Updated Traffic Impact and Access Study

Proposed Timber Crest Estates Residential Development
Holliston Street and Winthrop Street

Medway, Massachusetts

Prepared for

TIMBER CREST ESTATES, LLC

October 2016

Prepared by

GREEN INTERNATIONAL AFFILIATES, INC.
Civil and Structural Engineers

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1.0 Introduction and Executive Summary

This report describes the updated traffic analysis of a proposed residential subdivision development project situated in Medway, Massachusetts. The revised subdivision development is now proposed to consist of a total of 157 single-family houses, similarly split into two areas as the original plan separated by wetlands between Winthrop Street and Holliston Street. The western section is proposed to consist of 72 houses and be accessible via Winthrop Street 1,600 feet north of Lovering Street. The majority of the eastern section is now proposed to consist of 81 houses, with access provided via a site roadway connecting to Fairway Lane at a point about 2,300 feet west of Holliston Street and at #165 Holliston Street approximately 500 feet south of Fairway Lane; four additional houses will be accessed off the proposed cul-de-sac to be constructed at the end of existing Fern Path. The project site is located approximately 1.1 miles north of Route 109 and approximately 2.3 miles south of Holliston Center. The project location is shown in
Figure 1 with respect to the general area including the town Centers of Holliston and Medway. The current site is wooded with wetlands in the middle, and is situated behind other single family homes and south of power lines.

This report describes the potential impacts on the adjacent roadways and nearby intersections. Intersection capacity analyses were completed at each study intersection for the existing, future No-Build, and future Build conditions. An updated analysis of available stopping sight distance (SSD) and intersection sight distance (ISD) was also completed for the project site. This updated report takes into account the relevant comments made in the peer review performed by Tetra Tech[1] in June 2016 incorporating them into the new analysis where appropriate. The full comment letter is included in the Appendix.

The analysis and evaluation in this updated report includes traffic volumes, safety data and review, and an analysis of the roadway/site access interface. The guidelines of the Massachusetts Department of Transportation (MassDOT), and the Institute of Transportation Engineers (ITE) were used for completing this traffic impact and access study. The report's content contains descriptions of existing characteristics of the abutting roadway network, current traffic conditions, estimated traffic impacts and access/egress characteristics of the development.

EXISTING CONDITIONS

The site consists of two sections separated by wetlands between Winthrop Street and Holliston Street. The selection of the study area took into account the location and type of project and focused on the evaluation of the roadways and intersections in the vicinity of the site that are anticipated to be most impacted by the proposed development project. Figure 1 also indicates the intersections included in this updated study.

[1] Tetra Tech, Letter Review Report, Timber Crest Estates, - 40B Review, Traffic Impact and Access Study, Medway, MA June 14, 2016.

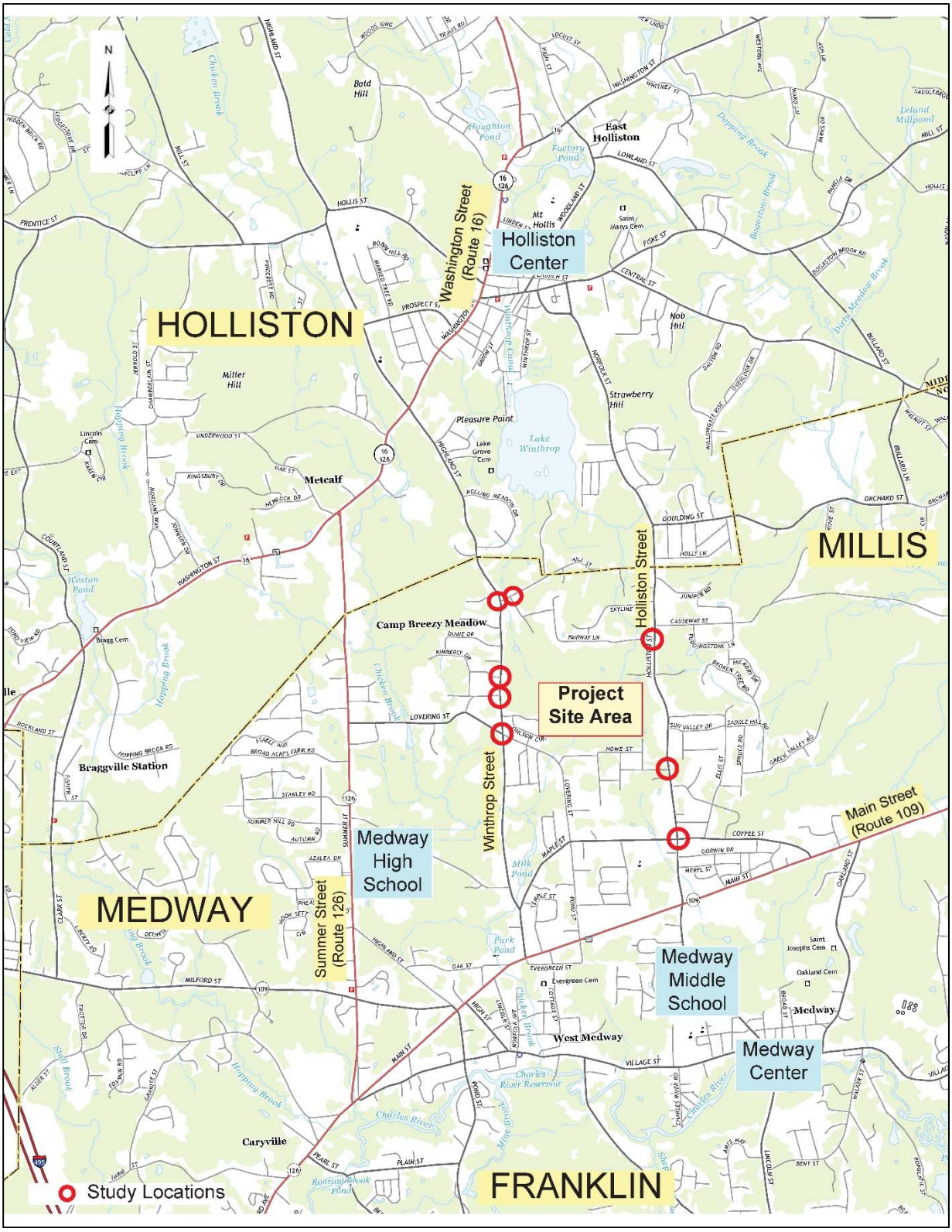

Figure 1. Project Location

Winthrop Street and Holliston Street, which are the major roadways serving the proposed development, are two-lane, two-way roadways under the jurisdiction of the town of Medway and are classified as "Urban Minor Arterial" roadways. Lovering Street is a two-lane, two-way road that falls under the jurisdiction of the town of Medway and is classified as an "Urban Collector" roadway that is one street that connects Holliston Street and Winthrop Street. All of the intersections in the study area are unsignalized.

Traffic data was originally collected on June 2nd and 3rd, 2015 for the project and in response to the initial peer review comments, was supplemented with additional data collected on September 14th and 15th, 2016. The weekday average daily traffic (ADT) volume on Winthrop Street (south of Stephanie Road) and Holliston Street (north of Redgate Drive) are approximately 5,200 and 7,700 vehicles per day (vpd), respectively. On Winthrop Street, the morning peak hour traffic volume represents approximately 13% of daily traffic while the afternoon peak hour represents approximately 9%. Holliston Street peak hour traffic volumes represent approximately 8-10% of daily traffic. Travel speeds on Winthrop Street and Holliston Street are approximately 5-10 mph above the posted speed limit. The analysis showed that, based on the current data available, there is available roadway capacity to accommodate new traffic.

Based on data between 2011 and 2014, the intersection of Winthrop Street and Lovering Street has a crash rate of 1.26 crashes per million entering vehicles which is above the MassDOT average of 0.66 for unsignalized intersections. There have been actions taken by the town in an effort to address this issue.

The evaluation of the intersections indicated no significantly long delays or excessive 95th percentile queue lengths at the study intersections. With the exception of Coffee Street and Lovering Street at their intersection with Holliston Street, all study intersections operate well during the peak hours in under existing conditions, with each approach operating at LOS 'C' or better for the analysis has shown that the Holliston Street/Lovering Street intersection experiences long delays on the eastbound approach during the morning peak hour.

Based on analysis of reported crash data between 2011 and 2014, there are some issues of collisions with roadside objects or oncoming vehicles along Holliston Street and Winthrop Street due to geometric roadway alignments, much vegetation, and excessive travel speeds.

FUTURE CONDITIONS

The future year 2023 was chosen for future evaluation based on MassDOT guidelines. This seven-year time frame allows for two years of permitting and construction and a five year build-out/full occupancy period. The evaluation of future conditions involves No-Build and Build conditions. The future No-Build traffic volumes are determined by adding a general background growth rate of 1.0% to the existing traffic volumes, and by adding expected trips from other specific development projects in or around the study area.

The future Build traffic volumes are determined by adding the expected project trips to the No-Build traffic volumes. Traffic volume forecasts of the proposed development project were based on models published by the Institute of Transportation Engineers (ITE) and observations of similar land uses. The updated residential project is expected to generate approximately 1,590 vehicle trips per day, with 120 and 158 vehicle trips added during the AM and PM peak hours, respectively. The trips were distributed across the study network based on existing traffic patterns of the area with minor adjustments made based on residence-to-work data collected from U.S. Census surveys. The analysis showed that

operations at the intersections and proposed site drives will not significantly impact the surrounding roadway network, and that there is capacity on the surrounding roadway network to accommodate the traffic generated by the fully occupied development.

CONCLUSIONS AND RECOMMENDATIONS

The analyses demonstrate that the roadways and intersections within the study area are able to accommodate the additional traffic associated with the proposed development project, although considering the crash records and available sight distances some safety improvements should be implemented on the surrounding roadways. The following summarizes the traffic analysis:

- The major streets of Winthrop Street and Holliston Street within this area are two lane urban minor arterial roads. The roadway network has and will have the capacity to accommodate additional peak vehicular demands.
- The proposed development project is expected to generate a total of 120 and 158 additional vehicle-trips during the weekday morning and afternoon peak hours, respectively, and 1,590 vehicle-trips during an average weekday. The predominant flow in the weekday morning peak period is expected to be exiting trips. During the afternoon peak period, the predominant direction of new traffic is expected to be entering vehicles.
- Traffic is expected to disperse with two separate development sites and a total of three driveways and a cul-de-sac extension of Fern Path.
- With the full occupancy of the proposed development project, motorists using the neighborhood roadways as well as Winthrop Street and Holliston Street will continue to experience relatively short delays during the weekday peak hours.
- The minimum safe stopping sight distance criteria are exceeded at all locations for posted speeds. While the minimum intersection sight distances are satisfied, the desired ISD criteria is also satisfied at most of the locations. Those sightlines that have some degree of limitation can be improved by taking certain remedial actions as discussed below. The ISD is restricted along Holliston Street due to vertical and roadside geometry, while ISD at the other two locations is limited by vegetation.

Recommendations

While the analyses show that the proposed project can be expected to be safely accommodated on the study area network, several recommendations have been made to enhance the project's access and the overall traffic flow in the project area. As noted, a number of these actions are designed to improve overall traffic safety along the public ways and are not necessarily required as part of the proposed development. The proposed actions are as follows:

- Each of the proposed site drive approaches to the major roadways should be STOP sign controlled with sign and markings as appropriate.
- Any proposed landscaping and signage should be low enough and/or set back sufficiently so as not to create any sight distance constraints at the proposed site drives.
- The roadside back slope along the west side of Holliston Street north of the proposed site drive should be graded to be more level with the roadway surface to provide greater sight distance from the site driveway to Holliston Street. The re-grading and leveling should occur, at a minimum, in

vicinity of the proposed Site Drive 3 (#165 Holliston Street) and north to the extent feasible in the right-of-way in front of #167 through #171 to maintain stable terrain. Ideally, the width of the leveling out would be in the range of 3 to 4 feet minimum. An added benefit of this action is that it would provide a safe area for any pedestrians walking along Holliston Street to remain out of the vehicle path.

- Regardless of whether the proposed project is approved or not, the roadside vegetation within the public rights-of-way on all major streets should be trimmed and/or cleared sufficiently, particularly in the vicinity of intersecting streets, to maintain and maximize sight distances. With regard to the proposed site drives, sight line triangles can be drawn on the site plans to demarcate the area within the intersection that landscape and signage would remain low-lying and set back to avoid creating visibility conflicts.
- Consideration should be given to installing intersection warning signs along Holliston Street approaching both Fairway Lane (in both directions) and the new proposed site driveway approaching from the north.
- A cross road warning sign (W2-1) on Winthrop Street north and south of the intersection of Lovering Street. Considering that the town installed on the Lovering Street approaches flashing STOP Ahead signs, the town may want to also consider equipping the cross road warning signs with flashing lights as well. The objective of these actions is to continue to increase awareness of this intersection to the motorists traveling along Winthrop Street.
- In an effort to encourage lower travel speeds, particularly on Holliston Street and Winthrop Street, without simply relying on enforcement, the town should consider increased use of the solar powered warning signs and speed monitoring display signs. While these actions should be considered by the town regardless of this proposed project, it may be possible for the Applicant to work with the town and participate by implementing a portion of this program. If agreeable, it is recommended that a permanently-mounted solar-powered speed monitoring feedback display signs with a speed limit sign be installed on Holliston Street as part of this development project. While two locations for these signs may be reasonable in the long range, it is currently recommended that one be installed in the vicinity of the Veterans of Foreign Wars Post #1526 property in the northbound direction as part of the approved development project.
- It is also suggested that curve warning signs be installed on Holliston Street in the northbound and southbound directions where the horizontal alignment makes two noticeable horizontal changes. The exact location can be reviewed with the Town's public works and police departments but they are north of the VFW and south of the proposed project's site drive on Holliston Street.
- It is recommended that the signage along Holliston Street also include an advance intersection warning sign on the northbound and southbound approaches to Lovering Street.
- Crosswalks should be marked in standard form along Holliston Street with standard pedestrian crosswalk signs on both sides of the street.
- A final action to consider in enhancing safe movement of vehicles is that once the new driveways are installed on both Holliston Street and Winthrop Street, installing a roadway street light on the utility poles situated at or near the site drives should be considered.

2.0 Existing Traffic Conditions

The following sections describe the existing transportation system in terms of physical and operational characteristics. The selection of the study area took into account the location and type of project and focused on the evaluation of the roadways and intersections in the vicinity of the site that are anticipated to be most impacted by the proposed development project. Since the previous traffic study for this development, two additional existing intersections have been included in the study area and analyses.

2.1 Existing Roadway Network

The site consists of two sections separated by wetlands between Winthrop Street and Holliston Street. The selection of the study area took into account the location and type of project and focused on the evaluation of the roadways and intersections in the vicinity of the site that are anticipated to be most impacted by the proposed development project. The study area was expanded to include two additional locations at the request of the town's peer review consultant. The following intersections were included in the updated study:

- Winthrop Street at Hill Street
- Winthrop Street at Stephanie Road
- Winthrop Street at Partridge Street
- Winthrop Street at Lovering Street
- Hill Street at Cider Mill Road
- Holliston Street at Fairway Lane
- Holliston Street at Redgate Drive
- Holliston Street at Lovering Street at Coffee Street

As part of this study, field visits were conducted to verify the physical and geometric layout of the study intersections and roadways and to observe traffic operations in the study area and in the updated study area. A description of the study roadways serving the project is as follows:

Winthrop Street

Winthrop Street is a two-lane, two-way road under the jurisdiction of the town of Medway and is classified as an "Urban Minor Arterial" roadway. Winthrop Street extends in a north-south direction from Main Street in Medway to the Medway/Holliston town border (where it becomes Highland Street). Within the study area Winthrop Street has travel lane widths of approximately 11.5 to 12 feet and shoulders that vary in width from approximately 1 foot to 5.5 feet. A double-yellow centerline separates the opposing travel directions. Curb or berm is not present alongside Winthrop Street within the study area. Utility poles are present along the east side of the road from the beginning of Winthrop Street at Main Street and cross over to the west side of the at the intersection with Maple Street. The utility poles cross back over to the east side just north of the intersection with Lovering Street and cross back over to the west side at the intersection with Ohlson Circle. Utility poles are set back at least three feet behind the pavement and some of the utility poles near intersections include overhead street lights.

The posted speed limit on Winthrop Street is 35 miles per hour (MPH) in the vicinity of the site in both directions. There is a horizontal curve at the intersections at Hill Street and Alexsandria Drive. Land use in the vicinity of the proposed development project is primarily residential.

At its intersection with Winthrop Street, Hill Street operates under STOP control whereas vehicles driving along Winthrop Street operate freely. The three-leg intersection consists of Hill Street forming the eastern leg and Winthrop Street forming the northern and southern legs. The intersection lies in a semi-wooded setting, with residences to the south and east of the intersection. The intersection of Winthrop Street and Alexsandria Drive (dead end) is located just north of the intersection with Hill Street. Curb or berm is not present at the intersection. A horizontal curve is present on Winthrop Street to the north and south of the intersection.

Intersection of Winthrop Street and Hill Street, looking north.

Intersection of Winthrop Street and Stephanie Road, looking east.

Approximately one half mile south of the Winthrop Street/Hill Street intersection is the intersection of Winthrop Street with Stephanie Road. At the three-leg intersection of Winthrop Street and Stephanie Road, Winthrop Street runs freely and Stephanie Road is STOP controlled. Winthrop Street forms the northern and southern legs, while Stephanie Road forms the western leg. The intersection lies in a semi-wooded residential setting with residents to the north, south and west of the intersection. The asphalt curbing and sidewalk along Stephanie Road terminate at the intersection.

Approximately 500 feet south of the Winthrop Street/Stephanie Road intersection is the intersection of Winthrop Street with Partridge Street. At this three-leg intersection, Winthrop Street runs freely whereas Partridge Street operates under STOP control. Winthrop Street forms the northern and southern legs while Partridge Street forms the eastern leg. There is a grass median located in the center of the Street approach to the intersection that contains a utility pole along with an R4-7a (Keep Right) road sign. The intersection is located in a semi-wooded residential setting with residents to the north and west of the intersection.

Hill Street

Hill Street is a two-lane, two-way road under Town jurisdiction along the Medway/Holliston Town line and is classified as a local roadway. Holliston Street extends in an east-west direction from Winthrop Street in Medway to the intersection at Holliston Street/Norfolk Street. Hill Street contains a single yellow centerline that separates the opposing travel directions and has lane widths of approximately 11 feet. There are no sidewalks, curbs, or berms present.

Approximately 250 feet east of Winthrop Street, Hill Street intersects Cider Mill Road, a local residential roadway that provides access to Fairway Lane. Hill Street forms the east and west legs and runs freely

while Cider Mill Road forms the south leg and operates under STOP control. The intersection is in a partly wooded residential setting.

Holliston Street

Holliston is a two-lane, two-way road under the jurisdiction of the town of Medway and is classified as an "Urban Minor Arterial" roadway. Holliston Street extends in a north-south direction from Village Street in Medway to the intersection at Hill Street (where it becomes Norfolk Street). Within the study area, Holliston Street has travel lane widths of approximately 10 feet to 12 feet and shoulders that vary in width from approximately 1-1.5 feet. A double-yellow centerline separates the opposing travel directions. Curb or berm is not present alongside Holliston Street within the study area. Holliston Street contains an asphalt sidewalk approximately 5 feet wide that runs alongside the roadway from the intersection with Village Street to the intersection with Ellis Street. Utility poles are present along the east side of the road. Utility poles are set back at least three feet behind the pavement and some of the utility poles near intersections include overhead street lights.

The posted speed limit on Holliston Street is 35 MPH in the vicinity of the site in both directions. There is a horizontal curve on Holliston Street located just north of the intersection at Ellis Street.

At its intersection with Fairway Lane, Fairway Lane operates under STOP control while vehicles driving along Holliston Street operate freely. This three-leg intersection consists of Fairway Lane forming the western leg while Holliston Street forms the northern and southern legs. The intersection lies in a semi-wooded setting, with residences to the north and west of the intersection. The entrance to the intersection at Fairway Lane consists of a granite curb at the corners as well as an asphalt sidewalk that is approximately five feet wide. There is a crest vertical curve located on Holliston Street just south of the intersection.

Intersection of Holliston Street and Fairway Lane looking south.

Intersection of Holliston Street and Redgate Drive looking north.

Approximately three-quarter miles south of the Holliston Street/Fairway Lane intersection is the intersection of Holliston Street and Redgate Drive. Holliston Drive runs freely whereas Redgate Drive operates under STOP control. At this three-leg intersection, Redgate Drive forms the western leg and Holliston Street forms the northern and southern legs. There is a granite curb located on the corners of the Redgate Drive entrance to the intersection. A five-foot wide crosswalk is located at the beginning of the northern leg of the intersection. This accommodates pedestrians crossing over from the sidewalk

located on the north side of Redgate Drive to the sidewalk located on the east side of Holliston Street. Both sidewalks are about five feet wide.

Lovering Street

Lovering Street is a two-lane, two-way road that falls under the jurisdiction of the town of Medway and is classified as an "Urban Collector" roadway. Lovering Street extends in a northwest-southeast direction from the intersection at Holliston Street to the east to the intersection at Summer Street to the west. Within the study area Lovering Street has lane widths of approximately 9.5 feet to 10.5 feet and shoulders of 1 foot. A double-yellow center line separates the opposing travel directions from the intersection at Holliston Street to the intersection at Winthrop Street. The stretch of Lovering Street from the intersection at Winthrop Street to the intersection at Summer Street consists of a single-yellow centerline. There is an asphalt berm along Lovering Street within the area of study. Utility poles are present along the northeast side of the roadway and are set back at least three feet behind the pavement line. Some of the utility poles located near intersections include overhead street lights. The posted speed limit is 30 mph in the vicinity of the site in both directions.

At its intersection with Winthrop Street, Lovering Street is STOP controlled (with flashing STOP signs and advance warning signs in each travel direction) and vehicles driving along Winthrop Street operate freely. At the four-leg intersection, Lovering Street forms the eastern and western legs and Winthrop Street forms the northern and southern legs. The intersection lies in a semi-wooded setting, with residences to the north, east and west of the intersection. No curb or berm is present at the intersection. Driveways to houses directly enter the intersection at the northeast and southeast corners of the intersection.

Intersection of Winthrop Street and Lovering Street, looking west before the addition of flashing STOP signs.

Intersection of Winthrop Street and Lovering Street, looking east in September 2016.

The intersection of Holliston Street with Lovering Street and Coffee Street is an unsignalized intersection with Lovering Street and Coffee Street under STOP control and Holliston Street operating freely. However, there are stop lines for the north and south legs associated with the presence of a crossing guard during (elementary) school pick-up and drop-off hours, and there are "Stop Here for Crossing Guard" signs on the north- and southbound approaches. The STOP signs on the east and west legs have flashing red lights around the perimeters of the signs. Holliston Street forms the north and south legs of this intersection, Lovering Street forms the west leg, and Coffee Street forms the east leg. The Lovering

Street approach has a short pocket for right-turning vehicles, but the other three approaches at this intersection have and operate with one lane. Crosswalks are present across the south and east legs of the intersection, and bituminous concrete sidewalk four feet wide or less with grass buffer is present along the east side of Holliston Street and the south side of Lovering Street. This intersection is in a residential and partly wooded setting, and the John D. McGovern Elementary School is approximately 650 feet west of the intersection.

Neighborhood Residential Roadways – General Characteristics

Fairway Lane, Fern Path, Redgate Drive, Cedar Mill Road, Partridge Street, and Stephanie Road are all two-way, unmarked local roadways providing access to single-family homes and fall under the jurisdiction of the town of Medway. Coffee Street is also a local roadway. These roadways have widths of approximately 30 feet except for Partridge Road and Coffee Street (which are approximately 20 feet wide) and Cider Mill Road (which is approximately 25 feet wide). Existing pavement conditions are generally good. There are no posted speed limits on these remaining roads excluding Fairway Lane; which has a posted speed limit of 20 MPH.

Fairway Lane

From its intersection with Holliston Street, Fairway Lane runs in an east-west direction for approximately one half mile. At this point there is a 90 degree turn in the roadway and the direction shifts to north-south. Fairway Lane ends at a cul-de-sac located approximately one quarter mile north of the turn. There are asphalt berms located on both sides of the roadway. An asphalt sidewalk is present along the south side of the roadway prior to the turn and along the west side after the turn. There are reflective pavement markings along the roadway leading up to the intersection with Holliston Street.

Hill Street, looking west toward the intersection at Winthrop Street.

Fairway Lane, looking from the intersection at Holliston Street.

These reflective markings are located on both sides of the road approximately a quarter of the length of the roadway in from the edge of the berms. The proposed site drive on Fairway Lane is located just over 300 feet west of Algonquin Avenue.

Fern Path

Fern Path is a dead-end road that generally runs in a north-south direction beginning at Redgate Drive. A sidewalk is present along the west side of the roadway and there are berms located along the edge of both sides of the roadway. The proposed site drive is located at the north end of Fern Path.

Fern Path, looking towards Redgate Drive.

Redgate Drive, looking east.

Redgate Drive

Redgate Drive extends from Holliston Street in the east to Bramble Road in the west. A sidewalk is present along the north side of the road and there are berms located along the edge of both sides of the roadway.

Coffee Street

Coffee Street is a two-way, two-lane roadway approximately 20 feet wide with a single yellow centerline. Coffee Street is approximately three-quarters of a mile long and provides access to residential side roads, Route 109, and Holliston Street. Coffee Street is Town-owned local road.

Cider Mill Road

Cider Mill Road is approximately one-quarter mile long. At its north end it intersects Hill Street, and at its south end it terminates in a cul-de-sac; Cider Mill Road also intersects Homestead Drive which provides access to Fairway Lane. Cedar Mill Road's jurisdiction status is "unaccepted by City or Town". North of Fairway Lane sidewalk is provided along the west side of the road, and south of Fairway Lane sidewalk is provided along the east side of the road. Bituminous berm is present along both sides of the roadway.

Partridge Street

Partridge Street extends from Winthrop Street in the east to Kimberly Drive in the west (where it becomes Wards Lane). No sidewalks, curbs, or berms are present. A median splitter island with a utility pole in it is present on Partridge Street at its mouth at its intersection with Winthrop Street.

Stephanie Road

Stephanie Road extends from Winthrop Street in the east to Kimberly Drive in the West. A sidewalk is present along the south side of the road and there are asphalt curbs located along the edge of both

sides of the roadway. There is a proposed site drive located at the intersection of Stephanie Drive and Winthrop Street. The proposed site drive will make the intersection a four-way intersection and will represent the eastern leg of the intersection.

Partridge Street, looking west from the intersection at Winthrop Street.

Stephanie Road, looking east toward the intersection at Winthrop Street.

2.2 Traffic Volumes

As part of this study, traffic volume data were obtained and used to form the basis of the traffic analysis. The data were collected on June 2nd and 3rd, 2015 and on September 14th and 15th, 2016, and consisted of weekday peak periods (7:00-9:00 AM and 4:00-6:00 PM) manual turning movement counts (TMC) at the study intersections noted previously. The count program also included 48-hour vehicle counts on Winthrop Street (south of Stephanie Road), Holliston Street (north of Redgate Drive), Cider Mill Road (north of Homestead Drive), Fairway Lane (west of Holliston Street), and Fern Path (north of Redgate Drive) using Automatic Traffic Recorders (ATR's) collected in June 2015, and on Holliston Street north of Woodland Road in September 2016. The complete TMC and ATR data collected as a part of this study are included in the Appendix.

Table 2.1 summarizes the ATR data that were collected as part of this study. As indicated, the weekday average daily traffic (ADT) volume on Winthrop Street (south of Stephanie Road) and Holliston Street (north of Redgate Drive) are approximately 5,240 and 7,688 vehicles per day (vpd), respectively. Because the 2015 and 2016 ATR counts on Holliston Street have similar volumes during the AM and PM weekday peak hours, the 2015 counts were not adjusted to the 2016 baseline used for this updated study.

On Winthrop Street the morning peak hour traffic volume represents approximately 12.5% of daily traffic while the afternoon peak hour represents approximately 9.3%. Holliston Street peak hour traffic volumes represent approximately 8-10% of daily traffic. Directional splits are high during peak hours; during the morning peak hour 81% of traffic on Winthrop Street between Partridge Street and Stephanie Road travels in the northbound direction while 73% of traffic in the afternoon peak hour travels in the southbound direction, splits of 63-71% in the dominant direction of travel along Holliston Street in the same direction as Winthrop Street were also recorded. These high directional splits are indicative of commuter traffic using Winthrop and Holliston Street.

The minor cross streets or neighborhood roadways generally carry much lower volumes. Cider Mill Road north of Homestead Drive, Fairway Lane west of Holliston Street, and Fern Path north of Redgate Drive have ADT volumes of 395, 318, and 220 vpd, respectively.

Average travel speeds on Holliston Street and Winthrop Street are approximately 40 miles per hour (mph), and between 20-30 mph on the smaller studied roadways. In general, observations show that motorists are traveling along Holliston Street and Winthrop Street at speeds typically above the posted speeds with measured 85th percentile speeds being five to ten miles per hour higher than posted.

Table 2.1 - Summary of Observed ATR Traffic Data

Location	ADT Weekday	Volume, Weekday AM Peak Hour	Percent of Daily Volume	Volume, Weekday PM Peak Hour	Percent of Daily Volume	Average Speed (MPH)	85th %-ile Speed (MPH)
Winthrop Street south of Stephanie Road (June 2015)	5,240	650	12.5%	490	9.3%	39 (NB) 42 (SB)	43 (NB) 46 (NB)
Holliston Street north of Woodland Road (Sept. 2016)	6,470	583	9.0%	661	10.2%	40 (NB) 37 (SB)	43 (NB) 41 (SB)
Holliston Street north of Redgate Drive (June 2015)	7,688	605	7.9%	700	9.1%	41 (NB) 40 (SB)	43 (NB) 43 (SB)
Cider Mill Road north of Homestead Drive (June 2015)	395	45	11.6%	40	10.4%	22 (NB) 21 (SB)	25 (NB) 25 (SB)
Fairway Lane west of Holliston Street (June 2015)	318	25	7.9%	30	10.1%	31 (EB) 29 (WB)	34 (EB) 33 (WB)
Fern Path north of Redgate Drive (June 2015)	220	25	11.4%	25	10.9%	23 (NB) 24 (SB)	27 (NB) 27 (SB)

Note: Data have been averaged over two days and rounded. June 2015 and Sept. 2016 (ATR) data as noted.

In developing the estimated average of typical volume conditions for study purposes, a review of permanent traffic count station data maintained by the Massachusetts Department of Transportation (MassDOT) was completed. This review determined the seasonal variation of traffic flow on roadways similar to the function and/or in the general region and serves as the basis of any appropriate seasonal adjustments. Data from the MassDOT permanent count stations 3321 (on I-495 in Milford south of Route 85), 6125 (on I-495 in Franklin north of Route 140), and Station 307 on Route 9 in Westborough were used. No nearby permanent count stations having sufficient monthly data were found on roadways having similar volumes and functions to those of the study area. The seasonal variation of the local stations indicated that June average daily traffic volumes tended to be approximately four to nine percent above annual daily volumes and that September average daily traffic volumes tended to be approximately two to three percent above annual daily volumes; thus, no seasonal adjustment factors were applied. Additionally, per peer review comments and to account for the shifting by one year of the existing and future conditions (updated in this report to 2016/2023, as opposed to the previous study as 2015/2022), the annual growth rate was applied to the counts collected in 2015 to bring these figures to

the year 2016. Counts collected in 2016 were not adjusted in the analysis. Figures 2 and 3 illustrate the existing weekday morning and afternoon peak hour traffic volumes, respectively.

2.3 Crash Experience

Recent crash history for the study intersections for the most recent four-year period available (2011-2014) were reviewed as part of this study. Crash data presented in this report were obtained from the MassDOT Crash Record System (CRS). Table 2.2 summarizes the recent crash data.

Within the study area, only one crash was reported in the year 2011 at the intersection of Winthrop Street at Lovering Street; except for this location, crash analyses were based off of a three-year period (2012-2014) rather than a four-year period.

- A total of 33 crashes were reported at or between the study intersections between the years of 2011 and 2014. There were also six additional crashes reported within the study area:
    - A crash involving a tree occurred at an unspecified location on Partridge Street.
    - One crash occurred on Cider Mill Road, involving a nighttime collision with a roadside object.
    - Two crashes were reported on each of Howe Avenue and Fairway Lane during the study period. On each of these roadways one crash involved a collision with a tree.
- One intersection, Winthrop Street at Lovering Street, had a crash rate (1.26) higher than that of the District-wide average crash rate (0.65). A contributing factor could be vegetation on both of the Winthrop Street approaches. There are also two residential driveways located directly at the intersection which could cause increased confusion among drivers traveling at the intersection. Per conversation with the Medway Police Department, lighted STOP and Stop Ahead signs have been recently added to alleviate the issue of drivers on Lovering Street who might assume that they do not need to stop at the intersection. Although the crash rate is above the MassDOT average, the average of 2.3 crashes per year is not a high number of average crashes and does not indicate a serious crash problem at the intersection.
- There was one reported fatality within the study limits, involving a collision with a tree. It occurred near #150 Holliston Street approximately 0.2 miles south of Woodland Road, during dark but lit roadway conditions.
- Eight of the reported crashes in the study area were single-vehicle collisions (22% of total reported crashes) involving trees or utility poles. Of these eight crashes, five occurred during dusk or nighttime.

    Holliston Street and Winthrop Street in the study area are fairly narrow (approximately 25 feet wide) and in a wooded area. Holliston Street between Lovering Street and Fairway Lane is a hilly and winding roadway. Conversation with the Medway Police Department suggests that the severity of crashes on this roadway are attributable to the roadway geometry. Recoverability and visibility issues are also likely factors in explaining the number of collisions with roadside objects along the study roadways.

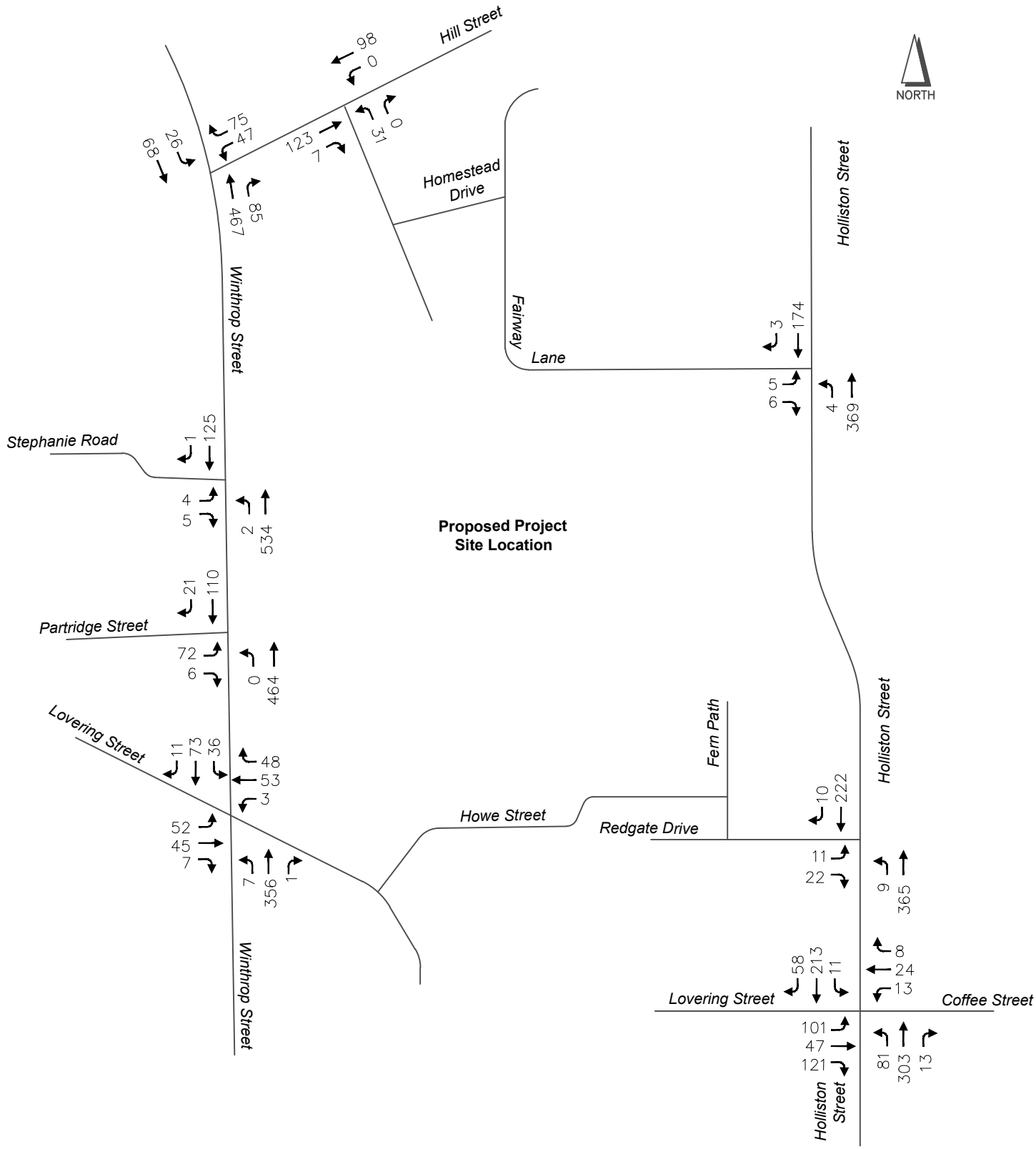

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FIGURE 2
2016 Existing Weekday AM Peak Hour Volumes
Timber Crest Estates
Medway, Massachusetts

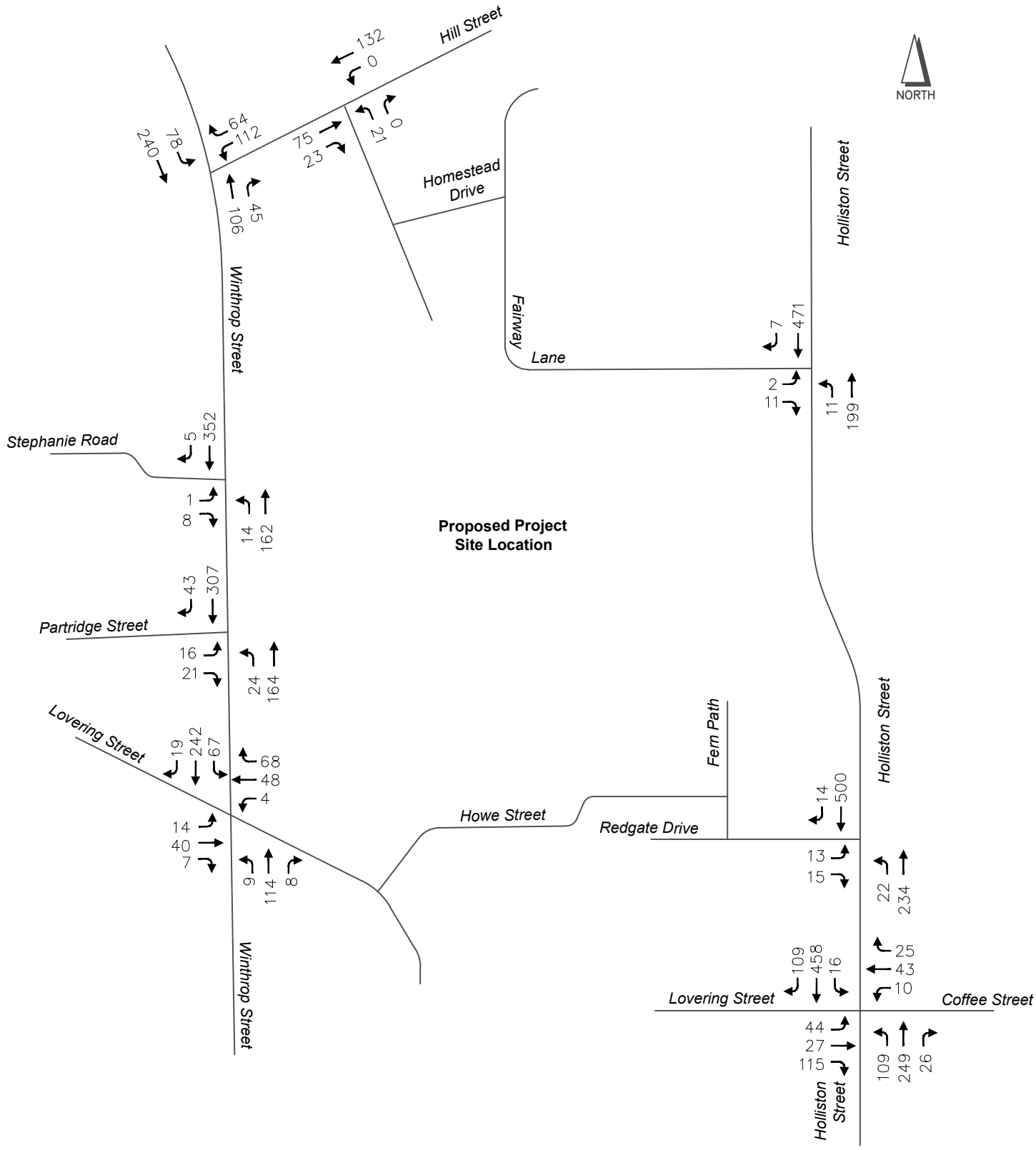

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FIGURE 3
2016 Existing Weekday PM Peak Hour Volumes
Timber Crest Estates
Medway, Massachusetts

- Approximately one-third of all collisions (12 total) reported in the study area occurred during nighttime or dusk.

Table 2.2 - Summary of Reported Crash Data

	Winthrop Street at Hill Street			*Winthrop Street at Partridge Street*			*Winthrop Street at Lovering Street*			
	2012	2013	2014	2012	2013	2014	2011	2012	2013	2014
Severity										
Property Damage					1				2	2
Injury							1	3	2	
Fatality										
Unknown	1									
Collision Type										
Rear End					1					
Angle							1	3	3	2
Side Swipe										
Head On									1	
Single Vehicle	1									
Collision with Ped										
Collision with Bike										
Other/Unknown										
Time of Day										
6:01 AM – 10:00 AM								1	1	
10:01 AM – 4:00 PM					1			1	2	
4:01 PM – 7:00 PM							1	1	1	2
7:01 PM – 6:00 AM	1									
Roadway Conditions										
Dry	1				1		1	1	2	2
Wet								2	2	
Snow/Ice										
Other/Unknown										
Season										
Dec-Feb							1	1	1	
Mar-May					1				1	1
June-Aug	1							1	2	1
Sept-Nov								1		
Light Conditions										
Daylight					1		1	3	4	2
Dawn/Dusk										
Dark (Unlit)										
Dark (Lit)	1									
Unknown										
Totals	***1***	***0***	***0***	***0***	***1***	***0***	***1***	***3***	***4***	***2***
Annual Average Crashes	0.3			0.3			3.0			
Intersection Crash Rate	***0.14***			***0.16***			***1.26***			
MassDOT District 3 Average Crash Rate	0.65			0.65			0.65			

Summary of Reported Crash Data (continued)

	Holliston Street at Fairway Lane			*Holliston Street at Redgate Drive*			*Holliston Street at Lovering Street at Coffee Street*		
	2012	2013	2014	2012	2013	2014	2012	2013	2014
Severity									
Property Damage						2			1
Injury	1	1					2	2	2
Fatality									
Unknown									
Collision Type									
Rear End						1			
Angle							2	1	2
Side Swipe									
Head On	1	1						1	1
Single Vehicle						1			
Collision with Ped									
Collision with Bike									
Other/Unknown									
Time of Day									
6:01 AM – 10:00 AM						1			1
10:01 AM – 4:00 PM		1				1			1
4:01 PM – 7:00 PM							1	1	
7:01 PM – 6:00 AM	1						1	1	1
Roadway Conditions									
Dry	1	1				1	2	2	3
Wet									
Snow/Ice						1			
Other/Unknown									
Season									
Dec-Feb						1			
Mar-May	1								1
June-Aug		1							
Sept-Nov						1	2	2	2
Light Conditions									
Daylight		1				2		1	2
Dawn/Dusk									
Dark (Unlit)								1	
Dark (Lit)	1						2		1
Unknown									
Totals	***1***	***1***	***0***	***0***	***0***	***2***	***2***	***2***	***3***
Annual Average Crashes	0.7			0.7			2.3		
Intersection Crash Rate	***0.25***			***0.22***			***0.49***		
MassDOT District 3 Average Crash Rate	0.65			0.65			0.65		

Summary of Holliston Street Segment Crash Data

	Holliston Street, At/South of Fairway Lane and North of Redgate Drive			Holliston Street, At/Between Redgate Drive and North of Lovering Street		
	2012	2013	2014	2012	2013	2014
Severity						
Property Damage		2	1		1	3
Injury	1	2	2			
Fatality	1					
Unknown						
Collision Type						
Rear End		1				1
Angle		1	2		1	1
Side Swipe						
Head On	1	1				
Single Vehicle	1	1	1			1
Collision with Ped						
Collision with Bike						
Other/Unknown						
Roadway Conditions						
Dry	2	3	3		1	2
Wet						
Snow/Ice		1				1
Other/Unknown						
Season						
Dec-Feb		2	1		1	2
Mar-May	2		1			
June-Aug		2				
Sept-Nov			1			1
Light Conditions						
Daylight		3	2			3
Dawn/Dusk						
Dark (Unlit)			1			
Dark (Lit)	2	1			1	
Unknown						
Total	**2**	**4**	**3**	**0**	**1**	**3**
Annual Average Number of Crashes	3.0			1.3		
Section Crash Rate	**1.52**			**1.32**		
Average Crash Rate [1]	3.65			3.65		

As part of this safety review, the "crash rate", measured in crashes per million entering vehicles (MEV) for the study intersections was also determined. The standard MassDOT Crash Rate Worksheet was used to determine the crash rate at each location. The calculation of the crash rate relates the number of accidents at a location to the amount of traffic that passes through the location. It is a more comprehensive measure for identifying potentially hazardous locations compared to simple averages as it takes into account volume, although crash rates can skew higher due to low volumes. The calculated rate is compared to the MassDOT District-wide averages. Intersections experiencing crash rates greater than the above averages are potentially experiencing an unusually high number or higher than expected number of crashes relative to traffic volumes at that particular location and may warrant further

investigation or improvements. MassDOT District 3, which includes the Town of Medway, has an average crash rate of 0.65 crashes per MEV for unsignalized intersections.

- Although seven out of the ten crashes reported between 2012 and 2014 on Holliston Street north of Redgate Drive and south of and including Fairway Lane, the segment crash rate is below the District 3 crash rate.
- Fairway Lane, with two reported accidents but having traffic volumes of only approximately 320 vpd, is above the District 3 crash rate for a local road. Considering that on average less than one crash was reported per year, this does not indicate a serious crash problem at the intersection. Detailed crash segment analyses can be found in the Appendix.
- No crashes were reported at the intersections of Winthrop Street at Partridge Lane, Winthrop Street at Stephanie Road, or Hill Street at Cider Mill Road.

2.4 Existing Public Transportation Network

As part of this study, the presence of nearby public transit systems was researched to better understand the potential interaction among multiple modes of travel as well the impact that commuters driving to transit stations will have on the roadway network. Based on the review, there is a shuttle bus that brings commuters between Medway Middle School, the Village Street post office, and the Norfolk commuter rail station. This limited service is provided by the Greater Attleborough Taunton Regional Transit Authority (GATRA) and the Medway Council on Aging. Considering the limited amount of parking available at the Middle School or town center and that the Middle School is 1.2 miles south of the project site, it is likely that few of the site's residents would use the shuttle bus. There are regional commuter rail stations located in the towns of Franklin and Norfolk operated by the Massachusetts Bay Transportation Authority (MBTA), and it is likely that some residents commuting to Boston or Cambridge (according to U.S. Census Bureau / American Community Survey data, slightly under 30% of these commuters) would drive to/from the commuter rail stations to access the trains.

3.0 Probable Impacts of the Project

The impact of the proposed residential development project on the roadway network within the study area was re-evaluated and the updated results are described in this section. This updated study used the year 2023 for the future analysis year, which represents a seven-year permitting and build-out timeframe from the present condition and is consistent with current MassDOT guidelines for traffic studies.

3.1 No-Build Traffic Volumes

A year 2023 No-Build traffic volume network was developed by identifying potential area-wide background traffic volume growth and known specific nearby development projects that could contribute to traffic flow on the 2023 study network.

Background Traffic Growth

Traffic growth and historical traffic count trends for the project's analysis area have been reviewed. Based upon review of local count stations, an annual growth rate of one percent (1%) per year for seven years was used to forecast future roadway volumes. These rates would presumably account for some of the more remote growth in the region as well as potential nearby smaller residential and business growth that could result in added traffic through the study area. The count station data can be found in the Appendix.

Specific Development Projects

In addition to the application of the background growth rate, research on other specific development projects that are likely to occur within the study time frame in the vicinity of the proposed project was completed. Local research via web investigation as well as discussions with the Planning Board offices of Medway and Holliston was performed.

Millstone Village is an 80-unit adult retirement community in the early stages of construction about 1,600 feet south of the Winthrop Street site drive, southwest of the Lovering Street/Winthrop Street intersection. This community will consist of 35 free-standing houses and 45 townhouses. As of autumn 2016, approximately several of these units have been constructed and occupied, although construction of the remainder of the site is ongoing. Trip distribution for Millstone Village has been assumed to be the same as that for the western portion of the Timber Crest Estates proposed project (see Section 3.3).
Tri Valley Commons is a small recently-constructed plaza along Route 109 approximately 600 feet west of Holliston Street. An automotive parts store and an automotive service garage have been constructed and occupied in the plaza. This project was assumed to generate trips onto Holliston Street[2], and the number of trips was taken from a traffic impact study. However, the 2012 study assumed a larger plaza than what is currently proposed or has been built, and as a result a conservatively higher number of trips is included in the No-Build volume network than what the plaza currently generates or is expected to generate.

Several additional developments in the vicinity in Medway are proposed or are under construction, but are relatively small and would not be expected to have a substantial impact on traffic volumes in the

[2] Green International Affiliates, Inc., Proposed 72 Main Street Tri Valley Commons Development Traffic Impact and Access Study, Medway, MA. December 2012.

study area. Applegate Farm is a development consisting of 12 single family homes at the intersection of Coffee Street and Ellis Street. A the Learning Tree Center daycare, located on Main Street near its intersection with Winthrop Street approximately 1.6 miles south of the project site, four classrooms have been added.

Several residential developments are under planning or construction in Holliston, but their location in the north or west side of Holliston would likely result in few of those residents driving through this study area. Hence, traffic from the following developments can be considered as part of the regional background growth:

- Constitution Village is a 52-unit development proposed to be located at Old Cart Path in the far north of Holliston.
- Cedar Ridge Estates is a 200-condominium development proposed on Marshall Street, in the northwest end of Holliston.
- Washington Hills, a 66-unit senior-housing development, is proposed to be located off of Route 16.
- A 66-senior housing unit development called Brooksmont Farm is proposed to be located off of Route 126 near the Ashland town line.

No-Build Traffic Volumes

Based on the above noted research, the year 2023 No-Build peak hour traffic volume projections were developed by adding seven (7) years' background traffic growth of one percent annually plus the volumes projected to result from the proposed Millstone Village and Tri-Valley Commons developments, conservatively assuming that these projects were not yet occupied in the existing condition. The projected year 2023 No-Build traffic volumes projected for the weekday morning and afternoon peak hours at the study intersections are shown in Figures 4 and 5.

3.2 Proposed Project Description

The proposed Timber Crest Estates residential development is currently proposed to consist of two portions, with the western portion consisting of 72 single family houses and the eastern portion consisting of 85 single family houses. The original traffic study analyzed the project when 76 single family homes and 112 condominiums were proposed. The residents of the western portion would access directly to Winthrop Street, opposite of Stephanie Drive. Under the current plan, the eastern portion residents would access Holliston Street via a proposed internal roadway as well as to Fairway Lane similar to the original plan. Access to Winthrop Street by residential roads west of the Fairway Lane remains similar to the original plan. There are also four homes proposed to access directly to Fern Path. The site is currently a wooded area lying between Winthrop Street and Holliston Street, with wetlands present in the center of the site and power lines present within the northern portion of the site. As part of this updated study and in response to the peer review consultant, large vehicle movements within the site and at key points were reviewed and details are in the Appendix.

3.3 Site Generated Traffic Volumes

In this section, the updated traffic forecasts related to the revised development plan are described. An estimate of traffic to be generated by the proposed development project was completed and assigned

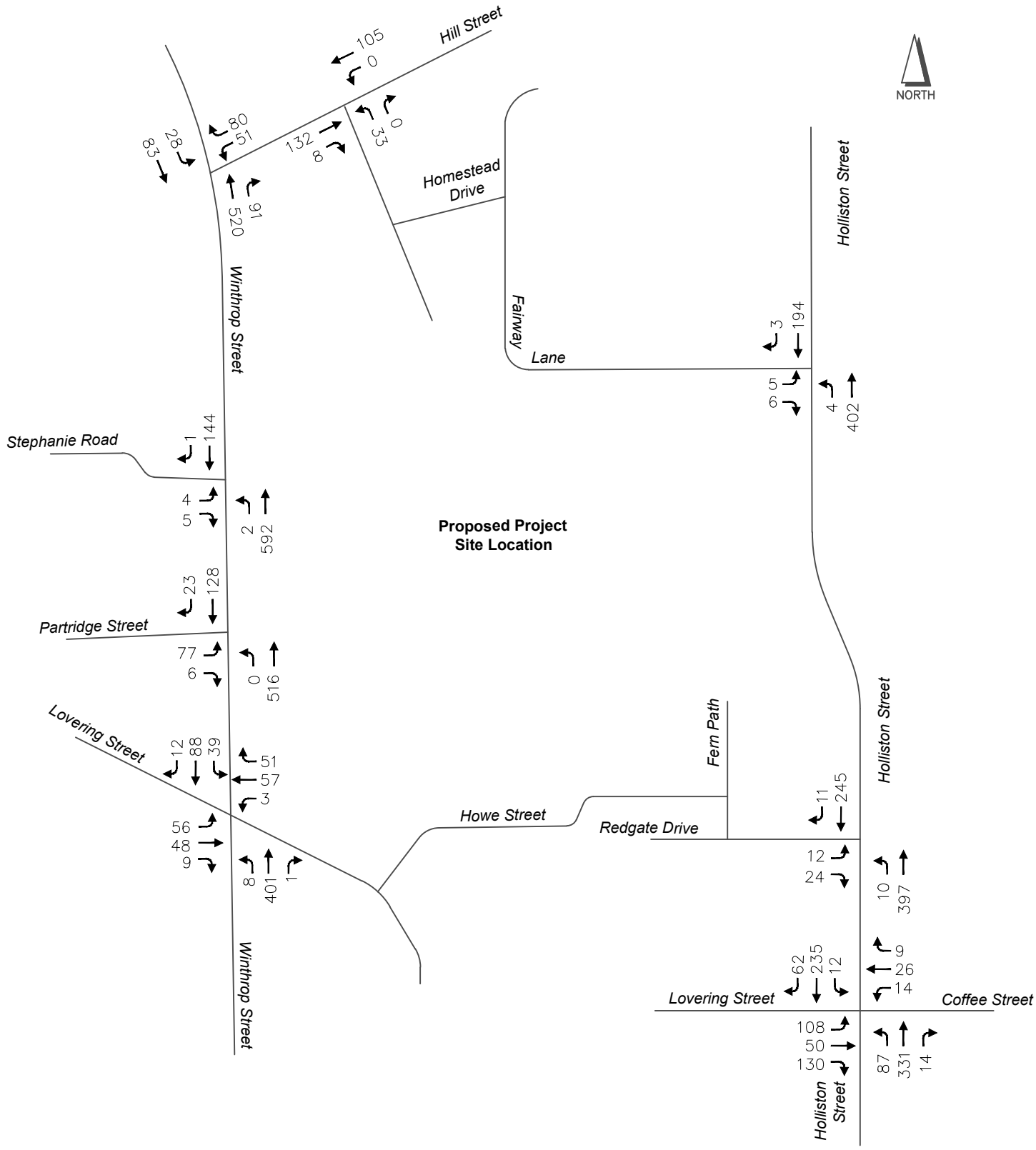

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FIGURE 4
2023 No-Build Weekday AM Traffic Volumes
Timber Crest Estates
Medway, Massachusetts

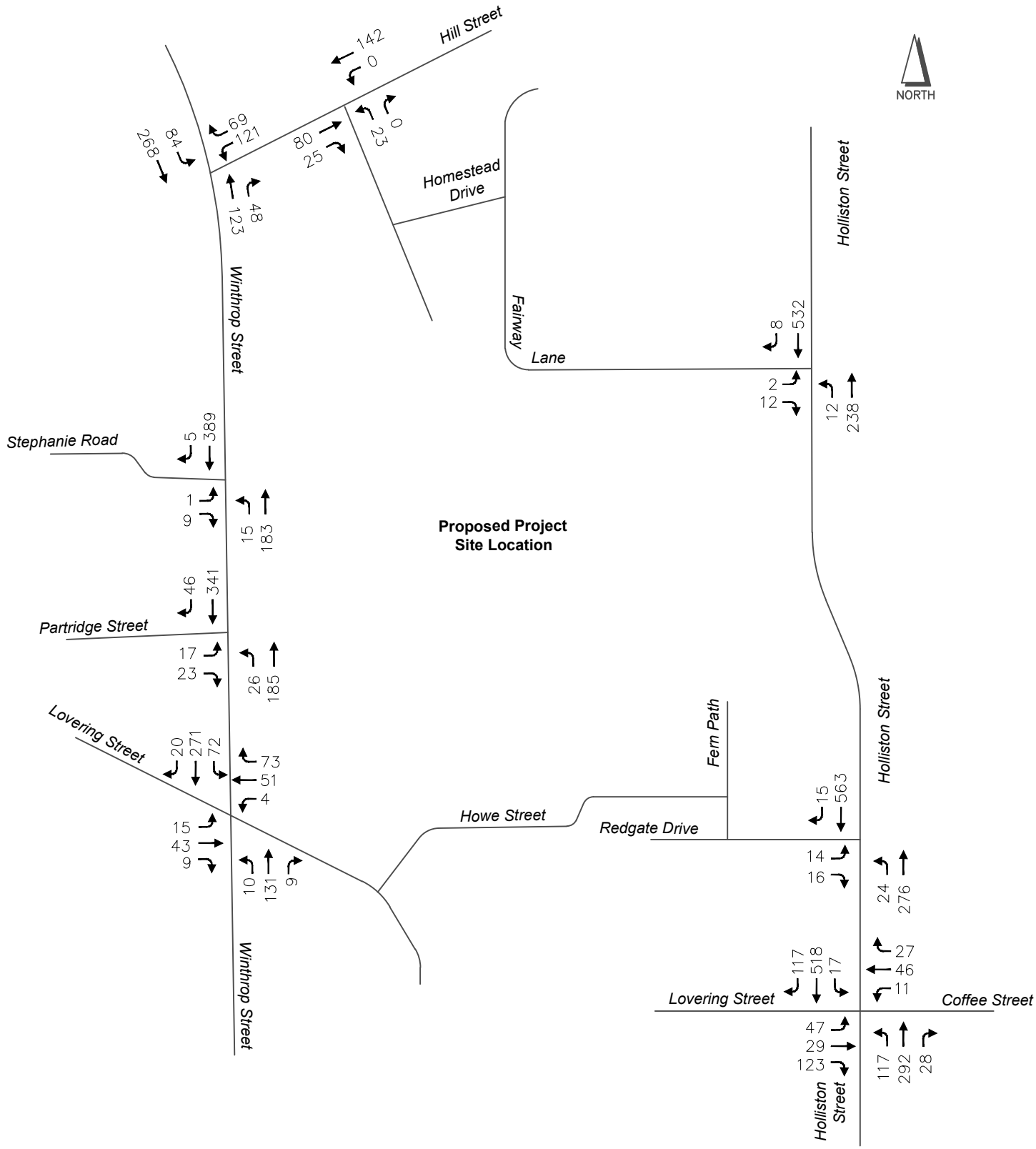

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FIGURE 5
2023 No-Build Weekday PM Traffic Volumes
Timber Crest Estates
Medway, Massachusetts

to roadways/intersections within the study area to develop the Build traffic condition, based upon the year 2023 No-Build traffic volume network.

Site Trip Generation

In order to estimate the number of trips that could be generated by the proposed development, statistics published by the Institute of Transportation Engineers (ITE) in *Trip Generation*[3] for similar land uses were examined. The ITE trip generation statistics represent compilations of data from studies/projects throughout the United States collected over the past 40+ years on trip generation characteristics for different types of land uses. The data have been compiled to provide transportation analysts with guidelines in forecasting daily and peak hour volumes for the specified use.

Based on a review of the ITE database and the residential related models, Land Use Code (LUC) 210 – Single Family Detached Housing was selected as the most similar to the most recent proposed layout for this development project. There are a total of 157 single family houses proposed for this project. The total estimated trips generated by the project are presented in Table 3.1. A total of 1,590 trips are predicted to be generated over the course of an average weekday, with 120 trips predicted during the AM peak hour and 158 trips predicted during the PM peak hour. These figures are similar to the trip generation predicted by the previous project layout that proposed both single family houses and townhouse condominiums (1,548 daily trips, 121 AM peak hour trips, 150 PM peak hour trips). Trip estimates were made separately for the east and west portions of the proposed development and combined in Table 3.1. Detailed trip generation calculations for the proposed development project are included in the Appendix.

Table 3.1 - Summary of Estimated Total Site Trip Generation

Time	Entering	Exiting	Total
Weekday Daily	795	795	1,590
AM Peak Hour	30	90	120
PM Peak Hour	100	58	158

Source: ITE Trip Generation, 9th Edition, 2012; LUC 210

Site Trip Distribution/Assignment

Once the number of trips projected to be generated by the development have been determined, trips are assigned to the site driveways and study area roadways based on trip distribution patterns determined for the project. For this project, an analysis of directional distribution of generated trips to and from the site was completed.

For this specific analysis, distribution patterns were completed following existing roadway volume patterns, with some minor adjustments made based upon residence-to-work data collected from U.S. Census surveys taken between 2006 and 2010. The strong existing volume splits along Winthrop Street in the study area (approximately 80%/20% in the northbound/southbound direction during the morning peak hour, for example) and largely residential setting of the study area indicate that local roadway

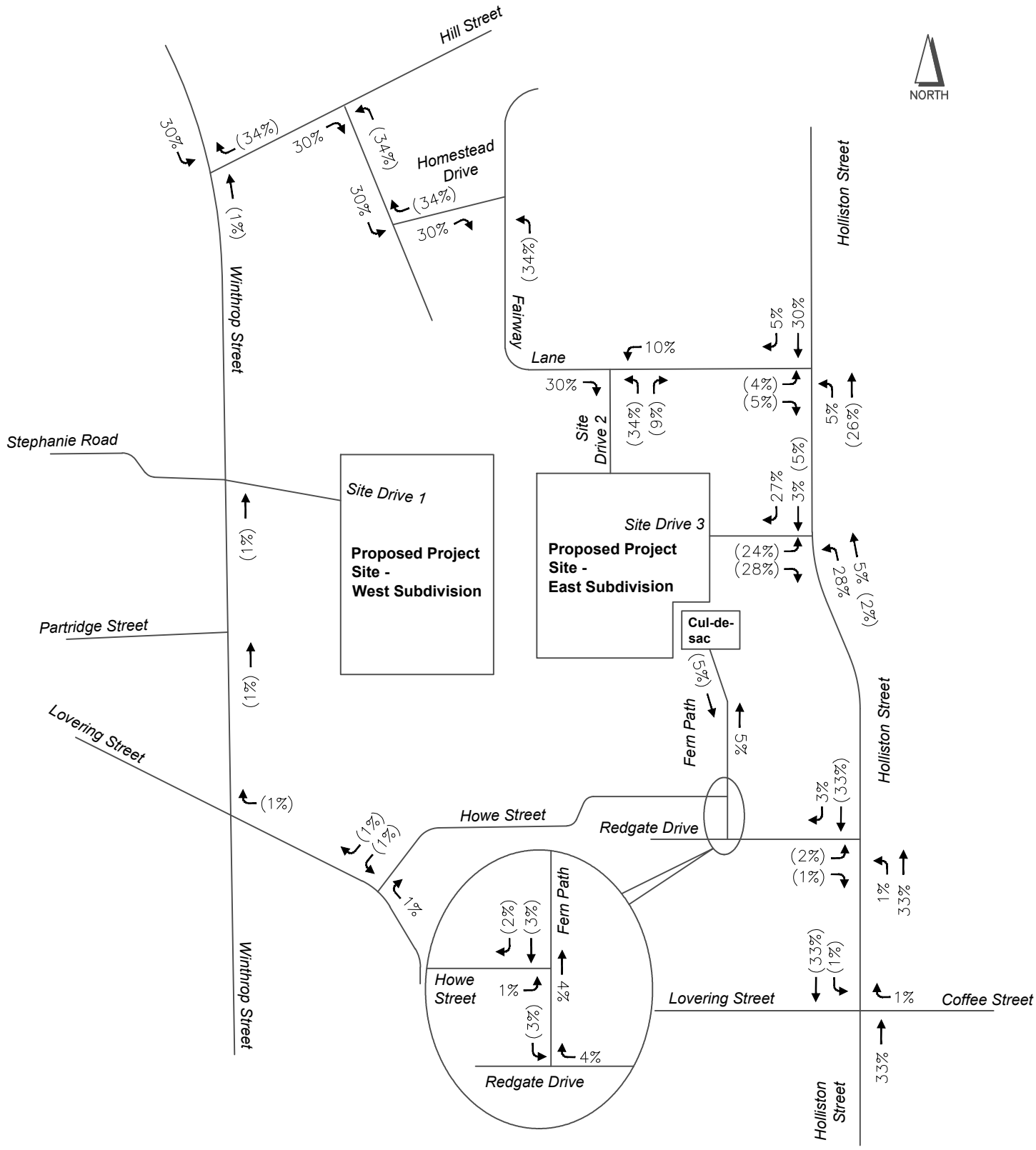
[3] Institute of Transportation Engineers, Trip Generation, 9th Edition, Washington, D.C., 2012.

volumes are biased towards residential trip patterns. It was assumed that residents of the proposed development project would have similar work-destinations as their existing neighbors. The estimated percentages by direction and for each analysis period were developed and are graphically presented in Figures 6 and 7. Figure 6 represents the percentages corresponding to the site drives located on Holliston Street, Fairway Lane, and Fern Path while Figure 7 represents the percentages corresponding to the site drive at the intersection of Winthrop Street and Stephanie Road. The trip distribution on study roadways were updated based on the revised site drive location and configurations in the eastern portion of the development and peer review comments. Detailed calculations of trip distribution are included in the Appendix.

Based upon U.S. Census survey data collected between 2006 and 2010, an estimated 3.4% of Medway residents used mass transit to arrive to their work place. Because the trip distribution for the proposed project is largely based upon existing traffic flow volumes, and that Medway residents are most likely driving to and from commuter rail stations, the transit-using portion of commuters has been taken into account in the trip distribution.

Build Traffic Volumes

Trips estimated for the proposed development were assigned to the site driveways and the study area roadways using the trip distribution percentages discussed above. Peak hour site traffic volumes were then added to traffic volumes in the study area that contained the adjustment for background growth as well as the site trips generated by the specific developments in the vicinity of the project site. This resulted in the 2023 Build condition traffic networks. The number of new trips during the morning and afternoon peak hours are shown in Figures 8 and 9, respectively for the east subdivision and in Figures 10 and 11 for the morning and afternoon peak hours, respectively, for the west subdivision. The total projected roadway volumes in the Build scenario for the weekday morning and afternoon peak hours are presented in Figures 12 and 13, respectively. Further details on the assignment are included in the Appendix.



KEY:
ENTERING (EXITING) SPLITS

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FIGURE 6
Trip Distribution - East Subdivision
Timber Crest Estates
Medway, Massachusetts

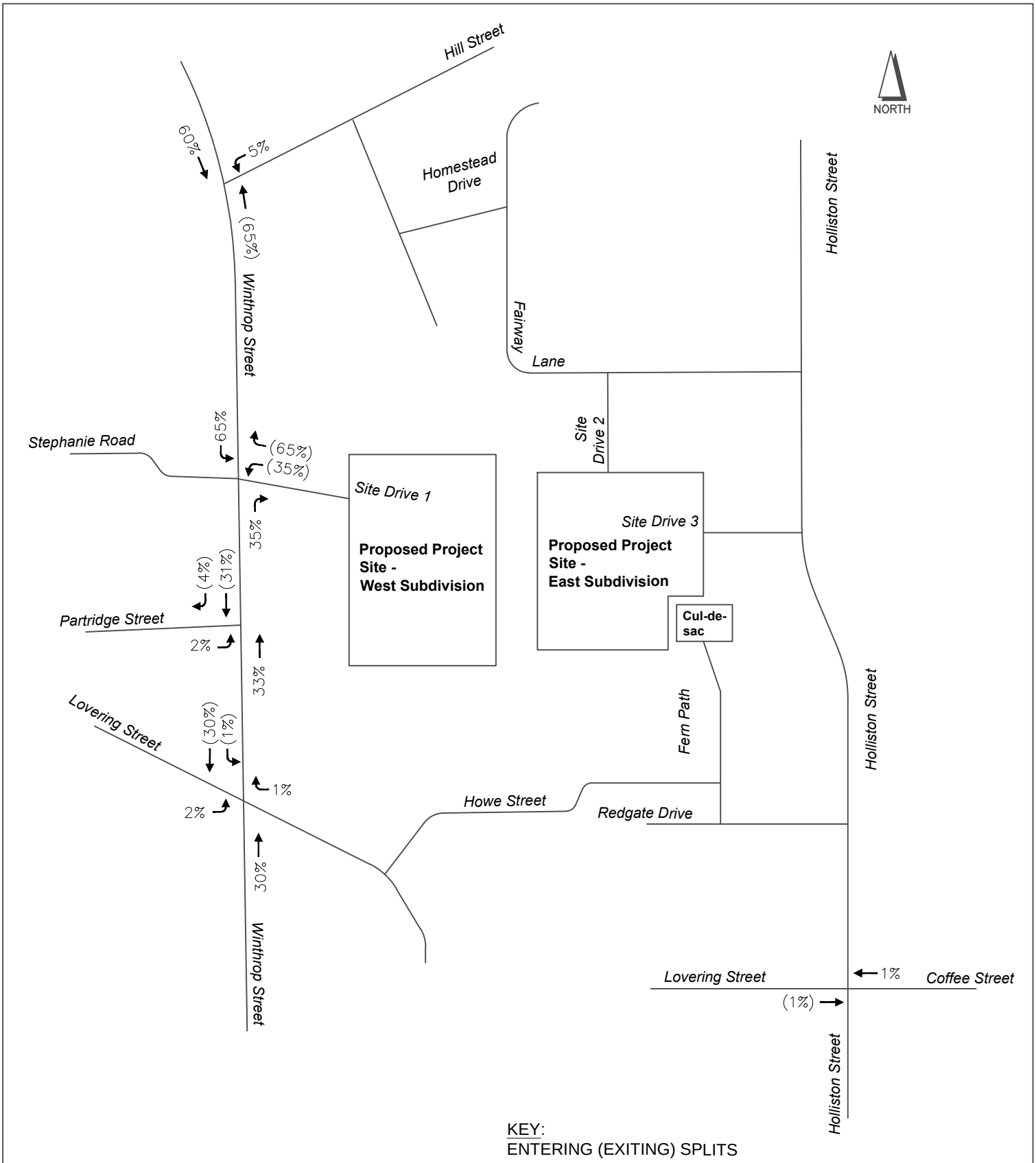

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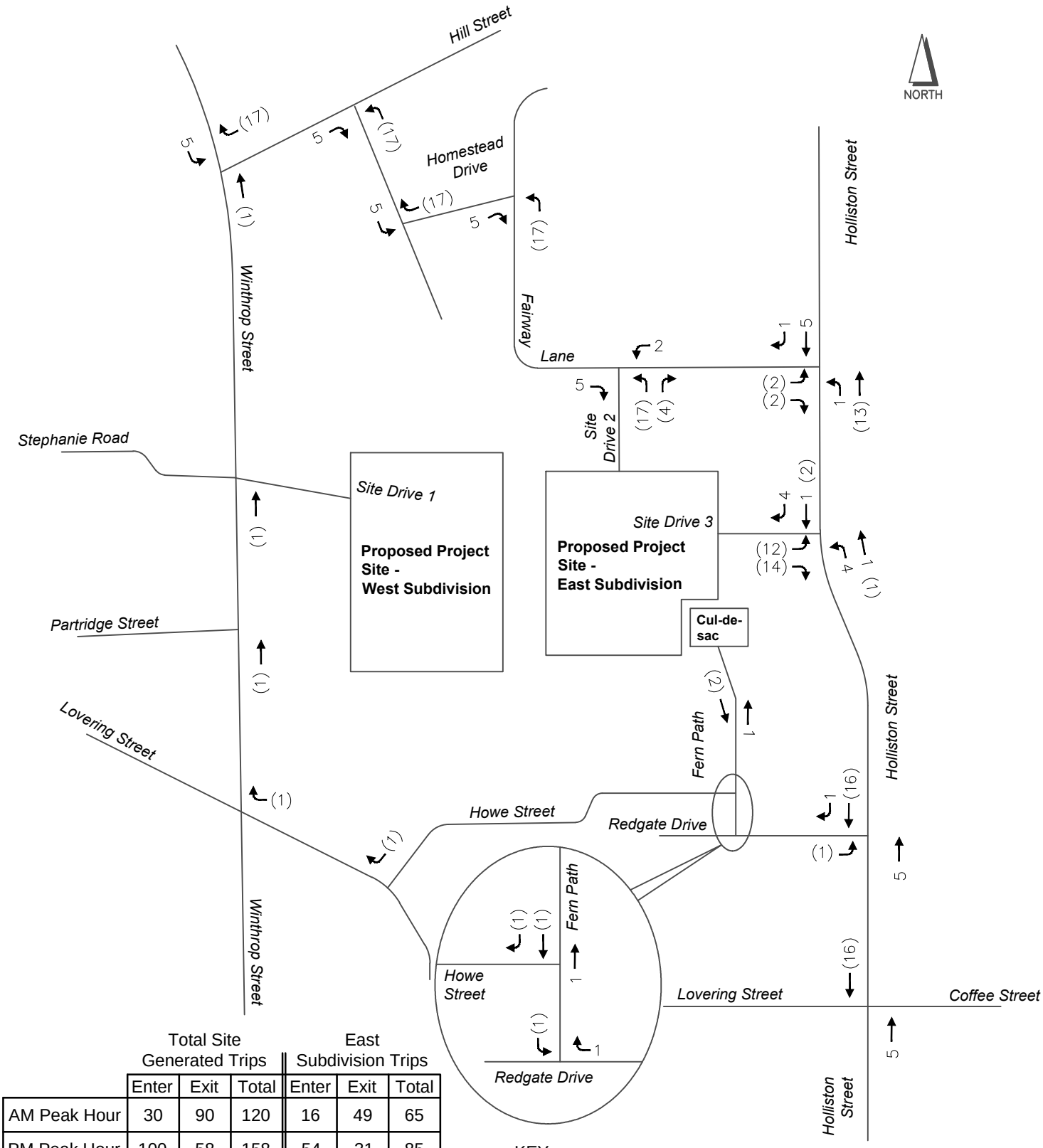
FIGURE 7
Trip Distribution - West Subdivision
Timber Crest Estates
Medway, Massachusetts



	Total Site Generated Trips			East Subdivision Trips		
	Enter	Exit	Total	Enter	Exit	Total
AM Peak Hour	30	90	120	16	49	65
PM Peak Hour	100	58	158	54	31	85

Note: includes both portions of development

KEY:
ENTERING (EXITING) SPLITS

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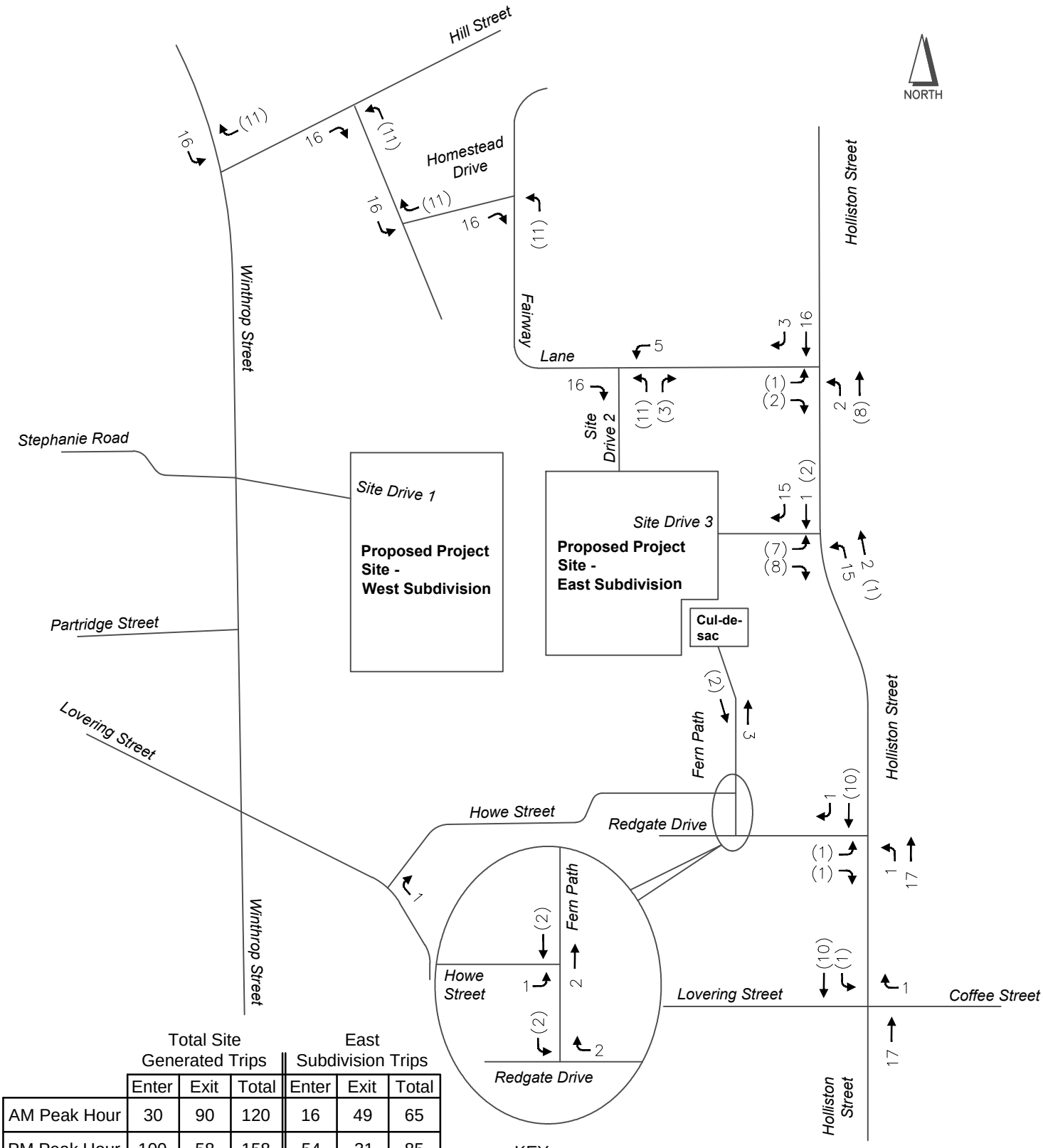
FIGURE 8
Site-Generated Vehicle Trips East Subdivision AM Peak Hour
Timber Crest Estates
Medway, Massachusetts



	Total Site Generated Trips			East Subdivision Trips		
	Enter	Exit	Total	Enter	Exit	Total
AM Peak Hour	30	90	120	16	49	65
PM Peak Hour	100	58	158	54	31	85

Note: includes both portions of development

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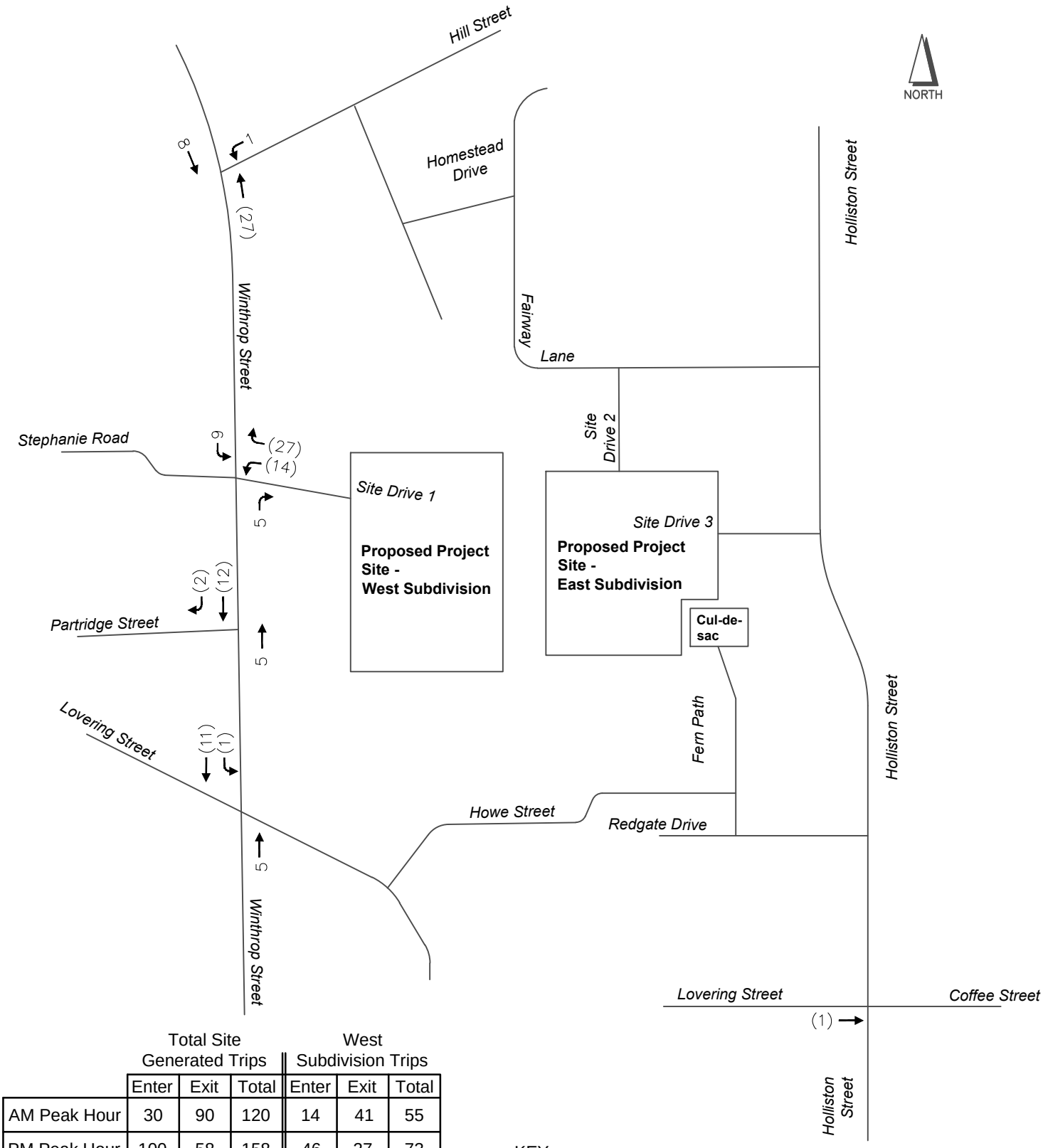
FIGURE 9
Site-Generated Vehicle Trips East Subdivision PM Peak Hour
Timber Crest Estates
Medway, Massachusetts



	Total Site Generated Trips			West Subdivision Trips		
	Enter	Exit	Total	Enter	Exit	Total
AM Peak Hour	30	90	120	14	41	55
PM Peak Hour	100	58	158	46	27	73

Note: includes both portions of development

KEY:
ENTERING (EXITING) SPLITS

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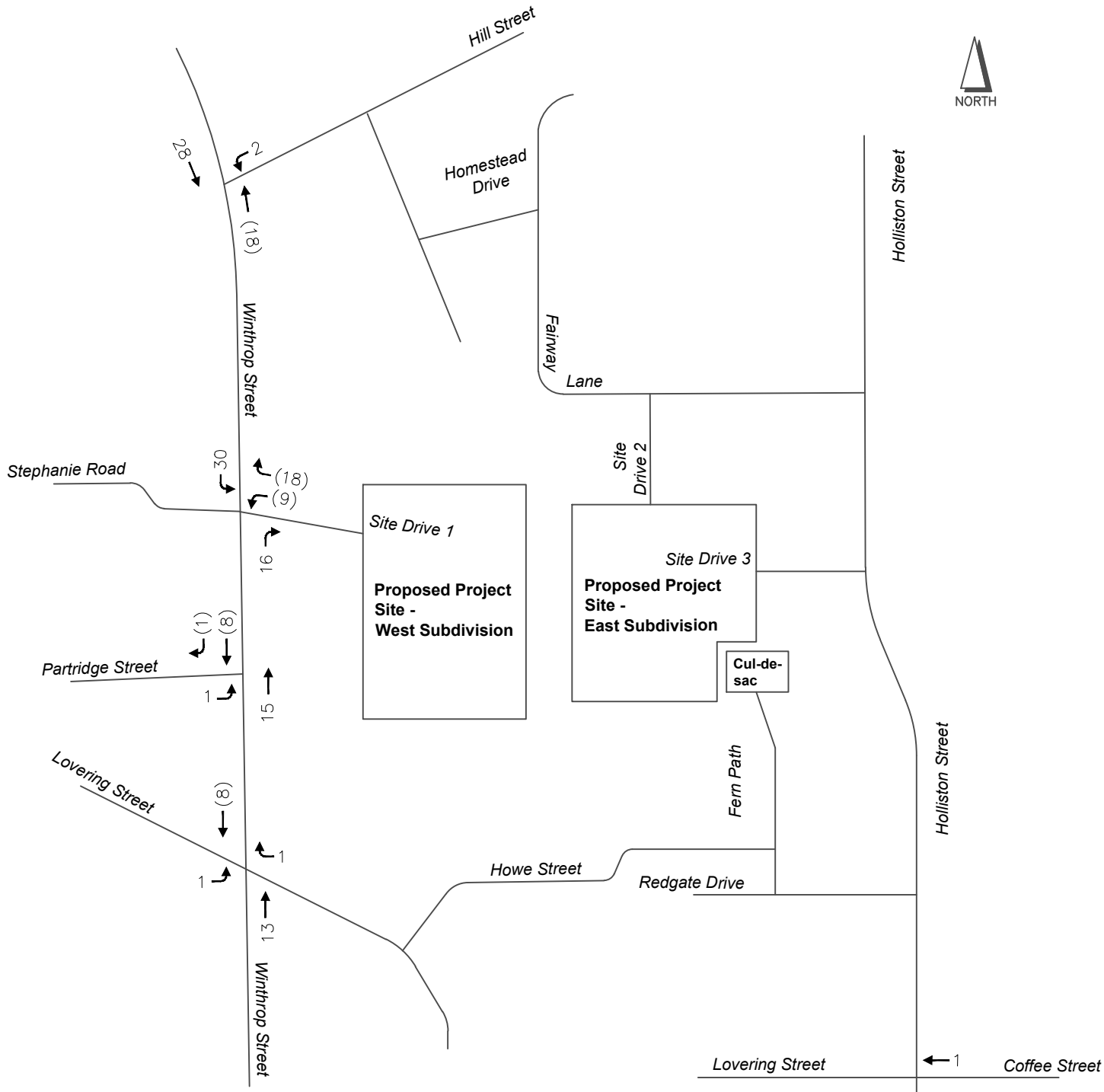
FIGURE 10
Site-Generated Vehicle Trips West Subdivision AM Peak Hour
Timber Crest Estates
Medway, Massachusetts



	Total Site Generated Trips			West Subdivision Trips		
	Enter	Exit	Total	Enter	Exit	Total
AM Peak Hour	30	90	120	14	41	55
PM Peak Hour	100	58	158	46	27	73

Note: includes both portions of development

KEY:
ENTERING (EXITING) SPLITS

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FIGURE 11
Site-Generated Vehicle Trips West Subdivision PM Peak Hour
Timber Crest Estates
Medway, Massachusetts

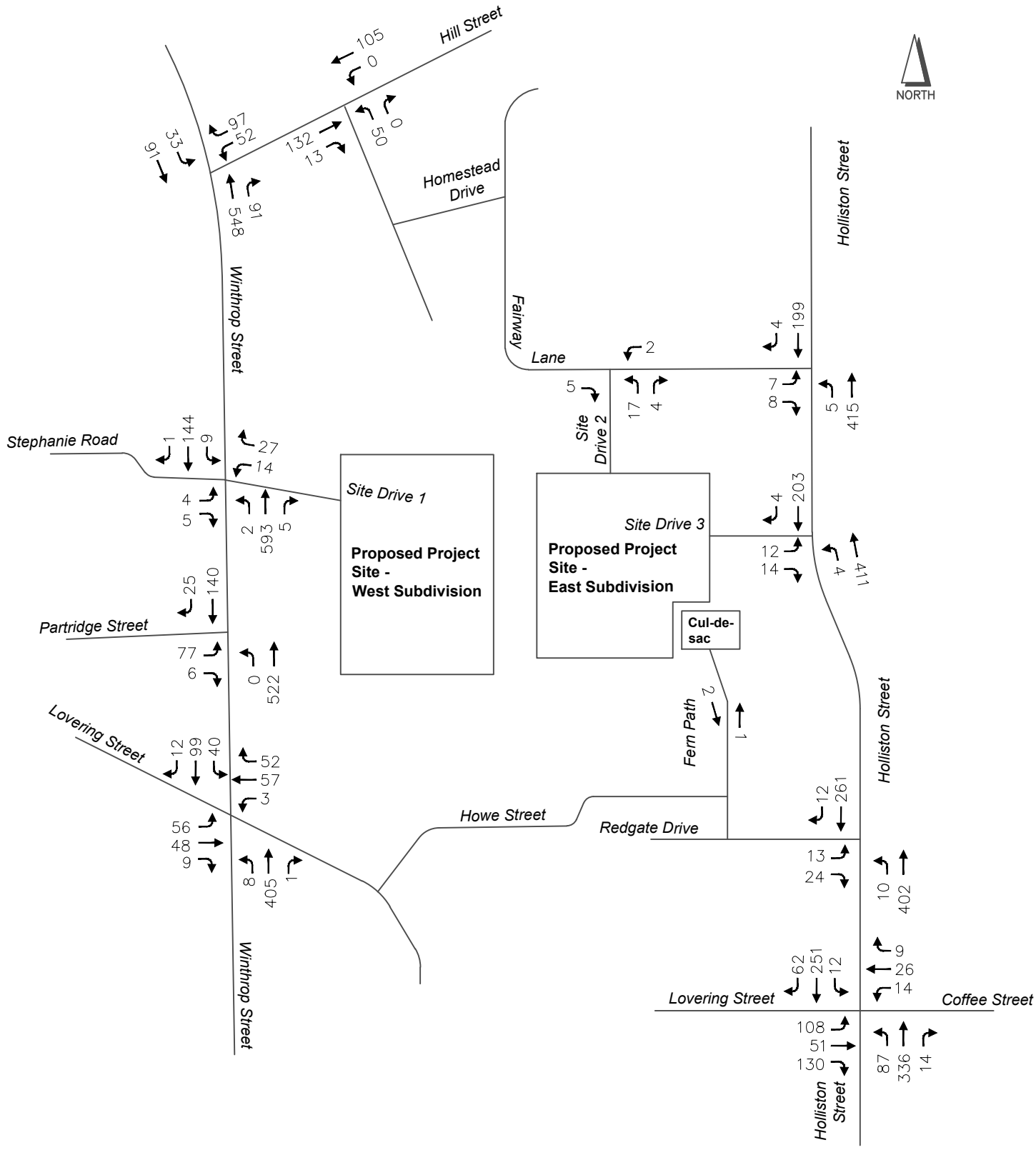

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FIGURE 12
2023 Build Weekday AM Peak Hour Traffic Volumes
Timber Crest Estates
Medway, Massachusetts

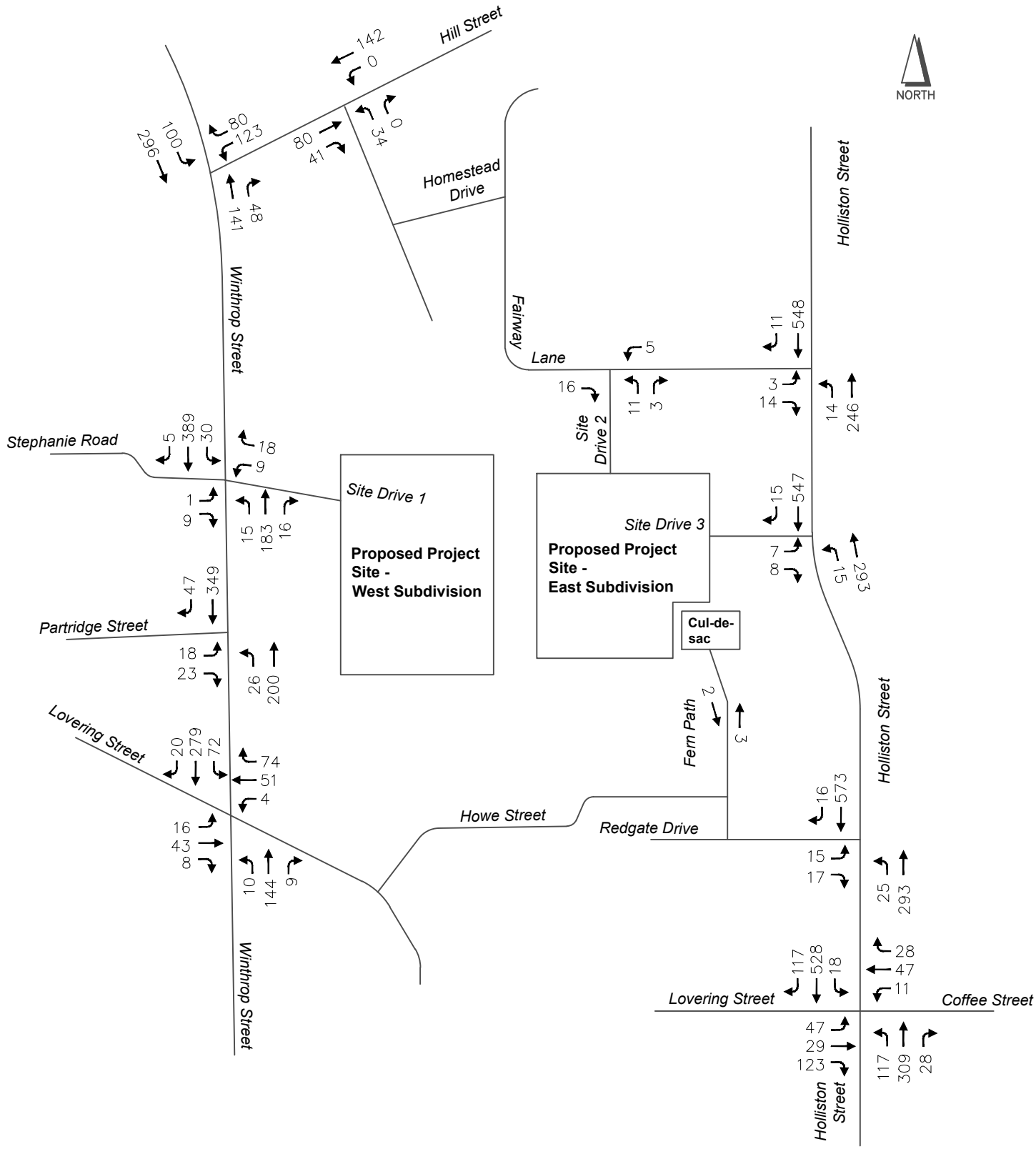

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FIGURE 13
2023 Build Weekday PM Peak Hour Traffic Volumes
Timber Crest Estates
Medway, Massachusetts

4.0 Analysis

Previous sections of this report described the current conditions of the updated study intersections and the revised development of the 2023 No-Build and 2023 Build traffic volume networks, including the site-generated trip forecasts. Included in this section is an examination of the volume changes, intersection capacity analyses for the study intersections and an analysis of available sight distances.

4.1 Traffic Volume Increases

A comparison of No-Build and Build volumes on the surrounding roadway system was completed. The proposed development based on the LUC 210 and 230 model is expected to generate a total of 1,590 additional vehicle trips over the course of an average weekday. The weekday morning peak hour is expected to generate a total of 120 trips, and the weekday afternoon peak hour is expected to generate 158 added total trips. Table 4.1 summarizes the changes in traffic volumes expected to occur on the roadway network from the No-Build to the Build conditions.

Table 4.1 - Summary of Estimated Roadway Traffic Increases

	AM Peak Hour			PM Peak Hour		
	No-Build	Build	% Increase	No-Build	Build	% Increase
Winthrop Street						
North of Hill Street	711	769	8.2%	544	617	13.4%
South of Stephanie Road	743	763	2.7%	596	621	4.2%
Holliston Street						
North of Fairway Lane	604	625	3.5%	780	808	3.6%
South of Redgate Drive	676	697	3.1%	879	908	3.3%

As indicated on Table 4.1, there is a relatively low increase in traffic volume due to the proposed project. Volumes on Holliston Street are expected to increase by less than three percent between the No-Build and Build scenarios during either peak hour. The largest estimated increase in traffic occurs on Winthrop Street north of Hill Street, up to 13.4% during the weekday PM peak hour. Compared to the expected 2023 No-Build traffic volumes, the traffic volumes increase on any other roadway segment is less than eight percent during either weekday peak hour.

4.2 Intersection Capacity Analysis

The study intersections were examined or re-examined with regard to flow rates, capacity and delay characteristics to determine the Level of Service (LOS), using the methodology defined in the Highway Capacity Manual (HCM)[4] for the existing and future (No-Build and Build) traffic conditions. Level of Service is an indicator of operating conditions which occur on a given roadway feature while accommodating varying levels of traffic volumes. It is a qualitative measure that accounts for a number of operational factors including roadway geometry, speed, traffic composition, peak hour factors, travel delay, freedom to maneuver and driver expectation. When all of these measures are assessed and a

[4] Transportation Research Board, of the National Academies, Highway Capacity Manual 2010, Washington, D.C., 2010.

Level of Service is assigned to a roadway or intersection, it is equivalent to presenting an "index" to the operational qualities of the section under study. Level of Service is classified into six levels that are designated 'A' through 'F' based on the control delay ranges they fall under. Additionally, a movement with a volume-to-capacity (v/c) ratio of over 1.00 also has a LOS of 'F', regardless of delay. These are presented in Table 4.2 for both signalized and unsignalized intersections.

In practice, any given roadway/intersection may operate at a wide LOS range depending upon time of day, day of week or period of year. It should be noted that for unsignalized intersections, the Level of Service is not computed for the intersection as a whole. Instead, the level of service is determined by the computed or measured control delay for each individual critical movement (typically the side street movements).

Table 4.2 - Level of Service Criteria for Unsignalized Intersections

Level of Service	Unsignalized Intersections Control Delay Range (sec)
A	<= 10
B	> 10 and <= 15
C	> 15 and <= 25
D	> 25 and <= 35
E	> 35 and <= 50
F	> 50 or v/c > 1.00

The study intersections were evaluated using the Synchro 9 computer software to complete the analysis for the unsignalized study intersections. Using existing roadway features and the intersection controls, traffic operations at the study intersections were evaluated for existing as well as future conditions. Analysis results are presented in Table 4.3 and Table 4.4 for the study intersections for the morning and afternoon peak hour, respectively.

The Level of Service analysis indicated the following:

Existing Conditions:

- With the exception of Holliston Street at Lovering Street and Coffee Street, all study intersections operate well during the peak hours, with each approach at a LOS 'C' or better.
- The analysis showed that at the intersection at Holliston Street, the Coffee Street and left/through Lovering Street, the overall minor street approaches experience moderate to relatively long delays (LOS 'D' or worse) during the peak hours. However, field observations indicate that actual vehicle delays at this intersection are not as high as the calculated analyses predict.
- The analyses showed that all approaches to the study intersections, apart from the Holliston Street / Lovering Street / Coffee Street intersection, experience at most, a 95th percentile queue length of 65 feet, or less than three vehicle lengths, during the weekday peak hours.

Table 4.3 - Summary of Intersection Capacity Analysis - Weekday Morning Peak Hour

	Existing Conditions				2023 Future No-Build Conditions				2023 Future Build Conditions			
	v/c	Delay	LOS	95th % Queue (ft.)	v/c	Delay	LOS	95th % Queue (ft.)	v/c	Delay	LOS	95th % Queue (ft.)
Winthrop Street at Hill Street												
Hill Street WB	0.28	15.5	C	28	0.33	17.5	C	35	0.39	19.2	C	45
Winthrop Street SB	0.03	3.1	A	3	0.03	2.3	A	3	0.04	2.4	A	3
Hill Street at Cider Mill Road												
Cider Mill Road NB	0.04	10.0	B	3	0.05	10.2	B	5	0.08	10.6	B	8
Hill Street WB	-	0.0	A	0	-	0.0	A	0	-	0.0	A	0
Winthrop Street at Stephanie Road												
Winthrop Street NB	0.00	0.0	A	0	0.00	0.0	A	0	0.00	0.0	A	0
Stephanie Road EB	0.02	12.5	B	3	0.02	12.5	B	3	0.03	14.3	B	3
Site Drive 1 WB	-	-	-	-	-	-	-	-	0.12	16.2	C	10
Winthrop Street SB	0.00	0.0	A	0	0.00	0.0	A	0	0.01	0.5	A	0
Winthrop Street at Partridge Street												
Partridge Street EB	0.12	13.9	B	10	0.27	19.2	C	28	0.24	17.2	C	23
Winthrop Street NB	0.00	0.0	A	0	0.00	0.0	A	0	0.00	0.0	A	0
Winthrop Street at Lovering Street												
Winthrop Street NB	0.01	0.1	A	0	0.01	0.1	A	0	0.01	0.1	A	0
Lovering Street EB	0.31	18.9	C	33	0.38	22.5	C	43	0.39	23.4	C	45
Lovering Street WB	0.23	14.6	B	23	0.27	16.1	C	28	0.28	16.4	C	28
Winthrop Street SB	0.03	2.5	A	3	0.04	2.4	A	3	0.04	2.2	A	3
Holliston Street at Fairway Lane												
Fairway Lane EB	0.02	11.1	B	3	0.02	11.5	B	3	0.03	11.8	B	3
Holliston Street NB	0.00	0.1	A	0	0.00	0.1	A	0	0.00	0.1	A	0
Holliston Street at Site Drive 3												
Holliston Street NB	-	-	-	-	-	-	-	-	0.00	0.1	A	0
Site Drive 3 EB	-	-	-	-	-	-	-	-	0.05	11.7	B	3
Holliston Street at Redgate Drive												
Redgate Drive EB	0.07	11.6	B	10	0.08	12.1	B	10	0.08	12.5	B	8
Holliston Street NB	0.01	0.2	A	0	0.01	0.2	A	0	0.01	0.1	A	0
Holliston Street at Lovering Street at Coffee Street												
Holliston Street NB	0.08	1.7	A	8	0.09	1.7	A	8	0.09	1.7	A	8
Lovering Street EBL	0.76	57.2	F	133	0.94	98.1	F	190	0.99	113.9	F	208
Lovering Street EBR	0.19	10.9	B	18	0.21	11.3	B	20	0.22	11.5	B	20
Coffee Street WB	0.23	24.8	C	20	0.29	29.8	D	28	0.03	31.6	D	30
Holliston Street SB	0.01	0.3	A	0	0.01	0.3	A	0	0.01	0.3	A	0

Table 4.4 - Summary of Intersection Capacity Analysis - Weekday Afternoon Peak Hour

	Existing Conditions				2023 Future No-Build Conditions				2023 Future Build Conditions			
	v/c	Delay	LOS	95th % Queue (ft.)	v/c	Delay	LOS	95th % Queue (ft.)	v/c	Delay	LOS	95th % Queue (ft.)
Winthrop Street at Hill Street												
Hill Street WB	0.40	16.4	C	48	0.47	18.6	C	63	0.55	23.1	C	83
Winthrop Street SB	0.07	1.9	A	5	0.07	1.9	A	5	0.09	2.0	A	8
Hill Street at Cider Mill Road												
Cider Mill Road NB	0.03	10.0	B	3	0.04	10.1	B	3	0.05	10.2	B	5
Hill Street WB	-	0.0	A	0	-	0.0	A	0	-	0.0	A	0
Winthrop Street at Stephanie Road												
Winthrop Street NB	0.02	0.7	A	0	0.02	0.6	A	3	0.02	0.6	A	3
Stephanie Road EB	0.02	11.1	B	3	0.02	11.5	B	3	0.02	11.8	B	3
Site Drive 1 WB	-	-	-	-	-	-	-	-	0.06	12.6	B	5
Winthrop Street SB	0.00	0.0	A	0	0.00	0.0	A	0	0.02	0.6	A	3
Winthrop Street at Partridge Street												
Partridge Street EB	0.08	12.3	B	8	0.10	13.0	B	8	0.10	13.2	B	8
Winthrop Street NB	0.03	1.0	A	3	0.03	1.0	A	3	0.03	1.0	A	5
Winthrop Street at Lovering Street												
Winthrop Street NB	0.01	0.5	A	0	0.01	0.5	A	0	0.01	0.5	A	0
Lovering Street EB	0.19	16.4	C	18	0.22	18.2	C	20	0.24	19.1	C	23
Lovering Street WB	0.25	13.3	B	25	0.28	14.4	B	30	0.29	14.7	B	30
Winthrop Street SB	0.06	1.6	A	5	0.06	1.5	A	5	0.06	1.5	A	5
Holliston Street at Fairway Lane												
Fairway Lane EB	0.03	12.5	B	3	0.04	13.6	B	3	0.04	13.7	B	3
Holliston Street NB	0.01	0.4	A	0	0.01	0.4	A	0	0.02	0.5	A	0
Holliston Street at Site Drive 3												
Holliston Street NB	-	-	-	-	-	-	-	-	0.02	0.4	A	3
Site Drive 3 EB	-	-	-	-	-	-	-	-	0.04	14.9	B	3
Holliston Street at Redgate Drive												
Redgate Drive EB	0.09	15.8	C	8	0.11	17.8	C	10	0.03	18.1	C	10
Holliston Street NB	0.03	0.7	A	3	0.03	0.7	A	3	0.12	0.7	A	3
Holliston Street at Lovering Street at Coffee Street												
Holliston Street NB	0.13	2.6	A	10	0.14	2.6	A	13	0.14	2.5	A	13
Lovering Street EBL	0.61	70.5	F	80	0.91	> 120	F	128	0.99	> 120	F	140
Lovering Street EBR	0.24	14.0	B	23	0.28	15.4	C	28	0.29	15.7	C	30
Coffee Street WB	0.45	38.3	E	53	0.62	63.0	F	85	0.67	71.3	F	93
Holliston Street SB	0.01	0.2	A	0	0.02	0.2	A	0	0.02	0.2	A	3

Future No-Build Conditions:

- Under the future No-Build conditions, all study intersections are predicted to operate similarly to the current conditions and no new deficiencies were noted.

Future Build Conditions:

- The analyses showed that all intersections will continue to operate well during the peak hours, with each approach remaining at LOS 'C' or better except for the Coffee Street and Lovering Street approaches at their intersection with Holliston Street.
- The addition of the project-generated traffic is not expected to significantly affect conditions at this or the other study intersections.
- The 95th-percentile vehicle queue lengths at all the study area intersections are estimated to increase in general by less than 15 feet between the No-Build and Build scenarios.
- Site traffic will be able to efficiently enter and exit the development at each of the proposed site drives with LOS 'B' or 'C' estimated depending on the location and/or peak hour.

In summary, the analysis has shown that the abutting roadway network will facilitate motorists related to the proposed development project to enter and exit the site in a safe and effective manner, with manageable delays experienced by the motorists.

4.3 Sight Distance Analysis

Adequate sight distance is an important safety consideration at intersections. Sight distances were reviewed at each of the three proposed site drive locations. Stopping sight distance (SSD) is the distance required for an approaching driver (with an eye height of 3.5 feet) to perceive and stop in time to avoid a collision with an object 2 feet high in the roadway. The values are based on a perception and reaction time of 2.5 seconds and braking distance required under wet, level pavements. Corner or intersection sight distance (ISD) is based upon the time required to perceive, react, and complete desired exiting maneuver from a driveway once the driver decides to execute the maneuver. Adjustments for the grade of the roadway are applied to both SSD and ISD.

Values for ISD represent the time to (1) turn left or right, in addition to accelerating to the operating speed of the roadway, without causing approaching vehicles to reduce speed by more than 10 mph, and (2) upon turning left, to clear the near half of the intersection without conflicting with the vehicles approaching from the left. ISD is more related to operations and to some degree, the convenience or inconvenience of oncoming motorists. The minimum criteria are defined by the American Association of State and Highway and Transportation Officials (AASHTO)[5]. SSD relates specifically to safety. As indicated by AASHTO, <u>if the available ISD meets or exceeds the minimum SSD criteria, then there is adequate safe sight distance available for motorists to avoid collisions.</u> A criterion for calculating minimum required sight distances can be established based on operating speed, the speed at or under which most motorists (85th-percentile) actually travel along a particular portion of roadway.

The posted speed limit on Winthrop Street and Holliston Street is 35 miles per hour (mph) in the vicinity of the project site. However, travel speeds on Winthrop Street between Partridge Street and Stephanie Road and on Holliston Street north of Redgate Road were each observed to be approximately 45 mph in each travel direction. Travel speeds on Fairway Lane west of Holliston Street were observed to be about 30-35 mph in each travel direction while there is a posted speed limit in the vicinity of the site drive location is 20 mph. Analysis was done for both posted and 85th-percentile speeds for these locations.

5 American Association of State Highway and Transportation Officials (AASHTO), <u>A Policy on Geometric Design of Highways and Streets</u>, Washington, D.C., 2011.

The SSD and ISD were measured in the field and compared to minimum and desirable distances; Tables 4.5 and 4.6 summarize the results of the evaluation with respect to posted speed limits and 85th-percentile travel speeds, respectively. Most of the sight distances within the study area exceed the minimum required distances as defined per AASHTO standards for posted speed limits. Based on the posted speed limits, the minimum SSD requirements will be satisfied for all locations. However, while the ISDs for left-turning drivers generally exceeded the minimum distances, there were a number of locations found to be less than the higher, desirable distances for the posted speed limit at the site drive intersections.

ISD is limited on the exit of Fairway Lane at its intersection with Holliston Street looking to the right under the criteria for the posted and 85th-percentile speeds and estimated looking to the left for the 85th-percentile speed. Similarly, ISD looking left from the proposed Site Drive 3 location at #165 Holliston Street would meet the minimum AASHTO requirements for the posted speed limit with proper driveway construction and some clearing and re-grading the roadside along the west side of Holliston Street. Although desirable ISD was not met for the posted speed limit for drivers looking out of the location of Site Drive 1 at Winthrop Street, when this area is constructed the associated vegetation clearing would improve ISD at this location.

In vicinity of the proposed Site Drive 3 (#165 Holliston Street), and to the extent allowable in the right-of-way in front of #167 through #171 to maintain stable terrain, the back slope along the west side of Holliston Street should be graded to be more level to provide greater sight distance from the site driveway to Holliston Street. Right-of-way width between the edge of roadway and private property lines is generally eight feet or less in this area, so outside of the #165 property such slope enhancements may be limited. Reducing travel speeds would reduce the risks of impact along Holliston Street, and is further described in the Conclusions and Recommendations section of this report.

Looking to the left (north) from the proposed Site Drive 3 at #165 Holliston Street. ISD is restricted by the back slope adjacent to the roadway and the vertical crest and sag curves between Fairway Lane and #165.

Looking south along Holliston Street facing Fairway Lane. Fairway Lane intersects Holliston Street along a vertical sag curve that is immediately north of a vertical crest curve.

Construction of future site drives (such as opposite of Stephanie Drive) would entail vegetation clearing and so it is anticipated that ISD at the proposed site drives would also be met or significantly improved after construction.

SSD on the basis of posted speed limits was met at all locations; however, along the northbound approach of Holliston Street at its intersection with Fairway Lane, SSD and on Holliston Street in the southbound direction at the location of Site Drive 3 were found to be insufficient based upon the 85th-percentile speed. Between these points there is a vertical sag curve immediately north of a vertical crest curve. It should be noted that the 85th-percentile speeds on Holliston Street are generally in the range of 5-10 mph above the posted speed limit.

Table 4.5 - Summary of Sight Distance Analysis – Posted Speed Limit

Location	Sight Distance				
	Measured (ft)	Minimum Required (ft)	Met?	Desirable (ft)	Met?
Stopping Sight Distance					
Proposed Site Drive 1 at Winthrop Street (35 mph)					
Winthrop Street Northbound	> 500	250	Yes	-	-
Winthrop Street Southbound	440	270[a]	Yes	-	-
Proposed Site Drive 2 at Fairway Lane (20 mph)					
Fairway Lane Eastbound	> 500	125	Yes	-	-
Fairway Lane Westbound	> 500	125	Yes	-	-
Intersection of Holliston Street/Fairway Lane (35 mph)					
Holliston Street Northbound	275	275[b]	Yes	-	-
Holliston Street Southbound	> 500	235[c]	Yes	-	-
Intersection of Holliston Street/Site Drive 3 (35 mph)					
Holliston Street Northbound	> 500	250	Yes	-	-
Holliston Street Southbound	340	250	Yes	-	-
Intersection Sight Distance					
Proposed Site Drive 1 at Winthrop Street (35 mph)					
Vehicles exiting the Site Drive, looking north	420	270[a]	Yes	425[a]	No
Vehicles exiting the Site Drive, looking south	460	240	Yes	390	Yes
Proposed Site Drive 2 at Fairway Lane (20 mph)					
Vehicles exiting the Site Drive, looking east	> 500	125	Yes	195	Yes
Vehicles exiting the Site Drive, looking west	> 500	125	Yes	225	Yes
Intersection of Holliston Street/Fairway Lane (35 mph)					
Vehicles exiting Fairway Lane, looking south	275	275[b]	Yes	405[b]	No**
Vehicles exiting Fairway Lane, looking north	420	235[c]	Yes	340[c]	Yes
Intersection of Holliston Street/Site Drive 3 (35 mph)					
Vehicles exiting the Site Drive, looking south	> 500	250	Yes	390	Yes
Vehicles exiting the Site Drive, looking north	400*	250	Yes	390	Yes*

Notes: a – Calculated assuming a downslope of 5.0 percent
b – Calculated assuming a downslope of 6.5 percent
c – Calculated assuming an upslope of 4.0 percent

* - with appropriate driveway construction and the roadside slope between the site drive and crest of hill cleared and re-graded to road surface grade.

** - available distances can be increased with the clearing and re-grading of roadside between Fairway Lane and crest of hill to the south.

Table 4.6 - Summary of Sight Distance Analysis – Based on 85th-Percentile Travel Speeds

Location	Sight Distance				
	Measured (ft)	Minimum Required (ft)	Met?	Desirable (ft)	Met?
Stopping Sight Distance					
Proposed Site Drive 1 at Winthrop Street (45 mph)					
Winthrop Street Northbound	> 500	350	Yes	-	-
Winthrop Street Southbound	440	395[a]	Yes	-	-
Proposed Site Drive 2 at Fairway Lane (35 mph)					
Fairway Lane Eastbound	> 500	250	Yes	-	-
Fairway Lane Westbound	> 500	250	Yes	-	-
Intersection of Holliston Street/Fairway Lane (45 mph)					
Holliston Street Northbound	275	405[b]	No	-	-
Holliston Street Southbound	> 500	340[c]	Yes	-	-
Intersection of Holliston Street/Site Drive 3 (45 mph)					
Holliston Street Northbound	> 500	360	Yes	-	-
Holliston Street Southbound	340	360	No	-	-
Intersection Sight Distance					
Proposed Site Drive 1 at Winthrop Street (45 mph)					
Vehicles exiting the Site Drive, looking north	420	395[a]	Yes	550[a]	No
Vehicles exiting the Site Drive, looking south	460	370	Yes	500	No
Proposed Site Drive 2 at Fairway Lane (35 mph)					
Vehicles exiting the Site Drive, looking east	> 500	250	Yes	335	Yes
Vehicles exiting the Site Drive, looking west	> 500	250	Yes	390	Yes
Intersection of Holliston Street/Fairway Lane (45 mph)					
Vehicles exiting Fairway Lane, looking south	275	405[b]	No**	550[b]	No**
Vehicles exiting Fairway Lane, looking north	420	340[c]	Yes	450[c]	No
Intersection of Holliston Street/Site Drive 3 (45 mph)					
Vehicles exiting the Site Drive, looking south	> 500	360	Yes	500	Yes
Vehicles exiting the Site Drive, looking north	400*	360	No	500	No

Notes: a – Calculated assuming a downslope of 5.0 percent
b – Calculated assuming a downslope of 6.5 percent
c– Calculated assuming an upslope of 4.0 percent

* - with appropriate driveway construction and the roadside slope between the site drive and crest of hill cleared and re-graded to road surface grade.

** - available distances can be increased with the clearing and re-grading of roadside between Fairway Lane and crest of hill to the south.

5.0 Conclusions And Recommendations

The previous sections of this traffic report described the analysis procedures, assumptions and results of this traffic study. The analyses demonstrate that the roadways and intersections within the study area are able to accommodate the additional traffic associated with the proposed development project, although considering the crash records and available sight distances some safety improvements should be implemented on the surrounding roadways. The following summarizes the traffic analysis:

The analyses demonstrate that the roadways and intersections within the study area are able to accommodate the additional traffic associated with the proposed development project, although considering the crash records and available sight distances some safety improvements should be implemented on the surrounding roadways. The following summarizes the traffic analysis:

- The major streets of Winthrop Street and Holliston Street within this area are two lane urban minor arterial roads. The roadway network has and will have the capacity to accommodate additional peak vehicular demands.
- The proposed development project is expected to generate a total of 120 and 158 additional vehicle-trips during the weekday morning and afternoon peak hours, respectively, and 1,590 vehicle-trips during an average weekday. The predominant flow in the weekday morning peak period is expected to be exiting trips. During the afternoon peak period, the predominant direction of new traffic is expected to be entering vehicles.
- Traffic is expected to disperse with two separate development sites and a total of three driveways and a cul-de-sac extension of Fern Path.
- With the full occupancy of the proposed development project, motorists using the neighborhood roadways as well as Winthrop Street and Holliston Street will continue to experience relatively short delays during the weekday peak hours.
- The minimum safe stopping sight distance criteria are exceeded at all locations for posted speeds. While the minimum intersection sight distances are satisfied, the desired ISD criteria is also satisfied at most of the locations. Those sightlines that have some degree of limitation can be improved by taking certain remedial actions as discussed below. The ISD is restricted along Holliston Street due to vertical and roadside geometry, while ISD at the other two locations is limited by vegetation.

Recommendations

While the analyses show that the proposed project can be expected to be safely accommodated on the study area network, several recommendations have been made to enhance the project's access and the overall traffic flow in the project area. As noted, a number of these actions are designed to improve overall traffic safety along the public ways and are not necessarily required as part of the proposed development. Additionally, Figure 14 depicts recommended changes that should be pursued along Holliston Street. The proposed actions are as follows:

- Each of the proposed site drive approaches to the major roadways should be STOP sign controlled with sign and markings as appropriate.
- Any proposed landscaping and signage should be low enough and/or set back sufficiently so as not to create any sight distance constraints at the proposed site drives.
- The roadside back slope along the west side of Holliston Street north of the proposed site drive should be graded to be more level with the roadway surface to provide greater sight distance from

the site driveway to Holliston Street. The re-grading and leveling should occur, at a minimum, in vicinity of the proposed Site Drive 3 (#165 Holliston Street) and north to the extent feasible in the right-of-way in front of #167 through #171 to maintain stable terrain. Ideally, the width of the leveling out would be in the range of 3 to 4 feet minimum. An added benefit of this action is that it would provide a safe area for any pedestrians walking along Holliston Street to remain out of the vehicle path. Diagrams illustrating these areas and sight triangles are in the Appendix.

- Regardless of whether the proposed project is approved or not, the roadside vegetation within the public rights-of-way on all major streets should be trimmed and/or cleared sufficiently, particularly in the vicinity of intersecting streets, to maintain and maximize sight distances. With regard to the proposed site drives, sight line triangles can be drawn on the site plans to demarcate the area within the intersection that landscape and signage would remain low-lying and set back to avoid creating visibility conflicts.
- Consideration should be given to installing intersection warning signs along Holliston Street approaching both Fairway Lane (in both directions) and the new proposed site driveway approaching from the north.
- A cross road warning sign (W2-1) on Winthrop Street north and south of the intersection of Lovering Street. Considering that the town installed on the Lovering Street approaches flashing STOP Ahead signs, the town may want to also consider equipping the cross road warning signs with flashing lights as well. The objective of these actions is to continue to increase awareness of this intersection to the motorists traveling along Winthrop Street.

- In an effort to encourage lower travel speeds, particularly on Holliston Street and Winthrop Street, without simply relying on enforcement, the town should consider increased use of the solar powered warning signs and speed monitoring display signs. While these actions should be considered by the town regardless of this proposed project, it may be possible for the Applicant to work with the town and participate by implementing a portion of this program. If agreeable, it is recommended that a permanently-mounted solar-powered speed monitoring feedback display signs with a speed limit sign be installed on Holliston Street as part of this development project. While two locations for these signs may be reasonable in the long range, it is currently recommended that one be installed in the vicinity of the Veterans of Foreign Wars Post #1526 property in the northbound direction as part of the approved development project.
- It is also suggested that curve warning signs be installed on Holliston Street in the northbound and southbound directions where the horizontal alignment makes two noticeable horizontal changes. The exact location can be reviewed with the Town's public works and police departments but they are north of the VFW and south of the proposed project's site drive on Holliston Street.
- It is recommended that the signage along Holliston Street also include an advance intersection warning sign on the northbound and southbound approaches to Lovering Street.
- Crosswalks should be marked in standard form along Holliston Street with standard pedestrian crosswalk signs on both sides of the street.
- A final action to consider in enhancing safe movement of vehicles is that once the new driveways are installed on both Holliston Street and Winthrop Street, installing a roadway street light on the utility poles situated at or near the site drives should be considered.

GREEN INTERNATIONAL AFFILIATES, INC.
CIVIL AND STRUCTURAL ENGINEERS

SCALE IN FEET
0 240 600 1200 FEET
HORZ. 1"=600'

Figure 14: Conceptual Plan
Proposed Traffic Safety Improvements on Holliston Street
Timber Crest Estates, Medway, MA

Appendix

- Traffic Volume Data
- MassDOT Season Adjustment Factors and Historical Growth
- Crash Rate Calculations
- Transit Schedules and Fares
- Trip Generation Calculations
- Residence to Work Data
- Trip Distribution Calculations
- Intersection Capacity Analysis Worksheets
- Peer Review Comments
- Sight Distance Figures and Calculations
- Emergency Vehicle Turning Movement Figures