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City of Rochester
Planning & Development
Attn: Mr. Ryan O'Connor, Senior Planner
33 Wakefield Street
Rochester, NH 03867

September 28, 2022

Re: Subdivision Design Review Submission
Traffic Memorandums
Roadrunner Real Estate, LLC
Elizabeth Dunnells
797 Portland Street
Tax Map 108, Lot 50

Mr. O'Connor,

Enclosed please find the following material in support of the proposed project at 797 Portland Street:

- Four copies of the Traffic Memorandum by BS&E
- Four copies of the Traffic Assessment Memorandum (TAM) by TEPP, LLC

Thank you for your time and attention to this matter.

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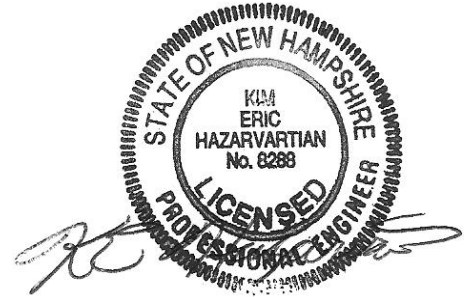


Christopher R. Berry
Principal, President

MEMORANDUM

93 Stiles Road, Suite 201, Salem, New Hampshire 03079 USA
800 Turnpike Street, Suite 300, North Andover, Massachusetts 01845 USA
Phone (603) 212-9133 and Fax (603) 226-4108
Email tepp@teppllc.com and Web www.teppllc.com

Ref: 1619
Subject: Preliminary Traffic Assessment
Portland Street/Grove Street/
Crow Hill Road/Green Street Intersection
Rochester, New Hampshire
From: Kim Eric Hazarvartian, Ph.D., P.E., PTOE
Principal
Date: September 28, 2022

**INTRODUCTION**

Berry Survey & Engineering (BS&E) has retained TEPP LLC to prepare this preliminary traffic-assessment memorandum (TAM). This TAM regards the Portland Street/Grove Street/Crow Hill Road multileg intersection in the City Rochester, New Hampshire.

This TAM concludes that the City may wish to consider reversing the direction of the Green Street leg to one way away from the intersection. The evaluation could consider emergency response, area schools, area recreational facilities, and area residents.

EXISTING INTERSECTION DESCRIPTION

The intersection:

- is under the jurisdiction of the City
- is five legged
- has Portland Street as the major north-south street
- has Grove Street as the minor west leg
- has Crow Hill Road as the minor east leg
- has Green Street as the minor northeast leg
- has one-lane approaches and departures as applicable
- has Green Street as one way toward the intersection, with a channelized left turn to Crow Hill Road
- has the minor-street approaches and the channelized left turn under STOP-sign control

- has a marked crosswalk across the legs, including a crosswalk on the Portland Street about 50 feet north of the intersection proper
- has no marked crosswalk across the channelized left turn
- has no marked crosswalk across the channelized left turn
- has sidewalk at corner radii
- is illuminated
- has residential development nearby

Regarding the intersecting streets:

- Portland Street functions as an arterial street with a speed limit of 30 miles per hour posted in the area
- the other streets function as local streets

EXISTING TRAFFIC VOLUMES

BS&E conducted traffic counts:

- during September 2022
- including the weekday AM and PM peak hours
- presented separately by BS&E
- indicating 30 or fewer peak-hour vehicle-trips entering the intersection from Green Street

POLICY ON GEOMETRIC DESIGN

The American Association of State Highway and Transportation Officials (AASHTO)¹ states the basic “intersection types are three-leg (T), four leg, multileg, and roundabouts.”² The Portland Street/Grove Street/Crow Hill Road intersection is a multileg intersection.

AASHTO continues that traffic “operational efficiency [at multileg intersections] can be improved by reconfigurations that remove some minor-roadway conflicting movements from the major intersection. Such reconfigurations are accomplished by realigning or more of the intersecting legs and combining some of the traffic movements at adjacent subsidiary intersections.”³ This means of reconfiguration breaks the one multileg intersection into at least two intersections,

¹ AASHTO, *A Policy on Geometric Design of Highways and Streets*, 7th Edition (Washington, DC, 2018).

² AASHTO, page 9-11.

³ AASHTO, page 9-24.

with no intersection having more than four legs. However, this often involves significant disruption and capital cost.

POTENTIAL MODIFICATION

A potential smaller-scope modification is reversing the direction of the Green Street leg to one way away from the intersection.

Such a modification could:

- remove four movements (Green Street to Portland Street northbound, to Portland Street southbound, to Grove Street, and to Crow Hill Road)
- involve low traffic volumes on Green Street
- involve less disruption and capital cost than significant physical modifications

CONCLUSION

The City may wish to consider reversing the direction of the Green Street leg to one way away from the Portland Street/Grove Street/Crow Hill Road multileg intersection. The evaluation could consider emergency response, area schools, area recreational facilities, and area residents.



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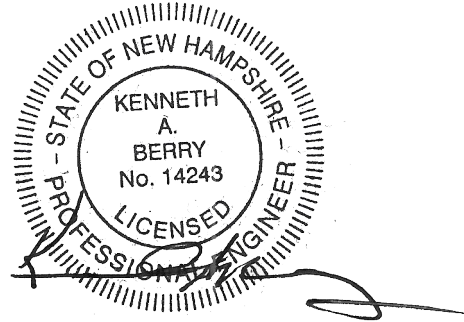
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City of Rochester Planning Department
Attention: Mr. Ryan O'Connor, Senior Planner
33 Wakefield Street
Rochester, NH 03867

September 26, 2022

RE: Memorandum
Trip Generation and Distribution
Roadrunner Real Estate, LLC
Tax Map 108, Lot 50
797 Portland Street
Rochester, NH 03867



Mr. O'Connor,

Berry Surveying & Engineering (BS&E), on behalf of Roadrunner Real Estate, LLC has prepared a Trip Generation and Distribution for the development of 16 duplex structures (32 total units) on Tax Map 108, Lot 50. Tibetan Drive is the proposed means of ingress/egress for the units, located off of Crow Hill Road. Due to the characteristics of Crow Hill Road, the point of analysis is the five legged intersection of Portland Street/Crow Hill Road/Green Street/Grove Street. BS&E has retained Kim Eric Hazarvartian, Ph.D., P.E., PTOE of TEPP, LLC regarding the function and operation of this five-legged intersection.

The following conclusions were reached as a result Traffic Impact Analysis:

- A total of 26 vehicle trips (7 enter/19 exit) are predicted to occur at the weekday AM peak hour and 34 vehicle trips (21 enter/13 exit) at the PM peak hour from the proposed development.
- It is recommended that the surrounding infrastructure will be sufficient to handle the projected increase in vehicle trips and peak hour and all other hours.
- While it is not necessitated by the peak hour trips generated from the proposed development, please find Traffic-Assessment Memorandum (TAM) from Kim Eric Hazarvartian, Ph.D., P.E., PTOE of TEPP, LLC that includes a possible alternative for the City of Rochester to improve this five-legged intersection, independent of the proposed project.

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September 26, 2022

Proposed Development & Introduction

The proposal is to develop Tax Map 108, Lot 58 to contain 16 duplex structures (32 total units). The proposed access to Lot 50 is a 24 foot wide roadway, known as Tibetan Drive, with 25 foot pavement entrance radii for vehicle turning. Tibetan Drive is 1,244 LF to the neck of the cul-de-sac, and a total of 1,658 LF. Tibetan Drive is located at the northern edge of the subject parcels frontage. The purpose of this analysis is to determine the maximum number of trips coming to and leaving the previously mentioned five-legged intersection due to the proposed development during the weekday AM and PM peak hour. This information is then used in determining the impact on safety as it relates to the existing roadway infrastructure. The following components of the analysis are typical for a project of this size pursuant to the Institute of Traffic Engineers (ITE) manual.

The City of Rochester has expressed concern about the operation of the five legged intersection of Portland Street, Crow Hill Road, Green Street, and Grove Street during conceptual meetings for the weekday AM and PM peak hours. BS&E has retained Kim Eric Hazarvartian, Ph.D., P.E., PTOE of TEPP, LLC to opine regarding the function of this intersection. Information regarding this intersection is found on pages #6-8. Please find Traffic-Assessment Memorandum (TAM) from TEPP, LLC. The intention of this TAM is to suggest a possible alternative to this intersection operation, independent of the proposed development, as it is not necessitated by the peak hour times of the proposed project.

Existing Conditions

Existing Site Description

The subject parcel is a wooded vacant piece of land known as Tax Map 108, Lot 50 containing 2,199,988 Sq. Ft. (50.50 Ac.) of land. The subject parcel is located within the agricultural zoning district with 291 feet of frontage along Crow Hill Road and 62 feet of frontage on Portland Street. Portland Street frontage is isolated from the remaining parcel by wetlands. There are twelve single family driveways located to the north and south of the subject parcel within 500' of the proposed roadway. Nearby roadways include Stair Falls Drive and Copper Lane which are located approximately 250 feet and 500 feet to the south, respectively. Both are dead end local collector roads servicing single family subdivisions.

Crow Hill Road Roadway Description

Crow Hill Road is a dead end, two lane local collector road that runs south to north, terminating in an unpassable gravel trail to the south. Crow Hill Road provides access to Portland Street/Highland Street (US Route 202/NH Route 11 & Maine) to the north and residences to the south. While traffic counts of Crow Hill Road were not performed, this roadway provides access to approximately 70-75 single family homes and Keay Field (baseball field) is located at the intersection of Crow Hill Road and Spring Street. Crow Hill Road, in the area of the project, is



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composed of a twenty-two foot wide paved surface with eleven foot travel lanes, variable width paved shoulders on the east and west sides of the road. There is no centerline delineation and fog / edge lines provided. The posted speed limit of the roadway is 30 miles per hour (MPH). The geometry of Crow Hill Road is relatively flat (3% grade) along the subject parcel frontage.

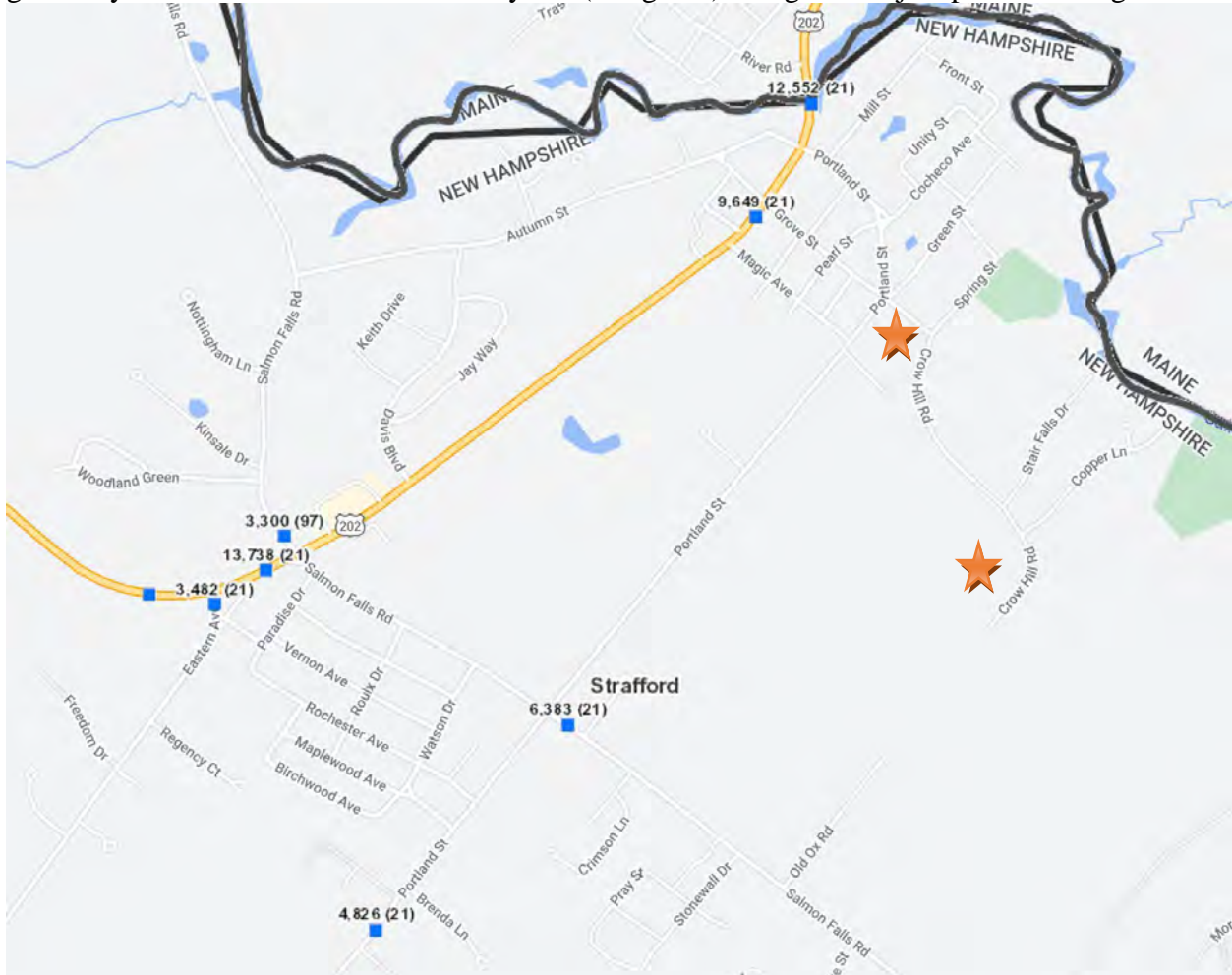


Figure 1: Crow Hill Road and point of analysis (NHDOT)

Portland St./Crow Hill Rd./Green St./Grove St. Intersection

Due to the dead-end termination of Crow Hill Road, it is assumed that all of the trips generated by the proposed development will enter from and exit to this five-legged intersection. Portland Street is a two-lane minor arterial roadway (NHDOT) that provides access to Highland Street (US Route 202/NH Route 11 and Maine) to the east and to downtown Rochester to the west. Centerline and fog line delineation is provided, along with raised sidewalks on the east and west sides of the road. There is no stop control for Portland Street in this intersection. Grove Street is a local collector road between Highland Street and Portland Street with a stop sign and stop bar treatment. There is no centerline or fog line delineation provided and there is a raised sidewalk



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on the north side of Grove Street. Green Street is a one way local collector road (southbound only). Fog line delineation and a raised sidewalk are provided on the northern side of the road and has a stop sign and stop bar treatment.

From Portland Street eastbound, vehicles can continue straight, turn right to Crow Hill Road, or turn left to Grove Street. From Portland Street westbound, vehicles can continue straight, turn left to Crow Hill Road, or turn right to Grove Street. From Crow Hill Road, vehicles can turn right to Portland Street, turn left to Portland Street, or go straight to Grove Street. From Grove Street, vehicles can turn right to Portland Street, turn left to Portland Street, or straight to Crow Hill Road. From Green Street, vehicles can turn right to Portland Street, turn left to Portland Street, straight to Grove Street, or turn left to Crow Hill Road. Crosswalks are provided at all legs of the intersection. The following figure is an aerial photo of this intersection and surrounding area.



Figure 2: Portland St/Grove St/Crow Hill Rd/Green St intersection (Rochester GIS)



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The concrete island in between Crow Hill Road and Green Street creates an opportunity for a vehicles to be making identical turning movements (left to Portland Street, right to Portland Street, or straight to Grove Street at the same time). Concern about this intersection has been expressed by the City of Rochester about the potential for turning movements to obstruct each other and cause unsafe situations. BS&E has performed turning movement counts (TMCs) at this intersection during the weekday AM peak hour on September 8, 2022 and during the weekday PM peak hour on September 1, 2022. The full collection of this data can be found in Appendix A as Figures #11 & 12. This data is then used to determine the directional distribution of the trips generated from the proposed project. The following figure shows the peak observed TMCs at this five-legged intersection during the weekday AM and PM peak hour.

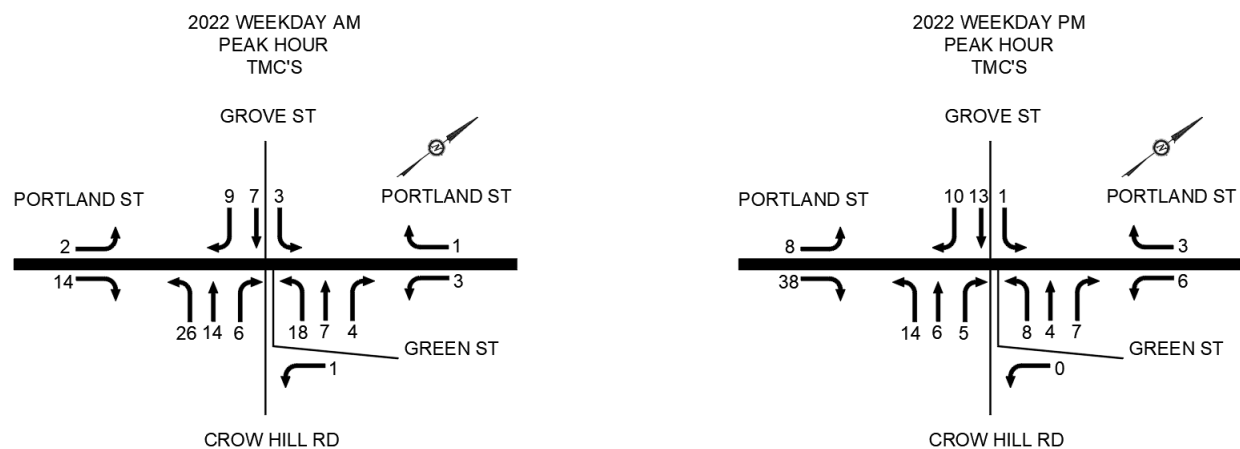


Figure 3: Portland St/Grove St/Crow Hill Rd/Green St TMC's

It can be seen from the TMC data that the primary turning movement during the weekday AM peak hour is either left from Crow Hill Road or Green Street to Portland Street westbound. During the weekday PM peak hour, the primary turning movement is right onto Crow Hill Road from Portland Street eastbound. This pattern of primary westbound AM peak hour travel and eastbound PM peak hour travel is also observed in the Portland Street traffic volumes in the subsequent section. Please find TAM from Kim Eric Hazarvartian, Ph.D., P.E., PTOE of TEPP, LLC included in this submission.

Existing Traffic Volumes

According to traffic counts recorded by Accurate Counts for December 12 & 13, 2019, the Portland Street Road AM and PM weekday two-way peaks were 308 trips and 312 trips, respectively. It is shown by Accurate Counts that this portion of Portland Street has an AADT of 3,024 (2019) vehicles. It is felt that due to the decrease in traffic volumes experienced across the state due to COVID-19 that these counts are an accurate reflection of 2022 traffic volumes. It is important to note from this data that the westbound peak traffic volume of this section of Portland Street occurs from 3-4PM, which is outside of the 4-6PM weekday peak hour that is



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analyzed within the memorandum. This is due to the East Rochester School, which exits daily at 3PM.

The highest weekday peak hour traffic volume on this section of Portland Street eastbound occurred from 8-9 AM with 84 vehicles and from 5-6 PM with 180 vehicles. Westbound highest weekday peak hour traffic volume occurred from 8-9 AM with 224 vehicles and from 5-6 PM with 314 vehicles. Table #1 shows the traffic direction breakdown of Portland Street and Figures #4-6 are graphical representations of the traffic variations occurring throughout the day. It can be seen from the directional percent distribution that the primary direction of travel during the Weekday AM peak hour is westbound towards downtown Rochester. The primary direction of travel during the PM peak hour is eastbound towards Maine. Traffic counts of Portland Street provided by Accurate Counts are included in Appendix A as Figure 10.

Traffic Distribution Portland Street						
Date	Eastbound		Westbound		Two-Way	
Thursday 12/12/19	AM Peak	84	AM Peak	224	AM Peak	308
	PM Peak	180	PM Peak	132	PM Peak	312
Friday 12/13/19	AM Peak	70	AM Peak	187	AM Peak	257
	PM Peak	168	PM Peak	130	PM Peak	282
Average Peak Hour Traffic	AM Peak	77	AM Peak	206	AM Peak	283
	PM Peak	174	PM Peak	131	PM Peak	297
% Distribution	AM Peak	27.3	AM Peak	72.7		
	PM Peak	57.0	PM Peak	43.0		

Table 1: Directional breakdown of trips occurring on Portland Street



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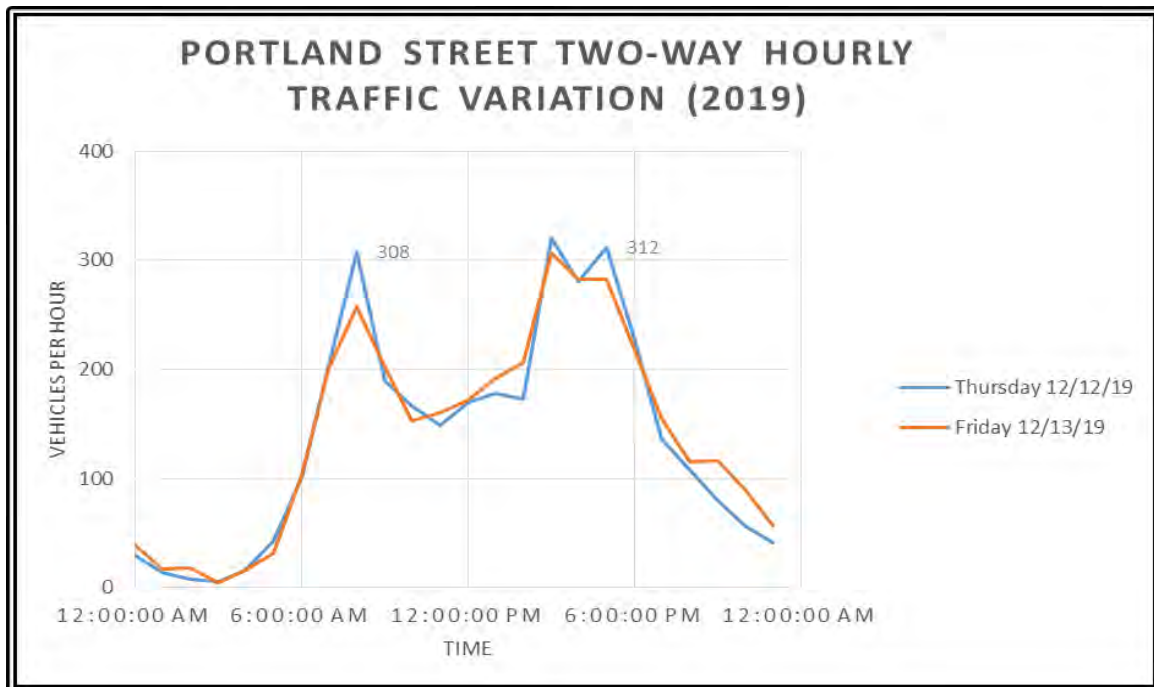


Figure 4: Graph of Portland Street 2019 two-way hourly variation

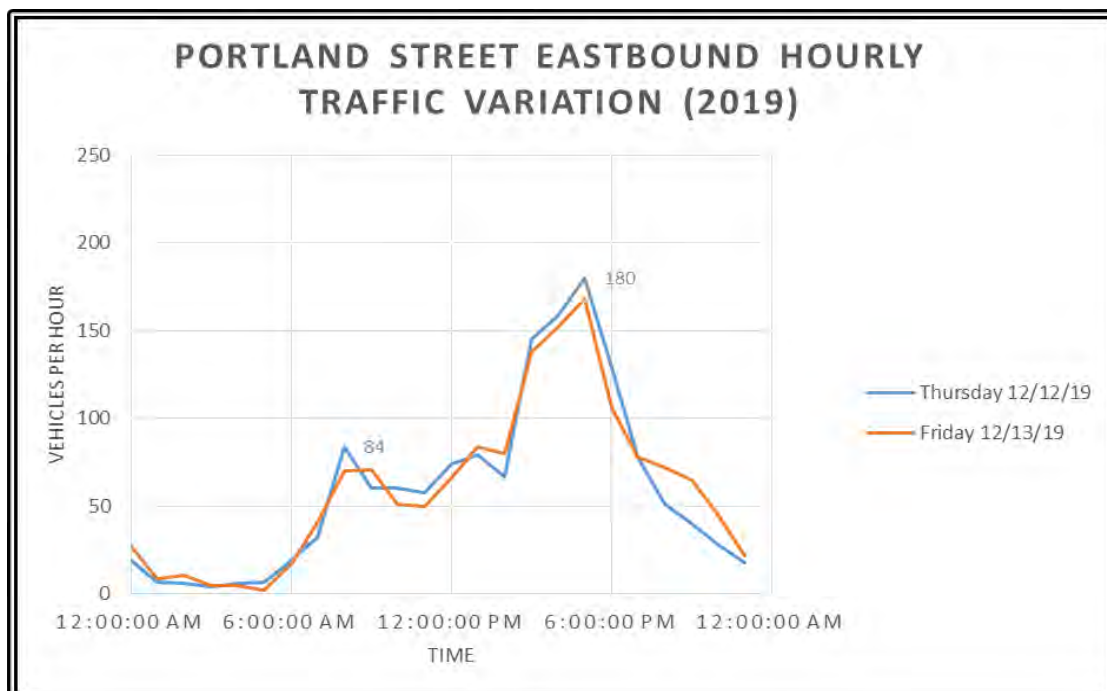


Figure 5: Graph of Portland Street 2019 eastbound hourly variation



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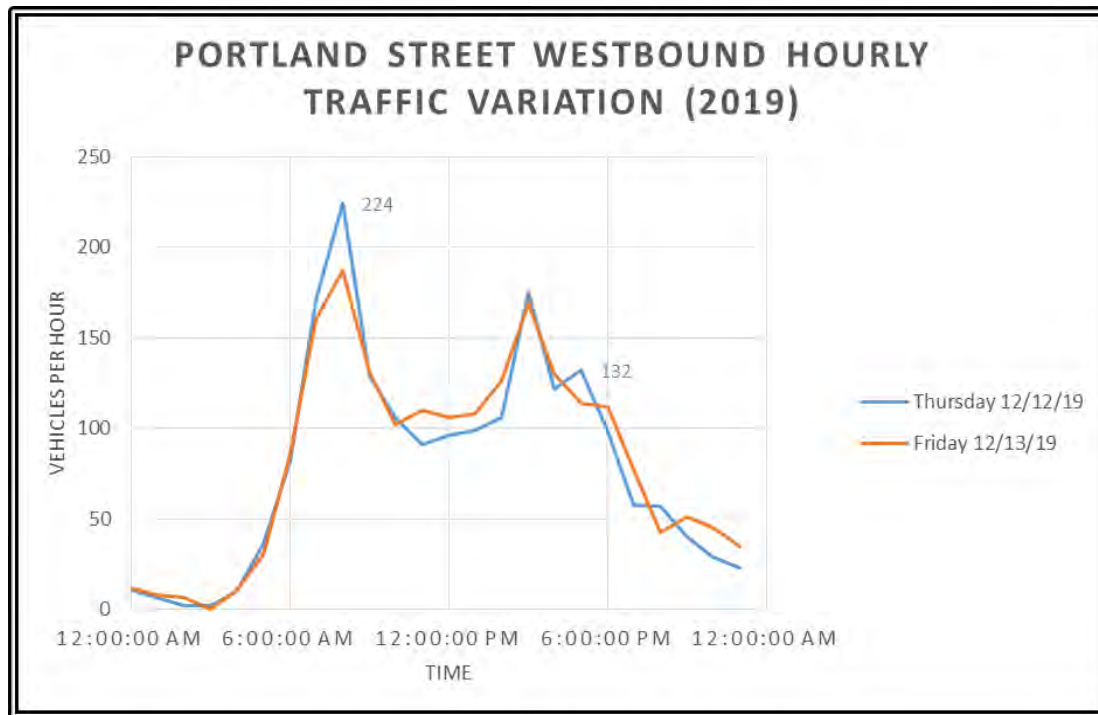


Figure 6: Graph of Portland Street 2019 westbound hourly variation with peak values

Existing Vehicle Speeds

As previously mentioned, the posted speed limit of Crow Hill Road is 30 MPH. For the purposes of the safety analysis below, the 85th percentile of speed is required for sight distance considerations. This particular section of Crow Hill Road was observed by Berry Surveying & Engineering to analyze the pass by traffic, reviewing speed. Excessive speeds were rare, and most operators obeyed the posted speed limits within a deviation of 5 MPH. This is consistent with speeds found on urban roads. The 85th percentile derived by observation and consistency with general practice is 35 MPH.

Proposed Trip Generation

The 11th Edition ITE Trip Generation Manual was used to determine the proposed volume of trips. Included is the percentage of entrance-to-exit traffic experienced during the weekday AM & PM peak hours between 7 and 9 AM and 4 and 6 PM. Land Use Code Single Family Detached Housing (210) was used in deriving the proposed trip generation from the project site. Table #2 provides average trip rate, total trips generated, enter to exit ratio, and the enter to exit distribution. Duplex unit trip generations are required to be calculated using the land use code for single family detached housing by the ITE manual.



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Single Family Detached Housing:

Time Method	Weekday Total (Page 2) Dwelling Units			Time Method	AM Peak Adj. Street (Page 3) Dwelling Units			Time Method	PM Peak Adj. Street (Page 4) Dwelling Units		
# Units	32			# Units	32			# Units	32		
Equation	$\ln(T) = 0.92\ln(X)+2.68$			Equation	$\ln(T) = 0.91\ln(X)+0.12$			Equation	$\ln(T) = 0.94\ln(X)+0.27$		
Total Trips	354			Total Trips	26			Total Trips	34		
% Enter	50	Total Enter	177	% Enter	26	Total Enter	7	% Enter	63	Total Enter	21
% Exit	50	Total Exit	177	% Exit	74	Total Exit	19	% Exit	37	Total Exit	13

Table 2: (Single Family Detached Housing) Peak hr of adjacent street traffic AM, PM, & weekday total***Build Traffic Projections and Turning Analysis***

Traffic data obtained from Accurate Counts in December 2019 has been projected to 2023 and ten years further to 2033. This has been done using a December peak seasonal adjustment factor of 1.22 (weekday AM, PM peak hour) and using an annual growth rate of 1%, compounded annually. This is shown in figures #8 and #9. The derivation of the peak seasonal adjustment factor comes from an average series of values from other urban highways from across New Hampshire, which can be found as Figure #15 in Appendix B. In determining the directional distribution of trips, the TMC's observed in 2022 are used to determine the directional distribution as opposed to the Portland Street pass by traffic counts. The following tables show the directional distribution determined based upon the summation of TMCs.

Total Trips Exiting From Crow Hill Road/Green Street (AM Turning Movement Count)					
to Portland St SB (Left Turn)		to Portland St NB (Right Turn)		to Grove St (Straight)	
9/8/2022		9/8/2022		9/8/2022	
7:00-7:15 AM	7	7:00-7:15 AM	5	7:00-7:15 AM	5
7:15-7:30 AM	10	7:15-7:30 AM	1	7:15-7:30 AM	8
7:30-7:45 AM	9	7:30-7:45 AM	1	7:30-7:45 AM	4
7:45-8:00 AM	9	7:45-8:00 AM	1	7:45-8:00 AM	3
8:00-8:15 AM	7	8:00-8:15 AM	1	8:00-8:15 AM	3
8:15-8:30 AM	12	8:15-8:30 AM	3	8:15-8:30 AM	2
8:30-8:45 AM	8	8:30-8:45 AM	5	8:30-8:45 AM	2
8:45-9:00 AM	4	8:45-9:00 AM	0	8:45-9:00 AM	2
Total Vehicles (2Hr Span)	66	Total Vehicles (2Hr Span)	17	Total Vehicles (2Hr Span)	29
Total Vehicles (Peak HR)	36	Total Vehicles (Peak HR)	10	Total Vehicles (Peak HR)	20
% of Peak Hr turns	54.5	% of Peak Hr turns	15.2	% of Peak Hr turns	30.3

Table 3: Weekday AM peak hour 2022 observed TMCs (exit distribution)**BERRY SURVEYING & ENGINEERING**

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22-023 Roadrunner Real Estate, LLC, Crow Hill Road, Rochester, NH
Trip Generation and Distribution

September 26, 2022

Total Trips Entering to Crow Hill Road (AM Turning Movement Count)					
From Portland St SB (Left Turn)		From Portland St NB (Right Turn)		From Grove St (Straight)	
9/8/2022		9/8/2022		9/8/2022	
7:00-7:15 AM	0	7:00-7:15 AM	2	7:00-7:15 AM	0
7:15-7:30 AM	1	7:15-7:30 AM	4	7:15-7:30 AM	0
7:30-7:45 AM	1	7:30-7:45 AM	4	7:30-7:45 AM	3
7:45-8:00 AM	0	7:45-8:00 AM	3	7:45-8:00 AM	1
8:00-8:15 AM	0	8:00-8:15 AM	2	8:00-8:15 AM	1
8:15-8:30 AM	2	8:15-8:30 AM	5	8:15-8:30 AM	2
8:30-8:45 AM	0	8:30-8:45 AM	2	8:30-8:45 AM	0
8:45-9:00 AM	1	8:45-9:00 AM	3	8:45-9:00 AM	0
Total Vehicles (2Hr Span)	5	Total Vehicles (2Hr Span)	25	Total Vehicles (2Hr Span)	7
Total Vehicles (Peak HR)	3	Total Vehicles (Peak HR)	13	Total Vehicles (Peak HR)	3
% of Peak Hr turns	15.8	% of Peak Hr turns	68.4	% of Peak Hr turns	15.8

Table 4: Weekday AM peak hour 2022 observed TMCs (enter distribution)

Total Trips Exiting From Crow Hill Road/Green Street (PM Turning Movement Count)					
to Portland St SB (Left Turn)		to Portland St NB (Right Turn)		to Grove St (Straight)	
9/2/2022		9/2/2022		9/2/2022	
4:00-4:15 PM	4	4:00-4:15 PM	0	4:00-4:15 PM	1
4:15-4:30 PM	5	4:15-4:30 PM	4	4:15-4:30 PM	1
4:30-4:45 PM	3	4:30-4:45 PM	2	4:30-4:45 PM	3
4:45-5:00 PM	5	4:45-5:00 PM	2	4:45-5:00 PM	1
5:00-5:15 PM	5	5:00-5:15 PM	3	5:00-5:15 PM	2
5:15-5:30 PM	6	5:15-5:30 PM	3	5:15-5:30 PM	2
5:30-5:45 PM	4	5:30-5:45 PM	1	5:30-5:45 PM	4
5:45-6:00 PM	5	5:45-6:00 PM	2	5:45-6:00 PM	1
Total Vehicles (2Hr Span)	37	Total Vehicles (2Hr Span)	17	Total Vehicles (2Hr Span)	15
Total Vehicles (Peak HR)	20	Total Vehicles (Peak HR)	11	Total Vehicles (Peak HR)	9
% of Peak Hr turns	50.0	% of Peak Hr turns	27.5	% of Peak Hr turns	22.5

Table 5: Weekday PM peak hour 2022 observed TMCs (exit distribution)

Total Trips Entering to Crow Hill Road (PM Turning Movement Count)					
From Portland St SB (Left Turn)		From Portland St NB (Right Turn)		From Grove St (Straight)	
9/2/2022		9/2/2022		9/2/2022	
4:00-4:15 PM	1	4:00-4:15 PM	5	4:00-4:15 PM	3
4:15-4:30 PM	3	4:15-4:30 PM	10	4:15-4:30 PM	1
4:30-4:45 PM	2	4:30-4:45 PM	11	4:30-4:45 PM	1
4:45-5:00 PM	0	4:45-5:00 PM	3	4:45-5:00 PM	3
5:00-5:15 PM	0	5:00-5:15 PM	10	5:00-5:15 PM	5
5:15-5:30 PM	0	5:15-5:30 PM	10	5:15-5:30 PM	4
5:30-5:45 PM	2	5:30-5:45 PM	6	5:30-5:45 PM	1
5:45-6:00 PM	1	5:45-6:00 PM	12	5:45-6:00 PM	3
Total Vehicles (2Hr Span)	9	Total Vehicles (2Hr Span)	67	Total Vehicles (2Hr Span)	21
Total Vehicles (Peak HR)	6	Total Vehicles (Peak HR)	38	Total Vehicles (Peak HR)	13
% of Peak Hr turns	10.5	% of Peak Hr turns	66.7	% of Peak Hr turns	22.8

Table 6: Weekday PM peak hour 2022 observed TMCs (enter distribution)



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Figure #7 show strictly the build generated turning movements to and from the intersection of Portland Street/Grove Street/Crow Hill Road/Green Street during weekday AM and PM peak hours.

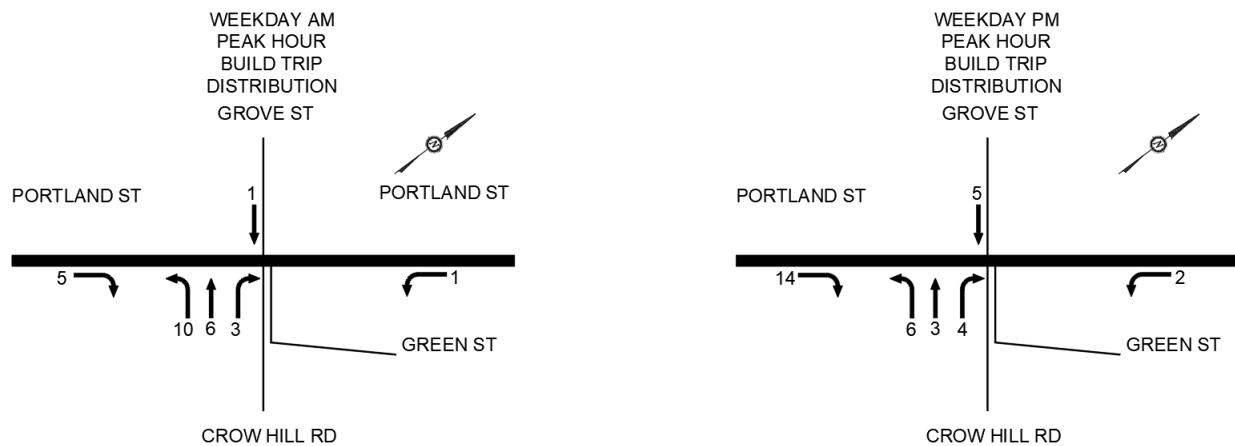


Figure 7: Projected build turn movements weekday peak hours

The following figures also show the projected volume of traffic eastbound and westbound on Portland Street for 2023 and 2033 and the build generation turning movements are shown in addition to the observed TMCs. Through volume for Portland Street h

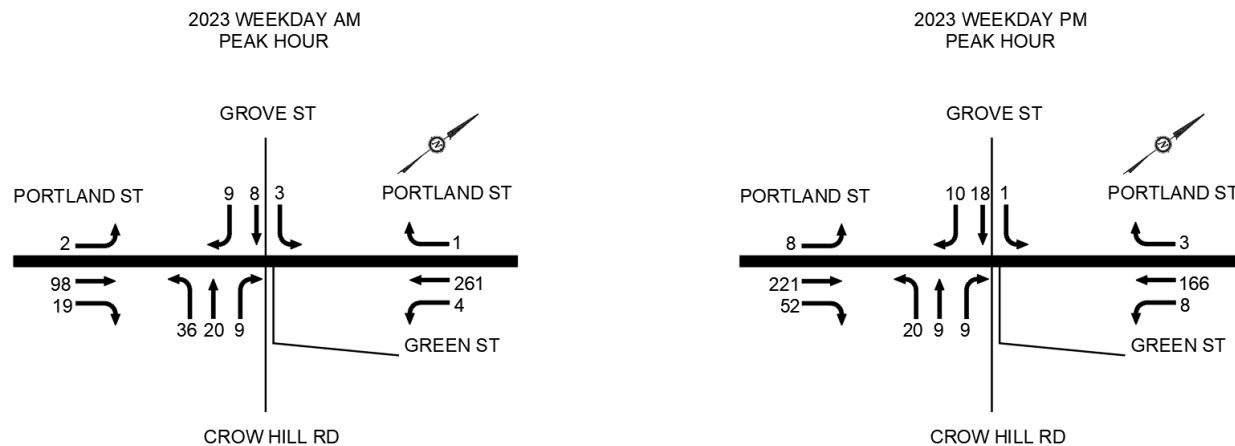


Figure 8: 2023 & 2033 build projected traffic volumes & turn movement weekday AM peak



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Sight Distance and Safety Analysis

Sight distance on Crow Hill Road to the east and west, as well as roadway alignment are the two determining factors of safety. For the proposed entrance, sight distance to the east un-obstructed for well over 300 feet (measured), while sight distance to the west is un-obstructed for well over 300 feet (measured). In this instance both the easterly and westerly sight distances exceed the standard AASHTO 30MPH standard practice of 200 feet on a less than 3% roadway and the local regulation of 250 feet. There are no improvements required to obtain this sight distance.

With respect to general safety of Crow Hill Road in relation to the peak hour trip generation and AADT, it is our assessment that the cross section of pavement and shoulder widths are appropriate.

*AASHTO Geometric Design of Highways and Streets (2018)



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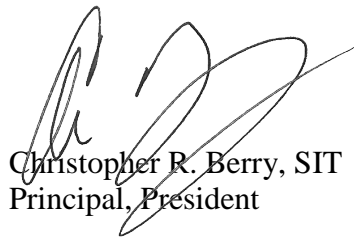
September 26, 2022


Conclusions and Recommendations


- 1.) A total of 26 vehicle trips (7 enter/19 exit) are predicted to occur at the weekday AM peak hour and 34 vehicle trips (21 enter/13 exit) at the PM peak hour.
- 2.) It is recommended that the surrounding infrastructure will be sufficient to handle the projected increase in vehicle trips and peak hour and all other hours.
- 3.) While it is not necessitated by the peak hour trips generated from the proposed development, please find Traffic-Assessment Memorandum (TAM) from Kim Eric Hazarvartian, Ph.D., P.E., PTOE of TEPP, LLC that includes a possible alternative for the City of Rochester to improve this five-legged intersection, independent of the proposed project.

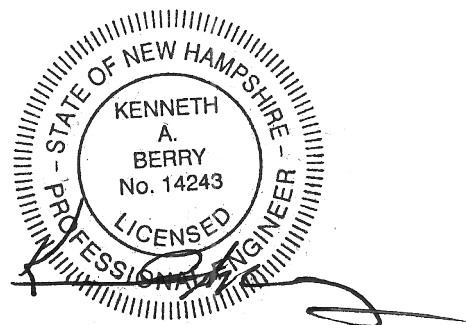
Respectfully Submitted,

BERRY SURVEYING & ENGINEERING


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Appendix A

Traffic Counts

Accurate Counts
978-664-2565

Location : Portland Street
Location : East of Carole Court
City/State: Rochester, NH

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1846VOL2

Start Time	12/9/2019		Tue		Wed		Thu		Fri		Sat		Sun		Week Average	
	EB	WB	EB	WB	EB	WB	EB	WB	EB	WB	EB	WB	EB	WB	EB	WB
12:00 AM	*	*	*	*	*	*	19	11	27	12	31	10	*	*	26	11
01:00	*	*	*	*	*	*	7	7	9	8	9	10	*	*	8	8
02:00	*	*	*	*	*	*	6	2	11	7	6	7	*	*	8	5
03:00	*	*	*	*	*	*	4	2	5	0	0	0	*	*	3	1
04:00	*	*	*	*	*	*	6	10	5	11	1	11	*	*	4	11
05:00	*	*	*	*	*	*	7	36	2	30	1	11	*	*	3	26
06:00	*	*	*	*	*	*	19	82	17	86	9	26	*	*	15	65
07:00	*	*	*	*	*	*	32	171	41	160	11	46	*	*	28	126
08:00	*	*	*	*	*	*	84	224	70	187	27	49	*	*	60	153
09:00	*	*	*	*	*	*	80	129	71	131	43	102	*	*	58	121
10:00	*	*	*	*	*	*	60	106	51	102	54	106	*	*	55	105
11:00	*	*	*	*	*	*	58	91	50	110	63	130	*	*	57	110
12:00 PM	*	*	*	*	*	*	74	96	66	108	54	116	*	*	65	108
01:00	*	*	*	*	*	*	79	99	84	108	66	103	*	*	76	103
02:00	*	*	*	*	*	*	67	106	80	126	79	82	*	*	75	105
03:00	*	*	*	*	*	*	145	175	138	169	60	108	*	*	114	151
04:00	*	*	*	*	*	*	158	122	152	130	75	108	*	*	128	120
05:00	*	*	*	*	*	*	180	132	168	114	83	101	*	*	144	116
06:00	*	*	*	*	*	*	129	98	106	112	68	106	*	*	101	105
07:00	*	*	*	*	*	*	78	58	76	77	50	60	*	*	69	65
08:00	*	*	*	*	*	*	51	57	72	43	44	46	*	*	56	49
09:00	*	*	*	*	*	*	40	40	65	51	35	31	*	*	47	41
10:00	*	*	*	*	*	*	28	29	45	45	32	35	*	*	35	36
11:00	*	*	*	*	*	*	18	23	22	35	30	28	*	*	23	29
Lane Day	0	0	0	0	0	0	1409	1906	1435	1960	931	1432	0	0	1258	1768
AM Peak	-	-	-	-	-	-	08:00	08:00	09:00	08:00	11:00	11:00	-	-	08:00	08:00
Vol.	-	-	-	-	-	-	84	224	71	187	63	130	-	-	60	153
PM Peak	-	-	-	-	-	-	17:00	15:00	17:00	15:00	17:00	12:00	-	-	17:00	15:00
Vol.	-	-	-	-	-	-	180	175	168	169	83	116	-	-	144	151
Comb. Total	0	0	0	0	0	0	3315	3395	2363	0	0	3026				
ADT	ADT 3,024		AADT 3,024													

Figure 10: Portland Street Traffic Count



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Trip Generation and Distribution

September 26, 2022

From Crow Hill Road (AM Turning Movement Count)					
to Portland St SB (Left Turn)	9/8/2022	to Portland St NB (Right Turn)	9/8/2022	to Grove St (Straight)	9/8/2022
7:00-7:15 AM	5	7:00-7:15 AM	2	7:00-7:15 AM	4
7:15-7:30 AM	8	7:15-7:30 AM	1	7:15-7:30 AM	7
7:30-7:45 AM	6	7:30-7:45 AM	0	7:30-7:45 AM	1
7:45-8:00 AM	7	7:45-8:00 AM	1	7:45-8:00 AM	2
8:00-8:15 AM	4	8:00-8:15 AM	1	8:00-8:15 AM	2
8:15-8:30 AM	5	8:15-8:30 AM	1	8:15-8:30 AM	0
8:30-8:45 AM	2	8:30-8:45 AM	3	8:30-8:45 AM	1
8:45-9:00 AM	2	8:45-9:00 AM	0	8:45-9:00 AM	1
Total Vehicles (2Hr Span)	39	Total Vehicles (2Hr Span)	9	Total Vehicles (2Hr Span)	18
Total Vehicles (Peak HR)	26	Total Vehicles (Peak HR)	6	Total Vehicles (Peak HR)	14

From Green Street (AM Turning Movement Count)					
to Portland St SB (Left Turn)	9/8/2022	to Portland St NB (Right Turn)	9/8/2022	to Grove St (Straight)	9/8/2022
7:00-7:15 AM	2	7:00-7:15 AM	3	7:00-7:15 AM	1
7:15-7:30 AM	2	7:15-7:30 AM	0	7:15-7:30 AM	1
7:30-7:45 AM	3	7:30-7:45 AM	1	7:30-7:45 AM	3
7:45-8:00 AM	2	7:45-8:00 AM	0	7:45-8:00 AM	1
8:00-8:15 AM	3	8:00-8:15 AM	0	8:00-8:15 AM	1
8:15-8:30 AM	7	8:15-8:30 AM	2	8:15-8:30 AM	2
8:30-8:45 AM	6	8:30-8:45 AM	2	8:30-8:45 AM	1
8:45-9:00 AM	2	8:45-9:00 AM	0	8:45-9:00 AM	1
Total Vehicles (2Hr Span)	27	Total Vehicles (2Hr Span)	8	Total Vehicles (2Hr Span)	11
Total Vehicles (Peak HR)	18	Total Vehicles (Peak HR)	4	Total Vehicles (Peak HR)	7

From Grove Street (AM Turning Movement Count)					
to Portland St SB (Right Turn)	9/8/2022	to Portland St NB (Left Turn)	9/8/2022	to Crow Hill Rd (Straight)	9/8/2022
7:00-7:15 AM	2	7:00-7:15 AM	0	7:00-7:15 AM	0
7:15-7:30 AM	0	7:15-7:30 AM	0	7:15-7:30 AM	0
7:30-7:45 AM	1	7:30-7:45 AM	0	7:30-7:45 AM	3
7:45-8:00 AM	3	7:45-8:00 AM	0	7:45-8:00 AM	1
8:00-8:15 AM	3	8:00-8:15 AM	2	8:00-8:15 AM	1
8:15-8:30 AM	0	8:15-8:30 AM	1	8:15-8:30 AM	2
8:30-8:45 AM	3	8:30-8:45 AM	0	8:30-8:45 AM	0
8:45-9:00 AM	2	8:45-9:00 AM	0	8:45-9:00 AM	0
Total Vehicles (2Hr Span)	14	Total Vehicles (2Hr Span)	3	Total Vehicles (2Hr Span)	7
Total Vehicles (Peak HR)	9	Total Vehicles (Peak HR)	3	Total Vehicles (Peak HR)	7

From Portland Street Southbound (AM Turning Movement Count)			
to Grove Street (Right Turn)	9/8/2022	to Crow Hill Rd (Left Turn)	9/8/2022
7:00-7:15 AM	0	7:00-7:15 AM	0
7:15-7:30 AM	0	7:15-7:30 AM	1
7:30-7:45 AM	0	7:30-7:45 AM	1
7:45-8:00 AM	0	7:45-8:00 AM	0
8:00-8:15 AM	0	8:00-8:15 AM	0
8:15-8:30 AM	0	8:15-8:30 AM	2
8:30-8:45 AM	1	8:30-8:45 AM	0
8:45-9:00 AM	0	8:45-9:00 AM	1
Total Vehicles (2Hr Span)	1	Total Vehicles (2Hr Span)	5
Total Vehicles (Peak HR)	1	Total Vehicles (Peak HR)	3

From Portland Street Northbound (AM Turning Movement Count)			
to Grove Street (Left Turn)	9/8/2022	to Crow Hill Rd (Right Turn)	9/8/2022
7:00-7:15 AM	0	7:00-7:15 AM	2
7:15-7:30 AM	0	7:15-7:30 AM	4
7:30-7:45 AM	0	7:30-7:45 AM	4
7:45-8:00 AM	0	7:45-8:00 AM	3
8:00-8:15 AM	0	8:00-8:15 AM	2
8:15-8:30 AM	2	8:15-8:30 AM	5
8:30-8:45 AM	0	8:30-8:45 AM	2
8:45-9:00 AM	0	8:45-9:00 AM	3
Total Vehicles (2Hr Span)	2	Total Vehicles (2Hr Span)	25
Total Vehicles (Peak HR)	2	Total Vehicles (Peak HR)	14

Figure 11: Thursday September 8, 2022 AM peak hour observed TMCs



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Trip Generation and Distribution

September 26, 2022

From Crow Hill Road (PM Turning Movement Count)							
to Portland St SB (Left Turn)		to Portland St NB (Right Turn)		to Grove St (Straight)			
9/2/2022		9/2/2022		9/2/2022			
4:00-4:15 PM	3	4:00-4:15 PM	0	4:00-4:15 PM	1		
4:15-4:30 PM	5	4:15-4:30 PM	2	4:15-4:30 PM	1		
4:30-4:45 PM	2	4:30-4:45 PM	1	4:30-4:45 PM	1		
4:45-5:00 PM	2	4:45-5:00 PM	0	4:45-5:00 PM	1		
5:00-5:15 PM	3	5:00-5:15 PM	2	5:00-5:15 PM	1		
5:15-5:30 PM	4	5:15-5:30 PM	0	5:15-5:30 PM	2		
5:30-5:45 PM	3	5:30-5:45 PM	1	5:30-5:45 PM	2		
5:45-6:00 PM	4	5:45-6:00 PM	2	5:45-6:00 PM	0		
Total Vehicles (2Hr Span)	26	Total Vehicles (2Hr Span)	8	Total Vehicles (2Hr Span)	9		
Total Vehicles (Peak HR)	14	Total Vehicles (Peak HR)	5	Total Vehicles (Peak HR)	6		
From Green Street (PM Turning Movement Count)							
to Portland St SB (Left Turn)		to Portland St NB (Right Turn)		to Grove St (Straight)		to Crow Hill Rd (Hard Left Turn)	
9/2/2022		9/2/2022		9/2/2022		9/2/2022	
4:00-4:15 PM	1	4:00-4:15 PM	0	4:00-4:15 PM	0	4:00-4:15 PM	0
4:15-4:30 PM	0	4:15-4:30 PM	2	4:15-4:30 PM	0	4:15-4:30 PM	0
4:30-4:45 PM	1	4:30-4:45 PM	1	4:30-4:45 PM	2	4:30-4:45 PM	0
4:45-5:00 PM	3	4:45-5:00 PM	2	4:45-5:00 PM	0	4:45-5:00 PM	0
5:00-5:15 PM	2	5:00-5:15 PM	1	5:00-5:15 PM	1	5:00-5:15 PM	0
5:15-5:30 PM	2	5:15-5:30 PM	3	5:15-5:30 PM	0	5:15-5:30 PM	0
5:30-5:45 PM	1	5:30-5:45 PM	0	5:30-5:45 PM	2	5:30-5:45 PM	0
5:45-6:00 PM	1	5:45-6:00 PM	0	5:45-6:00 PM	1	5:45-6:00 PM	0
Total Vehicles (2Hr Span)	11	Total Vehicles (2Hr Span)	9	Total Vehicles (2Hr Span)	6	Total Vehicles (2Hr Span)	0
Total Vehicles (Peak HR)	8	Total Vehicles (Peak HR)	7	Total Vehicles (Peak HR)	4	Total Vehicles (Peak HR)	0
From Grove Street (PM Turning Movement Count)							
to Portland St SB (Right Turn)		to Portland St NB (Left Turn)		to Crow Hill Rd (Straight)			
9/2/2022		9/2/2022		9/2/2022			
4:00-4:15 PM	0	4:00-4:15 PM	0	4:00-4:15 PM	3		
4:15-4:30 PM	1	4:15-4:30 PM	1	4:15-4:30 PM	1		
4:30-4:45 PM	1	4:30-4:45 PM	0	4:30-4:45 PM	1		
4:45-5:00 PM	4	4:45-5:00 PM	0	4:45-5:00 PM	3		
5:00-5:15 PM	1	5:00-5:15 PM	0	5:00-5:15 PM	5		
5:15-5:30 PM	2	5:15-5:30 PM	0	5:15-5:30 PM	4		
5:30-5:45 PM	3	5:30-5:45 PM	0	5:30-5:45 PM	1		
5:45-6:00 PM	3	5:45-6:00 PM	0	5:45-6:00 PM	3		
Total Vehicles (2Hr Span)	15	Total Vehicles (2Hr Span)	1	Total Vehicles (2Hr Span)	21		
Total Vehicles (Peak HR)	10	Total Vehicles (Peak HR)	1	Total Vehicles (Peak HR)	13		
From Portland Street Southbound (PM Turning Movement Count)							
to Grove Street (Right Turn)		to Crow Hill Rd (Left Turn)					
9/2/2022		9/2/2022					
4:00-4:15 PM	0	4:00-4:15 PM	1				
4:15-4:30 PM	0	4:15-4:30 PM	3				
4:30-4:45 PM	0	4:30-4:45 PM	2				
4:45-5:00 PM	2	4:45-5:00 PM	0				
5:00-5:15 PM	0	5:00-5:15 PM	0				
5:15-5:30 PM	0	5:15-5:30 PM	0				
5:30-5:45 PM	1	5:30-5:45 PM	2				
5:45-6:00 PM	0	5:45-6:00 PM	1				
Total Vehicles (2Hr Span)	3	Total Vehicles (2Hr Span)	9				
Total Vehicles (Peak HR)	3	Total Vehicles (Peak HR)	6				
From Portland Street Northbound (PM Turning Movement Count)							
to Grove Street (Left Turn)		to Crow Hill Rd (Right Turn)					
9/2/2022		9/2/2022					
4:00-4:15 PM	1	4:00-4:15 PM	5				
4:15-4:30 PM	2	4:15-4:30 PM	10				
4:30-4:45 PM	2	4:30-4:45 PM	11				
4:45-5:00 PM	3	4:45-5:00 PM	3				
5:00-5:15 PM	0	5:00-5:15 PM	10				
5:15-5:30 PM	3	5:15-5:30 PM	10				
5:30-5:45 PM	2	5:30-5:45 PM	6				
5:45-6:00 PM	1	5:45-6:00 PM	12				
Total Vehicles (2Hr Span)	14	Total Vehicles (2Hr Span)	67				
Total Vehicles (Peak HR)	8	Total Vehicles (Peak HR)	38				

Figure 12: Thursday September 1, 2022 PM peak hour observed TMCs

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Trip Generation and Distribution

September 26, 2022

Weekday AM Peak Hour Volume Projections			Weekday PM Peak Hour Volume Projections		
Year	Portland Street EB	EB Volume Peaked	Year	Portland Street EB	EB Volume Peaked
2019	77	94	2019	174	212
2020	78	95	2020	176	214
2021	79	96	2021	177	217
2022	79	97	2022	179	219
2023	80	98	2023	181	221
2024	81	99	2024	183	223
2025	82	100	2025	185	225
2026	83	101	2026	187	228
2027	83	102	2027	188	230
2028	84	103	2028	190	232
2029	85	104	2029	192	234
2030	86	105	2030	194	237
2031	87	106	2031	196	239
2032	88	107	2032	198	242
2033	89	108	2033	200	244
Year	Portland Street WB	WB Volume Peaked	Year	Portland Street WB	WB Volume Peaked
2019	206	251	2019	131	160
2020	208	253	2020	132	161
2021	210	256	2021	134	163
2022	212	258	2022	135	165
2023	214	261	2023	136	166
2024	216	263	2024	138	168
2025	218	266	2025	139	170
2026	220	269	2026	140	171
2027	223	271	2027	142	173
2028	225	274	2028	143	175
2029	227	277	2029	145	177
2030	229	280	2030	146	178
2031	232	283	2031	148	180
2032	234	285	2032	149	182
2033	236	288	2033	151	184
Seasonal Peaking Factor (December)		1.22	Seasonal Peaking Factor (December)		1.22

Figure 13: Portland Street AM & PM Peak Hour Volume Projections



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*Appendix B**Miscellaneous*

Table 3-1. Stopping Sight Distance on Level Roadways

U.S. Customary					Metric				
Design Speed (mph)	Brake Reaction Distance (ft)	Braking Distance on Level (ft)	Stopping Sight Distance		Design Speed (km/h)	Brake Reaction Distance (m)	Braking Distance on Level (m)	Stopping Sight Distance	
			Calculated (ft)	Design (ft)				Calculated (m)	Design (m)
15	55.1	21.6	76.7	80	20	13.9	4.6	18.5	20
20	73.5	38.4	111.9	115	30	20.9	10.3	31.2	35
25	91.9	60.0	151.9	155	40	27.8	18.4	46.2	50
30	110.3	86.4	196.7	200	50	34.8	28.7	63.5	65
35	128.6	117.6	246.2	250	60	41.7	41.3	83.0	85
40	147.0	153.6	300.6	305	70	48.7	56.2	104.9	105
45	165.4	194.4	359.8	360	80	55.6	73.4	129.0	130
50	183.8	240.0	423.8	425	90	62.6	92.9	155.5	160
55	202.1	290.3	492.4	495	100	69.5	114.7	184.2	185
60	220.5	345.5	566.0	570	110	76.5	138.8	215.3	220
65	238.9	405.5	644.4	645	120	83.4	165.2	248.6	250
70	257.3	470.3	727.6	730	130	90.4	193.8	284.2	285
75	275.6	539.9	815.5	820	140	97.3	224.8	322.1	325
80	294.0	614.3	908.3	910					
85	313.5	693.5	1007.0	1010					

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

Figure 14: Derivation of stopping sight distance requirements

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Year 2019 Monthly Data			
Group 4 Averages:		Urban Highways	
		Adjustment to	
Month	ADT	Average	Peak
January	11,431	1.12	1.23
February	11,848	1.08	1.18
March	12,141	1.06	1.15
April	12,860	1.00	1.09
May	13,551	0.95	1.03
June	13,785	0.93	1.02
July	13,942	0.92	1.01
August	14,016	0.92	1.00
September	13,379	0.96	1.05
October	13,339	0.96	1.05
November	12,265	1.05	1.14
December	11,496	1.12	1.22
Average ADT:	12,838		
Peak ADT:	14,016		

Figure 15: Derivation of the seasonal peaking factor



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Appendix C

Trip Generation Derivation

Single-Family Detached Housing (210)

Vehicle Trip Ends vs: Dwelling Units
On a: Weekday

Setting/Location: General Urban/Suburban

Number of Studies: 174

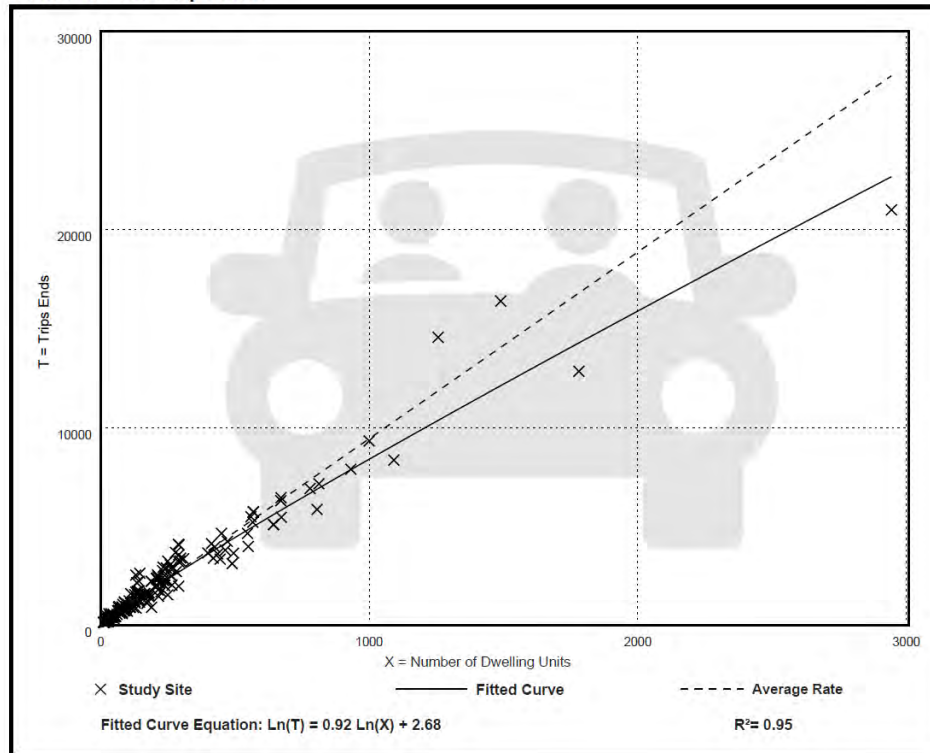
Avg. Num. of Dwelling Units: 246

Directional Distribution: 50% entering, 50% exiting

Vehicle Trip Generation per Dwelling Unit

Average Rate	Range of Rates	Standard Deviation
9.43	4.45 - 22.61	2.13

Data Plot and Equation



General Urban/Suburban and Rural (Land Uses 000-399) 219

Figure 16: ITE Trip Generation, 10th Edition



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Single-Family Detached Housing (210)

Vehicle Trip Ends vs: Dwelling Units

On a: Weekday,

Peak Hour of Adjacent Street Traffic,

One Hour Between 7 and 9 a.m.

Setting/Location: General Urban/Suburban

Number of Studies: 192

Avg. Num. of Dwelling Units: 226

Directional Distribution: 26% entering, 74% exiting

Vehicle Trip Generation per Dwelling Unit

Average Rate	Range of Rates	Standard Deviation
0.70	0.27 - 2.27	0.24

Data Plot and Equation

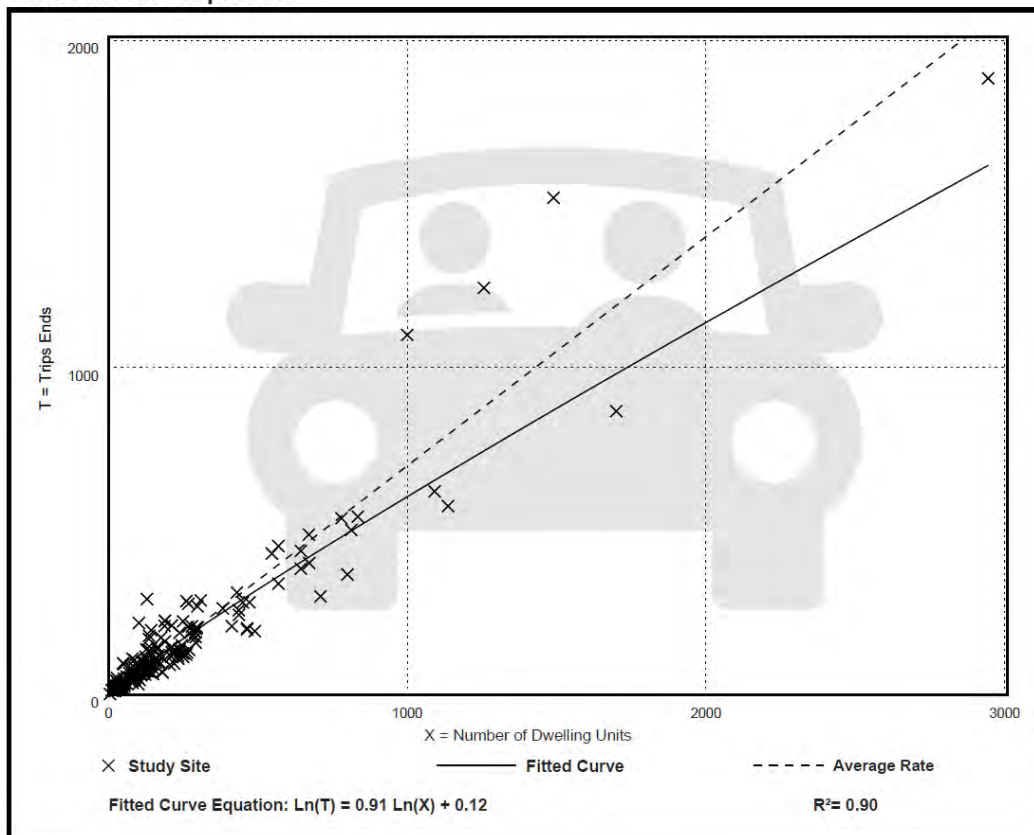


Figure 17: ITE Trip Generation, 10th Edition

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Single-Family Detached Housing (210)

Vehicle Trip Ends vs: Dwelling Units

On a: Weekday,

Peak Hour of Adjacent Street Traffic,

One Hour Between 4 and 6 p.m.

Setting/Location: General Urban/Suburban

Number of Studies: 208

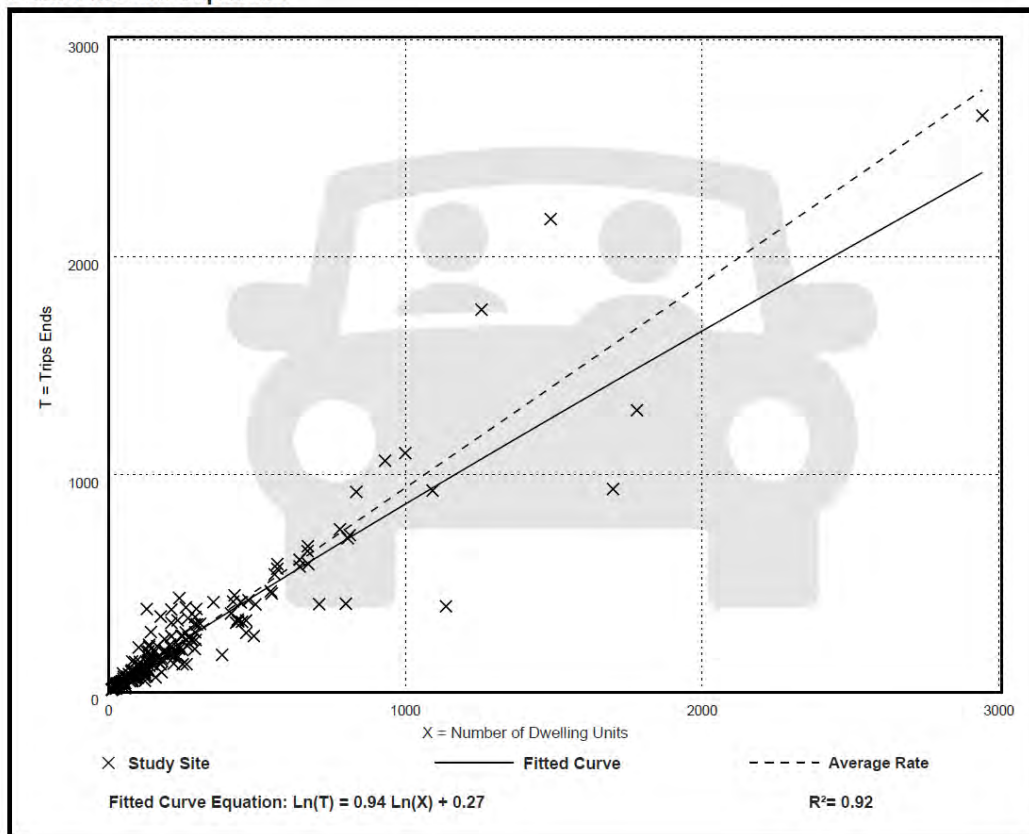
Avg. Num. of Dwelling Units: 248

Directional Distribution: 63% entering, 37% exiting

Vehicle Trip Generation per Dwelling Unit

Average Rate	Range of Rates	Standard Deviation
0.94	0.35 - 2.98	0.31

Data Plot and Equation



General Urban/Suburban and Rural (Land Uses 000-399) 221

Figure 18: ITE Trip Generation, 10th Edition

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