Posted Speed Limit (mph)	40	40

mph = miles per hour.

As can be seen in Table 2, the mean (average) vehicle travel speed along Greendale Avenue in the vicinity of the Project site was found to be approximately 43 mph. The average measured 85th percentile vehicle travel speed, or the speed at which 85 percent of the observed vehicles traveled at or below, was found to be approximately 48 mph, or 8 mph above the posted speed limit (40 mph). The 85th percentile speed is used as the basis of engineering design and in the evaluation of sight distances, and is often used in establishing posted speed limits.

MOTOR VEHICLE CRASH DATA

Motor vehicle crash information for the study area intersections was provided by the MassDOT Highway Division Safety Management/Traffic Operations Unit for the most recent three-year period available (2008 through 2010, inclusive) in order to examine motor vehicle crash trends occurring within the study area. The data is summarized by intersection, type, severity, and day of occurrence, and presented in Table 3.

Table 3
MOTOR VEHICLE CRASH DATA SUMMARY[a]

	Kendrick Street/ Hunting Road	Greendale Avenue/ Bird Street	Greendale Avenue/ Great Plain Avenue
Traffic Control Type:	TS	U	TS
Year:			
2008	2	0	0
2009	3	1	4
2010	4	1	3
Total	9	2	7
Average	3.00	0.67	2.33
Rate[b]	0.31	0.14	0.38
Significant?[c]	No	No	No
Type:			
Angle	5	1	6
Rear-End	3	1	1
Head-On	1	0	0
Sideswipe	0	0	0
Fixed Object	0	0	0
Unknown/Other	0	0	0
Total	9	2	7
Day of Week:			
Monday through Friday	9	2	3
Saturday	0	0	1
Sunday	0	0	3
Total	9	2	7
Severity:			
Property Damage Only	6	2	3
Personal Injury	3	0	4
Fatality	0	0	0
Total	9	2	7

[a]Source: MassDOT Safety Management/Traffic Operations Unit records, 2008 through 2010.
[b]Crash rate per million vehicles entering the intersection.
[c]The intersection crash rate is significant if it is found to exceed 0.58 crashes per million vehicles entering an intersection for an unsignalized intersection and 0.76 crashes per million vehicles entering an intersection for a signalized intersection as defined by MassDOT for the MassDOT District in which the Project is located (District 6).
Traffic Control Type: U = unsignalized; TS = traffic signal; R = rotary/roundabout.

As can be seen in Table 3, the study area intersections experienced an average of three (3) or fewer reported motor vehicle crashes per year over the three-year review period and were found to have a motor vehicle crash rate below the MassDOT average for a signalized or unsignalized intersection, as appropriate, for the MassDOT Highway Division District in which the intersections are located (District 6). No fatal motor vehicle crashes were reported within the study area over the three-year review period. As such, ***the MassDOT data did not indicate a discernible safety deficiency with respect to the immediate study area.*** The detailed MassDOT Crash Rate Worksheets are provided in the Appendix.

FUTURE CONDITIONS

Traffic volumes in the study area were projected to the year 2018, which reflects a five-year planning horizon consistent with State traffic study guidelines. Independent of the Project, traffic volumes on the roadway network in the year 2018 under No-Build conditions include all existing traffic and new traffic resulting from background traffic growth. Anticipated Project-generated traffic volumes superimposed upon the 2018 No-Build traffic volumes reflect 2018 Build traffic volume conditions with the Project.

FUTURE TRAFFIC GROWTH

Future traffic growth is a function of the expected land development in the immediate area and the surrounding region. Several methods can be used to estimate this growth. A procedure frequently employed estimates an annual percentage increase in traffic growth and applies that percentage to all traffic volumes under study. The drawback to such a procedure is that some turning volumes may actually grow at either a higher or a lower rate at particular intersections.

An alternative procedure identifies the location and type of planned development, estimates the traffic to be generated, and assigns it to the area roadway network. This procedure produces a more realistic estimate of growth for local traffic; however, potential population growth and development external to the study area would not be accounted for in the resulting traffic projections.

To provide a conservative analysis framework, both procedures were used, the salient components of which are described below.

Specific Development by Others

The Planning Department of the Town of Needham was contacted in order to determine if there were any projects planned within the study area that would have an impact on future traffic volumes at the study intersection. Based on these discussions, the following projects were identified:

- ***Proposed Greendale Village 40B Residential Development, Needham, Massachusetts.*** This proposed project is currently under review and consists of the construction of 20 single-family homes to be located at 894 and 906 Greendale Avenue in

Needham, Massachusetts. Traffic volumes expected to be generated by this project were obtained from the traffic study prepared for the project[5] and assigned onto the study area roadway network based on existing traffic patterns.

- ***Center 128 Commercial Development, Needham, Massachusetts.*** This approved redevelopment project consists of the construction of 740,000 square feet (sf) of office space and a 128-room hotel at 360-410 1st Avenue, 66 B Street and 37 A Street in Needham, Massachusetts. Traffic volumes expected to be generated by this project were obtained from the traffic study prepared for the project[6] and assigned onto the study area roadway network based on existing traffic patterns.

No other developments were identified at this time that are expected to result in an increase in traffic within the study area beyond the background traffic growth rate.

General Background Traffic Growth

Traffic-volume data compiled by MassDOT from permanent count stations and historic traffic counts in the area were reviewed in order to determine general background traffic growth trends. Based on a review of this data, it was determined that traffic volumes within the study area have declined by an average of approximately 3.9 percent over the past several years. In order to provide a conservative (high) analysis scenario and a prudent planning condition for the Project, a higher than average 1.0 percent per year compounded annual background traffic growth rate was used in order to account for future traffic growth and presently unforeseen development within the study area.

Roadway Improvement Projects

MassDOT and the Town of Needham were contacted in order to determine if there were any planned roadway improvement projects expected to be completed within the study area. Based on these discussions, the following roadway improvement project was identified:

- ***I-95/Route 128 Add-A-Lane Project.*** This project is currently under construction and entails widening approximately 14 miles of I-95/Route 128 from Randolph to Wellesley to provide four travel lanes in each direction and reconstruct twelve interchanges. The final phase of the contract includes reconstructing approximately 3.25 miles of I-95/Route 128 from just south of Kendrick Street in Needham to just north of Route 9 in Wellesley to include the following enhancements to this segment of the I-95/Route 128 corridor: an additional 12-foot wide travel lane and 10-foot wide shoulder in each direction; a new Kendrick Street interchange; and new collector and distributor roads between Highland Avenue and Kendrick Street. As part of the I-95/Route 128 Add-A-Lane project, traffic signal timing improvements will be implemented at the intersection of Kendrick Street and Hunting Road. Construction is scheduled to begin in the winter of 2013/2014, with completion expected by 2018.

The final phase of the I-95/Route 128 Add-A-Lane project is expected to improve access to the commercial development areas along Kendrick Street and Highland Avenue and reduce commuter traffic along local roadways such as Greendale Avenue and Hunting Road. The projected traffic volume reductions along Greendale Avenue associated with the I-95/Route 128

[5] *Proposed Greendale Village 40B Residential Development, 894 & 906 Greendale Avenue, Needham, Massachusetts;* MDM Transportation Consultants, Inc.; January 29, 2013.

[6] *Traffic Impact Study, Center 128, Needham Massachusetts;* Tetra Tech; August 24, 2012.

Add-A-Lane project and the planned traffic signal timing modifications at the Kendrick Street/Hunting Road intersection were included in the future conditions traffic volume projections and analyses (No-Build and Build). The projected traffic volume reductions along Greendale Avenue as a result of the I-95/Route 128 Add-A-Lane project were obtained from the Functional Design Report (FDR) prepared for the project.[7] Traffic volume networks illustrating the projected traffic volume reductions are included in the Appendix.

No-Build Traffic Volumes

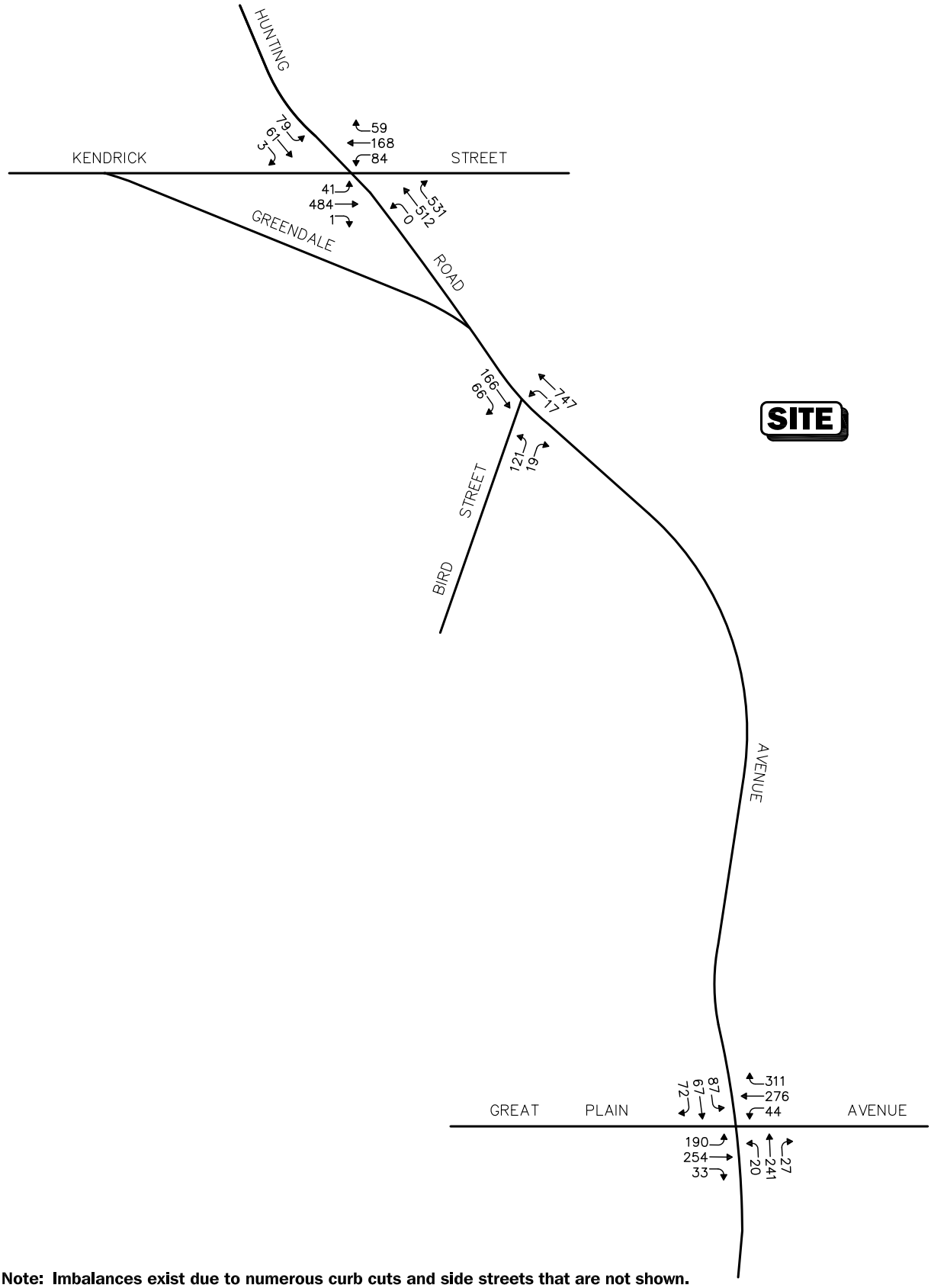
The 2018 No-Build condition peak-hour traffic-volumes were developed by: i) applying the 1.0 percent per year compounded annual background traffic growth rate to the 2013 Existing peak-hour traffic volumes; ii) adjusting traffic volumes along Greendale Avenue and at intersecting roadways to reflect the I-95/Route 128 Add-A-Lane project; and iii) superimposing the peak hour traffic volumes associated with the identified specific development projects by others. The resulting 2018 No-Build weekday morning and evening peak-hour traffic volumes are shown on Figures 4 and 5, respectively.

PROJECT-GENERATED TRAFFIC

Design year (2018 Build) traffic volumes for the study area roadways were determined by estimating Project-generated traffic volumes and assigning those volumes on the study roadway. The following sections describe the methodology used to develop the anticipated traffic characteristics of the Project.

As proposed, the Project will entail the construction of a 300-unit residential apartment community. In order to develop the traffic characteristics of the Project, trip-generation statistics published by the Institute of Transportation Engineers (ITE)[8] for a similar land use as that proposed were used. ITE Land Use Code (LUC) 220, *Apartment*, with the independent variable of number of dwelling units equal to 300, was used to develop the traffic characteristics of the Project. Table 4 summarizes the anticipated traffic characteristics of the Project.

[7] *Functional Design Report*, I-95/I-93 Transportation Improvement Project (Bridge V), Route 9/Highland Avenue/ Kendrick Street Section, Needham and Wellesley, Massachusetts; McMahon; October 2008.
[8] Ibid 1.



Note: Imbalances exist due to numerous curb cuts and side streets that are not shown.

Not To Scale

Figure 4

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2018 No-Build
Weekday Morning
Peak Hour Traffic Volumes

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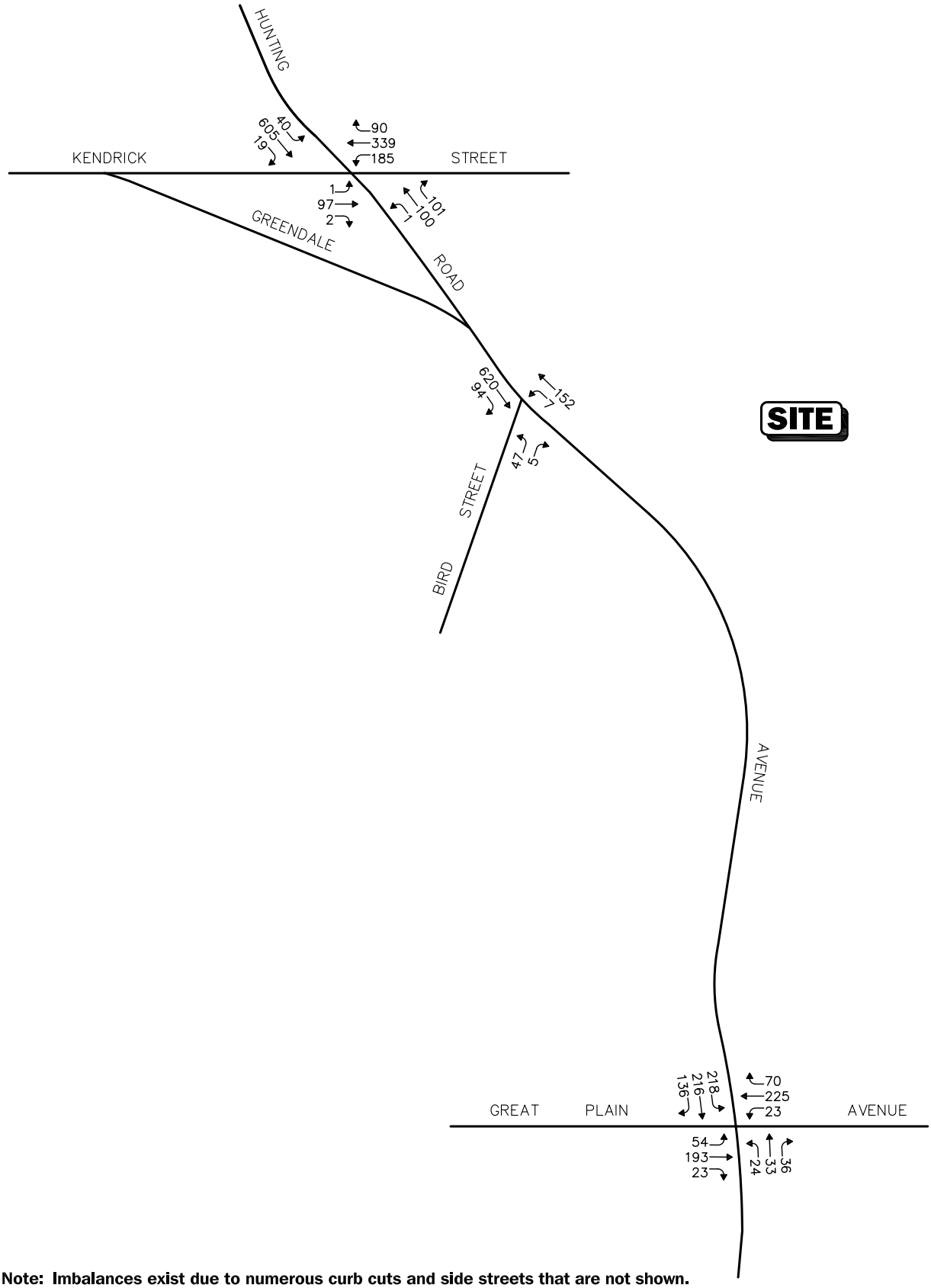

Note: Imbalances exist due to numerous curb cuts and side streets that are not shown.

Not To Scale

Figure 5

Vanasse & Associates, Inc.
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2018 No-Build
Weekday Evening
Peak Hour Traffic Volumes

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Table 4
TRIP GENERATION SUMMARY

Time Period/Direction	Vehicle Trips Proposed Residential Community (300 units)[a]
Average Weekday Daily:	
Entering	971
Exiting	971
Total	1,942
Weekday Morning Peak Hour:	
Entering	30
Exiting	121
Total	151
Weekday Evening Peak Hour:	
Entering	119
Exiting	64
Total	183

[a]Based on ITE LUC 220, *Apartment.*

As can be seen in Table 4, the Project is expected to generate approximately 1,942 vehicle trips on an average weekday (two-way, 24-hour volume, or 971 vehicles entering and 971 exiting), with approximately 151 vehicle trips (30 vehicles entering and 121 exiting) expected during the weekday morning peak-hour and 183 vehicle trips (119 vehicles entering and 64 exiting) expected during the weekday evening peak-hour.

Trip Distribution and Assignment

The directional distribution of generated trips to and from the Project site was determined based on a review of Journey-to-Work data obtained from the U.S. Census for persons residing in the Town of Needham and then refined based on existing traffic patterns within the study area during the commuter peak periods. This methodology is reflective of the residential nature of the Project and the surrounding land use. The general trip distribution for the Project is summarized in Table 5 and graphically depicted on Figure 6. The additional traffic expected to be generated by the Project was assigned on the study area roadway network as shown on Figures 7 and 8.

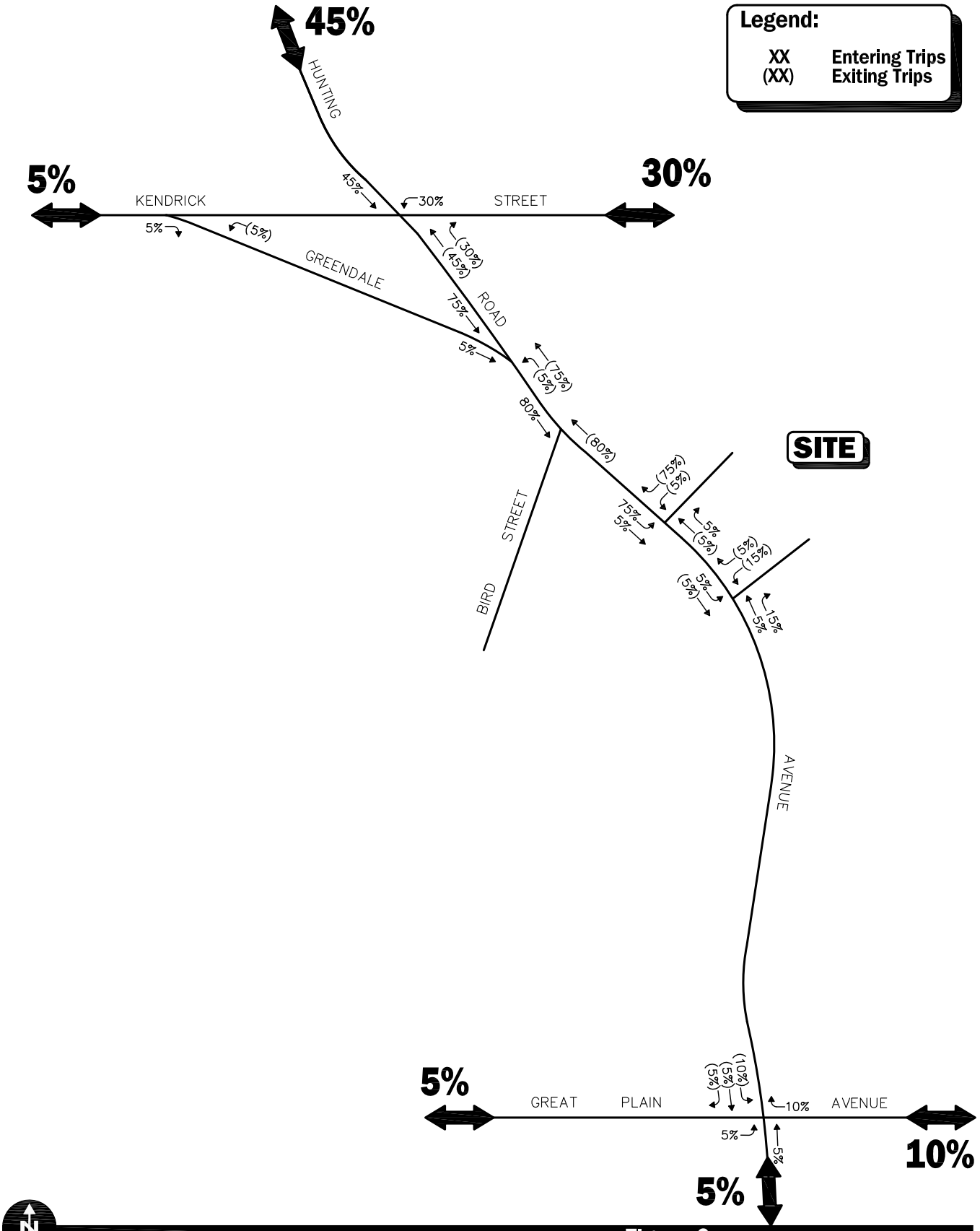

Figure 6

Trip Distribution Map

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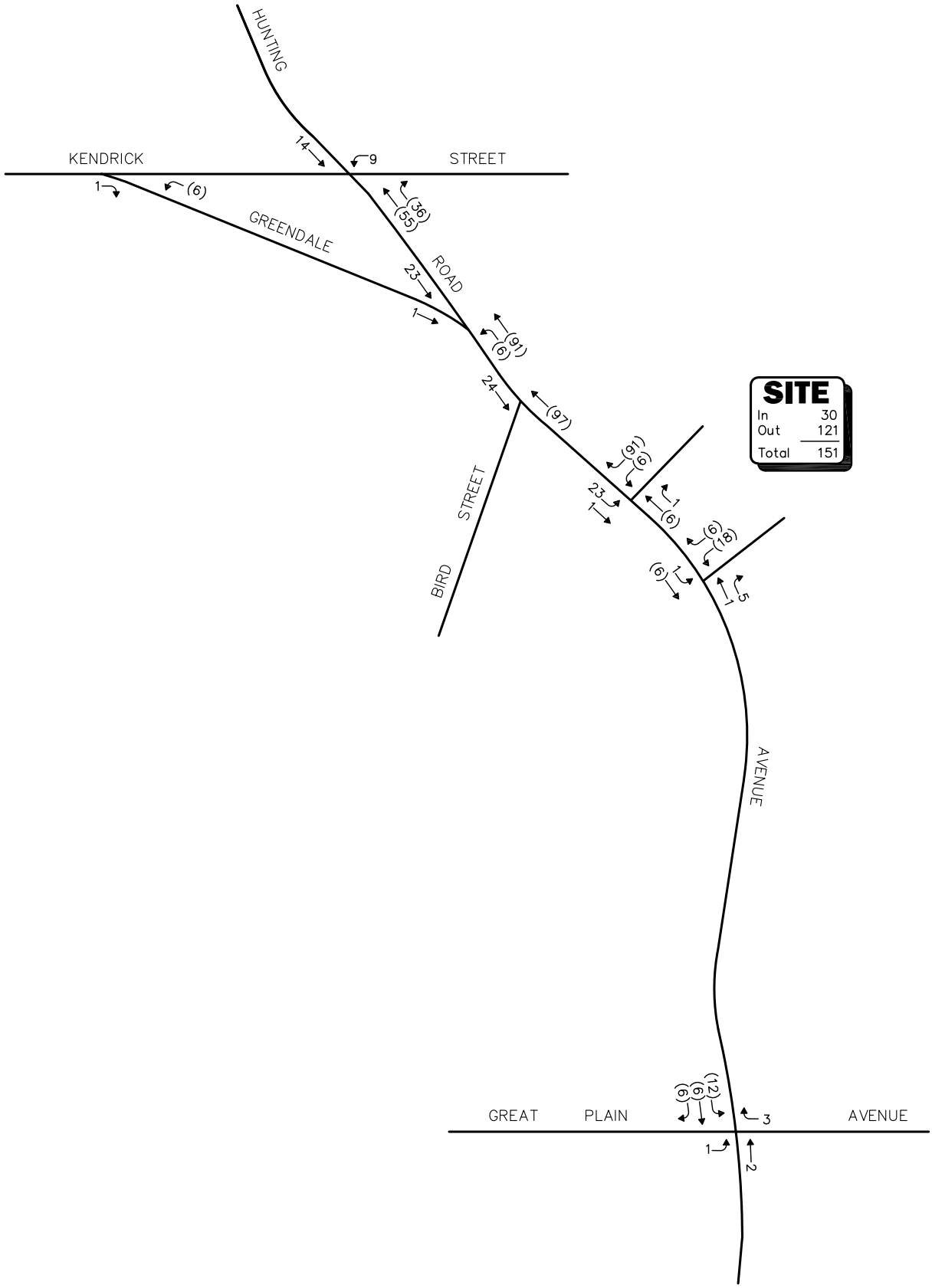

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Figure 7

Project-Generated Weekday Morning Peak Hour Traffic Volumes

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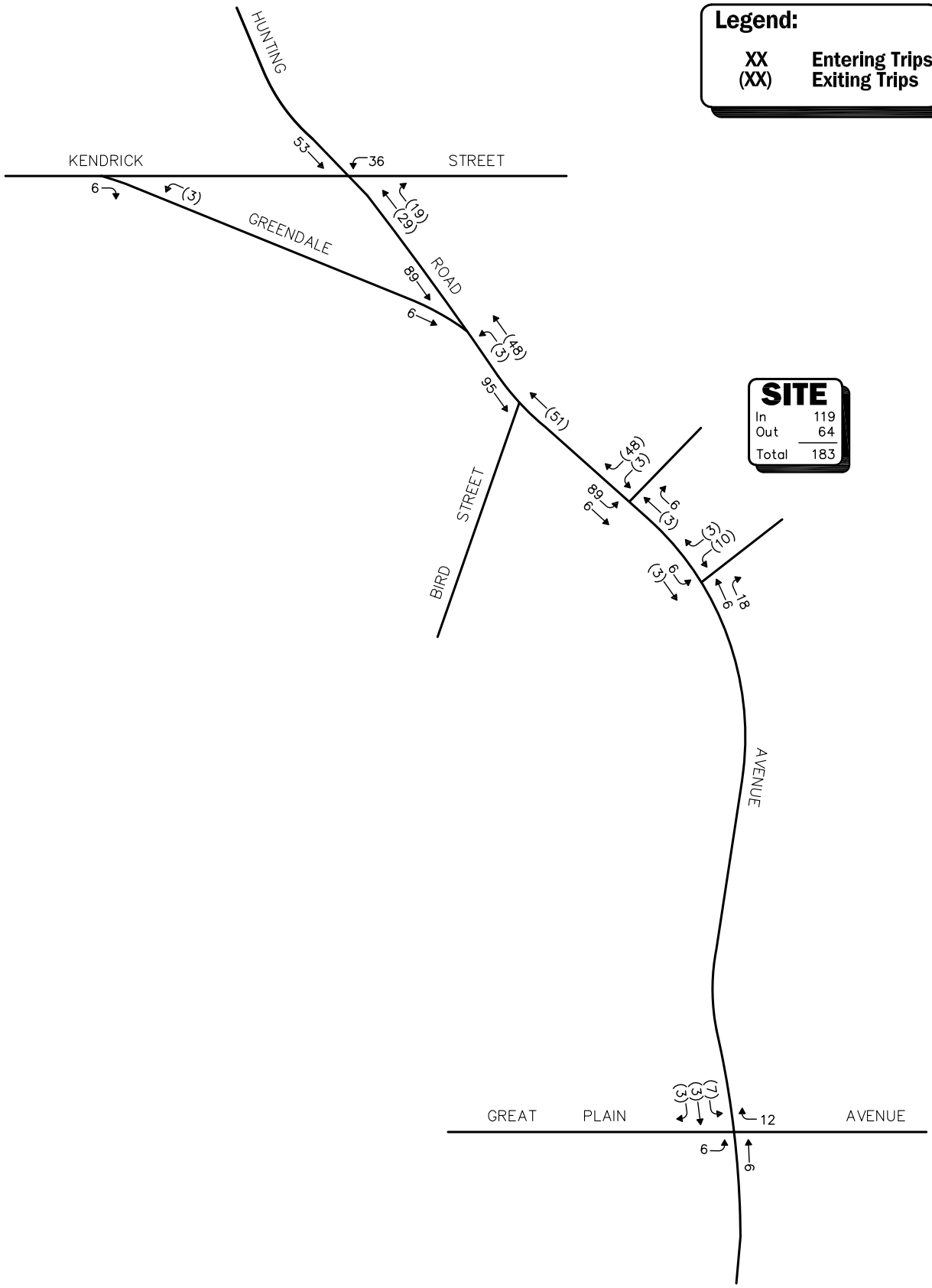

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Figure 8

Project-Generated Weekday Evening Peak Hour Traffic Volumes

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Transportation Engineers & Planners

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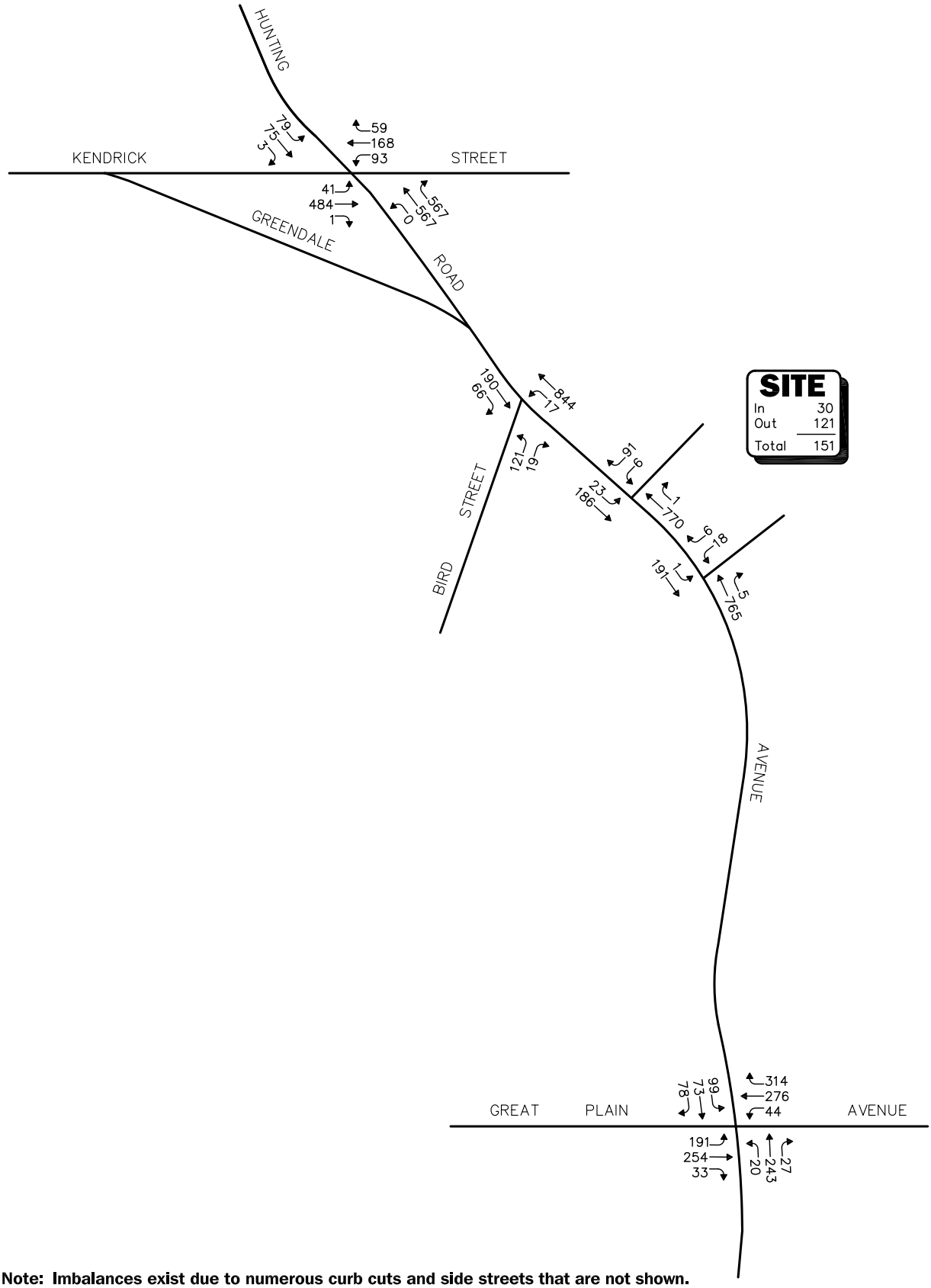
Table 5
TRIP-DISTRIBUTION SUMMARY

Roadway	Direction (To/From)	Percent
Hunting Road	North	45
Kendrick Street	East	30
Kendrick Street	West	5
Great Plain Avenue	East	10
Great Plain Avenue	West	5
Greendale Avenue	South	5
TOTAL		100

FUTURE TRAFFIC VOLUMES - BUILD CONDITION

The 2018 Build condition traffic volumes consist of the 2018 No-Build traffic volumes with the additional traffic expected to be generated by the Project added to them. The 2018 Build condition weekday morning and evening peak-hour traffic-volumes are graphically depicted on Figures 9 and 10.

A summary of peak-hour projected traffic-volume increases external to the study area that is the subject of this assessment is shown in Table 6. These volumes are based on the expected increases from the Project.



Note: Imbalances exist due to numerous curb cuts and side streets that are not shown.

Not To Scale

Figure 9

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2018 Build
Weekday Morning
Peak Hour Traffic Volumes

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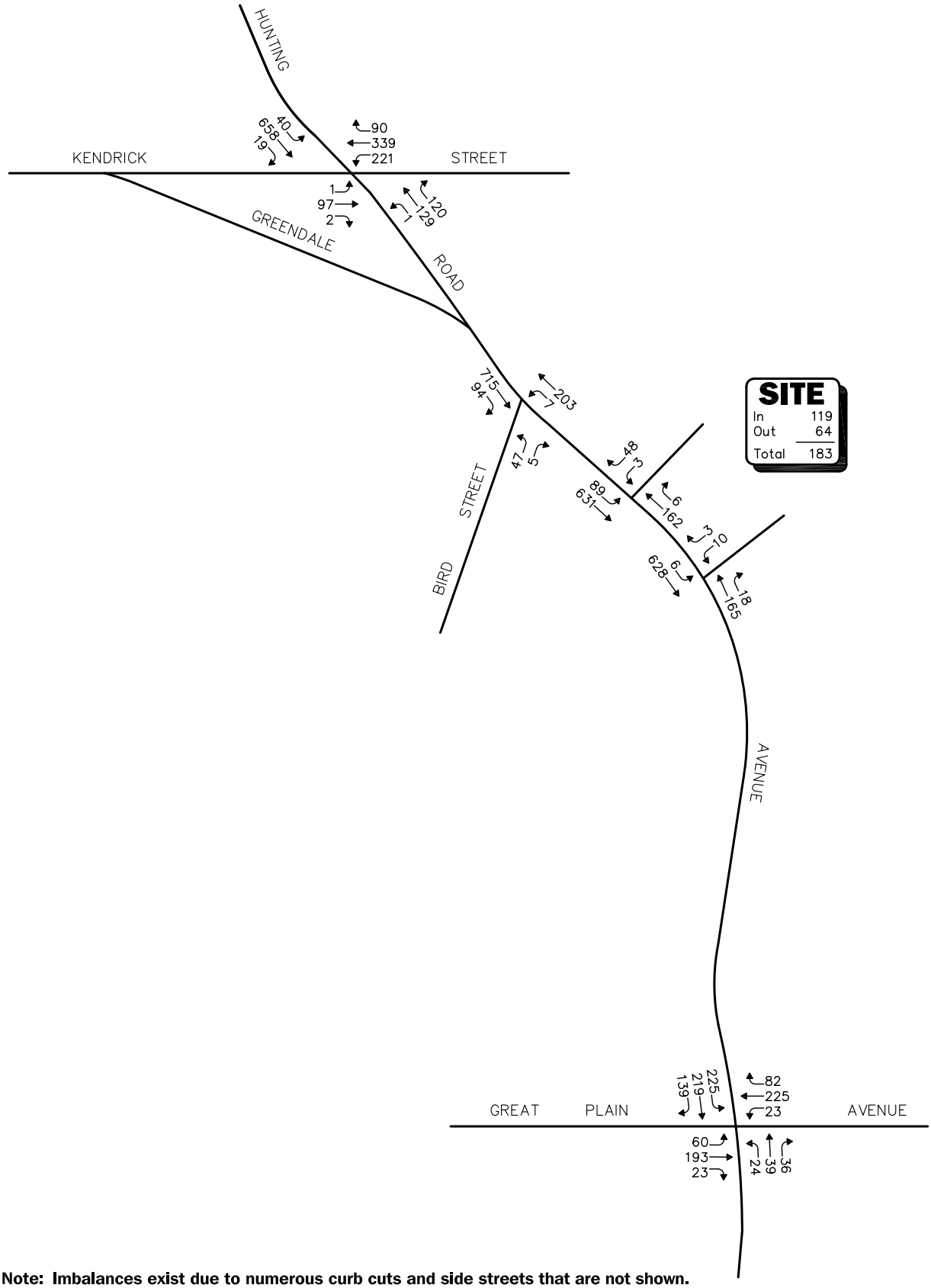

Note: Imbalances exist due to numerous curb cuts and side streets that are not shown.

Not To Scale

Figure 10

Vanasse & Associates, Inc.
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2018 Build
Weekday Evening
Peak Hour Traffic Volumes

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Table 6
PEAK-HOUR TRAFFIC-VOLUME INCREASES

Location/Peak Hour	2013 Existing	2018 No-Build	2018 Build	Traffic Volume Increase Over No-Build	Percent Increase Over No-Build
Hunting Road, north of Kendrick Street:					
Weekday Morning	831	755	824	69	9.1
Weekday Evening	897	855	937	82	9.6
Kendrick Street, east of Greendale Avenue:					
Weekday Morning	1,910	1,405	1,450	45	3.2
Weekday Evening	1,956	852	907	55	6.5
Great Plain Avenue, east of Greendale Avenue:					
Weekday Morning	1,032	999	1,014	15	1.5
Weekday Evening	911	765	784	19	2.5
Great Plain Avenue, west of Greendale Avenue:					
Weekday Morning	789	845	852	7	0.8
Weekday Evening	613	655	664	9	1.4
Greendale Avenue, south of Great Plain Avenue :					
Weekday Morning	472	432	440	8	1.9
Weekday Evening	495	355	364	9	2.5

Note: 2018 No-Build and Build traffic volumes include modifications in traffic patterns associated with I-95/Route 128 Add-A-Lane project.

As shown in Table 6, Project-related traffic-volume increases external to the study area relative to 2018 No-Build conditions are anticipated to range from 0.8 to 9.6 percent during the peak periods, with vehicle increases shown to range from 7 to 82 vehicles.

TRAFFIC OPERATIONS ANALYSIS

Measuring existing and future traffic volumes quantifies traffic flow within the study area. To assess quality of flow, roadway capacity and vehicle queue analyses were conducted under Existing, No-Build, and Build traffic-volume conditions. Capacity analyses provide an indication of how well the roadway facilities serve the traffic demands placed upon them, with vehicle queue analyses providing a secondary measure of the operational characteristics of an intersection or section of roadway under study.

METHODOLOGY

Levels of Service

A primary result of capacity analyses is the assignment of level of service to traffic facilities under various traffic-flow conditions.[9] The concept of level of service is defined as a qualitative measure describing operational conditions within a traffic stream and their perception by motorists and/or passengers. A level-of-service definition provides an index to quality of traffic flow in terms of such factors as speed, travel time, freedom to maneuver, traffic interruptions, comfort, convenience, and safety.

Six levels of service are defined for each type of facility. They are given letter designations from A to F, with level-of-service (LOS) A representing the best operating conditions and LOS F representing congested or constrained operating conditions.

Since the level of service of a traffic facility is a function of the traffic flows placed upon it, such a facility may operate at a wide range of levels of service, depending on the time of day, day of week, or period of year.

[9]The capacity analysis methodology is based on the concepts and procedures presented in the *Highway Capacity Manual;* Transportation Research Board; Washington, DC; 2010.

Unsignalized Intersections

The six levels of service for unsignalized intersections may be described as follows:

- *LOS A* represents a condition with little or no control delay to minor street traffic.
- *LOS B* represents a condition with short control delays to minor street traffic.
- *LOS C* represents a condition with average control delays to minor street traffic.
- *LOS D* represents a condition with long control delays to minor street traffic.
- *LOS E* represents operating conditions at or near capacity level, with very long control delays to minor street traffic.
- *LOS F* represents a condition where minor street demand volume exceeds capacity of an approach lane, with extreme control delays resulting.

The levels of service of unsignalized intersections are determined by application of a procedure described in the 2010 *Highway Capacity Manual.*[10] Level of service is measured in terms of average control delay. Mathematically, control delay is a function of the capacity and degree of saturation of the lane group and/or approach under study and is a quantification of motorist delay associated with traffic control devices such as traffic signals and STOP signs. Control delay includes the affects of initial deceleration delay approaching a STOP sign, stopped delay, queue move-up time, and final acceleration delay from a stopped condition. Definitions for level of service at unsignalized intersections are also given in the 2010 *Highway Capacity Manual*. Table 7 summarizes the relationship between level of service and average control delay for two-way stop controlled and all-way stop controlled intersections.

Table 7
LEVEL-OF-SERVICE CRITERIA FOR UNSIGNALIZED INTERSECTIONS[a]

Level-Of-Service by Volume-to-Capacity Ratio		Average Control Delay
v/c ≤ 1.0	v/c > 1.0	(Seconds Per Vehicle)
A	F	≤10.0
B	F	10.1 to 15.0
C	F	15.1 to 25.0
D	F	25.1 to 35.0
E	F	35.1 to 50.0
F	F	>50.0

[a]Source: *Highway Capacity Manual*; Transportation Research Board; Washington, DC; 2010; page 19-2.

[10]*Highway Capacity Manual*; Transportation Research Board; Washington, DC; 2010.

Signalized Intersections

The six levels of service for signalized intersections may be described as follows:

- *LOS A* describes operations with very low control delay; most vehicles do not stop at all.
- *LOS B* describes operations with relatively low control delay. However, more vehicles stop than LOS A.
- *LOS C* describes operations with higher control delays. Individual cycle failures may begin to appear. The number of vehicles stopping is significant at this level, although many still pass through the intersection without stopping.
- *LOS D* describes operations with control delay in the range where the influence of congestion becomes more noticeable. Many vehicles stop and individual cycle failures are noticeable.
- *LOS E* describes operations with high control delay values. Individual cycle failures are frequent occurrences.
- *LOS F* describes operations with high control delay values that often occur with over-saturation. Poor progression and long cycle lengths may also be major contributing causes to such delay levels.

Levels of service for signalized intersections were calculated using the Percentile Delay Method implemented as a part of the Synchro™ 8 software as suggested by MassDOT in order to compensate for errors found when employing the 2010 *Highway Capacity Manual* methodology as a part of the software. The Percentile Delay Method assesses the effects of signal type, timing, phasing, and progression; vehicle mix; and geometrics on "percentile" delay. Level-of-service designations are based on the criterion of percentile delay per vehicle and is a measure of: i) driver discomfort; ii) motorist frustration; and iii) fuel consumption; and includes a uniform delay based on percentile volumes using a Poisson arrival pattern, an initial queue move-up time, and a queue interaction delay that accounts for delays resulting from queues extending from adjacent intersections. Table 8 summarizes the relationship between level-of-service and percentile delay, and uses the same numerical delay thresholds as the HCM method. The tabulated percentile delay criterion may be applied in assigning level-of-service designations to individual lane groups, to individual intersection approaches, or to entire intersections.

Table 8
LEVEL-OF-SERVICE CRITERIA
FOR SIGNALIZED INTERSECTIONS[a]

Level of Service	Percentile Delay Per Vehicle (Seconds)
A	≤10.0
B	10.1 to 20.0
C	20.1 to 35.0
D	35.1 to 55.0
E	55.1 to 80.0
F	>80.0

Vehicle Queue Analysis

Vehicle queue analyses are a direct measurement of an intersection's ability to process vehicles under various traffic control and volume scenarios and lane use arrangements. The vehicle queue analysis was performed using the Synchro™ intersection capacity analysis software which is based upon the methodology and procedures presented in the 2000 *Highway Capacity Manual*. The Synchro™ vehicle queue analysis methodology is a simulation based model which reports the number of vehicles that experience a delay of six seconds or more at an intersection. For signalized intersections, Synchro™ reports both the average (50^{th} percentile) the 95^{th} percentile vehicle queue. For unsignalized intersections, Synchro™ reports the 95^{th} percentile vehicle queue; however, for all-way STOP-control intersections, Synchro™ does not report vehicle queues and it is necessary to use the associated SimTraffic™ traffic model to obtain vehicle queue data. Vehicle queue lengths are a function of the capacity of the movement under study and the volume of traffic being processed by the intersection during the analysis period. The 95^{th} percentile vehicle queue is the vehicle queue length that will be exceeded only 5 percent of the time, or approximately three minutes out of sixty minutes during the peak one hour of the day (during the remaining fifty-seven minutes, the vehicle queue length will be less than the 95th percentile queue length).

ANALYSIS RESULTS

Level-of-service and vehicle queue analyses were conducted for 2013 Existing, 2018 No-Build and 2018 Build conditions for the intersections within the study area. The results of the intersection capacity and vehicle queue analyses are summarized in Tables 9 and 10, with the detailed analysis results presented in the Appendix.

The following is a summary of the level-of-service and vehicle queue analyses for the intersections within the study area.

Table 9
SIGNALIZED INTERSECTION LEVEL-OF-SERVICE AND VEHICLE QUEUE SUMMARY

Signalized Intersection/Peak Hour/Movement	2013 Existing				2018 No-Build				2018 Build			
	V/C[a]	Delay[b]	LOS[c]	Queue[d] 50th/95th	V/C	Delay	LOS	Queue 50th/95th	V/C	Delay	LOS	Queue 50th/95th
Kendrick Street at Hunting Road												
Weekday Morning:												
Kendrick Street EB LT/TH/RT	0.78	46.6	D	9/14	0.72	36.9	D	6/12	0.77	39.8	D	6/13
Kendrick Street WB LT	0.46	40.6	D	3/5	0.29	26.8	C	2/4	0.34	29.0	C	2/4
Kendrick Street WB TH/RT	0.42	27.2	C	6/11	0.38	21.3	C	4/8	0.40	22.2	C	4/8
Hunting Road NB LT/TH	0.80	54.2	D	9/21	0.83	39.8	D	11/25	0.89	44.5	D	12/28
Hunting Road NB RT	0.48	1.1	A	0/0	0.36	0.6	A	0/0	0.39	0.7	A	0/0
Hunting Road SB LT	0.64	37.8	D	5/12	0.30	24.8	C	1/3	0.34	27.9	C	1/3
Hunting Road SB TH/RT	0.14	16.1	B	2/5	0.08	14.5	B	1/3	0.10	14.5	B	1/3
Overall	--	**29.2**	**C**	--	--	**24.8**	**C**	--	--	**27.0**	**C**	--
Weekday Evening:												
Kendrick Street EB LT/TH/RT	0.69	51.2	D	4/6	0.36	32.5	C	1/2	0.37	34.0	C	1/2
Kendrick Street WB LT	0.77	24.2	C	11/19	0.35	19.4	B	3/5	0.44	22.6	C	3/6
Kendrick Street WB TH/RT	0.62	13.4	B	10/17	0.65	23.1	C	6/12	0.68	26.0	C	7/12
Hunting Road NB LT/TH	0.73	69.4	E	3/6	0.18	22.6	C	1/4	0.22	21.8	C	2/5
Hunting Road NB RT	0.11	0.1	A	0/0	0.07	0.1	A	0/0	0.09	0.1	A	0/0
Hunting Road SB LT	0.56	43.1	D	5/7	0.06	10.2	B	1/1	0.06	10.2	B	1/1
Hunting Road SB TH/RT	0.69	44.0	D	8/12	0.76	20.9	C	8/15	0.78	21.2	C	10/16
Overall	--	**28.2**	**C**	--	--	**20.5**	**C**	--	--	**21.5**	**C**	--
Great Plain Avenue at Greendale Avenue												
Weekday Morning:												
Great Plain Avenue EB LT/TH/RT	0.98	58.0	E	7/14	1.01	64.6	E	9/16	1.08	>80.0	F	9/16
Great Plain Avenue WB LT/TH/RT	0.83	24.0	C	9/16	0.80	22.0	C	9/16	0.83	24.1	C	9/16
Greendale Avenue NB LT/TH/RT	0.69	22.8	C	7/7	0.69	22.8	C	6/6	0.66	21.6	C	6/6
Greendale Avenue SB LT/TH/RT	0.81	35.2	D	5/9	0.58	20.0	C	3/5	0.62	21.5	C	4/6
Overall	--	**33.2**	**C**	--	--	**32.7**	**C**	--	--	**38.8**	**D**	--
Weekday Evening:												
Great Plain Avenue EB LT/TH/RT	0.45	17.9	B	3/7	0.49	18.9	B	3/8	0.52	19.4	B	3/8
Great Plain Avenue WB LT/TH/RT	0.59	19.0	B	4/9	0.55	19.0	B	4/9	0.56	19.0	B	4/9
Greendale Avenue NB LT/TH/RT	0.18	13.0	B	1/3	0.15	10.9	B	1/3	0.16	11.6	B	1/3
Greendale Avenue SB LT/TH/RT	1.24	>80.0	F	15/37	0.84	31.3	C	7/24	0.87	34.5	C	7/25
Overall	--	**>80.0**	**F**	--	--	**23.8**	**C**	--	--	**25.3**	**C**	--

[a]Volume-to-capacity ratio.
[b]Percentile delay per vehicle in seconds.
[c]Level-of-Service.
[d]Queue length in vehicles.
NB = northbound; SB = southbound; EB = eastbound; WB = westbound; LT = left-turning movements; TH = through movements; RT = right-turning movements.
Note: The 2018 No-Build and Build conditions include improvements and modifications in traffic patterns associated with the I-95/Route 128 Add-A-Lane project.

Table 10
UNSIGNALIZED INTERSECTION LEVEL-OF-SERVICE AND VEHICLE QUEUE SUMMARY

	2013 Existing				2018 No-Build				2018 Build			
Unsignalized Intersection/Peak Hour/Movement	Demand[a]	Delay[b]	LOS[c]	Queue[d] 95th	Demand	Delay	LOS	Queue 95th	Demand	Delay	LOS	Queue 95th
Greendale Avenue at Bird Street												
Weekday Morning:												
Bird Street EB LT/RT	133	>50.0	F	6	140	>50.0	F	6	140	>50.0	F	8
Greendale Avenue NB LT/TH	780	0.2	A	0	764	0.2	A	0	861	0.2	A	0
Greendale Avenue SB TH/RT	287	0.0	A	0	232	0.0	A	0	256	0.0	A	0
Weekday Evening:												
Bird Street EB LT/RT	50	28.3	D	1	52	18.9	C	1	52	23.4	C	1
Greendale Avenue NB LT/TH	215	0.3	A	0	159	0.4	A	0	210	0.3	A	0
Greendale Avenue SB TH/RT	934	0.0	A	0	714	0.0	A	0	809	0.0	A	0
Greendale Avenue at the Project North Driveway												
Weekday Morning:												
Project North Driveway WB LT/RT	--	--	--	--	--	--	--	--	97	19.5	C	2
Greendale Avenue NB TH/RT	--	--	--	--	--	--	--	--	771	0.0	A	0
Greendale Avenue SB LT/TH	--	--	--	--	--	--	--	--	209	1.1	A	0
Weekday Evening:												
Project North Driveway WB LT/RT	--	--	--	--	--	--	--	--	51	10.3	B	1
Greendale Avenue NB TH/RT	--	--	--	--	--	--	--	--	168	0.0	A	0
Greendale Avenue SB LT/TH	--	--	--	--	--	--	--	--	720	1.0	A	1
Greendale Avenue at the Project South Driveway												
Weekday Morning:												
Project South Driveway WB LT/RT	--	--	--	--	--	--	--	--	24	19.5	C	1
Greendale Avenue NB TH/RT	--	--	--	--	--	--	--	--	770	0.0	A	0
Greendale Avenue SB LT/TH	--	--	--	--	--	--	--	--	192	0.0	A	0
Weekday Evening:												
Project South Driveway WB LT/RT	--	--	--	--	--	--	--	--	13	15.3	C	1
Greendale Avenue NB TH/RT	--	--	--	--	--	--	--	--	183	0.0	A	0
Greendale Avenue SB LT/TH	--	--	--	--	--	--	--	--	634	0.1	A	0

[a]Demand in vehicles per hour.
[b]Average control delay per vehicle (in seconds).
[c]Level-of-Service.
[d]Queue length in vehicles.
NB = northbound; SB = southbound; EB = eastbound; WB = westbound; LT = left-turning movements; TH = through movements; RT = right-turning movements.
Note: The 2018 No-Build and Build conditions include improvements and modifications in traffic patterns associated with the I-95/Route 128 Add-A-Lane project.

Signalized Intersections

Kendrick Street at Hunting Road

Under 2013 Existing conditions, this signalized intersection was shown to operate at an overall LOS C during both the weekday morning and evening peak hours. Under 2018 No-Build conditions, with the inclusion of the traffic signal timing improvements and the modification of travel patterns at the intersection associated with the I-95/Route 128 Add-A-Lane project, overall operating conditions were shown to remain at LOS C during both the weekday morning and evening peak hours. Under 2018 Build conditions, with the addition of Project-related traffic, overall operating conditions at this intersection were shown to remain at LOS C during both the weekday morning and evening peak hours (no change over No-Build conditions). Vehicle queues at the intersection were shown to range from 0 to 28 vehicles during the peak periods. The Project was not shown to result in a significant increase in vehicle queuing at the intersection over No-Build conditions (approximately 0 to 3 vehicles).

Great Plain Avenue at Greendale Avenue

Under 2013 Existing conditions, this signalized intersection was shown to operate at an overall LOS C during the weekday morning peak-hour and at LOS F during the weekday evening peak-hour. Under 2018 No-Build conditions, with the inclusion of the modification of travel patterns at the intersection associated with the I-95/Route 128 Add-A-Lane project, overall operating conditions were shown to remain at LOS C during the weekday morning peak-hour and to improve to LOS C during the weekday evening peak-hour. Under 2018 Build conditions, with the addition of Project-related traffic, overall operating conditions were shown to degrade slightly (6.1 second increase in average motorist delay) from LOS C to LOS D during the weekday morning peak-hour and to remain at LOS C during the weekday evening peak-hour. Vehicle queues at the intersection were shown to range from 1 to 25 vehicles during the peak periods. The Project was not shown to result in a significant increase in vehicle queuing at the intersection over No-Build conditions (approximately 0 to 1 vehicle).

Unsignalized Intersections

Greendale Avenue at Bird Street

Under 2013 Existing conditions, movements from Bird Street at this unsignalized intersection were shown to operate at LOS F during the weekday morning peak-hour and at LOS D during the weekday evening peak-hour, with all movements along Greendale Avenue shown to operate at LOS A. Under 2018 No-Build conditions, with the inclusion of the modification of travel patterns at the intersection associated with the I-95/Route 128 Add-A-Lane project, the movements from Bird Street were shown to remain operating at LOS F during the weekday morning peak-hour and to improve to LOS C during the weekday evening peak-hour, with all movements along Greendale Avenue shown to continue to operate at LOS A. Under 2018 Build conditions, with the addition of Project-related traffic, the movements from Bird Street were shown to remain operating at LOS F during the weekday morning peak-hour and at LOS C during the weekday evening peak-hour (no change over No-Build conditions), with all movements along Greendale Avenue shown to continue to operate at LOS A.. Vehicle queues at the intersection were shown to range from 0 to 8 vehicles during the peak periods. The addition of Project-related traffic to the intersection was not shown to result in a significant increase in vehicle queuing over No-Build conditions (approximately 0 to 2 vehicles).

Greendale Avenue at the North Project Site Driveway

Under 2018 Build conditions, all movements exiting the north Project site driveway were shown to operate at LOS C during the weekday morning peak-hour and at LOS B during the weekday evening peak-hour, with all movements along Greendale Avenue shown to operate at LOS A during the peak periods. Vehicle queues on Greendale Street at the north Project site driveway were shown to be minimal, ranging from 0 to 1 vehicle during the peak periods, with vehicle queues exiting the Project site shown to range from 1 to 2 vehicles.

Greendale Avenue at the South Project Site Driveway

Under 2018 Build conditions, all movements exiting the south Project site driveway were shown to operate at LOS C during both the weekday morning and evening peak-hours, with all movements along Greendale Avenue shown to operate at LOS A during the peak periods. Vehicle queues exiting the Project site were shown to be minimal (approximately 1 vehicle) with negligible vehicle queuing reported along Greendale Avenue.

SIGHT DISTANCE EVALUATION

Sight distance measurements were performed at the Project site driveway intersections with Greendale Avenue in accordance with MassDOT and American Association of State Highway and Transportation Officials (AASHTO)[11] requirements. Both stopping sight distance (SSD) and intersection sight distance (ISD) measurements were performed. In brief, SSD is the distance required by a vehicle traveling at the design speed of a roadway, on wet pavement, to stop prior to striking an object in its travel path. ISD or corner sight distance (CSD) is the sight distance required by a driver entering or crossing an intersecting roadway to perceive an on-coming vehicle and safely complete a turning or crossing maneuver with on-coming traffic. In accordance with AASHTO standards, if the measured ISD is at least equal to the required SSD value for the appropriate design speed, the intersection can operate in a safe manner. Table 11 presents the measured SSD and ISD at the subject intersections.

[11] Ibid 2.

Table 11
SIGHT DISTANCE MEASUREMENTS[a]

Intersection/Sight Distance Measurement	Feet		
	Required Minimum (Feet)	ISD[b]	Measured (Feet)
Greendale Avenue at the North Project Site Driveway			
Stopping Sight Distance:			
Greendale Avenue approaching from the north	425	--	520
Greendale Avenue approaching from the south	425	--	650+
Intersection Sight Distance:			
Looking to the north from the North Project Site Driveway	425	480/555[b]	470
Looking to the south from the North Project Site Driveway	425	480/555[b]	650+
Greendale Avenue at the South Project Site Driveway			
Stopping Sight Distance:			
Greendale Avenue approaching from the north	425	--	650+
Greendale Avenue approaching from the south	425	--	650+
Intersection Sight Distance:			
Looking to the north from the South Project Site Driveway	425	480/555[b]	650+
Looking to the south from the South Project Site Driveway	425	480/555[b]	650+

[a]Recommended minimum values obtained from *A Policy on Geometric Design of Highways and Streets*, 6th Edition; American Association of State Highway and Transportation Officials (AASHTO); 2011; and based on a 50 mph approach speed on Greendale Avenue.

[b]Values shown are the intersection sight distance for a vehicle turning right/left exiting a roadway under STOP control such that motorists approaching the intersection on the major street should not need to adjust their travel speed to less than 70 percent of their initial approach speed.

As can be seen in Table 11, the available lines of sight at the Project site driveway intersections with Greendale Avenue were found to exceed the recommended minimum sight distance requirements for a 50 mph approach speed along Greendale Avenue, consistent with the measured 85th percentile vehicle travel speed along this roadway (48 mph) and 10 mph above the posted speed limit (40 mph).

CONCLUSIONS AND RECOMMENDATIONS

CONCLUSIONS

VAI has completed a detailed assessment of the potential impacts on the transportation infrastructure associated with the proposed construction of a 300-unit residential apartment community to be located at 692 and 744 Greendale Avenue in Needham, Massachusetts. The following specific areas have been evaluated as they relate to the Project: i) access requirements; ii) potential off-site improvements; and iii) safety considerations; under existing and future conditions, both with and without the Project. Based on this assessment, we have concluded the following with respect to the Project:

1. Using trip-generation statistics published by the ITE[12] for a similar land use as that proposed, the Project is expected to generate approximately 1,942 new vehicle trips on an average weekday (two-way, 24-hour volume), with approximately 151 vehicle trips expected during the weekday morning peak-hour and 183 vehicle trips expected during the weekday evening peak-hour;

2. The additional traffic that may be associated with the Project along Greendale Avenue will be more than off-set by the projected reduction in traffic that is expected to occur as a result of the planned construction of the Kendrick Street interchange as a part of the MassDOT Add-A-Lane project;

3. The Project was shown to result in a measurable but minor impact on operating conditions (motorist delays or vehicle queuing) along the study roadways and at the study intersections over existing and anticipated future conditions without the Project;

4. All movements along Greendale Avenue at the Project site driveway intersections were shown to operate at a level-of-service of "A" during the peak periods with movements exiting the driveways shown to operate at a level-of-service "C" or better with minimal vehicle queuing (1 to 2 vehicles);

5. No apparent safety deficiencies were noted with respect to the motor vehicle crash history at the study intersections; and

[12] Ibid 1.

6. Lines of sight to and from the Project site driveway intersections with Greendale Avenue exceed the required minimum distance for the intersections to function in a safe and efficient manner based on a 50 mph approach speed along Greendale Avenue.

Based on the above, we have concluded that the Project can be accommodated within the confines of the existing transportation infrastructure in a safe and efficient manner with implementation of the recommendations that follow.

RECOMMENDATIONS

A detailed transportation improvement program has been developed that is designed to provide safe and efficient access to the Project site and address any deficiencies identified at off-site locations evaluated in conjunction with this study. The following improvements have been recommended as a part of this evaluation, and, where applicable, will be completed in conjunction with the Project subject to receipt of all necessary rights, permits, and approvals.

Project Access

Access to the Project site will be provided by way of two (2) new driveways that will intersect Greendale Avenue approximately 290 and 815 feet south of Bird Street, respectively. The following recommendations are offered with respect to the design and operation of the Project site driveways:

- The Project site driveways should be a minimum of 24-feet in width and accommodate two-way travel, with vehicles exiting the Project site placed under STOP-sign control.

- If centerline pavement markings are provided along the driveways serving the Project site or internal to the development, they should consist of a double-yellow line in accordance with the centerline pavement marking standards of the *Manual on Uniform Traffic Control Devices* (MUTCD).[13]

- All signs and other pavement markings to be installed within the Project site shall conform to the applicable standards of the MUTCD.

- Sidewalks should be provided within the Project site linking the proposed buildings and other amenities.

- Marked crosswalks and wheelchair ramps should be provided at pedestrian crossings within the Project site.

- Signs or landscaping along the Project driveways internal to the Project site and at their intersections with Greendale Avenue should be designed and maintained so as not to restrict lines of sight.

- If school bus service will not be provided within the Project site, a bus stop and an associated waiting area should be provided at the Project site driveway intersection with Greendale Avenue or at an appropriate location designated by the Town.

[13] Ibid 3.

Off-Site

Kendrick Street at Hunting Road

As a part of the MassDOT I-95/Route 128 Add-A-Lane project, traffic signal timing improvements are planned at the Kendrick Street/Hunting Road intersection. The addition of Project-related traffic to this signalized intersection was not shown to result in a significant impact in operating conditions over No-Build conditions, with the overall operating conditions shown to be maintained at level-of-service of "C" during the peak periods. Recognizing the importance of this intersection in providing access to the Project and the residences and businesses in the area, if the planned traffic signal timing improvements are not completed as a part of the MassDOT I-95/Route 128 Add-A-Lane project prior to the issuance of a Certificate of Occupancy for the Project, the Project proponent will design and implement an optimal traffic signal timing and phasing plan for the intersection.

Great Plain Avenue at Greendale Avenue

The addition of Project-related traffic to this signalized intersection was shown to result in a slight increase in motorist delay (approximately 6 seconds) over No-Build conditions; however, overall operating conditions were shown to be maintained at level-of-service "D" or better during the peak periods. That said, operating conditions for specific movements at the intersection during the weekday morning peak-hour were shown to be at or over capacity (defined as a level-of-service "E" or "F" respectively). As such, and recognizing the importance of this intersection in providing access to the Project and the residences and businesses in the area, the Project proponent will design and implement an optimal traffic signal timing and phasing plan for the intersection prior to the issuance of a Certificate of Occupancy for the Project. With the implementation of the recommended improvements, overall operating conditions at the intersection were shown to improve to a level-of-service of "C" during both peak periods.

Greendale Avenue at Bird Street

An analysis of operating conditions at this unsignalized intersection indicates that motorists exiting Bird Street experience excessive delay during one or both peak periods independent of the Project due to the relatively large volume of conflicting traffic on Greendale Avenue. It was also noted that the addition of Project-related resulted in a minimal increase in vehicle queuing at the intersection over No-Build conditions (0 to 2 vehicles). Given: i) the limited impact of the Project at the intersection; ii) the absence of an inherent safety deficiency as indicated by the MassDOT motor vehicle crash data; and iii) the significant reduction in conflicting traffic along Greendale Avenue that will occur as a result of the planned construction of the new Kendrick Street interchange as a part of the MassDOT I-95/Route 128 Add-A-Lane project; no improvements appear to be required at this intersection to accommodate the Project. However, it is recommended that a STOP-sign be installed on the Bird Street approach to Greendale Avenue independent of the Project in order to formalize the assignment of the vehicular right-of-way at the intersection.

With implementation of the above recommendations, safe and efficient access will be provided to the Project site and the Project can be constructed with minimal impact on the roadway system.

APPENDIX

TRAFFIC COUNT DATA
SEASONAL ADJUSTMENT DATA
PUBLIC TRANSPORTATION SCHEDULES
VEHICLE TRAVEL SPEED DATA
MASSDOT CRASH RATE WORKSHEETS
SITE-SPECIFIC DEVELOPMENT TRAFFIC-VOLUME NETWORKS
GENERAL BACKGROUND TRAFFIC GROWTH
I-95/ROUTE 128 ADD-A-LANE TRAFFIC VOLUME REDISTRIBUTION
TRIP-GENERATION CALCULATIONS
PROJECT DISTRIBUTION AND ASSIGNMENT
CAPACITY ANALYSIS WORKSHEETS

TRAFFIC COUNT DATA

Automatic Traffic Recorder Counts
Manual Turning Movement Counts

Automatic Traffic Recorder Counts

Accurate Counts
978-664-2565

6202VOL1

Location : Greendale Avenue
Location : South of Bird Street
City/State: Needham, MA

Start Time	27-Mar-13 Wed	NB Morning	NB Afternoon	Hour Totals Morning	Hour Totals Afternoon	SB Morning	SB Afternoon	Hour Totals Morning	Hour Totals Afternoon	Combined Totals Morning	Combined Totals Afternoon
12:00		3	56			5	81				
12:15		3	55			4	74				
12:30		0	40			9	73				
12:45		0	58	6	209	5	58	23	286	29	495
01:00		0	55			6	58				
01:15		0	40			1	60				
01:30		1	43			0	57				
01:45		0	56	1	194	2	64	9	239	10	433
02:00		0	48			0	64				
02:15		1	43			0	79				
02:30		0	54			2	108				
02:45		0	51	1	196	0	94	2	345	3	541
03:00		0	46			2	90				
03:15		0	46			0	101				
03:30		2	56			1	123				
03:45		2	51	4	199	1	110	4	424	8	623
04:00		1	59			0	148				
04:15		1	51			1	164				
04:30		2	43			6	203				
04:45		6	55	10	208	3	254	10	769	20	977
05:00		2	46			2	233				
05:15		9	55			3	228				
05:30		11	52			6	202				
05:45		16	52	38	205	5	175	16	838	54	1043
06:00		20	55			7	174				
06:15		38	40			5	168				
06:30		50	37			18	110				
06:45		114	43	222	175	13	95	43	547	265	722
07:00		128	42			18	85				
07:15		139	35			30	68				
07:30		174	30			38	59				
07:45		210	25	651	132	51	38	137	250	788	382
08:00		214	17			46	49				
08:15		190	21			56	33				
08:30		231	23			47	42				
08:45		239	22	874	83	42	30	191	154	1065	237
09:00		205	15			52	21				
09:15		141	12			52	24				
09:30		105	11			39	24				
09:45		100	7	551	45	30	23	173	92	724	137
10:00		78	7			47	26				
10:15		60	3			44	18				
10:30		51	8			38	11				
10:45		51	5	240	23	45	10	174	65	414	88
11:00		43	8			65	8				
11:15		53	3			46	14				
11:30		53	2			58	12				
11:45		58	7	207	20	54	6	223	40	430	60
Total		2805	1689			1005	4049			3810	5738
Percent		62.4%	37.6%			19.9%	80.1%			39.9%	60.1%

Accurate Counts
978-664-2565

6202VOL1

Location : Greendale Avenue
Location : South of Bird Street
City/State: Needham, MA

Start Time	28-Mar-13 Thu	NB Morning	NB Afternoon	Hour Totals Morning	Hour Totals Afternoon	SB Morning	SB Afternoon	Hour Totals Morning	Hour Totals Afternoon	Combined Totals Morning	Combined Totals Afternoon
12:00		3	43			6	55				
12:15		3	48			3	56				
12:30		2	46			3	60				
12:45		1	55	9	192	1	66	13	237	22	429
01:00		1	43			5	56				
01:15		0	50			1	48				
01:30		1	37			0	64				
01:45		0	42	2	172	3	70	9	238	11	410
02:00		0	46			1	66				
02:15		0	52			1	73				
02:30		1	56			2	87				
02:45		0	55	1	209	3	101	7	327	8	536
03:00		1	53			1	93				
03:15		0	55			0	107				
03:30		0	44			0	113				
03:45		1	52	2	204	0	128	1	441	3	645
04:00		2	50			1	173				
04:15		1	51			3	157				
04:30		1	32			2	198				
04:45		4	46	8	179	2	184	8	712	16	891
05:00		4	58			4	196				
05:15		12	53			2	243				
05:30		11	63			5	199				
05:45		15	72	42	246	6	202	17	840	59	1086
06:00		25	42			7	163				
06:15		45	51			9	141				
06:30		39	46			16	118				
06:45		64	37	173	176	19	97	51	519	224	695
07:00		100	30			24	78				
07:15		140	27			33	57				
07:30		170	29			31	50				
07:45		184	19	594	105	50	44	138	229	732	334
08:00		185	17			38	57				
08:15		203	20			43	47				
08:30		202	32			54	41				
08:45		191	24	781	93	47	28	182	173	963	266
09:00		167	23			36	32				
09:15		124	19			42	28				
09:30		88	14			50	29				
09:45		85	17	464	73	41	19	169	108	633	181
10:00		67	11			50	26				
10:15		65	9			43	19				
10:30		56	9			35	27				
10:45		47	7	235	36	45	11	173	83	408	119
11:00		50	3			49	16				
11:15		41	9			51	7				
11:30		61	11			53	6				
11:45		43	3	195	26	61	13	214	42	409	68
Total		2506	1711			982	3949			3488	5660
Percent		59.4%	40.6%			19.9%	80.1%			38.1%	61.9%
Grand Total		5311	3400			1987	7998			7298	11398
Percent		61.0%	39.0%			19.9%	80.1%			39.0%	61.0%
ADT		ADT 9,348		AADT 9,348							

Accurate Counts
978-664-2565

6202VOL1

Location : Greendale Avenue
Location : South of Bird Street
City/State: Needham, MA

Start	25-Mar-13		Tue		Wed		Thu		Fri		Sat		Sun		Week Average	
Time	NB	SB	NB	SB	NB	SB	NB	SB	NB	SB	NB	SB	NB	SB	NB	SB
12:00 AM	*	*	*	*	6	23	9	13	*	*	*	*	*	*	8	18
01:00	*	*	*	*	1	9	2	9	*	*	*	*	*	*	2	9
02:00	*	*	*	*	1	2	1	7	*	*	*	*	*	*	1	4
03:00	*	*	*	*	4	4	2	1	*	*	*	*	*	*	3	2
04:00	*	*	*	*	10	10	8	8	*	*	*	*	*	*	9	9
05:00	*	*	*	*	38	16	42	17	*	*	*	*	*	*	40	16
06:00	*	*	*	*	222	43	173	51	*	*	*	*	*	*	198	47
07:00	*	*	*	*	651	137	594	138	*	*	*	*	*	*	622	138
08:00	*	*	*	*	**874**	191	**781**	182	*	*	*	*	*	*	**828**	186
09:00	*	*	*	*	551	173	464	169	*	*	*	*	*	*	508	171
10:00	*	*	*	*	240	174	235	173	*	*	*	*	*	*	238	174
11:00	*	*	*	*	207	**223**	195	**214**	*	*	*	*	*	*	201	**218**
12:00 PM	*	*	*	*	**209**	286	192	237	*	*	*	*	*	*	200	262
01:00	*	*	*	*	194	239	172	238	*	*	*	*	*	*	183	238
02:00	*	*	*	*	196	345	209	327	*	*	*	*	*	*	202	336
03:00	*	*	*	*	199	424	204	441	*	*	*	*	*	*	202	432
04:00	*	*	*	*	208	769	179	712	*	*	*	*	*	*	194	740
05:00	*	*	*	*	205	**838**	**246**	**840**	*	*	*	*	*	*	**226**	**839**
06:00	*	*	*	*	175	547	176	519	*	*	*	*	*	*	176	533
07:00	*	*	*	*	132	250	105	229	*	*	*	*	*	*	118	240
08:00	*	*	*	*	83	154	93	173	*	*	*	*	*	*	88	164
09:00	*	*	*	*	45	92	73	108	*	*	*	*	*	*	59	100
10:00	*	*	*	*	23	65	36	83	*	*	*	*	*	*	30	74
11:00	*	*	*	*	20	40	26	42	*	*	*	*	*	*	23	41
Lane	0	0	0	0	4494	5054	4217	4931	0	0	0	0	0	0	4359	4991
Day	0		0		9548		9148		0		0		0		9350	
AM Peak	-	-	-	-	08:00	11:00	08:00	11:00	-	-	-	-	-	-	08:00	11:00
Vol.	-	-	-	-	874	223	781	214	-	-	-	-	-	-	828	218
PM Peak	-	-	-	-	12:00	17:00	17:00	17:00	-	-	-	-	-	-	17:00	17:00
Vol.	-	-	-	-	209	838	246	840	-	-	-	-	-	-	226	839

Comb. Total	0	0	9548	9148	0	0	0	9350
ADT	ADT 9,348	AADT 9,348						

Accurate Counts
978-664-2565

6202SPD1

Location : Greendale Avenue
Location : South of Bird Street
City/State: Needham, MA
Northbound

Start Time	1 15	16 20	21 25	26 30	31 35	36 40	41 45	46 50	51 55	56 60	61 65	66 70	71 75	76 999	Total	85th Percent	95th Percent
03/27/13	0	0	0	0	0	0	1	3	2	0	0	0	0	0	6	52	54
01:00	0	0	0	0	0	0	0	0	0	0	**1**	0	0	0	1	64	65
02:00	0	0	0	0	0	0	0	0	1	0	0	0	0	0	1	54	55
03:00	0	0	0	0	0	0	2	1	1	0	0	0	0	0	4	52	54
04:00	0	0	0	0	0	0	9	0	1	0	0	0	0	0	10	45	52
05:00	0	0	0	0	1	7	15	10	5	0	0	0	0	0	38	49	53
06:00	11	**8**	**3**	2	10	26	92	62	6	2	0	0	0	0	222	47	50
07:00	8	2	2	2	14	83	348	**178**	14	0	0	0	0	0	651	47	50
08:00	**18**	0	2	**21**	**66**	**192**	**417**	143	15	0	0	0	0	0	**874**	46	49
09:00	14	1	1	0	2	73	287	153	18	2	0	0	0	0	551	47	50
10:00	8	1	0	0	5	32	95	79	18	2	0	0	0	0	240	49	52
11:00	3	0	1	0	3	25	97	53	**21**	**4**	0	0	0	0	207	49	53
12 PM	5	0	0	1	**8**	30	77	66	**20**	2	0	0	0	0	**209**	49	52
13:00	8	0	0	0	1	25	82	**69**	9	0	0	0	0	0	194	48	50
14:00	16	0	**1**	**3**	4	31	80	52	9	0	0	0	0	0	196	47	50
15:00	6	**1**	0	0	6	29	81	66	9	1	0	0	0	0	199	48	51
16:00	**22**	0	1	0	3	36	**84**	51	8	**3**	0	0	0	0	208	47	50
17:00	18	0	0	0	1	**37**	78	54	14	3	0	0	0	0	205	48	52
18:00	15	0	0	0	3	27	63	54	13	0	0	0	0	0	175	48	51
19:00	2	0	0	3	5	18	64	29	11	0	0	0	0	0	132	48	51
20:00	0	0	0	0	2	17	39	21	3	1	0	0	0	0	83	47	50
21:00	3	1	0	1	1	9	14	13	1	2	0	0	0	0	45	48	53
22:00	0	0	0	0	2	9	4	7	1	0	0	0	0	0	23	48	50
23:00	0	0	0	0	1	5	8	5	1	0	0	0	0	0	20	48	50
Total	157	14	11	33	138	711	2037	1169	201	22	1	0	0	0	4494		
Percent	3.5%	0.3%	0.2%	0.7%	3.1%	15.8%	45.3%	26.0%	4.5%	0.5%	0.0%	0.0%	0.0%	0.0%			
AM Peak	08:00	06:00	06:00	08:00	08:00	08:00	08:00	07:00	11:00	11:00	01:00				08:00		
Vol.	18	8	3	21	66	192	417	178	21	4	1				874		
PM Peak	16:00	15:00	14:00	14:00	12:00	17:00	16:00	13:00	12:00	16:00					12:00		
Vol.	22	1	1	3	8	37	84	69	20	3					209		

Manual Turning Movement Counts

Accurate Counts
978-664-2565

N/S Street : Hunting Road
E/W Street : Kendrick Street
City/State : Needham, MA
Weather : Cloudy

File Name : 62020001
Site Code : 62020001
Start Date : 3/20/2013
Page No : 1

Groups Printed- Cars - Trucks

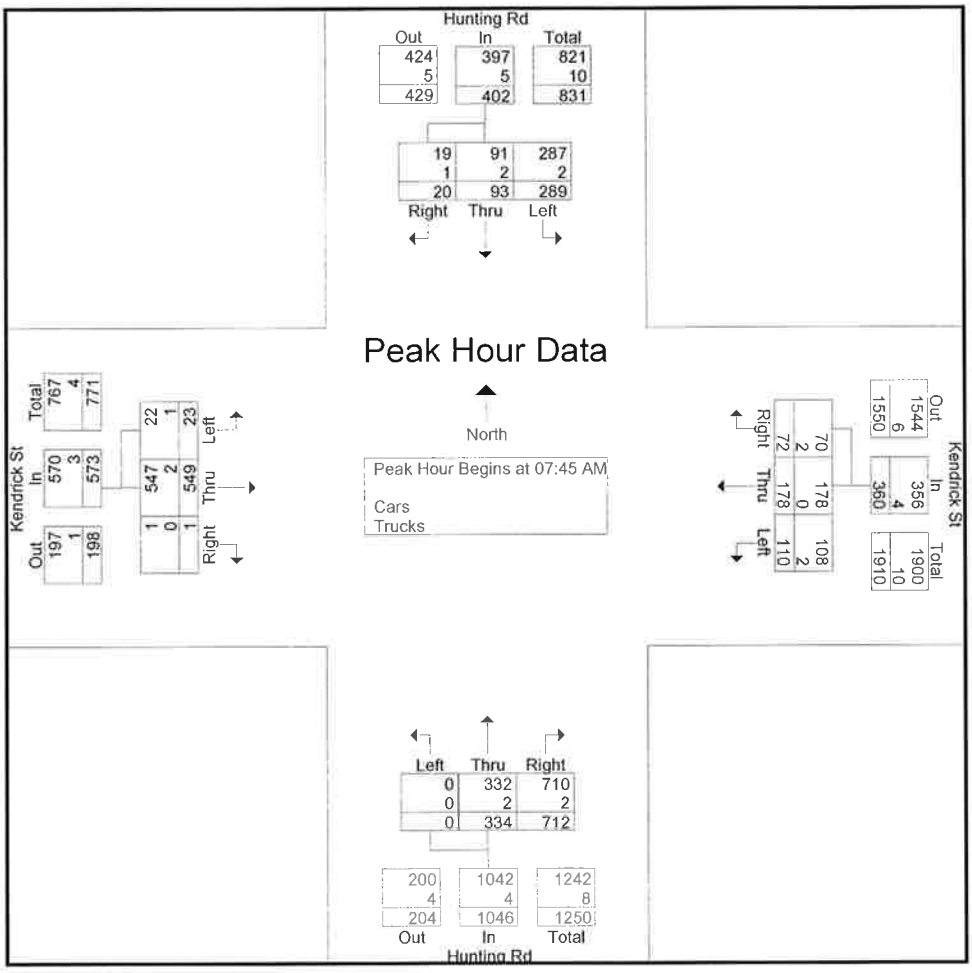
	Hunting Rd From North			Kendrick St From East			Hunting Rd From South			Kendrick St From West			
Start Time	Left	Thru	Right	Left	Thru	Right	Left	Thru	Right	Left	Thru	Right	Int. Total
07:00 AM	39	7	2	30	16	16	0	40	89	2	75	1	317
07:15 AM	46	8	8	24	33	10	1	60	112	9	90	0	401
07:30 AM	60	21	5	18	29	10	1	48	144	7	109	0	452
07:45 AM	74	27	6	46	36	16	0	80	183	6	149	0	623
Total	219	63	21	118	114	52	2	228	528	24	423	1	1793
08:00 AM	77	26	7	24	53	25	0	71	161	4	112	0	560
08:15 AM	80	16	7	23	46	16	0	85	182	9	136	1	601
08:30 AM	58	24	0	17	43	15	0	98	186	4	152	0	597
08:45 AM	80	11	1	25	47	15	1	90	183	6	139	0	598
Total	295	77	15	89	189	71	1	344	712	23	539	1	2356
Grand Total	514	140	36	207	303	123	3	572	1240	47	962	2	4149
Apprch %	74.5	20.3	5.2	32.7	47.9	19.4	0.2	31.5	68.3	4.6	95.2	0.2	
Total %	12.4	3.4	0.9	5	7.3	3	0.1	13.8	29.9	1.1	23.2	0	
Cars	509	137	34	201	302	121	3	570	1237	45	954	2	4115
% Cars	99	97.9	94.4	97.1	99.7	98.4	100	99.7	99.8	95.7	99.2	100	99.2
Trucks	5	3	2	6	1	2	0	2	3	2	8	0	34
% Trucks	1	2.1	5.6	2.9	0.3	1.6	0	0.3	0.2	4.3	0.8	0	0.8

	Hunting Rd From North				Kendrick St From East				Hunting Rd From South				Kendrick St From West				
Start Time	Left	Thru	Right	App. Total	Left	Thru	Right	App. Total	Left	Thru	Right	App. Total	Left	Thru	Right	App. Total	Int. Total
Peak Hour Analysis From 07:00 AM to 08:45 AM - Peak 1 of 1																	
Peak Hour for Entire Intersection Begins at 07:45 AM																	
07:45 AM	74	**27**	6	107	**46**	36	16	98	0	80	183	263	6	149	0	155	**623**
08:00 AM	77	26	**7**	**110**	24	**53**	**25**	**102**	0	71	161	232	4	112	0	116	560
08:15 AM	**80**	16	7	103	23	46	16	85	0	85	182	267	**9**	136	**1**	146	601
08:30 AM	58	24	0	82	17	43	15	75	0	**98**	**186**	**284**	4	**152**	0	**156**	597
Total Volume	289	93	20	402	110	178	72	360	0	334	712	1046	23	549	1	573	2381
% App. Total	71.9	23.1	5		30.6	49.4	20		0	31.9	68.1		4	95.8	0.2		
PHF	.903	.861	.714	.914	.598	.840	.720	.882	.000	.852	.957	.921	.639	.903	.250	.918	.955
Cars	287	91	19	397	108	178	70	356	0	332	710	1042	22	547	1	570	2365
% Cars	99.3	97.8	95.0	98.8	98.2	100	97.2	98.9	0	99.4	99.7	99.6	95.7	99.6	100	99.5	99.3
Trucks	2	2	1	5	2	0	2	4	0	2	2	4	1	2	0	3	16
% Trucks	0.7	2.2	5.0	1.2	1.8	0	2.8	1.1	0	0.6	0.3	0.4	4.3	0.4	0	0.5	0.7

Accurate Counts
978-664-2565

N/S Street : Hunting Road
E/W Street : Kendrick Street
City/State : Needham, MA
Weather : Cloudy

File Name : 62020001
Site Code : 62020001
Start Date : 3/20/2013
Page No : 2



Peak Hour Analysis From 07:00 AM to 08:45 AM - Peak 1 of 1

Peak Hour for Each Approach Begins at:

	07:30 AM				07:45 AM				08:00 AM				07:45 AM			
+0 mins.	60	21	5	86	**46**	36	16	98	0	71	161	232	6	149	0	155
+15 mins.	74	**27**	6	107	24	**53**	**25**	**102**	0	85	182	267	4	112	0	116
+30 mins.	77	26	**7**	**110**	23	46	16	85	0	**98**	**186**	**284**	**9**	136	**1**	146
+45 mins.	**80**	16	**7**	103	17	43	15	75	**1**	90	183	274	4	**152**	0	**156**
Total Volume	291	90	25	406	110	178	72	360	1	344	712	1057	23	549	1	573
% App. Total	71.7	22.2	6.2		30.6	49.4	20		0.1	32.5	67.4		4	95.8	0.2	
PHF	.909	.833	.893	.923	.598	.840	.720	.882	.250	.878	.957	.930	.639	.903	.250	.918
Cars	288	88	24	400	108	178	70	356	1	342	711	1054	22	547	1	570
% Cars	99	97.8	96	98.5	98.2	100	97.2	98.9	100	99.4	99.9	99.7	95.7	99.6	100	99.5
Trucks	3	2	1	6	2	0	2	4	0	2	1	3	1	2	0	3
% Trucks	1	2.2	4	1.5	1.8	0	2.8	1.1	0	0.6	0.1	0.3	4.3	0.4	0	0.5

Accurate Counts
978-664-2565

N/S Street : Hunting Road
E/W Street : Kendrick Street
City/State : Needham, MA
Weather : Cloudy

File Name : 62020001
Site Code : 62020001
Start Date : 3/20/2013
Page No : 1

Groups Printed- Trucks

	Hunting Rd From North			Kendrick St From East			Hunting Rd From South			Kendrick St From West			
Start Time	Left	Thru	Right	Left	Thru	Right	Left	Thru	Right	Left	Thru	Right	Int. Total
07:00 AM	1	0	0	1	0	0	0	0	0	0	2	0	4
07:15 AM	0	0	1	1	1	0	0	0	0	1	1	0	5
07:30 AM	1	1	0	1	0	0	0	0	1	0	2	0	6
07:45 AM	0	0	0	1	0	1	0	0	1	0	2	0	5
Total	2	1	1	4	1	1	0	0	2	1	7	0	20
08:00 AM	0	0	1	0	0	0	0	0	1	1	0	0	3
08:15 AM	2	1	0	1	0	0	0	1	0	0	0	0	5
08:30 AM	0	1	0	0	0	1	0	1	0	0	0	0	3
08:45 AM	1	0	0	1	0	0	0	0	0	0	1	0	3
Total	3	2	1	2	0	1	0	2	1	1	1	0	14
Grand Total	5	3	2	6	1	2	0	2	3	2	8	0	34
Apprch %	50	30	20	66.7	11.1	22.2	0	40	60	20	80	0	
Total %	14.7	8.8	5.9	17.6	2.9	5.9	0	5.9	8.8	5.9	23.5	0	

	Hunting Rd From North				Kendrick St From East				Hunting Rd From South				Kendrick St From West				
Start Time	Left	Thru	Right	App. Total	Left	Thru	Right	App. Total	Left	Thru	Right	App. Total	Left	Thru	Right	App. Total	Int. Total
Peak Hour Analysis From 07:00 AM to 08:45 AM - Peak 1 of 1																	
Peak Hour for Entire Intersection Begins at 07:00 AM																	
07:00 AM	1	0	0	1	1	0	0	1	0	0	0	0	0	2	0	2	4
07:15 AM	0	0	1	1	1	1	0	2	0	0	0	0	1	1	0	2	5
07:30 AM	1	1	0	2	1	0	0	1	0	0	1	1	0	2	0	2	6
07:45 AM	0	0	0	0	1	0	1	2	0	0	1	1	0	2	0	2	5
Total Volume	2	1	1	4	4	1	1	6	0	0	2	2	1	7	0	8	20
% App. Total	50	25	25		66.7	16.7	16.7		0	0	100		12.5	87.5	0		
PHF	.500	.250	.250	.500	1.00	.250	.250	.750	.000	.000	.500	.500	.250	.875	.000	1.00	.833

Accurate Counts
978-664-2565

N/S Street : Hunting Road
E/W Street : Kendrick Street
City/State : Needham, MA
Weather : Cloudy

File Name : 62020001
Site Code : 62020001
Start Date : 3/20/2013
Page No : 1

Groups Printed- Bikes Peds

	Hunting Rd From North				Kendrick St From East				Hunting Rd From South				Kendrick St From West						
Start Time	Left	Thru	Right	Peds	Left	Thru	Right	Peds	Left	Thru	Right	Peds	Left	Thru	Right	Peds	Exclu. Total	Inclu. Total	Int. Total
07:00 AM	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	1	0	1
07:15 AM	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	1	0	1
07:30 AM	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	1	0	1
07:45 AM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total	0	0	0	1	0	0	0	1	0	0	0	1	0	0	0	0	3	0	3
08:00 AM	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	1	1
08:15 AM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
08:30 AM	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	1	0	1
08:45 AM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total	0	0	0	0	1	0	0	0	0	0	0	1	0	0	0	0	1	1	2
Grand Total	0	0	0	1	1	0	0	1	0	0	0	2	0	0	0	0	4	1	5
Apprch %	0	0	0		100	0	0		0	0	0		0	0	0				
Total %	0	0	0		100	0	0		0	0	0		0	0	0		80	20	

	Hunting Rd From North				Kendrick St From East				Hunting Rd From South				Kendrick St From West				
Start Time	Left	Thru	Right	App. Total	Left	Thru	Right	App. Total	Left	Thru	Right	App. Total	Left	Thru	Right	App. Total	Int. Total
Peak Hour Analysis From 07:00 AM to 08:45 AM - Peak 1 of 1																	
Peak Hour for Entire Intersection Begins at 07:15 AM																	
07:15 AM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
07:30 AM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
07:45 AM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
08:00 AM	0	0	0	0	1	0	0	1	0	0	0	0	0	0	0	0	1
Total Volume	0	0	0	0	1	0	0	1	0	0	0	0	0	0	0	0	1
% App. Total	0	0	0		100	0	0		0	0	0		0	0	0		
PHF	.000	.000	.000	.000	.250	.000	.000	.250	.000	.000	.000	.000	.000	.000	.000	.000	.250

Accurate Counts
978-664-2565

N/S Street : Hunting Road
E/W Street : Kendrick Street
City/State : Needham, MA
Weather : Cloudy

File Name : 62020001
Site Code : 62020001
Start Date : 3/20/2013
Page No : 1

Groups Printed- Cars - Trucks

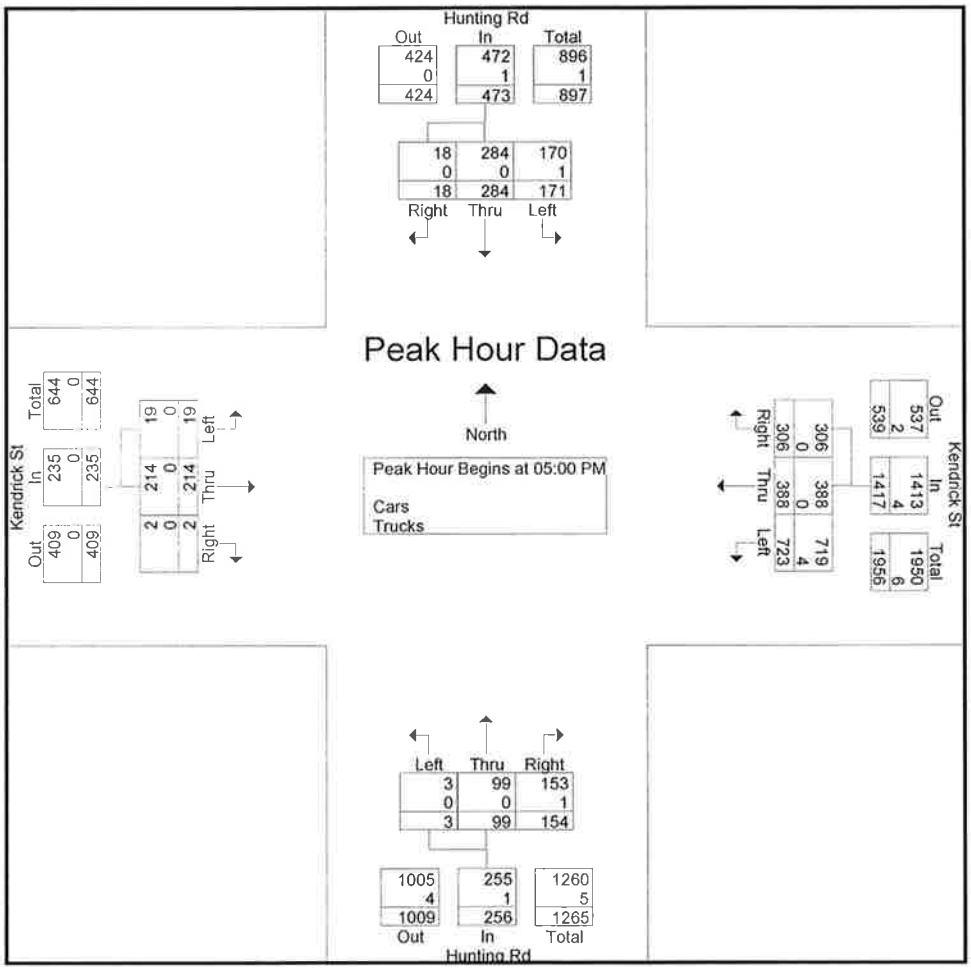
	Hunting Rd From North			Kendrick St From East			Hunting Rd From South			Kendrick St From West			
Start Time	Left	Thru	Right	Left	Thru	Right	Left	Thru	Right	Left	Thru	Right	Int. Total
04:00 PM	28	48	4	149	78	65	1	40	38	3	37	2	493
04:15 PM	31	49	2	114	87	57	1	24	30	6	61	0	462
04:30 PM	34	54	8	169	102	74	0	25	29	2	47	1	545
04:45 PM	36	59	4	149	79	69	1	23	42	5	54	1	522
Total	129	210	18	581	346	265	3	112	139	16	199	4	2022
05:00 PM	37	73	5	191	97	85	0	24	25	4	62	1	604
05:15 PM	48	75	4	183	94	88	1	22	43	6	56	1	621
05:30 PM	48	69	7	171	103	68	2	30	42	0	55	0	595
05:45 PM	38	67	2	178	94	65	0	23	44	9	41	0	561
Total	171	284	18	723	388	306	3	99	154	19	214	2	2381
Grand Total	300	494	36	1304	734	571	6	211	293	35	413	6	4403
Apprch %	36.1	59.5	4.3	50	28.1	21.9	1.2	41.4	57.5	7.7	91	1.3	
Total %	6.8	11.2	0.8	29.6	16.7	13	0.1	4.8	6.7	0.8	9.4	0.1	
Cars	299	494	36	1300	733	571	6	211	292	35	413	6	4396
% Cars	99.7	100	100	99.7	99.9	100	100	100	99.7	100	100	100	99.8
Trucks	1	0	0	4	1	0	0	0	1	0	0	0	7
% Trucks	0.3	0	0	0.3	0.1	0	0	0	0.3	0	0	0	0.2

	Hunting Rd From North				Kendrick St From East				Hunting Rd From South				Kendrick St From West				
Start Time	Left	Thru	Right	App. Total	Left	Thru	Right	App. Total	Left	Thru	Right	App. Total	Left	Thru	Right	App. Total	Int. Total
Peak Hour Analysis From 04:00 PM to 05:45 PM - Peak 1 of 1																	
Peak Hour for Entire Intersection Begins at 05:00 PM																	
05:00 PM	37	73	5	115	**191**	97	85	**373**	0	24	25	49	4	**62**	**1**	**67**	604
05:15 PM	**48**	**75**	4	**127**	183	94	**88**	365	1	22	43	66	6	56	1	63	**621**
05:30 PM	48	69	7	124	171	**103**	68	342	**2**	**30**	42	**74**	0	55	0	55	595
05:45 PM	38	67	2	107	178	94	65	337	0	23	**44**	67	**9**	41	0	50	561
Total Volume	171	284	18	473	723	388	306	1417	3	99	154	256	19	214	2	235	2381
% App. Total	36.2	60	3.8		51	27.4	21.6		1.2	38.7	60.2		8.1	91.1	0.9		
PHF	.891	.947	.643	.931	.946	.942	.869	.950	.375	.825	.875	.865	.528	.863	.500	.877	.959
Cars	170	284	18	472	719	388	306	1413	3	99	153	255	19	214	2	235	2375
% Cars	99.4	100	100	99.8	99.4	100	100	99.7	100	100	99.4	99.6	100	100	100	100	99.7
Trucks	1	0	0	1	4	0	0	4	0	0	1	1	0	0	0	0	6
% Trucks	0.6	0	0	0.2	0.6	0	0	0.3	0	0	0.6	0.4	0	0	0	0	0.3

Accurate Counts
978-664-2565

N/S Street : Hunting Road
E/W Street : Kendrick Street
City/State : Needham, MA
Weather : Cloudy

File Name : 62020001
Site Code : 62020001
Start Date : 3/20/2013
Page No : 2



Peak Hour Analysis From 04:00 PM to 05:45 PM - Peak 1 of 1
Peak Hour for Each Approach Begins at:

	05:00 PM				05:00 PM				05:00 PM				04:45 PM			
+0 mins.	37	73	5	115	**191**	97	85	**373**	0	24	25	49	5	54	**1**	60
+15 mins.	**48**	**75**	4	**127**	183	94	**88**	365	1	22	43	66	4	**62**	1	**67**
+30 mins.	48	69	**7**	124	171	**103**	68	342	**2**	**30**	42	**74**	**6**	56	1	63
+45 mins.	38	67	2	107	178	94	65	337	0	23	**44**	67	0	55	0	55
Total Volume	171	284	18	473	723	388	306	1417	3	99	154	256	15	227	3	245
% App. Total	36.2	60	3.8		51	27.4	21.6		1.2	38.7	60.2		6.1	92.7	1.2	
PHF	.891	.947	.643	.931	.946	.942	.869	.950	.375	.825	.875	.865	.625	.915	.750	.914
Cars	170	284	18	472	719	388	306	1413	3	99	153	255	15	227	3	245
% Cars	99.4	100	100	99.8	99.4	100	100	99.7	100	100	99.4	99.6	100	100	100	100
Trucks	1	0	0	1	4	0	0	4	0	0	1	1	0	0	0	0
% Trucks	0.6	0	0	0.2	0.6	0	0	0.3	0	0	0.6	0.4	0	0	0	0

Accurate Counts
978-664-2565

N/S Street : Hunting Road
E/W Street : Kendrick Street
City/State : Needham, MA
Weather : Cloudy

File Name : 62020001
Site Code : 62020001
Start Date : 3/20/2013
Page No : 1

Groups Printed- Trucks

	Hunting Rd From North			Kendrick St From East			Hunting Rd From South			Kendrick St From West			
Start Time	Left	Thru	Right	Left	Thru	Right	Left	Thru	Right	Left	Thru	Right	Int. Total
04:00 PM	0	0	0	0	0	0	0	0	0	0	0	0	0
04:15 PM	0	0	0	0	1	0	0	0	0	0	0	0	1
04:30 PM	0	0	0	0	0	0	0	0	0	0	0	0	0
04:45 PM	0	0	0	0	0	0	0	0	0	0	0	0	0
Total	0	0	0	0	1	0	0	0	0	0	0	0	1
05:00 PM	0	0	0	1	0	0	0	0	0	0	0	0	1
05:15 PM	0	0	0	0	0	0	0	0	0	0	0	0	0
05:30 PM	1	0	0	0	0	0	0	0	1	0	0	0	2
05:45 PM	0	0	0	3	0	0	0	0	0	0	0	0	3
Total	1	0	0	4	0	0	0	0	1	0	0	0	6
Grand Total	1	0	0	4	1	0	0	0	1	0	0	0	7
Apprch %	100	0	0	80	20	0	0	0	100	0	0	0	
Total %	14.3	0	0	57.1	14.3	0	0	0	14.3	0	0	0	

	Hunting Rd From North				Kendrick St From East				Hunting Rd From South				Kendrick St From West				
Start Time	Left	Thru	Right	App. Total	Left	Thru	Right	App. Total	Left	Thru	Right	App. Total	Left	Thru	Right	App. Total	Int. Total
Peak Hour Analysis From 04:00 PM to 05:45 PM - Peak 1 of 1																	
Peak Hour for Entire Intersection Begins at 05:00 PM																	
05:00 PM	0	0	0	0	1	0	0	1	0	0	0	0	0	0	0	0	1
05:15 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
05:30 PM	1	0	0	1	0	0	0	0	0	0	1	1	0	0	0	0	2
05:45 PM	0	0	0	0	3	0	0	3	0	0	0	0	0	0	0	0	3
Total Volume	1	0	0	1	4	0	0	4	0	0	1	1	0	0	0	0	6
% App. Total	100	0	0		100	0	0		0	0	100		0	0	0		
PHF	.250	.000	.000	.250	.333	.000	.000	.333	.000	.000	.250	.250	.000	.000	.000	.000	.500

Accurate Counts
978-664-2565

N/S Street : Hunting Road
E/W Street : Kendrick Street
City/State : Needham, MA
Weather : Cloudy

File Name : 62020001
Site Code : 62020001
Start Date : 3/20/2013
Page No : 1

Groups Printed- Bikes Peds

	Hunting Rd From North				Kendrick St From East				Hunting Rd From South				Kendrick St From West						
Start Time	Left	Thru	Right	Peds	Left	Thru	Right	Peds	Left	Thru	Right	Peds	Left	Thru	Right	Peds	Exclu. Total	Inclu. Total	Int. Total
04:00 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
04:15 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
04:30 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	0	1
04:45 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	0	1
05:00 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
05:15 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
05:30 PM	1	0	0	0	1	0	1	0	0	0	0	0	0	0	0	0	0	3	3
05:45 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total	1	0	0	0	1	0	1	0	0	0	0	0	0	0	0	0	0	3	3
Grand Total	1	0	0	0	1	0	1	0	0	0	0	0	0	0	0	1	1	3	4
Apprch %	100	0	0		50	0	50		0	0	0		0	0	0				
Total %	33.3	0	0		33.3	0	33.3		0	0	0		0	0	0		25	75	

	Hunting Rd From North				Kendrick St From East				Hunting Rd From South				Kendrick St From West				
Start Time	Left	Thru	Right	App. Total	Left	Thru	Right	App. Total	Left	Thru	Right	App. Total	Left	Thru	Right	App. Total	Int. Total
Peak Hour Analysis From 04:00 PM to 05:45 PM - Peak 1 of 1																	
Peak Hour for Entire Intersection Begins at 04:45 PM																	
04:45 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
05:00 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
05:15 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
05:30 PM	1	0	0	1	1	0	1	2	0	0	0	0	0	0	0	0	3
Total Volume	1	0	0	1	1	0	1	2	0	0	0	0	0	0	0	0	3
% App. Total	100	0	0		50	0	50		0	0	0		0	0	0		
PHF	.250	.000	.000	.250	.250	.000	.250	.250	.000	.000	.000	.000	.000	.000	.000	.000	.250

Accurate Counts
978-664-2565

N/S Street : Greendale Avenue
E/W Street: Bird Street
City/State : Needham, MA
Weather : Cloudy

File Name : 62020002
Site Code : 62020002
Start Date : 3/20/2013
Page No : 1

Groups Printed- Cars - Trucks

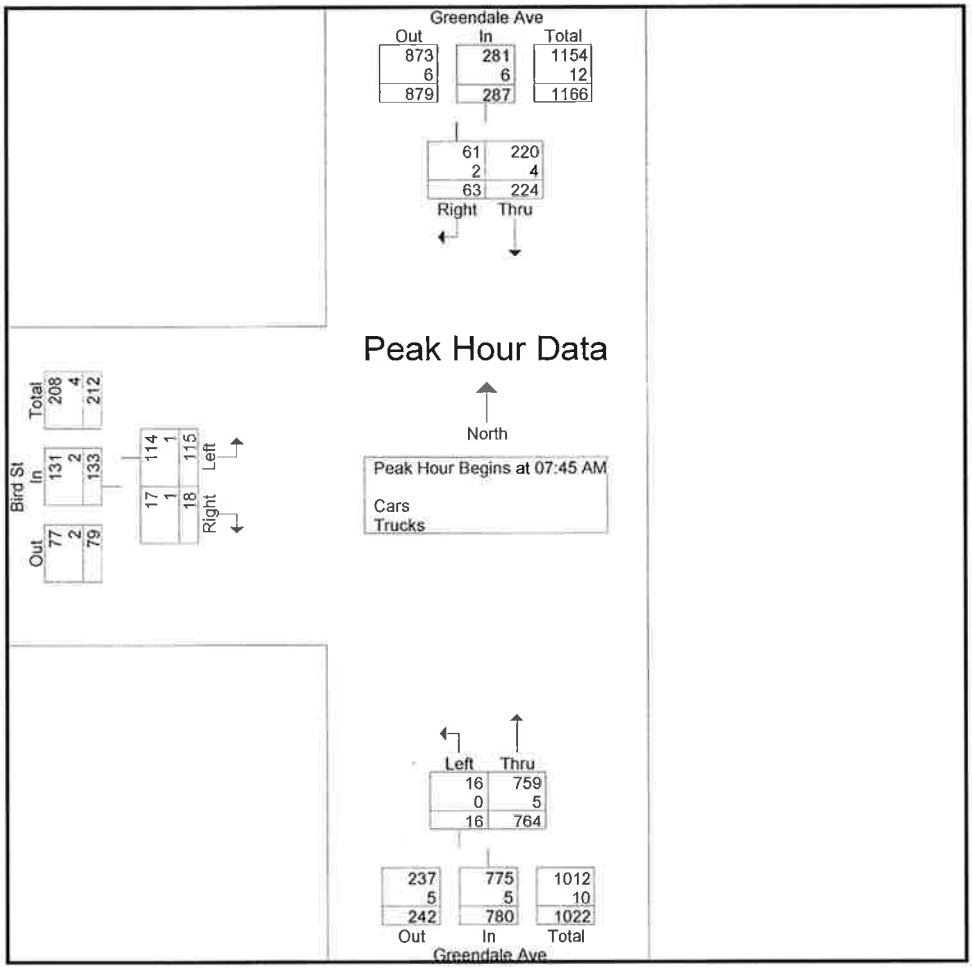
	Greendale Ave From North		Greendale Ave From South		Bird St From West		
Start Time	Thru	Right	Left	Thru	Left	Right	Int. Total
07:00 AM	27	7	1	87	11	0	133
07:15 AM	25	7	2	108	13	2	157
07:30 AM	48	18	1	169	20	1	257
07:45 AM	78	20	2	178	34	3	315
Total	178	52	6	542	78	6	862
08:00 AM	49	16	4	173	17	4	263
08:15 AM	44	17	10	207	27	5	310
08:30 AM	53	10	0	206	37	6	312
08:45 AM	58	9	2	203	19	0	291
Total	204	52	16	789	100	15	1176
Grand Total	382	104	22	1331	178	21	2038
Apprch %	78.6	21.4	1.6	98.4	89.4	10.6	
Total %	18.7	5.1	1.1	65.3	8.7	1	
Cars	375	102	21	1323	175	20	2016
% Cars	98.2	98.1	95.5	99.4	98.3	95.2	98.9
Trucks	7	2	1	8	3	1	22
% Trucks	1.8	1.9	4.5	0.6	1.7	4.8	1.1

	Greendale Ave From North			Greendale Ave From South			Bird St From West			
Start Time	Thru	Right	App. Total	Left	Thru	App. Total	Left	Right	App. Total	Int. Total
Peak Hour Analysis From 07:00 AM to 08:45 AM - Peak 1 of 1										
Peak Hour for Entire Intersection Begins at 07:45 AM										
07:45 AM	**78**	**20**	**98**	2	178	180	34	3	37	**315**
08:00 AM	49	16	65	4	173	177	17	4	21	263
08:15 AM	44	17	61	**10**	**207**	**217**	27	5	32	310
08:30 AM	53	10	63	0	206	206	**37**	**6**	**43**	312
Total Volume	224	63	287	16	764	780	115	18	133	1200
% App. Total	78	22		2.1	97.9		86.5	13.5		
PHF	.718	.788	.732	.400	.923	.899	.777	.750	.773	.952
Cars	220	61	281	16	759	775	114	17	131	1187
% Cars	98.2	96.8	97.9	100	99.3	99.4	99.1	94.4	98.5	98.9
Trucks	4	2	6	0	5	5	1	1	2	13
% Trucks	1.8	3.2	2.1	0	0.7	0.6	0.9	5.6	1.5	1.1

Accurate Counts
978-664-2565

N/S Street : Greendale Avenue
E/W Street: Bird Street
City/State : Needham, MA
Weather : Cloudy

File Name : 62020002
Site Code : 62020002
Start Date : 3/20/2013
Page No : 2



Peak Hour Analysis From 07:00 AM to 08:45 AM - Peak 1 of 1
Peak Hour for Each Approach Begins at:

	07:30 AM			08:00 AM			07:45 AM		
+0 mins.	48	18	66	4	173	177	34	3	37
+15 mins.	**78**	**20**	**98**	**10**	**207**	**217**	17	4	21
+30 mins.	49	16	65	0	206	206	27	5	32
+45 mins.	44	17	61	2	203	205	**37**	**6**	**43**
Total Volume	219	71	290	16	789	805	115	18	133
% App. Total	75.5	24.5		2	98		86.5	13.5	
PHF	.702	.888	.740	.400	.953	.927	.777	.750	.773
Cars	217	70	287	16	783	799	114	17	131
% Cars	99.1	98.6	99	100	99.2	99.3	99.1	94.4	98.5
Trucks	2	1	3	0	6	6	1	1	2
% Trucks	0.9	1.4	1	0	0.8	0.7	0.9	5.6	1.5

Accurate Counts
978-664-2565

N/S Street : Greendale Avenue
E/W Street: Bird Street
City/State : Needham, MA
Weather : Cloudy

File Name : 62020002
Site Code : 62020002
Start Date : 3/20/2013
Page No : 1

Groups Printed- Trucks

	Greendale Ave From North		Greendale Ave From South		Bird St From West		
Start Time	Thru	Right	Left	Thru	Left	Right	Int. Total
07:00 AM	1	0	1	1	1	0	4
07:15 AM	1	0	0	1	0	0	2
07:30 AM	0	0	0	0	1	0	1
07:45 AM	1	0	0	0	0	0	1
Total	3	0	1	2	2	0	8
08:00 AM	0	1	0	1	1	0	3
08:15 AM	1	0	0	2	0	1	4
08:30 AM	2	1	0	2	0	0	5
08:45 AM	1	0	0	1	0	0	2
Total	4	2	0	6	1	1	14
Grand Total	7	2	1	8	3	1	22
Apprch %	77.8	22.2	11.1	88.9	75	25	
Total %	31.8	9.1	4.5	36.4	13.6	4.5	

	Greendale Ave From North			Greendale Ave From South			Bird St From West			
Start Time	Thru	Right	App. Total	Left	Thru	App. Total	Left	Right	App. Total	Int. Total
Peak Hour Analysis From 07:00 AM to 08:45 AM - Peak 1 of 1										
Peak Hour for Entire Intersection Begins at 08:00 AM										
08:00 AM	0	1	1	0	1	1	1	0	1	3
08:15 AM	1	0	1	0	2	2	0	1	1	4
08:30 AM	2	1	3	0	2	2	0	0	0	5
08:45 AM	1	0	1	0	1	1	0	0	0	2
Total Volume	4	2	6	0	6	6	1	1	2	14
% App. Total	66.7	33.3		0	100		50	50		
PHF	.500	.500	.500	.000	.750	.750	.250	.250	.500	.700

Accurate Counts
978-664-2565

N/S Street : Greendale Avenue
E/W Street: Bird Street
City/State : Needham, MA
Weather : Cloudy

File Name : 62020002
Site Code : 62020002
Start Date : 3/20/2013
Page No : 1

Groups Printed- Bikes Peds

	Greendale Ave From North			Greendale Ave From South			Bird St From West					
Start Time	Thru	Right	Peds	Left	Thru	Peds	Left	Right	Peds	Exclu. Total	Inclu. Total	Int. Total
07:00 AM	0	0	0	0	0	0	0	0	0	0	0	0
07:15 AM	0	0	0	0	0	0	0	0	1	1	0	1
07:30 AM	0	0	0	0	0	0	0	0	0	0	0	0
07:45 AM	0	0	0	0	0	0	0	0	0	0	0	0
Total	0	0	0	0	0	0	0	0	1	1	0	1
08:00 AM	0	0	0	0	0	0	0	0	0	0	0	0
08:15 AM	0	0	0	0	0	0	0	0	0	0	0	0
08:30 AM	0	0	0	0	0	0	0	0	0	0	0	0
08:45 AM	0	0	0	0	0	0	0	0	0	0	0	0
Total	0	0	0	0	0	0	0	0	0	0	0	0
Grand Total	0	0	0	0	0	0	0	0	1	1	0	1
Apprch %	0	0		0	0		0	0				
Total %										100	0	

	Greendale Ave From North			Greendale Ave From South			Bird St From West			
Start Time	Thru	Right	App. Total	Left	Thru	App. Total	Left	Right	App. Total	Int. Total
Peak Hour Analysis From 07:00 AM to 08:45 AM - Peak 1 of 1										
Peak Hour for Entire Intersection Begins at 07:00 AM										
07:00 AM	0	0	0	0	0	0	0	0	0	0
07:15 AM	0	0	0	0	0	0	0	0	0	0
07:30 AM	0	0	0	0	0	0	0	0	0	0
07:45 AM	0	0	0	0	0	0	0	0	0	0
Total Volume	0	0	0	0	0	0	0	0	0	0
% App. Total	0	0		0	0		0	0		
PHF	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000

Accurate Counts
978-664-2565

N/S Street : Greendale Avenue
E/W Street: Bird Street
City/State : Needham, MA
Weather : Cloudy

File Name : 62020002
Site Code : 62020002
Start Date : 3/20/2013
Page No : 1

Groups Printed- Cars - Trucks

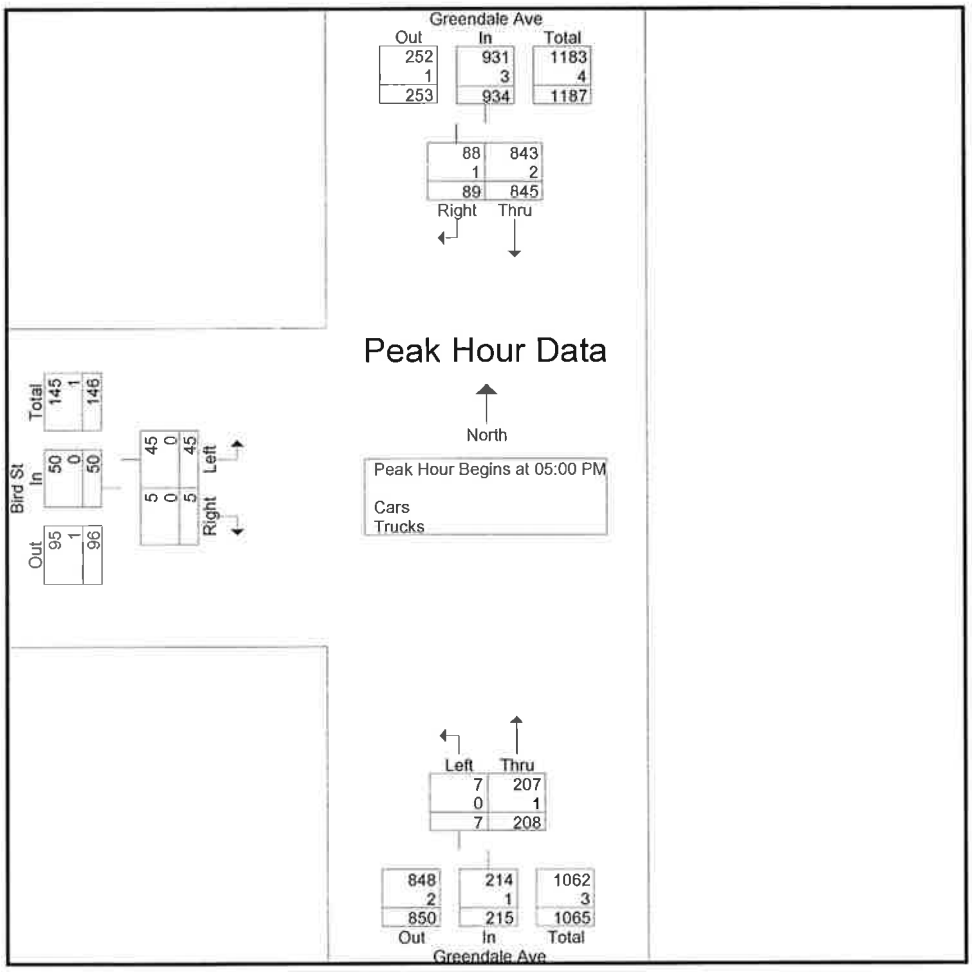
	Greendale Ave From North		Greendale Ave From South		Bird St From West		
Start Time	Thru	Right	Left	Thru	Left	Right	Int. Total
04:00 PM	159	14	1	50	7	0	231
04:15 PM	155	12	1	40	10	0	218
04:30 PM	179	8	0	51	6	1	245
04:45 PM	174	15	0	44	6	3	242
Total	667	49	2	185	29	4	936
05:00 PM	220	16	0	37	11	2	286
05:15 PM	213	25	4	62	9	1	314
05:30 PM	198	20	2	61	13	2	296
05:45 PM	214	28	1	48	12	0	303
Total	845	89	7	208	45	5	1199
Grand Total	1512	138	9	393	74	9	2135
Apprch %	91.6	8.4	2.2	97.8	89.2	10.8	
Total %	70.8	6.5	0.4	18.4	3.5	0.4	
Cars	1509	137	9	391	74	9	2129
% Cars	99.8	99.3	100	99.5	100	100	99.7
Trucks	3	1	0	2	0	0	6
% Trucks	0.2	0.7	0	0.5	0	0	0.3

	Greendale Ave From North			Greendale Ave From South			Bird St From West			
Start Time	Thru	Right	App. Total	Left	Thru	App. Total	Left	Right	App. Total	Int. Total
Peak Hour Analysis From 04:00 PM to 05:45 PM - Peak 1 of 1										
Peak Hour for Entire Intersection Begins at 05:00 PM										
05:00 PM	**220**	16	236	0	37	37	11	**2**	13	286
05:15 PM	213	25	238	**4**	**62**	**66**	9	1	10	**314**
05:30 PM	198	20	218	2	61	63	**13**	2	**15**	296
05:45 PM	214	**28**	**242**	1	48	49	12	0	12	303
Total Volume	845	89	934	7	208	215	45	5	50	1199
% App. Total	90.5	9.5		3.3	96.7		90	10		
PHF	.960	.795	.965	.438	.839	.814	.865	.625	.833	.955
Cars	843	88	931	7	207	214	45	5	50	1195
% Cars	99.8	98.9	99.7	100	99.5	99.5	100	100	100	99.7
Trucks	2	1	3	0	1	1	0	0	0	4
% Trucks	0.2	1.1	0.3	0	0.5	0.5	0	0	0	0.3

Accurate Counts
978-664-2565

N/S Street : Greendale Avenue
E/W Street: Bird Street
City/State : Needham, MA
Weather : Cloudy

File Name : 62020002
Site Code : 62020002
Start Date : 3/20/2013
Page No : 2



Peak Hour Analysis From 04:00 PM to 05:45 PM - Peak 1 of 1
Peak Hour for Each Approach Begins at:

	05:00 PM			05:00 PM			05:00 PM		
+0 mins.	**220**	16	236	0	37	37	11	**2**	13
+15 mins.	213	25	238	**4**	**62**	**66**	9	1	10
+30 mins.	198	20	218	2	61	63	**13**	2	**15**
+45 mins.	214	**28**	**242**	1	48	49	12	0	12
Total Volume	845	89	934	7	208	215	45	5	50
% App. Total	90.5	9.5		3.3	96.7		90	10	
PHF	.960	.795	.965	.438	.839	.814	.865	.625	.833
Cars	843	88	931	7	207	214	45	5	50
% Cars	99.8	98.9	99.7	100	99.5	99.5	100	100	100
Trucks	2	1	3	0	1	1	0	0	0
% Trucks	0.2	1.1	0.3	0	0.5	0.5	0	0	0

Accurate Counts
978-664-2565

N/S Street : Greendale Avenue
E/W Street: Bird Street
City/State : Needham, MA
Weather : Cloudy

File Name : 62020002
Site Code : 62020002
Start Date : 3/20/2013
Page No : 1

Groups Printed- Trucks

	Greendale Ave From North		Greendale Ave From South		Bird St From West		
Start Time	Thru	Right	Left	Thru	Left	Right	Int. Total
04:00 PM	0	0	0	1	0	0	1
04:15 PM	1	0	0	0	0	0	1
04:30 PM	0	0	0	0	0	0	0
04:45 PM	0	0	0	0	0	0	0
Total	1	0	0	1	0	0	2
05:00 PM	0	0	0	0	0	0	0
05:15 PM	0	0	0	0	0	0	0
05:30 PM	0	0	0	1	0	0	1
05:45 PM	2	1	0	0	0	0	3
Total	2	1	0	1	0	0	4
Grand Total	3	1	0	2	0	0	6
Apprch %	75	25	0	100	0	0	
Total %	50	16.7	0	33.3	0	0	

	Greendale Ave From North			Greendale Ave From South			Bird St From West			
Start Time	Thru	Right	App. Total	Left	Thru	App. Total	Left	Right	App. Total	Int. Total
Peak Hour Analysis From 04:00 PM to 05:45 PM - Peak 1 of 1										
Peak Hour for Entire Intersection Begins at 05:00 PM										
05:00 PM	0	0	0	0	0	0	0	0	0	0
05:15 PM	0	0	0	0	0	0	0	0	0	0
05:30 PM	0	0	0	0	1	1	0	0	0	1
05:45 PM	2	1	3	0	0	0	0	0	0	3
Total Volume	2	1	3	0	1	1	0	0	0	4
% App. Total	66.7	33.3		0	100		0	0		
PHF	.250	.250	.250	.000	.250	.250	.000	.000	.000	.333

Accurate Counts
978-664-2565

N/S Street : Greendale Avenue
E/W Street: Bird Street
City/State : Needham, MA
Weather : Cloudy

File Name : 62020002
Site Code : 62020002
Start Date : 3/20/2013
Page No : 1

Groups Printed- Bikes Peds

	Greendale Ave From North			Greendale Ave From South			Bird St From West					
Start Time	Thru	Right	Peds	Left	Thru	Peds	Left	Right	Peds	Exclu. Total	Inclu. Total	Int. Total
04:00 PM	0	0	0	0	0	0	0	0	0	0	0	0
04:15 PM	0	0	0	0	0	0	0	0	0	0	0	0
04:30 PM	0	0	0	0	0	0	0	0	0	0	0	0
04:45 PM	0	0	0	0	0	0	0	0	0	0	0	0
Total	0	0	0	0	0	0	0	0	0	0	0	0
05:00 PM	0	0	0	0	0	0	0	0	2	2	0	2
05:15 PM	0	0	0	0	0	0	0	0	0	0	0	0
05:30 PM	0	0	0	0	0	0	0	0	0	0	0	0
05:45 PM	0	0	0	0	0	0	0	0	0	0	0	0
Total	0	0	0	0	0	0	0	0	2	2	0	2
Grand Total	0	0	0	0	0	0	0	0	2	2	0	2
Apprch %	0	0		0	0		0	0				
Total %										100	0	

	Greendale Ave From North			Greendale Ave From South			Bird St From West			
Start Time	Thru	Right	App. Total	Left	Thru	App. Total	Left	Right	App. Total	Int. Total
Peak Hour Analysis From 04:00 PM to 05:45 PM - Peak 1 of 1										
Peak Hour for Entire Intersection Begins at 04:00 PM										
04:00 PM	0	0	0	0	0	0	0	0	0	0
04:15 PM	0	0	0	0	0	0	0	0	0	0
04:30 PM	0	0	0	0	0	0	0	0	0	0
04:45 PM	0	0	0	0	0	0	0	0	0	0
Total Volume	0	0	0	0	0	0	0	0	0	0
% App. Total	0	0		0	0		0	0		
PHF	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000

Accurate Counts
978-664-2565

N/S Street : Greendale Avenue
E/W Street : Great Plain Avenue
City/State : Needham, MA
Weather : Cloudy

File Name : 62020003
Site Code : 62020003
Start Date : 3/20/2013
Page No : 1

Groups Printed- Cars - Trucks

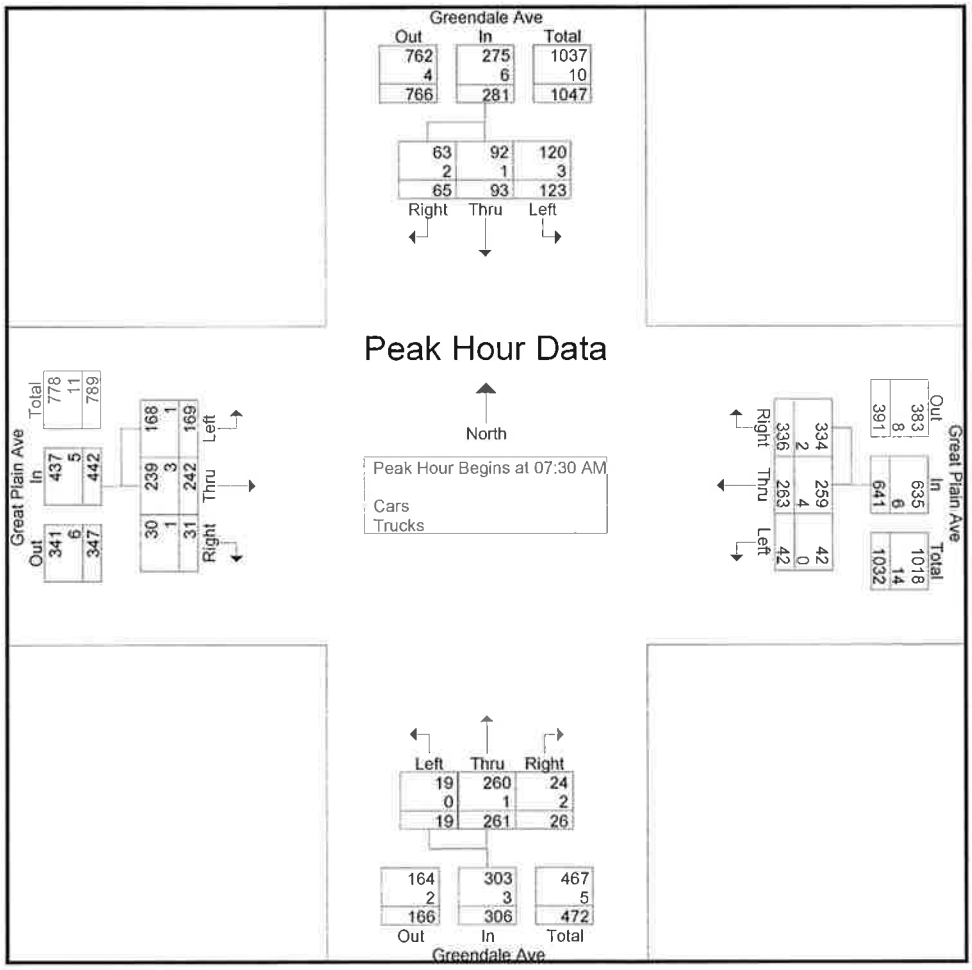
	Greendale Ave From North			Great Plain Ave From East			Greendale Ave From South			Great Plain Ave From West			
Start Time	Left	Thru	Right	Left	Thru	Right	Left	Thru	Right	Left	Thru	Right	Int. Total
07:00 AM	18	10	4	2	25	40	5	18	5	16	32	0	175
07:15 AM	21	12	6	6	53	53	13	40	3	29	39	11	286
07:30 AM	21	17	23	5	63	70	2	38	10	36	70	8	363
07:45 AM	25	41	17	13	58	96	3	47	2	36	63	9	410
Total	85	80	50	26	199	259	23	143	20	117	204	28	1234
08:00 AM	31	14	13	11	84	87	4	74	2	52	46	8	426
08:15 AM	46	21	12	13	58	83	10	102	12	45	63	6	471
08:30 AM	29	19	12	10	45	66	7	71	4	29	45	9	346
08:45 AM	21	20	10	8	43	90	6	86	5	43	31	22	385
Total	127	74	47	42	230	326	27	333	23	169	185	45	1628
Grand Total	212	154	97	68	429	585	50	476	43	286	389	73	2862
Apprch %	45.8	33.3	21	6.3	39.6	54.1	8.8	83.7	7.6	38.2	52	9.8	
Total %	7.4	5.4	3.4	2.4	15	20.4	1.7	16.6	1.5	10	13.6	2.6	
Cars	208	152	93	67	423	582	49	474	40	284	381	72	2825
% Cars	98.1	98.7	95.9	98.5	98.6	99.5	98	99.6	93	99.3	97.9	98.6	98.7
Trucks	4	2	4	1	6	3	1	2	3	2	8	1	37
% Trucks	1.9	1.3	4.1	1.5	1.4	0.5	2	0.4	7	0.7	2.1	1.4	1.3

	Greendale Ave From North				Great Plain Ave From East				Greendale Ave From South				Great Plain Ave From West				
Start Time	Left	Thru	Right	App. Total	Left	Thru	Right	App. Total	Left	Thru	Right	App. Total	Left	Thru	Right	App. Total	Int. Total
Peak Hour Analysis From 07:00 AM to 08:45 AM - Peak 1 of 1																	
Peak Hour for Entire Intersection Begins at 07:30 AM																	
07:30 AM	21	17	23	61	5	63	70	138	2	38	10	50	36	70	8	114	363
07:45 AM	25	41	17	83	13	58	96	167	3	47	2	52	36	63	9	108	410
08:00 AM	31	14	13	58	11	84	87	182	4	74	2	80	52	46	8	106	426
08:15 AM	46	21	12	79	13	58	83	154	10	102	12	124	45	63	6	114	471
Total Volume	123	93	65	281	42	263	336	641	19	261	26	306	169	242	31	442	1670
% App. Total	43.8	33.1	23.1		6.6	41	52.4		6.2	85.3	8.5		38.2	54.8	7		
PHF	.668	.567	.707	.846	.808	.783	.875	.880	.475	.640	.542	.617	.813	.864	.861	.969	.886
Cars	120	92	63	275	42	259	334	635	19	260	24	303	168	239	30	437	1650
% Cars	97.6	98.9	96.9	97.9	100	98.5	99.4	99.1	100	99.6	92.3	99.0	99.4	98.8	96.8	98.9	98.8
Trucks	3	1	2	6	0	4	2	6	0	1	2	3	1	3	1	5	20
% Trucks	2.4	1.1	3.1	2.1	0	1.5	0.6	0.9	0	0.4	7.7	1.0	0.6	1.2	3.2	1.1	1.2

Accurate Counts
978-664-2565

N/S Street : Greendale Avenue
E/W Street : Great Plain Avenue
City/State : Needham, MA
Weather : Cloudy

File Name : 62020003
Site Code : 62020003
Start Date : 3/20/2013
Page No : 2



Peak Hour Analysis From 07:00 AM to 08:45 AM - Peak 1 of 1
Peak Hour for Each Approach Begins at:

	07:30 AM				07:30 AM				08:00 AM				07:30 AM			
+0 mins.	21	**17**	**23**	61	5	63	70	138	4	74	2	80	36	**70**	8	**114**
+15 mins.	25	**41**	17	**83**	**13**	58	**96**	167	**10**	**102**	**12**	**124**	36	63	**9**	108
+30 mins.	31	**14**	13	58	11	**84**	87	**182**	7	71	4	82	**52**	46	8	106
+45 mins.	**46**	21	12	79	13	58	83	154	6	86	5	97	45	63	6	114
Total Volume	123	93	65	281	42	263	336	641	27	333	23	383	169	242	31	442
% App. Total	43.8	33.1	23.1		6.6	41	52.4		7	86.9	6		38.2	54.8	7	
PHF	.668	.567	.707	.846	.808	.783	.875	.880	.675	.816	.479	.772	.813	.864	.861	.969
Cars	120	92	63	275	42	259	334	635	27	333	20	380	168	239	30	437
% Cars	97.6	98.9	96.9	97.9	100	98.5	99.4	99.1	100	100	87	99.2	99.4	98.8	96.8	98.9
Trucks	3	1	2	6	0	4	2	6	0	0	3	3	1	3	1	5
% Trucks	2.4	1.1	3.1	2.1	0	1.5	0.6	0.9	0	0	13	0.8	0.6	1.2	3.2	1.1

Accurate Counts
978-664-2565

N/S Street : Greendale Avenue
E/W Street : Great Plain Avenue
City/State : Needham, MA
Weather : Cloudy

File Name : 62020003
Site Code : 62020003
Start Date : 3/20/2013
Page No : 1

Groups Printed- Trucks

	Greendale Ave From North			Great Plain Ave From East			Greendale Ave From South			Great Plain Ave From West			
Start Time	Left	Thru	Right	Left	Thru	Right	Left	Thru	Right	Left	Thru	Right	Int. Total
07:00 AM	0	1	0	0	0	0	1	0	0	0	1	0	3
07:15 AM	1	0	1	0	2	0	0	1	0	0	0	0	5
07:30 AM	1	1	0	0	1	0	0	0	0	1	1	0	5
07:45 AM	0	0	0	0	1	1	0	1	0	0	2	0	5
Total	2	2	1	0	4	1	1	2	0	1	4	0	18
08:00 AM	0	0	0	0	1	1	0	0	0	0	0	1	3
08:15 AM	2	0	2	0	1	0	0	0	2	0	0	0	7
08:30 AM	0	0	0	1	0	0	0	0	0	1	3	0	5
08:45 AM	0	0	1	0	0	1	0	0	1	0	1	0	4
Total	2	0	3	1	2	2	0	0	3	1	4	1	19
Grand Total	4	2	4	1	6	3	1	2	3	2	8	1	37
Apprch %	40	20	40	10	60	30	16.7	33.3	50	18.2	72.7	9.1	
Total %	10.8	5.4	10.8	2.7	16.2	8.1	2.7	5.4	8.1	5.4	21.6	2.7	

	Greendale Ave From North				Great Plain Ave From East				Greendale Ave From South				Great Plain Ave From West				
Start Time	Left	Thru	Right	App. Total	Left	Thru	Right	App. Total	Left	Thru	Right	App. Total	Left	Thru	Right	App. Total	Int. Total
Peak Hour Analysis From 07:00 AM to 08:45 AM - Peak 1 of 1																	
Peak Hour for Entire Intersection Begins at 07:30 AM																	
07:30 AM	1	1	0	2	0	1	0	1	0	0	0	0	1	1	0	2	5
07:45 AM	0	0	0	0	0	1	1	2	0	1	0	1	0	2	0	2	5
08:00 AM	0	0	0	0	0	1	1	2	0	0	0	0	0	0	1	1	3
08:15 AM	2	0	2	4	0	1	0	1	0	0	2	2	0	0	0	0	7
Total Volume	3	1	2	6	0	4	2	6	0	1	2	3	1	3	1	5	20
% App. Total	50	16.7	33.3		0	66.7	33.3		0	33.3	66.7		20	60	20		
PHF	.375	.250	.250	.375	.000	1.00	.500	.750	.000	.250	.250	.375	.250	.375	.250	.625	.714

Accurate Counts
978-664-2565

N/S Street : Greendale Avenue
E/W Street : Great Plain Avenue
City/State : Needham, MA
Weather : Cloudy

File Name : 62020003
Site Code : 62020003
Start Date : 3/20/2013
Page No : 1

Groups Printed- Bikes Peds

	Greendale Ave From North				Great Plain Ave From East				Greendale Ave From South				Great Plain Ave From West						
Start Time	Left	Thru	Right	Peds	Left	Thru	Right	Peds	Left	Thru	Right	Peds	Left	Thru	Right	Peds	Exclu. Total	Inclu. Total	Int. Total
07:00 AM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
07:15 AM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
07:30 AM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
07:45 AM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
08:00 AM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
08:15 AM	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	1	1
08:30 AM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
08:45 AM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	1	1
Grand Total	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	1	1
Apprch %	0	0	0		0	0	0		0	0	0		100	0	0				
Total %	0	0	0		0	0	0		0	0	0		100	0	0		0	100	

	Greendale Ave From North				Great Plain Ave From East				Greendale Ave From South				Great Plain Ave From West				
Start Time	Left	Thru	Right	App. Total	Left	Thru	Right	App. Total	Left	Thru	Right	App. Total	Left	Thru	Right	App. Total	Int. Total
Peak Hour Analysis From 07:00 AM to 08:45 AM - Peak 1 of 1																	
Peak Hour for Entire Intersection Begins at 07:30 AM																	
07:30 AM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
07:45 AM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
08:00 AM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
08:15 AM	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	1	1
Total Volume	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	1	1
% App. Total	0	0	0		0	0	0		0	0	0		100	0	0		
PHF	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.250	.000	.000	.250	.250

Accurate Counts
978-664-2565

N/S Street : Greendale Avenue
E/W Street : Great Plain Avenue
City/State : Needham, MA
Weather : Cloudy

File Name : 62020003
Site Code : 62020003
Start Date : 3/20/2013
Page No : 1

Groups Printed- Cars - Trucks

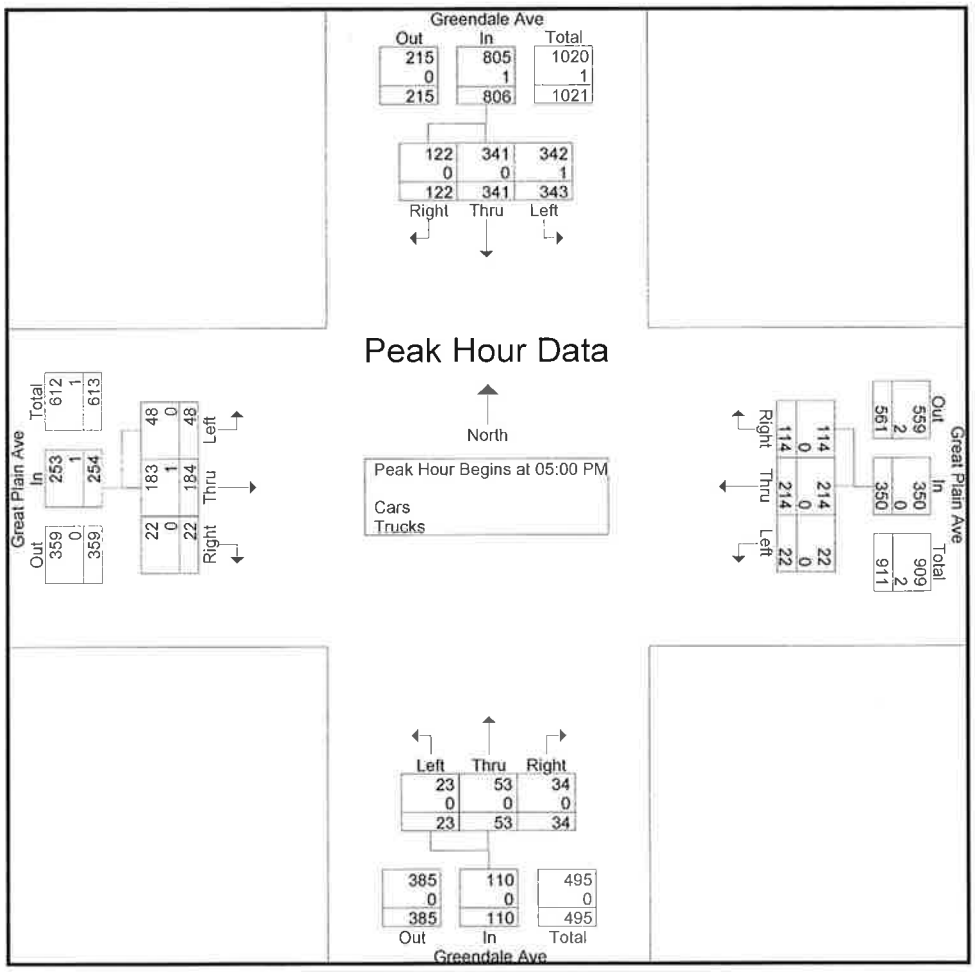
	Greendale Ave From North			Great Plain Ave From East			Greendale Ave From South			Great Plain Ave From West			
Start Time	Left	Thru	Right	Left	Thru	Right	Left	Thru	Right	Left	Thru	Right	Int. Total
04:00 PM	72	60	19	3	40	23	6	10	8	15	41	5	302
04:15 PM	81	50	31	3	36	23	4	12	7	7	50	7	311
04:30 PM	68	71	30	2	45	17	3	18	6	10	53	4	327
04:45 PM	64	78	34	3	58	18	5	10	4	9	34	3	320
Total	285	259	114	11	179	81	18	50	25	41	178	19	1260
05:00 PM	89	89	30	5	43	17	2	14	15	12	45	4	365
05:15 PM	97	84	33	8	53	33	6	12	9	16	46	3	400
05:30 PM	97	79	23	5	52	31	11	15	5	9	41	8	376
05:45 PM	60	89	36	4	66	33	4	12	5	11	52	7	379
Total	343	341	122	22	214	114	23	53	34	48	184	22	1520
Grand Total	628	600	236	33	393	195	41	103	59	89	362	41	2780
Apprch %	42.9	41	16.1	5.3	63.3	31.4	20.2	50.7	29.1	18.1	73.6	8.3	
Total %	22.6	21.6	8.5	1.2	14.1	7	1.5	3.7	2.1	3.2	13	1.5	
Cars	626	600	236	33	393	195	41	103	59	88	361	41	2776
% Cars	99.7	100	100	100	100	100	100	100	100	98.9	99.7	100	99.9
Trucks	2	0	0	0	0	0	0	0	0	1	1	0	4
% Trucks	0.3	0	0	0	0	0	0	0	0	1.1	0.3	0	0.1

	Greendale Ave From North				Great Plain Ave From East				Greendale Ave From South				Great Plain Ave From West				
Start Time	Left	Thru	Right	App. Total	Left	Thru	Right	App. Total	Left	Thru	Right	App. Total	Left	Thru	Right	App. Total	Int. Total
Peak Hour Analysis From 04:00 PM to 05:45 PM - Peak 1 of 1																	
Peak Hour for Entire Intersection Begins at 05:00 PM																	
05:00 PM	89	**89**	30	208	5	43	17	65	2	14	**15**	**31**	12	45	4	61	365
05:15 PM	**97**	84	33	**214**	**8**	53	**33**	94	6	12	9	27	**16**	46	3	65	**400**
05:30 PM	97	79	23	199	5	52	31	88	**11**	**15**	5	31	9	41	**8**	58	376
05:45 PM	60	89	**36**	185	4	**66**	**33**	**103**	4	12	5	21	11	**52**	7	**70**	379
Total Volume	343	341	122	806	22	214	114	350	23	53	34	110	48	184	22	254	1520
% App. Total	42.6	42.3	15.1		6.3	61.1	32.6		20.9	48.2	30.9		18.9	72.4	8.7		
PHF	.884	.958	.847	.942	.688	.811	.864	.850	.523	.883	.567	.887	.750	.885	.688	.907	.950
Cars	342	341	122	805	22	214	114	350	23	53	34	110	48	183	22	253	1518
% Cars	99.7	100	100	99.9	100	100	100	100	100	100	100	100	100	99.5	100	99.6	99.9
Trucks	1	0	0	1	0	0	0	0	0	0	0	0	0	1	0	1	2
% Trucks	0.3	0	0	0.1	0	0	0	0	0	0	0	0	0	0.5	0	0.4	0.1

Accurate Counts
978-664-2565

N/S Street : Greendale Avenue
E/W Street : Great Plain Avenue
City/State : Needham, MA
Weather : Cloudy

File Name : 62020003
Site Code : 62020003
Start Date : 3/20/2013
Page No : 2



Peak Hour Analysis From 04:00 PM to 05:45 PM - Peak 1 of 1
Peak Hour for Each Approach Begins at:

	05:00 PM				05:00 PM				05:00 PM				05:00 PM			
+0 mins.	89	**89**	30	208	5	43	17	65	2	14	**15**	**31**	12	45	4	61
+15 mins.	**97**	84	33	**214**	**8**	53	**33**	94	6	12	9	27	**16**	46	3	65
+30 mins.	97	79	23	199	5	52	31	88	**11**	**15**	5	31	9	41	**8**	58
+45 mins.	60	89	**36**	185	4	**66**	33	**103**	4	12	5	21	11	**52**	7	**70**
Total Volume	343	341	122	806	22	214	114	350	23	53	34	110	48	184	22	254
% App. Total	42.6	42.3	15.1		6.3	61.1	32.6		20.9	48.2	30.9		18.9	72.4	8.7	
PHF	.884	.958	.847	.942	.688	.811	.864	.850	.523	.883	.567	.887	.750	.885	.688	.907
Cars	342	341	122	805	22	214	114	350	23	53	34	110	48	183	22	253
% Cars	99.7	100	100	99.9	100	100	100	100	100	100	100	100	100	99.5	100	99.6
Trucks	1	0	0	1	0	0	0	0	0	0	0	0	0	1	0	1
% Trucks	0.3	0	0	0.1	0	0	0	0	0	0	0	0	0	0.5	0	0.4

Accurate Counts
978-664-2565

N/S Street : Greendale Avenue
E/W Street : Great Plain Avenue
City/State : Needham, MA
Weather : Cloudy

File Name : 62020003
Site Code : 62020003
Start Date : 3/20/2013
Page No : 1

Groups Printed- Trucks

	Greendale Ave From North			Great Plain Ave From East			Greendale Ave From South			Great Plain Ave From West			
Start Time	Left	Thru	Right	Left	Thru	Right	Left	Thru	Right	Left	Thru	Right	Int. Total
04:00 PM	0	0	0	0	0	0	0	0	0	1	0	0	1
04:15 PM	1	0	0	0	0	0	0	0	0	0	0	0	1
04:30 PM	0	0	0	0	0	0	0	0	0	0	0	0	0
04:45 PM	0	0	0	0	0	0	0	0	0	0	0	0	0
Total	1	0	0	0	0	0	0	0	0	1	0	0	2
05:00 PM	0	0	0	0	0	0	0	0	0	0	0	0	0
05:15 PM	0	0	0	0	0	0	0	0	0	0	0	0	0
05:30 PM	0	0	0	0	0	0	0	0	0	0	0	0	0
05:45 PM	1	0	0	0	0	0	0	0	0	0	1	0	2
Total	1	0	0	0	0	0	0	0	0	0	1	0	2
Grand Total	2	0	0	0	0	0	0	0	0	1	1	0	4
Apprch %	100	0	0	0	0	0	0	0	0	50	50	0	
Total %	50	0	0	0	0	0	0	0	0	25	25	0	

	Greendale Ave From North				Great Plain Ave From East				Greendale Ave From South				Great Plain Ave From West				
Start Time	Left	Thru	Right	App. Total	Left	Thru	Right	App. Total	Left	Thru	Right	App. Total	Left	Thru	Right	App. Total	Int. Total
Peak Hour Analysis From 04:00 PM to 05:45 PM - Peak 1 of 1																	
Peak Hour for Entire Intersection Begins at 04:00 PM																	
04:00 PM	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	1	1
04:15 PM	1	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	1
04:30 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
04:45 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total Volume	1	0	0	1	0	0	0	0	0	0	0	0	1	0	0	1	2
% App. Total	100	0	0		0	0	0		0	0	0		100	0	0		
PHF	.250	.000	.000	.250	.000	.000	.000	.000	.000	.000	.000	.000	.250	.000	.000	.250	.500

Accurate Counts
978-664-2565

N/S Street : Greendale Avenue
E/W Street : Great Plain Avenue
City/State : Needham, MA
Weather : Cloudy

File Name : 62020003
Site Code : 62020003
Start Date : 3/20/2013
Page No : 1

Groups Printed- Bikes Peds

	Greendale Ave From North				Great Plain Ave From East				Greendale Ave From South				Great Plain Ave From West						
Start Time	Left	Thru	Right	Peds	Left	Thru	Right	Peds	Left	Thru	Right	Peds	Left	Thru	Right	Peds	Exclu. Total	Inclu. Total	Int. Total
04:00 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
04:15 PM	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	1	0	1
04:30 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
04:45 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	1	0	1
05:00 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
05:15 PM	0	0	0	3	0	0	0	0	0	0	0	0	0	0	0	0	3	0	3
05:30 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
05:45 PM	0	0	0	1	0	1	0	0	0	0	0	0	1	0	0	0	1	2	3
Total	0	0	0	4	0	1	0	0	0	0	0	0	1	0	0	0	4	2	6
Grand Total	0	0	0	4	0	1	0	0	0	0	0	1	1	0	0	0	5	2	7
Apprch %	0	0	0		0	100	0		0	0	0		100	0	0				
Total %	0	0	0		0	50	0		0	0	0		50	0	0		71.4	28.6	

	Greendale Ave From North				Great Plain Ave From East				Greendale Ave From South				Great Plain Ave From West				
Start Time	Left	Thru	Right	App. Total	Left	Thru	Right	App. Total	Left	Thru	Right	App. Total	Left	Thru	Right	App. Total	Int. Total
Peak Hour Analysis From 04:00 PM to 05:45 PM - Peak 1 of 1																	
Peak Hour for Entire Intersection Begins at 05:00 PM																	
05:00 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
05:15 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
05:30 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
05:45 PM	0	0	0	0	0	1	0	1	0	0	0	0	1	0	0	1	2
Total Volume	0	0	0	0	0	1	0	1	0	0	0	0	1	0	0	1	2
% App. Total	0	0	0		0	100	0		0	0	0		100	0	0		
PHF	.000	.000	.000	.000	.000	.250	.000	.250	.000	.000	.000	.000	.250	.000	.000	.250	.250

SEASONAL ADJUSTMENT DATA

MASSACHUSETTS HIGHWAY DEPARTMENT - STATEWIDE TRAFFIC DATA COLLECTION

2007 WEEKDAY SEASONAL FACTORS *

* Note: These are weekday factors. The average of the factors for the year will not equal 1, as weekend data are not considered.

FACTOR GROUP	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
GROUP 1 - WEST INTERSTATE	0.95	0.91	0.85	0.85	0.87	0.86	0.91	0.96	0.90	0.88	0.90	0.91
GROUP 2 - RURAL MAJOR COLLECTOR (R-5)	1.11	1.07	1.07	0.98	0.92	0.88	0.88	0.86	0.89	0.93	1.01	1.04
GROUP 3A - RECREATIONAL **(1-4) See below	1.26	1.20	1.18	1.04	0.96	0.86	0.78	0.79	0.93	0.99	1.07	1.12
GROUP 3B - RECREATIONAL ***(5) See below	1.22	1.18	1.20	1.04	0.96	0.88	0.73	0.74	0.99	1.02	1.12	1.17
GROUP 4 - I-495 INTERSTATE	1.05	1.03	1.03	0.95	0.93	0.87	0.86	0.83	0.89	0.93	0.93	0.96
GROUP 5 - EAST INTERSTATE	1.02	0.99	0.97	0.94	0.95	0.91	0.92	0.92	0.94	0.94	0.98	0.99
GROUP 6 - URBAN ARTERIALS, COLLECTORS & RURAL ARTERIALS (R-2, R-3)	1.03	0.99	0.97	0.92	0.91	0.90	0.92	0.91	0.92	0.93	0.97	0.97
GROUP 7 - I-84 PROXIMITY (STA. 17)	0.84	1.15	1.17	1.08	1.10	1.02	1.01	0.96	1.06	1.06	1.11	1.15
GROUP 8 - I-295 PROXIMITY (STA. 6590)	0.95	1.01	0.96	0.92	0.89	0.88	0.91	0.86	0.91	0.93	0.95	0.92
GROUP 9 - I-195 PROXIMITY (STA. 7)	1.10	1.03	1.00	0.94	0.91	0.87	0.84	0.82	0.88	0.93	1.03	0.99

RECREATIONAL: (ALL YEARS)

**GROUP 3A:

1. CAPE COD (ALL TOWNS)
2. PLYMOUTH(SOUTH OF RTE 3A)

7014, 7079,7080,7090,7091,7092,7093,7094,7095,7096,7097,7108,7178

3. MARTHA'S VINEYARD
4. NANTUCKET

***GROUP 3B:

5. PERMANENTS 2 & 189

1066,1067,1083,1084,1085,1086,1087,1088,1089,1090,1091,1092, 1093,1094,1095,1096,1097,1098,1099,1100,1101,1102,1103,1104, 1105,1106,1107,1108,1113,1114,1116,2196,2197,2198

2007 AXLE CORRECTION FACTORS

ROAD INVENTORY FUNCTIONAL CLASSIFICATION	AXLE CORRECTION FACTOR
RURAL	
1	0.90
2	0.93
3	0.98
0,5,6	0.98
URBAN	
1	0.96
2,3	0.97
5	0.99
0,6	0.99
I-84	0.83

Apply I-84 factor to stations: 3290,3921,3929

ROUND OFF

0 - 999.....10
> 1,000.....100

PUBLIC TRANSPORTATION SCHEDULES

Needham Line Effective July 1, 2012

massDOT MBCR

Monday through Friday (NO SERVICE ON SATURDAY OR SUNDAY)

Inbound to South Station

Zone	Train No.	600 A.M.	602 A.M.	604 A.M.	606 A.M.	608 A.M.	610 A.M.	612 A.M.	614 P.M.	616 P.M.	618 P.M.	620 P.M.	622 P.M.	626 P.M.	628 P.M.	630 P.M.	632 P.M.
2	Needham Heights	6 10	6 45	7 30	8 02	8 30	9 35	10 55	12 55	3 05	3 50	5 00	5 35	7 18	8 00	9 00	10 10
2	Needham Center	6 14	6 49	7 34	8 06	8 34	9 39	10 59	12 59	3 09	3 54	5 04	5 39	7 22	8 04	9 04	10 14
2	Needham Junction	6 18	6 53	7 38	8 10	8 38	9 43	11 03	1 03	3 13	3 58	5 08	5 43	7 26	8 08	9 08	10 18
2	Hersey	6 21	6 56	7 42	8 13	8 41	9 46	11 06	1 06	3 16	4 01	5 15	5 46	7 29	8 11	9 11	10 21
1	West Roxbury	6 25	7 01	7 47	8 18	8 46	9 51	11 11	1 11	3 28	4 06	5 20	5 53	7 39	8 16	9 16	10 26
1	Highland	6 28	7 05	7 50	8 20	8 49	9 53	11 13	1 13	3 30	4 08	5 22	----	7 41	----	9 18	10 28
1	Bellevue	6 31	7 08	7 53	8 22	8 52	9 56	11 15	1 15	3 32	4 10	5 24	----	7 43	----	9 20	10 30
1	Roslindale Village	6 34	7 12	7 57	8 25	8 55	9 59	11 17	1 17	3 34	4 13	5 26	----	7 45	----	9 22	10 32
1A	Forest Hills	6 37	7 15	8 00	8 28	8 58	10 02	11 20	1 20	3 37	L4 15	L5 29	L6 04	7 48	8 23	9 25	10 35
1A	Ruggles	6 41	7 20	8 05	8 33	9 04	10 07	11 24	1 24	----	----	----	----	7 52	8 27	9 29	10 39
1A	BACK BAY	L6 45	L7 24	L8 09	L8 37	L9 08	10 11	11 28	1 28	3 45	4 22	L5 37	L6 12	7 56	8 31	9 33	10 42
	SOUTH STATION	6 50	7 29	8 14	8 42	9 13	10 16	11 33	1 33	3 50	4 27	5 42	6 17	8 01	8 36	9 38	10 47

Outbound from South Station

Zone	Train No.	605 A.M.	607 A.M.	609 A.M.	611 A.M.	613 P.M.	615 P.M.	617 P.M.	619 P.M.	621 P.M.	623 P.M.	625 P.M.	627 P.M.	629 P.M.	631 P.M.	633 P.M.	635 P.M.
	SOUTH STATION	7 05	7 25	8 40	10 00	12 00	2 00	3 00	4 00	4 40	5 20	5 55	6 25	7 10	8 10	9 15	10 30
1A	BACK BAY	7 10	7 30	8 45	10 05	12 05	2 05	3 05	4 05	4 45	5 25	6 00	6 30	7 15	8 15	9 20	10 35
1A	Ruggles	----	----	----	----	12 08	2 08	3 08	4 08	4 49	5 29	6 04	6 34	7 19	8 18	9 23	10 38
1A	Forest Hills	7 16	----	----	10 12	12 13	2 14	3 13	4 13	4 54	5 34	6 09	6 39	7 24	8 23	9 28	10 43
1	Roslindale Village	7 20	----	8 59	10 15	12 16	2 18	3 16	4 16	4 57	5 37	6 12	6 42	7 27	8 26	9 31	10 46
1	Bellevue	7 22	----	9 01	10 17	12 18	2 21	3 18	4 19	5 00	5 40	6 15	6 45	7 30	8 29	9 34	10 49
1	Highland	7 24	----	9 03	10 19	12 20	2 23	3 20	4 21	5 03	5 43	6 18	6 47	7 32	8 31	9 36	10 51
1	West Roxbury	7 26	7 42	9 05	10 21	12 22	2 27	3 22	4 23	5 06	5 49	6 21	6 49	7 34	8 33	9 38	10 53
2	Hersey	7 32	7 54	9 10	10 27	12 27	2 32	3 27	4 28	5 11	5 54	6 26	6 54	7 39	8 38	9 43	10 58
2	Needham Junction	7 42	8 12	9 13	10 30	12 30	2 35	3 30	4 31	5 14	5 58	6 29	6 57	7 42	8 41	9 46	11 01
2	Needham Center	7 46	8 16	9 17	10 34	12 34	2 39	3 34	4 35	5 18	6 02	6 33	7 01	7 46	8 45	9 50	11 05
2	Needham Heights	7 50	8 20	9 21	10 38	12 38	2 43	3 38	4 40	5 22	6 06	6 37	7 05	7 50	8 49	9 54	11 09

Notes: This schedule is effective July 1, 2012 and replaces the schedule of May 18, 2009.

Times shown in this schedule are train departure times; customers are asked to arrive at the station platform for a prompt departure.

Weekend Service:
No service is available on Saturday or Sunday.

Holiday Service:
No service on New Year's Day, President's Day, Memorial Day, 4th of July, Labor Day, Thanksgiving Day and Christmas Day.

All other holidays:
Regular service is provided on all other holidays. Consult 'Service Updates' at **www.mbta.com** or call Customer Service at **617-222-3200** for any extra service that may be provided.

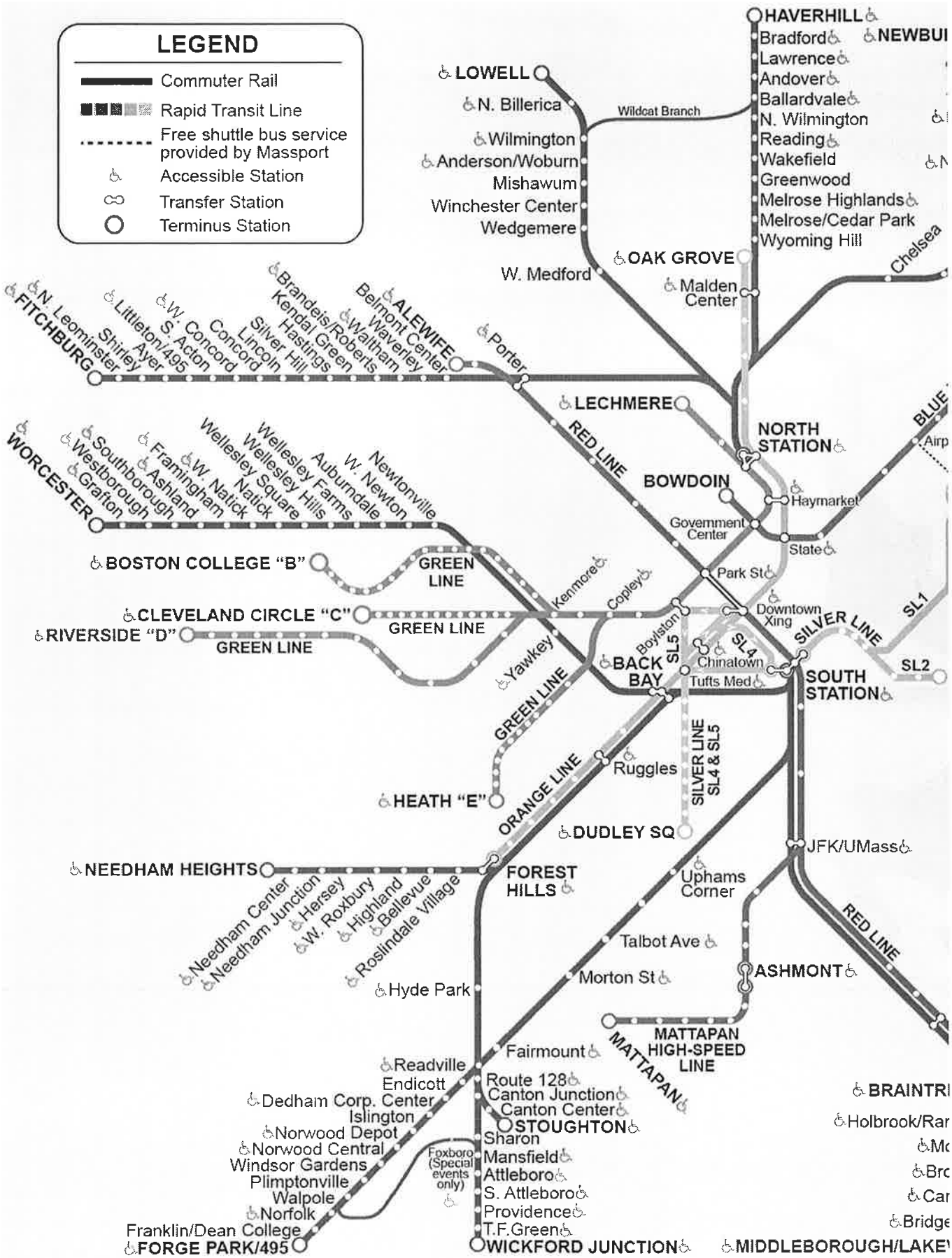
Times in blue indicate an L stop-
This is a regular stop to discharge or pick up passengers; however the train may leave ahead of schedule.

For additional service to Ruggles station refer to the Providence and Franklin schedules for particular trains.

Bicycles are allowed on trains with the bicycle symbol shown above the train number.

Shaded area indicates peak hour trains.

Scan the QR code on your smartphone to load the MBTA's moblie web site and recieve access to schedules, T-Alerts and service updates.


LEGEND
Commuter Rail
Rapid Transit Line
Free shuttle bus service provided by Massport
Accessible Station
Transfer Station
Terminus Station
HAVERHILL
Bradford
NEWBU
Lawrence
Andover
Ballardvale
N. Wilmington
Reading
Wakefield
Greenwood
Melrose Highlands
Melrose/Cedar Park
Wyoming Hill
LOWELL
N. Billerica
Wildcat Branch
Wilmington
Anderson/Woburn
Mishawum
Winchester Center
Wedgemere
W. Medford
OAK GROVE
Malden Center
Chelsea
N. Leominster
FITCHBURG
Shirley
Ayer
Littleton/495
W. Concord
S. Acton
Concord
Lincoln
Silver Hill
Hastings
Kendal Green
Brandeis/Roberts
ALEWIFE
Belmont Center
Waverley
Waltham
Porter
LECHMERE
RED LINE
NORTH STATION
BLUE
Airp
Southborough
Westborough
Grafton
WORCESTER
Framingham
W. Natick
Ashland
Natick
Wellesley Square
Wellesley Hills
Wellesley Farms
Auburndale
W. Newton
Newtonville
BOWDOIN
Haymarket
Government Center
State
BOSTON COLLEGE "B"
GREEN LINE
Kenmore
Copley
Park St
Downtown Xing
SILVER LINE
SL1
SL2
CLEVELAND CIRCLE "C"
GREEN LINE
RIVERSIDE "D"
GREEN LINE
Yawkey
Boylston
SL5
SL4
Chinatown
BACK BAY
Tufts Med
SOUTH STATION
GREEN LINE
SILVER LINE SL4 & SL5
Ruggles
ORANGE LINE
HEATH "E"
DUDLEY SQ
JFK/UMass
NEEDHAM HEIGHTS
FOREST HILLS
Uphams Corner
Needham Center
Needham Junction
Hersey
W. Roxbury
Highland
Bellevue
Roslindale Village
Talbot Ave
RED LINE
Morton St
ASHMONT
Hyde Park
MATTAPAN HIGH-SPEED LINE
Fairmount
MATTAPAN
Readville
Endicott
Dedham Corp. Center
Islington
Norwood Depot
Norwood Central
Windsor Gardens
Plimptonville
Walpole
Norfolk
Franklin/Dean College
FORGE PARK/495
Route 128
Canton Junction
Canton Center
STOUGHTON
Sharon
Foxboro (Special events only)
Mansfield
Attleboro
S. Attleboro
Providence
T.F.Green
WICKFORD JUNCTION
BRAINTR
Holbrook/Rar
Mc
Brc
Car
Bridge
MIDDLEBOROUGH/LAKE

Massachusetts Bay Transportation Authority

Hersey

Zone2

Great Plain Ave & Broad Meadow Rd Needham, MA 02492

For train information at Hershey Station tune to 1630 AM

This MBTA station is accessible (Accessibility Key)

Parking

Parking Spaces: 360

Average Weekday Availability: 52%

Parking Rate: $4.00

Accessible Spaces: 8

Bike Spaces: 11

Managed By: LAZ Parking
(781) 794-1791
Website

Comments:
LAZ ParkingÂ is responsible for parking lot snow removal, maintenance and fee collection. Please contactÂ MBCR [click here]Â regarding station and platform snow removal, cleanliness and maintenance issues.

Commuter Rail Lines

Needham Line

Massachusetts Bay Transportation Authority

Commuter Rail Fares and Passes

Commuter Rail fares are based on a "Zone" and "Interzone" system with Zone 1A servicing the Greater Boston area and Zones 1 through 10 servicing communities and suburban areas outside of Boston. Each Commuter Rail station's zone is identified in the chart below.

Zone Fares

"Zone fares" are intended for direct travel from any suburban area commuter rail station to a Zone 1A station within the Greater Boston area, including North Station, South Station, and Back Bay. You fare or pass is based on the Zone from which you are travelling.

For example, if your commute includes boarding the Lowell Line at Lowell Station (Zone 6) and getting off the train at North Station (Zone 1A), you would buy one single ride Zone 6 ticket.

Interzone Fares

"Interzone fares" are intended for travel between suburban area stations outside of the Zone 1A Greater Boston area. Interzone fares and passes are NOT valid for travel to Zone 1A stations, including North Station, South Station, and Back Bay. Interzone monthly pass and ticket fares are based on TOTAL zones "travelled" in.

For example, if your commute includes boarding the Lowell Line at Lowell Station (Zone 6) and getting off the train at Anderson/Woburn Station (Zone 2), you would pass through three zones and would buy one single ride Interzone 5 ticket.

Effective July 1, 2012, Commuter Rail tickets will have the following expiration periods:

- All 10-ride tickets will be sold with an expiration time limit of ninety (90) days.
- Single ride tickets will be sold with an expiration time limit of ninety (90) days.

ZONE	RIDE FARE	MONTHLY PASS	10-RIDE PASS[1]	CASH-ON-BOARD	
1A	$2.00[2]	$70.00[3]	$20.00	$5.00	Buy Now
1	$5.50[2]	$173.00[4]	$55.00	$8.50	Buy Now
Interzone 1	$2.50	$82.00[6]			Buy Now
2	$6.00[2]	$189.00[4]	$60.00	$9.00	Buy Now

Interzone 2	$3.00	$100.00[6]			Buy Now
3	$6.75[2]	$212.00[4]	$67.50	$9.75	Buy Now
Interzone 3	$3.25	$109.00[6]			Buy Now
4	$7.25[2]	$228.00[4]	$72.50	$10.25	Buy Now
Interzone 4	$3.50	$118.00[6]			Buy Now
5	$8.00[2]	$252.00[4]	$80.00	$11.00	Buy Now
Interzone 5	$4.00	$134.00[6]			Buy Now
6	$8.75[2]	$275.00[5]	$87.50	$11.75	Buy Now
Interzone 6	$4.50	$151.00[6]			Buy Now
7	$9.25[2]	$291.00[5]	$92.50	$12.25	Buy Now
Interzone 7	$5.00	$167.00[6]			Buy Now
8	$10.00[2]	$314.00[5]	$100.00	$13.00	Buy Now
Interzone 8	$5.50	$184.00[6]			Buy Now
9	$10.50[2]	$329.00[5]	$105.00	$13.50	Buy Now
Interzone 9	$6.00	$201.00[6]			Buy Now
10	$11.00[2]	$345.00[5]	$110.00	$14.00	Buy Now

Seniors and Persons with Disabilities — **50% Off Rides**

(Blind persons ride for free) Percentage off based on Commuter Rail 'ride' fares noted above. Requires a Senior/TAP ID or Mass Commission for the Blind ID. 10-Ride Tickets available based on ten half fares.

Children 11 years old and under — **Free**

Children under the age of twelve ride free when accompanied by an adult with a limit of two children for each adult.

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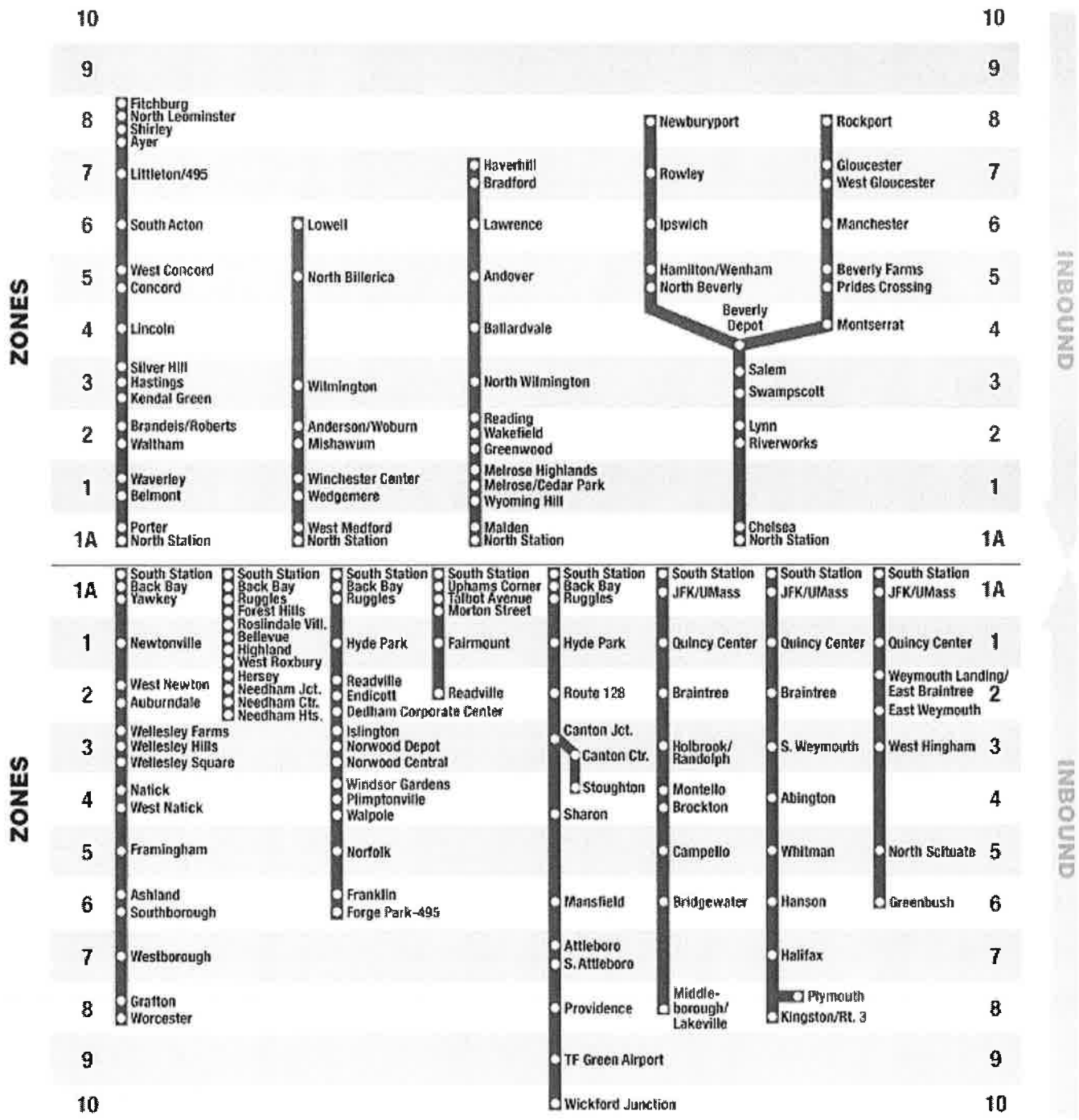
Commuter Rail Zone Chart



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[1] 10-Ride passes cannot be bought online.

[2] A $3.00 surcharge wil be added to tickets purchased on-board all trains departing from North

Station, South Station, and Back Bay Station. Monday-through-Friday customers will be charged $3.00 surcharge by the conductor when a ticket is purchased on board from a station with an MBTA ticket vending machine or where a Ticket Vendor is open. A list of these stations can be found on the MBTA website here: http://www.mbta.com/fares_and_passes/sales_locations/

[3] Zone passes valid on Local Bus, Subway, and Inner Harbor Ferries.

[4] Zone passes valid on Local Bus, Subway, Express Bus, and Inner Harbor Ferries.

[5] Zone passes valid on Local Bus, Subway, Express Bus, Inner Harbor Ferries, and Commuter Boat.

[6] Interzone passes valid on Local bus.

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VEHICLE TRAVEL SPEED DATA

Accurate Counts
978-664-2565

6202SPD1

Location : Greendale Avenue
Location : South of Bird Street
City/State: Needham, MA
Northbound

Start Time	1 15	16 20	21 25	26 30	31 35	36 40	41 45	46 50	51 55	56 60	61 65	66 70	71 75	76 999	Total	85th Percent	95th Percent
03/28/13	0	0	0	0	0	5	3	1	0	0	0	0	0	0	9	44	47
01:00	0	0	0	0	0	1	0	0	0	1	0	0	0	0	2	58	60
02:00	0	0	0	0	0	0	0	0	0	1	0	0	0	0	1	59	60
03:00	0	0	0	0	0	0	1	0	1	0	0	0	0	0	2	53	55
04:00	0	0	0	0	0	1	6	1	0	0	0	0	0	0	8	45	47
05:00	0	0	0	0	4	8	14	14	2	0	0	0	0	0	42	48	50
06:00	4	0	1	0	5	21	76	54	12	0	0	0	0	0	173	48	51
07:00	19	**1**	**2**	3	15	79	312	148	14	1	0	0	0	0	594	47	50
08:00	**26**	1	1	**17**	**44**	**157**	**369**	**159**	7	0	0	0	0	0	**781**	46	49
09:00	8	0	0	1	11	62	207	143	**27**	**5**	0	0	0	0	464	48	51
10:00	7	1	0	0	6	29	93	88	11	0	0	0	0	0	235	48	50
11:00	5	1	0	0	0	25	92	56	14	2	0	0	0	0	195	48	52
12 PM	5	**1**	0	2	10	32	64	65	13	0	0	0	0	0	192	48	51
13:00	6	0	**1**	1	3	21	66	62	9	**3**	0	0	0	0	172	48	51
14:00	10	0	0	3	12	**39**	81	52	9	3	0	0	0	0	209	48	51
15:00	12	0	0	3	**13**	39	70	55	10	2	0	0	0	0	204	48	51
16:00	15	0	0	0	7	28	72	52	5	0	0	0	0	0	179	47	50
17:00	**26**	0	0	2	6	24	**92**	**76**	**19**	1	0	0	0	0	**246**	48	51
18:00	3	0	0	1	4	27	73	52	14	2	0	0	0	0	176	49	52
19:00	3	0	0	2	3	29	44	22	2	0	0	0	0	0	105	46	49
20:00	4	0	0	0	3	23	43	17	3	0	0	0	0	0	93	46	49
21:00	1	0	0	**4**	9	20	20	13	6	0	0	0	0	0	73	48	51
22:00	1	0	0	0	1	11	15	6	2	0	0	0	0	0	36	47	50
23:00	0	0	0	1	1	7	9	7	1	0	0	0	0	0	26	47	50
Total	155	5	5	40	157	688	1822	1143	181	21	0	0	0	0	4217		
Percent	3.7%	0.1%	0.1%	0.9%	3.7%	16.3%	43.2%	27.1%	4.3%	0.5%	0.0%	0.0%	0.0%	0.0%			
AM Peak	08:00	07:00	07:00	08:00	08:00	08:00	08:00	08:00	09:00	09:00					08:00		
Vol.	26	1	2	17	44	157	369	159	27	5					781		
PM Peak	17:00	12:00	13:00	21:00	15:00	14:00	17:00	17:00	17:00	13:00					17:00		
Vol.	26	1	1	4	13	39	92	76	19	3					246		
Total	312	19	16	73	295	1399	3859	2312	382	43	1	0	0	0	8711		
Percent	3.6%	0.2%	0.2%	0.8%	3.4%	16.1%	44.3%	26.5%	4.4%	0.5%	0.0%	0.0%	0.0%	0.0%			

15th Percentile :	36 MPH
50th Percentile :	42 MPH
85th Percentile :	48 MPH
95th Percentile :	50 MPH

Stats

10 MPH Pace Speed :	40-49 MPH
Number in Pace :	5645
Percent in Pace :	64.8%
Number of Vehicles > 45 MPH :	2738
Percent of Vehicles > 45 MPH :	31.4%
Mean Speed(Average) :	41 MPH

Accurate Counts
978-664-2565

6202SPD1

Location : Greendale Avenue
Location : South of Bird Street
City/State: Needham, MA
Southbound

Start Time	1 15	16 20	21 25	26 30	31 35	36 40	41 45	46 50	51 55	56 60	61 65	66 70	71 75	76 999	Total	85th Percent	95th Percent
03/27/13	0	0	0	0	0	1	8	6	6	2	0	0	0	0	23	53	57
01:00	0	0	0	0	0	0	4	4	1	0	0	0	0	0	9	50	52
02:00	0	0	0	0	0	1	1	0	0	0	0	0	0	0	2	43	45
03:00	1	0	0	0	0	0	2	0	1	0	0	0	0	0	4	51	53
04:00	0	0	0	0	0	0	3	5	2	0	0	0	0	0	10	51	53
05:00	0	0	1	0	0	2	6	3	1	2	**1**	0	0	0	16	56	61
06:00	3	0	1	0	1	9	7	18	3	0	1	0	0	0	43	49	52
07:00	12	0	1	0	2	10	38	51	19	4	0	0	0	0	137	50	54
08:00	**19**	0	**5**	0	2	15	52	68	**28**	2	0	0	0	0	191	50	53
09:00	8	0	1	0	**4**	9	39	82	23	**7**	0	0	0	0	173	51	54
10:00	2	1	2	0	0	10	56	74	23	5	1	0	0	0	174	51	54
11:00	3	**2**	1	**2**	0	**24**	**74**	**85**	27	5	0	0	0	0	**223**	50	53
12 PM	5	**4**	3	0	4	20	118	102	26	2	**1**	**1**	0	0	286	49	52
13:00	4	1	2	1	2	20	84	86	31	**7**	1	0	0	0	239	50	54
14:00	**11**	0	**4**	0	0	22	136	128	40	4	0	0	0	0	345	50	53
15:00	3	1	2	2	**14**	36	147	175	41	3	0	0	0	0	424	49	52
16:00	9	1	4	**3**	11	72	315	300	50	4	0	0	0	0	769	49	51
17:00	8	2	3	0	4	**77**	**370**	**334**	37	3	0	0	0	0	**838**	48	51
18:00	5	2	3	2	3	33	212	229	**52**	6	0	0	0	0	547	49	52
19:00	6	0	1	2	3	22	101	92	21	2	0	0	0	0	250	49	52
20:00	1	0	0	1	0	15	72	54	11	0	0	0	0	0	154	49	51
21:00	0	0	2	0	1	4	41	33	11	0	0	0	0	0	92	49	52
22:00	0	0	0	0	0	4	23	25	10	3	0	0	0	0	65	51	55
23:00	1	0	0	0	0	4	15	18	2	0	0	0	0	0	40	49	51
Total	101	14	36	13	51	410	1924	1972	466	61	5	1	0	0	5054		
Percent	2.0%	0.3%	0.7%	0.3%	1.0%	8.1%	38.1%	39.0%	9.2%	1.2%	0.1%	0.0%	0.0%	0.0%			
AM Peak	08:00	11:00	08:00	11:00	09:00	11:00	11:00	11:00	08:00	09:00	05:00				11:00		
Vol.	19	2	5	2	4	24	74	85	28	7	1				223		
PM Peak	14:00	12:00	14:00	16:00	15:00	17:00	17:00	17:00	18:00	13:00	12:00	12:00			17:00		
Vol.	11	4	4	3	14	77	370	334	52	7	1	1			838		

Accurate Counts
978-664-2565

6202SPD1

Location : Greendale Avenue
Location : South of Bird Street
City/State: Needham, MA
Southbound

Start Time	1 15	16 20	21 25	26 30	31 35	36 40	41 45	46 50	51 55	56 60	61 65	66 70	71 75	76 999	Total	85th Percent	95th Percent
03/28/13	0	0	0	0	1	0	4	5	3	0	0	0	0	0	13	51	54
01:00	0	0	0	0	0	1	3	4	1	0	0	0	0	0	9	50	52
02:00	0	0	0	0	0	0	2	2	2	1	0	0	0	0	7	55	58
03:00	0	0	0	0	0	0	0	1	0	0	0	0	0	0	1	49	50
04:00	0	0	0	0	0	2	2	3	0	1	0	0	0	0	8	50	57
05:00	1	1	0	0	0	2	7	1	4	1	0	0	0	0	17	52	56
06:00	4	0	0	0	0	6	14	17	9	1	0	0	0	0	51	51	54
07:00	3	0	0	**1**	2	12	45	62	8	4	0	0	**1**	0	138	49	53
08:00	**9**	0	**2**	0	**5**	18	**71**	60	13	4	0	0	0	0	182	49	52
09:00	2	0	0	1	0	**23**	45	70	22	**5**	**1**	0	0	0	169	50	54
10:00	3	0	2	0	0	11	51	79	25	1	0	**1**	0	0	173	50	53
11:00	9	**3**	2	1	0	23	64	**82**	**26**	4	0	0	0	0	**214**	50	53
12 PM	7	**3**	0	0	3	18	95	76	29	**6**	0	0	0	0	237	50	54
13:00	6	1	1	0	5	14	99	90	19	3	0	0	0	0	238	49	52
14:00	6	0	**2**	3	6	44	130	110	22	4	0	0	0	0	327	49	52
15:00	8	1	1	2	1	37	221	140	26	4	0	0	0	0	441	48	51
16:00	**14**	0	0	1	7	77	288	**278**	**46**	1	0	0	0	0	712	49	51
17:00	13	1	0	**4**	**10**	**95**	**429**	262	25	1	0	0	0	0	**840**	48	50
18:00	7	0	2	1	6	47	224	191	39	2	0	0	0	0	519	49	51
19:00	2	0	0	1	2	20	103	86	14	1	0	0	0	0	229	49	51
20:00	2	0	2	1	3	28	80	49	8	0	0	0	0	0	173	48	50
21:00	4	0	0	0	4	13	48	30	8	1	0	0	0	0	108	48	52
22:00	0	0	0	0	1	11	28	33	7	2	0	**1**	0	0	83	50	54
23:00	0	0	0	0	1	9	17	13	2	0	0	0	0	0	42	48	50
Total	100	10	14	16	57	511	2070	1744	358	47	1	2	1	0	4931		
Percent	2.0%	0.2%	0.3%	0.3%	1.2%	10.4%	42.0%	35.4%	7.3%	1.0%	0.0%	0.0%	0.0%	0.0%			
AM Peak	08:00	11:00	08:00	07:00	08:00	09:00	08:00	11:00	11:00	09:00	09:00	10:00	07:00		11:00		
Vol.	9	3	2	1	5	23	71	82	26	5	1	1	1		214		
PM Peak	16:00	12:00	14:00	17:00	17:00	17:00	17:00	16:00	16:00	12:00		22:00			17:00		
Vol.	14	3	2	4	10	95	429	278	46	6		1			840		
Total	201	24	50	29	108	921	3994	3716	824	108	6	3	1	0	9985		
Percent	2.0%	0.2%	0.5%	0.3%	1.1%	9.2%	40.0%	37.2%	8.3%	1.1%	0.1%	0.0%	0.0%	0.0%			

	15th Percentile :	39 MPH
	50th Percentile :	44 MPH
	85th Percentile :	49 MPH
	95th Percentile :	52 MPH
Stats	10 MPH Pace Speed :	41-50 MPH
	Number in Pace :	6875
	Percent in Pace :	68.9%
	Number of Vehicles > 45 MPH :	4658
	Percent of Vehicles > 45 MPH :	46.6%
	Mean Speed(Average) :	44 MPH

Accurate Counts
978-664-2565

6202SPD1

Location : Greendale Avenue
Location : South of Bird Street
City/State: Needham, MA
Northbound, Southbound

Start Time	1 15	16 20	21 25	26 30	31 35	36 40	41 45	46 50	51 55	56 60	61 65	66 70	71 75	76 999	Total	85th Percent	95th Percent
03/27/13	0	0	0	0	0	1	9	9	8	2	0	0	0	0	29	53	56
01:00	0	0	0	0	0	0	4	4	1	0	**1**	0	0	0	10	52	62
02:00	0	0	0	0	0	1	1	0	1	0	0	0	0	0	3	52	54
03:00	1	0	0	0	0	0	4	1	2	0	0	0	0	0	8	51	54
04:00	0	0	0	0	0	0	12	5	3	0	0	0	0	0	20	50	53
05:00	0	0	1	0	1	9	21	13	6	2	1	0	0	0	54	50	56
06:00	14	**8**	4	2	11	35	99	80	9	2	1	0	0	0	265	48	50
07:00	20	2	3	2	16	93	386	229	33	4	0	0	0	0	788	48	50
08:00	**37**	0	**7**	**21**	**68**	**207**	**469**	211	43	2	0	0	0	0	**1065**	47	50
09:00	22	1	2	0	6	82	326	**235**	41	**9**	0	0	0	0	724	48	51
10:00	10	2	2	0	5	42	151	153	41	7	1	0	0	0	414	49	53
11:00	6	2	2	2	3	49	171	138	**48**	9	0	0	0	0	430	50	53
12 PM	10	**4**	3	1	12	50	195	168	46	4	**1**	**1**	0	0	495	49	52
13:00	12	1	2	1	3	45	166	155	40	**7**	1	0	0	0	433	49	53
14:00	27	0	**5**	3	4	53	216	180	49	4	0	0	0	0	541	49	52
15:00	9	2	2	2	**20**	65	228	241	50	4	0	0	0	0	623	49	52
16:00	**31**	1	5	3	14	108	399	351	58	7	0	0	0	0	977	48	51
17:00	26	2	3	0	5	**114**	**448**	**388**	51	6	0	0	0	0	**1043**	48	51
18:00	20	2	3	2	6	60	275	283	**65**	6	0	0	0	0	722	49	52
19:00	8	0	1	**5**	8	40	165	121	32	2	0	0	0	0	382	49	52
20:00	1	0	0	1	2	32	111	75	14	1	0	0	0	0	237	48	51
21:00	3	1	2	1	2	13	55	46	12	2	0	0	0	0	137	49	52
22:00	0	0	0	0	2	13	27	32	11	3	0	0	0	0	88	50	54
23:00	1	0	0	0	1	9	23	23	3	0	0	0	0	0	60	48	51
Total	258	28	47	46	189	1121	3961	3141	667	83	6	1	0	0	9548		
Percent	2.7%	0.3%	0.5%	0.5%	2.0%	11.7%	41.5%	32.9%	7.0%	0.9%	0.1%	0.0%	0.0%	0.0%			
AM Peak	08:00	06:00	08:00	08:00	08:00	08:00	08:00	09:00	11:00	09:00	01:00				08:00		
Vol.	37	8	7	21	68	207	469	235	48	9	1				1065		
PM Peak	16:00	12:00	14:00	19:00	15:00	17:00	17:00	17:00	18:00	13:00	12:00	12:00			17:00		
Vol.	31	4	5	5	20	114	448	388	65	7	1	1			1043		

Accurate Counts
978-664-2565

6202SPD1

Location : Greendale Avenue
Location : South of Bird Street
City/State: Needham, MA
Northbound, Southbound

Start Time	1 15	16 20	21 25	26 30	31 35	36 40	41 45	46 50	51 55	56 60	61 65	66 70	71 75	76 999	Total	85th Percent	95th Percent
03/28/13	0	0	0	0	1	5	7	6	3	0	0	0	0	0	22	50	53
01:00	0	0	0	0	0	2	3	4	1	1	0	0	0	0	11	51	57
02:00	0	0	0	0	0	0	2	2	2	2	0	0	0	0	8	56	59
03:00	0	0	0	0	0	0	1	1	1	0	0	0	0	0	3	52	54
04:00	0	0	0	0	0	3	8	4	0	1	0	0	0	0	16	48	55
05:00	1	1	0	0	4	10	21	15	6	1	0	0	0	0	59	49	53
06:00	8	0	1	0	5	27	90	71	21	1	0	0	0	0	224	49	52
07:00	22	1	2	4	17	91	357	210	22	5	0	0	1	0	732	47	50
08:00	**35**	1	**3**	**17**	**49**	**175**	**440**	**219**	20	4	0	0	0	0	**963**	47	49
09:00	10	0	0	2	11	85	252	213	**49**	**10**	**1**	0	0	0	633	49	52
10:00	10	1	2	0	6	40	144	167	36	1	0	**1**	0	0	408	49	52
11:00	14	**4**	2	1	0	48	156	138	40	6	0	0	0	0	409	49	53
12 PM	12	**4**	0	2	13	50	159	141	42	6	0	0	0	0	429	49	53
13:00	12	1	**2**	1	8	35	165	152	28	6	0	0	0	0	410	49	52
14:00	16	0	2	**6**	**18**	83	211	162	31	**7**	0	0	0	0	536	48	51
15:00	20	1	1	5	14	76	291	195	36	6	0	0	0	0	645	48	51
16:00	29	0	0	1	14	105	360	330	51	1	0	0	0	0	891	48	51
17:00	**39**	1	0	6	16	**119**	**521**	**338**	44	2	0	0	0	0	**1086**	48	50
18:00	10	0	2	2	10	74	297	243	**53**	4	0	0	0	0	695	49	52
19:00	5	0	0	3	5	49	147	108	16	1	0	0	0	0	334	48	51
20:00	6	0	2	1	6	51	123	66	11	0	0	0	0	0	266	47	50
21:00	5	0	0	4	13	33	68	43	14	1	0	0	0	0	181	48	52
22:00	1	0	0	0	2	22	43	39	9	2	0	**1**	0	0	119	49	53
23:00	0	0	0	1	2	16	26	20	3	0	0	0	0	0	68	48	50
Total	255	15	19	56	214	1199	3892	2887	539	68	1	2	1	0	9148		
Percent	2.8%	0.2%	0.2%	0.6%	2.3%	13.1%	42.5%	31.6%	5.9%	0.7%	0.0%	0.0%	0.0%	0.0%			
AM Peak	08:00	11:00	08:00	08:00	08:00	08:00	08:00	08:00	09:00	09:00	09:00	10:00	07:00		08:00		
Vol.	35	4	3	17	49	175	440	219	49	10	1	1	1		963		
PM Peak	17:00	12:00	13:00	14:00	14:00	17:00	17:00	17:00	18:00	14:00		22:00			17:00		
Vol.	39	4	2	6	18	119	521	338	53	7		1			1086		
Total	513	43	66	102	403	2320	7853	6028	1206	151	7	3	1	0	18696		
Percent	2.7%	0.2%	0.4%	0.5%	2.2%	12.4%	42.0%	32.2%	6.5%	0.8%	0.0%	0.0%	0.0%	0.0%			

	15th Percentile :	37 MPH
	50th Percentile :	43 MPH
	85th Percentile :	48 MPH
	95th Percentile :	51 MPH
Stats	10 MPH Pace Speed :	40-49 MPH
	Number in Pace :	12438
	Percent in Pace :	66.5%
	Number of Vehicles > 45 MPH :	7396
	Percent of Vehicles > 45 MPH :	39.6%
	Mean Speed(Average) :	43 MPH

MASSDOT CRASH RATE WORKSHEETS

MassDOT

CRASH RATE WORKSHEET

CITY/TOWN : Needham COUNT DATE : 2013

DISTRICT : 6 UNSIGNALIZED : SIGNALIZED : Yes

MHD USE ONLY

Source #

~ INTERSECTION DATA ~

MAJOR STREET : Kendrick Street ST #

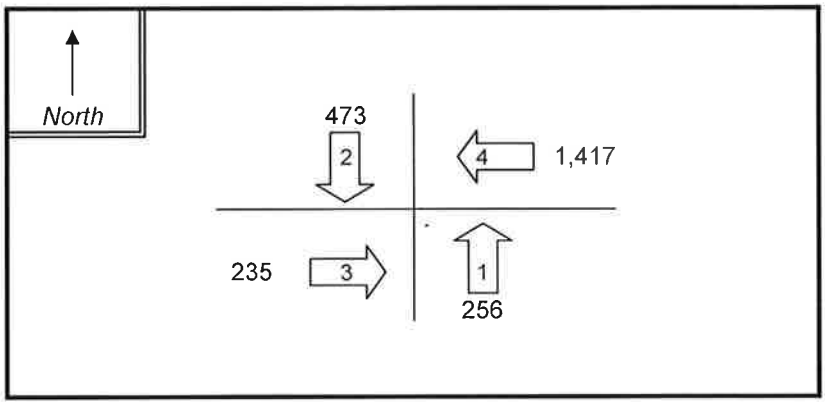
MINOR STREET(S) : Hunting Road ST #

ST #

ST #

ST #

INTERSECTION DIAGRAM (Label Approaches)



INTERSECTION REF #

Peak Hour Volumes

APPROACH :	1	2	3	4	5	Total Entering Vehicles
DIRECTION :	NB	SB	EB	WB		
VOLUMES (AM/**PM**) :	256	473	235	1,417		2,381

" K " FACTOR : 0.090 APPROACH ADT : 26,456 **ADT** = TOTAL VOL/"K" FACT.

TOTAL # OF ACCIDENTS : 9 # OF YEARS : 3 AVERAGE # OF ACCIDENTS (**A**) : 3.00

CRASH RATE CALCULATION : 0.31 RATE = $\frac{(A * 1{,}000{,}000)}{(ADT * 365)}$

Comments : Crash rate is significant if > 0.58 crashes per mev for an unsignalized intersection and >0.76 crashes per mev for a signalized intersection for MassDOT District 6.

MassDOT

CRASH RATE WORKSHEET

CITY/TOWN : Needham COUNT DATE : 2013

DISTRICT : 6 UNSIGNALIZED : Yes SIGNALIZED :

MHD USE ONLY

Source #

~ INTERSECTION DATA ~

MAJOR STREET : Greendale Avenue ST #

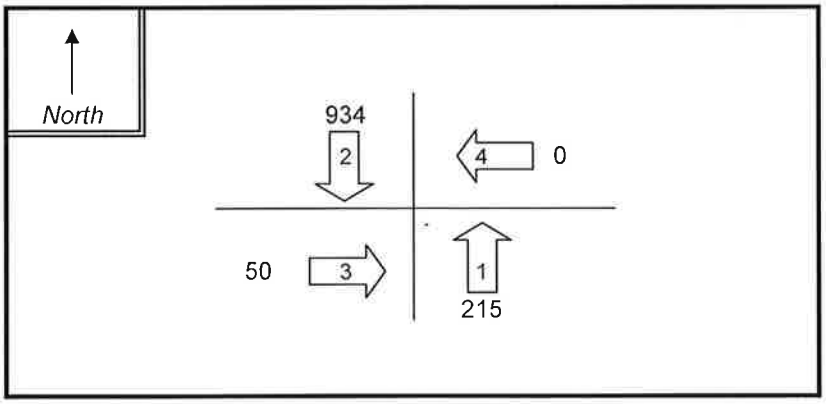
MINOR STREET(S) : Bird Street ST #

ST #

ST #

ST #

INTERSECTION DIAGRAM (Label Approaches)



INTERSECTION REF #

Peak Hour Volumes

APPROACH :	1	2	3	4	5	Total Entering Vehicles
DIRECTION :	NB	SB	EB	WB		
VOLUMES (AM/**PM**) :	215	934	50	0		1,199

" K " FACTOR : 0.090 APPROACH ADT : 13,322 **ADT** = TOTAL VOL/"K" FACT.

TOTAL # OF ACCIDENTS : 2 # OF YEARS : 3 AVERAGE # OF ACCIDENTS (**A**) : 0.67

CRASH RATE CALCULATION : 0.14 RATE = $\frac{(A * 1{,}000{,}000)}{(ADT * 365)}$

Comments : Crash rate is significant if > 0.58 crashes per mev for an unsignalized intersection and >0.76 crashes per mev for a signalized intersection for MassDOT District 6.

MassDOT

CRASH RATE WORKSHEET

CITY/TOWN : Needham COUNT DATE : 2013

DISTRICT : 6 UNSIGNALIZED : SIGNALIZED : Yes

MHD USE ONLY

Source #

~ INTERSECTION DATA ~

MAJOR STREET : Great Plain Avenue ST #

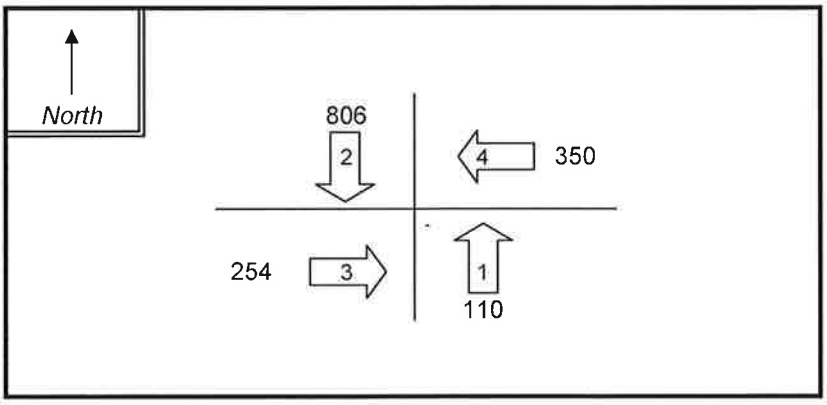
MINOR STREET(S) : Greendale Avenue ST #

ST #

ST #

ST #

INTERSECTION DIAGRAM (Label Approaches)



INTERSECTION REF #

Peak Hour Volumes

APPROACH :	1	2	3	4	5	Total Entering Vehicles
DIRECTION :	NB	SB	EB	WB		
VOLUMES (AM/**PM**) :	110	806	254	350		1,520

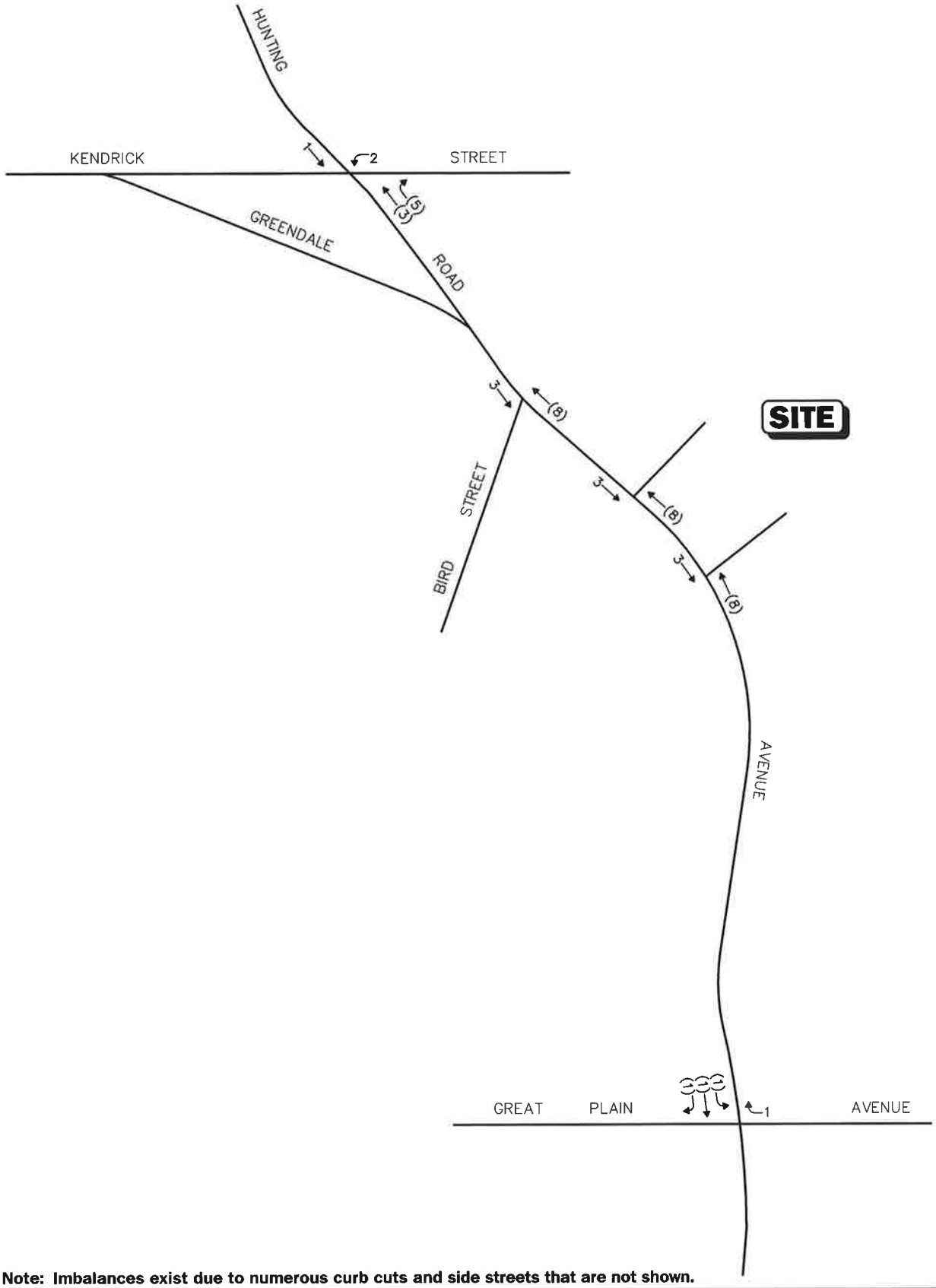
" K " FACTOR : 0.090 APPROACH ADT : 16,889 **ADT** = TOTAL VOL/"K" FACT.

TOTAL # OF ACCIDENTS : 7 # OF YEARS : 3 AVERAGE # OF ACCIDENTS (**A**) : 2.33

CRASH RATE CALCULATION : 0.38 RATE = $\frac{(A * 1{,}000{,}000)}{(ADT * 365)}$

Comments : Crash rate is significant if > 0.58 crashes per mev for an unsignalized intersection and >0.76 crashes per mev for a signalized intersection for MassDOT District 6.

SITE-SPECIFIC DEVELOPMENT TRAFFIC-VOLUME NETWORKS



Note: Imbalances exist due to numerous curb cuts and side streets that are not shown.

Not To Scale

Figure A-1

Vanasse & Associates, Inc.
Transportation Engineers & Planners

Background Development
Greendale Village
Weekday Morning
Peak Hour Trafifc Volumes

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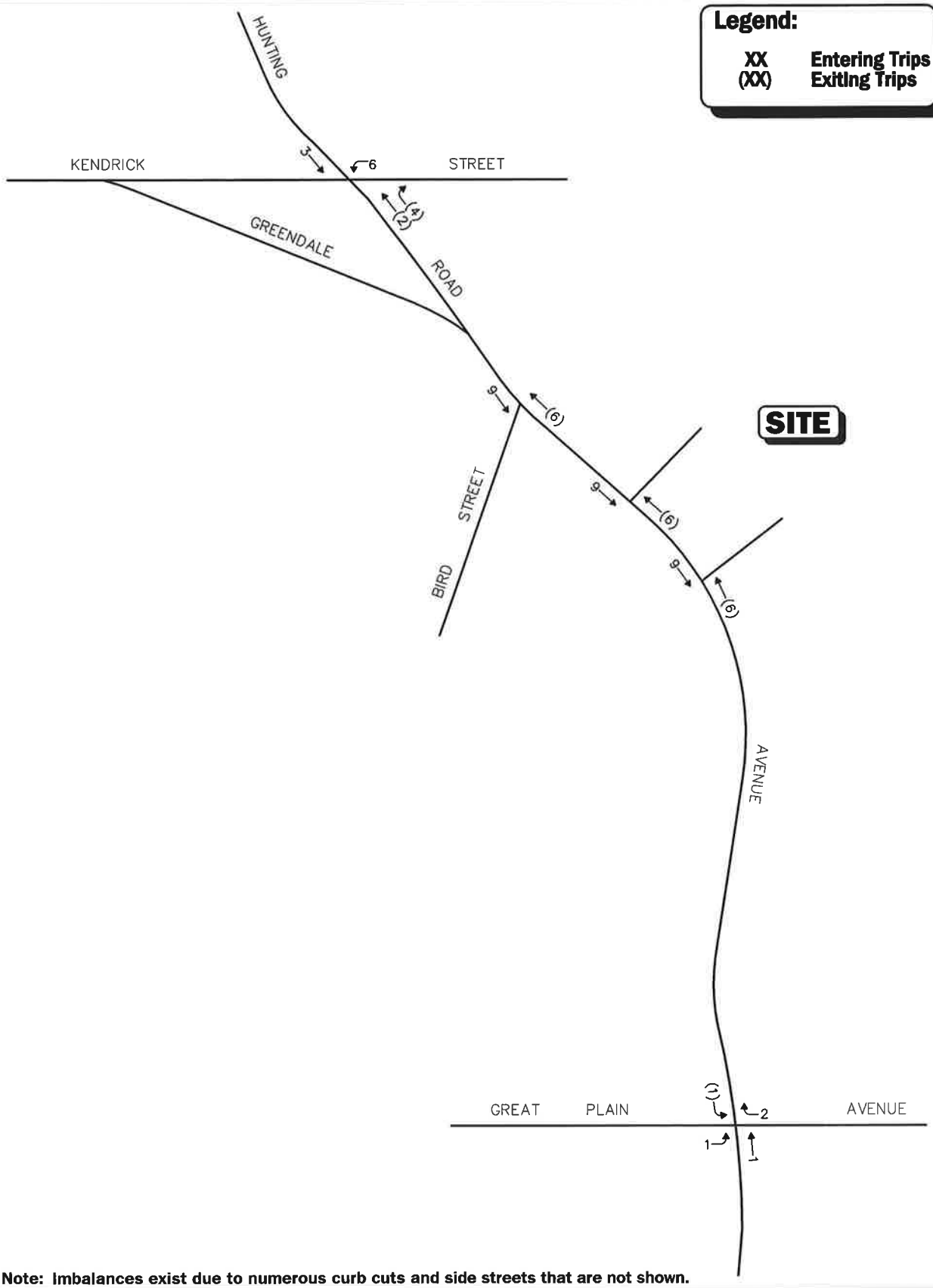

Note: Imbalances exist due to numerous curb cuts and side streets that are not shown.

Not To Scale

Figure A-2

Vanasse & Associates, Inc.
Transportation Engineers & Planners

Background Development
Greendale Village
Weekday Evening
Peak Hour Trafifc Volumes

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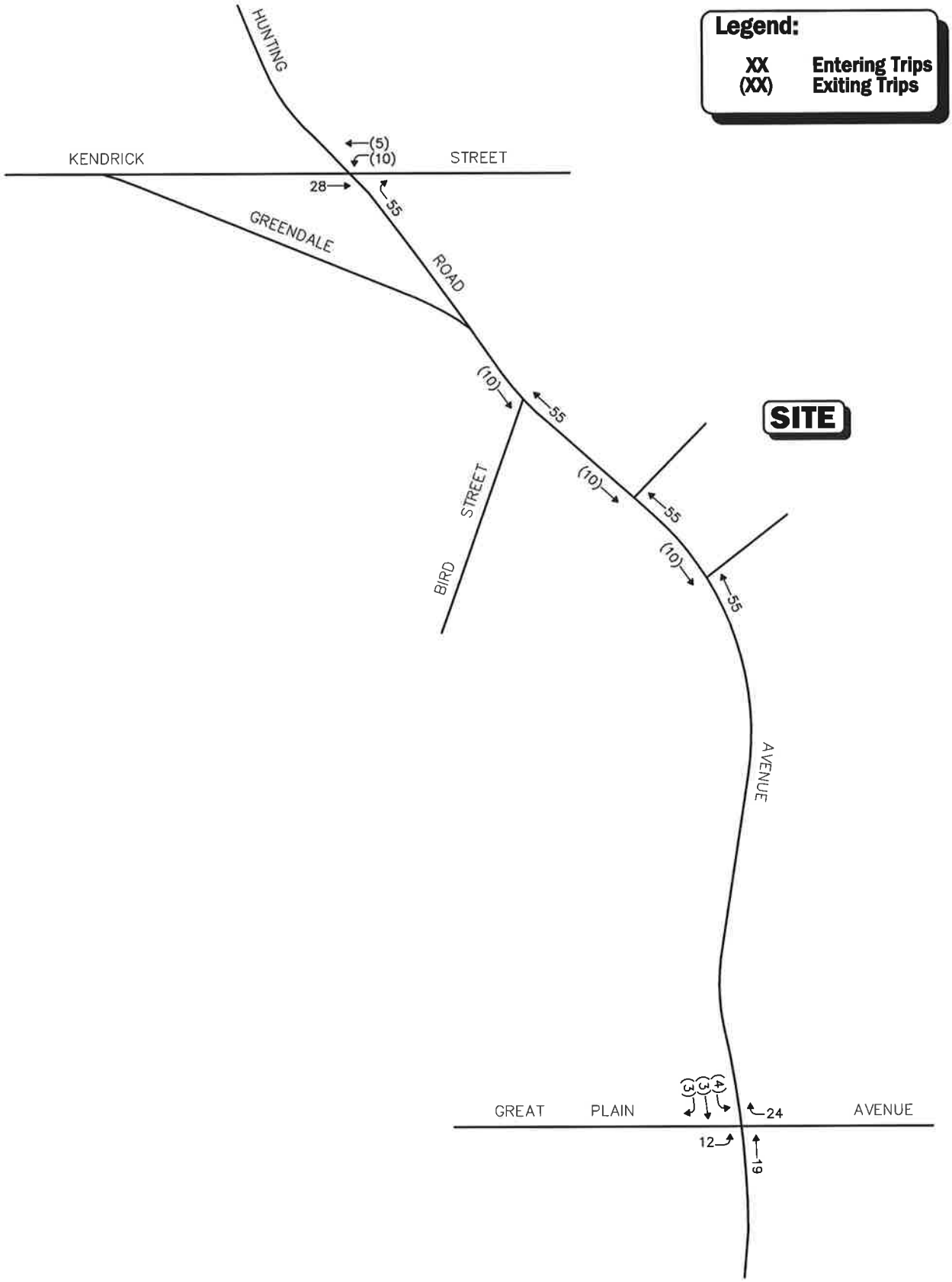

Not To Scale

Figure A-3

Background Development
Center 128
Weekday Morning
Peak Hour Traffic Volumes

Vanasse & Associates, Inc.
Transportation Engineers & Planners

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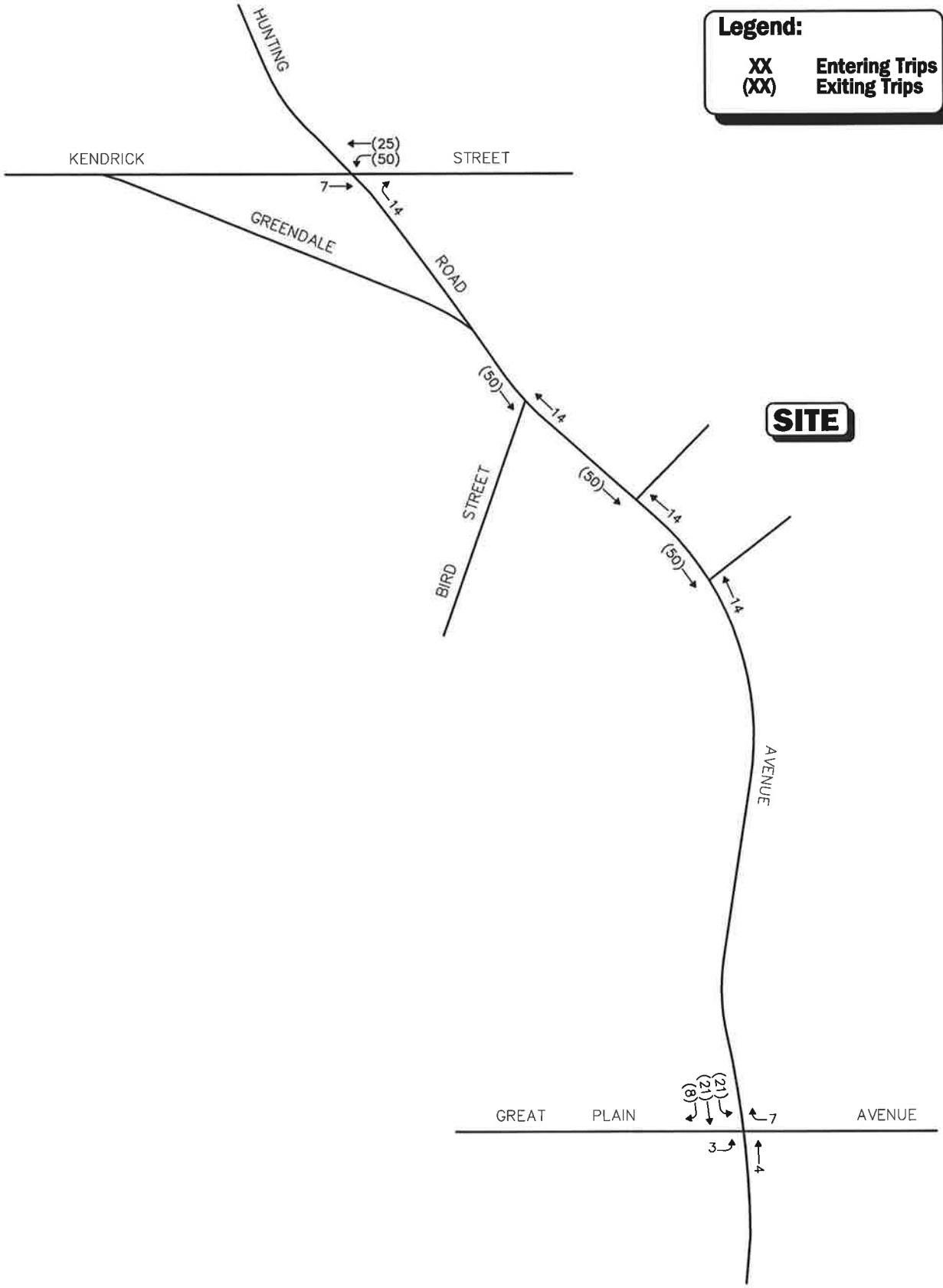

Not To Scale

Figure A-4

Background Development
Center 128
Weekday Evening
Peak Hour Traffic Volumes

Vanasse & Associates, Inc.
Transportation Engineers & Planners

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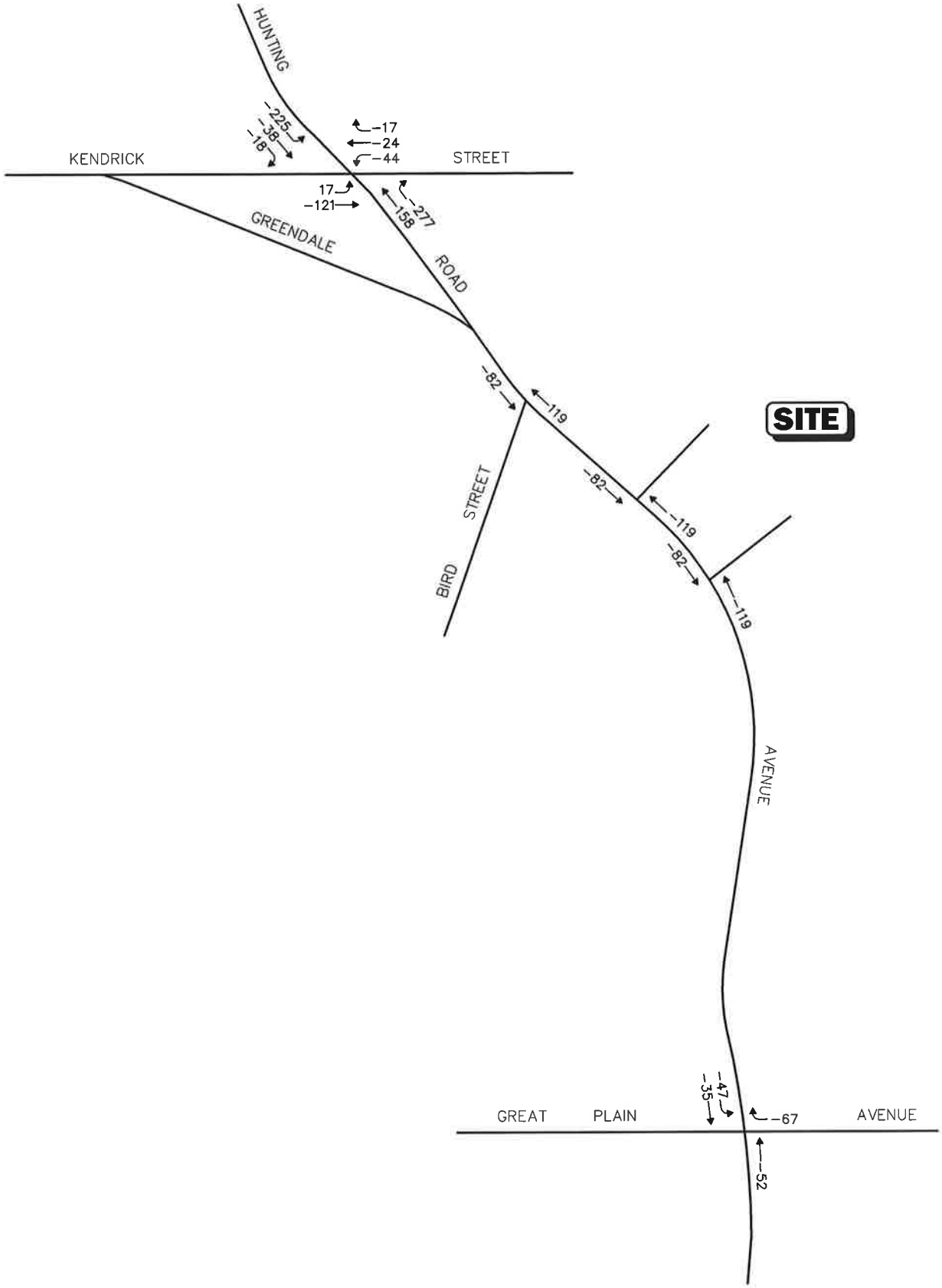
GENERAL BACKGROUND TRAFFIC GROWTH

General Background Traffic Growth

STA.	CITY/TOWN	ROUTE/STREET	LOCATION	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	Annual Growth Rate
6739	NEEDHAM	CHAPEL ST.	SOUTH OF MAY ST.	10400			7900			9000			8900	-1.13%
6697	NEEDHAM	HIGHLAND AVE.	WEST OF GOULD ST.			23300						19200		-3.17%
6738	NEEDHAM	HIGHLAND AVE.	WEST OF ROSEMARY ST.			18600			17200			18200		-0.34%
6698	NEEDHAM	RTE.135	BTWN. HIGHLAND AVE. & RTE.16		14600			9400						-13.65%
6696	NEEDHAM	RTE.135	BTWN. I-95 & HIGHLAND AVE.		13100			11700			11300			-2.43%
6732	NEEDHAM	RTE.135	BTWN. WEBSTER & SCHOOL STS.			8900			9600			8600		-0.54%
6204	NEEDHAM	WEBSTER ST.	SOUTH OF DEDHAM AVE.			2800			2300					-6.35%
														-3.94%

I-95/ROUTE 128 ADD-A-LANE TRAFFIC VOLUME REDISTRIBUTION



Not To Scale

Figure A-5

Vanasse & Associates, Inc.
Transportation Engineers & Planners

Roadway Improvement Project
I-95/Route 128 Add-A-Lane
Route 9/Highland Ave/Kendrick St
Weekday Morning
Peak Hour Traffic Volumes

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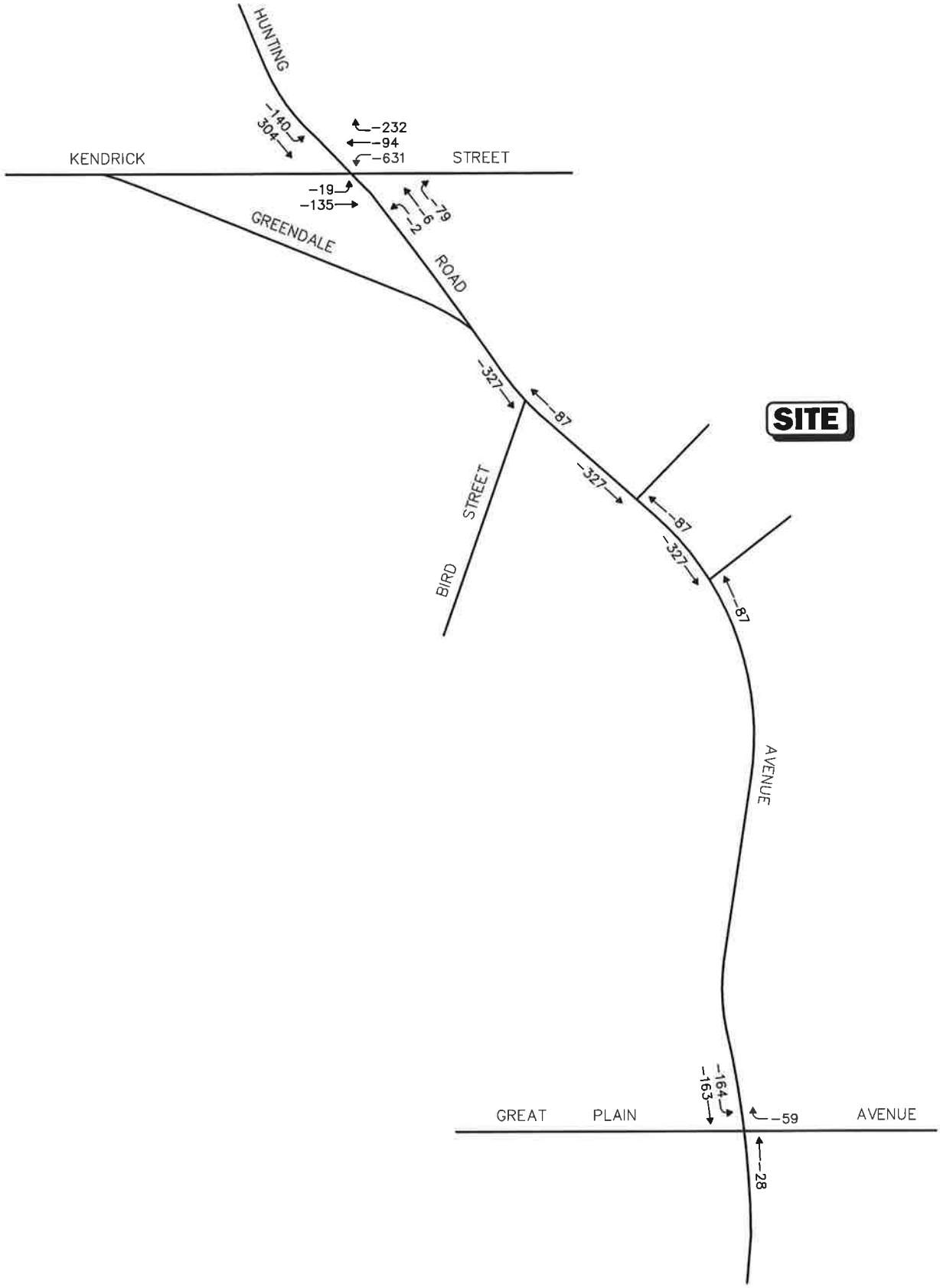

Not To Scale

Figure A-6

Roadway Improvement Project
I-95/Route 128 Add-A-Lane
Route 9/Highland Ave/Kendrick St
Weekday Evening
Peak Hour Traffic Volumes

Vanasse & Associates, Inc.
Transportation Engineers & Planners

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TRIP-GENERATION CALCULATIONS

Institute of Transportation Engineers (ITE)
Trip Generation, 9 th Edition
Land Use Code (LUC) 220 - Apartment

Average Vehicle Trips Ends vs: Dwelling Units
Independent Variable (X): 300

AVERAGE WEEKDAY DAILY

T = 6.06 * (X) + 123.56
T = 6.06 * 300 + (123.56)
T = 1941.56
T = 1,942 vehicle trips
with 50% (971 vpd) entering and 50% (971 vpd) exiting.

WEEKDAY MORNING PEAK HOUR OF ADJACENT STREET TRAFFIC

T = 0.49 * (X) + 3.73
T = 0.49 * 300 + (3.73)
T = 150.73
T = 151 vehicle trips
with 20% (30 vph) entering and 80% (121 vph) exiting.

WEEKDAY EVENING PEAK HOUR OF ADJACENT STREET TRAFFIC

T = 0.55 * (X) + 17.65
T = 0.55 * 300 + (17.65)
T = 182.65
T = 183 vehicle trips
with 65% (119 vph) entering and 35% (64 vph) exiting.

PROJECT DISTRIBUTION AND ASSIGNMENT

Residence MCD/County to Workplace MCD/County Flows for Massachusetts: 2000
Sorted by Residence State-County, or State-County-County Subdivision (in 12 states)

Residence State-County-MCD Name	Work County	Workplace State-County-MCD Name	Count	Percent	Route
Needham town Norfo	021	Quincy city Norfolk Co. MA	168	1.23%	GPA East
Needham town Norfo	021	Norwood town Norfolk Co. MA	149	1.09%	GPA East
Needham town Norfo	021	Canton town Norfolk Co. MA	95	0.69%	GPA East
Needham town Norfo	021	Braintree town Norfolk Co. MA	83	0.61%	GPA East
Needham town Norfo	021	Milton town Norfolk Co. MA	67	0.49%	GPA East
Needham town Norfo	021	Westwood town Norfolk Co. MA	62	0.45%	GPA East
Needham town Norfo	023	Brockton city Plymouth Co. MA	53	0.39%	GPA EAST
Needham town Norfo	021	Walpole town Norfolk Co. MA	51	0.37%	GPA East
Needham town Norfo	021	Weymouth town Norfolk Co. MA	48	0.35%	GPA East
Needham town Norfo	021	Sharon town Norfolk Co. MA	45	0.33%	GPA East
Needham town Norfo	021	Franklin city Norfolk Co. MA	40	0.29%	GPA East
Needham town Norfo	021	Stoughton town Norfolk Co. MA	34	0.25%	GPA East
Needham town Norfo	021	Foxbor. town Norfolk Co. MA	28	0.20%	GPA East
Needham town Norfo	023	Rockland town Plymouth Co. MA	22	0.16%	GPA EAST
Needham town Norfo	023	Hingham town Plymouth Co. MA	21	0.15%	GPA EAST
Needham town Norfo	021	Medfield town Norfolk Co. MA	17	0.12%	GPA East
Needham town Norfo	021	Plainville town Norfolk Co. MA	17	0.12%	GPA East
Needham town Norfo	023	Abington town Plymouth Co. MA	16	0.12%	GPA EAST
Needham town Norfo	021	Randolph town Norfolk Co. MA	15	0.11%	GPA East
Needham town Norfo	021	Bellingham town Norfolk Co. MA	14	0.10%	GPA East
Needham town Norfo	005	Taunton city Bristol Co. MA	14	0.10%	GPA East
Needham town Norfo	007	Providence city Providence Co. RI	14	0.10%	GPA East
Needham town Norfo	005	Mansfield town Bristol Co. MA	12	0.09%	GPA East
Needham town Norfo	005	Norton town Bristol Co. MA	12	0.09%	GPA East
Needham town Norfo	007	Lincoln town Providence Co. RI	12	0.09%	GPA East
Needham town Norfo	023	Pembroke town Plymouth Co. MA	10	0.07%	GPA EAST
Needham town Norfo	005	Attleboro city Bristol Co. MA	10	0.07%	GPA East
Needham town Norfo	023	Norwell town Plymouth Co. MA	9	0.07%	GPA EAST
Needham town Norfo	005	Fall River city Bristol Co. MA	9	0.07%	GPA East
Needham town Norfo	005	Raynham town Bristol Co. MA	9	0.07%	GPA East
Needham town Norfo	003	West Warwick town Kent Co. RI	9	0.07%	GPA East
Needham town Norfo	021	Cohasset town Norfolk Co. MA	8	0.06%	GPA East
Needham town Norfo	021	Medway town Norfolk Co. MA	8	0.06%	GPA East
Needham town Norfo	023	Hanover town Plymouth Co. MA	7	0.05%	GPA EAST
Needham town Norfo	005	North Attlebor. town Bristol Co. MA	6	0.04%	GPA East
Needham town Norfo	021	Avon town Norfolk Co. MA	5	0.04%	GPA East
Needham town Norfo	007	East Providence city Providence Co. RI	5	0.04%	GPA East
Needham town Norfo	023	Duxbury town Plymouth Co. MA	4	0.03%	GPA EAST
				8.83%	
Needham town Norfo	021	Wellesley town Norfolk Co. MA	635	4.64%	GPA West
Needham town Norfo	017	Natick town Middlesex Co. MA	257	1.88%	GPA West
Needham town Norfo	021	Dover town Norfolk Co. MA	65	0.47%	GPA West
Needham town Norfo	017	Sherborn town Middlesex Co. MA	7	0.05%	GPA West
				7.04%	
Needham town Norfo	021	Dedham town Norfolk Co. MA	229	**1.67%**	Greendale Ave South
Needham town Norfo	021	Needham town Norfolk Co. MA	687	**5.02%**	Kendrick West
Needham town Norfo	021	Needham town Norfolk Co. MA	2750	20.09%	Kendrick East
Needham town Norfo	017	Newton city Middlesex Co. MA	1038	7.58%	Kendrick East
Needham town Norfo	021	Brookline town Norfolk Co. MA	347	2.54%	Kendrick East
				30.21%	

Needham town Norfc 025	Boston city Suffolk Co. MA	3463	25.30%	Hunting Rd North
Needham town Norfc 017	Cambridge city Middlesex Co. MA	460	3.36%	Hunting Rd North
Needham town Norfc 017	Waltham city Middlesex Co. MA	364	2.66%	Hunting Rd North
Needham town Norfc 017	Framingham town Middlesex Co. MA	261	1.91%	Hunting Rd North
Needham town Norfc 017	Lexington town Middlesex Co. MA	200	1.46%	Hunting Rd North
Needham town Norfc 017	Burlington town Middlesex Co. MA	148	1.08%	Hunting Rd North
Needham town Norfc 017	Weston town Middlesex Co. MA	90	0.66%	Hunting Rd North
Needham town Norfc 017	Bedford town Middlesex Co. MA	88	0.64%	Hunting Rd North
Needham town Norfc 017	Marlbor. city Middlesex Co. MA	77	0.56%	Hunting Rd North
Needham town Norfc 017	Woburn city Middlesex Co. MA	76	0.56%	Hunting Rd North
Needham town Norfc 017	Wilmington town Middlesex Co. MA	57	0.42%	Hunting Rd North
Needham town Norfc 017	Billerica town Middlesex Co. MA	55	0.40%	Hunting Rd North
Needham town Norfc 027	Westbor. town Worcester Co. MA	51	0.37%	Hunting Rd North
Needham town Norfc 017	Watertown city Middlesex Co. MA	48	0.35%	Hunting Rd North
Needham town Norfc 027	Worcester city Worcester Co. MA	48	0.35%	Hunting Rd North
Needham town Norfc 009	Andover town Essex Co. MA	47	0.34%	Hunting Rd North
Needham town Norfc 017	Somerville city Middlesex Co. MA	46	0.34%	Hunting Rd North
Needham town Norfc 017	Everett city Middlesex Co. MA	45	0.33%	Hunting Rd North
Needham town Norfc 017	Acton town Middlesex Co. MA	44	0.32%	Hunting Rd North
Needham town Norfc 009	Peabody city Essex Co. MA	36	0.26%	Hunting Rd North
Needham town Norfc 017	Wayland town Middlesex Co. MA	36	0.26%	Hunting Rd North
Needham town Norfc 017	Sudbury town Middlesex Co. MA	33	0.24%	Hunting Rd North
Needham town Norfc 017	Stoneham town Middlesex Co. MA	32	0.23%	Hunting Rd North
Needham town Norfc 017	Concord town Middlesex Co. MA	31	0.23%	Hunting Rd North
Needham town Norfc 009	Salem city Essex Co. MA	30	0.22%	Hunting Rd North
Needham town Norfc 017	Hudson town Middlesex Co. MA	27	0.20%	Hunting Rd North
Needham town Norfc 017	Littleton town Middlesex Co. MA	25	0.18%	Hunting Rd North
Needham town Norfc 017	Wakefield town Middlesex Co. MA	23	0.17%	Hunting Rd North
Needham town Norfc 017	Arlington town Middlesex Co. MA	22	0.16%	Hunting Rd North
Needham town Norfc 017	Belmont town Middlesex Co. MA	22	0.16%	Hunting Rd North
Needham town Norfc 017	Lowell city Middlesex Co. MA	22	0.16%	Hunting Rd North
Needham town Norfc 025	Chelsea city Suffolk Co. MA	21	0.15%	Hunting Rd North
Needham town Norfc 017	Ashland town Middlesex Co. MA	20	0.15%	Hunting Rd North
Needham town Norfc 017	Melrose city Middlesex Co. MA	19	0.14%	Hunting Rd North
Needham town Norfc 027	Milford town Worcester Co. MA	19	0.14%	Hunting Rd North
Needham town Norfc 009	Beverly city Essex Co. MA	18	0.13%	Hunting Rd North
Needham town Norfc 027	Southbor. town Worcester Co. MA	18	0.13%	Hunting Rd North
Needham town Norfc 017	Hopkinton town Middlesex Co. MA	15	0.11%	Hunting Rd North
Needham town Norfc 017	Chelmsford town Middlesex Co. MA	13	0.09%	Hunting Rd North
Needham town Norfc 017	Lincoln town Middlesex Co. MA	13	0.09%	Hunting Rd North
Needham town Norfc 017	Medford city Middlesex Co. MA	13	0.09%	Hunting Rd North
Needham town Norfc 017	Maynard town Middlesex Co. MA	12	0.09%	Hunting Rd North
Needham town Norfc 017	Malden city Middlesex Co. MA	11	0.08%	Hunting Rd North
Needham town Norfc 009	Lynn city Essex Co. MA	10	0.07%	Hunting Rd North
Needham town Norfc 009	Manchester-by-the-Sea town Essex Co. M	10	0.07%	Hunting Rd North
Needham town Norfc 015	Exeter town Rockingham Co. NH	10	0.07%	Hunting Rd North
Needham town Norfc 017	Westford town Middlesex Co. MA	10	0.07%	Hunting Rd North
Needham town Norfc 027	Harvard town Worcester Co. MA	10	0.07%	Hunting Rd North
Needham town Norfc 027	Shrewsbury town Worcester Co. MA	10	0.07%	Hunting Rd North
Needham town Norfc 009	Groveland town Essex Co. MA	9	0.07%	Hunting Rd North
Needham town Norfc 017	Tyngsbor. town Middlesex Co. MA	9	0.07%	Hunting Rd North
Needham town Norfc 027	Barre town Worcester Co. MA	9	0.07%	Hunting Rd North
Needham town Norfc 027	Bolton town Worcester Co. MA	9	0.07%	Hunting Rd North
Needham town Norfc 027	Northbor. town Worcester Co. MA	9	0.07%	Hunting Rd North
Needham town Norfc 009	Danvers town Essex Co. MA	8	0.06%	Hunting Rd North
Needham town Norfc 027	Petersham town Worcester Co. MA	8	0.06%	Hunting Rd North
Needham town Norfc 017	Rochester city Strafford Co. NH	7	0.05%	Hunting Rd North
Needham town Norfc 017	Holliston town Middlesex Co. MA	7	0.05%	Hunting Rd North
Needham town Norfc 017	Townsend town Middlesex Co. MA	7	0.05%	Hunting Rd North
Needham town Norfc 017	Winchester town Middlesex Co. MA	7	0.05%	Hunting Rd North
Needham town Norfc 009	Lynnfield town Essex Co. MA	6	0.04%	Hunting Rd North
Needham town Norfc 017	Stow town Middlesex Co. MA	6	0.04%	Hunting Rd North
Needham town Norfc 017	Bethel town Oxford Co. ME	5	0.04%	Hunting Rd North
Needham town Norfc 011	Bedford town Hillsborough Co. NH	4	0.03%	Hunting Rd North
Needham town Norfc 025	Revere city Suffolk Co. MA	4	0.03%	Hunting Rd North
			46.56%	

CAPACITY ANALYSIS WORKSHEETS

Kendrick Street at Hunting Road
Greendale Avenue at Bird Street
Great Plain Avenue at Greendale Avenue
Greendale Avenue at the Project North Driveway
Greendale Avenue at the Project South Driveway

Kendrick Street at Hunting Road

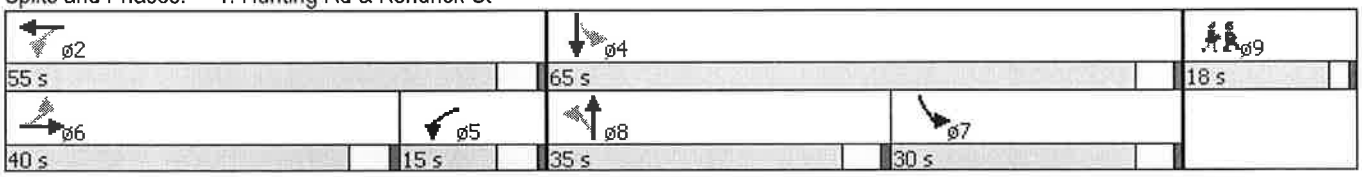
Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	23	549	1	110	178	72	0	334	712	289	93	20
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Lane Width (ft)	12	12	12	12	12	12	12	12	12	11	12	12
Storage Length (ft)	0		0	0		110	0		110	130		0
Storage Lanes	0		0	1		0	0		1	1		0
Taper Length (ft)	25			25			25			25		
Lane Util. Factor	0.95	0.95	0.95	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Frt					0.957				0.850		0.973	
Flt Protected		0.998		0.950						0.950		
Satd. Flow (prot)	0	3563	0	1770	1803	0	0	1881	1599	1728	1803	0
Flt Permitted		0.925		0.235						0.263		
Satd. Flow (perm)	0	3302	0	438	1803	0	0	1881	1599	478	1803	0
Right Turn on Red			Yes			Yes			Yes			Yes
Satd. Flow (RTOR)					17				300		10	
Link Speed (mph)		30			30			30			30	
Link Distance (ft)		477			405			232			310	
Travel Time (s)		10.8			9.2			5.3			7.0	
Peak Hour Factor	0.92	0.92	0.92	0.88	0.88	0.88	0.92	0.92	0.92	0.91	0.91	0.91
Heavy Vehicles (%)	4%	1%	0%	2%	0%	3%	0%	1%	1%	1%	2%	5%
Adj. Flow (vph)	25	597	1	125	202	82	0	363	774	318	102	22
Shared Lane Traffic (%)												
Lane Group Flow (vph)	0	623	0	125	284	0	0	363	774	318	124	0
Turn Type	Perm	NA		pm+pt	NA		Perm	NA	Free	pm+pt	NA	
Protected Phases		6		5	2			8		7	4	
Permitted Phases	6			2			8		Free	4		
Minimum Initial (s)	7.0	7.0		7.0	10.0		10.0	10.0		7.0	10.0	
Minimum Split (s)	12.0	12.0		12.0	15.0		15.0	15.0		12.0	15.0	
Total Split (s)	40.0	40.0		15.0	55.0		35.0	35.0		30.0	65.0	
Total Split (%)	29.0%	29.0%		10.9%	39.9%		25.4%	25.4%		21.7%	47.1%	
Maximum Green (s)	35.0	35.0		10.0	50.0		30.0	30.0		25.0	60.0	
Yellow Time (s)	4.0	4.0		4.0	4.0		4.0	4.0		4.0	4.0	
All-Red Time (s)	1.0	1.0		1.0	1.0		1.0	1.0		1.0	1.0	
Total Lost Time (s)		5.0		5.0	5.0			5.0		5.0	5.0	
Lead/Lag	Lead	Lead		Lag			Lead	Lead		Lag		
Lead-Lag Optimize?	Yes	Yes		Yes			Yes	Yes		Yes		
Vehicle Extension (s)	3.0	3.0		3.0	3.0		3.0	3.0		3.0	3.0	
Recall Mode	Min	Min		None	Min		None	None		None	None	
Walk Time (s)												
Flash Dont Walk (s)												
Pedestrian Calls (#/hr)												
Act Effct Green (s)		26.0		39.9	39.9			25.9	106.7	53.3	53.3	
Actuated g/C Ratio		0.24		0.37	0.37			0.24	1.00	0.50	0.50	
v/c Ratio		0.78		0.46	0.42			0.80	0.48	0.64	0.14	
Control Delay		46.6		40.6	27.2			54.2	1.1	37.8	16.1	
Queue Delay		0.0		0.0	0.0			0.0	0.0	0.0	0.0	
Total Delay		46.6		40.6	27.2			54.2	1.1	37.8	16.1	
LOS		D		D	C			D	A	D	B	
Approach Delay		46.6			31.3			18.0			31.7	

Lane Group	ø9
Lane Configurations	
Volume (vph)	
Ideal Flow (vphpl)	
Lane Width (ft)	
Storage Length (ft)	
Storage Lanes	
Taper Length (ft)	
Lane Util. Factor	
Frt	
Flt Protected	
Satd. Flow (prot)	
Flt Permitted	
Satd. Flow (perm)	
Right Turn on Red	
Satd. Flow (RTOR)	
Link Speed (mph)	
Link Distance (ft)	
Travel Time (s)	
Peak Hour Factor	
Heavy Vehicles (%)	
Adj. Flow (vph)	
Shared Lane Traffic (%)	
Lane Group Flow (vph)	
Turn Type	
Protected Phases	9
Permitted Phases	
Minimum Initial (s)	10.0
Minimum Split (s)	18.0
Total Split (s)	18.0
Total Split (%)	13%
Maximum Green (s)	15.0
Yellow Time (s)	2.0
All-Red Time (s)	1.0
Total Lost Time (s)	
Lead/Lag	
Lead-Lag Optimize?	
Vehicle Extension (s)	3.0
Recall Mode	None
Walk Time (s)	6.0
Flash Dont Walk (s)	11.0
Pedestrian Calls (#/hr)	1
Act Effct Green (s)	
Actuated g/C Ratio	
v/c Ratio	
Control Delay	
Queue Delay	
Total Delay	
LOS	
Approach Delay	

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Approach LOS		D			C			B			C	

Intersection Summary			
Area Type:	Other		
Cycle Length: 138			
Actuated Cycle Length: 106.7			
Control Type: Actuated-Uncoordinated			
Maximum v/c Ratio: 0.80			
Intersection Signal Delay: 29.2		Intersection LOS: C	
Intersection Capacity Utilization 79.9%		ICU Level of Service D	
Analysis Period (min) 15			

Splits and Phases: 1: Hunting Rd & Kendrick St



Lane Group	EBT	WBL	WBT	NBT	NBR	SBL	SBT
Lane Group Flow (vph)	623	125	284	363	774	318	124
v/c Ratio	0.78	0.46	0.42	0.80	0.48	0.64	0.14
Control Delay	46.6	40.6	27.2	54.2	1.1	37.8	16.1
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	46.6	40.6	27.2	54.2	1.1	37.8	16.1
Queue Length 50th (ft)	211	57	134	229	0	119	37
Queue Length 95th (ft)	350	126	262	#507	0	285	106
Internal Link Dist (ft)	397		325	152			230
Turn Bay Length (ft)					110	130	
Base Capacity (vph)	1126	300	887	549	1599	560	1058
Starvation Cap Reductn	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0
Reduced v/c Ratio	0.55	0.42	0.32	0.66	0.48	0.57	0.12

Intersection Summary

95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.

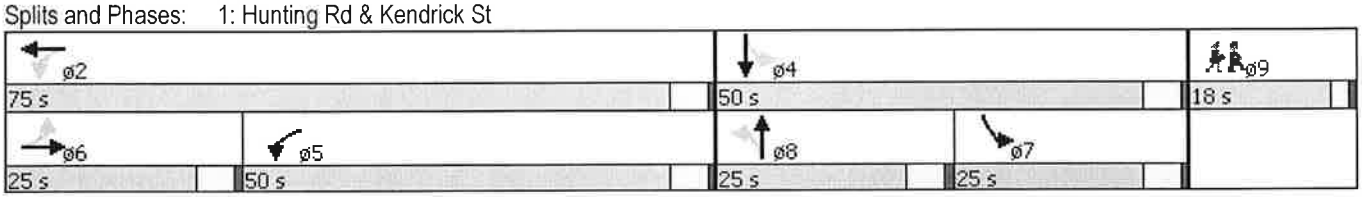
Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	19	214	2	723	388	306	3	99	154	171	284	18
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Lane Width (ft)	12	12	12	12	12	12	12	12	12	11	12	12
Storage Length (ft)	0		0	0		110	0		110	130		0
Storage Lanes	0		0	1		0	0		1	1		0
Taper Length (ft)	25			25			25			25		
Lane Util. Factor	0.95	0.95	0.95	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Frt		0.999			0.934				0.850		0.991	
Flt Protected		0.996		0.950				0.999		0.950		
Satd. Flow (prot)	0	3592	0	1787	1775	0	0	1898	1599	1728	1883	0
Flt Permitted		0.589		0.531				0.621		0.634		
Satd. Flow (perm)	0	2124	0	999	1775	0	0	1180	1599	1153	1883	0
Right Turn on Red			Yes			Yes			Yes			Yes
Satd. Flow (RTOR)					39				177		2	
Link Speed (mph)		30			30			30			30	
Link Distance (ft)		477			405			232			310	
Travel Time (s)		10.8			9.2			5.3			7.0	
Peak Hour Factor	0.88	0.88	0.88	0.95	0.95	0.95	0.87	0.87	0.87	0.93	0.93	0.93
Heavy Vehicles (%)	0%	0%	0%	1%	0%	0%	0%	0%	1%	1%	0%	0%
Adj. Flow (vph)	22	243	2	761	408	322	3	114	177	184	305	19
Shared Lane Traffic (%)												
Lane Group Flow (vph)	0	267	0	761	730	0	0	117	177	184	324	0
Turn Type	Perm	NA		pm+pt	NA		Perm	NA	Free	pm+pt	NA	
Protected Phases		6		5	2			8		7	4	
Permitted Phases	6			2			8		Free	4		
Minimum Initial (s)	7.0	7.0		7.0	10.0		10.0	10.0		7.0	10.0	
Minimum Split (s)	12.0	12.0		12.0	15.0		15.0	15.0		12.0	15.0	
Total Split (s)	25.0	25.0		50.0	75.0		25.0	25.0		25.0	50.0	
Total Split (%)	17.5%	17.5%		35.0%	52.4%		17.5%	17.5%		17.5%	35.0%	
Maximum Green (s)	20.0	20.0		45.0	70.0		20.0	20.0		20.0	45.0	
Yellow Time (s)	4.0	4.0		4.0	4.0		4.0	4.0		4.0	4.0	
All-Red Time (s)	1.0	1.0		1.0	1.0		1.0	1.0		1.0	1.0	
Total Lost Time (s)		5.0		5.0	5.0			5.0		5.0	5.0	
Lead/Lag	Lead	Lead		Lag			Lead	Lead		Lag		
Lead-Lag Optimize?	Yes	Yes		Yes			Yes	Yes		Yes		
Vehicle Extension (s)	3.0	3.0		3.0	3.0		3.0	3.0		3.0	3.0	
Recall Mode	Min	Min		None	Min		None	None		None	None	
Walk Time (s)												
Flash Dont Walk (s)												
Pedestrian Calls (#/hr)												
Act Effct Green (s)		19.5		69.5	69.5			14.5	106.1	26.5	26.5	
Actuated g/C Ratio		0.18		0.66	0.66			0.14	1.00	0.25	0.25	
v/c Ratio		0.69		0.77	0.62			0.73	0.11	0.56	0.69	
Control Delay		51.2		24.2	13.4			69.4	0.1	43.1	44.0	
Queue Delay		0.0		0.0	0.0			0.0	0.0	0.0	0.0	
Total Delay		51.2		24.2	13.4			69.4	0.1	43.1	44.0	
LOS		D		C	B			E	A	D	D	
Approach Delay		51.2			18.9			27.7			43.7	

Lane Group	ø9
Lane Configurations	
Volume (vph)	
Ideal Flow (vphpl)	
Lane Width (ft)	
Storage Length (ft)	
Storage Lanes	
Taper Length (ft)	
Lane Util. Factor	
Frt	
Flt Protected	
Satd. Flow (prot)	
Flt Permitted	
Satd. Flow (perm)	
Right Turn on Red	
Satd. Flow (RTOR)	
Link Speed (mph)	
Link Distance (ft)	
Travel Time (s)	
Peak Hour Factor	
Heavy Vehicles (%)	
Adj. Flow (vph)	
Shared Lane Traffic (%)	
Lane Group Flow (vph)	
Turn Type	
Protected Phases	9
Permitted Phases	
Minimum Initial (s)	10.0
Minimum Split (s)	18.0
Total Split (s)	18.0
Total Split (%)	13%
Maximum Green (s)	15.0
Yellow Time (s)	2.0
All-Red Time (s)	1.0
Total Lost Time (s)	
Lead/Lag	
Lead-Lag Optimize?	
Vehicle Extension (s)	3.0
Recall Mode	None
Walk Time (s)	6.0
Flash Dont Walk (s)	11.0
Pedestrian Calls (#/hr)	0
Act Effct Green (s)	
Actuated g/C Ratio	
v/c Ratio	
Control Delay	
Queue Delay	
Total Delay	
LOS	
Approach Delay	

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Approach LOS		D			B			C			D	

Intersection Summary			
Area Type:	Other		
Cycle Length: 143			
Actuated Cycle Length: 106.1			
Control Type: Actuated-Uncoordinated			
Maximum v/c Ratio: 0.77			
Intersection Signal Delay: 28.2		Intersection LOS: C	
Intersection Capacity Utilization 75.2%		ICU Level of Service D	
Analysis Period (min) 15			

Splits and Phases: 1: Hunting Rd & Kendrick St



Lane Group	EBT	WBL	WBT	NBT	NBR	SBL	SBT
Lane Group Flow (vph)	267	761	730	117	177	184	324
v/c Ratio	0.69	0.77	0.62	0.73	0.11	0.56	0.69
Control Delay	51.2	24.2	13.4	69.4	0.1	43.1	44.0
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	51.2	24.2	13.4	69.4	0.1	43.1	44.0
Queue Length 50th (ft)	89	279	244	78	0	106	200
Queue Length 95th (ft)	140	472	420	136	0	171	297
Internal Link Dist (ft)	397		325	152			230
Turn Bay Length (ft)					110	130	
Base Capacity (vph)	400	989	1186	222	1599	538	801
Starvation Cap Reductn	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0
Reduced v/c Ratio	0.67	0.77	0.62	0.53	0.11	0.34	0.40

Intersection Summary

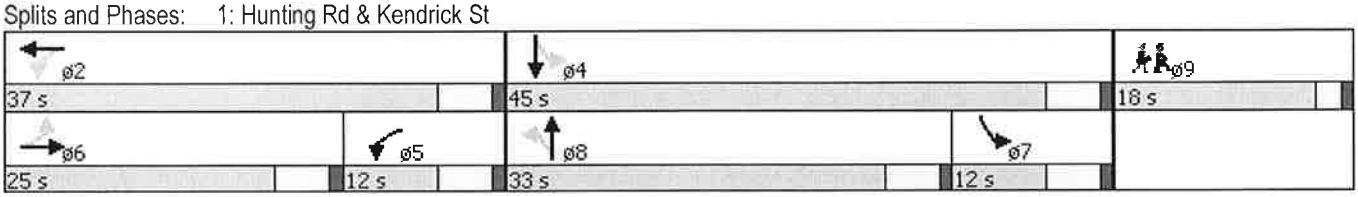
Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	41	484	1	84	168	59	0	512	531	79	61	3
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Lane Width (ft)	12	12	12	12	12	12	12	12	12	11	12	12
Storage Length (ft)	0		0	0		110	0		110	130		0
Storage Lanes	0		0	1		0	0		1	1		0
Taper Length (ft)	25			25			25			25		
Lane Util. Factor	0.95	0.95	0.95	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Frt					0.961				0.850		0.994	
Flt Protected		0.996		0.950						0.950		
Satd. Flow (prot)	0	3552	0	1770	1812	0	0	1881	1599	1728	1849	0
Flt Permitted		0.879		0.298						0.182		
Satd. Flow (perm)	0	3135	0	555	1812	0	0	1881	1599	331	1849	0
Right Turn on Red			Yes			Yes			Yes			Yes
Satd. Flow (RTOR)					19				218		3	
Link Speed (mph)		30			30			30			30	
Link Distance (ft)		477			405			232			310	
Travel Time (s)		10.8			9.2			5.3			7.0	
Peak Hour Factor	0.92	0.92	0.92	0.88	0.88	0.88	0.92	0.92	0.92	0.91	0.91	0.91
Heavy Vehicles (%)	4%	1%	0%	2%	0%	3%	0%	1%	1%	1%	2%	5%
Adj. Flow (vph)	45	526	1	95	191	67	0	557	577	87	67	3
Shared Lane Traffic (%)												
Lane Group Flow (vph)	0	572	0	95	258	0	0	557	577	87	70	0
Turn Type	Perm	NA		pm+pt	NA		Perm	NA	Free	pm+pt	NA	
Protected Phases		6		5	2			8		7	4	
Permitted Phases	6			2			8		Free	4		
Minimum Initial (s)	7.0	7.0		7.0	10.0		10.0	10.0		7.0	10.0	
Minimum Split (s)	12.0	12.0		12.0	15.0		15.0	15.0		12.0	15.0	
Total Split (s)	25.0	25.0		12.0	37.0		33.0	33.0		12.0	45.0	
Total Split (%)	25.0%	25.0%		12.0%	37.0%		33.0%	33.0%		12.0%	45.0%	
Maximum Green (s)	20.0	20.0		7.0	32.0		28.0	28.0		7.0	40.0	
Yellow Time (s)	4.0	4.0		4.0	4.0		4.0	4.0		4.0	4.0	
All-Red Time (s)	1.0	1.0		1.0	1.0		1.0	1.0		1.0	1.0	
Total Lost Time (s)		5.0		5.0	5.0			5.0		5.0	5.0	
Lead/Lag	Lead	Lead		Lag			Lead	Lead		Lag		
Lead-Lag Optimize?	Yes	Yes		Yes			Yes	Yes		Yes		
Vehicle Extension (s)	3.0	3.0		3.0	3.0		3.0	3.0		3.0	3.0	
Recall Mode	Min	Min		None	Min		None	None		None	None	
Walk Time (s)												
Flash Dont Walk (s)												
Pedestrian Calls (#/hr)												
Act Effct Green (s)		20.5		31.5	29.5			29.0	81.0	40.0	38.0	
Actuated g/C Ratio		0.25		0.39	0.36			0.36	1.00	0.49	0.47	
v/c Ratio		0.72		0.29	0.38			0.83	0.36	0.30	0.08	
Control Delay		36.9		26.8	21.3			39.8	0.6	24.8	14.5	
Queue Delay		0.0		0.0	0.0			0.0	0.0	0.0	0.0	
Total Delay		36.9		26.8	21.3			39.8	0.6	24.8	14.5	
LOS		D		C	C			D	A	C	B	
Approach Delay		36.9			22.8			19.9			20.2	

Lane Group	ø9
Lane Configurations	
Volume (vph)	
Ideal Flow (vphpl)	
Lane Width (ft)	
Storage Length (ft)	
Storage Lanes	
Taper Length (ft)	
Lane Util. Factor	
Frt	
Flt Protected	
Satd. Flow (prot)	
Flt Permitted	
Satd. Flow (perm)	
Right Turn on Red	
Satd. Flow (RTOR)	
Link Speed (mph)	
Link Distance (ft)	
Travel Time (s)	
Peak Hour Factor	
Heavy Vehicles (%)	
Adj. Flow (vph)	
Shared Lane Traffic (%)	
Lane Group Flow (vph)	
Turn Type	
Protected Phases	9
Permitted Phases	
Minimum Initial (s)	10.0
Minimum Split (s)	18.0
Total Split (s)	18.0
Total Split (%)	18%
Maximum Green (s)	15.0
Yellow Time (s)	2.0
All-Red Time (s)	1.0
Total Lost Time (s)	
Lead/Lag	
Lead-Lag Optimize?	
Vehicle Extension (s)	3.0
Recall Mode	None
Walk Time (s)	6.0
Flash Dont Walk (s)	11.0
Pedestrian Calls (#/hr)	1
Act Effct Green (s)	
Actuated g/C Ratio	
v/c Ratio	
Control Delay	
Queue Delay	
Total Delay	
LOS	
Approach Delay	

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Approach LOS		D			C			B			C	

Intersection Summary			
Area Type:	Other		
Cycle Length: 100			
Actuated Cycle Length: 81			
Control Type: Actuated-Uncoordinated			
Maximum v/c Ratio: 0.83			
Intersection Signal Delay: 24.8		Intersection LOS: C	
Intersection Capacity Utilization 79.0%		ICU Level of Service D	
Analysis Period (min) 15			

Splits and Phases: 1: Hunting Rd & Kendrick St



Lane Group	EBT	WBL	WBT	NBT	NBR	SBL	SBT
Lane Group Flow (vph)	572	95	258	557	577	87	70
v/c Ratio	0.72	0.29	0.38	0.83	0.36	0.30	0.08
Control Delay	36.9	26.8	21.3	39.8	0.6	24.8	14.5
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	36.9	26.8	21.3	39.8	0.6	24.8	14.5
Queue Length 50th (ft)	143	31	84	264	0	23	17
Queue Length 95th (ft)	#299	82	192	#614	0	69	56
Internal Link Dist (ft)	397		325	152			230
Turn Bay Length (ft)					110	130	
Base Capacity (vph)	800	324	751	672	1599	288	946
Starvation Cap Reductn	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0
Reduced v/c Ratio	0.72	0.29	0.34	0.83	0.36	0.30	0.07

Intersection Summary

95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.

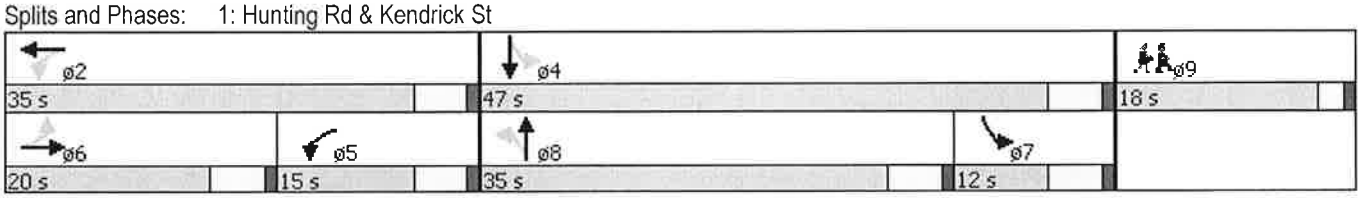
Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	1	97	2	185	339	90	1	100	101	40	605	19
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Lane Width (ft)	12	12	12	12	12	12	12	12	12	11	12	12
Storage Length (ft)	0		0	0		110	0		110	130		0
Storage Lanes	0		0	1		0	0		1	1		0
Taper Length (ft)	25			25			25			25		
Lane Util. Factor	0.95	0.95	0.95	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Frt		0.997			0.968				0.850		0.996	
Flt Protected				0.950						0.950		
Satd. Flow (prot)	0	3599	0	1787	1839	0	0	1900	1599	1728	1892	0
Flt Permitted		0.646		0.681				0.996		0.682		
Satd. Flow (perm)	0	2325	0	1281	1839	0	0	1892	1599	1240	1892	0
Right Turn on Red			Yes			Yes			Yes			Yes
Satd. Flow (RTOR)		1			14				218		2	
Link Speed (mph)		30			30			30			30	
Link Distance (ft)		477			405			232			310	
Travel Time (s)		10.8			9.2			5.3			7.0	
Peak Hour Factor	0.88	0.88	0.88	0.95	0.95	0.95	0.87	0.87	0.87	0.93	0.93	0.93
Heavy Vehicles (%)	0%	0%	0%	1%	0%	0%	0%	0%	1%	1%	0%	0%
Adj. Flow (vph)	1	110	2	195	357	95	1	115	116	43	651	20
Shared Lane Traffic (%)												
Lane Group Flow (vph)	0	113	0	195	452	0	0	116	116	43	671	0
Turn Type	Perm	NA		pm+pt	NA		Perm	NA	Free	pm+pt	NA	
Protected Phases		6		5	2			8		7	4	
Permitted Phases	6			2			8		Free	4		
Minimum Initial (s)	7.0	7.0		7.0	10.0		10.0	10.0		7.0	10.0	
Minimum Split (s)	12.0	12.0		12.0	15.0		15.0	15.0		12.0	15.0	
Total Split (s)	20.0	20.0		15.0	35.0		35.0	35.0		12.0	47.0	
Total Split (%)	20.0%	20.0%		15.0%	35.0%		35.0%	35.0%		12.0%	47.0%	
Maximum Green (s)	15.0	15.0		10.0	30.0		30.0	30.0		7.0	42.0	
Yellow Time (s)	4.0	4.0		4.0	4.0		4.0	4.0		4.0	4.0	
All-Red Time (s)	1.0	1.0		1.0	1.0		1.0	1.0		1.0	1.0	
Total Lost Time (s)		5.0		5.0	5.0			5.0		5.0	5.0	
Lead/Lag	Lead	Lead		Lag			Lead	Lead		Lag		
Lead-Lag Optimize?	Yes	Yes		Yes			Yes	Yes		Yes		
Vehicle Extension (s)	3.0	3.0		3.0	3.0		3.0	3.0		3.0	3.0	
Recall Mode	Min	Min		None	Min		None	None		None	None	
Walk Time (s)												
Flash Dont Walk (s)												
Pedestrian Calls (#/hr)												
Act Effct Green (s)		8.8		24.2	24.2			22.1	64.9	30.3	30.3	
Actuated g/C Ratio		0.14		0.37	0.37			0.34	1.00	0.47	0.47	
v/c Ratio		0.36		0.35	0.65			0.18	0.07	0.06	0.76	
Control Delay		32.5		19.4	23.1			22.6	0.1	10.2	20.9	
Queue Delay		0.0		0.0	0.0			0.0	0.0	0.0	0.0	
Total Delay		32.5		19.4	23.1			22.6	0.1	10.2	20.9	
LOS		C		B	C			C	A	B	C	
Approach Delay		32.5			22.0			11.3			20.2	

Lane Group	ø9
Lane Configurations	
Volume (vph)	
Ideal Flow (vphpl)	
Lane Width (ft)	
Storage Length (ft)	
Storage Lanes	
Taper Length (ft)	
Lane Util. Factor	
Frt	
Flt Protected	
Satd. Flow (prot)	
Flt Permitted	
Satd. Flow (perm)	
Right Turn on Red	
Satd. Flow (RTOR)	
Link Speed (mph)	
Link Distance (ft)	
Travel Time (s)	
Peak Hour Factor	
Heavy Vehicles (%)	
Adj. Flow (vph)	
Shared Lane Traffic (%)	
Lane Group Flow (vph)	
Turn Type	
Protected Phases	9
Permitted Phases	
Minimum Initial (s)	10.0
Minimum Split (s)	18.0
Total Split (s)	18.0
Total Split (%)	18%
Maximum Green (s)	15.0
Yellow Time (s)	2.0
All-Red Time (s)	1.0
Total Lost Time (s)	
Lead/Lag	
Lead-Lag Optimize?	
Vehicle Extension (s)	3.0
Recall Mode	None
Walk Time (s)	6.0
Flash Dont Walk (s)	11.0
Pedestrian Calls (#/hr)	0
Act Effct Green (s)	
Actuated g/C Ratio	
v/c Ratio	
Control Delay	
Queue Delay	
Total Delay	
LOS	
Approach Delay	

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Approach LOS		C			C			B			C	

Intersection Summary			
Area Type:	Other		
Cycle Length: 100			
Actuated Cycle Length: 64.9			
Control Type: Actuated-Uncoordinated			
Maximum v/c Ratio: 0.76			
Intersection Signal Delay: 20.5		Intersection LOS: C	
Intersection Capacity Utilization 64.6%		ICU Level of Service C	
Analysis Period (min) 15			

Splits and Phases: 1: Hunting Rd & Kendrick St



Lane Group	EBT	WBL	WBT	NBT	NBR	SBL	SBT
Lane Group Flow (vph)	113	195	452	116	116	43	671
v/c Ratio	0.36	0.35	0.65	0.18	0.07	0.06	0.76
Control Delay	32.5	19.4	23.1	22.6	0.1	10.2	20.9
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	32.5	19.4	23.1	22.6	0.1	10.2	20.9
Queue Length 50th (ft)	22	55	144	24	0	8	199
Queue Length 95th (ft)	52	121	288	95	0	26	370
Internal Link Dist (ft)	397		325	152			230
Turn Bay Length (ft)					110	130	
Base Capacity (vph)	561	599	894	923	1599	664	1278
Starvation Cap Reductn	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0
Reduced v/c Ratio	0.20	0.33	0.51	0.13	0.07	0.06	0.53

Intersection Summary

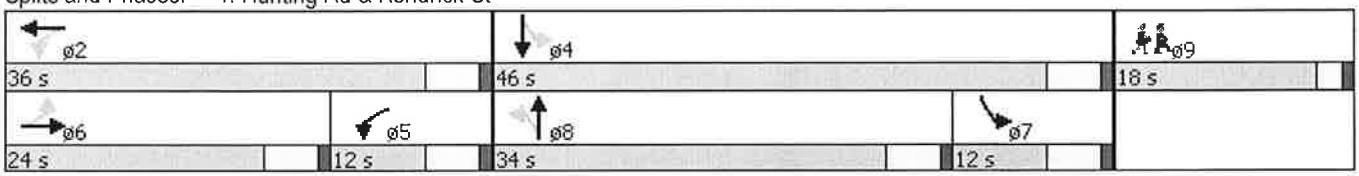
Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	41	484	1	93	168	59	0	567	567	79	75	3
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Lane Width (ft)	12	12	12	12	12	12	12	12	12	11	12	12
Storage Length (ft)	0		0	0		110	0		110	130		0
Storage Lanes	0		0	1		0	0		1	1		0
Taper Length (ft)	25			25			25			25		
Lane Util. Factor	0.95	0.95	0.95	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Frt					0.961				0.850		0.995	
Flt Protected		0.996		0.950						0.950		
Satd. Flow (prot)	0	3552	0	1770	1812	0	0	1881	1599	1728	1852	0
Flt Permitted		0.865		0.289						0.135		
Satd. Flow (perm)	0	3085	0	538	1812	0	0	1881	1599	245	1852	0
Right Turn on Red			Yes			Yes			Yes			Yes
Satd. Flow (RTOR)					18				218		2	
Link Speed (mph)		30			30			30			30	
Link Distance (ft)		477			405			232			310	
Travel Time (s)		10.8			9.2			5.3			7.0	
Peak Hour Factor	0.92	0.92	0.92	0.88	0.88	0.88	0.92	0.92	0.92	0.91	0.91	0.91
Heavy Vehicles (%)	4%	1%	0%	2%	0%	3%	0%	1%	1%	1%	2%	5%
Adj. Flow (vph)	45	526	1	106	191	67	0	616	616	87	82	3
Shared Lane Traffic (%)												
Lane Group Flow (vph)	0	572	0	106	258	0	0	616	616	87	85	0
Turn Type	Perm	NA		pm+pt	NA		Perm	NA	Free	pm+pt	NA	
Protected Phases		6		5	2			8		7	4	
Permitted Phases	6			2			8		Free	4		
Minimum Initial (s)	7.0	7.0		7.0	10.0		10.0	10.0		7.0	10.0	
Minimum Split (s)	12.0	12.0		12.0	15.0		15.0	15.0		12.0	15.0	
Total Split (s)	24.0	24.0		12.0	36.0		34.0	34.0		12.0	46.0	
Total Split (%)	24.0%	24.0%		12.0%	36.0%		34.0%	34.0%		12.0%	46.0%	
Maximum Green (s)	19.0	19.0		7.0	31.0		29.0	29.0		7.0	41.0	
Yellow Time (s)	4.0	4.0		4.0	4.0		4.0	4.0		4.0	4.0	
All-Red Time (s)	1.0	1.0		1.0	1.0		1.0	1.0		1.0	1.0	
Total Lost Time (s)		5.0		5.0	5.0			5.0		5.0	5.0	
Lead/Lag	Lead	Lead		Lag			Lead	Lead		Lag		
Lead-Lag Optimize?	Yes	Yes		Yes			Yes	Yes		Yes		
Vehicle Extension (s)	3.0	3.0		3.0	3.0		3.0	3.0		3.0	3.0	
Recall Mode	Min	Min		None	Min		None	None		None	None	
Walk Time (s)												
Flash Dont Walk (s)												
Pedestrian Calls (#/hr)												
Act Effct Green (s)		19.6		30.6	28.7			30.0	81.2	41.0	39.0	
Actuated g/C Ratio		0.24		0.38	0.35			0.37	1.00	0.50	0.48	
v/c Ratio		0.77		0.34	0.40			0.89	0.39	0.34	0.10	
Control Delay		39.8		29.0	22.2			44.5	0.7	27.9	14.2	
Queue Delay		0.0		0.0	0.0			0.0	0.0	0.0	0.0	
Total Delay		39.8		29.0	22.2			44.5	0.7	27.9	14.2	
LOS		D		C	C			D	A	C	B	
Approach Delay		39.8			24.2			22.6			21.1	

Lane Group	ø9
Lane Configurations	
Volume (vph)	
Ideal Flow (vphpl)	
Lane Width (ft)	
Storage Length (ft)	
Storage Lanes	
Taper Length (ft)	
Lane Util. Factor	
Frt	
Flt Protected	
Satd. Flow (prot)	
Flt Permitted	
Satd. Flow (perm)	
Right Turn on Red	
Satd. Flow (RTOR)	
Link Speed (mph)	
Link Distance (ft)	
Travel Time (s)	
Peak Hour Factor	
Heavy Vehicles (%)	
Adj. Flow (vph)	
Shared Lane Traffic (%)	
Lane Group Flow (vph)	
Turn Type	
Protected Phases	9
Permitted Phases	
Minimum Initial (s)	10.0
Minimum Split (s)	18.0
Total Split (s)	18.0
Total Split (%)	18%
Maximum Green (s)	15.0
Yellow Time (s)	2.0
All-Red Time (s)	1.0
Total Lost Time (s)	
Lead/Lag	
Lead-Lag Optimize?	
Vehicle Extension (s)	3.0
Recall Mode	None
Walk Time (s)	6.0
Flash Dont Walk (s)	11.0
Pedestrian Calls (#/hr)	1
Act Effct Green (s)	
Actuated g/C Ratio	
v/c Ratio	
Control Delay	
Queue Delay	
Total Delay	
LOS	
Approach Delay	

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Approach LOS		D			C			C			C	

Intersection Summary			
Area Type:	Other		
Cycle Length: 100			
Actuated Cycle Length: 81.2			
Control Type: Actuated-Uncoordinated			
Maximum v/c Ratio: 0.89			
Intersection Signal Delay: 27.0		Intersection LOS: C	
Intersection Capacity Utilization 81.9%		ICU Level of Service D	
Analysis Period (min) 15			

Splits and Phases: 1: Hunting Rd & Kendrick St



Lane Group	EBT	WBL	WBT	NBT	NBR	SBL	SBT
Lane Group Flow (vph)	572	106	258	616	616	87	85
v/c Ratio	0.77	0.34	0.40	0.89	0.39	0.34	0.10
Control Delay	39.8	29.0	22.2	44.5	0.7	27.9	14.2
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	39.8	29.0	22.2	44.5	0.7	27.9	14.2
Queue Length 50th (ft)	146	35	87	299	0	22	21
Queue Length 95th (ft)	#313	92	195	#689	0	67	65
Internal Link Dist (ft)	397		325	152			230
Turn Bay Length (ft)					110	130	
Base Capacity (vph)	745	312	725	694	1599	256	967
Starvation Cap Reductn	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0
Reduced v/c Ratio	0.77	0.34	0.36	0.89	0.39	0.34	0.09

Intersection Summary

95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.

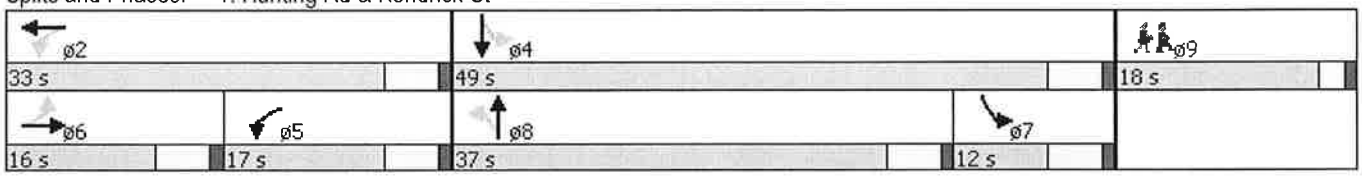
Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	1	97	2	221	339	90	1	129	120	40	658	19
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Lane Width (ft)	12	12	12	12	12	12	12	12	12	11	12	12
Storage Length (ft)	0		0	0		110	0		110	130		0
Storage Lanes	0		0	1		0	0		1	1		0
Taper Length (ft)	25			25			25			25		
Lane Util. Factor	0.95	0.95	0.95	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Frt		0.997			0.968				0.850		0.996	
Flt Protected				0.950						0.950		
Satd. Flow (prot)	0	3599	0	1787	1839	0	0	1900	1599	1728	1892	0
Flt Permitted		0.651		0.681				0.995		0.662		
Satd. Flow (perm)	0	2343	0	1281	1839	0	0	1890	1599	1204	1892	0
Right Turn on Red			Yes			Yes			Yes			Yes
Satd. Flow (RTOR)		1			13				218		2	
Link Speed (mph)		30			30			30			30	
Link Distance (ft)		477			405			232			310	
Travel Time (s)		10.8			9.2			5.3			7.0	
Peak Hour Factor	0.88	0.88	0.88	0.95	0.95	0.95	0.87	0.87	0.87	0.93	0.93	0.93
Heavy Vehicles (%)	0%	0%	0%	1%	0%	0%	0%	0%	1%	1%	0%	0%
Adj. Flow (vph)	1	110	2	233	357	95	1	148	138	43	708	20
Shared Lane Traffic (%)												
Lane Group Flow (vph)	0	113	0	233	452	0	0	149	138	43	728	0
Turn Type	Perm	NA		pm+pt	NA		Perm	NA	Free	pm+pt	NA	
Protected Phases		6		5	2			8		7	4	
Permitted Phases	6			2			8		Free	4		
Minimum Initial (s)	7.0	7.0		7.0	10.0		10.0	10.0		7.0	10.0	
Minimum Split (s)	12.0	12.0		12.0	15.0		15.0	15.0		12.0	15.0	
Total Split (s)	16.0	16.0		17.0	33.0		37.0	37.0		12.0	49.0	
Total Split (%)	16.0%	16.0%		17.0%	33.0%		37.0%	37.0%		12.0%	49.0%	
Maximum Green (s)	11.0	11.0		12.0	28.0		32.0	32.0		7.0	44.0	
Yellow Time (s)	4.0	4.0		4.0	4.0		4.0	4.0		4.0	4.0	
All-Red Time (s)	1.0	1.0		1.0	1.0		1.0	1.0		1.0	1.0	
Total Lost Time (s)		5.0		5.0	5.0			5.0		5.0	5.0	
Lead/Lag	Lead	Lead		Lag			Lead	Lead		Lag		
Lead-Lag Optimize?	Yes	Yes		Yes			Yes	Yes		Yes		
Vehicle Extension (s)	3.0	3.0		3.0	3.0		3.0	3.0		3.0	3.0	
Recall Mode	Min	Min		None	Min		None	None		None	None	
Walk Time (s)												
Flash Dont Walk (s)												
Pedestrian Calls (#/hr)												
Act Effct Green (s)		9.0		24.3	24.3			25.1	68.4	33.7	33.7	
Actuated g/C Ratio		0.13		0.36	0.36			0.37	1.00	0.49	0.49	
v/c Ratio		0.37		0.44	0.68			0.22	0.09	0.06	0.78	
Control Delay		34.0		22.6	26.0			21.8	0.1	9.6	21.2	
Queue Delay		0.0		0.0	0.0			0.0	0.0	0.0	0.0	
Total Delay		34.0		22.6	26.0			21.8	0.1	9.6	21.2	
LOS		C		C	C			C	A	A	C	
Approach Delay		34.0			24.9			11.4			20.5	

Lane Group	ø9
Lane Configurations	
Volume (vph)	
Ideal Flow (vphpl)	
Lane Width (ft)	
Storage Length (ft)	
Storage Lanes	
Taper Length (ft)	
Lane Util. Factor	
Frt	
Flt Protected	
Satd. Flow (prot)	
Flt Permitted	
Satd. Flow (perm)	
Right Turn on Red	
Satd. Flow (RTOR)	
Link Speed (mph)	
Link Distance (ft)	
Travel Time (s)	
Peak Hour Factor	
Heavy Vehicles (%)	
Adj. Flow (vph)	
Shared Lane Traffic (%)	
Lane Group Flow (vph)	
Turn Type	
Protected Phases	9
Permitted Phases	
Minimum Initial (s)	10.0
Minimum Split (s)	18.0
Total Split (s)	18.0
Total Split (%)	18%
Maximum Green (s)	15.0
Yellow Time (s)	2.0
All-Red Time (s)	1.0
Total Lost Time (s)	
Lead/Lag	
Lead-Lag Optimize?	
Vehicle Extension (s)	3.0
Recall Mode	None
Walk Time (s)	6.0
Flash Dont Walk (s)	11.0
Pedestrian Calls (#/hr)	0
Act Effct Green (s)	
Actuated g/C Ratio	
v/c Ratio	
Control Delay	
Queue Delay	
Total Delay	
LOS	
Approach Delay	

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Approach LOS		C			C			B			C	

Intersection Summary			
Area Type:	Other		
Cycle Length: 100			
Actuated Cycle Length: 68.4			
Control Type: Actuated-Uncoordinated			
Maximum v/c Ratio: 0.78			
Intersection Signal Delay: 21.5		Intersection LOS: C	
Intersection Capacity Utilization 67.4%		ICU Level of Service C	
Analysis Period (min) 15			

Splits and Phases: 1: Hunting Rd & Kendrick St



Lane Group	EBT	WBL	WBT	NBT	NBR	SBL	SBT
Lane Group Flow (vph)	113	233	452	149	138	43	728
v/c Ratio	0.37	0.44	0.68	0.22	0.09	0.06	0.78
Control Delay	34.0	22.6	26.0	21.8	0.1	9.6	21.2
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	34.0	22.6	26.0	21.8	0.1	9.6	21.2
Queue Length 50th (ft)	23	73	157	33	0	9	241
Queue Length 95th (ft)	52	150	302	112	0	24	397
Internal Link Dist (ft)	397		325	152			230
Turn Bay Length (ft)					110	130	
Base Capacity (vph)	390	593	785	930	1599	684	1258
Starvation Cap Reductn	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0
Reduced v/c Ratio	0.29	0.39	0.58	0.16	0.09	0.06	0.58

Intersection Summary

Greendale Avenue at Bird Street

Lane Group	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Volume (vph)	115	18	16	764	224	63
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Lane Width (ft)	12	12	13	13	16	16
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00
Frt	0.982				0.970	
Flt Protected	0.958			0.999		
Satd. Flow (prot)	1758	0	0	1942	2043	0
Flt Permitted	0.958			0.999		
Satd. Flow (perm)	1758	0	0	1942	2043	0
Link Speed (mph)	30			30	30	
Link Distance (ft)	472			1069	283	
Travel Time (s)	10.7			24.3	6.4	
Peak Hour Factor	0.77	0.77	0.90	0.90	0.73	0.73
Heavy Vehicles (%)	1%	6%	0%	1%	2%	3%
Adj. Flow (vph)	149	23	18	849	307	86
Shared Lane Traffic (%)						
Lane Group Flow (vph)	172	0	0	867	393	0
Sign Control	Stop			Free	Free	

Intersection Summary			
Area Type:	Other		
Control Type: Unsignalized			
Intersection Capacity Utilization 67.2%		ICU Level of Service C	
Analysis Period (min) 15			

Intersection	
Intersection Delay, s/veh	8.6

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Vol, veh/h	115	18	16	764	224	63
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Stop	Stop	Free	Free	Free	Free
RT Channelized	None	None	None	None	None	None
Storage Length	0	0	0			0
Median Width	12			0	0	
Grade, %	0%			0%	0%	
Peak Hour Factor	0.77	0.77	0.90	0.90	0.73	0.73
Heavy Vehicles, %	1	6	0	1	2	3
Mvmt Flow	149	23	18	849	307	86
Number of Lanes	1	0	0	1	1	0

Major/Minor				Major 1	Major 2	
Conflicting Flow All	1234	350	393	0	-	0
Stage 1	350	-	-	-	-	-
Stage 2	884	-	-	-	-	-
Follow-up Headway	3.509	3.354	2.2	-	-	-
Pot Capacity-1 Maneuver	196	684	1177	-	-	-
Stage 1	716	-	-	-	-	-
Stage 2	405	-	-	-	-	-
Time blocked-Platoon, %	0	0	0	-	-	-
Mov Capacity-1 Maneuver	190	684	1177	-	-	-
Mov Capacity-2 Maneuver	190	-	-	-	-	-
Stage 1	716	-	-	-	-	-
Stage 2	393	-	-	-	-	-

Approach	EB	NB	SB
HCM Control Delay, s	70.4	0.2	0
HCM LOS	F	-	-

Minor Lane / Major Mvmt	NBL	NBT	EBLn1	SBT	SBR
Cap, veh/h	1177	-	211	-	-
HCM Control Delay, s	8.106	0	70.4	-	-
HCM Lane V/C Ratio	0.02	-	0.82	-	-
HCM Lane LOS	A	A	F	-	-
HCM 95th-tile Q, veh	0.0	-	6.0	-	-

Notes

~ : Volume Exceeds Capacity; $: Delay Exceeds 300 Seconds; Error : Computation Not Defined

Lane Group	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Volume (vph)	45	5	7	208	845	89
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Lane Width (ft)	12	12	13	13	16	16
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00
Frt	0.986				0.987	
Flt Protected	0.957			0.998		
Satd. Flow (prot)	1793	0	0	1941	2104	0
Flt Permitted	0.957			0.998		
Satd. Flow (perm)	1793	0	0	1941	2104	0
Link Speed (mph)	30			30	30	
Link Distance (ft)	472			1069	283	
Travel Time (s)	10.7			24.3	6.4	
Peak Hour Factor	0.83	0.83	0.81	0.81	0.97	0.97
Heavy Vehicles (%)	0%	0%	0%	1%	1%	1%
Adj. Flow (vph)	54	6	9	257	871	92
Shared Lane Traffic (%)						
Lane Group Flow (vph)	60	0	0	266	963	0
Sign Control	Stop			Free	Free	

Intersection Summary			
Area Type:	Other		
Control Type: Unsignalized			
Intersection Capacity Utilization 59.9%		ICU Level of Service B	
Analysis Period (min) 15			

Intersection	
Intersection Delay, s/veh	1.4

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Vol, veh/h	45	5	7	208	845	89
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Stop	Stop	Free	Free	Free	Free
RT Channelized	None	None	None	None	None	None
Storage Length	0	0	0			0
Median Width	12			0	0	
Grade, %	0%			0%	0%	
Peak Hour Factor	0.83	0.83	0.81	0.81	0.97	0.97
Heavy Vehicles, %	0	0	0	1	1	1
Mvmt Flow	54	6	9	257	871	92
Number of Lanes	1	0	0	1	1	0

Major/Minor			Major 1		Major 2	
Conflicting Flow All	1191	917	963	0	-	0
Stage 1	917	-	-	-	-	-
Stage 2	274	-	-	-	-	-
Follow-up Headway	3.5	3.3	2.2	-	-	-
Pot Capacity-1 Maneuver	209	332	723	-	-	-
Stage 1	393	-	-	-	-	-
Stage 2	777	-	-	-	-	-
Time blocked-Platoon, %	0	0	0	-	-	-
Mov Capacity-1 Maneuver	206	332	723	-	-	-
Mov Capacity-2 Maneuver	206	-	-	-	-	-
Stage 1	393	-	-	-	-	-
Stage 2	765	-	-	-	-	-

Approach	EB	NB	SB
HCM Control Delay, s	28.3	0.3	0
HCM LOS	D	-	-

Minor Lane / Major Mvmt	NBL	NBT	EBLn1	SBT	SBR
Cap, veh/h	723	-	214	-	-
HCM Control Delay, s	10.039	0	28.3	-	-
HCM Lane V/C Ratio	0.01	-	0.28	-	-
HCM Lane LOS	B	A	D	-	-
HCM 95th-tile Q, veh	0.0	-	1.1	-	-

Notes

~ : Volume Exceeds Capacity; $: Delay Exceeds 300 Seconds; Error : Computation Not Defined

Lane Group	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Volume (vph)	121	19	17	747	166	66
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Lane Width (ft)	12	12	13	13	16	16
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00
Frt	0.981				0.962	
Flt Protected	0.959			0.999		
Satd. Flow (prot)	1758	0	0	1942	2025	0
Flt Permitted	0.959			0.999		
Satd. Flow (perm)	1758	0	0	1942	2025	0
Link Speed (mph)	30			30	30	
Link Distance (ft)	472			1069	283	
Travel Time (s)	10.7			24.3	6.4	
Peak Hour Factor	0.77	0.77	0.90	0.90	0.73	0.73
Heavy Vehicles (%)	1%	6%	0%	1%	2%	3%
Adj. Flow (vph)	157	25	19	830	227	90
Shared Lane Traffic (%)						
Lane Group Flow (vph)	182	0	0	849	317	0
Sign Control	Stop			Free	Free	

Intersection Summary			
Area Type:	Other		
Control Type: Unsignalized			
Intersection Capacity Utilization 67.5%		ICU Level of Service C	
Analysis Period (min) 15			

Intersection	
Intersection Delay, s/veh	7.6

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Vol, veh/h	121	19	17	747	166	66
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Stop	Stop	Free	Free	Free	Free
RT Channelized	None	None	None	None	None	None
Storage Length	0	0	0			0
Median Width	12			0	0	
Grade, %	0%			0%	0%	
Peak Hour Factor	0.77	0.77	0.90	0.90	0.73	0.73
Heavy Vehicles, %	1	6	0	1	2	3
Mvmt Flow	157	25	19	830	227	90
Number of Lanes	1	0	0	1	1	0

Major/Minor				Major 1	Major 2	
Conflicting Flow All	1141	273	318	0	-	0
Stage 1	273	-	-	-	-	-
Stage 2	868	-	-	-	-	-
Follow-up Headway	3.509	3.354	2.2	-	-	-
Pot Capacity-1 Maneuver	223	756	1253	-	-	-
Stage 1	775	-	-	-	-	-
Stage 2	413	-	-	-	-	-
Time blocked-Platoon, %	0	0	0	-	-	-
Mov Capacity-1 Maneuver	217	756	1253	-	-	-
Mov Capacity-2 Maneuver	217	-	-	-	-	-
Stage 1	775	-	-	-	-	-
Stage 2	401	-	-	-	-	-

Approach	EB	NB	SB
HCM Control Delay, s	55.4	0.2	0
HCM LOS	F	-	-

Minor Lane / Major Mvmt	NBL	NBT	EBLn1	SBT	SBR
Cap, veh/h	1253	-	240	-	-
HCM Control Delay, s	7.917	0	55.4	-	-
HCM Lane V/C Ratio	0.02	-	0.76	-	-
HCM Lane LOS	A	A	F	-	-
HCM 95th-tile Q, veh	0.0	-	5.4	-	-

Notes

~ : Volume Exceeds Capacity; $: Delay Exceeds 300 Seconds; Error : Computation Not Defined

Lane Group	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Volume (vph)	47	5	7	152	620	94
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Lane Width (ft)	12	12	13	13	16	16
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00
Frt	0.987				0.982	
Flt Protected	0.957			0.998		
Satd. Flow (prot)	1795	0	0	1941	2094	0
Flt Permitted	0.957			0.998		
Satd. Flow (perm)	1795	0	0	1941	2094	0
Link Speed (mph)	30			30	30	
Link Distance (ft)	472			1069	283	
Travel Time (s)	10.7			24.3	6.4	
Peak Hour Factor	0.83	0.83	0.81	0.81	0.97	0.97
Heavy Vehicles (%)	0%	0%	0%	1%	1%	1%
Adj. Flow (vph)	57	6	9	188	639	97
Shared Lane Traffic (%)						
Lane Group Flow (vph)	63	0	0	197	736	0
Sign Control	Stop			Free	Free	

Intersection Summary			
Area Type:	Other		
Control Type: Unsignalized			
Intersection Capacity Utilization	48.3%	ICU Level of Service	A
Analysis Period (min)	15		

Intersection	
Intersection Delay, s/veh	1.3

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Vol, veh/h	47	5	7	152	620	94
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Stop	Stop	Free	Free	Free	Free
RT Channelized	None	None	None	None	None	None
Storage Length	0	0	0			0
Median Width	12			0	0	
Grade, %	0%			0%	0%	
Peak Hour Factor	0.83	0.83	0.81	0.81	0.97	0.97
Heavy Vehicles, %	0	0	0	1	1	1
Mvmt Flow	57	6	9	188	639	97
Number of Lanes	1	0	0	1	1	0

Major/Minor			Major 1		Major 2	
Conflicting Flow All	893	688	736	0	-	0
Stage 1	688	-	-	-	-	-
Stage 2	205	-	-	-	-	-
Follow-up Headway	3.5	3.3	2.2	-	-	-
Pot Capacity-1 Maneuver	315	450	879	-	-	-
Stage 1	503	-	-	-	-	-
Stage 2	834	-	-	-	-	-
Time blocked-Platoon, %	0	0	0	-	-	-
Mov Capacity-1 Maneuver	312	450	879	-	-	-
Mov Capacity-2 Maneuver	312	-	-	-	-	-
Stage 1	503	-	-	-	-	-
Stage 2	825	-	-	-	-	-

Approach	EB	NB	SB
HCM Control Delay, s	18.9	0.4	0
HCM LOS	C	-	-

Minor Lane / Major Mvmt	NBL	NBT	EBLn1	SBT	SBR
Cap, veh/h	879	-	321	-	-
HCM Control Delay, s	9.136	0	18.9	-	-
HCM Lane V/C Ratio	0.01	-	0.20	-	-
HCM Lane LOS	A	A	C	-	-
HCM 95th-tile Q, veh	0.0	-	0.7	-	-

Notes

~ : Volume Exceeds Capacity; $: Delay Exceeds 300 Seconds; Error : Computation Not Defined

Lane Group	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Volume (vph)	121	19	17	844	190	66
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Lane Width (ft)	12	12	13	13	16	16
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00
Frt	0.981				0.965	
Flt Protected	0.959			0.999		
Satd. Flow (prot)	1758	0	0	1942	2032	0
Flt Permitted	0.959			0.999		
Satd. Flow (perm)	1758	0	0	1942	2032	0
Link Speed (mph)	30			30	30	
Link Distance (ft)	472			142	283	
Travel Time (s)	10.7			3.2	6.4	
Peak Hour Factor	0.77	0.77	0.90	0.90	0.73	0.73
Heavy Vehicles (%)	1%	6%	0%	1%	2%	3%
Adj. Flow (vph)	157	25	19	938	260	90
Shared Lane Traffic (%)						
Lane Group Flow (vph)	182	0	0	957	350	0
Sign Control	Stop			Free	Free	

Intersection Summary			
Area Type:	Other		
Control Type: Unsignalized			
Intersection Capacity Utilization 72.6%		ICU Level of Service C	
Analysis Period (min) 15			

Intersection	
Intersection Delay, s/veh	11.5

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Vol, veh/h	121	19	17	844	190	66
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Stop	Stop	Free	Free	Free	Free
RT Channelized	None	None	None	None	None	None
Storage Length	0	0	0			0
Median Width	12			0	0	
Grade, %	0%			0%	0%	
Peak Hour Factor	0.77	0.77	0.90	0.90	0.73	0.73
Heavy Vehicles, %	1	6	0	1	2	3
Mvmt Flow	157	25	19	938	260	90
Number of Lanes	1	0	0	1	1	0

Major/Minor				Major 1	Major 2	
Conflicting Flow All	1281	305	351	0	-	0
Stage 1	305	-	-	-	-	-
Stage 2	976	-	-	-	-	-
Follow-up Headway	3.509	3.354	2.2	-	-	-
Pot Capacity-1 Maneuver	184	726	1219	-	-	-
Stage 1	750	-	-	-	-	-
Stage 2	367	-	-	-	-	-
Time blocked-Platoon, %	0	0	0	-	-	-
Mov Capacity-1 Maneuver	178	726	1219	-	-	-
Mov Capacity-2 Maneuver	178	-	-	-	-	-
Stage 1	750	-	-	-	-	-
Stage 2	355	-	-	-	-	-

Approach	EB	NB	SB
HCM Control Delay, s	93.4	0.2	0
HCM LOS	F	-	-

Minor Lane / Major Mvmt	NBL	NBT	EBLn1	SBT	SBR
Cap, veh/h	1219	-	198	-	-
HCM Control Delay, s	8	0	93.4	-	-
HCM Lane V/C Ratio	0.02	-	0.92	-	-
HCM Lane LOS	A	A	F	-	-
HCM 95th-tile Q, veh	0.0	-	7.3	-	-

Notes

~ : Volume Exceeds Capacity; $: Delay Exceeds 300 Seconds; Error : Computation Not Defined

Lane Group	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Volume (vph)	47	5	7	203	715	94
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Lane Width (ft)	12	12	13	13	16	16
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00
Frt	0.987				0.984	
Flt Protected	0.957			0.998		
Satd. Flow (prot)	1795	0	0	1941	2098	0
Flt Permitted	0.957			0.998		
Satd. Flow (perm)	1795	0	0	1941	2098	0
Link Speed (mph)	30			30	30	
Link Distance (ft)	472			132	283	
Travel Time (s)	10.7			3.0	6.4	
Peak Hour Factor	0.83	0.83	0.81	0.81	0.97	0.97
Heavy Vehicles (%)	0%	0%	0%	1%	1%	1%
Adj. Flow (vph)	57	6	9	251	737	97
Shared Lane Traffic (%)						
Lane Group Flow (vph)	63	0	0	260	834	0
Sign Control	Stop			Free	Free	

Intersection Summary			
Area Type:	Other		
Control Type: Unsignalized			
Intersection Capacity Utilization 53.3%		ICU Level of Service A	
Analysis Period (min) 15			

Intersection	
Intersection Delay, s/veh	1.3

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Vol, veh/h	47	5	7	203	715	94
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Stop	Stop	Free	Free	Free	Free
RT Channelized	None	None	None	None	None	None
Storage Length	0	0	0			0
Median Width	12			0	0	
Grade, %	0%			0%	0%	
Peak Hour Factor	0.83	0.83	0.81	0.81	0.97	0.97
Heavy Vehicles, %	0	0	0	1	1	1
Mvmt Flow	57	6	9	251	737	97
Number of Lanes	1	0	0	1	1	0

Major/Minor			Major 1		Major 2	
Conflicting Flow All	1054	786	834	0	-	0
Stage 1	786	-	-	-	-	-
Stage 2	268	-	-	-	-	-
Follow-up Headway	3.5	3.3	2.2	-	-	-
Pot Capacity-1 Maneuver	252	395	808	-	-	-
Stage 1	453	-	-	-	-	-
Stage 2	782	-	-	-	-	-
Time blocked-Platoon, %	0	0	0	-	-	-
Mov Capacity-1 Maneuver	249	395	808	-	-	-
Mov Capacity-2 Maneuver	249	-	-	-	-	-
Stage 1	453	-	-	-	-	-
Stage 2	772	-	-	-	-	-

Approach	EB	NB	SB
HCM Control Delay, s	23.4	0.3	0
HCM LOS	C	-	-

Minor Lane / Major Mvmt	NBL	NBT	EBLn1	SBT	SBR
Cap, veh/h	808	-	258	-	-
HCM Control Delay, s	9.504	0	23.4	-	-
HCM Lane V/C Ratio	0.01	-	0.24	-	-
HCM Lane LOS	A	A	C	-	-
HCM 95th-tile Q, veh	0.0	-	0.9	-	-

Notes

~ : Volume Exceeds Capacity; $: Delay Exceeds 300 Seconds; Error : Computation Not Defined

Great Plain Avenue at Greendale Avenue

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		↕			↕			↕			↕	
Volume (vph)	169	242	31	42	263	336	19	261	26	123	93	65
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Lane Width (ft)	15	15	15	15	15	15	13	13	13	14	14	14
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Frt		0.991			0.929			0.989			0.969	
Flt Protected		0.981			0.997			0.997			0.979	
Satd. Flow (prot)	0	2009	0	0	1910	0	0	1907	0	0	1887	0
Flt Permitted		0.490			0.948			0.964			0.536	
Satd. Flow (perm)	0	1003	0	0	1816	0	0	1844	0	0	1033	0
Right Turn on Red			Yes			Yes			Yes			Yes
Satd. Flow (RTOR)		5			78			6			19	
Link Speed (mph)		30			30			30			30	
Link Distance (ft)		425			440			329			1069	
Travel Time (s)		9.7			10.0			7.5			24.3	
Peak Hour Factor	0.97	0.97	0.97	0.88	0.88	0.88	0.62	0.62	0.62	0.85	0.85	0.85
Heavy Vehicles (%)	1%	1%	3%	0%	2%	1%	0%	1%	8%	2%	1%	3%
Adj. Flow (vph)	174	249	32	48	299	382	31	421	42	145	109	76
Shared Lane Traffic (%)												
Lane Group Flow (vph)	0	455	0	0	729	0	0	494	0	0	330	0
Turn Type	Perm	NA		Perm	NA		Perm	NA		Perm	NA	
Protected Phases		2			2			4			4	
Permitted Phases	2			2			4			4		
Minimum Initial (s)	7.0	7.0		7.0	7.0		7.0	7.0		7.0	7.0	
Minimum Split (s)	12.0	12.0		12.0	12.0		12.0	12.0		12.0	12.0	
Total Split (s)	35.0	35.0		35.0	35.0		30.0	30.0		30.0	30.0	
Total Split (%)	43.2%	43.2%		43.2%	43.2%		37.0%	37.0%		37.0%	37.0%	
Maximum Green (s)	30.0	30.0		30.0	30.0		25.0	25.0		25.0	25.0	
Yellow Time (s)	4.0	4.0		4.0	4.0		4.0	4.0		4.0	4.0	
All-Red Time (s)	1.0	1.0		1.0	1.0		1.0	1.0		1.0	1.0	
Total Lost Time (s)		5.0			5.0			5.0			5.0	
Lead/Lag							Lag	Lag		Lag	Lag	
Lead-Lag Optimize?							Yes	Yes		Yes	Yes	
Vehicle Extension (s)	5.0	5.0		5.0	5.0		5.0	5.0		5.0	5.0	
Recall Mode	Min	Min		Min	Min		Min	Min		Min	Min	
Walk Time (s)												
Flash Dont Walk (s)												
Pedestrian Calls (#/hr)												
Act Effct Green (s)		30.0			30.0			25.0			25.0	
Actuated g/C Ratio		0.46			0.46			0.38			0.38	
v/c Ratio		0.98			0.83			0.69			0.81	
Control Delay		58.0			24.0			22.8			35.2	
Queue Delay		0.0			0.0			0.0			0.0	
Total Delay		58.0			24.0			22.8			35.2	
LOS		E			C			C			D	
Approach Delay		58.0			24.0			22.8			35.2	
Approach LOS		E			C			C			D	

Intersection Summary

Lane Group	ø3
Lane Configurations	
Volume (vph)	
Ideal Flow (vphpl)	
Lane Width (ft)	
Lane Util. Factor	
Frt	
Flt Protected	
Satd. Flow (prot)	
Flt Permitted	
Satd. Flow (perm)	
Right Turn on Red	
Satd. Flow (RTOR)	
Link Speed (mph)	
Link Distance (ft)	
Travel Time (s)	
Peak Hour Factor	
Heavy Vehicles (%)	
Adj. Flow (vph)	
Shared Lane Traffic (%)	
Lane Group Flow (vph)	
Turn Type	
Protected Phases	3
Permitted Phases	
Minimum Initial (s)	13.0
Minimum Split (s)	16.0
Total Split (s)	16.0
Total Split (%)	20%
Maximum Green (s)	13.0
Yellow Time (s)	2.0
All-Red Time (s)	1.0
Total Lost Time (s)	
Lead/Lag	Lead
Lead-Lag Optimize?	Yes
Vehicle Extension (s)	3.0
Recall Mode	None
Walk Time (s)	7.0
Flash Dont Walk (s)	9.0
Pedestrian Calls (#/hr)	0
Act Effct Green (s)	
Actuated g/C Ratio	
v/c Ratio	
Control Delay	
Queue Delay	
Total Delay	
LOS	
Approach Delay	
Approach LOS	

Intersection Summary

Area Type:	Other		
Cycle Length: 81			
Actuated Cycle Length: 65			
Control Type: Actuated-Uncoordinated			
Maximum v/c Ratio: 0.98			
Intersection Signal Delay: 33.2		Intersection LOS: C	
Intersection Capacity Utilization 109.4%		ICU Level of Service H	
Analysis Period (min) 15			

Splits and Phases: 3: Greendale Ave & Great Plain Ave

Lane Group	EBT	WBT	NBT	SBT
Lane Group Flow (vph)	455	729	494	330
v/c Ratio	0.98	0.83	0.69	0.81
Control Delay	58.0	24.0	22.8	35.2
Queue Delay	0.0	0.0	0.0	0.0
Total Delay	58.0	24.0	22.8	35.2
Queue Length 50th (ft)	166	214	157	107
Queue Length 95th (ft)	#352	#400	149	#221
Internal Link Dist (ft)	345	360	249	989
Turn Bay Length (ft)				
Base Capacity (vph)	465	880	712	409
Starvation Cap Reductn	0	0	0	0
Spillback Cap Reductn	0	0	0	0
Storage Cap Reductn	0	0	0	0
Reduced v/c Ratio	0.98	0.83	0.69	0.81

Intersection Summary

95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		↕			↕			↕			↕	
Volume (vph)	48	184	22	22	214	114	23	53	34	343	341	122
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Lane Width (ft)	15	15	15	15	15	15	13	13	13	14	14	14
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Frt		0.988			0.956			0.959			0.980	
Flt Protected		0.991			0.997			0.990			0.979	
Satd. Flow (prot)	0	2032	0	0	1992	0	0	1864	0	0	1936	0
Flt Permitted		0.855			0.968			0.846			0.805	
Satd. Flow (perm)	0	1753	0	0	1934	0	0	1593	0	0	1592	0
Right Turn on Red			Yes			Yes			Yes			Yes
Satd. Flow (RTOR)		7			34			28			11	
Link Speed (mph)		30			30			30			30	
Link Distance (ft)		425			440			329			1069	
Travel Time (s)		9.7			10.0			7.5			24.3	
Peak Hour Factor	0.91	0.91	0.91	0.85	0.85	0.85	0.89	0.89	0.89	0.94	0.94	0.94
Heavy Vehicles (%)	0%	1%	0%	0%	0%	0%	0%	0%	0%	1%	0%	0%
Adj. Flow (vph)	53	202	24	26	252	134	26	60	38	365	363	130
Shared Lane Traffic (%)												
Lane Group Flow (vph)	0	279	0	0	412	0	0	124	0	0	858	0
Turn Type	Perm	NA		Perm	NA		Perm	NA		Perm	NA	
Protected Phases		2			2			4			4	
Permitted Phases	2			2			4			4		
Minimum Initial (s)	7.0	7.0		7.0	7.0		7.0	7.0		7.0	7.0	
Minimum Split (s)	12.0	12.0		12.0	12.0		12.0	12.0		12.0	12.0	
Total Split (s)	35.0	35.0		35.0	35.0		30.0	30.0		30.0	30.0	
Total Split (%)	43.2%	43.2%		43.2%	43.2%		37.0%	37.0%		37.0%	37.0%	
Maximum Green (s)	30.0	30.0		30.0	30.0		25.0	25.0		25.0	25.0	
Yellow Time (s)	4.0	4.0		4.0	4.0		4.0	4.0		4.0	4.0	
All-Red Time (s)	1.0	1.0		1.0	1.0		1.0	1.0		1.0	1.0	
Total Lost Time (s)		5.0			5.0			5.0			5.0	
Lead/Lag							Lag	Lag		Lag	Lag	
Lead-Lag Optimize?							Yes	Yes		Yes	Yes	
Vehicle Extension (s)	5.0	5.0		5.0	5.0		5.0	5.0		5.0	5.0	
Recall Mode	Min	Min		Min	Min		Min	Min		Min	Min	
Walk Time (s)												
Flash Dont Walk (s)												
Pedestrian Calls (#/hr)												
Act Effct Green (s)		21.1			21.1			25.9			25.9	
Actuated g/C Ratio		0.35			0.35			0.43			0.43	
v/c Ratio		0.45			0.59			0.18			1.24	
Control Delay		17.9			19.0			13.0			141.6	
Queue Delay		0.0			0.0			0.0			0.0	
Total Delay		17.9			19.0			13.0			141.6	
LOS		B			B			B			F	
Approach Delay		17.9			19.0			13.0			141.6	
Approach LOS		B			B			B			F	

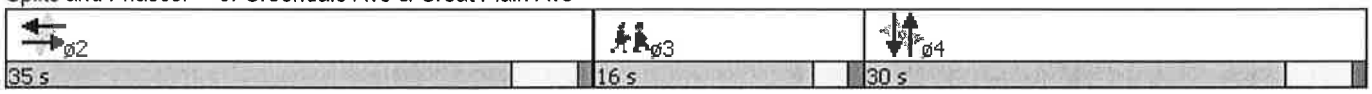
Intersection Summary

Lane Group	ø3
Lane Configurations	
Volume (vph)	
Ideal Flow (vphpl)	
Lane Width (ft)	
Lane Util. Factor	
Frt	
Flt Protected	
Satd. Flow (prot)	
Flt Permitted	
Satd. Flow (perm)	
Right Turn on Red	
Satd. Flow (RTOR)	
Link Speed (mph)	
Link Distance (ft)	
Travel Time (s)	
Peak Hour Factor	
Heavy Vehicles (%)	
Adj. Flow (vph)	
Shared Lane Traffic (%)	
Lane Group Flow (vph)	
Turn Type	
Protected Phases	3
Permitted Phases	
Minimum Initial (s)	13.0
Minimum Split (s)	16.0
Total Split (s)	16.0
Total Split (%)	20%
Maximum Green (s)	13.0
Yellow Time (s)	2.0
All-Red Time (s)	1.0
Total Lost Time (s)	
Lead/Lag	Lead
Lead-Lag Optimize?	Yes
Vehicle Extension (s)	3.0
Recall Mode	None
Walk Time (s)	7.0
Flash Dont Walk (s)	9.0
Pedestrian Calls (#/hr)	3
Act Effct Green (s)	
Actuated g/C Ratio	
v/c Ratio	
Control Delay	
Queue Delay	
Total Delay	
LOS	
Approach Delay	
Approach LOS	

Intersection Summary

Area Type:	Other		
Cycle Length: 81			
Actuated Cycle Length: 60.1			
Control Type: Actuated-Uncoordinated			
Maximum v/c Ratio: 1.24			
Intersection Signal Delay: 81.2		Intersection LOS: F	
Intersection Capacity Utilization 86.6%		ICU Level of Service E	
Analysis Period (min) 15			

Splits and Phases: 3: Greendale Ave & Great Plain Ave



Lane Group	EBT	WBT	NBT	SBT
Lane Group Flow (vph)	279	412	124	858
v/c Ratio	0.45	0.59	0.18	1.24
Control Delay	17.9	19.0	13.0	141.6
Queue Delay	0.0	0.0	0.0	0.0
Total Delay	17.9	19.0	13.0	141.6
Queue Length 50th (ft)	65	95	18	~360
Queue Length 95th (ft)	177	229	79	#918
Internal Link Dist (ft)	345	360	249	989
Turn Bay Length (ft)				
Base Capacity (vph)	910	1017	703	693
Starvation Cap Reductn	0	0	0	0
Spillback Cap Reductn	0	0	0	0
Storage Cap Reductn	0	0	0	0
Reduced v/c Ratio	0.31	0.41	0.18	1.24

Intersection Summary

~ Volume exceeds capacity, queue is theoretically infinite.
Queue shown is maximum after two cycles.

95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		↕			↕			↕			↕	
Volume (vph)	190	254	33	44	276	311	20	241	27	87	67	72
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Lane Width (ft)	15	15	15	15	15	15	13	13	13	14	14	14
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Frt		0.991			0.934			0.987			0.957	
Flt Protected		0.980			0.997			0.997			0.981	
Satd. Flow (prot)	0	2007	0	0	1920	0	0	1902	0	0	1865	0
Flt Permitted		0.498			0.942			0.964			0.632	
Satd. Flow (perm)	0	1020	0	0	1814	0	0	1839	0	0	1201	0
Right Turn on Red			Yes			Yes			Yes			Yes
Satd. Flow (RTOR)		5			68			7			30	
Link Speed (mph)		30			30			30			30	
Link Distance (ft)		425			440			329			1069	
Travel Time (s)		9.7			10.0			7.5			24.3	
Peak Hour Factor	0.97	0.97	0.97	0.88	0.88	0.88	0.62	0.62	0.62	0.85	0.85	0.85
Heavy Vehicles (%)	1%	1%	3%	0%	2%	1%	0%	1%	8%	2%	1%	3%
Adj. Flow (vph)	196	262	34	50	314	353	32	389	44	102	79	85
Shared Lane Traffic (%)												
Lane Group Flow (vph)	0	492	0	0	717	0	0	465	0	0	266	0
Turn Type	Perm	NA		Perm	NA		Perm	NA		Perm	NA	
Protected Phases		2			2			4			4	
Permitted Phases	2			2			4			4		
Minimum Initial (s)	7.0	7.0		7.0	7.0		7.0	7.0		7.0	7.0	
Minimum Split (s)	12.0	12.0		12.0	12.0		12.0	12.0		12.0	12.0	
Total Split (s)	35.0	35.0		35.0	35.0		30.0	30.0		30.0	30.0	
Total Split (%)	43.2%	43.2%		43.2%	43.2%		37.0%	37.0%		37.0%	37.0%	
Maximum Green (s)	30.0	30.0		30.0	30.0		25.0	25.0		25.0	25.0	
Yellow Time (s)	4.0	4.0		4.0	4.0		4.0	4.0		4.0	4.0	
All-Red Time (s)	1.0	1.0		1.0	1.0		1.0	1.0		1.0	1.0	
Total Lost Time (s)		5.0			5.0			5.0			5.0	
Lead/Lag							Lag	Lag		Lag	Lag	
Lead-Lag Optimize?							Yes	Yes		Yes	Yes	
Vehicle Extension (s)	5.0	5.0		5.0	5.0		5.0	5.0		5.0	5.0	
Recall Mode	Min	Min		Min	Min		Min	Min		Min	Min	
Walk Time (s)												
Flash Dont Walk (s)												
Pedestrian Calls (#/hr)												
Act Effct Green (s)		30.1			30.1			23.0			23.0	
Actuated g/C Ratio		0.48			0.48			0.36			0.36	
v/c Ratio		1.01			0.80			0.69			0.58	
Control Delay		64.6			22.0			22.8			20.0	
Queue Delay		0.0			0.0			0.0			0.0	
Total Delay		64.6			22.0			22.8			20.0	
LOS		E			C			C			C	
Approach Delay		64.6			22.0			22.8			20.0	
Approach LOS		E			C			C			C	

Intersection Summary

Lane Group	ø3
Lane Configurations	
Volume (vph)	
Ideal Flow (vphpl)	
Lane Width (ft)	
Lane Util. Factor	
Frt	
Flt Protected	
Satd. Flow (prot)	
Flt Permitted	
Satd. Flow (perm)	
Right Turn on Red	
Satd. Flow (RTOR)	
Link Speed (mph)	
Link Distance (ft)	
Travel Time (s)	
Peak Hour Factor	
Heavy Vehicles (%)	
Adj. Flow (vph)	
Shared Lane Traffic (%)	
Lane Group Flow (vph)	
Turn Type	
Protected Phases	3
Permitted Phases	
Minimum Initial (s)	13.0
Minimum Split (s)	16.0
Total Split (s)	16.0
Total Split (%)	20%
Maximum Green (s)	13.0
Yellow Time (s)	2.0
All-Red Time (s)	1.0
Total Lost Time (s)	
Lead/Lag	Lead
Lead-Lag Optimize?	Yes
Vehicle Extension (s)	3.0
Recall Mode	None
Walk Time (s)	7.0
Flash Dont Walk (s)	9.0
Pedestrian Calls (#/hr)	0
Act Effct Green (s)	
Actuated g/C Ratio	
v/c Ratio	
Control Delay	
Queue Delay	
Total Delay	
LOS	
Approach Delay	
Approach LOS	

Intersection Summary

Area Type:	Other		
Cycle Length: 81			
Actuated Cycle Length: 63.1			
Control Type: Actuated-Uncoordinated			
Maximum v/c Ratio: 1.01			
Intersection Signal Delay: 32.7		Intersection LOS: C	
Intersection Capacity Utilization 106.7%		ICU Level of Service G	
Analysis Period (min) 15			

Splits and Phases: 3: Greendale Ave & Great Plain Ave

Lane Group	EBT	WBT	NBT	SBT
Lane Group Flow (vph)	492	717	465	266
v/c Ratio	1.01	0.80	0.69	0.58
Control Delay	64.6	22.0	22.8	20.0
Queue Delay	0.0	0.0	0.0	0.0
Total Delay	64.6	22.0	22.8	20.0
Queue Length 50th (ft)	~216	212	145	70
Queue Length 95th (ft)	#387	#394	139	127
Internal Link Dist (ft)	345	360	249	989
Turn Bay Length (ft)				
Base Capacity (vph)	488	899	734	494
Starvation Cap Reductn	0	0	0	0
Spillback Cap Reductn	0	0	0	0
Storage Cap Reductn	0	0	0	0
Reduced v/c Ratio	1.01	0.80	0.63	0.54

Intersection Summary

~ Volume exceeds capacity, queue is theoretically infinite.
Queue shown is maximum after two cycles.

95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		↕			↕			↕			↕	
Volume (vph)	54	193	23	23	225	70	24	33	36	218	216	136
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Lane Width (ft)	15	15	15	15	15	15	13	13	13	14	14	14
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Frt		0.989			0.970			0.948			0.968	
Flt Protected		0.990			0.996			0.987			0.981	
Satd. Flow (prot)	0	2032	0	0	2019	0	0	1837	0	0	1917	0
Flt Permitted		0.852			0.961			0.843			0.830	
Satd. Flow (perm)	0	1749	0	0	1948	0	0	1569	0	0	1622	0
Right Turn on Red			Yes			Yes			Yes			Yes
Satd. Flow (RTOR)		7			20			40			20	
Link Speed (mph)		30			30			30			30	
Link Distance (ft)		425			440			329			1069	
Travel Time (s)		9.7			10.0			7.5			24.3	
Peak Hour Factor	0.91	0.91	0.91	0.85	0.85	0.85	0.89	0.89	0.89	0.94	0.94	0.94
Heavy Vehicles (%)	0%	1%	0%	0%	0%	0%	0%	0%	0%	1%	0%	0%
Adj. Flow (vph)	59	212	25	27	265	82	27	37	40	232	230	145
Shared Lane Traffic (%)												
Lane Group Flow (vph)	0	296	0	0	374	0	0	104	0	0	607	0
Turn Type	Perm	NA		Perm	NA		Perm	NA		Perm	NA	
Protected Phases		2			2			4			4	
Permitted Phases	2			2			4			4		
Minimum Initial (s)	7.0	7.0		7.0	7.0		7.0	7.0		7.0	7.0	
Minimum Split (s)	12.0	12.0		12.0	12.0		12.0	12.0		12.0	12.0	
Total Split (s)	35.0	35.0		35.0	35.0		30.0	30.0		30.0	30.0	
Total Split (%)	43.2%	43.2%		43.2%	43.2%		37.0%	37.0%		37.0%	37.0%	
Maximum Green (s)	30.0	30.0		30.0	30.0		25.0	25.0		25.0	25.0	
Yellow Time (s)	4.0	4.0		4.0	4.0		4.0	4.0		4.0	4.0	
All-Red Time (s)	1.0	1.0		1.0	1.0		1.0	1.0		1.0	1.0	
Total Lost Time (s)		5.0			5.0			5.0			5.0	
Lead/Lag							Lag	Lag		Lag	Lag	
Lead-Lag Optimize?							Yes	Yes		Yes	Yes	
Vehicle Extension (s)	5.0	5.0		5.0	5.0		5.0	5.0		5.0	5.0	
Recall Mode	Min	Min		Min	Min		Min	Min		Min	Min	
Walk Time (s)												
Flash Dont Walk (s)												
Pedestrian Calls (#/hr)												
Act Effct Green (s)		20.2			20.2			26.0			26.0	
Actuated g/C Ratio		0.34			0.34			0.44			0.44	
v/c Ratio		0.49			0.55			0.15			0.84	
Control Delay		18.9			19.0			10.9			31.3	
Queue Delay		0.0			0.0			0.0			0.0	
Total Delay		18.9			19.0			10.9			31.3	
LOS		B			B			B			C	
Approach Delay		18.9			19.0			10.9			31.3	
Approach LOS		B			B			B			C	

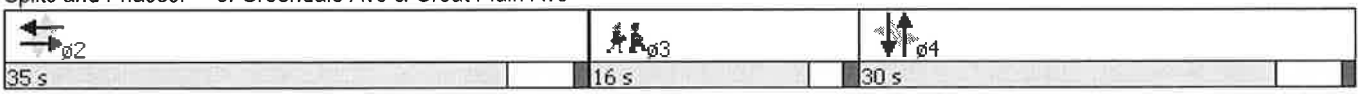
Intersection Summary

Lane Group	ø3
Lane Configurations	
Volume (vph)	
Ideal Flow (vphpl)	
Lane Width (ft)	
Lane Util. Factor	
Frt	
Flt Protected	
Satd. Flow (prot)	
Flt Permitted	
Satd. Flow (perm)	
Right Turn on Red	
Satd. Flow (RTOR)	
Link Speed (mph)	
Link Distance (ft)	
Travel Time (s)	
Peak Hour Factor	
Heavy Vehicles (%)	
Adj. Flow (vph)	
Shared Lane Traffic (%)	
Lane Group Flow (vph)	
Turn Type	
Protected Phases	3
Permitted Phases	
Minimum Initial (s)	13.0
Minimum Split (s)	16.0
Total Split (s)	16.0
Total Split (%)	20%
Maximum Green (s)	13.0
Yellow Time (s)	2.0
All-Red Time (s)	1.0
Total Lost Time (s)	
Lead/Lag	Lead
Lead-Lag Optimize?	Yes
Vehicle Extension (s)	3.0
Recall Mode	None
Walk Time (s)	7.0
Flash Dont Walk (s)	9.0
Pedestrian Calls (#/hr)	3
Act Effct Green (s)	
Actuated g/C Ratio	
v/c Ratio	
Control Delay	
Queue Delay	
Total Delay	
LOS	
Approach Delay	
Approach LOS	

Intersection Summary

Area Type:	Other		
Cycle Length: 81			
Actuated Cycle Length: 59.3			
Control Type: Actuated-Uncoordinated			
Maximum v/c Ratio: 0.84			
Intersection Signal Delay: 23.8		Intersection LOS: C	
Intersection Capacity Utilization 75.1%		ICU Level of Service D	
Analysis Period (min) 15			

Splits and Phases: 3: Greendale Ave & Great Plain Ave



Lane Group	EBT	WBT	NBT	SBT
Lane Group Flow (vph)	296	374	104	607
v/c Ratio	0.49	0.55	0.15	0.84
Control Delay	18.9	19.0	10.9	31.3
Queue Delay	0.0	0.0	0.0	0.0
Total Delay	18.9	19.0	10.9	31.3
Queue Length 50th (ft)	70	87	11	155
Queue Length 95th (ft)	189	211	61	#596
Internal Link Dist (ft)	345	360	249	989
Turn Bay Length (ft)				
Base Capacity (vph)	924	1035	710	722
Starvation Cap Reductn	0	0	0	0
Spillback Cap Reductn	0	0	0	0
Storage Cap Reductn	0	0	0	0
Reduced v/c Ratio	0.32	0.36	0.15	0.84

Intersection Summary

95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		↕			↕			↕			↕	
Volume (vph)	191	254	33	44	276	314	20	243	27	99	73	78
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Lane Width (ft)	15	15	15	15	15	15	13	13	13	14	14	14
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Frt		0.991			0.933			0.987			0.958	
Flt Protected		0.980			0.997			0.997			0.981	
Satd. Flow (prot)	0	2007	0	0	1918	0	0	1902	0	0	1867	0
Flt Permitted		0.481			0.942			0.963			0.621	
Satd. Flow (perm)	0	985	0	0	1812	0	0	1837	0	0	1182	0
Right Turn on Red			Yes			Yes			Yes			Yes
Satd. Flow (RTOR)		5			69			7			29	
Link Speed (mph)		30			30			30			30	
Link Distance (ft)		425			440			329			658	
Travel Time (s)		9.7			10.0			7.5			15.0	
Peak Hour Factor	0.97	0.97	0.97	0.88	0.88	0.88	0.62	0.62	0.62	0.85	0.85	0.85
Heavy Vehicles (%)	1%	1%	3%	0%	2%	1%	0%	1%	8%	2%	1%	3%
Adj. Flow (vph)	197	262	34	50	314	357	32	392	44	116	86	92
Shared Lane Traffic (%)												
Lane Group Flow (vph)	0	493	0	0	721	0	0	468	0	0	294	0
Turn Type	Perm	NA		Perm	NA		Perm	NA		Perm	NA	
Protected Phases		2			2			4			4	
Permitted Phases	2			2			4			4		
Minimum Initial (s)	7.0	7.0		7.0	7.0		7.0	7.0		7.0	7.0	
Minimum Split (s)	12.0	12.0		12.0	12.0		12.0	12.0		12.0	12.0	
Total Split (s)	35.0	35.0		35.0	35.0		30.0	30.0		30.0	30.0	
Total Split (%)	43.2%	43.2%		43.2%	43.2%		37.0%	37.0%		37.0%	37.0%	
Maximum Green (s)	30.0	30.0		30.0	30.0		25.0	25.0		25.0	25.0	
Yellow Time (s)	4.0	4.0		4.0	4.0		4.0	4.0		4.0	4.0	
All-Red Time (s)	1.0	1.0		1.0	1.0		1.0	1.0		1.0	1.0	
Total Lost Time (s)		5.0			5.0			5.0			5.0	
Lead/Lag							Lag	Lag		Lag	Lag	
Lead-Lag Optimize?							Yes	Yes		Yes	Yes	
Vehicle Extension (s)	5.0	5.0		5.0	5.0		5.0	5.0		5.0	5.0	
Recall Mode	Min	Min		Min	Min		Min	Min		Min	Min	
Walk Time (s)												
Flash Dont Walk (s)												
Pedestrian Calls (#/hr)												
Act Effct Green (s)		30.0			30.0			25.0			25.0	
Actuated g/C Ratio		0.46			0.46			0.38			0.38	
v/c Ratio		1.08			0.83			0.66			0.62	
Control Delay		86.8			24.1			21.6			21.5	
Queue Delay		0.0			0.0			0.0			0.0	
Total Delay		86.8			24.1			21.6			21.5	
LOS		F			C			C			C	
Approach Delay		86.8			24.1			21.6			21.5	
Approach LOS		F			C			C			C	

Intersection Summary

Lane Group	ø3
Lane Configurations	
Volume (vph)	
Ideal Flow (vphpl)	
Lane Width (ft)	
Lane Util. Factor	
Frt	
Flt Protected	
Satd. Flow (prot)	
Flt Permitted	
Satd. Flow (perm)	
Right Turn on Red	
Satd. Flow (RTOR)	
Link Speed (mph)	
Link Distance (ft)	
Travel Time (s)	
Peak Hour Factor	
Heavy Vehicles (%)	
Adj. Flow (vph)	
Shared Lane Traffic (%)	
Lane Group Flow (vph)	
Turn Type	
Protected Phases	3
Permitted Phases	
Minimum Initial (s)	13.0
Minimum Split (s)	16.0
Total Split (s)	16.0
Total Split (%)	20%
Maximum Green (s)	13.0
Yellow Time (s)	2.0
All-Red Time (s)	1.0
Total Lost Time (s)	
Lead/Lag	Lead
Lead-Lag Optimize?	Yes
Vehicle Extension (s)	3.0
Recall Mode	None
Walk Time (s)	7.0
Flash Dont Walk (s)	9.0
Pedestrian Calls (#/hr)	0
Act Effct Green (s)	
Actuated g/C Ratio	
v/c Ratio	
Control Delay	
Queue Delay	
Total Delay	
LOS	
Approach Delay	
Approach LOS	

Intersection Summary

Area Type:	Other		
Cycle Length: 81			
Actuated Cycle Length: 65			
Control Type: Actuated-Uncoordinated			
Maximum v/c Ratio: 1.08			
Intersection Signal Delay: 38.8		Intersection LOS: D	
Intersection Capacity Utilization 108.4%		ICU Level of Service G	
Analysis Period (min) 15			

Splits and Phases: 3: Greendale Ave & Great Plain Ave

Lane Group	EBT	WBT	NBT	SBT
Lane Group Flow (vph)	493	721	468	294
v/c Ratio	1.08	0.83	0.66	0.62
Control Delay	86.8	24.1	21.6	21.5
Queue Delay	0.0	0.0	0.0	0.0
Total Delay	86.8	24.1	21.6	21.5
Queue Length 50th (ft)	~224	214	146	82
Queue Length 95th (ft)	#395	#398	140	146
Internal Link Dist (ft)	345	360	249	578
Turn Bay Length (ft)				
Base Capacity (vph)	457	873	710	472
Starvation Cap Reductn	0	0	0	0
Spillback Cap Reductn	0	0	0	0
Storage Cap Reductn	0	0	0	0
Reduced v/c Ratio	1.08	0.83	0.66	0.62

Intersection Summary

~ Volume exceeds capacity, queue is theoretically infinite.
Queue shown is maximum after two cycles.

95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		↕			↕			↕			↕	
Volume (vph)	60	193	23	23	225	82	24	39	36	225	219	139
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Lane Width (ft)	15	15	15	15	15	15	13	13	13	14	14	14
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Frt		0.989			0.967			0.951			0.968	
Flt Protected		0.989			0.997			0.988			0.981	
Satd. Flow (prot)	0	2030	0	0	2015	0	0	1845	0	0	1917	0
Flt Permitted		0.823			0.962			0.851			0.826	
Satd. Flow (perm)	0	1689	0	0	1944	0	0	1589	0	0	1614	0
Right Turn on Red			Yes			Yes			Yes			Yes
Satd. Flow (RTOR)		6			23			36			20	
Link Speed (mph)		30			30			30			30	
Link Distance (ft)		425			440			329			696	
Travel Time (s)		9.7			10.0			7.5			15.8	
Peak Hour Factor	0.91	0.91	0.91	0.85	0.85	0.85	0.89	0.89	0.89	0.94	0.94	0.94
Heavy Vehicles (%)	0%	1%	0%	0%	0%	0%	0%	0%	0%	1%	0%	0%
Adj. Flow (vph)	66	212	25	27	265	96	27	44	40	239	233	148
Shared Lane Traffic (%)												
Lane Group Flow (vph)	0	303	0	0	388	0	0	111	0	0	620	0
Turn Type	Perm	NA		Perm	NA		Perm	NA		Perm	NA	
Protected Phases		2			2			4			4	
Permitted Phases	2			2			4			4		
Minimum Initial (s)	7.0	7.0		7.0	7.0		7.0	7.0		7.0	7.0	
Minimum Split (s)	12.0	12.0		12.0	12.0		12.0	12.0		12.0	12.0	
Total Split (s)	35.0	35.0		35.0	35.0		30.0	30.0		30.0	30.0	
Total Split (%)	43.2%	43.2%		43.2%	43.2%		37.0%	37.0%		37.0%	37.0%	
Maximum Green (s)	30.0	30.0		30.0	30.0		25.0	25.0		25.0	25.0	
Yellow Time (s)	4.0	4.0		4.0	4.0		4.0	4.0		4.0	4.0	
All-Red Time (s)	1.0	1.0		1.0	1.0		1.0	1.0		1.0	1.0	
Total Lost Time (s)		5.0			5.0			5.0			5.0	
Lead/Lag							Lag	Lag		Lag	Lag	
Lead-Lag Optimize?							Yes	Yes		Yes	Yes	
Vehicle Extension (s)	5.0	5.0		5.0	5.0		5.0	5.0		5.0	5.0	
Recall Mode	Min	Min		Min	Min		Min	Min		Min	Min	
Walk Time (s)												
Flash Dont Walk (s)												
Pedestrian Calls (#/hr)												
Act Effct Green (s)		20.7			20.7			26.0			26.0	
Actuated g/C Ratio		0.35			0.35			0.44			0.44	
v/c Ratio		0.52			0.56			0.16			0.87	
Control Delay		19.4			19.0			11.6			34.5	
Queue Delay		0.0			0.0			0.0			0.0	
Total Delay		19.4			19.0			11.6			34.5	
LOS		B			B			B			C	
Approach Delay		19.4			19.0			11.6			34.5	
Approach LOS		B			B			B			C	

Intersection Summary

Lane Group	ø3
Lane Configurations	
Volume (vph)	
Ideal Flow (vphpl)	
Lane Width (ft)	
Lane Util. Factor	
Frt	
Flt Protected	
Satd. Flow (prot)	
Flt Permitted	
Satd. Flow (perm)	
Right Turn on Red	
Satd. Flow (RTOR)	
Link Speed (mph)	
Link Distance (ft)	
Travel Time (s)	
Peak Hour Factor	
Heavy Vehicles (%)	
Adj. Flow (vph)	
Shared Lane Traffic (%)	
Lane Group Flow (vph)	
Turn Type	
Protected Phases	3
Permitted Phases	
Minimum Initial (s)	13.0
Minimum Split (s)	16.0
Total Split (s)	16.0
Total Split (%)	20%
Maximum Green (s)	13.0
Yellow Time (s)	2.0
All-Red Time (s)	1.0
Total Lost Time (s)	
Lead/Lag	Lead
Lead-Lag Optimize?	Yes
Vehicle Extension (s)	3.0
Recall Mode	None
Walk Time (s)	7.0
Flash Dont Walk (s)	9.0
Pedestrian Calls (#/hr)	3
Act Effct Green (s)	
Actuated g/C Ratio	
v/c Ratio	
Control Delay	
Queue Delay	
Total Delay	
LOS	
Approach Delay	
Approach LOS	

Intersection Summary

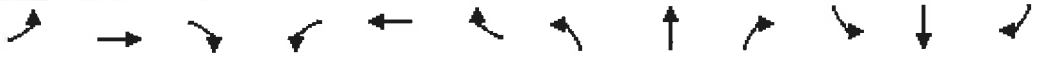
Area Type:	Other		
Cycle Length: 81			
Actuated Cycle Length: 59.7			
Control Type: Actuated-Uncoordinated			
Maximum v/c Ratio: 0.87			
Intersection Signal Delay: 25.3		Intersection LOS: C	
Intersection Capacity Utilization 78.4%		ICU Level of Service D	
Analysis Period (min) 15			

Splits and Phases: 3: Greendale Ave & Great Plain Ave

Lane Group	EBT	WBT	NBT	SBT
Lane Group Flow (vph)	303	388	111	620
v/c Ratio	0.52	0.56	0.16	0.87
Control Delay	19.4	19.0	11.6	34.5
Queue Delay	0.0	0.0	0.0	0.0
Total Delay	19.4	19.0	11.6	34.5
Queue Length 50th (ft)	73	91	13	163
Queue Length 95th (ft)	196	219	67	#614
Internal Link Dist (ft)	345	360	249	616
Turn Bay Length (ft)				
Base Capacity (vph)	884	1025	711	712
Starvation Cap Reductn	0	0	0	0
Spillback Cap Reductn	0	0	0	0
Storage Cap Reductn	0	0	0	0
Reduced v/c Ratio	0.34	0.38	0.16	0.87

Intersection Summary

95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.



Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		↕			↕			↕			↕	
Volume (vph)	191	254	33	44	276	314	20	243	27	99	73	78
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Lane Width (ft)	15	15	15	15	15	15	13	13	13	14	14	14
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Frt		0.991			0.933			0.987			0.958	
Flt Protected		0.980			0.997			0.997			0.981	
Satd. Flow (prot)	0	2007	0	0	1918	0	0	1902	0	0	1867	0
Flt Permitted		0.521			0.943			0.962			0.532	
Satd. Flow (perm)	0	1067	0	0	1814	0	0	1835	0	0	1012	0
Right Turn on Red			Yes			Yes			Yes			Yes
Satd. Flow (RTOR)		6			75			6			27	
Link Speed (mph)		30			30			30			30	
Link Distance (ft)		425			440			329			658	
Travel Time (s)		9.7			10.0			7.5			15.0	
Peak Hour Factor	0.97	0.97	0.97	0.88	0.88	0.88	0.62	0.62	0.62	0.85	0.85	0.85
Heavy Vehicles (%)	1%	1%	3%	0%	2%	1%	0%	1%	8%	2%	1%	3%
Adj. Flow (vph)	197	262	34	50	314	357	32	392	44	116	86	92
Shared Lane Traffic (%)												
Lane Group Flow (vph)	0	493	0	0	721	0	0	468	0	0	294	0
Turn Type	Perm	NA		Perm	NA		Perm	NA		Perm	NA	
Protected Phases		2			2			4			4	
Permitted Phases	2			2			4			4		
Minimum Initial (s)	7.0	7.0		7.0	7.0		7.0	7.0		7.0	7.0	
Minimum Split (s)	12.0	12.0		12.0	12.0		12.0	12.0		12.0	12.0	
Total Split (s)	39.0	39.0		39.0	39.0		26.0	26.0		26.0	26.0	
Total Split (%)	48.1%	48.1%		48.1%	48.1%		32.1%	32.1%		32.1%	32.1%	
Maximum Green (s)	34.0	34.0		34.0	34.0		21.0	21.0		21.0	21.0	
Yellow Time (s)	4.0	4.0		4.0	4.0		4.0	4.0		4.0	4.0	
All-Red Time (s)	1.0	1.0		1.0	1.0		1.0	1.0		1.0	1.0	
Total Lost Time (s)		5.0			5.0			5.0			5.0	
Lead/Lag							Lag	Lag		Lag	Lag	
Lead-Lag Optimize?							Yes	Yes		Yes	Yes	
Vehicle Extension (s)	5.0	5.0		5.0	5.0		5.0	5.0		5.0	5.0	
Recall Mode	Min	Min		Min	Min		Min	Min		Min	Min	
Walk Time (s)												
Flash Dont Walk (s)												
Pedestrian Calls (#/hr)												
Act Effct Green (s)		34.0			34.0			21.0			21.0	
Actuated g/C Ratio		0.52			0.52			0.32			0.32	
v/c Ratio		0.88			0.73			0.79			0.85	
Control Delay		34.5			16.1			31.3			44.7	
Queue Delay		0.0			0.0			0.0			0.0	
Total Delay		34.5			16.1			31.3			44.7	
LOS		C			B			C			D	
Approach Delay		34.5			16.1			31.3			44.7	
Approach LOS		C			B			C			D	

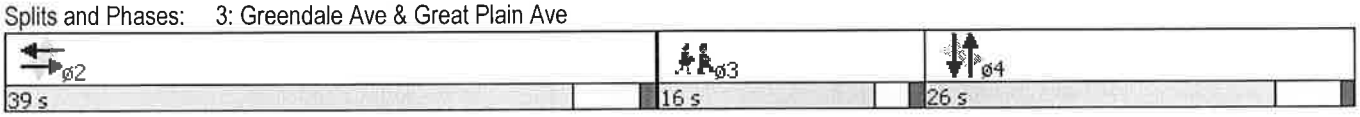
Intersection Summary

Lane Group	ø3
Lane Configurations	
Volume (vph)	
Ideal Flow (vphpl)	
Lane Width (ft)	
Lane Util. Factor	
Frt	
Flt Protected	
Satd. Flow (prot)	
Flt Permitted	
Satd. Flow (perm)	
Right Turn on Red	
Satd. Flow (RTOR)	
Link Speed (mph)	
Link Distance (ft)	
Travel Time (s)	
Peak Hour Factor	
Heavy Vehicles (%)	
Adj. Flow (vph)	
Shared Lane Traffic (%)	
Lane Group Flow (vph)	
Turn Type	
Protected Phases	3
Permitted Phases	
Minimum Initial (s)	13.0
Minimum Split (s)	16.0
Total Split (s)	16.0
Total Split (%)	20%
Maximum Green (s)	13.0
Yellow Time (s)	2.0
All-Red Time (s)	1.0
Total Lost Time (s)	
Lead/Lag	Lead
Lead-Lag Optimize?	Yes
Vehicle Extension (s)	3.0
Recall Mode	None
Walk Time (s)	7.0
Flash Dont Walk (s)	9.0
Pedestrian Calls (#/hr)	0
Act Effct Green (s)	
Actuated g/C Ratio	
v/c Ratio	
Control Delay	
Queue Delay	
Total Delay	
LOS	
Approach Delay	
Approach LOS	

Intersection Summary

Area Type:	Other		
Cycle Length: 81			
Actuated Cycle Length: 65			
Control Type: Actuated-Uncoordinated			
Maximum v/c Ratio: 0.88			
Intersection Signal Delay: 28.6		Intersection LOS: C	
Intersection Capacity Utilization 108.4%		ICU Level of Service G	
Analysis Period (min) 15			

Splits and Phases: 3: Greendale Ave & Great Plain Ave



Lane Group	EBT	WBT	NBT	SBT
Lane Group Flow (vph)	493	721	468	294
v/c Ratio	0.88	0.73	0.79	0.85
Control Delay	34.5	16.1	31.3	44.7
Queue Delay	0.0	0.0	0.0	0.0
Total Delay	34.5	16.1	31.3	44.7
Queue Length 50th (ft)	157	181	163	98
Queue Length 95th (ft)	#349	294	157	#211
Internal Link Dist (ft)	345	360	249	578
Turn Bay Length (ft)				
Base Capacity (vph)	560	984	596	345
Starvation Cap Reductn	0	0	0	0
Spillback Cap Reductn	0	0	0	0
Storage Cap Reductn	0	0	0	0
Reduced v/c Ratio	0.88	0.73	0.79	0.85

Intersection Summary

95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.

Greendale Avenue at the Project North Driveway

Lane Group	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Volume (vph)	6	91	770	1	23	186
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00
Frt	0.874					
Flt Protected	0.997					0.995
Satd. Flow (prot)	1623	0	1863	0	0	1853
Flt Permitted	0.997					0.995
Satd. Flow (perm)	1623	0	1863	0	0	1853
Link Speed (mph)	30		30			30
Link Distance (ft)	203		270			142
Travel Time (s)	4.6		6.1			3.2
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	7	99	837	1	25	202
Shared Lane Traffic (%)						
Lane Group Flow (vph)	106	0	838	0	0	227
Sign Control	Stop		Free			Free

Intersection Summary			
Area Type:	Other		
Control Type: Unsignalized			
Intersection Capacity Utilization 53.2%		ICU Level of Service A	
Analysis Period (min) 15			

Intersection	
Intersection Delay, s/veh	2

Movement	WBL	WBR	NBT	NBR	SBL	SBT
Vol, veh/h	6	91	770	1	23	186
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Stop	Stop	Free	Free	Free	Free
RT Channelized	None	None	None	None	None	None
Storage Length	0	0		0	0	
Median Width	12		0			0
Grade, %	0%		0%			0%
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Heavy Vehicles, %	2	2	2	2	2	2
Mvmt Flow	7	99	837	1	25	202
Number of Lanes	1	0	1	0	0	1

Major/Minor			Major 1		Major 2	
Conflicting Flow All	1090	838	0	0	838	0
Stage 1	838	-	-	-	-	-
Stage 2	252	-	-	-	-	-
Follow-up Headway	3.518	3.318	-	-	2.218	-
Pot Capacity-1 Maneuver	238	366	-	-	796	-
Stage 1	424	-	-	-	-	-
Stage 2	790	-	-	-	-	-
Time blocked-Platoon, %	0	0	-	-	0	-
Mov Capacity-1 Maneuver	230	366	-	-	796	-
Mov Capacity-2 Maneuver	230	-	-	-	-	-
Stage 1	424	-	-	-	-	-
Stage 2	762	-	-	-	-	-

Approach	WB	NB	SB
HCM Control Delay, s	19.5	0	1.1
HCM LOS	C	-	-

Minor Lane / Major Mvmt	NBT	NBR	WBLn1	SBL	SBT
Cap, veh/h	-	-	353	796	-
HCM Control Delay, s	-	-	19.5	9.669	0
HCM Lane V/C Ratio	-	-	0.30	0.03	-
HCM Lane LOS	-	-	C	A	A
HCM 95th-tile Q, veh	-	-	1.2	0.1	-

Notes

~ : Volume Exceeds Capacity; $: Delay Exceeds 300 Seconds; Error : Computation Not Defined

Lane Group	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Volume (vph)	3	48	162	6	89	631
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00
Frt	0.872		0.995			
Flt Protected	0.997					0.994
Satd. Flow (prot)	1619	0	1853	0	0	1852
Flt Permitted	0.997					0.994
Satd. Flow (perm)	1619	0	1853	0	0	1852
Link Speed (mph)	30		30			30
Link Distance (ft)	259		242			132
Travel Time (s)	5.9		5.5			3.0
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	3	52	176	7	97	686
Shared Lane Traffic (%)						
Lane Group Flow (vph)	55	0	183	0	0	783
Sign Control	Stop		Free			Free

Intersection Summary			
Area Type:	Other		
Control Type: Unsignalized			
Intersection Capacity Utilization 60.4%		ICU Level of Service B	
Analysis Period (min) 15			

Intersection	
Intersection Delay, s/veh	1.3

Movement	WBL	WBR	NBT	NBR	SBL	SBT
Vol, veh/h	3	48	162	6	89	631
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Stop	Stop	Free	Free	Free	Free
RT Channelized	None	None	None	None	None	None
Storage Length	0	0		0	0	
Median Width	12		0			0
Grade, %	0%		0%			0%
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Heavy Vehicles, %	2	2	2	2	2	2
Mvmt Flow	3	52	176	7	97	686
Number of Lanes	1	0	1	0	0	1

Major/Minor			Major 1			Major 2
Conflicting Flow All	1058	179	0	0	183	0
Stage 1	179	-	-	-	-	-
Stage 2	879	-	-	-	-	-
Follow-up Headway	3.518	3.318	-	-	2.218	-
Pot Capacity-1 Maneuver	249	864	-	-	1392	-
Stage 1	852	-	-	-	-	-
Stage 2	406	-	-	-	-	-
Time blocked-Platoon, %	0	0	-	-	0	-
Mov Capacity-1 Maneuver	221	864	-	-	1392	-
Mov Capacity-2 Maneuver	221	-	-	-	-	-
Stage 1	852	-	-	-	-	-
Stage 2	360	-	-	-	-	-

Approach	WB	NB	SB
HCM Control Delay, s	10.3	0	1
HCM LOS	B	-	-

Minor Lane / Major Mvmt	NBT	NBR	WBLn1	SBL	SBT
Cap, veh/h	-	-	738	1392	-
HCM Control Delay, s	-	-	10.3	7.779	0
HCM Lane V/C Ratio	-	-	0.08	0.07	-
HCM Lane LOS	-	-	B	A	A
HCM 95th-tile Q, veh	-	-	0.2	0.2	-

Notes

~ : Volume Exceeds Capacity; $: Delay Exceeds 300 Seconds; Error : Computation Not Defined

Greendale Avenue at the Project South Driveway

Lane Group	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Volume (vph)	18	6	765	5	1	191
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00
Frt	0.965		0.999			
Flt Protected	0.964					
Satd. Flow (prot)	1733	0	1861	0	0	1863
Flt Permitted	0.964					
Satd. Flow (perm)	1733	0	1861	0	0	1863
Link Speed (mph)	30		30			30
Link Distance (ft)	205		658			270
Travel Time (s)	4.7		15.0			6.1
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	20	7	832	5	1	208
Shared Lane Traffic (%)						
Lane Group Flow (vph)	27	0	837	0	0	209
Sign Control	Stop		Free			Free

Intersection Summary			
Area Type:	Other		
Control Type: Unsignalized			
Intersection Capacity Utilization 50.6%		ICU Level of Service A	
Analysis Period (min) 15			

Intersection	
Intersection Delay, s/veh	0.5

Movement	WBL	WBR	NBT	NBR	SBL	SBT
Vol, veh/h	18	6	765	5	1	191
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Stop	Stop	Free	Free	Free	Free
RT Channelized	None	None	None	None	None	None
Storage Length	0	0		0	0	
Median Width	12		0			0
Grade, %	0%		0%			0%
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Heavy Vehicles, %	2	2	2	2	2	2
Mvmt Flow	20	7	832	5	1	208
Number of Lanes	1	0	1	0	0	1

Major/Minor			Major 1		Major 2	
Conflicting Flow All	1044	834	0	0	837	0
Stage 1	834	-	-	-	-	-
Stage 2	210	-	-	-	-	-
Follow-up Headway	3.518	3.318	-	-	2.218	-
Pot Capacity-1 Maneuver	254	368	-	-	797	-
Stage 1	426	-	-	-	-	-
Stage 2	825	-	-	-	-	-
Time blocked-Platoon, %	0	0	-	-	0	-
Mov Capacity-1 Maneuver	254	368	-	-	797	-
Mov Capacity-2 Maneuver	254	-	-	-	-	-
Stage 1	426	-	-	-	-	-
Stage 2	824	-	-	-	-	-

Approach	WB	NB	SB
HCM Control Delay, s	19.5	0	0
HCM LOS	C	-	-

Minor Lane / Major Mvmt	NBT	NBR	WBLn1	SBL	SBT
Cap, veh/h	-	-	275	797	-
HCM Control Delay, s	-	-	19.5	9.523	0
HCM Lane V/C Ratio	-	-	0.10	0.00	-
HCM Lane LOS	-	-	C	A	A
HCM 95th-tile Q, veh	-	-	0.3	0.0	-

Notes

~ : Volume Exceeds Capacity; $: Delay Exceeds 300 Seconds; Error : Computation Not Defined

Lane Group	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Volume (vph)	10	3	165	18	6	628
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00
Frt	0.971		0.986			
Flt Protected	0.962					0.999
Satd. Flow (prot)	1740	0	1837	0	0	1861
Flt Permitted	0.962					0.999
Satd. Flow (perm)	1740	0	1837	0	0	1861
Link Speed (mph)	30		30			30
Link Distance (ft)	279		696			242
Travel Time (s)	6.3		15.8			5.5
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	11	3	179	20	7	683
Shared Lane Traffic (%)						
Lane Group Flow (vph)	14	0	199	0	0	690
Sign Control	Stop		Free			Free

Intersection Summary			
Area Type:	Other		
Control Type: Unsignalized			
Intersection Capacity Utilization 47.8%		ICU Level of Service A	
Analysis Period (min) 15			

Intersection	
Intersection Delay, s/veh	0.3

Movement	WBL	WBR	NBT	NBR	SBL	SBT
Vol, veh/h	10	3	165	18	6	628
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Stop	Stop	Free	Free	Free	Free
RT Channelized	None	None	None	None	None	None
Storage Length	0	0		0	0	
Median Width	12		0			0
Grade, %	0%		0%			0%
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Heavy Vehicles, %	2	2	2	2	2	2
Mvmt Flow	11	3	179	20	7	683
Number of Lanes	1	0	1	0	0	1

Major/Minor			Major 1			Major 2
Conflicting Flow All	885	189	0	0	199	0
Stage 1	189	-	-	-	-	-
Stage 2	696	-	-	-	-	-
Follow-up Headway	3.518	3.318	-	-	2.218	-
Pot Capacity-1 Maneuver	315	853	-	-	1373	-
Stage 1	843	-	-	-	-	-
Stage 2	495	-	-	-	-	-
Time blocked-Platoon, %	0	0	-	-	0	-
Mov Capacity-1 Maneuver	312	853	-	-	1373	-
Mov Capacity-2 Maneuver	312	-	-	-	-	-
Stage 1	843	-	-	-	-	-
Stage 2	491	-	-	-	-	-

Approach	WB	NB	SB
HCM Control Delay, s	15.3	0	0.1
HCM LOS	C	-	-

Minor Lane / Major Mvmt	NBT	NBR	WBLn1	SBL	SBT
Cap, veh/h	-	-	365	1373	-
HCM Control Delay, s	-	-	15.3	7.635	0
HCM Lane V/C Ratio	-	-	0.04	0.01	-
HCM Lane LOS	-	-	C	A	A
HCM 95th-tile Q, veh	-	-	0.1	0.0	-

Notes

~ : Volume Exceeds Capacity; $: Delay Exceeds 300 Seconds; Error : Computation Not Defined