

January 28, 2015

Ms. Emilie A. Cademartori, Coordinator
Wenham Zoning Board of Appeals
Wenham Town Hall, 2nd Floor
138 Main Street
Wenham, MA 01938

Re: Response to Transportation Comments
Proposed Age-Restricted Residential Development – Maple Woods
62 Maple Street – Wenham, Massachusetts

Dear Ms. Cademartori:

MDM Transportation Consultants, Inc. (MDM) has developed the attached figures in response to the Zoning Board of Appeals' request for clarification on sight lines to and from the proposed site driveway on Maple Street. As can be seen in **Exhibits 1 through 4**, adequate Stopping Sight Distance (SSD) can be obtained for vehicles approaching the site driveway from the east and west and adequate Intersection Sight Distance (ISD) can be obtained for vehicles exiting the site driveway to the east and west. It should be noted that in order to achieve the recommended ISD to the west, selective trimming and/or clearing of trees and vegetation within the sight triangle is necessary. **Table 1** below summarizes the recommended sight distance per AASHTO guidelines¹ and the corresponding available sight distance as measured in the field. AASHTO guidelines are provided in the **Attachments**.

As indicated in **Table 1**, the available SSD approaching the proposed site driveway and the available ISD from the proposed driveway will meet or exceed AASHTO guidelines for the 85th percentile Maple Street travel speeds. With regards to Intersection Sight Distance, the minimum requirement, that is, the corresponding Stopping Sight Distance needed for below-average operators to have sufficient sight distance to anticipate and avoid collisions, is exceeded. In addition, the desirable sight distance, as stated by AASHTO, is the distance that provides "*sufficient time for the minor-road vehicle to accelerate from a stop and complete a left turn without unduly interfering with major-road traffic operations*", is met. As stated above, the measured ISD assumes clearing of trees and vegetation at the proposed site driveway.

¹ A Policy on Geometric Design of Highways and Streets, American Association of State Highway and Transportation Officials (AASHTO), 2011.

TABLE 1
SIGHT DISTANCE SUMMARY – Maple Street at Site Driveway

Location	Stopping Sight Distance (Feet)		Intersection Sight Distance (Feet)		
	Measured	Required for 40 MPH ^a	Measured	Minimum Required ^b	Desirable ^c
<i>West of Site Driveway</i>	720	305	445 ^d	305	445
<i>East of Site Driveway</i>	570	305	555	305	445

^a Values based on AASHTO guidelines for approximate 85th percentile travel speeds on Maple Street (40 Miles per hour).
^b The ISD must be equal to or greater than the required SSD in order to provide safe operations at the intersection.
^c To enhance traffic operations, ISD that exceed stopping sight distances are desirable along the major road. Values based on AASHTO guidelines for approximate 85th percentile travel speeds on Maple Street (40 Miles per hour).
^d Assumes trimming and/or clearing of trees and vegetation within the sight triangle during site development.

I trust this information will be useful in your continued review of the project. Please contact me with any questions.

Sincerely,

MDM TRANSPORTATION CONSULTANTS, INC.



Daniel J. Mills, P.E., PTOE
Principal

Attachments

cc: Andrew DeFranza – Harborlight Community Partners (via e-mail)
Theodore C. Regnante, Esq. and Paul J. Haverty, Esq. (via e-mail)

Attachments

- Sight Distance Exhibits 1 through 4
- AASHTO References

Stopping Sight Distance (Eastbound)



NOTES

1. BASED ON FIELD MEASUREMENTS CONDUCTED BY MDM ON JANUARY 22, 2015.
2. PROPOSED SITE DRIVE LOCATION IS APPROXIMATE BASED ON PLAN PROVIDED BY MERIDIAN ASSOCIATES.

MINIMUM STOPPING SIGHT DISTANCE (SSD)

85TH PERCENTILE SPEED ALONG MAPLE STREET = 40 MPH
 SSD (40 MPH) = 305 FT*
 *AASHTO EXHIBIT 3-1

Proposed Harborlight Residential Development
 Wenham, Massachusetts



Exhibit 1

MDM TRANSPORTATION CONSULTANTS, INC.
 Planners & Engineers

28 Lord Road, Suite 280
 Marlborough, MA 01752

Stopping Sight Distance (Westbound)



APPROACHING DRIVEWAY FROM EAST

NOTES	MINIMUM STOPPING SIGHT DISTANCE (SSD)
1. BASED ON FIELD MEASUREMENTS CONDUCTED BY MDM ON JANUARY 22, 2015.	85TH PERCENTILE SPEED ALONG MAPLE STREET = 40 MPH
2. PROPOSED SITE DRIVE LOCATION IS APPROXIMATE BASED ON PLAN PROVIDED BY MERIDIAN ASSOCIATES.	SSD (40 MPH) = 305 FT*
	*AASHTO EXHIBIT 3-1

Proposed Harborlight Residential Development
Wenham, Massachusetts

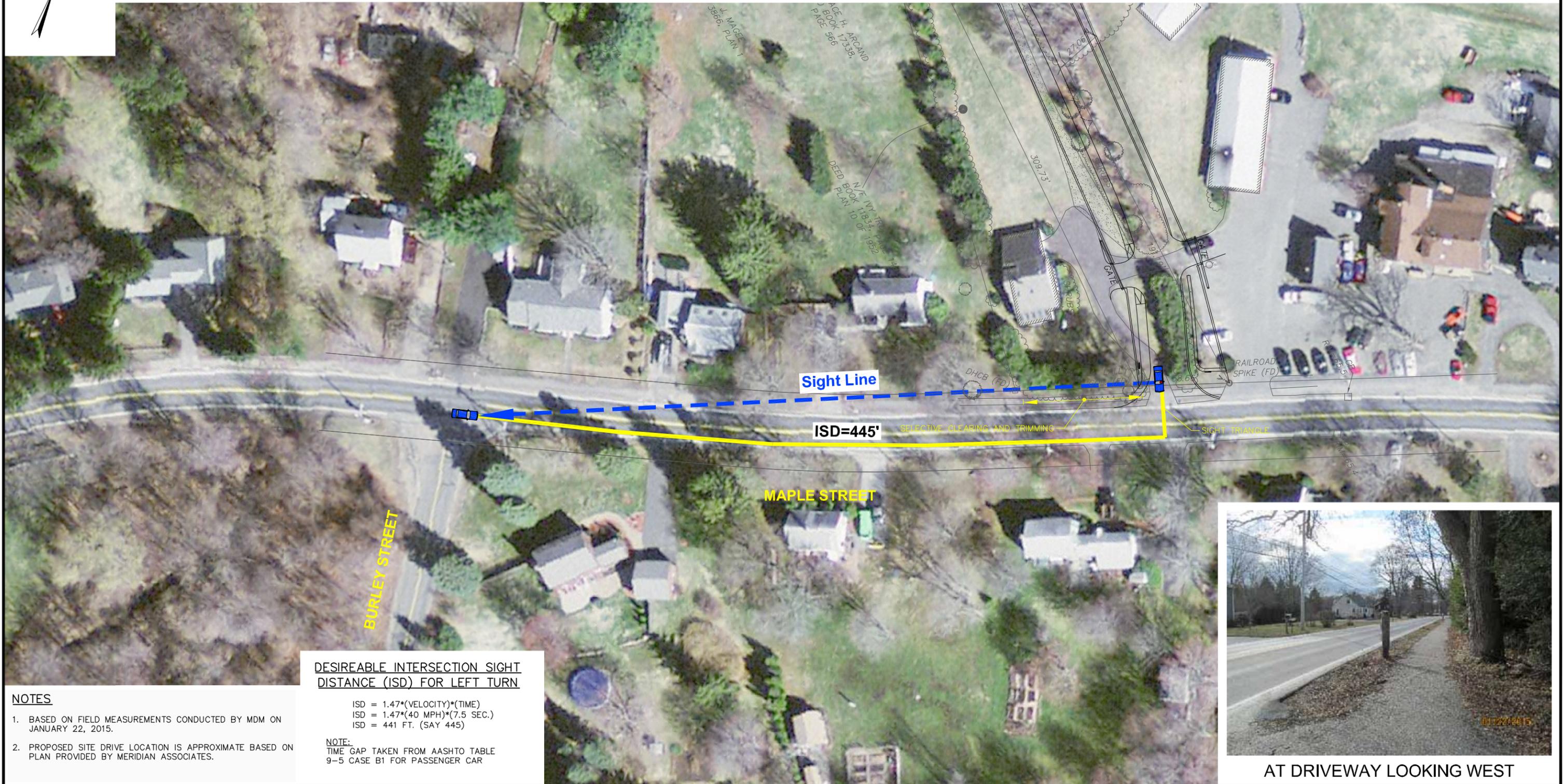


Exhibit 2

MDM TRANSPORTATION CONSULTANTS, INC.
Planners & Engineers

28 Lord Road, Suite 280
Marlborough, MA 01752

Intersection Sight Distance (Westbound View)



NOTES

1. BASED ON FIELD MEASUREMENTS CONDUCTED BY MDM ON JANUARY 22, 2015.
2. PROPOSED SITE DRIVE LOCATION IS APPROXIMATE BASED ON PLAN PROVIDED BY MERIDIAN ASSOCIATES.

DESIREABLE INTERSECTION SIGHT DISTANCE (ISD) FOR LEFT TURN

$$ISD = 1.47 * (VELOCITY) * (TIME)$$

$$ISD = 1.47 * (40 \text{ MPH}) * (7.5 \text{ SEC.})$$

$$ISD = 441 \text{ FT. (SAY 445)}$$

NOTE:
TIME GAP TAKEN FROM AASHTO TABLE
9-5 CASE B1 FOR PASSENGER CAR



AT DRIVEWAY LOOKING WEST

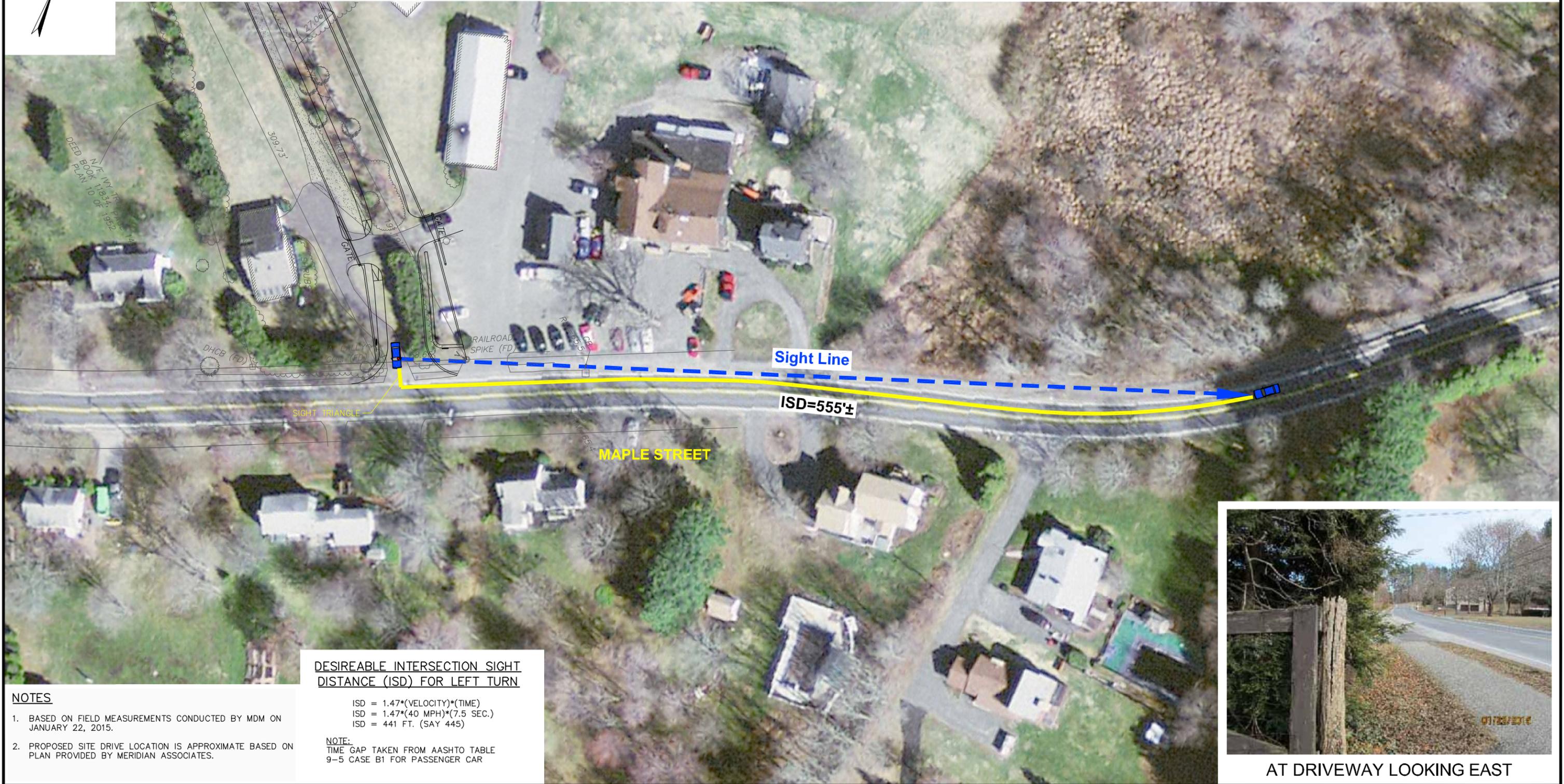
Proposed Harborlight Residential Development
Wenham, Massachusetts



Exhibit 3

MDM TRANSPORTATION CONSULTANTS, INC.
Planners & Engineers
28 Lord Road, Suite 280
Marlborough, MA 01752

Intersection Sight Distance (Eastbound View)



NOTES

1. BASED ON FIELD MEASUREMENTS CONDUCTED BY MDM ON JANUARY 22, 2015.
2. PROPOSED SITE DRIVE LOCATION IS APPROXIMATE BASED ON PLAN PROVIDED BY MERIDIAN ASSOCIATES.

DESIREABLE INTERSECTION SIGHT DISTANCE (ISD) FOR LEFT TURN

$$ISD = 1.47 * (VELOCITY) * (TIME)$$

$$ISD = 1.47 * (40 \text{ MPH}) * (7.5 \text{ SEC.})$$

$$ISD = 441 \text{ FT. (SAY 445)}$$

NOTE:
TIME GAP TAKEN FROM AASHTO TABLE
9-5 CASE B1 FOR PASSENGER CAR



AT DRIVEWAY LOOKING EAST

Proposed Harborlight Residential Development
Wenham, Massachusetts



Exhibit 4

MDM TRANSPORTATION CONSULTANTS, INC.
Planners & Engineers

28 Lord Road, Suite 280
Marlborough, MA 01752

Table 3-1. Stopping Sight Distance on Level Roadways

Metric					U.S. Customary				
Design Speed (km/h)	Brake Reaction Distance (m)	Braking Distance on Level (m)	Stopping Sight Distance		Design Speed (mph)	Brake Reaction Distance (ft)	Braking Distance on Level (ft)	Stopping Sight Distance	
			Calculated (m)	Design (m)				Calculated (ft)	Design (ft)
20	13.9	4.6	18.5	20	15	55.1	21.6	76.7	80
30	20.9	10.3	31.2	35	20	73.5	38.4	111.9	115
40	27.8	18.4	46.2	50	25	91.9	60.0	151.9	155
50	34.8	28.7	63.5	65	30	110.3	86.4	196.7	200
60	41.7	41.3	83.0	85	35	128.6	117.6	246.2	250
70	48.7	56.2	104.9	105	40	147.0	153.6	300.6	305
80	55.6	73.4	129.0	130	45	165.4	194.4	359.8	360
90	62.6	92.9	155.5	160	50	183.8	240.0	423.8	425
100	69.5	114.7	184.2	185	55	202.1	290.3	492.4	495
110	76.5	138.8	215.3	220	60	220.5	345.5	566.0	570
120	83.4	165.2	248.6	250	65	238.9	405.5	644.4	645
130	90.4	193.8	284.2	285	70	257.3	470.3	727.6	730
					75	275.6	539.9	815.5	820
					80	294.0	614.3	908.3	910

Note: Brake reaction distance predicated on a time of 2.5 s; deceleration rate of 3.4 m/s² [11.2 ft/s²] used to determine calculated sight distance.

Design Values

The stopping sight distance is the sum of the distance traversed during the brake reaction time and the distance to brake the vehicle to a stop. The computed distances for various speeds at the assumed conditions on level roadways are shown in Table 3-1 and were developed from the following equation:

Metric	U.S. Customary
$SSD = 0.278Vt + 0.039 \frac{V^2}{a}$	$SSD = 1.47Vt + 1.075 \frac{V^2}{a} \quad (3-2)$
<p>where:</p> <p>SSD = stopping sight distance, m</p> <p>V = design speed, km/h</p> <p>t = brake reaction time, 2.5 s</p> <p>a = deceleration rate, m/s²</p>	<p>where:</p> <p>SSD = stopping sight distance, ft</p> <p>V = design speed, mph</p> <p>t = brake reaction time, 2.5 s</p> <p>a = deceleration rate, ft/s²</p>

Stopping sight distances exceeding those shown in Table 3-1 should be used as the basis for design wherever practical. Use of longer stopping sight distances increases the margin for error for all drivers and, in particular, for those who operate at or near the design speed during wet pavement conditions. New pavements should have initially, and should retain, friction coefficients consistent with the deceleration rates used to develop Table 3-1.

intersection is located on a 4 percent upgrade, then the time gap selected for intersection sight distance design for left turns should be increased from 8.0 to 8.8 s, equivalent to an increase of 0.2 s for each percent grade.

The design values for intersection sight distance for passenger cars are shown in Table 9-6. Figure 9-17 includes design values, based on the time gaps for the design vehicles included in Table 9-5.

No adjustment of the recommended sight distance values for the major-road grade is generally needed because both the major- and minor-road vehicle will be on the same grade when departing from the intersection. However, if the minor-road design vehicle is a heavy truck and the intersection is located near a sag vertical curve with grades over 3 percent, then an adjustment to extend the recommended sight distance based on the major-road grade should be considered.

Table 9-6. Design Intersection Sight Distance—Case B1, Left Turn from Stop

Metric				U.S. Customary			
Design Speed (km/h)	Stopping Sight Distance (m)	Intersection Sight Distance for Passenger Cars		Design Speed (mph)	Stopping Sight Distance (ft)	Intersection Sight Distance for Passenger Cars	
		Calculated (m)	Design (m)			Calculated (ft)	Design (ft)
20	20	41.7	45	15	80	165.4	170
30	35	62.6	65	20	115	220.5	225
40	50	83.4	85	25	155	275.6	280
50	65	104.3	105	30	200	330.8	335
60	85	125.1	130	35	250	385.9	390
70	105	146.0	150	40	305	441.0	445
80	130	166.8	170	45	360	496.1	500
90	160	187.7	190	50	425	551.3	555
100	185	208.5	210	55	495	606.4	610
110	220	229.4	230	60	570	661.5	665
120	250	250.2	255	65	645	716.6	720
130	285	271.1	275	70	730	771.8	775
—	—	—	—	75	820	826.9	830
—	—	—	—	80	910	882.0	885

Note: Intersection sight distance shown is for a stopped passenger car to turn left onto a two-lane highway with no median and grades 3 percent or less. For other conditions, the time gap should be adjusted and the sight distance recalculated.

Sight distance design for left turns at divided-highway intersections should consider multiple design vehicles and median width. If the design vehicle used to determine sight distance for a divided-highway intersection is larger than a passenger car, then sight distance for left turns will need to be checked for that selected design vehicle and for smaller design vehicles as well. If the divided-highway median is wide enough to store the design vehicle with a clearance to the through lanes of approximately 1 m [3 ft] at both ends of the vehicle, no separate analysis for the departure sight triangle for left turns is needed on the minor-road approach for the near roadway to the left. In most cases, the departure sight triangle for right