



APPLICATION FOR SUBDIVISION OF LAND
 Water Division/ Subsurface Systems Bureau
 Land Resources Management



RSA/Rule: RSA 485-A, Env-Wq 1000

Work Number:	Check No.	Amount:	Initials:
Administrative Use Only	Administrative Use Only	Administrative Use Only	Administrative Use Only

****Fee: See Checklist**

1. PROJECT LOCATION			
PROJECT LOCATION STREET ADDRESS: Bush Hill Road			
TOWN/CITY: Hudson		ZIP CODE: 03051	
PARENT LOT TAX MAP(S): 186;194;195;201	BLOCK(S):	LOT(S):24,20-4;9,10;1;7	UNIT(S):
PROPOSED SUBDIVISION NAME: Eagles Nest Estates			
PROPOSED NEW LOT NUMBERS: 1-65		NUMBER OF NEW LOTS: 65	
2. APPLICANT			
NAME: Keach Nordstrom Associates, Inc.			
MAILING ADDRESS: 10 Commerce Park North Suite 3			
TOWN/CITY: Bedford		STATE: NH	ZIP CODE: 03110
PHONE: (603) 627-2881		EMAIL OR FAX: jmerritt@keachnordstrom.com	
NHDES DESIGNER NUMBER: 1629		SURVEYOR NUMBER: 903	
3. PROPERTY OWNER			
NAME: Eagles Nest Estates, LLC (Owner of Map 186, Lot 24; Map 194, Lots 9 & 10, Map 195, Lot 1			
MAILING ADDRESS: 21 Continental Boulevard			
TOWN/CITY: Merrimack		STATE: NH	ZIP CODE: 03054
PHONE: (603) 320-5123		EMAIL OR FAX: johngargas@gmail.com	
4. SIGNATURES			
APPLICANT SIGNATURE DATE: 1/22/15		OWNER SIGNATURE DATE: 1/22/15	



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TOWN/CITY: Bedford		STATE: NH	ZIP CODE: 03110
PHONE: (603) 627-2881		EMAIL OR FAX: jmerritt@keachnordstrom.com	
NHDES DESIGNER NUMBER: 1629		SURVEYOR NUMBER: 903	
3. PROPERTY OWNER			
NAME: Green Mountain Partners Realty Trust, Mario & Denyse Plante, Trustees (Owner of Map 201, Lot 7)			
MAILING ADDRESS: 9 Old Derry Road			
TOWN/CITY: Hudson		STATE: NH	ZIP CODE: 03051
PHONE:		EMAIL OR FAX:	
4. SIGNATURES			
APPLICANT SIGNATURE DATE: 1/22/2015 		OWNER SIGNATURE DATE: 6/22/2015 	



APPLICATION FOR SUBDIVISION OF LAND
 Water Division/ Subsurface Systems Bureau
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PROPOSED SUBDIVISION NAME: Eagles Nest Estates			
PROPOSED NEW LOT NUMBERS: 1-65		NUMBER OF NEW LOTS: 65	
2. APPLICANT			
NAME: Keach Nordstrom Associates, Inc.			
MAILING ADDRESS: 10 Commerce Park North Suite 3			
TOWN/CITY: Bedford		STATE:NH	ZIP CODE:03110
PHONE: (603) 627-2881		EMAIL OR FAX: jmerritt@keachnordstrom.com	
NHDES DESIGNER NUMBER: 1629		SURVEYOR NUMBER: 903	
3. PROPERTY OWNER			
NAME:Kelly A. Trudell (Owner of Map 186; Lot 20-4)			
MAILING ADDRESS: 11 Karas Crossing Drive			
TOWN/CITY:Hudson		STATE: NH	ZIP CODE: 03051
PHONE:		EMAIL OR FAX:	
4. SIGNATURES			
APPLICANT SIGNATURE DATE: 1/22/2015		OWNER SIGNATURE DATE: 1/24/15	

5. WATER SUPPLY (Indicate the type of water supply that services the lot – check all that apply)

PUBLIC WATER SYSTEM: Name: _____

WELL RADIUS ON LOT: Yes No (If NO, provide a recorded easement for the off lot well radius).

WELL RADIUS OFF LOT BUT PRECLUDED FROM DEVELOPMENT (Reason must be clearly depicted on plan),

WELL OFF LOT (Provide a recorded easement or deeded water rights),

OTHER (THIS MUST BE A POTABLE WATER SUPPLY): _____

6. TYPE OF PROPOSED DEVELOPMENT

TYPE OF DEVELOPMENT:	LOT NUMBERS (*INCLUDES LOTS, CAMPSITES, CONDO UNITS)	TOTAL NUMBER OF LOTS
<input checked="" type="checkbox"/> SINGLE FAMILY	1-65	65 NEW LOTS
<input type="checkbox"/> APARTMENT BUILDING		
<input type="checkbox"/> CONDOMINIUM		
<input type="checkbox"/> MANUFACTURED HOUSING PARK		
<input type="checkbox"/> CAMPING /TENTING		
<input type="checkbox"/> COMMERCIAL		
<input type="checkbox"/> INDUSTRIAL		
<input type="checkbox"/> PUBLIC FOOD ESTABLISHMENT		
<input type="checkbox"/> DUPLEX		
<input type="checkbox"/> UNBUILDABLE LOT		
<input type="checkbox"/> OTHER		

FLOW PER LOT 600 GPD
DESCRIPTION: 4 BEDROOM HOMES

7. WATERBODY INFORMATION

IS ANY PART OF THE LOT WITHIN 250 FEET OF THE "PROTECTED SHORELAND"? YES NO

TYPE OF WATERBODY: LAKE / POND TIDAL RIVER / STREAM

NAME OF WATERBODY: _____

8. INDICATE IF OTHER NHDES APPROVALS ARE REQUIRED

ISDS APPROVAL, PENDING, CONSTRUCTION APPROVAL # _____

CHECK HERE IF INDIVIDUAL SEWAGE DISPOSAL SYSTEM APPLICATIONS HAVE BEEN SUBMITTED FOR THIS PROJECT.

WATER SUPPLY APPROVAL, PENDING, PERMIT # _____

ALTERATION OF TERRAIN PERMIT, PENDING, PERMIT # _____

UIC REGISTRATION, PENDING, REGISTRATION DATE: / /

WETLANDS BUREAU APPROVAL, PENDING, PERMIT # _____

SHORELAND PERMIT, PENDING, PERMIT # _____

Eagles Nest Estates, LLC
21 Continental Blvd.
Merrimack, NH 03054

BANK OF AMERICA, NA
54-049/114

2128

1/22/2015

PAY TO THE
ORDER OF State of NH - Treasurer

\$**19,500.00

Nineteen Thousand Five Hundred and 00/100***** DOLLARS

State of NH - Treasurer

MEMO

NHDES Subdivision App



⑈002128⑈ ⑆011400495⑆ 388002320921⑈



KEACH-NORDSTROM ASSOCIATES, INC.

February 3, 2015

NHDES Subsurface Systems Bureau
29 Hazen Drive
P.O. Box 95
Concord, NH 03303

RE: Eagles Nest Estates
Bush Hill Road
Hudson, New Hampshire
KNA#11-0202-1

To whom it may concern:

This office represents Eagles Nest Estates, LLC, the applicant, for the above reference project. The proposed project entails the creation of a 65 lot open space development (OSD). The project involves six (6) separate parent tracts of land, all located within the Town of Hudson, New Hampshire.

First, a lot line adjustment between Map 186; Lot 24 and Map 186; Lot 20-4 will be executed. This lot line adjustment will give approximately 11.5 acres of additional land area to existing Lot 24.

Newly adjusted Map 186; Lot 24 and the remaining tracts that form the overall project area (Map 195; Lot 1, Map 194; Lot 9, Map 194; Lot 10, and Map 201; Lot 7) will then be consolidated to form one overall large tract of land.

The consolidated tract of land will then be subdivided to create sixty five (65) open space residential lots. Frontage for the proposed lots will be achieved through the construction of three (3) new Town roadways. The first roadway, Franklin Street, will be constructed from Bush Hill Road through a portion of the right-of-way associated with the Circumferential Highway. Franklin Street will terminate at approximately 650 feet. At the termination of Franklin Street is where construction of the proposed second roadway will begin. The second roadway is to be named Standish Lane. Standish lane is a cul-de-sac roadway of approximately 7,400-lf. The roadway dead ends with a cul-de-sac and will provide two emergency access roads. One emergency access roadway will connect to Hawkview Road and the second emergency access road will connect to Kara's Crossing Drive. The third proposed roadway is named Warren Road. Warren Road is located at centerline station 36+00 of Standish Lane. Warren Road will be a 1,000-lf cul-de-sac.

All of the proposed roadways will be 28 feet in width (pavement), have sloped granite curbing, sidewalk on one side, and a closed drainage system. Construction of the roadway, drainage, and underground utilities will be pursuant to the Town of Hudson Standards. The proposed lots are to contain private sewer and water.

Again, the project is an open space residential development. The project boundary is extremely large as compared to the overall density of the project. As such, for the purpose of

Civil Engineering

Land Surveying

Landscape Architecture

10 Commerce Park North, Suite 3B

Bedford, NH 03110

Phone (603) 627-2881

Fax (603) 627-2915

demonstrating the lot loading calculations for this project, the most conservative upland soil type has been assumed for all upland area. Chatfield Very Stony, group 3, E slope soil has been used as the basis for the lot loading calculations. This soil type has corresponding factor of 2.4. The lot loading calculations area as follows:

Total Combined Parcel Area	= 11,327,859-sf of 260.052 Acres
Soil Factor for Chatfield Very Stony	= 2.40
Area of 35% Slopes	= 244,976-sf or 5.624 Acres
Area of Jurisdictional Wetland	= 1,874,093-sf or 43.023 Acres
Area of Exposed Ledge	= 39,438-sf or 0.905 Acres
Area of Protective Well Radius	= 1,166,316-sf or 26.775 Acres
Total Deduct	= 3,324,823-sf or 76.327 Acres

Design Flow

Q = 65 OSD Lots + 1 Conventional @ 4 Bedrooms Each
Q = 65+1*600 GPD = 39,600 GPD

Lot Area Provided For Sewerage Loadings

Total Combined Parcel Area – Total Deduct = Area Provided for Sewerage Loading
260.052 Acres – 76.327 Acres = 183.725 Acres

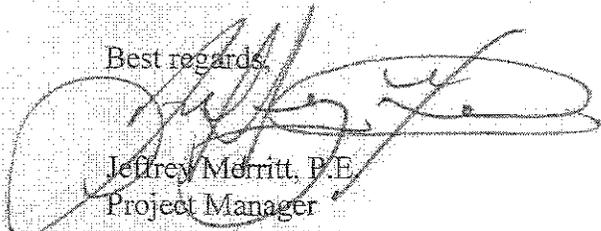
Area Required for Sewerage Loading

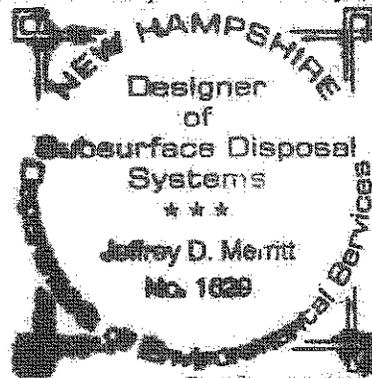
Q / 2000 (GPD/Acre) * Soil Factor = Area Required for Sewerage Loading
39,600 GPD / (2000 GPD/Acre) * 2.4 = 47.52 Acres

260.052 Acres > 47.52 Acres

We trust that the above calculations and enclosed documents are adequate. As always, please do not hesitate to contact our office with any questions.

Best regards,

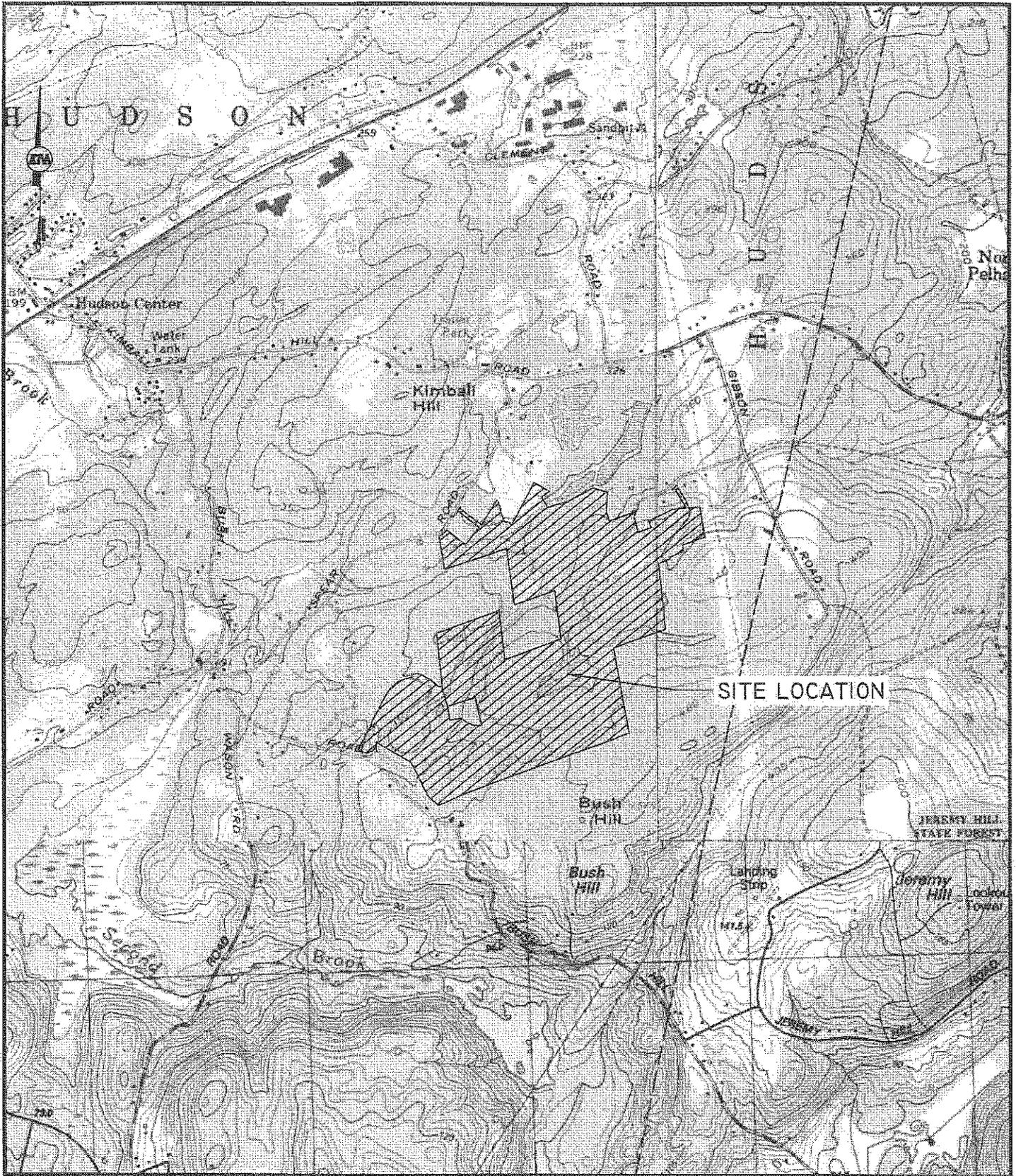

Jeffrey Merritt, P.E.
Project Manager



Civil Engineering

Land Surveying

Landscape Architecture



KNA
 KEACH-NORDSTROM ASSOCIATES, INC.

Civil Engineering Land Surveying Landscape Architecture
 10 Commerce Park North, Suite 3B, Bedford, NH 03110
 Phone (603) 627-2881

TITLE: USGS PREPARED FOR
EAGLES NEST ESTATES
 MAP/LOT: 194-9&10; 195-1; 186-20-4&24; 201-7 - BUSH HILL ROAD - HUDSON, NH

DRAWN BY: DMS DATE: 2/3/15 JOB. NO. II-0202-1

CHECKED BY: BJC SCALE: 1" = 2000' SHEET 1 OF 1



KEACH-NORDSTROM ASSOCIATES, INC.

LETTER OF TRANSMITTAL

DATE: February 9, 2015

PROJECT NO: 11-0202-1

REFERENCE: Eagles Nest Estates – Residential OSD Subdivision

TO: NHDES
Subsurface Systems Bureau
29 Hazen Drive
Concord, NH

ATTENTION: Subsurface Systems Bureau

**WE ARE SENDING YOU
THE FOLLOWING ITEMS:**

THESE ARE TRANSMITTED AS FOLLOWS:

- PLANS (2 sets)
- SPECIFICATIONS
- COPY OF LETTER
- APPLICATION
- CHANGE ORDER
- REPORT
- QUALIFICATIONS
- OTHER (USGS Map, Check for \$19,500)

- FOR APPROVAL
- FOR YOUR USE
- AS REQUESTED
- FOR REVIEW & COMMENT
- RETURNED FOR CORRECTIONS
- APPROVED AS NOTED
- APPROVED AS SUBMITTED

NOTE: _____

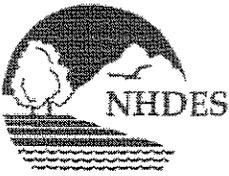
COPY TO: _____

SIGNED: Jeffrey Merritt, P.E.

Civil Engineering

Land Surveying

Landscape Architecture



THE STATE OF NEW HAMPSHIRE
DEPARTMENT OF ENVIRONMENTAL SERVICES
LAND RESOURCES MANAGEMENT
WETLANDS BUREAU

29 Hazen Drive, PO Box 95, Concord, NH 03302-0095
Phone: (603) 271-2147 Fax: (603) 271-6588
<http://des.nh.gov/organization/divisions/water/wetlands>



PERMIT APPLICATION

Project Name	Applicant Name	Project Location	File No.
Project No.	Project Date	Project Size	Check No.
			Project No.
			Project No.

1. REVIEW TIME:
Indicate your Review Time below. Refer to Guidance Document A for instructions.

- Standard Review (Minimum, Minor or Major Impact) Expedited Review (Minimum Impact)

2. PROJECT LOCATION:
Separate applications must be filed with each municipality that jurisdictional impacts will occur in.

ADDRESS: **Hawkview, Bush Hill and Spear Road** TOWN/CITY: **Hudson**

TAX MAP: **186/194/195/201** BLOCK: LOT: **24/10/17** UNIT:

USGS TOPO MAP WATERBODY NAME: NA STREAM WATERSHED SIZE: **<269 acres** NA

LOCATION COORDINATES (If known): Latitude/Longitude UTM State Plane

3. PROJECT DESCRIPTION:
Provide a brief description of the project outlining the scope of work. Attach additional sheets as needed to provide a detailed explanation of your project. DO NOT reply "See Attached" in the space provided below.

The proposed project is for the construction of a residential subdivision and road construction. Total impacts are 6,284 square feet, of these 2,235 square feet will be temporary. This will include 5 separate wetland impacts, all of which will be installing box culverts to minimize impacts to the systems and maintain flow and animal passage.

4. RELATED PERMITS, ENFORCEMENT, EMERGENCY AUTHORIZATION, SHORELAND, ALTERATION OF TERRAIN, ETC...

5. NATURAL HERITAGE BUREAU & DESIGNATED RIVERS:
See the Instructions & Required Attachments document for instructions to complete a & b below.

a. Natural Heritage Bureau File ID: **NHB 14 - 2279**

b. Designated River the project is in ¼ miles of: _____; and
date a copy of the application was sent to Local River Advisory Committee: Month: ___ Day: ___ Year: ___

NA

6. APPLICANT INFORMATION (Desired permit holder)LAST NAME, FIRST NAME, M.I.: **John Gargasz**TRUST / COMPANY NAME: **Eagles Nest Estates, LLC**MAILING ADDRESS: **21 Continental BLVD**TOWN/CITY: **Merrimack**STATE: **NH**ZIP CODE: **03054**

EMAIL or FAX:

PHONE: **603-320-5123**ELECTRONIC COMMUNICATION: By Initialing here: **LH**, I hereby authorize DES to communicate all matters relative to this application electronically**7. PROPERTY OWNER INFORMATION (If different than applicant)**

LAST NAME, FIRST NAME, M.I.:

TRUST / COMPANY NAME:

MAILING ADDRESS:

TOWN/CITY:

STATE:

ZIP CODE:

EMAIL or FAX:

PHONE:

ELECTRONIC COMMUNICATION: By initialing here _____, I hereby authorize DES to communicate all matters relative to this application electronically

8. AUTHORIZED AGENT INFORMATIONLAST NAME, FIRST NAME, M.I.: **Luke Hurley**COMPANY NAME: **Gove Environmental Services, Inc**MAILING ADDRESS: **8 Continental Drive**TOWN/CITY: **Exeter**STATE: **NH**ZIP CODE: **03833**EMAIL or FAX: **lhurley@gesinc.biz**PHONE: **603-778-0644**ELECTRONIC COMMUNICATION: By initialing here **LH**, I hereby authorize DES to communicate all matters relative to this application electronically**9. PROPERTY OWNER SIGNATURE:**

See the Instructions & Required Attachments document for clarification of the below statements

By signing the application, I am certifying that:

1. I authorize the applicant and/or agent indicated on this form to act in my behalf in the processing of this application, and to furnish upon request, supplemental information in support of this permit application.
2. I have reviewed and submitted information & attachments outlined in the instructions and Required Attachment document.
3. All abutters have been identified in accordance with RSA 482-A:3, I and Env-Wt 100-900.
4. I have read and provided the required information outlined in Env-Wt 302.04 for the applicable project type.
5. I have read and understand Env-Wt 302.03 and have chosen the least impacting alternative.
6. Any structure that I am proposing to repair/replace was either previously permitted by the Wetlands Bureau or would be considered grandfathered per Env-Wt 101.47.
7. I have submitted a copy of the application materials to the NH State Historic Preservation Officer.
8. I authorize DES and the municipal conservation commission to inspect the site of the proposed project.
9. I have reviewed the information being submitted and that to the best of my knowledge the information is true and accurate.
10. I understand that the willful submission of falsified or misrepresented information to the New Hampshire Department of Environmental Services is a criminal act, which may result in legal action.
11. I am aware that the work I am proposing may require additional state, local or federal permits which I am responsible for obtaining.
12. The mailing addresses I have provided are up to date and appropriate for receipt of DES correspondence. DES will not forward returned mail.



Property Owner Signature

John Gargasz

Print name legibly

1/16/2015

Date

MUNICIPAL SIGNATURES

10. CONSERVATION COMMISSION SIGNATURE

The signature below certifies that the municipal conservation commission has reviewed this application, and:

1. Waives its right to intervene per RSA 482-A:11;
2. Believes that the application and submitted plans accurately represent the proposed project; and
3. Has no objection to permitting the proposed work.

 Authorized Commission Signature	 Print name legibly	 Date
---	--------------------------------	------------------

DIRECTIONS FOR CONSERVATION COMMISSION

1. Expedited review ONLY requires that the conservation commission's signature is obtained in the space above.
2. The Conservation Commission signature should be obtained prior to the submittal of the original application and four copies to the town/city clerk for mailing to the DES.
3. The Conservation Commission may refuse to sign. If the Conservation Commission does not sign this statement for any reason, the application is not eligible for expedited review and the application will reviewed in the standard review time frame.

11. TOWN / CITY CLERK SIGNATURE

As required by Chapter 482-A:3 (amended 1991), I hereby certify that the applicant has filed five application forms, five detailed plans, and five USGS location maps with the town/city indicated below and I have received and retained certified postal receipts (or copies) for all abutters identified by the applicant.

 Town/City Clerk Signature	 Print name legibly	 Town/City	 Date
---	--------------------------------	-----------------------	------------------

DIRECTIONS FOR TOWN/CITY CLERK:

Per RSA 482-A:3, I(d):

1. For applications where "Expedited Review" is checked on page 1, accept the application for mailing only if the Conservation Commission signature has been sought;
2. Collect the postal receipts demonstrating that all abutters and the Local Advisory Committee were sent proper notice;
3. Collect any administrative fees, not to exceed \$10 plus the cost of postage by certified mail (RSA 482-A:3, I);
4. IMMEDIATELY sign the original application and four copies in the signature space provided above;
5. Retain one copy of the application form, one complete set of attachments and the postal receipts demonstrating that all abutters and the Local River Advisory Committee were notified and make them reasonably accessible to the public;
6. IMMEDIATELY distribute a copy of the application with one complete set of attachments to each of the following bodies: the municipal Conservation Commission, the local governing body (Board of Selectmen or Town/City Council), and the Planning Board in accordance with RSA 482-A:3, I; and
7. IMMEDIATELY send the ORIGINAL application form, one complete set of attachments and filing fee, by CERTIFIED MAIL to the NHDES Wetlands Bureau at the address indicated on page 1 of this application. (DO NOT HOLD FOR CONSERVATION COMMISSION SIGNATURE).

12. IMPACT AREA:

For each jurisdictional area that will be/has been impacted, provide square feet and, if applicable, linear feet of impact

Permanent: impacts that will remain after the project is complete.

Temporary: impacts not intended to remain (and will be restored to pre-construction conditions) after the project is complete.

After-the-fact (ATF): work completed prior to receipt of this application by DES. Check box to indicate ATF.

JURISDICTIONAL AREA	PERMANENT Sq. Ft. / Lin. Ft.	TEMPORARY Sq. Ft. / Lin. Ft.
Forested wetland	<input type="checkbox"/> ATF	<input type="checkbox"/> ATF
Scrub-shrub wetland	6284 <input type="checkbox"/> ATF	<input type="checkbox"/> ATF
Emergent wetland	<input type="checkbox"/> ATF	<input type="checkbox"/> ATF
Wet meadow	<input type="checkbox"/> ATF	<input type="checkbox"/> ATF
Intermittent stream	150lf <input type="checkbox"/> ATF	<input type="checkbox"/> ATF
Perennial Stream / River	/ <input type="checkbox"/> ATF	/ <input type="checkbox"/> ATF
Lake / Pond	/ <input type="checkbox"/> ATF	/ <input type="checkbox"/> ATF
Bank - Intermittent stream	/ <input type="checkbox"/> ATF	/ <input type="checkbox"/> ATF
Bank - Perennial stream / River	/ <input type="checkbox"/> ATF	/ <input type="checkbox"/> ATF
Bank - Lake / Pond	/ <input type="checkbox"/> ATF	/ <input type="checkbox"/> ATF
Tidal water	/ <input type="checkbox"/> ATF	/ <input type="checkbox"/> ATF
Salt marsh	<input type="checkbox"/> ATF	<input type="checkbox"/> ATF
Sand dune	<input type="checkbox"/> ATF	<input type="checkbox"/> ATF
Prime wetland	<input type="checkbox"/> ATF	<input type="checkbox"/> ATF
Prime wetland buffer	<input type="checkbox"/> ATF	<input type="checkbox"/> ATF
Undeveloped Tidal Buffer Zone (TBZ)	<input type="checkbox"/> ATF	<input type="checkbox"/> ATF
Previously-developed upland in TBZ	<input type="checkbox"/> ATF	<input type="checkbox"/> ATF
Docking - Lake / Pond	<input type="checkbox"/> ATF	<input type="checkbox"/> ATF
Docking - River	<input type="checkbox"/> ATF	<input type="checkbox"/> ATF
Docking - Tidal Water	<input type="checkbox"/> ATF	<input type="checkbox"/> ATF
TOTAL	6284 / 150	/

13. APPLICATION FEE: See the Instructions & Required Attachments document for further instruction

Minimum Impact Fee: Flat fee of \$ 200

Minor or Major Impact Fee: Calculate using the below table below

Permanent and Temporary (non-docking) 6284 sq. ft. X \$0.20 = \$ 1256.80

Temporary (seasonal) docking structure: _____ sq. ft. X \$1.00 = \$

Permanent docking structure: _____ sq. ft. X \$2.00 = \$

Projects proposing shoreline structures (including docks) add \$200 = \$

Total = \$

The Application Fee is the above calculated Total or \$200, whichever is greater = \$ 1256.80

TRAFFIC IMPACT AND ACCESS STUDY

**RESIDENTIAL DEVELOPMENT
HUDSON, NEW HAMPSHIRE**



**181 BALLARDVALE STREET, SUITE 202
WILMINGTON, MASSACHUSETTS 01887
(978) 570-2999**

PREPARED FOR:

**ELKRIDGE REAL ESTATE INVESTORS
21 CONTINENTAL BOULEVARD
MERRIMACK, NEW HAMPSHIRE 03054**

JANUARY 2015



***Traffic Impact and Access Study
Residential Development
Hudson, New Hampshire
January 2015***

TECHNICAL MEMORANDUM

REF: MAX-2011031

DATE: January 29, 2015

TO: Mr. John Gargasz
Elkridge Real Estate Investors
21 Continental Boulevard
Merrimack, New Hampshire 03054

FROM: Ms. Heather L. Monticup, P.E., Project Manager
Ms. Susannah E. Barnes, E.I.T., Engineer
Ms. Heather Georgallas, Engineer

RE: Traffic Impact and Access Study
Residential Development
Bush Hill Road – Hudson, New Hampshire

INTRODUCTION

Greenman-Pedersen, Inc. (GPI) has prepared this Traffic Impact and Access Study (TIAS) for a proposed residential subdivision to be located off of Bush Hill Road in Hudson, New Hampshire. The site is currently undeveloped. As proposed, the project consists of constructing a 65-lot open space residential subdivision. Access is currently proposed via a new Town road, Franklin Street (located within the New Hampshire Department of Transportation (NHDOT) right-of-way for White Service Road), off of Bush Hill Road and emergency-only access only will be provided via Kara's Crossing Drive and Hawkview Road. Figure 1 shows the site in relation to the surrounding roadways.

TRAFFIC IMPACT AND ACCESS STUDY

Proposed Residential Development – Hudson, New Hampshire

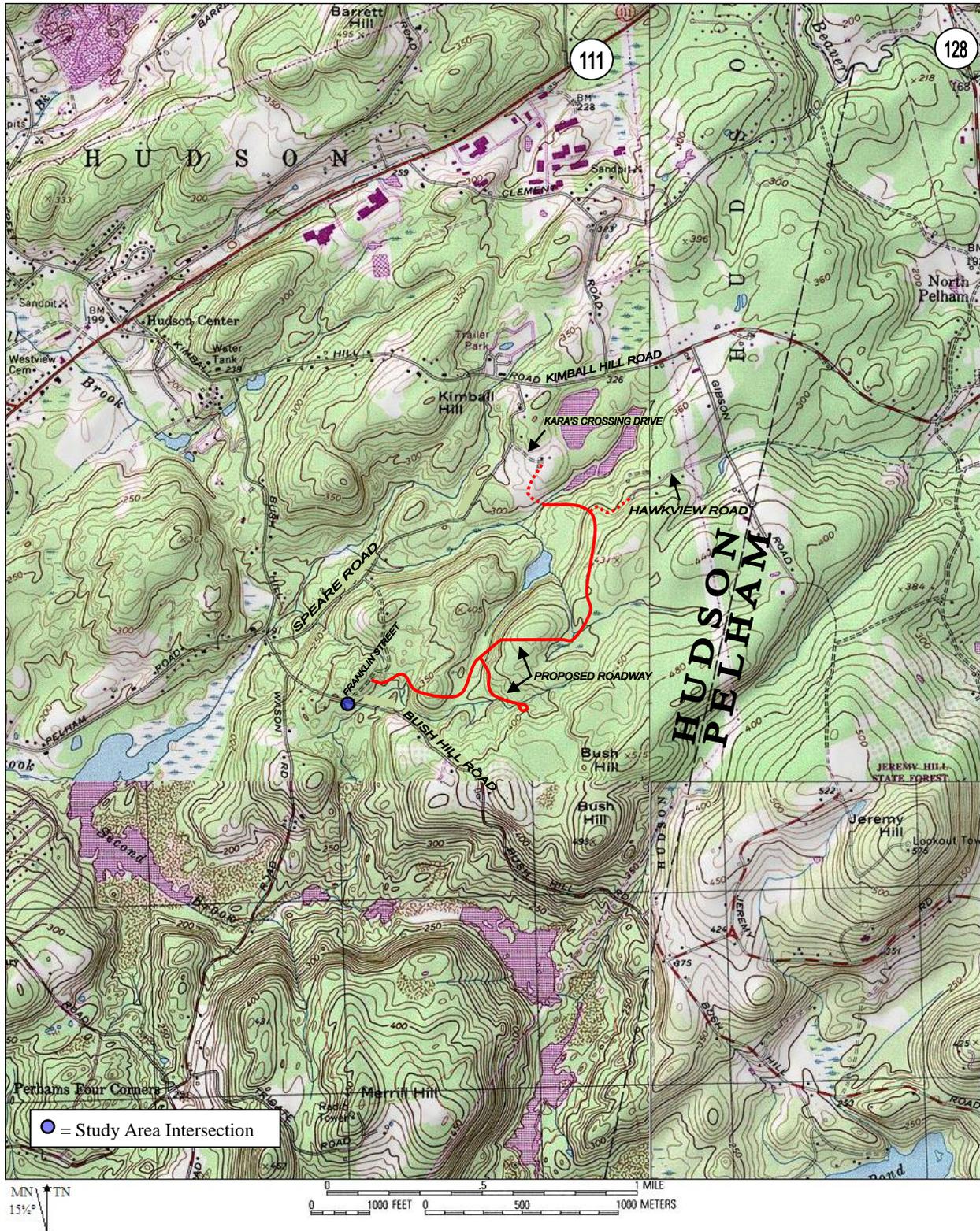


Figure 1
Site Location Map

EXISTING CONDITIONS

Study Area

Evaluation of the traffic impacts associated with the proposed project requires an evaluation of existing and projected traffic volumes on the adjacent streets, the volume of traffic expected to be generated by the project, and the impact that this traffic will have on the adjacent streets and nearby intersections. In preparing this TIAS for the proposed project, the intersection of Bush Hill Road at proposed Franklin Street has been analyzed and evaluated.

Bush Hill Road

Bush Hill Road is a local roadway that runs in a general northwest/southeast direction between Kimball Hill Road to the north and Route 28 (Mammoth Road) to the south. The roadway is town-maintained consisting of many horizontal and vertical curves. Bush Hill Road generally provides 21 to 22 feet of overall pavement width in the vicinity of the proposed site with a posted speed limit of 30 miles per hour (mph). Striping separates travel lanes and distinguishes shoulders. Land use along Bush Hill Road in the vicinity of the proposed roadway consists of residential homes.

Traffic Volumes

Base traffic conditions within the study area were developed using automatic traffic recorders (ATR) to obtain weekday daily traffic volumes on Bush Hill Road adjacent to the site in August 2014. Evaluation of the traffic-count data reveals that the weekday AM peak hour generally occurs between 7:30 and 8:30 AM and the weekday PM peak hour generally occurs between 5:00 and 6:00 PM. All traffic-count data are provided in the Appendix.

Seasonal Adjustment

Traffic on a given roadway typically fluctuates throughout the year depending on the area and the type of roadway. Based on NHDOT guidelines for the preparation of a traffic study, existing traffic volumes must represent the peak of the monthly average peak-hour conditions. To determine if the data needed to be adjusted to account for this fluctuation, seasonal adjustment and historical traffic-count data provided by NHDOT were reviewed.¹ This information revealed that the August weekday traffic volumes are 0.3 percent lower than peak-month conditions. Additionally, this information indicated that the August traffic volumes are 8.9 percent lower

¹ *New Hampshire Department of Transportation Traffic Volume Report*; Group 4 Averages—Urban Highways.

TRAFFIC IMPACT AND ACCESS STUDY

Proposed Residential Development – Hudson, New Hampshire

than the peak-month volumes during weekday AM peak period and are 0.9 percent lower than the peak-month conditions during the weekday PM peak period. Therefore, the August traffic counts were upwardly adjusted to reflect peak-month conditions. The NHDOT seasonal adjustment factors are provided in the Appendix.

Table 1 summarizes the existing traffic volumes on Bush Hill Road.

Table 1
EXISTING TRAFFIC-VOLUME SUMMARY

Location/Time Period	Daily Volume (vph) ^a	Peak Hour Volume (vph) ^b	K Factor (%) ^c	Directional Distribution ^d
Bush Hill Road adjacent to the site:				
<i>Weekday Daily</i>	1,350			
<i>Weekday AM peak hour</i>		107	7.9	65% WB
<i>Weekday PM peak hour</i>		134	9.9	55% EB

^a In vehicles per day. ATR data upwardly adjusted by 0.3 percent to reflect monthly peak conditions.

^b In vehicles per hour. Raw data upwardly adjusted by 8.9 percent for the weekday AM peak hour and 0.9 percent for the weekday PM peak hour to reflect the monthly peak-hour conditions.

^c Percentage of daily traffic occurring during the peak hour.

^d EB = eastbound, WB = westbound

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Collision History

Collision data for the study corridor from 81 Bush Hill Road to 101 Bush Hill Road were obtained from the Hudson Police Department (2011 through 2013) and NHDOT (2008 through 2011) for the latest three years available. A summary of the Hudson Police Department and NHDOT collision data at the study area intersection and roadway segment is provided in Table 2.

Table 2
COLLISION HISTORY SUMMARY

Location	Number of Crashes		Severity ^a			Percent During ^b	
	Total	Average per Year	PD	PI	F	Commuter Peak	Wet/Icy Conditions
Hudson Police Department (2011-2013)							
Corridor between 81 and 101 Bush Hill Road	15	5	12	3	--	7%	33%
NHDOT (2008-2010)							
Corridor between 81 and 101 Bush Hill Road	2	0.67	1	1	0	--	100%

Source: Hudson Police Department (2011-2013) and NHDOT Crash Data (2008-2010)

^a PD = property damage only; PI = personal injury; F = fatality.

^b Percent of vehicle incidents that occurred during the weekday AM and weekday PM commuter peak periods.

Based on data obtained from the NHDOT, the study corridor from 81 Bush Hill Road to 101 Bush Hill Road has experienced two reported collisions between 2008 and 2010, averaging 0.67 collisions per year. Based on data obtained from the Hudson Police, the study corridor from 81 Bush Hill Road to 101 Bush Hill Road has experienced 15 reported collisions between 2011 and 2013, averaging five collisions per year. Of the reported seventeen collisions, four reported collisions resulted in injury, 41 percent of the collisions occurred during wet/icy conditions, and six percent of collisions occurred during commuter peaks. It should be noted that the Hudson Police listed speed as the cause of nine of the reported collisions.

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Vehicle Speeds

Speed measurements were conducted along Bush Hill Road adjacent to the site by measuring the elapsed time for vehicles traveling a short, pre-measured distance between two checkpoints. The travel time was recorded using ATRs over a 24-hour period, thereby also recording travel speeds during non-peak hours when vehicle speeds are not affected by commuter congestion. Dividing the elapsed time by the measured distance between checkpoints derives the speed. The observed speeds are summarized in Table 3.

Table 3
OBSERVED TRAVEL SPEEDS (in miles per hour)

Location/Direction	Posted Speed Limit	Average Speed	85 th Percentile Speed ^a
Bush Hill Road adjacent to the site:			
<i>Eastbound</i>	30	33	43
<i>Westbound</i>	30	35	44

^a Speed at, or below which 85 percent of all observed vehicles travel. It is commonly used for posting speed limits.

As shown in Table 3, the average speeds along Bush Hill Road adjacent to the site were found to be 33 and 35 mph for eastbound and westbound travel, respectively. The 85th percentile speeds were found to be 43 and 44 mph for northbound and southbound travel, respectively. The speeds along Bush Hill Road were observed to be higher than the posted speed limit of 30 mph which is likely due to the horizontal alignment of Bush Hill Road adjacent to the site (straight).

FUTURE CONDITIONS

To estimate the impact of site-generated traffic within the study area, existing traffic volumes were projected to the expected opening year (2015) of the development and to the expected opening year plus ten years (2025). These design horizons were chosen to be consistent with Town of Hudson and NHDOT guidelines for the preparation of a traffic study. Traffic volumes on the roadway network at these times will include existing traffic, new traffic due to normal traffic growth, and traffic related to any significant development by others expected to be completed within the area by the 2015 and 2025 design years. Consideration of these factors resulted in the development of 2015 and 2025 No-Build traffic volumes, which assume that the proposed residential development is not built. The incremental impacts of the proposed project may then be determined by adding site-generated traffic volumes (Build conditions) and making comparisons to the No-Build conditions.

Traffic Growth

To develop the 2015 No-Build and 2025 No-Build forecast volumes, two components of traffic growth were considered. First, an annual growth percentage was determined based on the historical traffic-count data obtained from the Nashua Regional Planning Commission (NRPC)² and NHDOT³. The historical traffic-count data indicate that traffic volumes in the area have been increasing at a rate of 1.3 percent since 2002 and 1.5 percent per year since 2006, respectively. The historical increase in traffic may be because Bush Hill Road provides a cut-through from NH Route 111 to NH Route 128. In order to provide a conservative (worse-case) analysis scenario, a compounded annual traffic growth rate of 2.0 percent per year was assumed to account for general population growth and the traffic generated by smaller area developments. The NRPC and NHDOT historical traffic-volume data are provided in the Appendix.

Second, any planned or approved specific developments in the area that would generate a significant volume of traffic on study area roadways by the 2015 and 2025 design years were included. Based on discussions with officials from the Town of Hudson, there are no specific developments planned in the area that are expected to significantly affect traffic volumes adjacent to the site.

² Nashua Regional Planning Commission. *Transportation Planning Traffic Count Data*: ID #359065, ID #229036, ID #229037, ID #359060, ID #229043.

³ NHDOT *Traffic Volume Report*; 2012.

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Planned Roadway Improvements

Officials from the Town of Hudson were contacted to determine if any improvements are planned within the study area. Based on these discussions, there are no roadway improvements planned in the vicinity of the site.

No-Build Conditions

The 2015 No-Build peak-hour traffic volumes were accordingly developed by applying a total growth of 2.0 percent (2.0 percent compounded over one year) to the 2014 Existing traffic volumes. The 2025 No-Build peak-hour traffic volumes were developed by applying a total growth of 24.3 percent (2.0 percent compounded over eleven years) to the 2014 Existing traffic volumes. Table 4 summarizes the No-Build peak-hour traffic volumes along Bush Hill Road adjacent to the site.

Table 4
NO-BUILD TRAFFIC-VOLUME SUMMARY

<u>Location/Time Period</u>	<u>Peak Hour Volume (vph) ^a</u>	<u>Directional Distribution ^b</u>
2015 Opening-Year:		
Bush Hill Road adjacent to the site		
<i>Weekday AM Peak Hour</i>	109	65% WB
<i>Weekday PM Peak Hour</i>	136	55% EB
2025 Opening-Year:		
Bush Hill Road adjacent to the site		
<i>Weekday AM Peak Hour</i>	133	65% WB
<i>Weekday PM Peak Hour</i>	166	55% EB

^a Vehicles per hour.

^b WB = westbound; EB = eastbound.

Trip Generation

As currently planned, the proposed development consists of the construction of 65 detached housing units. To estimate the volume of traffic to be generated by the proposed development, trip-generation rates published by the Institute of Transportation Engineers (ITE) *Trip*

*Generation Manual*⁴ were researched. Land Use Code (LUC) 210, Single-Family Detached Housing, was used to estimate the potential trip generation of the site. Table 4 summarizes the results of the trip-generation estimates. All trip-generation data are provided in the Appendix.

Table 5
TRIP-GENERATION SUMMARY

Time Period/Direction	Proposed Trips ^a
Weekday Daily	700
Weekday AM Peak Hour:	
<i>In</i>	14
<i>Out</i>	<u>41</u>
<i>Total</i>	55
Weekday PM Peak Hour:	
<i>In</i>	45
<i>Out</i>	<u>27</u>
<i>Total</i>	72

^a ITE LUC 210, Single-Family Detached Housing for 65 dwelling units.

As shown in Table 5, the proposed residential development is expected to generate 55 trips (14 entering and 41 exiting) during the weekday AM peak hour and 72 trips (45 entering and 27 exiting) during the weekday PM peak hour.

Trip Distribution

Having estimated project-generated vehicle trips, the next step is to determine the distribution of project traffic and assign these trips to the local roadway network. Due to the uses of the surrounding area and the proposed project, the distribution of proposed site-generated traffic was based on United States Census Bureau Journey-to-Work information and expected travel routes to the site. Accordingly, during the critical peak hours, 20 percent of the future site traffic is expected to and from the north on Speare Road, 10 percent to and from the east on Bush Hill Road, and 70 percent to and from the west. The journey-to-work census data is provided in the Appendix.

⁴*Trip Generation Manual*, 9th Edition; Institute of Transportation Engineers; Washington, DC; 2012.

Sight Distance

To identify potential safety concerns associated with site access and egress, sight distances have been evaluated at the proposed site driveway location to determine if the available sight distances for vehicles exiting the site meet or exceed the minimum distances required for approaching vehicles to safely stop. The available sight distances were compared with minimum requirements, as established by the American Association of State Highway and Transportation Officials (AASHTO)⁵. AASHTO is the national standard by which vehicle sight distance is calculated, measured, and reported. In addition, the available sight distances were compared with the Town of Hudson’s and NHDOT’s requirement of 400 feet of All-Season Safe Sight Distance.

Sight distance is the length of roadway ahead that is visible to the driver. Stopping Sight Distance (SSD) is the minimum distance required for a vehicle traveling at a certain speed to safely stop before reaching a stationary object in its path. The values are based on a driver perception and reaction time of 2.5 seconds and a braking distance calculated for wet, level pavements. When the roadway is either on an upgrade or downgrade, grade correction factors are applied. Stopping sight distance is measured from an eye height of 3.5 feet to an object height of 2 feet above street level, equivalent to the taillight height of a passenger car. The SSD is measured along the centerline of the traveled way of the major road.

Intersection sight distance (ISD) is provided on minor street approaches to allow the drivers of stopped vehicles a sufficient view of the major roadway to decide when to enter the major roadway. By definition, ISD is the minimum distance required for a motorist exiting a minor street to turn onto the major street, without being overtaken by an approaching vehicle reducing its speed from the design speed to 70 percent of the design speed. ISD is measured from an eye height of 3.5 feet to an object height of 3.5 feet above street level. The use of an object height equal to the driver eye height makes intersection sight distances reciprocal (i.e., if one driver can see another vehicle, then the driver of that vehicle can also see the first vehicle). When the minor street is on an upgrade that exceeds 3 percent, grade correction factors are applied.

SSD is generally more important as it represents the minimum distance required for safe stopping while ISD is based only upon acceptable speed reductions to the approaching traffic stream. The ISD, however, must be equal to or greater than the minimum required SSD in order to provide safe operations at the intersection. In accordance with the AASHTO manual, *“If the available sight distance for an entering or crossing vehicle is at least equal to the appropriate stopping sight distance for the major road, then drivers have sufficient sight distance to anticipate and avoid collisions. However, in some cases, this may require a major-road vehicle to stop or slow to accommodate the maneuver by a minor-road vehicle. To enhance traffic operations,*

⁵A Policy on Geometric Design of Highways and Streets; American Association of State Highway and Transportation Officials (AASHTO); 2004.

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intersection sight distances that exceed stopping sight distances are desirable along the major road.” Accordingly, the ISD should be at least equal to the distance required to allow a driver approaching the minor road to safely stop.

The available SSD and ISD at the proposed site driveway location were measured and compared to minimum requirements as established by AASHTO. Since the distance required to stop a vehicle is dependent on the speed of that vehicle, speed studies were conducted as presented in the *Existing Conditions: Vehicle Speeds* section. Based on both the posted speed limit and the observed speeds, the SSD and ISD requirements at this intersection were calculated. The required minimum sight distances for each speed are compared to the available distances for the proposed site driveway along Bush Hill Road, as shown in Table 6.

**Table 6
SIGHT DISTANCE SUMMARY**

Location/Direction	Stopping Sight Distance (feet)		Intersection Sight Distance (feet)		
	Measured	Minimum Required ^a	Measured	Minimum Required ^b	Desirable ^a
Bush Hill Rd at Franklin Street:					
<i>West of intersection</i>	500+	338	500+	338	335
<i>East of intersection</i>	500	349	500+	349	335

^a Values based on AASHTO requirements for 85th percentile speeds of 43 mph for Bush Hill Road eastbound travel (west of intersection) and 44 mph for Bush Hill Road westbound travel (east of intersection).

^b Values based on AASHTO requirements for SSD.

^c Values based on AASHTO requirements for posted speed limit of 30 mph on Bush Hill Road.

As indicated in Table 6, available sight distance at the intersection of Bush Hill Road and Franklin Street will meet the minimum and desirable SSD and ISD requirements for safe operation. The available sight distance at the proposed driveway along Bush Hill Road also meets the Town requirement for 400 feet of available sight distance.

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Looking east from Bush Hill Road Driveway

Looking west from Bush Hill Road Driveway

Figure 2

To ensure the safe and efficient flow of traffic to and from the site, it is recommended that any proposed plantings, vegetation, landscaping, and signing along the site frontage be kept low to the ground (no more than 3.0 feet above street level) or set back sufficiently from the edge of the roadways so as not to inhibit the available sight lines.

Build Conditions

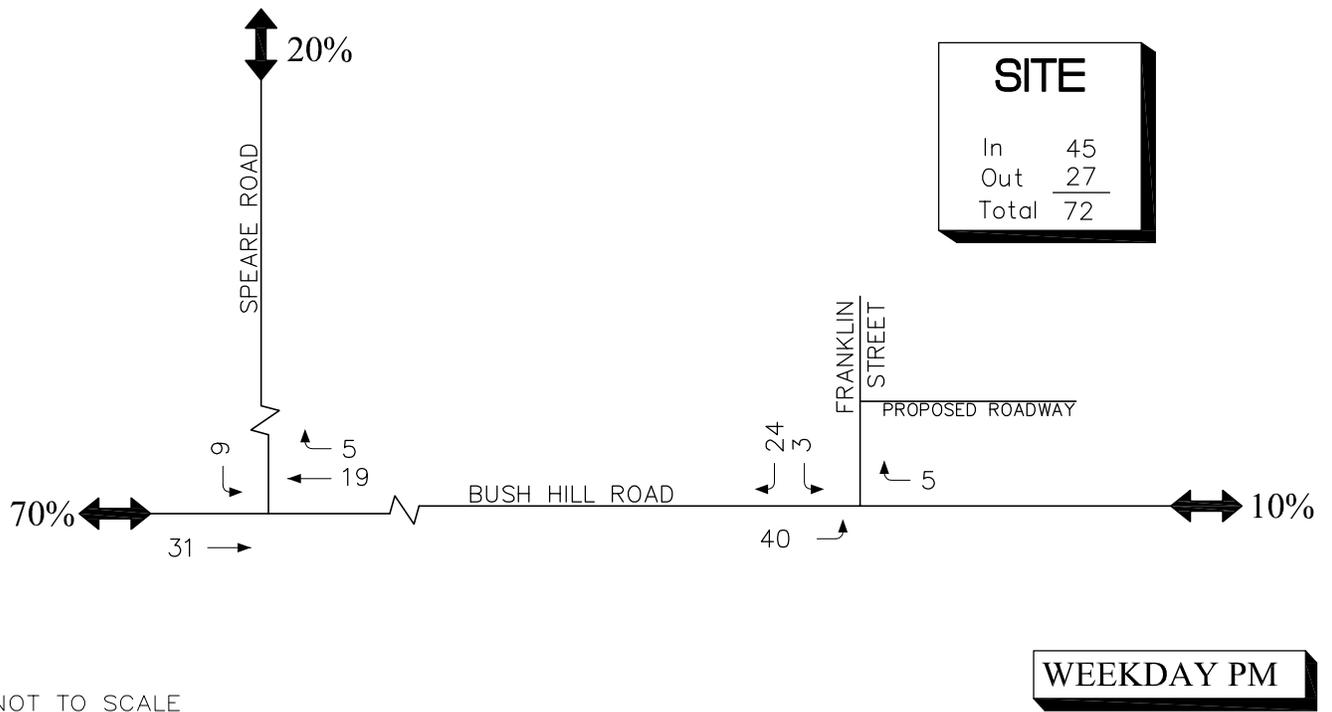
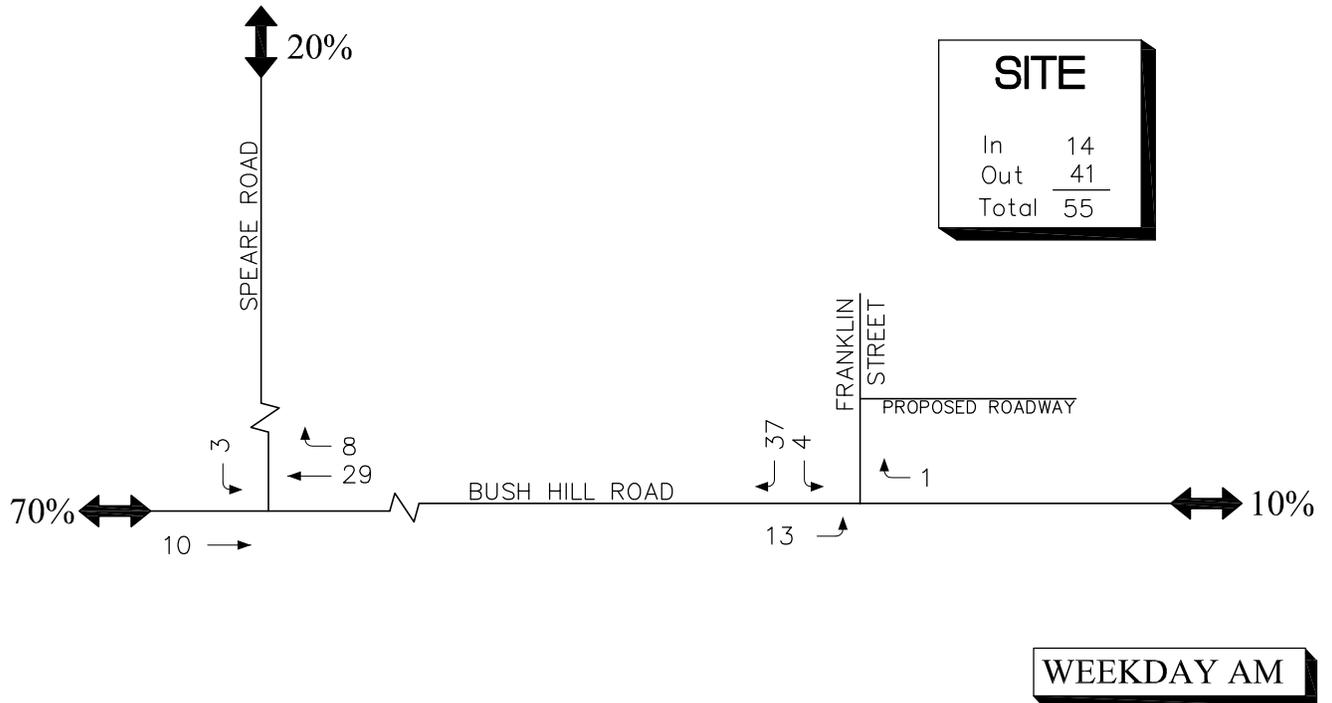
Based on the traffic-generation and distribution estimates for this project, the traffic volumes from the proposed project were assigned to the roadway network, as shown on Figure 3. The site-generated traffic volumes were then added to the No-Build traffic volumes to develop the Build traffic volumes. The 2015 and 2025 Build weekday AM and weekday PM peak-hour traffic-volume networks are graphically depicted on Figures 4 and 5, respectively.

Traffic Increases

The proposed residential development is expected to result in minimal increases in traffic on the study area roadways. As shown on Figure 3, traffic-volume increases beyond the study area during the peak hours are projected to be in the range of 5 to 50 vehicle trips. These increases represent, on average, one additional vehicle every 1 to 12 minutes during the critical peak hours.

TRAFFIC IMPACT AND ACCESS STUDY

Proposed Residential Development - Hudson, New Hampshire



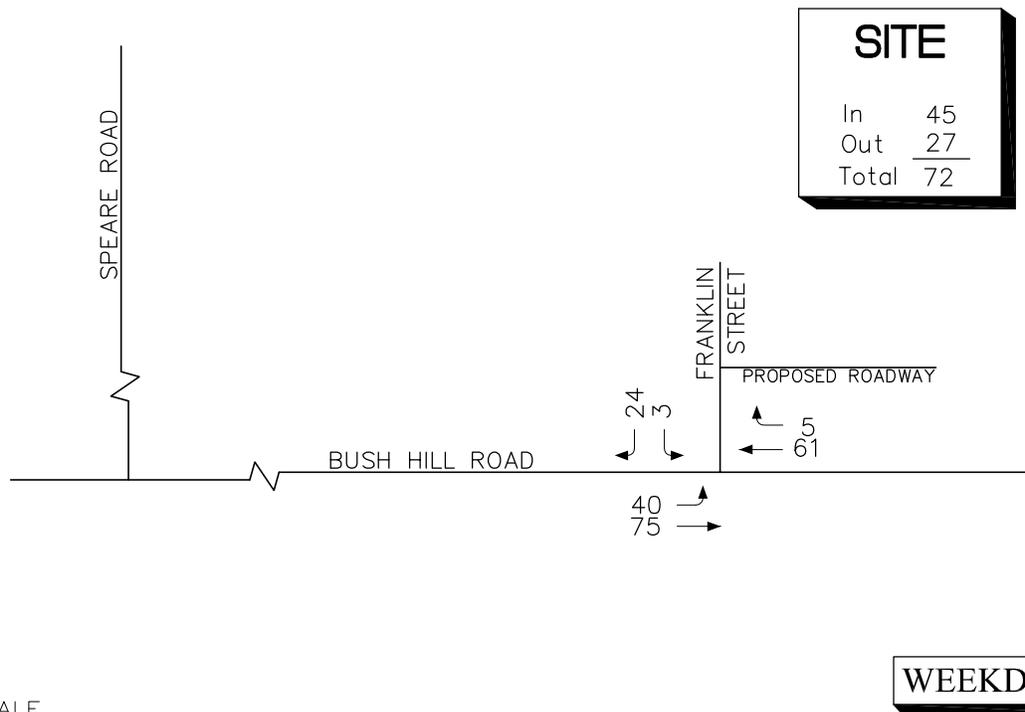
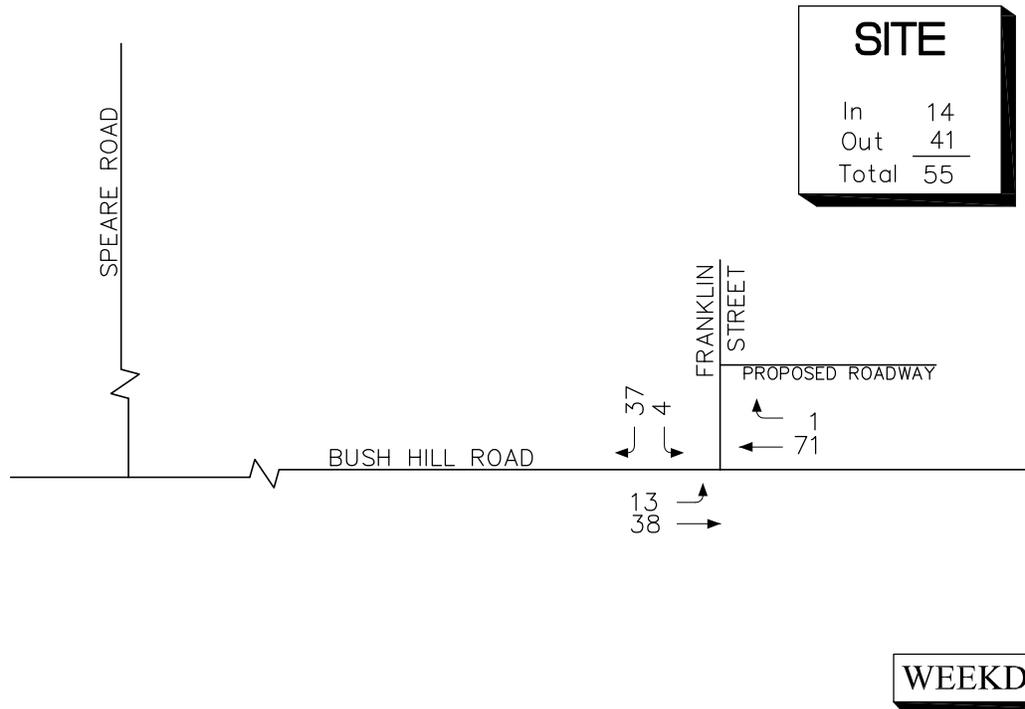
NOT TO SCALE

Figure 3

Site-Generated for 65 Units
Peak Hour Traffic Volumes

TRAFFIC IMPACT AND ACCESS STUDY

Proposed Residential Development - Hudson, New Hampshire

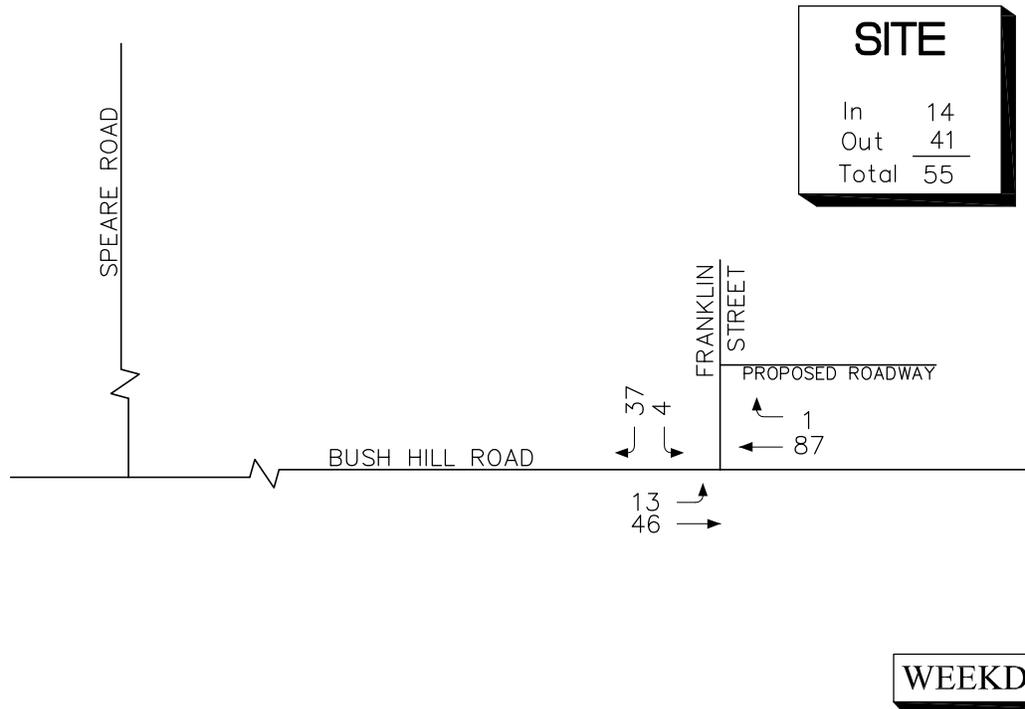


NOT TO SCALE

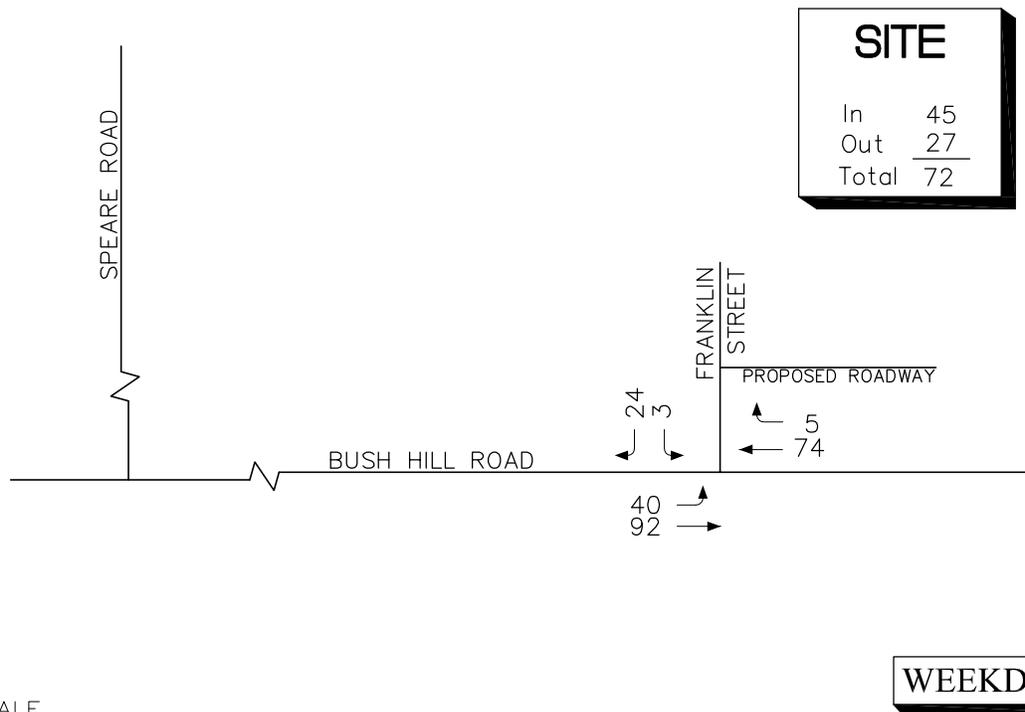
Figure 4
 2015 Build
 Peak Hour Traffic Volumes

TRAFFIC IMPACT AND ACCESS STUDY

Proposed Residential Development - Hudson, New Hampshire



WEEKDAY AM



WEEKDAY PM



NOT TO SCALE

CAPACITY AND QUEUE ANALYSIS

Capacity and queuing analyses were conducted at the study-area locations under 2014 Existing, 2015 No-Build, 2015 Build, 2025 No-Build, and 2025 Build conditions during the weekday AM and weekday PM peak hours. The impact of site-generated traffic can be measured by comparing No-Build conditions to Build conditions.

Methodology

The capacity analysis methodology is based on the concepts and procedures in the *Highway Capacity Manual* (HCM) and is described in the Appendix of this report.⁶

The queue analysis methodology for unsignalized intersections is based on the concepts and procedures described in the HCM. For unsignalized intersections, the 95th percentile queue represents the length of queue of the critical minor-street movement that is not expected to be exceeded 95 percent of the time during the analysis period (typically one hour). In this case, the queue length is a function of the capacity of the movement and the movement's degree of saturation.

Analysis Results

The study area intersection has been analyzed through application of the procedures previously described. The level-of-service (LOS) and queue analysis results are presented in Tables 7 and 8 and are discussed below. All analysis worksheets are provided in the Appendix.

Bush Hill Road at Franklin Street

Under 2015 and 2025 Build traffic-volume conditions, the Bush Hill Road and Franklin Street critical movements are expected to operate at optimal levels (LOS A) during the weekday AM and weekday PM peak hours. Vehicles exiting the site will experience minimal delay (less than 10 seconds) and queue lengths are expected to be less than 1 vehicle. The proposed residential development is not expected to affect traffic operations on Bush Hill Road. Volume-to-capacity ratios are expected to be well below 1.00 (0.05 or less) indicating there will be ample capacity available with the proposed development in place.

⁶ *Highway Capacity Manual 2010*, Transportation Research Board; Washington, D.C.; 2010.

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**Table 7
CAPACITY ANALYSIS SUMMARY – OPENING YEAR CONDITIONS**

Intersection/Peak Hour/Lane Group	2015 Build			
	V/C	Del.	LOS	Queue
Bush Hill Road at Franklin Street				
<i>Weekday AM:</i>				
Bush Hill Road EB Left	0.009	7.4	A	0
Franklin Street SB	0.046	8.9	A	2.5
<i>Weekday PM:</i>				
Bush Hill Road EB Left	0.028	7.4	A	2.5
Franklin Street SB	0.031	8.9	A	2.5

^a Volume-to-capacity ratio.

^b Average control delay in seconds per vehicle.

^c Level of service.

^d Maximum queue length in feet per lane (assuming 25 feet per vehicle) that is not expected to be exceeded 95 percent of the time.

Note: Using Synchro 8 Software & HCM 2010 Analysis.

**Table 8
CAPACITY ANALYSIS SUMMARY – DESIGN YEAR CONDITIONS**

Intersection/Peak Hour/Lane Group	2025 Build			
	V/C	Del.	LOS	Queue
Bush Hill Road at Franklin Street				
<i>Weekday AM:</i>				
Bush Hill Road EB Left	0.009	7.4	A	0
Franklin Street SB	0.047	9.0	A	2.5
<i>Weekday PM:</i>				
Bush Hill Road EB Left	0.029	7.5	A	2.5
Franklin Street SB	0.031	9.0	A	2.5

^a Volume-to-capacity ratio.

^b Average control delay in seconds per vehicle.

^c Level of service.

^d Maximum queue length in feet per lane (assuming 25 feet per vehicle) that is not expected to be exceeded 95 percent of the time.

Note: Using Synchro 8 Software & HCM 2010 Analysis.

CONCLUSIONS AND RECOMMENDATIONS

Existing and future conditions in the study area have been described, analyzed, and evaluated with respect to traffic operations and the impact of the proposed residential development. Conclusions of this effort and recommendations are presented below.

- The site currently is undeveloped. As proposed, the project consists of constructing a 65-lot residential subdivision. Site access is proposed to be provided via Franklin Street off of Bush Hill Road, and emergency-only access will be provided via Kara's Crossing Drive and Hawkview Road.
- During peak-month conditions, Bush Hill Road adjacent to proposed Franklin Street carries approximately 1,350 vehicles during an average weekday with 107 vehicles during the weekday AM peak hour and 134 vehicles during the weekday PM peak hour.
- Available sight distance at the proposed site driveway (Franklin Street) along Bush Hill Road will meet the minimum and desirable SSD and ISD requirements for safe operation. In addition to meeting AASHTO requirements, the available sight distances also meet the local requirement of 400 feet of All-Season Safe Sight Distance.
- To ensure the safe and efficient flow of traffic to and from the site, it is recommended that any proposed plantings, vegetation, landscaping, and signing along the site frontage be kept low to the ground (no more than 3.0 feet above street level) or set back sufficiently from the edge of the roadways so as not to inhibit the available sight lines.
- Based on standard engineering methodology, it is expected that the proposed site will generate 55 trips (14 entering and 41 exiting) during the weekday AM peak hour and 72 trips (45 entering and 27 exiting) during the weekday PM peak hour. Traffic-volume increases beyond the study area during the peak hours are projected to be in the range of 5 to 50 vehicle trips. These increases represent, on average, one additional vehicle every 1 to 12 minutes during the critical peak hours.
- The proposed residential development is expected to have minimal impact along Bush Hill Road at the proposed site driveway with minimal expected delays and queue lengths less than 1 vehicle are expected on any movement. The proposed residential development is not expected to affect traffic operations on Bush Hill Road. Volume-to-capacity ratios are expected to be well below 1.00 (0.05 or less) indicating there will be ample capacity available after the proposed residential development is constructed and occupied.

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APPENDIX

TRAFFIC-COUNT DATA

TRAFFIC-VOLUME ADJUSTMENT DATA

JOURNEY-TO-WORK DATA

TRIP-GENERATION CALCULATIONS

CAPACITY ANALYSIS METHODOLOGY

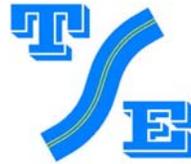
CAPACITY AND QUEUE ANALYSIS WORKSHEETS

TRAFFIC IMPACT AND ACCESS STUDY

Proposed Residential Development – Hudson, New Hampshire

TRAFFIC-COUNT DATA

GPI Project #:
Hudson, NH
Client: John DeBarros



Traffic Survey Expedition
106 Sharon Road
N. Quincy, MA 02171
P: 617-448-5686
F: 617-801-8300
www.tsetraffic.com

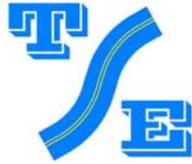
Site Code: Hudson NH
Station ID: Bush Hill Road
Between Two Ponds

Start Time	07-Aug-14 Thu	Eastbound	Westbound	Combined Total	
12:00 AM		6	2	8	█
01:00		3	0	3	█
02:00		1	0	1	█
03:00		3	0	3	█
04:00		5	6	11	█
05:00		4	16	20	█
06:00		20	35	55	█
07:00		30	51	81	█
08:00		34	54	88	█
09:00		20	47	67	█
10:00		26	33	59	█
11:00		28	30	58	█
12:00 PM		45	40	85	█
01:00		34	36	70	█
02:00		48	41	89	█
03:00		48	43	91	█
04:00		75	53	128	█
05:00		73	59	132	█
06:00		48	55	103	█
07:00		34	31	65	█
08:00		28	28	56	█
09:00		36	18	54	█
10:00		17	15	32	█
11:00		10	9	19	█
Total		676	702	1378	
Percent		49.1%	50.9%		
Grand Total		1332	1368		
Percentage		49.3%	50.7%		

ADT

ADT 1,350

AADT 1,350



Traffic Survey Expedition
106 Sharon Road
N. Quincy, MA 02171
P: 617-448-5686
F: 617-301-3300
www.tsetraffic.com

GPI Project #:
 Hudson, NH
 Client: John DeBarros

Site Code: Hudson NH
 Station ID: Bush Hill Road
 Between Two Ponds

Start Time	06-Aug-14 Wed		Eastbound		Westbound		Combined		07-Aug Thu		Eastbound		Westbound		Combined	
	A.M.	P.M.	A.M.	P.M.	A.M.	P.M.	A.M.	P.M.	A.M.	P.M.	A.M.	P.M.	A.M.	P.M.	A.M.	P.M.
12:00	1	9	0	9	1	18			3	9	1	7	4	16		
12:15	1	10	1	13	2	23			2	10	0	6	2	16		
12:30	1	7	1	6	2	13			1	11	1	14	2	25		
12:45	0	7	1	10	1	17			0	15	0	13	0	28		
01:00	2	9	0	8	2	17			0	8	0	6	0	14		
01:15	0	14	1	10	1	24			1	10	0	15	1	25		
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03:30	1	17	0	13	1	30			1	13	0	6	1	19		
03:45	0	16	0	14	0	30			1	10	0	10	1	20		
04:00	1	19	0	10	1	29			1	18	1	15	2	33		
04:15	0	12	1	14	1	26			0	22	1	11	1	33		
04:30	0	16	1	10	1	26			1	17	0	13	1	30		
04:45	1	16	1	24	2	40			3	18	4	14	7	32		
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06:00	6	20	6	24	12	44			4	12	8	13	12	25		
06:15	2	13	7	17	9	30			2	12	7	14	9	26		
06:30	5	16	10	13	15	29			3	11	11	17	14	28		
06:45	10	14	10	18	20	32			11	13	9	11	20	24		
07:00	11	7	9	9	20	16			9	14	6	9	15	23		
07:15	8	11	16	8	24	19			6	6	15	9	21	15		
07:30	10	8	15	5	25	13			8	6	18	6	26	12		
07:45	12	4	12	5	24	9			7	8	12	7	19	15		
08:00	5	6	11	2	16	8			7	9	13	7	20	16		
08:15	8	8	14	5	22	13			12	11	21	7	33	18		
08:30	2	5	15	3	17	8			8	3	10	9	18	12		
08:45	9	6	17	2	26	8			7	5	10	5	17	10		
09:00	7	9	13	6	20	15			4	13	7	3	11	16		
09:15	7	11	20	5	27	16			2	9	20	2	22	11		
09:30	4	3	8	4	12	7			7	8	12	7	19	15		
09:45	6	15	9	3	15	18			7	6	8	6	15	12		
10:00	9	4	9	4	18	8			12	5	8	5	20	10		
10:15	12	3	7	1	19	4			7	2	8	6	15	8		
10:30	5	3	14	2	19	5			5	6	8	1	13	7		
10:45	7	0	6	3	13	3			2	4	9	3	11	7		
11:00	4	2	3	0	7	2			9	3	10	1	19	4		
11:15	7	4	4	1	11	5			7	5	5	4	12	9		
11:30	8	0	6	2	14	2			6	0	6	1	12	1		
11:45	8	1	8	2	16	3			6	2	9	3	15	5		
Total	186	470	262	404	448	874			180	496	274	428	454	924		
Day Total		656		666		1322				676		702		1378		
% Total		14.1%	35.6%	19.8%	30.6%				13.1%	36.0%	19.9%	31.1%				
Peak	-	07:00	05:00	08:30	06:00	07:00	05:45		-	06:45	04:00	07:30	05:45	07:30	05:00	
Vol.	-	41	77	65	72	93	141		-	34	75	64	61	98	132	
P.H.F.		0.854	0.802	0.813	0.750	0.930	0.801			0.773	0.852	0.762	0.897	0.742	0.868	
ADT		ADT 1,350		AADT 1,350												



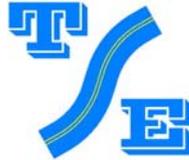
Traffic Survey Expedition
106 Sharon Road
N. Quincy, MA 02171
P: 617-448-5686
F: 617-801-8800
www.tsetraffic.com

GPI Project #:
 Hudson, NH
 Client: John DeBarros

Site Code: Hudson NH
 Station ID: Bush Hill Road
 Between Two Ponds

Eastbound

Start Time	1	36	41	46	51	56	61	66	71	76	81	86	91	96	Total
	35	40	45	50	55	60	65	70	75	80	85	90	95	999	
08/06/14	1	2	0	0	0	0	0	0	0	0	0	0	0	0	3
01:00	0	3	0	0	0	0	0	0	0	0	0	0	0	0	3
02:00	0	2	0	0	0	0	0	0	0	0	0	0	0	0	2
03:00	0	1	0	0	0	0	0	0	0	0	0	0	0	0	1
04:00	0	2	0	0	0	0	0	0	0	0	0	0	0	0	2
05:00	0	2	1	0	0	0	0	0	0	0	0	0	0	0	3
06:00	8	12	2	1	0	0	0	0	0	0	0	0	0	0	23
07:00	10	24	7	0	0	0	0	0	0	0	0	0	0	0	41
08:00	0	11	11	1	1	0	0	0	0	0	0	0	0	0	24
09:00	0	9	9	6	0	0	0	0	0	0	0	0	0	0	24
10:00	1	8	15	6	3	0	0	0	0	0	0	0	0	0	33
11:00	7	5	6	8	1	0	0	0	0	0	0	0	0	0	27
12 PM	3	14	14	2	0	0	0	0	0	0	0	0	0	0	33
13:00	10	13	10	5	1	0	0	0	0	0	0	0	0	0	39
14:00	6	13	10	5	2	0	0	0	0	0	0	0	0	0	36
15:00	6	20	15	8	0	0	0	0	0	0	0	0	0	0	49
16:00	5	22	19	15	2	0	0	0	0	0	0	0	0	0	63
17:00	7	18	41	10	1	0	0	0	0	0	0	0	0	0	77
18:00	7	20	27	8	1	0	0	0	0	0	0	0	0	0	63
19:00	2	13	10	3	0	2	0	0	0	0	0	0	0	0	30
20:00	1	13	8	2	0	0	0	0	1	0	0	0	0	0	25
21:00	5	14	19	0	0	0	0	0	0	0	0	0	0	0	38
22:00	3	3	4	0	0	0	0	0	0	0	0	0	0	0	10
23:00	0	1	3	2	0	0	1	0	0	0	0	0	0	0	7
Total	82	245	231	82	12	2	1	0	1	0	0	0	0	0	656



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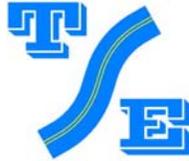
Site Code: Hudson NH
 Station ID: Bush Hill Road
 Between Two Ponds

Eastbound

Start Time	1	36	41	46	51	56	61	66	71	76	81	86	91	96	Total
	35	40	45	50	55	60	65	70	75	80	85	90	95	999	
08/07/14	0	2	1	3	0	0	0	0	0	0	0	0	0	0	6
01:00	0	1	2	0	0	0	0	0	0	0	0	0	0	0	3
02:00	0	1	0	0	0	0	0	0	0	0	0	0	0	0	1
03:00	1	0	0	0	1	1	0	0	0	0	0	0	0	0	3
04:00	1	1	2	0	1	0	0	0	0	0	0	0	0	0	5
05:00	1	0	1	2	0	0	0	0	0	0	0	0	0	0	4
06:00	1	3	10	5	1	0	0	0	0	0	0	0	0	0	20
07:00	4	10	11	4	1	0	0	0	0	0	0	0	0	0	30
08:00	4	6	20	3	1	0	0	0	0	0	0	0	0	0	34
09:00	1	6	9	4	0	0	0	0	0	0	0	0	0	0	20
10:00	6	8	10	2	0	0	0	0	0	0	0	0	0	0	26
11:00	5	8	13	2	0	0	0	0	0	0	0	0	0	0	28
12 PM	5	12	23	5	0	0	0	0	0	0	0	0	0	0	45
13:00	7	9	15	3	0	0	0	0	0	0	0	0	0	0	34
14:00	9	15	14	6	3	0	0	1	0	0	0	0	0	0	48
15:00	7	22	14	4	1	0	0	0	0	0	0	0	0	0	48
16:00	3	22	33	16	1	0	0	0	0	0	0	0	0	0	75
17:00	8	30	24	10	1	0	0	0	0	0	0	0	0	0	73
18:00	5	19	20	2	0	1	1	0	0	0	0	0	0	0	48
19:00	3	12	10	6	0	1	1	0	1	0	0	0	0	0	34
20:00	5	7	12	3	1	0	0	0	0	0	0	0	0	0	28
21:00	2	15	12	3	2	1	1	0	0	0	0	0	0	0	36
22:00	0	5	10	2	0	0	0	0	0	0	0	0	0	0	17
23:00	0	6	4	0	0	0	0	0	0	0	0	0	0	0	10
Total	78	220	270	85	14	4	3	1	1	0	0	0	0	0	676
Grand Total	160	465	501	167	26	6	4	1	2	0	0	0	0	0	1332

15th Percentile : 19 MPH
 50th Percentile : 34 MPH
 85th Percentile : 43 MPH
 95th Percentile : 47 MPH

Statistics
 Mean Speed(Average) : 33 MPH
 10 MPH Pace Speed : 35-44 MPH
 Number in Pace : 498
 Percent in Pace : 37.4%
 Number of Vehicles > 55 MPH : 13
 Percent of Vehicles > 55 MPH : 1.0%



Traffic Survey Expedition
106 Sharon Road
N. Quincy, MA 02171
P: 617-443-5686
F: 617-801-3300
www.tsetraffic.com

GPI Project #:
 Hudson, NH
 Client: John DeBarros

Site Code: Hudson NH
 Station ID: Bush Hill Road
 Between Two Ponds

Westbound

Start Time	1	36	41	46	51	56	61	66	71	76	81	86	91	96	Total
	35	40	45	50	55	60	65	70	75	80	85	90	95	999	
08/06/14	0	1	2	0	0	0	0	0	0	0	0	0	0	0	3
01:00	0	0	1	0	0	0	0	0	0	0	0	0	0	0	1
02:00	0	1	1	0	0	0	0	0	0	0	0	0	0	0	2
03:00	0	1	0	0	0	0	0	0	0	0	0	0	0	0	1
04:00	0	1	2	0	0	0	0	0	0	0	0	0	0	0	3
05:00	0	2	1	0	0	0	0	0	0	0	0	0	0	0	3
06:00	0	9	22	2	0	0	0	0	0	0	0	0	0	0	33
07:00	0	17	26	9	0	0	0	0	0	0	0	0	0	0	52
08:00	5	11	33	6	2	0	0	0	0	0	0	0	0	0	57
09:00	8	12	17	12	1	0	0	0	0	0	0	0	0	0	50
10:00	4	4	16	10	2	0	0	0	0	0	0	0	0	0	36
11:00	0	11	5	4	1	0	0	0	0	0	0	0	0	0	21
12 PM	2	14	14	8	0	0	0	0	0	0	0	0	0	0	38
13:00	5	10	10	7	1	0	0	0	0	0	0	0	0	0	33
14:00	6	15	13	2	1	0	0	0	0	0	0	0	0	0	37
15:00	3	12	16	8	3	0	0	0	0	0	0	0	0	0	42
16:00	1	22	22	12	1	0	0	0	0	0	0	0	0	0	58
17:00	1	12	23	14	1	0	1	0	0	0	0	0	0	0	52
18:00	2	18	42	7	0	1	0	1	1	0	0	0	0	0	72
19:00	1	13	8	5	0	0	0	0	0	0	0	0	0	0	27
20:00	2	2	6	2	0	0	0	0	0	0	0	0	0	0	12
21:00	2	6	6	4	0	0	0	0	0	0	0	0	0	0	18
22:00	0	1	4	5	0	0	0	0	0	0	0	0	0	0	10
23:00	0	0	2	2	1	0	0	0	0	0	0	0	0	0	5
Total	42	195	292	119	14	1	1	1	1	0	0	0	0	0	666



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 Client: John DeBarros

Site Code: Hudson NH
 Station ID: Bush Hill Road
 Between Two Ponds

Westbound

Start Time	1	36	41	46	51	56	61	66	71	76	81	86	91	96	Total
	35	40	45	50	55	60	65	70	75	80	85	90	95	999	
08/07/14	1	0	0	0	1	0	0	0	0	0	0	0	0	0	2
01:00	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
02:00	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
03:00	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
04:00	1	3	0	0	2	0	0	0	0	0	0	0	0	0	6
05:00	0	3	9	3	1	0	0	0	0	0	0	0	0	0	16
06:00	1	12	13	5	2	0	1	1	0	0	0	0	0	0	35
07:00	5	10	26	10	0	0	0	0	0	0	0	0	0	0	51
08:00	6	20	24	3	1	0	0	0	0	0	0	0	0	0	54
09:00	5	15	21	6	0	0	0	0	0	0	0	0	0	0	47
10:00	3	10	12	6	2	0	0	0	0	0	0	0	0	0	33
11:00	2	7	14	6	1	0	0	0	0	0	0	0	0	0	30
12 PM	4	8	13	12	2	1	0	0	0	0	0	0	0	0	40
13:00	4	8	18	4	2	0	0	0	0	0	0	0	0	0	36
14:00	3	8	22	6	2	0	0	0	0	0	0	0	0	0	41
15:00	5	19	11	5	2	0	1	0	0	0	0	0	0	0	43
16:00	10	9	23	8	3	0	0	0	0	0	0	0	0	0	53
17:00	2	18	22	11	4	2	0	0	0	0	0	0	0	0	59
18:00	5	14	21	12	0	2	1	0	0	0	0	0	0	0	55
19:00	1	11	16	2	1	0	0	0	0	0	0	0	0	0	31
20:00	6	6	13	3	0	0	0	0	0	0	0	0	0	0	28
21:00	0	6	5	6	1	0	0	0	0	0	0	0	0	0	18
22:00	2	4	7	1	0	1	0	0	0	0	0	0	0	0	15
23:00	0	3	5	1	0	0	0	0	0	0	0	0	0	0	9
Total	66	194	295	110	27	6	3	1	0	0	0	0	0	0	702
Grand Total	108	389	587	229	41	7	4	2	1	0	0	0	0	0	1368

15th Percentile : 22 MPH
 50th Percentile : 36 MPH
 85th Percentile : 44 MPH
 95th Percentile : 48 MPH

Statistics
 Mean Speed(Average) : 35 MPH
 10 MPH Pace Speed : 37-46 MPH
 Number in Pace : 563
 Percent in Pace : 41.2%
 Number of Vehicles > 55 MPH : 14
 Percent of Vehicles > 55 MPH : 1.0%

TRAFFIC IMPACT AND ACCESS STUDY

Proposed Residential Development – Hudson, New Hampshire

TRAFFIC-VOLUME ADJUSTMENT DATA

TRAFFIC VOLUME ADJUSTMENT FACTORS

Automatic Traffic Recorder Report (2013)

Prepared by the NHDOT Bureau of Transportation Planning

Urban Highways Group 4						
Month	Avg. Weekday	Adj. To Avg.	Adj. To Peak	Avg. Saturday	Adj. To Avg.	Adj. To Peak
January	303,209	1.096	1.167	264,294	1.087	1.182
February	310,361	1.070	1.140	221,927	1.294	1.408
March	316,917	1.048	1.117	285,808	1.005	1.093
April	334,816	0.992	1.057	293,105	0.980	1.066
May	349,527	0.950	1.012	302,837	0.948	1.032
June	353,866	0.939	1.000	312,453	0.919	1.000
July	346,008	0.960	1.023	298,894	0.961	1.045
August	352,666	0.942	1.003	301,518	0.952	1.036
September	340,876	0.975	1.038	303,479	0.946	1.030
October	340,098	0.977	1.040	301,288	0.953	1.037
November	323,336	1.027	1.094	283,293	1.014	1.103
December	314,882	1.055	1.124	277,095	1.036	1.128
Year Avg.	332,214			287,166		

TRAFFIC VOLUME ADJUSTMENT FACTORS

Automatic Traffic Recorder Report (2013)

Prepared by the NHDOT Bureau of Transportation Planning

Month	Urban Highways Group 4								
	Weekday AM Peak	Adj. To Avg.	Adj. To Peak	Weekday PM Peak	Adj. To Avg.	Adj. To Peak	Saturday Midday Peak	Adj. To Avg.	Adj. To Peak
January	23647	1.044	1.108	27359	1.070	1.125	22790	1.054	1.107
February	24211	1.019	1.082	27553	1.063	1.117	18839	1.275	1.339
March	24330	1.014	1.077	28527	1.026	1.079	24172	0.993	1.044
April	25508	0.968	1.027	29822	0.982	1.032	24338	0.987	1.037
May	26038	0.948	1.006	30649	0.955	1.004	25007	0.960	1.009
June	25643	0.963	1.022	30785	0.951	1.000	25067	0.958	1.006
July	23380	1.056	1.120	29585	0.990	1.041	24347	0.986	1.036
August	24049	1.026	1.089	30525	0.959	1.009	25190	0.953	1.001
September	26120	0.945	1.003	30217	0.969	1.019	25105	0.956	1.005
October	26196	0.942	1.000	30434	0.962	1.012	25227	0.952	1.000
November	24502	1.007	1.069	28608	1.023	1.076	23826	1.008	1.059
December	22564	1.094	1.161	27273	1.074	1.129	24247	0.990	1.040

Year Avg.

24,682

29,278

24,013

Traffic Growth Rate

Hudson and Pelham, New Hampshire

Location ^a	Year											Average Annual Rate
	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	
Bush Hill Road (Pelham) at Hudson Town Line		933			961			860			1,017	0.61%
Bush Hill Road north of Wason Road	4,400			5,129			5,760	5,530		6,052		2.77%
Keyes Hill Road (Pelham) at Hudson Town Line				4,120			4,170			4,103		-0.07%
Bush Hill Road south of Kimball Hill Road		3,562			3,924			3,306			4,470	1.97%

Average Growth Rate = 1.32%

^a Source: Based upon historical data; Nashua Regional Planning Commission ID's 359065, 229036, 229037, 359060, and 229043

Location ^b	Year											Average Annual Rate
	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	
Pelham Road west of Bush Hill Road							1,400					N/A
Bush Hill Road north of Wason Road							5,200			5,300		0.64%
Bush Hill Road south of Kimball Hill Road					3,500			3,300			4,000	2.31%

Average Growth Rate = 1.47%

^b Source: Based upon historical data; NHDOT Station Numbers 229036, 229037, and 229043

TRAFFIC IMPACT AND ACCESS STUDY

Proposed Residential Development – Hudson, New Hampshire

JOURNEY-TO-WORK DATA

Residence State-County-MCD Name	Workplace State-County-MCD Name	Count	To/From North	To/From West	To/From East
			Speare Road	Bush Hill Road (goes to Pelham & Wason)	Bush Hill Road
Hudson town Hillsborough Co. NH	Nashua city Hillsborough Co. NH	3107	466	2641	
Hudson town Hillsborough Co. NH	Hudson town Hillsborough Co. NH	2797	280	2377	140
Hudson town Hillsborough Co. NH	Lowell city Middlesex Co. MA	596		298	298
Hudson town Hillsborough Co. NH	Manchester city Hillsborough Co. NH	491	344	147	
Hudson town Hillsborough Co. NH	Billerica town Middlesex Co. MA	355		302	53
Hudson town Hillsborough Co. NH	Merrimack town Hillsborough Co. NH	337	34	303	
Hudson town Hillsborough Co. NH	Boston city Suffolk Co. MA	297	178	119	
Hudson town Hillsborough Co. NH	Bedford town Hillsborough Co. NH	279	28	251	
Hudson town Hillsborough Co. NH	Chelmsford town Middlesex Co. MA	274		247	27
Hudson town Hillsborough Co. NH	Salem town Rockingham Co. NH	254	178	13	64
Hudson town Hillsborough Co. NH	Andover town Essex Co. MA	251	100	75	75
Hudson town Hillsborough Co. NH	Londonderry town Rockingham Co. NH	219	175	44	
Hudson town Hillsborough Co. NH	Tewksbury town Middlesex Co. MA	199	20	119	60
Hudson town Hillsborough Co. NH	Tyngsbor. town Middlesex Co. MA	175		175	
Hudson town Hillsborough Co. NH	Wilmington town Middlesex Co. MA	146	58	22	66
Hudson town Hillsborough Co. NH	Bedford town Middlesex Co. MA	134		114	20
Hudson town Hillsborough Co. NH	Hollis town Hillsborough Co. NH	133		133	
Hudson town Hillsborough Co. NH	Woburn city Middlesex Co. MA	132		125	7
Hudson town Hillsborough Co. NH	Waltham city Middlesex Co. MA	131		124	7
Hudson town Hillsborough Co. NH	Burlington town Middlesex Co. MA	123		117	6
Hudson town Hillsborough Co. NH	Derry town Rockingham Co. NH	114	80	34	
Hudson town Hillsborough Co. NH	Dracut town Middlesex Co. MA	99			99
Hudson town Hillsborough Co. NH	Westford town Middlesex Co. MA	97		97	
Hudson town Hillsborough Co. NH	Milford town Hillsborough Co. NH	88		88	
Hudson town Hillsborough Co. NH	Lawrence city Essex Co. MA	75	26		49
Hudson town Hillsborough Co. NH	Marlbor. city Middlesex Co. MA	70		70	
Hudson town Hillsborough Co. NH	Littleton town Middlesex Co. MA	68		68	
Hudson town Hillsborough Co. NH	Lexington town Middlesex Co. MA	65		65	
Hudson town Hillsborough Co. NH	Methuen city Essex Co. MA	55	28		28
Hudson town Hillsborough Co. NH	Concord city Merrimack Co. NH	55	50	6	
Hudson town Hillsborough Co. NH	Acton town Middlesex Co. MA	52		52	
Hudson town Hillsborough Co. NH	Amherst town Hillsborough Co. NH	50	13	38	
Hudson town Hillsborough Co. NH	Pelham town Hillsborough Co. NH	49			49
Hudson town Hillsborough Co. NH	Litchfield town Hillsborough Co. NH	47	2	45	
Hudson town Hillsborough Co. NH	Concord town Middlesex Co. MA	45		45	
Hudson town Hillsborough Co. NH	Worcester city Worcester Co. MA	42		42	
Hudson town Hillsborough Co. NH	Newton city Middlesex Co. MA	39		39	
Hudson town Hillsborough Co. NH	North Andover town Essex Co. MA	38	15	11	11
Hudson town Hillsborough Co. NH	Malden city Middlesex Co. MA	36	7	22	7
Hudson town Hillsborough Co. NH	Newburyport city Essex Co. MA	34	10		24
Hudson town Hillsborough Co. NH	Somerville city Middlesex Co. MA	34	7	20	7
Hudson town Hillsborough Co. NH	Goffstown town Hillsborough Co. NH	34	7	27	
Hudson town Hillsborough Co. NH	Everett city Middlesex Co. MA	29	6	17	6
Hudson town Hillsborough Co. NH	Cambridge city Middlesex Co. MA	28	1	27	
Hudson town Hillsborough Co. NH	Windham town Rockingham Co. NH	27	27		
Hudson town Hillsborough Co. NH	Haverhill city Essex Co. MA	23	16	1	6
Hudson town Hillsborough Co. NH	Peabody city Essex Co. MA	23	6	14	3
Hudson town Hillsborough Co. NH	Stoneham town Middlesex Co. MA	23	6	16	1
Hudson town Hillsborough Co. NH	Danvers town Essex Co. MA	22	6	13	3
Hudson town Hillsborough Co. NH	Ashland town Middlesex Co. MA	21		21	
Hudson town Hillsborough Co. NH	Natick town Middlesex Co. MA	21		15	6
Hudson town Hillsborough Co. NH	Wilton town Hillsborough Co. NH	21		21	
Hudson town Hillsborough Co. NH	Townsend town Middlesex Co. MA	20		20	
Hudson town Hillsborough Co. NH	Lincoln town Middlesex Co. MA	19		17	2
Hudson town Hillsborough Co. NH	Hillsbor. town Hillsborough Co. NH	18	4	14	
Hudson town Hillsborough Co. NH	Beverly city Essex Co. MA	17	4	10	3
Hudson town Hillsborough Co. NH	Peterbor. town Hillsborough Co. NH	17		17	
Hudson town Hillsborough Co. NH	Exeter town Rockingham Co. NH	17	17		
Hudson town Hillsborough Co. NH	Boxbor. town Middlesex Co. MA	16		16	
Hudson town Hillsborough Co. NH	Shrewsbury town Worcester Co. MA	16		16	
Hudson town Hillsborough Co. NH	Mont Vernon town Hillsborough Co. NH	16		16	
Hudson town Hillsborough Co. NH	Fremont town Rockingham Co. NH	16	16		
Hudson town Hillsborough Co. NH	Durham town Strafford Co. NH	16	16		
Hudson town Hillsborough Co. NH	Maynard town Middlesex Co. MA	15		15	
Hudson town Hillsborough Co. NH	North Reading town Middlesex Co. MA	15	5	5	5
Hudson town Hillsborough Co. NH	Wakefield town Middlesex Co. MA	15	2	11	2
Hudson town Hillsborough Co. NH	Boylston town Worcester Co. MA	15		15	
Hudson town Hillsborough Co. NH	Portsmouth city Rockingham Co. NH	15	11	5	
Hudson town Hillsborough Co. NH	Dover city Strafford Co. NH	15	11	5	
Hudson town Hillsborough Co. NH	Charlestown town Sullivan Co. NH	15	3	12	
Hudson town Hillsborough Co. NH	Hooksett town Merrimack Co. NH	14	10	4	
Hudson town Hillsborough Co. NH	Dunstable town Middlesex Co. MA	13		13	
Hudson town Hillsborough Co. NH	Bow town Merrimack Co. NH	13	9	4	
Hudson town Hillsborough Co. NH	Groton town Middlesex Co. MA	12		12	
Hudson town Hillsborough Co. NH	Greenland town Rockingham Co. NH	12	12		
Hudson town Hillsborough Co. NH	Lynn city Essex Co. MA	11	2	9	
Hudson town Hillsborough Co. NH	Newbury town Essex Co. MA	11	11		
Hudson town Hillsborough Co. NH	Needham town Norfolk Co. MA	11		9	2
Hudson town Hillsborough Co. NH	Fairfax Co. VA	11			
Hudson town Hillsborough Co. NH	Chelsea city Suffolk Co. MA	10	2	7	2
Hudson town Hillsborough Co. NH	Westbor. town Worcester Co. MA	10		10	
Hudson town Hillsborough Co. NH	Andover town Merrimack Co. NH	10	6	4	
			2312	8926	1136
			19%	72%	9%
	SAY:		20%	70%	10%

TRAFFIC IMPACT AND ACCESS STUDY

Proposed Residential Development – Hudson, New Hampshire

TRIP-GENERATION CALCULATIONS

Institute of Transportation Engineers (ITE)
Land Use Code (LUC) 210 - Single-Family Detached Housing

Average Vehicle Trips Ends vs: Dwelling Units
Independent Variable (X): 65

AVERAGE WEEKDAY DAILY

$$\text{Ln } T = 0.92 \text{ Ln } (X) + 2.71$$

$$\text{Ln } T = 0.92 \text{ Ln } 65 + (2.71)$$

$$\text{Ln } T = 6.55$$

$$T = 699.55$$

$$T = 700 \text{ vehicle trips}$$

with 50% (350 vpd) entering and 50% (350 vpd) exiting.

WEEKDAY MORNING PEAK HOUR OF ADJACENT STREET TRAFFIC

$$T = 0.70 (X) + 9.74$$

$$T = 0.70 * 65 + (9.74)$$

$$T = 55.24$$

$$T = 55 \text{ vehicle trips}$$

with 25% (14 vph) entering and 75% (41 vph) exiting.

WEEKDAY EVENING PEAK HOUR OF ADJACENT STREET TRAFFIC

$$\text{Ln } T = 0.90 \text{ Ln } (X) + 0.51$$

$$\text{Ln } T = 0.92 \text{ Ln } 65 + (0.51)$$

$$\text{Ln } T = 4.27$$

$$T = 71.30$$

$$T = 72 \text{ vehicle trips}$$

with 63% (45 vpd) entering and 37% (27 vpd) exiting.

SATURDAY DAILY

$$\text{Ln } T = 0.95 \text{ Ln } (X) + 2.59$$

$$\text{Ln } T = 0.95 \text{ Ln } 65 + (2.59)$$

$$\text{Ln } T = 6.56$$

$$T = 703.22$$

$$T = 704 \text{ vehicle trips}$$

with 50% (352 vpd) entering and 50% (352 vpd) exiting.

SATURDAY MIDDAY PEAK HOUR OF GENERATOR

$$T = 0.89 (X) + 9.56$$

$$T = 0.89 * 65 + (9.56)$$

$$T = 67.41$$

$$T = 67 \text{ vehicle trips}$$

with 53% (36 vph) entering and 47% (31 vph) exiting.

TRAFFIC IMPACT AND ACCESS STUDY

Proposed Residential Development – Hudson, New Hampshire

CAPACITY ANALYSIS METHODOLOGY

CAPACITY ANALYSIS METHODOLOGY

A primary result of capacity analysis is the assignment of levels of service to traffic facilities under various traffic flow conditions. The capacity analysis methodology is based on the concepts and procedures in the *Highway Capacity Manual* (HCM).⁷ The concept of level of service (LOS) is defined as a qualitative measure describing operational conditions within a traffic stream and their perception by motorists and/or passengers. A level-of-service definition provides an index to quality of traffic flow in terms of such factors as speed, travel time, freedom to maneuver, traffic interruptions, comfort, convenience, and safety.

Six levels of service are defined for each type of facility. They are given letter designations from A to F, with LOS A representing the best operating conditions and LOS F the worst. Since the level of service of a traffic facility is a function of the traffic flows placed upon it, such a facility may operate at a wide range of levels of service, depending on the time of day, day of week, or period of year. A description of the operating condition under each level of service is provided below:

- *LOS A* describes conditions with little to no delay to motorists.
- *LOS B* represents a desirable level with relatively low delay to motorists.
- *LOS C* describes conditions with average delays to motorists.
- *LOS D* describes operations where the influence of congestion becomes more noticeable. Delays are still within an acceptable range.
- *LOS E* represents operating conditions with high delay values. This level is considered by many agencies to be the limit of acceptable delay.
- *LOS F* is considered to be unacceptable to most drivers with high delay values that often occur, when arrival flow rates exceed the capacity of the intersection.

Unsignalized Intersections

Levels of service for unsignalized intersections are calculated using the operational analysis methodology of the HCM. The procedure accounts for lane configuration on both the minor and major street approaches, conflicting traffic stream volumes, and the type of intersection control (STOP, YIELD, or all-way STOP control). The definition of level of service for unsignalized

⁷ *Highway Capacity Manual 2010*, Transportation Research Board; Washington, D.C.; 2010.

TRAFFIC IMPACT AND ACCESS STUDY

Proposed Residential Development – Hudson, New Hampshire

intersections is a function of average *control* delay. Control delay includes initial deceleration delay, queue move-up time, stopped delay, and final acceleration delay. The level-of-service criteria for unsignalized intersections are shown in Table A-1.

Table A-1
LEVEL-OF-SERVICE CRITERIA FOR
UNSIGNALIZED INTERSECTIONS

Level of Service	Unsignalized Intersection Criteria Average Control Delay (Seconds per Vehicle)
A	≤ 10
B	> 10 and ≤ 15
C	> 15 and ≤ 25
D	> 25 and ≤ 35
E	> 35 and ≤ 50
F	> 50 or $v/c > 1.0$

Source: *Highway Capacity Manual 2010*, Transportation Research Board; Washington, D.C.; 2010. Pages 18-6 and 19-2.

For unsignalized intersections, this delay criterion may be applied in assigning level-of-service designations to individual lane groups or to individual intersection approaches.

TRAFFIC IMPACT AND ACCESS STUDY

Proposed Residential Development – Hudson, New Hampshire

CAPACITY AND QUEUE ANALYSIS WORKSHEETS

Intersection

Int Delay, s/veh 2.8

Movement	EBL	EBT	WBT	WBR	SBL	SBR
Vol, veh/h	13	38	71	1	4	37
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Free	Free	Free	Free	Stop	Stop
RT Channelized	-	None	-	None	-	None
Storage Length	-	-	-	-	0	-
Veh in Median Storage, #	-	0	0	-	0	-
Grade, %	-	0	0	-	0	-
Peak Hour Factor	92	92	92	92	92	92
Heavy Vehicles, %	2	2	2	2	2	2
Mvmt Flow	14	41	77	1	4	40

Major/Minor	Major1	Major2	Minor2
Conflicting Flow All	78	0	148
Stage 1	-	-	78
Stage 2	-	-	70
Critical Hdwy	4.12	-	6.42
Critical Hdwy Stg 1	-	-	5.42
Critical Hdwy Stg 2	-	-	5.42
Follow-up Hdwy	2.218	-	3.518
Pot Cap-1 Maneuver	1520	-	844
Stage 1	-	-	945
Stage 2	-	-	953
Platoon blocked, %	-	-	-
Mov Cap-1 Maneuver	1520	-	836
Mov Cap-2 Maneuver	-	-	836
Stage 1	-	-	945
Stage 2	-	-	944

Approach	EB	WB	SB
HCM Control Delay, s	1.9	0	8.9
HCM LOS			A

Minor Lane/Major Mvmt	EBL	EBT	WBT	WBR	SBLn1
Capacity (veh/h)	1520	-	-	-	966
HCM Lane V/C Ratio	0.009	-	-	-	0.046
HCM Control Delay (s)	7.4	0	-	-	8.9
HCM Lane LOS	A	A	-	-	A
HCM 95th %tile Q(veh)	0	-	-	-	0.1

Intersection

Int Delay, s/veh 2.6

Movement	EBL	EBT	WBT	WBR	SBL	SBR
Vol, veh/h	40	75	61	5	3	24
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Free	Free	Free	Free	Stop	Stop
RT Channelized	-	None	-	None	-	None
Storage Length	-	-	-	-	0	-
Veh in Median Storage, #	-	0	0	-	0	-
Grade, %	-	0	0	-	0	-
Peak Hour Factor	92	92	92	92	92	92
Heavy Vehicles, %	2	2	2	2	2	2
Mvmt Flow	43	82	66	5	3	26

Major/Minor	Major1	Major2	Minor2
Conflicting Flow All	72	0	237
Stage 1	-	-	69
Stage 2	-	-	168
Critical Hdwy	4.12	-	6.42
Critical Hdwy Stg 1	-	-	5.42
Critical Hdwy Stg 2	-	-	5.42
Follow-up Hdwy	2.218	-	3.518
Pot Cap-1 Maneuver	1528	-	751
Stage 1	-	-	954
Stage 2	-	-	862
Platoon blocked, %	-	-	-
Mov Cap-1 Maneuver	1528	-	729
Mov Cap-2 Maneuver	-	-	729
Stage 1	-	-	954
Stage 2	-	-	837

Approach	EB	WB	SB
HCM Control Delay, s	2.6	0	8.9
HCM LOS			A

Minor Lane/Major Mvmt	EBL	EBT	WBT	WBR	SBLn1
Capacity (veh/h)	1528	-	-	-	955
HCM Lane V/C Ratio	0.028	-	-	-	0.031
HCM Control Delay (s)	7.4	0	-	-	8.9
HCM Lane LOS	A	A	-	-	A
HCM 95th %tile Q(veh)	0.1	-	-	-	0.1

Intersection

Int Delay, s/veh 2.5

Movement	EBL	EBT	WBT	WBR	SBL	SBR
Vol, veh/h	13	46	87	1	4	37
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Free	Free	Free	Free	Stop	Stop
RT Channelized	-	None	-	None	-	None
Storage Length	-	-	-	-	0	-
Veh in Median Storage, #	-	0	0	-	0	-
Grade, %	-	0	0	-	0	-
Peak Hour Factor	92	92	92	92	92	92
Heavy Vehicles, %	2	2	2	2	2	2
Mvmt Flow	14	50	95	1	4	40

Major/Minor	Major1	Major2	Minor2
Conflicting Flow All	96	0	173
Stage 1	-	-	95
Stage 2	-	-	78
Critical Hdwy	4.12	-	6.42
Critical Hdwy Stg 1	-	-	5.42
Critical Hdwy Stg 2	-	-	5.42
Follow-up Hdwy	2.218	-	3.518
Pot Cap-1 Maneuver	1498	-	817
Stage 1	-	-	929
Stage 2	-	-	945
Platoon blocked, %	-	-	-
Mov Cap-1 Maneuver	1498	-	809
Mov Cap-2 Maneuver	-	-	809
Stage 1	-	-	929
Stage 2	-	-	936

Approach	EB	WB	SB
HCM Control Delay, s	1.6	0	9
HCM LOS			A

Minor Lane/Major Mvmt	EBL	EBT	WBT	WBR	SBLn1
Capacity (veh/h)	1498	-	-	-	945
HCM Lane V/C Ratio	0.009	-	-	-	0.047
HCM Control Delay (s)	7.4	0	-	-	9
HCM Lane LOS	A	A	-	-	A
HCM 95th %tile Q(veh)	0	-	-	-	0.1

Intersection

Int Delay, s/veh 2.3

Movement	EBL	EBT	WBT	WBR	SBL	SBR
Vol, veh/h	40	92	74	5	3	24
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Free	Free	Free	Free	Stop	Stop
RT Channelized	-	None	-	None	-	None
Storage Length	-	-	-	-	0	-
Veh in Median Storage, #	-	0	0	-	0	-
Grade, %	-	0	0	-	0	-
Peak Hour Factor	92	92	92	92	92	92
Heavy Vehicles, %	2	2	2	2	2	2
Mvmt Flow	43	100	80	5	3	26

Major/Minor	Major1	Major2	Minor2
Conflicting Flow All	86	0	270
Stage 1	-	-	83
Stage 2	-	-	187
Critical Hdwy	4.12	-	6.42
Critical Hdwy Stg 1	-	-	5.42
Critical Hdwy Stg 2	-	-	5.42
Follow-up Hdwy	2.218	-	3.518
Pot Cap-1 Maneuver	1510	-	719
Stage 1	-	-	940
Stage 2	-	-	845
Platoon blocked, %	-	-	-
Mov Cap-1 Maneuver	1510	-	697
Mov Cap-2 Maneuver	-	-	697
Stage 1	-	-	940
Stage 2	-	-	820

Approach	EB	WB	SB
HCM Control Delay, s	2.3	0	9
HCM LOS			A

Minor Lane/Major Mvmt	EBL	EBT	WBT	WBR	SBLn1
Capacity (veh/h)	1510	-	-	-	934
HCM Lane V/C Ratio	0.029	-	-	-	0.031
HCM Control Delay (s)	7.5	0	-	-	9
HCM Lane LOS	A	A	-	-	A
HCM 95th %tile Q(veh)	0.1	-	-	-	0.1