RICE ROAD APPLICATION

ATTACHMENT 11

TRAFFIC IMPACT STUDY UPDATE

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Traffic Impact Study Update

Prepared For

Whitney Street Home Builders

Multifamily Residential Development

Located at

15-17 Rice Road
Millbury, Massachusetts

September 2022

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INTRODUCTION

Whitney Street Home Builders, hereafter referred to as the applicant, is proposing the development of a parcel of land totaling 15.6 acres to construct a multifamily residential development. The proposed development is located on the north side of Rice Road between the Providence & Worcester Railroad Company railroad tracks and power line easement. The applicant is proposing to evaluate the traffic impact of this development on area roadways and consider any improvements that may be necessary to make this development feasible and acceptable. This traffic study is prepared to make this evaluation. The purpose of this traffic study is to update an earlier traffic study and to develop an understanding of existing traffic operations and concerns, forecast future site generated traffic, assess the adequacy of the existing roadway system to accommodate the new proposed development into the future, and to identify and recommend appropriate mitigation strategies, should any be deemed necessary.

Project description

Under the new site plan, the applicant proposes to develop a 15.6-acre parcel of land and build three four story apartment buildings, each floor housing 16 apartment units, for a total of 192 apartment units. Also, the site will include a total of 294 parking spaces, including 30 spaces within garages. Finally, ten of the parking spaces will be designed and designated as van accessible handicap parking.

The site will be accessed directly from Rice Road via a single driveway that is 30 feet wide and is located approximately 800' west of the Providence Street intersection, or directly across from Thomas Hill Road, thus creating a four-legged intersection. The site driveway will provide access to all proposed parking spaces that are strategically located in front of the proposed apartment buildings. This entrance driveway has a 30-foot paved surface. The driveway and all parking aisles are proposed to meet or exceed the requirements of the town of Millbury zoning bylaws. The proposed site driveway provides access to all off-street parking spaces for each building and each garage space. The proposed site is in an R-1 zoning district and it currently includes one residential property and its approximate location is shown in the aerial photograph in Figure 1.

As stated herein above, the apartment buildings are designed and situated in such a way that they will all have access to off-street parking. This will eliminate the potential for on-street parking activities alongside Rice Road, thus maintaining optimum safety for the neighborhood and for the residents driving through the development.

Figure 1 - Proposed Multi Family Development Site

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EXISTING CONDITIONS

Evaluation of the transportation impacts associated with the proposed multi-family residential development project requires a thorough understanding of the existing transportation system in the immediate vicinity of the site. Evaluating existing roadway network operating conditions necessitates an examination of existing roadway traffic volumes, geometric features, and local community traffic-related issues. Each of these elements is described below.

Study Area Roadway Network

As in the original report, the study area for this traffic impact report has been defined to include the evaluation of the following intersections located within 1,000 feet of the proposed site driveway.

- Rice Road at Providence Street (Route 122A)
- Rice Road at Thomas Hill Road
- Rice Road at South Main Street

South Main Street is a two-way roadway with one travel lane in each direction. The roadway width is approximately 26' near its intersection with Rice Road. It provides sidewalks on one side of the street north of the Rice Road intersection. South Main Street intersects with Rice Road at an acute angle. However, the intersection is treated with a traffic island that creates a nearly 90-degree turn into and out of Rice Road for left-turn traffic. It is a suburban roadway with predominately residential land use. It traverses in northerly and southerly general directions and provides access to the center of Millbury to the north and it becomes Dudley Road and connects with Route 146 to the south. Daily traffic volumes in both directions for South Main Street in the vicinity of where its name changes to Dudley Road was obtained from the Massachusetts Department of Transportation (*massDOT*) website. In 2019, the Annual Average Daily Traffic (AADT) on South Main Street from permanent counting station #240695 was 930 vehicles per day at a point approximately a half mile south of the Rice Road intersection. South Main Street intersects with Rice Road, Woodland Street, Sycamore Street, Maple Street, and finally, Elm Street in the center of Millbury.

Rice Road is also a residential street that traverses in the easterly and westerly directions. Its pavement width varies from 20' to 22', except at/near its intersection with South Main Street, where the roadway width increases to 36'+ for a distance of approximately 95', to accommodate a right-turn only when leaving Rice Road, and a traffic island separating traffic entering Rice Road from those leaving it and destined for points south. Rice Road also crosses the Providence & Worcester Railroad Company railroad tracks near its easterly terminus and connects South Main Street to Providence Street (Route 122A) at its easterly terminus. There are no speed limit signs posted on Rice Road.

Providence Street (Route 122A) is a rural arterial street and is also a state numbered highway. It traverses in the northerly and southerly general directions. It connects to Grafton Street in the center of Millbury to the north, and to Wilkinsonville and Saundersville, and eventually intersecting Providence Road (Route 122) to the south in South Grafton. Its pavement width ranges from 36' to 38' near its intersection with Rice Road. Providence Street in the area near the Rice Road intersection is posted with 30 miles per hour speed limit signs. In 2019, the AADT along Providence Street from permanent counting station #240693 was 6,284 vehicles per day at a point approximately a half mile south of the Rice Road intersection. Finally, land use along Providence Street in this area is primarily commercial/business which also includes the Town of Millbury Department of Public Works facilities.

Intersection of South Main Street and Rice Road also known as Victor Pelletier Square, is a three-legged "T" intersection with a two-lane approach for the westbound traffic. It provides a westbound right-turn only lane to form the second lane. As stated earlier, Rice Road has an acute angle of intersection towards South Main Street, however, the last 95' of the approach is realigned to form an angle much closer to 90 degrees for traffic entering and those exiting Rice Road heading to points south. The South Main Street approaches of this intersection have one lane each. Finally, the westbound right-turn lane is posted with a stop sign, but no stop signs were observed for the westbound left-turn lane.

Intersection of Providence Street and Rice Road is also a three-legged intersection with one lane in each direction for its approaches. The Rice Road approach of this intersection forms a "Y" intersection due to the acute angle of intersect. There is no stop or yield control sign posted for the eastbound approach of Rice Road at this intersection.

Traffic Volumes

Due to the reductions in traffic volumes caused by the Covid-19 pandemic, taking new traffic counts in 2021 and 2022 may undercount the baseline for which future years are based. Therefore, the peak hour traffic counts were adjusted to pre-Covid-19 conditions using *massDOT* historic traffic data and guidelines.

The peak hour turning movement counts are from the original report and were collected on Tuesday, March 2, 2021, during two-hour periods between the hours of 7-9 AM and 4-6 PM at peak commuter periods in order to capture the critical peak hour.

To establish the present baseline volumes, the intersection turning movement counts were adjusted and normalized into the present year (baseline) utilizing the *massDOT* factor as described below. The adjusted peak hour turning movement counts are summarized in the following Table 1. They are also depicted in the following Figure 2.

Table 1
Covid Adjusted and Normalized 2022 Peak Hour Turning Movement Counts

	S Main St at Rice Rd						Rice Rd at Thomas Hill Rd						Providence St at Rice Rd					
	NB T	NB R	SB L	SB T	WB L	WB R	NB L	NB R	EB T	EB R	WB L	WB T	EB L	EB R	NB L	NB T	SB T	SB R
AM Peak	22	3	10	31	3	8	3	4	11	5	3	7	8	4	2	201	148	5
PM Peak	31	3	12	50	8	10	3	1	7	3	5	12	5	3	6	1 95	245	1 0

A more concise method is using the *massDOT* guidance as prescribed in an engineering directive. The *massDOT* Yearly Growth Rates data from 2014 -2019 are shown in the Technical Appendix. The growth rates go back to 2014, and therefore, the rates were averaged and then expanded to a three-year period to adjust for the Covid-19 pandemic and then a five-year period to account for the future no-build and build conditions. The average annual growth rate was calculated at 0.0034. This rate was multiplied by three to get the total increased rate of 0.0102 for the Covid-19 adjustment (for baseline) and then the resultant was multiplied by five to get the total increase rate of 0.0175 for future conditions. Therefore, the turning movement counts were increased by these factors. Again, as per *massDOT* guidance, this increase also accounts for all future traffic from any other additional developments that may take place in the general area of the proposed development site between now and the year 2027.

Additionally, the *massDOT* Highway Division provides statewide traffic data collection that includes weekday seasonal factors. To evaluate the potential for seasonal fluctuation of traffic volumes on roadways near the proposed site, weekday seasonal factors were obtained from the *massDOT* Statewide Traffic Data Collection. The data indicated that the seasonal factor for traffic collected during the month of March is 1.11 for R4-7 category roadways. Usually, the TMCs are multiplied by the factor of 1.11 to reflect those of the yearly average. Therefore, the extrapolated data were further adjusted to reflect those of an average year. A copy of adjustment factors is presented in the Technical Appendix section of this report. The seasonally adjusted turning movement counts are shown in Figure 3.

Typically, the PM peak period has the higher volumes, and is considered the critical peak. As is the case here, higher traffic volumes also occur during the PM peak period at these intersections. Percentage of truck traffic at permanent counting station #240695 along South Main Street was recorded by the *massDOT* at 1.7%. This rate includes all vehicles having three axles, some of which provide services to the residential properties along South Main Street. This rate is considered average to slightly below average for roadways having similar characteristics. Again, Figure 3 depicts the base line turning movement counts that were adjusted to reflect an average year for the year 2022.

Figure 2
Existing Turning Movement Counts COVID Adjusted

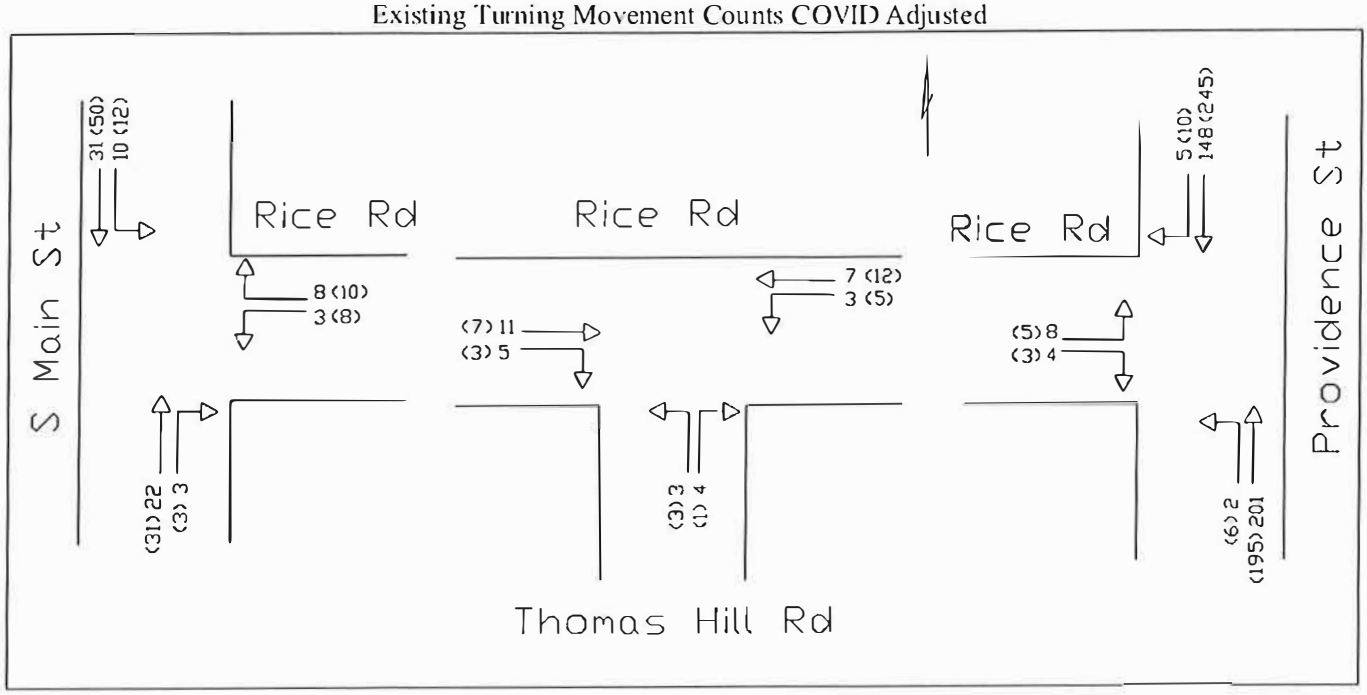
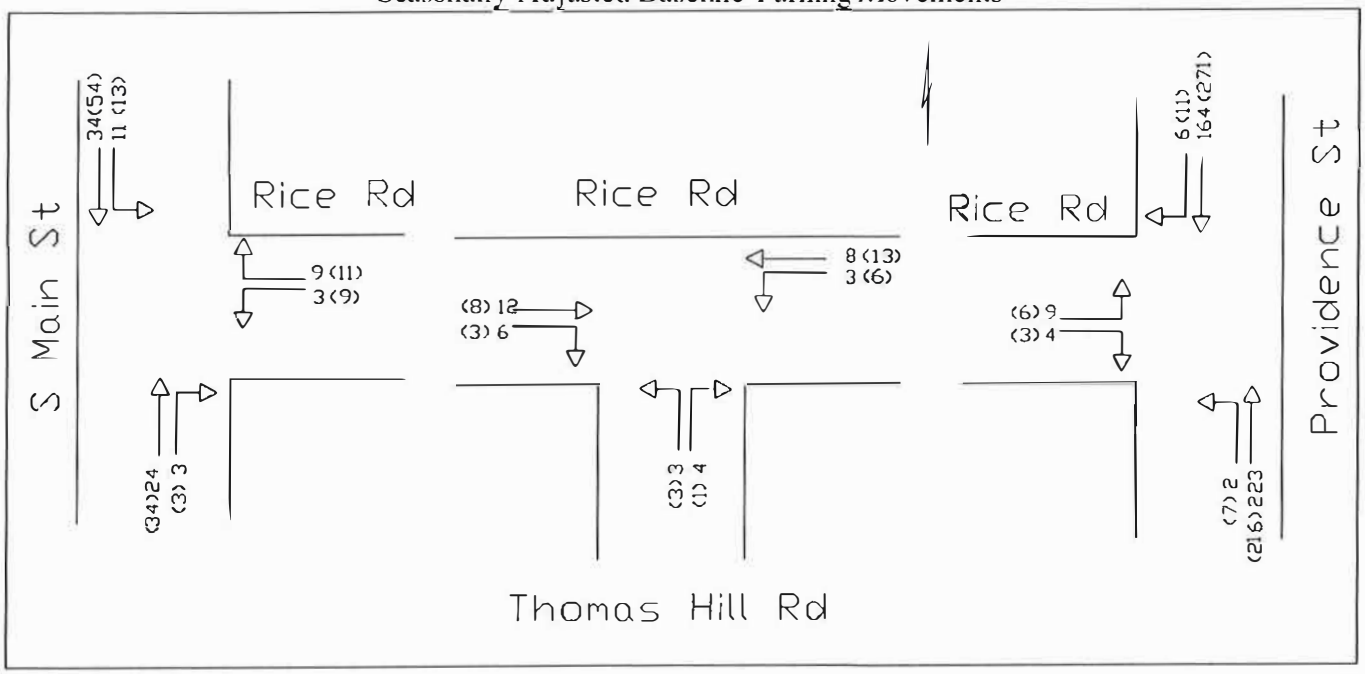


Figure 3
Seasonally Adjusted Baseline Turning Movements



Safety Concerns

Sight Distances: To evaluate the safety of traffic to and from the proposed site via its proposed driveway, sight distances were measured in the field and analyzed.

Sight distance is defined in the *massDOT Project Development and Design Guide* as the length of roadway ahead that is visible to the road users. In most cases, specific sight distance measures apply to motor vehicles and bicyclists. There are two aspects of sight distance that apply to this case. They are:

- Stopping sight distance
- Intersection sight distance

The sight distances are related to the design speed (posted speed) of the roadway and are based on the standards of the American Association of State Highway and Transportation Officials (AASHTO) publication entitled *A Policy on Geometric Design of Highways and Streets* also referred to as the *Green Book*.

Stopping Sight Distance is further described in the *massDOT Project Development and Design Guide* as the distance necessary for a vehicle traveling at the design speed (posted speed) before reaching a stationary object in its path. The sight distance at every point along a roadway should be at least the stopping sight distance.

The sight distances for vehicles leaving the site via the proposed driveway to the right (west) and left (east) of the proposed site driveway were measured in the field. The measured distances are those from a point 5 feet back of a stop bar (approximately 15 feet from the street line) and 3.5 feet above grade to represent drivers' eye height to an object 3.5 feet above roadway grade. The field review of Rice Road showed that the available sight line for the traffic coming out of the proposed site driveway is approximately 500+ feet to the right (west) and 350 feet to the left (east). As stated earlier, no speed limit signs are posted on Rice Road. Therefore, the statutory prima facie speed limit of 30 miles per hour applies.

Based on Basic Design Controls for roadway design, the Stopping Sight Distance is calculated using the formula d=(V*V)/(30*f), plus the time required for perception and reaction by a driver (2.5 seconds). V is approach speed in mph, and f=0.28-0.35. The stopping sight distances are calculated and are provided in Exhibit 3-8 of the 2006 *massDOT* Project Development and Design Guide. A copy of this exhibit is presented in the Technical Appendix section of this report. The required stopping sight distance for 30 miles per hour speed on Rice Road is 200 feet.

Intersection Sight Distance is explained by the *massDOT Project Development and Design Guide* as a sight distance at an intersection to allow drivers to perceive the presence of potentially conflicting vehicles. This should occur in sufficient time for a motorist to stop or adjust their speed, as appropriate, to avoid colliding in the intersection. Intersection sight distance also allows drivers of stopped vehicles with a sufficient view of the intersecting roadway to decide when to enter or cross the intersecting roadway. The AASHTO *Green Book* provides procedures

to determine desirable intersection sight distances at intersections for various cases, one procedure is Intersection Sight Triangle. Exhibit 3-11 of the *massDOT Project Development and Design Guide* that demonstrates the sight distances desired based on Intersection Sight Triangle methodology is included in the Technical Appendix section of this report. As shown in this exhibit, for the posted speed limit of 30 mph on Rice Road, 335 feet should be provided for vehicles turning left from the site driveway, and 290 feet should be provided for vehicles turning right from the site driveway.

Again, as demonstrated herein above, available sight distances are greater than the desired values for intersection sight distances. Therefore, proper intersection sight distances can be provided in both directions for the proposed driveway. The following Table 2 shows the relationship between the available sight distances, required stopping sight distances, and the desired intersection sight distances.

The following photographs illustrate the available sight distances visually for both directions of Rice Road at the proposed site driveway.

The sight distances were examined both horizontally and vertically. The following Google Earth aerials show the grade profile of Rice Road in respect to the proposed site driveway in both directions. It should be noted that these same sight distances currently provide safe sight lines for traffic in and out of Thomas Hill Road at its intersection with Rice Road.

From proposed Driveway looking to the right (west)

From proposed Driveway looking to the left (east)

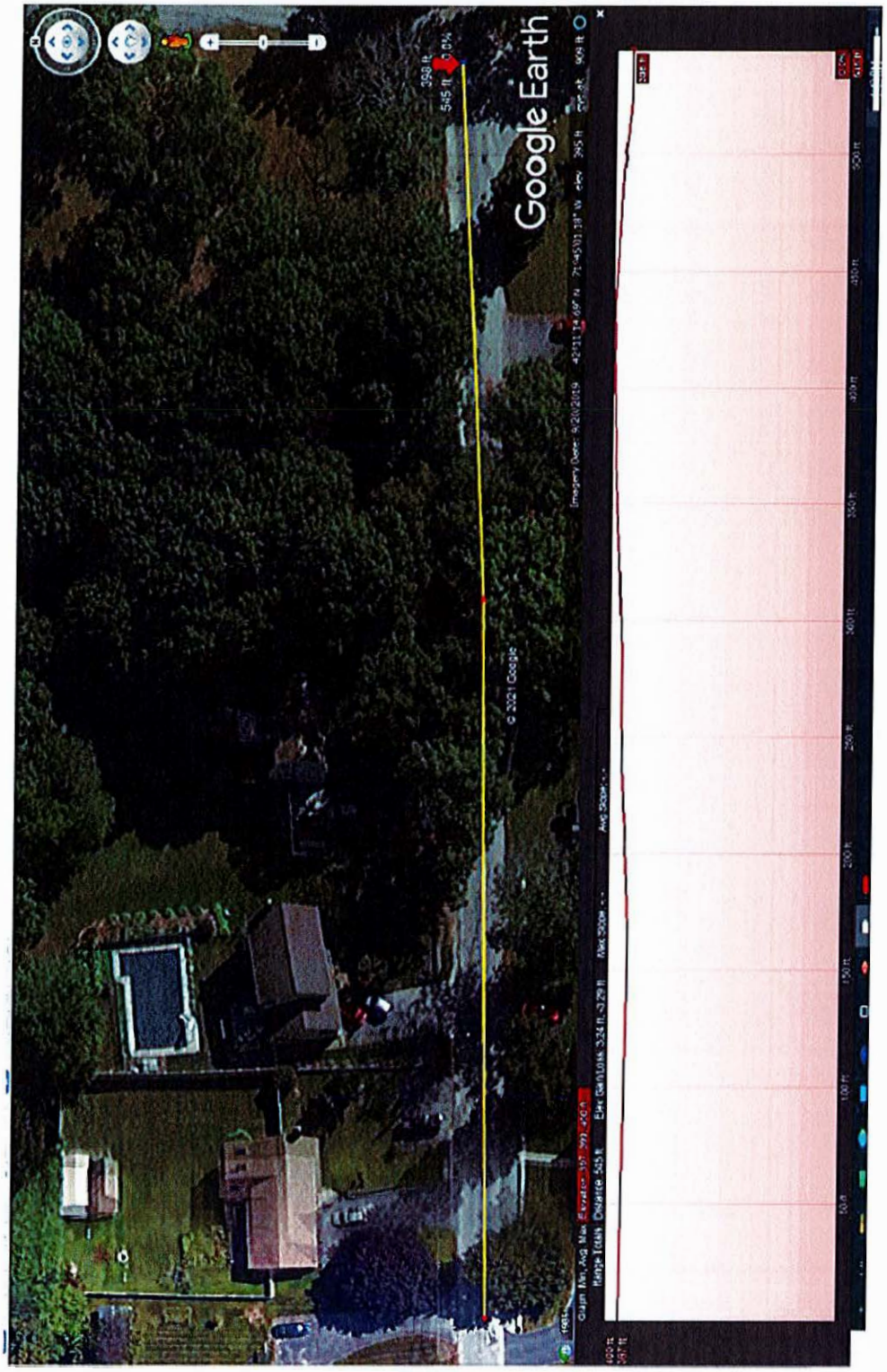
Table 2
Sight Distance Analysis

Direction	Available SD	Required SSD	Desired ISD
Looking to right (west)	500'+	200'	335'(LT), 290'(RT)
Looking to the left (east)	350'	200'	335'(LT), 290'(RT)

As demonstrated herein above, available sight distances are significantly greater than the required values. Therefore, proper sight distances in both directions will be provided along Rice Road for vehicles entering and exiting the proposed site.

Rice Road profile looking to the east (left) from proposed site driveway

Rice Road profile looking to the west (right) from proposed site driveway



Accidents: The latest accident data compiled by the *massDOT* were obtained and reviewed for a four-year period of 2018-2021. This review revealed that no accidents were reported for any of these intersections during this four-year period. Therefore, it is concluded that no safety issues could be associated with these intersections. There was one accident recorded in front of #9 Rice Road that is approximately 400' west of the proposed site driveway. This accident occurred on March 17, 2019, at 3:00 PM and it involved a single vehicle backing out and hitting a parked car. This accident involved no injuries.

Existing Conditions Summary

Rice Road can be characterized as a two-way roadway with one travel lane in each direction along its length in the vicinity of the proposed multifamily residential development site. However, Rice Road at its intersections with South Main Street has a dedicated right-turn lane and a left-turn lane separated by a triangular traffic island. The roadway width varies from 20' to 22', and it is approximately 1,700' in length. It connects South Main Street to Providence Street. It is a residential roadway and has a combination of gentle horizontal and vertical curves on either side of the proposed site driveway.

The current land use designation for the proposed multifamily development site is R-1, and the site currently includes one residential property, and its approximate location is shown in the aerial photograph in Figure 1.

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FUTURE CONDITIONS

Where possible, traffic volumes in the study area are projected to post-development levels. Projected traffic volumes include the existing traffic data obtained from the turning movement counts, adjusted, and normalized into the year 2022 to account for the Covid-19 pandemic and to represent the post-pandemic baseline, then projected into the future no build (year 2027) to reflect increases due to future area projects, and finally, added to the new traffic expected to be generated by the proposed multifamily residential development to represent future build conditions.

Site-Generated Traffic

The magnitude of traffic volumes that will be generated by the proposed development was projected by using the 10th Edition of *Trip Generation*[1] *Manual* plus its supplement published by the Institute of Transportation Engineers (ITE) and its computer software.

Based on the ITE *Trip Generation Manual*, the rates at which the proposed land use generates traffic vary depending upon the time of day. These rates were used to calculate the number of trips expected to be generated by the proposed multifamily residential development during an average weekday, morning, and afternoon peak traffic periods. To obtain the most accurate forecast and to be consistent with the guidelines established by the *massDOT*, when available, the fitted curves in the *Trip Generation Manual* were used to forecast trips to and from the proposed site for daily and both peak hours. The ITE trip tabulations computer outputs are presented in the Technical Appendix section ofthis report. The resulting trips and their directional distribution for this site are shown in the following Table 3.

TABLE 3
ITE Trip Generation for Multi-Family Development
192 Units Multi-Family Housing (Mid-Rise) ITE LU Code 221

Daily	%In	%Out	AM Pk	%In	%Out	PM Pk	%In	%Out
5.44	50%	50%	0.36	26%	74%	0.44	61%	39%
1045*	522*	523*	69	18	51	84	51	33

* *Fitted Curve values were used as they were greater than Average values*

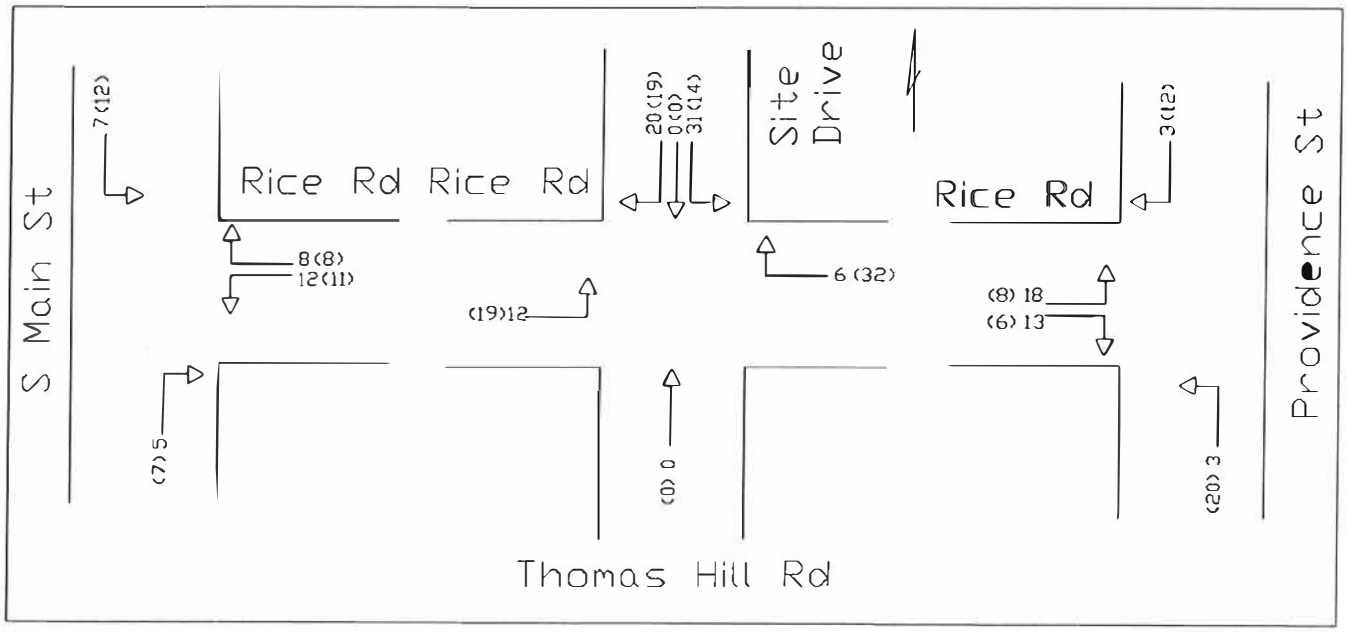
As can be seen in Table 3 above, the total number of new trips expected to be generated by the proposed multifamily residential development results in the highest traffic during PM peak period, thus making the PM peak hour the critical peak. In standard traffic engineering practice, the critical peak period trips are usually used to evaluate the worst-case scenario. However, both the AM and PM peak traffic periods were evaluated for all three intersections.

Trip Distribution and Assignment

Because such factors as population density, land use, availability of major highways in the area, and other demographics that make up the traffic patterns within a community, the directional distribution of the projected site-generated trips to and from the proposed multifamily residential development site was based on the existing traffic patterns within the immediate vicinity of the site and based on the knowledge of local traffic patterns. The turning movement traffic counts for the intersection of Rice Road with South Main Street, Thomas Hill Road, and Providence Street are good indicators of the traffic patterns in this area.

Using this information, the projected new site-generated trips from the above Table 3 are proportionally assigned to each approach of these intersections. As shown in Table 3 above and Figure 4 below, during AM peak period, a sum of 18 vehicles would be arriving at the proposed development site and 51 vehicles would be departing from the site in both directions along Rice Road via the proposed site driveway. During PM peak period, a total of 51 vehicles are expected to arrive at and 33 vehicles would depart from the proposed site via the proposed site driveway. Finally, a total of 522 vehicles will be arriving at and 523 vehicles will be departing from the proposed site during a 24-hour period on an average day.

Figure 4
Trip Generation and Distribution



[1] *Trip Generation, 10th Edition,* Institute of Transportation Engineers; Washington,

Site Access and Circulation

Site access and internal traffic circulation was evaluated as part of assessing the proposed residential development site. Access to the proposed site is achieved through a driveway located directly opposite Thomas Hill Road, thus forming a four-legged intersection. The proposed site driveway will provide full access to all three apartment buildings. This driveway is intended to accommodate all traffic to and from the proposed development leading up to these buildings and garages in a safe and efficient manner. The site driveway is 30 feet in width with corner radii of 30 feet to accommodate emergency apparatus.

Also, as stated earlier, a total of 294 parking spaces are proposed, ten of which will be designed and designated as van accessible handicap parking. A total of 30 of the proposed parking spaces will be inside garages. This will eliminate the potential for on-street parking activities alongside Rice Road, thus maintaining optimum safety for residents driving through the area. This translates into 1.53 parking spaces per apartment unit.

The magnitude of parking spaces that will be required by the proposed multifamily residential development was forecasted by using the 3rd Edition of *Parking Generation Manual*[1] document also published by the ITE.

Based on the ITE Parking Generation document, the rates at which Residential Low/Mid-Rise Apartments (land use 221) generate demand for parking vary depending upon the location of the project. The demand for off-street parking is greatest for residences located in suburban areas primarily due to the lack of public transportation and long distances from daily conveniences. The average peak period parking demand for apartments is 1.2 vehicles per dwelling unit, and the 85th percentile demand for apartments located in suburban areas is 1.46 vehicles per unit. This translates into anywhere from 4.8% to 27.5% more proposed parking spaces than will be needed during an average weekday or peak periods.

[1] *Parking Generation,* Institute of Transportation Engineers; Washington, DC

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TRAFFIC OPERATIONS

Measuring existing traffic volumes and projecting future traffic volumes quantify traffic flow within the study area. To assess the quality of traffic flow, intersection capacity analyses were performed to measure existing baseline conditions and for projected future design year (2027) conditions with and without the implementation of the proposed multifamily residential development project. Intersection capacity analyses provide an indication of how well roadway facilities and their components serve the traffic demands placed upon them. This section, which updates the original report, includes potential on-site and off-site mitigation improvements should any be deemed necessary to minimize the impact of the proposed multifamily development on the surrounding roadways.

Traffic operations measures

Level of service (LOS) is the term used to demonstrate the different operating conditions which occur on a given roadway segment or at an intersection under different traffic volume conditions. LOS is a qualitative measure of the effect of several other factors including roadway geometry, speed, travel delay, signalization timing, freedom to maneuver and safety. The criteria used to analyze the intersections within 1,000' of the proposed development site are based on the Highway Capacity Manual and its computer software, Synchro. The computer output sheets are presented in the Technical Appendix section of this report.

The LOS concept is an indicator of the operational qualities of a roadway or an intersection. Six LOSs are defined for each type of facility. They are given letter designations from "A" to "F". LOS "A" represents the best operating conditions, while LOS "F" represents the worst. Typically, LOS "D" is considered acceptable during peak hour conditions, but LOS "E" may also be acceptable under some circumstances.

The LOS designation is reported differently for signalized and unsignalized intersections. For signalized intersections, the analysis considers the operation of all traffic entering the intersection, and a LOS designation can be calculated for overall conditions at the intersection. For an unsignalized intersection, however, the analysis assumes that through traffic on major roadways is not affected by traffic on side streets (streets with lower volumes and/or ones under stop sign control). Therefore, a LOS designation is typically calculated for the controlled movements (minor street approaches and major street left-turn movements). As described in the following paragraphs, capacity or LOS analyses were considered for year 2022 existing, year 2027 future no build, and year 2027 future build conditions for morning and evening peak hour periods at the above-mentioned intersections, including the proposed site driveway.

Existing Conditions

Intersection capacity analyses were performed for all three intersections during morning and evening peak traffic periods. These intersections are the only locations within 1,000', or the immediate vicinity of the proposed development site that may be affected by the traffic expected to be generated by the proposed multifamily residential development.

The analysis concluded that LOS "A" is calculated for all approaches of these intersections during AM and PM peak periods, except for the eastbound approach of Rice Road at Providence Street which is operating at LOS "B" during both AM and PM peak periods. A summary of intersection analyses results for existing conditions is shown below in Table 4.

Future Conditions

Capacity analyses for the future year peak hour traffic operations were performed for the year 2027 volumes during both peak periods with and without the proposed multifamily development project in place. A summary of intersection analyses results for both future no-build and future build conditions is also shown below in Table 4.

As noted earlier in this report, in projecting the year 2027 future no-build traffic volumes, the latest *massDOT* available statistics were used. As stated earlier under the Traffic Volumes section, the growth rates that go back to 2014 were averaged and then applied to expand to a five-year period in order to represent the buildout year. The average annual growth rate over the past five-year period was calculated at 0.0034. Therefore, the baseline volumes were increased by that rate over five years. Figure 5 shows the volumes for the future no-build conditions for all three intersections within the study area. The projected future no build year (2027) traffic should account for any future developments in the general area of the proposed site.

Build traffic volumes were determined by projecting site-generated traffic volumes and distributing those volumes over the intersections within the study area, and finally, adding them to the future no-build conditions volumes. Figure 6 shows future build conditions traffic volumes for all three intersections, including the proposed site driveway that will form the fourth leg of the intersection of Rice Road and Thomas Hill Road.

Figure 5
Turning Movement Counts, Future No Build Conditions

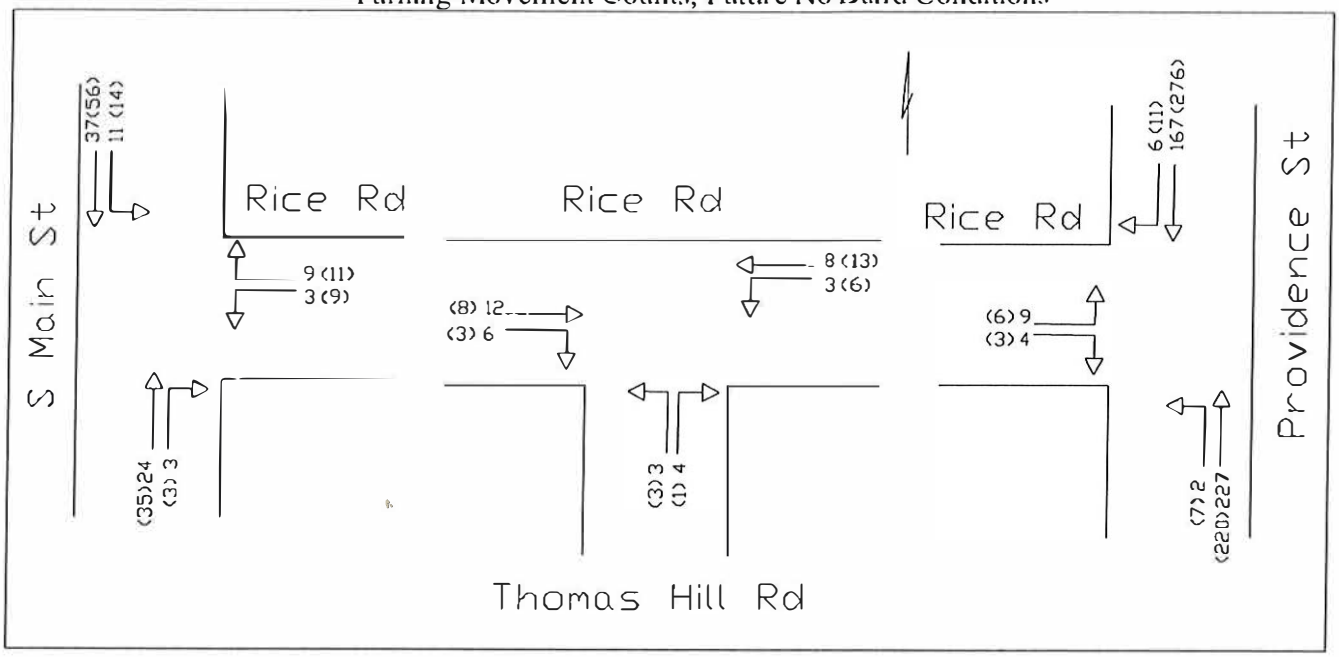
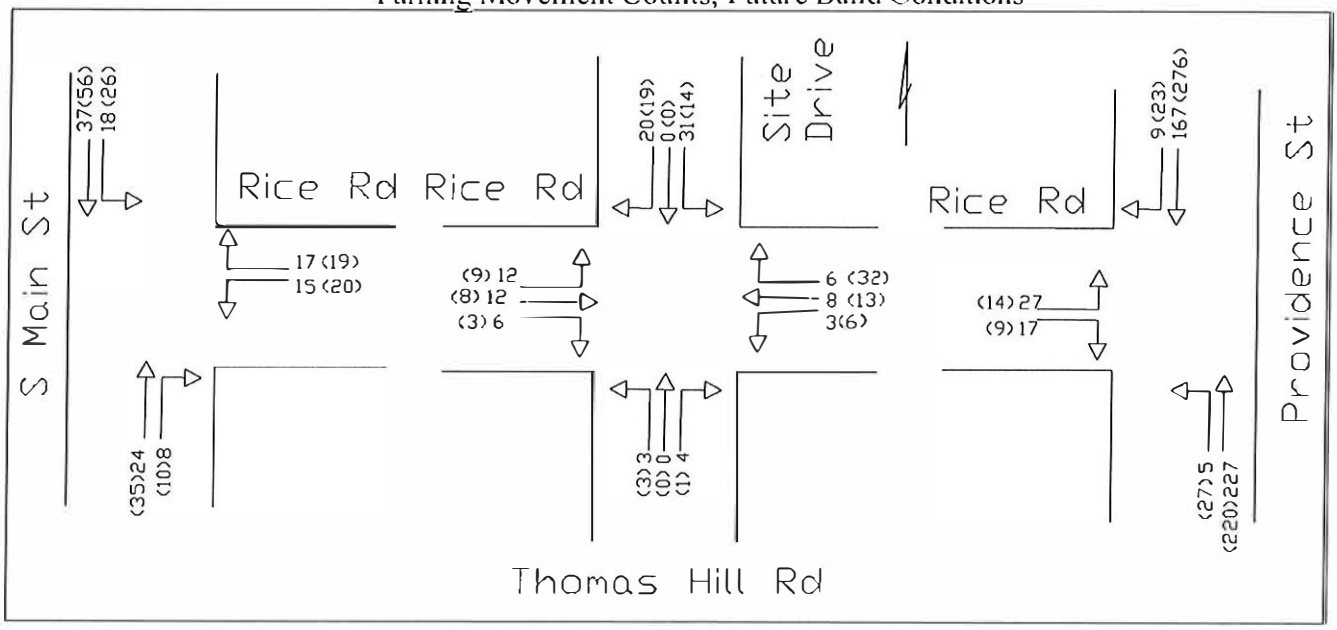


Figure 6
Turning Movement Counts, Future Build Conditions



The intersection LOSs for the year 2027 no-build conditions were calculated for the approaches of these intersections and are expected to be "A" during both peak periods except the eastbound approach of Rice Road at its intersection with Providence Street which will be operating at LOS "B",

signifying no increase in vehicular delays.

To assess the potential traffic impact of the proposed development on these intersections, all traffic from the site was distributed along Rice Road and its three intersections. This will result in the assessment of these intersections under worst-case scenario. The above Figures 3, 5 and 6 show the traffic volumes at all intersections for the AM and PM peak hours under existing, future no-build, and future build conditions.

The intersection analysis for the year 2027 build conditions were performed for approaches of all three intersections including the site driveway. The analysis revealed that under future build conditions, all three existing intersections will continue to operate at the same LOS as the future no-build with LOS "A" except for the eastbound approach of Rice Road at Providence Street which, again will be operating at LOS "B".

Again, the above-mentioned LOSs "A" and "B" for all existing intersections for future no-build and build conditions are indicative of no impact associated with the development of the proposed multifamily project.

A summary of intersection analyses for all three intersections, including the proposed driveway that forms the fourth leg of the intersection of Rice Road and Thomas Hill Road is also provided herein below in Table 4. Finally, the computer printout of the above-mentioned analysis is presented and included in the Technical Appendix section of this report.

Table 4
Level Of Service Analysis Results Summary

	South Main Street at Rice Road AM Peak								
	Existing 2022			No Build 2027			Build 2027		
Approach	SB L	WB L	WB R	SB L	WB L	WB R	SB L	WB L	WB R
App Delay	1.8	9	8.5	1.7	9	8.5	2.5	9.2	8.5
v/c	0.01	0.00	0.01	0.01	0.00	0.01	0.01	0.02	0.02
App LOS	A	A	A	A	A	A	A	A	A
Int Av Dela	2.2			2.1			3.5		
Int LOS	A			A			A	2.4	

PM Peak	Existing 2022			No Build 2027			Build 2027		
Approach	SB L	WB L	WB R	SB L	WB L	WB R	SB L	WB L	WB R
App Delay	1.5	9.2	8.5	1.5	9.3	8.5	2	9.5	8.6
v/c	0.01	0.01	0.01	0.01	0.01	0.01	0.02	0.03	0.02
App LOS	A	A	A	A	A	A	A	A	A
Int Sig Dela	2.2			2.2			3.3		
Int LOS	A			A			A		

	Providence Street at Rice Road AM Peak								
	Existing 2022			No Build 2027			Build 2027		
Approach	NB L	SB R	EB	NB L	SB R	EB	NBL	SB R	EB
App Delay	0.1	0	10.7	0.1	0	10.7	0.2	0	10.9
v/c	0	0.11	0.02	0.0	0.11	0.02	0	1.1	0.07
App LOS	A		B	A		B	A		B
Int Av Dela	0.4			0.4			1.2		
ICU LOS	A			A			A		

PM Peak	Existing 2022			No Build 2027			Build 2027		
Approach	NB L	SB R	EB	NB L	SB R	EB	NB L	SB R	EB
App Delay	0.3	0	11.6	0.3	0	11.7	1.1	0	12.2
v/c	0.01	0.18	0.02	0.01	0.18	0.02	0.02	0.19	0.05
App LOS	A		B	A		B	A		B
Int Sig Dela	0.3			0.3			1		
Int LOS	A			A			A		

	Rice Road at Thomas Hill Road AM Peak									
	Existing 2022			No Build 2027			Build 2027			
Approach	EB	WB	NB	EB	WB	NB	EB	WB	NB	SB
App Delay	0	2	8.5	0.0	2	8.5	2.9	1.3	8.7	8.9
v/c	0.01	0.00	0.01	0.01	0.00	0.01	0.01	0.00	0.01	0.06
App LOS		A	A		A	A	A	A	A	A
Int Av Dela	2.3			2.3			6			
Int LOS	A			A			A			

PM Peak	Rice Road at Thomas Hill Road PM Peak									
	Existing 2022			No Build 2027			Build 2027			
Approach	EB	WB	NB	EB	WB	NB	EB	WB	NB	SB
App Delay	0	2.3	8.6	0.0	2.3	8.6	3.3	0.9	9	8.8
v/c	0.01	0.00	0.00	0.01	0.00	0.00	0.01	0.00	0.00	0.04
App LOS		A	A		A	A	A	A	A	A
Int Av Dela	2.3			2.3			4.1			
Int LOS	A			A			A			

5

FINDINGS

This traffic study has been conducted to evaluate the potential traffic impacts associated with the proposed multifamily residential development site located north of Rice Road in Millbury, Massachusetts. This study includes the evaluation of three unsignalized intersections within 1,000 feet and in proximity of the proposed site which are likely to be impacted by any traffic from the proposed development project. Evaluation of the area to identify capacity constraints was performed for existing, future no-build, and future build conditions. Future analyses have determined that the site-generated traffic volumes are not significant, and they can safely be accommodated with the existing roadways and the proposed site driveway. These analyses demonstrated that with the additional traffic volumes associated with the proposed multifamily development, the intersection LOSs would not degrade and remain at "B" or better. The analysis showed that the intersection of Rice Road, Thomas Hill Road and the site driveway will be operating at LOS "A" during both AM and PM peak periods.

As stated earlier, the percentage of truck traffic at permanent counting station #3989 along South Main Street was recorded by the *massDOT* at 1.7%. This value is considered average to slightly below average for roadways having similar characteristics.

Conclusion & Recommendations

It is concluded that the area roadways within the vicinity of the proposed development site have enough capacity to safely serve the anticipated additional traffic associated with the proposed multifamily development. The level of service evaluation presented herein above is an indicator of the quality of traffic flow through the area. This evaluation indicates that the LOSs are not expected to change and will not fall below "B" at the intersections studied.

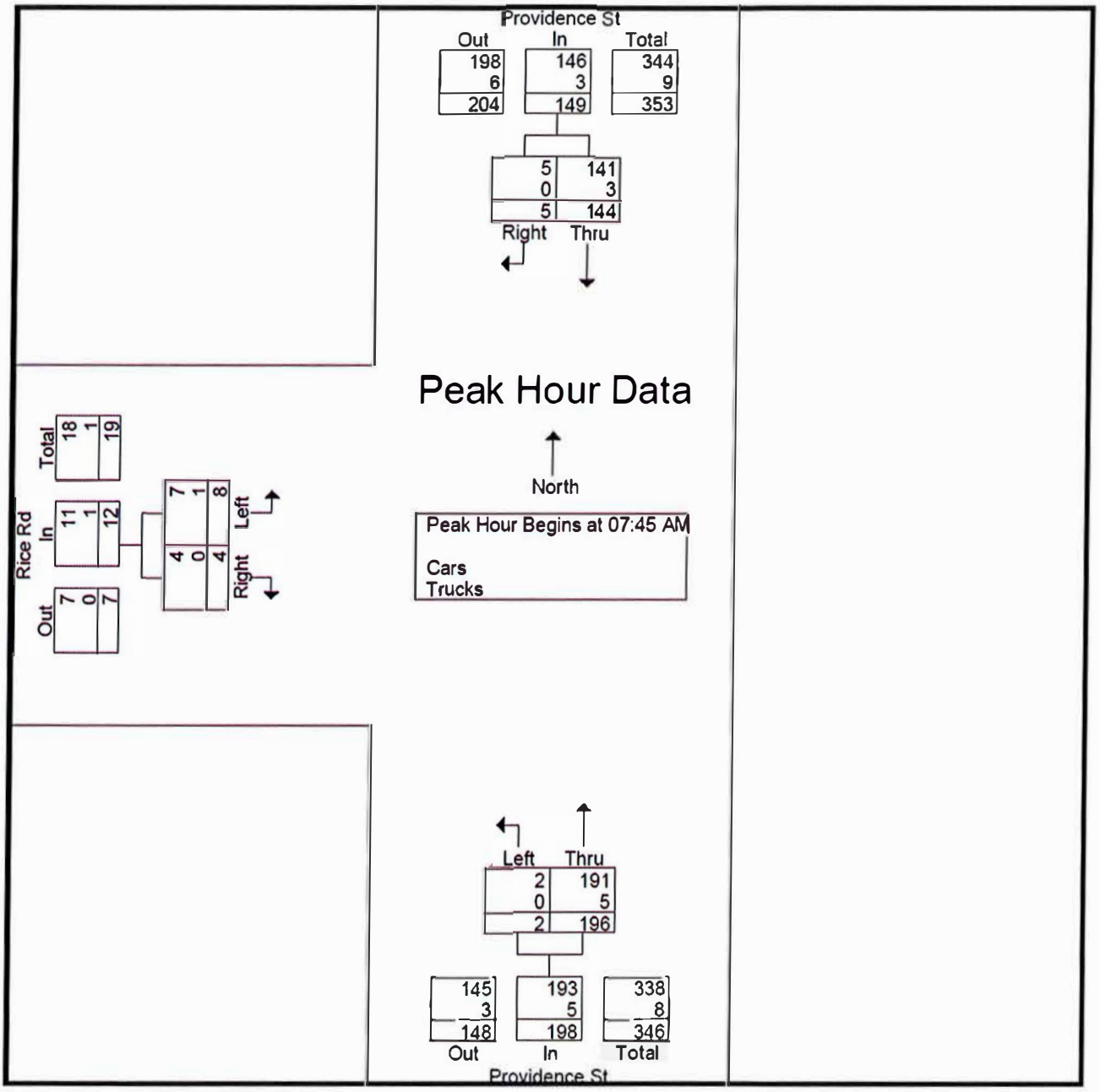
It should be noted that, the applicant will need to make an effort to trim vegetation along the frontage of the proposed site along Rice Road, particularly to the west, in order to further enhance the sight distances for vehicles leaving the site.

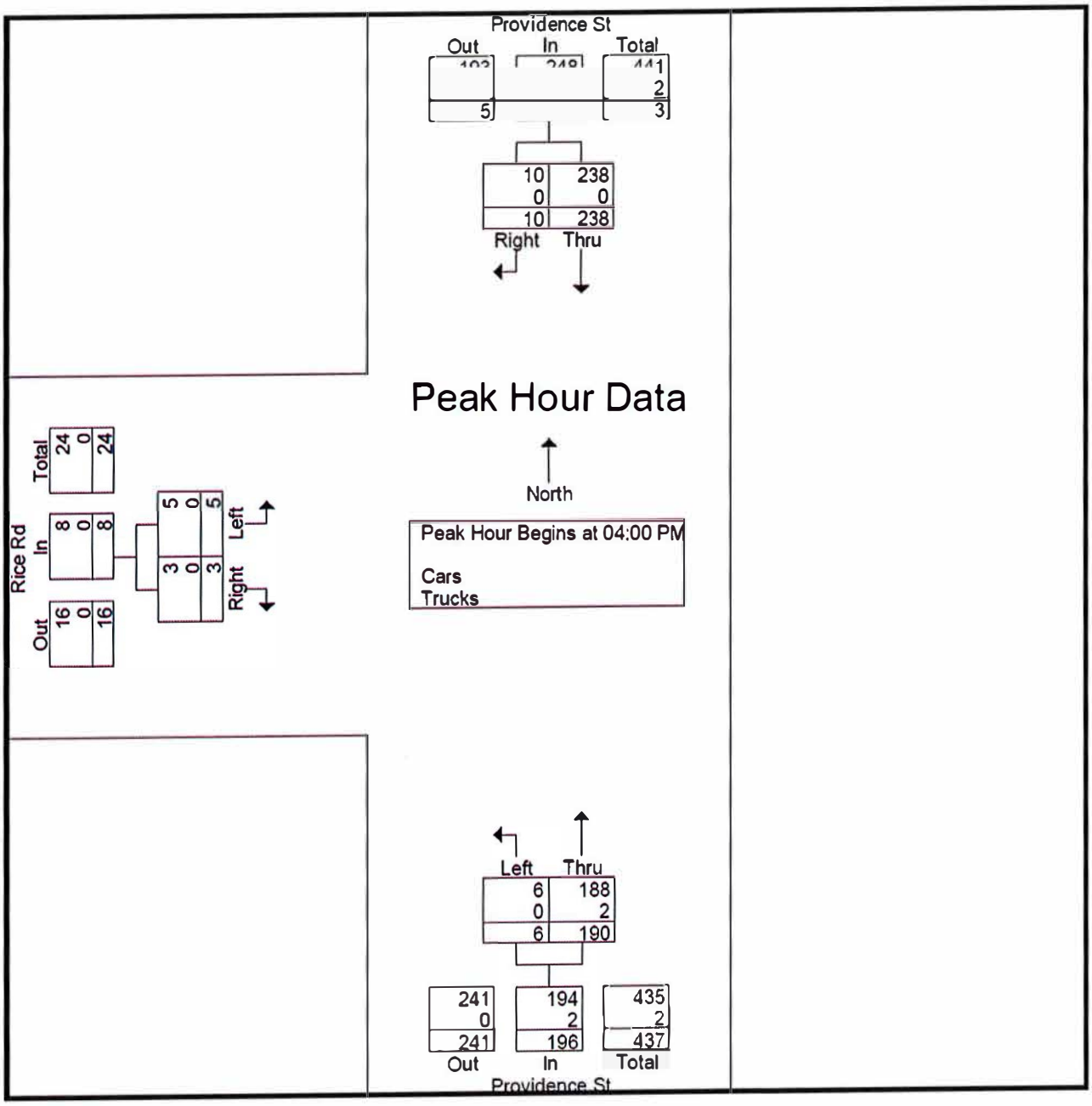
Therefore, to maintain optimum safety and efficiency, the following improvements are recommended.

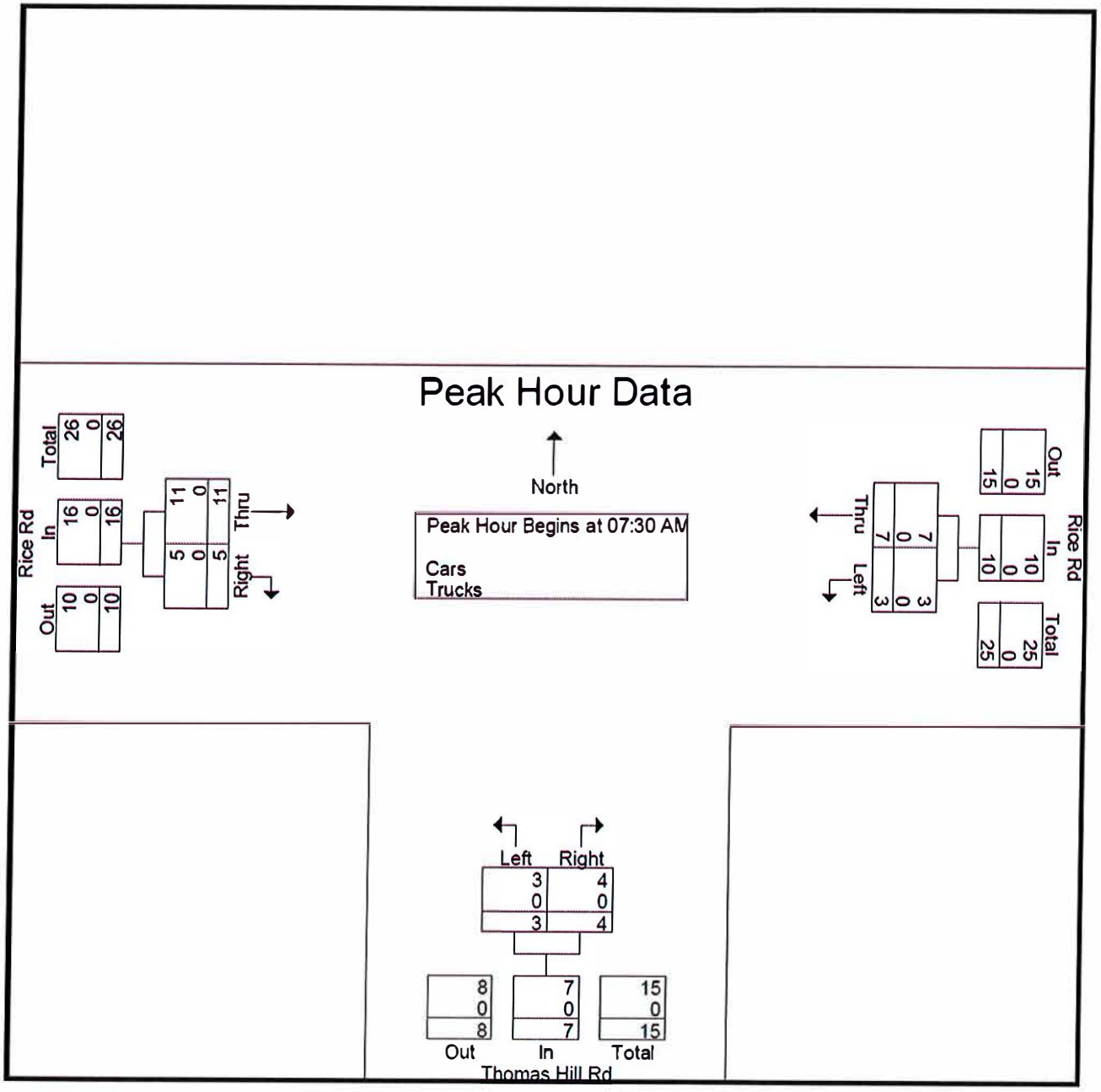
1. The site frontage on the north side of Rice Road to the west of the intersection of Rice Road and the access driveway should be graded and cleared of tall vegetation to further improve the sight distance to the west (right).
2. Any landscaping along the frontage of the proposed site on Rice Road should be limited to vegetation variety that does not grow higher than 2.5' to ensure best sight distances are provided.

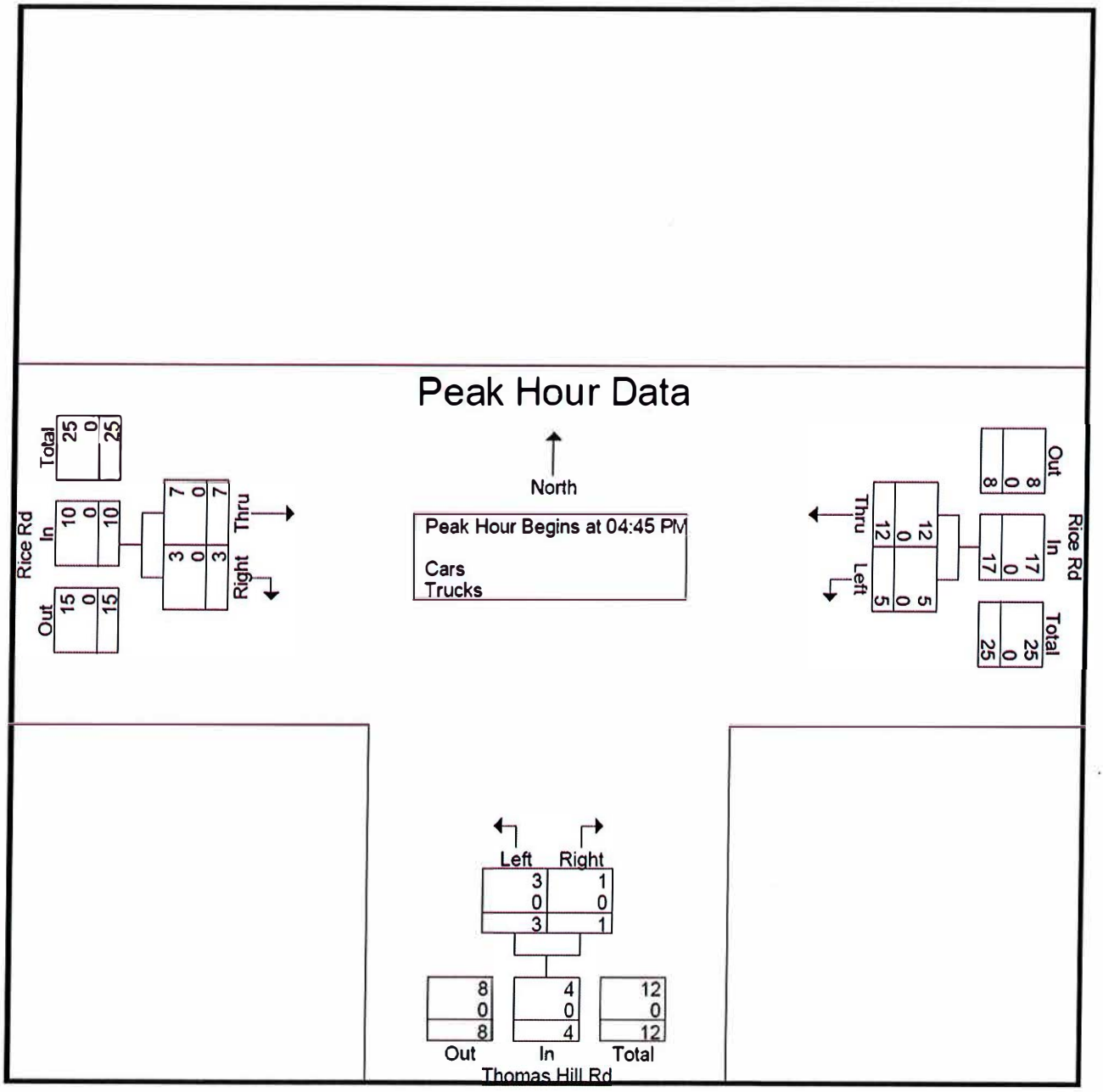
3. It is recommended that stop signs be installed for both the northbound approach of Thomas Hill Road and the southbound approach of the proposed site driveway at Rice Road.
4. Finally, it is recommended that a stop sign be installed for the eastbound approach of Rice Road at its intersection with Providence Street.

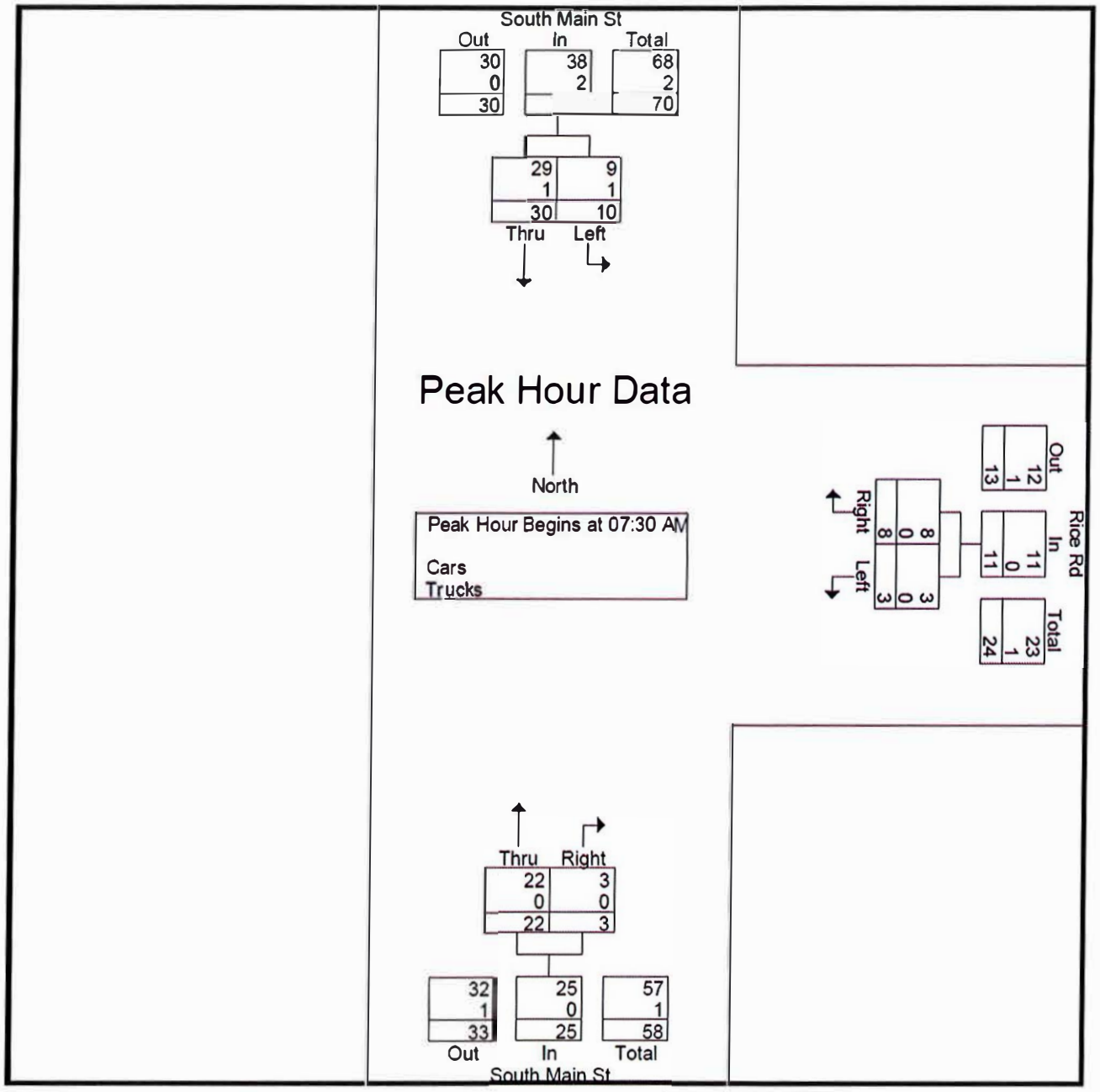
Technical Appendix


Providence St
Out
In
Total
198
6
204
146
3
149
344
9
353
5
0
5
141
3
144
Right
Thru
Peak Hour Data
North
Peak Hour Begins at 07:45 AM
Cars
Trucks
Rice Rd
Total
18
1
19
In
11
1
12
Out
7
0
7
7
1
8
Left
4
0
4
Right
Left
Thru
2
0
2
191
5
196
145
3
148
193
5
198
338
8
346
Out
In
Total
Providence St


Providence St
Out
In
Total
5
2
3
10
0
10
238
0
238
Right
Thru
Peak Hour Data
North
Peak Hour Begins at 04:00 PM
Cars
Trucks
Rice Rd
Total
24
0
24
In
8
0
8
Out
16
0
16
5
0
5
3
0
3
Left
Right
Left
Thru
6
0
6
188
2
190
241
0
241
194
2
196
435
2
437
Out
In
Total
Providence St


Peak Hour Data
North
Peak Hour Begins at 07:30 AM
Cars
Trucks
Rice Rd
Total
26
0
26
In
16
0
16
Out
10
0
10
11
0
11
5
0
5
Thru
Right
Rice Rd
Out
15
0
15
In
10
0
10
Total
25
0
25
Thru
7
0
7
Left
3
0
3
Left
Right
3
0
3
4
0
4
8
0
8
7
0
7
15
0
15
Out
In
Total
Thomas Hill Rd


Peak Hour Data
North
Peak Hour Begins at 04:45 PM
Cars
Trucks
Rice Rd
Total
25
0
25
In
10
0
10
Out
15
0
15
7
0
7
Thru
3
0
3
Right
Thru
12
0
12
Left
5
0
5
Out
8
0
8
In
17
0
17
Total
25
0
25
Left
Right
3
0
3
1
0
1
8
0
8
4
0
4
12
0
12
Out
In
Total
Thomas Hill Rd


South Main St
Out
In
Total
30
0
30
38
2
68
2
70
29
1
30
9
1
10
Thru
Left
Peak Hour Data
North
Peak Hour Begins at 07:30 AM
Cars
Trucks
Out
In
Total
12
1
13
11
0
11
23
1
24
Right
Left
8
0
8
3
0
3
Rice Rd
Thru
Right
22
0
22
3
0
3
32
1
33
25
0
25
57
1
58
Out
In
Total
South Main St

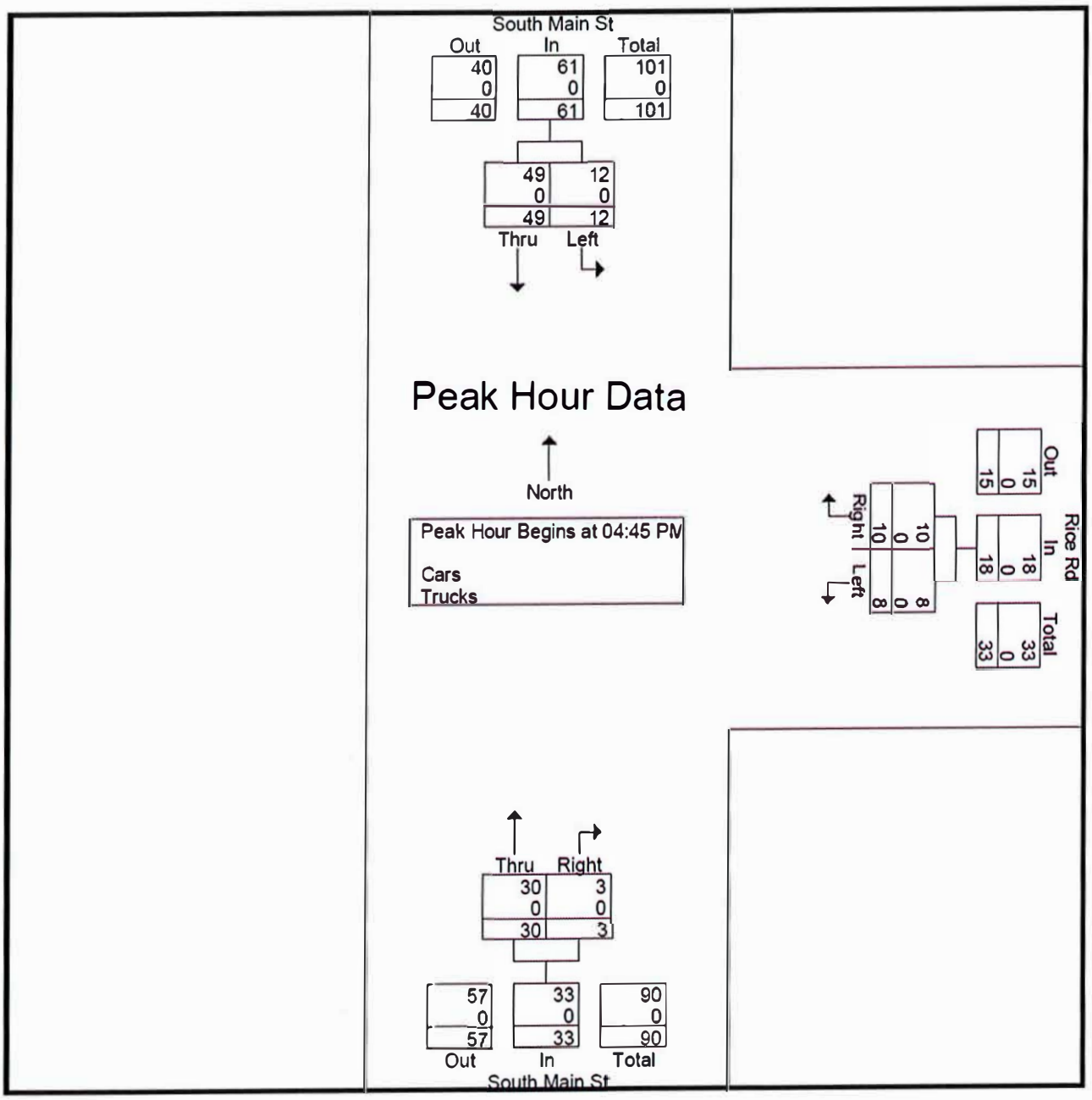
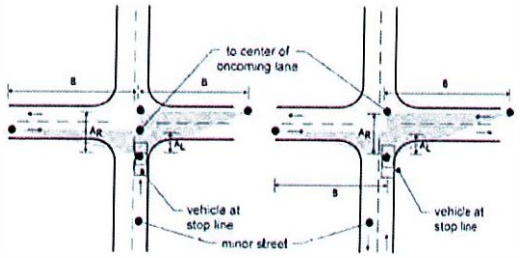

South Main St
Out
In
Total
40
0
40
61
0
61
101
0
101
49
0
49
12
0
12
Thru
Left
Peak Hour Data
North
Peak Hour Begins at 04:45 PM
Cars
Trucks
Out
15
0
15
Rice Rd
In
18
0
18
Total
33
0
33
Right
10
0
10
Left
8
0
8
Thru
Right
30
0
30
3
0
3
57
0
57
33
0
33
90
0
90
Out
In
Total
South Main St

Exhibit 3-8
Motor Vehicle Stopping Sight Distances

	Stopping Sight Distance (ft) by Percent Grade (%)						
		Downgrade			Upgrade		
Design Speed	0	3	6	9	3	6	9
20	115	116	120	126	109	107	104
25	155	158	165	173	147	143	140
30	200	205	215	227	200	184	179
35	250	257	271	287	237	229	222
40	305	315	333	354	289	278	269
45	360	378	400	427	344	331	320
50	425	446	474	507	405	388	375
55	495	520	553	593	469	450	433
60	570	598	638	686	538	515	495
65	645	682	728	785	612	584	561
70	730	771	825	891	690	658	631
75	820	866	927	1003	772	736	704

Source: A Policy on Geometric Design of Streets and Highways, AASHTO, Washington DC, 2004, Chapter 3 Elements of Design

Exhibit 3-11
Sight Triangle Case B
Departure Sight Triangles



for right turns and through movement

for left turns

Sight Triangle Legs: Case B – Stop Control on Cross Street

	Length of Sight Triangle Legs (feet)			
Major Street Design Speed (mph)	Minor Street for Vehicles Approaching From Right (AR, feet)	Minor Street for Vehicles Approaching From Left (AL, feet)	Major Street For Left Turns (B, feet)	Major Street for Right Turns or Through (B, feet)
15	325	205	170	145
20	325	205	225	195
25	325	205	280	240
30	325	205	335	290
35	325	205	390	335
40	325	205	445	385
45	325	205	500	430
50	325	205	555	480
55	325	205	610	530
60	325	205	665	575
65	325	205	720	625
70	325	205	775	670
75	325	205	830	720

Sight triangle legs shown are for passenger car crossing or turning into a two-lane street, with grades 3 percent or flatter. For other grades and for other major street widths, recalculate using AASHTO Green Book formulas.
Source: A Policy on Geometric Design of Streets and Highways, AASHTO, Washington DC, 2004, Chapter 3 Elements of Design

MassDOT Yearly Growth Rates

Data from 2014 to 2018

Growth Factors					
Group	Grow 2014 to 2015	Grow 2015 to 2016	Grow 2016 to 2017	Grow 2017 to 2018	Grow 2018 to 2019
R1	0	0.023	0.004	0.018	0.016
R2	0.05	0.068	0.004	0.014	0.014
R3	-0.038	0.002	0.008	0.011	0.06
R4-7	-0.01	0.003	0.001	0.011	0.012
Rec - East		0.032	0.02	0.041	0.025
Rec - West		0.051	-0.008	0.029	0
U1-Boston	0.061	0.07	-0.003	0.012	0.006
U1-Essex	0.024	0.025	0.007	0.014	0.011
U1-Southeast	0.05	0.062	0.021	0.014	0
U1-West	0.03	-0.027	0.02	0.028	0.013
U1-Worcester	0.042	0.005	0.018	0.01	0.01
U2	0.04	0.048	0.008	0.01	0.02
U3	0.011	0.013	0.011	0.014	0.004
U4-7	0.023	0.062	0.017	0.003	-0.004

updated
5/1/2020

Massachusetts Highway Department
Statewide Traffic Data Collection
2019 Weekday Seasonal Factors

Factor Group	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	Axle Factor
R1	1.22	1.14	1.12	1.06	1.00	0.96	0.87	0.85	0.96	0.99	1.04	1.12	0.85
R2	0.95	0.96	0.98	0.97	0.97	0.93	0.97	0.94	0.96	0.90	0.92	0.93	0.96
R3	1.15	1.06	1.07	1.00	0.89	0.88	0.89	0.89	0.95	0.92	1.02	1.01	0.97
R4-R7	1.09	1.09	1.11	1.02	0.96	0.92	0.89	0.89	0.99	0.98	1.09	1.13	0.98
U1-Boston	1.03	1.01	0.98	0.94	0.94	0.92	0.95	0.93	0.94	0.94	0.97	1.04	0.96
U1-Essex	1.09	1.06	1.03	0.99	0.94	0.90	0.88	0.86	0.93	0.94	0.99	1.06	0.93
U1-Southeast	1.06	1.05	1.01	0.97	0.95	0.93	0.93	0.90	0.94	0.94	0.98	1.04	0.98
U1-West	1.19	1.14	1.09	0.95	0.92	0.89	0.89	0.86	0.91	0.95	0.97	1.07	0.84
U1-Worcester	1.02	1.04	0.97	0.94	0.93	0.91	0.95	0.91	0.93	0.92	0.95	1.10	0.88
U2	1.01	1.00	0.94	0.93	0.91	0.89	0.93	0.90	0.90	0.91	0.94	1.02	0.99
U3	1.06	1.03	0.98	0.94	0.93	0.91	0.95	0.91	0.92	0.93	0.97	1.00	0.98
U4-U7	1.01	1.00	0.95	0.92	0.88	0.86	0.92	0.91	0.92	0.94	0.99	1.04	0.99
Rec - East	1.04	1.16	1.12	0.98	0.92	0.88	0.77	0.81	0.94	1.02	1.08	1.12	0.99
Rec- West	1.30	1.23	1.32	1.18	0.95	0.82	0.70	0.69	0.97	0.96	1.16	1.15	0.98

Round off:
0-999 = 10
>1000 = 100

U = Urban
R = Rural

1 - Interstate
2 - Freeway and Expressway
3 - Other Principal Arterial
4 - Minor Arterial
5 - Major Collector
6 - Minor Collector
7 - Local Road and Street

Recreational - East Group - Cape Cod (all towns) including the town of Plymouth south of Route 3A (stations 7014,7079,7080,7090,7091,7092,7093,7094,7095,7096,7097,7108 and 7178), Martha's Vineyard and Nantucket.
Recreational - West Group - Continuous Stations 2 and 189 including stations 1066,1067,1083,1084,1085,1086,1087,1088,1089,1090,1091,1092,1093,1094,1095,1096,1097,1098,1099,1100,1101,1102,1103,1104,1105,1106,1107,1108,1113,1114, 1116,2196,2197 and 2198.

5/31/2020

ITE Trip Generation Data

DATA STATISTICS

Land Use:
Multifamily Housing (Mid-Rise) (221)
Click for Description and Data Plots

Independent Variable:

Dwelling Units

Time Period:

Weekday

Setting/Location:

General Urban/Suburban

Trip Type:

Vehicle

Number of Studies:

27

Avg. Num. of Dwelling Units:
205

Average Rate:

5.44

Range of Rates:

1.27 - 12.50

Standard Deviation:

2.03

Fitted Curve Equation:

T = 5.45(X) - 1.75

R^2:

0.77

Directional Distribution:

50% entering, 50% exiting

Calculated Trip Ends:

Average Rate: 1044 (Total), 522 (Entry), 522 (Exit)
Fitted Curve: 1045 (Total), 522 (Entry), 523 (Exit)

DATA STATISTICS

Land Use:
Multifamily Housing (Mid-Rise) (221)
Click for Description and Data Plots

Independent Variable:

Dwelling Units

Time Period:

Weekday
Peak Hour of Adjacent Street Traffic
One Hour Between 7 and 9 a.m.

Setting/Location:

General Urban/Suburban

Trip Type:

Vehicle

Number of Studies:

53

Avg. Num. of Dwelling Units:
207

Average Rate:

0.36

Range of Rates:

0.06 - 1.61

Standard Deviation:

0.19

Fitted Curve Equation:

Ln(T) = 0.98 Ln(X) - 0.98

R^2:

0.67

Directional Distribution:

26% entering, 74% exiting

Calculated Trip Ends:

Average Rate: 69 (Total), 18 (Entry), 51 (Exit)

DATA STATISTICS

Land Use:
Multifamily Housing (Mid-Rise) (221)
Click for Description and Data Plots

Independent Variable:

Dwelling Units

Time Period:

Weekday
Peak Hour of Adjacent Street Traffic
One Hour Between 4 and 6 p.m.

Setting/Location:

General Urban/Suburban

Trip Type:

Vehicle

Number of Studies:

60

Avg. Num. of Dwelling Units:
208

Average Rate:

0.44

Range of Rates:

0.15 - 1.11

Standard Deviation:

0.19

Fitted Curve Equation:

Ln(T) = 0.96 Ln(X) - 0.63

R^2:

0.72

Directional Distribution:

61% entering, 39% exiting

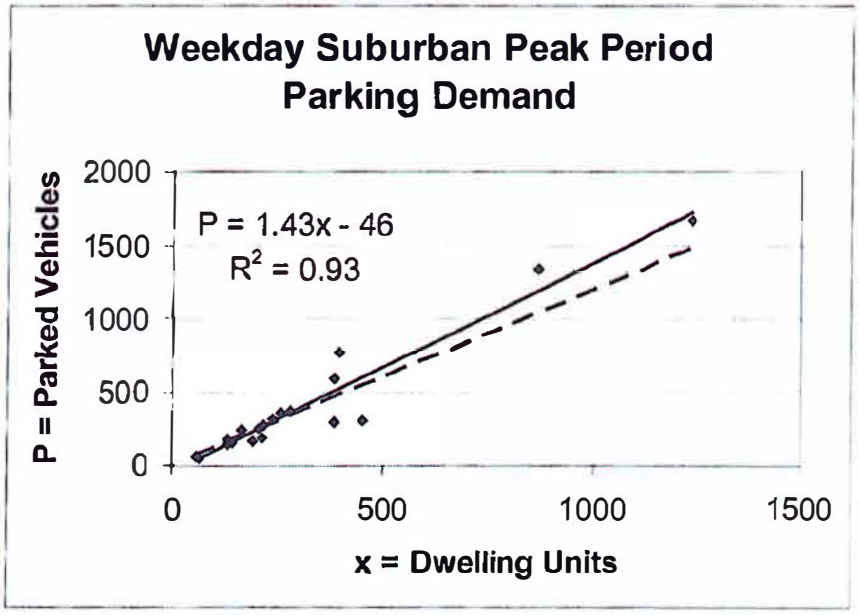
Calculated Trip Ends:

Average Rate: 84 (Total), 51 (Entry), 33 (Exit)

Land Use: 221
Low/Mid-Rise Apartment

Average Peak Period Parking Demand vs: Dwelling Units
On a: Weekday
Location: Suburban

Statistic	Peak Period Demand
Peak Period	12:00–5:00 a.m.
Number of Study Sites	19
Average Size of Study Sites	320 dwelling units
Average Peak Period Parking Demand	1.20 vehicles per dwelling unit
Standard Deviation	0.32
Coefficient of Variation	26%
Range	0.68–1.94 vehicles per dwelling unit
85th Percentile	1.46 vehicles per dwelling unit
33rd Percentile	1.09 vehicles per dwelling unit



Providence at Rice AM Peak Existing

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Sign Control	Stop			Free	Free	
Grade	0%			0%	0%	
Volume (veh/h)	9	4	2	223	164	6
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (veh/h)	10	4	2	242	178	7
Pedestrians						
Lane Width (ft)						
Walking Speed (ft/s)						
Percent Blockage						
Right turn flare (veh)						
Median type	None					
Median storage veh)						
vC, conflicting volume	428	182	185			
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
tC, single (s)	6.4	6.2	4.1			
tC, 2 stage (s)						
tF (s)	3.5	3.3	2.2			
p0 queue free %	98	99	100			
cM capacity (veh/h)	583	861	1390			

Direction, Lane #	EB 1	NB 1	SB 1
Volume Total	14	245	185
Volume Left	10	2	0
Volume Right	4	0	7
cSH	647	1390	1700
Volume to Capacity	0.02	0.00	0.11
Queue Length (ft)	2	0	0
Control Delay (s)	10.7	0.1	0.0
Lane LOS	B	A	
Approach Delay (s)	10.7	0.1	0.0
Approach LOS	B		

Intersection Summary			
Average Delay		0.4	
Intersection Capacity Utilization		23.2%	ICU Level of Service A

Providence at Rice PM Peak Existing

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Sign Control	Stop			Free	Free	
Grade	0%			0%	0%	
Volume (veh/h)	6	3	7	216	266	11
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (veh/h)	7	3	8	235	289	12
Pedestrians						
Lane Width (ft)						
Walking Speed (ft/s)						
Percent Blockage						
Right turn flare (veh)						
Median type	None					
Median storage veh)						
vC, conflicting volume	545	295	301			
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
tC, single (s)	6.4	6.2	4.1			
tC, 2 stage (s)						
tF (s)	3.5	3.3	2.2			
p0 queue free %	99	100	99			
cM capacity (veh/h)	496	744	1260			

Direction, Lane #	EB 1	NB 1	SB 1
Volume Total	10	242	301
Volume Left	7	8	0
Volume Right	3	0	12
cSH	558	1260	1700
Volume to Capacity	0.02	0.01	0.18
Queue Length (ft)	1	0	0
Control Delay (s)	11.6	0.3	0.0
Lane LOS	B	A	
Approach Delay (s)	11.6	0.3	0.0
Approach LOS	B		

Intersection Summary			
Average Delay	0.3		
Intersection Capacity Utilization	25.9%	ICU Level of Service	A

Rice at Thomas Hill AM Peak Existing

Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations						
Sign Control	Free			Free	Stop	
Grade	0%			0%	0%	
Volume (veh/h)	12	6	3	8	3	4
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (veh/h)	13	7	3	9	3	4
Pedestrians						
Lane Width (ft)						
Walking Speed (ft/s)						
Percent Blockage						
Right turn flare (veh)						
Median type					None	
Median storage veh)						
vC, conflicting volume			20		32	16
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
tC, single (s)			4.1		6.4	6.2
tC, 2 stage (s)						
tF (s)			2.2		3.5	3.3
p0 queue free %			100		100	100
cM capacity (veh/h)			1597		980	1063

Direction, Lane #	EB 1	WB 1	NB 1
Volume Total	20	12	8
Volume Left	0	3	3
Volume Right	7	0	4
cSH	1700	1597	1026
Volume to Capacity	0.01	0.00	0.01
Queue Length (ft)	0	0	1
Control Delay (s)	0.0	2.0	8.5
Lane LOS		A	A
Approach Delay (s)	0.0	2.0	8.5
Approach LOS			A

Intersection Summary			
Average Delay		2.3	
Intersection Capacity Utilization		13.3%	ICU Level of Service A

Rice at Thomas Hill PM Peak Existing

Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations						
Sign Control	Free			Free	Stop	
Grade	0%			0%	0%	
Volume (veh/h)	8	3	6	13	3	1
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (veh/h)	9	3	7	14	3	1
Pedestrians						
Lane Width (ft)						
Walking Speed (ft/s)						
Percent Blockage						
Right turn flare (veh)						
Median type					None	
Median storage veh)						
vC, conflicting volume			12		38	10
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
tC, single (s)			4.1		6.4	6.2
tC, 2 stage (s)						
tF (s)			2.2		3.5	3.3
p0 queue free %			100		100	100
cM capacity (veh/h)			1607		971	1071

Direction, Lane #	EB 1	WB 1	NB 1
Volume Total	12	21	4
Volume Left	0	7	3
Volume Right	3	0	1
cSH	1700	1607	994
Volume to Capacity	0.01	0.00	0.00
Queue Length (ft)	0	0	0
Control Delay (s)	0.0	2.3	8.6
Lane LOS		A	A
Approach Delay (s)	0.0	2.3	8.6
Approach LOS			A

Intersection Summary			
Average Delay		2.3	
Intersection Capacity Utilization		13.3%	ICU Level of Service A

S Main at Rice AM Peak Existing

Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Sign Control	Stop		Free			Free
Grade	0%		0%			0%
Volume (veh/h)	3	9	24	3	11	34
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (veh/h)	3	10	26	3	12	37
Pedestrians						
Lane Width (ft)						
Walking Speed (ft/s)						
Percent Blockage						
Right turn flare (veh)						
Median type	None					
Median storage veh)						
vC, conflicting volume	89	28			29	
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
tC, single (s)	6.4	6.2			4.1	
tC, 2 stage (s)						
tF (s)	3.5	3.3			2.2	
p0 queue free %	100	99			99	
cM capacity (veh/h)	905	1048			1584	

Direction, Lane #	WB 1	WB 2	NB 1	SB 1
Volume Total	3	10	29	49
Volume Left	3	0	0	12
Volume Right	0	10	3	0
cSH	905	1048	1700	1584
Volume to Capacity	0.00	0.01	0.02	0.01
Queue Length (ft)	0	1	0	1
Control Delay (s)	9.0	8.5	0.0	1.8
Lane LOS	A	A		A
Approach Delay (s)	8.6		0.0	1.8
Approach LOS	A			

Intersection Summary			
Average Delay	2.2		
Intersection Capacity Utilization	13.3%	ICU Level of Service	A

S Main at Rice PM Peak Existing

Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Sign Control	Stop		Free			Free
Grade	0%		0%			0%
Volume (veh/h)	9	11	33	3	13	54
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (veh/h)	10	12	36	3	14	59
Pedestrians						
Lane Width (ft)						
Walking Speed (ft/s)						
Percent Blockage						
Right turn flare (veh)						
Median type	None					
Median storage veh)						
vC, conflicting volume	124	38			39	
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
tC, single (s)	6.4	6.2			4.1	
tC, 2 stage (s)						
tF (s)	3.5	3.3			2.2	
p0 queue free %	99	99			99	
cM capacity (veh/h)	863	1035			1571	

Direction, Lane #	WB 1	WB 2	NB 1	SB 1
Volume Total	10	12	39	73
Volume Left	10	0	0	14
Volume Right	0	12	3	0
cSH	863	1035	1700	1571
Volume to Capacity	0.01	0.01	0.02	0.01
Queue Length (ft)	1	1	0	1
Control Delay (s)	9.2	8.5	0.0	1.5
Lane LOS	A	A		A
Approach Delay (s)	8.8		0.0	1.5
Approach LOS	A			

Intersection Summary			
Average Delay	2.2		
Intersection Capacity Utilization	14.0%	ICU Level of Service	A

Providence at Rice AM Peak Future No Build

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Sign Control	Stop			Free	Free	
Grade	0%			0%	0%	
Volume (veh/h)	9	4	2	227	167	6
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (veh/h)	10	4	2	247	182	7
Pedestrians						
Lane Width (ft)						
Walking Speed (ft/s)						
Percent Blockage						
Right turn flare (veh)						
Median type	None					
Median storage veh)						
vC, conflicting volume	436	185	188			
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
tC, single (s)	6.4	6.2	4.1			
tC, 2 stage (s)						
tF (s)	3.5	3.3	2.2			
p0 queue free %	98	99	100			
cM capacity (veh/h)	577	857	1386			

Direction, Lane #	EB 1	NB 1	SB 1
Volume Total	14	249	188
Volume Left	10	2	0
Volume Right	4	0	7
cSH	641	1386	1700
Volume to Capacity	0.02	0.00	0.11
Queue Length (ft)	2	0	0
Control Delay (s)	10.7	0.1	0.0
Lane LOS	B	A	
Approach Delay (s)	10.7	0.1	0.0
Approach LOS	B		

Intersection Summary			
Average Delay	0.4		
Intersection Capacity Utilization	23.5%	ICU Level of Service	A

Providence at Rice PM Peak Future No Build

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Sign Control	Stop			Free	Free	
Grade	0%			0%	0%	
Volume (veh/h)	6	3	7	220	276	11
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (veh/h)	7	3	8	239	300	12
Pedestrians						
Lane Width (ft)						
Walking Speed (ft/s)						
Percent Blockage						
Right turn flare (veh)						
Median type	None					
Median storage veh)						
vC, conflicting volume	560	306	312			
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
tC, single (s)	6.4	6.2	4.1			
tC, 2 stage (s)						
tF (s)	3.5	3.3	2.2			
p0 queue free %	99	100	99			
cM capacity (veh/h)	486	734	1248			

Direction, Lane #	EB 1	NB 1	SB 1
Volume Total	10	247	312
Volume Left	7	8	0
Volume Right	3	0	12
cSH	548	1248	1700
Volume to Capacity	0.02	0.01	0.18
Queue Length (ft)	1	0	0
Control Delay (s)	11.7	0.3	0.0
Lane LOS	B	A	
Approach Delay (s)	11.7	0.3	0.0
Approach LOS	B		

Intersection Summary			
Average Delay		0.3	
Intersection Capacity Utilization		26.5%	ICU Level of Service A

Rice at Thomas Hill AM Peak Future No Build

Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations						
Sign Control	Free			Free	Stop	
Grade	0%			0%	0%	
Volume (veh/h)	12	6	3	8	3	4
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (veh/h)	13	7	3	9	3	4
Pedestrians						
Lane Width (ft)						
Walking Speed (ft/s)						
Percent Blockage						
Right turn flare (veh)						
Median type					None	
Median storage veh)						
vC, conflicting volume			20		32	16
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
tC, single (s)			4.1		6.4	6.2
tC, 2 stage (s)						
tF (s)			2.2		3.5	3.3
p0 queue free %			100		100	100
cM capacity (veh/h)			1597		980	1063

Direction, Lane #	EB 1	WB 1	NB 1
Volume Total	20	12	8
Volume Left	0	3	3
Volume Right	7	0	4
cSH	1700	1597	1026
Volume to Capacity	0.01	0.00	0.01
Queue Length (ft)	0	0	1
Control Delay (s)	0.0	2.0	8.5
Lane LOS		A	A
Approach Delay (s)	0.0	2.0	8.5
Approach LOS			A

Intersection Summary			
Average Delay		2.3	
Intersection Capacity Utilization		13.3%	ICU Level of Service A

Rice at Thomas Hill PM Peak Future No Build

Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations						
Sign Control	Free			Free	Stop	
Grade	0%			0%	0%	
Volume (veh/h)	8	3	6	13	3	1
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (veh/h)	9	3	7	14	3	1
Pedestrians						
Lane Width (ft)						
Walking Speed (ft/s)						
Percent Blockage						
Right turn flare (veh)						
Median type					None	
Median storage veh)						
vC, conflicting volume			12		38	10
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
tC, single (s)			4.1		6.4	6.2
tC, 2 stage (s)						
tF (s)			2.2		3.5	3.3
p0 queue free %			100		100	100
cM capacity (veh/h)			1607		971	1071

Direction, Lane #	EB 1	WB 1	NB 1
Volume Total	12	21	4
Volume Left	0	7	3
Volume Right	3	0	1
cSH	1700	1607	994
Volume to Capacity	0.01	0.00	0.00
Queue Length (ft)	0	0	0
Control Delay (s)	0.0	2.3	8.6
Lane LOS		A	A
Approach Delay (s)	0.0	2.3	8.6
Approach LOS			A

Intersection Summary			
Average Delay		2.3	
Intersection Capacity Utilization		13.3%	ICU Level of Service A

S Main at Rice AM Peak Future No Build

Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Sign Control	Stop		Free			Free
Grade	0%		0%			0%
Volume (veh/h)	3	9	24	3	11	37
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (veh/h)	3	10	26	3	12	40
Pedestrians						
Lane Width (ft)						
Walking Speed (ft/s)						
Percent Blockage						
Right turn flare (veh)						
Median type	None					
Median storage veh)						
vC, conflicting volume	92	28			29	
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
tC, single (s)	6.4	6.2			4.1	
tC, 2 stage (s)						
tF (s)	3.5	3.3			2.2	
p0 queue free %	100	99			99	
cM capacity (veh/h)	901	1048			1584	

Direction, Lane #	WB 1	WB 2	NB 1	SB 1
Volume Total	3	10	29	52
Volume Left	3	0	0	12
Volume Right	0	10	3	0
cSH	901	1048	1700	1584
Volume to Capacity	0.00	0.01	0.02	0.01
Queue Length (ft)	0	1	0	1
Control Delay (s)	9.0	8.5	0.0	1.7
Lane LOS	A	A		A
Approach Delay (s)	8.6		0.0	1.7
Approach LOS	A			

Intersection Summary			
Average Delay	2.1		
Intersection Capacity Utilization	13.3%	ICU Level of Service	A

S Main at Rice PM Peak Future No Build

Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Sign Control	Stop		Free			Free
Grade	0%		0%			0%
Volume (veh/h)	9	11	35	3	14	56
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (veh/h)	10	12	38	3	15	61
Pedestrians						
Lane Width (ft)						
Walking Speed (ft/s)						
Percent Blockage						
Right turn flare (veh)						
Median type	None					
Median storage veh)						
vC, conflicting volume	131	40			41	
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
tC, single (s)	6.4	6.2			4.1	
tC, 2 stage (s)						
tF (s)	3.5	3.3			2.2	
p0 queue free %	99	99			99	
cM capacity (veh/h)	855	1032			1568	

Direction, Lane #	WB 1	WB 2	NB 1	SB 1
Volume Total	10	12	41	76
Volume Left	10	0	0	15
Volume Right	0	12	3	0
cSH	855	1032	1700	1568
Volume to Capacity	0.01	0.01	0.02	0.01
Queue Length (ft)	1	1	0	1
Control Delay (s)	9.3	8.5	0.0	1.5
Lane LOS	A	A		A
Approach Delay (s)	8.9		0.0	1.5
Approach LOS	A			

Intersection Summary			
Average Delay	2.2		
Intersection Capacity Utilization	14.3%	ICU Level of Service	A

Providence at Rice AM Peak Future Build

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Sign Control	Stop			Free	Free	
Grade	0%			0%	0%	
Volume (veh/h)	27	17	5	227	167	9
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (veh/h)	29	18	5	247	182	10
Pedestrians						
Lane Width (ft)						
Walking Speed (ft/s)						
Percent Blockage						
Right turn flare (veh)						
Median type	None					
Median storage veh)						
vC, conflicting volume	444	186	191			
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
tC, single (s)	6.4	6.2	4.1			
tC, 2 stage (s)						
tF (s)	3.5	3.3	2.2			
p0 queue free %	95	98	100			
cM capacity (veh/h)	569	856	1382			

Direction, Lane #	EB 1	NB 1	SB 1
Volume Total	48	252	191
Volume Left	29	5	0
Volume Right	18	0	10
cSH	654	1382	1700
Volume to Capacity	0.07	0.00	0.11
Queue Length (ft)	6	0	0
Control Delay (s)	10.9	0.2	0.0
Lane LOS	B	A	
Approach Delay (s)	10.9	0.2	0.0
Approach LOS	B		

Intersection Summary			
Average Delay	1.2		
Intersection Capacity Utilization	24.3%	ICU Level of Service	A

Providence at Rice PM Peak Future Build

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Sign Control	Stop			Free	Free	
Grade	0%			0%	0%	
Volume (veh/h)	14	9	27	220	276	23
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (veh/h)	15	10	29	239	300	25
Pedestrians						
Lane Width (ft)						
Walking Speed (ft/s)						
Percent Blockage						
Right turn flare (veh)						
Median type	None					
Median storage veh)						
vC, conflicting volume	610	312	325			
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
tC, single (s)	6.4	6.2	4.1			
tC, 2 stage (s)						
tF (s)	3.5	3.3	2.2			
p0 queue free %	97	99	98			
cM capacity (veh/h)	447	728	1235			

Direction, Lane #	EB 1	NB 1	SB 1
Volume Total	25	268	325
Volume Left	15	29	0
Volume Right	10	0	25
cSH	526	1235	1700
Volume to Capacity	0.05	0.02	0.19
Queue Length (ft)	4	2	0
Control Delay (s)	12.2	1.1	0.0
Lane LOS	B	A	
Approach Delay (s)	12.2	1.1	0.0
Approach LOS	B		

Intersection Summary			
Average Delay		1.0	
Intersection Capacity Utilization		34.6%	ICU Level of Service A

Rice at Thomas Hill AM Peak Future Build

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		↔			↔			↔			↔	
Sign Control		Free			Free			Stop			Stop	
Grade		0%			0%			0%			0%	
Volume (veh/h)	12	12	6	3	8	6	3	0	4	31	0	20
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (veh/h)	13	13	7	3	9	7	3	0	4	34	0	22
Pedestrians												
Lane Width (ft)												
Walking Speed (ft/s)												
Percent Blockage												
Right turn flare (veh)												
Median type								None			None	
Median storage veh)												
vC, conflicting volume	15			20			83	64	16	65	64	12
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
tC, single (s)	4.1			4.1			7.1	6.5	6.2	7.1	6.5	6.2
tC, 2 stage (s)												
tF (s)	2.2			2.2			3.5	4.0	3.3	3.5	4.0	3.3
p0 queue free %	99			100			100	100	100	96	100	98
cM capacity (veh/h)	1603			1597			879	818	1063	917	818	1069

Direction, Lane #	EB 1	WB 1	NB 1	SB 1
Volume Total	33	18	8	55
Volume Left	13	3	3	34
Volume Right	7	7	4	22
cSH	1603	1597	976	971
Volume to Capacity	0.01	0.00	0.01	0.06
Queue Length (ft)	1	0	1	5
Control Delay (s)	2.9	1.3	8.7	8.9
Lane LOS	A	A	A	A
Approach Delay (s)	2.9	1.3	8.7	8.9
Approach LOS			A	A

Intersection Summary				
Average Delay		6.0		
Intersection Capacity Utilization	13.3%	ICU Level of Service	A	

Rice at Thomas Hill PM Peak Future Build

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		✣			✣			✣			✣	
Sign Control		Free			Free			Stop			Stop	
Grade		0%			0%			0%			0%	
Volume (veh/h)	9	8	3	6	13	32	3	0	1	14	0	19
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (veh/h)	10	9	3	7	14	35	3	0	1	15	0	21
Pedestrians												
Lane Width (ft)												
Walking Speed (ft/s)												
Percent Blockage												
Right turn flare (veh)												
Median type								None			None	
Median storage veh)												
vC, conflicting volume	49			12			95	92	10	76	76	32
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
tC, single (s)	4.1			4.1			7.1	6.5	6.2	7.1	6.5	6.2
tC, 2 stage (s)												
tF (s)	2.2			2.2			3.5	4.0	3.3	3.5	4.0	3.3
p0 queue free %	99			100			100	100	100	98	100	98
cM capacity (veh/h)	1558			1607			863	790	1071	906	806	1042

Direction, Lane #	EB 1	WB 1	NB 1	SB 1
Volume Total	22	55	4	36
Volume Left	10	7	3	15
Volume Right	3	35	1	21
cSH	1558	1607	907	980
Volume to Capacity	0.01	0.00	0.00	0.04
Queue Length (ft)	0	0	0	3
Control Delay (s)	3.3	0.9	9.0	8.8
Lane LOS	A	A	A	A
Approach Delay (s)	3.3	0.9	9.0	8.8
Approach LOS			A	A

Intersection Summary				
Average Delay		4.1		
Intersection Capacity Utilization		13.3%	ICU Level of Service	A

S Main at Rice AM Peak Future Build

Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Sign Control	Stop		Free			Free
Grade	0%		0%			0%
Volume (veh/h)	15	17	24	8	18	37
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (veh/h)	16	18	26	9	20	40
Pedestrians						
Lane Width (ft)						
Walking Speed (ft/s)						
Percent Blockage						
Right turn flare (veh)						
Median type	None					
Median storage veh)						
vC, conflicting volume	110	30			35	
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
tC, single (s)	6.4	6.2			4.1	
tC, 2 stage (s)						
tF (s)	3.5	3.3			2.2	
p0 queue free %	98	98			99	
cM capacity (veh/h)	876	1044			1577	

Direction, Lane #	WB 1	WB 2	NB 1	SB 1
Volume Total	16	18	35	60
Volume Left	16	0	0	20
Volume Right	0	18	9	0
cSH	876	1044	1700	1577
Volume to Capacity	0.02	0.02	0.02	0.01
Queue Length (ft)	1	1	0	1
Control Delay (s)	9.2	8.5	0.0	2.5
Lane LOS	A	A		A
Approach Delay (s)	8.8		0.0	2.5
Approach LOS	A			

Intersection Summary			
Average Delay	3.5		
Intersection Capacity Utilization	13.3%	ICU Level of Service	A

S Main at Rice PM Peak Future Build

Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Sign Control	Stop		Free			Free
Grade	0%		0%			0%
Volume (veh/h)	20	19	35	10	26	56
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (veh/h)	22	21	38	11	28	61
Pedestrians						
Lane Width (ft)						
Walking Speed (ft/s)						
Percent Blockage						
Right turn flare (veh)						
Median type	None					
Median storage veh)						
vC, conflicting volume	161	43			49	
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
tC, single (s)	6.4	6.2			4.1	
tC, 2 stage (s)						
tF (s)	3.5	3.3			2.2	
p0 queue free %	97	98			98	
cM capacity (veh/h)	815	1027			1558	

Direction, Lane #	WB 1	WB 2	NB 1	SB 1
Volume Total	22	21	49	89
Volume Left	22	0	0	28
Volume Right	0	21	11	0
cSH	815	1027	1700	1558
Volume to Capacity	0.03	0.02	0.03	0.02
Queue Length (ft)	2	2	0	1
Control Delay (s)	9.5	8.6	0.0	2.4
Lane LOS	A	A		A
Approach Delay (s)	9.1		0.0	2.4
Approach LOS	A			

Intersection Summary			
Average Delay	3.3		
Intersection Capacity Utilization	16.1%	ICU Level of Service	A