APPENDIX

Hudson CTAP Discretionary Project Report – October 2009

NRPC Hudson Boulevard Traffic Analysis – June 2018 with Update Letter June 2019

Value of Time Guidance Document

Traffic Data Route 3A – March 2017

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Hudson Police Department Crash Data – June 2019

Guidance on Treatment of Economic Value of Statistical Life

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Hudson CTAP Discretionary Project Report

Hudson, New Hampshire

October, 2009

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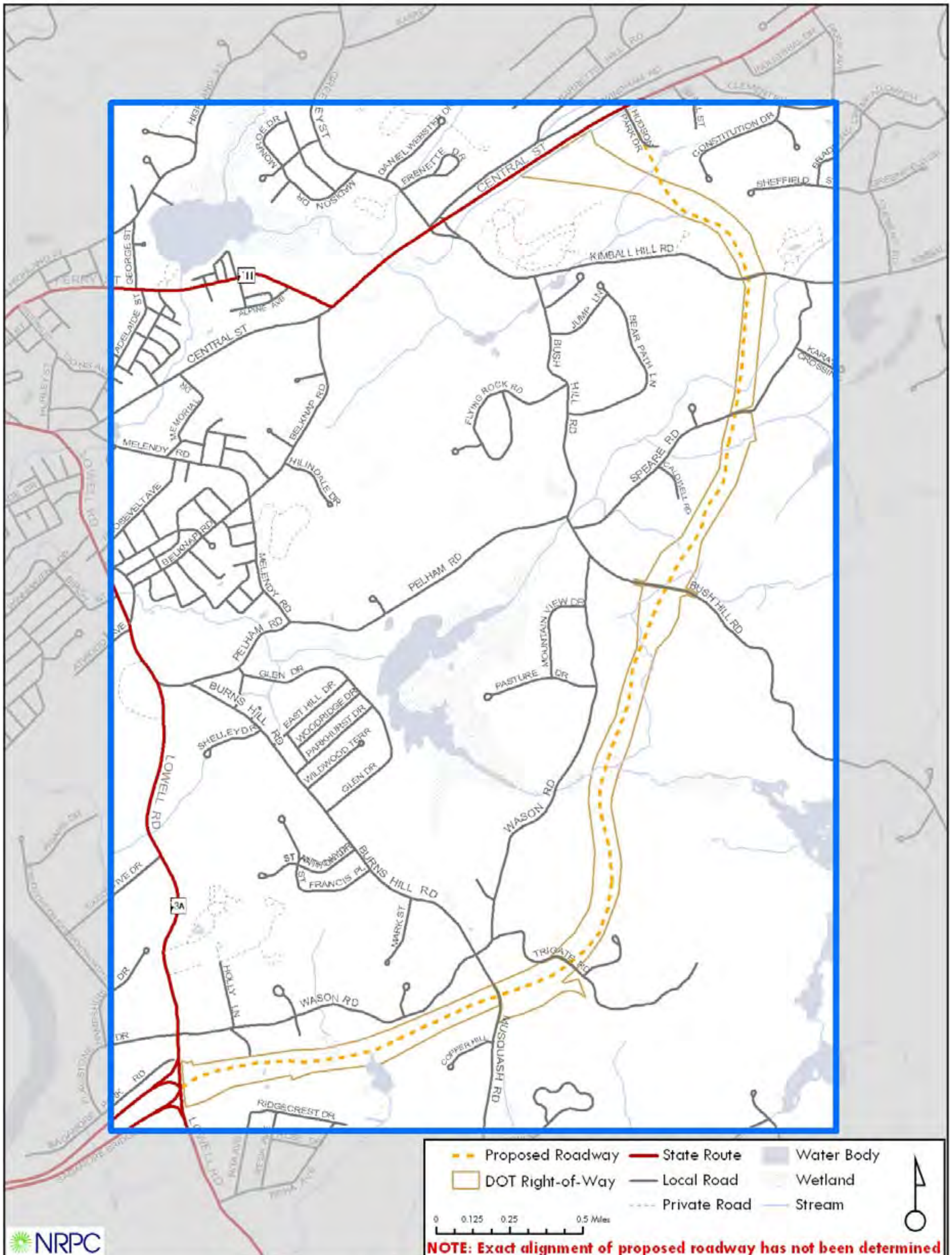
A. PRELIMINARY PLANNING STUDY DESCRIPTION

Downtown Hudson experiences one of the highest levels of traffic congestion in the region. This is due in large part to the presence of the bridges across the Merrimack River and the traffic that flows to and from those bridges on NH 3A, NH 102 and NH 111. Due to the long delays at the Taylor Falls/Veteran's Memorial Bridges, increasing amounts of traffic have been diverting from the Taylor Falls/Veteran's Memorial Bridges to the Sagamore Bridge. There is sufficient capacity on the Sagamore Bridge to accommodate this traffic diversion. However, the diverted traffic is resulting in heavy traffic on other roads in south and east Hudson including NH 3A, Wason Road, and Kimball Hill Road. This study has modeled the existing and anticipated future traffic patterns and identified impacts to select intersections in the vicinity of these roadways.

The Circumferential Highway Project was intended to address many of the congestion issues in Hudson. It has become evident that the project as currently conceived is not going to move forward due to funding and environmental and community concerns. NRPC has engaged officials from the affected communities and developed a number of alternative project recommendations each with independent utility. Connecting NH 3A (Lowell Road) to NH 111 beginning at the Sagamore Bridge in Hudson could relieve traffic congestion along key roadways, currently dealing with diverted traffic including Wason Road, and Kimball Hill Road.

The study area is roughly defined as; NH 111 to the north, the Merrimack River to the west, NH 3A/Dracut Road to the south, and NH 128 (Mammoth Rd.) to the East. This preliminary planning study evaluates a potential connection between NH 3A at the Sagamore Bridge and NH 111 in Hudson.

FIGURE 1: STUDY AREA



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1. Project Purpose

The proposed project will connect NH 3A at the Sagamore Bridge with NH 111 in Hudson. This connection would facilitate the movement of traffic between the west side of Hudson, at NH 3A and the Sagamore Bridge, to Central Hudson just east of the town center along NH 111. The town center of Hudson experiences one of the highest levels of traffic congestion in the region. This is due in large part to the capacity constraints of the bridges across the Merrimack River. Long delays at the Taylor Falls/Veteran's Memorial Bridges have resulted in increased traffic diversion to the Sagamore Bridge resulting in heavy traffic on other roads in south and east Hudson including NH 3A, Wason Road, and Kimball Hill Road.

2. Need for Action

Hudson is located in southern New Hampshire between two major north-south routes: the F.E. Everett Turnpike, just to the west and I-93 to the east. Southeastern Hudson has large areas of hilly terrain, with steep slopes and varied vegetation from densely wooded parcels to apple orchards. This area is primarily developed as single family suburban residences and subdivisions. The transportation network in this area is comprised of fairly narrow two lane roads with limited shoulders and lined with significant vegetation. Many of the roads have significant curves and steep grades making winter travel particularly hazardous.

The F.E. Everett Turnpike provides a direct connection to a wealth of jobs in northern Massachusetts and is therefore a significant commuting route. Access to the F.E. Everett Turnpike from the east is limited to three bridge crossings of the Merrimack River with one in Tyngsboro, MA the Sagamore Bridge in south Hudson, and the Taylor Falls/Veteran's Memorial Bridges in Hudson's town center. Of the three river crossings, the Sagamore Bridge is the only crossing that provides direct access to the F.E. Everett Turnpike and is therefore a highly attractive option for commuters.

In addition, the heavy traffic volume and delay experienced in downtown Hudson has led to significant traffic diversion to the Sagamore Bridge. Many of these diverted trips begin further east and north in Hudson and beyond resulting in heavy traffic on secondary roads in south and east Hudson. These vital east-west connections are limited and have led to commuters utilizing a network of narrow and windy residential roads such as NH 3A, Wason Road, and Kimball Hill Road on a daily basis. The increased traffic volume from the diverted traffic has resulted in safety concerns in neighborhoods impacted by the increase in diverted traffic.

B. CONCEPTUAL DESIGN

This preliminary planning study focused on developing a concept plan to connect NH 3A at the Sagamore Bridge with NH 111 in Hudson. The conceptual plan was developed using planning tools such as the NRPC Travel Demand Model and GIS datasets and analysis techniques. There has been no formal engineering evaluation of this concept as part of this study. A programming level cost estimate has been developed for the project.

- Horizontal and vertical alignments are based on available topographical, environmental, and land use data available in a GIS format.
- The plan used the existing Circumferential Highway alignment as a starting point. This allowed for the use of the environmental review that has already been completed for that proposed roadway alignment. In addition, due to the fact that the town of Hudson has been anticipating the development of a roadway in that alignment, the right-of-way has generally been protected from development. Finally, a reduced cross section will allow more flexibility in avoiding environmental resources.

- The concept plan evaluates a 2-lane controlled access facility with a posted speed limit of no more than 35 MPH. Limited access will be provided at existing intersections only. This reduces the impact on the natural and built environment, as well as reducing the traffic expected on surrounding roads.
- There will be no direct access to properties abutting the proposed roadway. Access to the proposed roadway will be limited to at grade intersections with existing cross streets. Limiting direct access will reduce the secondary land use impacts from the project and improve the safety of the roadway.
- There will be at-grade intersections at the main cross roads along the proposed roadway. Allowing at-grade intersections will reduce the right-of-way requirements, since land will not be needed for interchanges.
- The new roadway is anticipated to be similar to the design and layout of Albuquerque Avenue in Litchfield, NH.

The following images from Microsoft Virtual Earth are examples of the types of potential intersections that are proposed for the terminal ends of the connector road. Figure 1 is an example of a single point diamond intersection proposed for the southern terminus at the intersection of the Sagamore Bridge, Wason Road, and NH 3A. Figure 2 is an example of an at grade T intersection proposed for the intersection of Kimball Hill Road and NH 111, at the connector's northern terminus.

FIGURE 2: INTERSECTION OF NH 101 AND NH 108 IN STRATHAM, NH

FIGURE 3: INDUSTRIAL DRIVE AND D.W. HIGHWAY/US 3 NEAR EXIT 10 IN MERRIMACK, NH

C. TRAFFIC

Downtown Hudson experiences one of the highest levels of traffic congestion in the region. This is due in large part to the capacity constraints of the bridges across the Merrimack River. Long delays at the Taylor Falls/Veteran's Memorial Bridges has resulted in increased traffic diversion to the Sagamore Bridge resulting in heavy traffic on other roads in south and east Hudson including NH 3A, Wason Road, and Kimball Hill Road.

The purpose identified for the Circumferential Highway, since it was first proposed in the late1950's, has been to provide additional crossings of the Merrimack River and mitigate congestion in downtown Hudson and downtown Nashua. In 2007, The NHDOT held a public meeting in Hudson effectively ending any future consideration for the Circumferential Highway. However, the need for the project still remains. NRPC, working with the Transportation Technical Advisory Committee (TTAC) has proposed that the needs of the Circumferential Highway Project be met through a series of smaller scale projects with independent utility.

The Merrimack River forms a major barrier in southern New Hampshire separating the eastern part of the state from the central and western portion. Traffic needs to move across southern New Hampshire between the Derry-Salem area along Interstate 93 and the Nashua area along the F.E. Everett Turnpike. The Merrimack River flows north to south between the two areas and forces all east-west traffic to cross the river at only two locations in the region: the Taylor Falls/Veterans Memorial Bridges between downtown Hudson and downtown Nashua; and the Sagamore Bridge between southern Hudson and southern Nashua.

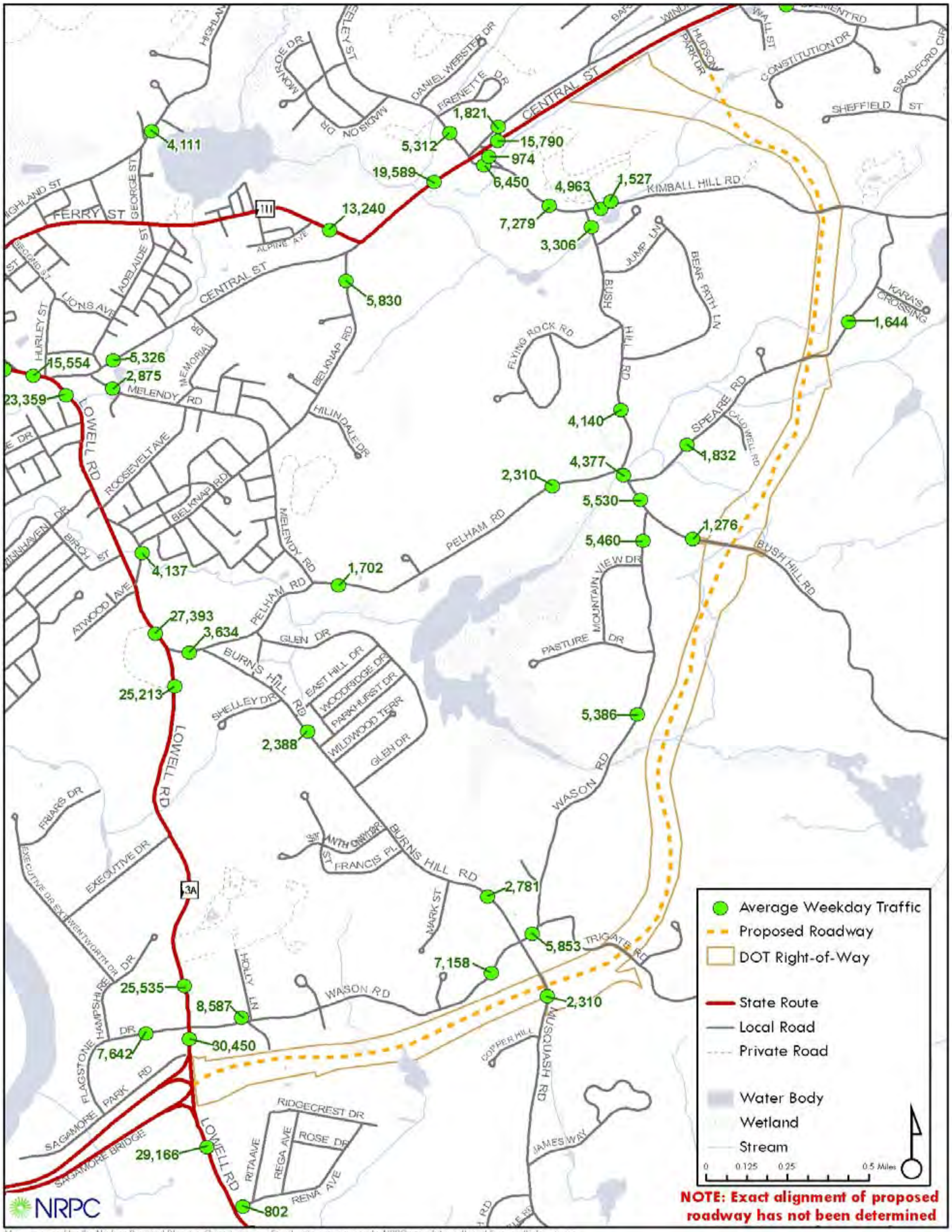
Traffic across the Taylor Falls/Veterans Memorial Bridges has been stable at approximately 37,000 annual average daily trips. Traffic on the Sagamore Bridge between southern Hudson and southern Nashua has been rapidly increasing in recent years. In 1995, approximately 25,000 annual average daily trips crossed the Merrimack River via the Sagamore Bridge. By 2002 this traffic volume had increased to approximately 36,500 annual average daily trips, an increase of 46% or 5.6% increase per year.

Traffic forecasting using NRPC's regional traffic model indicates that traffic across the Merrimack River will continue to increase rapidly. Traffic across the Taylor Falls/Veterans Memorial Bridge between downtown Hudson and downtown Nashua is expected to increase from 37,000 vehicles per day (vpd) today to 53,500 vpd in 2025. This is an increase of 45% at a rate of 1.7% per year. The Sagamore Bridge is expected to increase from 36,500 vpd currently to 61,900 by 2025. This is an increase of 67% at a rate of 2.3% per year. It should be noted that these increases will take place despite the development of the Airport Access Road Bridge across the Merrimack River that is expected to be used by at least 20,000 vpd by 2025.

The result of high traffic volumes on the Taylor Falls Bridge is congestion in downtown Hudson and on NH 3A. The congestion during the peak travel hours is resulting in diversion onto Wason Road and Kimball Hill Road. For example, during the AM peak hour westbound traffic queues at Wason Road and NH 3A have been observed to approach ½ mile.

NRPC collected traffic volume data on NH 3A, NH 111, Kimball Hill Road, Wason Road and other local roads that will intersect the proposed alignment. Both 24 hour volume counts and peak hour turning movement count data was collected to support the travel demand modeling effort and to analyze the conditions and existing and proposed intersections. Automatic traffic recorders were set on Wason Road, Kimball Hill Road, Bush Hill Road, and Lowell Road. Data from these traffic counts was used in the travel demand model process. Figure 3 shows traffic volumes collected by NRPC.

FIGURE 4: TRAFFIC VOLUMES



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D. INTERSECTION ANALYSIS

An evaluation of existing year (2009) traffic conditions was conducted in order to establish a baseline for analysis of the study area intersections. NRPC conducted morning and afternoon (peak-period) manual turning movement counts (TMC's) at critical intersections in the project study area. The counts were conducted in the field by NRPC staff on weekdays between the hours of 7:00am and 9:00am and 4:00pm and 6:00pm. The locations of the TMC's are listed below and shown on Figure 4.

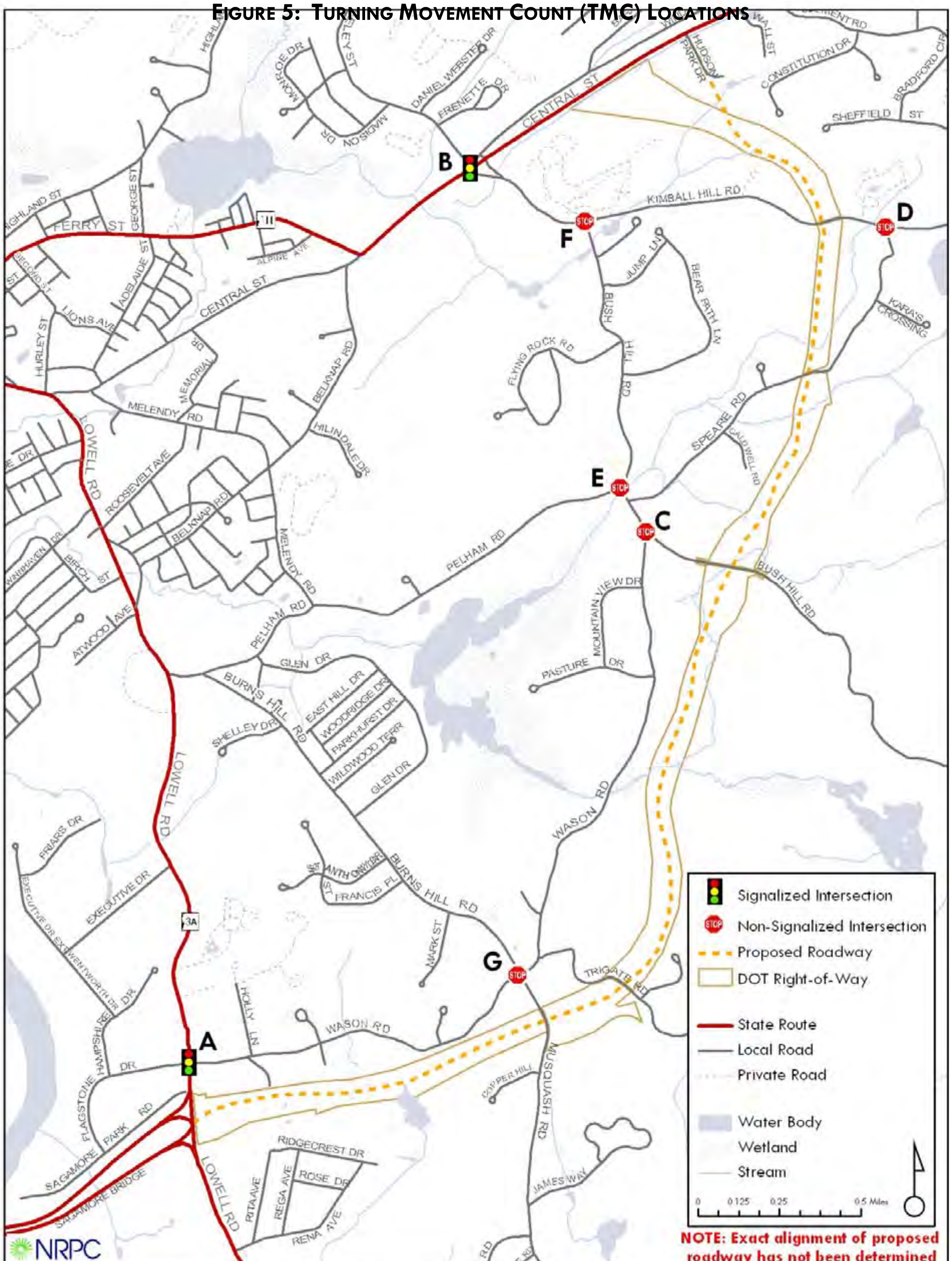
TABLE 1: TRAFFIC COUNT LOCATIONS
SIGNALIZED INTERSECTIONS

A. Lowell Rd (NH 3A)@ Wasson & Flagstone
B. Central St (NH111) @ Kimball Hill & Greeley

TABLE 2: TRAFFIC COUNT LOCATIONS
NON-SIGNALIZED INTERSECTIONS

C. Bush Hill @ Wason Rd
Kimball Hill Rd @ Speare Rd.
Bush Hill Rd @ Pelham Rd.
Kimball Hill Rd. @ Bush Hill Rd.
Wason Rd. @ Burns Hill & Musquash

FIGURE 5: TURNING MOVEMENT COUNT (TMC) LOCATIONS



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The TMC's were used to determine the Level of Service (LOS) at critical intersections in each community. Level-of-service analysis was performed based on the industry standards as described in the Highway Capacity Manual 2000 (HCM), published by the Transportation Research Board. The HCM defines the quality of traffic operations at specific highway facilities (roads, lanes, intersections, and intersection approaches) under specific conditions (peak hour) by a means of "level-of-service." The LOS characterizes the operating conditions on a facility in terms of traffic performance measures related to speed and travel time, freedom to maneuver, traffic interruptions, and comfort and convenience.

Level-of-service can range from "A" (least congested) to "F" (most congested). The following table shows the general definitions of LOS.

TABLE 3: LOS GENERAL DEFINITIONS

Level of Service	General Operating Conditions
A	Free flow
B	Reasonably free flow
C	Stable flow
D	Approaching unstable flow
E	Unstable flow
F	Forced or breakdown flow

Source: "A Policy on Geometric Design of Highways and Streets", AASHTO

Operational analysis at non-signalized (two-way and four-way stop controlled) depends upon the understanding of the interaction of drivers on the minor or stop-controlled approach with the drivers on the major street. The LOS for a stop-controlled intersection is determined by the computed or measured control delay and is defined for each minor movement. The LOS is not defined for the intersection as a whole. The LOS criteria for signalized and non-signalized intersections are shown in the following tables.

TABLE 4: LEVEL OF SERVICE CRITERIA/NON-SIGNALIZED INTERSECTIONS

Level of Service	Control Delay per Vehicle (sec./veh.)
A	0 – 10
B	10 – 15
C	15 – 25
D	25 – 35
E	35 – 50
F	> 50

Source: "Highway Capacity Manual 2000", TRB.

TABLE 5: LEVEL OF SERVICE CRITERIA/SIGNALIZED INTERSECTIONS

Level of Service	Control Delay per Vehicle (sec./veh.)
A	0 – 10
B	10 – 20
C	20 – 35
D	35 – 55
E	55 – 80
F	> 80

Source: "Highway Capacity Manual 2000", TRB.

1. Signalized Intersections

The signalized intersections in the project study area generally exhibit poor Levels of Service under the existing (2009) traffic conditions. See Figure 4 and Table 6. Traffic using the intersection of Wason Road, Lowell Road, and Flagstone Road is experiencing delays approaching or exceeding 80 seconds during both the AM and PM peak hours. Intersection operations continue to deteriorate into 2017 particularly on the Lowell Road Northbound and Southbound approach. Under the build condition, greatest improvement is expected to be on the Wason Road west bound approach as the connector will serve to remove trips from this intersection. Table 6 shows the level of service for this link improving from "F" under existing conditions to "D" under the build condition.

On NH 111 at Kimball Hill Road and Greeley Street current traffic operation are fair to poor on the approach legs to the intersection during the AM and PM peak hours. Vehicles at this intersection will continue to experience delay approaching 80 seconds or more during peak hours. Under the build condition we expect to see improvement on the approach legs from NH 111 westbound, NH 111 eastbound, and Kimball Hill Road. Southbound traffic on Greeley Street, during the AM peak hour, may experience some increased delay as the connector road may draw additional traffic through this intersection.

Table 6: Approach Level of Service (LOS) at Signalized Intersections

Signalized Intersections	Approach Level of Service					
Location	2009		2017 No Build		2017 Build	
	AM	PM	AM	PM	AM	PM
Lowell Rd @Wason & Flagstone						
- Flagstone - EB	E	F	F	F	F	F
- Wason Rd - WB	F	E	E	D	D	D
- Lowell Rd - NB	F	F	F	F	F	F
- Lowel Rd- SB	E	F	E	F	E	F
Central St (NH111) @ Kimball Hill & Greeley						
- Central St (NH111) EB	D	F	D	F	D	F
- Central St (NH111) WB	F	E	E	E	D	D
- Kimball Hill Rd NB	F	D	D	D	D	D
- Greely SB	E	E	E	D	F	D

2. Non-signalized Intersections

The non-signalized intersections in the study area generally exhibit satisfactory Levels of Service. Under the 2017 Build condition the connector road is drawing traffic away from the parallel routes of Wason Road and Kimball Hill Road. As a result the operations at intersecting roads such as Musquash Road, Bush Hill Road, and Burns Hill Road remain satisfactory or show improvement. The exception is the Kimball Hill /Speare Road "Build" scenario (2017). In this scenario the Speare Road movement exhibits a LOS of "F" in both the AM and PM. Traffic on the western segment of Speare Road may experience delay in excess of 80 seconds when attempting to access Kimball Hill Road. This is due to increased westbound volume on Kimball Hill Road attempting to access the Connector Road.

TABLE 7: APPROACH LEVEL OF SERVICE (LOS) AT NON-SIGNALIZED INTERSECTIONS

Non-signalized	Approach Level of Service					
Bush Hill @ Wason Rd						
- Bush Hill WB Left	A	A	A	A	A	A
- Wason NB Left	B	C	B	C	A	B
Kimball Hill Rd @ Speare Rd.						
- Kimble Hill Rd – WB - Left	A	A	A	A	A	A
- Spear Rd – NB- Left	A	A	A	A	F	F
Bush Hill Rd @ Pelham Rd.						
- Pelham Rd - EB Left	B	B	A	A	B	B
- Bush Hill Rd - NB Left	A	A	A	A	A	A
Kimball Hill Rd. @ Bush Hill Rd.						
- Kimball Hill Rd. - WB Left	A	A	A	A	A	A
- Bush Hill Rd - NB Left	B	C	B	B	B	B
Wason Rd. @ Burns Hill & Musquash						
- Wason Rd - EB	A	A	A	A	A	A
- Wason Rd - WB	A	A	A	A	A	A
- Musquash - NB	C	D	B	D	B	C
- Burns Hill Rd - SB	B	D	B	D	B	C

E. FUTURE TRAFFIC CONDITIONS AND MODELING

NRPC's Regional Travel Demand Forecasting Model (the model) was used to develop future traffic conditions for the Hudson Connector project. The model uses a 3-step modeling process: trip generation, trip distribution, and traffic assignment. To maintain and run the model, NRPC uses TransCad, a leading traffic modeling and GIS software package produced by the Caliper Corporation. The base year of the model was originally calibrated to 2002 traffic counts and uses 2000 U.S. Census data.

Network – NRPC's model network consists of nearly every thru-traffic road in the region (over 800 total miles of segments) and certain major routes outside of the region to account for external trips. Each road segment is coded with certain attributes needed to run the model:

- Direction
- Length
- Posted speed
- Capacity (derived from number of lanes, presence of median or turn lanes, and density of surrounding uses)
- Tolls (represented as a time penalty – 2 minutes for every $1)

Socioeconomic Data – The main inputs of employment and household data are summarized by Traffic Analysis Zone (TAZ). There are 2,034 TAZs in the NRPC model, including roughly 50 external zones. Each TAZ contains total households, residents, and employees. Residents and employees are both assigned an industry classification, based on Census data. Industry classes include retail, manufacturing, professional services, finance, real estate, and others. In addition, each household is coded with the number of vehicles available to it, also derived from Census data.

1. Step One – Trip Generation

In this step, the model uses trip generation rates to determine how many trips of various purposes will be produced by each TAZ, according to the socioeconomic data within it. These rates are derived both from standard Institute of Transportation Engineers (ITE) results and from the results of origin and destination surveys conducted by NRPC.

Different classifications of businesses will attract a different number of trips to its zone, for instance a retail store versus a shipping warehouse. Another example is a household with 3 vehicles will produce more trips than one with only 1 or 2 vehicles.

2. Step Two – Trip Distribution

Trip distribution takes the expected number of trips produced and attracted by each zone and determines how they will match up. NRPC uses a "gravity model" to distribute the trips, meaning that people are more likely to travel to nearby zones that match their trip purpose than other zones that are further away. Average journey to work time in the region is also factored in – meaning that if survey and census data shows that 60% of all work trips take between 20 and 30 minutes, the model will attempt to match that ratio.

3. Step Three – Trip Assignment

Once the model knows where all the trips begin and end, it can find the paths on which to assign them. The model begins by sending every trip via the shortest path possible (in terms of time). Then, because of capacity constraints, it uses an iterative process to reassign certain trips along alternate routes.

F. FUTURE TRAVEL DEMANDS

Initial model runs were conducted to establish a no-build scenario to allow a comparison of the future traffic volumes without the connector road to the traffic volume with the connector road. The modeling effort assumed a future design year of 2017. Once the future traffic volumes were established for the 2017 no-build condition, the Travel Demand Model was updated to include the proposed connector road. The proposed connector road was assumed to be a two lane, controlled access roadway with a modeled speed of 35 MPH. The model assumed no curb cuts would be allowed along the connector with access limited to existing cross roads.

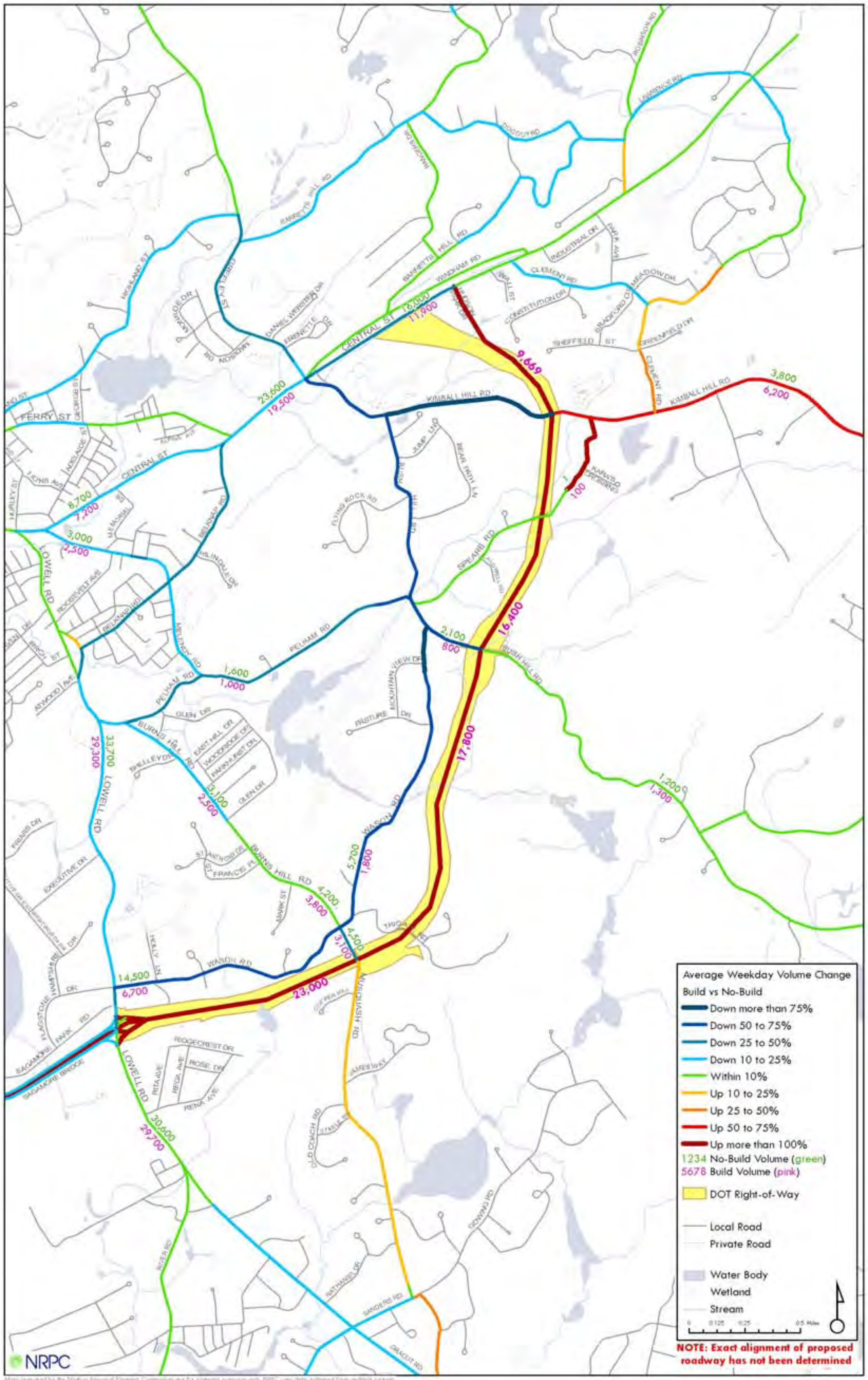
A set of build assumptions were developed and incorporated into the model to represent the traffic and land use conditions expected in 2017. This includes a network of future roads in the Long Range Transportation Plan that are expected to have a regional impact. Specific road network additions to the model included the Airport Access Road and bridge crossing the Merrimack River near the Merrimack-Bedford town line, as well as capacity improvements on NH 101A in Nashua, Amherst, and Milford, the F.E. Everett Turnpike in Merrimack, and NH 101 in Nashua, Milford, and Amherst.

Socioeconomic data representing both general future growth rates and specific known future developments were also included in the model. Specific development projects such as Green Meadow were added to the model based on recent development proposals. Development proposals for the Green Meadow property have varied greatly in recent years. NRPC staff assumed a high intensity mixed use development similar to the formerly proposed River Place development proposal from 2007. This proposal would include retail, office and commercial developments and would generate approximately 12,000 trips per average weekday.

G. CONNECTOR TRAFFIC VOLUMES:

An analysis of the 2017 traffic volumes indicates that the connector road will provide regional traffic with an attractive alternative route through Hudson and will alleviate volume and congestion on local roads. Build condition (2017) traffic volumes show significant traffic volumes accessing the connector at the Sagamore Bridge. It is estimated that approximately 23,000 vehicles per day would use the connector between Lowell Road and Musquash Road in 2017. To the north between Musquash Road and Bush Hill Road Traffic Volumes drop off as local traffic disperses. Figure 5 shows 2017 traffic volume of 17,800 between Musquash and Bush Hill Roads and 16,400 between Bush Hill Road and Kimball Hill Road. North of Kimball Hill Road to NH 111 approximately 9,700 vehicles per day are expected to use the connector road in 2017.

FIGURE 6: CONNECTOR TRAFFIC VOLUMES



The 2017 traffic volume on the parallel local roads decreases significantly with the connector road in place. A comparison of the build and no build scenarios with current 2009 traffic volumes demonstrates that the connector provides additional capacity to relieve Wason Road and Kimball Hill of traffic diversions due to the congested downtown area. The 2017 traffic volumes on Wason Road, Kimball Hill Road, NH 3A, and NH 111 with the proposed connector show a decrease in cut through traffic volumes. Table 8 provides a comparison of the 2017 24 hour traffic volumes with and without the connector to the existing 2009 24 hour traffic volumes.

TABLE 8: COMPARISON 2017 VS. 2009 24 HR TRAFFIC VOLUMES

	2017 No Build	2017 Build	2009 Current Traffic
Wason Road Between NH 3A and Musquash	14,500	6,700	7,200
Wason Road Between Musquash and Bush Hill	5,700	1,800	5,900
Bush Hill Road Between Kimball Hill and Spear Road	7,400	1,900	2,800
Kimball Hill Between NH 111 and Bush Hill Road	7,200	2,300	7,300
NH 111 East of Kimball Hill Road	23,600	19,500	16,000
Lowell Road South of Pelham Road	33,700	29,300	25,500

The anticipated future traffic volumes indicate that the intersection at the Sagamore Bridge, Lowell Road and connector road will need to be grade separated. In addition, travel demand projections for the southwestern segment of the connector road between the Sagamore Bridge, Lowell Road, and Musquash Road exceed the capacity of a one lane facility. Construction of a one lane facility would force traffic to self meter and divert traffic to Wason Road and Lowell Road during peak travel periods. Under this scenario the reduction in traffic on parallel local roads would be less significant as the connector road would approach capacity during the peak periods resulting in some drivers diverting to alternate routes.

H. PROPOSED ALIGNMENT

The Circumferential Highway project had advanced to a point where NHDOT acquired Right of Way to accommodate proposed the alternatives described in the final Environmental Impact Statement from October of 1993. Originally proposed to be a limited access highway facility, the ROW approaches 400 feet in most areas. The large right of way acquisition would have allowed for two 12 foot lanes in each direction, 8 to 10 foot shoulders, a median of varying widths throughout the corridor as well as the horizontal geometry to accommodate a 70 MPH design speed.

For the purposes of this study NRPC has proposed an alignment for a smaller roadway within the existing right of way. The concept plan will include a 2-lane controlled access facility with a design speed of 35 MPH. Limited access will be provided at existing intersections only. This reduces the impact on the natural and built environment, as well as reducing the traffic expected on surrounding roads. In addition, the smaller scale roadway will allow for flexibility in the design and layout of the road which may allow the roadway to avoid critical environmental, cultural, and socioeconomic resources.

The proposed connector road is anticipated to consist of one 12 foot lane in each direction with a 4' shoulder for a total width of approximately 75 feet in most areas. Bridges are proposed at all wetlands that appear to be significant to the ecosystem of the project area. No median is proposed for this facility. The proposed connector will be on the scale of a town road and is expected to be similar to Albuquerque Avenue in Litchfield (as shown in picture below) in both design and scale.

The proposed Hudson connector road will begin at NH 3A/Lowell Road at the Sagamore Bridge. Preliminary traffic data indicates that a grade separated interchange will be needed at this location to accommodate future traffic demands. The proposed connector will continue east, to south of Wason Road, as a four lane roadway where it will cross Musquash Road with an at-grade intersection. East of Musquash the connector will be reduced in cross section to 2 lanes. It will cross Trigate Road North of Homestead. It is anticipated that this crossing will be grade separated. The alignment continues to turn north parallel to Wason Road and crosses Bush Hill Road with an anticipated at-grade crossing. Continuing in a northeasterly direction the connector will cross Speare Road (see Figure 6). It is anticipated that Speare Road would be reconfigured and end on either side of the connector in a cul-de-sac without access to the connector. The connector road would continue north forming a 4 way intersection with Kimball Hill Road. North of Kimball Hill Road the connector road would deviate from the Circumferential Highway Right of Way and tie into the existing road network at Hudson Park Drive. The intersection of Hudson Park Drive and NH 111 would be upgraded to accommodate the increase in traffic at this location.

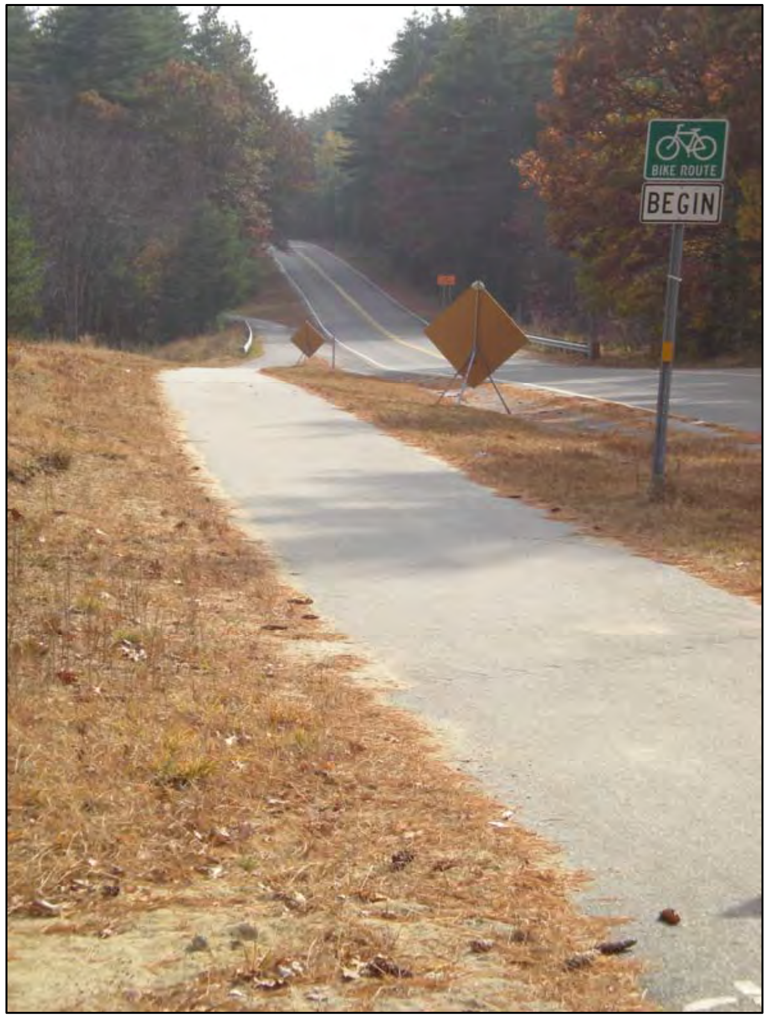


FIGURE 7: SPEAR ROAD CONFIGURATION

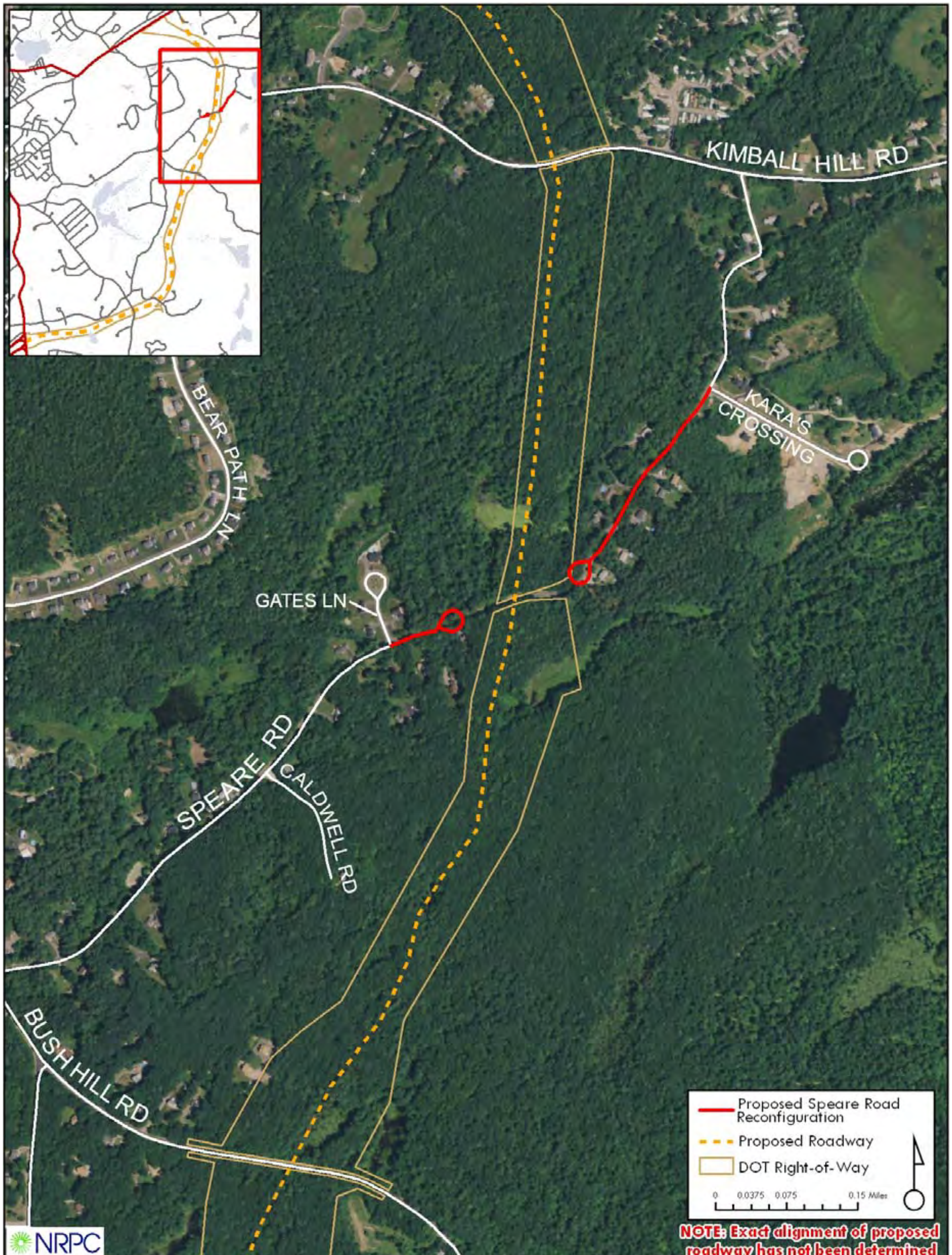


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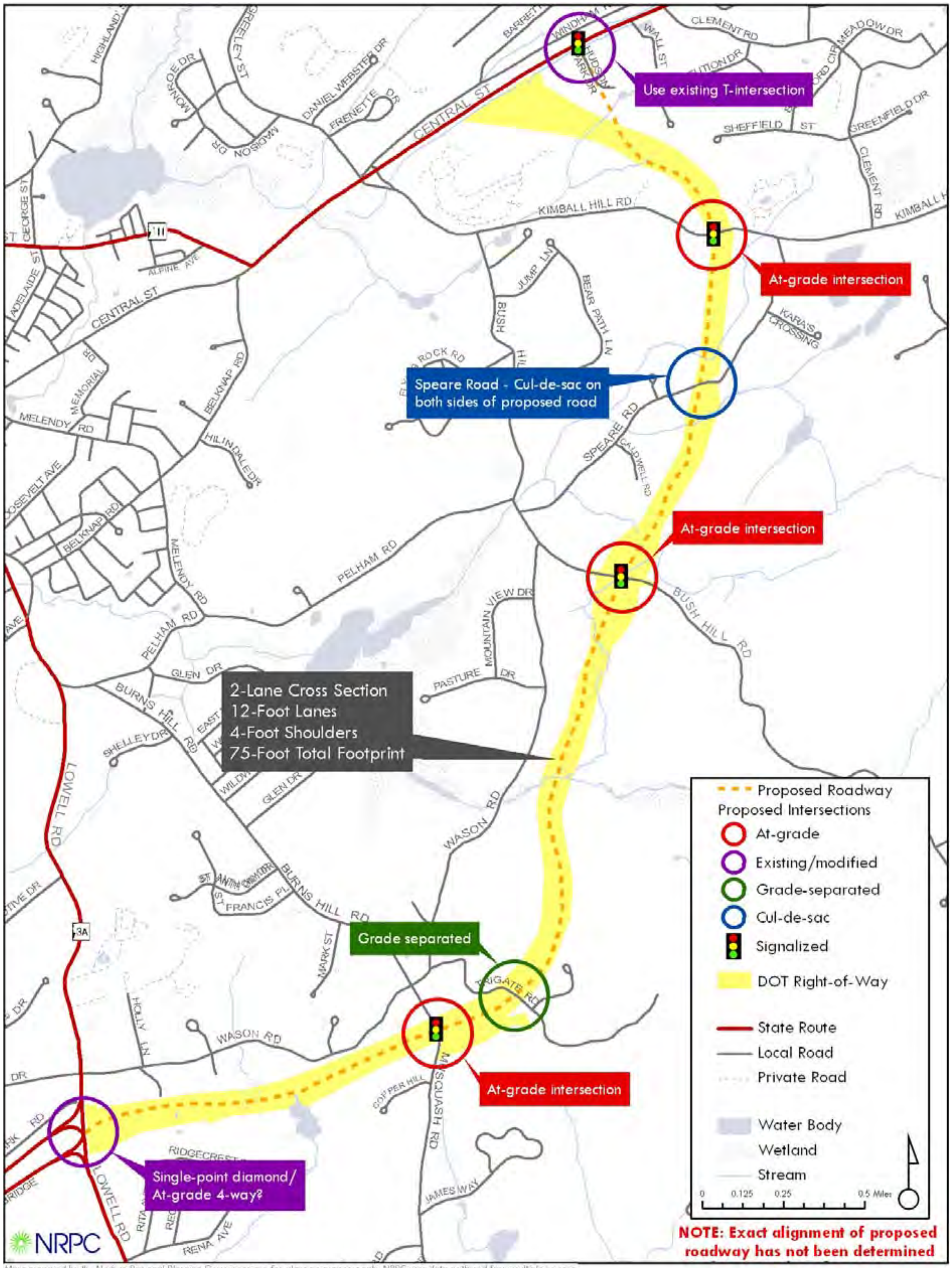
FIGURE 8: PROPOSED ALIGNMENT



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I. ENVIRONMENTAL AND LAND USE

1. Environmental Constraints

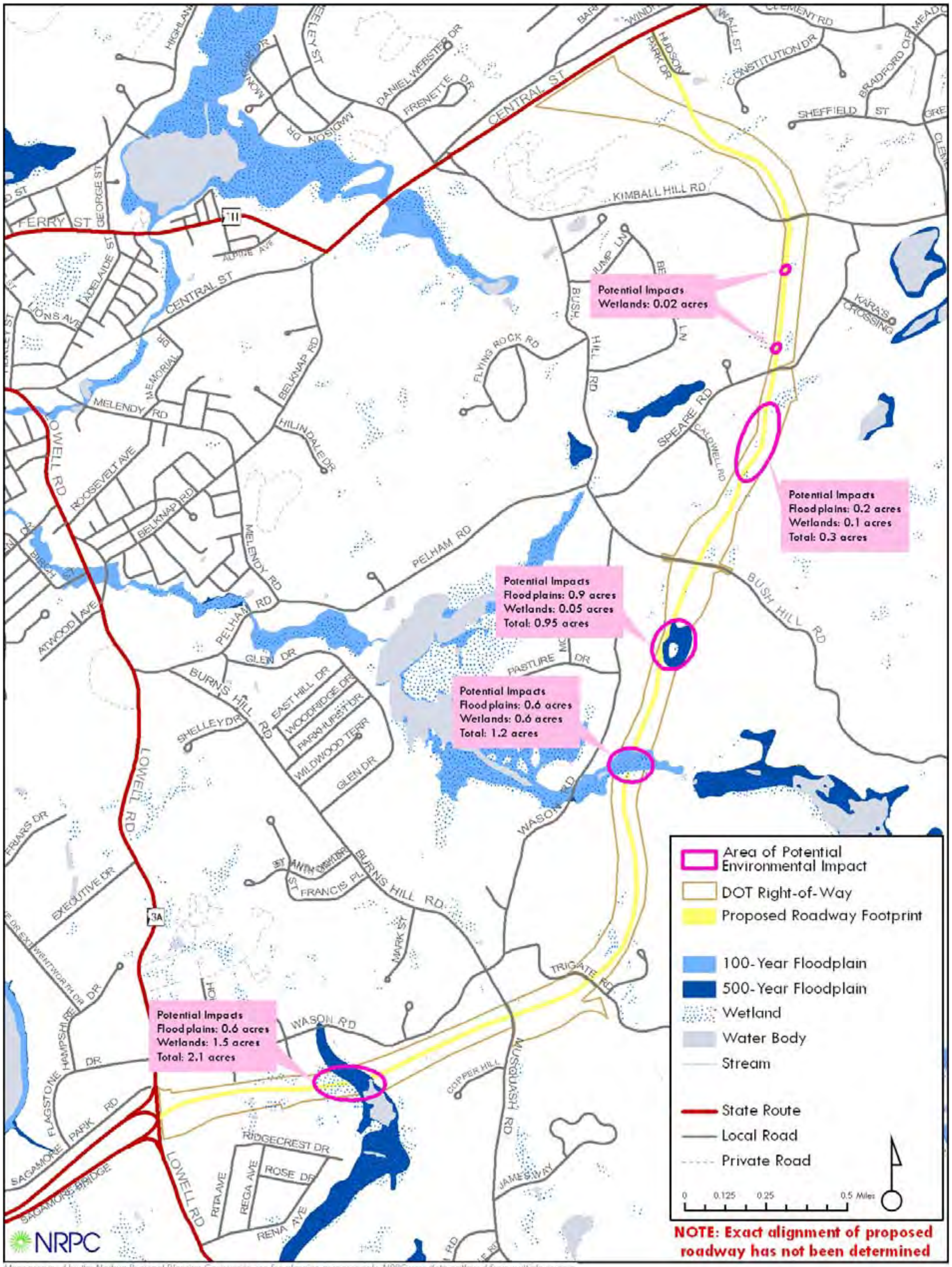
The Circumferential Highway as originally proposed had significant impacts to natural and cultural resources. These impacts were compiled, quantified, and analyzed in an Environmental Impact Statement completed in October 1993. The impacts to the resources were based on research, data collection, and survey of the existing conditions at the time. Using the base data collected during the environmental study, the US Army Corp of Engineers was able to layout various alternatives for the proposed highway and accurately quantify impacts to the resources in the project area. The impacts shown in the FEIS are based upon a 4 lane limited access toll facility with a design speed of 70 MPH and full service interchanges proposed at major cross roads. The foot print of the proposed Circumferential Highway was substantial and would allow for two 12 foot lanes, 10 foot shoulders and a variable width median; similar in scope to NH 101 east of Manchester.

The FEIS reports impacts for all of the alternatives considered in the study. These impacts are broken out and quantified in three sections. The impacts associated with the southern section of the proposed Circumferential Highway are in the same study area as the proposed connector road. The FEIS indicates that impacts from the alternatives alignments considered between the Sagamore Bridge and NH 111 range between 17 and 44 acres.

This planning level study of the proposed connector road is relying on available GIS datasets and analysis techniques to estimate the impacts of a greatly reduced roadway along the circumferential highway alignment. The proposed connector road is anticipated to consist of one 12 foot lane in each direction with a 4' shoulder for a total footprint of about 75 feet in most areas. A lower design speed will also allow design engineers to avoid resources by designing the road to curve around critical resources. The smaller footprint and flexibility in design will result in reduced impact on natural and cultural resources. In addition, the proposed layout of the roadway and associated cost estimate includes several bridges to span wetlands that are anticipated to be significant to the ecosystem in the area.

The available GIS datasets are not the same data used in the FEIS analysis. Therefore, a direct comparison of impact on natural and cultural resources of the connector road with the FEIS alternatives is not appropriate at this time. Preliminary estimates of wetland impacts based on GIS data indicate that the connector road concept would result in 3 to 5 acres of wetland impact and approximately 2 acres of floodplain impact. It must be stressed that the GIS wetland data is very general and is not adequate for permitting purposes. Further environmental study would be required to fully assess the reduction in impact from the proposed connector road. It is likely that the impact from the proposed connector will be orders of magnitude less than the proposed Circumferential Highway Project. Figure 8 shows the location and estimated impacts to wetlands and flood plain in the project area.

FIGURE 9: LOCATION & ESTIMATED IMPACTS TO WETLANDS AND FLOOD PLAIN IN THE PROJECT AREA



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2. Secondary Impacts

Numerous homes and subdivisions exist to the west of the proposed connector road, while to the east many large parcels still remain undeveloped. The area to the west is primarily zoned General and Residential 2, while to the east there is some Industrial and Residential 2 zoning with the majority falling under General 1. The following excerpt from the zoning code provides a description of the G-1 District:

> *General-One (G-1). The G-1 District includes all areas not specifically zoned as being within an R-1, R-2, B, or I District located outside the right-of-way of the Circumferential Highway as depicted on the Town Zoning Map. The District is designed to permit a wide diversity of land uses at a density appropriate to the rural nature of the area, the natural constraints of the land and the lack of infrastructure. Uses permitted in this District are the same as those permitted in the G District. [Added 3-13-2001 by Amdt. No. 3]*

Locating the proposed connector road in this area will provide access to this substantial area of land currently zoned G-1. If this proposed roadway is developed, the town may want to re-evaluate the existing zoning and allowable uses to ensure that the appropriate framework is in place to guide desired growth in this area. It is likely that land will become more attractive and land values may rise with the development of the connector road.

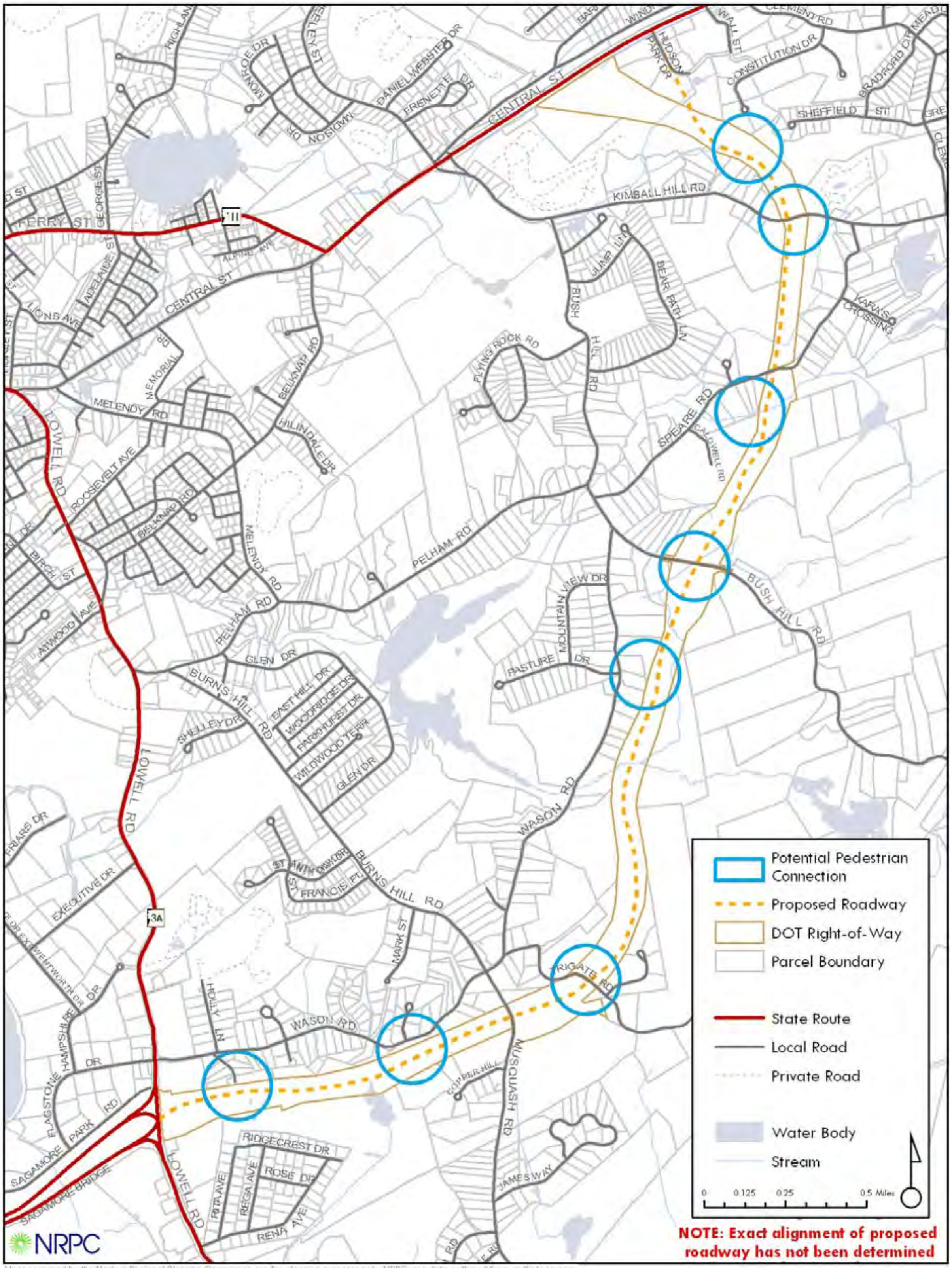
3. Bicycle and Pedestrian Path

Locating a shared bicycle and pedestrian path adjacent to the connector road would serve as a unique amenity to the town. This would be similar in layout and design to the shared path along Albuquerque Avenue in Litchfield. Below are some photos of Albuquerque Avenue and the associated bike path.

Ideally the proposed bicycle and pedestrian path would be separated from the road by a 5-10' grassed esplanade. This separation creates a buffer between vehicles and pedestrians and bicyclists. People are often more likely to utilize a shared path than ride or walk in the shoulder due to a greater feeling of safety. If located on the west side of the connector road, the path will travel behind a number of large subdivisions and could provide easy access to these residents. Such a path provides recreational opportunities as well as alternative transportation. Residents at the southern terminus, who are in close proximity to the grocery store, may choose to walk to the grocery store for small shopping trips. This may be an especially attractive option during peak traffic times.

The cost estimate for the roadway includes totals with and without the shared path. The incremental cost for a 10' wide mixed use path is estimated to be $4.1M. The following map shows potential access points for the shared bicycle and pedestrian path. Proposed access points are shown at existing roads as well as larger subdivisions in close proximity to the connector road.

FIGURE 10: POTENTIAL BICYCLE AND PEDESTRIAN ACCESS POINTS



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J. PRELIMINARY COST ESTIMATE

NRPC contracted with Vanasse Hangen and Brustlin to develop a programming cost estimate based on available data and a conceptual connector roadway alignment provided by NRPC. A programming cost estimate is considered to be of appropriate level of detail to allow a project to be programmed in a Metropolitan Planning Organization's Long Range Transportation Plan or Transportation Improvement Program when a funding source is identified.

The programming cost estimate was based on the following criteria:

- 12' lanes/4' shoulders, no curbs
- Trucks are allowed
- Assume all at-grade intersections with the exception of Trigate Road, Spear Road, and an alternative for a single point diamond interchange at the Sagamore Bridge (Rte 3A)
- Assume left turns needed at intersections
- Assume bridging of wetlands will be required where dry land alternatives do not exist within the right-of-way
- All work will be within the existing Circumferential Highway right-of-way
- A Supplemental EIS will not be required since the assumption is that no federal funds will be required
- The design speed will be 35 mph, and the intent is to follow the existing topography to the extent possible to avoid major cuts and fills. This is to be considered a local collector road

The estimate was developed utilizing existing aerial orthophotos as a base for measuring distances for estimating purposes. Available GIS information on resource area boundaries was used to make educated approximations of wetland bridges and/or mitigation areas.

VHB developed construction costs per mile for this roadway facility based on current unit pricing and normally assumed contingencies. Construction items such as stormwater treatment, traffic signals, turning lanes, structures, and an alternative bikeway along one side separated from the road by a grass buffer were also considered. The program estimate also includes the approximate cost for design, however permitting and mitigation cost will no be included due to their uncertain nature. VHB also provided an approximate incremental cost to increase the typical section width to 12' lanes with 10' shoulders in the event Federal funds are used which could require this wider typical section. Since VHB's estimating efforts did not include conceptual design work, the grade separated crossing and Rte 3A interchange will be based on very broad assumptions on bridge sizes.

A detailed cost estimate is shown in Appendix A. The estimate shows costs of each segment of the connector road between the major cross roads. The cost estimate is provided in 2009 dollars. The estimated cost to construct a 2 lane connector road with 4' shoulders and a single point grade separated interchange at Lowell Road is $29.3 M. A 10 foot wide multi use path would add an additional $4.1 M.

It should also be noted that the Town does not own the right of way. This land was purchased by NHDOT with Turnpike funds. NHDOT considers unused right of way surplus land and periodically sells parcels when they are no longer useful to the agency. The Town of Hudson will need to reach and agreement with NHDOT regarding the use of this land and should anticipate that some compensation to the NHDOT will be required.

K. IMPLEMENTATION

The connector road is being planned as a local town connector arterial to be built by the town with a combination of private and town funds. Since the project is significant in size and scope, a phased approach to construction is recommended. One approach would be to begin the project at NH 111 and Hudson Park Drive and work north to south as follows:

1. NH 111 to Kimball Hill Road
2. Kimball Hill Road to Spear Road
3. Spear Road to Bush Hill Road
4. Bush Hill Road to Musquash Road
5. Musquash Road to Lowell Road and the Sagamore Bridge

Segments 1 through 4 could be constructed in any order and would have little impact on traffic until connections to the Sagamore Bridge, and Lowell Road are completed. Assuming that a grade separated intersection will be required at Lowell Road to tie into the Sagamore Bridge the town might consider using federal funds to complete this section of the project. In addition to being the most expensive segment of the project this section of roadway is a transition from the turnpike system to the town road network which will require coordination of construction and maintenance.

CP/kmb
#4420-19

APPENDIX A

PRELIMINARY COST ESTIMATE

Vanasse Hangen Brustlin, Inc.

PROGRAM COST ESTIMATE :
HUDSON - LOCAL ROAD FROM RTE 3A TO RTE 111

1-LANE	$	3,200,000	per mile
2-LANE / w 4' SHLDR	$	3,500,000	per mile
3-LANE	$	4,200,000	per mile
2-LANE / w 10' SHLDR	$	4,200,000	per mile
STD. BRIDGE COST	$	190	per SF
4-WAY SIGNAL COST	$	150,000	per signal
3-WAY SIGNAL COST	$	125,000	per signal
1-WAY SIGNAL COST	$	30,000	per signal

Estimated B	JMH	9/17/2009
Checked By:	GLB	9/22/2009
Revised By:	JMH	9/25/2009

SECTION	BEGIN STATION	END STATION	NUMBER SIGNALS	LENGTH FEET	TYPE	LENGTH MILES	WIDTH FEET	COST / SIGNAL	CONSTRUCTION COST / SF	CONSTRUCTION COST / MILE	COST SUBTOTAL MILLIONS
Sta. 0+00 to Sta. 61+40				6,140		1.16					
Lowell Rd to Mushquash Rd											
Connector	00+000	03+175		3,175	2-Lane	0.60				$ 3,500,000	$ 2.10
Wetland Crossing Bridge	03+175	03+675		500	2-Lane Bridge	0.09	32		$ 190		$ 3.04
Connector	03+675	05+740		2,065	2-Lane	0.39				$ 3,500,000	$ 1.37
Connector	05+740	06+140		400	3-Lane	0.08				$ 4,200,000	$ 0.32
Musquash Road Signals			1		4 Way			$ 150,000			$ 0.15
Musquash Approaches (2 directions)				600	3-Lane	0.11				$ 4,200,000	$ 0.48
Lowell Rd (Rte 3A) modifications				1,500	add 1 lane	0.28				$ 1,000,000	$ 0.28
SPUI:											
Connector Over Lowell Road	-01+260	00+000		1,260	2-Lane	0.24				$ 3,500,000	$ 0.84
SPUI Access Ramp Westbound to Lowell Road				1,400	1-Lane	0.27				$ 3,200,000	$ 0.85
SPUI Access Ramp Westbound to Nashua				1,000	1-Lane	0.19				$ 3,200,000	$ 0.61
SPUI Access Ramp Eastbound from Nashua				1,000	1-Lane	0.19				$ 3,200,000	$ 0.61
SPUI Access Ramp Eastbound from Lowell Road				1,400	1-Lane	0.27				$ 3,200,000	$ 0.85
Single Point Urban Interchange Bridge				180	2-Lane Bridge	0.03	32		$ 250		$ 1.44
SPUI Signals (8 existing)			2		1 Way			$ 30,000			$ 0.06
										SPUI Subtotal =	$ 5.24
									SECTION TOTAL (Without SPUI)		$ 7.74
Sta. 61+40 to Sta. 148+40				8,700		1.65					
Mushquash Road to Bush Hill Road											
Connector	06+140	06+440		300	3-Lane	0.06				$ 4,200,000	$ 0.24
Connector	06+440	07+529		1,089	2-Lane	0.21				$ 3,500,000	$ 0.72
Trigate Road Bridge (Span 62')	07+529	07+591		62	2-Lane Bridge	0.01	32		$ 190		$ 0.38
Connector	07+591	11+280		3,689	2-Lane	0.70				$ 3,500,000	$ 2.45
Wetland Crossing Bridge	11+280	11+320		40	2-Lane Bridge	0.01	32		$ 190		$ 0.24
Connector	11+320	13+770		2,450	2-Lane	0.46				$ 3,500,000	$ 1.62
Wetland Crossing Bridge	13+770	13+810		40	2-Lane Bridge	0.01	32		$ 190		$ 0.24
Connector	13+810	14+540		730	2-Lane	0.14				$ 3,500,000	$ 0.48
Connector	14+540	14+840		300	3-Lane	0.06				$ 4,200,000	$ 0.24
Bush Hill Road Signals		14+840	1		4 Way			$ 150,000			$ 0.15
Bush Hill Road Approaches (2 Directions)				600	3-Lane	0.11				$ 4,200,000	$ 0.48
										SECTION TOTAL	$ 7.24
Sta. 148+40 to Sta. 183+00				3,460		0.66					
Bush Hill Road to Spear Road											
Connector	14+840	15+140		300	3-Lane	0.06				$ 4,200,000	$ 0.24
Connector	15+140	17+780		2,640	2-Lane	0.50				$ 3,500,000	$ 1.75
Wetland Crossing Bridge	17+780	17+800		20	2-Lane Bridge	0.00	32		$ 190		$ 0.12
Connector	17+800	18+300		500	2-Lane	0.09				$ 3,500,000	$ 0.33
Connector	18+000	18+300		300	3-Lane	0.06				$ 4,200,000	$ 0.24
Spear Road Signals		18+300	1		4 Way			$ 150,000			$ 0.15
Spear Road Approches (2 Directions)				600	3-Lane	0.11				$ 4,200,000	$ 0.48
										SECTION TOTAL	$ 3.31
Sta. 183+00 to Sta. 208+00				2,500		0.47					
Spear Road to Kimball Hill Road											
Connector	18+300	18+600		300	3-Lane	0.06				$ 4,200,000	$ 0.24
Connector	18+600	18+650		50	2-Lane	0.01				$ 3,500,000	$ 0.03
Wetland Crossing Bridge	18+650	18+700		50	2-Lane Bridge	0.01	32		$ 190		$ 0.30
Connector	18+700	20+500		1,800	2-Lane	0.34				$ 3,500,000	$ 1.19
Connector	20+500	20+800		300	3-Lane	0.06				$ 4,200,000	$ 0.24
Kimball Hill Road Signals			1		4 Way			$ 150,000			$ 0.15
Kimball Hill Road Approaches (2 directions)				600	3-Lane	0.11				$ 4,200,000	$ 0.48
										SECTION TOTAL	$ 2.63
Sta. 208+00 to Sta. 245+80				4080		0.77					
Kimball Hill Road to NH Route 111 (Central Street)											
Connector	20+800	21+100		300	3-Lane	0.06				$ 4,200,000	$ 0.24
Connector	21+100	24+280		3,180	2-Lane	0.60				$ 3,500,000	$ 2.11
Connector	24+280	24+580		300	3-Lane	0.06				$ 4,200,000	$ 0.24
NH Route 111 Signals			1		3 Way			$ 125,000			$ 0.13
NH Route 111 Approaches				600	3-Lane	0.11				$ 4,200,000	$ 0.48
										SECTION TOTAL	$ 3.19
Multi Use Path 10' wide				23,688		4.49				$ 528,000	$ 2.4
Addition Bridge width for Path				892			10.00		$ 190		$ 1.7
Additional cost for 10' shoulder											$ 4.5

COST OF PROJECT WITH 4' SHOULDERS (INCLUDING BRIDGES, TRAFFIC SIGNALS, ENGINEERING/DESIGN) = $24.1 M

COST OF PROJECT WITH 10' SHOULDERS (INCLUDING BRIDGES, TRAFFIC SIGNALS, ENGINEERING/DESIGN) = $28.6 M

ADDITIONAL COST OF SINGLE POINT INTERCHANGE = $5.2 M

ADDITIONAL COST OF 10' WIDE MULTI-USE PATH = $4.1 M

NRPC
NASHUA REGIONAL PLANNING COMMISSION

May 30, 2019

Jeffrey Santacruce, PE PTOE
Senior Project Manager
Weston & Sampson
7 Perimeter Road
Manchester, NH 03103

RE: Hudson Boulevard Traffic Model Forecast

Dear Jeff,

In June 2018 NRPC completed a traffic analysis of the impact of constructing the proposed Hudson Boulevard connecting NH 111 with NH 3A. The traffic model projections were for the year 2040. Although NRPC has since updated its land use forecast to 2045, the new projections are not measurably different for 2045 than 2040. We conclude that the technical memo for this analysis submitted on June 22, 2018 remains valid for your BLVD grant submission.

Sincerely,

Gregg Lantos
Principal Transportation Planner/MPO Coordinator
(603) 417-6571
greggl@nashuarpc.org

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Nashua Regional Planning Commission
Metropolitan Planning Organization
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NRPC
NASHUA REGIONAL PLANNING COMMISSION
METROPOLITAN PLANNING ORGANIZATION

MEMORANDUM

TO: Elvis Dhima, Town of Hudson; Jeff Santacruce, McFarland Johnson

FROM: Gregg Lantos, MPO Coordinator

SUBJECT: Hudson Boulevard Traffic Analysis

DATE: June 22, 2018

This memo provides updated data and analysis to the Hudson CTAP Discretionary Project Report prepared by the Nashua Regional Planning Commission (NRPC) in October, 2009. That report provided the first evaluation of a modified Circumferential Highway Project, entailing the scaling back of the original proposal to a roadway which would connect NH 111 to NH 3A at the Sagamore Bridge in Hudson. That alternative is currently contained within the Nashua Metropolitan Planning Organization (MPO) Metropolitan Transportation Plan (MTP) as an "Illustrative" project. This defines the project as a key priority for the Town of Hudson, but with the recognition that traditional federal and state transportation funding will not be sufficient to advance the project within the 25-year time frame of the long-range plan.

Traffic Count Trends

NRPC maintains an ongoing program of automatic traffic recorder counts for the N.H. Department of Transportation and conducts additional counts on request by member communities. This enables the agency to identify growth trends at many locations. The map on the following page illustrates the most recent average daily weekday traffic counts in Hudson and Table 1 provides comparisons with previous counts taken. Many of the prior counts were taken specifically for the 2009 study.

At the Taylor Falls Bridge traffic has declined by 0.5% per year since 2009 to a level of 36,820 average weekday traffic (AWDT). This continued the same rate of decline that began in 1992, when AWDT was 41,900. At the Sagamore Bridge to the south, traffic increased 1.3% per year to a level of 49,150. The increased capacity of the Sagamore Bridge with the Exit 2 interchange project that was completed in 1999 enabled traffic to nearly double from its 1992 level of 25,300. This location has the capability to accommodate additional traffic induced by the construction of the proposed NH 3A to NH 111 connector, now known as the Hudson Boulevard.

The segment of NH 111 Central Street west of Kimball Hill Rd. has increased at a 2.0% rate over the past ten years. Proceeding along the highway to the west toward the center of Hudson, traffic growth diminishes progressively to virtually no change approaching the Taylor Falls Bridge. Likewise, little change in volume along Route 3A south of the town center has occurred, with slight decreases in the annual rate of change generally occurring. However, there has been sustained growth along a corridor that is increasingly being used for travel from the east to the south – Kimball Hill Rd. (1.9% growth rate) to Bush Hill Rd. (3.4%) to Wason Rd. (5.3%). Motorists are increasingly finding the use of these local and collector roads more efficient than the arterials intended to serve through traffic.

FIGURE 1
CURRENT TRAFFIC VOLUMES

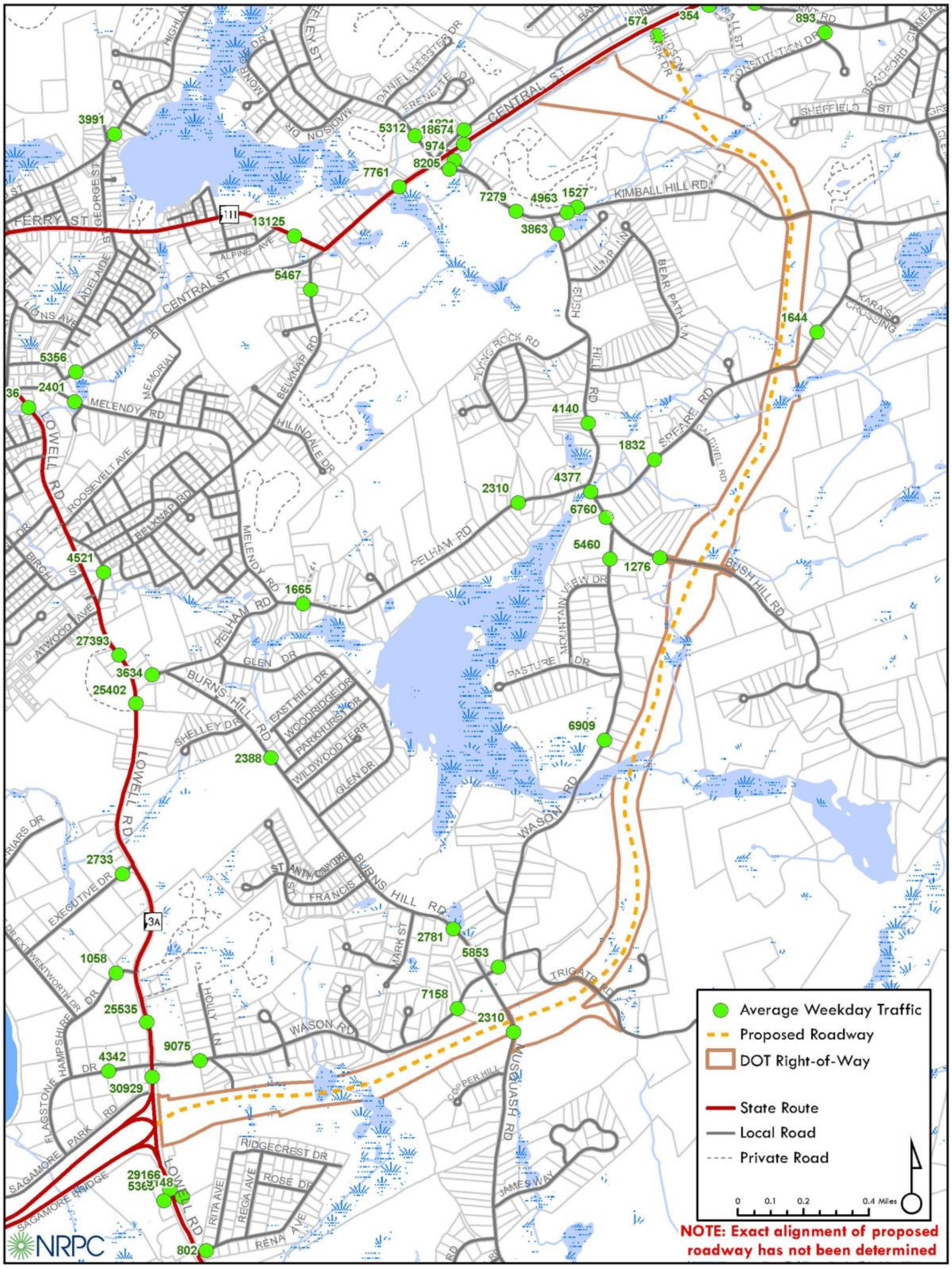

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TABLE 1
CURRENT COUNTS AND GROWTH TRENDS IN HUDSON BLVD. STUDY AREA

		Prior Count	Prior AWDT	Current Count	AWDT	Annual % Change
Taylor Falls Bridge	Hudson/Nashua CL	2009	37,870	2015	36,820	-0.5%
Sagamore Bridge	Hudson/Nashua CL	2009	45,055	2016	49,150	1.3%
NH 111 Central St.	W. of Kimball Hill Rd.	2008	15,575	2014	17,555	2.0%
NH 111 Central St.	E. of Greeley St.	2011	21,360	2017	23,140	1.3%
NH 111 Burnham Rd.	N. of Central St.	2007	13,420	2013	13,130	-0.4%
NH 111 Ferry St.	W. of Library St.	2007	14,260	2016	14,560	0.2%
NH 3A/102 Derry St	N. of Ledge Rd.	2008	28,690	2017	26,330	-0.9%
NH 3A/102 Derry St	N. of Ferry St.	2009	18,640	2018	15,750	-1.9%
NH 3A Lowell Rd	S. of Central St.	2008	23,360	2017	22,640	-0.3%
NH 3A Lowell Rd	S. of Pelham Rd.	2008	25,450	2017	25,400	0.0%
NH 3A Lowell Rd	S. of Wason Rd.	2009	30,450	2017	39,700	3.4%
Library St.	N. of NH 3A Central St.	2009	10,420	2018	9,000	-1.6%
Speare Rd.	E. of Bush Hill Rd.	--	--	2009	1,830	--
Greeley St.	N. of NH 111 Central St.	--	--	2009	5,310	--
Central St.	E. of Adelaide St.	2009	5,326	2018	5,770	0.9%
Melendy Rd.	S. of Central St.	2009	2,880	2018	1,970	-4.1%
Belknap Rd.	S. of Central St.	2007	5,830	2013	5,470	-0.9%
County Rd.	E. of NH 3A	2008	4,140	2017	4,520	1.0%
Kimball Hill Rd.	E. of Bush Hill Rd.	--	--	2009	4,960	--
Kimball Hill Rd.	S. of NH 111 Central St.	2010	7,175	2017	8,200	1.9%
Bush Hill Rd.	S. of Kimball Hill Rd.	2012	4,470	2018	5,470	3.4%
Bush Hill Rd.	S. of Speare Rd.	2008	5,760	2017	6,760	1.8%
Bush Hill Rd.	S. of Wason Rd.	--	--	2009	1,280	--
Pelham Rd.	W. of Bush Hill Rd.	2009	2,310	2018	2,150	-0.8%
Burns Hill Rd.	N. of Wason Rd.	--	--	2009	2,780	--
Wason Rd.	E. of Musquash Rd.	2009	5,850	2018	9,330	5.3%
Wason Rd.	E. of NH 3A	2009	8,590	2015	9,070	0.9%

Traffic Model Assignment Calibration

Evaluating the need and impact of major investment projects such as the Hudson Boulevard requires the development and maintenance of a regional traffic model which can estimate the impact of future changes to land use and the highway network on roadway volumes. NRPC utilizes the TransCAD modeling software for this purpose. For its MTP update, NRPC is in the process of updating its base year to 2017 population and employment and its future forecast year to 2045. As these have not been finalized, the present analysis was run using 2012 base year data and 2040 land use forecasts. For this reason, the forecasted volumes to be presented in the MTP update are likely to be somewhat different than those presented in this report, but not to a point that are likely to alter the findings in a significant manner.

Calibration of the model is a key component of the analysis. For the construction of a new connecting roadway such as Hudson Blvd., we particularly want to ensure that existing travel paths are correctly coded for free-flow speeds and lane capacity. The former is critical to the formation of proper uncongested shortest paths, i.e. the preferred paths of travel during light traffic periods of the day. The latter is the key determinant of shifting traffic to alternative paths as volumes build on the preferred paths.

Google Maps has become an indispensable tool for identifying free flow and congested times. Figure 2 identifies three alternative paths between Hudson Park Drive and Walmart Blvd. (a path that would be directly served by the proposed Hudson Blvd (shown by the thin blue line) that are twelve minutes each in travel time during low-volume periods. They are:

- NH 111 – Central St. – NH 3A
- NH 111 – Central St. – Belknap Rd. – NH 3A
- NH 111 – Kimball Hill Rd. – Bush Hill Rd. – Wason Rd. – NH 3A

Congested travel times and speeds are calculated by the model at the conclusion of the highway assignment module. These times were compared with Google Map times observed during the AM and PM peak periods, with a number of samples being taken over a few days to obtain a representative peak period travel time. The NRPC TransCAD model is a daily volume model, which means that only one congested speed results, rather than AM and PM speeds, with the peak directional flows factoring into the process. This is a shortcoming of using a daily volume model but does not compromise obtaining accurate path data for planning purposes.

Table 2 presents a comparison of observed travel times with the model. Travel times were recorded for trips in both directions between Hudson Park Drive and Walmart Blvd (there will be differences only in congested times, since free flow speeds are the same in both directions). We see that under free flow conditions the model closely replicates observed travel times for each path. The congested travel times from the model are then matched up against the observed AM and PM travel times. As noted, the single congested travel time per path from the model can deviate from the observed due to the directional peaks. For example, the model congested time from Walmart to Hudson Park Drive is 18 minutes, but since the PM is the peak directional flow, it is lower than the observed 20 minutes; conversely it is higher than the 14 minutes recorded in the AM when the flow is counter to the peak direction. Averaging the two peaks brings the model result much closer (18 min. vs. observed peak average of 17 min.).

Following calibration of the model to produce correct assignment paths, it was run for the 2040 No-Build scenario and then the Build alternative with the Hudson Boulevard. The proposed northern bridge crossing of the Merrimack River from Route 3A to US 3 and the FEE Turnpike is not included in the future year network. Although it remains as a long-range MTP project from the previous update in 2014, that status is expected to change, as the project does not meet the federal "fiscal constraint" requirement.

FIGURE 2
SHORTEST UNCONGESTED PATHS: HUDSON PARK DRIVE – WALMART BLVD.

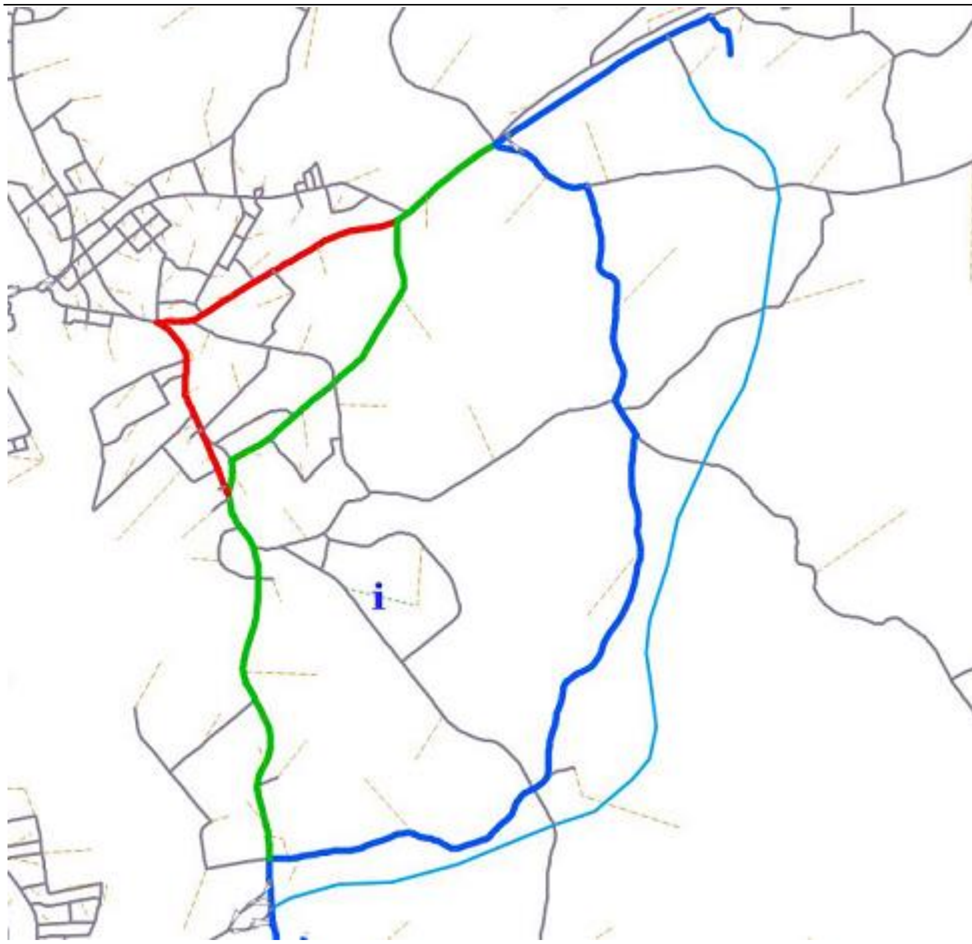

TABLE 2

FREE FLOW & CONGESTED SPEEDS: HUDSON PARK DR. TO WALMART BLVD.

Hudson Park Drive to Walmart Blvd.				**Walmart Blvd to Hudson Park Drive**		
			Model			Model
Free Flow Conditions	length	time	Uncong	length	time	Uncong
via Bush Hill/Wason	5.5	12	12.4	5.5	12	12.4
via Central/Belknap/3A	4.8	12	11.6	4.8	12	11.6
via Central/3A	5.2	12	12.2	5.2	12	12.2
AM Peak	length	time		length	time	
via Bush Hill/Wason	5.5	16	15.8	5.5	13	15.5
via Central/Belknap/3A	4.8	18	16.7	4.8	13	16.6
via Central/3A	5.2	19	17.8	5.2	14	18.0
PM Peak	length	time		length	time	
via Bush Hill/Wason	5.5	15	15.8	5.5	14	15.5
via Central/Belknap/3A	4.8	14	16.7	4.8	19	16.6
via Central/3A	5.2	15	17.8	5.2	20	18.0
Ave Peak Congested Speed	length	time	TC Assn	length	time	TC Assn
via Bush Hill/Wason	5.5	15.5	15.8	5.5	13.5	15.5
via Central/Belknap/3A	4.8	16	16.7	4.8	16	16.6
via Central/3A	5.2	17	17.8	5.2	17	18.0

2040 Highway Assignment Volumes: No-Build and Build Scenarios

The 2040 No-Build assignment run produced a 16% increase from 2017 traffic volumes at the Taylor Falls Bridge – a somewhat counter-trend result since it reverses a long trend of slight decreasing traffic at this location – and the Sagamore Bridge is projected to increase by 15%. Traffic along NH 111 west of the proposed boulevard is forecasted to increase moderately in the range of 5% to 9%. NH 3A south of the town center is projected at increases of 3% and 8% at two locations. South of Wason Rd., however, in the vicinity of the southern terminus of the boulevard, a more significant 13% rise in volume is projected.

For the existing parallel path to the proposed boulevard – Kimball Hill Rd., Bush Hill Rd. and Wason Rd. – moderate to high rates of growth are projected. Kimball Hill Rd. south of NH 111 is projected to increase 10%, Bush Hill Rd. increases 10% south of Kimball Hill but 23% south of Speare Rd, which itself increases 60% as it absorbs increasing volumes of traffic from points east to points south. Wason Rd. is projected to rise by 49% east of Musquash Rd. and 26% east of NH 3A.

Under the Build scenario the new Hudson Blvd. is projected to carry about 13,000 vehicles per weekday at its northern terminus and add volume from intersecting streets to reach a level of 21,700 north of Musquash Rd. Along its southernmost segment to NH 3A Hudson Blvd. AWDT is projected at 23,600. Substantial reductions of traffic are forecasted for Kimball Hill Rd. (-23%), Bush Hill Rd (-60%) and Wason Rd. (-53%). These roads will largely revert to serving local traffic rather than functioning as collectors for longer distance through traffic.

TABLE 3

HUDSON BLVD. TRAFFIC ANALYSIS: 2040 BASE AND BUILD ESTIMATED VOLUMES

		2017 AWDT	2040 Base Vol.	2017-40 % Change	2040 Bld Hud Blvd	Base to Build % Change
Taylor Falls Bridge	Hudson/Nashua CL	36,820	42,833	16%	38,732	-10%
Sagamore Bridge	Hudson/Nashua CL	49,150	56,340	15%	63,524	13%
NH 111 Central St.	W. of Kimball Hill Rd.	17,555	19,082	9%	13,175	-31%
NH 111 Central St.	E. of Greeley St.	23,140	25,095	8%	20,209	-19%
NH 111 Burnham Rd.	N. of Central St.	13,130	13,741	5%	12,036	-12%
NH 111 Ferry St.	W. of Library St.	14,560	15,640	7%	14,077	-10%
NH 3A/102 Derry St	N. of Ledge Rd.	26,330	28,284	7%	27,324	-3%
NH 3A/102 Derry St	N. of Ferry St.	15,750	18,008	14%	16,811	-7%
NH 3A Lowell Rd	S. of Central St.	22,640	23,390	3%	21,222	-9%
NH 3A Lowell Rd	S. of Pelham Rd.	25,400	27,492	8%	23,289	-15%
NH 3A Lowell Rd	S. of Wason Rd.	39,700	44,936	13%	33,939	-24%
Library St.	N. of NH 3A Central St.	9,000	9,934	10%	9,392	-5%
Speare Rd.	E. of Bush Hill Rd.	1,830	2,931	60%	2,038	-30%
Greeley St.	N. of NH 111 Central St.	5,310	5,850	10%	5,833	0%
Central St.	E. of Adelaide St.	5,770	6,293	9%	3,957	-37%
Melendy Rd.	S. of Central St.	1,970	2,595	32%	2,187	-16%
Belknap Rd.	S. of Central St.	5,470	6,548	20%	5,944	-9%
County Rd.	E. of NH 3A	4,520	5,523	22%	4,950	-10%
Kimball Hill Rd.	E. of Bush Hill Rd.	4,960	5,448	10%	4,194	-23%
Kimball Hill Rd.	S. of NH 111 Central St.	8,200	9,278	13%	8,488	-9%
Bush Hill Rd.	S. of Kimball Hill Rd.	5,470	6,040	10%	2,201	-64%
Bush Hill Rd.	S. of Speare Rd.	6,760	8,335	23%	3,340	-60%
Bush Hill Rd.	S. of Wason Rd.	1,280	2,073	62%	1,164	-44%
Pelham Rd.	W. of Bush Hill Rd.	2,150	2,934	36%	2,269	-23%
Burns Hill Rd.	N. of Wason Rd.	2,780	3,109	12%	4,126	33%
Wason Rd.	E. of Musquash Rd.	9,330	13,875	49%	6,576	-53%
Wason Rd.	E. of NH 3A	9,070	11,407	26%	6,154	-46%
Hudson Blvd	NH 3A to Musquash Rd.				23,620	
Hudson Blvd	Musquash Rd to Bush Hill Rd				21,740	
Hudson Blvd	Bush Hill Rd to Kimball Hill Rd				20,380	
Hudson Blvd	Kimball Hill Rd to NH 111				12,995	

Peak period congested speeds under existing and future No-Build and Build conditions are presented in Table 4. The Hudson Boulevard will result in lower travel times along NH 3A between Central Street and the new roadway; NH 111 will improve from 22 mph to 32 mph west of Kimball Hill Rd. Bush Hill Rd. and Wason Rd., increasingly being used for traffic that would otherwise use the Boulevard, also will experience significant increases in travel speeds.

TABLE 4

HUDSON BLVD. TRAFFIC ANALYSIS: PEAK HOUR CONGESTED SPEED

		2017 Pk Hr Speed	2040 Base Pk Hr Speed	2040 Build Pk Hr Speed
Taylor Falls Bridge	Hudson/Nashua CL	6.4	4.9	5.8
Sagamore Bridge	Hudson/Nashua CL	30.6	29.3	27.7
NH 111 Central St.	W. of Kimball Hill Rd.	25.2	22.4	32.0
NH 111 Central St.	E. of Greeley St.	14.9	12.5	19.2
NH 111 Burnham Rd.	N. of Central St.	18.3	17.3	19.7
NH 111 Ferry St.	W. of Library St.	18.9	16.9	19.3
NH 3A/102 Derry St	N. of Ledge Rd.	14.4	12.9	14.0
NH 3A/102 Derry St	N. of Ferry St.	12.4	9.2	10.1
NH 3A Lowell Rd	S. of Central St.	17.7	16.6	19.1
NH 3A Lowell Rd	S. of Pelham Rd.	11.0	9.3	13.6
NH 3A Lowell Rd	S. of Wason Rd.	8.1	11.8	15.6
Library St.	N. of NH 3A Central St.	20.3	19.4	19.8
Speare Rd.	E. of Bush Hill Rd.	25.0	24.9	25.0
Greeley St.	N. of NH 111 Central St.	20.0	18.8	19.1
Central St.	E. of Adelaide St.	16.7	16.5	18.1
Melendy Rd.	S. of Central St.	29.9	29.8	29.9
Belknap Rd.	S. of Central St.	21.9	21.3	21.8
County Rd.	E. of NH 3A	9.8	8.7	9.5
Kimball Hill Rd.	E. of Bush Hill Rd.	25.2	24.0	26.5
Kimball Hill Rd.	S. of NH 111 Central St.	6.7	5.7	6.3
Bush Hill Rd.	S. of Kimball Hill Rd.	25.2	24.6	29.6
Bush Hill Rd.	S. of Speare Rd.	24.8	21.8	28.9
Bush Hill Rd.	S. of Wason Rd.	24.9	24.7	24.9
Pelham Rd.	W. of Bush Hill Rd.	25.0	24.8	24.9
Burns Hill Rd.	N. of Wason Rd.	29.8	29.8	29.4
Wason Rd.	E. of Musquash Rd.	25.8	19.5	28.7
Wason Rd.	E. of NH 3A	17.5	14.0	21.3
Hudson Blvd	NH 3A to Musquash Rd.			26.3
Hudson Blvd	Musquash Rd to Bush Hill Rd			28.5
Hudson Blvd	Bush Hill Rd to Kimball Hill Rd			30.5
Hudson Blvd	Kimball Hill Rd to NH 111			39.0

Table 5 presents a comparison of shortest path times between Hudson Park Drive and Walmart Boulevard for each scenario. As shown earlier at present the Bush Hill/Wason Rd path provides the shortest path, with the model indicating 15.8 minutes between the two points. By 2040 this time is projected to increase to 18 minutes, with Central/Belknap to NH 3A providing the most efficient route. Construction of the Hudson Boulevard is projected to reduce travel time to 11.5 minutes, a 6.5 minute improvement in the trip time. The other paths shown, although not the best paths under congested conditions, show significant reductions in travel time to below 2017 levels. The implication is that capacity will be freed up on these routes for travel between various locations on these facilities.

TABLE 5
2017, 2040 NO-BUILD, 2040 BUILD CONGESTED SPEEDS
HUDSON PARK DR – WALMART BLVD.

	2017 Existing	2040 No-Build	2040 Build
via Bush Hill/Wason	**15.8**	18.1	14.1
via Central/Belknap/3A	16.7	**18.0**	15.0
via Central/3A	17.8	20.2	16.7
via Hudson Blvd	--	--	**11.5**

The 2009 CTAP study examined two signalized intersections for each scenario, NH 111/Kimball Hill Rd/ Greely St. and NH 3A/Flagstone Dr./Wason Rd. Several unsignalized intersections were also evaluated in that study; however, since they were found to operate at acceptable levels of service even under opening year No-Build conditions, the present analysis is confined to the two signalized intersections. The NH 3A/Flagstone/Wason intersection was recounted in October 2016 for a Congestion Mitigation and Air Quality (CMAQ) application and the NH 111/Kimball Hill/Greely intersection was recounted in June 2018. Future year No-Build and Build intersection volumes were estimated from changes in link volume changes at the intersection produced by TransCAD. These are shown below in Table 6.

TABLE 6

SIGNALIZED INTERSECTION VOLUMES: 2018, 2040 NO-BUILD, 2040 BUILD

2018 Counts	AM Peak(7:00 - 8:00 AM)			PM Peak(7:00 - 8:00 AM)		
	Right	Thru	Left	Right	Thru	Left
Lowell Rd @ Wason & Flagstone						
- Flagstone Dr (EB)	178	14	21	376	72	41
- Wason Rd (WB)	36	39	569	55	14	459
- NH 3A Lowell Rd (NB)	159	764	245	991	1,029	106
- NH 3A Lowell Rd (SB)	15	991	16	6	823	63
NH 111 Central St. @ Kimball Hill & Greeley						
- NH 111 (Central St) EB	211	483	71	160	651	119
- NH 111 (Central St) WB	17	633	80	42	616	70
- Kimball Hill Rd (NB)	0	94	205	1	206	204
- Greely St./Windham Rd (SB)	80	140	49	74	97	32
2040 No-Build Estimated Volumes	AM Peak(7:00 - 8:00 AM)			PM Peak(7:00 - 8:00 AM)		
	Right	Thru	Left	Right	Thru	Left
Lowell Rd @ Wason & Flagstone						
- Flagstone Dr (EB)	174	14	20	367	70	40
- Wason Rd (WB)	46	49	721	70	18	582
- NH 3A Lowell Rd (NB)	179	860	276	1,116	1,159	119
- NH 3A Lowell Rd (SB)	17	1,091	18	7	906	69
NH 111 Central St. @ Kimball Hill & Greeley						
- NH 111 (Central St) EB	241	551	81	182	742	136
- NH 111 (Central St) WB	19	700	88	46	681	77
- Kimball Hill Rd (NB)	0	107	234	1	235	233
- Greely St./Windham Rd (SB)	88	155	54	82	107	35
2040 Build Estimated Volumes	AM Peak(7:00 - 8:00 AM)			PM Peak(7:00 - 8:00 AM)		
	Right	Thru	Left	Right	Thru	Left
Lowell Rd @ Wason & Flagstone						
- Flagstone Dr (EB)	177	14	21	375	72	41
- Wason Rd (WB)	26	28	414	40	10	334
- NH 3A Lowell Rd (NB)	132	633	203	821	852	88
- NH 3A Lowell Rd (SB)	15	979	16	6	813	62
NH 111 Central St. @ Kimball Hill & Greeley						
- NH 111 (Central St) EB	176	402	59	133	542	99
- NH 111 (Central St) WB	13	474	60	31	461	52
- Kimball Hill Rd (NB)	0	94	205	1	206	204
- Greely St./Windham Rd (SB)	86	150	53	80	104	34

The intersection traffic flows for each scenario were evaluated using the McTrans Highway Capacity Software. A planning level analysis was conducted, which focuses on the overall capacity utilization of an intersection rather than operational analysis, which is intended for use in evaluating each signal phase for the purpose of signal optimization or making intersection capacity improvements. The volume-to-capacity (v/c) ratios identified in Table 7 are generalized statements on the congestion conditions that actually exist, as a number of intersection-specific characteristics (cycle length, number of phases in the intersection, area type, etc.) but they do show the future trends in congestion with and without the Hudson Boulevard. Conditions are projected to progressively worsen under the No-Build, but the new roadway is projected to improve conditions at each location from current levels of congestion.

TABLE 7

INTERSECTION VOLUME TO CAPACITY: 2018, 2040 NO-BUILD, 2040 BUILD

	Critical Volume to Capacity	
NH 3A/Flagstone/Wason	AM Peak	PM Peak
2018	1.03	1.29
2040 No-Build	1.18	1.46
2040 Build	0.94	1.00
NH 111/Kimball Hill/Greely		
2018	0.86	1.06
2040 No-Build	0.99	1.31
2040 Build	0.74	0.96

Intersection v/c Ratio Status Criteria	(from the Highway Capacity Manual)
v/c < .85	Capacity available
0.85 < v/c < 0.95	Near capacity
0.95 < v/c < 1.00	At capacity
v/c >1.00	Over capacity

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Value of Time Guidance Document

U.S. Department of Transportation
Office of the Secretary of Transportation

Assistant Secretary

1200 New Jersey Avenue SE
Washington, DC 20590

September 27, 2016

MEMORANDUM TO: SECRETARIAL OFFICERS
MODAL ADMINISTRATORS

From: Vinn White
Acting Assistant Secretary for Transportation Policy, x69044

Subject: Revised Departmental Guidance on Valuation of Travel Time in Economic Analysis

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The value of travel time is a critical factor in evaluating the benefits of transportation infrastructure investment and rulemaking initiatives. Reduction of delay in passenger or freight transportation is a major purpose of investments, and rules to enhance safety sometimes include provisions that slow travel. As the Department expands its use of benefit-cost analysis in evaluating competitive funding applications under such programs as the TIGER and FASTLANE Grant programs and the High-Speed Intercity Passenger Rail program, it is essential to have appropriate, well-reasoned guidance for valuing delays and time savings.

This version of the guidance updates the value of travel time savings with median household income information for 2015 from the Census Bureau and salary information from the Bureau of Labor Statistics National Occupational Employment and Wage Estimates from May 2015. The household income data are drawn from the Census Bureau's Current Population Survey, Annual Social and Economic Supplements, and are not released until the September following the year in which they are collected; the 2015 data are thus the most recent data available. The percentages of earnings used to determine the value of travel time savings (shown in tables 1 and 2) remain unchanged. The revised dollar values of travel time savings are shown in tables 3, 4, and 5.

DOT published its first guidance on this subject, "Departmental Guidance for the Valuation of Travel Time in Economic Analysis," on April 9, 1997, to assist analysts in developing consistent evaluations of actions that save or cost time in travel. That memorandum recommended an array of values for different categories of travel, according to purpose, mode and distance. For each category, the Guidance specified a percentage of hourly income that would normally be used to determine the value per hour of savings in travel time, a range of percentages defining upper and lower bounds about the normal value for sensitivity testing, and an average hourly income level. Special values were assigned to walking and waiting time, travel by general aviation, and truck drivers.

Revised guidance, labeled as "Revision 1," was issued on February 11, 2003. A further revision, labeled "Revision 2," was issued on September 28, 2011 and adjusted these values for use in 2011, incorporated some additional values and procedures, and redefined the sources of data. In particular, time savings in high-speed rail travel were identified as equivalent to those in air travel and distinguished from intercity travel by conventional surface modes. Although we found no need to alter the normal percentages of hourly income and the ranges of percentages that were assigned in the 1997 memorandum, more recent and appropriate sources were used to specify hourly incomes. In particular, the income data used in that guidance were derived from public and regularly updated sources that allow the Department to update the values annually. This revision also included a bibliography of documents available online that provide an overview of the research literature in the field and the recommendations developed by experts in several countries.

A link to this revised guidance will be found on the Office of Transportation Policy website at: http://www.dot.gov/policy/transportation-policy/economy. Questions should be addressed to Darren Timothy ((202) 366-4051 or darren.timothy@dot.gov) in the Office of Transportation Policy.

Attachment

cc: Regulations Officers and Liaison Officers

The Value of Travel Time Savings: Departmental Guidance for Conducting Economic Evaluations Revision 2 (2016 Update)

Introduction

Many actions by the Department of Transportation and other governmental agencies are designed to benefit travelers by reducing the time spent in traveling. Actions in pursuit of other goals such as improved safety may also have the intended or unavoidable consequence of slowing travel. The purpose of this document is to state the procedures approved for use by all administrations within DOT when evaluating reductions or increases in passenger travel time that result from such actions. The value of travel time savings (VTTS) derived here is to be used in all DOT benefit-cost or cost-effectiveness analyses.

Governments employ benefit-cost analysis to ensure that their regulatory actions and investments in transportation infrastructure will use society's resources most efficiently and to promote transparency in decision-making. Doing so often requires assigning money values to factors that lack observable market prices. As one of the most important of these factors, travel time has been the subject of research in many countries over several decades. Individual experts and official panels have reviewed and summarized this literature repeatedly as it has grown, and this document draws on that body of research and interpretation to establish procedures for use in valuing travel time consistently throughout DOT.

These expert summaries represent only a rough consensus about relevant variables and relationships among values. Because VTTS varies widely, standard values for government decisions must ignore or simplify many important factors. A complete model of real travel choices would require a large number of variables and associated coefficients, yet there are no sources for most of these variables, and the coefficients estimated from available data vary between studies and are subject to considerable uncertainty and interpretation. Combining individual decisions to draw conclusions for an entire society implies subjective assumptions about the influence of incomes and other personal characteristics. Therefore, the object of this guidance must be seen as construction of a useful framework for assigning values to government actions, rather than distilling precise scientific conclusions from the literature or predicting travel behavior.

The initial Departmental guidance for the valuation of travel time in economic analysis was published on April 9, 1997, and the first tables of revised values were published on February 11, 2003. Part of the reason for the long intervals between revisions was that certain data were available only from private sources or updated infrequently. The resulting delay and lack of transparency was inconvenient, confusing, and a potential cause of economic inefficiency. Consequently, we revised our guidance in 2011 to derive VTTS from public and regularly published data that permits the Department to issue annual updates. We use median income levels, rather than means, as consistently as possible. We believe that this approach reflects the valuations of typical travelers in diverse populations more reliably and yields conclusions that are less sensitive to fluctuations in extreme values.

General concepts

The demand for travel is generally derived from the demand for activities it permits at either end of the trip, just as sporting equipment is valued only for participation in the complementary sport it permits. In contrast, travel time must be conceived as having a negative demand, a consumer's willingness to pay to have less of it. This too is derived, not from complements, but from substitutes, i.e., the time available for activities at origin or destination, which may vary greatly in their value and urgency. The value of time saved from travel will depend on the traveler, the circumstances of the trip, and the available transportation options. There can be no assurance in principle that these factors will be stable. A large share of individual trips, however, particularly commuting to work, have similar purposes and are repeated on daily and weekly schedules. By focusing on a few choices of mode and route (e.g., rail transit vs. private auto, toll highway vs. parallel free thoroughfare) researchers have approximated explanations of travelers' decisions with a manageable number of variables yet with some confidence that their conclusions can be applied to a reasonably large share of travel by the larger community.

The values so derived are broadly representative and practically useful for estimating social benefits—the purpose for which this guidance is intended. They cannot be used to predict the number of travelers who would choose a specific mode or route, however. Such predictions depend on the distribution of time values over the population, rather than the most common value, and on the number of travelers who are close to the margin in deciding between alternatives.

The value of reducing travel time expresses three principles. First, time saved from travel could be dedicated to production, yielding a monetary benefit to either travelers or their employers. Second, it could be spent in recreation or other enjoyable or necessary leisure activities, which individuals value and are thus willing to pay for. Third, the conditions of travel during part or all of a trip may be unpleasant and involve tension, fatigue, or discomfort. Reducing the time spent while exposed to such conditions may be more valuable than saving time on more comfortable portions of the trip. These principles underlie the distinctions among values recommended in this guidance.

Specific topics

Reliability

Closely associated with VTTS, reliability has long been viewed as a source of utility distinct from reduction of the expected trip time. If travelers are uncertain about travel time, they may include a "buffer" in their schedules, leaving early and sacrificing a certain amount of time at the origin to insure against a more costly delay in arriving at the destination. This insurance will be frequently unnecessary or excessive and occasionally inadequate. Alternatively, insuring against delay may mean choosing a more reliable route or mode with a slower expected speed and/or a higher monetary cost.

There are several ways to measure the travelers' experience and define their perception of future delay risks, including standard deviation of trip time; the difference or ratio between the median trip time and a higher percentile trip time (such as the 95th percentile); or the probability of lateness beyond a fixed target. Furthermore, variation of travel time over some period will differ between origin-destination pairs, depending both on the reliability of travel on each trip segment and on the correlation of delays between segments.

Thus, a "value of reliability" is much more complex to estimate than an average VTTS, since it requires knowledge of the joint distribution of travel times and of the rates of change of value at the margins, rather than just the means. Studies have been conducted in several countries, using different measures of reliability, and suggestive results have been produced. Although it may be possible to derive estimates for specific cases, we are not yet prepared to provide guidance for routine valuation of reliability. In contrast to differences in reliability among modes or routes, however, improvements in reliability on a single route will often be linked to reductions in expected travel time, so that one possible approach is to add an allowance to VTTS to reflect the value of improved reliability.

<u>Size of time change</u>

Another subject of discussion has been whether VTTS should be ignored below some threshold increment of time saved. Some research has suggested the conclusion that discrete, small savings may have negligible benefits. See Australia Bureau of Transport Economics, Fosgerau *et al.*, Mackie *et al.* (2001, 2003).

There is no persuasive evidence of where such a threshold might be for any population or how it could be used to predict an appropriate threshold for another. A more important problem is that all changes in travel time resulting from government actions are composed of many smaller changes, and it would be impossible to identify particular changes considered large enough to affect each individual decision. To evaluate the aggregate impact of any action, therefore, we must assume that the value of each minute of saved time is constant, regardless of the total time required for a trip.

<u>Value of Time in Freight Transportation</u>

Most of the VTTS literature focuses on passenger travel, rather than freight transportation. Estimates have been made of the labor costs of freight vehicle operators (e.g., truck drivers or locomotive engineers) and of the operating costs of freight vehicles that would be affected by changes in travel time. The value of time to shippers (i.e., the owners of the freight that is being transported) cannot be estimated so easily, however. Because freight in transit represents unproductive capital that incurs an interest cost, part of the benefit of saved time will be proportional to the time saved, the interest rate, and the value of the freight. The principal obstacle to estimating this value is likely to be the heterogeneity and uncertainty of freight categories affected by any specific time saving. Each corridor or mode would thus require a specific estimate of the composition of freight carried. The cost of freight transportation time will also be influenced by factors independent of value, such as how quickly products become obsolete (because of fashion or technological obsolescence), whether the products spoil over time (as do agricultural commodities), and whether some production process is dependent upon timely delivery. Various reasons, then, explain why products may be "perishable" in the sense that their value declines appreciably while they are in transit. The cost to shippers may also depend on business practices, such as the amount of inventory kept on hand, and the likelihood of running out of inventory because of shipment delays.

The value of time in freight transportation is thus considerably more complex than is the case in passenger travel. Although we are not yet prepared to offer guidance on this issue, we are conducting research, and hope that additional information will permit concrete recommendations in the future.

Determinants of VTTS

Research into VTTS is conducted, not merely to understand the motives of travel decisions taken by the sampled individuals, but to estimate the influence of measurable factors on other groups, often remote in time and place. Each estimate depends on the demographic characteristics of the traveling population, the mode, time, location, and purpose of travel, and the menu of available alternatives, so the selected explanatory variables must be important for these decisions, practically observable or published, and also obtainable for new samples. Not all relevant factors can be controlled for in a single study or measured consistently for new studies or populations affected by government actions. Our object is therefore to express VTTS in terms of a limited number of variables that have been used in empirical research and are likely to be available for application in new analyses. The sources of variation will inevitably be simplified and distorted, but the result may be a realistic approximation. The variables discussed here are those that are most common in the primary research literature and have been found most useful for applied evaluations.

Trip purpose

The principal distinction in trip purpose is that between "on-the-clock" business travel time, for which a market wage is paid, and personal or leisure time allocated according to the traveler's preferences. In some cases, commuting is treated as a separate category, intermediate between personal and business, but more frequently it is included in personal travel. Research has typically found VTTS for personal travel to be lower than the hourly earning rate. This conclusion does not imply that leisure is less intrinsically desirable than paid work. In theory, a worker's hourly wage is equal to his marginal value of time, but with an institutionally fixed working day, this concept can be no better than an approximation. People who earn a salary may have few opportunities to convert saved time into added income, which they would have to do to equate VTTS on and off the clock. Inclusion of commuting in personal travel is consistent with the hypothesis of fixed hours for salaried work. Personal travel may also be undertaken to enjoy the passing scenery or the qualities of a particular mode: a sports car, cruise ship, or steam railroad. In such a case, VTTS could actually be negative, the individual being willing to pay to spend more time traveling along a particular route or via a particular mode.

In business travel, though it may seem paradoxical, the treatment of commercial drivers (whose travel time is spent working) and travelers who are unable to perform work *en route* should be identical. In either case, savings in travel time are made available for additional productive work. When work can be performed by passengers during travel by means of a laptop computer, a mobile telephone, documents on paper, or discussion among travelers, time savings may increase productivity only slightly, if at all, implying a lower VTTS.

Personal characteristics

Demographic variables such as age, sex, education, and employment are widely incorporated as explanatory variables in social and economic research and may well influence VTTS. While they are sometimes included in empirical studies, they are unlikely to be practical for appraising the impact of government actions. More closely associated with VTTS are the distinctions between drivers and passengers and between parents and children. Clearly, in a public transit vehicle or a car pool, each passenger may have an independent value of time, and the value of increasing the speed of the trip can be conceived as the sum of values for individual vehicle occupants. In private vehicles, the case is more ambiguous. Adult or child passengers may be "along for the ride" and have no pressing business that would influence the driver's decisions. Alternatively, the driver's motive for speeding up travel may be altruistic or joint with the passengers' (rushing a child to the emergency room or a group to a show). Without the possibility of distinguishing the composition or motives of ridership, it must be assumed that all travelers' VTTS are independent and additive.

Hourly income

In theory, hourly income influences VTTS through two channels. The simplest model evaluates savings in paid business travel time. While workers are assumed to be indifferent between travel and other ways to spend time for which they are compensated, employers perceive their employees' gross compensation (including payroll taxes and fringe benefits) as the value of the productivity sacrificed to travel. In general practice, VTTS for business-related travel is not estimated empirically but is defined by the gross compensation.

VTTS for personal travel lacks such a theoretical formulation, and leisure time is seen instead as an object of consumption that can be substituted for other desirable objects according to individual preferences. In general, VTTS is estimated to be lower for personal than for business travel. See Mackie *et al.* (2001).
Suggested reasons include:

- Employers' compensation costs include taxes and benefits excluded from workers' disposable income;
- Working hours are typically fixed by employers, preventing workers from earning more by saving personal travel time;
- Compensation is spread over several family members, including non-earners.

While such rationales are plausible, circumstances may dictate high or low willingness to pay for faster travel by either working travelers or dependents, and only empirical research can yield quantitative estimates. Neither specifying a model of household travel decisions nor obtaining the appropriate data for estimation is a straightforward process. Households include varied numbers of earners and dependents for whom work, school, child care, and other demands on time and income may influence VTTS in unknown ways. Travel by families incurs joint costs of lost time that cannot be assigned to particular members. Besides compensation, unearned income from investments or annuities contributes to travel budgets. Among all of these factors, the compensation level of an individual traveler may not be the most important or the most accessible variable. Research tends to use either a few broad household income bands stated by sampled travelers or the median household incomes of the geographic areas studied. See, *e.g.*, Asensio and Matas (2008) and Small *et al.* (2005).

To adjust past estimates for application to new populations, we require income measures that are nationwide, comparable and stable in definition, and regularly updated and published. The most reliable variable for projecting business VTTS is the median hourly wage for all occupations. Since median fringe benefits are not published, the median wage can be scaled upward to approximate the median gross compensation by multiplying by the ratio of mean gross compensation (including fringe benefits and payroll taxes) to mean money wages. The best variable for projecting personal VTTS is annual median household income. In order to present business and personal VTTS on a practical and comparable basis, annual household income is scaled to an hourly rate by dividing by 2,080 hours per year, although it should not be inferred that travelers prorate their household incomes by the hour to make decisions.

In using hourly income as a scaling factor to transfer VTTS estimates to new times and locations it has been common to assume an income elasticity of 1.0 (a one percent increase in VTTS per one percent increase in income), implying a constant proportional relationship. Some recent studies have yielded lower elasticities for personal travel, although they have not been unchallenged. Such studies tend to be based on cross-sectional models, which compare travelers of different incomes at the same time and location. Apart from the credibility of particular results, the assumption that parameters derived from cross-section studies are valid for time series is problematic. Furthermore, use of non-unitary income elasticities would raise a serious question. If VTTS for business travel is defined as equal to the cost of employment, it must display a unitary elasticity, growing at the same rate as growing incomes, while VTTS in personal travel, with a smaller elasticity, would display slower growth. As a result, an ever-larger discrepancy would emerge between VTTS for business and personal travel, negating the hypothesis of a stable ratio between them. VTTS could then be defined only for the period of each study and extrapolated to the present or the future only by complex and arbitrary calculations. Instead, we retain the assumption of fixed VTTS relationships for different trip purposes and an income elasticity of 1.0 for all.

Where travelers of distinct income levels use modes that are not close substitutes, VTTS may be associated with an expected income for each mode. If there are wide and overlapping income ranges in substitutable modes, it is preferable not to differentiate VTTS estimates on the basis of travelers' incomes but to use a single value for all.

Mode and distance

VTTS research is often based on the factors influencing mode choice, including the comfort, privacy, and prestige subjectively ascribed to particular modes, as well as travel time and cost. Since the conclusions of this research are used primarily to evaluate time and cost benefits, analysts must control for the other factors affecting mode choice. The question remains whether differences among modes in VTTS are systematic or are accidents of specification and the data used. For example, should VTTS differ between auto drivers and bus passengers after other factors are taken into account? Should income differences between the groups be assumed to affect the comparative benefits of time savings? As indicated above, where modes are relatively close substitutes in location, purpose, and trip distance, it is appropriate to assume that the incomes and preferences of travelers are distributed identically among and within modes, yielding a common VTTS.

While this uniformity is appropriate among local modes, research has found evidence of a moderate rise in VTTS with trip distance. This tendency may be seen as a consequence of the limited amount of time available for taking a long trip. In addition, it may reflect the high value of time at destinations which justify increased costs of travel and complementary food and lodging. Although some governments have derived VTTS from an estimated distance elasticity, this is an awkward parameter to use, requiring a specific distance for each application, whereas a route segment or mode affected by a government action is likely to support trips of widely varying distance. A more practical approach differentiates trips by broad categories of local travel (i.e., within a metropolitan area) and intercity travel (for trips over 50 miles).

Certain modes, particularly airlines and high-speed railways, are not close substitutes for conventional surface modes. (High-speed railways are associated with the Core Express Corridors defined in the FRA National Rail Plan as connecting large urban areas up to 500 miles apart with 2-3 hour travel time and speeds between 125 and 250 mph.) Since these modes charge higher fares to travelers who place a greater value on time saving, it is reasonable to derive a distinct VTTS from the higher incomes of their passengers. Although income information on travelers in these markets is limited in detail, estimates from the 2001 National Household Travel Survey of the household incomes of air passengers on personal and business trips permit construction of expected VTTS specific to air travel. Because high-speed rail will often compete with air travel for similar consumers, the same VTTS is applied to both modes.

<u>Comfort</u>

Travelers will vary widely in willingness to pay to shorten the time during which they are subject to uncomfortable conditions such as walking, bicycling, and standing on platforms or in vehicles. Indeed, many other conditions—stressful driving in heavy traffic, exposure to weather, crowding, uncomfortable seating, and lack of personal security—could be included in this list, but it would be difficult to assign values to all of them or measure their severity and duration. VTTS estimates already incorporate assumptions about such conditions. Since shortening walking distances and waiting times and increasing seating are routine options in transportation planning, we assign values to their benefits. A distinction should be noted between actions that shorten the time period during which such conditions are experienced (reducing waiting by more frequent train service) and those that improve conditions during the whole trip (adding cars to permit more passengers to be seated). In the former case, VTTS is fixed at a higher level while the travel time varies; in the latter, travel time is constant, but VTTS varies.

Research and syntheses

The appended bibliography compiles references, accessible via the Internet, that demonstrate the evolution of theoretical and empirical research into VTTS and contain even more comprehensive lists of sources. These include reviews of the research literature and recommended guidance for government agencies in the U.S. and abroad. The history of the economic theory of time valuation is discussed in Mackie *et al.* (2001) and more formally in Jara-Díaz and Guevara (1999). The pioneering articles by Becker (1965) and DeSerpa (1971) place time-allocation decisions in a context of consumption choice based on utility maximization, subject to constraints on income and the minimum amount of time required by each activity. With its subsequent extensions, this model permits derivation of equilibrium conditions for time allocation and has provided a widely-used basis for estimation of the parameters of VTTS.

Analysts have employed various techniques for estimating travelers' willingness to pay to save time. Where behavioral patterns such as choice of route or mode can be observed and other causal factors can be controlled for, estimates are derived from revealed preference. More frequently, stated preference methods are employed, using questionnaires to elicit hypothetical choices among trips that vary across several dimensions. This approach allows consideration of a greater number of behavioral alternatives and independent variables. Although revealed preference studies observe actual consumer choices, they are subject to error in the specification and measurement of the explanatory variables. Stated preference studies, in contrast, specify explanatory variables precisely but may be subject to errors when respondents predict their own hypothetical behavior unrealistically. Recent research has also combined these methods, using questionnaires to elicit information on the factors influencing real travel choices. Most research employs discrete choice techniques such as logit analysis to estimate the parameters influencing preference for specific modes or routes. As the number of published studies has grown, some investigators have also used meta-analysis to estimate the causes of variation among the conclusions of separate investigations.

Although VTTS was first investigated in English-speaking countries, concerted efforts to develop national models based on systematic data collection have been undertaken in the Netherlands, Switzerland, and the Scandinavian countries, as well as the United Kingdom (U.K.). VTTS has also been the object of research in Latin America and Asia. While several of these studies are cited in the bibliography, we will not analyze all of their conclusions.

There is wide agreement that the VTTS for business travel should equal the gross hourly cost of employment, including payroll taxes and fringe benefits. Because of international differences in tax structures, labor markets, data resources, and analysts' view of the social groups being studied, however, the definition of hourly income varies. In theory, it is equal to the worker's marginal product that would be sacrificed if travel were slower. Productivity may vary during work hours, allowing travel to be scheduled to minimize losses and, as noted earlier, modern technology can combine work with travel. Still, there is no well-accepted basis for estimating how the generalized value of business travel time differs from the simple gross compensation or predicting its variation in applied evaluation. All of the cited syntheses adopt the assumption that business travel time is equal to gross compensation, except for Boiteux and Baumstark (2001), where VTTS on business is estimated at 61 percent of the hourly cost of employment or 85 percent of the employee's gross salary (relating to the French system of accounts). Whether the earnings to which estimates are applied should be averages over broad or narrow groups (defined by mode, driver/passenger, or type of employment) is often unclear.

For personal travel, the range of recommended values is broader, reflecting the absence of a theoretically compelling hypothesis. Some studies find lower VTTS for auto passengers than for drivers and lower values for shopping or recreational travel than for commuting. Application of such distinctions, even if consistently supported by research, would require data on the specific characteristics and travel purposes of the population affected by government actions. To suggest the values developed in other countries, the following table converts VTTS for commuting auto drivers recommended in several European studies to dollars of the same years as the estimates and projects them to 2008 dollars by the growth in U.S. median household income. These values span a range that is significant but not so wide as to suggest major specification errors or other inconsistencies. It may be observed that the values we now recommend are near the center of this distribution.

Commuter VTTS

Country	Year	VTTS in $/hr.	US income growth to 2008	Equivalent 2008 VTTS
Denmark	2004	$10.98	1.13	$12.46
France	1998	$10.26	1.29	$13.27
Norway	1995	$6.32	1.48	$9.33
Spain	2005	$17.06	1.09	$18.52
Sweden	1994	$4.34	1.56	$6.77
Switzerland	2003	$15.85	1.16	$18.41
UK	2002	$7.71	1.19	$9.15

The U.K. practice, as seen in Mackie *et al.* (2003) and in the U.K.'s Transport Analysis Guidance (TAG) 3.5.6 (the official guidance which Mackie's work informs), is to distinguish modes by mean income but not by distance. VTTS for commuting is set at less than 25 percent of the average for business travel and VTTS for other purposes at 90 percent of the commuting rate. Gwilliam suggests that the World Bank use values of 30 percent of household income per hour for adults and 15 percent for children. Boiteux also recommends 30 percent of total employment cost per hour or 42 percent of gross wages (50 percent of the VTTS on business). The value grows with distance at a rate that diminishes by distance bands. Austroads (the association of Australian and New Zealand road transport and traffic authorities) recognizes a range of 30 to 60 percent of average earnings and suggests a standard of 40 percent. Both Concas and Kolpakov and Zhang *et al.* recommend a rate of 50 percent of the national average wage for both commuting and other personal trips. Boiteux and Baumstark, Mackie *et al.* (2003), and Zhang *et al.* all recommend explicit use of income elasticities of personal VTTS over time: 0.7, 0.8, and 0.75, respectively.

Concas and Kolpakov assign a value of only 35 percent of the wage for reducing seated riding time on transit vehicles but value standing at 100 percent and waiting under unpleasant conditions at up to 175 percent of the wage. Boiteux recommends increasing the VTTS in urban transit by 50 percent in crowded conditions and by 100 percent for walking or waiting. Gwilliam approves a 50-percent increase for both walking and waiting. Both TAG 3.5.6 and Zhang *et al.* prescribe a VTTS twice the normal value for walking or bicycling and 2.5 times the normal value when waiting.

In sum, there is a broad consensus on the approach adopted and the relevant variables and categories, as well as a degree of similarity in the specific values recommended. Still, neither the findings of research nor the judgments of expert panels are sufficiently uniform to eliminate arbitrariness.

Values for DOT applications

All studies have acknowledged the necessity of simplifying the many occasions and determinants of VTTS into a tractable system corresponding to the information available on the sources and targets of valuation. The structure of values that we adopted in 1997 is broadly consistent with those employed in other countries, and it continues to be useful for evaluation of the costs and benefits of government investments or regulations. As stated in the introduction, it is not specific enough to predict travelers' demand for particular modes or routes. In the following tables, the proportions of VTTS to income for personal vs. business, local vs. intercity, and surface vs. air travel are unchanged from our initial guidance of 1997, except for the association of high-speed rail with air travel, rather than with conventional surface modes. Similarly, the ranges of high and low proportions for conceptual testing are identical. Although valuing local personal travel at 50 percent of hourly income and intercity travel at 70 percent places our estimate among the higher ones examined, it is not beyond the range estimated in several studies and commonly viewed as reasonable.

The principal changes that we adopted in 2011 were the sources of income data to which these proportions are applied. We use data exclusively from Federal government sources and median income values whenever possible, considering them more representative of the incomes of typical travelers than the means. We present separate VTTS estimates for different categories of transportation vehicle operators, which can be used together with passenger VTTS to derive the benefits to vehicle occupants or combined with estimates of freight time value from other sources to derive the benefits of time savings in freight shipment. We also calculate hourly values as annual values divided by 2,080, rather than 2,000, for the sake of consistency with the wage figures published by the Bureau of Labor Statistics (BLS).

<u>Categories of VTTS</u>

The ratios of VTTS to hourly incomes in Tables 1 and 2, expressed as percentages, must be multiplied by appropriate income estimates to convert them to dollar values. These estimates are shown in Table 3, and the resulting VTTS estimates appear in Table 4. The appropriate ranges of VTTS for comparison of alternative estimates are shown in Table 5.

The tables present additional rows of "all purposes" values; these are weighted averages of the values prescribed for personal and business travel with weights derived from the 2001 NHTS. Although person-miles of travel are used to weight the surface modes, person-trips are more appropriate for air travel because many government actions that change air travel time will be independent of trip length.
The distributions so derived are:

- Local travel by surface modes: 95.4% personal, 4.6% business;
- Intercity travel by surface modes: 78.6% personal, 21.4% business;

- Intercity travel by air: 59.6% personal, 40.4% business.

Business travel

For "on-the-clock" business travelers over all distances and by every surface mode, VTTS is assumed to be equal to a nationwide median gross compensation, defined as the sum of the median hourly wage and an estimate of hourly benefits.

Median wages are obtained from the BLS National Occupational Employment and Wage Estimates. The updated (May 2015) value for this figure is $17.40 per hour. Median benefits are not available from this source; instead, they are approximated by taking the ratio of average total compensation (including fringe benefits) to average wages in the Employer Costs for Employee Compensation series and applying it to median wages. Based on BLS data for June 2015, this ratio is 1.46. This extrapolation is performed for business travelers on all modes, using the share of benefits for all workers. This procedure generates a VTTS estimate of $25.40 for general business travel.

For vehicle operators (including truck drivers, bus drivers, transit rail operators, locomotive engineers, and airline pilots and engineers), the benefit share applied is derived from the series for transportation and material moving occupations; the ratio derived from BLS data for these occupations is 1.54 in June 2015. Truck drivers' wages are estimated for a weighted average of heavy and light truck drivers from the National Occupational Employment and Wage Estimates.

In the case of air and high-speed rail travel, high-cost modes used for fast trips over long distances, we conclude that use of a distinct wage is justified. The best source for incomes of air travelers is the BTS National Household Travel Survey of 2001 (no long-distance travel survey has been conducted since then), which permits estimation of distributions of household money income by trip purpose. The ratio of 2001 median household income of business air travelers (approximately $105,000) to the U.S. Census Bureau 2001 median household income ($42,228) yield a factor of 2.5 to be multiplied by the gross median compensation estimate for surface business travelers. Recent confidential survey data suggest that income levels for high-speed rail travelers are similar to those for air travelers, so we apply the same VTTS to high-speed rail travelers. Applying the 2.5 factor to the value for general business travel yields a VTTS for air and high-speed rail travel of $63.20.

Personal travel

For local personal travel, VTTS is estimated at 50 percent of hourly median household income. The nationwide median annual household income, $56,516 in 2015, is divided by 2,080 to yield an income of $27.20 per hour. The local VTTS is thus $13.60. We distinguish local from intercity personal travel, estimating a VTTS that rises with distance. For the latter purpose, we have adopted a ratio of VTTS to hourly income of 70 percent. The VTTS for intercity personal surface travel is then $19.00 per hour.

For personal travel by air or high-speed rail, the above estimate of VTTS for personal intercity surface travel is multiplied by 1.9, the ratio from the NHTS of the 2001 median household income of air travelers on personal business to the nationwide median household income in

2001. Updating median household income with 2015 information from the US Census Bureau yields a VTTS estimate of $36.10.

Special issues

In application, vehicle-hours are to be converted to person-hours by multiplying by average passenger occupancy of vehicles. Although riders may be a family with a joint VTTS or passengers in a car pool or transit vehicle with independent values, these circumstances can seldom be distinguished. Therefore, all individuals are assumed to have independent values.

Except for specific distinctions, we consider it inappropriate to use different income levels or sources for different categories of traveler.   Neither the incomes associated with published research nor the stability of the relationship between income and VTTS are certain enough to imply that fine adjustments would yield more realistic estimates. The first distinction we recognize is that between personal and business (on-the-clock) travel; the second is that between surface travel by conventional modes and travel by air or high-speed rail. While VTTS for business travel is correlated with an estimate of passengers' employment compensation, for vehicle operators on several modes we have provided VTTS estimates based on median compensation data by employment category as reported by the Bureau of Labor Statistics. The scale of income levels developed here is applicable nationwide, and analysts should not attempt to substitute incomes for particular modes or locations. Nevertheless, estimates derived by reliable and focused research may be superior for predicting behavioral responses in specific cases.

Personal time spent walking or waiting outside of vehicles, as well as time spent standing in vehicles or bicycling, should be evaluated at 100 percent of hourly income, with a range of 80 to 120 percent to reflect uncertainty. As stated above, reducing the time during which uncomfortable conditions are experienced provides a benefit equal to the product of this VTTS and the reduction in time, while the benefit of improved travel conditions (such as additional seating) is equal to the product of the difference in VTTS (50 percent of hourly income) and the total time during which discomfort would have been experienced.

Uncertainty in the recommended values

The ratios in Table 1 represent the best single figures for defining VTTS as a fraction of hourly income. These figures, like all parameters of travel behavior, are subject to uncertainty. Table 2 summarizes a plausible range for each trip category, not necessarily symmetric about the point estimates in Table 1. The corresponding high and low dollar estimates are shown in Table 5. In addition to evaluations based on the most likely estimates, alternative calculations using these ranges should be presented to test the sensitivity of analyses to potential errors in estimation.

Updating the estimated values

The Office of the Assistant Secretary for Transportation Policy will publish annual updates of VTTS to reflect growth in hourly incomes, using the data sources cited above. No updating of the percentages developed in Tables 1 and 2 is required. We will monitor and interpret available research on travel behavior and issue new guidance as appropriate.

Table 1 (Revision 2 – 2016 Update)

Recommended Values of Travel Time Savings (per person-hour as a percentage of total earnings)		
Category	**Surface Modes*** **(except High-Speed Rail)**	**Air and High-Speed Rail Travel**
Local Travel -		
Personal	50%	--
Business	100%	--
Intercity Travel -		
Personal	70%	70%
Business	100%	100%

Vehicle operators- 100% on all modes

* Surface figures apply to all combinations of in-vehicle and other time. Walk access, waiting, and transfer time should be valued at 100% of hourly income when actions affect only those elements of travel time.

Table 2 (Revision 2 – 2016 Update)

Plausible Ranges for Values of Travel Time Savings (per person-hour as a percentage of total earnings)		
Category	**Surface Modes*** **(except High-Speed Rail)**	**Air and High-Speed Rail Travel**
Local Travel -		
Personal	35% - 60%	--
Business	80% - 120%	--
Intercity Travel-		
Personal	60% - 90%	60% - 90%
Business	80% - 120%	80% - 120%

Vehicle operators- 80%-120% on all modes

* Surface figures apply to all combinations of in-vehicle and other transit time. Walk access, waiting, and transfer time should be valued at 80%-120% of hourly income when actions affect only those elements of travel time.

Table 3 (Revision 2 – 2016 Update)

Recommended Hourly Earnings Rates for Determining Values of Travel Time Savings (2015 U.S. $ per person-hour)		
Category	**Surface Modes (except High-Speed Rail)**	**Air and High-Speed Rail Travel**
Local Travel -		
Personal	$27.20	
Business	$25.40	
Intercity Travel -		
Personal	$27.20	$36.10
Business	$25.40	$63.20

Truck Drivers	$27.20
Bus Drivers	$28.30
Transit Rail Operators	$46.10
Locomotive engineers	$41.60
Airline Pilots and Engineers	$86.70

Table 3 (Revision 2, continued)

Sources:

(1) Local and intercity personal travel by conventional surface modes: median income for all U.S. households in 2015 ($56,516), reported in U.S. Census Bureau, Table H-8. Median Household Income by State: 1984 to 2015, divided by 2,080 hours per year.
http://www.census.gov/hhes/www/income/data/historical/household/

(2) Local and intercity business travel by conventional surface modes: Bureau of Labor Statistics, May 2015 Occupational Employment and Wage Estimates, median wage for all occupations, http://www.bls.gov/oes/current/oes_nat.htm multiplied by the ratio of mean total compensation to mean wage from BLS Employer Costs for Employee Compensation, 2nd Quarter 2015,
http://www.bls.gov/ncs/ect/sp/ececqrtn.pdf

(3) Intercity personal travel by air or high-speed rail: median hourly household income from (1), multiplied by 1.9.
Intercity business travel by air or high-speed rail: median hourly household income from (1), multiplied by 2.5 and by the ratio of median national employee compensation to median household income.

(4) Truck Drivers: weighted average of May 2015 median hourly wages of heavy- and light-truck drivers ($17.71) from BLS National Occupational Employment and Wage Estimates; expanded to total compensation by the ratio of total compensation to wages for transportation and material moving occupations from the 2015 Employer Cost for Employee Compensation series.
http://stats.bls.gov/oes/current/oes_nat.htm#b53-0000

Other vehicle operators: May 2015 median hourly wages from BLS National Occupational Employment and Wage Estimates; expanded to total compensation by the ratio of total compensation to wages for transportation and material moving occupations from the 2015 Employer Cost for Employee Compensation series.

Table 4 (Revision 2 – 2016 Update)

Recommended Hourly Values of Travel Time Savings (2015 U.S. $ per person-hour)		
Category	**Surface Modes* (except High-Speed Rail)**	**Air and High-Speed Rail Travel**
Local Travel-		
Personal	$13.60	
Business	$25.40	
All Purposes **	$14.10	
Intercity Travel -		
Personal	$19.00	$36.10
Business	$25.40	$63.20
All Purposes **	$20.40	$47.10

Truck Drivers	$27.20
Bus Drivers	$28.30
Transit Rail Operators	$46.10
Locomotive engineers	$41.60
Airline Pilots and Engineers	$86.70

Table 4 (Revision 2, continued)

* Surface figures apply to all combinations of in-vehicle and other time. Walk access, waiting, transfer, and standing time should be valued at $27.20 per hour for personal travel when actions affect only those elements of travel time.

** Weighted averages, using distributions of travel by trip purpose on various modes. Distribution for local travel by surface modes: 95.4% personal, 4.6% business. Distribution for intercity travel by conventional surface modes: 78.6% personal, 21.4% business. Distribution for intercity travel by air or high-speed rail: 59.6% personal, 40.4% business. Surface figures derived using annual person-mile (PMT) data from the 2001 National Household Travel Survey. http://nhts.ornl.gov/. Air figures use person-trip data.

Table 5 (Revision 2 - corrected)

Plausible Ranges for Hourly Values of Travel Time Savings (2015 U.S. $ per person-hour)				
Category	**Surface Modes*** **(except High-Speed Rail)**		**Air and High-Speed Rail Travel**	
	Low	High	Low	High
Local Travel-				
Personal	$9.50	$16.30	--	--
Business	$20.30	$30.50	--	--
All Purposes **	$10.00	$17.00	--	--
Intercity Travel -				
Personal	$16.30	$24.50	$31.00	$46.50
Business	$20.30	$30.50	$50.60	$75.80
All Purposes **	$17.20	$25.80	$38.90	$58.30

	Low	High
Truck Drivers	$21.80	$32.70
Bus Drivers	$22.70	$34.00
Transit Rail Operators	$36.90	$55.30
Locomotive engineers	$33.30	$49.90
Airline Pilots and Engineers	$69.40	$104.10

Table 5 (Revision 2, continued)

* Surface figures apply to all combinations of in-vehicle and other transit time. Walk access, waiting, and transfer time in personal travel should be valued at $21.70 - $32.60 per hour when actions affect only those elements of travel time.

** Weighted averages, using distributions of travel by trip purpose on various modes. Distribution for local travel by surface modes: 95.4% personal, 4.6% business. Distribution for intercity travel by conventional surface modes: 78.6% personal, 21.4% business. Distribution for intercity travel by air or high-speed rail: 59.6% personal, 40.4% business. Surface figures derived using annual person-mile (PMT) data from the 2001 National Household Travel Survey. http://nhts.ornl.gov/. Air figures use person-trip data.

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Traffic Data Route 3A – March 2017

Accurate Counts

978-664-2565

N/S Street : Lowell Road (Route 3A)
E/W Street : Fox Hollow Drive
City/State : Hudson, NH
Weather : Clear

File Name : 17004001
Site Code : 17004001
Start Date : 3/23/2017
Page No : 1

Groups Printed- Cars - Trucks

	Lowell Rd From North			Nottingham Sq From East			Lowell Rd From South			Fox Hollw Dr From West			
Start Time	Left	Thru	Right	Left	Thru	Right	Left	Thru	Right	Left	Thru	Right	Int. Total
07:00 AM	4	258	0	2	0	2	1	101	0	17	0	13	398
07:15 AM	3	313	0	1	0	1	0	110	0	4	0	7	439
07:30 AM	5	276	0	3	0	3	3	166	0	2	2	12	472
07:45 AM	3	277	3	4	0	0	1	132	1	6	0	10	437
Total	15	1124	3	10	0	6	5	509	1	29	2	42	1746
08:00 AM	6	259	0	2	0	5	0	117	0	0	0	7	396
08:15 AM	5	247	1	4	0	0	1	143	0	10	0	6	417
08:30 AM	7	232	0	0	0	5	1	144	0	1	0	5	395
08:45 AM	7	242	4	0	0	2	0	112	1	3	0	7	378
Total	25	980	5	6	0	12	2	516	1	14	0	25	1586
Grand Total	40	2104	8	16	0	18	7	1025	2	43	2	67	3332
Apprch %	1.9	97.8	0.4	47.1	0	52.9	0.7	99.1	0.2	38.4	1.8	59.8	
Total %	1.2	63.1	0.2	0.5	0	0.5	0.2	30.8	0.1	1.3	0.1	2	
Cars	40	2092	8	16	0	18	7	1009	2	42	2	66	3302
% Cars	100	99.4	100	100	0	100	100	98.4	100	97.7	100	98.5	99.1
Trucks	0	12	0	0	0	0	0	16	0	1	0	1	30
% Trucks	0	0.6	0	0	0	0	0	1.6	0	2.3	0	1.5	0.9

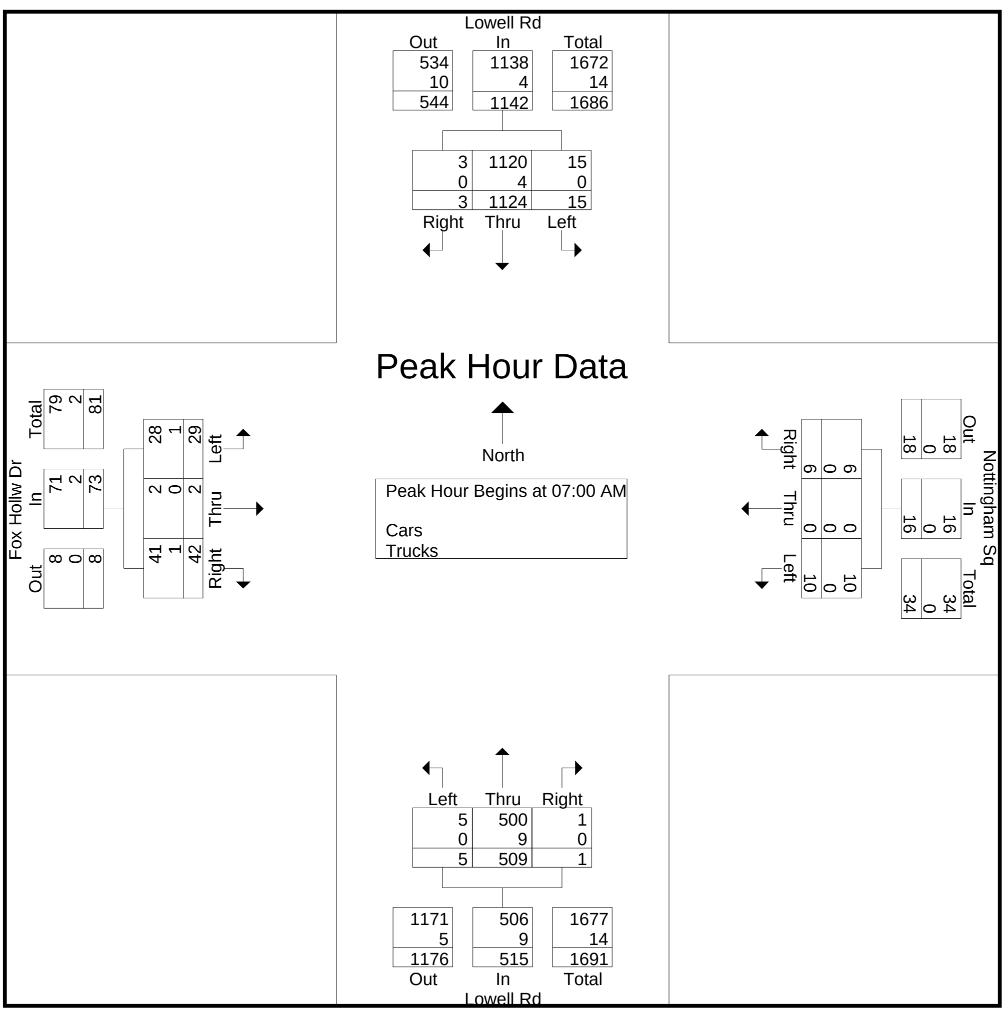
Accurate Counts

978-664-2565

N/S Street : Lowell Road (Route 3A)
E/W Street : Fox Hollow Drive
City/State : Hudson, NH
Weather : Clear

File Name : 17004001
Site Code : 17004001
Start Date : 3/23/2017

	Lowell Rd From North				Nottingham Sq From East				Lowell Rd From South				Fox Hollw Dr From West				
Start Time	Left	Thru	Right	App. Total	Left	Thru	Right	App. Total	Left	Thru	Right	App. Total	Left	Thru	Right	App. Total	Int. Total
Peak Hour Analysis From 07:00 AM to 08:45 AM - Peak 1 of 1																	
Peak Hour for Entire Intersection Begins at 07:00 AM																	
07:00 AM	4	258	0	262	2	0	2	4	1	101	0	102	**17**	0	**13**	**30**	398
07:15 AM	3	**313**	0	**316**	1	0	1	2	0	110	0	110	4	0	7	11	439
07:30 AM	**5**	276	0	281	3	0	**3**	**6**	**3**	**166**	0	**169**	2	**2**	12	16	**472**
07:45 AM	3	277	**3**	283	**4**	0	0	4	1	132	**1**	134	6	0	10	16	437
Total Volume	15	1124	3	1142	10	0	6	16	5	509	1	515	29	2	42	73	1746
% App. Total	1.3	98.4	0.3		62.5	0	37.5		1	98.8	0.2		39.7	2.7	57.5		
PHF	.750	.898	.250	.903	.625	.000	.500	.667	.417	.767	.250	.762	.426	.250	.808	.608	.925
Cars	15	1120	3	1138	10	0	6	16	5	500	1	506	28	2	41	71	1731
% Cars	100	99.6	100	99.6	100	0	100	100	100	98.2	100	98.3	96.6	100	97.6	97.3	99.1
Trucks	0	4	0	4	0	0	0	0	0	9	0	9	1	0	1	2	15
% Trucks	0	0.4	0	0.4	0	0	0	0	0	1.8	0	1.7	3.4	0	2.4	2.7	0.9

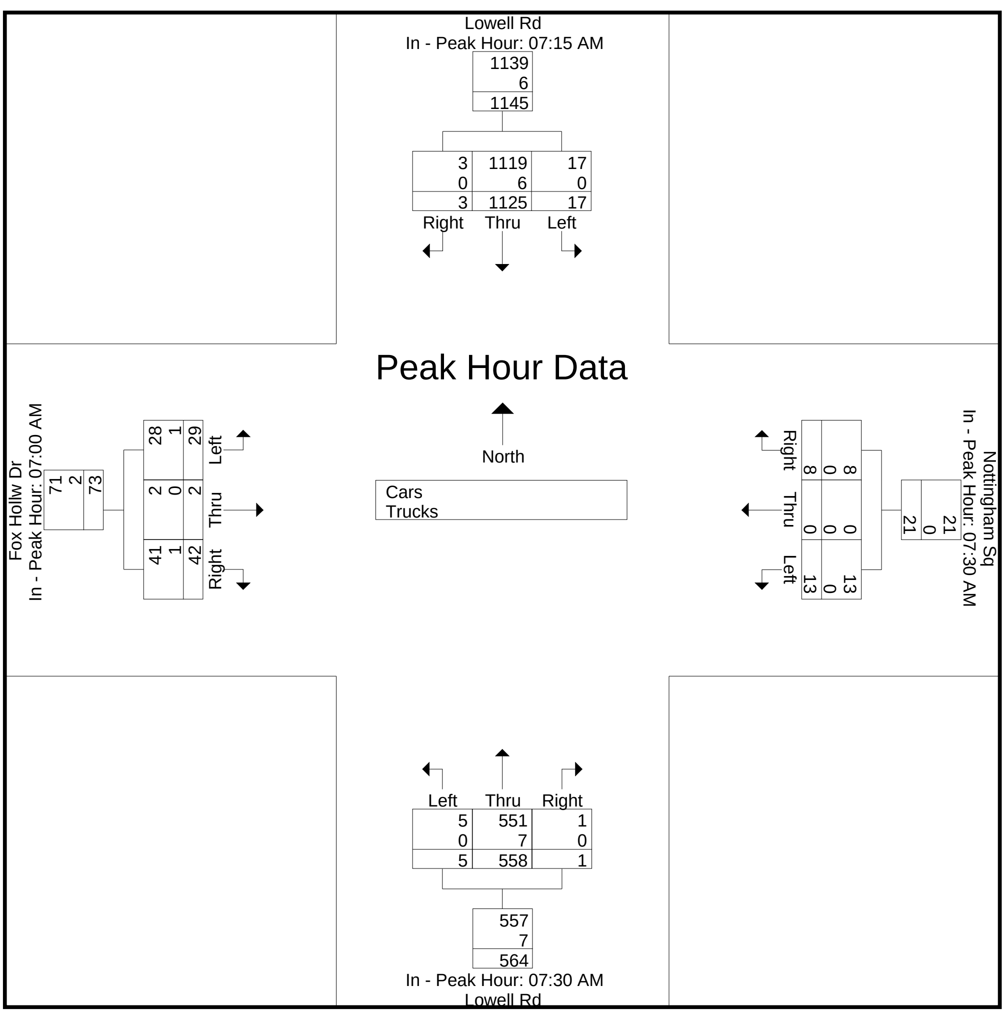


Accurate Counts
978-664-2565

N/S Street : Lowell Road (Route 3A)
E/W Street : Fox Hollow Drive
City/State : Hudson, NH
Weather : Clear

File Name : 17004001
Site Code : 17004001
Start Date : 3/23/2017
Page No : 3

	Lowell Rd From North				Nottingham Sq From East				Lowell Rd From South				Fox Hollw Dr From West				
Start Time	Left	Thru	Right	App. Total	Left	Thru	Right	App. Total	Left	Thru	Right	App. Total	Left	Thru	Right	App. Total	Int. Total
Peak Hour Analysis From 07:00 AM to 08:45 AM - Peak 1 of 1																	
Peak Hour for Each Approach Begins at:																	
	07:15 AM				07:30 AM				07:30 AM				07:00 AM				
+0 mins.	3	**313**	0	**316**	3	0	3	6	**3**	**166**	0	**169**	**17**	0	**13**	**30**	
+15 mins.	5	276	0	281	**4**	0	0	4	1	132	**1**	134	4	0	7	11	
+30 mins.	3	277	**3**	283	2	0	**5**	**7**	0	117	0	117	2	**2**	12	16	
+45 mins.	**6**	259	0	265	4	0	0	4	1	143	0	144	6	0	10	16	
Total Volume	17	1125	3	1145	13	0	8	21	5	558	1	564	29	2	42	73	
% App. Total	1.5	98.3	0.3		61.9	0	38.1		0.9	98.9	0.2		39.7	2.7	57.5		
PHF	.708	.899	.250	.906	.813	.000	.400	.750	.417	.840	.250	.834	.426	.250	.808	.608	
Cars	17	1119	3	1139	13	0	8	21	5	551	1	557	28	2	41	71	
% Cars	100	99.5	100	99.5	100	0	100	100	100	98.7	100	98.8	96.6	100	97.6	97.3	
Trucks	0	6	0	6	0	0	0	0	0	7	0	7	1	0	1	2	
% Trucks	0	0.5	0	0.5	0	0	0	0	0	1.3	0	1.2	3.4	0	2.4	2.7	



Accurate Counts

978-664-2565

N/S Street : Lowell Road (Route 3A)
E/W Street : Fox Hollow Drive
City/State : Hudson, NH
Weather : Clear

File Name : 17004001
Site Code : 17004001
Start Date : 3/23/2017

Groups Printed- Cars

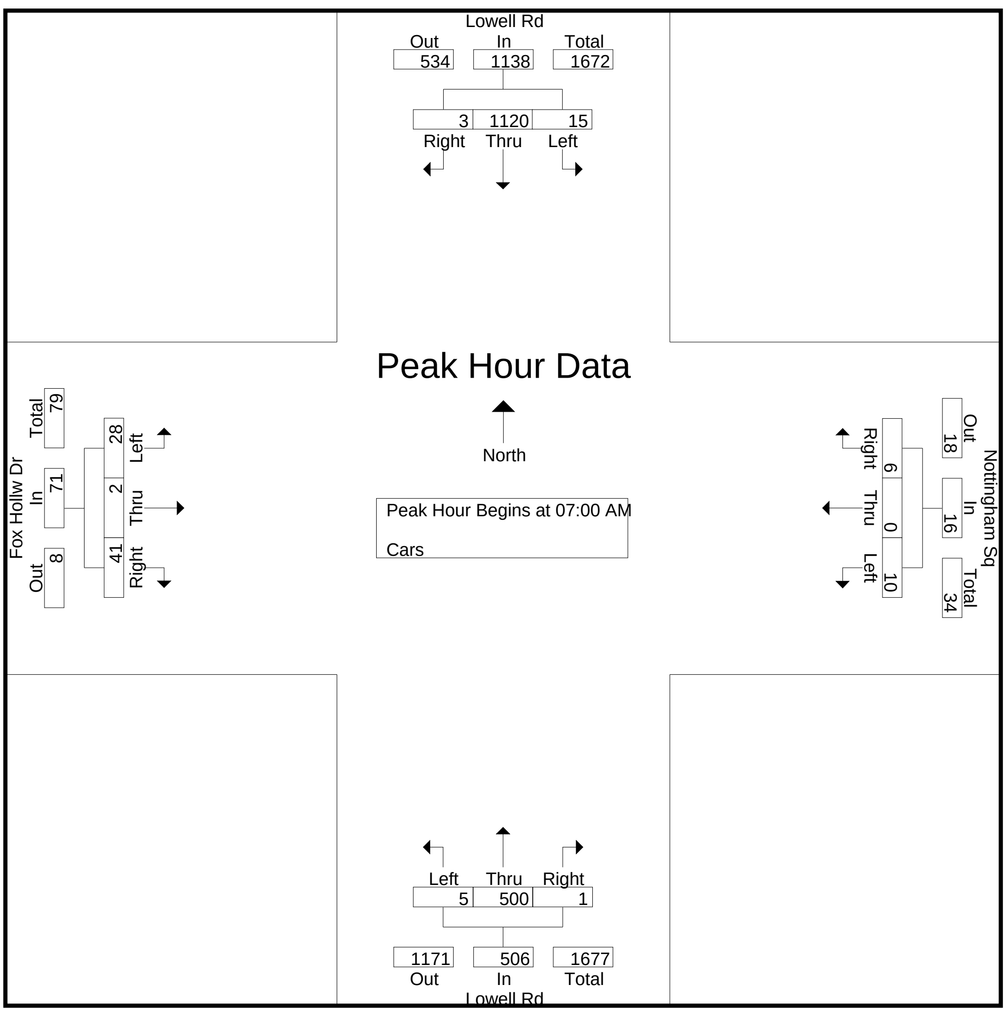
	Lowell Rd From North			Nottingham Sq From East			Lowell Rd From South			Fox Hollw Dr From West			
Start Time	Left	Thru	Right	Left	Thru	Right	Left	Thru	Right	Left	Thru	Right	Int. Total
07:00 AM	4	257	0	2	0	2	1	99	0	16	0	13	394
07:15 AM	3	313	0	1	0	1	0	107	0	4	0	7	436
07:30 AM	5	274	0	3	0	3	3	163	0	2	2	12	467
07:45 AM	3	276	3	4	0	0	1	131	1	6	0	9	434
Total	15	1120	3	10	0	6	5	500	1	28	2	41	1731
08:00 AM	6	256	0	2	0	5	0	117	0	0	0	7	393
08:15 AM	5	247	1	4	0	0	1	140	0	10	0	6	414
08:30 AM	7	228	0	0	0	5	1	141	0	1	0	5	388
08:45 AM	7	241	4	0	0	2	0	111	1	3	0	7	376
Total	25	972	5	6	0	12	2	509	1	14	0	25	1571
Grand Total	40	2092	8	16	0	18	7	1009	2	42	2	66	3302
Apprch %	1.9	97.8	0.4	47.1	0	52.9	0.7	99.1	0.2	38.2	1.8	60	
Total %	1.2	63.4	0.2	0.5	0	0.5	0.2	30.6	0.1	1.3	0.1	2	

Accurate Counts
978-664-2565

N/S Street : Lowell Road (Route 3A)
E/W Street : Fox Hollow Drive
City/State : Hudson, NH
Weather : Clear

File Name : 17004001
Site Code : 17004001
Start Date : 3/23/2017

	Lowell Rd From North				Nottingham Sq From East				Lowell Rd From South				Fox Hollw Dr From West				
Start Time	Left	Thru	Right	App. Total	Left	Thru	Right	App. Total	Left	Thru	Right	App. Total	Left	Thru	Right	App. Total	Int. Total
Peak Hour Analysis From 07:00 AM to 08:45 AM - Peak 1 of 1																	
Peak Hour for Entire Intersection Begins at 07:00 AM																	
07:00 AM	4	257	0	261	2	0	2	4	1	99	0	100	**16**	0	**13**	**29**	394
07:15 AM	3	**313**	0	**316**	1	0	1	2	0	107	0	107	4	0	7	11	436
07:30 AM	**5**	274	0	279	3	0	**3**	**6**	**3**	**163**	0	**166**	2	**2**	12	16	**467**
07:45 AM	3	276	**3**	282	**4**	0	0	4	1	131	**1**	133	6	0	9	15	434
Total Volume	15	1120	3	1138	10	0	6	16	5	500	1	506	28	2	41	71	1731
% App. Total	1.3	98.4	0.3		62.5	0	37.5		1	98.8	0.2		39.4	2.8	57.7		
PHF	.750	.895	.250	.900	.625	.000	.500	.667	.417	.767	.250	.762	.438	.250	.788	.612	.927



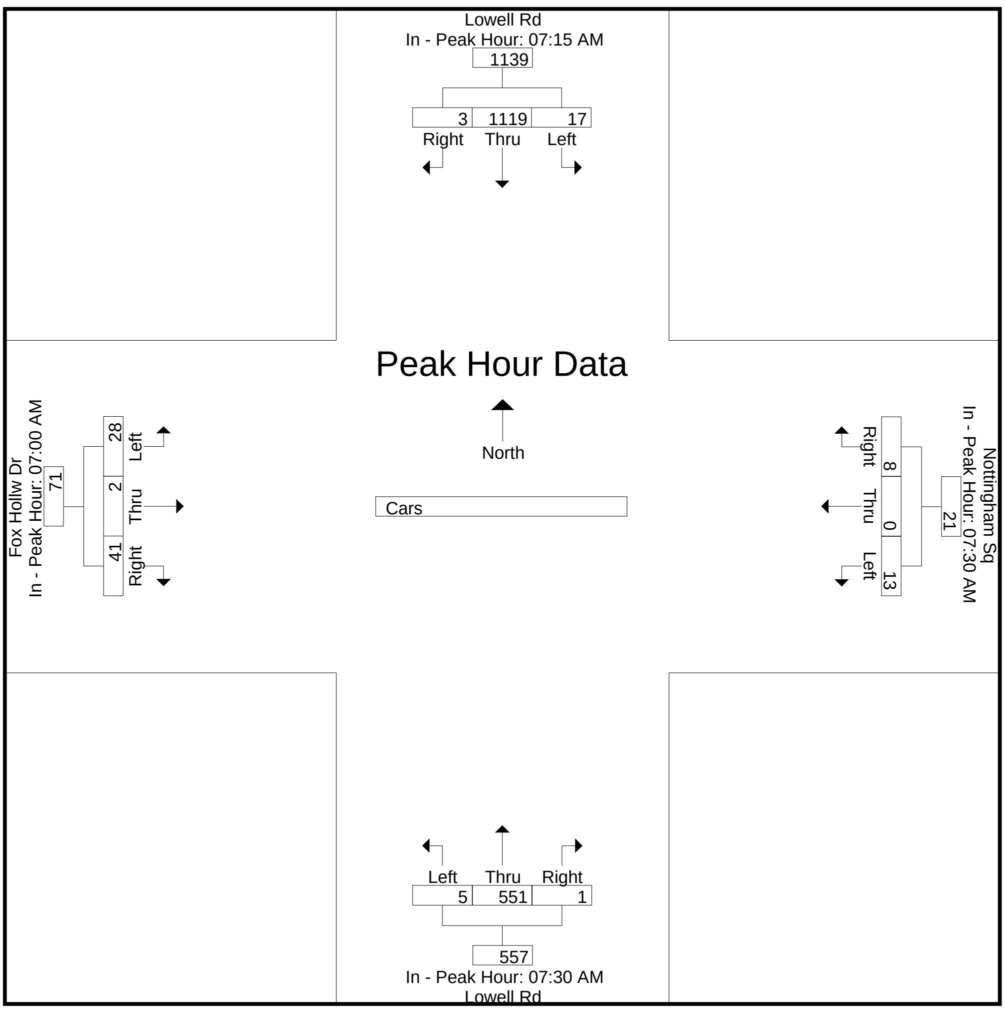
Accurate Counts

978-664-2565

N/S Street : Lowell Road (Route 3A)
E/W Street : Fox Hollow Drive
City/State : Hudson, NH
Weather : Clear

File Name : 17004001
Site Code : 17004001
Start Date : 3/23/2017
Page No : 6

	Lowell Rd From North				Nottingham Sq From East				Lowell Rd From South				Fox Hollw Dr From West				
Start Time	Left	Thru	Right	App. Total	Left	Thru	Right	App. Total	Left	Thru	Right	App. Total	Left	Thru	Right	App. Total	Int. Total
Peak Hour Analysis From 07:00 AM to 08:45 AM - Peak 1 of 1																	
Peak Hour for Each Approach Begins at:																	
	07:15 AM				07:30 AM				07:30 AM				07:00 AM				
+0 mins.	3	**313**	0	**316**	3	0	3	6	**3**	**163**	0	**166**	**16**	0	**13**	**29**	
+15 mins.	5	274	0	279	**4**	0	0	4	1	131	**1**	133	4	0	7	11	
+30 mins.	3	276	**3**	282	2	0	**5**	**7**	0	117	0	117	2	**2**	12	16	
+45 mins.	**6**	256	0	262	4	0	0	4	1	140	0	141	6	0	9	15	
Total Volume	17	1119	3	1139	13	0	8	21	5	551	1	557	28	2	41	71	
% App. Total	1.5	98.2	0.3		61.9	0	38.1		0.9	98.9	0.2		39.4	2.8	57.7		
PHF	.708	.894	.250	.901	.813	.000	.400	.750	.417	.845	.250	.839	.438	.250	.788	.612	



Accurate Counts
978-664-2565

N/S Street : Lowell Road (Route 3A)
E/W Street : Fox Hollow Drive
City/State : Hudson, NH
Weather : Clear

File Name : 17004001
Site Code : 17004001
Start Date : 3/23/2017

Groups Printed- Trucks

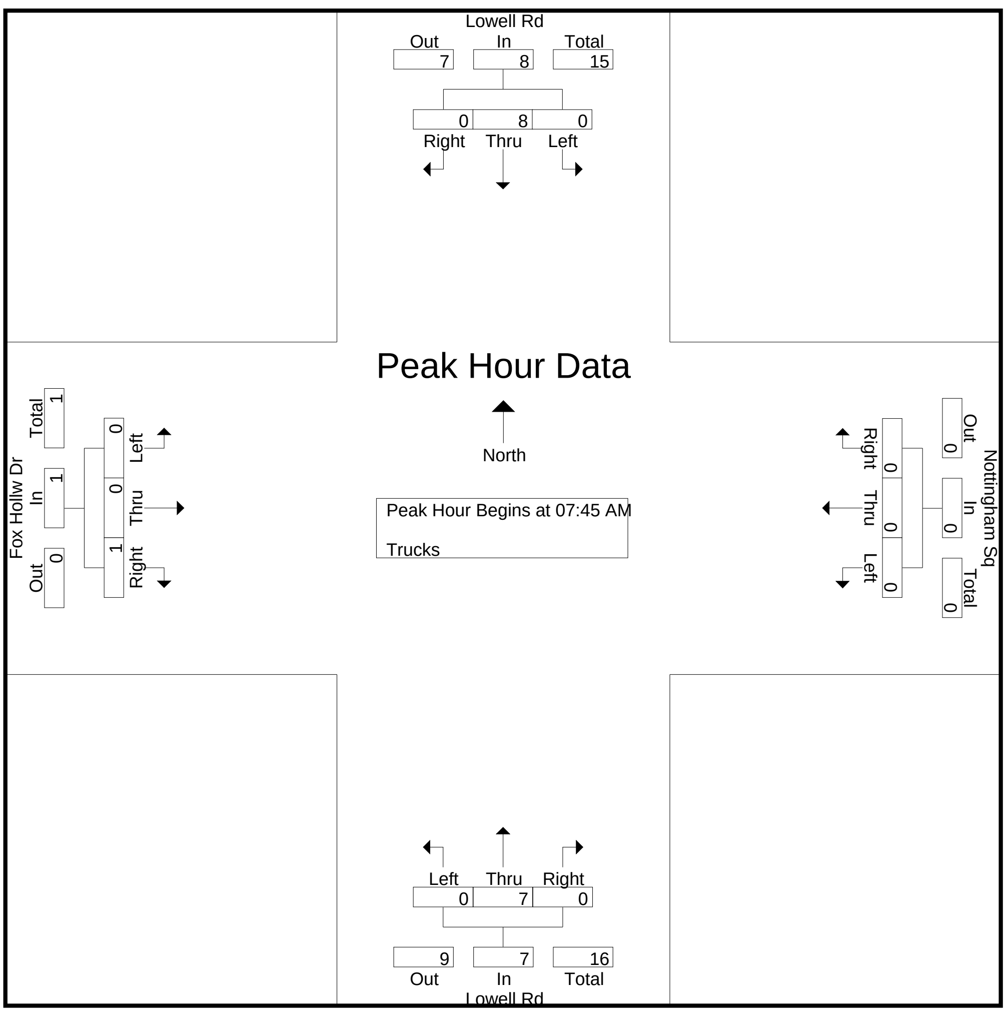
	Lowell Rd From North			Nottingham Sq From East			Lowell Rd From South			Fox Hollw Dr From West			
Start Time	Left	Thru	Right	Left	Thru	Right	Left	Thru	Right	Left	Thru	Right	Int. Total
07:00 AM	0	1	0	0	0	0	0	2	0	1	0	0	4
07:15 AM	0	0	0	0	0	0	0	3	0	0	0	0	3
07:30 AM	0	2	0	0	0	0	0	3	0	0	0	0	5
07:45 AM	0	1	0	0	0	0	0	1	0	0	0	1	3
Total	0	4	0	0	0	0	0	9	0	1	0	1	15
08:00 AM	0	3	0	0	0	0	0	0	0	0	0	0	3
08:15 AM	0	0	0	0	0	0	0	3	0	0	0	0	3
08:30 AM	0	4	0	0	0	0	0	3	0	0	0	0	7
08:45 AM	0	1	0	0	0	0	0	1	0	0	0	0	2
Total	0	8	0	0	0	0	0	7	0	0	0	0	15
Grand Total	0	12	0	0	0	0	0	16	0	1	0	1	30
Apprch %	0	100	0	0	0	0	0	100	0	50	0	50	
Total %	0	40	0	0	0	0	0	53.3	0	3.3	0	3.3	

Accurate Counts
978-664-2565

N/S Street : Lowell Road (Route 3A)
E/W Street : Fox Hollow Drive
City/State : Hudson, NH
Weather : Clear

File Name : 17004001
Site Code : 17004001
Start Date : 3/23/2017

	Lowell Rd From North				Nottingham Sq From East				Lowell Rd From South				Fox Hollw Dr From West				
Start Time	Left	Thru	Right	App. Total	Left	Thru	Right	App. Total	Left	Thru	Right	App. Total	Left	Thru	Right	App. Total	Int. Total
Peak Hour Analysis From 07:00 AM to 08:45 AM - Peak 1 of 1																	
Peak Hour for Entire Intersection Begins at 07:45 AM																	
07:45 AM	0	1	0	1	0	0	0	0	0	1	0	1	0	0	**1**	**1**	3
08:00 AM	0	3	0	3	0	0	0	0	0	0	0	0	0	0	0	0	3
08:15 AM	0	0	0	0	0	0	0	0	0	**3**	0	**3**	0	0	0	0	3
08:30 AM	0	**4**	0	**4**	0	0	0	0	0	3	0	3	0	0	0	0	**7**
Total Volume	0	8	0	8	0	0	0	0	0	7	0	7	0	0	1	1	16
% App. Total	0	100	0		0	0	0		0	100	0		0	0	100		
PHF	.000	.500	.000	.500	.000	.000	.000	.000	.000	.583	.000	.583	.000	.000	.250	.250	.571



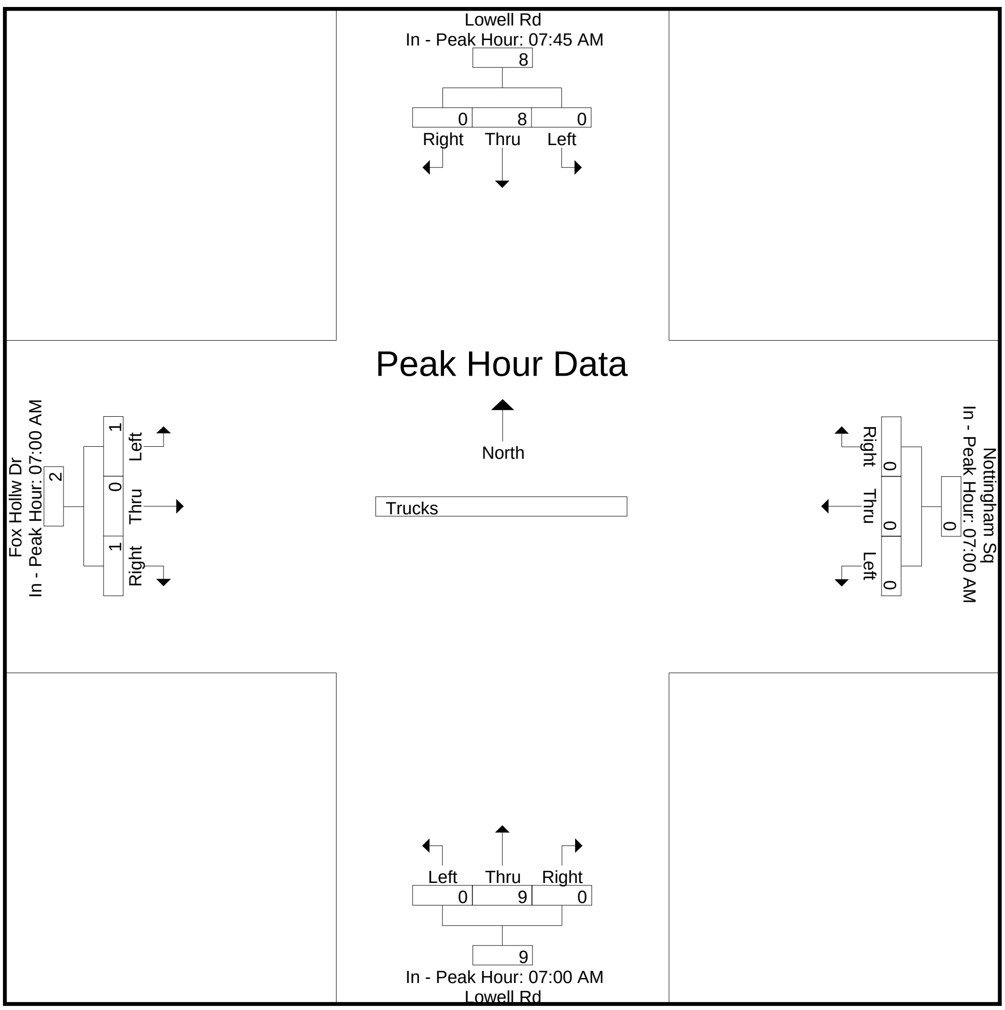
Accurate Counts

978-664-2565

N/S Street : Lowell Road (Route 3A)
E/W Street : Fox Hollow Drive
City/State : Hudson, NH
Weather : Clear

File Name : 17004001
Site Code : 17004001
Start Date : 3/23/2017
Page No : 9

	Lowell Rd From North				Nottingham Sq From East				Lowell Rd From South				Fox Hollw Dr From West				
Start Time	Left	Thru	Right	App. Total	Left	Thru	Right	App. Total	Left	Thru	Right	App. Total	Left	Thru	Right	App. Total	Int. Total
Peak Hour Analysis From 07:00 AM to 08:45 AM - Peak 1 of 1																	
Peak Hour for Each Approach Begins at:																	
	07:45 AM				07:00 AM				07:00 AM				07:00 AM				
+0 mins.	0	1	0	1	0	0	0	0	0	2	0	2	**1**	0	0	**1**	
+15 mins.	0	3	0	3	0	0	0	0	0	**3**	0	**3**	0	0	0	0	
+30 mins.	0	0	0	0	0	0	0	0	0	3	0	3	0	0	0	0	
+45 mins.	0	**4**	0	**4**	0	0	0	0	0	1	0	1	0	0	**1**	1	
Total Volume	0	8	0	8	0	0	0	0	0	9	0	9	1	0	1	2	
% App. Total	0	100	0		0	0	0		0	100	0		50	0	50		
PHF	.000	.500	.000	.500	.000	.000	.000	.000	.000	.750	.000	.750	.250	.000	.250	.500	



Accurate Counts
978-664-2565

N/S Street : Lowell Road (Route 3A)
E/W Street : Fox Hollow Drive
City/State : Hudson, NH
Weather : Clear

File Name : 17004001
Site Code : 17004001
Start Date : 3/23/2017

Groups Printed- Bikes Peds

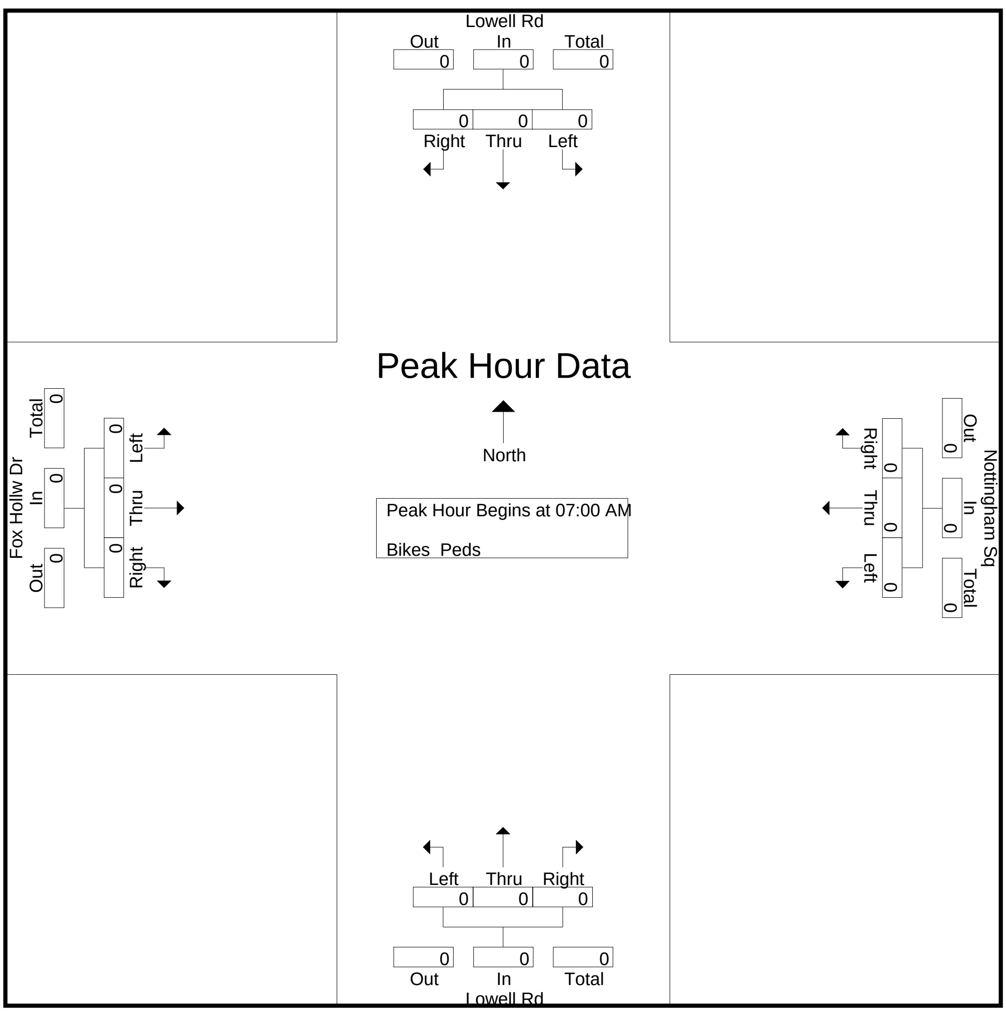
	Lowell Rd From North				Nottingham Sq From East				Lowell Rd From South				Fox Hollw Dr From West						
Start Time	Left	Thru	Right	Peds	Left	Thru	Right	Peds	Left	Thru	Right	Peds	Left	Thru	Right	Peds	Exclu. Total	Inclu. Total	Int. Total
07:00 AM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
07:15 AM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
07:30 AM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
07:45 AM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
08:00 AM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
08:15 AM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
08:30 AM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
08:45 AM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Grand Total	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Apprch %	0	0	0		0	0	0		0	0	0		0	0	0				
Total %																	0	0	

Accurate Counts
978-664-2565

N/S Street : Lowell Road (Route 3A)
E/W Street : Fox Hollow Drive
City/State : Hudson, NH
Weather : Clear

File Name : 17004001
Site Code : 17004001
Start Date : 3/23/2017

	Lowell Rd From North				Nottingham Sq From East				Lowell Rd From South				Fox Hollw Dr From West				
Start Time	Left	Thru	Right	App. Total	Left	Thru	Right	App. Total	Left	Thru	Right	App. Total	Left	Thru	Right	App. Total	Int. Total
Peak Hour Analysis From 07:00 AM to 08:45 AM - Peak 1 of 1																	
Peak Hour for Entire Intersection Begins at 07:00 AM																	
07:00 AM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
07:15 AM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
07:30 AM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
07:45 AM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total Volume	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
% App. Total	0	0	0		0	0	0		0	0	0		0	0	0		
PHF	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000

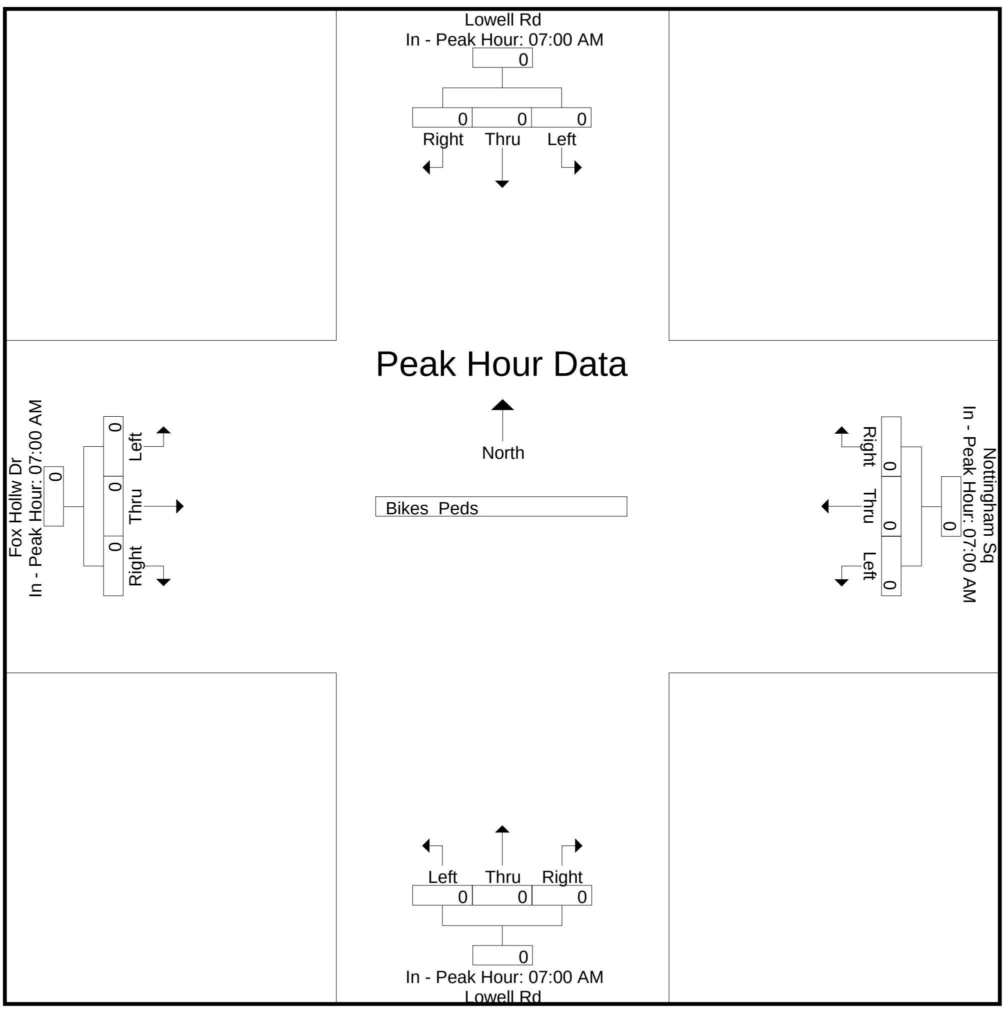


Accurate Counts
978-664-2565

N/S Street : Lowell Road (Route 3A)
E/W Street : Fox Hollow Drive
City/State : Hudson, NH
Weather : Clear

File Name : 17004001
Site Code : 17004001
Start Date : 3/23/2017

	Lowell Rd From North				Nottingham Sq From East				Lowell Rd From South				Fox Hollw Dr From West				
Start Time	Left	Thru	Right	App. Total	Left	Thru	Right	App. Total	Left	Thru	Right	App. Total	Left	Thru	Right	App. Total	Int. Total
Peak Hour Analysis From 07:00 AM to 08:45 AM - Peak 1 of 1																	
Peak Hour for Each Approach Begins at:																	
	07:00 AM				07:00 AM				07:00 AM				07:00 AM				
+0 mins.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
+15 mins.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
+30 mins.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
+45 mins.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
Total Volume	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
% App. Total	0	0	0		0	0	0		0	0	0		0	0	0		
PHF	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	



Accurate Counts

978-664-2565

N/S Street : Lowell Road (Route 3A)
E/W Street : Fox Hollow Drive
City/State : Hudson, NH
Weather : Clear

File Name : 17004001
Site Code : 17004001
Start Date : 3/23/2017

Groups Printed- Cars - Trucks

	Lowell Rd From North			Nottingham Sq From East			Lowell Rd From South			Fox Hollw Dr From West			
Start Time	Left	Thru	Right	Left	Thru	Right	Left	Thru	Right	Left	Thru	Right	Int. Total
04:00 PM	11	154	4	8	0	14	3	302	0	4	0	2	502
04:15 PM	8	177	0	6	0	12	5	271	6	0	0	4	489
04:30 PM	11	210	4	8	1	16	5	310	0	3	1	5	574
04:45 PM	23	163	4	9	0	10	5	309	3	0	3	4	533
Total	53	704	12	31	1	52	18	1192	9	7	4	15	2098
05:00 PM	22	164	4	18	1	13	2	294	4	1	3	4	530
05:15 PM	18	170	4	9	0	19	6	310	3	3	0	5	547
05:30 PM	15	154	0	11	0	15	4	293	0	5	1	6	504
05:45 PM	24	142	4	6	1	16	4	300	2	2	3	0	504
Total	79	630	12	44	2	63	16	1197	9	11	7	15	2085
Grand Total	132	1334	24	75	3	115	34	2389	18	18	11	30	4183
Apprch %	8.9	89.5	1.6	38.9	1.6	59.6	1.4	97.9	0.7	30.5	18.6	50.8	
Total %	3.2	31.9	0.6	1.8	0.1	2.7	0.8	57.1	0.4	0.4	0.3	0.7	
Cars	132	1326	24	75	3	115	34	2379	18	18	11	30	4165
% Cars	100	99.4	100	100	100	100	100	99.6	100	100	100	100	99.6
Trucks	0	8	0	0	0	0	0	10	0	0	0	0	18
% Trucks	0	0.6	0	0	0	0	0	0.4	0	0	0	0	0.4

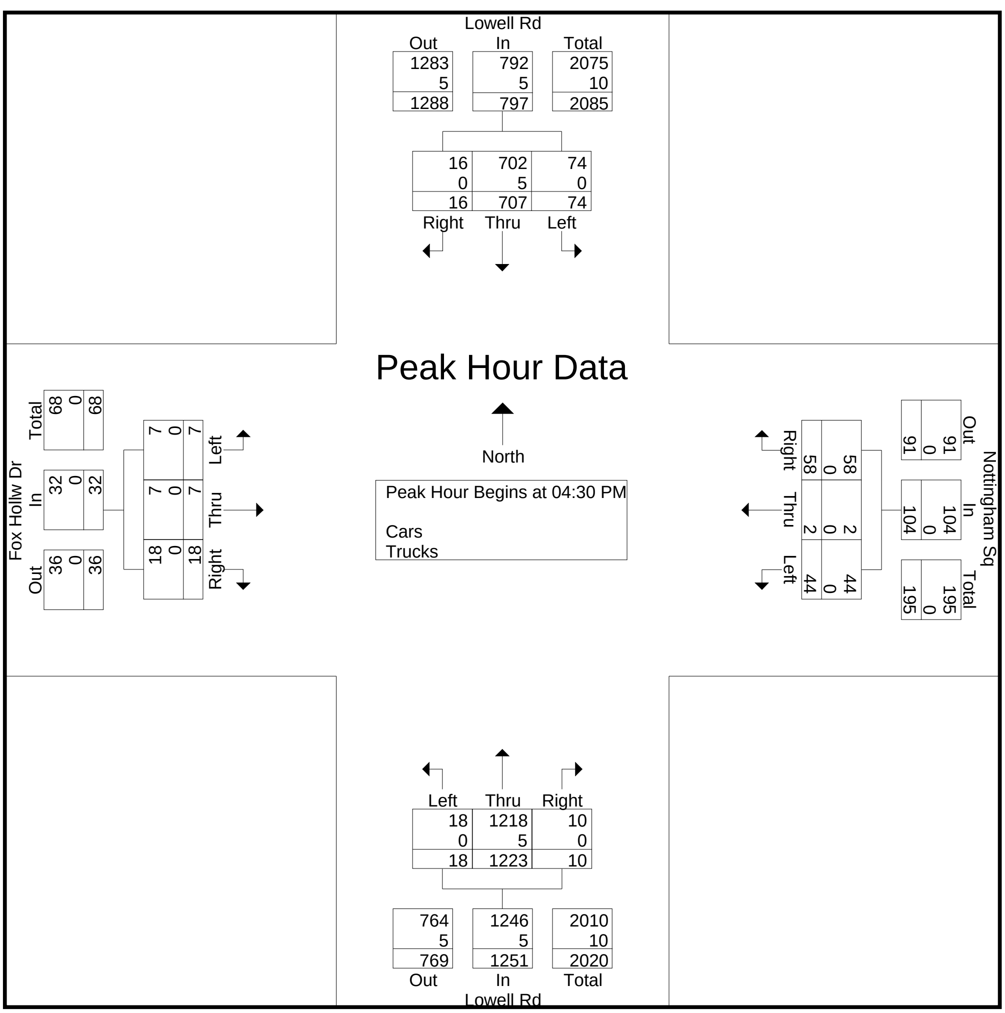
Accurate Counts

978-664-2565

N/S Street : Lowell Road (Route 3A)
E/W Street : Fox Hollow Drive
City/State : Hudson, NH
Weather : Clear

File Name : 17004001
Site Code : 17004001
Start Date : 3/23/2017
Page No : 2

	Lowell Rd From North				Nottingham Sq From East				Lowell Rd From South				Fox Hollw Dr From West				
Start Time	Left	Thru	Right	App. Total	Left	Thru	Right	App. Total	Left	Thru	Right	App. Total	Left	Thru	Right	App. Total	Int. Total
Peak Hour Analysis From 04:00 PM to 05:45 PM - Peak 1 of 1																	
Peak Hour for Entire Intersection Begins at 04:30 PM																	
04:30 PM	11	**210**	**4**	**225**	8	**1**	16	25	5	**310**	0	315	**3**	1	**5**	**9**	**574**
04:45 PM	**23**	163	4	190	9	0	10	19	5	309	3	317	0	**3**	4	7	533
05:00 PM	22	164	4	190	**18**	1	13	**32**	2	294	**4**	300	1	3	4	8	530
05:15 PM	18	170	4	192	9	0	**19**	28	**6**	310	3	**319**	3	0	5	8	547
Total Volume	74	707	16	797	44	2	58	104	18	1223	10	1251	7	7	18	32	2184
% App. Total	9.3	88.7	2		42.3	1.9	55.8		1.4	97.8	0.8		21.9	21.9	56.2		
PHF	.804	.842	1.00	.886	.611	.500	.763	.813	.750	.986	.625	.980	.583	.583	.900	.889	.951
Cars	74	702	16	792	44	2	58	104	18	1218	10	1246	7	7	18	32	2174
% Cars	100	99.3	100	99.4	100	100	100	100	100	99.6	100	99.6	100	100	100	100	99.5
Trucks	0	5	0	5	0	0	0	0	0	5	0	5	0	0	0	0	10
% Trucks	0	0.7	0	0.6	0	0	0	0	0	0.4	0	0.4	0	0	0	0	0.5



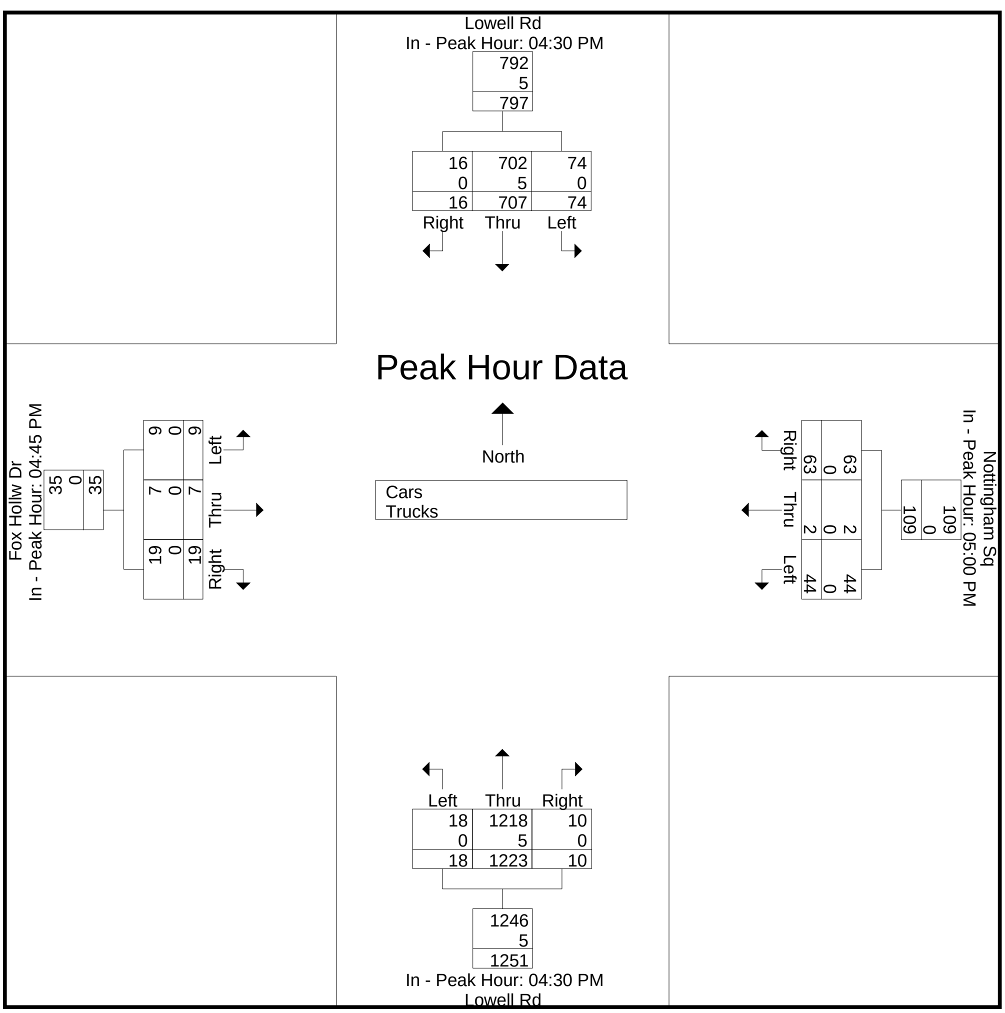
Accurate Counts

978-664-2565

N/S Street : Lowell Road (Route 3A)
E/W Street : Fox Hollow Drive
City/State : Hudson, NH
Weather : Clear

File Name : 17004001
Site Code : 17004001
Start Date : 3/23/2017
Page No : 3

	Lowell Rd From North				Nottingham Sq From East				Lowell Rd From South				Fox Hollw Dr From West				
Start Time	Left	Thru	Right	App. Total	Left	Thru	Right	App. Total	Left	Thru	Right	App. Total	Left	Thru	Right	App. Total	Int. Total
Peak Hour Analysis From 04:00 PM to 05:45 PM - Peak 1 of 1																	
Peak Hour for Each Approach Begins at:																	
	04:30 PM				05:00 PM				04:30 PM				04:45 PM				
+0 mins.	11	**210**	**4**	**225**	**18**	**1**	13	**32**	5	**310**	0	315	0	**3**	4	7	
+15 mins.	**23**	163	4	190	9	0	**19**	28	5	309	3	317	1	3	4	8	
+30 mins.	22	164	4	190	11	0	15	26	2	294	**4**	300	3	0	5	8	
+45 mins.	18	170	4	192	6	1	16	23	**6**	310	3	**319**	**5**	1	**6**	**12**	
Total Volume	74	707	16	797	44	2	63	109	18	1223	10	1251	9	7	19	35	
% App. Total	9.3	88.7	2		40.4	1.8	57.8		1.4	97.8	0.8		25.7	20	54.3		
PHF	.804	.842	1.000	.886	.611	.500	.829	.852	.750	.986	.625	.980	.450	.583	.792	.729	
Cars	74	702	16	792	44	2	63	109	18	1218	10	1246	9	7	19	35	
% Cars	100	99.3	100	99.4	100	100	100	100	100	99.6	100	99.6	100	100	100	100	
Trucks	0	5	0	5	0	0	0	0	0	5	0	5	0	0	0	0	
% Trucks	0	0.7	0	0.6	0	0	0	0	0	0.4	0	0.4	0	0	0	0	



Accurate Counts

978-664-2565

N/S Street : Lowell Road (Route 3A)
E/W Street : Fox Hollow Drive
City/State : Hudson, NH
Weather : Clear

File Name : 17004001
Site Code : 17004001
Start Date : 3/23/2017

Groups Printed- Cars

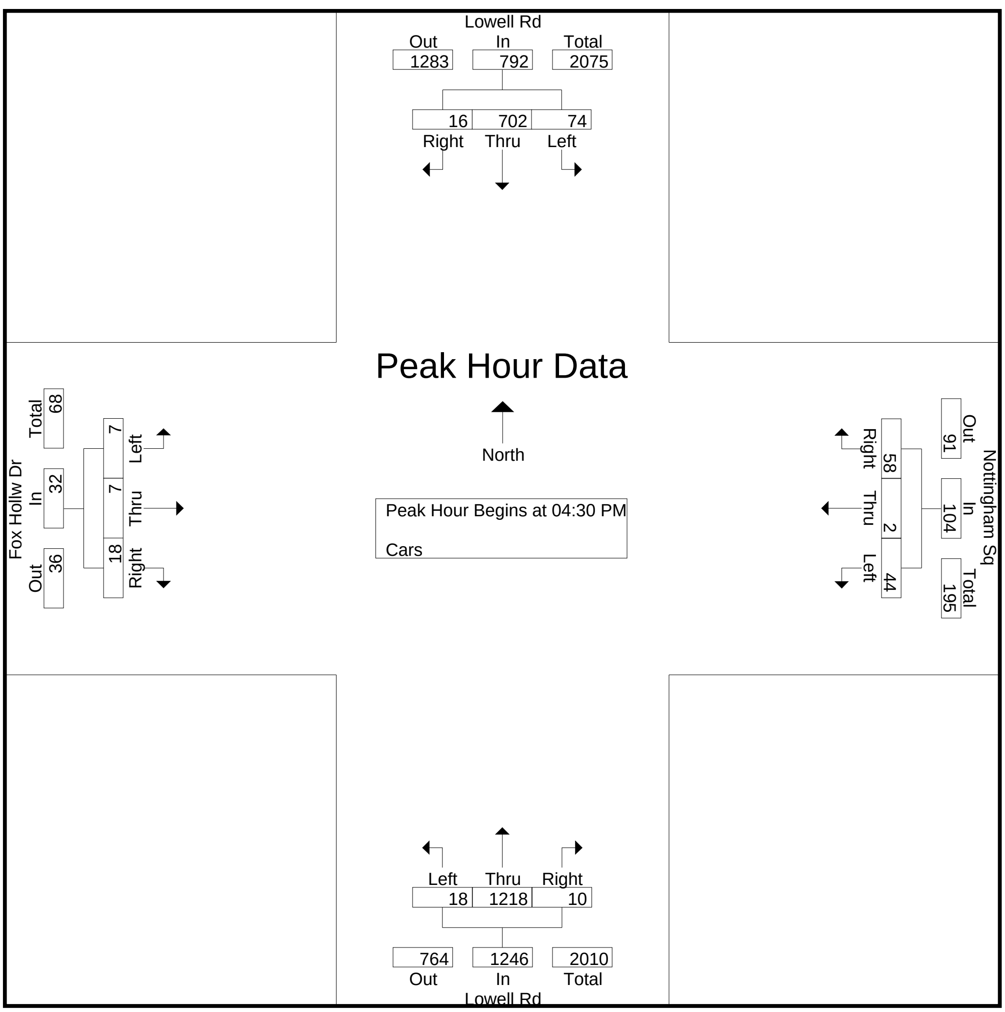
	Lowell Rd From North			Nottingham Sq From East			Lowell Rd From South			Fox Hollw Dr From West			
Start Time	Left	Thru	Right	Left	Thru	Right	Left	Thru	Right	Left	Thru	Right	Int. Total
04:00 PM	11	154	4	8	0	14	3	300	0	4	0	2	500
04:15 PM	8	176	0	6	0	12	5	270	6	0	0	4	487
04:30 PM	11	208	4	8	1	16	5	308	0	3	1	5	570
04:45 PM	23	160	4	9	0	10	5	308	3	0	3	4	529
Total	53	698	12	31	1	52	18	1186	9	7	4	15	2086
05:00 PM	22	164	4	18	1	13	2	293	4	1	3	4	529
05:15 PM	18	170	4	9	0	19	6	309	3	3	0	5	546
05:30 PM	15	154	0	11	0	15	4	292	0	5	1	6	503
05:45 PM	24	140	4	6	1	16	4	299	2	2	3	0	501
Total	79	628	12	44	2	63	16	1193	9	11	7	15	2079
Grand Total	132	1326	24	75	3	115	34	2379	18	18	11	30	4165
Apprch %	8.9	89.5	1.6	38.9	1.6	59.6	1.4	97.9	0.7	30.5	18.6	50.8	
Total %	3.2	31.8	0.6	1.8	0.1	2.8	0.8	57.1	0.4	0.4	0.3	0.7	

Accurate Counts
978-664-2565

N/S Street : Lowell Road (Route 3A)
E/W Street : Fox Hollow Drive
City/State : Hudson, NH
Weather : Clear

File Name : 17004001
Site Code : 17004001
Start Date : 3/23/2017
Page No : 5

	Lowell Rd From North				Nottingham Sq From East				Lowell Rd From South				Fox Hollw Dr From West				
Start Time	Left	Thru	Right	App. Total	Left	Thru	Right	App. Total	Left	Thru	Right	App. Total	Left	Thru	Right	App. Total	Int. Total
Peak Hour Analysis From 04:00 PM to 05:45 PM - Peak 1 of 1																	
Peak Hour for Entire Intersection Begins at 04:30 PM																	
04:30 PM	11	**208**	**4**	**223**	8	**1**	16	25	5	308	0	313	**3**	1	**5**	**9**	**570**
04:45 PM	**23**	160	4	187	9	0	10	19	5	308	3	316	0	**3**	4	7	529
05:00 PM	22	164	4	190	**18**	1	13	**32**	2	293	**4**	299	1	3	4	8	529
05:15 PM	18	170	4	192	9	0	**19**	28	**6**	**309**	3	**318**	3	0	5	8	546
Total Volume	74	702	16	792	44	2	58	104	18	1218	10	1246	7	7	18	32	2174
% App. Total	9.3	88.6	2		42.3	1.9	55.8		1.4	97.8	0.8		21.9	21.9	56.2		
PHF	.804	.844	1.00	.888	.611	.500	.763	.813	.750	.985	.625	.980	.583	.583	.900	.889	.954



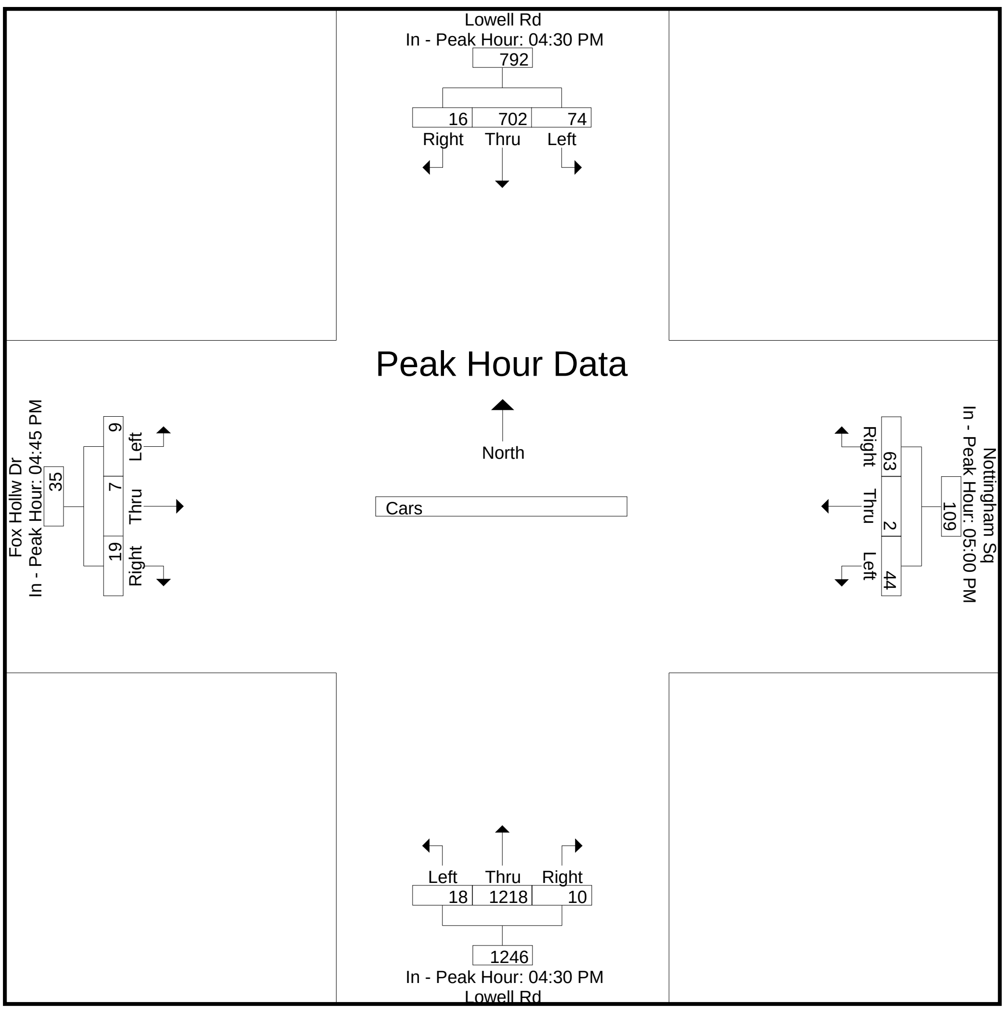
Accurate Counts

978-664-2565

N/S Street : Lowell Road (Route 3A)
E/W Street : Fox Hollow Drive
City/State : Hudson, NH
Weather : Clear

File Name : 17004001
Site Code : 17004001
Start Date : 3/23/2017
Page No : 6

	Lowell Rd From North				Nottingham Sq From East				Lowell Rd From South				Fox Hollw Dr From West				
Start Time	Left	Thru	Right	App. Total	Left	Thru	Right	App. Total	Left	Thru	Right	App. Total	Left	Thru	Right	App. Total	Int. Total
Peak Hour Analysis From 04:00 PM to 05:45 PM - Peak 1 of 1																	
Peak Hour for Each Approach Begins at:																	
	04:30 PM				05:00 PM				04:30 PM				04:45 PM				
+0 mins.	11	**208**	**4**	**223**	**18**	**1**	13	**32**	5	308	0	313	0	**3**	4	7	
+15 mins.	**23**	160	4	187	9	0	**19**	28	5	308	3	316	1	3	4	8	
+30 mins.	22	164	4	190	11	0	15	26	2	293	**4**	299	3	0	5	8	
+45 mins.	18	170	4	192	6	1	16	23	**6**	**309**	3	**318**	**5**	1	**6**	**12**	
Total Volume	74	702	16	792	44	2	63	109	18	1218	10	1246	9	7	19	35	
% App. Total	9.3	88.6	2		40.4	1.8	57.8		1.4	97.8	0.8		25.7	20	54.3		
PHF	.804	.844	1.000	.888	.611	.500	.829	.852	.750	.985	.625	.980	.450	.583	.792	.729	



Accurate Counts

978-664-2565

N/S Street : Lowell Road (Route 3A)
E/W Street : Fox Hollow Drive
City/State : Hudson, NH
Weather : Clear

File Name : 17004001
Site Code : 17004001
Start Date : 3/23/2017

Groups Printed- Trucks

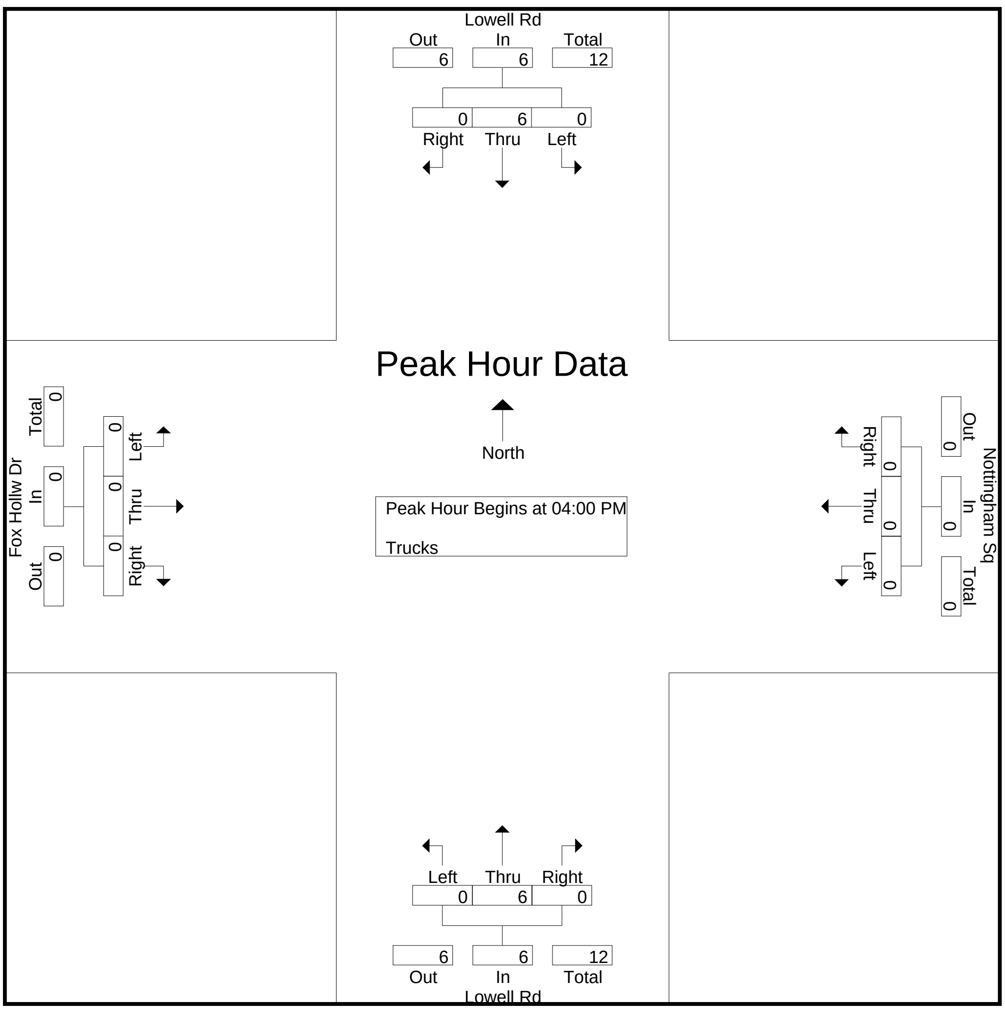
	Lowell Rd From North			Nottingham Sq From East			Lowell Rd From South			Fox Hollw Dr From West			
Start Time	Left	Thru	Right	Left	Thru	Right	Left	Thru	Right	Left	Thru	Right	Int. Total
04:00 PM	0	0	0	0	0	0	0	2	0	0	0	0	2
04:15 PM	0	1	0	0	0	0	0	1	0	0	0	0	2
04:30 PM	0	2	0	0	0	0	0	2	0	0	0	0	4
04:45 PM	0	3	0	0	0	0	0	1	0	0	0	0	4
Total	0	6	0	0	0	0	0	6	0	0	0	0	12
05:00 PM	0	0	0	0	0	0	0	1	0	0	0	0	1
05:15 PM	0	0	0	0	0	0	0	1	0	0	0	0	1
05:30 PM	0	0	0	0	0	0	0	1	0	0	0	0	1
05:45 PM	0	2	0	0	0	0	0	1	0	0	0	0	3
Total	0	2	0	0	0	0	0	4	0	0	0	0	6
Grand Total	0	8	0	0	0	0	0	10	0	0	0	0	18
Apprch %	0	100	0	0	0	0	0	100	0	0	0	0	
Total %	0	44.4	0	0	0	0	0	55.6	0	0	0	0	

Accurate Counts
978-664-2565

N/S Street : Lowell Road (Route 3A)
E/W Street : Fox Hollow Drive
City/State : Hudson, NH
Weather : Clear

File Name : 17004001
Site Code : 17004001
Start Date : 3/23/2017

	Lowell Rd From North				Nottingham Sq From East				Lowell Rd From South				Fox Hollw Dr From West				
Start Time	Left	Thru	Right	App. Total	Left	Thru	Right	App. Total	Left	Thru	Right	App. Total	Left	Thru	Right	App. Total	Int. Total
Peak Hour Analysis From 04:00 PM to 05:45 PM - Peak 1 of 1																	
Peak Hour for Entire Intersection Begins at 04:00 PM																	
04:00 PM	0	0	0	0	0	0	0	0	0	**2**	0	**2**	0	0	0	0	2
04:15 PM	0	1	0	1	0	0	0	0	0	1	0	1	0	0	0	0	2
04:30 PM	0	2	0	2	0	0	0	0	0	2	0	2	0	0	0	0	**4**
04:45 PM	0	**3**	0	**3**	0	0	0	0	0	1	0	1	0	0	0	0	4
Total Volume	0	6	0	6	0	0	0	0	0	6	0	6	0	0	0	0	12
% App. Total	0	100	0		0	0	0		0	100	0		0	0	0		
PHF	.000	.500	.000	.500	.000	.000	.000	.000	.000	.750	.000	.750	.000	.000	.000	.000	.750



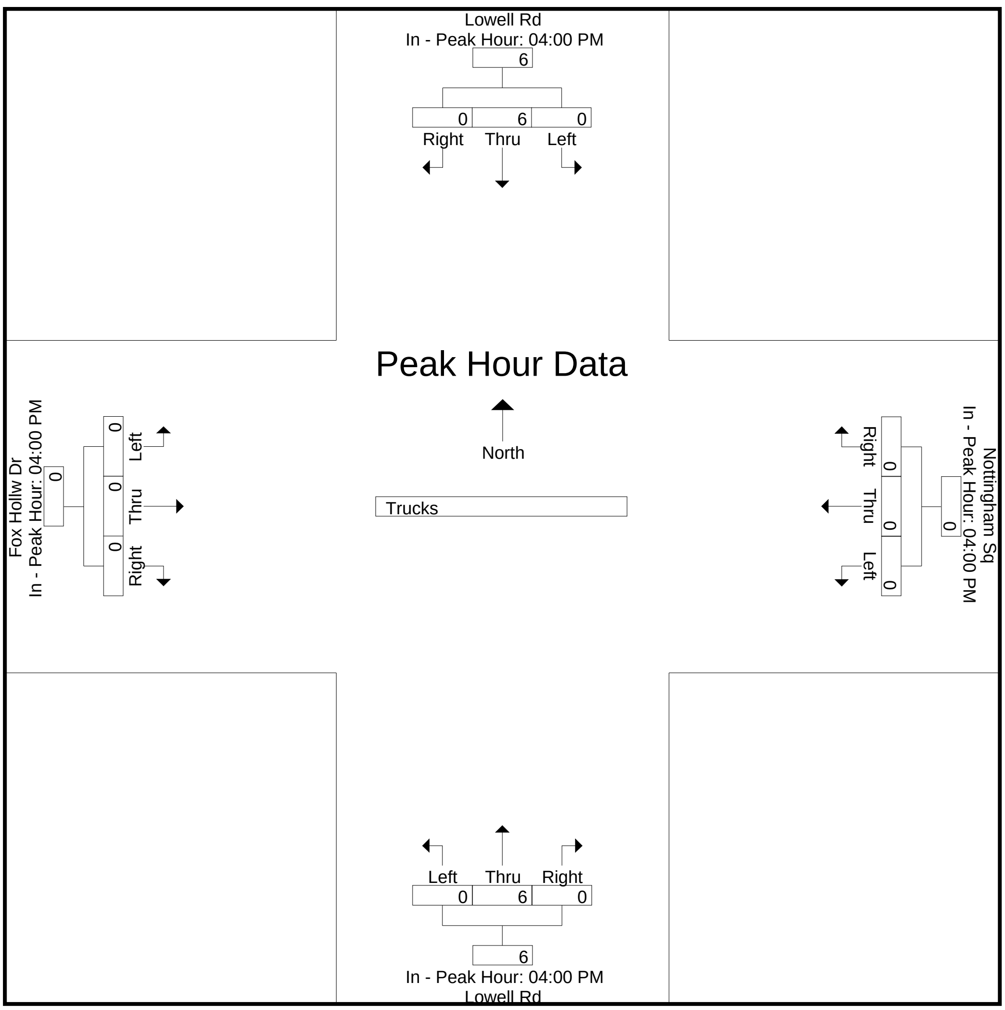
Accurate Counts

978-664-2565

N/S Street : Lowell Road (Route 3A)
E/W Street : Fox Hollow Drive
City/State : Hudson, NH
Weather : Clear

File Name : 17004001
Site Code : 17004001
Start Date : 3/23/2017
Page No : 9

	Lowell Rd From North				Nottingham Sq From East				Lowell Rd From South				Fox Hollw Dr From West				
Start Time	Left	Thru	Right	App. Total	Left	Thru	Right	App. Total	Left	Thru	Right	App. Total	Left	Thru	Right	App. Total	Int. Total
Peak Hour Analysis From 04:00 PM to 05:45 PM - Peak 1 of 1																	
Peak Hour for Each Approach Begins at:																	
	04:00 PM				04:00 PM				04:00 PM				04:00 PM				
+0 mins.	0	0	0	0	0	0	0	0	0	**2**	0	**2**	0	0	0	0	
+15 mins.	0	1	0	1	0	0	0	0	0	1	0	1	0	0	0	0	
+30 mins.	0	2	0	2	0	0	0	0	0	2	0	2	0	0	0	0	
+45 mins.	0	**3**	0	**3**	0	0	0	0	0	1	0	1	0	0	0	0	
Total Volume	0	6	0	6	0	0	0	0	0	6	0	6	0	0	0	0	
% App. Total	0	100	0		0	0	0		0	100	0		0	0	0		
PHF	.000	.500	.000	.500	.000	.000	.000	.000	.000	.750	.000	.750	.000	.000	.000	.000	



Accurate Counts
978-664-2565

N/S Street : Lowell Road (Route 3A)
E/W Street : Fox Hollow Drive
City/State : Hudson, NH
Weather : Clear

File Name : 17004001
Site Code : 17004001
Start Date : 3/23/2017
Page No : 10

Groups Printed- Bikes Peds

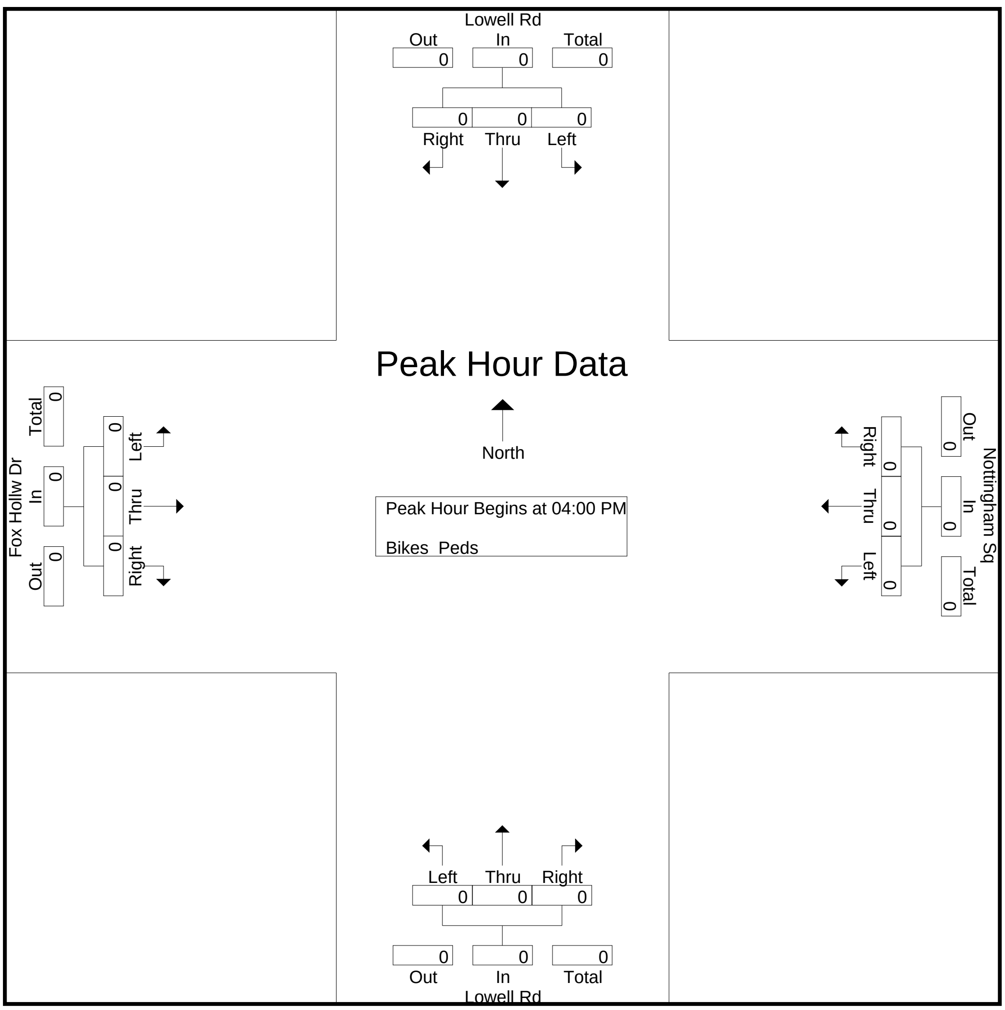
	Lowell Rd From North				Nottingham Sq From East				Lowell Rd From South				Fox Hollw Dr From West						
Start Time	Left	Thru	Right	Peds	Left	Thru	Right	Peds	Left	Thru	Right	Peds	Left	Thru	Right	Peds	Exclu. Total	Inclu. Total	Int. Total
04:00 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
04:15 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
04:30 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
04:45 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
05:00 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
05:15 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
05:30 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
05:45 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Grand Total	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Apprch %	0	0	0		0	0	0		0	0	0		0	0	0				
Total %																	0	0	

Accurate Counts
978-664-2565

N/S Street : Lowell Road (Route 3A)
E/W Street : Fox Hollow Drive
City/State : Hudson, NH
Weather : Clear

File Name : 17004001
Site Code : 17004001
Start Date : 3/23/2017
Page No : 11

	Lowell Rd From North				Nottingham Sq From East				Lowell Rd From South				Fox Hollw Dr From West				
Start Time	Left	Thru	Right	App. Total	Left	Thru	Right	App. Total	Left	Thru	Right	App. Total	Left	Thru	Right	App. Total	Int. Total
Peak Hour Analysis From 04:00 PM to 05:45 PM - Peak 1 of 1																	
Peak Hour for Entire Intersection Begins at 04:00 PM																	
04:00 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
04:15 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
04:30 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
04:45 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total Volume	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
% App. Total	0	0	0		0	0	0		0	0	0		0	0	0		
PHF	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000

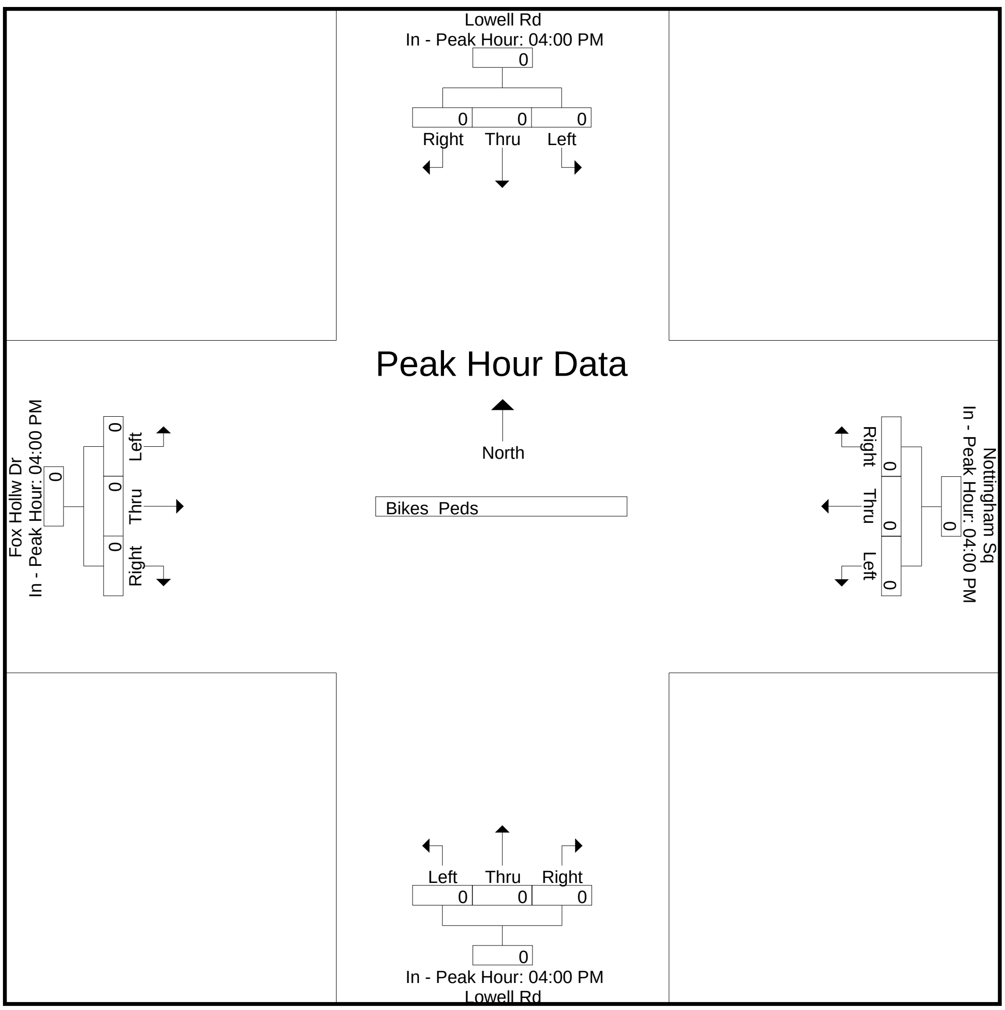


Accurate Counts
978-664-2565

N/S Street : Lowell Road (Route 3A)
E/W Street : Fox Hollow Drive
City/State : Hudson, NH
Weather : Clear

File Name : 17004001
Site Code : 17004001
Start Date : 3/23/2017

	Lowell Rd From North				Nottingham Sq From East				Lowell Rd From South				Fox Hollw Dr From West				
Start Time	Left	Thru	Right	App. Total	Left	Thru	Right	App. Total	Left	Thru	Right	App. Total	Left	Thru	Right	App. Total	Int. Total
Peak Hour Analysis From 04:00 PM to 05:45 PM - Peak 1 of 1																	
Peak Hour for Each Approach Begins at:																	
	04:00 PM				04:00 PM				04:00 PM				04:00 PM				
+0 mins.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
+15 mins.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
+30 mins.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
+45 mins.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
Total Volume	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
% App. Total	0	0	0		0	0	0		0	0	0		0	0	0		
PHF	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	



Accurate Counts
978-664-2565

N/S Street : Lowell Road (Route 3A)
E/W Street : Fox Hollow Drive
City/State : Hudson, NH
Weather : Rain

File Name : 170040S1
Site Code : 17004001
Start Date : 3/25/2017
Page No : 1

Groups Printed- Cars - Trucks

	Lowell Rd From North			Nottingham Sq From East			Lowell Rd From South			Fox Hollw Dr From West			
Start Time	Left	Thru	Right	Left	Thru	Right	Left	Thru	Right	Left	Thru	Right	Int. Total
11:00 AM	23	211	1	10	0	7	6	207	2	3	0	5	475
11:15 AM	10	226	3	7	0	10	1	173	0	1	2	8	441
11:30 AM	12	223	2	7	0	15	8	200	2	1	0	10	480
11:45 AM	13	220	5	10	0	9	8	215	4	4	0	6	494
Total	58	880	11	34	0	41	23	795	8	9	2	29	1890
12:00 PM	10	204	6	15	2	18	8	223	4	5	2	11	508
12:15 PM	16	240	2	11	1	13	6	229	1	4	0	4	527
12:30 PM	12	210	2	10	0	17	7	211	3	3	0	2	477
12:45 PM	14	206	2	9	0	9	5	232	4	4	0	4	489
Total	52	860	12	45	3	57	26	895	12	16	2	21	2001
01:00 PM	9	196	3	8	2	10	3	221	0	5	0	4	461
01:15 PM	13	227	3	7	0	14	8	201	1	1	1	7	483
01:30 PM	6	200	0	15	0	13	5	240	4	6	1	6	496
01:45 PM	14	228	2	17	0	15	3	190	0	5	0	9	483
Total	42	851	8	47	2	52	19	852	5	17	2	26	1923
Grand Total	152	2591	31	126	5	150	68	2542	25	42	6	76	5814
Apprch %	5.5	93.4	1.1	44.8	1.8	53.4	2.6	96.5	0.9	33.9	4.8	61.3	
Total %	2.6	44.6	0.5	2.2	0.1	2.6	1.2	43.7	0.4	0.7	0.1	1.3	
Cars	152	2590	31	126	5	150	68	2537	25	42	6	76	5808
% Cars	100	100	100	100	100	100	100	99.8	100	100	100	100	99.9
Trucks	0	1	0	0	0	0	0	5	0	0	0	0	6
% Trucks	0	0	0	0	0	0	0	0.2	0	0	0	0	0.1

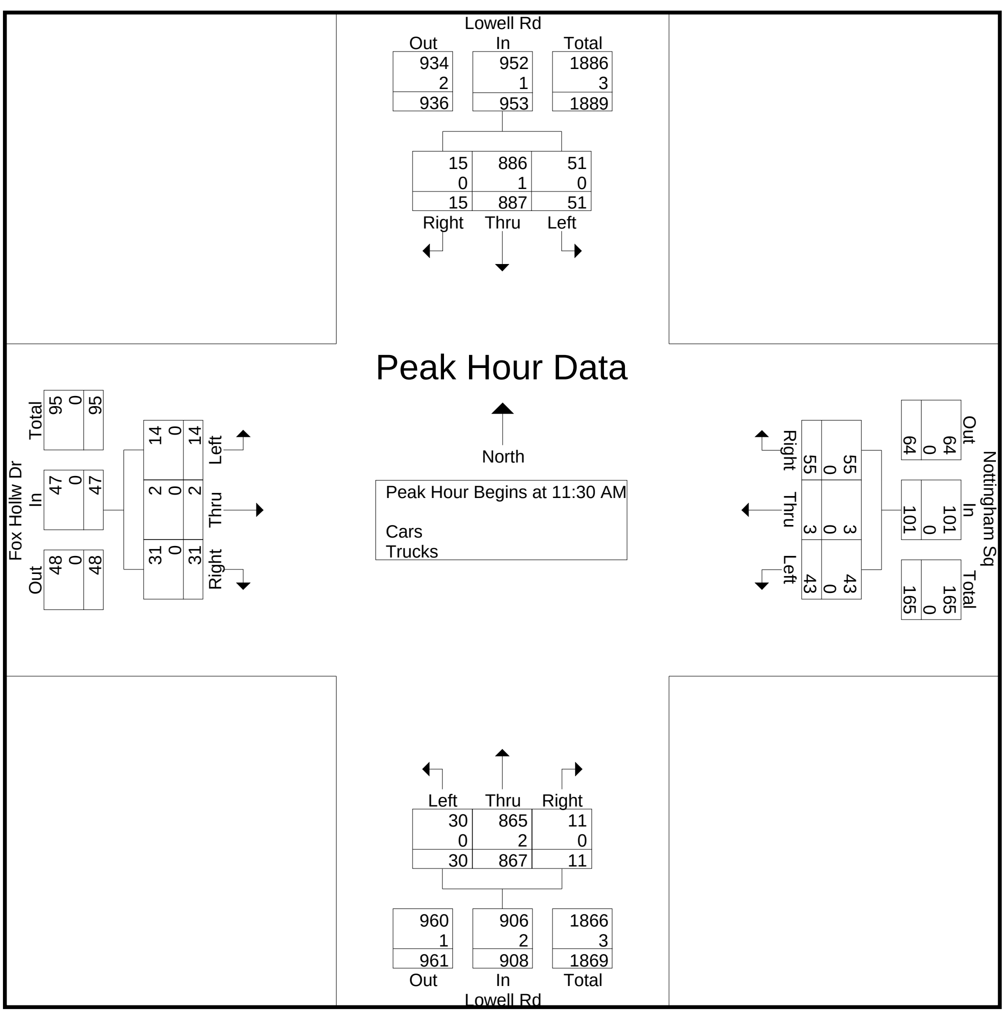
Accurate Counts

978-664-2565

N/S Street : Lowell Road (Route 3A)
E/W Street : Fox Hollow Drive
City/State : Hudson, NH
Weather : Rain

File Name : 170040S1
Site Code : 17004001
Start Date : 3/25/2017
Page No : 2

	Lowell Rd From North				Nottingham Sq From East				Lowell Rd From South				Fox Hollw Dr From West				
Start Time	Left	Thru	Right	App. Total	Left	Thru	Right	App. Total	Left	Thru	Right	App. Total	Left	Thru	Right	App. Total	Int. Total
Peak Hour Analysis From 11:00 AM to 01:45 PM - Peak 1 of 1																	
Peak Hour for Entire Intersection Begins at 11:30 AM																	
11:30 AM	12	223	2	237	7	0	15	22	**8**	200	2	210	1	0	10	11	480
11:45 AM	13	220	5	238	10	0	9	19	8	215	**4**	227	4	0	6	10	494
12:00 PM	10	204	**6**	220	**15**	**2**	**18**	**35**	8	223	4	235	**5**	**2**	**11**	**18**	508
12:15 PM	**16**	**240**	2	**258**	11	1	13	25	6	**229**	1	**236**	4	0	4	8	**527**
Total Volume	51	887	15	953	43	3	55	101	30	867	11	908	14	2	31	47	2009
% App. Total	5.4	93.1	1.6		42.6	3	54.5		3.3	95.5	1.2		29.8	4.3	66		
PHF	.797	.924	.625	.923	.717	.375	.764	.721	.938	.947	.688	.962	.700	.250	.705	.653	.953
Cars	51	886	15	952	43	3	55	101	30	865	11	906	14	2	31	47	2006
% Cars	100	99.9	100	99.9	100	100	100	100	100	99.8	100	99.8	100	100	100	100	99.9
Trucks	0	1	0	1	0	0	0	0	0	2	0	2	0	0	0	0	3
% Trucks	0	0.1	0	0.1	0	0	0	0	0	0.2	0	0.2	0	0	0	0	0.1



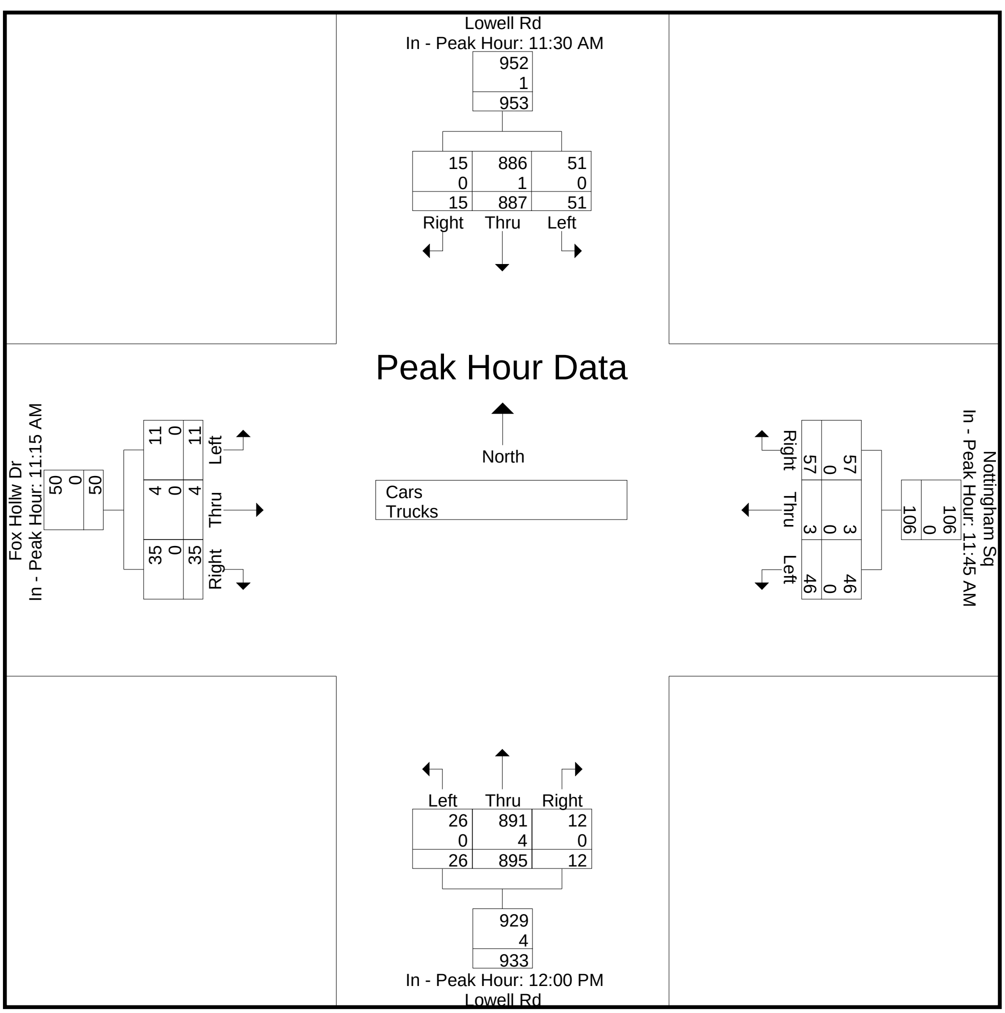
Accurate Counts

978-664-2565

N/S Street : Lowell Road (Route 3A)
E/W Street : Fox Hollow Drive
City/State : Hudson, NH
Weather : Rain

File Name : 170040S1
Site Code : 17004001
Start Date : 3/25/2017

	Lowell Rd From North				Nottingham Sq From East				Lowell Rd From South				Fox Hollw Dr From West				
Start Time	Left	Thru	Right	App. Total	Left	Thru	Right	App. Total	Left	Thru	Right	App. Total	Left	Thru	Right	App. Total	Int. Total
Peak Hour Analysis From 11:00 AM to 01:45 PM - Peak 1 of 1																	
Peak Hour for Each Approach Begins at:																	
	11:30 AM				11:45 AM				12:00 PM				11:15 AM				
+0 mins.	12	223	2	237	10	0	9	19	**8**	223	**4**	235	1	**2**	8	11	
+15 mins.	13	220	5	238	**15**	**2**	**18**	**35**	6	229	1	236	1	0	10	11	
+30 mins.	10	204	**6**	220	11	1	13	25	7	211	3	221	4	0	6	10	
+45 mins.	**16**	**240**	2	**258**	10	0	17	27	5	**232**	4	**241**	**5**	2	**11**	**18**	
Total Volume	51	887	15	953	46	3	57	106	26	895	12	933	11	4	35	50	
% App. Total	5.4	93.1	1.6		43.4	2.8	53.8		2.8	95.9	1.3		22	8	70		
PHF	.797	.924	.625	.923	.767	.375	.792	.757	.813	.964	.750	.968	.550	.500	.795	.694	
Cars	51	886	15	952	46	3	57	106	26	891	12	929	11	4	35	50	
% Cars	100	99.9	100	99.9	100	100	100	100	100	99.6	100	99.6	100	100	100	100	
Trucks	0	1	0	1	0	0	0	0	0	4	0	4	0	0	0	0	
% Trucks	0	0.1	0	0.1	0	0	0	0	0	0.4	0	0.4	0	0	0	0	



Accurate Counts

978-664-2565

N/S Street : Lowell Road (Route 3A)
E/W Street : Fox Hollow Drive
City/State : Hudson, NH
Weather : Rain

File Name : 170040S1
Site Code : 17004001
Start Date : 3/25/2017

Groups Printed- Cars

	Lowell Rd From North			Nottingham Sq From East			Lowell Rd From South			Fox Hollw Dr From West			
Start Time	Left	Thru	Right	Left	Thru	Right	Left	Thru	Right	Left	Thru	Right	Int. Total
11:00 AM	23	211	1	10	0	7	6	206	2	3	0	5	474
11:15 AM	10	226	3	7	0	10	1	173	0	1	2	8	441
11:30 AM	12	223	2	7	0	15	8	200	2	1	0	10	480
11:45 AM	13	220	5	10	0	9	8	215	4	4	0	6	494
Total	58	880	11	34	0	41	23	794	8	9	2	29	1889
12:00 PM	10	203	6	15	2	18	8	223	4	5	2	11	507
12:15 PM	16	240	2	11	1	13	6	227	1	4	0	4	525
12:30 PM	12	210	2	10	0	17	7	211	3	3	0	2	477
12:45 PM	14	206	2	9	0	9	5	230	4	4	0	4	487
Total	52	859	12	45	3	57	26	891	12	16	2	21	1996
01:00 PM	9	196	3	8	2	10	3	221	0	5	0	4	461
01:15 PM	13	227	3	7	0	14	8	201	1	1	1	7	483
01:30 PM	6	200	0	15	0	13	5	240	4	6	1	6	496
01:45 PM	14	228	2	17	0	15	3	190	0	5	0	9	483
Total	42	851	8	47	2	52	19	852	5	17	2	26	1923
Grand Total	152	2590	31	126	5	150	68	2537	25	42	6	76	5808
Apprch %	5.5	93.4	1.1	44.8	1.8	53.4	2.6	96.5	1	33.9	4.8	61.3	
Total %	2.6	44.6	0.5	2.2	0.1	2.6	1.2	43.7	0.4	0.7	0.1	1.3	

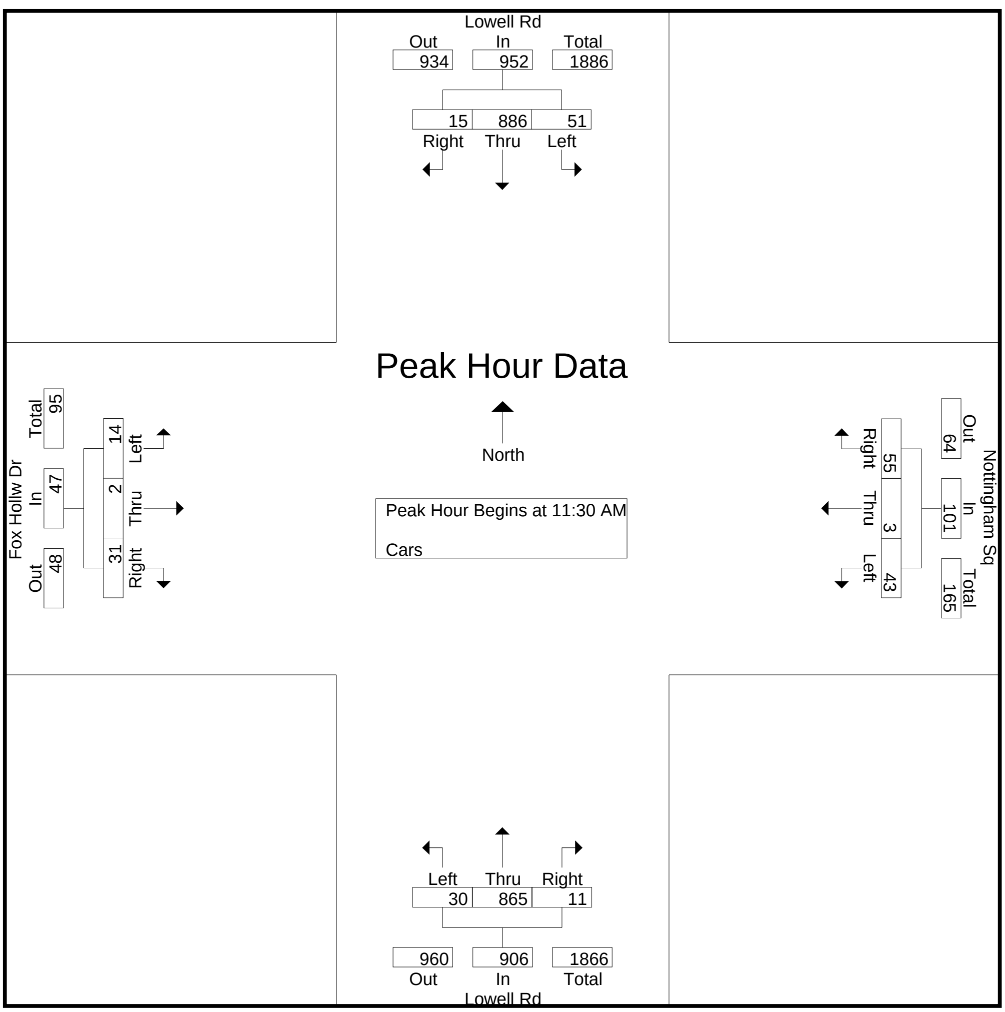
Accurate Counts

978-664-2565

N/S Street : Lowell Road (Route 3A)
E/W Street : Fox Hollow Drive
City/State : Hudson, NH
Weather : Rain

File Name : 170040S1
Site Code : 17004001
Start Date : 3/25/2017

	Lowell Rd From North				Nottingham Sq From East				Lowell Rd From South				Fox Hollw Dr From West				
Start Time	Left	Thru	Right	App. Total	Left	Thru	Right	App. Total	Left	Thru	Right	App. Total	Left	Thru	Right	App. Total	Int. Total
Peak Hour Analysis From 11:00 AM to 01:45 PM - Peak 1 of 1																	
Peak Hour for Entire Intersection Begins at 11:30 AM																	
11:30 AM	12	223	2	237	7	0	15	22	**8**	200	2	210	1	0	10	11	480
11:45 AM	13	220	5	238	10	0	9	19	8	215	**4**	227	4	0	6	10	494
12:00 PM	10	203	**6**	219	**15**	**2**	**18**	**35**	8	223	4	**235**	**5**	**2**	**11**	**18**	507
12:15 PM	**16**	**240**	2	**258**	11	1	13	25	6	**227**	1	234	4	0	4	8	**525**
Total Volume	51	886	15	952	43	3	55	101	30	865	11	906	14	2	31	47	2006
% App. Total	5.4	93.1	1.6		42.6	3	54.5		3.3	95.5	1.2		29.8	4.3	66		
PHF	.797	.923	.625	.922	.717	.375	.764	.721	.938	.953	.688	.964	.700	.250	.705	.653	.955



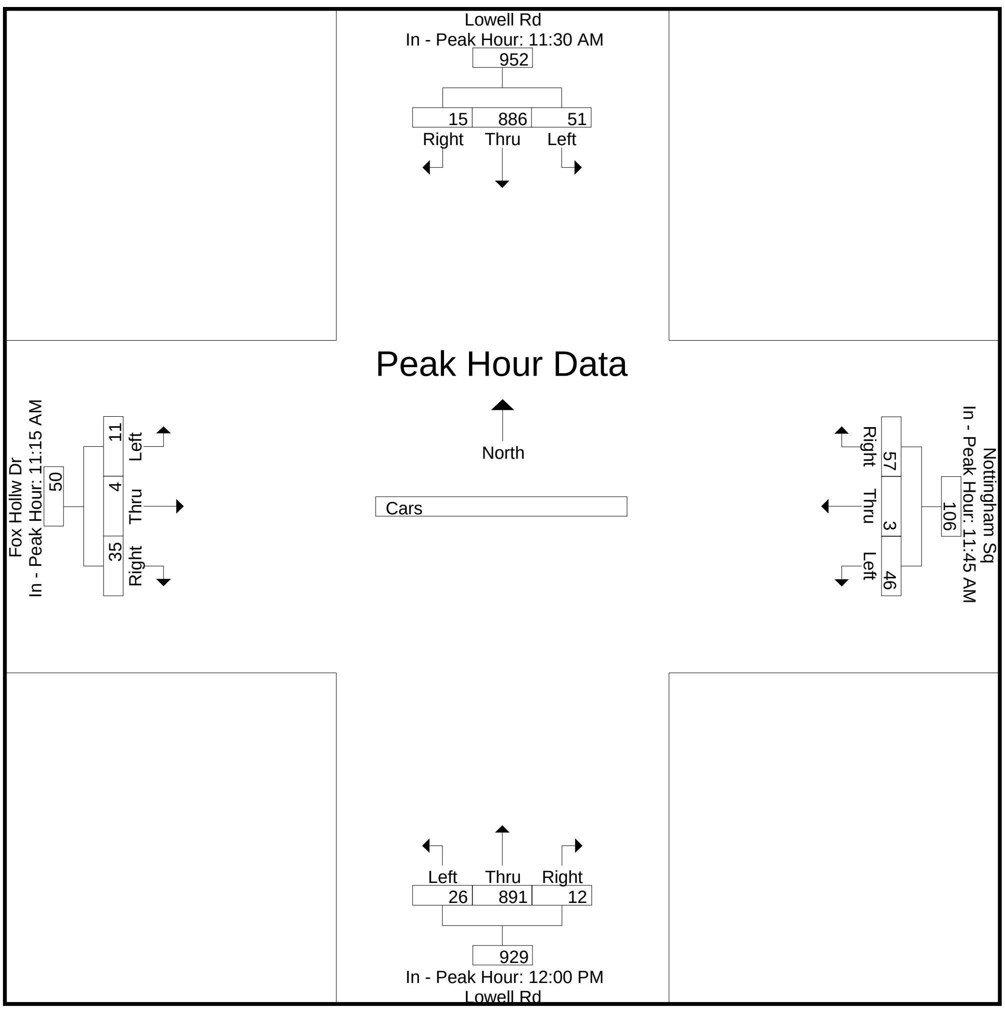
Accurate Counts

978-664-2565

N/S Street : Lowell Road (Route 3A)
E/W Street : Fox Hollow Drive
City/State : Hudson, NH
Weather : Rain

File Name : 170040S1
Site Code : 17004001
Start Date : 3/25/2017
Page No : 6

	Lowell Rd From North				Nottingham Sq From East				Lowell Rd From South				Fox Hollw Dr From West				
Start Time	Left	Thru	Right	App. Total	Left	Thru	Right	App. Total	Left	Thru	Right	App. Total	Left	Thru	Right	App. Total	Int. Total
Peak Hour Analysis From 11:00 AM to 01:45 PM - Peak 1 of 1																	
Peak Hour for Each Approach Begins at:																	
	11:30 AM				11:45 AM				12:00 PM				11:15 AM				
+0 mins.	12	223	2	237	10	0	9	19	**8**	223	**4**	235	1	**2**	8	11	
+15 mins.	13	220	5	238	**15**	**2**	**18**	**35**	6	227	1	234	1	0	10	11	
+30 mins.	10	203	**6**	219	11	1	13	25	7	211	3	221	4	0	6	10	
+45 mins.	**16**	**240**	2	**258**	10	0	17	27	5	**230**	4	**239**	**5**	2	**11**	**18**	
Total Volume	51	886	15	952	46	3	57	106	26	891	12	929	11	4	35	50	
% App. Total	5.4	93.1	1.6		43.4	2.8	53.8		2.8	95.9	1.3		22	8	70		
PHF	.797	.923	.625	.922	.767	.375	.792	.757	.813	.968	.750	.972	.550	.500	.795	.694	



Accurate Counts
978-664-2565

N/S Street : Lowell Road (Route 3A)
E/W Street : Fox Hollow Drive
City/State : Hudson, NH
Weather : Rain

File Name : 170040S1
Site Code : 17004001
Start Date : 3/25/2017
Page No : 7

Groups Printed- Trucks

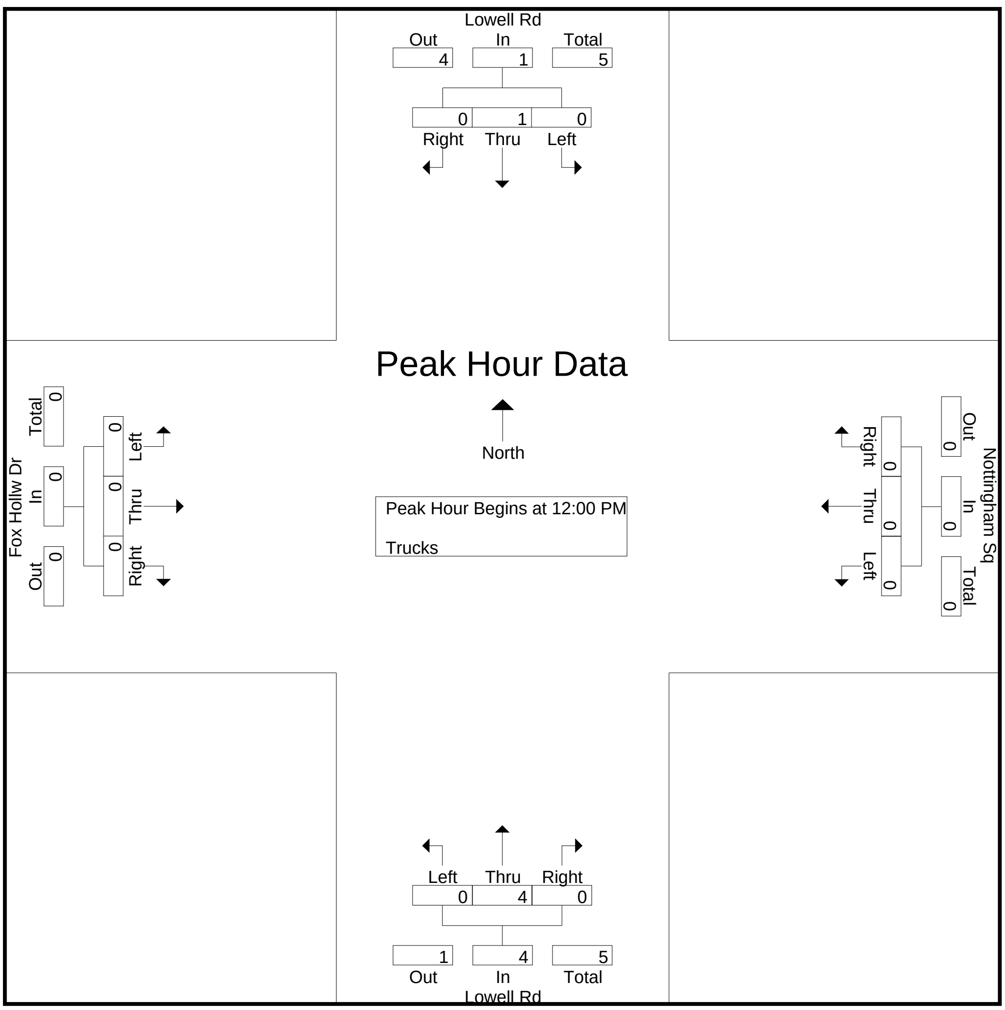
	Lowell Rd From North			Nottingham Sq From East			Lowell Rd From South			Fox Hollw Dr From West			
Start Time	Left	Thru	Right	Left	Thru	Right	Left	Thru	Right	Left	Thru	Right	Int. Total
11:00 AM	0	0	0	0	0	0	0	1	0	0	0	0	1
11:15 AM	0	0	0	0	0	0	0	0	0	0	0	0	0
11:30 AM	0	0	0	0	0	0	0	0	0	0	0	0	0
11:45 AM	0	0	0	0	0	0	0	0	0	0	0	0	0
Total	0	0	0	0	0	0	0	1	0	0	0	0	1
12:00 PM	0	1	0	0	0	0	0	0	0	0	0	0	1
12:15 PM	0	0	0	0	0	0	0	2	0	0	0	0	2
12:30 PM	0	0	0	0	0	0	0	0	0	0	0	0	0
12:45 PM	0	0	0	0	0	0	0	2	0	0	0	0	2
Total	0	1	0	0	0	0	0	4	0	0	0	0	5
01:00 PM	0	0	0	0	0	0	0	0	0	0	0	0	0
01:15 PM	0	0	0	0	0	0	0	0	0	0	0	0	0
01:30 PM	0	0	0	0	0	0	0	0	0	0	0	0	0
01:45 PM	0	0	0	0	0	0	0	0	0	0	0	0	0
Total	0	0	0	0	0	0	0	0	0	0	0	0	0
Grand Total	0	1	0	0	0	0	0	5	0	0	0	0	6
Apprch %	0	100	0	0	0	0	0	100	0	0	0	0	
Total %	0	16.7	0	0	0	0	0	83.3	0	0	0	0	

Accurate Counts
978-664-2565

N/S Street : Lowell Road (Route 3A)
E/W Street : Fox Hollow Drive
City/State : Hudson, NH
Weather : Rain

File Name : 170040S1
Site Code : 17004001
Start Date : 3/25/2017
Page No : 8

	Lowell Rd From North				Nottingham Sq From East				Lowell Rd From South				Fox Hollw Dr From West				
Start Time	Left	Thru	Right	App. Total	Left	Thru	Right	App. Total	Left	Thru	Right	App. Total	Left	Thru	Right	App. Total	Int. Total
Peak Hour Analysis From 11:00 AM to 01:45 PM - Peak 1 of 1																	
Peak Hour for Entire Intersection Begins at 12:00 PM																	
12:00 PM	0	**1**	0	**1**	0	0	0	0	0	0	0	0	0	0	0	0	1
12:15 PM	0	0	0	0	0	0	0	0	0	**2**	0	**2**	0	0	0	0	**2**
12:30 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
12:45 PM	0	0	0	0	0	0	0	0	0	2	0	2	0	0	0	0	2
Total Volume	0	1	0	1	0	0	0	0	0	4	0	4	0	0	0	0	5
% App. Total	0	100	0		0	0	0		0	100	0		0	0	0		
PHF	.000	.250	.000	.250	.000	.000	.000	.000	.000	.500	.000	.500	.000	.000	.000	.000	.625



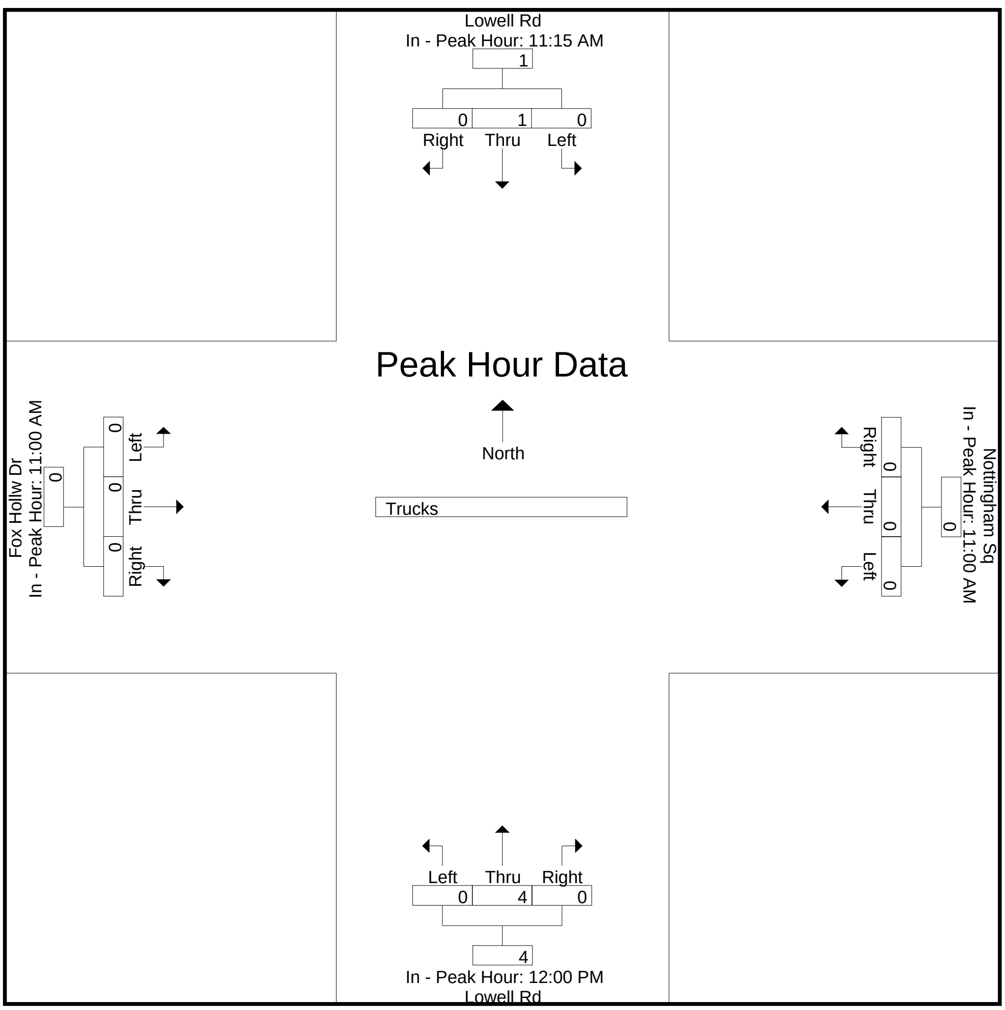
Accurate Counts

978-664-2565

N/S Street : Lowell Road (Route 3A)
E/W Street : Fox Hollow Drive
City/State : Hudson, NH
Weather : Rain

File Name : 170040S1
Site Code : 17004001
Start Date : 3/25/2017

	Lowell Rd From North				Nottingham Sq From East				Lowell Rd From South				Fox Hollw Dr From West				
Start Time	Left	Thru	Right	App. Total	Left	Thru	Right	App. Total	Left	Thru	Right	App. Total	Left	Thru	Right	App. Total	Int. Total
Peak Hour Analysis From 11:00 AM to 01:45 PM - Peak 1 of 1																	
Peak Hour for Each Approach Begins at:																	
	11:15 AM				11:00 AM				12:00 PM				11:00 AM				
+0 mins.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
+15 mins.	0	0	0	0	0	0	0	0	0	**2**	0	**2**	0	0	0	0	
+30 mins.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
+45 mins.	0	**1**	0	**1**	0	0	0	0	0	2	0	2	0	0	0	0	
Total Volume	0	1	0	1	0	0	0	0	0	4	0	4	0	0	0	0	
% App. Total	0	100	0		0	0	0		0	100	0		0	0	0		
PHF	.000	.250	.000	.250	.000	.000	.000	.000	.000	.500	.000	.500	.000	.000	.000	.000	



Accurate Counts
978-664-2565

N/S Street : Lowell Road (Route 3A)
E/W Street : Fox Hollow Drive
City/State : Hudson, NH
Weather : Rain

File Name : 170040S1
Site Code : 17004001
Start Date : 3/25/2017
Page No : 10

Groups Printed- Bikes Peds

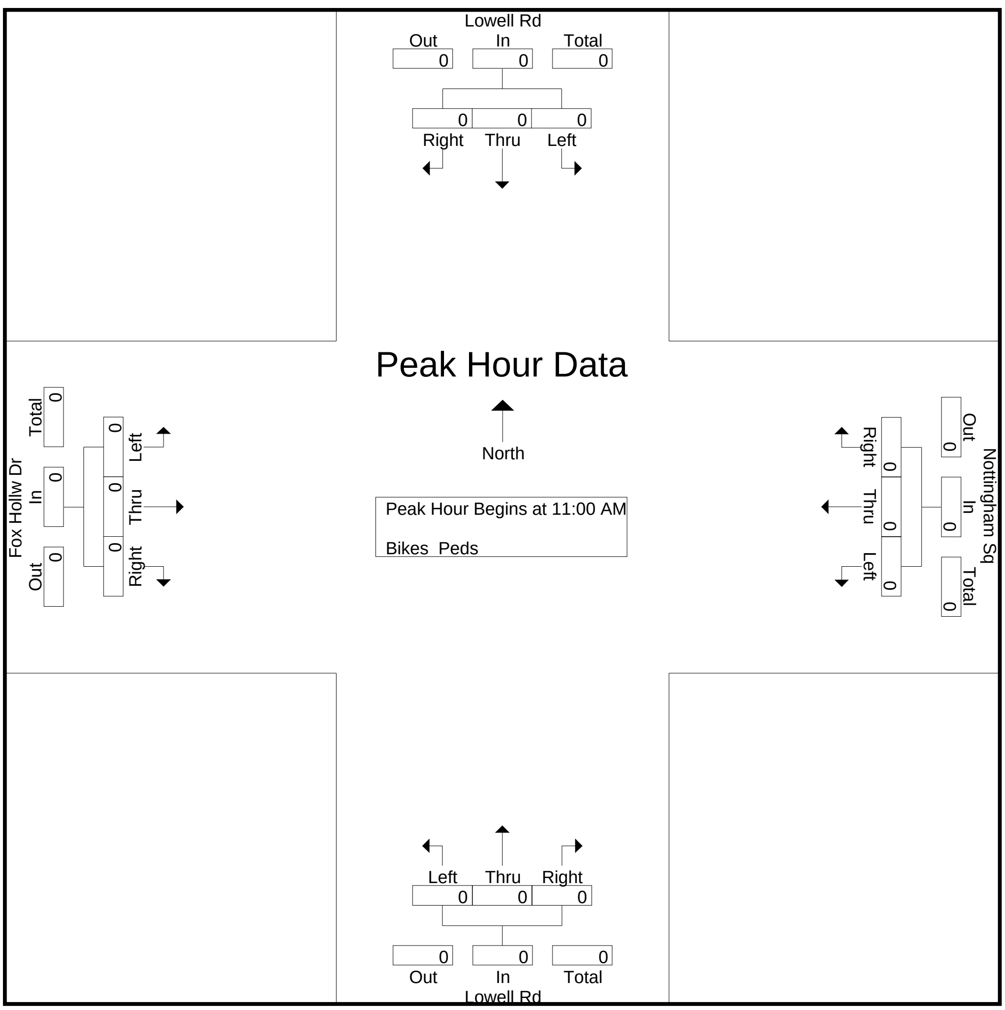
	Lowell Rd From North				Nottingham Sq From East				Lowell Rd From South				Fox Hollw Dr From West						
Start Time	Left	Thru	Right	Peds	Left	Thru	Right	Peds	Left	Thru	Right	Peds	Left	Thru	Right	Peds	Exclu. Total	Inclu. Total	Int. Total
11:00 AM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
11:15 AM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
11:30 AM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
11:45 AM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
12:00 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
12:15 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
12:30 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
12:45 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
01:00 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
01:15 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
01:30 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
01:45 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Grand Total	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Apprch %	0	0	0		0	0	0		0	0	0		0	0	0				
Total %																	0	0	

Accurate Counts
978-664-2565

N/S Street : Lowell Road (Route 3A)
E/W Street : Fox Hollow Drive
City/State : Hudson, NH
Weather : Rain

File Name : 170040S1
Site Code : 17004001
Start Date : 3/25/2017
Page No : 11

	Lowell Rd From North				Nottingham Sq From East				Lowell Rd From South				Fox Hollw Dr From West				
Start Time	Left	Thru	Right	App. Total	Left	Thru	Right	App. Total	Left	Thru	Right	App. Total	Left	Thru	Right	App. Total	Int. Total
Peak Hour Analysis From 11:00 AM to 01:45 PM - Peak 1 of 1																	
Peak Hour for Entire Intersection Begins at 11:00 AM																	
11:00 AM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
11:15 AM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
11:30 AM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
11:45 AM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total Volume	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
% App. Total	0	0	0		0	0	0		0	0	0		0	0	0		
PHF	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000

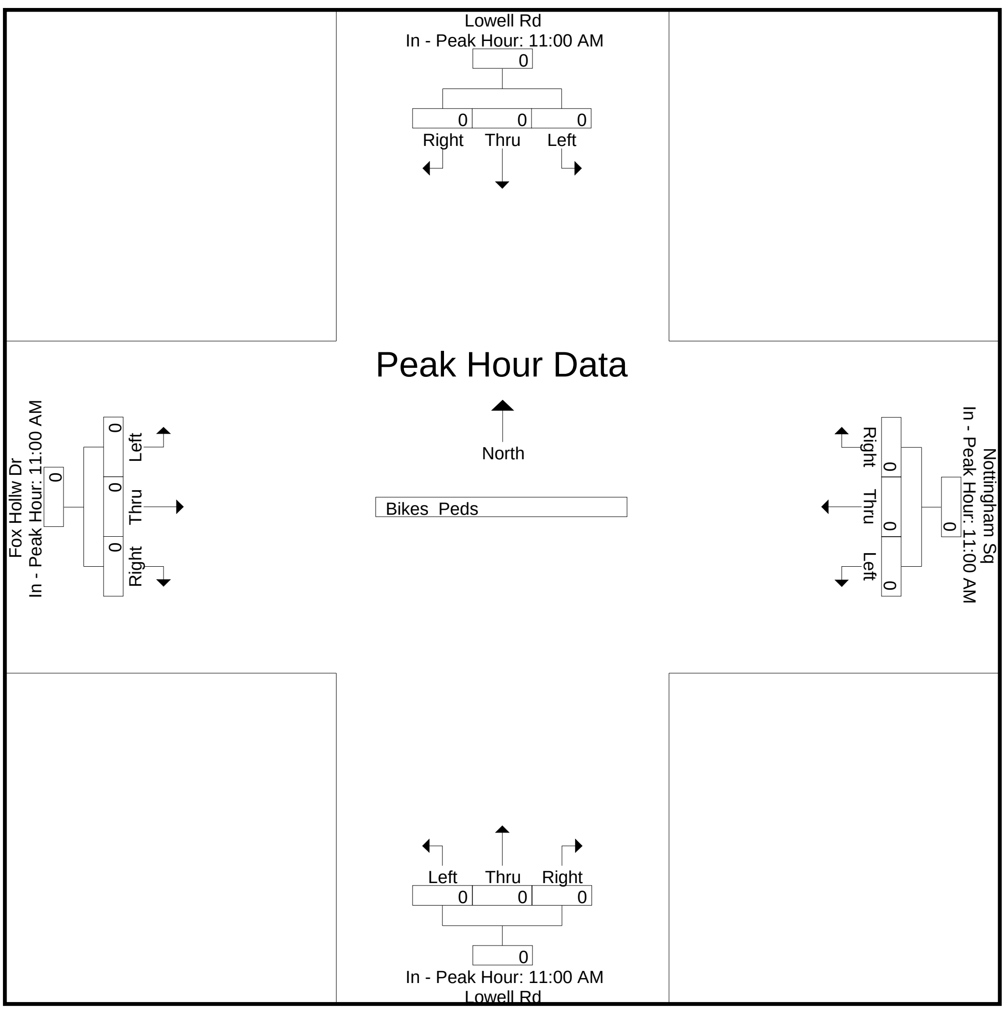


Accurate Counts
978-664-2565

N/S Street : Lowell Road (Route 3A)
E/W Street : Fox Hollow Drive
City/State : Hudson, NH
Weather : Rain

File Name : 170040S1
Site Code : 17004001
Start Date : 3/25/2017

	Lowell Rd From North				Nottingham Sq From East				Lowell Rd From South				Fox Hollw Dr From West				
Start Time	Left	Thru	Right	App. Total	Left	Thru	Right	App. Total	Left	Thru	Right	App. Total	Left	Thru	Right	App. Total	Int. Total
Peak Hour Analysis From 11:00 AM to 01:45 PM - Peak 1 of 1																	
Peak Hour for Each Approach Begins at:																	
	11:00 AM				11:00 AM				11:00 AM				11:00 AM				
+0 mins.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
+15 mins.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
+30 mins.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
+45 mins.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
Total Volume	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
% App. Total	0	0	0		0	0	0		0	0	0		0	0	0		
PHF	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	



Truck Traffic Volume Calculations

Truck Traffic Volume

Traffic counts along the Route 3A Corridor that were conducted in March 2017 for a different project were used to determine the percentage of trucks that use the corridor compared to Automobiles. See below for calculations and results.

Table 1: AM Peak Hour Traffic – Route 3A

Time Period	Total Traffic	Automobile Traffic	Truck Traffic
7 AM – 8 AM	1746	1731	15

Table 2: PM Peak Hour Traffic – Route 3A

Time Period	Total Traffic	Automobile Traffic	Truck Traffic
4 PM – 5 PM	2098	2086	12

Assumptions:

It was assumed that the peak hour k value factor would be 8%, meaning the peak hour traffic volume represents 8% of the Average Daily Traffic (ADT).

Calculations:

Average percent of trucks was calculated by taking the averages between the AM & PM peak hour volumes.

Avg. of AM & PM = (15+12)/2 => 13.5 Trucks, Round up to 14 Trucks

Avg. of AM & PM = (1746+2098)/2 => 1922 Total Traffic

Percent of Trucks = 14/1922 => .00728, round up to .0073, .73% Trucks

Hudson Police Department Crash Data – June 2019

Reportable accidents for the Intersection of Lowell Rd. @ Sagamore Bridge 1/1/2013 - 5/22/2018

YEAR	NUMBER OF ACCIDENTS	NUMBER OF ACCCIDENTS WITH INJURY	FATAL ACCIDENTS
2013	9	1	0
2014	13	2	0
2015	14	1	0
2016	3	1	0
2017	6	1	0
2018	2	0	0

Reportable accidents for the Intersection of Lowell Rd. @ Wason Rd./Flagstone Dr. 1/1/2013 - 5/22/2018

YEAR	NUMBER OF ACCIDENTS	NUMBER OF ACCCIDENTS WITH INJURY	FATAL ACCIDENTS
2013	7	1	0
2014	7	4	1
2015	5	1	0
2016	9	1	0
2017	7	2	0
2018	5	0	0

Reportable accidents for the Intersection of Lowell Rd. @ Hampshire Dr. 1/1/2013 - 5/22/2018

YEAR	NUMBER OF ACCIDENTS	NUMBER OF ACCCIDENTS WITH INJURY	FATAL ACCIDENTS
2013	1	0	0
2015	1	0	0

Reportable accidents for the Intersection of Lowell Rd. @ Executive Dr. 1/1/2013 - 5/22/2018

YEAR	NUMBER OF ACCIDENTS	NUMBER OF ACCCIDENTS WITH INJURY	FATAL ACCIDENTS
2013	3	1	0
2015	1	0	0
2016	1	0	0
2017	2	1	0

Reportable accidents for the Intersection of Lowell Rd. @ Fox Hollow Dr. 1/1/2013 - 5/22/2018

YEAR	NUMBER OF ACCIDENTS	NUMBER OF ACCCIDENTS WITH INJURY	FATAL ACCIDENTS
2014	3	2	0
2015	1	1	0
2017	3	1	0
2018	3	0	0

Reportable accidents for the Intersection of Lowell Rd. @ Pelham Road 1/1/2013 - 5/22/2018

YEAR	NUMBER OF ACCIDENTS	NUMBER OF ACCCIDENTS WITH INJURY	FATAL ACCIDENTS
2013	3	1	0
2014	4	0	0
2015	3	1	0
2016	1	0	0
2018	1	0	0

Reportable accidents for the Intersection of Lowell Rd. @ Birch Street 1/1/2013 - 5/22/2018

YEAR	NUMBER OF ACCIDENTS	NUMBER OF ACCCIDENTS WITH INJURY	FATAL ACCIDENTS
2013	1	0	0
2014	2	0	0
2015	5	2	0
2016	2	0	0
2017	3	0	0

Reportable accidents for the Intersection of Lowell Rd. @ County Road 1/1/2013 - 5/22/2018

YEAR	NUMBER OF ACCIDENTS	NUMBER OF ACCCIDENTS WITH INJURY	FATAL ACCIDENTS
2013	1	0	0
2014	4	2	0
2015	4	2	0
2016	6	0	0
2017	7	2	0

Reportable accidents for the Intersection of Lowell Rd. @ Central Street 1/1/2013 - 5/22/2018

YEAR	NUMBER OF ACCIDENTS	NUMBER OF ACCCIDENTS WITH INJURY	FATAL ACCIDENTS
2013	1	0	0
2014	2	0	0
2015	4	1	0
2016	3	0	0
2017	2	0	0

Reportable accidents for the Intersection of Central St. @ Library Street 1/1/2013 - 5/22/2018

YEAR	NUMBER OF ACCIDENTS	NUMBER OF ACCCIDENTS WITH INJURY	FATAL ACCIDENTS
2013	2	0	0
2014	2	1	0
2015	4	1	0
2016	7	1	0
2017	4	0	0

Reportable accidents for the Intersection of Library Street @ Rte. 111/Rte. 102 1/1/2013 - 5/22/2018

YEAR	NUMBER OF ACCIDENTS	NUMBER OF ACCCIDENTS WITH INJURY	FATAL ACCIDENTS
2013	11	2	0
2014	8	1	0
2015	14	2	0
2016	19	4	0
2017	6	1	0
2018	11	1	0

Reportable accidents for the Intersection of Central Street @ Burnham Road 1/1/2013 - 5/22/2018

YEAR	NUMBER OF ACCIDENTS	NUMBER OF ACCCIDENTS WITH INJURY	FATAL ACCIDENTS
2013	5	0	0
2014	5	0	0
2015	3	0	0
2016	1	0	0

Reportable accidents for the Intersection of Central St. @ Greeley St./Kimball Hill Rd. 1/1/2013 - 5/22/2018

YEAR	NUMBER OF ACCIDENTS	NUMBER OF ACCCIDENTS WITH INJURY	FATAL ACCIDENTS
2013	7	1	0
2014	4	2	0
2015	7	0	0
2016	8	0	0
2017	6	3	0
2018	3	0	0

Reportable accidents for the Intersection of Lowell Rd. @ County Road 5/22/2018 - 5/27/2019

YEAR	NUMBER OF ACCIDENTS	NUMBER OF ACCCIDENTS WITH INJURY	FATAL ACCIDENTS
2018	2	0	0
2019	3	1	0

Reportable accidents for the Intersection of Lowell Rd. @ Central Street 5/22/2018 - 5/27/2019

YEAR	NUMBER OF ACCIDENTS	NUMBER OF ACCCIDENTS WITH INJURY	FATAL ACCIDENTS
2018	0	0	0
2019	0	0	0

Reportable accidents for the Intersection of Central St. @ Library Street 5/22/2018 - 5/27/2019

YEAR	NUMBER OF ACCIDENTS	NUMBER OF ACCCIDENTS WITH INJURY	FATAL ACCIDENTS
2018	2	0	0
2019	0	0	0

Reportable accidents for the Intersection of Library Street @ Rte. 111/Rte. 102 5/22/2018 - 5/27/2019

YEAR	NUMBER OF ACCIDENTS	NUMBER OF ACCCIDENTS WITH INJURY	FATAL ACCIDENTS
2018	12	4	0
2019	6	2	0

Reportable accidents for the Intersection of Central Street @ Burnham Road 5/22/2018 - 5/27/2019

YEAR	NUMBER OF ACCIDENTS	NUMBER OF ACCCIDENTS WITH INJURY	FATAL ACCIDENTS
2018	2	2	0
2019	2	0	0

Reportable accidents for the Intersection of Central St. @ Greeley St./Kimball Hill Rd. 5/22/2018 - 5/27/2019

YEAR	NUMBER OF ACCIDENTS	NUMBER OF ACCCIDENTS WITH INJURY	FATAL ACCIDENTS
2018	2	1	0
2019	3	0	0

Reportable accidents for the Intersection of Lowell Rd. @ Sagamore Bridge 5/22/2018 - 5/27/2019

YEAR	NUMBER OF ACCIDENTS	NUMBER OF ACCCIDENTS WITH INJURY	FATAL ACCIDENTS
2018	8	2	0
2019	12	2	0

Reportable accidents for the Intersection of Lowell Rd. @ Wason Rd./Flagstone Dr. 5/22/2018 - 5/27/2019

YEAR	NUMBER OF ACCIDENTS	NUMBER OF ACCCIDENTS WITH INJURY	FATAL ACCIDENTS
2018	4	1	0
2019	6	0	0

Reportable accidents for the Intersection of Lowell Rd. @ Hampshire Dr. 5/22/2018 - 5/27/2019

YEAR	NUMBER OF ACCIDENTS	NUMBER OF ACCCIDENTS WITH INJURY	FATAL ACCIDENTS
2018	1	0	0
2019	0	0	0

Reportable accidents for the Intersection of Lowell Rd. @ Executive Dr. 5/22/2018 - 5/27/2019

YEAR	NUMBER OF ACCIDENTS	NUMBER OF ACCCIDENTS WITH INJURY	FATAL ACCIDENTS
2018	3	1	0
2019	5	2	0

Reportable accidents for the Intersection of Lowell Rd. @ Pelham Road 5/22/2018 - 5/27/2019

YEAR	NUMBER OF ACCIDENTS	NUMBER OF ACCCIDENTS WITH INJURY	FATAL ACCIDENTS
2018	4	0	0
2019	0	0	0

Reportable accidents for the Intersection of Lowell Rd. @ Birch Street 5/22/2018 - 5/27/2019

YEAR	NUMBER OF ACCIDENTS	NUMBER OF ACCCIDENTS WITH INJURY	FATAL ACCIDENTS
2018	2	1	0
2019	1	0	0

Reportable accidents for the Intersection of Lowell Rd. @ Fox Hollow Dr. 5/22/2018 - 5/27/2019

YEAR	NUMBER OF ACCIDENTS	NUMBER OF ACCCIDENTS WITH INJURY	FATAL ACCIDENTS
2018	1	0	0
2019	0	0	0

Guidance on Treatment of Economic Value of Statistical Life

U.S. Department of Transportation
Office of the Secretary
Of Transportation

1200 New Jersey Ave., S.E.
Washington, DC 20590

August 8, 2016

MEMORANDUM TO: SECRETARIAL OFFICERS
MODAL ADMINISTRATORS

From: Molly J. Moran
Acting General Counsel, x64702

Carlos Monje
Assistant Secretary for Transportation Policy, x60396

Subject: Guidance on Treatment of the Economic Value of a Statistical Life (VSL) in U.S. Department of Transportation Analyses – 2016 Adjustment

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Departmental guidance on valuing the reduction of fatalities and injuries by regulations or investments has been published periodically by this office since 1993. We issued a thorough revision of our guidance in 2013 and indicated that we planned to issue annual updates to adjust for changes in prices and real incomes since then.

Our 2013 revision indicated a VSL of $9.1 million in current dollars for analyses using a base year of 2012, which was updated to $9.4 million in the 2015 guidance for analyses using a base year of 2014. Using the 2015 value as a baseline, and taking into account both changes in prices and changes in real incomes, we now find that these changes over the past year result in an increased VSL of $9.6 million for analyses prepared in 2016. The procedure for adjusting VSL for changes in prices and real incomes is described on pages 8-9 of the guidance.

This guidance also includes a table of the relative values of preventing injuries of varied severity as a fraction of the VSL; these fractions remain unchanged since the 2013 guidance. We also prescribe a sensitivity analysis of the effects of using alternative VSL values. Instead of treating alternative values in terms of a probability distribution, analysts should apply only a test of low and high alternative values of $5.4 million and $13.4 million (in 2015 dollars).

This guidance and other relevant documents will be posted on the Office of Transportation Policy website, http://www.dot.gov/policy/transportation-policy/economy , and on the General Counsel's regulatory information website, http://www.transportation.gov/regulations. Questions should be addressed to Darren Timothy, (202) 366-4051 or darren.timothy@dot.gov.

cc: Regulations officers and liaison officers

Revised Departmental Guidance 2016:

Treatment of the Value of Preventing Fatalities and Injuries in Preparing Economic Analyses

On the basis of the best available evidence, this guidance identifies **$9.6 million as the value of a statistical life to be used for Department of Transportation analyses assessing the benefits of preventing fatalities and using a base year of 2015**. It also establishes policies for assigning comparable values to prevention of injuries.

Background

Prevention of injury, illness, and loss of life is a significant factor in many private economic decisions, including job choices and consumer product purchases. When government makes direct investments or controls external market impacts by regulation, it also pursues these benefits, often while also imposing costs on society. The Office of the Secretary of Transportation and other DOT administrations are required by Executive Order 13563, Executive Order 12866, Executive Order 12893, OMB Circular A-4, and DOT Order 2100.5 to evaluate in monetary terms the costs and benefits of their regulations, investments, and administrative actions, in order to demonstrate the faithful execution of their responsibilities to the public. Since 1993, the Office of the Secretary of Transportation has periodically reviewed the published research on the value of safety and updated guidance for all administrations. Our previous guidance revision, issued on February 28, 2013, stated that we planned to update our guidance annually to adjust for changes in prices and real incomes. This guidance updates our values based on 2015 prices and real incomes.

The benefit of preventing a fatality is measured by what is conventionally called the Value of a Statistical Life (VSL), defined as the additional cost that individuals would be willing to bear for improvements in safety (that is, reductions in risks) that, in the aggregate, reduce the expected number of fatalities by one. This conventional terminology has often provoked misunderstanding on the part of both the public and decision-makers. What is involved is not the valuation of life as such, but the valuation of reductions in risks. While new terms have been proposed to avoid misunderstanding, we will maintain the common usage of the research literature and OMB Circular A-4 in referring to VSL.

Most regulatory actions involve the reduction of risks of low probability (as in, for example, a one-in-10,000 annual chance of dying in an automobile crash). For these low-probability risks, we shall assume that the willingness to pay to avoid the risk of a fatal injury increases proportionately with growing risk. That is, when an individual is willing to pay $1,000 to reduce the annual risk of death by one in 10,000, she is said to have a VSL of $10 million. The assumption of a linear relationship between risk and willingness to pay therefore implies that she would be willing to pay $2,000 to reduce risk by two in 10,000 or $5,000 to reduce risk by five in 10,000. The assumption of a linear relationship between risk and willingness to pay (WTP) breaks down when the annual WTP becomes a substantial portion of annual income, so the assumption of a constant VSL is not appropriate for substantially larger risks.

When first applied to benefit-cost analysis in the 1960s and 1970s, the value of saving a life was measured by the potential victim's expected earnings, measuring the additional product society might have lost. These lost earnings were widely believed to understate the real costs of loss of life, because the value that we place on the continued life of our family and friends is not based entirely, or even principally, on their earning capacity. In recent decades, studies based on estimates of individuals' willingness to pay for improved safety have become widespread, and offer a way of measuring the value of reduced risk in a more comprehensive way. These estimates of the individual's value of safety are then treated as the ratio of the individual marginal utility of safety to the marginal utility of wealth. These estimates of the individual values of changes in safety can then be aggregated to produce estimates of social benefits of changes in safety, which can then be compared with the costs of these changes.

Studies estimating the willingness to pay for safety fall into two categories. Some analyze subjects' responses in real markets, and are referred to as revealed preference (RP) studies, while others analyze subjects' responses in hypothetical markets, and are described as stated preference (SP) studies. Revealed preference studies in turn can be divided into studies based on consumer purchase decisions and studies based on employment decisions (usually referred to as hedonic wage studies). Even in revealed preference studies, safety is not purchased directly, so the value that consumers place upon it cannot be measured directly. Instead, the value of safety can be inferred from market decisions that people make in which safety is one factor in their decisions. In the case of consumer purchase decisions, since goods and services usually display multiple attributes, and are purchased for a variety of reasons, there is no guarantee that safety will be the conclusive factor in any purchasing decision (note that even products like bicycle helmets, which are purchased primarily for safety, also vary in style, comfort, and durability). Similarly, in employment decisions, safety is one of many considerations in the decision of which job offer to accept. Statistical techniques must therefore be used to identify the relative influence of price (or wage), safety, and other qualitative characteristics of the product or job on the consumer's or worker's decision on which product to buy or which job to accept.

An additional complication in RP studies is that, even if the real risks confronted by individuals can be estimated accurately by the analyst, the consumer or employee may not estimate these risks accurately. It is possible for individuals, through lack of relevant information or limited ability to analyze risks, to assign an excessively low or high probability to fatal risks. Alternatively, detailed familiarity with the hazards they face and their own skills may allow individuals to form more accurate estimates of risk at, for example, a particular job-site than those derived by researchers, which inevitably are based on more aggregate data.

In the SP approach, market alternatives incorporating hypothetical risks are presented to test subjects, who respond with what they believe would be their choices. Answers to hypothetical questions may provide helpful information, but they remain hypothetical. Although great pains are usually taken to communicate probabilities and measure the subjects' understanding, there is no assurance that individuals' predictions of their own behavior would be observed in practice. Against this weakness, the SP method can evaluate many more alternatives than those for which market data are available, and it can guarantee that risks are described objectively to subjects. With indefinitely large potential variations in cost and risk and no uncontrolled variation in any other dimension, some of the objections to RP models are obviated. Despite procedural safeguards, however, SP studies have not proven consistently successful in estimating measures of WTP that increase proportionally with greater risks.

RP studies involving decisions to buy and/or use various consumer products have focused on decisions such as buying cars with better safety equipment, wearing seat belts or helmets, or buying and installing smoke detectors. These studies often lack a continuum of price-risk opportunities, so that the price paid for a safety feature (such as a bicycle helmet) does not necessarily represent the value that the consumer places on the improvement in safety that the helmet provides. In the case of decisions to use a product (like a seatbelt) rather than to buy the product, the "price" paid by the consumer must be inferred from the amount of time and degree of inconvenience involved in using the product, rather than the directly observable price of buying the product. The necessity of making these inferences introduces possible sources of error. Studies of purchases of automobiles probably are less subject to these problems than studies of other consumer decisions, because the price of the safety equipment is directly observable, and there are usually a variety of more or less expensive safety features that provide more of a range of price-risk trade-offs for consumers to make.

While there are many examples of SP studies and RP studies involving consumer product purchases, the most widely cited body of research comprises hedonic wage studies, which estimate the wage differential that employers must pay workers to accept riskier jobs, taking other factors into account. Besides the problem of identifying and quantifying these factors, researchers must have a reliable source of data on fatality and injury risks and also assume that workers' psychological risk assessment conforms to the objective data. The accuracy of hedonic wage studies has improved over the last decade with the availability of more complete data from the Bureau of Labor Statistics' (BLS) Census of Fatal Occupational Injuries (CFOI), supported by advances in econometric modeling, including the use of panel data from the Panel Study of Income Dynamics (PSID). The CFOI data are, first of all, a complete census of occupational fatalities, rather than a sample, so they allow more robust statistical estimation. Second, they classify occupational fatalities by both industry and occupation, allowing variations in fatalities across both dimensions to be compared with corresponding variations in wage rates. Some of the new studies use panel data to analyze the behavior of workers who switch from one job to another, where the analysis can safely assume that any trade-off between wage levels and risk reflects the preferences of a single individual, and not differences in preferences among individuals.

VSL estimates are based on studies of groups of individuals that are covered by the study, but those VSL estimates are then applied to other groups of individuals who were not the subjects of the original studies. This process is called benefit transfer. One issue that has arisen in studies of VSL is whether this benefit transfer process should be applied broadly over the general population of people that are affected by a rulemaking, or whether VSL should be estimated for particular subgroups, such as workers in particular industries, and people of particular ages, races, and genders. Advances in data and econometric techniques have allowed specialized estimates of VSL for these population subgroups. Safety regulations issued by the Department of Transportation typically affect a broad cross-section of people, rather than more narrowly defined subgroups. For that, and other policy reasons, we do not consider variations in VSL among different population groups in this guidance.

Principles and policies of DOT guidance

This guidance for the conduct of Department of Transportation analyses is a synthesis of empirical estimates, practical adaptations, and social policies. We continue to explore new empirical literature as it appears and to give further consideration to the policy resolutions embodied in this guidance. Although our current approach is unchanged from previous guidance, the numbers and their sources are new, consistent with OMB guidance in Circular A-4 and with the use of the best available evidence. The methods we adopt are:

1. Prevention of an expected fatality is assigned a single, nationwide value in each year, regardless of the age, income, or other distinct characteristics of the affected population, the mode of travel, or the nature of the risk. When Departmental actions have distinct impacts on infants, disabled passengers, or the elderly, no adjustment to VSL should be made, but analysts should call the attention of decision-makers to the special character of the beneficiaries.
2. The value to be used by all DOT administrations will be published annually by the Office of the Secretary of Transportation.
3. Alternative high and low benefit estimates should be prepared, using a range of VSLs prescribed on pages 11-12 of this guidance

2008 VSL Guidance Update

In Circular A-4 (2003), the Office of Management and Budget endorsed VSL values between $1 million and $10 million[1], drawing on two then recently completed VSL meta-analyses.[2] . The basis for our 2008 guidance comprised five studies, four of which were meta-analyses that synthesized many primary studies, identifying their sources of variation and estimating the most likely common parameters. These studies were written by Ted R. Miller;[3] Ikuho Kochi, Bryan Hubbell, and Randall Kramer;[4] W. Kip Viscusi;[5] Janusz R. Mrozek and Laura O. Taylor;[6] and W. Kip Viscusi and Joseph Aldy.[7] They narrowed VSL estimates to the $2 million to $7 million range in dollar values of the original data, between 1995 and 2000 (about $3 million to

[1] In 2015 dollars, these values would be between $1.3 million and $13 million.
[2] Viscusi, W. K. and J.E. Aldy (2003). "The Value of a Statistical Life: A Critical Review of Market Estimates Throughout the World." *Journal of Risk and Uncertainty*, 27(1): 5-76; and Mrozek, J.R. and L. O. Taylor (2002). "What Determines the Value of a Life? A Meta-Analysis." *Journal of Policy Analysis and Management*. 21(2).
[3] Miller, T. R. (2000). "Variations between Countries in Values of Statistical Life." *Journal of Transport Economics and Policy*. 34(2): 169-188. http://www.bath.ac.uk/e-journals/jtep/pdf/Volume_34_Part_2_169-188.pdf
[4] Kochi, I., B. Hubbell, and R. Kramer (2006). "An Empirical Bayes Approach to Combining and Comparing Estimates of the Value of a Statistical Life for Environmental Policy Analysis." *Environmental and Resource Economics.* 34(3): 385-406.
[5] Viscusi, W. K. (2004). "The Value of Life: Estimates with Risks by Occupation and Industry." *Economic Inquiry.* 42(1): 29-48.
[6] Mrozek, J. R., and L. O. Taylor (2002). "What Determines the Value of Life? A Meta-Analysis." *Journal of Policy Analysis and Management.* 21(2).
[7] Viscusi, W. K. and J. E. Aldy (2003). "The Value of a Statistical Life: A Critical Review of Market Estimates Throughout the World." *Journal of Risk and Uncertainty*. 27(1): 5-76.

$9 million at current prices). Miller and Viscusi and Aldy also estimated income elasticities for VSL (the percent increase in VSL per one percent increase in income). Miller's estimates were close to 1.0, while Viscusi and Aldy estimated the elasticity to be between 0.5 and 0.6. DOT used the Viscusi and Aldy elasticity estimate (averaged to 0.55), along with the Wages and Salaries component of the Employer Cost for Employee Compensation, as well as price levels represented by the Consumer Price Index, to project these estimates to a 2007 VSL estimate of $5.8 million.

2013 VSL Guidance Update

Since these studies were published, the credibility of these meta-analyses has been qualified by recognition of weaknesses in the data used by the earlier primary studies whose results are synthesized in the meta-analyses. We now believe that the most recent primary research, using improved data (particularly the CFOI data discussed above) and specifications, provides more reliable results. This conclusion is based in part on the advice of a panel of expert economists that we convened to advise us on this issue. The panel consisted of Maureen Cropper (University of Maryland), Alan Krupnick (Resources for the Future), Al McGartland (Environmental Protection Agency), Lisa Robinson (independent consultant), and W. Kip Viscusi (Vanderbilt University). The Panel unanimously concluded that we should base our guidance only on hedonic wage studies completed within the past 10 years that made use of the CFOI database and used appropriate econometric techniques.

A White Paper prepared for the U.S. Environmental Protection Agency (EPA) in 2010 identified eight hedonic wage studies using the CFOI data;[8] we also identified seven additional studies, including five published since the EPA White Paper was issued (see Table 1). Some of these studies focus on estimating VSL values for narrowly defined economic, demographic, or occupational categories, or use inappropriate econometric techniques, resulting in implausibly high VSL estimates. We therefore focused on nine studies that we think are useful for informing an appropriate estimate of VSL. There is broad agreement among researchers that these newer hedonic wage studies provide an improved basis for policy-making.[9]

The 15 hedonic wage studies we have identified that make use of the CFOI database to estimate VSL are listed in Table 1. Several of these studies focus on estimating how VSL varies for different categories of people, such as males and females,[10] older workers and younger workers,[11] blacks and whites,[12] immigrants and non-immigrants,[13] and smokers and non-

[8] U.S. Environmental Protection Agency (2010), *Valuing Mortality Risk Reductions for Environmental Policy: A White Paper (Review Draft)*. Prepared by the National Center for Environmental Economics for consultation with the Science Advisory Board – Environmental Economics Advisory Committee.

[9] A current survey of theoretical and empirical research on VSL may be found in: Cropper, M., J.K. Hammitt, and L.A. Robinson (2011). "Valuing Mortality Risk Reductions: Progress and Challenges." *Annual Review of Resource Economics.* 3: 313-336. http://www.annualreviews.org/doi/abs/10.1146/annurev.resource.012809.103949

[10] Leeth, J.D. and J. Ruser (2003). "Compensating Wage Differentials for Fatal and Nonfatal Injury Risks by Gender and Race." *Journal of Risk and Uncertainty*, 27(3): 257-277.

[11] Kniesner, T.J., W.K. Viscusi, and J.P. Ziliak (2006). "Life-Cycle Consumption and the Age-Adjusted Value of Life." *Contributions to Economic Analysis and Policy*. 5(1): 1-34; Viscusi, W.K. and J.E. Aldy (2007). "Labor Market Estimates of the Senior Discount for the Value of Statistical Life." *Journal of Environmental Economics and Management*. 53: 377-392; Aldy, J.E. and W.K. Viscusi (2008). "Adjusting the Value of a Statistical Life for

smokers,[14] as well as for different types of fatality risks.[15] Some of these studies do not estimate an overall "full-sample" VSL, instead estimating VSL values only for specific categories of people. Some of the studies, as the authors themselves sometimes acknowledge, arrive at implausibly high values of VSL, because of econometric specifications which appear to bias the results, or because of a focus on a narrowly-defined occupational group. Moreover, these papers generally offer multiple model specifications, and it is often not clear (even to the authors) which specification most accurately represents the actual VSL. We have generally chosen the specification that the author seems to believe is best. In cases where the author does not express a clear preference, we have had to average estimates based on alternative models within the paper to get a representative estimate for the paper as a whole.

Table 1: VSL Studies Using CFOI Database

(VSLs in millions of dollars)

	Study	Year of Study $	VSL in Study-Year $	VSL in 2012$	Comments
1.	Viscusi (2003) *	1997	$14.185M	$21.65M	Implausibly high; industry-only risk measure
2.	Leeth and Ruser (2003) *	2002	$7.04M	$8.90M	Occupation-only risk measure
3.	Viscusi (2004)	1997	$4.7M	$7.17M	Industry/occupation risk measure
4.	Kniesner and Viscusi (2005)	1997	$4.74M	$7.23M	Industry/occupation risk measure
5.	Kniesner *et al*. (2006) *	1997	$23.70M	$36.17M	Implausibly high; industry/occupation risk measure
6.	Viscusi and Aldy (2007) *	2000			Industry-only risk measure; no full-sample VSL estimate
7.	Aldy and Viscusi (2008) *	2000			Industry-only risk measure, no full-sample VSL estimate
8.	Evans and Smith (2008)	2000	$9.6M	$12.84M	Industry-only risk measure

Age and Cohort Effects." *Review of Economics and Statistics*. 90(3): 573-581; and Evans, M.F. and G. Schaur (2010). "A Quantile Estimation Approach to Identify Income and Age Variation in the Value of a Statistical Life." *Journal of Environmental Economics and Management*. 59: 260-270.

[12] Viscusi, W.K. (2003). "Racial Differences in Labor Market Values of a Statistical Life." *Journal of Risk and Uncertainty*. 27(3): 239-256, and Leeth, J.D. and J. Ruser (2003), *op. cit*.

[13] Hersch, J. and W.K. Viscusi (2010). "Immigrant Status and the Value of Statistical Life." *Journal of Human Resources*. 45(3): 749-771.

[14] Viscusi, W.K. and J. Hersch (2008). "The Mortality Cost to Smokers." *Journal of Health Economics*. 27: 943-958.

[15] Scotton, C.R. and L.O. Taylor. "Valuing Risk Reductions: Incorporating Risk Heterogrneity into a Revealed Preference Framework." *Resource and Energy Economics*. 33 and Kochi, I and L.O. Taylor (2011). "Risk Heterogeneity and the Value of Reducing Fatal Risks: Further Market-Based Evidence." *Journal of Benefit-Cost Analysis*. 2(3): 381-397.

9.	Viscusi and Hersch (2008)	2000	$7.37M	$9.86M	Industry-only risk measure
10.	Evans and Schaur (2010)	1998	$6.7M	$9.85M	Industry-only risk measure
11.	Hersch and Viscusi (2010)	2003	$6.8M	$8.43M	Industry/occupation risk measure
12.	Kniesner *et al*. (2010)	2001	$7.55M	$9.76M	Industry/occupation risk measure
13.	Kochi and Taylor (2011)*	2004			VSL estimated only for occupational drivers
14.	Scotton and Taylor (2011)	1997	$5.27M	$8.04M	Industry/occupation risk measure; VSL is mean of estimates from three preferred specifications
15.	Kniesner *et al*. (2012)	2001	$4M - $10M	$5.17M - $12.93M	Industry/occupation risk measure; mean VSL estimate is $9.05M

* Studies shown in grayed-out rows were not used in determining the VSL Guidance value.

We found that nine of these studies provided usable estimates of VSL for a broad cross-section of the population.[16] We excluded Viscusi (2003) and Kniesner *et al*. (2006) on the grounds that their estimates of VSL were implausibly high (Viscusi acknowledges that the estimated VSLs in his study are very high). We excluded Leeth and Ruser (2003) because it used only variations in occupation for estimating variation in risk (the occupational classifications are generally regarded as less accurate than the industry classifications). We excluded Viscusi and Aldy (2007) and Aldy and Viscusi (2008) because they did not estimate overall "full-sample" VSLs (they focused instead on estimating VSLs for various subgroups). We excluded Kochi and Taylor (2011) because it estimated VSL only for a narrow occupational group (occupational drivers). For Scotton and Taylor (2011) and Kniesner *et al*. (2012) we calculated average values for VSL from what appeared to be the preferred model specifications. For our 2013 guidance, we adopted the average of the VSLs estimated in the remaining nine studies, updated to 2012 dollars (based both on changes in the price level and changes in real incomes from the year for which the VSL was originally estimated). This average was $9.14 million, which we rounded to $9.1 million for purposes of that guidance.

[16] In addition to Viscusi (2004) [cited in footnote 4], Viscusi and Hersch (2008) [cited in footnote 13], Evans and Schaur (2010) [cited in footnote 10], Hersch and Viscusi (2010) [cited in footnote 12], and Scotton and Taylor (2011) [cited in footnote 14], these include Kniesner, T.J. and W.K. Viscusi (2005). "Value of a Statistical Life: Relative Position vs. Relative Age." *AEA Papers and Proceedings*. 95(2): 142-146; Evans, M.F. and V.K. Smith (2008). "Complementarity and the Measurement of Individual Risk Tradeoffs: Accounting for Quantity and Quality of Life Effects." National Bureau of Economic Research Working Paper 13722; Kniesner, T.J., W.K. Viscusi, and J.P. Ziliak (2010). "Policy Relevant Heterogeneity in the Value of Statistical Life: New Evidence from Panel Data Quantile Regressions." *Journal of Risk and Uncertainty*. 40: 15-31; and Kniesner, T.J., W.K. Viscusi, C. Woock, and J.P. Ziliak (2012). "The Value of a Statistical; Life: Evidence from Panel Data." *Review of Economics and Statistics*. 94(1): 74-87.

Adjustments for Inflation and Real Income Growth

Updating the VSL from the original base year to a new base year involves adjusting for inflation and real incomes over the intervening years. Specifically, the formula used is:

$$VSL_T = VSL_0 * (P_T / P_0) * (I_T / I_0)^{\varepsilon}$$

where

0 = Original Base Year
T = Updated Base Year
P_t = Price Index in Year t
I_t = Real Incomes in Year t
ε = Income Elasticity of VSL.

Inflation. This guidance uses the Consumer Price Index for All Urban Consumers Current Series (CPI) to adjust for inflation over time, as this price index is deemed to be representative of changes in the value of money that would be considered by a typical worker making decisions corresponding to his income level. This index grew by 3.23 percent from 2012 to 2015.

Real Incomes. The index we use to measure real income growth as it affects VSL is the Median Usual Weekly Earnings (MUWE), in constant (1982-84) dollars, derived by BLS from the Current Population Survey (Series LEU0252881600 – not seasonally adjusted). This series is more appropriate than the Wages and Salaries component of the Employment Cost Index (ECI), which we used previously, because the ECI applies fixed weights to employment categories, while the weekly earnings series uses a median employment cost for wage and salary workers over the age of 16. A median value is preferred because it should better reflect the factors influencing a typical traveler affected by DOT actions (very high incomes would cause an increase in the mean, but not affect the median). In contrast to a median, an average value over all income levels might be unduly sensitive to factors that are less prevalent among actual travelers. Similarly, we do not take into account changes in non-wage income, on the grounds that this non-wage income is not likely to be significant for the average person affected by our rules. While the constant dollar MUWE has been relatively flat over the past two decades, it grew by 1.79 percent from 2012 to 2015.

Income Elasticity. The VSL literature is generally in agreement that VSL increases with real incomes, but the exact rate at which it does so is subject to some debate. In our 2011 guidance, we cited research by Viscusi and Aldy (2003) that estimated the elasticity of VSL with respect to increases in real income as being between 0.5 and 0.6 (i.e., a one-percent increase in real income results in an increase in VSL of 0.5 to 0.6 percent). We accordingly increased VSL by 0.55 percent for every one-percent increase in real income. More recent research by Kniesner, Viscusi, and Ziliak (2010) has derived more refined income elasticity estimates ranging from 2.24 at low incomes to 1.23 at high incomes, with an overall figure of 1.44.[17] An alternative specification yielded an overall elasticity of 1.32. Similarly, Costa and Kahn (2004) estimated

[17] Kniesner, T.J., W.K. Viscusi, and J.P. Ziliak (2010). "Policy Relevant Heterogeneity in the Value of Statistical Life: New Evidence from Panel Data Quantile Regressions." *Journal of Risk and Uncertainty.* 40(1):15–31.

the income-elasticity of VSL to be between 1.5 and 1.6.[18] These empirical results are consistent with theoretical arguments suggesting that the income-elasticity of VSL should be greater than 1.0.[19]

In view of the large increase in the income elasticity of VSL that would be suggested by these empirical results, and because the literature seems somewhat unsettled, we decided in our 2013 guidance to increase our suggested income-elasticity figure only to 1.0. While this figure is lower than the elasticity estimates of Kniesner *et al.* and Costa and Kahn, it is higher than that of Viscusi and Aldy, the basis for our previous guidance. It is difficult to state with confidence whether a cross-sectional income elasticity (such as those estimated in these empirical analyses), representing the difference in sensitivity to fatality risks between low-income and high-income workers in a given population, corresponds to a longitudinal elasticity, representing the way in which VSL is affected by growth in income over time for an overall population. Consequently, we adopt this more moderate figure, pending more comprehensive documentation.

This VSL guidance is updated each year to take into account both the changes in price levels and changes in real incomes. Applying the procedure above for updating the overall VSL value yields an increased VSL of $9.6 million for analyses prepared in 2016 using a 2015 base year. For analyses using base years prior to 2015, the appropriate VSL are found below in Table 2.

Table 2: Prior Year VSL

Guidance Year	Value (million$)	Base year
2015	9.4	2014
2014	9.2	2013
2013	9.1	2012

Value of Preventing Injuries

Nonfatal injuries are far more common than fatalities and vary widely in severity, as well as probability. In principle, the resulting losses in quality of life, including both pain and suffering and reduced income, should be estimated by potential victims' WTP for personal safety. While estimates of WTP to avoid injury are available, often as part of a broader analysis of factors influencing VSL, these estimates are generally only available for an average injury resulting in a lost workday, and not for a range of injuries varying in severity. Because detailed WTP

[18] Costa, D.L. and M.E. Kahn (2004). "Changes in the Value of Life, 1940-1980." *Journal of Risk and Uncertainty*. 29(2): 159-180.

[19] Eeckhoudt, L.R. and J.K. Hammitt (2001). "Background Risks and the Value of a Statistical Life." *Journal of Risk and Uncertainty*. 23(3): 261-279; Kaplow, L. (2005). "The Value of a Statistical Life and the Coefficient of Relative Risk Aversion." *Journal of Risk and Uncertainty*, 31(1); Murphy, K.M. and R.H. Topel (2006). "The Value of Health and Longevity." *Journal of Political Economy*. 114(5): 871-904; and Hammitt, J.K. and L.A. Robinson (2011). "The Income Elasticity of the Value per Statistical Life: Transferring Estimates between High and Low Income Populations." *Journal of Benefit-Cost Analysis*. 2(1): 1-27.

estimates covering the entire range of potential disabilities are unobtainable, we use an alternative standardized method to interpolate values of expected outcomes, scaled in proportion to VSL. Each type of accidental injury is rated (in terms of severity and duration) on a scale of quality-adjusted life years (QALYs), in comparison with the alternative of perfect health. These scores are grouped, according to the Maximum Abbreviated Injury Scale (MAIS), yielding coefficients that can be applied to VSL to assign each injury class a value corresponding to a fraction of a fatality.

In our 2011 guidance, the values of preventing injuries were updated by new estimates from a study by Spicer and Miller.[20] The measure adopted was the quality-adjusted percentage of remaining life lost for median utility weights, based on QALY research considered "best," as presented in Table 9 of the cited study. The rate at which disability is discounted over a victim's lifespan causes these percentages to vary slightly, and the study shows estimates for 0, 3, 4, 7, and 10 percent discount rates. These differences are minor in comparison with other sources of variation and uncertainty, which we recognize by sensitivity analysis. Since OMB recommends the use of alternative discount rates of 3 and 7 percent, we present the scale corresponding to an intermediate rate of 4 percent for use in all analyses. The fractions shown should be multiplied by the current VSL to obtain the values of preventing injuries of the types affected by the government action being analyzed.

Table 3: Relative Disutility Factors by Injury Severity Level (MAIS)
For Use with 3% or 7% Discount Rate

MAIS Level	Severity	Fraction of VSL
MAIS 1	Minor	0.003
MAIS 2	Moderate	0.047
MAIS 3	Serious	0.105
MAIS 4	Severe	0.266
MAIS 5	Critical	0.593
MAIS 6	Unsurvivable	1.000

Note that these factors represent an average disutility of all injuries sustained by persons with a given MAIS. Although injured persons normally have multiple injuries, only one disutility factor should be applied to each injured person. For example, if the analyst were seeking to estimate the value for an injured person whose highest level injury was rated "serious" (MAIS 3), he or she would multiply the Fraction of VSL for a serious injury (0.105) by the VSL ($9.6 million) to calculate the value of the serious injury ($1.01 million).

[20] Rebecca S. Spicer and Ted R. Miller. "Final Report to the National Highway Traffic Safety Administration: Uncertainty Analysis of Quality Adjusted Life Years Lost." Pacific Institute for Research and Evaluation. February 5, 2010. http://ostpxweb.dot.gov/policy/reports/QALY Injury Revision_PDF Final Report 02-05-10.pdf.

These factors have two direct applications in analyses. The first application is as a basis for establishing the value of preventing nonfatal injuries in benefit-cost analysis. The total value of preventing injuries and fatalities can be combined with the value of other economic benefits not measured by VSLs, and then compared to costs to determine either a benefit/cost ratio or an estimate of net benefits.

The second application stems from the requirement in OMB Circular A-4 that evaluations of major regulations for which safety is the primary outcome include cost-effectiveness analysis, in which the cost of a government action is compared with a non-monetary measure of benefit. The values in the above table may be used to translate nonfatal injuries into fatality equivalents which, when added to fatalities, can be divided into costs to determine the cost per equivalent fatality. This ratio may also be seen as a "break-even" VSL, the value that would have to be assumed if benefits of a proposed action were to equal its costs. It would illustrate whether the costs of the action can be justified by a VSL that is well within the accepted range or, instead, would require a VSL approaching the upper limit of plausibility. Because the values assigned to prevention of injuries and fatalities are derived in part by using different methodologies, it is useful to understand their relative importance in drawing conclusions. Consequently, in analyses where benefits from reducing both injuries and fatalities are present, the estimated values of injuries and fatalities prevented should be stated separately, as well as in the aggregate.

Recognizing Uncertainty

Regulatory and investment decisions must be made by officials informed of the limitations of their information. The values we adopt here do not establish a threshold dividing justifiable from unjustifiable actions; they only suggest a region where officials making these decisions can have relatively greater or lesser confidence that their decisions will generate positive net benefits. To convey the sensitivity of this confidence to changes in assumptions, OMB Circular A-4 and Departmental policy require analysts to prepare estimates using alternative values. We have previously encouraged the use of probabilistic methods such as Monte Carlo analysis to synthesize the many uncertain quantities determining net benefits.

While the individual estimates of VSL reported in the studies cited above are often accompanied by estimates of confidence intervals, we do not, at this time, have any reliable method for estimating the overall probability distribution of the average VSL that we have calculated from these various studies. Consequently, alternative VSL values can only illustrate the conclusions that would result if the true VSL actually equaled the higher or lower alternative values. Analysts should not imply a known probability that the true VSL would exceed or fall short of either the primary VSL figure or the alternative values used for sensitivity analysis. Kniesner *et al*. (2012) suggest that a reasonable range of values for VSL is between $4 million and $10 million (in 2001 dollars), or about $5.4 million to $13.4 million in 2015 dollars. This range of values includes all the estimates from the eight other studies on which this guidance is based. For illustrative purposes, analysts should calculate high and low alternative estimates of the values of fatalities and injuries by using alternative VSLs of $5.4 million and $13.4 million.

Because the relative costs and benefits of different provisions of a rule can vary greatly, it is important to disaggregate the provisions of a rule, displaying the expected costs and benefits of each provision, together with estimates of costs and benefits of reasonable alternatives to each provision.

This guidance and other relevant documents will be posted on the Office of Transportation Policy website, http://www.dot.gov/policy/transportation-policy/economy. Questions should be addressed to Darren Timothy, (202) 366-4051, or darren.timothy@dot.gov.

Individual Airport Summary Report Manchester-Boston Regional Airport, 2015

2015

Individual Airport Summary Report
Manchester-Boston Regional Airport

AVIATION FACILITIES

Manchester-Boston Regional Airport (MHT) is a publicly-owned, public-use commercial service airport in the Merrimack Valley region of New Hampshire (NH). It is classified as a Primary airport within the NH State Airport System Plan (NHSASP). Located three miles south of Manchester, the airport occupies approximately 1,500 acres. There are two paved runways at MHT, Runway 17-35 and Runway 6-24, which measure 9,250' and 7,651' in length, respectively. Runway 17-35 is served by a full parallel taxiway, while Runway 6-24 has a partial parallel taxiway but access to both runway ends is possible via a combination of several taxiways. The airport offers both precision and non-precision instrument approaches to its runways, including a near-zero visibility instrument approach to Runway 35.

The airport has a full-service FBO, which sells AvGas and Jet A fuel, provides flight training, aircraft maintenance, avionics sales and installation, and hangar and tie-down storage. Overall, the airport offers 21 T-hangars, 5 conventional hangars, and 59 tie-downs for aircraft storage. In additional to commercial airline services, a significant amount of aircraft operations at MHT are generated by corporate and charter aircraft, as well as extensive cargo services.

AVIATION FORECAST

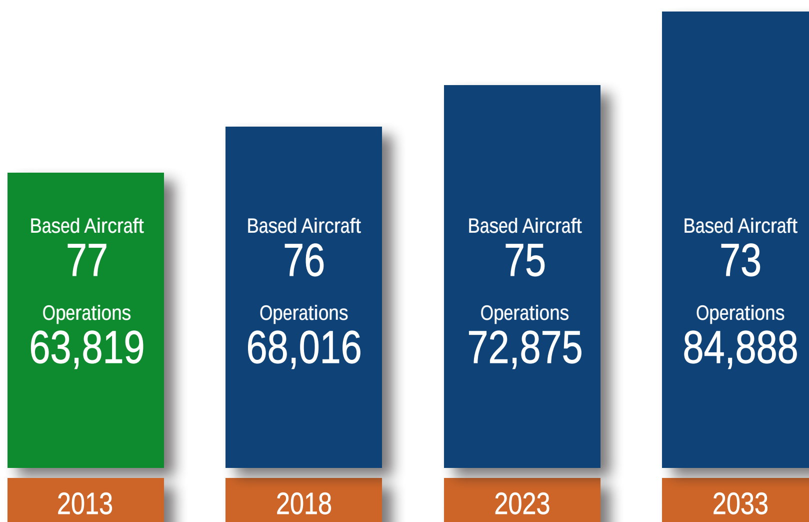
The statewide forecasting effort assessed future airport activity according to the projected number of based aircraft and annual operations expected to occur at the airport. These two factors can be helpful in determining the type, size, and timing of necessary improvements. The bar graph on the right highlights the aviation forecasts for MHT.

Overall, based aircraft are anticipated to decrease from 77 to 73 over the 20-year planning period, while annual operations are expected to increase substantially over the same time frame.

AVIATION SERVICES

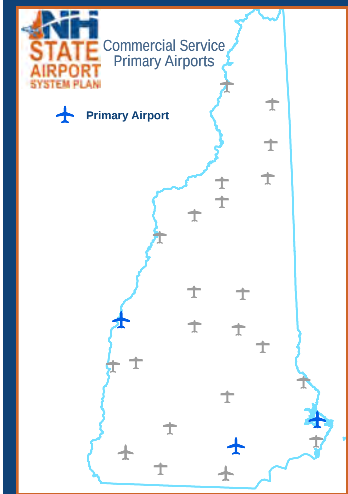
U.S. Customs	Aircraft Maintenance
Flight Instruction	Avionics Maintenance
Charter Services	Parts Sales
Cargo Handling	24-Hour Fueling
Aircraft Storage	AvGas
Rental Cars	Jet A

AVIATION FORECAST



* Military operations were excluded.

AIRPORT ROLE & RECOMMENDATIONS



MHT is one of three Primary airports in NH that provide the highest level of air access for aviation users and the state's residents. Key attributes include scheduled commercial passenger/cargo services and the ability to accommodate a wide range of general aviation users.

MHT is a key transportation facility serving NH and is one of the largest economic drivers supporting NH's economy. The airport boasts robust legacy and low-cost carrier air service as well as a central air cargo hub for UPS and Federal Express serving all of northern New England. The airport also supports a large business and industrial park on and around the airport that generates a significant number of jobs, providing large economic benefits to the city of Manchester, town of Londonderry, and the state.

The NHSASP has categorized the NH system of airports by the role each plays. Below is a summary list of facilities and services typically found in this airport role and not present at MHT in priority order. This list provides a basis of support for future projects but does not reflect deficiencies at the airport.

NHSASP-Supported Facility and Service Improvements

Primary Priority	***Secondary Priority***
• Meets Standards	• Meets Standards

In addition to these airport improvement projects, there are additional project costs that may be incurred over the next 20 years, funding for which is not guaranteed by NHDOT or FAA. Such additional project costs are related to both capital and non-capital projects identified in airport master plans and/or airport capital improvement plans (ACIP). When combined, MHT ensures the highest level of operational safety and efficient access to serve the needs of aviation users and the state of NH.

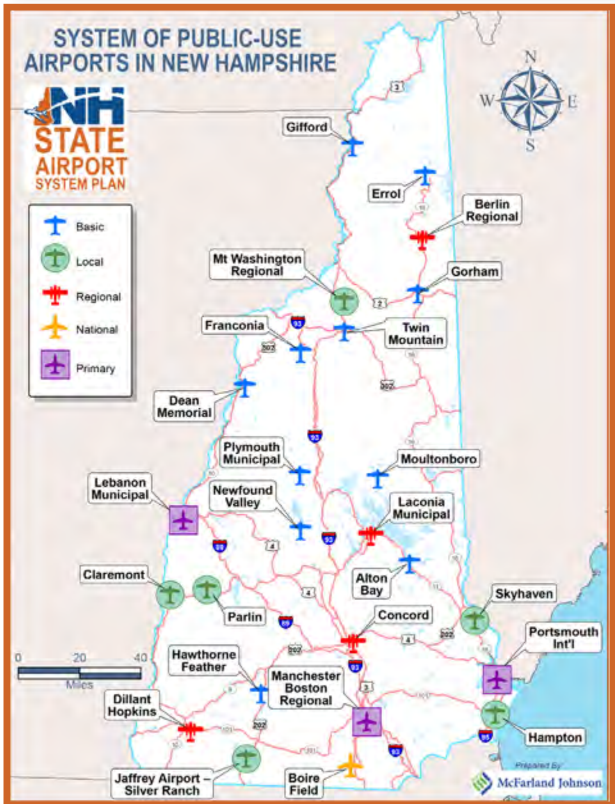
Additional projects may include:

- Additional Airside & Landside Infrastructure
- Pavement Maintenance
- Planning/Environmental/Specialty Studies

MHT is one of 25 airport facilities critical to the aviation component of NH's public transportation infrastructure. Even more importantly, the system contributes to the overall economic development opportunities of the local municipalities and regions each airport serves. Implementing the capital development needs of MHT and the other system airports is crucial to maintaining NH's overall success today and into the future.

Once a final stop for military bombers and fighters before transiting the Atlantic to Europe during WWII, MHT now serves as New **England's fourth-largest airport by passenger volume and third largest airport by cargo** volume.

NEW HAMPSHIRE AIRPORT STATE SYSTEM PLAN



Comprised of 3 commercial service and 22 public-use general aviation airports, the NH airport system consists of 25 facilities that serve the air transportation needs of over 1.3 million NH residents, business users, leisure travelers, and the military. The system is an important contributor to state and local economies, supporting thousands of jobs and generating millions of dollars in state tax revenue.

The NHSASP provides a guide to maintain and develop the system of airports in NH. Maintaining and improving airport infrastructure and facilities will allow NH to continue to meet future aviation demand and support its communities. However, as market demands and socioeconomic conditions vary for every airport, facility and service needs will also differ. The key components of the system plan and airport-specific improvements are summarized in this brochure.

AVIATION'S ECONOMIC BENEFIT TO NEW HAMPSHIRE

The total economic contribution of aviation in NH is measured by both the state airport system (NHSAS) and aviation-related manufacturing. These components contributed an estimated 12,954 jobs and $2.16 billion in revenues for NH businesses, and approximately $32.19 million in state tax revenue.

In addition to economic benefits, the NHSAS provides numerous critical services and qualitative impacts that enhance the quality of life for those who live and work in NH, including medical transportation and evacuation in rural areas, search and rescue operations, wildlife management, law enforcement flights, military exercises, and flight training.

Overview Economic Contribution to NH			
	Total Employment	Total Output	Total Tax Revenue
NH State Airports	9,283	$1.16 billion	$27.96 million
Aviation Related	3,671	$1 billion	$4.23 million
TOTAL IMPACT	12,954	$2.16 billion	$32.19 million

ECONOMIC BENEFIT OF MHT AIRPORT:

The system plan quantifies the total economic impact of each airport in NH. Using a comprehensive survey process, both the direct economic benefits related to on-airport business and tenants, as well as the indirect benefits associated with off-airport visitor-related expenditures, were determined for each system airport. The multiplier effect of these benefits was then computed to gauge the total airport-related impacts. Thus, the total economic impact of MHT is the sum of all direct, indirect, and multiplier impacts. This economic analysis demonstrates that airports and aviation-related businesses support thousands of jobs and pump billions of dollars into the state economy.

Economic Contribution of this Airport				
	Total Employment (Jobs)	Total Payroll	Total Output	Total Tax Revenue
TOTAL IMPACT	7,018	$268.13 million	$832.22 million	$23.73 million

For more information visit:
http://www.nh.gov/dot/org/aerorailtransit/aeronautics/documents.htm

Benefit Cost Analysis Worksheets

Benefits

Calendar Year	Project Year[1]	Affected Population[2]	Travel Time Saved[3]	Value of Time Saved ($2017)[4]	Crash Reductions Savings ($2017)[5]	Total Benefits ($2017)	7% Rate	Total Benefits ($2017) Discounted 7%	3% Rate	Total Benefits ($2017) Discounted 3%
2017										
2018										
2019										
2020										
2021	1	0	0	$0	$0	$0	0.82	$0	0.92	$0
2022	2	0	0	$0	$0	$0	0.76	$0	0.89	$0
2023	3	0	0	$0	$0	$0	0.71	$0	0.86	$0
2024	4	0	0	$0	$0	$0	0.67	$0	0.84	$0
2025	5	0	0	$0	$0	$0	0.62	$0	0.81	$0
2026	6	2750	74481	$1,813,811	$2,499,690	$4,313,500	0.58	$2,510,496	0.79	$3,405,117
2027	7	2765	74873	$1,823,366	$2,499,978	$4,323,344	0.54	$2,351,613	0.77	$3,313,483
2028	8	2779	75266	$1,832,922	$2,500,266	$4,333,188	0.51	$2,202,773	0.74	$3,224,299
2029	9	2794	75658	$1,842,478	$2,500,554	$4,343,031	0.48	$2,063,343	0.72	$3,137,498
2030	10	2808	76051	$1,852,033	$2,500,842	$4,352,875	0.44	$1,932,729	0.70	$3,053,019
2031	11	2823	76443	$1,861,589	$2,501,130	$4,362,719	0.41	$1,810,373	0.68	$2,970,799
2032	12	2837	76835	$1,871,145	$2,501,418	$4,372,563	0.39	$1,695,755	0.66	$2,890,779
2033	13	2851	77228	$1,880,700	$2,501,706	$4,382,407	0.36	$1,588,386	0.64	$2,812,900
2034	14	2866	77620	$1,890,256	$2,501,994	$4,392,250	0.34	$1,487,807	0.62	$2,737,105
2035	15	2880	78012	$1,899,812	$2,502,283	$4,402,094	0.32	$1,393,590	0.61	$2,663,339
2036	16	2895	78405	$1,909,367	$2,502,571	$4,411,938	0.30	$1,305,333	0.59	$2,591,549
2037	17	2909	78797	$1,918,923	$2,502,859	$4,421,782	0.28	$1,222,659	0.57	$2,521,680
2038	18	2924	79190	$1,928,479	$2,503,147	$4,431,625	0.26	$1,145,216	0.55	$2,453,684
2039	19	2938	79582	$1,938,034	$2,503,435	$4,441,469	0.24	$1,072,673	0.54	$2,387,509
2040	20	2953	79974	$1,947,590	$2,503,723	$4,451,313	0.23	$1,004,720	0.52	$2,323,107
2041	21	2967	80367	$1,957,146	$2,504,011	$4,461,157	0.21	$941,067	0.51	$2,260,431
			Totals	**$30,167,650**	**$40,029,606**	**$70,197,255**		**$25,728,534**		**$44,746,298**

Notes

1. Construction starts in 2021, with a Completion year of 2026.
2. Assuming average occupancy rate of 1.68people per passenger vehicle and 1.00 per Truck * volume of traffic Source: Federal Highway Administration Highway Statistics 2016, Table VM1.
3. Based on time savings reported in Hudson Boulevard Traffic Analysis by Nashua Regional Planning Comission, 2018.
4. Intercity Travel All purposes - Source "The Value of Travel Time Savings: Departmental Guidance for Conducting Economic Evaluations Revision 2 (2016 Update) - US DOT 2015 monetized to $2017.
5. Crash reduction cost based on FHWA cost.

Costs

Initial Construction Cost ($2017)[1]	Bridge Operation & Maintenance Cost ($2017)[2]	Highway Operation & Maintenance Cost ($2017)[3]	Total Cost ($2017)	7% Rate	Total Costs ($2018) Discounted 7%	3% Rate	Total Costs ($2017) Discounted 3%	Net Present Value
$11,137,500		$0	$11,137,500	0.82	$9,091,518	0.92	$10,192,390	($10,192,390)
$11,137,500		$0	$11,137,500	0.76	$8,496,745	0.89	$9,895,524	($9,895,524)
$11,137,500		$0	$11,137,500	0.71	$7,940,884	0.86	$9,607,305	($9,607,305)
$11,137,500		$0	$11,137,500	0.67	$7,421,387	0.84	$9,327,481	($9,327,481)
$4,950,000		$0	$4,950,000	0.62	$3,082,611	0.81	$4,024,803	($4,024,803)
$0	$9,000	$0	$9,000	0.58	$5,238	0.79	$7,105	$4,306,395
$0	$9,000	$0	$9,000	0.54	$4,895	0.77	$6,898	$4,316,446
$0	$9,000	$0	$9,000	0.51	$4,575	0.74	$6,697	$4,326,491
$0	$9,000	$0	$9,000	0.48	$4,276	0.72	$6,502	$4,336,530
$0	$9,000	$48,000	$57,000	0.44	$25,309	0.70	$39,979	$4,312,897
$0	$9,000	$0	$9,000	0.41	$3,735	0.68	$6,129	$4,356,590
$0	$9,000	$0	$9,000	0.39	$3,490	0.66	$5,950	$4,366,613
$0	$9,000	$0	$9,000	0.36	$3,262	0.64	$5,777	$4,376,630
$0	$9,000	$0	$9,000	0.34	$3,049	0.62	$5,609	$4,386,642
$0	$9,000	$1,440,000	$1,449,000	0.32	$458,716	0.61	$876,669	$3,525,425
$0	$9,000	$0	$9,000	0.30	$2,663	0.59	$5,287	$4,406,651
$0	$9,000	$0	$9,000	0.28	$2,489	0.57	$5,133	$4,416,649
$0	$9,000	$0	$9,000	0.26	$2,326	0.55	$4,983	$4,426,642
$0	$9,000	$0	$9,000	0.24	$2,174	0.54	$4,838	$4,436,631
$0	$9,000	$48,000	$57,000	0.23	$12,866	0.52	$29,748	$4,421,565
$0	$9,000	$0	$9,000	0.21	$1,899	0.51	$4,560	$4,456,597
$49,500,000	**$144,000**	**$1,536,000**	**$51,180,000**		**$36,574,104**		**$44,069,365**	**$26,127,891**

Notes

1. Based on Conceptual Cost Estimate ($2017) dated July 2018
2 Bridge Maintenance cost assumed to be yearly cleaning. Additional work such as membrane and deck replacement would occur outside the scope of this BCA timeline
3 Highway Maintenance includes crack sealing at year 5 and 15 with a pavement overlay at year 10

Estimate Construction Cost ($2017)	**$49,500,000**

Benefit Cost Ratio	
Real Dollars	1.37
7% Discount Rate	0.70
3% Discount Rate	1.02

Implicit Price Deflators for Gross Domestic Product

Base Year	Multiplier to Adjust to Real $2018[1]
2009	1.1342
2010	1.1205
2011	1.0979
2012	1.0780
2013	1.0609
2014	1.0422
2015	1.0310
2016	1.0180
2017	1.0000

1. Source: Bureau of Economic Analysis, National Income and Product Accounts Table 1.1.9 "Implicit Price Deflators for Gross Domestic Product" (March 2018)

Value of Travel Time (Hours)

Calendar Year	Project Year	Affected Population[1]	Total Travel Time Saved[2]	Business Travel Time Saved	Personal Travel Time Saved	Truck Travel Time Saved	Value of Time Saved ($2018)
2017							
2018							
2019							
2020							
2021	1	0	0	$0	$0	$0	$0
2022	2	0	0	$0	$0	$0	$0
2023	3	0	0	$0	$0	$0	$0
2024	4	0	0	$0	$0	$0	$0
2025	5	0	0	$0	$0	$0	$0
2026	6	2,750	74,481	$489,963	$1,308,298	$15,550	$1,813,811
2027	7	2,765	74,873	$492,544	$1,315,190	$15,632	$1,823,366
2028	8	2,779	75,266	$495,125	$1,322,083	$15,714	$1,832,922
2029	9	2,794	75,658	$497,706	$1,328,975	$15,796	$1,842,478
2030	10	2,808	76,051	$500,288	$1,335,868	$15,878	$1,852,033
2031	11	2,823	76,443	$502,869	$1,342,760	$15,960	$1,861,589
2032	12	2,837	76,835	$505,450	$1,349,653	$16,042	$1,871,145
2033	13	2,851	77,228	$508,032	$1,356,545	$16,124	$1,880,700
2034	14	2,866	77,620	$510,613	$1,363,438	$16,206	$1,890,256
2035	15	2,880	78,012	$513,194	$1,370,330	$16,287	$1,899,812
2036	16	2,895	78,405	$515,775	$1,377,223	$16,369	$1,909,367
2037	17	2,909	78,797	$518,357	$1,384,115	$16,451	$1,918,923
2038	18	2,924	79,190	$520,938	$1,391,008	$16,533	$1,928,479
2039	19	2,938	79,582	$523,519	$1,397,900	$16,615	$1,938,034
2040	20	2,953	79,974	$526,100	$1,404,793	$16,697	$1,947,590
2041	21	2,967	80,367	$528,682	$1,411,685	$16,779	$1,957,146
		Totals	**1,238,782**				**$30,167,650**

Recommended Hourly Values of Travel Time Savings		
Category - Intercity Travel	Surface Modes ($2017)	Surface Modes ($2017)
Personal	$14.80	$14.80
Business	$26.50	$26.50
Truck	$28.60	$28.60

Estimated Percentage of Personal and Business Travel	
Business	21.40%
Personal	78.60%

Source: Intercity Travel All purposes - Based on "The Value of Travel Time Savings: Departmental Guidance for Conducting Economic Evaluations Revision 2 (2016 Update) - US DOT 2015 monetized to $2017

Notes

1. Assuming average occupancy rate of 1.68 people per passenger vehicle and 1.00 per Truck * volume of traffic Source: Federal Highway Administration Highway Statistics 2016, Table VM1.

2. 6.5 Minute improvement in trip time based on Hudson Boulevard Traffic Analysis by Nashua Regional Planning Commission, 2018.

based on average daily traffic during peak hours, accounts for 250 days of the year

Value of Life Crash Cost by Type

Relative Disutility Factor by AIS for use with 3 or 7% discount rate				
AIS Level	Severity	Fraction of VSL	Cost ($201)	Cost ($2017)
1	Minor	0.003	$28,800	$28,800
2	Moderate	0.047	$451,200	$451,200
3	Serious	0.105	$1,008,000	$1,008,000
4	Severe	0.266	$2,553,600	$2,553,600
5	Critical	0.593	$5,692,800	$5,692,800
6	Fatal	1	$9,600,000	$9,600,000

Source: Guidance on Treatment of Economic Value of a Staticital Life (VSL) in U.S. Department of Transportation Analyses - 2016 Adjustment

Kabco - AIS Data Conversion for Kabco "0" Accident (i.e. PDO)				
		Cost ($2016)	Cost ($2017)	Cost ($2017)
AIS 0	0.92534	$0	$0	$0
AIS 1	0.07426	$28,800	$2,139	$2,139
AIS 2	0.00198	$451,200	$893	$893
AIS 3	0.00008	$1,008,000	$81	$81
AIS 4	0.00000	$2,553,600	$0	$0
AIS 5	0.00003	$5,692,800	$171	$171
AIS 6	0.00000	$9,600,000	$0	$0
		Total	$3,283	$3,283

Source: Guidance on Treatment of Economic Value of a Staticital Life (VSL) in U.S. Department of Transportation Analyses - 2016 Adjustment

Type	Cost ($2017)
PDO	$4,300
Injury	$451,200
Fatality	$9,600,000

Source: The Economic and Societal Impact of Motor Vehicle Crashes, 2010 - PDO value of $4,300 ($2017)

Observed Crashes (2013-2019)[1]		Average per year
Total	359	55.2
PDO	297	45.7
Injury	61	9.4
Fatal	1	0.2

1.) Source: Hudson Police Department for the years 2013-2019 which is the newest data available at major intersection along three major routes.

Cost of crashes per year	
Type	Cost ($2017)
PDO	$196,477
Injury	$4,234,338
Fatal	$1,476,923
Total per year	$5,907,738

Expected Crashes per year based on % increase in traffic volume per year based on No-Build Scenario						Expected Reduction in crashes per year			
Year	Traffic Volume	% increase in traffic volume	PDO Crashes	Injury Crashes	Fatal Crashes)	PDO Crashes	Injury Crashes	Fatal Crashes)	Cost Savings ($2017)
2018	368045	0	46	9.4	0.2	0	0	0	
2019	370174	0.58%	46	9.5	0.2	0	0	0	
2020	372303	0.57%	46.3	9.6	0.2	0	0	0	
2021	374432	0.57%	46.6	9.7	0.2	0	0	0	$0
2022	376561	0.57%	46.9	9.8	0.2	0	0	0	$0
2023	378690	0.56%	47.2	9.9	0.2	0	0	0	$0
2024	380820	0.56%	47.5	10.0	0.2	0	0	0	$0
2025	382949	0.56%	47.8	10.1	0.2	0	0	0	$0
2026	385078	0.55%	48.1	10.2	0.2	15.0	2.5	0.1	$2,499,690
2027	387207	0.55%	48.4	10.3	0.2	15.1	2.5	0.1	$2,499,978
2028	389336	0.55%	48.7	10.4	0.2	15.1	2.5	0.1	$2,500,266
2029	391465	0.54%	49	10.5	0.2	15.2	2.5	0.1	$2,500,554
2030	393594	0.54%	49.3	10.6	0.2	15.3	2.5	0.1	$2,500,842
2031	395723	0.54%	49.6	10.7	0.2	15.3	2.5	0.1	$2,501,130
2032	397852	0.54%	49.9	10.8	0.2	15.4	2.5	0.1	$2,501,418
2033	399981	0.53%	50.2	10.9	0.2	15.5	2.5	0.1	$2,501,706
2034	402110	0.53%	50.5	11.0	0.2	15.5	2.5	0.1	$2,501,994
2035	404239	0.53%	50.8	11.1	0.2	15.6	2.5	0.1	$2,502,283
2036	406369	0.52%	51.1	11.2	0.2	15.7	2.5	0.1	$2,502,571
2037	408498	0.52%	51.4	11.3	0.2	15.7	2.5	0.1	$2,502,859
2038	410627	0.52%	51.7	11.4	0.2	15.8	2.5	0.1	$2,503,147
2039	412756	0.52%	52	11.5	0.2	15.9	2.5	0.1	$2,503,435
2040	414885	0.51%	52.3	11.6	0.2	15.9	2.5	0.1	$2,503,723
2041	417014	0.51%	52.6	11.7	0.2	16.0	2.5	0.1	$2,504,011
								Total	$40,029,606

1. Reduction in crashes is directly related to the reduction in volume on the congested roads after the construction of Hudson Boulevard as the traffic will now be distributed over an additional roadway which will reduce the likelihood of crashes at the existing congested intersections. However this is not assumed to be a 1:1 relationship so the reduction has been adjusted to 2/3 ratio to account for variablility in the data and type of roadway. It is anticipated that additional reductions at minor intersections and along the segments may also occur but were not quantified for this analysis. Since the likehood of crashes is based on total VMT through the study area, the shift of the traffic to the new roadway accounts for the liklihood of crashes on the new roadway no additional calculation to account for new crashes on the new roadway are required.

Expected Crashes based on % decrease in traffic volume per year based on Build Scenario					
Year	Traffic Volume	% increase in traffic volume	PDO Crashes	Injury Crashes	Fatal Crashes
2018	368045	0%	0	0	0
2019	334719	0%	0	0	0
2020	320532	0%	0	0	0
2021	322276	0%	0	0	0
2022	324019	0%	0	0	0
2023	325763	0%	0	0	0
2024	327507	0%	0	0	0
2025	329251	0%	0	0	0
2026	330994	0.53%	25.7	6.4	0.1
2027	332738	0.52%	25.9	6.5	0.1
2028	334482	0.52%	26.1	6.6	0.1
2029	336226	0.52%	26.3	6.7	0.1
2030	337969	0.52%	26.5	6.8	0.1
2031	339713	0.51%	26.7	6.9	0.1
2032	341457	0.51%	26.9	7.0	0.1
2033	343201	0.51%	27.1	7.1	0.1
2034	344945	0.51%	27.3	7.2	0.1
2035	346688	0.50%	27.5	7.3	0.1
2036	348432	0.50%	27.7	7.4	0.1
2037	350176	0.50%	27.9	7.5	0.1
2038	351920	0.50%	28.1	7.6	0.1
2039	353663	0.49%	28.3	7.7	0.1
2040	355407	0.49%	28.5	7.8	0.1
2041	357151	0.49%	28.7	7.9	0.1

1.) Reduction in volumes based on calculations provided in Volume Calculations

Traffic Volumes

Calendar Year	Total Traffic Volumes[1]	Automobile Traffic Volumes 99.27%	Truck Traffic Volumes[2] 0.73%	Volume of Business Travel (21.4% of Auto) 21.40%	Volume of Personal Travel (78.6% of Auto) 78.60%	Volume of Truck Travel (100% of Truck)
2017						
2018						
2019						
2020						
2021	1599	1587	12	340	1247	12
2022	1607	1595	12	341	1254	12
2023	1616	1604	12	343	1261	12
2024	1624	1613	12	345	1268	12
2025	1633	1621	12	347	1274	12
2026	1642	1630	12	349	1281	12
2027	1650	1638	12	351	1288	12
2028	1659	1647	12	352	1295	12
2029	1668	1656	12	354	1301	12
2030	1676	1664	12	356	1308	12
2031	1685	1673	12	358	1315	12
2032	1694	1681	12	360	1322	12
2033	1702	1690	12	362	1328	12
2034	1711	1699	12	363	1335	12
2035	1720	1707	13	365	1342	13
2036	1728	1716	13	367	1349	13
2037	1737	1724	13	369	1355	13
2038	1746	1733	13	371	1362	13
2039	1754	1741	13	373	1369	13
2040	1763	1750	13	375	1376	13
2041	1772	1759	13	376	1382	13

Volumes Calculations

Street Name[1]	Volume[2] 2017	Build Volume[2] **2041**	No-Build Volume[2] **2041**	Change Per Year (No-Build)	% Change Base to Build	No-Build Volume **2019**	Build Volume **2019**	No-Build Volume **2020**	Build Volume **2020**	No-Build Volume **2021**	Build Volume **2021**	No-Build Volume **2022**	Build Volume **2022**	No-Build Volume **2023**	Build Volume **2023**	No-Build Volume **2024**	Build Volume **2024**	No-Build Volume **2025**	Build Volume **2025**	No-Build Volume **2026**	Build Volume **2026**	No-Build Volume **2027**	Build Volume **2027**	No-Build Volume **2028**	Build Volume **2028**	No-Build Volume **2029**	Build Volume **2029**
Taylow Falls Bridge	36820	38732	42833	0.0071	-9.57%	37081	49463	37343	33768	37604	34004	37866	34240	38127	34477	38389	34713	38650	34950	38911	35186	39173	35422	39434	35659	39696	35895
Sagamore Bridge	49150	63524	56340	0.00636	12.75%	49463	55770	49775	56122	50088	56475	50400	56827	50713	57180	51026	57532	51338	57884	51651	58237	51963	58589	52276	58942	52589	59294
NH 111 Central St.	17555	13175	19082	0.003782	-30.96%	17621	12167	17688	12212	17754	12258	17821	12304	17887	12350	17953	12396	18020	12442	18086	12487	18153	12533	18219	12579	18285	12625
NH 111 Central St.	23140	20209	25095	0.003673	-19.47%	23225	18703	23310	18772	23395	18840	23480	18908	23565	18977	23650	19045	23735	19114	23820	19182	23905	19251	23990	19319	24075	19388
NH 111 Burnham Rd.	13130	12036	13741	0.002023	-12.41%	13157	11524	13183	11547	13210	11571	13236	11594	13263	11617	13289	11640	13316	11664	13343	11687	13369	11710	13396	11734	13422	11757
NH 111 Ferry St.	14560	14077	15640	0.003225	-9.99%	14607	13147	14654	13189	14701	13232	14748	13274	14795	13316	14842	13359	14889	13401	14936	13443	14983	13485	15030	13528	15077	13570
NH 3A/102 Derry St.	26330	27324	28284	0.003227	-3.39%	26415	25518	26500	25600	26585	25683	26670	25765	26755	25847	26840	25929	26925	26011	27010	26093	27095	26175	27180	26257	27265	26339
NH 3A/102 Derry St.	15750	16811	18008	0.006233	-6.65%	15848	14795	15946	14886	16045	14978	16143	15070	16241	15161	16339	15253	16437	15345	16535	15436	16634	15528	16732	15620	16830	15711
NH 3A Lowell Rd.	22640	21222	23390	0.00144	-9.27%	22673	20571	22705	20601	22738	20630	22770	20660	22803	20689	22836	20719	22868	20749	22901	20778	22933	20808	22966	20837	22999	20867
NH 3A Lowell Rd.	25400	23289	27492	0.003581	-15.29%	25491	21594	25582	21671	25673	21748	25764	21825	25855	21902	25946	21979	26037	22056	26128	22133	26219	22210	26310	22287	26401	22364
NH 3A Lowell Rd.	39700	33939	44936	0.005734	-24.47%	39928	30156	40155	30328	40383	30500	40611	30672	40838	30844	41066	31016	41294	31188	41521	31360	41749	31532	41977	31704	42204	31876
Libray St.	9000	9392	9934	0.004512	-5.46%	9041	8547	9081	8586	9122	8624	9162	8663	9203	8701	9244	8739	9284	8778	9325	8816	9365	8854	9406	8893	9447	8931
Speare Rd.	1830	2038	2931	0.026158	-30.47%	1878	1306	1926	1339	1974	1372	2021	1406	2069	1439	2117	1472	2165	1505	2213	1539	2261	1572	2309	1605	2357	1639
Greeley St.	5310	5833	5850	0.004422	-0.29%	5333	5318	5357	5341	5380	5365	5404	5388	5427	5412	5451	5435	5474	5458	5498	5482	5521	5505	5545	5529	5568	5552
Central St.	5770	3957	6293	0.003941	-37.12%	5793	3642	5815	3657	5838	3671	5861	3685	5884	3700	5906	3714	5929	3728	5952	3743	5975	3757	5997	3771	6020	3785
Melendy Rd.	1970	2187	2595	0.013794	-15.72%	1997	1683	2024	1706	2052	1729	2079	1752	2106	1775	2133	1798	2160	1821	2187	1843	2215	1866	2242	1889	2269	1912
Belknap Rd.	5470	5944	6548	0.008568	-9.22%	5517	5008	5564	5051	5611	5093	5657	5136	5704	5178	5751	5221	5798	5263	5845	5306	5892	5348	5939	5391	5986	5433
County Rd.	4520	4950	5523	0.009648	-10.37%	4564	4090	4607	4129	4651	4168	4694	4207	4738	4246	4782	4286	4825	4325	4869	4364	4912	4403	4956	4442	5000	4481
Kimball Hill Rd.	4960	4194	5448	0.004278	-23.02%	4981	3835	5002	3851	5024	3867	5045	3884	5066	3900	5087	3916	5109	3933	5130	3949	5151	3965	5172	3982	5193	3998
Kimball Hill Rd.	8200	8488	9278	0.005716	-8.51%	8247	7545	8294	7588	8341	7630	8387	7673	8434	7716	8481	7759	8528	7802	8575	7845	8622	7888	8669	7931	8716	7973
Bush Hill Rd.	5470	2201	6040	0.004531	-63.56%	5495	2002	5520	2011	5544	2020	5569	2029	5594	2038	5619	2047	5643	2057	5668	2066	5693	2075	5718	2084	5743	2093
Bush Hill Rd.	6760	3340	8335	0.01013	-59.93%	6828	2736	6897	2764	6965	2791	7034	2819	7102	2846	7171	2874	7239	2901	7308	2928	7376	2956	7445	2983	7513	3011
Bush Hill Rd.	1280	1164	2073	0.026936	-43.85%	1314	738	1349	757	1383	777	1418	796	1452	816	1487	835	1521	854	1556	874	1590	893	1625	912	1659	932
Pelham Rd.	2150	2269	2934	0.015854	-22.67%	2184	1689	2218	1715	2252	1742	2286	1768	2320	1795	2355	1821	2389	1847	2423	1874	2457	1900	2491	1926	2525	1953
Burns Hill Rd.	2780	4126	3109	0.005145	32.71%	2794	3708	2809	3727	2823	3746	2837	3765	2852	3784	2866	3803	2880	3822	2894	3841	2909	3860	2923	3879	2937	3898
Wason Rd.	9330	6576	13875	0.02118	-52.61%	9528	4516	9725	4609	9923	4703	10120	4797	10318	4890	10516	4984	10713	5078	10911	5171	11108	5265	11306	5358	11504	5452
Wason Rd.	9070	6154	11407	0.011203	-46.05%	9172	4948	9273	5003	9375	5058	9476	5112	9578	5167	9680	5222	9781	5277	9883	5332	9984	5387	10086	5441	10188	5496
Total	**368045**	**357151**	**417014**	--	--	**370174**	**334719**	**372303**	**320532**	**374432**	**322276**	**376561**	**324019**	**378690**	**325763**	**380820**	**327507**	**382949**	**329251**	**385078**	**330994**	**387207**	**332738**	**389336**	**334482**	**391465**	**336226**

1. Street names that are repeated are due to the street being broken up into different segments. Please refer to the NRPC Hudson Boulevard Traffic Analysis to see Street segments.

2. Volumes from NRPC Traffic Analysis.

3. Volumes Calculated in spreadsheet.

	Build Scenario Volume Hudson Boulevard																				
Hudson Boulevard	**2021**	**2022**	**2023**	**2024**	**2025**	**2026**	**2027**	**2028**	**2029**	**2030**	**2031**	**2032**	**2033**	**2034**	**2035**	**2036**	**2037**	**2038**	**2039**	**2040**	**2041**
NH 3A to Musquash Rd.	21314	21429	21544	21659	21775	21890	22005	22121	22236	22351	22467	22582	22697	22813	22928	23043	23159	23274	23389	23505	23620
Musquash Rd. to Bush Hill Rd.	19617	19723	19829	19936	20042	20148	20254	20360	20466	20572	20679	20785	20891	20997	21103	21209	21315	21422	21528	21634	21740
Bush Hill Rd. to Kimball Hill Rd.	18390	18489	18589	18688	18788	18887	18987	19086	19186	19285	19385	19484	19584	19683	19783	19882	19982	20081	20181	20280	20380
Kimball Hill Rd. to NH 111	11726	11789	11853	11916	11980	12043	12107	12170	12234	12297	12361	12424	12487	12551	12614	12678	12741	12805	12868	12932	12995
Avg.	**17762**	**17858**	**17954**	**18050**	**18146**	**18242**	**18338**	**18434**	**18530**	**18627**	**18723**	**18819**	**18915**	**19011**	**19107**	**19203**	**19299**	**19395**	**19492**	**19588**	**19684**

No-Build Volume **2030**	Build Volume **2030**	No-Build Volume **2031**	Build Volume **2031**	No-Build Volume **2032**	Build Volume **2032**	No-Build Volume **2033**	Build Volume **2033**	No-Build Volume **2034**	Build Volume **2034**	No-Build Volume **2035**	Build Volume **2035**	No-Build Volume **2036**	Build Volume **2036**	No-Build Volume **2037**	Build Volume **2037**	No-Build Volume **2038**	Build Volume **2038**	No-Build Volume **2039**	Build Volume **2039**	No-Build Volume **2040**	Build Volume **2040**	No-Build Volume[3] **2041**	Build Volume[3] **2041**
39957	36132	40219	36368	40480	36604	40742	36841	41003	37077	41264	37314	41526	37550	41787	37786	42049	38023	42310	38259	42572	38496	42833	38732
52901	59647	53214	59999	53527	60352	53839	60704	54152	61057	54464	61409	54777	61762	55090	62114	55402	62467	55715	62819	56027	63172	56340	63524
18352	12671	18418	12717	18484	12762	18551	12808	18617	12854	18684	12900	18750	12946	18816	12992	18883	13037	18949	13083	19016	13129	19082	13175
24160	19456	24245	19524	24330	19593	24415	19661	24500	19730	24585	19798	24670	19867	24755	19935	24840	20004	24925	20072	25010	20141	25095	20209
13449	11780	13475	11803	13502	11827	13528	11850	13555	11873	13582	11896	13608	11920	13635	11943	13661	11966	13688	11989	13714	12013	13741	12036
15123	13612	15170	13654	15217	13697	15264	13739	15311	13781	15358	13823	15405	13866	15452	13908	15499	13950	15546	13992	15593	14035	15640	14077
27349	26421	27434	26503	27519	26585	27604	26667	27689	26749	27774	26832	27859	26914	27944	26996	28029	27078	28114	27160	28199	27242	28284	27324
16928	15803	17026	15895	17124	15986	17223	16078	17321	16169	17419	16261	17517	16353	17615	16444	17713	16536	17812	16628	17910	16719	18008	16811
23031	20897	23064	20926	23097	20956	23129	20985	23162	21015	23194	21044	23227	21074	23260	21104	23292	21133	23325	21163	23357	21192	23390	21222
26491	22441	26582	22518	26673	22596	26764	22673	26855	22750	26946	22827	27037	22904	27128	22981	27219	23058	27310	23135	27401	23212	27492	23289
42432	32048	42659	32220	42887	32392	43115	32563	43342	32735	43570	32907	43798	33079	44025	33251	44253	33423	44481	33595	44708	33767	44936	33939
9487	8970	9528	9008	9569	9046	9609	9085	9650	9123	9690	9162	9731	9200	9772	9238	9812	9277	9853	9315	9893	9354	9934	9392
2404	1672	2452	1705	2500	1738	2548	1772	2596	1805	2644	1838	2692	1872	2740	1905	2787	1938	2835	1971	2883	2005	2931	2038
5592	5575	5615	5599	5639	5622	5662	5646	5686	5669	5709	5693	5733	5716	5756	5739	5780	5763	5803	5786	5827	5810	5850	5833
6043	3800	6066	3814	6088	3828	6111	3843	6134	3857	6157	3871	6179	3886	6202	3900	6225	3914	6248	3928	6270	3943	6293	3957
2296	1935	2323	1958	2350	1981	2378	2004	2405	2027	2432	2050	2459	2072	2486	2095	2513	2118	2541	2141	2568	2164	2595	2187
6032	5476	6079	5519	6126	5561	6173	5604	6220	5646	6267	5689	6314	5731	6361	5774	6407	5816	6454	5859	6501	5901	6548	5944
5043	4520	5087	4559	5131	4598	5174	4637	5218	4676	5261	4715	5305	4755	5349	4794	5392	4833	5436	4872	5479	4911	5523	4950
5215	4014	5236	4031	5257	4047	5278	4063	5299	4080	5321	4096	5342	4112	5363	4129	5384	4145	5406	4161	5427	4178	5448	4194
8762	8016	8809	8059	8856	8102	8903	8145	8950	8188	8997	8231	9044	8274	9091	8316	9137	8359	9184	8402	9231	8445	9278	8488
5767	2102	5792	2111	5817	2120	5842	2129	5867	2138	5891	2147	5916	2156	5941	2165	5966	2174	5990	2183	6015	2192	6040	2201
7582	3038	7650	3066	7719	3093	7787	3120	7856	3148	7924	3175	7993	3203	8061	3230	8130	3258	8198	3285	8267	3313	8335	3340
1694	951	1728	970	1763	990	1797	1009	1832	1028	1866	1048	1901	1067	1935	1087	1970	1106	2004	1125	2039	1145	2073	1164
2559	1979	2593	2005	2627	2032	2661	2058	2695	2084	2729	2111	2764	2137	2798	2164	2832	2190	2866	2216	2900	2243	2934	2269
2952	3917	2966	3936	2980	3955	2995	3974	3009	3993	3023	4012	3037	4031	3052	4050	3066	4069	3080	4088	3095	4107	3109	4126
11701	5546	11899	5639	12097	5733	12294	5827	12492	5920	12689	6014	12887	6108	13085	6201	13282	6295	13480	6389	13677	6482	13875	6576
10289	5551	10391	5606	10493	5661	10594	5715	10696	5770	10797	5825	10899	5880	11001	5935	11102	5990	11204	6044	11305	6099	11407	6154
393594	**337969**	**395723**	**339713**	**397852**	**341457**	**399981**	**343201**	**402110**	**344945**	**404239**	**346688**	**406369**	**348432**	**408498**	**350176**	**410627**	**351920**	**412756**	**353663**	**414885**	**355407**	**417014**	**357151**

Nashua Regional Planning Commission Letter

July 13, 2018

Elvis Dhima, P.E.
Town Engineer
Town of Hudson, NH
12 School Street
Hudson, NH 03051

Re: Hudson Boulevard Project

Dear Mr. Dima:

The Hudson Boulevard Project has the potential to unlock the economic development potential of some of the most significant commercial and industrial sites in southern New Hampshire resulting in the creation of close to 6million square feet of commercial and industrial development, over 6,000 new jobs, new business and investment opportunities and additional tax revenues for the town. As I am sure you can appreciate, all the critical factors are in place: large tracks of contiguous undeveloped or underdeveloped land, market demand, utility infrastructure and a highly skilled labor force. These attributes, however, are constrained by Hudson's existing street and highway capacity limitations; particularly in south Hudson along the Lowell Road Corridor and Hudson's two Merrimack River bridge crossings.

A summary of the development potential of key commercial and industrial areas that would be enhanced by the proposed Hudson Boulevard are provided below.

The Friary

This undeveloped parcel is located north of the Sagamore Industrial Park and has frontage along Lowell Rd and the Merrimack River. The site could serve as an expansion of the Sagamore Industrial Park since Friar Road terminates at the border of the property.

- Potential Building Area (industrial): 781,830 sq. ft.
- Potential Property Assessment: $52,616,160
- Potential Tax Revenue: $1,037,591
- Additional Employment: 844
- Additional Traffic: 2,542 Average Daily Trips

South Lowell Road Properties

With its large contiguous parcels of vacant and underutilized land, direct access to Lowell Road (3A), proximity to the FE Everett Turnpike and potential availability of water and sewer, the South Lowell Road properties offer perhaps the greatest opportunity for both commercial and industrial development in Hudson and in the overall region. Market demand in the region is currently strongest for industrial type development, with particularly strong demand for warehousing & distribution. Industrial development also offers strong job creation potential with relatively high wages. The estimated 16,545 Average Daily Trips at buildout is relatively moderate, however it would maximize road capacity in the corridor and would result in significant increases in congestion, particularly during peak hours, without additional road improvements.

<u>EXISTING AREA PROFILE</u>

- 7 parcels totaling 583 acres consisting of vacant or private recreationally used land
- Existing Property Assessment: $4,584,689
- Existing Building Square Footage: 14,785 sq. feet
- 2017 Tax Revenue: $90,410
- Zone: General

<u>DEVELOPMENT POTENTIAL</u>

- Potential Additional Building Area (industrial): 5,064,521 sq. ft.
- Additional Property Assessment: $340,842,263
- Additional Tax Revenue: $6,721,409
- Additional Employment: 5,466
- Additional Traffic: 16,545 Average Daily Trips

I hope you will find this information to be of value in helping to further advance this important transportation initiative. Please let me know if you have any questions or concerns or require any additional information.

Sincerely,

NASHUA REGIONAL PLANNING COMMISION

Jay Minkarah
Executive Director