Memorandum

To:	Jennifer Ciara, Chief Planner City of Newton 1000 Commonwealth Avenue Newton, MA 02459	Date:	February 22, 2019
		Project #:	12239.00
From:	Randall C. Hart, Principal Curtis Quitzau, P.E. Monica Tibbetts-Nutt, Exec. Director, 128 Business Council	Re:	Response to BETA Group, Alta Planning + Design comments. The Northland Newton Development Transportation Peer Review

INTRODUCTION

Vanasse Hangen Brustlin, Inc. (VHB) and 128 Business Council (128BC) have prepared the following response to comments received on the referenced Peer Review. Comments were received from BETA Group Inc. and Alta Planning + Design Inc. in December 2018. For ease of review the comments that were received are outlined below along with the responses.

2.1 Study Area

Comment 2.1: As currently proposed, a "Mobility Hub" would be constructed on-site (Building 7) that would provide connections to nearby Massachusetts Bay Transportation Authority (MBTA) transit stations by way of a shuttle service program. As envisioned, the shuttle service would serve the Newton Highlands MBTA rapid transit station (and others) on the Green Line D Branch located at 60 Station Avenue in Newton. **Therefore, a quantitative assessment should be conducted at the Newton Highlands MBTA Station for the shuttle connection that describes the operations of the buses, pedestrians, bicyclists, transit users, shuttle loading and unloading, and shuttle parking. Current observations and details of future transportation conditions and impacts should be described at the Walnut Street intersections with Floral Street, with Lincoln Street, with Station Avenue, and with Lake Avenue.**

Response: *We are aware of accessibility improvements to be undertaken at the Newton Highlands T, and we know that Councilor Rice has been involved in preventing engine idling in the neighborhood. Shuttle routes are subject to Council approval";*

2.2 Existing Conditions

Comment 2.2: At the Chestnut Street unsignalized intersection with the Route 9 (Boylston Street) westbound service road, Chestnut Street travels in a north/south alignment, the east leg provides egress from the Route 9 westbound off-ramp, and the west leg provides access to the Route 9 westbound on-ramp. The Chestnut Street northbound approach is under free flow traffic conditions, with the other three approaches under STOP-sign control. The Route 9 westbound service road westbound approach appears to have limited sight lines to the south (looking left) to see approaching Chestnut Street northbound vehicles. Vehicles exiting from the Route 9 westbound service road approach were observed to stop beyond the STOP line (within the intersection) in an effort to have improved sight lines to on-coming vehicles. **Although a crash evaluation was conducted in the traffic study, this safety concern was not identified at this study area intersection.**

Response: *This safety concern has been noted.*

Comment 2.3: Upon review of the Intersection Capacity Analyses provided in the Appendix of the traffic study, the Chestnut Street unsignalized intersection with the Route 9 westbound service road was evaluated as an All-Way Stop-Control (AWSC) intersection. Due to the limitations of the software program used as part of the traffic study, a four-way unsignalized intersection with three approaches under STOP-sign control cannot be properly modeled. **Therefore, a different software program should be used to properly model operations at this intersection (e.g., SIDRA).**

<u>Response:</u> *The Proponent has acknowledged the congestion along this corridor (see Comment 2.24), therefore further review and modeling of the congestion is not considered a productive exercise at this time. Should the city require additional modeling in the future, the Proponent will consider providing.*

Comment 2.4: At the Chestnut Street unsignalized intersection with the Route 9 eastbound service road, Chestnut Street travels in a north/south alignment, the east leg provides access to the Route 9 eastbound on-ramp, and the west leg provides egress from the Route 9 eastbound off-ramp. The Chestnut Street southbound approach is under free flow traffic conditions, with the other three approaches under STOP-sign control. **The description of the traffic control at this intersection mistakenly states that the Chestnut Street northbound approach is under free-flow conditions and the Chestnut Street southbound approach is under STOP-sign control.**

<u>Response:</u> *This comment has been noted.*

Comment 2.5: The Route 9 eastbound service road eastbound approach appears to have limited sight lines to the north (looking left) to see approaching Chestnut Street southbound vehicles. In addition, the Route 9 eastbound service road westbound approach appears to have limited sight lines to the north (looking right) to see approaching Chestnut Street southbound vehicles. Vehicles exiting from the Route 9 eastbound service road approaches were observed to stop beyond the STOP line (within the crosswalks and within the intersection) in an effort to have improved sight lines to on-coming vehicles. **Although a crash evaluation was conducted in the traffic study, this safety concern was not identified at this study area intersection.**

<u>Response:</u> *This safety concern has been noted.*

Comment 2.6: Upon review of the Intersection Capacity Analyses provided in the Appendix of the traffic study, the Chestnut Street unsignalized intersection with the Route 9 eastbound service road was evaluated as an AWSC intersection. Due to the limitations of the software program used as part of the traffic study, a four-way unsignalized intersection with three approaches under STOP-sign control cannot be properly modeled. **Therefore, a different software program should be used to properly model operations at this intersection (e.g., SIDRA).**

<u>Response:</u> *The Proponent has acknowledged the congestion along this corridor (see Comment 2.24), therefore further review and modeling of the congestion is not considered a productive exercise at* *this time. Additionally, the operating conditions have changed at that intersection with the 2018 closing of the access to Wellesley Office Park from Route 9 which has made the eastbound service road the sole access to the Wellesley Office Park. Northland would be willing to contribute to further study of this area.*

Comment 2.7: Oak Street and Christina Street intersect Needham Street from the west and east, respectively, to form a four-way signalized intersection with the Oak Street and Christina Street legs slightly offset (Oak Street approximately 40 feet south of Christina Street). Based on field observations, the traffic signal operates on a three-phase vehicular system with a Needham Street northbound/southbound permissive phase, an Oak Street eastbound phase, and a Christina Street westbound phase. Upon review of the Intersection Capacity Analyses provided in the Appendix of the traffic study, however, existing traffic-volume conditions were evaluated with a two-phase traffic signal system (i.e., a Needham Street northbound/southbound permissive phase and an Oak Street/Christina Street permissive phase).

While the existing conditions are not reflected accurately in the analyses for this intersection, the project's impacts are measured under future traffic-volume conditions (i.e., 2025 No-Build and 2025 Build) and roadway improvements are planned along the Needham Street corridor that includes this signalized intersection. As part of the planned improvements (MassDOT Project No. 608137), Christina Street would be relocated to the south opposite Oak Street to form a standard four-way intersection and allow the Christina Street and Oak Street approaches to run permissively.

Agreed. No response is required.

Comment 2.8: At the Winchester Street unsignalized intersection with the Route 9 eastbound service road, the Route 9 eastbound service road intersects Winchester Street from the east. The Route 9 eastbound service road westbound approach appears to have limited sight lines to the north (looking right) and to the south (looking left) to see approaching Winchester Street vehicles. Vehicles exiting from the Route 9 eastbound service road approach were observed to stop beyond the STOP line (within the crosswalks and within the intersection) in an effort to have improved sight lines to on-coming vehicles.

Although a crash evaluation was conducted in the traffic study, this safety concern was not identified at this study intersection. Since the Needham Street, Highland Avenue, and Winchester Street corridor project (MassDOT Project No. 606635) would place this intersection under traffic signal control, however, this safety deficiency is anticipated to be alleviated.

Agreed. No response is required.

Comment 2.9: At the Winchester Street unsignalized intersection with the Route 9 westbound service road, the Route 9 westbound service road intersects Winchester Street from the east (off-ramp) and west (on-ramp). The Route 9 westbound service road westbound approach appears to have limited sight lines to the north (looking right) and to the south (looking left) to see approaching

Winchester Street vehicles. Vehicles exiting from the Route 9 westbound service road westbound approach were observed to stop beyond the STOP line (within the crosswalks and within the intersection) in an effort to have improved sight lines to on-coming vehicles.

Although a crash evaluation was conducted in the traffic study, this safety concern was not identified at this study area intersection. Since the Needham Street, Highland Avenue, and Winchester Street corridor project (MassDOT Project No. 606635) would place this intersection under traffic signal control, however, this safety deficiency is anticipated to be alleviated.

Agreed. No response is required.

2.2.2. Traffic Counts

Comment 2.10: Upon review of the ATR data provided in the Appendix of The Northland Newton Development *Traffic Impact and Access Study*, Weekday Midday traffic volumes have been found to be higher than the typical Weekday commuting time periods (i.e., 7-9 AM and 4-6 PM). Table 1 below summarizes our review of the traffic counts.

Response: *Midday peak hour traffic analyses were conducted at key study area intersection and are provided in a supplemental memorandum to the City of Newton (December 10, 2018).*

2.2.4 Historical Adjustment

Comment 2.11: MassDOT guidelines state that historical traffic counts should be increased by a seasonal adjustment, a background growth rate, and any new traffic from developments that have been completed subsequent to the time of the original counts.[1] **Therefore, the Applicant should confirm with the Newton Planning Department that no additional developments have been constructed subsequent to the 2017 traffic counts that would increase traffic volumes within the study area. Should developments be identified that have been constructed and occupied within this timeframe, then the existing and future traffic volumes used within The Northland Newton Development *Traffic Impact and Access Study* may need to be revised.**

Response: *Agreed. Background development projects included in the TIA were discussed with the City prior to finalization of the study. All projects referenced were included in the study.*

Comment 2.12: The Northland Newton Development *Traffic Impact and Access Study* stated that research of historic traffic data, the Needham Street FDR, and other developments in proximity to the subject

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[1] Ibid., 2.

Attachments

- Response 2.20: 2017 National Household Travel Survey
- Response 2.21: ITE Technical Paper
- Response 2.22: Trip Generation Person Trip Conversion Calculations
- Response 2.23: Site-Generated Traffic Volume Networks by Use
- Response 5.4: Oak Street Driveway Capacity Analysis Update

Summary of Travel Trends

2017 National Household Travel Survey

U.S. Department of Transportation
Federal Highway Administration

Technical Report Documentation Page

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Daniel E. Jenkins, PE, Travel Behavior Data Program Manager
1200 New Jersey Avenue, SE
Washington DC 20590

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15. Supplementary Notes

16. Abstract

The 2017 National Household Travel Survey (NHTS) provides an inventory of daily travel in the US and its major Census Divisions and add-on areas. It is the only source of national-level statistics on personal travel in the US. The survey series (conducted since 1969) includes demographic data on households, people, vehicles, and detailed information on daily travel by all modes of transportation and for all purposes.

NHTS survey data are collected from a sample of households and expanded to provide estimates of trips and miles of travel by travel mode, trip purpose, and other important attributes. When combined with historical data from the earlier surveys (1969, 1977, 1983, 1990, and 1995 NPTS and the 2001 NHTS, 2009 NHTS, and 2017 NHTS) these data serve as a rich source of information on the trends in travel over time.

This report summarizes trends in household and personal travel patterns, including information on changes to the household-based vehicle fleet and commuting patterns. The report begins with a summary of the changes in the population, demographics, and related travel. Next, travel trends are examined at the household level, including differences between different areas of the US and by household income, for example. Next, changes in travel are summarized at the person-level, including trips by purpose and miles of travel by age and sex. Following sections detail changes in vehicle availability and usage, commute travel patterns, temporal distribution, and the travel of special populations.

The 2017 NHTS was conducted with major changes in sampling strategy (an address-based sample compared to previous land-line random-digit sample) and methodology (Web-based self-reports compared to previous computer-aided interviewing). These and other critical changes are summarized here in Appendix A and in the data documentation at https://nhts.ornl.gov/. Researchers and data users are cautioned to do their best to assess how the change in methods may affect their estimates and to caution their readers about these critical changes in the data series.

17. Key Words	18. Distribution Statement
National Household Travel Survey, NHTS, US travel, daily travel, means of travel, mode of travel, trip purpose, VMT, PMT, demographics and travel, vehicle use trends, fleet changes, vehicle availability, commute data, commute patterns, travel purpose, travel patterns by age, travel patterns by gender	**No restrictions**

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Unclassified	**Unclassified**	**148**	**N/A**

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In 2017, the NHTS underwent a major change in survey methodology. The most impactful changes are 1) using an address-based sample rather than an RDD land-line sample, and 2) moving from an interviewer assisted telephone surveys (CATI) to a self-completed web-based survey. These changes made the 2017 NHTS a better sample survey, with better coverage of US households and lower respondent burden. In addition, the method of obtaining trip length used a Google API shortest path route between a geocoded origin and destination whereas previous NHTS used the respondent's estimate of trip length for each trip. These changes may have impacted the number of reported trips, including incidental trips, and the estimate of trip lengths, which in turn impact VMT and PMT estimates. The change in methods may have measurable impacts on many of the survey estimates, and unknown impacts yet to be identified. Some of the measured impacts of methods changes in 2017 are outlined in Appendix A. Users should take into account the impacts identified here and do further analysis of their own to assess the best use of the data series for any specific application.

The data presented here are based on a sample of the population, and so is subject to sampling error. Sampling error is the calculated statistical imprecision due to interviewing a random sample instead of the entire population. The margin of error provides an estimate of how much the results of the sample may differ due to chance when compared to what would have been found if the entire population was interviewed. For the 2017 data the margin of error is added to and subtracted from the point estimate to provide the range for each estimate. Sampling error is the only error that can be quantified, but there are other errors to which surveys are susceptible. Please read 'Reliability of the Estimates' in Chapter 1 for more details.

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LIST OF TABLES

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SUMMARY OF TRAVEL TRENDS

2017 National Household Travel Survey

1. INTRODUCTION AND RELIABILITY OF THE ESTIMATES

Policymakers rely on transportation statistics, including data on personal travel behavior, to formulate strategic transportation policies and to improve the safety and efficiency of the U.S. transportation system. Policymakers, individual state Department of Transportation (DOTs), metropolitan planning organizations, industry professionals, and academic researchers use the data to gauge the extent and patterns of travel, plan new investments, and better understand the implications of travel trends on the nation's transportation infrastructure.

To address these data needs, the U. S. Department of Transportation (USDOT) initiated an effort in 1969 to collect detailed data on personal travel. The 1969 survey was the first Nationwide Personal Transportation Survey (NPTS). The survey was conducted again in 1977, 1983, 1990, and 1995. In 2001, the survey was expanded by integrating the Federal Highway Administration (FHWA) managed NPTS and the Bureau of Transportation Statistics-sponsored American Travel Survey (ATS), and the survey was re-named the National Household Travel Survey (NHTS). The NHTS was conducted without the long-distance component again in 2009 and 2017.

The recent evaluation of the NHTS data program found that NHTS data are used extensively to inform policy initiatives, provide context for decision-making, and benchmark progress for policies and programs.[1] More directly, NHTS data are used as inputs to statistical analyses and models related to health, energy, air quality, and mobility. At the state and local levels, NHTS has its greatest impact in developing, calibrating, or validating travel demand models that are used to inform transportation planning and project selection.

The 2017 NHTS is the most recent national inventory of daily travel, and the authoritative source on the travel behavior of the American public. The NPTS/NHTS data series is the only source of national travel behavior data that tracks trends in personal and household travel. The survey gathers trip-related data, such as mode of transportation, duration, distance, and purpose of trip, and links the travel-related information to demographic, geographic, and economic data for analysis purposes.

The 2017 NHTS is a nationally representative survey of travel behavior conducted from April 2016 through April 2017. The 2017 survey is the latest in the series and updates information gathered in the NPTS conducted in 1969, 1977, 1983, 1990, and 1995, and the NHTS conducted in 2001 and 2009. The 2017 NHTS includes samples added by 13 state and local planning agencies from around the country, plus the core national sample.

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[1] Federal Highway Administration Research and Technology Evaluation: National Household Travel Survey Program Final Report, Publication Number: FHWA-HRT-16-082, Date: August 2016. https://www.fhwa.dot.gov/publications/research/randt/evaluations/16082/index.cfm

During the survey period□researchers collected data from roughly 130□000 households□which were sampled based on postal address lists□and 2□□000 persons in the United States. They mailed sampled households a survey form with a small incentive and asked them to join the survey by either logging onto the website or mailing the form back. Each participating household reported all travel by household members on a randomly assigned 2□-hour single “travel day.” They assigned travel days for all □days of the week□including all holidays. Weighting reflected the day of week and month of travel to allow comparisons of weekdays or seasons.

This report uses 201□NHTS data to highlight travel trends over the entire survey series□almost □0 years of travel data for the United States. There are nine chapters□with each chapter representing a topic in travel behavior. The first section of statistical data focuses on demographic trends of households□persons□vehicles□and workers. The next chapter provides statistical data on overall household travel. Subse□uent sections of this report present person travel□private vehicle travel□vehicle use□and commute travel patterns. The final chapter highlights travel behavior of special populations and some new data elements from the 201□ NHTS. The research findings in this report do not include a detailed analysis of the 201□NHTS data set in its entirety but provide a very short overview of available data.

Of course□this report relies on the work of previous authors and reproduces the analysis done as part of the previous reports. The first *Summary of Travel Trends* was a pamphlet produced for the 1983 NPTS by Comsis. In 199□and 2001□Oak Ridge □ORNL□produced the trends report after retrieving the 19□□archived data. In 2009□the FHWA produced the report with Travel Behavior Analysts□and FHWA produced the current report with Travel Behavior Analysts and Westat. All errors are the responsibility of the authors.

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In 201□□the NHTS underwent a major change in survey methodology. The most impactful changes are 1□using an address-based sample rather than a random digit dialing □RDD□ landline telephone sample□and 2□moving from primarily an interviewer-led computer-assisted telephone interviewing □CATI□to a self-completed web-based survey with CATI as an alternative. With these changes□the 201□NHTS sample had better coverage of U.S. households as it included households without landline telephones. The design reduced coverage bias and respondent burden.

In addition□the method of obtaining trip length used a Google API □application programming interfaces□shortest path route between a geocoded origin and destination whereas previous NHTS’ used the respondent’s estimate of trip length for each trip. These changes may have impacted the number of reported trips□including incidental trips□and the estimate of trip lengths□ which in turn impact vehicle miles of travel □VMT□and person miles of travel □PMT□estimates. The change in methods may have measurable impacts on many of the survey estimates□and unknown impacts that not yet identified.

Appendix A outlines some of the measured impacts of methods changes in 201□. Users should consider the impacts identified here and do further analysis of their own to assess the best use of the data series for any specific application.

1.2 RELIABILITY OF THE ESTIMATES (SOURCE AND ACCURACY)

An estimate based on a sample survey has two types of error — sampling error and nonsampling error. The estimated standard errors provided approximate the true sampling errors. They do incorporate the effect of some nonsampling errors in response and enumeration, but do not account for any systematic biases in the data.

Nonsampling error. The full extent of nonsampling error is unknown, but special studies have quantified some sources of nonsampling error. Some sources of nonsampling errors in surveys include the inability to obtain information about all persons in the sample, differences in the interpretation of questions, inability or unwillingness of respondents to provide correct information, inability of respondents to recall information, errors made in collecting and processing the data, errors made in estimating values for missing data, and failure to represent all sample households and all persons within sample households (undercoverage).

In a national sample such as that used for the NHTS, undercoverage can occur when households reside in very newly constructed homes whose addresses are not yet available on the sampling frame, households have simplified addresses (e.g., John Doe, Anytown, MD 12345), or the household respondent either accidentally or purposely does not report all the people living in the household. The weighting process adjusts for some nonresponse and matches independent age-sex-race-ethnicity population controls, which partially corrects for the biases due to survey undercoverage. However, biases exist in the estimates to the extent that missed persons in missed households or missed persons in interviewed households have travel characteristics different from those of interviewed persons in the same age-sex-race-origin group.

Sampling error. When a portion of the population is surveyed, rather than the entire population, estimates differ from the true population values that they represent. This difference, or sampling error, occurs by chance, and variability is measured by the standard error of the estimate. The standard error is the margin of error (MOE), which is the half-confidence interval at the 95% confidence level.

Sample estimates from a given survey design are unbiased when an average of the estimates from all possible samples would yield, hypothetically, the true population value. In this case, the sample estimate and its margin of error can be used to construct approximate confidence intervals, or ranges of values that include the true population value with known probabilities.

The margin of error in this document is at the 95 percent confidence level. To construct the bounds of the margin of error—that is, a high estimate and a low estimate—the MOE shown in tables is added to and subtracted from the estimate given.

For example, if the estimate is 500 and the margin of error is 2, then in 95 repeated samples the estimates obtained would fall between 498 and 502; therefore, if the survey were conducted 100 times with the same protocols, 95 percent of the time the true population estimate would fall between 498 and 502. It is important to determine the significant differences from those estimates that are a product of the known sample error when analyzing these data. When comparing values, if the ranges of two estimates overlap, then there is no significant difference in the estimated values.

Users should be cautious when computing estimates for smaller population groups, such as specific geographies, groups of people, or even less common forms of transportation, like bicycle, Uber/Lyft, or even transit. While the weights support a large variety of travel-related estimates, caution should be taken for estimates generated from a small number of responding households or persons. Computing the confidence interval or MOE is especially important for such analyses to ascertain whether any apparent nominal differences are actually statistically different.

On the other hand, the NHTS sample can produce robust estimates of major travel indicators at census region or division (as shown in Table 2b) or by Metropolitan Area size (as shown in Table 28), and for specific groups of travelers (see Section 9 on Travel by Special Populations). Using the data appropriately is the responsibility of the analyst. The data trends shown here are just a small sample of the analysis possible with the NHTS data, and each of the topics presented could be the subject of a more in-depth and stringent analysis.

Public-use national data from the 2017 NHTS is available for download and for on-line analysis on the NHTS website (http://nhts.ornl.gov). Weights and replicates are included for each of the data files. Weights match the sample of households and persons to the population for demographic characteristics and geographic levels. Use replicate weights to calculate the MOE of each estimate.

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Tables 1a through 1d present summary statistics on key demographic characteristics by survey year. For years 2009 and 201□□the MOEs are also included.

There was a major change in the method used to collect trip distance in 201□ that impacts the estimates of PMT□VMT□and average person and vehicle trip lengths. In 201□□the NHTS calculated trip length using the shortest path routes between geocoded origins and destinations. Previous surveys used self-reported distances.

As a result of the change in method□the 201□ original estimates of VMT and PMT may not be directly comparable with previous years. The 201□ trip distance is adjusted to be more comparable, shown as "adj." in this document. See Appendix A for further details.

T□□□e 1□□Summary Statistics on Demographic Characteristics□Households

□□□se□□□ds □t□□□s□nds□					
S□r□e□ □e□r	□□□	1 □ers□n	2 □ers□ns	□ □ers□ns	□□ □ers□ns
19□9	□2□□0□	10□980	18□□□8	10□□□□	22□330
19□□	□□□□12	1□□21□	22□92□	13□0□□	23□22□
1983	8□□3□1	19□3□□	2□□1□9	1□□□□□	2□□092
1990 □adj□	93□3□□	22□999	30□11□	1□□128	2□□10□
199□	98□990	2□□□32	31□83□	1□□82□	2□□□9□
2001	10□□3□□	2□□□18	3□□032	1□□□□9	2□□8□□
2009	113□101	31□□□1	3□□□28	18□10□	2□□□28
2009 MOE	-	10□	13□	2□□	2□3
201□	118□208	32□9□2	□0□0□□	18□□21	2□□□□9
201□ MOE	-	-	-	9□	9□

Note□

- Totals in all tables can include cases that were not included in any table subcategory□for instance people who did not report their age are included in the total persons□but not in any age category.
- 1990 NPTS data were adjusted to make them more comparable with later surveys.
- 2001 NHTS sample included children 0 to □ in the survey. The data shown here exclude them to be comparable with other survey years.
- 2009 NHTS sample did not include households without landlines telephones□the cell-phone only □CPO□households.
- 201□ NHTS sample was address-based and included more urban and CPO households. This and other methods changes in the data series are outlined in Appendix B.

T□□□e 1□□Summary Statistics on Demographic Characteristics□Persons

□ers□ns □t□□□s□nds□						
S□r□e□ □e□r	**□□□**	**□nder 1□**	**1□□1□**	**2□□□□**	**□□□□□**	**□□□**
19□9	19□□213	□0□100	1□□□98	□0□0□0	□2□982	19□□□3
19□□	213□1□1	□□□9□8	1□□□□2	□2□2□2	□□□988	22□391
1983	229□□□3	□3□□82	1□□2□8	□0□□88	□□□3□3	2□□3□2
1990 □adj□	239□□□1□	□□□303	13□8□1	□9□□1□	82□□80	2□9□□
199□	2□9□99□	□1□□11	1□□0□□	□9□□9□	93□□□□	31□2□9
2001	2□□□203	□□□98□	1□□29□	□□□□80	103□29□	32□88□
2009	283□0□□	□□□□2□	19□□1□	□0□8□□	129□202	38□8□0
2009 MOE	-	□□1	□□3	1□089	8□□	0
201□	321□□19	□□□98	1□□□□□	□□□339	12□□3□0	□□□□□□
201□ MOE	0	□□□	9□□	9□□	98□	0
□ers□ns □t□□□s□nds□						
S□r□e□ □e□r	**□□□1□□□**	**□□□M□e**	**□□□M□e 1□□□**	**□□□□e□ □e**	**□□□□e□ □e 1□□□**	**□□□□□**
19□9	13□□113	9□□□□□	□□□□□2	102□□□8	□3□□2□	NA
19□□	1□8□183	102□□21	□□□□□2	110□□20	83□□21	198□□3□
1983	1□□□□□1	111□□1□	83□□□□	11□939	92□080	212□932
1990 □adj□	182□803	11□□□□1	8□□□32	12□□9□□	9□□3□1	222□101
199□	198□□83	12□□□□3	9□□□2□	133□□□1	102□9□□	2□1□□□□
2001	208□1□□	12□□321	100□308	132□2□0	10□8□□	2□□□□□0
2009	238□330	139□2□□	11□□□21	1□3□□9□	121□908	283□0□□
2009 MOE	□□1	81	338	81	338	0
201□	2□□□101	1□8□039	12□903	1□3□□□0	131□198	321□□19
201□ MOE	□□□	0	□□1	0	39□	0

Note□

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- 2001 NHTS sample included children 0 to □in the survey. The data shown here exclude them to be comparable with other survey years.
- 2009 NHTS sample did not include households without landlines telephones □CPO households□.
- 201□ NHTS sample was address-based and included more urban and CPO households. This and other methods changes in the data series are outlined in Appendix B.

T□□□e 1□□Summary Statistics on Demographic Characteristics□Drivers and Workers

S□r□e□ □e□r	Dri□ers □t□□□s□nds□			□ □r□ers □t□□□s□nds□		
	□□□	M□□e	□e□ □□e	□□□	M□□e	□e□ □□e
19□9	102□98□	□□□981	□□□00□	□□□□□8	□8□8□	2□2□1
19□□	12□□□□2	□□□199	□1□3□3	93□019	□□□□2□	3□39□
1983	1□□□01□	□□□□39	□1□3□□	103□2□□	□8□8□9	□□□39□
1990 □adj□	1□3□02□	80□289	82□□0□	118□3□3	□3□99□	□□□33□
199□	1□□□330	88□□80	8□□8□1	131□□9□	□1□10□	□0□□93
2001	190□□2□	9□□□□1	9□□□□3	1□□□2□2	□8□2□□	□□□00□
2009	212□309	10□□813	10□□□9□	1□1□3□3	81□939	□9□□3□
2009 MOE	9□9	□09	□31	893	□□9	□28
201□	223□2□□	111□1□3	112□11□	1□□□988	83□□89	□3□399
201□ MOE	82□	□88	9□3	1□012	□9□	8□9

Note□

- Totals in all tables can include cases that were not included in any table subcategory□for instance people who did not report their age are included in the total persons□but not in any age category.
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- 2001 NHTS sample included children 0 to □ in the survey. The data shown here exclude them to be comparable with other survey years.
- 2009 NHTS sample did not include households without landlines telephones □CPO households□.
- 201□ NHTS sample was address-based and included more urban and CPO households. This and other methods changes in the data series are outlined in Appendix B.

T□□□e 1d□Summary Statistics on Demographic Characteristics and Total Travel

Tr□□e□□ □□r□□teristi□s					
S□r□e□ □e□r	**□□□se□□□d □e□i□□es □t□□□s□nds□**	**□□□se□□□d □e□i□□e Tri□s □□ i□i□□ns□**	**□□□se□□□d □e□i□□e Mi□es □□ Tr□□e□□□MT in □ i□i□□ns□**	**□ers□□n Tri□s □□ i□i□□ns□**	**□ers□□n Mi□es □□ Tr□□e□□□MT in □ i□i□□ns□**
19□9	□2□□00	8□28□	□□□9□0	1□□□1□□	1□□0□□13□
19□□	120□098	108□82□	90□□□03	211□□□8	1□8□9□21□
1983	1□3□□1□	12□□8□□	1□002□139	22□□38□	1□9□□□□□2
1990 □adj□	1□□□221	193□91□	1□□9□290	30□□□□1	2□829□93□
199□	1□□□0□□	229□□□□	2□0□8□3□8	3□8□930	3□□11□122
2001	201□308	233□030	2□2□□□□□9	38□□□8□	3□□83□9□9
2009	210□□□8	233□8□9	2□2□□□111	392□023	3□□32□□91
2009 MOE	918	2□381	□□□1□□	3□□□□	1□□1□39□
201□	222□□□9	220□□30	2□10□882	3□□1□1□2	3□9□0□28□
201□ MOE	91□	2□□□1	88□113	□39□	1□□0□8□□
201□ □adj□	-	-	2□321□820	-	□□291□1□0
201□ □adj□MOE	-	-	98□0□□	-	1□□□□□□0

Note□

- Totals in all tables can include cases that were not included in any table subcategory□for instance people who did not report their age are included in the total persons□but not in any age category.
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- 2001 NHTS sample included children 0 to □ in the survey. The data shown here exclude them to be comparable with other survey years.
- 2009 NHTS sample did not include households without landlines telephones □CPO households□.
- 201□ NHTS sample was address-based and included more urban and CPO households. This and other methods changes in the data series are outlined in Appendix B.
- Household VMT and PMT "adjusted" includes estimates of miles in all vehicles, including "18" Rental Car.
- In 19□9□household vehicles did not include pickups or other light trucks.

The 2017 NHTS obtained larger households with more workers compared to the 2009 survey, possibly because the 2017 address-based sample included about □□ percent cell phone only (CPO) households, which are more likely younger and working. CPO households were not included in the sample in 2009 (see Appendix B).

The data series in Tables 2a and 2b show that over the last five decades, American households acquired more vehicles and drivers. In the United States in 1969, there were as many vehicles as workers. By 1990 and continuing to the present, there are as many vehicles as drivers.

As average household size has stabilized, average vehicles per household, licensed drivers per household, and workers per household have all remained rather stable over the last decade or so.

There are important differences between the census regions listed in Table 2b (the states in each census region are listed in Appendix C). The West continues to have the highest household size, vehicle ownership, and driver rates in the country. The Midwest has smaller households on average, and fewer workers per household. The Northeast has fewer vehicles and drivers per household.

Table 2a: Major Travel Indicators by Survey Year

Major Travel Indicators by Year								
Travel Indicator	**1969**	**1977**	**1983**	**1990**	**1995**	**2001**	**2009**	**2017**
Persons per Household	3.1□	2.83	2.□9	2.□□	2.□3	2.□8	2.□0	2.□□
Vehicles per Household	1.1□	1.□9	1.□8	1.□□	1.□8	1.89	1.8□	1.88
Licensed drivers per Household	1.□□	1.□9	1.□2	1.□□	1.□8	1.□□	1.88	1.89
Vehicles per Licensed Driver	0.□0	0.9□	0.98	1.01	1.00	1.0□	0.99	1.00
Workers per Household	1.21	1.23	1.21	1.2□	1.33	1.3□	1.3□	1.33
Vehicles per Worker	0.9□	1.29	1.39	1.□0	1.3□	1.39	1.39	1.□2

Notes:

- 1990 NPTS data were adjusted to make them more comparable with later surveys.
- 2001 NHTS sample included children 0 to □ in the survey. The data shown here exclude them to be comparable with other survey years.
- 2009 NHTS sample did not include households without landlines telephones (CPO households).
- 2017 NHTS sample was address-based and included more urban and CPO households. This and other methods changes in the data series are outlined in Appendix B.
- In 1969, household vehicles did not include pickups or other light trucks.

Table 2: Major Travel Indicators by Survey Region

Major Travel Indicators by Region						
Census Region	**Persons per Household**	**Vehicles per Household**	**Drivers per Household**	**Vehicles per Driver**	**Workers per Household**	**Vehicles per Worker**
ALL [illegible]1[illegible]	2.[illegible]	1.88	1.89	1.00	1.33	1.[illegible]2
Northeast	2.[illegible]3	1.[illegible]3	1.[illegible]9	0.91	1.3[illegible]	1.22
Midwest	2.[illegible]2	1.9[illegible]	1.83	1.0[illegible]	1.29	1.[illegible]2
South	2.[illegible]	1.90	1.91	0.99	1.31	1.[illegible]
West	2.[illegible]0	1.98	1.98	1.00	1.38	1.[illegible]3

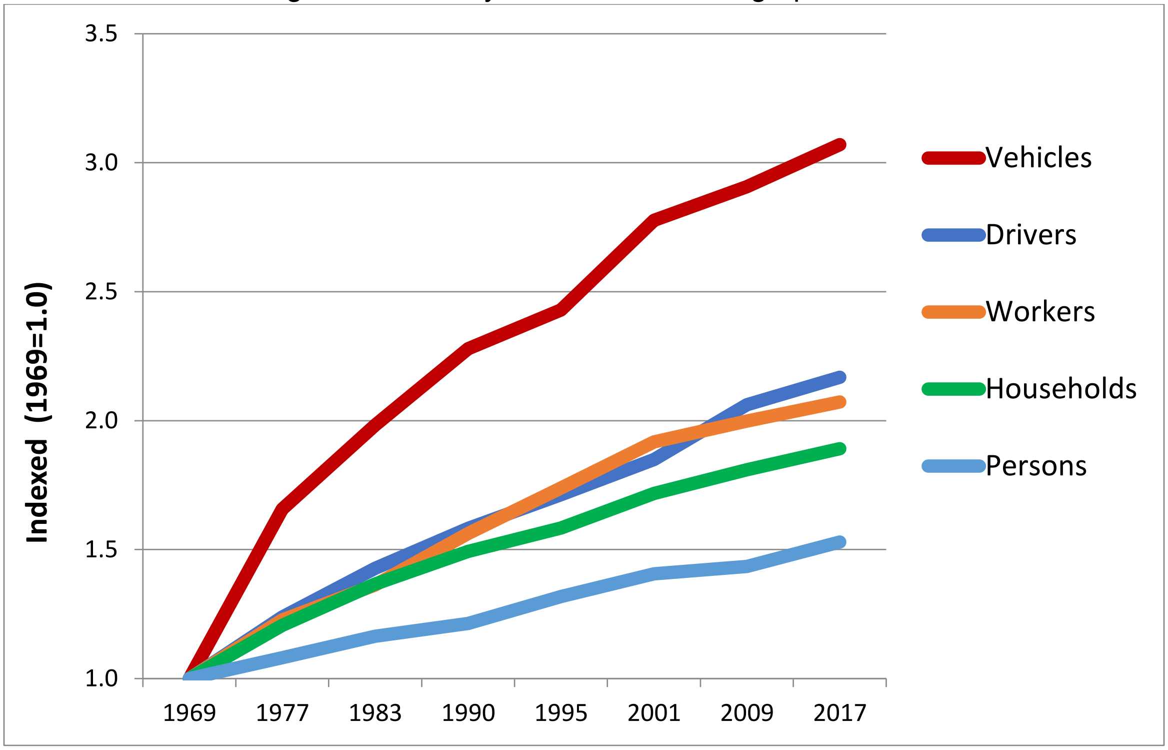
Notes:

- 1990 NPTS data were adjusted to make them more comparable with later surveys.
- 2001 NHTS sample included children 0 to [illegible] in the survey. The data shown here exclude them to be comparable with other survey years.
- 2009 NHTS sample did not include households without landlines telephones (CPO households).
- 201[illegible] NHTS sample was address-based and included more urban and CPO households. This and other methods changes in the data series are outlined in Appendix B.
- In 19[illegible]9, household vehicles did not include pickups or other light trucks.

During the past four decades, the growth in the number of workers and drivers has far outpaced the growth in the number of households and persons.

However, as shown in Figure 1, the growth in the number of vehicles has outpaced all other indicators. Since 19[illegible]9, the annual rate of increase in the number of personal vehicles was almost 1[illegible] times the annual rate of increase in the number of drivers.

Figure 1. Changes in Summary Statistics on Demographics and Total Travel



Note:

- 1990 NPTS data were adjusted to make them more comparable with later surveys.
- 2001 NHTS sample included children 0 to □ in the survey. The data shown here exclude them to be comparable with other survey years.
- 2009 NHTS sample did not include households without landlines telephones (CPO households).
- 2017 NHTS sample was address-based and included more urban and CPO households. This and other methods changes in the data series are outlined in Appendix B.
- In 1969, household vehicles did not include pickups or other light trucks.

The data series indicates that the per capita growth in travel that the United States experienced over the last four decades may be changing. Statistically, of the 10 estimates of major travel indicators shown in Tables 3a and 3b, □ are lower than the 2001 estimates and the remainder are statistically the same (within the confidence interval). Importantly, the number of reported person- and vehicle-trips per person is statistically lower in 2017 than in 2009, which is statistically lower than 2001.

The estimates of travel for U.S. households show significant changes in trip-making. The estimates of person and vehicle trips per household are lower in 2017 than 2009, which in turn was lower than the 2001 estimates.

As mentioned earlier, there was a major change in the method used to collect trip distance in 2017 that impacts the estimates of PMT, VMT, and Average Person and Vehicle Trip Lengths. In 2017, the NHTS calculated trip length using the shortest path routes between geocoded origins and destinations. Previous surveys used self-reported distances.

As a result of the change in method□the original estimates of VMT and PMT may not be directly comparable with previous years. See Appendix A for further details.

Table 1 Summary of Household Travel Statistics

	Household Statistics			
Survey Year	Daily Person Trips per Household	Daily PMT per Household	Daily Vehicle Trips per Household	Daily VMT per Household
1969	□.3□	□1.□□	3.83	3□.01
1977	□.□9	□8.2□	3.9□	32.9□
1983	□.20	□2.□□	□.0□	32.1□
1990	8.9□	83.0□	□.□9	□9.□□
1995	10.□9	9□.□1	□.3□	□□.2□
2001	9.□□	9□.2□	□.9□	□8.0□
2009	9.□0	90.□2	□.□□	□□.38
2009 MOE	0.09	3.38	0.0□	1.3□
2017 orig.	8.□0	92.02	□.11	□8.81
2017 orig. MOE	0.10	3.□0	0.0□	2.0□
2017 adj.		99.□□		□3.81
2017 adj. MOE		3.□0		2.2□

Notes:

- 1990 NPTS data were adjusted to make them more comparable with later surveys.
- 2001 NHTS sample included children 0 to □ in the survey. The data shown here excludes them to be comparable with other survey years.
- 2009 NHTS sample did not include households without landlines telephones □CPO households□
- 2017 NHTS sample was address-based and included more urban and CPO households. This and other methods changes in the data series are outlined in Appendix B.
- Household VMT and PMT "adjusted" includes estimates of miles in all vehicles, including "18" Rental Car.

T□□□e □□□Summary of Person Travel Statistics

S□r□e□ □e□r□	□ers□n St□tisti□s					
	D□i□□ □ers□n Tri□s □er □ers□n	D□i□□ □MT □er □ers□n	D□i□□ □e□i□□e Tri□s □er Dri□er	D□i□□ □MT □er Dri□er	□□er□□e □ers□n Tri□ □en□t□ □□ i□es□	□□er□□e □e□i□□e Tri□ □en□t□ □□ i□es□
19□9	2.02	19.□1	2.32	20.□□	9.□□	8.89
19□□	2.92	2□.9□	2.3□	19.□9	8.8□	8.3□
1983	2.89	2□.0□	2.3□	18.□8	8.□8	□.90
1990	3.□□	3□.91	3.2□	28.□9	9.□□	8.8□
199□	□.30	38.□□	3.□□	32.1□	9.13	9.0□
2001	□.09	3□.89	3.3□	32.□3	10.0□	9.8□
2009	3.□9	3□.13	3.02	28.9□	9.□□	9.□2
2009 MOE	0.03	1.3□	0.03	0.□1	0.3□	0.22
201□ orig.	3.3□	3□.0□	2.□0	2□.8□	10.□0	9.□□
201□ orig. MOE	0.0□	1.□□	0.03	1.0□	0.□0	0.3□
201□ adj.		38.98		28.□9	11.□□	10.□3
201□ adj. MOE		1.□1		1.1□	0.□1	0.□2

Note□

- 1990 NPTS data were adjusted to make them more comparable with later surveys.
- 2001 NHTS sample included children 0 to □ in the survey. The data shown here excludes them to be comparable with other survey years.
- 2009 NHTS sample did not include households without landlines telephones □CPO households□
- 201□ NHTS sample was address-based and included more urban and CPO households. This and other methods changes in the data series are outlined in Appendix B.
- Household VMT and PMT "adjusted" includes estimates of miles in all vehicles, including "18" Rental Car.

Table □ compares key survey variables for each NPTS survey with external sources.

T□□□e □□ Comparison of Survey Variables with Other Sources □Numbers in Thousands□ Except VMT □millions□□

□□te□□r□	□□□se□□ds	□□□□□ti□n	□i□ensed Dri□ers	□ □r□ers	□e□i□□es	□MT
	19□9					
Other Sources	□1□80□	199□1□□	108□30□		89□1□□	
19□9 NPTS	□2□□0□	19□□213	102□98□		□2□□00	
	19□□					
Other Sources	□□□1□2	218□10□	138□121		132□1□□	
19□□ NPTS	□□□□12	213□1□1	12□□□□2		120□098	
	1983					
Other Sources	83□918	232□08□	1□□□389		1□2□0□0	1□□□2□88
1983 NPTS	8□□3□1	229□□□3	1□□□01□		1□3□□1□	1□002□139
	1990					
Other Sources	91□9□□	2□□82□	1□□□01□	12□□8□0	1□2□902	2□1□□□3□2
1990 NPTS	93□3□□	239□□1□	1□3□02□	118□3□3	1□□□221	1□□9□□290
	199□					
Other Sources	9□□38□	2□1□□38	1□□□□28	132□300	180□□3□	2□139□30□
199□ NPTS	98□990	2□9□99□	1□□□330	131□□9□	1□□□0□□	2□0□8□3□8
	2001					
Other Sources	108□209	28□□318	191□2□□	1□3□□30	20□□□□1	2□□9□□9□1
2001 NHTS	10□□3□□	2□□□203	18□□280	1□2□8□0	202□□8□	2□2□□□□□9
	2009					
Other Sources	11□□181	30□□00□	208□321	1□□□1□0	231□□90	2□□□2□30□
2009 NHTS	112□□20	299□802	211□2□0	1□□1□3□0	21□□0□□	2□2□□□111
	201□					
Other Sources	118□208	321□□19	218□08□	1□□1□1□□	231□□90	2□□38□□83
201□ NHTS	118□208	321□□19	223□2□□	1□□□988	222□□□9	2□10□□882
201□ NHTS □adj□						2□□31□□□8

Note□

Please see previous *Summary of Travel Trends* publications for the sources used for comparisons to prior surveys.

Other Sources for 201□ Comparisons□

□□□se□□ds - Census □uickFacts Table US Households 2012-201□
https□□www.census.gov□□uickfacts□fact□table□US□HSD□1021□□viewtop

□□□□□ti□n - Population in Occupied Housing Units□estimate 201□
https□□factfinder.census.gov□faces□nav□jsf□pages□index.xhtml

Dri□ers - 201□ estimate from Highway Statistics Table DL-22
https□□www.fhwa.dot.gov□policyinformation□statistics□201□□dl22.cfm

□ □r□ers - Source□201□ American Community Survey 1-year estimate□Table B18120
https□□factfinder.census.gov□faces□tableservices□jsf□pages□productview.xhtml□src□CF

□e□i□□es □nd □MT - Light Duty Vehicles □short WB□plus Motorcycles plus □based on the 2002 VIUS□8□.□□ of Light Duty Vehicles with wheelbases □WB□larger than 121 inches□
http□□www.fhwa.dot.gov□policyinformation□statistics□201□□vm1.cfm

HOUSEHOLD TRAVEL

Overall, households generated about the same person miles of travel in 201[illegible] (Table [illegible]a) compared to the 2009 estimate, but fewer person trips (Table [illegible]c). The person miles of travel–overall and for most trip purposes–were statistically the same between 2009 for both the original and adjusted estimates for 201[illegible]. The exception was person miles of travel for social and recreational purposes, which were significantly lower in the original 201[illegible] estimate.

The fact that the number of reported trips is lower while the total miles of travel is about the same as previous surveys could be an artifact of the shift away from interviewer-aided surveys to self-reported travel on the web. Without the aid of an interviewer, people may forget to report incidental stops and other short trips that impact the estimate of trips more than the estimate of miles of travel.

T□□□e □□□ Trends in the Average Annual Person Miles of Travel per Household by Trip Purpose

	□□er□□e □nn□□□□MT □er □□□se□□□d							
Tri□ □□r□□se	**□□□ □□r□□ses**	**T□ □ □r□□ □ □r□**	**□ □r□ Re□□ted □□siness**	**S□□□□in□**	**□t□er □□□ i□□ □ □ers□n□□ □rr□nds**	**S□□□□□ □ □□□r□□**	**S□□i□□□ Re□re□ti□n**	**□t□er**
1983	22□802	□□8□	1□3□□	2□□□	3□311	1□22	8□9□□	□00
1990	30□31□	□□3□	1□0□3	3□3□3	□1□□	1□99	11□308	21□
199□	3□□□9	□□□0	1□98□	□□□9	□381	1□9□3	10□□1	131
2001	3□2□□	□□0□	2□98□	□88□	□□□1	2□0□0	10□8□	1□21□
2009	33□00□	□2□□	2□0□8	□□20	□13□	2□0□9	9□989	2□8□8
2009 MOE	1□23□.1	1□0.1	2□□.2	181.□	222.8	123.0	□8□.8	8□□.□
201□ Orig.	33□8□	□2□9	1□32□	□122	□□□9	2□189	8□9□□	□2□0
201□ Orig. MOE	1□2□□.2	20□.□	32□.0	3□3.3	2□3.□	39□.0	3□2.3	9□1.□
201□ Adj.	3□302	□□□8	1□399	□□□8	□939	2□39□	9□883	□□29
201□ Adj. MOE	1□31□.0	21□.3	330.0	3□8.2	280.0	□3□.8	38□.8	9□0.□

Note

- Totals in all tables can include cases that were not included in any table subcategory□for instance people who did not report their age are included in the total persons□but not in any age category.
- “Other Family/Personal Errands” includes trips such as to the post office, dry cleaners, or library
- 1990 NPTS data were adjusted to make them more comparable with later surveys.
- In 199□□VMT and vehicle trips with "To or From Work" as a trip purpose are believed to be overstated.
- 2001 NHTS sample included children 0 to □ in the survey. The data shown here exclude them to be comparable with other survey years.
- 2009 NHTS sample did not include households without landlines telephones □CPO households□
- 201□ NHTS sample was address-based and included more urban and CPO households. This and other methods changes in the data series are outlined in Appendix B.

T□□e □□□Trends in the Average Person Trip Length by Trip Purpose

Tri□ □□r□□se	□□er□□e □ers□n Tri□ □en□t□ □□ i□es□							
	□□□ □□r□□ses	T□ □ □r□□ □ □r□	□ □r□ Re□ted □□siness	S□□□□in□	□t□er □□□ i□□ □ □ers□n□□ □rr□nds	S□□□□□ □ □□□r□□	S□□i□□□ Re□re□ti□n	□t□er
1983	8.□	8.□	21.8	□.□	□3	□9	12.3	8.2
1990	9.□	10.□	28.2	□.□	8.□	□.□	13.2	10.3
199□	9.1	11.□	20.3	□1	□.□	□0	11.3	22.8
2001	10.0	12.1	28.3	□0	□8	□0	11.□	□3.1
2009	9.□	11.8	20.0	□.□	□0	□3	10.□	□1.□
2009 MOE	0.□	0.3	2.0	0.2	0.3	0.3	0.□	1□.□
201□ Orig.	10.□	11.□	2□9	□1	□1	□.□	10.□	□9.1
201□ Orig. MOE	0.□	0.3	□.□	0.□	0.3	1.2	0.□	□3
201□ Adj.	11.□	12.2	2□.□	□9	□9	□0	11.□	□0.□
201□ Adj. MOE	0.□	0.□	□.□	0.□	0.3	1.□	0.□	□2

Note□

- Totals in all tables can include cases that were not included in any table subcategory□for instance people who did not report their age are included in the total persons□but not in any age category.
- 1990 NPTS data were adjusted to make them more comparable with later surveys.
- In 199□□VMT and vehicle trips with "To or From Work" as a trip purpose are believed to be overstated.
- “Other Family/Personal Errands” includes trips such as to the post office, dry cleaners, or library
- 2001 NHTS sample included children 0 to □in the survey. The data shown here exclude them to be comparable with other survey years.
- 2009 NHTS sample did not include households without landlines telephones □CPO households□
- 201□ NHTS sample was address-based and included more urban and CPO households. This and other methods changes in the data series are outlined in Appendix B.

While the 201□ estimates of the number of person trips for work and school□church are statistically the same as in 2009 and 2001□the 201□ survey shows a significant decrease in the number of person trips for three major purposes□shopping□family and personal errands□and social and recreational travel.

There may also be a change in trip-making for shopping, family errands, and social and recreational travel. This is a large, catch-all category of purposes that may be affected by changes in on-line shopping and other electronic communication. Further research into the specific and detailed trends of changes in trip-making by purpose, including changes in trip-chaining, would be useful.

Table [illegible]: Trends in the Average Annual Person Trips per Household by Trip Purpose

Trip Purpose	Average Annual Person Trips per Household							
	All Purposes	To or From Work	Work Related Business	Shopping	Other Family/Personal Errands	School/Church	Social and Recreation	Other
1983	2[illegible]28	[illegible]3[illegible]	[illegible]2	[illegible]	[illegible]	310	[illegible]28	[illegible]1
1990	3[illegible]2[illegible]2	[illegible]39	38	[illegible]30	8[illegible]	30[illegible]	8[illegible]	22
199[illegible]	3[illegible]828	[illegible]	100	[illegible]	981	33[illegible]	9[illegible]3	[illegible]
2001	3[illegible]81	[illegible]	109	[illegible]0[illegible]	8[illegible]3	3[illegible]1	9[illegible]2	30
2009	3[illegible]	[illegible]1	10[illegible]	[illegible]2[illegible]	[illegible]8	333	9[illegible]2	[illegible]1
2009 MOE	31.8	[illegible].9	[illegible]	1[illegible]	13.9	9.8	1[illegible].1	[illegible].1
201[illegible] Orig.	3[illegible]1[illegible]0	[illegible]	[illegible]1	[illegible]80	[illegible]28	3[illegible]1	8[illegible]	128
201[illegible] Orig. MOE	3[illegible].2	11.3	3.[illegible]	1[illegible].1	13.8	8.1	22.0	3.1

Notes:

- Totals in all tables can include cases that were not included in any table subcategory, for instance people who did not report their age are included in the total persons, but not in any age category.
- 1990 NPTS data were adjusted to make them more comparable with later surveys.
- In 199[illegible], VMT and vehicle trips with "To or From Work" as a trip purpose are believed to be overstated.
- "Other Family/Personal Errands" includes trips such as to the post office, dry cleaners, or library
- 2001 NHTS sample included children 0 to [illegible] in the survey. The data shown here exclude them to be comparable with other survey years.
- 2009 NHTS sample did not include households without landlines telephones (CPO households).
- 201[illegible] NHTS sample was address-based and included more urban and CPO households. This and other methods changes in the data series are outlined in Appendix B.

Tables [illegible]a and [illegible]b display trends in the average annual vehicle miles of travel and average trip length by select trip purposes.

The original □unadjusted□201□ estimates of overall VMT per household is statistically lower than 2009□while the adjusted estimate is about the same—within the margin of error of the 2009 estimate. While nominally lower□the VMT per household for shopping is within range of the earlier estimates. However□the estimates of VMT per household in 201□ for errands and social□recreational travel are statistically lower than the 2001 estimates for the same purposes.

Using the adjusted estimates of vehicle miles of travel increases the estimate of VMT per household to be about the same as the 2009 estimates □within the margin of error□overall and for all trip purposes. For more information on the trip length adjustment□see Appendix A.

T□□□e □□□Trends in the Average Annual Vehicle Miles of Travel by Selected Trip Purposes

Tri□ □□r□□se	□□er□□e □nn□□□□MT □er □□□se□□d				
	□□□□□r□□ses	T□ □□r□□ □ □r□	S□□□□in□	□t□er □□□ i□□ □□ers□n□□ □rr□nds	S□□i□□□ Re□re□ti□n
19□9	12□□23	□□183	929	1□2□0	□□09□
19□□	12□03□	3□81□	1□33□	1□□□□	3□28□
1983	11□□39	3□□38	1□□□□	1□81□	3□□3□
1990	18□1□1	□□8□3	2□1□8	□□2□0	□□3□9
199□	20□89□	□□□92	2□80□	□□30□	□□□□□
2001	21□18□	□□□2□	3□0□2	3□9□□	□□18□
2009	19□8□0	□□□13	2□9□9	3□□1□	□□8□2
2009 MOE	□90.□	1□□.□	9□.9	120.1	2□□.8
201□ Original	1□□81□	□□3□9	2□□18	2□982	□□32□
201□ Orig. MOE	□□□.□	192.3	30□.3	21□.0	182.3
201□ Adjusted	19□□□1.8	□□□□3.9	2□919.9	3□32□.2	□□82□.□
201□ Adj. MOE	829.□	20□.□	339.3	2□1.9	203.2

Note□

- Totals in all tables can include cases that were not included in any table subcategory□for instance people who did not report their age are included in the total persons□but not in any age category.
- "Other Family/Personal Errands" includes trips such as to the post office, dry cleaners, or library
- In 199□□VMT and vehicle trips with "To or From Work" as a trip purpose are believed to be overstated.
- 1990 NPTS data were adjusted to make them more comparable with later surveys.
- 2001 NHTS sample included children 0 to □ in the survey. The data shown here exclude them to be comparable with other survey years.
- 2009 NHTS sample did not include households without landlines telephones □CPO households□.
- 201□ NHTS sample was address-based and included more urban and CPO households. This and other methods changes in the data series are outlined in Appendix B.

Table □: Trends in the Average Trip Length by Selected Trip Purposes

Trip Purpose	Average Vehicle Trip Length (Miles)				
	All Purposes	To or From Work	Shopping	Other Family/Personal Errands	Social and Recreation
1969	8.9	9.□	□.□	□.□	13.1
1977	8.□	9.0	□.0	□.□	10.3
1983	□.9	8.□	□.3	□.□	10.□
1990	8.9	11.0	□.1	□.□	11.8
1995	9.1	11.8	□.□	□.9	11.2
2001	9.9	12.1	□.□	□.□	11.9
2009	9.□	12.2	□.□	□.1	11.2
2009 MOE	0.2	0.3	0.2	0.2	0.□
2017 Original	9.□	12.0	□.0	□.9	10.□
2017 Orig. MOE	0.□	0.□	0.8	0.□	0.□
2017 Adjusted	10.□	12.8	□.9	□.□	11.8
2017 Adj. MOE	0.□	0.□	0.8	0.□	0.□

Notes:

- Totals in all tables can include cases that were not included in any table subcategory, for instance people who did not report their age are included in the total persons, but not in any age category.
- “Other Family/Personal Errands” includes trips such as to the post office, dry cleaners, or library
- 1990 NPTS data were adjusted to make them more comparable with later surveys.
- In 1995, VMT and vehicle trips with "To or From Work" as a trip purpose are believed to be overstated.
- 2001 NHTS sample included children 0 to □ in the survey. The data shown here exclude them to be comparable with other survey years.
- 2009 NHTS sample did not include households without landlines telephones (CPO households).
- 2017 NHTS sample was address-based and included more urban and CPO households. This and other methods changes in the data series are outlined in Appendix B.

Following the trends in person trips□in 201□□a typical household generated significantly fewer vehicle trips than in 2009 □Table □c□ While the 201□ estimates of the number of vehicle trips for work and school□church are statistically the same as in 2009 and 2001□the 201□ survey shows a significant decrease in the number of vehicle trips for three major purposes□shopping□family and personal errands□and social and recreational travel.

The original estimates of vehicle miles overall and for most purposes □except commuting□are statistically lower in 201□ compared to 2009. The adjustment for vehicle miles of travel brings the estimates into the same range as the 2009 estimates □within the margin of error□ For more information on the trip length adjustment□see Appendix A.

The fact that the number of reported vehicle trips is lower while the total □adjusted□vehicle miles of travel □Table □a□is about the same as previous surveys could be an artifact of the shift away from interviewer-aided surveys to self-reported travel on the web. Without the aid of an interviewer□people may forget to report incidental stops and other short trips that impact the estimate of trips more than the estimate of miles of travel.

However□there may also be a change in trip-making for shopping□family errands□and social and recreational travel. This is a large□catch-all category of purposes that may be affected by changes in on-line shopping and other electronic communication. Further research into the specific and detailed trends of changes in trip-making by purpose□including trip-chaining□would be enlightening.

Table □□ Trends in the Average Annual Vehicle Trips per Household by Selected Trip Purposes

Trip Purpose	Average Annual Vehicle Trips per Household				
	All Purposes	To or From Work	Shopping	Other Family/ Personal Errands	Social and Recreation
19□9	1□39□	□□□	213	19□	312
19□□	1□□□2	□23	2□8	21□	320
1983	1□8□	□1□	29□	2□2	33□
1990	2□0□□	□□8	□31	□□9	□□0
199□	2□321	□□3	□01	□2□	□2□
2001	2□1□1	□□9	□□9	□3□	□□1
2009	2□0□8	□□□	□□8	□00	□3□
2009 MOE	20.8	□.8	9.2	9.2	8.□
201□ Original	1□8□□	□□0	3□2	□3□	□10
201□ Orig. MOE	21.□	9.□	10.2	11.0	10.□

Note□

- Totals in all tables can include cases that were not included in any table subcategory□for instance people who did not report their age are included in the total persons□but not in any age category.
- “Other Family/Personal Errands” includes trips such as to the post office, dry cleaners, or library
- 1990 NPTS data were adjusted to make them more comparable with later surveys.
- In 199□□VMT and vehicle trips with "To or From Work" as a trip purpose are believed to be overstated.
- 2001 NHTS sample included children 0 to □ in the survey. The data shown here exclude them to be comparable with other survey years.
- 2009 NHTS sample did not include households without landlines telephones □CPO households□.
- 201□ NHTS sample was address-based and included more urban and CPO households. This and other methods changes in the data series are outlined in Appendix B.

Table □ displays the trends in average annual person trips per household by mode of transportation and metropolitan statistical area □MSA□si□e. Future surveys will tell if there is a shift to using public transit instead of private vehicles.

T□□□e □□Trends in the Average Annual Person Trips per Household by Mode of Transportation and MSA Si□e

MS□ Si□e	1□□□	1□□□	1□□□	1□□□	2□□1	2□□□	2□□□ M□□	2□1□	2□1□ M□□
□ri□□te □e□i□e									
ALL	2□3□1	2□1□2	2□8□1	3□30□	3□090	2□892	30	2□□92	30
Not in MSA	2□□3□	2□322	2□83□	3□□92	3□0□□	2□898	□2	2□□23	81
Less than 2□0□000	2□□1□	2□3□□	3□090	3□□03	3□30□	2□980	118	2□□20	123
2□0□000 - □99□999	2□□□□	2□□□3	3□01□	3□□□2	3□2□1	2□9□0	1□1	2□□18	122
□00□000 - 999□999	2□□28	2□1□0	2□9□□	3□□09	3□3□8	3□020	1□□	2□□98	□3
1□000□000 - 2□999□999	2□3□□	2□031	2□98□	3□3□□	3□1□□	2□9□1	□□	2□□□8	89
3□000□000 and above	1□□8□	1□□91	2□□□9	3□0□□	2□911	2□□93	□0	2□□□□	3□
□□□□i□ Tr□nsit									
ALL	□3	□0	□8	□□	□8	□□	□	80	□
Not in MSA	22	11	1□	9	□	□	2	□	2
Less than 2□0□000	□□	1□	30	23	12	1□	8	33	8
2□0□000 - □99□999	□□	23	22	18	18	1□	□	3□	12
□00□000 - 999□999	□8	□8	33	33	11	□1	1□	□2	9
1□000□000 - 2□999□999	8□	□□	□2	3□	3□	39	8	□0	9
3□000□000 and above	189	181	12□	13□	128	1□8	11	1□0	8
□ □□□									
ALL	2□1	22□	23□	20□	309	3□2	13	329	1□
Not in MSA	199	211	1□□	13□	221	239	1□	20□	3□
Less than 2□0□000	2□1	280	212	138	2□8	2□0	□8	21□	18
2□0□000 - □99□999	20□	199	203	1□2	2□1	2□8	23	228	33
□00□000 - 999□999	2□□	18□	1□1	138	22□	31□	□2	2□□	20
1□000□000 - 2□999□999	29□	1□9	20□	1□2	2□□	313	20	303	2□
3□000□000 and above	39□	330	33□	301	□23	□1□	29	□□9	1□
□□□ M□des									
ALL	2□808	2□□28	3□2□2	3□828	3□□81	3□□□□	32	3□1□0	3□
Not in MSA	2□800	2□□□□	3□1□1	3□8□8	3□□3□	3□2□□	□□	2□9□□	8□
Less than 2□0□000	2□9□□	2□889	3□□□0	3□92□	3□□□8	3□39□	128	2□98□	128
2□0□000 - □99□999	2□9□□	2□891	3□3□0	3□89□	3□□□□	3□3□□	1□□	3□103	128
□00□000 - 999□999	3□0□9	2□□□2	3□2□2	3□91□	3□□92	3□□29	1□1	3□1□1	□9
1□000□000 - 2□999□999	2□8□1	2□□□3	3□3□□	3□□9□	3□□02	3□□□□	□8	3□1□8	100
3□000□000 and above	2□□□9	2□32□	3□213	3□□□□	3□□93	3□□1□	□□	3□2□□	□3

Note□

- Totals in all tables can include cases that were not included in any table subcategory□for instance people who did not report their age are included in the total persons□but not in any age category.

- 1990 NPTS data were adjusted to make them more comparable with later surveys.
- 2001 NHTS sample included children 0 to 4 in the survey. The data shown here exclude them to be comparable with other survey years.
- 2009 NHTS sample did not include households without landlines telephones (CPO households).
- 2017 NHTS sample was address-based and included more urban and CPO households. This and other methods changes in the data series are outlined in Appendix B.
- "Rural/Not in MSA" includes only full counties designated as rural. There may also be rural pockets included within MSA boundaries.
- The population size groups for 1969 - 1983 NPTS are MSA size groups. 1990 - 2001 are MSA size groups. 2009 - 2017 are Consolidated Metropolitan Statistical Area (CMSA) size groups.
- Changes in walk trips throughout the data series could be a result, at least in part, to questionnaire changes. Recent NHTS surveys explicitly prompt respondents to include walk and bike trips, which was not the case in prior surveys. The 2017 NHTS changed the definition of a trip to allow walk and bike trips to and from hone (loop trips).
- Public transit includes local bus, commuter bus, commuter train, subway, trolley, and streetcar.

The data series in Table 8 shows that more income is related to more travel. The households in the highest income group annually produce 80 percent more person trips compared to households in the lowest income group.

The income categories in 2017 changed slightly from the 2009 and earlier surveys. The data here are shown in 2017 current dollars

The 2009 and earlier surveys were conducted with a telephone sample (landline only) which excluded CPO households. This was especially an issue in 2009, when an estimated 2□ percent of all US households did not have a landline. Therefore, the 2009 sample may have under coverage of households with lower income. Care should be taken in interpreting trends of estimates that might be correlated to telephone ownership, such as household income.

T□□□e □□Trends in the Number of Annual Person Trips per Household by Household Income

In□□□ e	1□□□	1□□□	2□□1	2□□□	2□□□ M□ □	2□1□	2□1□ M□ □
ALL	3□2□2	3□828	3□□93	3□□□□	31	3□1□0	3□
Less than □1□□000	2□298	2□□2□	2□2□2	2□200	99	2□21□	112
□1□□000 to □2□□999	3□0□2	3□2□3	3□028	2□□1□	102	2□□□□	1□□
□2□□000 to □3□□999	3□□8□	3□91□	3□□11	3□018	112	2□□□□	9□
□3□□000 to □□9□999	□□21□	□□□83	□□01□	3□2□8	110	2□9□9	13□
□□0□000 to □□□□999	□□□□9	□□□10	□□□□1	3□9□□	100	3□1□2	81
□□□□000 to □99□999	□□□3□	□□910	□□21□	□□□0□	112	3□□8□	90
□100□000 and over	-	□□□23	□□2□3	□□9□□	11□	□□033	10□

Note□

- Totals in all tables can include cases that were not included in any table subcategory□for instance people who did not report their age are included in the total persons□but not in any age category.
- 1990 NPTS data were adjusted to make them more comparable with later surveys.
- 2001 NHTS sample included children 0 to □in the survey. The data shown here exclude them to be comparable with other survey years.
- 2009 NHTS sample did not include households without landlines telephones □CPO households□.
- 201□ NHTS sample was address-based and included more urban and CPO households. This and other methods changes in the data series are outlined in Appendix B.
- The 201□ NHTS asked income in different categories than previous surveys□therefore this table will not match the *Summary of Travel Trends* 2009 and earlier
- In 1990 the highest income group was □80□000 and above
- Incomes for 1983□1990□adjusted 1990□and 199□have been adjusted to 2001 dollars□ https□□□www.bls.gov□data□inflation_calculator.htm

□□□ □□RS□□ TR□□□□

In 201□, the overall number of reported trips by private vehicle was significantly lower than the 2009 estimate. However, the declines were not equal across all purposes. For example, the estimate for the number of vehicle commutes and vehicle trips to school and church were statistically the same in 201□ compared to 2009 and previous years (within the margin of error). However, the reported total number of vehicle trips for shopping and errands was nominally closer to the 1990 estimate than any intervening year and a significant decline from the 2009 estimate.

On the other hand, the overall number of transit trips reported was significantly higher than the 2009 estimate, fueled by the significant increase in the number of reported commutes on transit. The estimate for the number of transit trips for all other purposes was statistically the same in 201□ compared to 2009.

The total number of walk trips reported was statistically within the margin of error of the 2009 estimate. The definition of a reported walk trip changed slightly to allow trips that begin and end at home, like walks for exercise. This change in definition impacts the total estimate of walks and requires more investigation.

But it should be noted that the common thread is an overall decline in reported trips for shopping and errands. This category of trip purposes is a large, catch-all category of trip-making that may be affected by many competing factors. For example, some of the difference in reported trips in 201□ NHTS may be a result of moving to a self-completed questionnaire compared to interview-assisted in previous surveys. Interviewers are trained to prompt for short stops and under-reported trips.

There may also be changes in trip-making for shopping and errands related to on-line purchasing. Other demographic trends, such as shifts in the percentage of households with children, may also be a factor. It would be helpful to conduct further research into the specific and detailed trends of changes in trip-making by purpose, including trip-chaining.

The Table 9 series displays these findings.

T□□□e □□□ Trends in the Annual Number □millions□of Person Trips by Mode of Transportation and Trip Purpose

□□te□□r□	□ri□□te □e□i□e					
	T□□□r□□ □ □r□	□ □r□Re□ted □□siness	S□□□□in□ □nd □rr□nds	S□□□□□□r □□□r□□	S□□i□□□nd Re□re□ti□n□□	□t□er
1990	□□8□□	3□1□8	128□3□8	1□□□□□	□0□382	1□□29
199□	□0□□□0	8□83□	1□□□0□□	22□□3□	□8□809	□□0
2001	□□0□□	10□□□8	1□3□2□0	2□8□1	82□□3□	2□1□□
2009	□□9□9	10□□2□	1□□□1□8	2□□□□□	82□88□	□92□
2009 MOE	9□1.□	□□□.1	2□8□.□	9□8.2	1□83.2	30□.1
201□	□□981	□8□□	12□□2□8	28□□2□	□8□890	10□988
201□ MOE	12□□.□	2□2.□	13□3.8	990.0	22□2.□	□00.8
□□te□□r□	□□□i□ Tr□nsit					
	T□□□r□□ □ □r□	□ □r□Re□ted □□siness	S□□□□in□ □nd □rr□nds	S□□□□□□r □□□r□□	S□□i□□□nd Re□re□ti□n□□	□t□er
1990	1□992	92	1□318	1□0□□	9□□	3□
199□	2□328	123	2□000	82□	1□3□0	11
2001	2□2□1	213	1□□□□	800	989	13□
2009	2□2□□	2□□	2□3□□	829	1□□2□	□09
2009 MOE	2□□.2	93.□	2□□.□	131.8	19□.0	11□.□
201□	3□□3□	208	2□□8□	1□009	1□□18	□8□
201□ MOE	21□.3	□2.2	198.□	182.0	131.0	82.□

T□□□e □□□ Trends in the Annual Number □millions□ of Person Trips by Mode of Transportation and Trip Purpose □continued□

□□te□□r□	□ □□□					
	T□□□r□□ □ □r□	□ □r□Re□□ted □□siness	S□□□□in□ □nd □rr□nds	S□□□□□□□r □□□r□□	S□□i□□□nd Re□re□ti□n□□	□t□er
1990	1□999	1□□	□□22	3□□9	8□090	2□□
199□	1□□10	2□0	8□□□	2□92□	□8□□	□□
2001	1□□1□	□8□	11□93□	3□□30	1□82□	□0□
2009	1□8□□	□8□	1□□1□□	3□□□2	18□833	8□□
2009 MOE	230.□	13□.1	818.□	□□9.□	□□8.□	1□□.□
201□	2□□23	□10	11□□9□	□□1□□	18□□83	1□□90
201□ MOE	2□8.3	□8.2	□80.0	□□9.□	□2□.0	122.3
□□te□□r□	□t□er					
	T□□□r□□ □ □r□	□ □r□Re□□ted □□siness	S□□□□in□ □nd □rr□nds	S□□□□□□□r □□□r□□	S□□i□□□nd Re□re□ti□n□□	□t□er
1990	□28	9□	1□08□	□08□	2□098	□3
199□	88□	□1□	1□□□8	□03□	2□9□□	3□
2001	□8□	31□	1□□□8	□3□1	3□829	39□
2009	1□1□□	□□9	2□8□9	□□□□1	□□□□□	□2□
2009 MOE	1□□.1	1□9.2	33□.3	□13.1	38□.□	13□.1
201□	1□□□0	□8□	2□□0□	□□□21	3□330	1□8□3
201□ MOE	18□.□	139.□	29□.1	29□.8	309.0	2□□.□

T□□□e □□□Trends in the Annual Number □millions□of Person Trips by Mode of Transportation and Trip Purpose □continued□

□□te□□r□	T□t□□					
	T□□□r□□ □ □r□	□ □r□Re□ted □□siness	S□□□□in□ □nd □rr□nds	S□□□□□□r □□□r□□	S□□i□□□nd Re□re□ti□n□□	□t□er
1990	□0□31□	3□□29	138□□□9	28□39□	81□□□□	2□01□
199□	□□□901	9□8□0	1□3□□□□	33□3□□	9□□3□2	□23
2001	□0□□90	11□□□□	1□8□□□0	3□□□□1	102□1□□	3□198
2009	□1□21□	11□9□3	1□□□□3□	3□□□□□	10□□□22	□933
2009 MOE	901.9	8□9.2	2□3□.□	1119.2	1□1□.9	□□8.3
201□	□□□□82	□□0□8	1□2□□□□	□0□303	102□32□	1□□139
201□ MOE	1333.0	□09.3	1□□9.3	9□□.□	2□0□.□	3□2.8

Note□

- Totals in all tables can include cases that were not included in any table subcategory□for instance people who did not report their age are included in the total persons□but not in any age category.
- 1990 NPTS data were adjusted to make them more comparable with later surveys.
- In 199□□VMT and vehicle trips with "To or From Work" as a trip purpose are believed to be overstated
- 2001 NHTS sample included children 0 to □ in the survey. The data shown here exclude them to be comparable with other survey years.
- 2009 NHTS sample did not include households without landlines telephones □CPO households□.
- 201□ NHTS sample was address-based and included more urban and CPO households. This and other methods changes in the data series are outlined in Appendix B.
- "Other" trip purpose includes trips for work-related business and trips not categori□ed.

T□□e □□□Trends in the Percent of Person Trips by Mode of Transportation and Trip Purpose □Millions□

□e□r	T□□□r□□ □ □r□	□ □r□Re□ted □□siness	S□□□□in□ □nd □rr□nds	S□□□□□□□r □□□r□□	S□□i□□□nd Re□re□ti□n□□	□t□er	T□t□□
	□ri□□te □e□i□e						
1990	91.2□	90.3□	92.□□	□1.9□	8□.3□	81.□□	8□.8□
199□	92.8□	91.9□	92.□□	□9.□□	8□.□□	83.2□	89.3□
2001	92.□□	91.2□	90.9□	□1.3□	80.□□	□□.2□	8□.3□
2009	91.□□	88.1□	8□.8□	□0.□□	□□.9□	□1.0□	83.□□
201□	88.2□	80.1□	88.□□	□0.□□	□□.1□	□2.□□	82.□□
	□□□i□ Tr□nsit						
□e□r	T□□□r□□ □ □r□	□ □r□Re□ted □□siness	S□□□□in□ □nd □rr□nds	S□□□□□□□r □□□r□□	S□□i□□□nd Re□re□ti□n□□	□t□er	T□t□□
1990	□.0□	2.□□	1.0□	3.8□	1.2□	1.□□	1.8□
199□	3.□□	1.3□	1.2□	2.□□	1.□□	1.9□	1.8□
2001	3.□□	1.8□	1.1□	2.1□	1.0□	□.2□	1.□□
2009	3.□□	2.2□	1.□□	2.2□	1.3□	□.9□	1.9□
201□	□.□□	3.□□	1.8□	2.□□	1.□□	3.2□	2.□□
	□ □□□						
□e□r	T□□□r□□ □ □r□	□ □r□Re□ted □□siness	S□□□□in□ □nd □rr□nds	S□□□□□□□r □□□r□□	S□□i□□□nd Re□re□ti□n□□	□t□er	T□t□□
1990	□.0□	□.□□	□.□□	12.8□	9.9□	13.2□	□.2□
199□	2.3□	2.□□	□.0□	8.8□	□.3□	□.□□	□.□□
2001	2.8□	□.2□	□.1□	9.□□	1□.□□	1□.9□	8.□□
2009	3.0□	□.□□	9.1□	9.□□	1□.□□	12.□□	10.□□
201□	3.9□	8.□□	8.1□	10.3□	18.1□	11.8□	10.□□

T□□□e □□□ Trends in the Percent of Person Trips by Mode of Transportation and Trip Purpose □Millions□□continued□

□e□r	□t□er						
	T□□□r□□ □ □r□	□ □r□Re□ted □□siness	S□□□□in□ □nd □rr□nds	S□□□□□□r □□□r□□	S□□i□□□nd Re□re□ti□n□□	□t□er	T□t□□
1990	0.8□	2.□□	0.8□	21.□□	2.□□	3.□□	3.2□
199□	1.3□	□.2□	1.0□	18.1□	3.1□	□.0□	3.2□
2001	1.0□	2.□□	0.9□	1□.9□	3.□□	12.3□	3.□□
2009	1.9□	3.9□	1.□□	1□.□□	□.2□	10.□□	□.2□
201□	2.□□	8.0□	1.□□	1□.□□	3.3□	12.□□	□.□□

Note□

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- In 199□□VMT and vehicle trips with "To or From Work" as a trip purpose are believed to be overstated
- 2001 NHTS sample included children 0 to □ in the survey. The data shown here exclude them to be comparable with other survey years.
- 2009 NHTS sample did not include households without landlines telephones □CPO households□
- 201□ NHTS sample was address-based and included more urban and CPO households. This and other methods changes in the data series are outlined in Appendix B. .
- Changes in walk trips throughout the data series could be a result□at least in part□to □uestionnaire changes□Recent NHTS surveys explicitly prompt respondents to include walk and bike trips□which was not the case in prior surveys. The 201□ NHTS changed the definition of a trip to allow walk and bike trips to and from hone □loop trips□
- "Other" trip purpose includes trips for work-related business and trips not categori□ed.

The most striking gender difference in travel behavior is in the difference in the number of household-supporting trips taken by men and women.

Traditionally□women make many more trips for shopping and errands compared to men. Table 10a shows that these gender differences persist in the 201□ data. In the 201□ NHTS□women reported making more trips overall than men and more trips for shopping and family errands compared to men.

On the other hand□men reported more trips than women for work and for work-related business. Men and women reported about the same number of social and recreational trips □within the margin of error□.

Continuing trends noted previously□both men and women took fewer trips on average in 201□ compared to the estimates for 2009 and 2001 □Table 10b□. Men and women reported about 11 percent fewer trips in 201□ compared to 2009. Nearly all the decline in trip-making came from declines in the estimate of trips for shopping and errands.

T□□□e 1□□□ Trends in the Annual Number of Person Trips per Person by Trip Purpose and Gender

□□te□□r□	□□□						
	1□□□	1□□□	2□□1	2□□□	2□□□ M□□	2□1□	2□1□ M□□
TOTAL	1□3□1	1□□□8	1□□□9	1□38□	1□.1	1□231	1□.□
To or From Work	210	2□□	219	21□	□.□	21□	□.□
Work Related Business	1□	38	□2	□2	3.9	20	1.□
Shopping and Errands	□□9	□□8	□08	□88	11.□	□□3	□.2
School□Church	119	128	13□	133	□.9	13□	3.□
Social and Recreational	3□1	3□3	3□9	381	□.□	339	8.□
Other	8	2	12	2□	2.2	□0	1.2

T□□□e 1□□□ Trends in the Annual Number of Person Trips per Person by Trip Purpose and Gender □continued□

	Men						
	1□□□	1□□□	2□□1	2□□□	2□□□ M□□	2□1□	2□1□ M□□
TOTAL	1□339	1□□□9	1□□91	1□3□8	1□.□	1□210	23.2
To or From Work	2□9	32□	2□3	2□1	□.□	2□0	□.9
Work Related Business	21	□0	□□	□8	□.2	2□	2.□
Shopping and Errands	□□9	□□8	□90	□29	10.□	□20	9.9
School□Church	123	13□	1□1	128	□.3	132	□.3
Social and Recreational	3□□	□0□	□0□	38□	□.9	33□	10.9
Other	9	2	13	2□	2.□	□8	2.□

	□ □□ en						
	1□□□	1□□□	2□□1	2□□□	2□□□ M□□	2□1□	2□1□ M□□
TOTAL	1□□01	1□□□8	1□□9□	1□□01	1□.□	1□2□1	1□.0
To or From Work	19□	229	200	193	□.□	189	□.□
Work Related Business	11	23	2□	2□	2.□	1□	0.8
Shopping and Errands	□93	□8□	□1□	□□□	12.1	□2□	10.□
School□Church	132	1□1	1□1	138	□.□	13□	3.9
Social and Recreational	3□8	3□□	389	3□□	□.2	3□□	9.3
Other	9	3	12	23	2.0	□2	2.□

Note□

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- In 199□□VMT and vehicle trips with "To or From Work" as a trip purpose are believed to be overstated.
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- 2009 NHTS sample did not include households without landlines telephones □CPO households□.
- 201□ NHTS sample was address-based and included more urban and CPO households. This and other methods changes in the data series are outlined in Appendix B.
- "Other" trip purpose includes trips for work-related business and trips not categori□ed.

T□□□e 1□□□ Trends in the Percent of Person Trips per Person by Trip Purpose and Gender

□□te□□r□	□ □□				
	1□□□	**1□□□**	**2□□1**	**2□□□**	**2□1□**
TOTAL	100□	100□	100□	100□	100□
To or From Work	1□.3□	1□.□□	1□.9□	1□.□□	1□.□□
Work Related Business	1.1□	2.□□	2.9□	3.0□	1.□□
Shopping and Errands	□2.2□	□2.□□	□1.□□	□2.□□	38.□□
School□Church	8.□□	8.2□	9.2□	9.□□	10.9□
Social and Recreational	2□.9□	23.1□	2□.1□	2□.□□	2□.□□
Other	0.□□	0.2□	0.8□	1.8□	□.1□
□□te□□r□	**Men**				
	1□□□	**1□□□**	**2□□1**	**2□□□**	**2□1□**
TOTAL	100□	100□	100□	100□	100□
To or From Work	19.3□	20.□□	18.3□	1□.□□	19.8□
Work Related Business	1.□□	3.8□	□.□□	□.2□	2.1□
Shopping and Errands	□1.0□	□1.0□	39.□□	38.□□	3□.□□
School□Church	9.2□	8.□□	9.□□	9.□□	10.9□
Social and Recreational	28.2□	2□.□□	2□.2□	28.2□	2□.□□
Other	0.□□	0.1□	0.9□	1.9□	□.8□

T□□□e 1□□□Trends in the Percent of Person Trips per Person by Trip Purpose and Gender □continued□

□□te□□r□	□ □□en				
	1□□□	1□□□	2□□1	2□□□	2□1□
TOTAL	100□	100□	100□	100□	100□
To or From Work	1□.1□	1□.□□	13.□□	13.8□	1□.1□
Work Related Business	0.8□	1.□□	1.□□	1.9□	1.2□
Shopping and Errands	□9.□□	□0.□□	□□.9□	□□.1□	□2.0□
School□Church	9.□□	9.1□	10.1□	9.9□	10.9□
Social and Recreational	2□.□□	2□.1□	2□.0□	2□.8□	2□.□□
Other	0.□□	0.2□	0.8□	1.□□	3.□□

Note□

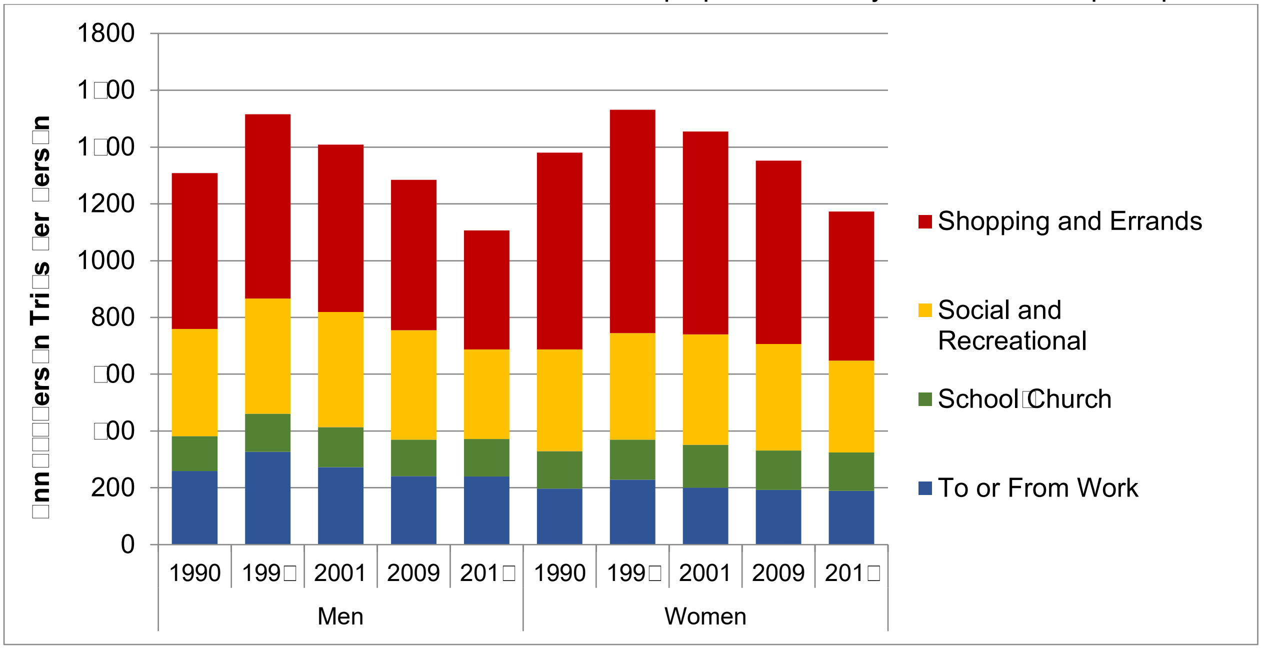
- Totals in all tables can include cases that were not included in any table subcategory□for instance people who did not report their age are included in the total persons□but not in any age category.
- 1990 NPTS data were adjusted to make them more comparable with later surveys.
- In 199□□VMT and vehicle trips with "To or From Work" as a trip purpose are believed to be overstated.
- 2001 NHTS sample included children 0 to □in the survey. The data shown here exclude them to be comparable with other survey years.
- 2009 NHTS sample did not include households without landlines telephones □CPO households□.
- 201□ NHTS sample was address-based and included more urban and CPO households. This and other methods changes in the data series are outlined in Appendix B.
- "Other" trip purpose includes trips for work-related business and trips not categori□ed.

Figure 2 shows the estimate of the number of annual person trips by purpose for men and women from 1990 to 201□. The decline in the total number of trips per person since 199□ appears to be mostly due to declines in the estimate of trips for shopping and errands.

Interestingly□both men and women report about one-third fewer trips for shopping and errands in 201□ compared to 199□. However□in 201□□women still reported making about 2□ percent more shopping and errand trips than men.

The category of trip purposes called "shopping and errands" is a large□catch-all category of purposes that may be affected by the change in methods □e.g.□self-reports on the web may under-report incidental stops□and may also be affected by increases in online shopping as well as shifts in the number of households with children. It would be enlightening to conduct further research into the specific and detailed changes in trip-making by purpose□including trip-chaining.

□i□□re 2□Trends in the Distribution of Person Trips per Person by Gender and Trip Purpose



Note□

- Totals in all tables can include cases that were not included in any table subcategory□for instance people who did not report their age are included in the total persons□but not in any age category.
- 1990 NPTS data were adjusted to make them more comparable with later surveys.
- In 199□□VMT and vehicle trips with "To or From Work" as a trip purpose are believed to be overstated.
- 2001 NHTS sample included children 0 to □ in the survey. The data shown here exclude them to be comparable with other survey years.
- 2009 NHTS sample did not include households without landlines telephones □CPO households□.
- 201□ NHTS sample was address-based and included more urban and CPO households. This and other methods changes in the data series are outlined in Appendix B.
- "Other" trip purpose includes trips for work-related business and trips not categori□ed.

In 201□□the person trip rates overall were lower than the 2009 estimates □Table 11□. It is interesting to note that not all trip purposes declined at the same rate. For example□the estimate for the number of trips to and from work and trips to school and church were statistically the same in 201□ compared to 2009 and previous years.

The majority of the decline in trip-making came from lower estimates for daily trips for shopping and family errands. The estimate for the number of daily trips for shopping and errands declined from 1.□1 in 2009 to 1.31 in 201□. This follows a decline from 2001-2009 □from 1.□9 to 1.□1 □□which follows a decline from 199□-2001 from 1.9□ to 1.□9□.

This is a large□catch-all category of purposes that may be affected by the change in methods □e.g.□self-reports on the web may under-report incidental stops□and may also be affected by changes in online shopping as well as shifts in the number of households with children. It would be enlightening to conduct further research into the specific and detailed trends of changes in trip-making by purpose□including trip-chaining.

In terms of miles of travel□the results are also mixed. The average daily miles travelled for work□ school□and church were statistically lower for all purposes when measured via the shortest path. However□with the adjusted factors applied□the average daily miles were significantly higher for shopping and errands and for social and recreational travel in 201□ compared to 2009. Details about the mileage estimate obtained in the 201□ NHTS is in Appendix A.

T□□□e 11□ Trends in the Daily Trip Rates and Person Miles of Travel per Person by Trip Purpose

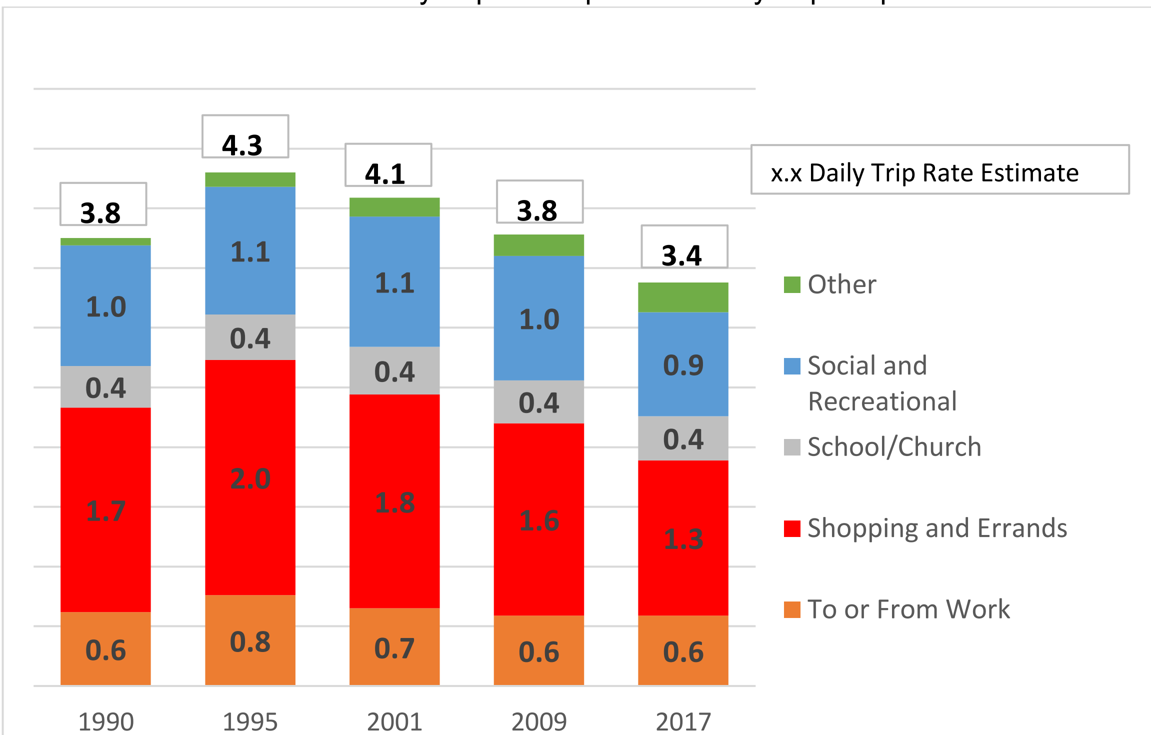
	S□r□e□ □e□r	T□t□□	T□ □□r□□ □ □r□	S□□□□in□ □ □rr□nds	S□□□□□□ □□□r□□	S□□i□□□ Re□re□ti□n
Person Trips per Day	19□□	2.92	0.□□	0.91	0.3□	0.□1
	1983	2.89	0.□9	1.02	0.3□	0.8
	1990	3.□□	0.□2	1.□1	0.3□	1.01
	199□	□.30	0.□□	1.9□	0.38	1.0□
	2001	□.09	0.□□	1.□9	0.□	1.09
	2009	3.□9	0.□9	1.□1	0.3□	1.0□
	2009 MOE	0.03	0.01	0.02	0.01	0.02
	201□	3.3□	0.□9	1.30	0.3□	0.93
	201□ MOE	0.0□	0.01	0.01	0.01	0.02
	S□r□e□ □e□r	T□t□□	T□ □□r□□ □ □r□	S□□□□in□ □ □rr□nds	S□□□□□□ □□□r□□	S□□i□□□ Re□re□ti□n
Person Miles per Day	19□□	2□.9□	□.1□	□.□8	1.□1	□.81
	1983	2□.0□	□.0□	□.□□	1.□□	9.8□
	1990	3□.91	□.□9	12.1	1.8□	13.02
	199□	38.□□	8.□9	13.□1	2.21	11.8□
	2001	□0.2□	□.□□	13.2	2.3□	12.09
	2009	3□.13	□.8□	10.□8	2.2□	10.93
	2009 MOE	1.3□	0.19	0.31	0.13	0.□□
	201□ Orig.	3□.0□	□.□2	9.22	2.3□	9.□3
	201□ Orig. MOE	1.□□	0.2□	0.□0	0.□□	0.39
	201□ Adj	38.98	□.1□	10.22	2.□□	10.□1
	201□ Adj. MOE	1.□1	0.23	0.□1	0.□□	0.□2

Note□

- Totals in all tables can include cases that were not included in any table subcategory.
- 1990 NPTS data were adjusted to make them more comparable with later surveys.
- In 199□□VMT and vehicle trips with "To or From Work" as a trip purpose are believed to be overstated.
- 2001 NHTS sample included children 0 to □ in the survey. The data shown here exclude them to be comparable with other survey years.
- 2009 NHTS sample did not include households without landlines telephones □CPO households□.
- 201□ NHTS sample was address-based and included more urban and CPO households. This and other methods changes in the data series are outlined in Appendix B.
- The 201□ estimates of vehicle trip length have an adjusted value to account for different methods in trip length reporting□see Appendix A.
- "Other" trip purpose includes trips for work-related business and trips not categori□ed.
- Trip rates are calculated including travelers and non-travelers□resulting in travel estimates per-capita.

Figures 3a and 3b and Tables 12 and 13 display daily trip and person rates and person miles of travel and show a decline in overall trip-making.

□i□□re □□□Daily Trip Rates per Person by Trip Purpose



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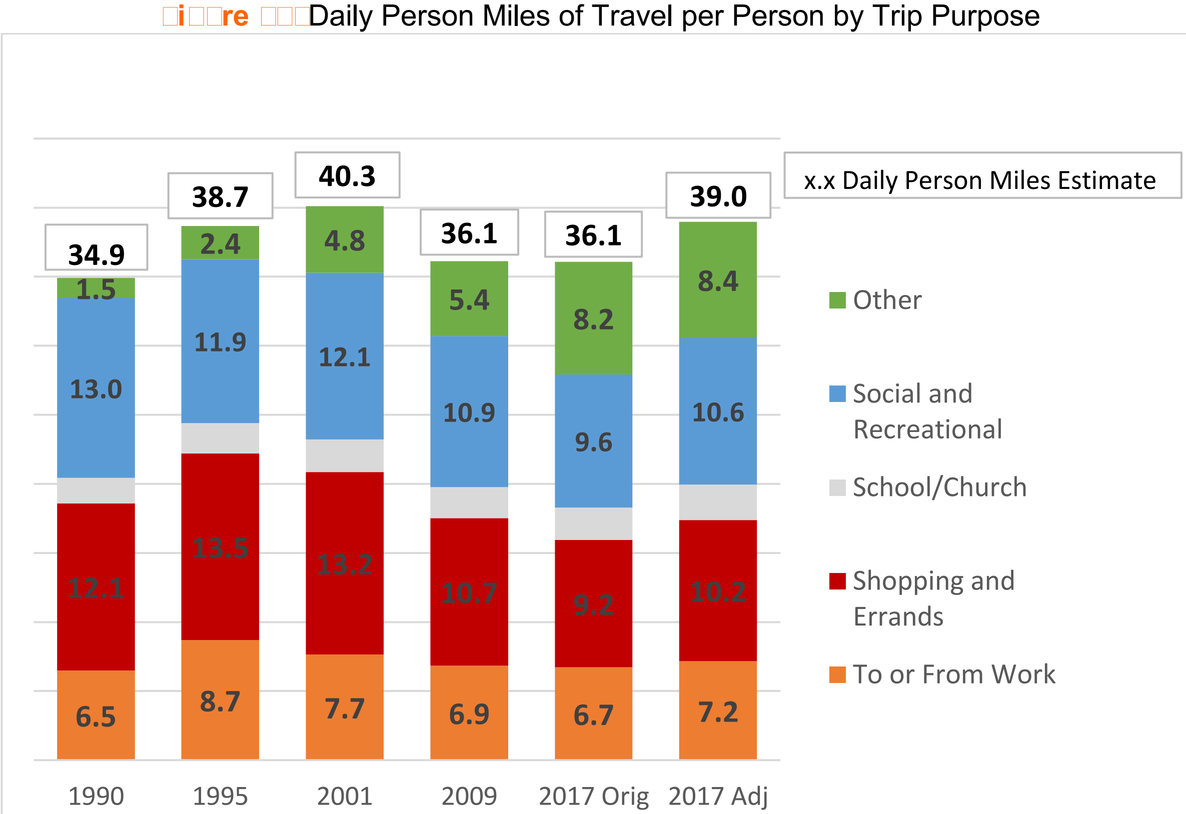
□i□□re □□□Daily Person Miles of Travel per Person by Trip Purpose



Note□

- Totals in all tables can include cases that were not included in any table subcategory□for instance people who did not report their age are included in the total persons□but not in any age category.
- 1990 NPTS data were adjusted to make them more comparable with later surveys.
- In 199□□VMT and vehicle trips with "To or From Work" as a trip purpose are believed to be overstated.
- 2001 NHTS sample included children 0 to □ in the survey. The data shown here exclude them to be comparable with other survey years.
- 2009 NHTS sample did not include households without landlines telephones □CPO households□.
- 201□ NHTS sample was address-based and included more urban and CPO households. This and other methods changes in the data series are outlined in Appendix B.
- The 201□ estimates of vehicle trip length have an adjusted value to account for different methods in trip length reporting□see Appendix A.
- "Other" trip purpose includes trips for work-related business and trips not categori□ed.

T□□□e 12□Trends in the Distribution of Daily Person Miles of Travel per Person by Mode of Transportation and Trip Purpose

□□te□□r□	□ri□□te □e□i□□e								
	1□□□	1□□□	2□□1	2□□□	2□□□ M□□	2□1□ □ri□□	2□1□ □ri□□ M□□	2□1□ □d□□	2□1□ □d□□ M□□
TOTAL	30.8□	3□.2□	3□.□9	31.92	0.88	2□.□□	0.80	30.□□	0.83
Percent	88.□□	91.2□	88.2□	88.3□		□□.□□		□8.1□	
To or From Work	□.1□	8.09	□.11	□.□□	0.1□	□.13	0.21	□.□8	0.22
Percent	1□.□□	20.9□	1□.□□	1□.9□		1□.0□		1□.9□	
Work-Related Business	0.□3	1.8□	2.2□	1.88	0.21	0.□8	0.0□	0.□□	0.0□
Percent	1.80□	□.□8□	□.□□□	□.20□		1.89□		1.9□□	
Shopping and Errands	11.39	12.□	12.□□	10.30	0.32	8.□□	0.□□	9.□□	0.□0
Percent	32.□□	32.8□	31.□□	28.□□		2□.0□		2□.□□	
School□Church	1.32	1.□8	1.8□	1.80	0.13	1.93	0.□1	2.1□	0.□□
Percent	3.□8□	□.3□□	□.□□□	□.98□		□.3□□		□.□2□	
Social and Recreational	11.12	10.83	11.01	9.98	0.□2	8.□□	0.□2	9.□□	0.□□
Percent	31.9□	28.0□	2□.□□	2□.□□		23.8□		2□.□□	
Other	0.23	0.10	0.3□	1.□9	0.3□	1.□8	0.20	1.□□	0.22
Percent	0.□□□	0.2□□	0.89□	□.12□		□.38□		□.□2□	

T□□□e 12□ Trends in the Distribution of Daily Person Miles of Travel per Person by Mode of Transportation and Trip Purpose □continued□

□□te□□r□	□□□□i□ Tr□nsit								
	1□□□	1□□□	2□□1	2□□□	2□□□ M□□	2□1□ □ri□□	2□1□ □ri□□ M□□	2□1□ □d□□	2□1□ □d□□ M□□
TOTAL	0.□□	0.82	0.□□	0.□3	0.11	0.9□	0.10	0.9□	0.10
Percent	2.1□	2.1□	1.2□	1.□□		2.□□		2.□□	
To or From Work	0.2□	0.30	0.2□	0.18	0.0□	0.39	0.0□	0.39	0.0□
Percent	0.□□□	0.□8□	0.□0□	0.□0□		1.08□		1.00□	
Work-Related Business	0.01	0.02	0.01	0.02	0.01	0.0□	0.0□	0.0□	0.0□
Percent	0.03□	0.0□□	0.02□	0.0□□		0.1□□		0.1□□	
Shopping and Errands	0.1□	0.19	0.10	0.10	0.02	0.1□	0.02	0.1□	0.02
Percent	0.□0□	0.□9□	0.2□□	0.28□		0.□□□		0.□□□	
School□Church	0.12	0.0□	0.0□	0.0□	0.01	0.0□	0.01	0.0□	0.01
Percent	0.3□□	0.18□	0.10□	0.1□□		0.19□		0.18□	
Social and Recreational	0.18	0.2□	0.0□	0.10	0.03	0.18	0.0□	0.18	0.0□
Percent	0.□2□	0.□2□	0.1□□	0.28□		0.□0□		0.□□□	
Other	0.01	0.00	0.00	0.08	0.09	0.08	0.02	0.08	0.02
Percent	0.03□	0.00□	0.00□	0.22□		0.22□		0.21□	

T□□□e 12□ Trends in the Distribution of Daily Person Miles of Travel per Person by Mode of Transportation and Trip Purpose □continued□

□□te□□r□	□t□er Me□ns								
	1□□□	1□□□	2□□1	2□□□	2□□□ M□□	2□1□ □ri□□	2□1□ □ri□□ M□□	2□1□ □d□□	2□1□ □d□□ M□□
TOTAL	3.31	2.2	□.10	3.□8	0.9□	□.□8	1.2□	□.□8	1.2□
Percent	9.□□	□.□□	10.2□	10.2□		21.0□		19.□□	
To or From Work	0.0□	0.22	0.30	0.20	0.09	0.20	0.0□	0.20	0.0□
Percent	0.1□□	0.□□□	0.□□□	0.□□□		0.□□□		0.□1□	
Work-Related Business	0.□□	0.3□	1.12	0.38	0.1□	0.□9	0.32	0.□9	0.32
Percent	1.□0□	0.88□	2.□8□	1.0□□		1.91□		1.□□□	
Shopping and Errands	0.□□	0.□9	0.32	0.28	0.0□	0.□1	0.1□	0.□1	0.1□
Percent	1.□3□	1.2□□	0.80□	0.□□□		1.1□□		1.0□□	
School□Church	0.□0	0.□□	0.□□	0.□0	0.03	0.3□	0.0□	0.3□	0.0□
Percent	1.1□□	1.1□□	1.09□	1.11□		0.9□□		0.90□	
Social and Recreational	1.□1	0.□□	1.01	0.8□	0.3□	0.88	0.□2	0.88	0.□2
Percent	□.90□	1.□1□	2.□1□	2.3□□		2.□□□		2.2□□	
Other	0.01	0.0□	0.8□	1.□□	0.8□	□.0□	1.1□	□.0□	1.1□
Percent	0.0□	0.1□	2.2□	□.3□		1□.0□		13.0□	

T□□□e 12□Trends in the Distribution of Daily Person Miles of Travel per Person by Mode of Transportation and Trip Purpose □continued□

□□te□□r□	T□t□□								
	1□□□	1□□□	2□□1	2□□□	2□□□ M□□	2□1□ □ri□□	2□1□ □ri□□ M□□	2□1□ □d□	2□1□ □d□ M□□
TOTAL	3□.91	38.□□	□0.2□	3□.13	1.3□	3□.0□	1.3□	38.98	1.□1
Percent	100□	100□	100□	100□		100□		100□	
To or From Work	□.□9	8.□9	□.□□	□.8□	0.19	□.□2	0.22	□.1□	0.23
Percent	18.□□	22.□□	19.0□	19.0□		18.□□		18.□□	
Work-Related Business	1.20	2.23	3.□1	2.28	0.2□	1.□2	0.3□	1.□	0.3□
Percent	3.□□□	□.□□□	8.□□□	□.31□		3.9□□		3.8□□	
Shopping and Errands	12.10	13.□1	13.2	10.□8	0.31	9.22	0.□□	10.22	0.□1
Percent	3□.□□	3□.9□	32.8□	29.□□		2□.□□		2□.2□	
School□Church	1.8□	2.21	2.3□	2.2□	0.13	2.3□	0.□2	2.□□	0.□□
Percent	□.2□□	□.□2□	□.8□□	□.20□		□.□2□		□.□9□	
Social and Recreational	13.02	11.8□	12.09	10.93	0.□□	9.□3	0.39	10.□1	0.□2
Percent	3□.3□	30.□□	30.0□	30.3□		2□.□□		2□.2□	
Other	0.2□	0.1□	1.39	3.1□	0.9□	□.□2	1.0□	□.9	1.03
Percent	0.□□	0.□□	3.□□	8.□□		18.□□		1□.□□	

Note

- Totals in all tables can include cases that were not included in any table subcategory□for instance people who did not report their age are included in the total persons□but not in any age category.
- 1990 NPTS data were adjusted to make them more comparable with later surveys.

- In 1995, VMT and vehicle trips with "To or From Work" as a trip purpose are believed to be overstated.
- 2001 NHTS sample included children 0 to 4 in the survey. The data shown here exclude them to be comparable with other survey years.
- 2009 NHTS sample did not include households without landlines telephones (CPO households).
- 2017 NHTS sample was address-based and included more urban and CPO households. This and other methods changes in the data series are outlined in Appendix B.
- In 2001, the mode "Bus" was divided into "Local Public Transit Bus," "Commuter Bus," "Charter/Tour Bus," and "City to City Bus." Only "Local Public Transit Bus" and "Commuter Bus" are included in public transit calculations.
- Increases in walk trips between 2001 and 2017 are due, at least in part, to questionnaire changes; recent NHTS surveys explicitly ask respondents to include walk and bike trips, which was not the case in prior surveys.
- In 2017, walk and bike trips were sometimes reported as Home-Home loops (single round trips). In prior surveys, “loop” trips were coded to the farthest destination and reported as two trips: outbound and return.
- The 2017 estimates of vehicle trip length have an adjusted value to account for different methods in trip length reporting (see Appendix A.
- "Other" trip purpose includes trips for work-related business and trips not categorized.
- Percentages are a percent of total daily person miles of travel.

T□□e 1□□Trends in the Average Daily Person Trips per Person by Age and Gender

□□e	T□t□□							
	1□□□	1□□□	1□□□	2□□1	2□□□	2□□□ M□□	2□1□	2□1□ M□□
TOTAL	2.9	3.8	□.3	□.1	3.8	0.03	3.□	0.0□
Under 1□	2.3	3.1	3.□	3.□	3.2	0.0□	2.8	0.0□
1□ to 20	3.3	□.2	□.□	□.1	3.□	0.11	2.8	0.08
21 to 3□	3.□	□.□	□.□	□.3	3.9	0.09	3.□	0.10
3□ to □□	2.9	3.9	□.□	□.□	□.2	0.0□	3.□	0.03
Over □□	1.8	2.□	3.□	3.□	3.2	0.0□	3.2	0.0□
□□e	**Men**							
	1□□□	1□□□	1□□□	2□□1	2□□□	2□□□ M□□	2□1□	2□1□ M□□
TOTAL	2.9	3.□	□.3	□.1	3.□	0.0□	3.3	0.0□
Under 1□	2.3	3	3.□	3.□	3.2	0.09	2.8	0.0□
1□ to 20	3.2	□.2	□.□	□.0	3.3	0.13	2.8	0.13
21 to 3□	3.□	□.2	□.□	□.2	3.□	0.11	3.2	0.10
3□ to □□	2.9	3.□	□.□	□.□	□.1	0.0□	3.□	0.0□
Over □□	2.2	2.8	3.9	3.8	3.□	0.10	3.□	0.0□
□□e	**□ □□en**							
	1□□□	1□□□	1□□□	2□□1	2□□□	2□□□ M□□	2□1□	2□1□ M□□
TOTAL	2.9	3.8	□.3	□.1	3.8	0.0□	3.□	0.0□
Under 1□	2.3	3.1	3.8	3.□	3.2	0.10	2.8	0.0□
1□ to 20	3.□	□.2	□.□	□.2	3.□	0.1□	2.8	0.12
21 to 3□	3.□	□.□	□.8	□.□	□.1	0.12	3.□	0.12
3□ to □□	3	□.1	□.□	□.□	□.3	0.0□	3.8	0.0□
Over □□	1.□	2.2	3	3.1	2.9	0.09	3.0	0.0□

Note□

- Totals in all tables can include cases that were not included in any table subcategory□for instance people who did not report their age are included in the total persons□but not in any age category.
- 1990 NPTS data were adjusted to make them more comparable with later surveys.
- 2001 NHTS sample included children 0 to □in the survey. The data shown here exclude them to be comparable with other survey years.
- 2009 NHTS sample did not include households without landlines telephones □CPO households□
- 201□NHTS sample was address-based and included more urban and CPO households. This and other methods changes in the data series are outlined in Appendix B.

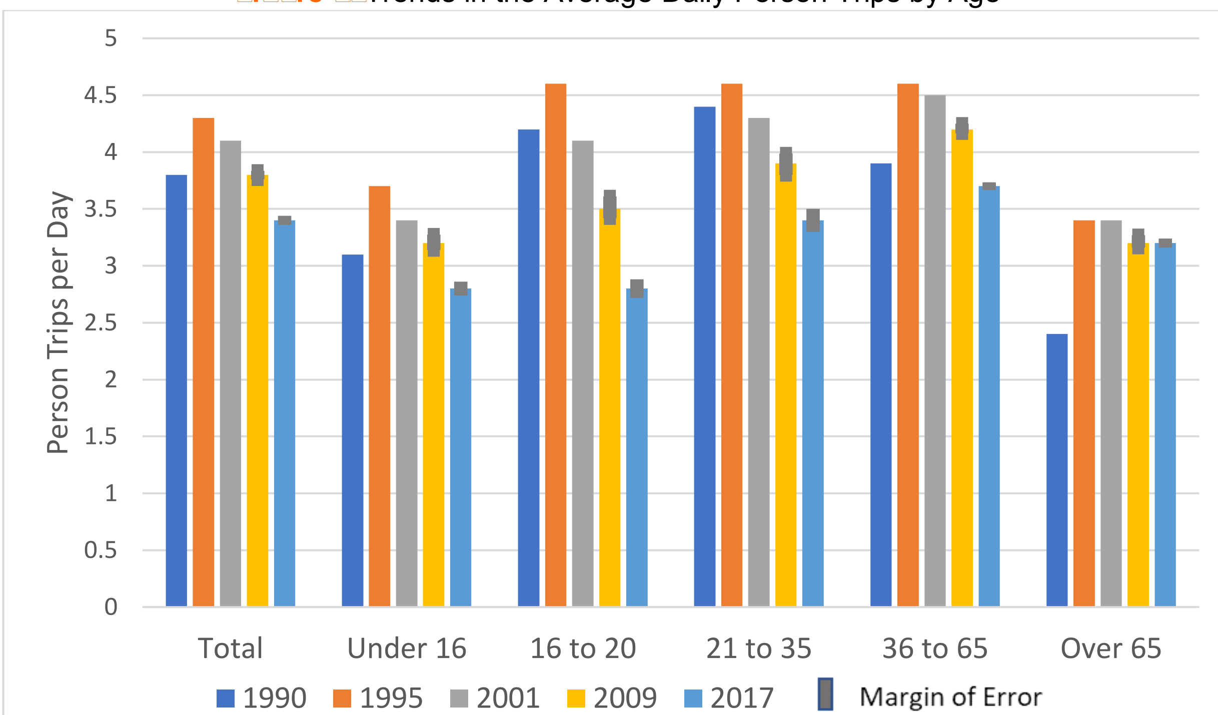
According to the 2017 NHTS estimates, all people younger than 65 reported significantly fewer trips in 2017 compared to 2009 (which was significantly lower than 2001, which was lower than 1995). Figure □ shows that the 2017 estimate of person trips per person by age in these categories were lower than previous survey estimates, except for people aged 65 and older.

The data show that the decrease in trip-making was similar for both men and women, with men's trip-making declining by 21 percent and women's by 19 percent since 1995.

Some of the difference in reported trips in 2017 NHTS may be a result of moving to a self-completed questionnaire, compared to interview-assisted in previous surveys. For example, interviewers are trained to prompt for short stops and under-reported trips. Other factors, such as shifts related to online shopping may affect these estimates. Changes in household structure and other demographic trends may also play a role.

However, the trends over the last two decades clearly indicate that the NHTS estimates of overall trip-making are declining, with larger declines noted for younger people.

Figure □□ Trends in the Average Daily Person Trips by Age



Note:

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- 2001 NHTS sample included children 0 to □ in the survey. The data shown here exclude them to be comparable with other survey years.
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- 2017 NHTS sample was address-based and included more urban and CPO households. This and other methods changes in the data series are outlined in Appendix B.

T□□□e 1□□ Trends in the Average Daily Person Miles of Travel per Person by Age and Gender

□□e	T□T□□									
	1□□□	1□□□	1□□□	2□□1	2□□□	2□□□ M□□	2□1□ □ri□□	2□1□ □ri□□ M□□	2□1□ □d□□	2□1□ □d□□ M□□
TOTAL	2□.1	3□.9	38.□	□0.2	3□.1	1.□	3□.1	1.□	39.0	1.□
Under 1□	1□.2	20.1	2□	2□.□	2□.3	3.□	22.9	2.8	2□.9	3.0
1□ to 20	22.2	3□.□	3□.□	38.1	29.□	1.8	2□.3	2.0	29.□	2.2
21 to 3□	31.1	□□.3	□□	□□.□	3□.□	1.9	□1.□	□.□	□□.□	□.1
3□ to □□	29.2	□0.1	□□.1	□8.8	□□.0	1.9	□1.□	1.□	□□.9	1.□
Over □□	12.0	18.□	2□.□	2□.□	2□.0	1.2	30.1	2.8	32.8	2.8
□□e	**Men**									
	1□□□	**1□□□**	**1□□□**	**2□□1**	**2□□□**	**2□□□ M□□**	**2□1□ □ri□□**	**2□1□ □ri□□ M□□**	**2□1□ □d□□**	**2□1□ □d□□ M□□**
TOTAL	2□.□	38.0	□3.9	□□.0	□0.9	2.1	39.□	1.□	□2.□	1.□
Under 1□	1□.8	20.3	23.□	2□.□	2□.2	□.3	2□.□	□.8	2□.□	□.1
1□ to 20	23.0	3□.9	3□.□	3□.1	28.2	2.3	2□.9	3.1	28.0	3.2
21 to 3□	32.8	□8.2	□1.3	□9.8	□0.□	2.8	□2.9	□.□	□□.0	□.□
3□ to □□	33.□	□3.□	□3.2	□□.□	□0.9	3.0	□□.1	2.3	□0.□	2.3
Over □□	1□.8	22.□	31.□	32.9	30.□	1.9	33.8	□.0	3□.8	□.2

T□□□e 1□□ Trends in the Average Daily Person Miles of Travel per Person by Age and Gender □continued□

□□e	□ □□en									
	1□□□	1□□□	1□□□	2□□1	2□□□	2□□□ M□□	2□1□ □ri□□	2□1□ □ri□□ M□□	2□1□ □d□	2□1□ □d□ M□□
TOTAL	22.□	32.1	33.8	3□.□	31.□	1.0	32.8	1.8	3□.□	2.0
Under 1□	1□.□	19.9	2□.2	2□.□	23.3	2.□	20.2	1.□	22.1	1.8
1□ to 20	21.□	32.2	3□	□2.□	31.0	2.8	28.8	2.□	31.3	2.8
21 to 3□	29.□	□0.□	□0.8	□1.□	3□.0	2.3	39.8	□.8	□3.2	□.□
3□ to □□	2□.2	3□	3□.□	□0.□	3□.0	1.□	3□.□	1.□	39.□	1.□
Over □□	10.2	1□.3	19.2	23.□	19.3	1.2	2□.2	2.9	29.□	2.9

Note□

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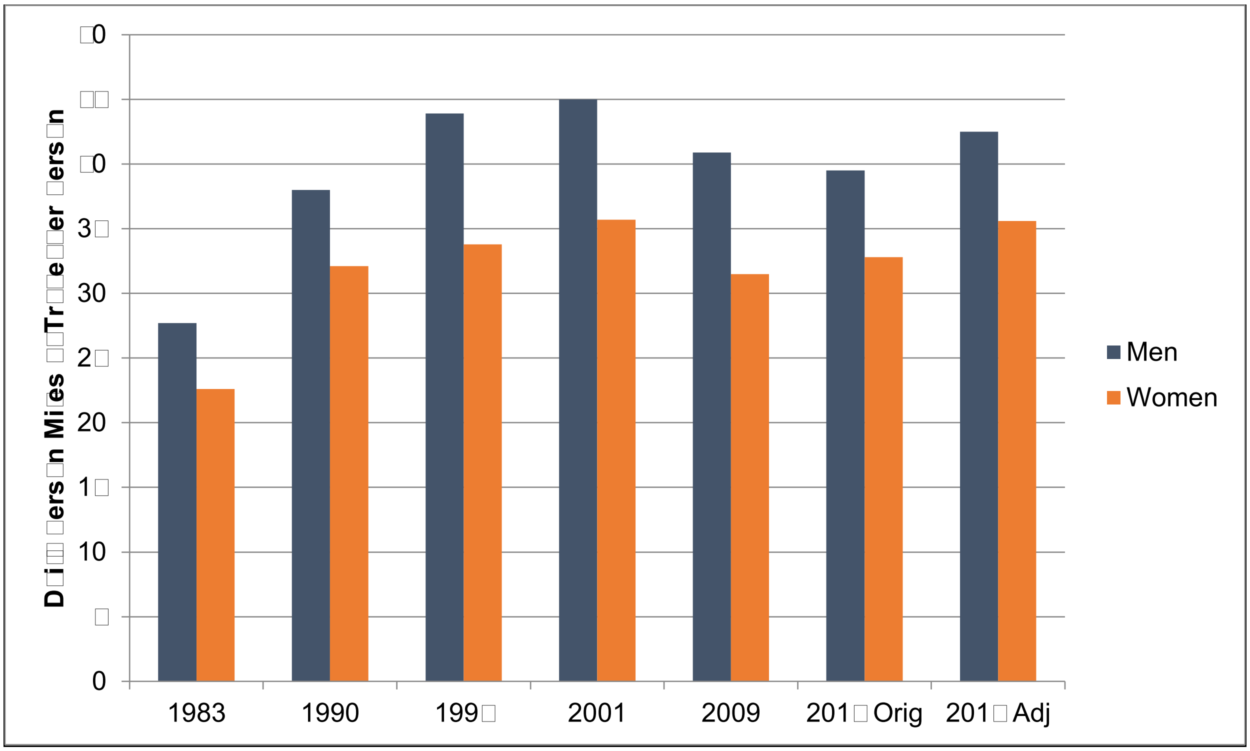
- 1990 NPTS data were adjusted to make them more comparable with later surveys.
- 2001 NHTS sample included children 0 to □ in the survey. The data shown here exclude them to be comparable with other survey years.
- 2009 NHTS sample did not include households without landlines telephones □CPO households□.
- 201□ NHTS sample was address-based and included more urban and CPO households. This and other methods changes in the data series are outlined in Appendix B.
- The 201□ estimates of vehicle trip length have an adjusted value to account for different methods in trip length reporting□see Appendix A.

Overall□the unadjusted estimate of person miles per day in 201□was 3□.1 miles on average□ nominally the same as the 2009 estimate. These miles are reported for all means of transportation and for all purposes and include people who traveled and those who did not.

In 201□ □Figure □□□the unadjusted estimate for average daily miles for men was 39.□ miles per day□for women the estimate was 32.8 miles per day. These were statistically the same as the estimates in 2009 □within the margin of error□.

The adjusted estimates are higher for both men and women than the 2009 estimates. The adjusted estimates were □2.□ miles per day for men and 3□.□ miles for women. See Appendix A for more details.

□i□□re □□Average Daily Person Miles of Travel by Gender□1983□1990□199□ NPTS and 2001□ 2009□and 201□ NHTS



Note□

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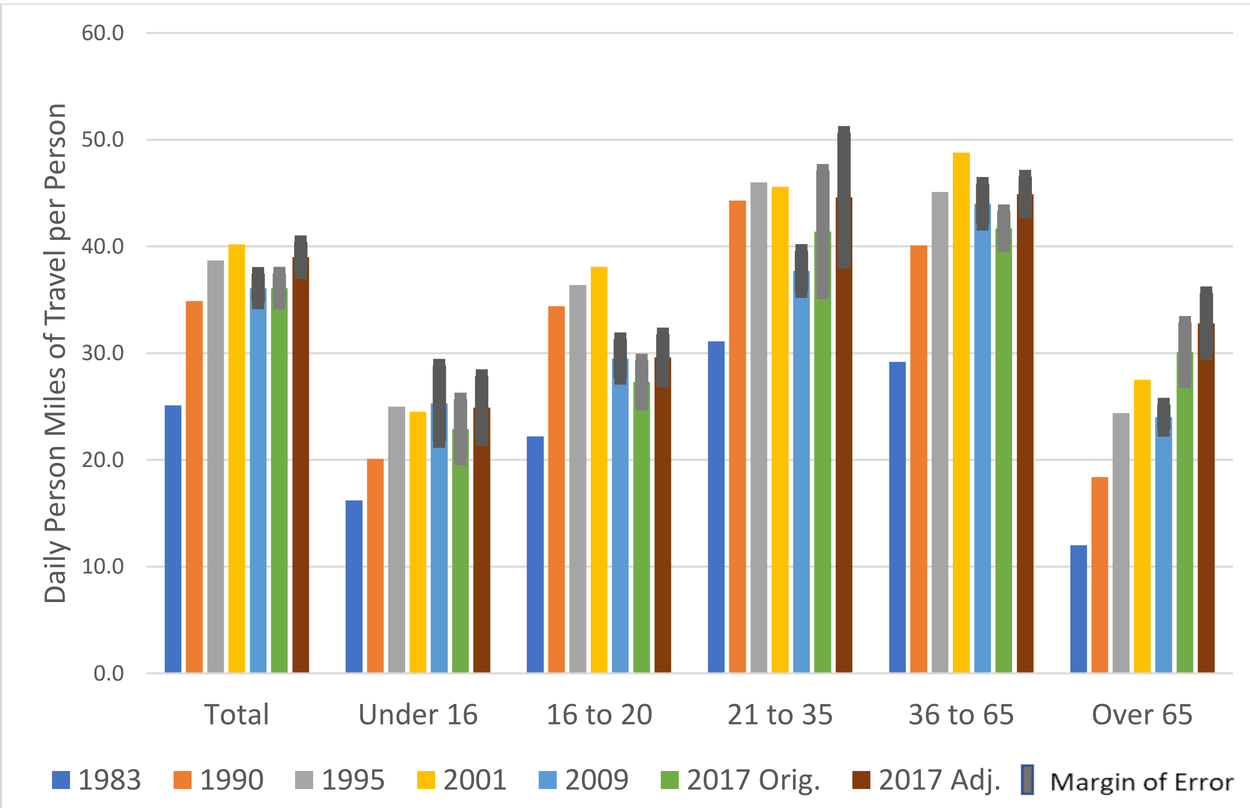
- The 201□ estimates of vehicle trip length have an adjusted value to account for different methods in trip length reporting□see Appendix A.

The overall trends in person miles of travel □Figure □□are not as significant as the changes in trip-making. The original estimate of person miles was exactly the same as the estimate in 2009 □3□.1 miles per day□□while the adjusted estimate is exactly the same as the 199□ estimate □38.□ miles per day□

A notable trend is the increase in travel by people aged □□ and older. The 201□ estimates of daily miles of travel are higher than all previous surveys. For every other age group shown□the 201□ original estimate of person miles per person is within the margin of error of estimates from the earlier surveys.

□i□□re □□Average Daily Person Miles of Travel by Age Group 199□ NPTS and 2001□2009□and 201□ NHTS



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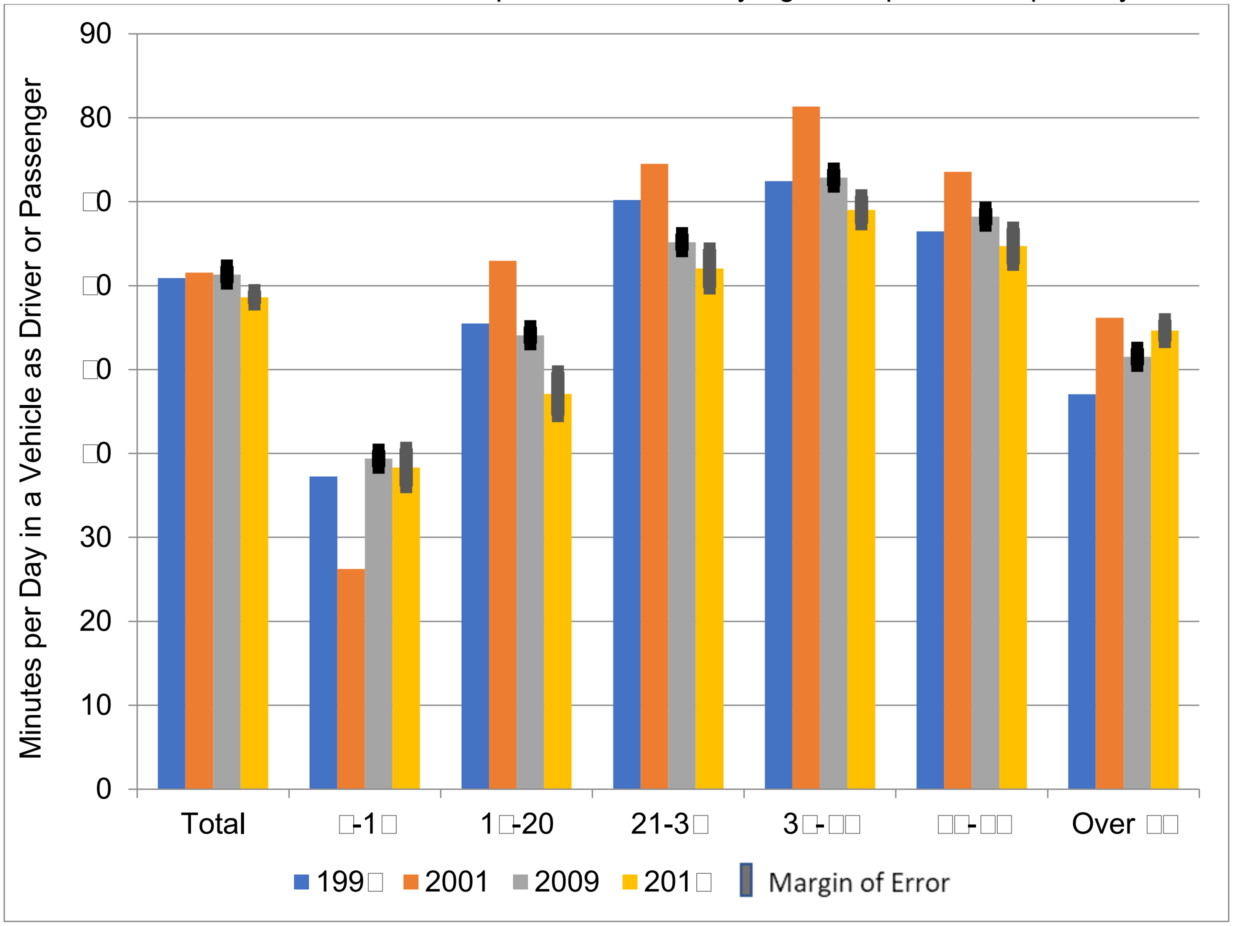
- 2009 NHTS sample did not include households without landlines telephones □CPO households□
- 201□ NHTS sample was address-based and included more urban and CPO households. This and other methods changes in the data series are outlined in Appendix B.
- In 199□□VMT and vehicle trips with "To or From Work" as a trip purpose are believed to be overstated.
- The 201□ estimates of vehicle trip length have an adjusted value to account for different methods in trip length reporting□see Appendix A.

Including people who drive and those who are passengers in vehicles□the average American in 201□ spends just under 1 hour a day in a vehicle—□8.□ minutes per capita—as a driver or passenger □Figure □□. This estimate is □ percent lower □2.□ minutes□compared to the 2009 estimate□and the difference is statistically significant.

People in their prime working and commuting years□ages 3□-□□□spend the most amount of time in a vehicle while children under the age of 1□ spend the least amount of time in a vehicle.

In the 201□ NHTS□only people aged 1□-20 have a significant decrease in time spent in a vehicle as a passenger or driver. All other age groups have estimates that fall within the margin of error.

□i□□re □□Trends in the Time Spent in a Vehicle by Age Group □Minutes per Day□



Note□

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- The 201□ estimates of vehicle trip length have an adjusted value to account for different methods in trip length reporting□see Appendix A.

□□□ □RI□□T□ □□□I□□□ TR□□□□

In Table 1□□researchers calculated the average amount of time spent driving using two different methods□□1□by including all drivers□even those who did not drive a private vehicle on the designated travel day□and □2□by excluding any drivers who did not drive on the designated travel day.

In 201□□while the nominal estimates were slightly lower than 2009□they were significantly lower than the 2001 estimates. That is□the estimate of the time spent driving for all drivers □including those who drove and those who did not□did not change between 2009 and 201□ □were within the margin of error□□the 201□ estimate was significantly lower than the 2001 estimate.

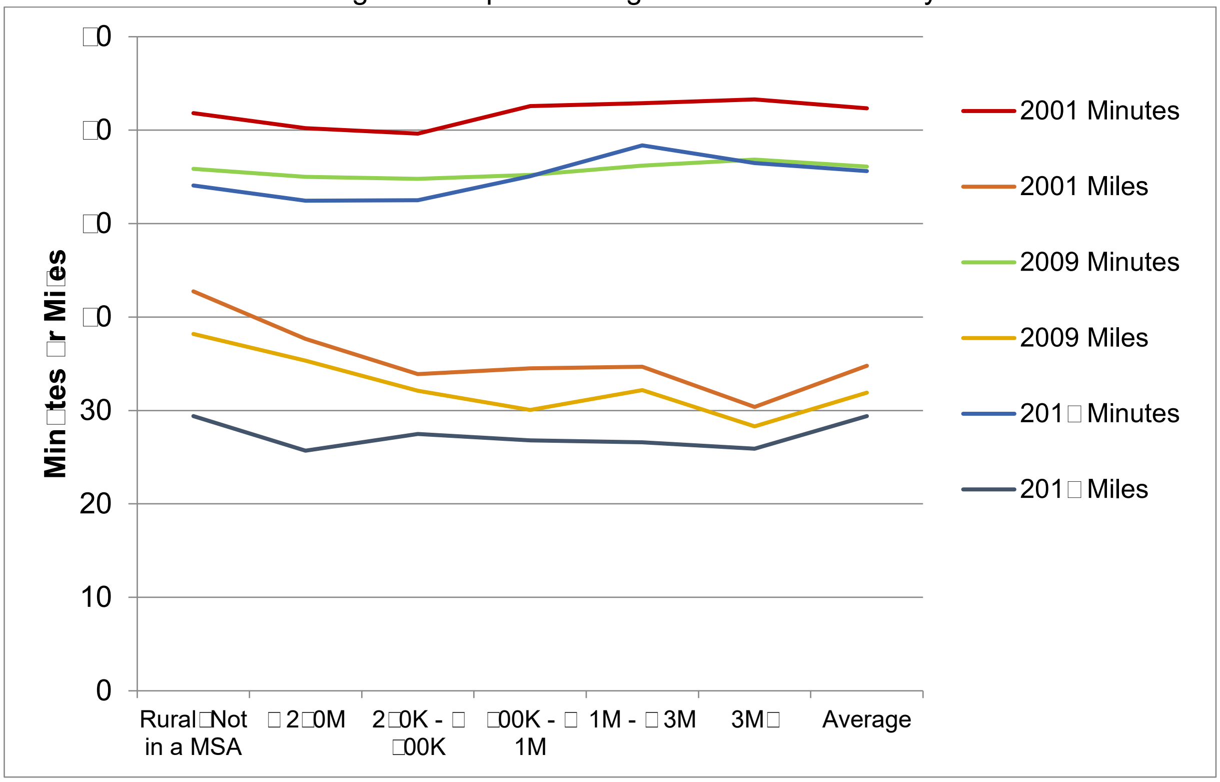
However□looking at people who reported driving on the travel day□the estimate of time spent driving was significantly higher in 201□ compared to 2009. The increase in reported time driving on travel day was notably higher for drivers in metro areas of 1-3 million in population.

T□□□e 1□□Trends in the Average Time Spent Driving a Private Vehicle in a Typical Day by MSA Si□e □minutes□

MSA Si□e	All Drivers						
	1990	199□	2001	2009	2009 MOE	201□	201□ MOE
ALL	□9.3□	□□.28	□2.32	□□.09	0.□1	□□.□2	0.80
Rural□Not in MSA	□8.8□	□□.□□	□1.83	□□.8□	1.80	□□.08	1.1□
□2□0□000	□8.3□	□3.98	□0.22	□□.01	□.02	□2.□□	1.3□
2□0□000 to □99□999	□□.82	□□.9□	□9.□3	□□.□9	2.□8	□2.□9	3.11
□00□000 to 999□999	□0.20	□□.91	□2.□9	□□.21	2.3□	□□.0□	1.□2
1 million to 2.9 million	□0.□1	□□.□8	□2.89	□□.20	1.□□	□8.3□	1.□3
3 million□	□9.38	□□.□9	□3.29	□□.8□	1.1□	□□.□9	1.01
MSA Si□e	**Only Persons Who Drove**						
	1990	199□	2001	2009	2009 MOE	201□	201□ MOE
ALL	□1.88	□3.2□	81.3□	□□.3□	0.8□	□8.91	0.90
Rural□Not in MSA	□9.20	□2.9□	81.□□	□□.28	2.13	□8.□□	2.1□
□2□0□000	□□.9□	□9.3□	□□.□0	□3.30	□.□□	□2.□9	1.□9
2□0□000 to □99□999	□1.□□	□1.□2	□□.□0	□2.□□	3.□2	□2.9□	3.33
□00□000 to 999□999	□2.□2	□3.3□	□9.3□	□3.□□	2.8□	□□.□□	1.□2
1 million to 2.9 million	□□.38	□2.19	□9.□□	□3.□□	1.9□	□9.19	1.□□
3 million□	□1.08	□□.02	8□.12	80.□8	1.3□	83.22	1.□9

Figure 8 displays the trends in driving by American households in minutes and miles by MSA si□e for the 2001□2009 and 201□ surveys.

□i□□re □□Average Time Spent Driving and Miles Traveled by MSA Si□e



Note□

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- 2009 NHTS sample did not include households without landlines telephones □CPO households□.
- 201□ NHTS sample was address-based and included more urban and CPO households. This and other methods changes in the data series are outlined in Appendix B.
- "Rural□Not in MSA" includes only full counties designated as rural. There may also be rural pockets included within MSA boundaries.

Since about 1990□the vehicle occupancy estimates□measured as person miles per vehicle mile□ seems to have stayed about the same □Table 1□□.

While there are small nominal differences between the 201□ and earlier estimates□these differences are all within the margins of error.

T□□□e 1□□Average Vehicle Occupancy for Selected Trip Purposes
□Person Mile per Vehicle Mile□

S□r□e□ □e□r	Tri□ □□r□□se				
	T□ □□r□□ □ □r□	S□□□□in□	□t□er □□□ i□□ □ □ers□n□□ □rr□nds	S□□i□□□ Re□re□ti□n	□□□□□r□□ses
19□□	1.30	2.10	2.00	2.□0	1.90
1983	1.29	1.□9	1.81	2.12	1.□□
1990	1.1□	1.□1	1.8□	2.08	1.□□
199□	1.1□	1.□□	1.□8	2.0□	1.□9
2001	1.1□	1.□9	1.83	2.03	1.□3
2009	1.13	1.□8	1.8□	2.20	1.□□
2009 MOE	0.0□	0.□8	0.8□	1.20	0.□□
201□	1.18	1.82	1.82	2.10	1.□□
201□ MOE	0.01	0.0□	0.13	0.0□	0.0□

Note
- Totals in all tables can include cases that were not included in any table subcategory□for instance people who did not report their age are included in the total persons□but not in any age category.
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- 2001 NHTS sample included children 0 to □ in the survey. The data shown here exclude them to be comparable with other survey years.
- 2009 NHTS sample did not include households without landlines telephones □CPO households□.
- 201□ NHTS sample was address-based and included more urban and CPO households. This and other methods changes in the data series are outlined in Appendix B.
- “Other Family/Personal Errands” includes trips such as to the post office, dry cleaners, or library.
- All Purposes includes other trip purposes not shown□such as trips to school□church□doctor□ dentist□and work-related business trips.

□□□ □□□I□□□ □S□ □□D □□□I□□□I□IT□

As displayed in Table 1□□two thirds of the households in the United States have one or two vehicles available□according to the 201□ NHTS.

Statistically□the number of households with □ero vehicles or two vehicles remained about the same. On the other hand□the number of households with one vehicle and three or more vehicles were significantly higher in 201□ compared to the 2009 estimates.

The estimate of the number of households with three or more vehicles rose significantly between 2009 and 201□□from 2□.□ million households to 28.9 million households in 201□.

T□□□e 1□□Trends in the Number and Percent of Households by Availability of Household Vehicles □Thousands□

S□r□e□ □e□r	□□ □e□i□e	□ne □e□i□e	T□□ □e□i□es	T□ree □r M□re □e□i□es	□□□	□e□i□es □er □□□se□□□d
19□9	12□8□□	30□2□2	1□□□01	2□8□□	□2□□0□	1.1□
19□□	11□□38	2□□092	2□□9□2	11□8□0	□□□□12	1.□9
1983	11□□□8	28□□80	28□□32	1□□□11	8□□3□1	1.□8
1990	8□□□3	30□□□□	3□□8□2	18□2□8	93□3□□	1.□□
199□	□□989	32□0□□	□0□02□	18□91□	98□990	1.□8
2001	8□□1□	33□□□□	39□938	2□□9□□	10□□3□□	1.89
2009	9□828	3□□□09	□1□0□□	2□□□88	113□101	1.8□
2009 MOE	□9	302	2□□	2□0	0	0.01
201□	10□□□□	39□□□8	39□12□	28□8□9	118□208	1.88
201□ MOE	0	0	2□2	2□2	0	0.01

T□□□e 1□□ Trends in the Number and Percent of Households by Availability of Household Vehicles □Thousands□□continued□

□er□ent	□□ □e□i□e	□ne □e□i□e	T□□ □e□i□es	T□ree □r M□re □e□i□es	□□□
19□9	20.□□	□8.□□	2□.□□	□.□□	100□
19□□	1□.3□	3□.□□	3□.□□	1□.□□	100□
1983	13.□□	33.□□	33.□□	19.2□	100□
1990	9.2□	32.8□	38.□□	19.□□	100□
199□	8.1□	32.□□	□0.□□	19.1□	100□
2001	8.1□	31.□□	3□.2□	23.2□	100□
2009	8.□□	32.3□	3□.3□	22.□□	100□
201□	8.9□	33.□□	33.1□	2□.□□	100□

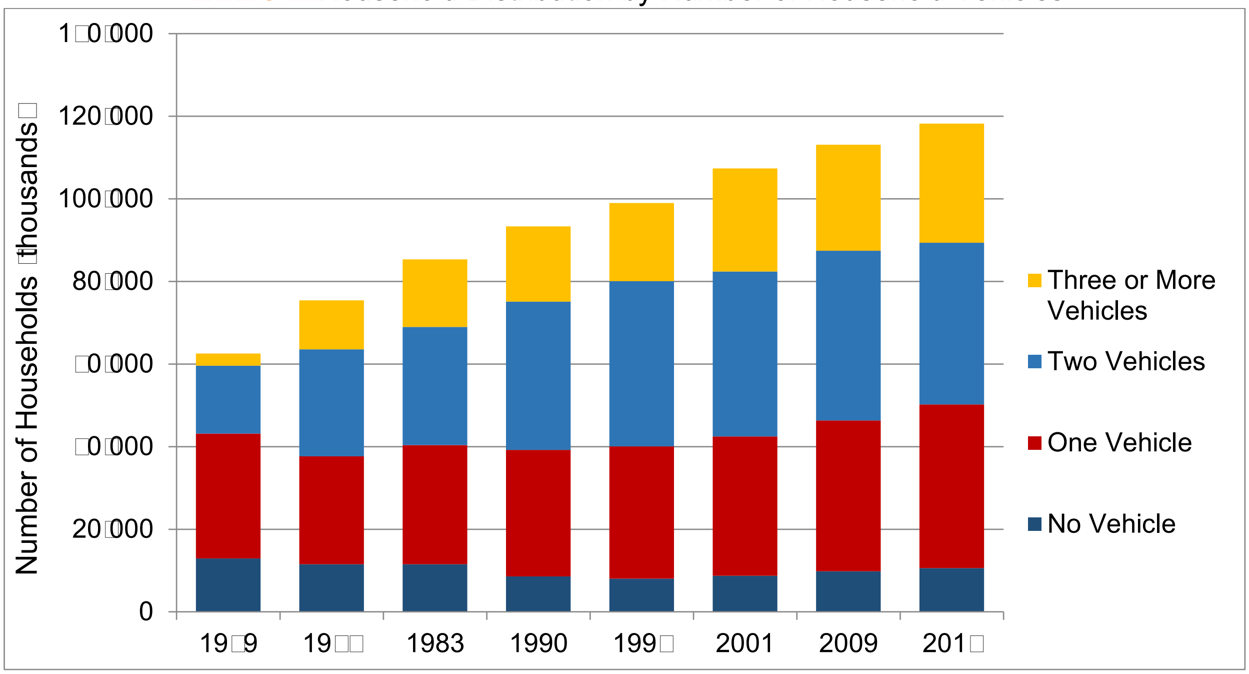
Note□

- Totals in all tables can include cases that were not included in any table subcategory□for instance people who did not report their age are included in the total persons□but not in any age category.
- 2009 NHTS sample did not include households without landlines telephones □CPO households□.
- 201□ NHTS sample was address-based and included more urban and CPO households. This and other methods changes in the data series are outlined in Appendix B.
- In 19□9□household vehicles did not include pickups or other light trucks.
- SUVs were added as a vehicle class in the NHTS survey in 199□.
- In 2009 the survey included Light Electric Vehicles □LEV□as a separate classification.
- Motorcycle, moped, LEVs and “other” POV are excluded from the calculation of vehicle age.
- Standard error of the estimate is too small to show.
- No Vehicle and One Vehicle categories were used as controls in calibrating the weights according to the weighting plan and should have nearly no variance in the replicate weights□resulting in standard errors close to 0.

Out of the 120 million households in the United States, about 10.□ million are without a vehicle, according to the 2017 NHTS (Figure 9). The number of households with zero vehicles available remained statistically the same in 2017 (within the margin of error of the 2009 estimate).

On the other hand, since 1969 the number of households that owned three or more vehicles has grown by tenfold—from 2.9 million to nearly 29 million. The percentage of households with three or more vehicles has gone from □ percent to nearly a quarter of all U.S. households.

Figure 9: Household Distribution by Number of Household Vehicles



Note:

- Totals in all tables can include cases that were not included in any table subcategory, for instance people who did not report their age are included in the total persons, but not in any age category.
- 2009 NHTS sample did not include households without landlines telephones (CPO households).
- 2017 NHTS sample was address-based and included more and CPO urban households. This and other methods changes in the data series are outlined in Appendix B.
- In 1969, household vehicles did not include pickups or other light trucks
- SUVs were added as a vehicle class in the NHTS survey in 1995.
- In 2009 the survey included Light Electric Vehicles (LEV) as a separate classification.
- Motorcycle, moped, LEVs and “other” POV are excluded from the calculation of vehicle age.

Table 18 shows the traditional correlation between high population density and the percentage of households with fewer or no vehicles in the NHTS data series.

Over a □uarter □2□.8□ □of the households in areas with a population density greater than 10□000 per s□uare mile did not own a vehicle in 201□ and 30.□ percent owned two or more vehicles.

On the other hand□ only □.3 percent of the households in the least densely populated areas did not own a vehicle in 201□ and almost □0 percent □□8.3□ □owned two or more vehicles.

T□□□e 1□□ Trends in the Distribution of Households by Household Vehicle Availability and Population Density

□□□□□□ti□n Densit□	S□r□e□ □e□r	□□□se□□□d □e□i□e □□□□i□□i□it□			
		□□□	□□ □e□i□e	□ne □e□i□e	T□□ □r □ □re □e□i□es
Less than 2□000 People per S□uare Mile	1990	100.0□	□1□	30.□□	□3.□□
	199□	100.0□	3.□□	2□.□□	□9.8□
	2001	100.0□	3.8□	2□.8□	□0.□□
	2009	100.0□	□.□□	2□.8□	□8.8□
	2009 MOE	-	0.□1	0.□□	0.89
	201□	100.0□	□.3□	2□.□□	□8.3□
	201□ MOE	-	0.31	0.□2	0.□□
2□000 to □□000 People per S□uare Mile	1990	100.0□	□.□□	33.□□	□9.0□
	199□	100.0□	□.8□	33.3□	□0.8□
	2001	100.0□	□.8□	32.8□	□1.□□
	2009	100.0□	□.□□	3□.1□	□9.□□
	2009 MOE	-	0.8□	1.□□	1.□□
	201□	100.0□	□.□□	3□.□□	□□.□□
	201□ MOE	-	0.□1	0.8□	0.89

T□□□e 1□□ Trends in the Distribution of Households by Household Vehicle Availability and Population Density □continued□

□□□□□□ti□n Densit□	S□r□e□ □e□r	□□□se□□□d □e□i□□e □□□i□□□i□it□			
		□□□	□□ □e□i□□e	□ne □e□i□□e	T□□ □r □ □re □e□i□□es
□000 to 10□000 People per S□uare Mile	1990	100.0□	10.9□	38.2□	□0.9□
	199□	100.0□	□.□□	3□.2□	□□.1□
	2001	100.0□	8.1□	3□.3□	□□.□□
	2009	100.0□	8.□□	3□.□□	□□.1□
	2009 MOE	-	0.□3	1.3□	1.3□
	201□	100.0□	9.3□	38.1□	□2.□□
	201□ MOE	-	0.□9	1.23	1.39
10□000 or more People per S□uare Mile	1990	100.0□	3□.1□	□0.0□	2□.9□
	199□	100.0□	2□.□□	□1.8□	30.8□
	2001	100.0□	2□.3□	□0.3□	33.□□
	2009	100.0□	28.□□	39.9□	31.□□
	2009 MOE	-	1.□0	1.□8	1.□□
	201□	100.0□	2□.8□	□2.□□	30.□□
	201□ MOE	-	1.13	1.32	1.20

Note□

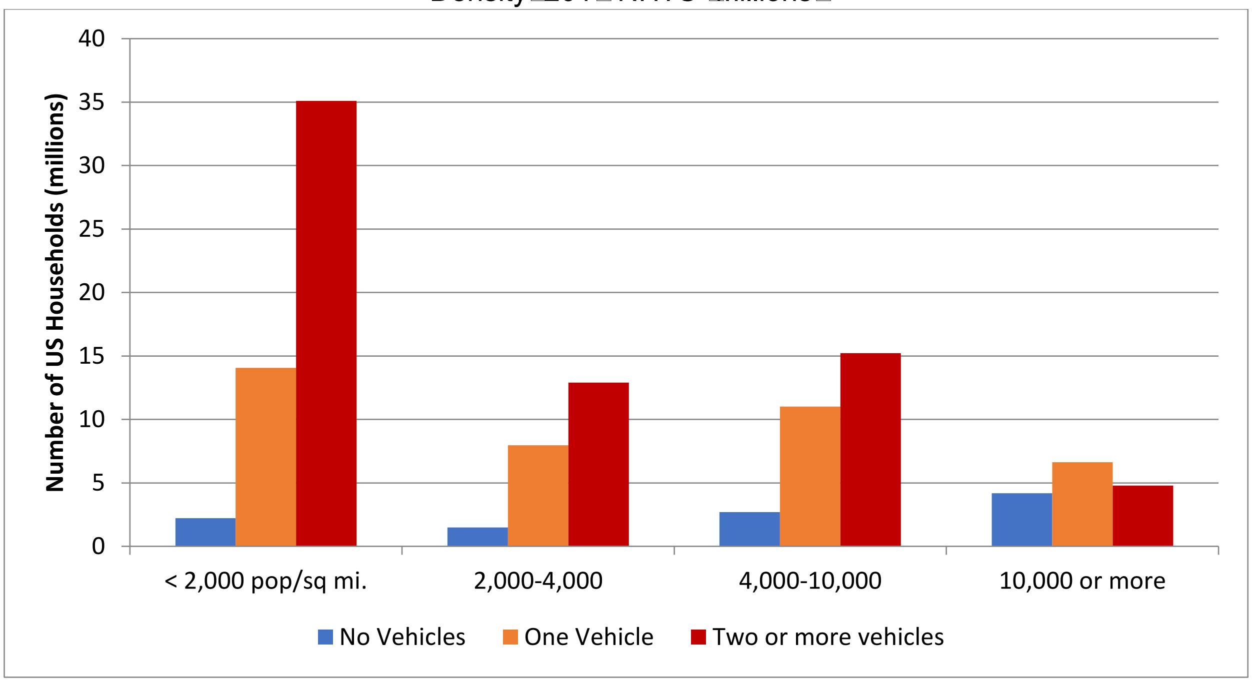
- Totals in all tables can include cases that were not included in any table subcategory.
- 2009 NHTS sample did not include households without landlines telephones □CPO households□.
- 201□ NHTS sample was address-based and included more urban and CPO households. This and other methods changes in the data series are outlined in Appendix B.
- In 19□9□household vehicles did not include pickups or other light trucks.
- SUVs were added as a vehicle class in the NHTS survey in 199□.
- In 2009 the survey included Light Electric Vehicles □LEV□as a separate classification.
- Motorcycle, moped, LEVs and “other” POV are excluded from the calculation of vehicle age.

Overall□most households in the United States—over □1 million or □3.□ percent of all—are in low-density areas with less than 2□000 people per s□uare mile □Figure 10□

An e□ual amount□another □1 million and □3.□ percent of all□are in areas with between 2□000 and 10□000 people per s□uare mile.

Only 13.2 percent of households are in very high-density areas of more than 10□000 people per s□uare mile. In these denser urban areas□households are less likely to have two or more vehicles□and more likely to have fewer vehicles.

□i□□re 1□□Distribution of the Number of U.S. Households by Vehicle Ownership and Population Density□201□ NHTS □Millions□



Note□

- Totals in all tables can include cases that were not included in any table subcategory.
- 2009 NHTS sample did not include households without landlines telephones □CPO households□
- 201□ NHTS sample was address-based and included more urban and CPO households. This and other methods changes in the data series are outlined in Appendix B.
- In 19□9□household vehicles did not include pickups or other light trucks.
- SUVs were added as a vehicle class in the NHTS survey in 199□
- In 2009 the survey included Light Electric Vehicles □LEV□as a separate classification.
- Motorcycle□moped□LEVs and “other” POV are excluded from the calculation of vehicle age.

Table 19 shows that larger metro areas have higher proportions of households with no vehicles than smaller towns and rural areas.

Overall□the proportion of households without a vehicle declined significantly from 19□□ to 199□□ and then—in some areas—experienced a small shift upward.

The proportion of households without a vehicle available overall was 1□.3 percent in 19□□□and fell to 8.1 percent in 199□ and 2001□rising to 8.□ percent in 2009 and 8.9 percent in 201□.

T□□□e 1□□Trends in the Percent of Households Without a Vehicle Within MSA Si□e Group

S□r□e□ □e□r	Metr□ □re□ Si□e						
	R□r□□□ □□t in MS□	□ess t□□n 2□□□□□□	2□□□□□□ t□ □□□□□□□	□□□□□□□ t□ □□□□□□□	1 t□ 2□□ □i□i□n	□□ □i□i□n	□□□
19□□	12.2□	13.□□	12.2□	1□.0□	1□.2□	2□.1□	1□.3□
1983	10.□□	10.1□	8.1□	1□.3□	12.1□	2□.□□	13.□□
1990	□.□□	8.□□	□.□□	8.□□	8.2□	12.□□	9.2□
199□	□.3□	□.8□	□.3□	□.3□	□.9□	11.2□	8.1□
2001	□.8□	□.8□	□.2□	□.0□	□.□□	11.9□	8.1□
2009	□.□□	□.3□	□.□□	8.3□	□.2□	12.□□	8.□□
2009 MOE	0.1□	0.12	0.09	0.12	0.1□	0.1□	0.0□
201□	□.8□	□.0□	□.8□	□.□□	□.□□	12.8□	8.9□
201□ MOE	0.0□	0.0□	0.0□	0.0□	0.11	0.12	0.00

Note□

- Totals in all tables can include cases that were not included in any table subcategory..
- 2009 NHTS sample did not include households without landlines telephones □CPO households□
- 201□ NHTS sample was address-based and included more urban and CPO households. This and other methods changes in the data series are outlined in Appendix B.
- In 19□9□household vehicles did not include pickups or other light trucks.
- SUVs were added as a vehicle class in the NHTS survey in 199□.
- In 2009 the survey included Light Electric Vehicles □LEV□as a separate classification.
- Motorcycle, moped, LEVs and “other” POV are excluded from the calculation of vehicle age.
- "Rural□Not in MSA" includes only full counties designated as rural. There may also be rural pockets included within MSA boundaries.
- The population si□e groups for 19□□ - 1983 NPTS are MSA Si□e Groups. 1990 - 2001 are MSA Si□e Groups. 2009 - 201□ are CMSA si□e groups.

Table 20 shows vehicle in the household-based fleet by vehicle type and age. It shows how much the average vehicle has aged over the last decades. Figure 11 shows these trends in a pictorial format.

The share of vans in the household vehicle fleet declined again in 201□—the percentage of vehicles classified as vans in 201□ □□.1□ □was lower than the 2009 estimate □□.8□ □. On the other hand□the percentage of vehicles classified as SUVs continued to increase—as they have since the survey included a category for them in 199□. From just under □percent of all vehicles in 199□□SUVs grew to almost a □uarter □23.□□ □of all household vehicles in 201□.

Continuing a long-standing trend□the household vehicle fleet continues to age. The most recent data shows the average vehicle owned by U.S. households is 10.3 years old□about 1 year older than the estimate in 2009.

Auto□Van□SUV□and Pickups were significantly older in 201□compared to the age estimate in 2009□and each of these vehicle types were significantly older in 2009 compared to 2001. Over the last □decades the U.S. fleet has aged almost □years—the average vehicle in the household fleet was □.□years old in 19□□□compared to 10.2□years old in 201□.

T□□e 2□□Household-Based Vehicle Distribution and Average Vehicle Age by Vehicle Type

Distri□□ti□n □□□e□i□es □□ □e□i□e T□□e									
□□te□□r□	1□□□	1□□□	1□□□	1□□□	2□□1	2□□□	2□□□ M□□	2□1□	2□1□ M□□
TOTAL	100□	100□	100□	100□	100□	100□	0.00	100□	0.00
Auto	□9.□□	□□.9□	□□.□□	□□.3□	□□.8□	□9.9□	0.□□	□9.□□	0.□□
Van	2.8□	3.□□	□.□□	□.8□	9.0□	8.2□	0.28	□.1□	0.28
Sport Utility	NA	NA	NA	□.9□	12.1□	19.□□	0.3□	23.□□	0.□□
Pickup	12.8□	1□.2□	1□.2□	1□.□□	18.□□	1□.8□	0.29	1□.9□	0.21
Other Truck	1.3□	1.□□	0.□□	0.□□	0.□□	0.□□	0.08	0.□□	0.10
RV□Motor Home	0.□□	0.□□	0.□□	0.□□	0.□□	0.□□	0.0□	0.□□	0.0□
Motorcycle□Moped	2.9□	3.1□	1.□□	0.9□	2.1□	3.3□	0.2□	3.3□	0.1□
Other	0.2□	0.2□	0.1□	0.1□	0.□□	0.3□	0.0□	0.□□	0.0□

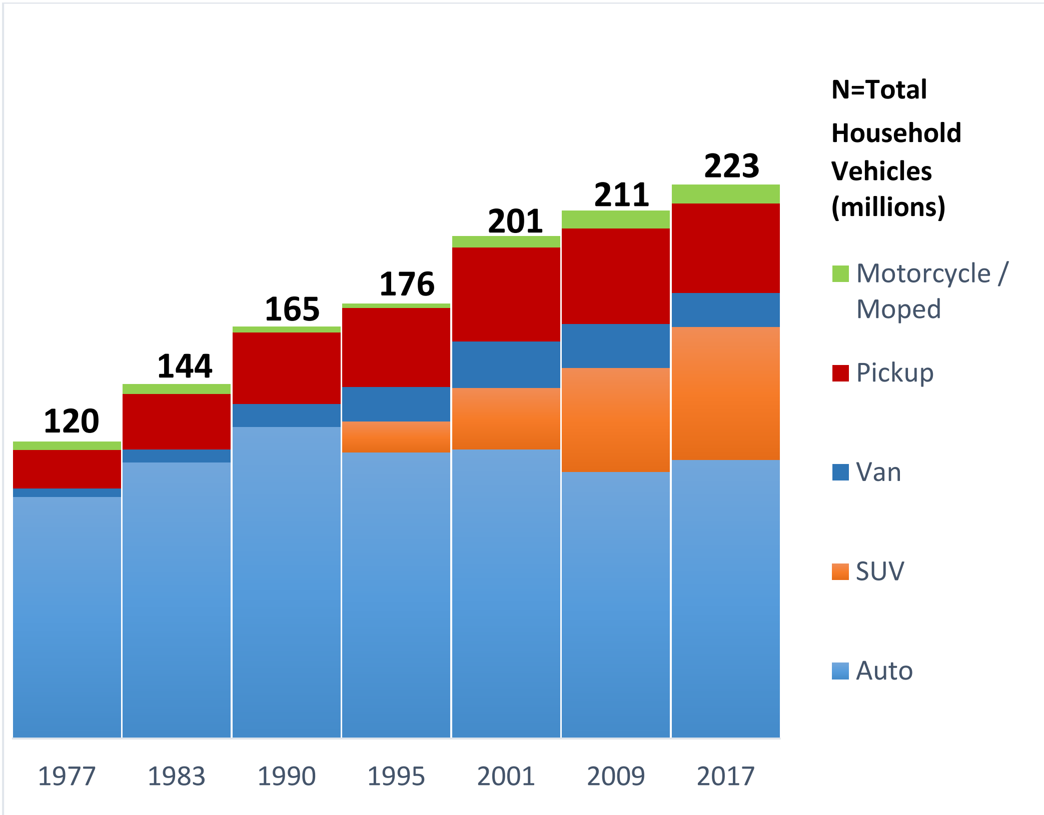
Table 2[illegible]: Household-Based Vehicle Distribution and Average Vehicle Age by Vehicle Type (continued)

Average Vehicle Age									
Category	**1969**	**1977**	**1983**	**1990**	**2001**	**2009**	**2009 MOE**	**2017**	**2017 MOE**
All	[illegible].[illegible]0	[illegible].[illegible]0	[illegible].[illegible]1	8.33	8.8[illegible]	9.38	0.10	10.2[illegible]	0.12
Auto	[illegible].[illegible]0	[illegible].20	[illegible].[illegible]1	8.2[illegible]	8.98	9.[illegible][illegible]	0.11	10.10	0.18
Van	[illegible].[illegible]0	8.[illegible][illegible]	[illegible].88	[illegible].[illegible]8	[illegible].[illegible][illegible]	8.[illegible]8	0.18	10.[illegible][illegible]	0.2[illegible]
Sport Utility	NA	NA	NA	[illegible].[illegible][illegible]	[illegible].[illegible][illegible]	[illegible].09	0.1[illegible]	8.3[illegible]	0.13
Pickup	[illegible].30	8.[illegible][illegible]	8.[illegible]3	9.[illegible][illegible]	10.0[illegible]	11.10	0.21	13.12	0.1[illegible]
Other Truck	11.[illegible]0	12.39	1[illegible].[illegible]8	1[illegible].93	1[illegible].[illegible]2	1[illegible].[illegible][illegible]	1.[illegible][illegible]	1[illegible].29	1.0[illegible]
RV/Motor Home	[illegible].[illegible]0	10.[illegible]9	10.[illegible][illegible]	13.21	13.[illegible]9	1[illegible].[illegible][illegible]	1.[illegible][illegible]	1[illegible].[illegible][illegible]	1.29

Notes:

- Totals in all tables can include cases that were not included in any table subcategory.
- 2009 NHTS sample did not include households without landlines telephones (CPO households).
- 2017 NHTS sample was address-based and included more urban and CPO households. This and other methods changes in the data series are outlined in Appendix B.
- In 1969 household vehicles did not include pickups or other light trucks.
- SUVs were added as a vehicle class in the NHTS survey in 1990.
- In 2009 the survey included Light Electric Vehicles (LEV) as a separate classification.
- Motorcycle, moped, LEVs and "other" POV are excluded from the calculation of vehicle age.
- Totals do not include any unreported vehicle ages, but do include vehicle types such as motorcycle, RV, etc. that are not shown.

Figure 11: Trends in the Number of Household-Based Vehicles by Type (Millions)



Note:

- Totals in all tables can include cases that were not included in any table subcategory.
- 2009 NHTS sample did not include households without landlines telephones (CPO households).
- 2017 NHTS sample was address-based and included more urban and CPO households. This and other methods changes in the data series are outlined in Appendix B.
- In 1969 household vehicles did not include pickups or other light trucks.
- SUVs were added as a vehicle class in the NHTS survey in 1995.
- In 2009 the survey included Light Electric Vehicles (LEV) as a separate classification.
- Motorcycle/moped, LEVs and "other" POV are excluded from the calculation of vehicle age.

Over the last □ decades□ a striking feature of the household vehicle fleet is the increase in the number of years an average vehicle is operated □Table 21□.

In 19□□□ automobiles averaged □.□ years of age while automobiles in 201□ averaged 10.1 years of age—an increase of 3.□ years on average. In 199□ □the first year SUVs were separately catalogued in the NHTS□□ Vans□SUV□Pickup Trucks were 8.3 years old on average. By 201□□ they averaged 10.□ years—more than 2 years older.

As a result□ of the aging fleet□ many older cars are in daily use. In 19□□□ about one out of six vehicles was 10 years old or older□ by 201□□ nearly half □□8.□□ □of the household-based fleet was 10 years old or more.

T□□□e 21□ Trends in the Distribution of Household-Based Vehicles by Vehicle Age and Vehicle Type □Percent□

S□r□e□ □e□r	□e□i□e T□□e	□e□i□e □□e□					
		□t□ 2 □e□rs	□t□ □ □e□rs	□t□ □ □e□rs	1□ □r □ □re	T□t□□	□□er□□e □□e
19□□	Auto	2□.3□	30.□□	2□.□□	1□.□□	100.0□	□.□
	Van□Pickup	29.9□	2□.□□	21.1□	23.□□	100.0□	□.□
	ALL	2□.8□	29.□□	2□.□□	1□.9□	100.0□	□.□
1983	Auto	20.0□	28.0□	2□.□□	2□.□□	100.0□	□.2
	Van□Pickup	1□.□□	2□.□□	2□.0□	31.8□	100.0□	□.8
	ALL	19.2□	2□.□□	2□.9□	2□.3□	100.0□	□.□
1990	Auto	1□.□□	2□.□□	2□.8□	29.9□	100.0□	□.□
	Van□Pickup	19.□□	2□.2□	20.9□	32.2□	100.0□	8.0
	ALL	1□.□□	2□.□□	2□.3□	30.□□	100.0□	□.□
199□	Auto	1□.9□	21.□□	30.3□	33.1□	100.0□	8.2
	Van□SUV□Pickup	19.2□	21.□□	2□.□□	33.□□	100.0□	8.3
	ALL	1□.2□	21.□□	28.□□	33.8□	100.0□	8.3

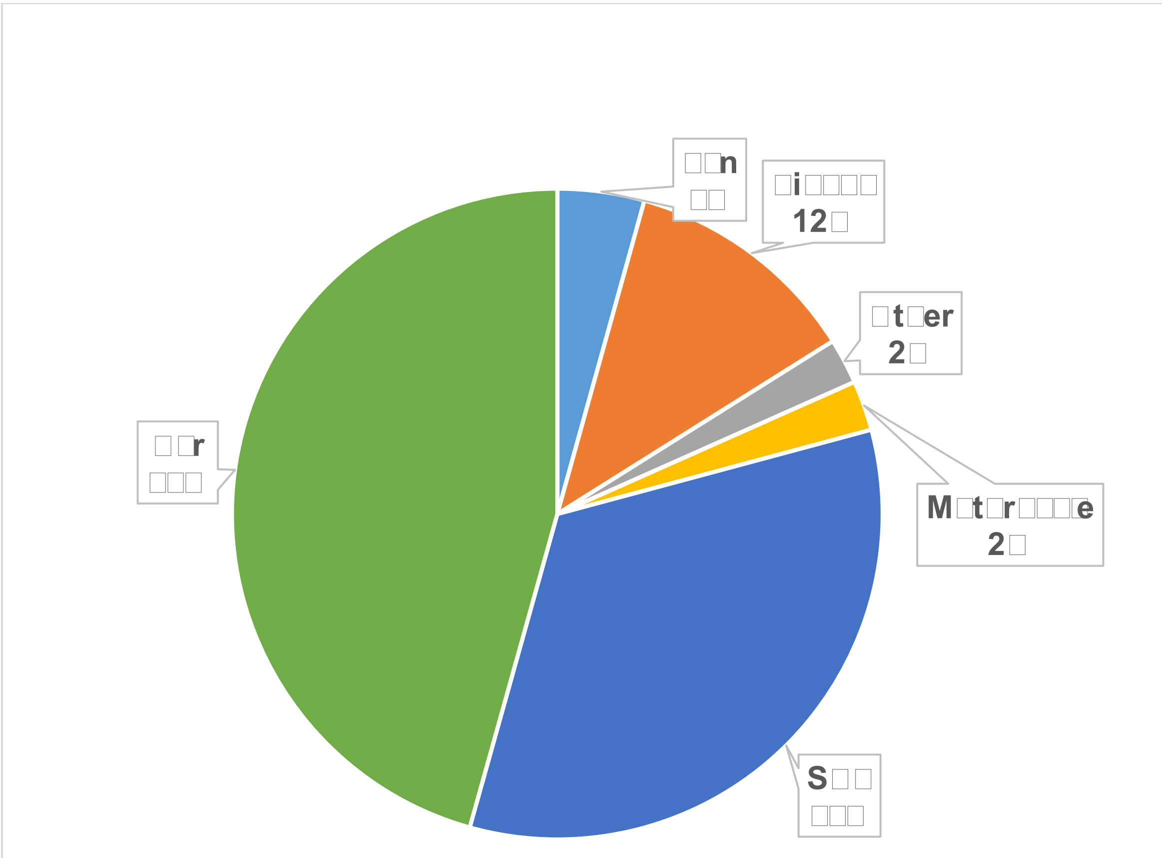
Table 21. Trends in the Distribution of Household-Based Vehicles by Vehicle Age and Vehicle Type (Percent) (continued)

Survey Year	Vehicle Type	Vehicle Age: □ to 2 Years	□ to □ Years	□ to □ Years	1□ or More	Total	Average Age
2001	Auto	13.3□	20.□□	2□.□□	□0.9□	100.0□	9.0
	Van/SUV/Pickup	18.□□	23.□□	22.□□	3□.□□	100.0□	8.□
	ALL	1□.□□	21.□□	2□.1□	39.0□	100.0□	8.9
2009	Auto	12.□□	19.□□	2□.0□	□0.9□	100.0□	9.□
	Van/SUV/Pickup	12.8□	23.□□	2□.1□	3□.□□	100.0□	9.0
	ALL	12.□□	21.□□	2□.8□	38.9□	100.0□	9.□
2009 MOE	Auto	0.□9□	0.□8□	0.□0□	0.□□□	0.00□	0.11
	Van/SUV/Pickup	0.□9□	0.□0□	0.□9□	0.□□□	0.00□	0.11
	ALL	0.3□□	0.□2□	0.□9□	0.□□□	0.00□	0.10
201□	Auto	12.2□	20.□□	20.8□	□□.□□	100.0□	10.1
	Van/SUV/Pickup	1□.□□	1□.□□	18.0□	□0.0□	100.0□	10.□
	ALL	13.2□	18.9□	19.□□	□8.□□	100.0□	10.3
201□ MOE	Auto	0.39□	0.□0□	0.□□□	0.91□	0.00□	0.18
	Van/SUV/Pickup	0.□0□	0.□1□	0.□□□	0.□□□	0.00□	0.09
	ALL	0.32□	0.□□□	0.□9□	0.□2□	0.00□	0.12

Note:
- 201□ NHTS sample was address-based and included more urban and CPO households. This and other methods changes in the data series are outlined in Appendix B.
- Motorcycle, moped, LEVs and “other” POV are excluded from the calculation of vehicle age.

Figure 12 shows that after cars□SUVs appear to be the most popular vehicle type among newer vehicles□according to the 201□ NHTS.

□i□□re 12□Distribution of Household-Based Vehicles Two Years old or Newer by Vehicle Type □Percent□



Note□

- 201□ NHTS sample was address-based and included more urban and CPO households. This and other methods changes in the data series are outlined in Appendix B.
- Motorcycle, moped, LEVs and “other” POV are excluded from the calculation of vehicle age.

Based on vehicle owners' estimates, an average U.S. vehicle was driven slightly more than 10□000 miles a year in 201□□statistically the same as in 2009 □Table 22□.

Overall□average miles per vehicle □from the owner□s estimate□seems to have peaked in the 1990s. In the 201□ survey□it is lower than the estimates in 2001 for all vehicles in all age categories.

T□□□e 22□Trends in the Average Annual Miles per Vehicle by Vehicle Age □Vehicle Owner□s Estimate□

S□r□e□ □e□r	□e□i□e □□e				
	□t□ 2 □e□rs	□t□ □ □e□rs	□t□ □ □e□rs	1□ □r □ □re □e□rs	□□□
19□9	1□□□00	11□200	9□□00	□□□00	11□□00
19□□	1□□□□0	11□0□□	9□199	□□□□□	10□□□9
1983	1□□292	11□902	9□2□3	□□023	10□31□
1990	1□□811	13□□0□	12□□□□	9□1□□	12□□□8
199□	1□□092	1□□00□	12□□08	8□□□8	12□22□
2001	1□□892	13□230	11□□03	□□8□3	11□0□8
2009	13□8□1	12□0□2	10□□□1	□□□01	10□088
2009 MOE	□33	198	280	1□0	133
201□	13□0□□	12□□82	11□□32	□□812	10□1□□
201□ MOE	3□2	□21	3□9	21□	131

Note□

- Totals in all tables can include cases that were not included in any table subcategory.
- 2009 NHTS sample did not include households without landlines telephones □CPO households□.
- 201□ NHTS sample was address-based and included more urban and CPO households. This and other methods changes in the data series are outlined in Appendix B.
- In 19□9□household vehicles did not include pickups or other light trucks.
- SUVs were added as a vehicle class in the NHTS survey in 199□.
- In 2009 the survey included Light Electric Vehicles □LEV□as a separate classification.
- Motorcycle, moped, LEVs and "other" POV are excluded from the calculation of vehicle age.

The annual miles shown in Table 23a and 23b are based on the driver□s estimate of how many miles he or she drives □in all vehicles□ in a year.

Like other measures of vehicle travel□ these estimates have also decreased significantly between 2009 and 201□. Drivers aged 20 to □□ estimated that in a year they drove significantly fewer miles than comparable age groups in 2009.

The decrease in annual miles estimated by men drivers was significant for 20 to □□-year-olds□ but not drivers 1□-19 or those over □□. Women driver□s estimates were statistically the same as in 2009 in all age groups □although the nominal estimate was lower in every age group□.

T□□□e 2□□□ Trends in the Average Annual Miles per Licensed Driver-by-Driver Age □Self-Estimate□

S□r□e□ □e□r	Dri□ers					
	1□ t□ 1□	2□ t□ □□	□□ t□ □□	□□ t□ □□	□□□	□□□
19□9	□□□33	9□3□8	9□□□1	8□□11	□□1□1	8□□8□
19□□	□□□□2	11□0□3	11□□39	9□19□	□□□□□	10□00□
1983	□□98□	11□□31	12□□2□	9□□11	□□38□	10□□3□
1990	8□□8□	1□□□□□	1□□83□	11□□3□	□□08□	13□12□
199□	□□□2□	1□□098	1□□291	11□9□2	□□□□□	13□□□□
2001	□□331	1□□□□0	1□□□2□	13□1□□	□□□8□	13□82□
2009	□□2□□	13□□09	1□□11□	12□□28	8□2□0	12□888
2009 MOE	□□0	□1□	321	38□	3□□	20□
201□	□□□□1	12□18□	13□80□	12□09□	8□218	11□□21
201□ MOE	383	□□□	29□	2□□	223	1□9

T□□e 2□□□Trends in the Average Annual Miles per Licensed Driver-by-Driver Age and Gender □Self-Estimate□

S□r□e□ □e□r	M□e Dri□ers					
	1□t□ 1□	2□t□ □□	□□t□ □□	□□t□ □□	□□□	□□□
19□9	□□□1	13□133	12□8□1	10□9□	□919	11□3□2
19□□	□0□□	1□222	1□09□	12□□□	□□9□	13□39□
1983	□908	1□8□□	1□808	13□31	□198	13□9□2
1990	9□□3	18□310	18□8□1	1□22□	9□1□2	1□□3□
199□	8□20□	1□9□□	18□8□8	1□8□9	10□30□	1□□□0
2001	8□228	18□3□	19□28□	1□883	10□1□3	1□9□□
2009	□□□2	1□□1□	1□□□□	1□11□	10□322	1□139
2009 MOE	□33	10□1	□□0	□□□	32□	328
201□	□893	13□291	1□□0□	1□□1□	9□9□□	13□393
201□ MOE	□9□	□83	□3□	□2□	2□3	228

S□r□e□ □e□r	□e□ □e Dri□ers					
	1□t□ 1□	2□t□ □□	□□t□ □□	□□t□ □□	□□□	□□□
19□9	3□8□	□□12	□003	□3□□	3□□□	□□11
19□□	□03□	□□□1	□□3□	□09□	3□□2	□9□0
1983	3□8□□	□121	□3□□	□□32	3□308	□382
1990	□38□	11□1□□	10□39	□211	□□□0	9□28
199□	□8□3	12□00□	11□□□	□□80	□□8□	10□1□2
2001	□10□	12□2□□	11□90	8□9□	□803	10□2□□
2009	□□□3	11□8□	12□03□	9□□□	□82□	10□2□□
2009 MOE	881	□□2	381	□0□	□□□	213
201□	□10□	11□02□	11□89□	9□3□	□3□3	9□8□□
201□ MOE	□10	□□2	389	200	23□	2□1

Note□

- Totals in all tables can include cases that were not included in any table subcategory.
- In 199□□some drivers reported □ero annual miles. These were changed to miles not reported.
- 2009 NHTS sample did not include households without landlines telephones □CPO households□
- 201□ NHTS sample was address-based and included more urban and CPO households. This and other methods changes in the data series are outlined in Appendix B.
- In 19□9□household vehicles did not include pickups or other light trucks.
- SUVs were added as a vehicle class in the NHTS survey in 199□.
- In 2009 the survey included Light Electric Vehicles □LEV□as a separate classification.
- Motorcycle, moped, LEVs and “other” POV are excluded from the calculation of vehicle age.

□□□ □□MM□T□ TR□□□□ □□TT□R□S

Table 2□ shows that the estimate of the number of vehicle trips to and from work is about the same in 201□ compared to that of 2009 □within the margin of error□. Although the estimate of total vehicle miles for commuting is nominally higher in 201□ compared to 2009□the differences are not significant.

The total number of estimated workers has increased□while the annual commute vehicle trips per worker has remained virtually the same over many survey iterations□excepting the 199□ NPTS.

T□□□e 2□□Trends in Commute Trips and Vehicle Miles in Commute

S□r□e□ □e□r	□□□ □ □te □e□i□e Tri□s □□ i□i□ns□	□□□ □ □te □MT □□ i□i□ns□	T□t□□□MT □□ i□i□ns□	□ □□□ □ □te □MT □□ T□t□□□MT	□ □r□ers □t□□□s□nds□	□nn□□□ □□□ □ □te □e□i□e Tri□s □er □ □r□er
19□9	2□8□□	2□0□□1□	□□□9□0	33.□0□	□□□□□8	3□8
19□□	31□88□	28□□□10	90□□□03	31.□0□	93□019	3□3
1983	3□□2□1	301□□□□	1□002□139	30.10□	103□2□□	3□2
1990	□1□□92	□□3□0□2	1□□9□□290	2□.□2□	118□3□3	3□3
199□	□□□□82	□□2□□10	2□0□8□3□8	31.0□□	131□□9□	□1□
2001	□1□39□	□1□□□□8	2□2□□□□9□	2□.02□	1□□□2□2	3□□
2009	□1□□99	□23□□□9	2□2□□□112	2□.□□□	1□1□3□3	3□2
2009 MOE	89□	1□□□9□	□□□1□8	-	893	-
201□ Orig.	□3□1□□□	□3□□□92	2□10□□882	30.19□	1□□□988	339
201□ Orig. MOE	1□131	22□□□1	88□132	-	1□012	-
201□ Adj.	-	□82□□□8	2□321□820	28.0□□	-	-
201□ Adj. MOE	-	2□□399	98□080	-	-	-

Note□

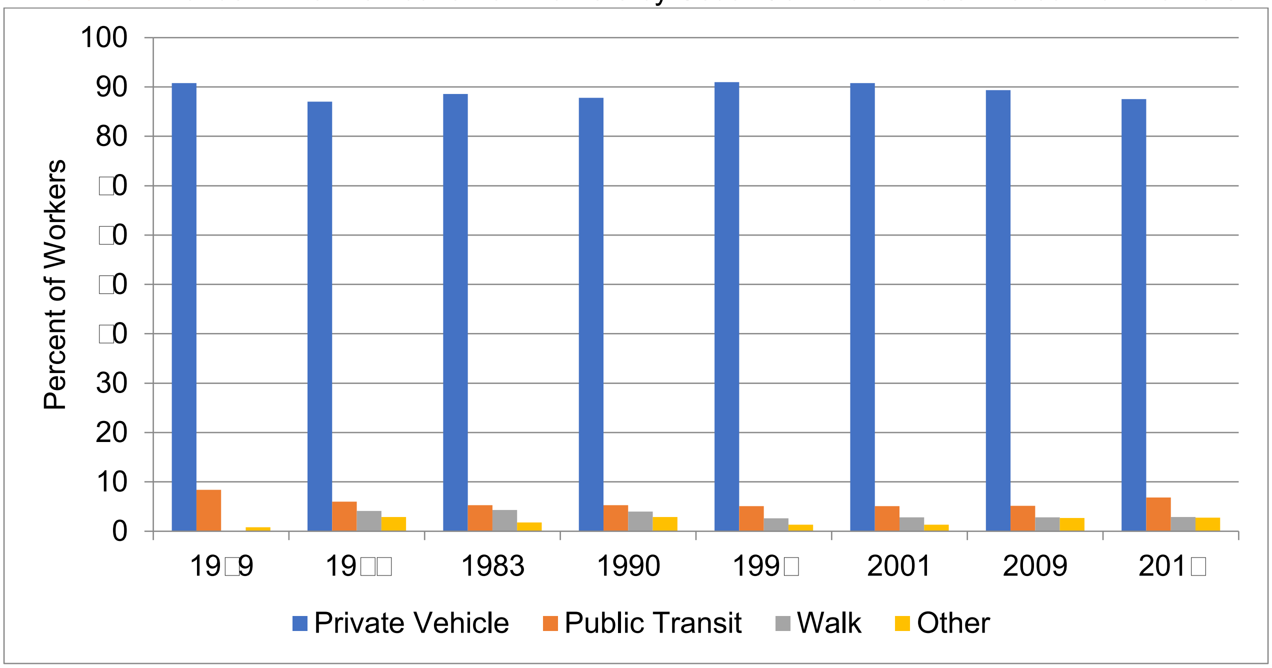
- Totals in all tables can include cases that were not included in any table subcategory.
- 1990 NPTS data were adjusted to make them more comparable with later surveys.
- 2009 NHTS sample did not include households without landlines telephones □CPO households□.
- 201□ NHTS sample was address-based and included more urban and CPO households. This and other methods changes in the data series are outlined in Appendix B.
- In 199□□VMT and vehicle trips with "To or From Work" as a trip purpose are believed to be overstated.
- Trip miles and travel times were calculated using actual trips to and from work as reported in the travel day file.

- The usual mode is defined as the means of transportation usually used to go to work in the week prior to the travel day.
- Unlike the Census Journey-to-Work data□the NHTS does not include “work at home” in usual commute data.
- “Other” includes travel modes not specifically cited□such as motorcycle□taxi□bike□truck□and other.

Across many decades□the vast majority of workers have traveled to work in a privately-owned vehicle. However□in the 201□ NHTS the estimate of workers commuting by private vehicle is significantly lower □8□.□□ of workers□than the 2009 estimate □89.□□ of workers□□Figure 13□.

Table 2□ shows that the 201□ NHTS estimates □.9 percent of workers use public transit as their usual means of travel to work□a significant increase from 2009 and previous estimates.

□i□□re 1□□Trends in the Distribution of Workers by Usual Commute Mode □Percent of Workers□



Note□

- Totals in all tables can include cases that were not included in any table subcategory.
- 1990 NPTS data were adjusted to make them more comparable with later surveys.
- 2009 NHTS sample did not include households without landlines telephones □CPO households□.
- 201□ NHTS sample was address-based and included more urban and CPO households. This and other methods changes in the data series are outlined in Appendix B.
- Trip miles and travel times were calculated using actual trips to and from work as reported in the travel day file.
- The usual mode is defined as the means of transportation usually used to go to work in the week prior to the travel day.
- Unlike the Census Journey-to-Work data□the NHTS does not include “work at home” in usual commute data.
- “Other” includes travel modes not specifically cited, such as motorcycle, taxi, bike, truck, and other.
- Public transit includes local bus□commuter bus□commuter train□subway□trolley□and streetcar.

T□□□e 2□□Trends in the Distribution of Workers by Usual Commute Mode □Percent of Workers□

S□r□e□ □e□r	□□ M□des	□ri□□te □e□i□e	□□□□i□ Tr□nsit	□ □□□	□t□er
19□9	100□	90.8	8.□	N□A	0.8
19□□	100□	8□.0	□.0	□.1	2.9
1983	100□	88.□	□.3	□.3	1.8
1990	100□	8□.8	□.3	□.0	2.9
199□	100□	91.0	□.1	2.□	1.3
2001	100□	90.8	□.1	2.8	1.3
2009	100□	89.□	□.1	2.8	2.□
2009 MOE		0.□2	0.□1	0.3□	0.2□
201□	100□	8□.□	□.9	2.9	2.□
201□ MOE		0.□3	0.32	0.3□	0.29

Note□

- Totals in all tables can include cases that were not included in any table subcategory.
- 2009 NHTS sample did not include households without landlines telephones □CPO households□.
- 201□ NHTS sample was address-based and included more urban and CPO households. This and other methods changes in the data series are outlined in Appendix B.
- In 199□□ VMT and vehicle trips with "To or From Work" as a trip purpose are believed to be overstated.
- The usual mode is defined as the means of transportation usually used to go to work in the week prior to the travel day.
- Unlike the Census Journey-to-Work data□ the NHTS does not include “work at home” in usual commute data.
- “Other” includes travel modes not specifically cited□ such as motorcycle□ taxi□ bike□ truck□ and other.
- Public transit includes local bus□ commuter bus□ commuter train□ subway□ trolley□ and streetcar.

Interestingly□when comparing the report by the same respondents of how they “usually” commute and how they actually travelled to work on the travel day□some important differences emerge. For example□as shown in Table 2□□driving alone has the highest mode loyalty—8□.2 percent of workers who say they usually drive alone do so on the travel day.

About □0 percent of commuters who usually travel by transit□walk□or bike report doing so on their travel day. When they do not use their usual mode□they are most likely to share a ride in a private auto.

The percentage of workers on their assigned travel day who share a ride to work □including family members riding together□is 18.8 percent compared to the “usual” estimate of 11.0 percent. “Shared ride” does not include ride-hailing □such as Uber□Lyft□which is classified with “taxi” in the 2017 NHTS and would be in “Other”). The table does not show “Other” modes and excludes workers who did not report both a usual and actual mode to work □1□□ of all□.

T□□□e 2□□Usual Commute Mode to Work vs Actual Commute Mode on Travel Day

□□s□□□□□□□ □ □te M□de	□n Tr□□e□D□□ □□□ □ □ted □□□					
	Dr□□e □□□ne	S□□red Ride	Tr□nsit	□ □□□	□i□e	□s□□□ M□de S□□re□
Drove Alone	8□.2□	12.8□	0.2□	0.□□	0.1□	□□.2□
Shared Ride	3□.2□	□0.2□	1.0□	1.2□	0.2□	11.0□
Transit	□.8□	1□.□□	□0.8□	□.0□	0.8□	□.9□
Walk	□.3□	18.2□	2.□□	□9.8□	0.9□	2.9□
Bike	8.1□	11.9□	3.□□	□.□□	□0.3□	1.1□
Actual Mode Share	□1.0□	18.8□	□.2□	3.3□	1.0□	

Note□

- Totals in all tables can include cases that were not included in any table subcategory.
- 201□ NHTS sample was address-based and included more urban and CPO households. This and other methods changes in the data series are outlined in Appendix B.
- The usual mode is defined as the means of transportation usually used to go to work in the week prior to the travel day.
- Table does not show “Other” modes of travel.

Table 2□ displays trends in average trip lengths□ travel time□ and speed for different modes of transportation.

T□□□e 2□□ Trends in General Commute Patterns by Mode of Transportation

S□r□e□ □e□r	□□ M□des		
	□□er□□e □□□ □ □te Tri□ □en□t□ □□ i□es□	□□er□□e □□□ □ □te Tr□□e□Ti□ e □□ in□tes□	□□er□□e □□□ □ □te S□eed □□ i□es □er □□□□r□
19□□	9.0□	19.23	3□.□2
1983	8.□□	18.20	2□.8□
1990	10.□□	19.□0	33.3□
199□	11.□3	20.□□	3□.□□
2001	12.11	23.32	32.23
2009	11.□9	23.8□	2□.□0
2009 MOE	0.29	0.3□	0.33
201□ Orig.	11.□□	2□.□8	23.□2
201□ Orig. MOE	0.3□	0.□□	0.28
201□ Adj.	12.22	2□.□8	2□.0□
201□ Adj. MOE	0.3□	0.□□	0.29

S□r□e□ □e□r	□ri□□te □e□i□□e		
	□□er□□e □□□ □ □te Tri□ □en□t□ □□ i□es□	□□er□□e □□□ □ □te Tr□□e□Ti□ e □□ in□tes□	□□er□□e □□□ □ □te S□eed □□ i□es □er □□□□r□
19□□	9.□1	18.9□	3□.□0
1983	8.8□	1□.□2	2□.□8
1990	11.02	19.0□	31.□9
199□	11.8□	20.10	3□.18
2001	12.10	22.□9	32.2□
2009	12.09	22.8□	28.8□
2009 MOE	0.2□	0.3□	0.31
201□ Orig.	11.8□	2□.01	2□.22
201□ Orig. MOE	0.38	0.□□	0.33
201□ Adj.	12.□1	2□.01	2□.08
201□ Adj. MOE	0.□1	0.□□	0.3□

Table 27. Trends in General Commute Patterns by Mode of Transportation (continued)

Survey Year	Public Transit		
	Average Commute Trip Length (miles)	Average Commute Travel Time (minutes)	Average Commute Speed (miles per hour)
1977	[illegible].[illegible]8	3[illegible].[illegible]9	12.[illegible]8
1983	9.00	3[illegible].[illegible]9	1[illegible].[illegible]
1990	12.[illegible]	[illegible]1.10	18.02
1995	12.88	[illegible]1.9[illegible]	18.22
2001	11.[illegible]3	[illegible].[illegible]0	12.9[illegible]
2009	10.18	[illegible]2.98	11.[illegible]2
2009 MOE	1.[illegible]	[illegible].19	0.99
2017 Orig.	12.09	[illegible]8.11	11.[illegible]3
2017 Orig. MOE	1.1[illegible]	2.0[illegible]	0.[illegible]3

Survey Year	Walk		
	Average Commute Trip Length (miles)	Average Commute Travel Time (minutes)	Average Commute Speed (miles per hour)
1977	-	-	-
1983	-	-	-
1990	0.83	9.[illegible]9	[illegible].99
1995	0.[illegible]	10.8[illegible]	3.[illegible]8
2001	0.91	1[illegible].0[illegible]	3.18
2009	0.98	1[illegible].1[illegible]	[illegible].[illegible]
2009 MOE	0.23	2.28	0.[illegible]1
2017 Orig.	1.19	1[illegible].2[illegible]	3.1[illegible]
2017 Orig. MOE	0.[illegible]3	1.[illegible]9	0.18

Notes:
- Totals in all tables can include cases that were not included in any table subcategory.
- 1990 NPTS data were adjusted to make them more comparable with later surveys.
- In 1995, VMT and vehicle trips with "To or From Work" as a trip purpose are believed to be overstated.
- 2009 NHTS sample did not include households without landlines telephones (CPO households).
- 2017 NHTS sample was address-based and included more urban and CPO households. This and other methods changes in the data series are outlined in Appendix B.
- Trip miles and travel times were calculated using actual trips to and from work as reported in the travel day file.
- The usual mode is defined as the means of transportation usually used to go to work in the week prior to the travel day.

- Average commute speed was calculated using only those trips with both trip mileage and travel time information present.
- Average commute trip length was calculated using only those records with trip mileage information present.
- Commute time for public transit includes total trip time□including access and egress. Wait time is not included.
- Unlike the Census Journey-to-Work data□the NHTS does not include “work at home” in usual commute data.
- Public transit includes local bus□commuter bus□commuter train□subway□trolley□and streetcar.

Table 28 shows the trends in the average speed of commutes in areas of different population si□es. On average□larger metro areas have slower speeds—both as a result of more congestion□but also more workers commuting by non-auto means of travel□like transit and walking.

T□□□e 2□□Trends in Average Commute Speed by MSA Si□e □Miles per Hour□
19□□□1983□1990□199□NPTS□and 2001□2009□and 201□NHTS

	MS□ Si□e					
	R□r□□□□t in MS□	□ess t□□n 2□□□□□□	2□□□□□□ t□ □□□□□□□	□□□□□□□ t□ □□□□□□□	1 t□ 2□□ □ i□i□n	□ □ i□i□n □nd □□er
	□□M□des □n□□din□ □ri□□te □e□i□e□					
19□□	-	2□.8	2□.□	2□.□	2□.□	20.0
1983	28.9	2□.□	2□.3	2□.3	2□.□	2□.8
1990	32.0	29.□	30.□	31.□	30.2	2□.□
199□	31.2	28.9	30.0	30.□	29.9	28.□
2001	31.9	28.□	28.3	28.8	2□.9	2□.□
2009	31.□	2□.□	2□.□	28.1	2□.8	2□.□
2009 MOE	0.8	0.8	0.2	0.9	0.□	0.□
201□ Orig.	2□.□	2□.8	2□.3	2□.□	23.8	20.□
201□ Orig. MOE	0.□	0.9	1.3	0.□	0.□	0.3
201□ Adj.	29.□	2□.□	2□.1	2□.2	2□.□	21.9
201□ Adj. MOE	0.□	0.9	1.□	0.□	0.□	0.□

Note□

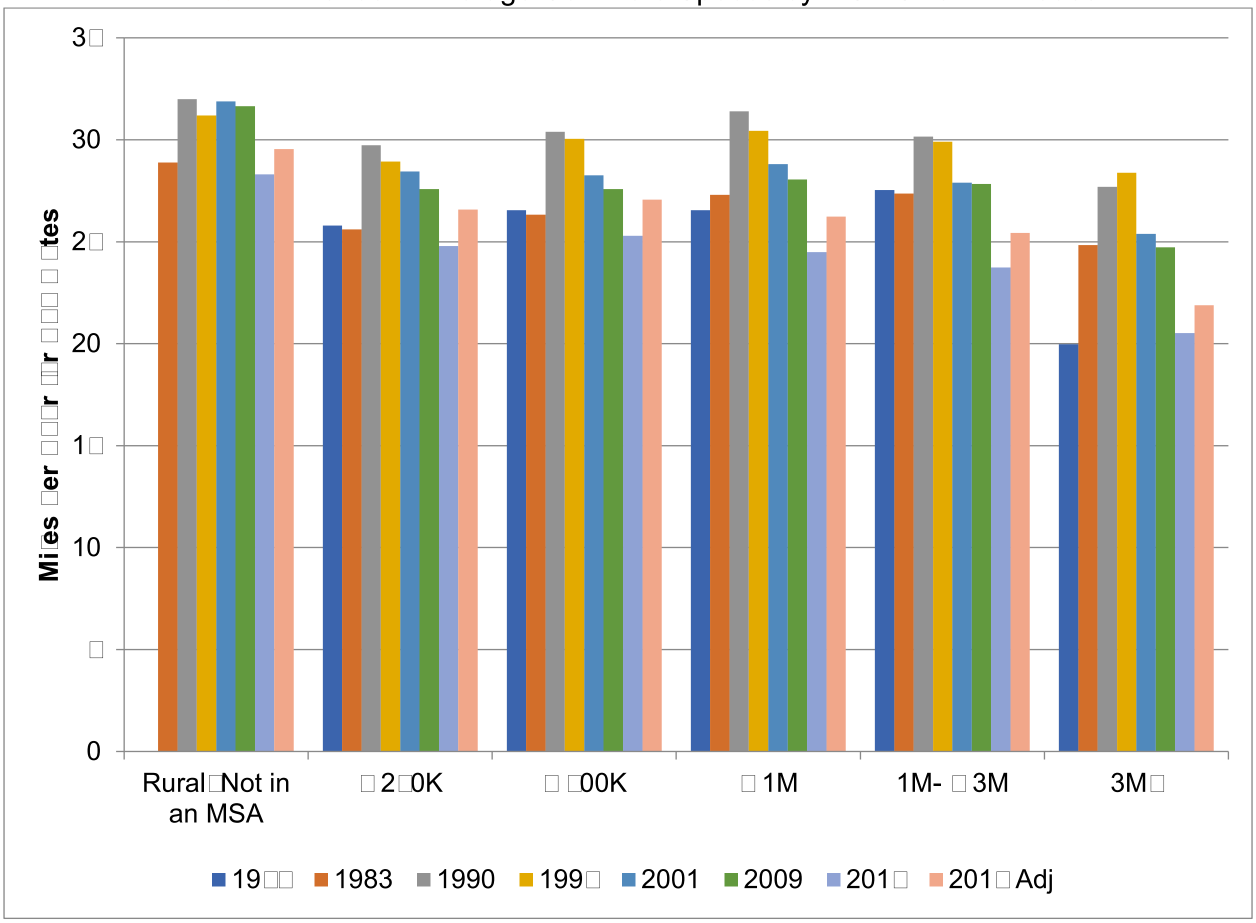
- Totals in all tables can include cases that were not included in any table subcategory.
- 1990 NPTS data were adjusted to make them more comparable with later surveys.
- 2009 NHTS sample did not include households without landlines telephones □CPO households□.

- 201□ NHTS sample was address-based and included more urban and CPO households. This and other methods changes in the data series are outlined in Appendix B.
- In 199□□VMT and vehicle trips with "To or From Work" as a trip purpose are believed to be overstated.
- Trip miles and travel times were calculated using actual trips to and from work as reported in the travel day file.
- The usual mode is defined as the means of transportation usually used to go to work in the week prior to the travel day.
- Average commute speed was calculated using only those trips with both trip mileage and travel time information present.
- Average commute trip length was calculated using only those records with trip mileage information present.
- Commute time for public transit includes total trip time□including access and egress. Wait time is not included.
- Unlike the Census Journey-to-Work data, the NHTS does not include “work at home” in usual commute data.
- "Rural□Not in MSA" includes only full counties designated as rural. There may also be rural pockets included within MSA boundaries.
- The population si□e groups for 19□□ - 1983 NPTS are MSA Si□e Groups. 1990 - 2001 are MSA Si□e Groups. 2009 - 201□ are CMSA si□e groups.

Figure 1□ shows that the average speed of commuting by all modes has declined in all metro areas, regardless of size. Since 1990, the largest metro areas have seen the greatest decline in commute speed.

As mentioned earlier, trip distance was collected differently in the 2017 NHTS, which affects the trends in speed (see Appendix A). The 2017 adjusted values show higher speeds because the trip distance was adjusted to be more comparable to earlier surveys, while the reported time remained the same.

Figure 1□: Trends in Average Commute Speeds by MSA Size (All Modes)



Note:

- Totals in all tables can include cases that were not included in any table subcategory.
- 1990 NPTS data were adjusted to make them more comparable with later surveys.
- In 1995, VMT and vehicle trips with "To or From Work" as a trip purpose are believed to be overstated.
- 2009 NHTS sample did not include households without landlines telephones (CPO households).
- 2017 NHTS sample was address-based and included more urban and CPO households. This and other methods changes in the data series are outlined in Appendix B.
- Trip miles and travel times were calculated using actual trips to and from work as reported in the travel day file.

- Average commute speed was calculated using only those trips with both trip mileage and travel time information present.
- Average commute trip length was calculated using only those records with trip mileage information present.
- Commute time for public transit includes total trip time including access and egress. Wait time is not included.

□□□ T□M□□R□□ DISTRI□□TI□□

Table 29 shows the percentage of person trips by time of day. The 201□ data shows a notable increase in the percentage of trips during the morning peak period □□-9 am□ However□the distribution of trips by time of day has remained about the same for many decades.

The 201□ survey data shows that almost half □□□□ □of all person trips start in the midday between 9 a.m. and □ p.m.□virtually the same as the estimates since 199□.

T□□□e 2□□Trends in the Distribution of Person Trips by Start Time of Trip

Ti□e □□D□□	1□□□	1□□□	1□□□	2□□1	2□□□	2□□□ M□□	2□1□	2□1□ M□□
10 p.m. - 1 a.m.	□.0	□.1	3.□	2.9	2.□	0.13	2.3	0.0□
1 a.m. - □ a.m.	3.3	1.8	1.□	1.8	1.8	0.08	1.9	0.12
□ a.m. - 9 a.m.	1□.□	12.□	13.8	1□.□	1□.0	0.21	1□.□	0.21
9 a.m. - 1 p.m.	23.□	20.□	2□.2	2□.□	2□.8	0.29	2□.□	0.3□
1 p.m. - □ p.m.	20.8	20.□	22.1	22.1	22.□	0.3□	22.1	0.33
□ p.m. - □ p.m.	21.2	22.9	23.0	22.3	22.□	0.29	22.1	0.2□
□ p.m.- 10 p.m.	12.3	13.2	11.8	11.□	11.0	0.23	9.8	0.2□
ALL	100.0	100.0	100.0	100.0	100.0	-	100.0	-

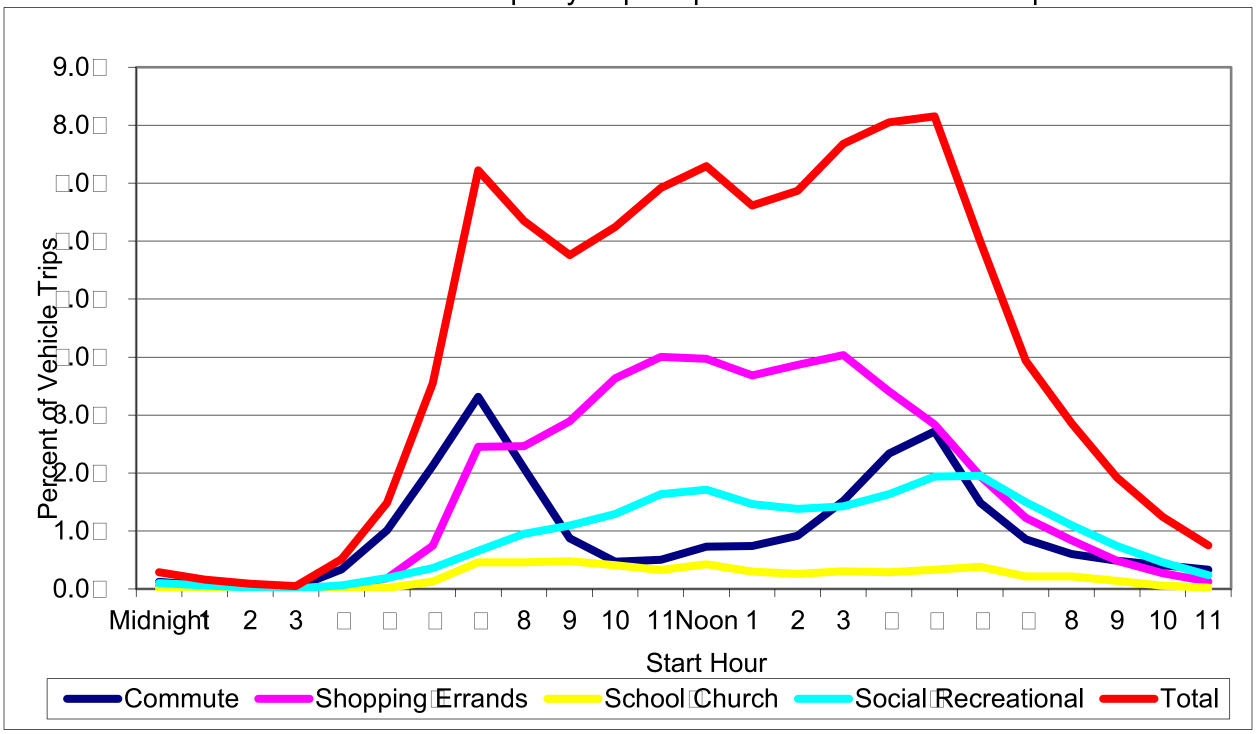
Note□

- Totals in all tables can include cases that were not included in any table subcategory.
- 1990 NPTS data were adjusted to make them more comparable with later surveys.
- In 199□□VMT and vehicle trips with "To or From Work" as a trip purpose are believed to be overstated.
- 2001 NHTS sample included children 0 to □ in the survey. The data shown here exclude them to be comparable with other survey years.
- 2009 NHTS sample did not include households without landlines telephones □CPO households□
- 201□ NHTS sample was address-based and included more urban and CPO households. This and other methods changes in the data series are outlined in Appendix B.

Figure 1□ shows vehicle trips by time of day and purpose. The data show that the morning and evening peak periods include not just commutes□but shopping and family errands □which includes dropping children at school□□and other non-work trips. These vehicle trips add to the total number of vehicles traveling during the peak periods.

As expected□in 201□ most vehicle commutes started between □ a.m. and 9 a.m. in the morning and between □ p.m. and □ p.m. More than half of vehicle trips for other purposes started between 9 a.m. and □ p.m.

□i□□re 1□□Distribution of Vehicle Trips by Trip Purpose and Start Time of Trip□201□ NHTS



Note

- Totals in all tables can include cases that were not included in any table subcategory.
- 1990 NPTS data were adjusted to make them more comparable with later surveys.
- In 199□□VMT and vehicle trips with "To or From Work" as a trip purpose are believed to be overstated.
- 2001 NHTS sample included children 0 to □ in the survey. The data shown here exclude them to be comparable with other survey years.
- 2009 NHTS sample did not include households without landlines telephones □CPO households□.
- 201□ NHTS sample was address-based and included more urban and CPO households. This and other methods changes in the data series are outlined in Appendix B.

Table 30 displays trends for key travel characteristics for weekday and weekend travel.

T□□□e □□□Trends in Travel Characteristics for Weekday vs. Weekend

□ ee□d□□									
S□r□e□ □e□r	□e□i□e Tri□s □er Dri□er	□er□ent □ □r□ Tri□s	□er□ent □ □n□ □ □r□ Tri□s	□MT □er Dri□er	□ □er□□e □e□i□e Tri□ □en□t□	□ □er□□e Ti□ e S□ent Dri□in□ in □ in□tes□	□ers□n Tri□s □er □ers□n	□MT □er □ers□n	□ □er□□e □ers□n Tri□ □en□t□
1990	3.□	28□	□2□	28.□	8.□	□0.□	3.8	32.□	9.□
199□	3.8	32□	□8□	33.□	8.9	□9.□	□.□	3□.□	8.□
2001	3.□	31□	□9□	3□.□	9.8	□□.8	□.2	39.□	9.□
2009	3.2	31□	□9□	30.□	9.□	□9.8	3.9	3□.8	9.□
2009 MOE	0.0	0.□8	0.□8	0.9	0.3	0.8	0.0	1.3	0.3
201□ Orig	2.9	31□	□9□	2□.9	9.3	□9.0	3.□	3□.3	10.2
201□ Orig MOE	0.0	0.□8	0.□8	1.□	0.□	0.9	0.1	2.0	0.□
201□ Adj.	-	-	-	29.□	10.3	-	-	38.0	10.9
201□ Adj. MOE	-	-	-	1.□	0.□	-	-	2.1	0.□
□ ee□ends									
S□r□e□ □e□r	□e□i□e Tri□s □er Dri□er	□er□ent □ □r□ Tri□s	□er□ent □ □n□ □ □r□ Tri□s	□MT □er Dri□er	□ □er□□e □e□i□e Tri□ □en□t□	□ □er□□e Ti□ e S□ent Dri□in□ in □ in□tes□	□ers□n Tri□s □er □ers□n	□MT □er □ers□n	□ □er□□e □ers□n Tri□ □en□t□
1990	2.9	10□	90□	28.□	10.0	□□.1	3.□	□0.□	11.□
199□	3.0	13□	88□	28.9	9.□	□8.1	□.0	□1.1	10.□
2001	2.9	11□	89□	28.□	10.2	□2.□	3.9	□2.3	11.2
2009	2.□	10□	90□	2□.0	10.0	□□.□	3.□	3□.1	10.8
2009 MOE	0.1	0.□□	0.□□	1.1	0.□	1.3	0.1	3.3	1.0
201□ Orig	2.3	11□	89□	23.2	10.3	□□.3	3.1	38.1	12.2
201□ Orig MOE	0.0	0.□1	0.□1	0.8	0.□	0.9	0.0	2.9	1.0
201□ Adj.	-	-	-	2□.□	11.□	-	-	□1.□	13.3
201□ Adj MOE	-	-	-	0.9	0.□	-	-	3.0	1.1

Note

- Totals in all tables can include cases that were not included in any table subcategory.
- 1990 NPTS data were adjusted to make them more comparable with later surveys.
- In 199□□VMT and vehicle trips with "To or From Work" as a trip purpose are believed to be overstated.
- 2001 NHTS sample included children 0 to □ in the survey. The data shown here exclude them to be comparable with other survey years.
- 2009 NHTS sample did not include households without landlines telephones □CPO households□.
- 201□ NHTS sample was address-based and included more urban and CPO households. This and other methods changes in the data series are outlined in Appendix B.
- Average time spent driving includes all drivers□even those who did not drive a private vehicle on the day in which the household was interviewed.
- Average trip length is calculated using only those records with trip mileage information present.
- "□ Work Trips" also includes work-related business.

□□□ S□□□I□□ □□□□□□TI□□S

Table 31 shows that the estimates of travel for people aged □□ and older is a mixed bag□While reported vehicle trips per driver are lower than 2009 estimates□person trips and person miles of travel both show increases for older individuals.

On a daily basis□people aged □□ and older took significantly fewer vehicle trips per driver than the same age group in 2009□2001□and 199□. This estimate includes all people who drive□ whether they drove on the travel day or not.

The original estimate of miles driven by drivers aged □□ and older in 201□ is statistically the same as in 2009□2001□and 199□—meaning that there has been virtually no change in the estimates. The adjusted estimate for 201□ is significantly higher than the 2009 estimate.

Likewise□the original estimate for the average vehicle- and person-trip length are statistically the same as in 2009□while the adjusted estimate is higher.

However□the original and adjusted estimates for the daily PMT are significantly higher in 201□ than in 2009□but statistically the same as the estimate of PMT for people □□ and older in 2001. In addition□the reported number of person trips per person □including those who travel and those who do not□remains exactly the same as the 2009 estimate.

Tables 32a□32b□and 32c display additional characteristics for older persons.

T□□□e □1□ Daily Travel Statistics of People □□ and Older

D□i□□ Tr□□e□St□tisti□s □□□ □nd □ □der□	**1□□□**	**1□□□**	**1□□□**	**2□□1**	**2□□□**	**2□□□ M□□**	**2□1□**	**2□1□ M□□**
Vehicle Trips per Driver	1.□□	2.2□	2.9□	2.8□	2.□□	0.0□	2.□□	0.0□
Percent Work Trips	10.2□	□.8□	8.□□	□.2□	10.□□	0.9□	8.□□	0.□9
Percent Non-Work Trips	89.8□	9□.2□	91.□□	93.8□	89.□□	0.9□	91.□□	0.□9
VMT per Driver	9.80	1□.83	19.□□	21.13	19.□9	0.□□	20.21	1.21
201□ Adjusted VMT per Driver	-	-	-	-	-	-	22.□□	1.3□
Average Vehicle Trip Length	□.92	□.□1	□.□9	□.□1	□.□□	0.29	□.91	0.□1
201□ Adjusted Vehicle Trip Length	-	-	-	-	-	-	8.80	0.□□
Average Time Spent Driving □in minutes□	-	30.83	□2.89	□9.11	□□.3□	1.2□	□8.29	1.□8
Person Trips per Person	1.8	2.□	3.□	3.□	3.2	0.1	3.2	0.0
PMT per Person	12.2	19.9	2□.2	28.0	2□.0	1.2	31.□	2.□
201□ PMT per Person adj.	-	-	-	-	-	-	3□.3	2.□
Average Person Trip Length	□.□	8.1	□.□	8.□	8.0	0.□	9.9	0.□
201□ Adjusted Person Trip Length	-	-	-	-	-	-	10.3	0.8

Note□

- Totals in all tables can include cases that were not included in any table subcategory.
- 1990 NPTS data were adjusted to make them more comparable with later surveys.
- In 199□□VMT and vehicle trips with "To or From Work" as a trip purpose are believed to be overstated.
- 2009 NHTS sample did not include households without landlines telephones □CPO households□.
- 201□ NHTS sample was address-based and included more urban and CPO. This and other methods changes in the data series are outlined in Appendix B.
- Average time spent driving includes all drivers□even those who did not drive a private vehicle on the day in which the household was interviewed.
- Average trip length is calculated using only those records with trip mileage information present.
- "□ Work Trips" also includes work-related business.

T□□□e □2□□Selected Data for Older Persons

S□r□e□ □e□r□	□□□r□□teristi□	□□□				
		□□□□□e □r□□□s □□ □nd □□der	□□□□□	□□□□□	□□□□□	□□ □nd □□der
2009	Percent Drivers	8□.9□	93.□□	91.□□	83.0□	□1.□□
	2009 MOE	0.□2	0.□9	0.89	1.32	2.1□
201□	Percent Drivers	8□.3□	91.2□	89.□□	8□.8□	□3.□□
	201□ MOE	0.□0	0.38	0.□1	1.□2	2.23
2009	Vehicle Miles□Driver	2□.83	31.□1	2□.□3	18.□□	12.0□
	2009 MOE	0.□□	1.29	1.18	1.1□	1.03
201□	Vehicle Miles□Driver Orig.	2□.□3	28.28	2□.22	20.08	12.9□
	201□ MOE for Orig VMT□Driver	0.□9	1.□□	1.09	1.3□	1.83
201□	Vehicle Miles□Driver Adj.	2□.01	31.1□	2□.81	22.33	1□.□1
	201□ MOE for Adj. VMT□Driver	0.88	1.□3	1.21	1.□0	2.0□
2009	Percent with □ero Vehicles Available	□.□□	□.9□	□.8□	10.3□	1□.□□
	2009 MOE	0.□0	0.□□	0.92	1.28	1.8□
201□	Percent with □ero Vehicles Available	□.□□	□.9□	□.□□	□.1□	12.□□
	201□ MOE	0.□0	0.32	0.□□	0.93	1.30
2009	Percent Who Did Not Travel	1□.3□	11.2□	1□.9□	2□.3□	38.0□
	2009 MOE	0.□0	0.□1	0.9□	1.□8	2.91
201□	Percent Who Did Not Travel	19.□□	1□.□□	18.□□	2□.8□	3□.3□
	201□ MOE	0.□9	1.09	0.□1	0.89	2.□0
2009	Percent with Disability	1□.□□	10.9□	1□.8□	22.□□	□1.3□
	2009 MOE	0.□3	0.91	0.8□	1.30	2.11
201□	Percent with Disability	13.9□	8.0□	11.2□	1□.1□	□8.9□
	201□ MOE	0.□0	0.□1	0.82	1.0□	1.□3

T□□□e □2□□Selected Data for Older Men

S□r□e□ □e□r	□□□r□□teristi□	Men				
		□□Men □□ □nd □□der	□□□□□	□□□□□	□□□□□	□□ □nd □□der
2009	Percent Drivers	93.2□	*95.7%*	*95.1%*	90.8□	□□.□□
	2009 MOE	0.□0	*0.67*	*0.94*	1.□2	2.□□
201□	Percent Drivers	91.2□	92.□□	*92.4%*	91.□□	□□.□□
	201□ MOE	0.□2	0.□8	*0.97*	1.2□	1.□□
2009	Vehicle Miles□Driver	33.□□	3□.□3	3□.□2	2□.□1	1□.98
	2009 MOE	1.1□	1.□□	2.2□	2.18	2.20
201□	Vehicle Miles□Driver Orig.	30.0□	33.8□	30.1□	2□.□2	1□.□2
	201□ MOE for Orig VMT□Driver	1.2□	2.03	2.21	2.0□	2.□□
201□	Vehicle Miles□Driver Adj.	33.22	3□.2□	33.3□	28.□1	18.28
	201□ MOE for Adj. VMT□Driver	1.38	2.2□	2.□□	2.28	2.9□
2009	Percent with □ero Vehicles Available	□.2□	□.□□	□.2□	□.□□	9.0□
	2009 MOE	0.□□	0.□□	1.09	1.2□	2.8□
201□	Percent with □ero Vehicles Available	□.1□	□.□□	□.□□	□.□□	□.□□
	201□ MOE	0.□8	0.8□	1.2□	1.0□	1.□□
2009	Percent Who Did Not Travel	1□.3□	10.8□	12.8□	18.3□	31.2□
	2009 MOE	0.83	1.11	1.13	1.8□	3.90
201□	Percent Who Did Not Travel	1□.9□	13.2□	1□.9□	21.□□	31.□□
	201□ MOE	0.82	1.31	1.02	1.38	3.□8
2009	Percent with Disability	1□.□□	9.9□	13.□□	18.□□	3□.2□
	2009 MOE	0.□1	1.19	1.2□	1.□0	2.9□
201□	Percent with Disability	11.□□	□.1□	9.□□	12.□□	□□.9□
	201□ MOE	0.□□	1.02	0.8□	1.□8	3.□□

T□□□e □2□□Selected Data for Older Women

S□r□e□ □e□r	□□□r□□teristi□	□ □□ en				
		□□□□ □□ en □□ □nd □ □der	□□□□□	□□□□□	□□□□□	□□ □nd □□der
2009	Percent Drivers	83.3□	*91.8%*	*88.2%*	□□.1□	□2.□□
	2009 MOE	0.8□	*1.19*	*1.52*	1.9□	2.□3
201□	Percent Drivers	83.8□	*90.0%*	*87.0%*	81.0□	□□.3□
	201□ MOE	0.93	*0.78*	*1.18*	2.30	3.82
2009	Vehicle Miles□Driver	20.33	2□.29	20.92	11.8□	□.□□
	2009 MOE	0.8□	1.82	1.18	0.□9	0.81
201□	Vehicle Miles□Driver Orig.	19.0□	22.□9	18.□2	1□.93	9.□□
	201□ MOE for Orig VMT□Driver	0.9□	1.□9	1.2□	2.23	2.3□
201□	Vehicle Miles□Driver Adj.	21.0□	2□.12	20.□2	1□.□1	10.□□
	201□ MOE for Adj. VMT□Driver	1.38	1.□□	1.39	2.□9	2.□3
2009	Percent with □ero Vehicles Available	9.9□	□.2□	8.3□	1□.0□	22.□□
	2009 MOE	0.□1	0.9□	1.18	1.90	2.23
201□	Percent with □ero Vehicles Available	9.1□	□.3□	8.9□	9.1□	1□.□□
	201□ MOE	0.82	0.□3	1.2□	1.19	2.3□
2009	Percent Who Did Not Travel	20.0□	11.□□	1□.□□	28.9□	□2.1□
	2009 MOE	0.8□	0.83	1.□0	2.1□	3.□2
201□	Percent Who Did Not Travel	22.1□	1□.9□	20.□□	2□.3□	□1.1□
	201□ MOE	0.□9	1.2□	0.80	1.33	3.01
2009	Percent with Disability	20.2□	11.8□	1□.9□	2□.□□	□□.□□
	2009 MOE	0.□2	1.2□	1.21	2.01	2.□□
201□	Percent with Disability	1□.9□	9.0□	12.□□	1□.0□	□1.□□
	201□ MOE	0.□2	0.89	1.□1	1.□□	1.9□

Note□

- Totals in all tables can include cases that were not included in any table subcategory□for instance people who did not report their age are included in the total persons□but not in any age category.
- 1990 NPTS data were adjusted to make them more comparable with later surveys.
- 2001 NHTS sample included children 0 to □ in the survey. The data shown here exclude them to be comparable with other survey years.
- 2009 NHTS sample did not include households without landlines telephones □CPO households□.
- 201□ NHTS sample was address-based and included more urban and CPO households. This and other methods changes in the data series are outlined in Appendix B.
- Percent with Disability is based on respondents who answered that they had a temporary or permanent condition that makes it difficult for them to travel outside of the home.

Overall, younger drivers report driving fewer miles per capita (including drivers who drove on the travel day and those who did not) in 2017 compared to the trend data. However, the estimates for both the original and adjusted VMT in 2017 are statistically the same as the 2009 estimates across the board (within the margin of error) (Table 33).

In urbanized areas, where the majority of the U.S. population lives, the declines in VMT per day are significant for 1[illegible]-2[illegible] year olds compared to 2001 but not 2009.

As the data series shows, VMT per driver in these age groups has not significantly declined between 2017 and 2009, but the estimates are statistically lower than 2001.

T[illegible]e [illegible] Vehicle Miles of Travel (VMT) Trends for Younger People by Urban or Rural Household Location

S[illegible]r[illegible]e[illegible] [illegible]e[illegible]r	[illegible]e[illegible]e in [illegible]re[illegible]s				
	D[illegible]i[illegible] [illegible]MT	1[illegible]2[illegible]	2[illegible]	[illegible]	[illegible]
1990	2[illegible].1	22.[illegible]	31.9	30.9	19.[illegible]
1995	28.[illegible]	22.[illegible]	33.[illegible]	3[illegible].[illegible]	2[illegible].0
2001	29.[illegible]	22.[illegible]	32.8	3[illegible].[illegible]	2[illegible].3
2009	2[illegible].8	1[illegible].[illegible]	2[illegible].8	32.[illegible]	2[illegible].2
2009 MOE	0.[illegible]	1.1	1.[illegible]	1.8	0.8
2017 Orig.	22.[illegible]	1[illegible].9	2[illegible].0	2[illegible].1	22.2
2017 Orig. MOE	1.0	1.2	[illegible].8	1.8	0.[illegible]
2017 Adj.	2[illegible].8	1[illegible].[illegible]	28.[illegible]	29.8	2[illegible].[illegible]
2017 Adj. MOE	1.1	1.3	[illegible].3	1.9	0.8

T□□e □□□ Vehicle Miles of Travel □VMT□ Trends for Younger People by Urban or Rural Household Location □continued□

S□r□e□ □e□r	□e□□□e in □r□□n □re□s				
	D□i□□ □MT	1□□2□	2□□□□	□□□□□	□□□
1990	22.□	20.2	28.□	2□.□	1□.0
199□	2□.0	19.□	30.1	30.3	21.□
2001	2□.3	20.9	30.□	33.3	2□.0
2009	23.1	1□.□	2□.□	30.1	22.□
2009 MOE	0.□	1.0	2.0	2.1	0.8
201□ Orig.	20.8	13.3	2□.0	2□.2	20.2
201□ Orig. MOE	1.2	1.□	□.3	1.□	0.8
201□ Adj.	23.0	1□.□	2□.□	2□.□	22.3
201□ Adj. MOE	1.□	1.□	□.9	1.□	0.8

S□r□e□ □e□r	□e□□□e in R□r□□□re□s				
	D□i□□ □MT	1□□2□	2□□□□	□□□□□	□□□
1990	29.□	2□.9	38.□	3□.9	23.0
199□	3□.□	28.2	□0.1	□1.□	30.8
2001	3□.□	28.2	□2.1	□□.1	3□.□
2009	3□.2	2□.8	3□.□	□0.□	3□.2
2009 MOE	1.2	3.1	2.□	3.2	1.□
201□ Orig.	30.3	22.□	32.8	3□.0	30.3
201□ Orig. MOE	0.8	3.1	3.0	□.□	1.□
201□ Adj.	33.□	2□.□	3□.1	□0.□	33.□
201□ Adj. MOE	0.8	3.□	3.3	□.8	1.8

Notes:

- Totals in all tables can include cases that were not included in any table subcategory, for instance people who did not report their age are included in the total persons, but not in any age category.
- 1990 NPTS data were adjusted to make them more comparable with later surveys.
- In 1995, VMT and vehicle trips with "To or From Work" as a trip purpose are believed to be overstated.
- 2001 NHTS sample included children 0 to 4 in the survey. The data shown here exclude them to be comparable with other survey years.
- 2009 NHTS sample did not include households without landlines telephones (CPO households).
- 2017 NHTS sample was address-based and included more urban and CPO households. This and other methods changes in the data series are outlined in Appendix B.
- “Rural” encompasses all territory not included within a Census Bureau classified urban area.

Table 3□ shows select travel characteristics by urban and rural areas.

T□□□e □□□ Travel Characteristics of People in Urban and Rural Areas□ 201□ NHTS

□□□r□□teristi□s	□i□in□ in □r□□n □re□s	M□□ □r□□n	□i□in□ in R□r□□ □re□s	M□□ R□r□□
Overall Percent □People 1□ and older□	82.2□	0.□2	1□.8□	0.□2
Percent Drivers	8□.9□	0.□□	91.9□	0.□1
Percent Workers	□2.0□	0.□2	□□.9□	0.3□
Percent with Household Members Younger than 21 Years Old	□2.□□	0.□8	□□.8□	0.3□
Percent with □ero Vehicles Available	□.□□	0.22	2.3□	0.11
Percent Who Did Not Travel on Travel Day	1□.3□	0.□□	20.0□	0.1□
□ers□n Tri□s □□ □□e □r□□□	**□i□in□ in □r□□n □re□s**	**M□□ □r□□n**	**□i□in□ in R□r□□ □re□s**	**M□□ R□r□□**
All 1□ and older	3.□	0.0□	3.2	0.08
1□-19 Years Old	2.8	0.1□	2.□	0.20
20-3□	3.□	0.09	3.2	0.1□
3□-□□	3.9	0.0□	3.□	0.10
□□-□□	3.□	0.0□	3.□	0.20
□□ and Older	3.2	0.0□	3.0	0.10

Note□

- Totals in all tables can include cases that were not included in any table subcategory□ for instance people who did not report their age are included in the total persons□ but not in any age category.
- 1990 NPTS data were adjusted to make them more comparable with later surveys.
- 2001 NHTS sample included children 0 to □ in the survey. The data shown here exclude them to be comparable with other survey years.
- 2009 NHTS sample did not include households without landlines telephones □CPO households□.
- 201□ NHTS sample was address-based and included more urban and CPO households. This and other methods changes in the data series are outlined in Appendix B.
- “Rural” encompasses all territory not included within a Census Bureau classified urban area.

One of the major new conveniences for U.S. households is online shopping and home delivery of many types of goods. The data series added a question about online purchases delivered to the home for the first time in the 2009 NHTS. The question also changed slightly in 2017.

In 2009, the survey asked: “In the last month, how many of your online purchases were delivered to your home?”, while in 2017 the question was: “In the past 30 days, how many times did you purchase something online and have it delivered?"

Assuming the answers are comparable, the estimate of the number of deliveries in an average month has doubled between the two survey time points (Table 3[illegible]).

The data indicates that online shopping is more prevalent in households with children, especially older teens and young adults (children aged 1[illegible]-21). However, households with small children and those without children—including those headed by older individuals—had larger increases in the number of online purchases delivered to the household.

Table [illegible]: Average Number of On-Line Purchases and Deliveries to U.S. Households in the Last Month

Household Type by Presence of Children	2009 NHTS		2017 NHTS	
	Purchases Delivered to the Household	2009 MOE	Purchases Delivered to the Household	2017 MOE
All Households	2.[illegible]	0.1	[illegible].9	0.1
Households Without Members [illegible]21	1.[illegible]	0.1	3.9	0.1
Households With Members Aged [illegible]-1[illegible]	3.[illegible]	0.2	[illegible].9	0.1
Households With Members Aged 1[illegible]-21	[illegible].2	0.[illegible]	[illegible].[illegible]	0.[illegible]

Note:
- Totals in all tables can include cases that were not included in any table subcategory, for instance people who did not report their age are included in the total persons, but not in any age category.
- 1990 NPTS data were adjusted to make them more comparable with later surveys.
- 2001 NHTS sample included children 0 to [illegible] in the survey. The data shown here exclude them to be comparable with other survey years.
- The 2009 NHTS was the first time data was collected on home deliveries from Internet shopping and on-line purchases.
- 2009 NHTS sample did not include households without landlines telephones (CPO households).
- 2017 NHTS sample was address-based and included more urban and CPO households. This and other methods changes in the data series are outlined in Appendix B.

Table 3□ displays select characteristics for users of transportation network companies.

T□□□e □□□ Characteristics of Users of Transportation Network Companies □Uber□Lyft□□201□ NHTS

□□□r□□teristi□□	□sed Rides□□re	M□□	□□□□t□ers	M□□
Overall Percent □1□ and older□	9.8□	0.□□	90.2□	0.□□
Percent Drivers	8□.□□	0.3□	8□.9□	0.3□
Percent Workers	81.3□	0.□0	□9.1□	0.3□
Percent Urban	9□.□□	0.□1	80.□□	0.8□
Percent with Household Members Younger than 21 Years Old	3□.□□	0.20	□3.□□	0.□□
Percent with □ero Vehicles Available	12.3□	0.08	□.0□	0.20
Percent Who Did Not Travel on Travel Day	10.2□	0.12	1□.□□	0.□2
□ers□n Tri□s □□ □□e □r□□□□				
All 1□ and older	□.0	0.20	3.□	0.0□
1□-19 years old	3.2	0.□8	2.8	0.11
20-3□	3.9	0.1□	3.3	0.08
3□-□□	□.1	0.1□	3.8	0.0□
□□-□□	□.1	0.2□	3.□	0.0□
□□ and Older	3.9	0.3□	3.2	0.0□

Note□

- Totals in all tables can include cases that were not included in any table subcategory□for instance people who did not report their age are included in the total persons□but not in any age category.
- 1990 NPTS data were adjusted to make them more comparable with later surveys.
- 2001 NHTS sample included children 0 to □ in the survey. The data shown here exclude them to be comparable with other survey years.
- 2009 NHTS sample did not include households without landlines telephones □CPO households□.
- 201□ NHTS sample was address-based and included more urban and CPO households. This and other methods changes in the data series are outlined in Appendix B.

APPENDIX A – CHANGES IN SURVEY METHODOLOGY AND THE ADJUSTMENT OF TRIP LENGTH ESTIMATES

Introduction

The 2017 National Household Travel Survey (NHTS) underwent a redesign of the survey methodology and sampling strategy. Although these improvements lowered respondent burden (web-based self-reports) and improved coverage (address-based sample selection), they make direct comparisons between the results of the 2017 NHTS and the 2009 and earlier surveys problematic. Any travel changes observed between the 2009 and 2017 surveys may reflect not only actual changes in travel during the period but also artifacts of differences in survey methodology and sampling, or some of both.

That is, any changes observed between the 2009 and 2017 travel data are presumably attributable to:

(1) Real changes in travel behavior;

(2) Shift from using interviewer-assisted interviewers to web-based self-reports (about [illegible]0% of respondents reported via web);

(3) Inclusion of households not sampled in 2009 ([illegible] of completed households[2] in 2017 are cell phone only (CPO)); and

(4) Other improvements/changes in the 2017 survey methods.

The first part of this document summarizes the potential impact of the changes in methods and sampling in the 2017 NHTS that will be the subject of on-going research.

One specific change in the 2017 NHTS is an immediate and calculable impact on the survey estimates for trip distances. In the 2017 NHTS, researchers calculated trip distance via the shortest-path on the network from the geocoded origin of the trip to the geocoded destination. Previous surveys depended on the respondent to report the trip distance for each trip. The difference in trip distance reporting in 2017 NHTS impacts the estimation of average trip length by purpose and person miles of travel (PMT)/vehicle miles of travel (VMT) estimates for persons and households. The distance calculation estimates are in the second part of this document.

This document has two parts:

Part One presents a summary of a few of the important changes in methodology and protocols between the 2017 NHTS and earlier surveys (more detail is found in the User's Guide here: https://nhts.ornl.gov/assets/2017UsersGuide.pdf).

Part Two describes an effort researchers made to quantify the impact of the change in trip distance reporting and to calculate simple adjustment factors to bring the 2017 more in line with earlier estimates and outside sources (Highway Performance Monitoring System (HPMS) VMT).

[2] In 2009, a completed household was defined as having [illegible]0 percent of the adults complete the survey. In 2017, a completed household required 100 percent of household members [illegible] and older to have a completed survey.

The resulting “adjusted” estimates are displayed along with the original distance estimates in the tables in this report that include trip length□VMT□or PMT trends.

Users of the data series should spend the time to understand how the changes in methodology and sampling in the 201□ NHTS might impact the estimates in their analyses. Researchers should include the necessary cautions to readers of their reports and findings.

□□rt 1□□ □er□ie□ □□l□ □□rt□nt □□□n□es in S□r□e□ Met□□d□□□□

For major population estimates□the change in methodology and sampling had little effect□as shown in Table A-1 □a reprint of Table □in Section 2□. The notable exception is the difference in the estimate of total household-based VMT from the NHTS 201□ and other sources □HPMS□□ which is discussed in Part Two.

Table A-1 Comparison of NHTS 201□ to Other Sources □Thousands□

□□ri□□e	2□1□ □□TS	□t□er S□□r□es	□er□ent Di□eren□e□□t□er S□□r□es□□□TS
Households[3]	118□208	118□208	0□
Population□	321□□19	321□□19	0□
Drivers□	223□2□□	218□08□	-2□
Workers□	1□□□988	1□1□1□□	□□
Vehicles□	222□□□9	231□□90	□□
VMT□	2□10□882	2□□38□83	2□□

The population estimates match because researchers controlled them at the census division level during the weighting process. The weighting followed a similar protocol to the 2009 NHTS weighting process. This included the standard□best-practice methodology that is appropriate for any household survey□regardless of survey design or mode. The steps in weighting the survey data include□

- Computing base weights as the inverse of the selection probability from each sampled unit □in the case of 201□ NHTS this was the household address□□
- Adjusting the base weights for eligibility and nonresponse□and

[3] Households - Census □uickFacts Table US Households 2011-201□ https□□www.census.gov□□uickfacts□fact□table□US□HSD□1021□□viewtop
□ Population - Population in Occupied Housing Units□estimate 201□ https□□factfinder.census.gov□faces□nav□jsf□pages□index.xhtml
□Drivers - 201□ estimate from Highway Statistics Table DL-22 https□□www.fhwa.dot.gov□policyinformation□statistics□201□□dl22.cfm
□ Workers - Source□Statista Civilian labor force in the United States from 1990 to 201□ □in millions□ https://factfinder.census.gov/faces/tableservices/jsf/pages/productview.xhtml?src=CF
□ Vehicles and VMT - Light Duty Vehicles □short WB□plus Motorcycles plus □based on the 2002 VIUS□ 8□.□□ of Light Duty Vehicles with wheelbases □WB□larger than 121 inches http□□www.fhwa.dot.gov□policyinformation□statistics□201□□vm1.cfm

- Trimming and post-stratifying (or raking) to known reliable external data sources such as the Census. The 2017 NHTS data were raked by month and day of week, along with demographic characteristics such as age, sex, race/ethnicity, and worker status. (The User's Guide provides more details on the weighting method: https://nhts.ornl.gov/assets/2017UsersGuide.pdf).

Researchers designed the 2017 NHTS to support state-, regional-, or city-level estimates only for areas that purchased additional samples (add-ons). The 2017 NHTS add-ons are:

- Arizona
- California
- Dallas-Ft. Worth, Texas
- Des Moines, Iowa
- Georgia
- Maryland
- New York
- North Carolina
- South Carolina
- Texas
- Tulsa, Oklahoma
- Waterloo, Iowa
- Wisconsin

The user is also cautioned not to attempt to estimate travel differences (e.g., between population groups, geographic areas, or between survey years) without calculating the confidence intervals to ensure statistically sound estimates.

Sample Design and Address-Based Sampling

The random digit dialing (RDD) landline sample used in 2009 had coverage issues related to the growth in CPO households. In 2009, an estimated 2[illegible] percent of households nationwide did not have a landline, and these households were not included in the sample frame. To increase coverage the 2017 NHTS sample used an address-based sample frame, which included about 98 percent of U.S. households. About [illegible] percent of completed households in the 2017 NHTS are CPO (see definition of a completed household below).

There are important demographic differences between people in CPO households compared to landline households. For example, the CPO respondents in the 2017 sample were more likely racial/ethnic minorities and younger than respondents in landline households.

Mail-Out/Mail-Back Recruit

The 2009 and earlier surveys mailed preliminary information to the sampled households but depended on a telephone interviewer to recruit the households into the study. In 2017, households at the sampled address received a recruitment package that they completed and returned by mail in order to be included in the survey.

Definition of a Completed Household

In 2017, 100 percent of household members aged [illegible] and older had to provide information relating to their travel on the assigned travel day in order for the household to be included in the survey. In previous (199[illegible]-2009) surveys, if [illegible]0 percent of adults 18 and older in the household provided information about their travel, the household was included in the survey. Therefore, in 2017, some larger households have more burden to complete the survey compared to smaller households. It should be noted that the earliest NHTS surveys (1990 and earlier) accepted proxy reports from one household adult for all other household members.

Web-Based Retrieval Questionnaire

In 2017, the majority (70%) of respondents participated via the web-based questionnaire. Previous NHTS surveys were administered by computer-assisted telephone interviewing (CATI) only and used a trained interviewer to lead respondents through the survey. Interviewers were therefore available to answer respondent questions and probe responses where needed. In the 2017 survey, only 30 percent of respondents completed by CATI (these respondents either called in or were contacted via telephone).

The mixed-mode nature of the 2017 NHTS resulted in different population groups utilizing different methods to complete the survey. The respondents who completed with an interviewer (CATI) were older, poorer, and on average less educated. A greater proportion of CATI respondents came from single-person households, households with no workers, rural households, and households with no vehicle or one vehicle.

In contrast, people who reported via the web-based retrieval were younger, had higher incomes, and were more educated. Web-based respondents were more likely from larger households, more likely urban, with one or more workers, and had higher vehicle ownership. People aged [illegible] and older reporting via the web were almost twice as likely to be a worker and more likely to work at home compared to the same aged respondents who completed by CATI.

The percentage of people reporting no travel also varied between the respondents completing via CATI or web. The data show that many more children under 1[illegible] (who all have their travel reported by proxy from a household adult) have no travel reports in the web-based format. At the other end of the age spectrum—people [illegible] and older—many fewer older respondents reported no travel on the web-based format. The differences in the proportion of people reporting no travel impacts the average trip rates.

Changes in the Questionnaire

The differences between the 2017 redesigned survey instrument and the 2009 instrument are in Table A-2. One difference was the use of a place-based reporting compared to trip-based. For example, in 2009 respondents were given the definition of a trip: “A trip is whenever you travel from one address to another.” In 2017, respondents were given the definition of a place: “A place is any location you go to, no matter how long you are there.”

Table A-2 Differences between 2009 and 201□ Travel Diary□Travel Log

2□□□ Di□r□
Where did you go□
What was the Location□
What time did you start and end each trip□
How did you travel□
How far was it□ □blocks or miles□
2□1□ Tr□□e□□□□
Where did you go next□
What time did you arrive at this place□
How did you get to this place□
How many people went with you to this place□
What time did you leave this place□
What did you do at this place□

Researchers changed the definition of a “trip” to allow reports of travel that began and ended at home □loop trips□. This particularly influences walk and bike trends. In the 201□ NHTS□trips that began or ended at home were coded as a single trip. In 2009 and earlier surveys trips that began and ended at home were split into an outbound and inbound segment based on the farthest point. About 2 percent of trips were home-to-home loops. Most of these were walk and bicycle trips.

Researchers asked additional walk and bike □uestions in the 201□ NHTS.

2009□
Number of walk and bike trips.
201□□
Number of walk and bike trips.
Number of walk□bike trips for exercise.
What keeps you from walking□biking more often□ □□0 AND NOT PROXY□

The 201□ NHTS also had additional trip prompts.

2009□
Interviewer prompted respondent at the end of trip roster□
So far□I have recorded □N□trip□s□. Before we continue□did □you□SUBJECT□take any other walks□bike rides□or drives on □TRIPDATE□□ Please include any other trips where □you□SUBJECT□used public transit or started and ended in the same place.
201□□
The survey displayed a pop-up prompt after the places roster for respondents□
- Did you include all places □□YOU□went on the assigned travel day□including short stops such as the dry cleaners or ATM□
- Participants provided two options (I Need to Add a Place / I’m done).
- Must select an option to advance.

These changes in the □uestionnaire wording□and the change in trip definition□may have impacted travel estimates□especially for walk and bike trips.

□□rt 2□□ □□□□□ti□n □□Di□eren□es in Tri□ Dist□n□e Re□□rts

The 201□ NHTS collected trip distance based on the calculated shortest route between a valid geocoded origin and a valid address destination using an interface similar to Google maps. This marks a major change to the data series—previous surveys depended on the respondent to report the distance for each trip. The change in the calculation of trip distance impacts estimates of total PMT and VMT□as well as average person- and vehicle-trip lengths □including commute trip length□. Analysts should use extreme caution in developing trends with these variables.

□□r□□se □□t□e Tri□ Dist□n□e □ssess□ent

To assess how these two measures of trip distance vary□the 2009 NHTS origin-destination data from the following add-on areas were geocoded and used to compute shortest distance paths using the same Google API used to compute trip distance in the 201□ NHTS□

- California
- Georgia
- New York State
- North Carolina
- South Carolina
- Texas
- Wisconsin

More than half a million □□□1□009□trips were assessed overall□including 3□2□□□□ vehicle □driver□ trips □□□□ □. Only vehicle trips were included in the analysis□because the 201□ estimate of VMT was lower than the HPMS estimate□and lower nominally compared to the 2001 and 2009 estimates. Researchers examined vehicle trips to understand how much the self-reported estimate differed from the calculated estimate by purpose. Interestingly□self-reported distances for work trips were closer to calculated □shortest-path□distances than self-reported distances for non-work purposes. Therefore□researchers analy□ed work and non-work vehicle trips separately.

The distribution of the difference between self-reported and calculated vehicle trip distances showed some extreme values—self-reported distances that were more than twice as long or twice as short compared to the calculated distance. Extreme values can have a big impact on the mean estimates. Researchers examined these outliers further by the trip characteristics. The reported trip distance for these outliers skewed toward very short trips□over half were trips with reported distances of less than one mile.

The vehicle trips that had a difference between self-reported and calculated distance of □□- 100 percent as outliers were removed. With these outliers removed□the calculated distance in the 2009 dataset was shorter for both work and non-work trips □the raw data showed the opposite effect□.

Next□researchers applied the mean difference in vehicle trip length estimates between self-reported and calculated trip distance in 2009 to the 201□ data □the percentage difference applied to work and non-work trips separately□. The adjustment raised the 201□ overall VMT estimate by 10.3 percent. This brings the 201□ VMT adjusted estimate above the estimate for 2009—showing growth in VMT between the two survey years.

They then compared the mean vehicle trip length—adjusted and original—to the estimates from previous surveys. The increases in average trip length were significant for most purposes □trips for shopping were nominally but not significantly longer□. The overall difference was □ percent for commute trips and 11 percent for trips of other purposes.

The Summary of Travel Trends includes both the original and adjusted estimate□ along with the margin of error□ to let data users decide on the appropriate estimate for their particular use.

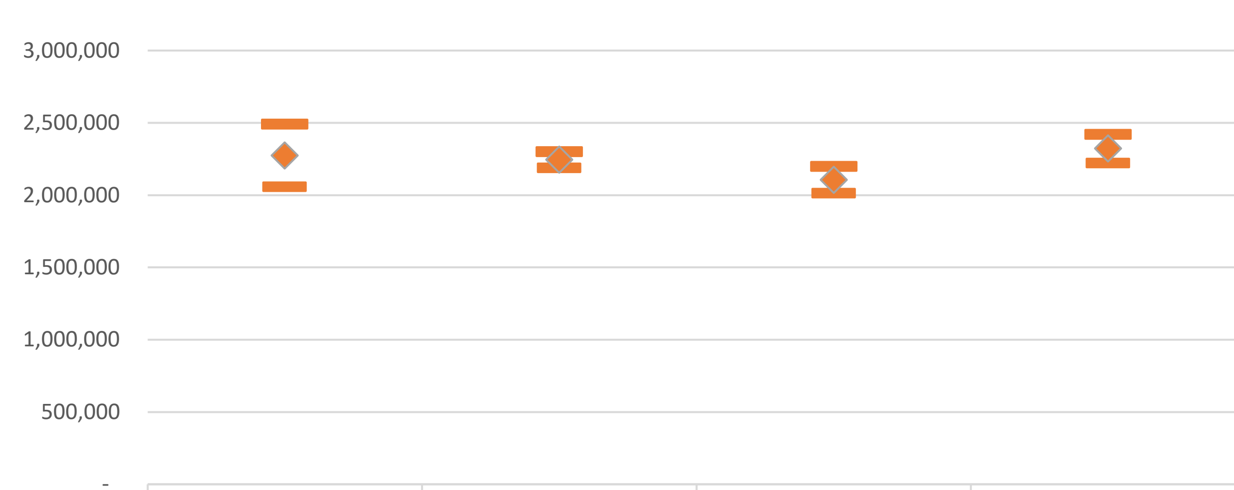
□□□□□r□□nd □nd □□nte□t

Though the “lower” estimate in 201□ for VMT is within the margin of error of the 2009 estimate and statistically the estimates for 2009 and 201□ VMT are not different □see Figure A-1□□ the total estimate of 2□10□882 million miles in 201□ was nominally □ percent lower than the estimate in 2009.

Importantly□ other sources of VMT estimates show that total VMT had grown in the period between 2009 and 201□. HPMS estimates in 201□ □the most recent year available□ were 3□09□3□3 million miles of vehicle travel. The 201□ estimate for passenger travel was only □8 percent of that total □compared to □□□ in 2009 and 81□ in 2001□.

The adjusted values for trip distance raises the nominal estimate of VMT above the nominal estimate for 2009 and within the margin of error of the 2001 estimate. Figure A-1 displays these estimates and the confidence limits at the 9□ percent level.

Figure A-1 Estimates of VMT for 2001, 2009, and 2017 NHTS (original and adjusted)

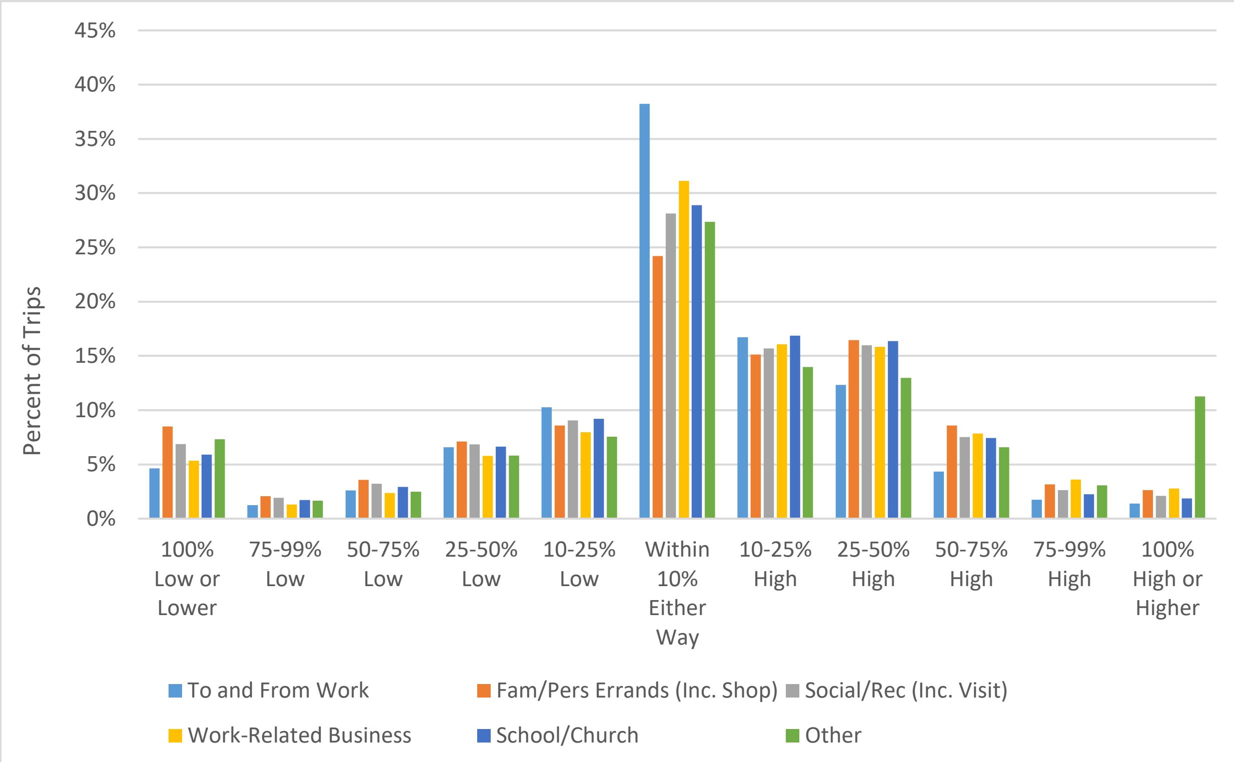


	2001 VMT	2009 VMT	2017 VMT Orig. Distance	2017 VMT Adj. Distance
High	2,491,535	2,301,276	2,197,419	2,419,900
Low	2,058,003	2,188,947	2,014,344	2,223,740
Estimate	2,274,769	2,245,111	2,105,882	2,321,820

Method and Approach

As shown in Figure A-2, the variation between reported and calculated distance was different for work and non-work trip purposes. Driver's reports for commute trip lengths were close to the shortest path calculated distance—a plurality of work trips had reported distance within +/- 10% of the calculated trip distance. On the other hand, self-reported distance for non-work trips were not as close to the calculated distance. However, social and recreational, errands and shopping, and other purposes all had similar distributions. Therefore, going forward the purposes were categorized as "work" and "non-work".

Figure A-2 Difference in Trip Length by Purpose

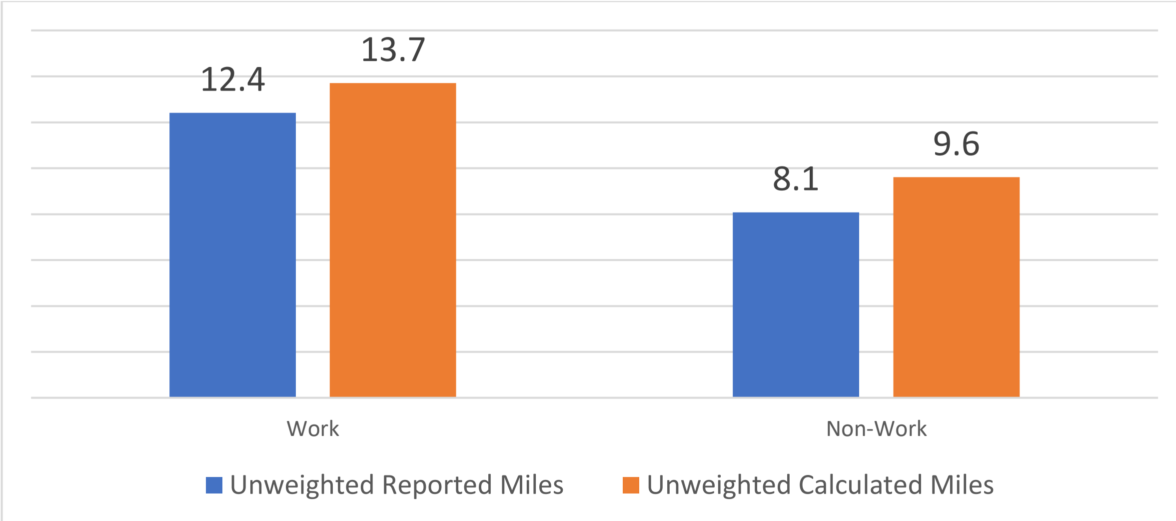


□□□□ inin□ t□e Distri□□ti□n □□t□e D□t□□□ □t□iers

Figure A-3 displays the mean unweighted trip distances from the 2009 self-reported and calculated distance estimates. The calculated distance is about 10 percent higher for work trips and about 20 percent higher for non-work □using □CALC_DIST-TRPMILES□TRPMILES□[8]. Remember□these are the distance estimates from the Google API run as the shortest path at the time the respondent entered a valid □geocoded□origin and destination for the trip.

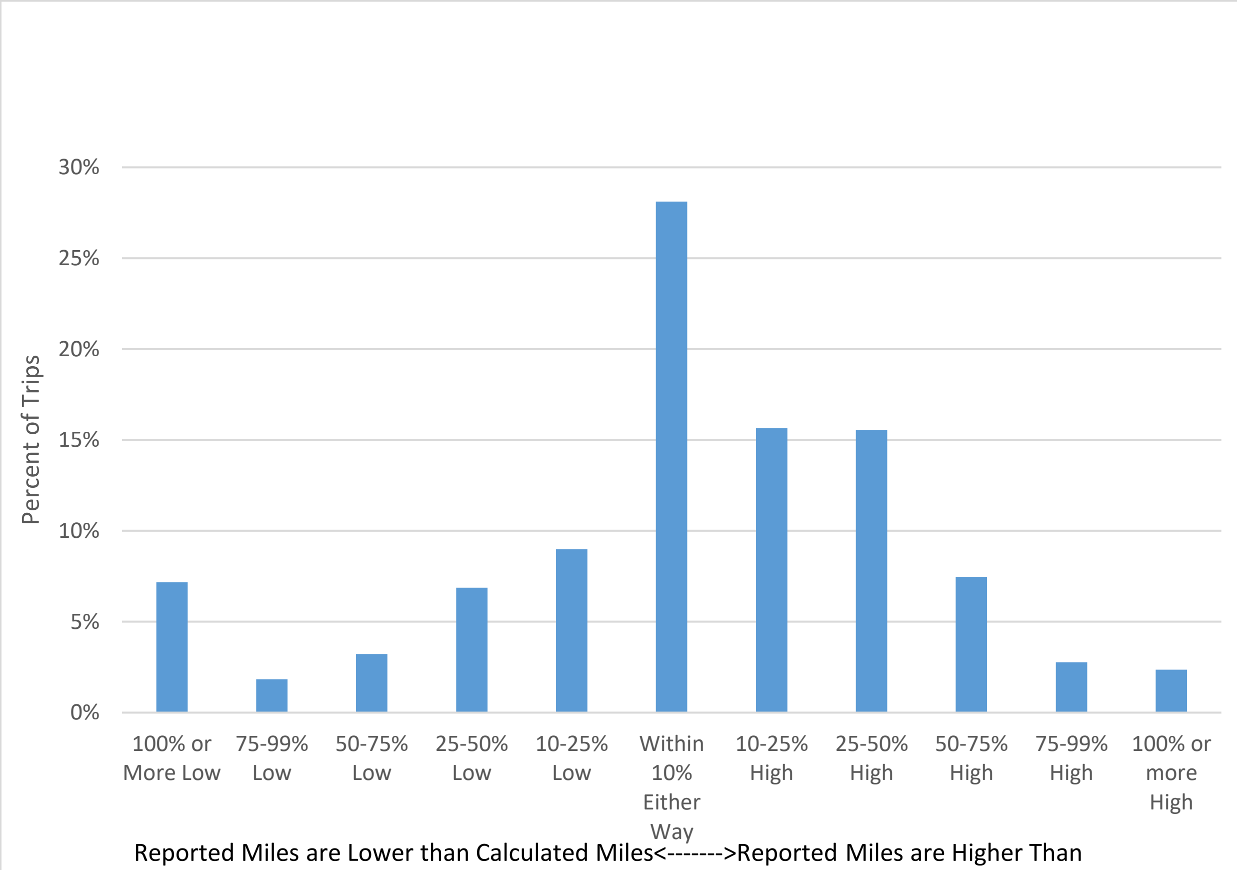
[8] The NHTS uses negative values to code legitimate skip and unreported □1□-8□-9□□and these must be removed to calculate correct means.

Figure A-3 Mean Distance for Work and Non-Work Trips by Two Methods (Uncapped)



The “average” or means in data such as these are very sensitive to the number of extreme values (outliers). The difference between reported and calculated miles skews to the right (shown in Figure A-□□)—meaning that in most cases reported miles were higher than calculated miles. Few of the values were on the extreme edges of the distribution (reported distances were more or less than 100% of the calculated distance).

Figure A- Distribution of the Percent Difference in Trip Length between Reported Miles and Calculated Miles



After several univariate analyses□researchers identified the trips with a difference between reported and calculated miles of more than 100 percent as potential outliers. Table A-3 shows the original and final number of records and the logic used for each step.

Table A-3 Number of Records Used In Analysis

□□te□□r□	n	□□□i□
Geocoded Records	□□9□009	
With Reported Miles	□32□2□3	TRPMILES□0
Driver Trips	3□9□30□	TRPMILES□0 and DRVR_FLG□01□
Within Range	318□919	PCT_DIFF_MILES □□ 100□ of Reported Miles
Removed as Outliers	30□38□	
Outliers as a Percent of Driver Trips	8.□□	

The outliers skewed to the negative range□as shown in Figure A-□. The bottom graphic in Figure A-□ shows the distribution of trip records considered outliers. The blue bar across the bottom represents a frequency of “one”□with occasional spikes ranging from two to six reported trips with the same extreme difference between self-reported and calculated trip distance.

Figure A-□ Distribution of Distance Outliers□2009 NHTS

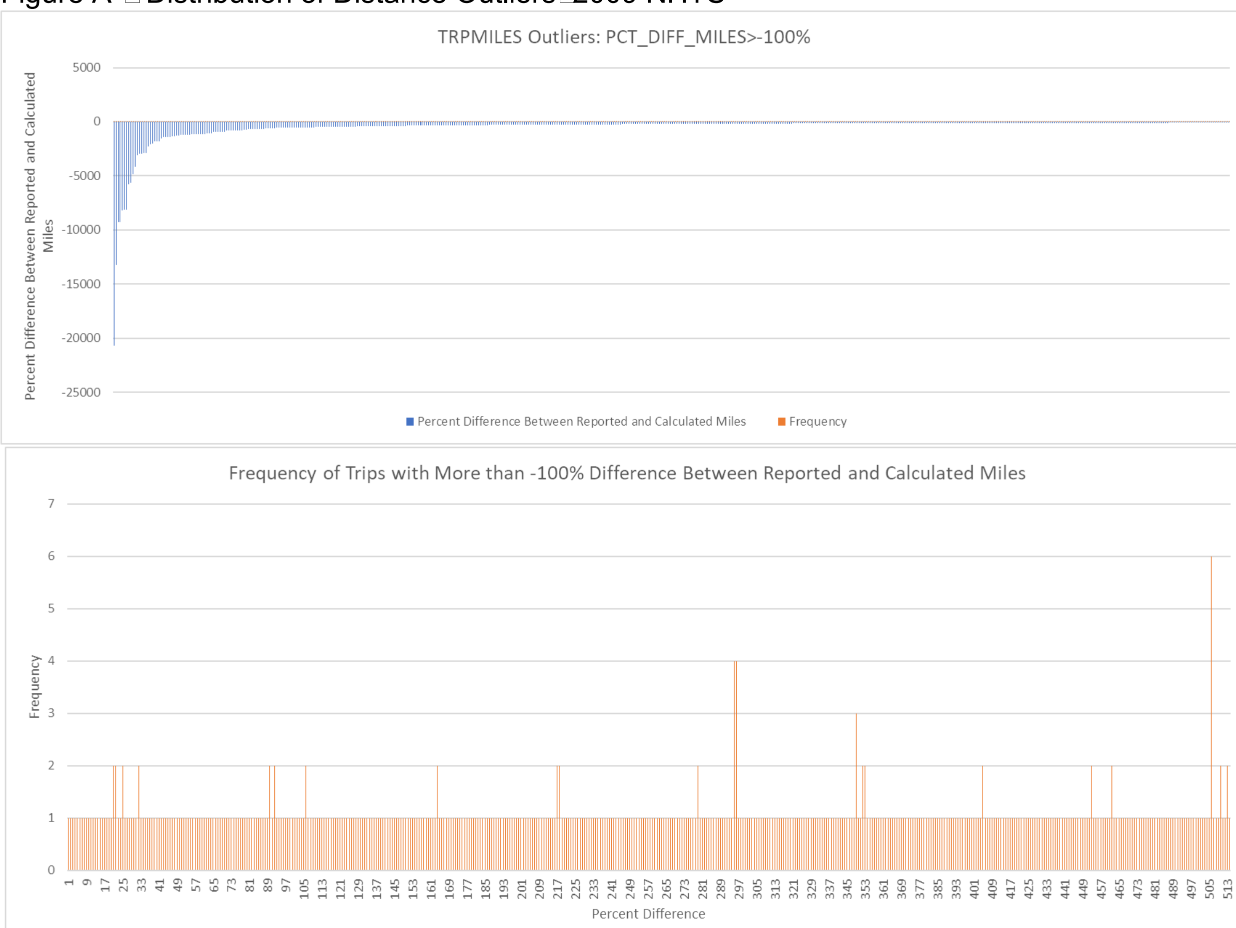
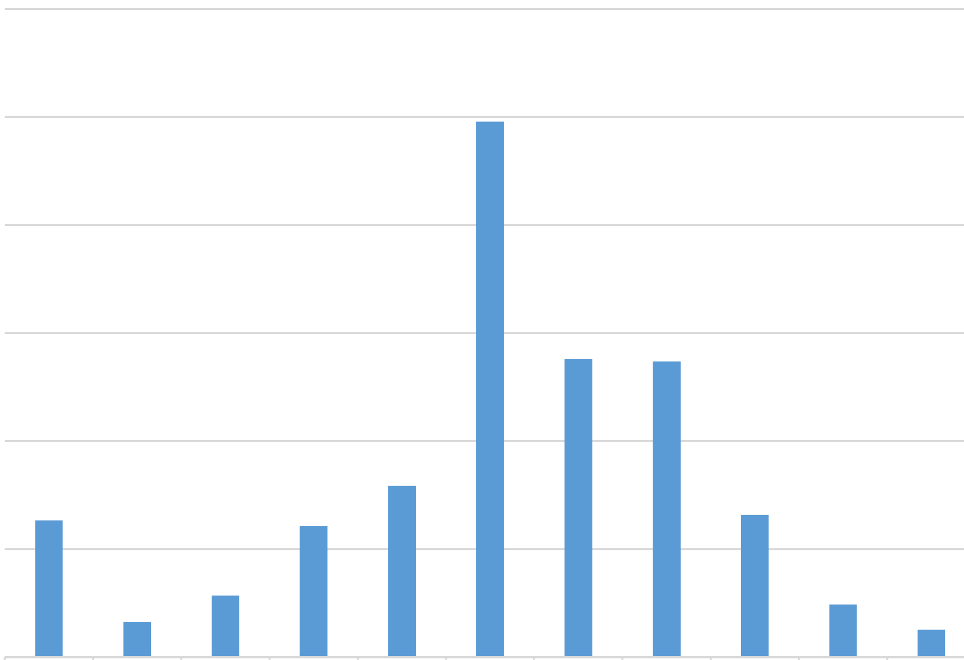


Figure A-□ shows the number of trip records in each bin. Note again that the outliers skew to the negative side□trips with self-reported distances that were less than half the calculated distance were 83 percent of all outliers □2□32□ of 30□38□□. Altogether□the 30□38□ total records with self-reported distances of more or less than 100 percent of the calculated distance represented 8.□ percent of driver trips in the analysis dataset.

Figure A-□ Distribution and Fre□uency of Trips by Percent Difference between Reported and Calculated Miles



	100% or More Low	75-99% Low	50-75% Low	25-50% Low	10-25% Low	Within 10% Either Way	10-25% High	25-50% High	50-75% High	75-99% High	100% or More High
Number of Trip Records	25,327	6,464	11,386	24,233	31,703	99,145	55,152	54,759	26,350	9,727	5,059

Researchers examined the outliers further to identify the types of trips that had large differences between reported and calculated distances.

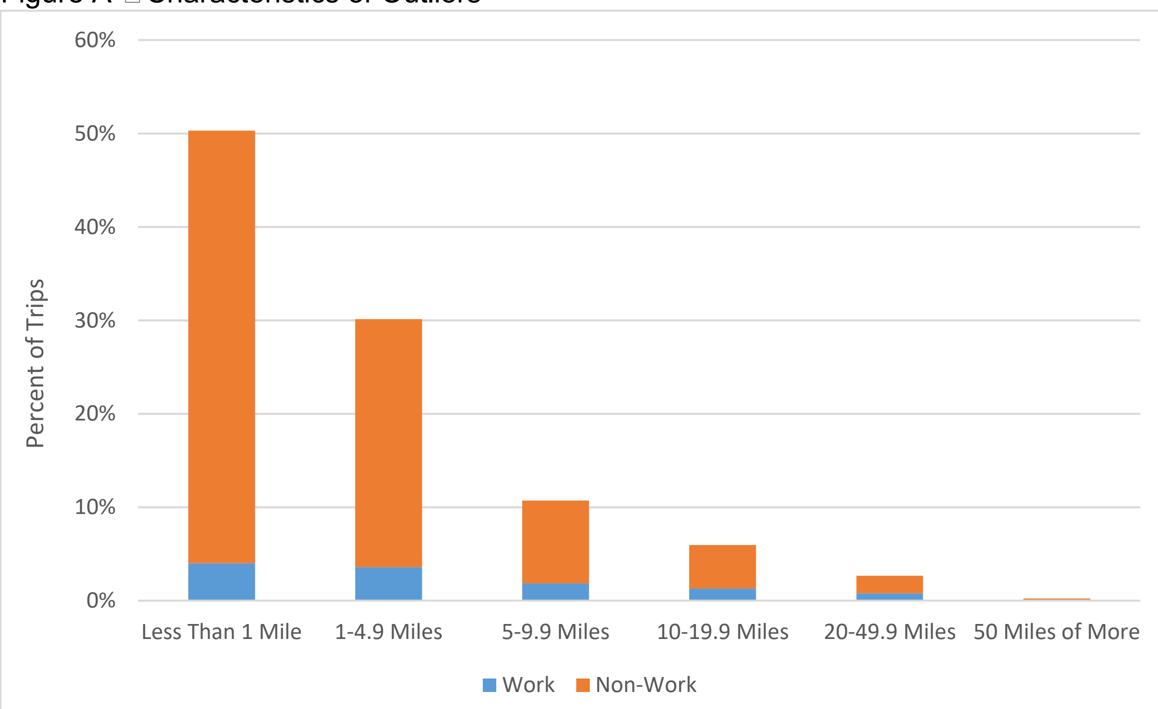
Table A-□ shows some characteristics between the trips considered outliers □greater than □□-100□ difference between reported and calculated trip distance□and all others. Households that were rural and people who did not start their day at home were more likely to have trips that were considered outliers.

Table A-□ Characteristics of Trips with Extreme Differences between Reported and Calculated Miles

□□□r□□teristi□s □□Tri□s □it□ □□tre□e Di□eren□e □et□een Re□□rted □nd □□□□□□ted Dist□n□e□ 2□□□ Se□e□ted □re□s □Dri□er Tri□s □n□□		
	Outliers	Non-Outliers
Reported by Proxy	12.□□	13.□□
Household is Rural	39.□□	28.□□
Purpose is Non-Work	88.8□	81.□□
Trip was a Weekend Trip	22.0□	2□.□□
Person did Not Start the Travel Day at Home	8.□□	2.8□

Of the outliers□fully half were under one mile in length □recall that only driver trips are included in this analysis□. Overall□almost nine out of ten □88.3□ □were for non-work purposes. Figure A-□ shows the distribution of the outliers by trip length and purpose.

Figure A-□ Characteristics of Outliers



□n□□sis □□Tri□ Dist□n□e

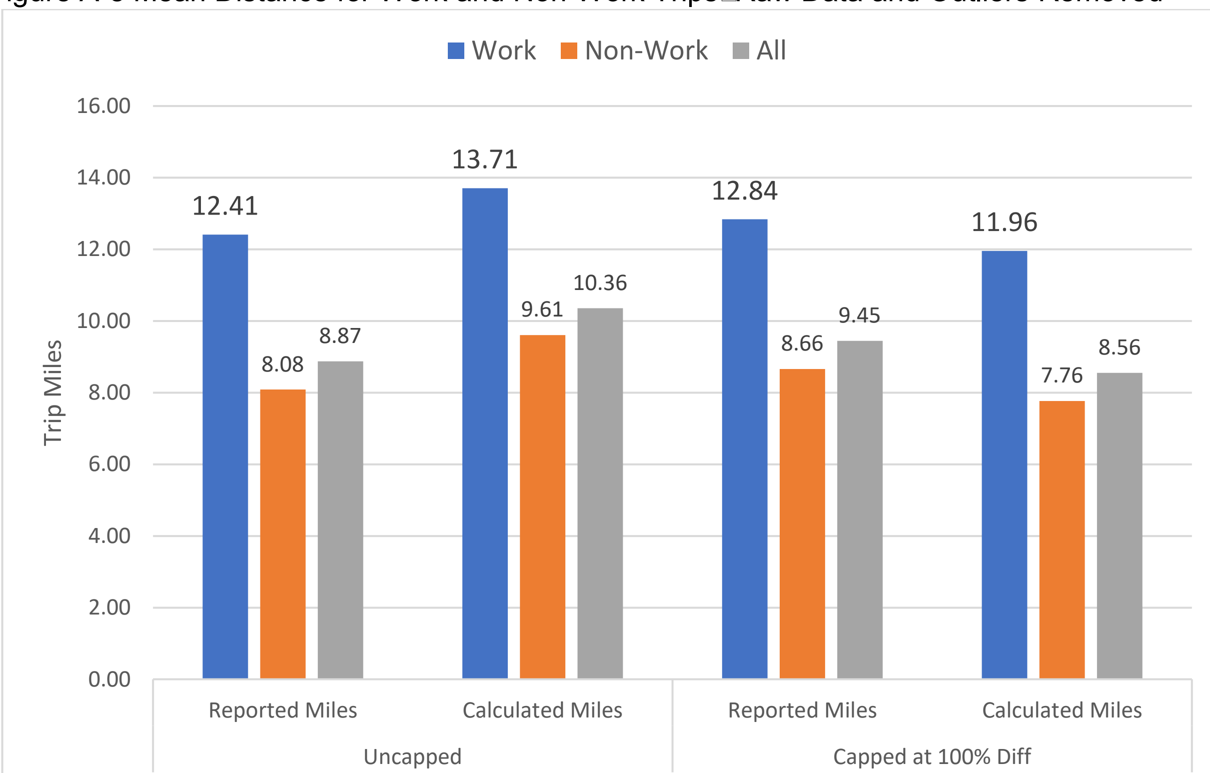
Figure A-8 shows the difference in the mean estimate of trip distance for the analysis areas in the 2009 NHTS for all reported vehicle trips □3□9□30□ records□□and for the same set of records with outliers removed □318□919 records□.

With the outliers removed, the relationship changed. With extreme values removed, the average trip distance using the shortest-path calculation is less than the average using reported miles. Table A-7 and Figure A-8 show the capped and uncapped values. Note that this calculation uses “calculated miles” as the base because it is common to both datasets.

Table A-7 Percent Difference Between Calculated and Reported Miles

Category	Category	Work	Non-Work	All
Uncapped	Reported Miles	12.41	8.08	8.87
	Calculated Miles	13.71	9.61	10.36
Capped at 100% Diff	Reported Miles	12.84	8.66	9.45
	Calculated Miles	11.96	7.76	8.56
	Difference	0.88	0.89	0.89
Percent Diff	(Diff./calculated miles)	[illegible].3[illegible]%	11.[illegible]1%	10.[illegible]1%

Figure A-8 Mean Distance for Work and Non-Work Trips, Raw Data and Outliers Removed

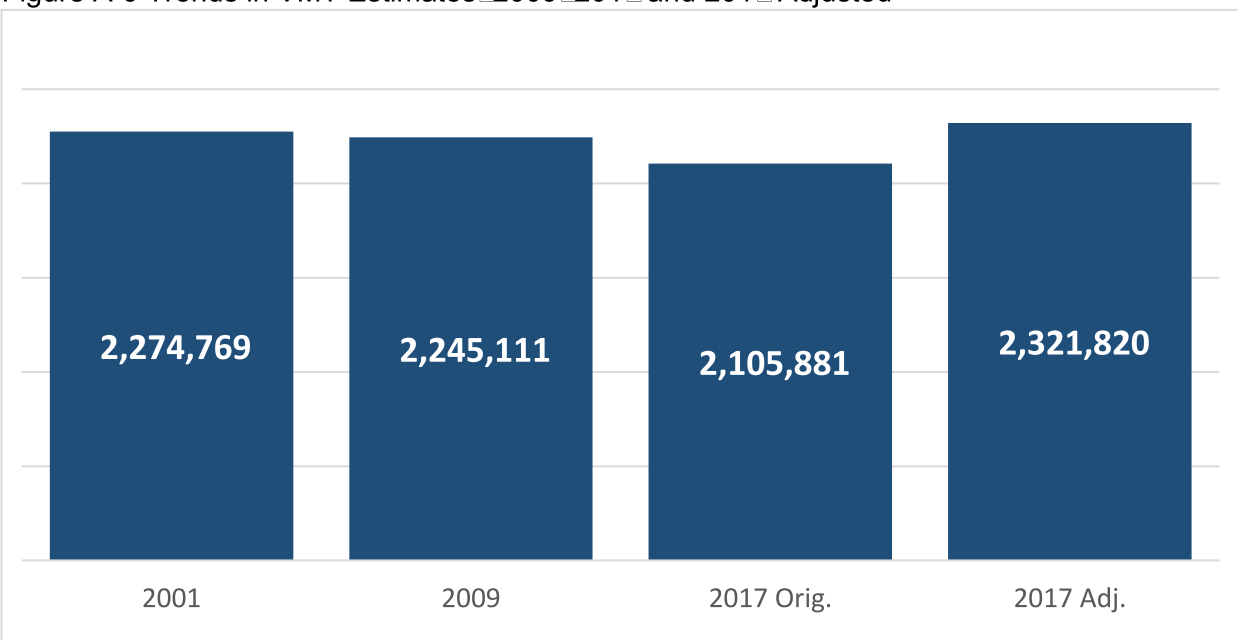


Testing the Effect on 2017 NHTS VMT Estimate

Researchers tested the effect of adjusting the disaggregate trip miles (at the trip level) by these factors on the estimates of VMT for 2017. That is, the calculated trip miles in the 2017 NHTS trip file (vehicle trips) was adjusted at the trip level by a factor of 1.0□3□ for work trips and 1.11□1 for non-work trips (based on the calculations in Table A-3). This adjustment to each vehicle trip distance was then weighted by the individual trip record weight (MILE_ADJ*WTTRDFIN) to obtain weighted total estimate of household-based VMT. In addition, they added a new mode of travel in 2017 NHTS (rental cars, including Car2Go and ZipCar)—to the estimate.

The adjusted estimate of trip distance for vehicle trips added 10.3 percent to the total estimate for household-based VMT in 2017. Figure A-9 shows the 2001, 2009, 2017 (original) and 2017 adjusted VMT estimates.

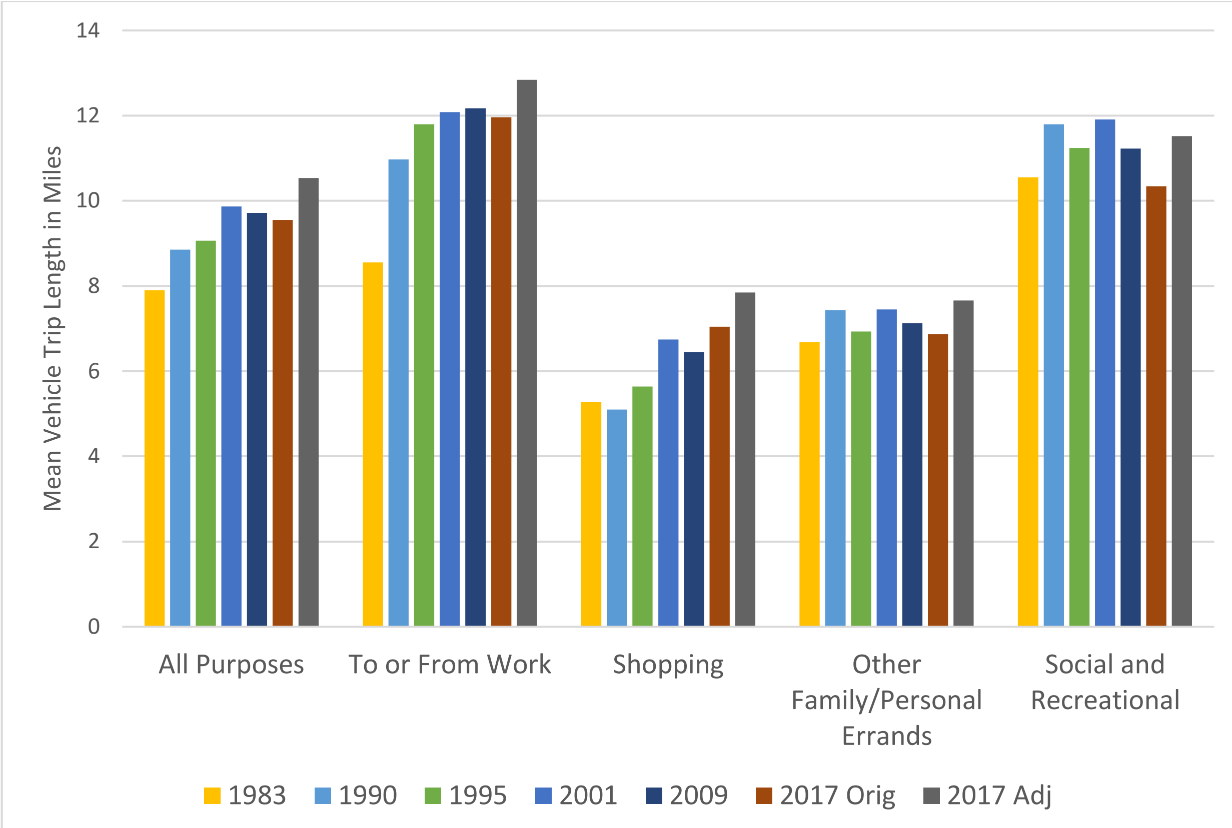
Figure A-9 Trends in VMT Estimates, 2009, 2017 and 2017 Adjusted



Trends in Trip Length Estimates by Purpose

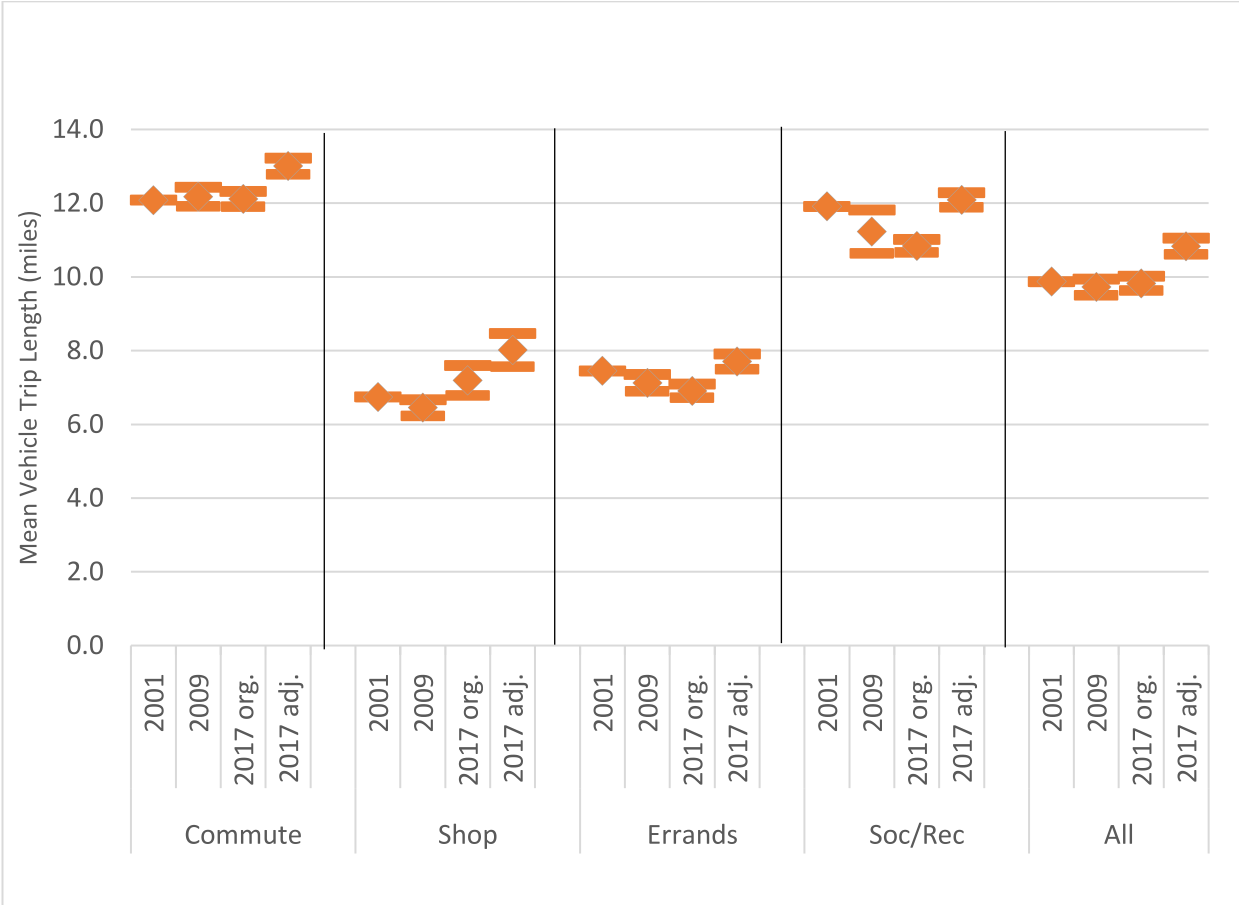
Researchers compared the adjusted vehicle trip length estimates to the original estimates in the 2017 NHTS and previous surveys for major trip purposes (see Figure A-10). For each major purpose category, the adjusted data are noticeably higher than the original estimates. (The data for this table is also shown in Table □ of the 2017 Summary of Travel Trends).

Figure A-10 Trends in Mean Vehicle Trip Length by Purpose



Researchers tested the mean trip lengths from the original distance measure and adjusted distance measure for significance. As shown in Figure A-11, the adjusted trip length estimates are significantly higher than previous estimates for commute trips, social/recreational trips, and overall. Shopping trips, while nominally longer (7.2 miles original to 8.0 miles adjusted), are not statistically different between 2009 and 2017.

Figure A-11
Mean Vehicle Trip Length by Purpose with Confidence Intervals, 2001, 2009, 2017 Original and 2017 Adjusted



Conclusion

The 2017 NHTS obtained estimates of trip distance using a Google API shortest-path route distance between a geocoded origin and a geocoded destination. This is a major difference compared to previous surveys which depended on the driver's estimate of trip distance for each reported trip. The impact of this change resulted in a low estimate of VMT in 2017, compared to previous estimates and other sources (HPMS).

To assess the impact on the estimate of vehicle trip distance obtained by these two different methods, researchers calculated trip distances for a sub-set of 2009 (add-on) data from the geocoded origins and destinations using the same Google API method as that used in 2017. The analysis showed that the different methods of obtaining trip distance between 2017 NHTS and the earlier surveys resulted in a nominal decrease the estimates of vehicle trip lengths and VMT for the 2017 NHTS.

The estimate of vehicle trip lengths from the two methods (self-reported and calculated) varied by trip purpose. Commuters who reported the trip distance to work (in the 2009 NHTS) were closer to the calculated shortest-path distance obtained by Google API (within [illegible]). However, for other trip purposes, the self-reported distances were over 11 percent different compared to calculated shortest-path distances. Researchers developed an adjustment factor based on the percentage difference between calculated and self-reported vehicle trip distance for work and non-work purposes. They then adjusted the 2017 NHTS vehicle trip lengths by this factor for work and non-work trips.

The adjusted estimates resulted in higher VMT estimates overall, and longer vehicle trip lengths for most purposes (shopping trips were nominally but not significantly longer after the adjustment). The 2017 NHTS Summary of Travel Trends report provides both the original and adjusted vehicle trip distance for the user.

The adjusted mileage estimates for vehicle trips will also affect other estimates, such as PMT, and comparisons of trip length by mode. Therefore, including both the adjusted and original estimates in the Summary of Travel Trends documentation will offer the most flexibility to the NHTS user community.

History of Adjusting NHTS Data

As a reference, when the methods changed between the 1990 NPTS (which used a recall of “yesterday”) and the 1995 NPTS (which used a two-stage survey with a travel diary), the earlier survey was given an “adjustment” (in that case applied to the weights) to bring the trip reporting in line with the 1995 NPTS.

The adjusted data were provided on the dataset and in the 1995 documentation along with the original estimate until 2001, when the Summary of Travel Trends dropped the original estimate for 1990 and only included the adjusted estimates. The documentation of the adjustment is found in the 1995 Summary of Travel Trends, Appendix 2 “Adjustment of the 1990 NPTS Data”: http://nhts.ornl.gov/1995/Doc/trends_report.pdf

APPENDIX B KEY CHANGES

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	1□□□	1□□□	1□□□	1□□□	1□□□	2□□1	2□□□	2□1□
Approximate Sample Si□e □Number of Households□	1□□000	18□000	□□□00	18□000 national and □□300 add-on	21□000 national and 21□000 add-on	2□□000 national and □0□000 add-ons	2□□000 national and 12□□000 add-on □Combined into single sample□	2□□000 national and 10□□000 add-on □Combined into a single sample□
	1□□□	1□□□	1□□□	1□□□	1□□□	2□□1	2□□□	2□1□
Sample Selection	Outgoing panels of Census □uarterly Housing Survey	Outgoing panels of Census Current Population Survey	Outgoing panels of Census Current Population Survey	Random Digit Dialing □RDD□ Telephone sample	RDD Telephone sample	RDD Telephone sample	RDD Telephone sample	Address-based sample
	1□□□	1□□□	1□□□	1□□□	1□□□	2□□1	2□□□	2□1□
Interview Method	In-home interview with some telephone follow-up	In-home interview with some telephone follow-up	In-home interview with some telephone follow-up	One stage□ computer-assisted telephone interviewing □CATI□ recruit and recall of travel day	Two stage□ CATI recruit-mail out diary-CATI collection	Two stage□ CATI recruit-mail out diary-CATI collection	Two stage□ CATI recruit-mail out diary-CATI collection	Two-stage□ Mail-out recruit plus web-based self-report or CATI retrieval
	1□□□	1□□□	1□□□	1□□□	1□□□	2□□1	2□□□	2□1□
Pre-Contact□Incentive	Pre-Interview Letter	Pre-Interview Letter	Pre-Interview Letter	Pre-Interview Letter	Advance letter and □2 per person with diary	Advance letter with □□ and □2 per person with diary	Advance letter with □□ and □2 per person with diary	Advance letter with □2 plus □□ per person plus □20 post-completion

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Diary "Memory Jogger"	None□ Respondent recalled "yesterday"	None□ Respondent recalled "yesterday"	None□ Respondent recalled "yesterday"	None□ Respondent recalled "yesterday"	Diary as a memory jogger	Diary as a memory jogger	Diary as a memory jogger	Diary as a memory jogger
	1□□□	1□□□	1□□□	1□□□	1□□□	2□□1	2□□□	2□1□
Trip Rostering to Reduce Item Nonresponse	None	None	None	None	Full day trip rostering before collecting trip detail	Full day trip rostering before collecting trip detail	Full day trip rostering before collecting trip detail	Full day trip rostering before collecting trip detail
	1□□□	1□□□	1□□□	1□□□	1□□□	2□□1	2□□□	2□1□
Eligible Persons	Household members aged □and older	Household members aged □and older	Household members aged □and older	Household members aged □and older	Household members aged □and older	All household members	Household members aged □and older	Household members aged □and older
	1□□□	1□□□	1□□□	1□□□	1□□□	2□□1	2□□□	2□1□
Usable Household Definition	At least one adult member of the household	At least one adult member of the household	At least one adult member of the household	At least one adult member of the household	At least half the adult members of the household	At least half the adult members of the household	At least half the adult members of the household	100□ of all household members aged □and older

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	1□□□	**1□□□**	**1□□□**	**1□□□**	**1□□□**	**2□□1**	**2□□□**	**2□1□**
Proxy Rules	An Adult household member reported all trips □excluding bike and walk trips□ made by household members between the ages of □ to 13 years	An Adult household member reported all trips □excluding bike and walk trips□ made by household members between the ages of □ to 13 years	An Adult household member reported all trips □excluding bike and walk trips□ made by household members between the ages of □ to 13 years	An Adult household member reported all trips made by household members between the ages of □ to 13 years. Adult proxy allowed	Proxy reports re□uired for 13 and under. Parental approval for 1□- to 1□- year olds. Adult proxy from diary allowed	Proxy reports re□uired for 13 and under. Parental approval for 1□- to 1□- year olds. Adult proxy from diary after 3 days	Proxy reports re□uired for 13 and under. Parental approval for 1□- to 1□- year olds. Adult proxy from diary after three days	Whether travel day report was via a proxy was self-reported in the web-based retrieval. Proxy flag is carried on the person record
	1□□□	**1□□□**	**1□□□**	**1□□□**	**1□□□**	**2□□1**	**2□□□**	**2□1□**
Travel Day Trip Definition	Travel within a defined area □such as a strip mall or shopping mall□ not counted	Travel within a defined area □such as a strip mall or shopping mall□ not counted	Travel within a defined area □such as a strip mall or shopping mall□ not counted	Travel within a defined area □such as a strip mall or shopping mall□ not counted	Any stop from one address to another□ including trips to change transportation mode	Any trip from one address to another□ mode changes not included □access and egress asked separately□	Any trip from one address to another□ mode changes not included □access and egress asked separately□	Any trip from one address to another□ including trips to change transportation mode

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	1□□□	1□□□	1□□□	1□□□	1□□□	2□□1	2□□□	2□1□
Reporting Prompts	None	None	Prompts to include walking and bike trips□to lunch□ stopping at a gas station□ etc.	Prompts for forgotten trips	Prompts for forgotten trips	Prompts to include walk□bike trips and trips that started and ended in the same place	Prompts to include walk□bike and trips that started and ended in the same place. Added prompts to include transit	Prompts to include incidental trips□stops plus walk□bike rides and trips that started and ended in the same place
	1□□□	1□□□	1□□□	1□□□	1□□□	2□□1	2□□□	2□1□
Walk and Bike Coding	Collected walk and bike trips by respondents aged 1□ and older	Collected walk and bike trips by respondents aged 1□ and older	Collected walk and bike trips by respondents aged 1□ and older	Collected walk and bike trips by all respondents	Collected walk and bike trips by all respondents	Collected walk and bike by all respondents. Split home-to-home trips to geocode trip location	Collected walk and bike by all respondents. Split home-to-home trips to geocode trip location	Collected walk and bike by all respondents□ allowed home-to-home trips □loop trips□

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	1□□□	1□□□	1□□□	1□□□	1□□□	2□□1	2□□□	2□1□
Trip Verification □verifying joint trips reported by other household members□	None	None	Manual checks across household member's travel	Interviewer instructed to check across household member's travel	CATI program checked across household members	CATI program checked across household members	CATI program checked across household members	CATI and web-based systems checked across household members. Also checked as part of the □C and corrected with household recontact as necessary
	1□□□	1□□□	1□□□	1□□□	1□□□	2□□1	2□□□	2□1□
Geocoding	None	None	None	None or limited manual coding	Limited manual geocoding	Extensive post-survey GIS-based geocoding	Online real time geocoding during interview□ followed by post processing GIS coding	Real-time geocoding of each trip destination from a map interface. Shortest network-path distance calculated by Google between every geocoded origin and destination

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Weighting	Raking to control totals	Raking to control totals	Nonresponse and noncoverage adjustments included in weight development	Nonresponse and noncoverage adjustments included in weight development	Raking to control totals□ within household nonresponse adjustment	Nonresponse adjustment□ several stages of weighting□ and trimming. Changes to the cells used for raking based on nonresponse follow-up survey	Nonresponse adjustment□ several stages of weighting□ and trimming. Changes to the cells used for raking based on cell phone only sample	Nonresponse adjustment□ several stages of weighting□ and trimming. Address-based sample weighted to geography. Raking variables consistent with 2009
	1□□□	**1□□□**	**1□□□**	**1□□□**	**1□□□**	**2□□1**	**2□□□**	**2□1□**
Travel Day Trip Purpose	There were 10 trip purposes plus “Other”□ respondent selected the “Main" purpose of trip to code return home segment	There were 21 trip purposes□ respondent selected the “Main" purpose of trip to code return home segment	There were 10 trip purposes plus “Other”, respondent selected the “Main" purpose of trip to code return home segment	There were 10 trip purposes plus “Other”, respondent selected the “Main" purpose of trip to code return home segment	There were 1□ trip purposes plus “Other”□ FHWA coded “Main" purpose for return home and included a separate tour file	There were 3□ trip purposes□ FHWA coded “Main" purpose for return home and included a separate tour file	There were 3□ trip purposes□ FHWA coded “Main" purpose for return home and included a separate tour file	There were 19 purpose codes. FHWA coded “Main" purpose for return home trips

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Vehicle Detail	Only included automobiles as household vehicles	Included all motor vehicles in household□ pickups□ vans□ motorcycles□ etc.	Included all motor vehicles in household□ pickups□ vans□ motorcycles□ etc.	Included all motor vehicles in household□ pickups□ vans□ motorcycles□ etc.	Coded SUVs separately□but not Hybrid or electric	Coded SUVs separately□ but not Hybrid or electric	Coded Hybrid□alt fuel for all vehicle classes. Coded Light Electric Vehicles□but did not count them as household vehicles.	Coded Hybrid□alt fuel for all vehicle classes. Coded Light Electric Vehicles□but did not count them as household vehicles.
	1□□□	1□□□	1□□□	1□□□	1□□□	2□□1	2□□□	2□1□
Odometer Readings	None	None	None	None	Two readings collected by contacting respondent by phone or mail	Two readings collected multi-modal □Internet□ mail□800 number□	One reading collected at time of interview	One reading collected at time of interview
	1□□□	1□□□	1□□□	1□□□	1□□□	2□□1	2□□□	2□1□
Long-Distance Component	None	Included 2-week travel period for trips of □□ miles or more	Included 2-week travel period for trips of □□ miles or more	Included 2-week travel period for trips of □□ miles or more	Included 2-week travel period for trips of □□ miles or more	Included 28-day travel period □long distance□	None	Some add-ons asked □uestions related to long-distance for their specific areas

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Other Notes		NPTS and National Travel Survey □long distance□ combined			Major shift in methods from recall of travel day to two-stage survey with pre-mailed diary	NPTS and American Travel Survey □long-distance□ combined		Major shifts in methods from RDD□CATI to address-based sample and web-based retrieval. See Appendix A and User□s Guide for more detail
	1□□□	1□□□	1□□□	1□□□	1□□□	2□□1	2□□□	2□1□
Add-Ons	None	None	None	New York MPO	New York State	Baltimore MPO	California	Ari□ona
				Connecticut	Massachusetts	Des Moines□ IA MPO	Florida	California
				Indianapolis MPO	Oklahoma and Tulsa□ Oklahoma	Hawaii	Georgia	Des Moines Area MPO
					Puget Sound	Kentucky	Indiana	Georgia
						Lancaster□ PA MPO	Iowa	Indian Nations Council of Governments
						New York State	New York State	Iowa Northland Regional COG
						Oahu HI MPO	North Carolina	Maryland
						Texas	South Carolina	New York State
						Wisconsin	South Dakota	North Carolina

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							Texas	Wisconsin
							Vermont	Texas
							Virginia	North Central Texas COG
							Wisconsin	
							Chittenden County MPO	
							Linn County RPC	
							Maricopa Association of Governments	
							Pima County MPO	
							Piedmont Regional Transportation	
							Omaha-Council Bluffs Metro Area Planning Agency	

APPENDIX C: TRAVEL CONCEPTS AND GLOSSARY OF TERMS

Travel Concepts

Person Trip A movement in the public space between two identifiable points. In 2017, NHTS trips that begin and end at home are included as one trip record and flagged as "loop" trips. These primarily include walks, jogs, and bike rides that in the past were divided into an outbound portion (geocoded to the farthest point) and an inbound portion. In 2017, the entire "loop" trip is included as one unit. Each record in the trip file represents one trip.

For example, two household members traveling together in one car are counted as two person-trips. Three household members walking to the store together are counted as three person-trips. In 2017 NHTS, a jogger who leaves home and jogs around the neighborhood and back home is counted as one "loop" trip.

Person Miles of Travel (PMT) The number of miles traveled by each person on a trip.

For example, if two people traveling together take a 6-mile subway trip to the airport, that trip results in 12 person-miles of travel. A 5-mile van trip with a driver and four passengers counts as 25 person-miles of travel (5 people times 5 miles).

Vehicle Trip A trip by a single privately-operated vehicle (POV) regardless of the number of persons in the vehicle.

For example, two people traveling together in a car would be counted as one vehicle trip. Four people going to a restaurant in a van is considered one vehicle trip.

Note: To be considered a vehicle trip in NHTS, the trip must have been made in a POV, namely a household-based car, van, sport utility vehicle (SUV), pickup truck, other truck, recreational vehicle, motorcycle or other POV. The vehicle does not need to belong to the household—in 2017 a category for rental cars was added to the mode list, and are included in estimates of private vehicle travel (including services like Car2Go and ZipCar).

Trips made in other highway vehicles, such as buses, streetcars, taxis (including Uber/Lyft), and school buses are collected in the NHTS, but these are shown as person trips by those modes. The design of the NHTS is such that it does not serve as a source for vehicle trips in modes using other highway vehicles, because there is no way to trace the movement of these vehicles throughout the day. Those interested in vehicle trips by buses, taxis, etc., need to use a data source that relies on reports from the fleet operators of those vehicles. The National Transit Database of the Federal Transit Administration is one such source.

Vehicle Miles of Travel (VMT)

One vehicle mile of travel is the movement of one privately operated (POV) vehicle for one mile, regardless of the number of people in the vehicle.

For example, when one person drives her car 12 miles to work, that equals 12 vehicle miles of travel. If two people travel 3 miles by pickup, that equals 3 vehicle miles of travel.

The same definition of household vehicles is used. For NHTS data, vehicle miles are restricted to the same POVs as vehicle trips, that is a household-based car, van, SUV, pickup truck, other truck, recreational vehicle, or other POV, including rental car.

Vehicle Occupancy

For NHTS data, vehicle occupancy is generally computed as person miles of travel per vehicle mile (referred to as the travel method). Note that the other commonly used definition of vehicle occupancy is persons per vehicle trip (referred to as the trip method).

Because longer trips often have higher occupancies, the distance-based method generally yields a higher rate than the trip-based method. The calculation of the distance-based method requires that trip distance be included in the record. In 2017, every geocoded origin and destination pair had a calculated shortest-path distance appended to the trip record. Some trips may be missing trip distance, therefore, vehicle occupancy using distance is calculated on a slightly smaller number of trips than the trip method.

Glossary of Terms

This glossary provides the most common terms used in this report and the NHTS survey, and definitions of those terms. These definitions are provided to assist the user in the interpretation of the NHTS data and tables in this report.

Adult — For NHTS, this is defined as a person 18 years or older.

Census Region and Division — The U.S. Census Bureau divides the states into four regions and nine divisions. Note that the divisions are wholly contained within a region (i.e., region lines do not split division lines). The regions and their component divisions are:

Northeast Region:

- New England Division: Connecticut, Maine, Massachusetts, New Hampshire, Rhode Island, Vermont
- Middle Atlantic Division: New Jersey, New York, Pennsylvania

Midwest Region:

- East North Central Division: Illinois, Indiana, Michigan, Ohio, Wisconsin
- West North Central Division: Iowa, Kansas, Minnesota, Missouri, Nebraska, North Dakota, South Dakota

South Region:

- South Atlantic Division: Delaware, Florida, Georgia, Maryland, North Carolina, South Carolina, Virginia, West Virginia
- East South Central Division: Alabama, Kentucky, Mississippi, Tennessee
- West South Central Division: Arkansas, Louisiana, Oklahoma, Texas

West Region:

- Mountain Division: Arizona, Colorado, Idaho, Montana, Nevada, New Mexico, Utah, Wyoming
- Pacific Division: Alaska, California, Hawaii, Oregon, Washington

Destination — For travel day trips, the destination is the end-point of the reported trip.

Driver — A driver is a person who operates a motorized vehicle. NHTS does not specifically ask about license status.

Employed Worker — A person is considered a worker/employed if they worked for pay, either full time or part time, during the week before the interview.

Education Level The number of years of regular schooling completed in graded public, private, or parochial schools, or in colleges, universities, or professional schools, whether day school or night school. Regular schooling advances a person toward an elementary or high school diploma, or a college, university, or professional school degree.

Household A group of persons whose usual place of residence is a specific housing unit; these persons may or may not be related to each other. The total of all U.S. households represents the total civilian non-institutionalized population.

Household Income Household income is the money earned by all family members in a household, including those temporarily absent. Annual income is the income earned 12 months preceding the interview.

Household Members Household members include all people, whether present or temporarily absent, whose usual place of residence is in the sample unit. Household members also include people staying in the sample unit who have no other usual place of residence elsewhere and does not include anyone who usually lives somewhere else or is just visiting, such as a college student away at school.

Household Vehicle A household vehicle is a motorized vehicle that is owned, leased, rented or company-owned and available to be used regularly by household members. Household vehicles include vehicles used solely for business purposes or business-owned vehicles, so long as they are driven home and can be used for the home to work trip, (e.g., taxicabs, police cars, etc.). Household vehicles include all vehicles that were owned or available for use by members of the household during the travel day, even though a vehicle may have been sold before the interview. Vehicles excluded from household vehicles are those that were not working and were not expected to be working, and vehicles that were purchased or received after the designated travel day.

Means of Transportation A mode of travel used for going from one place (origin) to another (destination). A means of transportation includes private and public modes, as well as walking.

The following transportation modes, grouped by major mode, are included in the NHTS data.

Private Vehicle

- Car: A privately owned and/or operated licensed motorized vehicle including cars and station wagons. Leased and rented cars are included if they are privately operated and not used for picking up passengers in return for fare.
- Van: A privately owned and/or operated van or minivan designed to carry [illegible] to 13 passengers, or to haul cargo.

- Sport utility vehicle: A privately owned and/or operated vehicle that is a hybrid of design elements from a van, a pickup truck and a station wagon. Examples include a Chevrolet Blazer, Ford Bronco, Jeep Cherokee, or Nissan Pathfinder.
- Pickup truck: A pickup truck is a motorized vehicle, privately owned and/or operated, with an enclosed cab that usually accommodates two to three passengers, and an open cargo area in the rear. Later model pickups often have a back seat that allows for total seating of four to six passengers. Pickup trucks usually have the same size of wheel-base as a full-size station wagon. This category also includes pickups with campers.
- Motorcycle/moped: This category includes large, medium, and small motorcycles and mopeds. Electric Bicycles are not included.
- Golf cart/Segway: This category consists of self-powered small vehicles (generally light electric vehicles) and any two-wheeled motorized personal vehicle consisting of a platform for the feet mounted above an axle and an upright post surmounted by handles.
- RV (motor home, ATV, snowmobile): An RV or motor home includes a self-powered recreational vehicle that is operated as a unit without being towed by another vehicle (e.g., a Winnebago motor home). This category includes all terrain vehicles and snowmobiles.

Public Transportation

- Public or commuter bus: This category includes buses that are part of transit systems, or a private service buses operating on a fixed schedule to serve commuters.
- Subway/elevated/light rail/streetcar: Any transit service operated on a fixed rail or guide way system, vehicles that run on a fixed rail system powered by electricity obtained from an overhead power distribution system, and any other
- Amtrak/commuter rail: This category includes all commuter trains and passenger trains.
- City-to-city bus (Greyhound, Megabus): This category includes all passenger buses operating between population centers.
- Paratransit/dial-a-ride: This category includes publicly operated on-call transit services for qualified individuals.

Non-Motorized

- Walk: This category includes walking and jogging.
- Bicycle: This category includes bicycles of all speeds and sizes, including electric bikes.

Other Modes:

- Airplane includes commercial airplanes and smaller planes that are available for use by the public in exchange for a fare. Private and corporate planes and helicopters are also included.
- Boat/ferry/water taxi: This includes travel by ships, cruise ships, passenger lines and ferries, sailboats, motorboats and yachts including water taxi.
- Taxi/limo (including Uber/Lyft): This category includes the use of a mobility service by a passenger for fare, including traditional and ride-hailing services. The taxi category does not include rental cars if they are privately operated.
- Private/charter/tour/shuttle bus: This includes privately operated large or shuttle buses that are operated for a fare.

Metropolitan Statistical Area (MSA): Geographic areas of more than 50,000 persons managed by the Office of Management and Budget to categorize official population estimates. Counties and county equivalents are combined based on social and economic integration with its designated urban center. 2017 NHTS derived MSA variables using the 2010-201[illegible] [illegible]-year American Community Survey B01003_001E variable.

Margin of Error (MOE): The 95 percent confidence interval of the estimate, calculated in this report by multiplying a factor of 1.98[illegible] to the standard error of the estimate. Add and subtract the MOE to the estimate to determine the range of values that the statistic would fall into 95% of the time.

Motorized Vehicle: Motorized vehicles are all vehicles that are licensed for highway driving.

Nationwide Personal Transportation Survey (NPTS): The name of the national survey program responsible for data collected in 1969, 1977, 1983, 1990, and 1995.

Occupancy: Occupancy is the number of persons, including driver and passenger(s) in a vehicle. NHTS occupancy rates are generally calculated as person miles divided by vehicle miles. See Vehicle Occupancy in Travel Concepts.

Origin: The starting point of a trip.

Passenger: For a specific trip, a passenger is any occupant of a motorized vehicle, other than the driver.

Person Miles of Travel (PMT): PMT is a primary measure of person travel. When one person travels one mile, one person mile of travel results. Where 2 or more persons travel together in the same vehicle, each person makes the same number of person miles as the vehicle miles. Therefore, four persons traveling 5 miles in the same vehicle results in 20 person miles (4 x 5 = 20).

Person Trip A person trip is a trip by one or more persons in any mode of transportation. Each person is considered as making one person trip. For example, four persons traveling together in one auto are counted as four person trips.

POV A privately-owned vehicle or privately-operated vehicle. Either way, the intent here is that this is not a vehicle available to the public for a fee, such as a bus, subway, taxi, etc.

Travel Day A travel day is a 24-hour period from 4:00 a.m. to 3:59 a.m. designated as the reference period for studying trips and travel by members of a sampled household.

Travel Day Trip A travel day trip is defined as any time the respondent went from one address to another by private motor vehicle, public transportation, bicycle, walking, or other means.

Trip Purpose A trip purpose is the main reason that motivates a trip. In the 2017 NHTS survey, the number of trip purposes were reduced because of the move to self-reported travel on the web. For each trip, the origin and destination are on the file in generic terms, e.g. from work to shopping. There were 19 trip reasons that were on a pick-list for respondents to choose from, and the data were compiled into a legacy format (WHYTRP90) to match previous data from the NPTS/NHTS data series. These legacy purposes used in this report include trips to and from:

‘01'	To and From Work (Commuting)
‘02'	Work Related Business (meeting or trip)
‘03'	Shopping
‘04'	Family/Personal Errands (including drop-off/pickup, volunteer activities, and buying services such as cleaners, pet care, automotive care)
‘05'	School/Church
‘06'	Medical/Dental (any health care visit)
‘07'	Vacation
‘08'	Visit Friends and Family
‘10'	Social/Recreational (exercise, movies, parks, museums and bars)
‘11', '98', '99'	Other

Urbanized Area An urbanized area consists of the built-up area surrounding a central core (or central city), with a population density of at least 1,000 persons per square mile. Urbanized areas do not follow jurisdictional boundaries thus it is common for the urbanized area boundary to divide a county.

Vehicle In the 2017 NHTS, the term vehicle includes autos, passenger vans, sport utility vehicles, pickups and other light trucks, RVs, motorcycles and mopeds owned or available to the household.

Vehicle Miles of Travel (VMT)

VMT is a unit to measure vehicle travel made by a private vehicle, such as an automobile, van, pickup truck, or motorcycle. Each mile traveled is counted as 1 vehicle mile regardless of the number of persons in the vehicle.

Vehicle Occupancy

Vehicle occupancy is the number of persons, including driver and passenger(s) in a vehicle; also includes persons who did not complete a whole trip. NHTS occupancy rates are generally calculated as person miles divided by vehicle miles.

Vehicle Trip

A trip by a single privately operated vehicle (POV) regardless of the number of persons in the vehicle.

Vehicle Type

The 201[illegible] NHTS codes vehicles by make and model, and then generally into one of the following major vehicle types:

1. Automobile (including station wagon)
2. Van
3. Sport utility vehicle
4. Pickup truck (including pickup with camper)
5. Other truck
6. RV or motor home
7. Motorcycle
8. Other

The Effect of Transit Service on Trips Generated by Suburban Development

Kevin G. Hooper, P.E. (M)*

Transportation planning literature often touts the many benefits which accrue from the provision of transit service to suburban development. This paper quantifies actual, field-measured effects of transit service on suburban trip-making characteristics and places bounds on realistic expectations regarding these effects. The findings are based on data collected as part of several studies in six major metropolitan areas.

The effects of rail transit service were measured for the Washington Metropolitan Area Transit Authority[1] throughout the Washington, D.C. area and for the Maryland-National Capital Park and Planning Commission[2] throughout suburban Montgomery County, adjacent to Washington, D.C. The effects of bus transit service were measured for M-NCPPC[2] throughout Montgomery County and at six suburban activity centers, as reported in NCHRP Report 323, Travel Characteristics at Large-Scale Suburban Activity Centers.[3] The surveyed sites were:

- Perimeter Center -- located in DeKalb and Fulton Counties, north of Atlanta, Georgia
- Parkway Center -- located in the Cities of Dallas, Addison, and Farmers Branch, north of the Dallas, Texas CBD
- Southdale -- located in the Cities of Bloomington and Edina, south of Minneapolis, Minnesota
- South Coast Metro -- located in the Cities of Santa Ana and Costa Mesa in Orange County, California
- Bellevue -- an incorporated city located east of Seattle, Washington
- Tysons Corner -- located in Fairfax County, Virginia west of the Washington, D.C. CBD.

All six surveyed suburban activity centers (SAC) have at least one regional mall and a total of at least seven million square feet of office and retail space.

OFFICE DEVELOPMENT

Rail Transit Service

For suburban office development, there is a direct relationship between transit mode share for commute trips and the proximity of the office site to a rail transit station. In the Washington, D.C. metropolitan area, suburban office development located within 500 feet of a Metrorail station can expect commute trip transit mode shares of between 20 and 25 percent. These transit mode shares for suburban office sites reflect the use of Metrorail and of extensive bus transit service from surrounding residential areas which primarily feeds the rail station.

During the morning peak hour, the Montgomery County office buildings within the rail station walkshed have vehicle trip generation rates as low as half of the typical suburban rates for the County. However, the same office buildings with high transit mode shares do not exhibit commensurate reductions in the evening peak hour vehicle trip generation rates. As part of an attempt to explain these "non-reduced" rates, it was determined that employee densities tend to rise as office sites get closer to rail stations. Therefore, person trip generation rates have a tendency to rise as a function of rail station proximity (and also as a function of the increasing office space lease rates), which during the evening peak hour tends to balance the vehicle trip rate reductions associated with increased transit usage.

Bus Transit Service

As was observed for office development located near rail transit service, office sites near transit centers fed by radial bus service can experience significant transit mode shares for commute trips. For example, in Bellevue, Washington (a suburb of Seattle) the overall transit mode share for office employees is roughly 8 percent. For the office buildings located directly adjacent to or within 500 feet of the Bellevue transit center, commute trip transit mode shares range between 10 and 15 percent with an average of 12 percent.

Bellevue is a suburban activity center (SAC) with a relatively high amount of transit. At present, the transit center is served by 17 different Seattle Metro routes and roughly 190 peak period bus trips. The focus of the bus service is the Bellevue Transit Center, which is situated at the heart of the Bellevue office building concentration. The transit center has six bus bays, covered seating areas, and information kiosks. In addition to the service tailored for persons destined for Bellevue, timed transfer schedules are in place for persons who wish to continue to downtown Seattle.

With the exception of Bellevue, none of the surveyed suburban activity centers have a transit mode share of over one percent. In those five SACs, fixed-route transit service is not structured to serve the SAC as an end-of-the-line destination. Rather, most of the SAC transit service passes through a portion of the SAC area along its route between the residential suburbs and the regional central business district.

Other Factors Affecting Transit Usage

In addition to the large number of radial transit routes feeding the transit center, the Bellevue SAC benefits from two other elements which contribute directly to the high transit mode share for commute trips. First, the activity center is quite dense for a suburban area and has a substantially complete sidewalk system. A person will not be inclined to take transit to and from work if their bus stop is a grassy (or muddy) area and if they must walk along the curb or in the street down a long driveway to their place of employment. The five non-Bellevue SACs are geared for the auto driver and not for the pedestrian.

* Senior Associate, JHK & Associates Alexandria, Virginia

Building densities are lower than in Bellevue, building setbacks are substantial, and pedestrian systems are either non-existent or incomplete.

The second factor contributing to the success of Seattle Metro transit service in encouraging the use of bus transit for commute trips to Bellevue is the price of parking paid by area employees. The larger office buildings in Bellevue have monthly parking fees which range between $35 and $65 (most of the office buildings in the other five surveyed SACs provide free parking).

However, this apparant benefit provided transit by the imposition of office building parking fees is not as effective as it could be. Even where there are posted daily parking fees in office buildings, these costs are not necessarily passed on to the employee. Many employees receive free or discounted parking privileges from their employers. In Bellevue, where virtually every office building has pay parking, only 25 percent of the employees report paying any fee at all to park. At the other five surveyed SACs, the number of office employees who pay to park is typically less than 3 percent.

Intermediate Stops

A contrary factor which has impeded and will continue to impede the success of efforts to encourage suburban employees to use transit or to rideshare is the need for many employees to make intermediate stops on their way to or from work.

NCHRP 323 reports that many office employees stop along their way to or from work. On a typical day, roughly one-half will stop either on the way to work or home from work. In other words, one out of every two employees has been effectively removed from the transit and ridesharing markets. The primary purposes of the stops on the way to work include child daycare or school and work-related trips. On the way home, the primary purposes are for general shopping, the grocery store, social/recreation, and childcare/school. Depending on the location and duration of these stops, they may very well restrict a commuter's ability or propensity to take transit or to carpool.

A number of developers and building managers have provided some on-site ancillary retail services to capture some of these trips. In reality, these services are being provided in order to better market the office space but their side effects are positive. Many buildings have on-site food service in the form of a snack shop, deli, or even full-scale restaurants. Some buildings have on-site drycleaners and banks. Several activity center transportation management associations (e.g., in Tysons Corner, Virginia) and even a few building managers (e.g., One Spectrum Center in Parkway Center, Texas) have established child daycare centers.

During the midday, NCHRP 323 reports that roughly half of the office employees leave their building for lunch, a work-related trip, or for other errands. In a typical suburban activity center, approximately 25 percent of the office employees make midday trips within the SAC. In a typical SAC, 80-90 percent of these internal midday trips are by auto. This reliance on the automobile for midday trips in a SAC is quite different from the typical CBD where far fewer of the internal trips are by auto. These characteristics should not be surprising, but they should be disappointing. In downtowns, when a person makes a midday trip for work, or for lunch, or for an errand, they usually walk. In suburban activity centers, the walk distances are typically too great and the tripmaker chooses to use a car. Bellevue provides an exception where the midday intra-SAC trip auto mode share drops to 50 percent (due in part to the density of the SAC and to its extensive pedestrian system). Nevertheless, that still leaves half of the midday intra-Bellevue SAC trips being made by auto.

RESIDENTIAL DEVELOPMENT

Rail Transit Service

Intercept surveys were conducted at 18 residential complexes near suburban Metrorail stations located throughout the Washington, D.C. metropolitan region. Based on the data collected, buildings located within 400 feet of the rail station portal should expect commute trip transit mode shares of between 60 and 70 percent; at a distance of 1,000 feet, the transit mode share should be roughly 50 percent; and even at a distance of 2,000 feet, a transit mode share of 30 percent is a reasonable expectation. Residential vehicle trip generation rates were found to likewise decrease as a function of rail station proximity.

Bus Transit Service

Measurements have been taken at single-family dwelling units (detached and townhomes) served by a traditional radial (to elsewhere) bus service with roughly half-hour headways. Whether the bus routes are feeding a downtown or a suburban transit transfer point, the field observations indicate that transit has a relatively small impact. Peak hour transit mode shares of between one and two percent were observed. Based on intercept surveys conducted with the transit-riding residents, some of the transit trips replace trips previously made by auto.

The effect of new transit service on trip generation characteristics at the subdivision level is statistically insignificant (i.e., less than one percent). In other words, there is no statistical justification for changing residential trip generation rates with the initiation of new bus feeder transit service.

However, for residential development in suburban activity centers, the results are much more encouraging. Within an SAC, proximity to more frequent feeder bus service has a significant effect on transit mode share and total vehicle trips generated by residential development. Within the six surveyed activity centers described previously, commute trip transit mode shares for SAC residents exceed the overall averages for SAC office workers. Bellevue SAC residents have a 15 percent transit mode share for work trips. At the other five surveyed SACs, commute trip transit mode shares of between 2 and 5 percent were observed.

One of the key, positive findings of NCHRP 323 regarding SAC residents is that roughly one-third of the employed residents living in a large-scale SAC also work within the SAC. With one-third of the employed people working within the activity center, trip lengths are shortened and there certainly is potential for transit patronage or at least walk trips.

Other Factors Affecting Transit Usage

Before any estimates of the effectiveness of transit service at SAC residential development can be derived, there are two key complicating factors which also must be understood: (1) the type of tenants in the residential complex (e.g., retired vs. employed) and (2) the proximity of employment sites to the development. First, there is definite trend for retired persons or "empty nesters" to reside in activity center housing. In one condominium in Tysons Corner, for example, with 1,200 dwelling units, 40 percent of the dwelling units do not have an employed resident and 60 percent of the residents are at least 65 years old. Many other residential sites in large-scale SACs display the same tendencies. If a significant proportion of the SAC residents are not employed, the potential effects on trip length reductions and peak period transit usage are substantial.

The second issue deals with the relatively small number of residential units built within suburban activity centers. Tysons Corner in northern Virginia, for example, has a total of roughly 2,500 dwelling units (which house an estimated 2,500 employed persons). If one-third of these employed persons also work within the activity center, that comes to maybe 800 Tysons Corner residents working within the Tysons Corner SAC. Compare that with the estimated 60,000 jobs in Tysons Corner. These figures translate to roughly one percent of the Tysons Corner employees also living within the SAC, an insignificant amount in any effort to reduce regional auto travel.

RETAIL DEVELOPMENT

Suburban retail development has also been surveyed, near both rail and bus transit service. The factors which most directly affect mode shares at retail sites include proximity to transit stations (rail or bus), proximity to complementary land uses (e.g., office buildings), and the type of tenants (e.g., a discount retail center with no eating establishments will generate fewer trips to an office building located next door than would a retail center with several restaurants).

Rail Transit Service

Significant transit mode shares can be achieved at suburban retail sites located near rail transit stations based on data collected in the Washington, D.C. metropolitan area. In fact, retail sites appear to attract higher transit mode shares than office sites at the same Metrorail station. This relationship holds true for roughly the first 1,000 feet of distance from the station portal. Beyond that distance, the retail transit mode share drops off more rapidly than it does for office development.

The observed transit mode shares for large, suburban retail sites with direct connections to rail transit stations is roughly 40 percent for the afternoon peak period. At a distance of 1,000 feet from the station, the transit mode share drops to the 20 percent range.

With regard to vehicle trip generation, the data compiled thusfar in the M-NCPPC and WMATA studies indicate virtually no correlation between retail vehicle trip generation and distance to a Metrorail station. Other factors have a more significant impact on retail trip generating characteristics, including the availability of parking, the price of parking, and the retail tenant mix.

Bus Transit Service

The effect of bus transit service on the generation of trips by retail development is relatively minor. For isolated retail development (i.e., not within a suburban activity center and not located near a transit center), the presence or absence of bus transit service has no measurable impact on vehicle trip generation rates. Within suburban activity centers, however, the effects of bus transit service, albeit minor, can be measured.

Bellevue Square, the regional mall located within the Bellevue SAC, is located roughly 2,000 feet from the Bellevue Transit Center and is directly served by several transit routes. During the midday, five percent of the mall person-trips (approximately 240 persons) either arrive or depart by means of a bus. The midday walk mode share for Bellevue Square is another six percent. At the other five surveyed SACs, the transit mode share for the regional malls is essentially zero and the walk mode share ranges between two and five percent.

For the regional malls, the midday non-auto mode shares appear to have a direct relationship to the proximity of office space to the site. The highest midday non-auto share (18 percent) was observed at the Galleria in north Dallas, which is connected by enclosed walkways to one million square feet of office space and a 440-room high-rise hotel. The Bellevue Square non-auto share of 11 percent is the product of the extensive bus service in the area, the 2.1 million square feet of office space within 2,000 feet of Bellevue Square, and the complete pedestrian pathway system.

At the smaller retail centers located within the surveyed SACs, the transit mode share is essentially zero. Based on intercept surveys, most of the trips to these centers are either linked with other retail trips or are trips to/from an office with time constraints (e.g., for lunch). Neither type of trip is conducive to traditional fixed-route, half-hour headway schedules.

Other Factors Affecting Transit Usage

As is the case for office development, there is a great deal of internalization of trips generated by retail centers. In the large activity centers, half of the midday trips to and from the regional malls come from within the activity center. Of that 50 percent, roughly half are from the offices (people going to lunch, errands, etc,) and the other half are linked trips from other retail sites within the activity center. During the evening peak period, 30 percent of the regional mall trips are from within the activity center. These internal evening trips consist primarily of office workers on their way home from work stopping for errands, at a health club, or at a lounge or restaurant.

HOTEL DEVELOPMENT

Transit mode share for hotels is no doubt subject to more variability from day to day than for any of the other surveyed land uses. The data compiled to date from hotels does not allow any "average" or "typical" transit mode share to be established with any degree of confidence. Nevertheless, the data does point to several conclusions.

The factors which most directly affect mode shares at hotels are similar to those affecting retail sites. They include proximity to transit stations (rail or bus), proximity to complementary land uses (e.g., office buildings), and the type of tenants (e.g., a 5-Star hotel will generate few trips to a Class B office building located next door).

Current vehicle trip generation rates for hotels are based on the type of hotel and its number of rooms. NCHRP 323 clearly demonstrates that additional research is needed on improved independent variables for hotel trip generation such as the hotel "class" and rate structure, the amount and use of conference and meeting room space, and the amount of on-site retail and service use, including lounges.

Rail Transit Service

Peak period transit mode shares at suburban hotels located within 2,000 feet of a rail transit station have been observed to range as high as 20 percent and as low as zero. The mean observed value is nine percent but no correlation was found between proximity to the station and the hotel transit mode share.

Bus Transit Service

For isolated hotels, the initiation or removal of bus transit service has no significant impact on the number of vehicle trips generated. Within suburban activity centers, the impact is likewise limited.

The primary non-auto mode for SAC hotels is walking. As proximity to office space increases, so does the proportion of hotel trips made by foot.

CONCLUSIONS AND RECOMMENDATIONS

The results of the studies reported in this paper clearly demonstrate that suburban areas still have a long way to go to capture the full benefits of regional transit systems. Moreover, the studies indicate that these benefits can indeed be substantial. Responsibility for achieving these benefits rests with both the providers of the transportation system and with the land use principles which guide suburban development patterns.

The following are recommendations of the author which have been derived from the research cited throughout this paper. The recommendations are not new, nor are they intended to be comprehensive. They do, however, represent key conclusions drawn from actual, field-measured experiences with respect to suburban development and transit patronage.

Transportation System

Set realistic goals for transit usage and plan the total transportation system accordingly.

Provide radial bus transit service to SACs and focus the service on a centralized transit center with timed-transfer scheduling.

Provide convenient feeder bus access to rail transit stations (which will have the beneficial side-effect of serving the surrounding development). For this to occur, it will be necessary to construct an adequate roadway network.

Provide pedestrian facilities which are convenient, direct, and complete. This includes both pathways physically separated from roadways and designated walkways through parking lots. Provide convenient walk access between the transit station (bus and rail) and the adjacent land uses, especially the office, retail, hotel, and residential uses.

Be innovative, but match your innovation to the market demand -- the travel characterisitics of individual persons. NCHRP 323 provides a base dataset for dissecting these characteristics. For example, if we are going to effectively get people to take transit or to rideshare, we must understand their need for midday trips or for stops along the way to or from work. Roughly half of the suburban activity center employees make only a midday trip or no stops at all during the day. If company vehicles, subsidized taxi service, or in some cases jitney service were provided, these employees could take transit or rideshare on their commute trip.

Land Use

Locate the types of land uses that tend to generate the most transit trips in rail or bus station areas. Office development with the associated convenience retail should be located closest to the transit station because it is the most sensitive to distance from the station. The distance people are willing to walk can be increased by careful planning of the pedestrian system. For example, utilizing underground walkways or skywalks between buildings can be used to separate pedestrians from vehicular traffic. Major retail and hotel uses would occupy the next ring of development from the transit station. And mid- to high-density residential developments could occupy the outer ring of development because residential users of the transit system are less sensitive to distance from the transit station.[3]

If midday retail trips by office employees can be accommodated by means other than a personal auto, transit properties would be better able to attract greater shares of the work trip market. Accommodation of the midday retail trips can best be achieved by means of a comprehensive approach. From a land use perspective, put the retail within walking distance of their patrons (in particular, office buildings, other retail establishments, and possibly residential).

Provide more residential space in suburban activity centers. Most SACs have very few dwelling units and a high proportion of the residents also work within the SAC. Additional residential development (1) will provide additional workers for the SAC with short commute trips, (2) will start to balance the inflow and outflow of trips during the peak commuting periods, and (3) will provide a concentration of potential transit users for service emanating from a centralized transit center.

In general, encourage development density near rail transit stations and bus transit centers. These centers will concentrate employee densities which will further generate interaction between land uses and buildings, thereby providing more potential for transit usage, ridesharing, and walking. However, it must be recognized that despite the significant levels of internal interaction and use of non-auto modes of travel, the increased density will also generate additional vehicle trips. These trips must be accommodated by the regional roadway system and by the roadway access system for the suburban activity center.

REFERENCES

[1] Washington Metropolitan Area Transit Authority, "Development-Related Ridership Survey II" prepared by JHK & Associates, December 1989

[2] Maryland-National Capital Park and Planning Commission, "Post-Metrorail Transportation Characteristics Study" prepared by JHK & Associates, July 1987

[3] NCHRP Report 323, Travel Characteristics at Large-Scale Suburban Activity Centers, prepared by JHK & Associates, October 1989

TRIP GENERATION - WITH ROBUST SHUTTLE SERVICE

	FUTURE DEVELOPMENT - RETAIL						FUTURE DEVELOPMENT - RESIDENTIAL				FUTURE DEVELOPMENT - OFFICE				TOTAL NON-VEHICLE		TOTAL VEHICLE TRIPS		
	Proposed Retail Net Person Trips [a]	Proposed Retail Walk/Bike Trips	Proposed Retail Transit Trips	Proposed Retail Vehicle Trips	Proposed Retail Pass-By	Proposed Retail Net 237 KSF	Proposed Residential Net Person Trips [a]	Proposed Residential Walk/Bike Trips	Proposed Residential Transit Trips	Proposed Residential Net 824 UNITS	Proposed Office Net Person Trips [a]	Proposed Office Walk/Bike Trips	Proposed Office Transit Trips	Proposed Office Net 180 KSF	Proposed Walk/Bike Trips Net	Proposed Transit Trips Net	Proposed Development Net	Existing Net Trips	Proposed Development Net New
				VOR 1.78						VOR 1.13				VOR 1.12					
Weekday AM Peak Hour					25%														
Enter	287	14	14	145	29	116	77	8	23	41	177	18	53	95	40	90	252	221	31
Exit	173	9	9	87	29	58	219	22	66	116	22	2	7	12	33	82	186	56	130
Total	460	23	23	232	58	174	296	30	89	157	199	20	60	107	73	172	438	277	161
Weekday Evening Peak Hour					34%														
Enter	779	39	39	394	139	255	121	12	36	64	19	2	6	10	53	81	329	120	209
Exit	835	42	42	422	139	283	80	8	24	42	147	15	44	79	65	110	404	248	156
Total	1,614	81	81	816	278	538	201	20	60	106	166	17	50	89	118	191	733	368	365
Saturday Midday Peak Hour					26%														
Enter	1,038	52	52	525	130	395	104	10	31	55	32	3	10	17	65	93	467	186	281
Exit	938	47	47	474	130	344	110	11	33	58	39	4	12	21	62	92	423	163	260
Total	1,976	99	99	999	260	739	214	21	64	113	71	7	22	38	127	185	890	349	541

a - Net Person trips includes credit for internal capture

TRIP GENERATION - WITH EXISTING MODE SHARES

	FUTURE DEVELOPMENT - RETAIL						FUTURE DEVELOPMENT - RESIDENTIAL				FUTURE DEVELOPMENT - OFFICE				TOTAL NON-VEHICLE		TOTAL VEHICLE TRIPS		
	Proposed Retail Net Person Trips [a]	Proposed Retail Walk/Bike Trips	Proposed Retail Transit Trips	Proposed Retail Vehicle Trips	Proposed Retail Pass-By	Proposed Retail Net 237 KSF	Proposed Residential Net Person Trips [a]	Proposed Residential Walk/Bike Trips	Proposed Residential Transit Trips	Proposed Residential Net 824 UNITS	Proposed Office Net Person Trips [a]	Proposed Office Walk/Bike Trips	Proposed Office Transit Trips	Proposed Office Net 180 KSF	Proposed Walk/Bike Trips Net	Proposed Transit Trips Net	Proposed Development Net Vehicle Trips	Existing Net Trips	Proposed Development Net New Vehicle Trips
				VOR 1.78						VOR 1.13				VOR 1.12					
Weekday AM Peak Hour					25%														
Enter	287	14	14	145	29	116	77	4	10	56	177	9	12	139	27	36	311	221	90
Exit	173	9	9	87	29	58	219	11	28	159	22	1	2	17	21	39	234	56	178
Total	460	23	23	232	58	174	296	15	38	215	199	10	14	156	48	75	545	277	268
Weekday Evening Peak Hour					34%														
Enter	779	39	39	394	139	255	121	6	16	88	19	1	1	15	46	56	358	120	238
Exit	835	42	42	422	139	283	80	4	10	58	147	7	10	116	53	62	457	248	209
Total	1,614	81	81	816	278	538	201	10	26	146	166	8	11	131	99	118	815	368	447
Saturday Midday Peak Hour					26%														
Enter	1,038	52	52	525	130	395	104	5	14	75	32	2	2	25	59	68	495	186	309
Exit	938	47	47	474	130	344	110	6	14	80	39	2	3	31	55	64	455	163	292
Total	1,976	99	99	999	260	739	214	11	28	155	71	4	5	56	114	132	950	349	601

a - Net Person trips includes credit for internal capture

Mode Splits - Conservative
Future Mode Splits Based on 2010 Census Data

	Existing Mode Splits [1]			Assumed Future Mode Splits [2]		
Mode Share	Workers	Residents	Retail [3]	Workers	Residents	Retail
Drive	88%	82%	90%	88%	82%	90%
Transit	7%	13%	5%	7%	13%	5%
Walk / Bike	5%	5%	5%	5%	5%	5%
Total	100%	100%	100%	100%	100%	100%

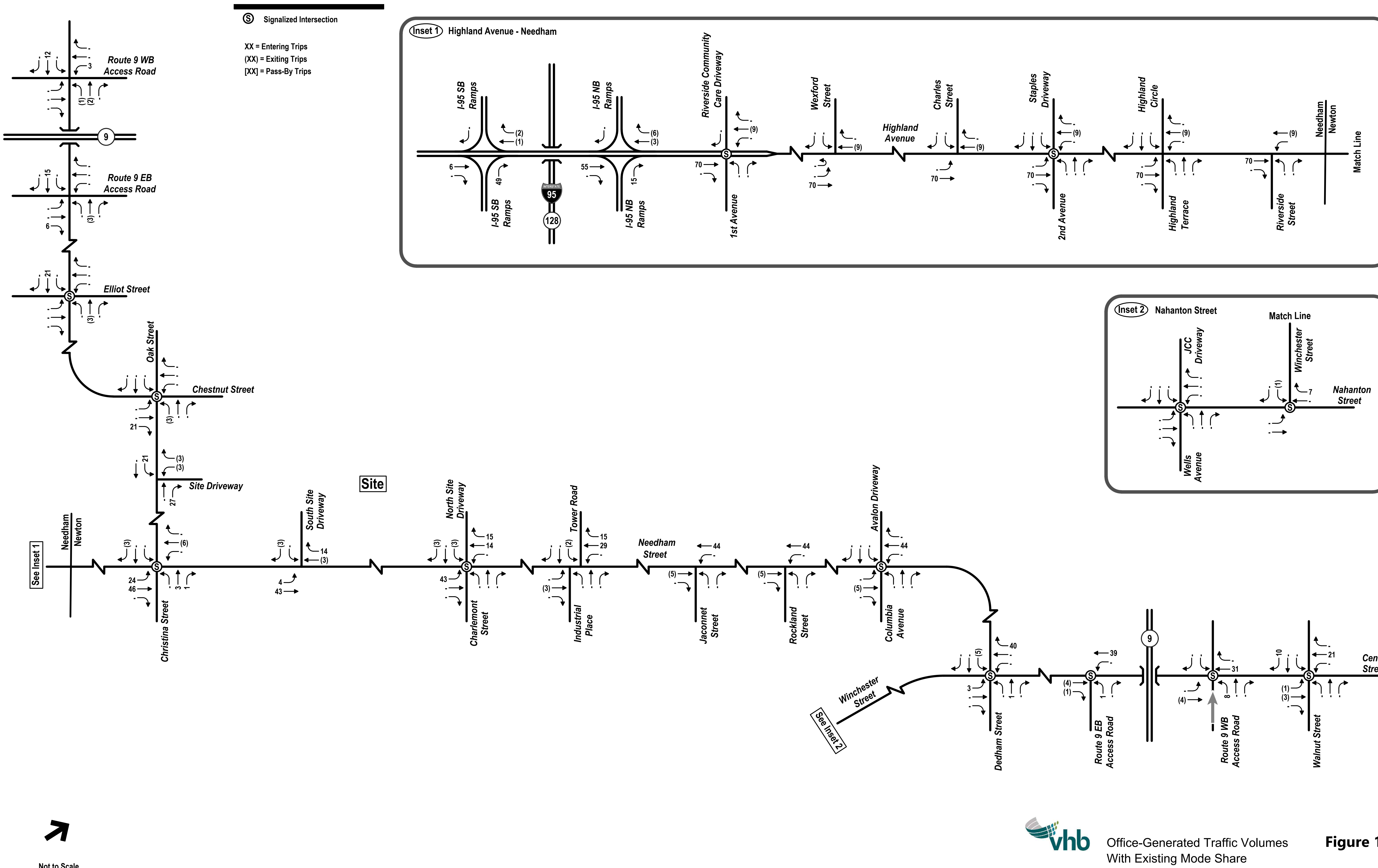
[1] Based on US Census Bureau Journey to Work Data, City of Newton, 2010
[2] Based on assumed transit rates
[3] Based on prediction of retail mode split

Mode Splits - Aggressive
Future Mode Splits Based on Aggressive TDM and Shuttle Usage

	Existing Mode Splits [1]			Assumed Future Mode Splits [2]		
Mode Share	Workers	Residents	Retail [3]	Workers	Residents	Retail
Drive	88%	82%	90%	60%	60%	90%
Transit	7%	13%	5%	30%	30%	5%
Walk / Bike	5%	5%	5%	10%	10%	5%
Total	100%	100%	100%	100%	100%	100%

[1] Based on US Census Bureau Journey to Work Data, City of Newton, 2010
[2] Based on assumed transit rates
[3] Based on prediction of retail mode split

Response 2.23: Site-Generated Traffic Volume Networks by Use



Office-Generated Traffic Volumes
With Existing Mode Share
Weekday Morning Peak Hour
The Northland Newton Development

Figure 1

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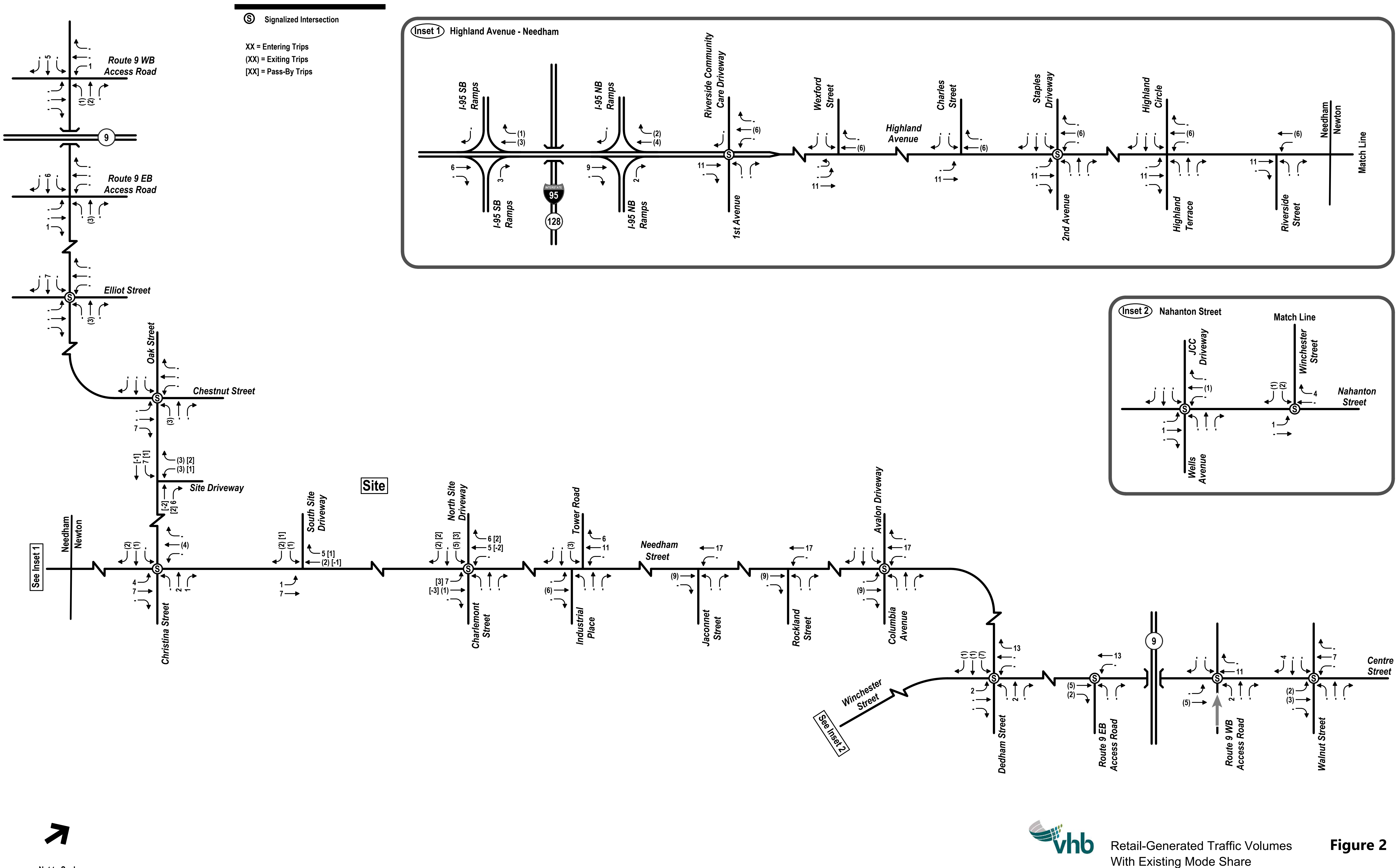
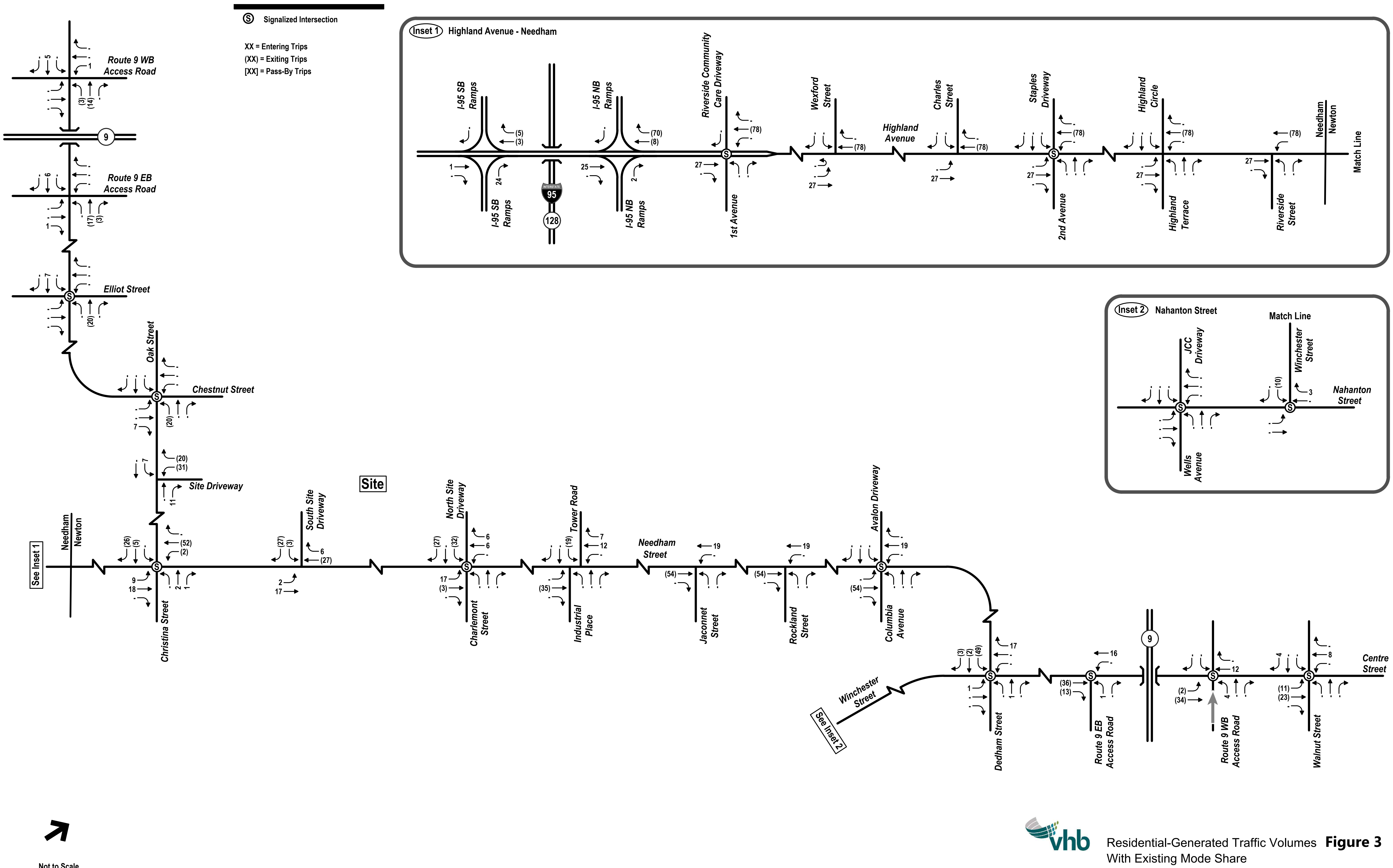
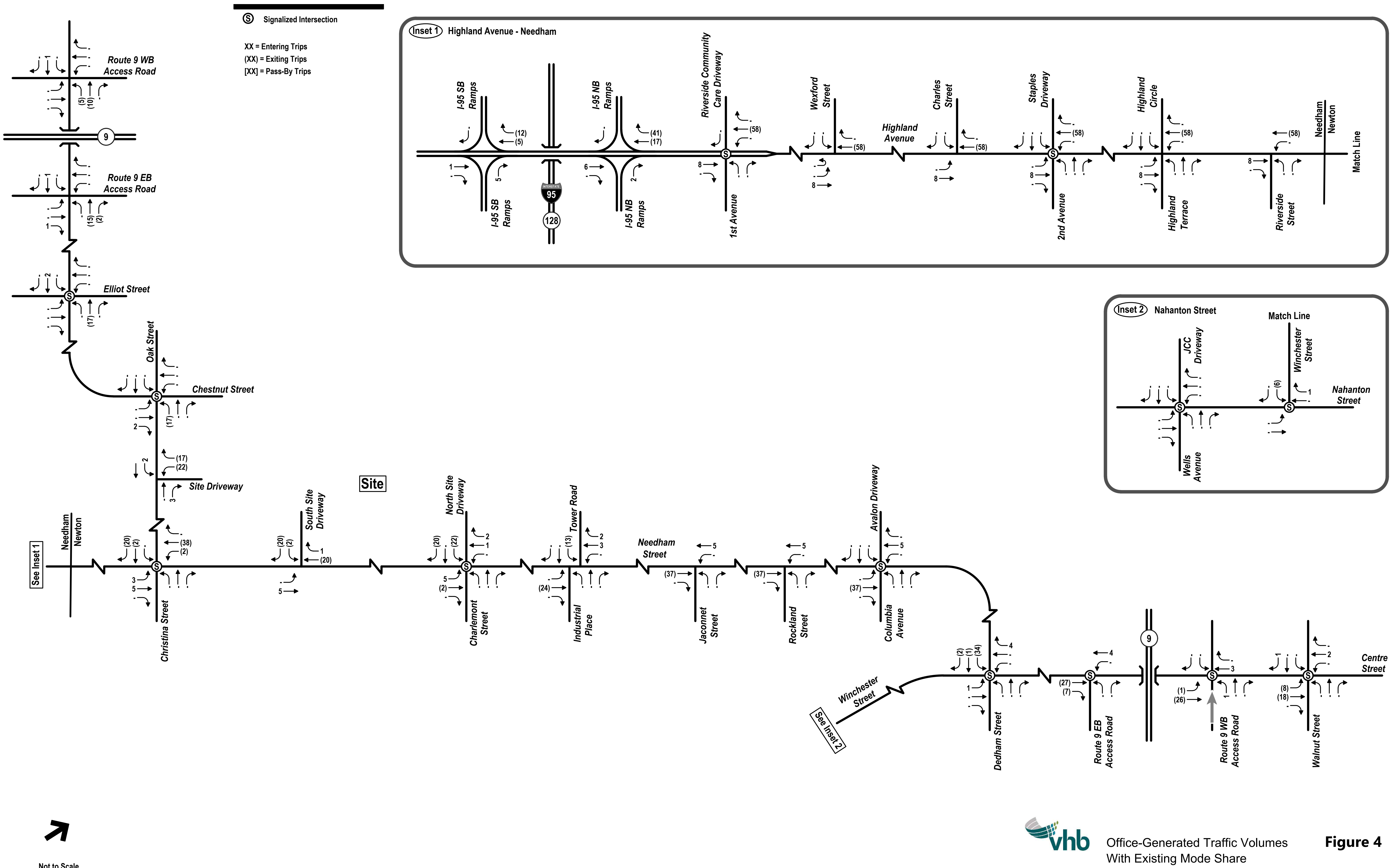


Retail-Generated Traffic Volumes
With Existing Mode Share
Weekday Morning Peak Hour
The Northland Newton Development

Figure 2

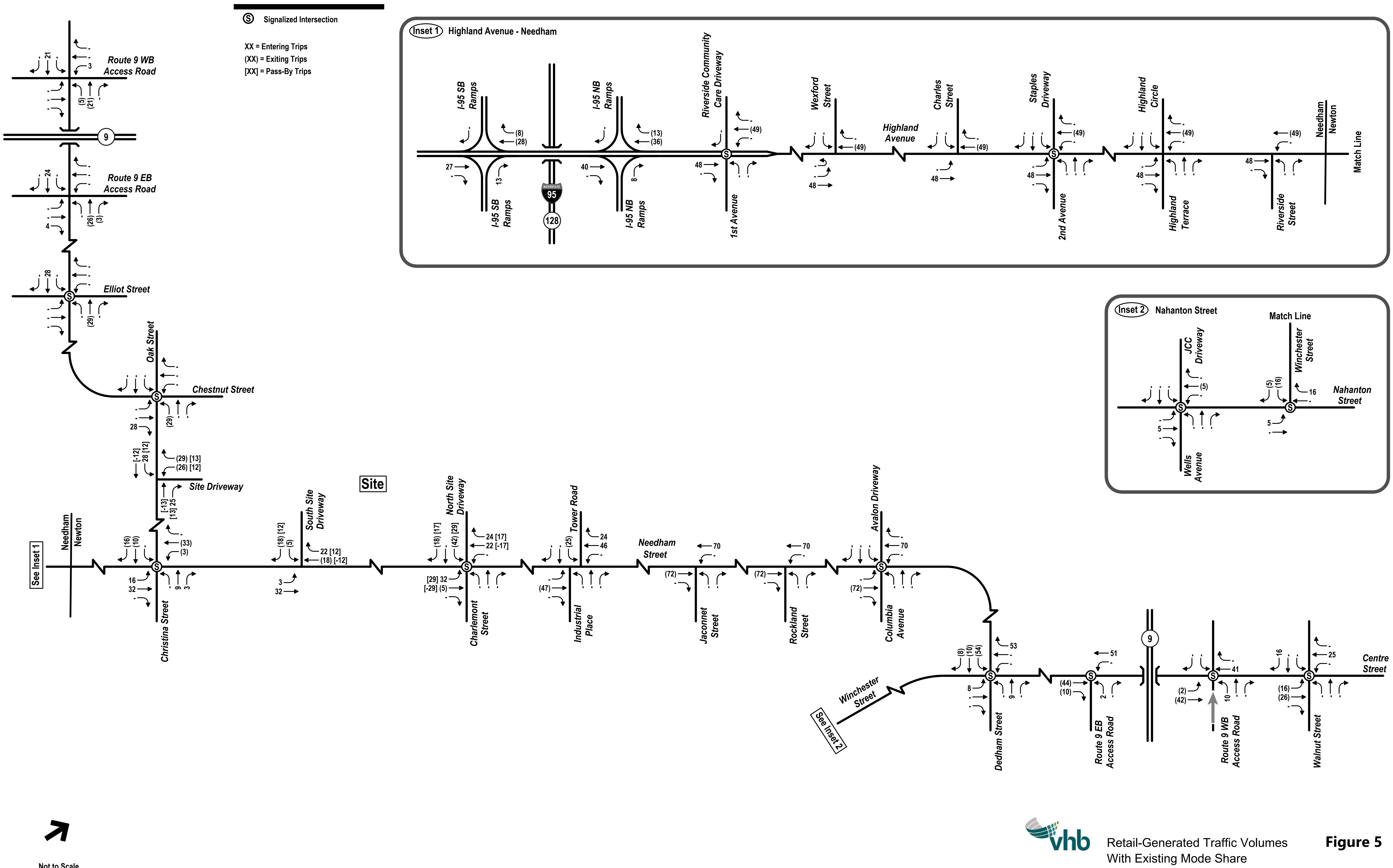


Residential-Generated Traffic Volumes With Existing Mode Share Weekday Morning Peak Hour The Northland Newton Development **Figure 3**



Office-Generated Traffic Volumes
With Existing Mode Share
Weekday Evening Peak Hour
The Northland Newton Development

Figure 4



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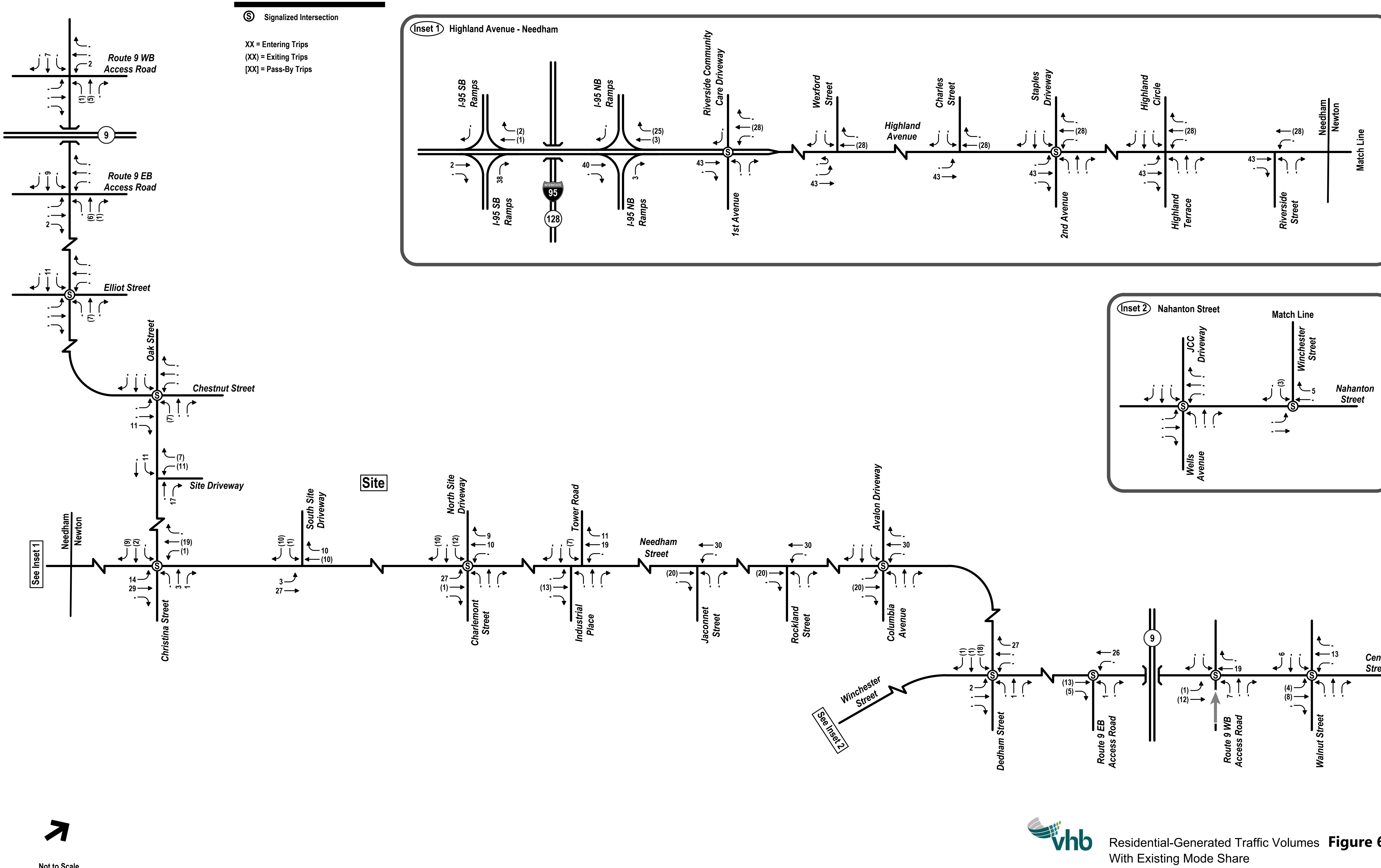
Retail-Generated Traffic Volumes
With Existing Mode Share
Weekday Evening Peak Hour
The Northland Newton Development

Figure 5

Ⓢ Signalized Intersection

XX = Entering Trips
(XX) = Exiting Trips
[XX] = Pass-By Trips



Residential-Generated Traffic Volumes With Existing Mode Share
Weekday Evening Peak Hour
The Northland Newton Development

Figure 6

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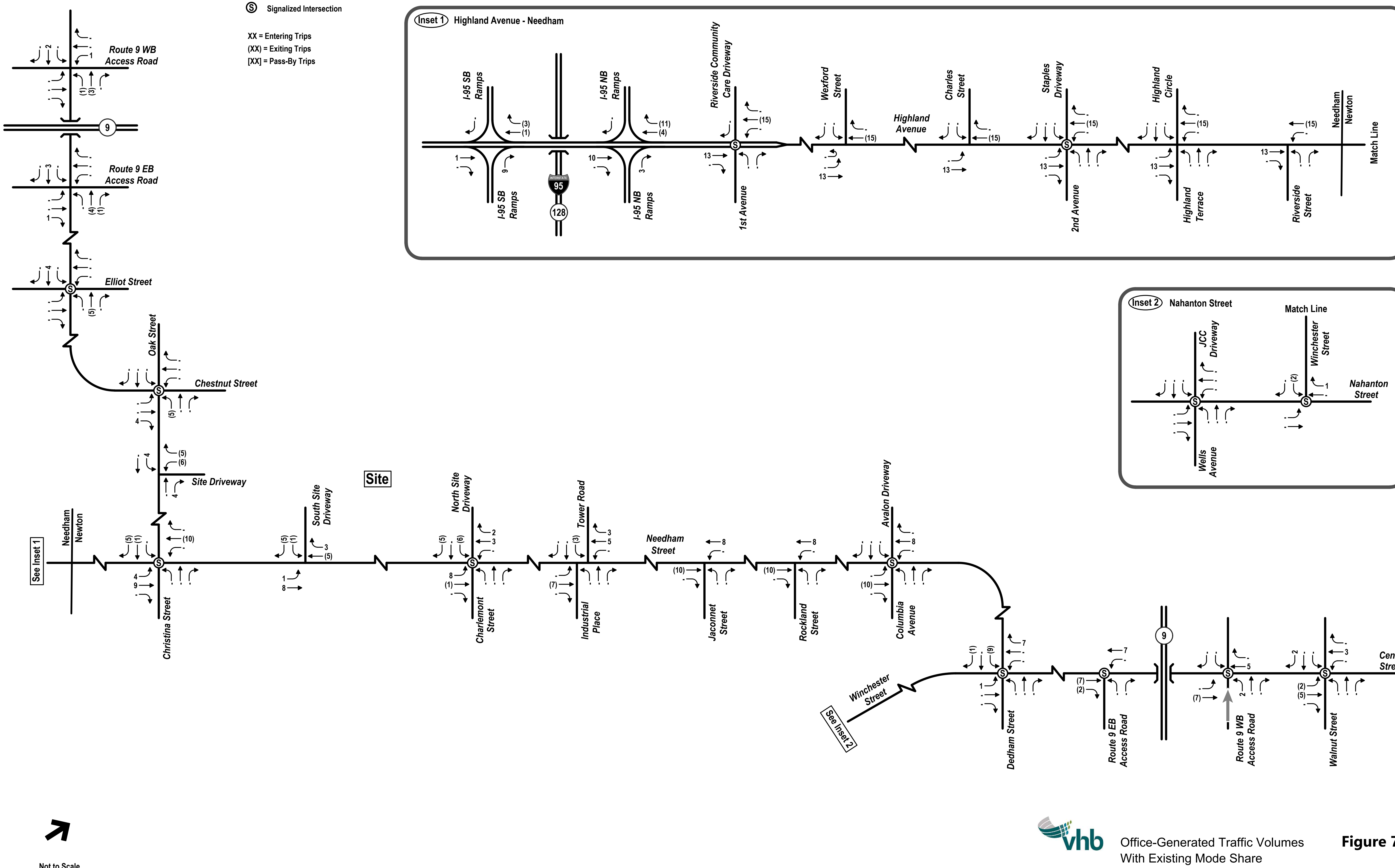
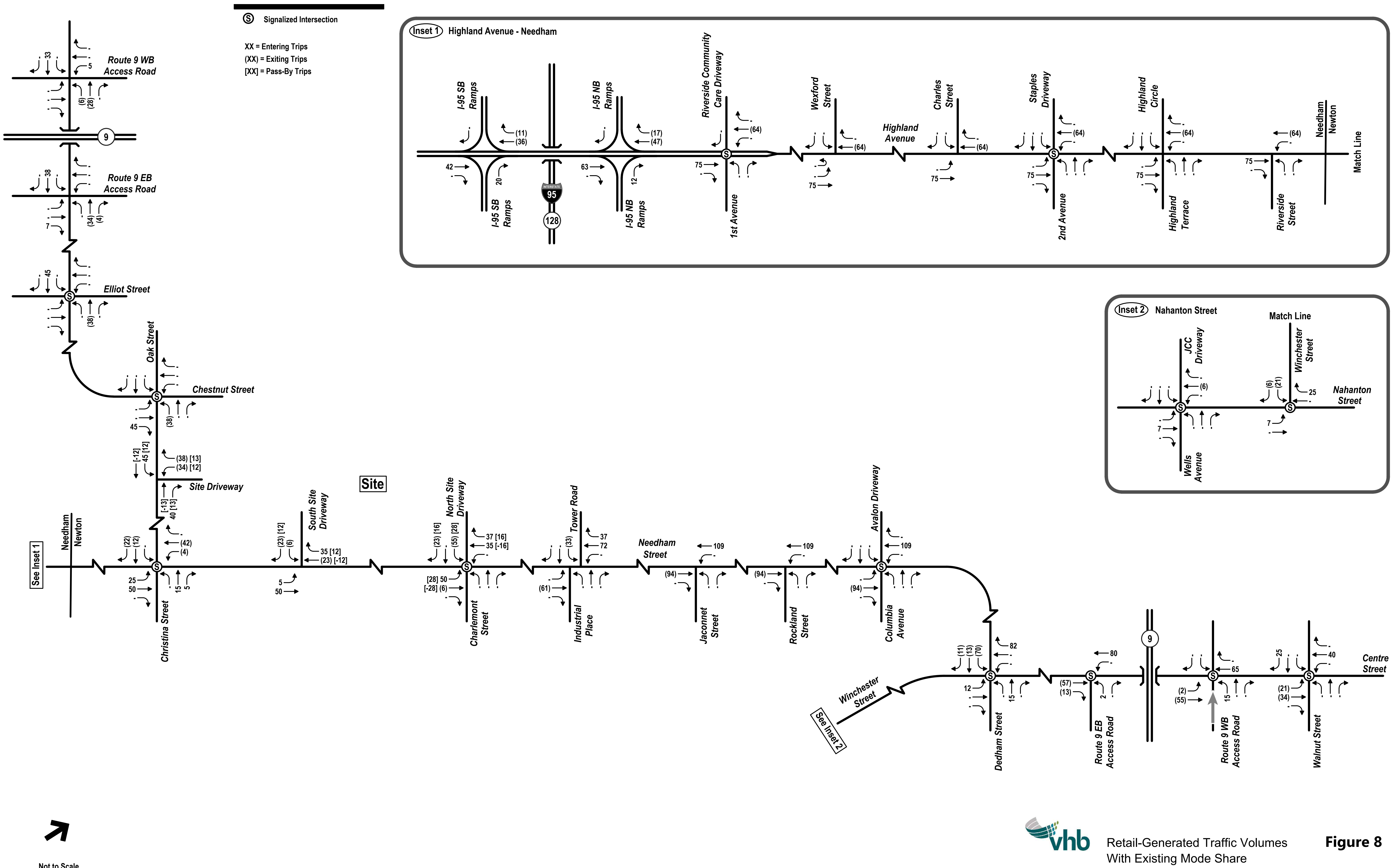
Ⓢ Signalized Intersection

XX = Entering Trips
(XX) = Exiting Trips
[XX] = Pass-By Trips



Office-Generated Traffic Volumes
With Existing Mode Share
Saturday Midday Peak Hour
The Northland Newton Development

Figure 7



Retail-Generated Traffic Volumes
With Existing Mode Share
Saturday Midday Peak Hour
The Northland Newton Development

Figure 8

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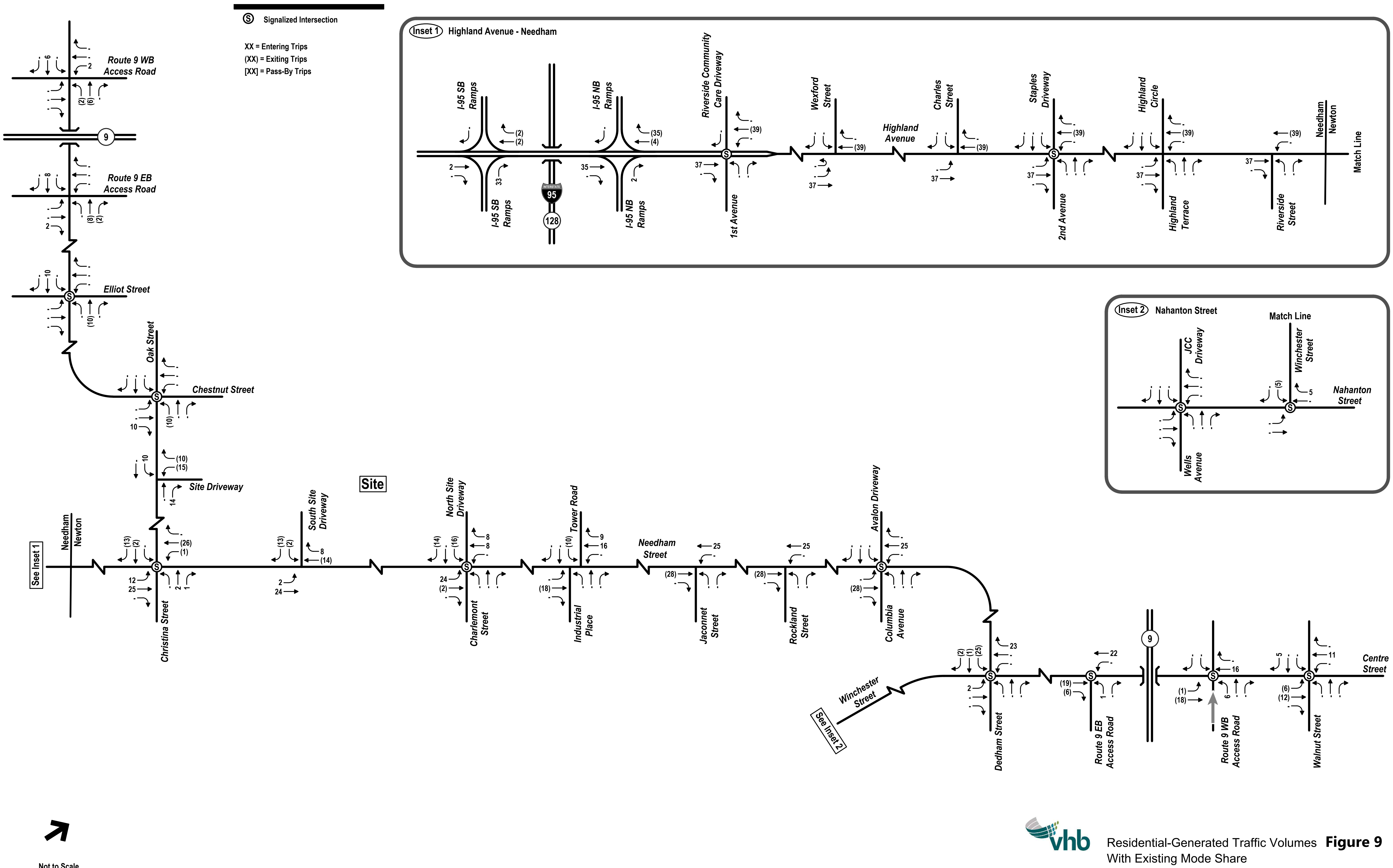
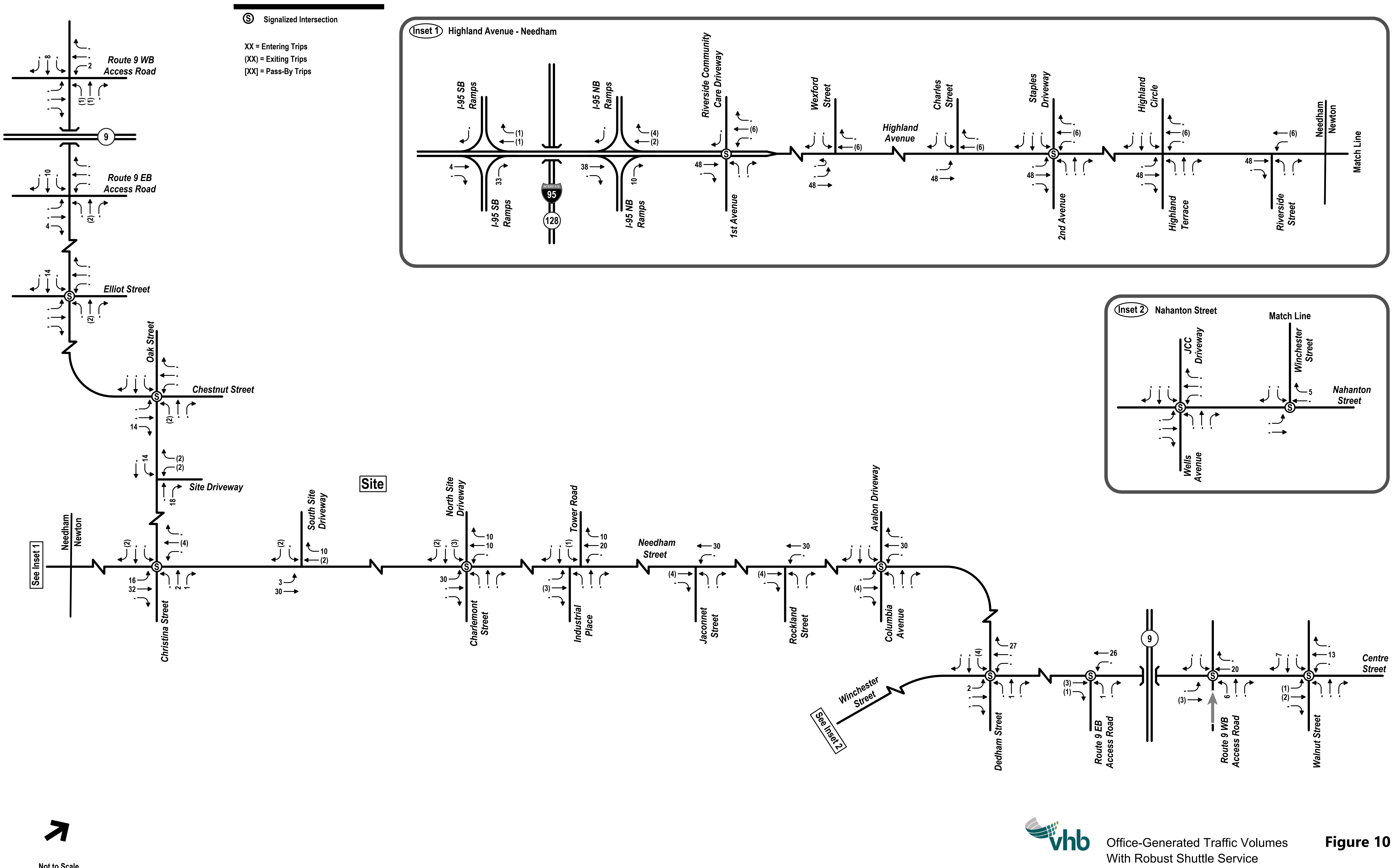


Residential-Generated Traffic Volumes With Existing Mode Share
Saturday Midday Peak Hour
The Northland Newton Development

Figure 9



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Office-Generated Traffic Volumes
With Robust Shuttle Service
Weekday Morning Peak Hour
The Northland Newton Development

Figure 10

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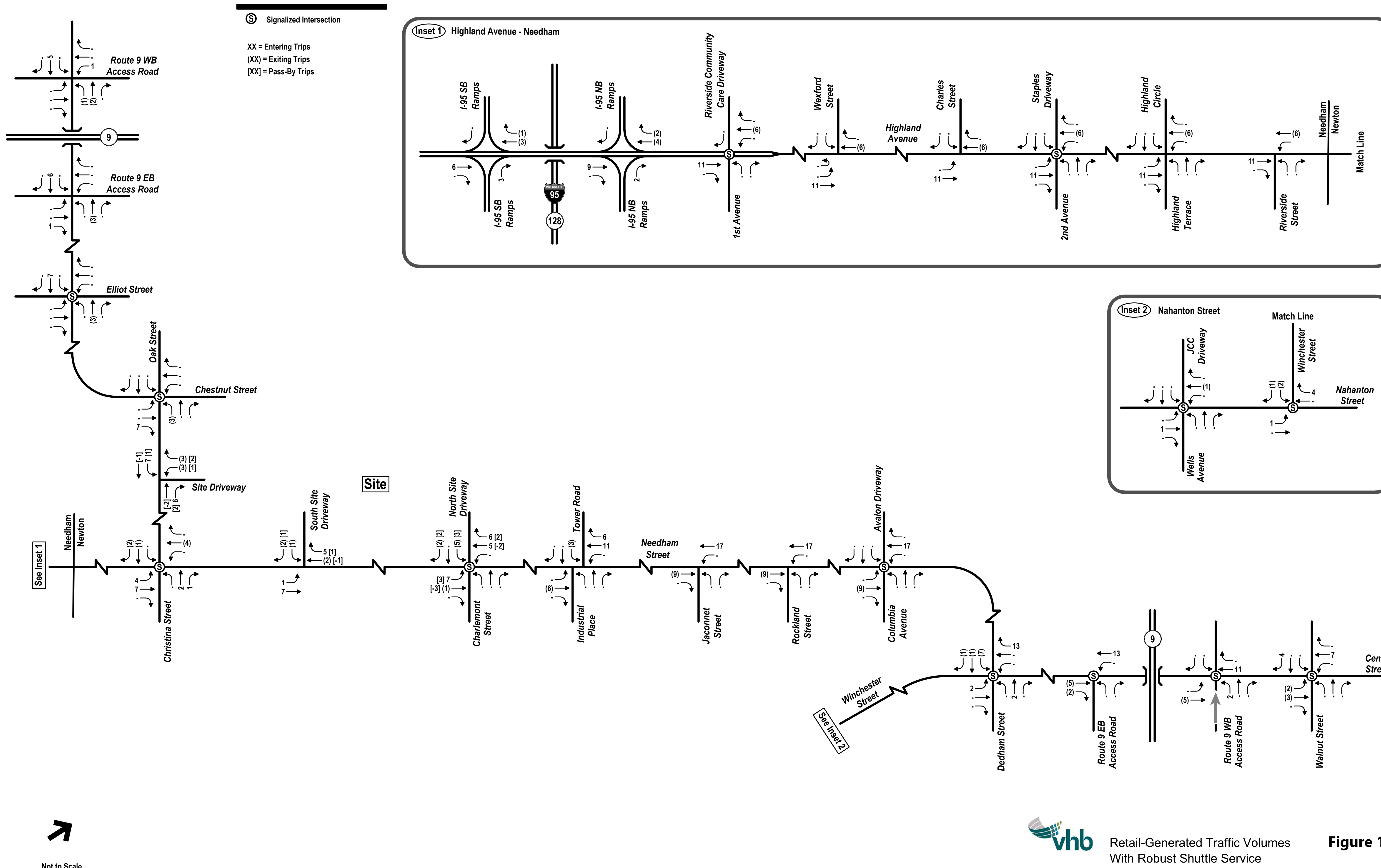
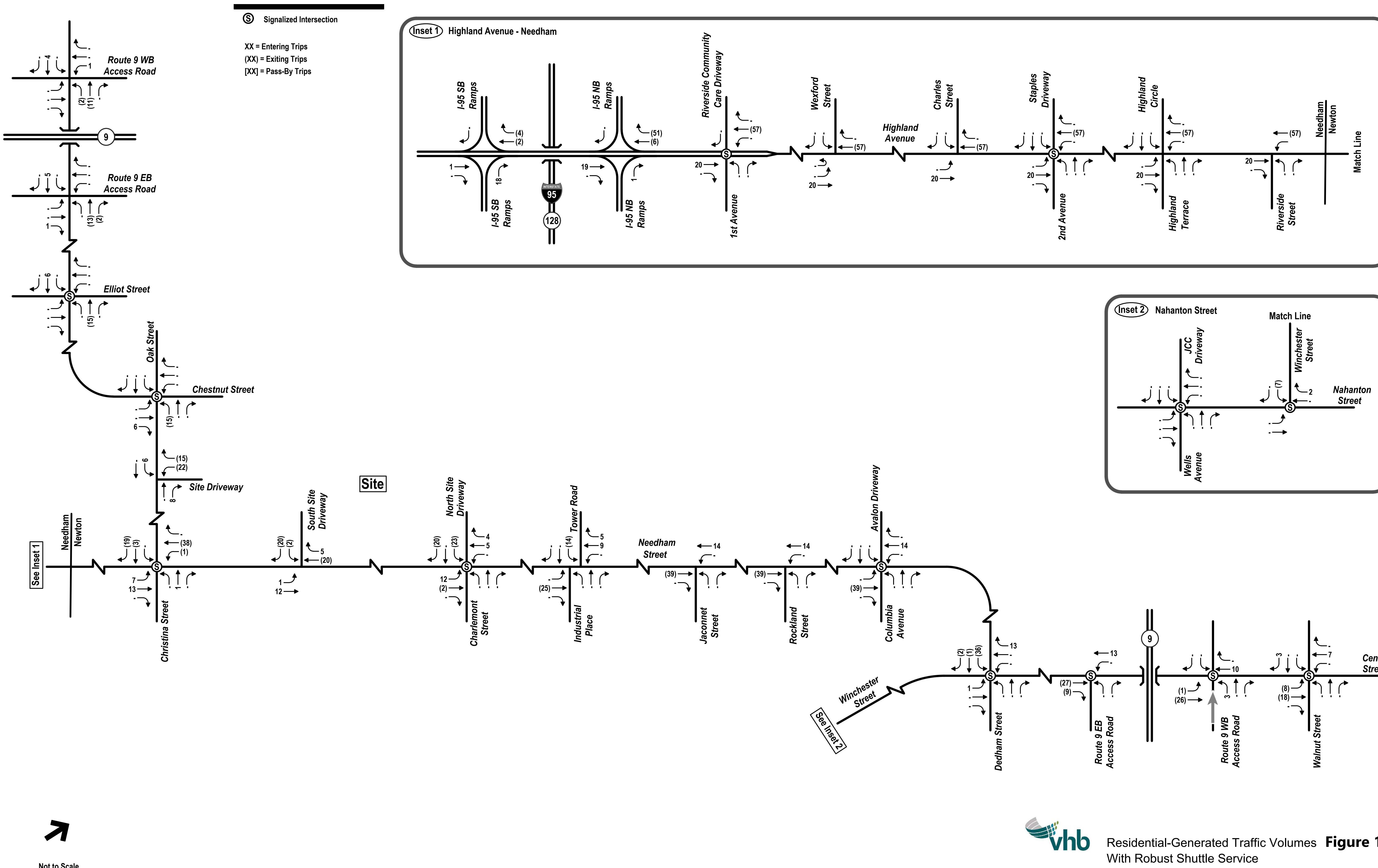


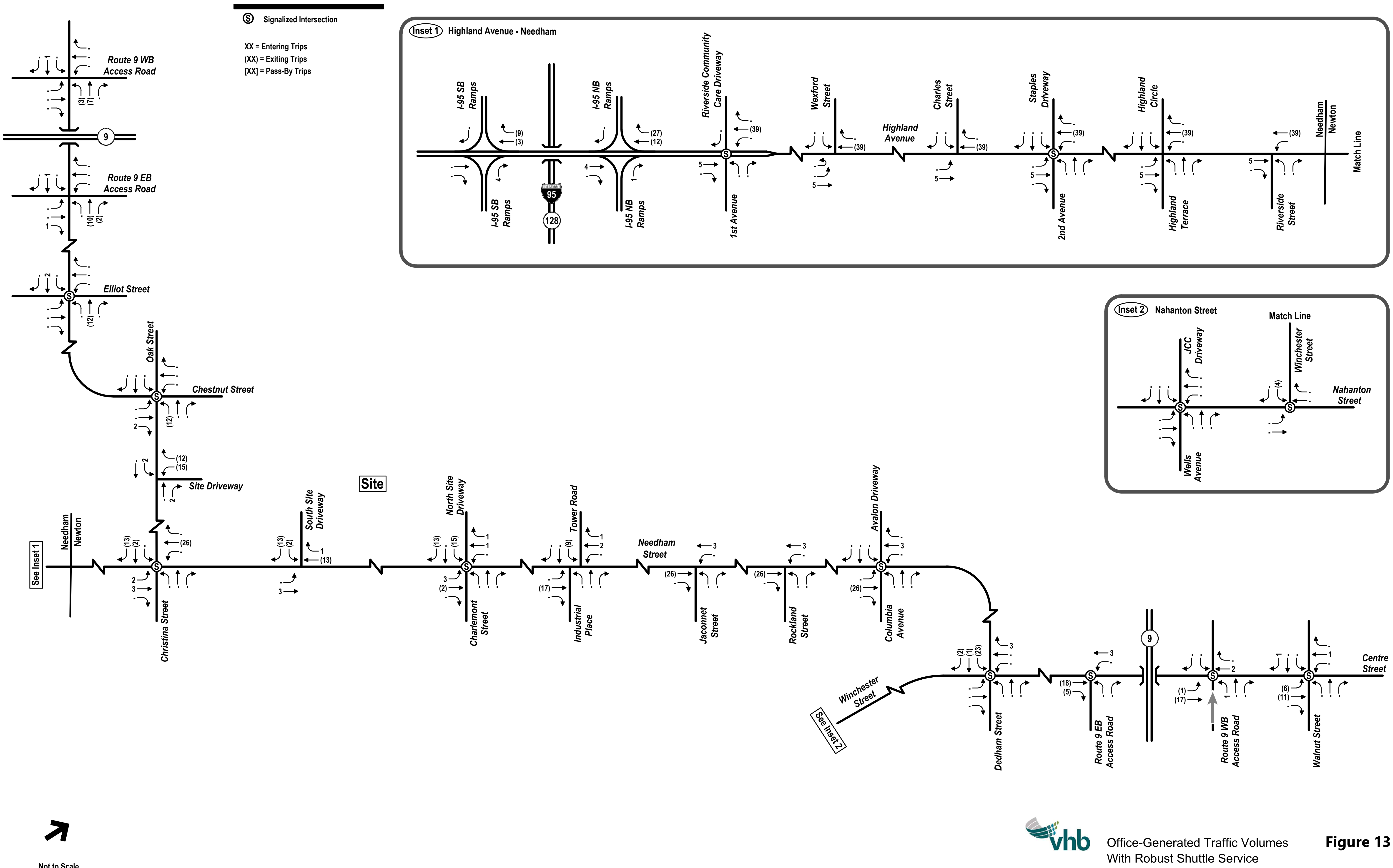
Retail-Generated Traffic Volumes
With Robust Shuttle Service
Weekday Morning Peak Hour
The Northland Newton Development

Figure 11



Residential-Generated Traffic Volumes With Robust Shuttle Service
Weekday Morning Peak Hour
The Northland Newton Development

Figure 12



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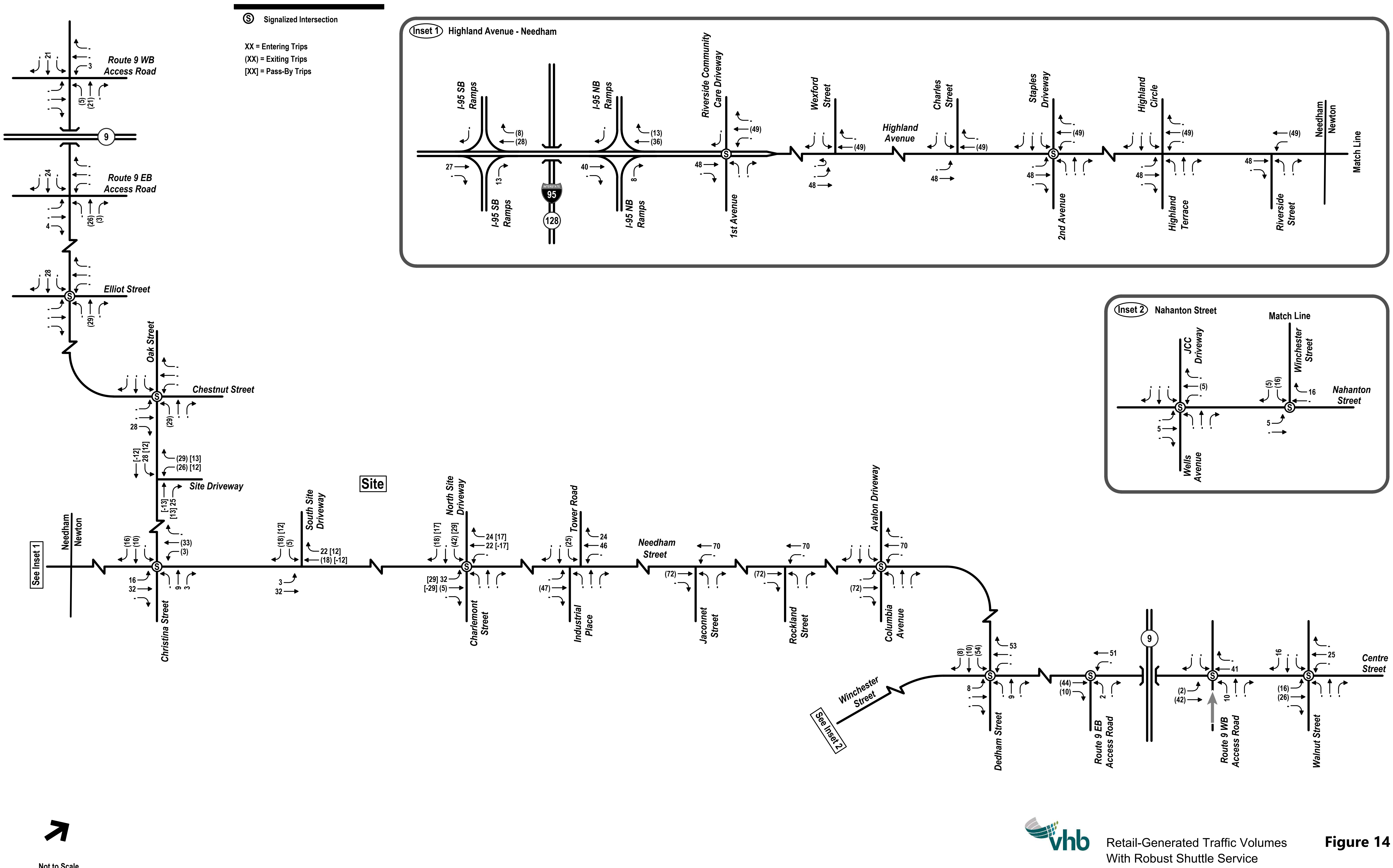
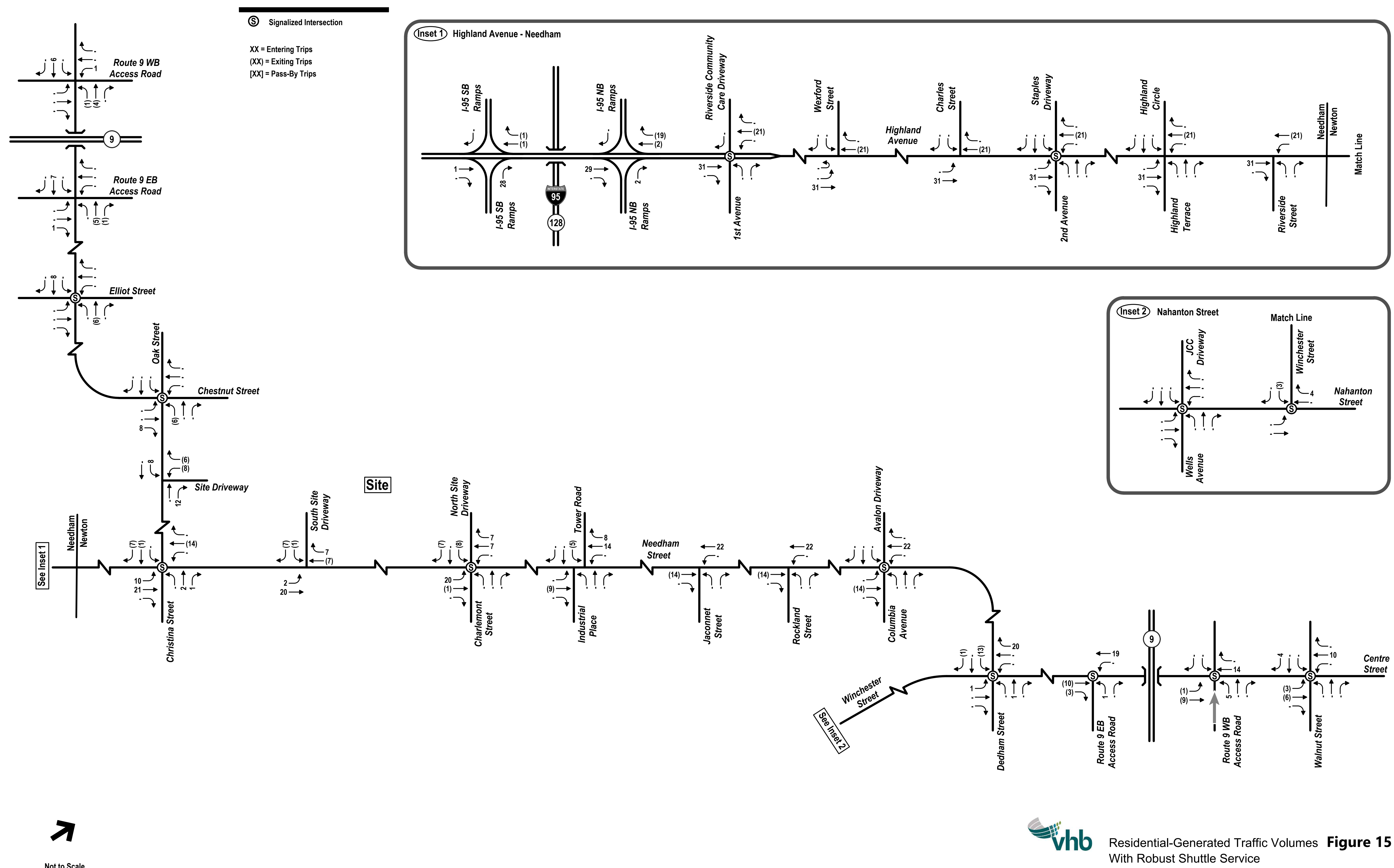
Office-Generated Traffic Volumes
With Robust Shuttle Service
Weekday Evening Peak Hour
The Northland Newton Development

Figure 13



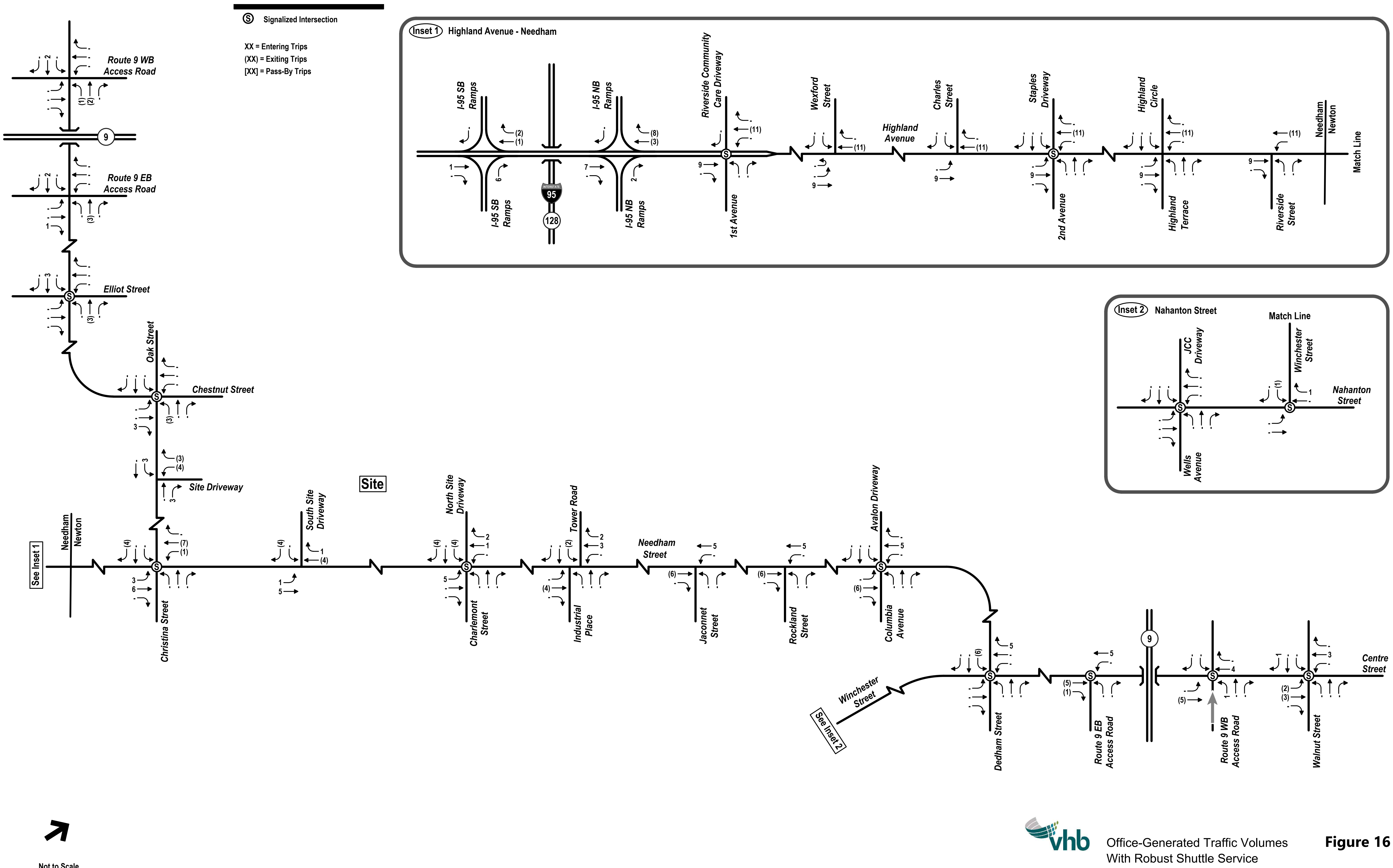
Retail-Generated Traffic Volumes
With Robust Shuttle Service
Weekday Evening Peak Hour
The Northland Newton Development

Figure 14



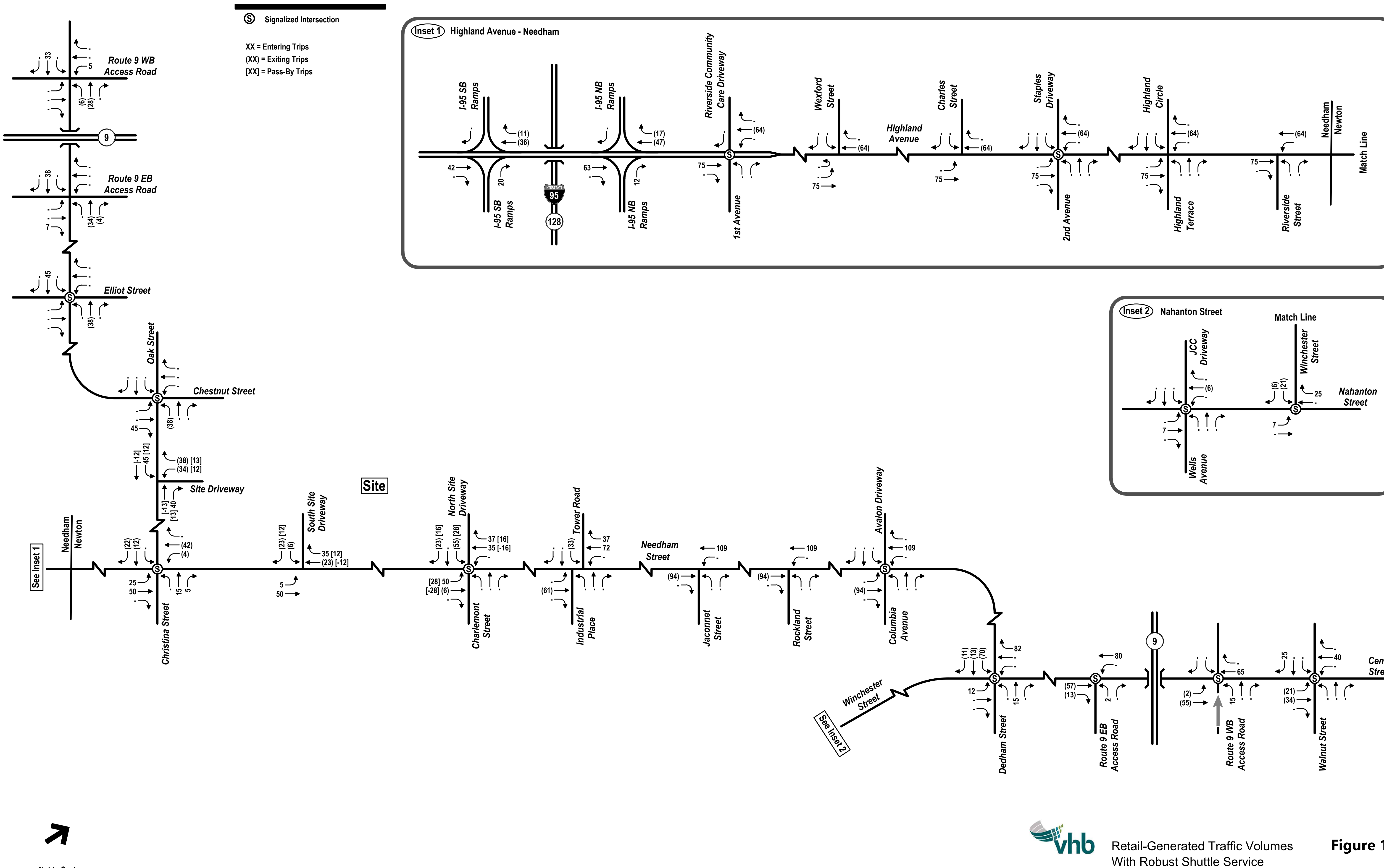
Residential-Generated Traffic Volumes With Robust Shuttle Service
Weekday Evening Peak Hour
The Northland Newton Development

Figure 15



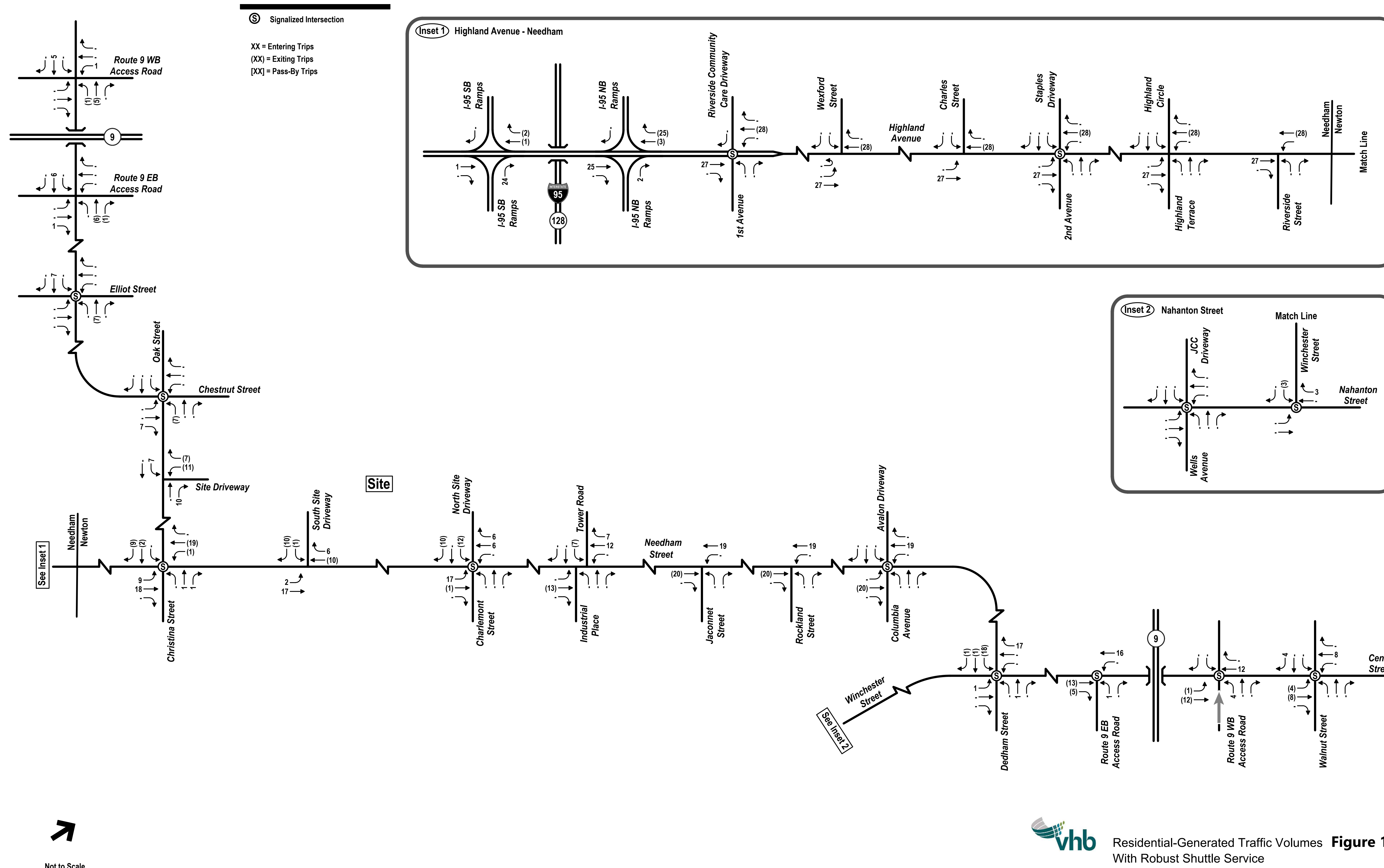
Office-Generated Traffic Volumes
With Robust Shuttle Service
Saturday Midday Peak Hour
The Northland Newton Development

Figure 16



Retail-Generated Traffic Volumes
With Robust Shuttle Service
Saturday Midday Peak Hour
The Northland Newton Development

Figure 17



Residential-Generated Traffic Volumes **Figure 18**
With Robust Shuttle Service
Saturday Midday Peak Hour
The Northland Newton Development

Table 1 Unsignalized Intersection Capacity Analysis – Oak Street at Site Driveway with Modification

	2025 Build Conditions With Existing Mode Share				
Location / Movement	D [a]	v/c [b]	Del [c]	LOS [d]	95 Q [e]
5: Oak Street at Site Driveway / Saco Street					
Weekday Morning					
EB L/T/R (Saco Street)	10	0.04	18	C	3
WB L (Site Driveway)	40	0.23	29	D	20
WB T/R (Site Driveway)	30	0.06	12	B	5
NB L (Oak Street)	5	0.01	8	A	0
SB L (Oak Street)	40	0.04	9	A	3
Weekday Evening					
EB L/T/R (Saco Street)	10	0.04	20	C	3
WB L (Site Driveway)	75	0.44	38	E	50
WB T/R (Site Driveway)	65	0.12	12	B	10
NB L (Oak Street)	5	0.01	8	A	0
SB L (Oak Street)	55	0.06	9	A	5
Saturday Midday					
EB L/T/R (Saco Street)	10	0.05	21	C	3
WB L (Site Driveway)	75	0.47	43	E	55
WB T/R (Site Driveway)	65	0.11	11	B	10
NB L (Oak Street)	5	0.01	8	A	0
SB L (Oak Street)	70	0.07	9	A	5

a Demand.
b Volume to capacity ratio.
c Average total delay, in seconds per vehicle.
d Level-of-service.
e 95th percentile queue, in feet.

Intersection	
Int Delay, s/veh	2.1

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Vol, veh/h	5	0	5	40	0	30	5	440	50	40	405	5
Future Vol, veh/h	5	0	5	40	0	30	5	440	50	40	405	5
Conflicting Peds, #/hr	0	0	0	4	0	0	0	0	3	3	0	0
Sign Control	Stop	Stop	Stop	Stop	Stop	Stop	Free	Free	Free	Free	Free	Free
RT Channelized	-	-	None	-	-	None	-	-	None	-	-	None
Storage Length	-	-	-	100	-	-	-	-	-	-	-	-
Veh in Median Storage, #	-	0	-	-	0	-	-	0	-	-	0	-
Grade, %	-	0	-	-	0	-	-	0	-	-	0	-
Peak Hour Factor	92	92	92	92	92	92	92	92	92	92	92	92
Heavy Vehicles, %	2	2	2	0	2	0	2	1	1	1	1	2
Mvmt Flow	5	0	5	43	0	33	5	478	54	43	440	5

Major/Minor	Minor2			Minor1			Major1			Major2		
Conflicting Flow All	1063	1076	447	1056	1052	508	446	0	0	536	0	0
Stage 1	530	530	-	519	519	-	-	-	-	-	-	-
Stage 2	533	546	-	537	533	-	-	-	-	-	-	-
Critical Hdwy	7.12	6.52	6.22	7.1	6.52	6.2	4.12	-	-	4.11	-	-
Critical Hdwy Stg 1	6.12	5.52	-	6.1	5.52	-	-	-	-	-	-	-
Critical Hdwy Stg 2	6.12	5.52	-	6.1	5.52	-	-	-	-	-	-	-
Follow-up Hdwy	3.518	4.018	3.318	3.5	4.018	3.3	2.218	-	-	2.209	-	-
Pot Cap-1 Maneuver	201	219	612	205	227	569	1114	-	-	1037	-	-
Stage 1	533	527	-	544	533	-	-	-	-	-	-	-
Stage 2	531	518	-	532	525	-	-	-	-	-	-	-
Platoon blocked, %								-	-		-	-
Mov Cap-1 Maneuver	181	205	610	193	213	568	1110	-	-	1037	-	-
Mov Cap-2 Maneuver	181	205	-	193	213	-	-	-	-	-	-	-
Stage 1	530	498	-	539	528	-	-	-	-	-	-	-
Stage 2	498	514	-	497	496	-	-	-	-	-	-	-

Approach	EB	WB	NB	SB
HCM Control Delay, s	18.4	21.6	0.1	0.8
HCM LOS	C	C		

Minor Lane/Major Mvmt	NBL	NBT	NBR	EBLn1	WBLn1	WBLn2	SBL	SBT	SBR
Capacity (veh/h)	1110	-	-	279	193	568	1037	-	-
HCM Lane V/C Ratio	0.005	-	-	0.039	0.225	0.057	0.042	-	-
HCM Control Delay (s)	8.3	0	-	18.4	29	11.7	8.6	0	-
HCM Lane LOS	A	A	-	C	D	B	A	A	-
HCM 95th %tile Q(veh)	0	-	-	0.1	0.8	0.2	0.1	-	-

Intersection	
Int Delay, s/veh	4

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Vol, veh/h	5	0	5	75	0	65	5	405	60	55	415	5
Future Vol, veh/h	5	0	5	75	0	65	5	405	60	55	415	5
Conflicting Peds, #/hr	0	0	0	0	0	0	0	0	6	6	0	0
Sign Control	Stop	Stop	Stop	Stop	Stop	Stop	Free	Free	Free	Free	Free	Free
RT Channelized	-	-	None	-	-	None	-	-	None	-	-	None
Storage Length	-	-	-	100	-	-	-	-	-	-	-	-
Veh in Median Storage, #	-	0	-	-	0	-	-	0	-	-	0	-
Grade, %	-	0	-	-	0	-	-	0	-	-	0	-
Peak Hour Factor	92	92	92	92	92	92	92	92	92	92	92	92
Heavy Vehicles, %	2	2	2	0	2	0	2	1	1	1	1	2
Mvmt Flow	5	0	5	82	0	71	5	440	65	60	451	5

Major/Minor	Minor2			Minor1			Major1			Major2		
Conflicting Flow All	1092	1095	454	1066	1066	479	457	0	0	511	0	0
Stage 1	573	573	-	490	490	-	-	-	-	-	-	-
Stage 2	519	522	-	576	576	-	-	-	-	-	-	-
Critical Hdwy	7.12	6.52	6.22	7.1	6.52	6.2	4.12	-	-	4.11	-	-
Critical Hdwy Stg 1	6.12	5.52	-	6.1	5.52	-	-	-	-	-	-	-
Critical Hdwy Stg 2	6.12	5.52	-	6.1	5.52	-	-	-	-	-	-	-
Follow-up Hdwy	3.518	4.018	3.318	3.5	4.018	3.3	2.218	-	-	2.209	-	-
Pot Cap-1 Maneuver	192	214	606	202	222	591	1104	-	-	1059	-	-
Stage 1	505	504	-	564	549	-	-	-	-	-	-	-
Stage 2	540	531	-	506	502	-	-	-	-	-	-	-
Platoon blocked, %								-	-		-	-
Mov Cap-1 Maneuver	158	196	606	187	203	588	1104	-	-	1059	-	-
Mov Cap-2 Maneuver	158	196	-	187	203	-	-	-	-	-	-	-
Stage 1	502	466	-	558	543	-	-	-	-	-	-	-
Stage 2	472	525	-	463	464	-	-	-	-	-	-	-

Approach	EB	WB	NB	SB
HCM Control Delay, s	20	26.1	0.1	1
HCM LOS	C	D		

Minor Lane/Major Mvmt	NBL	NBT	NBR	EBLn1	WBLn1	WBLn2	SBL	SBT	SBR
Capacity (veh/h)	1104	-	-	251	187	588	1059	-	-
HCM Lane V/C Ratio	0.005	-	-	0.043	0.436	0.12	0.056	-	-
HCM Control Delay (s)	8.3	0	-	20	38.3	12	8.6	0	-
HCM Lane LOS	A	A	-	C	E	B	A	A	-
HCM 95th %tile Q(veh)	0	-	-	0.1	2	0.4	0.2	-	-

Intersection	
Int Delay, s/veh	4.3

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Vol, veh/h	5	0	5	75	0	65	5	345	70	70	470	5
Future Vol, veh/h	5	0	5	75	0	65	5	345	70	70	470	5
Conflicting Peds, #/hr	0	0	0	0	0	2	0	0	6	6	0	0
Sign Control	Stop	Stop	Stop	Stop	Stop	Stop	Free	Free	Free	Free	Free	Free
RT Channelized	-	-	None	-	-	None	-	-	None	-	-	None
Storage Length	-	-	-	100	-	-	-	-	-	-	-	-
Veh in Median Storage, #	-	0	-	-	0	-	-	0	-	-	0	-
Grade, %	-	0	-	-	0	-	-	0	-	-	0	-
Peak Hour Factor	92	92	92	92	92	92	92	92	92	92	92	92
Heavy Vehicles, %	2	2	2	0	2	0	2	0	0	0	0	2
Mvmt Flow	5	0	5	82	0	71	5	375	76	76	511	5

Major/Minor	Minor2			Minor1			Major1			Major2		
Conflicting Flow All	1127	1134	514	1098	1098	421	516	0	0	457	0	0
Stage 1	666	666	-	430	430	-	-	-	-	-	-	-
Stage 2	461	468	-	668	668	-	-	-	-	-	-	-
Critical Hdwy	7.12	6.52	6.22	7.1	6.52	6.2	4.12	-	-	4.1	-	-
Critical Hdwy Stg 1	6.12	5.52	-	6.1	5.52	-	-	-	-	-	-	-
Critical Hdwy Stg 2	6.12	5.52	-	6.1	5.52	-	-	-	-	-	-	-
Follow-up Hdwy	3.518	4.018	3.318	3.5	4.018	3.3	2.218	-	-	2.2	-	-
Pot Cap-1 Maneuver	182	203	560	192	213	637	1050	-	-	1114	-	-
Stage 1	449	457	-	607	583	-	-	-	-	-	-	-
Stage 2	581	561	-	451	456	-	-	-	-	-	-	-
Platoon blocked, %								-	-		-	-
Mov Cap-1 Maneuver	149	181	560	174	190	633	1050	-	-	1112	-	-
Mov Cap-2 Maneuver	149	181	-	174	190	-	-	-	-	-	-	-
Stage 1	446	413	-	600	577	-	-	-	-	-	-	-
Stage 2	512	555	-	404	412	-	-	-	-	-	-	-

Approach	EB	WB	NB	SB
HCM Control Delay, s	21.1	28.2	0.1	1.1
HCM LOS	C	D		

Minor Lane/Major Mvmt	NBL	NBT	NBR	EBLn1	WBLn1	WBLn2	SBL	SBT	SBR
Capacity (veh/h)	1050	-	-	235	174	633	1112	-	-
HCM Lane V/C Ratio	0.005	-	-	0.046	0.469	0.112	0.068	-	-
HCM Control Delay (s)	8.4	0	-	21.1	42.7	11.4	8.5	0	-
HCM Lane LOS	A	A	-	C	E	B	A	A	-
HCM 95th %tile Q(veh)	0	-	-	0.1	2.2	0.4	0.2	-	-

site revealed an annual growth rate of 0.5% for the study area. Although the Needham Street FDR was listed, no other developments were identified and no historic traffic data were provided to support this growth rate. **Therefore, the Applicant should provide this additional data to confirm the growth rate used within the study area.**

Response: *As stated above, the TIA used a 0.5-percent annual growth rate that was consistent with the 0.5-percent annual growth rate used in the Needham Street FDR, which was submitted in August 2017. In addition, the traffic studies for 2 Wells Avenue and 180 Wells Avenue (both included as background projects in the TIA) also used an annual growth rate of 0.5-percent. The studies for those two developments were submitted in May 2015 and August 2015, respectively. A review of historic count data on MassDOT's MS2 count portal indicates that traffic volumes have actually gone down in the study area in recent years. Based on the MassDOT MS2 data, traffic counts were conducted on Needham Street and Oak Street 2001 (the most recent year data is provided on these roadways) that showed approximately 25,200 vehicles traveled on Needham Street on a typical weekday and 12,000 vehicles traveled on Oak Street on a typical weekday. The 2018 existing conditions presented in the TIA showed that approximately 20,500 vehicles and 9,600 vehicles travel on Needham Street and Oak Street on a typical weekday, respectively. Since historic count data show that traffic has decreased between 2001 and 2018, using a 0.5-percent annual growth rate provides a conservative analysis.*

Comment 2.13: Traffic counts were collected in 2017 and adjusted to reflect 2018 traffic-volume conditions. As noted in Chapter 2 on pages 17 and 18 of The Northland Newton Development *Traffic Impact and Access Study*, improvements were implemented in 2018 at the Highland Avenue intersections with 1st Avenue and Riverside Community Health driveway, with the I-95 northbound ramps, and with the I-95 southbound ramps. These roadway improvements are not reflected in the 2018 existing traffic volumes, but are accounted for within the 2025 future traffic-volume conditions. While the existing conditions are not reflected accurately, the project's impacts are measured under future traffic-volume conditions (i.e., 2025 No-Build and 2025 Build) that have been evaluated appropriately with planned improvements implemented.

Agreed No response is required.

2.25 Safety Evaluation

Comment 2.14: In accordance with MassDOT *Transportation Impact Assessment Guidelines*, an RSA shall be conducted in the place of a safety review for those locations considered HSIP-eligible. Accordingly, the RSA should be completed during the early project stages to help identify appropriate improvements. **Since the Centre Street and Walnut Street intersection is a high crash location and is MassDOT HSIP eligible, the proposed RSA at this location should be conducted before the mitigation measures can be finalized.**

Response: *As stated in the TIA, an RSA will be conducted at this location prior to final mitigation program being established and prior to the Draft Environmental Impact Report (DEIR) being submitted* *through the MEPA process. Prior to the RSA, VHB will review crash data from the City of Newton Police Department to verify that the location does indeed exceed the threshold of a high crash cluster by determining the calculated Equivalent Property Damage Only (EDPO).*

Comment 2.15: Of these 12 high crash rate locations, no improvements are planned for the Chestnut Street and Oak Street intersection. **The Applicant should coordinate with the Newtown City Planner, the Newton City Engineer, and the Newton Police Department in identifying safety improvement measures that should be considered. For example, pedestrian crossing indications and signal equipment should be upgraded in conformance with current standards.**

Response: *See response to comment 2.6. The Applicant is proposing programmatic rather than physical mitigation as a more effective strategy in mitigating the effect of the Applicant's project.*

2.2.6 Vehicle Speeds

Comment 2.16: The average vehicle travel speed through much of the corridor during the Weekday Midday and Weekday PM peak period was found to be approximately 4-5 miles per hour. The travel times confirm that the Needham Street corridor experiences significant congestion during the Weekday Midday peak period. **Due to these oversaturated conditions along the corridor, a software program (e.g., SimTraffic) should be used that evaluates operations along a corridor instead of at individual intersections (Synchro) as was presented in the traffic study (see Comment 2.24).**

Response: *The Applicant has acknowledged the congestion along this corridor (see Comment 2.24), therefore further review and modeling of the congestion is not considered a productive exercise at this time.*

2.3 Future Conditions

Comment 2.17: **While we concur that the seven-year design horizon is considered to be the typical future time period to evaluate traffic conditions in Massachusetts, the Applicant should confirm that the proposed development will not be phased and the full build-out of the project is expected to be completed by 2025. Should the Northland Newton Development be phased and/or not completed by 2025, then the project's impacts will need to be evaluated under other design horizons.**

Response: *Agreed. At this time the project is anticipated to be completed within the future horizon established. Should it be determined that phasing is desired or extended construction necessary, supplemental analyses can be provided to demonstrate operations of such.*

2.3.1 Background Traffic Growth

Comment 2.18: As previously stated (Comment 2.11), any developments constructed and occupied subsequent to the 2017 traffic counts (and not listed above) that would generate traffic within the study area should be included. In addition, and in accordance with MassDOT guidelines, developments that generated traffic within the past 2 years but are currently vacant can be accounted for as being re-occupied with by-right uses (either based on the traffic studies prepared for those projects or estimated using ITE methodologies). If the vacant space within the existing site was unoccupied for more than 2 years from the date of the traffic study, however, then a vehicle trip credit cannot be made for re-occupancy of the existing site with by-right uses. **Therefore, the Applicant should confirm how long the existing space on the site has been vacant.**

Response: *The office space on-Site is currently vacant and was vacant in 2017 during the time of the traffic counts. However, the lease for C&J Clarks America, Inc. (Clarks Shoes) ran through the end of December 2016. The lease on the office space was occupied within 2 years of when the traffic counts were conducted and when the TIA was submitted to the City of Newton, as well as within two years of the submission of the Environmental Notification Form (ENF) to MEPA and MassDOT (August 2017).*

2.3.3.3 Mode Share Splits

Comment 2.19: There is an issue for the reported *Private Vehicle* estimates for 2010 (82%) compared to 2015 (72%); the Applicant should determine the reason for this discrepancy. Table 4 indicates that *Transit* mode share is slightly less than that reported in the traffic study, while *Walk/Bike* is slightly higher; however, what is most interesting is that the *Worked at Home* category is comparable to both *Transit* and *Walk/Bike* and is about twice that of the region. **The Applicant should use the 2015 U.S. Census data for any additional analysis; this would also be consistent with the Needham Street Area Vision Plan, page 25-25 (see Comment 3.2).**

Response: *The 2105 Census data will result in a lower level of projected traffic generation from the project. This can be recalculated if the Planning Department requests revised projections*

Comment 2.20: The mode share percentages for the proposed residential trips were based on the data associated with Newton residents. In addition, the mode share percentages for the proposed office trips were based on the data associated with those people working in Newton. While this methodology is in conformance with standard traffic engineering practice, the rationale for the mode share percentages associated with the proposed retail trips was not provided in The Northland Newton Development *Traffic Impact and Access Study* (90% vehicle, 5% transit, and 5% walk/bike). **Therefore, support should be provided for the selected mode share used for the retail portion of the proposed development.**

Response: *The mode share percentages used for the retail portion of the proposed development are consistent with the 2017 National Household Travel Survey (NHTS) developed by the US Department of Transportation (provided in the Attachments). The NHTS is a national survey that collects detailed data on personal travel throughout the country. According to the most recent data provided by the NHTS, the mode shares for all trips generated for the purpose of shopping or running errands was approximately 88.5% by private vehicle, 1.8% by public transit, 8.1% by walking, and 1.7% by other modes of transportation. In the TIA, a slightly more conservative* *private vehicle mode share of 90% was used, and a higher public transit mode share of 5% was used due to the proximity of public transportation option in the area.*

As proposed, the development would include a robust shuttle bus program with direct connections to nearby transit stations and to Cambridge and Boston. This scenario was referred to as "Build Condition with Robust Shuttle Service" that assumed the following modal splits:

- *Residential and Office Trips:*
    - *60% by vehicle*
    - *30% by transit*
    - *10% by walking/bicycling*
- *Retail Trips (consistent with the "Build Condition with Existing Mode Share" condition):*
    - *90% by vehicle*
    - *5% by transit*
    - *5% by walking/bicycling*

Comment 2.21: While an improved or newly implemented transit system can reduce the number of vehicles on the roadway, the methodology for determining these theoretical mode share percentages was not provided in The Northland Newton Development *Traffic Impact and Access Study*. **Therefore, support should be provided for the estimated mode share percentages.**

Response: *As described through email transactions during the early stages of the peer review, there is not good data that we are aware of that fully support the percentages outlined. However, we did provide the City and BETA with the Kevin Hooper paper "The Effect of Transit Service on Trips Generated by Suburban Development" (attached) as a reference point as it does provide some antidotal information but nothing solid. For these reasons we choose to provide two future condition assessments of project impacts; 1. With Robust Shuttle Service; 2. With Existing Mode Share. That is described on Pages 50-51 of the report. The reality is that the actual is likely to be something in-between the existing and that represented under the Robust Shuttle scenario. We really feel that this project will be an exemplary one that is seeking to move the needle on transit opportunities for the uses on site and also for our commercial and residential neighbors. The approach is unique and coupled with the proposed mobility hub, pedestrian and bicycle initiatives is highly consistent with the Needham Street Area Vision Plan and with directives outlined in the MassDOT TIA requirements. The Applicant proposes to maintain continuing review of the operation and effect of its mitigation strategy and to adjust over time as appropriate to mitigate traffic impacts. It is expected that a post-construction condition will be attached to the special permit.*

2.3.3.5 Project-Generated Trips-Build Conditions

The next step in determining the site-generated trip impacts on the adjacent roadway system was to apply the mode share splits to the person trips and then to recalculate these values back to vehicle trips from person trips.

Comment 2.22: Since these calculations were not provided in the Appendix of The Northland Newton Development *Traffic Impact and Access Study*, BETA attempted to confirm the numbers provided in Tables 7 through 10. Based on our estimates, we have found differing values than as presented in the traffic study. **Therefore, the breakdown of the calculations used to generate the values presented in these tables should be provided for review.**

Response: *VHB's calculations for converting the person trips back into vehicle trips with the mode share splits were provided to BETA in an email on December 7, 2018 and are attached hereto.*

2.3.3.6 Trip Distribution

Trips were assigned to the study area based on existing traffic patterns, population densities, places of employment, and the type and efficiency of the nearby roadway system. Since the different components of the proposed mixed-use development (residential, office, and retail) have varying characteristics, the U.S. Census Data were used to estimate a trip-distribution of the proposed residential and office site trips. For the proposed retail component of the overall development, travel patterns are anticipated to be similar to those within the study area due to the existing commercial nature of nearby land uses. **BETA finds this methodology to be reasonable.**

Comment 2.23: Upon review of the site-generated networks provided in the Appendix of The Northland Newton Development *Traffic Impact and Access Study*, the proposed residential, office, and retail site trips were combined into the same figures. **Due to the different distribution patterns used for the three components of the proposed mixed-use development, the individual site-generated peak-hour traffic volumes should be provided on separate figures for the proposed residential, office, and retail site trips.**

Response: *Separate figures for the residential, office, and retail site trips have been prepared and are included in the Attachments. VHB believes that the data and conclusions remain valid.*

2.4 INTERSECTION ANALYSES

Comment 2.24: Due to the limitations of the software program used as part of the traffic study, the queue results are not accurately modeled. **Therefore, a different software program should be used to properly determine queue lengths at the signalized intersections along the Needham Street/Highland Avenue corridor within the study area between 2nd Avenue/Staples Driveway and Winchester Street.** A computer program to consider is SimTraffic software, also a MassDOT analytical tool, that accounts for these factors of delay and constrained intersections (i.e., vehicles that may not reach a downstream intersection due to spillback conditions). The SimTraffic software performs micro-simulation and animation of vehicular traffic. With SimTraffic, individual vehicles are modeled and displayed traveling through a roadway network.

In addition, the signalized intersections appear to provide lower lane group delays in The Northland Newton Development *Traffic Impact and Access Study* presented than are experienced in the field. Based on the travel time runs along the Highland Avenue/Needham Street corridor (see Section 2.2.6 – Vehicle Speed Study), the average vehicle travel speed through much of the corridor during the Weekday Midday and Weekday PM peak period was found to be approximately 4-5 miles per hour.

In VHB's January 4, 2019 letter to Ms. Jennifer Caira, Newton Chief Planner, the Applicant provides "There is no dispute that the corridor is saturated at certain hours, so differing opinions on how much are not useful;" Since VHB has agreed that the Needham Street corridor is congested, using a different computer model to analyze intersection operations would only further demonstrate the saturated conditions. Therefore, BETA recommends that additional corridor analyses not be provided at this time but has identified additional mitigation measures shown below (Comment 2.27) to reduce the impact of the project and improve traffic operations along the Needham Street and Winchester Street corridors and at other study intersections.

Response: *The Proponent has acknowledged the congestion along this corridor, therefore further review and modeling of the congestion is superfluous. Should the city require additional modeling in the future, the Proponent will consider providing.*

Comment 2.25: As stated in the Synchro User Guide, when the defacto left-turn lane ("dl") indication is listed for a shared left-turn/through lane on a multi-lane approach, that shared lane is experiencing congestion that exceeds the level of the other through lanes. Since the Synchro computer program does not model this situation correctly, the user is required to manually change the shared lane into an exclusive left-turn lane. Based on a review of the signalized intersection analyses, the Highland Avenue westbound approach to the signalized intersection with 2nd Avenue and Staples Driveway includes the "dl" indication under 2018 Existing, 2025 No-Build, and 2025 Build traffic-volume conditions during the Weekday AM peak hour (Tables 16 and in the Appendix). **Therefore, this intersection should be reanalyzed under existing and future conditions during the Weekday AM peak hour with the Highland Avenue westbound approach modeled as an exclusive left-turn lane and a shared through/right-turn lane.**

Response: *The intersection will be reanalyzed with the westbound approach modeled as an exclusive left-turn lane and a shared through/right-turn lane as part of the DEIR during the MEPA submission.*

Comment 2.26: Based on a review of the capacity analysis worksheets provided in the Appendix, it was noted that the traffic signal splits and phases at the Highland Avenue, 2nd Avenue, and Staples Driveway intersection appear to be incorrect under future traffic-volume conditions. For Phase 2 (Highland Avenue westbound approach) and Phase 6 (Highland Avenue eastbound approach) permissive phase, the green time for Phase 2 should be extended to end at the same time as Phase 6. **Therefore, this intersection should be reanalyzed with this adjustment to the traffic signal parameters.**

<u>Response:</u> *The intersection will be reanalyzed with this adjustment to the traffic signal parameters as part of the DEIR during the MEPA submission.*

2.5 MITIGATION

Comment 2.27: **Since these intersections satisfy MassDOT's criteria for locations with significant impact as a result of a proposed development, the Applicant should develop improvement measures for these study area intersections (also see Comment 10.2). The following traffic mitigation measures are recommended:**

<u>Response:</u> *MassDOT's criteria for project impacts may indeed be met, but the guidelines say that "the Proponent must assess options to mitigate impacts" . The MassDOT mitigation requirements provide emphasis on mitigation initiatives that provide alternatives to reducing traffic and reliance single occupancy vehicle travel. The Northland Newton development is proposing active mitigation by creating a privately owned, publicly available transit system looking forward in the 21st Century rather than exclusively accommodating more vehicles. This approach is recognized in several key areas of the MassDOT TIA Guidelines referenced below as examples:*

From the TIA Guidelines Purpose & Policy Context (statement)
As outlined in the document, "MassDOT seeks to ensure that the transportation impact review process reflects and advances the Commonwealth of Massachusetts's policy goals, in particular those that promote MassDOT's Project Development and Design Guide standards on Complete Streets, the Global Warming Solutions Act, the Massachusetts GreenDOT Policy Initiative, the Mode Shift Initiative, the Healthy Transportation Compact, the Healthy Transportation Policy Directive, and the Massachusetts Ridesharing Regulation. These goals work together to mutually reinforce one another and strengthen the Commonwealth's efforts to <u>reduce its dependence on driving</u>

From Section IV Performance*:*

> *B. Vehicular operations*
>
> *Impacts to elements of the transportation system (e.g intersections, ramps terminals) are generally determined by the technical analysis described above (e.g. vehicular operations at intersections, safety assessment of crashes). The analysis typically indicates when impacts result from the proposed development, but the location and mode of the impacts does not necessarily dictate the optimal location or mode for mitigation. The Proponent is encouraged to work closely with MassDOT to determine the best locations and <u>modes</u> to target for mitigation*

C. Bicycle, Pedestrian, and Transit Modes

1. The TIA should include an assessment of the mode split assumptions, as well as the Proponent's plan to maximize travel choice, promote non-single occupancy vehicle modes, and achieve the assumed mode shares.

2. If a facility is impacted by the Proponent's trips and the facility has an access or accommodation deficiency in the mode under review (bicycle, pedestrian, transit), the Proponent must assess options to facility safe, convenient, and attractive access via these modes.

3. In location where transit facilities are not available, the Proponent shall evaluate and document needs, origins and destinations, and opportunities to provide transit service or connections.

From Section 4 Mitigation

This section provides an overview of the mitigation analysis process and typical mitigation measures that may be considered. The Proponent is required to propose and justify recommended project mitigation based on the context of the project, the location, existing conditions, and other relevant considerations.

I Mitigation Analysis

Attract trips to a site that fails to provide adequate pedestrian, bicycle, or public transit access, the Proponent is required to commit to a mitigation program that demonstrates the following:

1. *The Proponent has identified and evaluated a set of potential mitigation alternatives, including improvements to pedestrian, bicycle, and public transit access, as well as a range of geometric and operational improvements for traffic.*
2. *The commitment program mitigates impacts of the proposed development in a manner that enhances walking, bicycling, and public transit access to the project site and avoids further degradation to the traffic performance of the transportation system by the time of development in a manner that meets the following conditions:*
    a. *The transportation impacts of the proposal are mitigated to the most practical degree possible through transportation improvements or measures that directly address the transportation impacts of the development and/or the inadequacy of walking, bicycling, or public transit access.*
    b. *An effective transportation demand management (TDM) program is prepared and fully funded.*
    c. *The overall benefits of the development outweigh it unresolved impacts.*

As you can see from the examples provided, the MassDOT guidelines are broad and favor mitigation that is geared toward giving people options for access to a project. MassDOT and the City of Newton have a major reconstruction project proposed along the Needham Street corridor.

That project is expected to start construction in Fall of this year. The project is basically improving the operations and safety along the corridor to the extent practical and feasible. There will be substantial pedestrian and bicycle enhancements as part of the project that the proponent will tie into and bolster in many areas of the site and surroundings. Since the state is proposing a substantial infrastructure enhancement within the right of way that exists in the vicinity of the site, the Proponent has focused mitigation dollars on non-traditional (non-infrastructure) initiatives geared to addressing the demand side of the transportation equation. These include a robust privately owned and publicly available shuttle bus system for local and regional connections, integrated with a reduced supply of parking, a host of pedestrian and bicycle improvements, and a transportation hub onsite to focus and locate multi-modal access to the site. The project initiatives are consistent with the Needham Street Vision Plan 2018 and highly consistent with MassDOT mitigation initiatives. The MassDOT guidelines allow alternative mitigation to physical changes as referenced throughout the guideline document. The proposed project is very strong in putting these goals to work along the Needham Street corridor.

Comment 2.28: **With the proposed improvements, Traffic Management Plans should be prepared and submitted to the City of Newton. These plans should include Temporary Traffic Control Plans (TTCPs), typical layouts, detour routes, and pedestrian and bicycle accommodations as necessary.**

Response: ***Agreed.***

3.2 Trip Distribution

Comment 3.1: U.S. Census Journey to Work tabulations for 2010 was used to support the trip distribution analysis and this is the appropriate database to use.

No response is needed.

Comment 3.2: There is an issue for the reported *Private Vehicle* estimates for 2010 (82%) compared to 2015 (72%); **the Applicant should determine the reason for the discrepancy**. Table 2 indicates that *Transit* mode share is slightly less than that reported in the impact study, while *Walk/Bike* is slightly higher; however, what is most interesting is that the *Worked at Home* category is comparable to both *Transit* and *Walk/Bike* and is about twice that of the region. **The applicant should use the 2015 U.S. Census data for any additional analysis; this would also be consistent with the Needham Street Area Vision Plan, page 25-25 (see Comment 2.19).**

Response: ***Agreed.*** *Same response as to Comment 2.19: any additional analysis will use the 2015 U.S. Census data in order to be consistent with the most recent data available.*

Comment 3.3: This survey was used by the 128 Business Council to develop a map of key trip destinations and the level of demand to and from those destinations. Combined with existing transit service routes, this provided a good starting point for the shuttle service routes and schedules. **For future**

surveys, it may be useful to include a stated preference set of questions to assess willingness to pay; this would help inform the development of the fare structure.

Response: *This comment has been noted.*

4.0 Pedestrian and Bicycle Accommodations

4.1 Raised Intersections

Comment 4.1: **Will the one-way loop around the Village Green also be raised? If so, are there curbs separating the roadway from the adjacent sidewalk and green space?**

Response: *The loop around the Village Green is no longer being considered. See the Response Plan.*

Comment 4.2: **What is the design speed of the raised intersections?**

Response: *The design speed of all raised intersections is 20-25 MPH, consistent with the Newton Street Design Guidelines.*

Comment 4.3: **Will there be a posted speed limit on internal project roadways? Based on the pedestrian orientation of the internal streets, a maximum of 20 mph should be considered.**

Response: *Speed limit signage will be posted at key locations near the vehicular entrances to the site.*

Comment 4.4: **What is the unit paver material shown at the raised intersections? Will the material be colored and is it porous?**

Response: *Pavers will be mostly concrete unit pavers of various colors throughout the site. Porous pavers will be utilized in some, but not all raised intersection locations depending on soils and other drainage-related design factors.*

Comment 4.5: No crosswalks are shown at the two raised intersections on Main Street and the Village Green Loop. **Crosswalks should be included to encourage pedestrian crossing at designated locations.**

Response: *Comment has been noted.*

4.2 Sidewalks and Parks

Comment 4.6: **Ensure that the design of the sidewalks along Main Street include a furniture zone flexible enough to incorporate plentiful bike racks that provide convenient access to the retail businesses. Additionally, a significant portion of the bike racks designated for the Mobility Hub should be covered so that bus shuttle users can leave their bicycles out of inclement weather for the duration of a workday.**

Response: *Sidewalks along Main Street and throughout the development are dimensioned to include a furniture zone. Bike racks will be positioned convenient to retail businesses.*

Comment 4.7: **Will the Village Green, parks, and playground be accessible by the public?**

Response: *The Village Green, parks, and playground will be accessible by the public, and the public will be encouraged to use these spaces.*

Comment 4.8: The drawings seem to indicate that the only entry to the retail space in Building 2 is from Main Street**. Enlivening Needham Street with an entry to the east would help to make a more pedestrian friendly environment.**

Response: *Comment will be considered.*

4.3 Multi-Use Path

Comment 4.9: **The shared use bike path should be a minimum of 11 feet wide (Newton Street Design Guide), preferably 12 feet, to accommodate two-direction travel for pedestrians and bicyclists. To provide the additional width, it may be prudent to shift 2 feet of width from the Charlemont Street south sidewalk to the north sidewalk/bike path. Because this entails moving Charlemont's centerline 2 feet to the south, impact to the Needham Street/ Charlemont Street intersection geometry will need to be considered.**

Response: *There are separate sidewalks along both sides of Charlemont Street, so the bike path does not need to be shared and widened here. The intersection geometry at Charlemont/Needham St was coordinated with the MassDot Needham Street design team and is now fixed.*

Comment 4.10: **A more visible and intuitive connection is needed from the shared use bike path to Main Street and the Village Green. The most logical route is Tower Road. While a designated bike lane is unlikely to be necessary—due to low traffic volumes—an enhanced link should be made at the northeast corner of the Charlemont Street/Tower Road intersection. This can be achieved with a wide, bike friendly curb cut, potential pavement markings and/or additional signage at this corner.**

Response: *Comment will be considered.*

Comment 4.11: **A turning radius is needed at the north end of the share use bike path, just east of where the path turns to cross Tower Road. Though very close to the adjacent sidewalk, a minimum 10-foot inner radius is needed to accommodate bicyclists with trailers or on tandem bicycles. The nearby bikeway crossing should include green pavement marking to distinguish it from the adjacent Tower Road crosswalk (see *Newton Street Design Guide*, 5.1.3 Bicycle Crossing Design, p. 49).**

Response: *All good suggestions. Refinements and details such as these will be addressed during final design.*

Comment 4.12: **Due to the two-way bicycle crossing of the bikeway at Needham Street, a bicycle signal with its own distinct phase will need to be part of the Needham Street/Charlemont Street intersection *and signal design.***

Response: *Correct. This has been coordinated with the MassDot Needham Street design team.*

Comment 4.13: The old rail bridge over the Charles River south of Christina Street is currently gated, but not locked. The bridge deck is in poor condition. **Please provide information on the ownership and condition of the bridge and Northland's ability to acquire an easement over the bridge and make improvements if needed.**

Response: *The old rail bridge is owned by the MBTA, accessed from the Newton side across land owned by the Barry Price Center. DCR owns the land on the City of Needham side of the river Northland and the City have been working together to coordinate with MBTA, DCR and the Price Center, to assess its condition and feasibility to be utilized for bikes and pedestrians.*

Comment 4.14: **A crosswalk should be provided where the proposed multi-use path would cross Christina Street. It appears there is limited site distance at this location due to a curve in the road. Identify the required stopping sight distance at this location and indicate if enhancements such as an RRFB or other devices would be required to improve motorist awareness of the crossing. Indicate if Northland would provide a new crosswalk and safety enhancements as needed.**

Response: *These are good comments and we are aware of the design challenges at this location. The bike path will be designed to meet industry safety standards and best practices throughout the project limits, but we are not at a point in the design process to identify these with specificity at this time.*

Comment 4.15: The area behind the Stark Building at 55 Christina Street includes a paved walkway with wooden guardrail between the Stark parking lot and a rear entrance of the building. **This walkway would need to be modified to 1) provide at least 10 feet of width for bicycle and pedestrian travel and 2) provide a connection to the old rail alignment between the walkway and Christina Street. Please indicate Northland's commitment to provide these improvements.**

Response: *Northland is committed to continue working with City officials and other stakeholders to make a bike path link between the greenway and the DCR Charles River Reservation path system happen, and Northland now owns the Stark building. The bike path will be designed to meet industry safety standards and best practices throughout the project limits, as noted previously.*

4.4 Reconstruction Plans for Needham Street/Winchester Street

Comment 4.16: **BETA suggested various revisions to the MassDOT Needham Street reconstruction**.

Response: *VHB believes that revisions to the Needham Street reconstruction are not appropriate or practical at this time and not indicated for the Northland Newton development. The City may raise these issues with DOT if they are warranted*

The Applicant should investigate if it is feasible to extend the Upper Falls Greenway along the former rail right of way to the northeast to intersect with Winchester Street via Curtis Street.

Response: *Other stakeholders, including planning staff and bike advocate groups have already looked at different ways to connect or extend the north end of the greenway beyond its termination behind National Lumber. Northland is willing to engage with efforts to enhance/extend the Greenway but does not have rights in the land of others.*

4.5 Miscellaneous Additional Comments

Comment 4.17: The intersection of Chestnut Street/Elliot Street has old pedestrian and traffic equipment and signal heads. **The Applicant should consider upgrading both the traffic and pedestrian signal equipment including countdown signal heads.**

Response: *The comment has been noted*

Comment 4.18: Generally, the two-designated bike share drop spots are in the most-logical locations within the proposed development. **The Mobility Hub drop spot would be more easily accessible to/from the shared use bike path if relocated to the opposite side of Unnamed Road however.** Though a few steps further from the shuttle service pick-up/drop-off locations, its proximity to the Charlemont Street crosswalk will provide more seamless access to the path. Avoiding the need for bike share users to cross the Unnamed Road crosswalk will also minimize the conflicts between bike share users and shuttle buses turning right onto Charlemont Street.

Response: *Comment will be considered in light of all aspects of design and operational objectives.*

Comment 4.19: **Ensure that all shuttle buses have front-mounted racks to carry at least two bicycles. These should be intuitive to use and similar in design to those used on MBTA buses.**

Response: *All shuttle buses will have bike racks that are able to carry two bicycles, using the same design as the bike racks used on MBTA buses. This is in keeping with 128BC's current fleet standards. Illustrated instruction cards that can be handed to cyclist-riders are provided aboard all shuttles.*

5.0 Internal Circulation and Parking

5.1 Site Access Plan

Comment 5.1: **The Applicant should indicate if site roadways will be privately owned and maintained.**

Response: *All site roadways will be privately owned and maintained.*

Comment 5.2: Based on a review of the site plans (Sheet A-7.01), the Needham Street south site driveway is shown as a shared through/right-turn lane instead of a shared left-turn/right-turn lane. **Due to the heavy traffic demands along the Needham Street corridor and the long delays for vehicles attempting to exit the site destined for Needham Street to the north, BETA recommends that the south site driveway be modified to restrict left-turns onto Needham Street.** On-site vehicles can use the north site driveway signalized intersection to complete this maneuver.

Response: *There is no need to modify the driveway to restrict maneuvers here. In reality, drivers destined northbound on Needham Street are more likely to choose to leave the site at the Charlemont Street driveway or the Tower Road exit during heavy traffic demand periods.*

Comment 5.3: Based on a review of the site plans and the intersection capacity analyses provided in the *Traffic Impact and Access Study*, vehicle queues are projected to extend westerly along the north site driveway (Charlemont Street Extension) from Needham Street and through the first internal intersection (Unnamed Street) during the Weekday PM and Saturday Midday peak hours. **With Building 7 representing the transportation hub and vehicles estimated to turn right onto the north site driveway headed for Needham Street, BETA recommends that DO NOT BLOCK INTERSECTION pavement markings and signs be implemented at this location.**

Response: *Agreed.*

Comment 5.4: As shown on the site plans (Sheet C-6.1) and as described in the *Traffic Impact and Access Study*, the proposed Oak Street site driveway would be relocated across from Saco Street to form a four-way signalized intersection. The site plan depicts the site driveway as a two-lane approach with an exclusive left-turn lane and an exclusive right-turn lane. Based on the traffic study, however, this site driveway would be a single lane approach. **If the site driveway would be a two-lane approach, then updated intersection analyses should be provided.** In addition, the traffic study analyzed the proposed Oak Street site driveway as a three-way unsignalized intersection. **The updated intersection analyses should also include Saco Street within this location.** A one-way counter-clockwise roadway is shown around the Village Green.

Response: *Updated analyses have been conducted at the location of Oak Street and the proposed Site driveway / Saco Street with the proposed Site driveway approach having a designated left-turn lane and a designated through / right-turn lane. Based on the results, the left-turns from Oak Street are expected to operate at LOS A with minimal queues under all time periods and the Saco Street approach is expected to operate at LOS C with minimal queues under all time periods. The proposed Site driveway left-turn movement is expected to operate at LOS D or E with maximum queues of 1-2 vehicles during all time periods, and the proposed Site driveway right-turn movement is expected to operate at LOS B with minimal queues under all time periods. A LOS table and capacity analysis worksheets are included in the Attachments.*

Comment 5.5: **A Do Not Enter sign should be installed on the Village Green loop exit at Main Street.** The internal roadways are shown to be 20 or 22 feet wide with on-street parking in some areas. **The**

proposed roadway widths appear adequate in terms of encouraging slower vehicular speeds. The proposed four raised intersections will further reduce vehicle speeds.

Response: *Vehicular use within the Village Green has been reconsidered and there will no longer be regular parking and pick-up/drop-off maneuvers. Please see revised plans.*

Comment 5.6: The site plans show that the raised intersections will be constructed with pavers. **Are the pavers permeable? Will the site roadways be constructed with a porous material?**

Response: Different paver types will be used throughout the project and will ultimately depend upon underlying soils and other drainage related considerations. All options for porous pavements are being evaluated, but generally no, the site roadways will be predominately standard hot-mix asphalt paving.

Comment 5.7: **Will there be a posted speed limit on internal project roadways?**

Response: *Speed limit signage will be posted at key locations near the vehicular entrances to the site.*

Comment 5.8: **The Newton Fire Department should review the proposed plan for emergency vehicle access and circulation. Confirm that all internal turn radii are adequate to accommodate emergency vehicle.**

In accordance with the City of Newton's Rules and Regulations of the Planning Board Acting as a Board Survey (Section V.B.4), the grades of roadways and access points shall be between 0.6% and 12% unless otherwise permitted by the Planning Board. Upon review of the site plans, the internal roadways and driveways appear to meet this criterion.

The site plans show a separated pull-out for loading and shuttle service and drop-off/pick-up on the east side of the Unnamed Road. There is a bump-out shown on the east side that separates the two areas.

Response: *The minimum design basis for turning maneuvers at all internal roadway intersections is the Newton Fire Truck (Bus-45) turning template. The Fire Department has reviewed the site plan, and Northland will keep the Department informed as to changes*

Comment 5.9: **The Applicant should consider removing the bump-out to maximize the curb space available for loading, shuttle service, and drop-off/pick-up. Confirm that the proposed pull-out curb space is adequate to accommodate peak loading/shuttle/drop-off and pick-up volumes.**

Response: *The loading area is designed to accommodate three shuttle buses including room to load and unload bikes from the shuttle mounted bike rack.*

5.2 Parking

5.2.2 Shared Parking Spaces

Comment 5.10: Based on a review of the October 12, 2018 Right-Size Parking calculations provided for The Northland Newton Development, discrepancies were found with the base parking ratios that were used versus the ULI recommended ratios. **Therefore, the Applicant should indicate if 2,283 parking spaces are required on-site to meet the demand per ITE and ULI methodologies.**

Response: *Northland is not utilizing ULI ratios which do not apply to a mixed use development of this nature with the assumed shuttle services. The petitioner intends to be responsive to the City Council's request that parking be reduced to the minimum necessary so as to encourage shared uses and alternative transportation.*

5.2.3 MBTA and MassDOT Transit Oriented Development Policies and Guidelines

Comment 5.11: The Applicant is proposing one parking space for each of the 822 residential units. This ratio meets the TOD parking guideline for residential land use (0.75-1.5 spaces per unit) provided in the MBTA and MassDOT TOD Policies and Guidelines.[2] Parking ratio guidelines for the other relevant land uses include:

- Office: 1.0-2.5 spaces per 1,000 square feet
- Retail 1.5-3.0 per 1,000 square feet

As presented in Table 2 – Peak Parking demand – Shared Parking, Memorandum from VHB, Inc. to Mr. Barney Heath, Director of Planning, October 12, 2018, it appears that the shared parking demand for the retail, office, restaurant, medical office, and health club components may exceed the parking ratios provided in the MBTA and MassDOT TOD guidelines.[3] **Please provide information on the proposed parking supply ratios for each of the project land use components.**

Response: *See above 5.10*

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[2] Ibid., 17
[3] Ibid., 17

5.2.5 Parking Design and Layout

On-street angle parking is show on the south end of the Village Green loop.

Comment 5.12: **The applicant should consider reverse-angle spaces for this area to reduce conflicts with pedestrians when backing out of the spaces.**

Response: *Angled spaces are no longer proposed on the Village Green. See our Response Plan.*

Comment 5.13: The internal on-street parking spaces are shown to be 21 feet long and 8 feet wide. Off-street surface spaces are 19 feet long and 9 feet wide. **Since the internal on-street parking spaces are shown to be only 8 feet wide, the City's minimum requirements are not met (9 feet).**

Response: ***Agreed.*** *A waiver has been requested.*

Comment 5.14: The on-street parking spaces along Main Street between Buildings 3 and 6 are shown to be 16 feet long for the angle/perpendicular parking. **Since these on-street parking spaces are shown to be only 16 feet deep, the City's minimum requirements are not met (19 feet).**

Response: *These stalls are dimensioned on the Layout and Materials Plan to be 8' x 21'*

Comment 5.15: **Any other parking stalls not previously identified as part of this peer review that do not meet the City's requirements should be reconfigured accordingly.**

Response: *Waivers are being sought.*

Comment 5.16: **Indicate where visitors for on-site retail will be directed to park**.

Response: *Retail visitors will be directed to park in the garage. On-street parking spaces are available also on a first-come basis.*

Comment 5.17: **Any compact parking stalls should be identified, counted, and supported with industry standards.**

Response: *Compact spaces are noted on the drawings.*

Comment 5.18: **The number and dimensions of the proposed handicapped parking stalls should be provided.**

Response: *Accessible spaces are noted on the drawings.*

6.0 Loading and Curbside Activity

Comment 6.1: **To confirm that the City's Ordinances are being met, truck turning plans should be provided for each of the delivery areas and within the site to ensure that all necessary maneuvering space can be accommodated on-site and would not require traveling onto parking spaces or into vertical obstructions.**

Response: *Truck loading areas are noted on the plans, and no new loading areas require truck maneuvers off site (i.e. from Oak Street and Needham Street). The ordinance does not stipulate the design loading vehicle.*

Comment 6.2: **To ensure that the City's Ordinances are being met, dimensions of all loading areas should be provided.**

Response: *In addition to the loading areas labeled and dimensioned on the plans, delivery trucks will utilize on-street parking lanes as loading zones during retailer non-business hours, typically before 9 am. Dimensional waivers are being sought.*

Comment 6.3: As identified in The Northland Newton Development *Traffic Impact and Access Study*, the existing loading dock for Building 1 along Oak Street will be maintained. Based on a review of the site plans (Sheet C-5.1), however, the existing loading dock would be expanded to accommodate two trucks. **This discrepancy should be clarified and the dimensions of the Oak Street curb cut should be provided.**

Response: *Northland plans to maintain the loading area a on Oak Street for Building 1, but a second truck dock next to the existing is proposed.*

Comment 6.4: The study states that on-street spaces would be provided along Unnamed Road to load and unload for Building 2. It appears, however, that direct ingress to Building 2 may not be available. **This issue should be clarified and a designated loading space should be identified.**

Response: *Delivery trucks will utilize on-street parking lanes as loading zones during retailer non-business hours, typically before 9 am.*

Comment 6.5: A loading dock would be provided for Building 3 that would be accessed by way of the Village Green Perimeter Road. **With the Village Green Perimeter Road proposed as a one-way counterclockwise roadway, details should be provided as to how a delivery truck would be able to access the loading area (i.e., turn right in or need to reverse in).**

Response: ***This response is applicable to Comments 6.5 through 6.11.*** *Deliveries and loading for all buildings will be further evaluated and scrutinized by the design team as the Response Plan advances through design. Please recognize that the internal roadways, although open to the public, will be privately owned and maintained. Therefore, any loading on the internal streets is "off-site" as far as zoning is concerned.*

An adequate and convenient loading plan is a fundamental imperative needed to attract and retain retailers to the site willing to lease the spaces being created. Therefore, it is in the proponent's best interest to get it right whether conventional or not. To guide this important aspect of the development plan, the proponent has engaged retail design specialists whose feedback has influenced the Response Plan. Additional details can be provided in due course.

Comment 6.6: As proposed, delivery trucks would access the loading dock for Building 4 from the surface parking lot off Pettee Lane. **A description and details should be provided as to how delivery trucks would access the loading dock (e.g., enter parking lot via Pettee Lane, circulate in a counterclockwise manner, and back into loading area).**

Comment 6.7: For Building 5, delivery trucks would enter the parking garage from either Pettee Lane or Tower Road to access the loading dock. **A description and details should be provided as to how delivery trucks would access the loading dock within the parking garage.**

Comment 6.8: As proposed, trucks would access the loading dock at Building 6 from the North Site Driveway (Charlemont Street Extension). During times when service and loading trucks are not present, parking would be permitted in front of the loading curb cut. **A description and details should be provided as to how delivery trucks would access the loading dock (e.g., back in from Charlemont Street Extension eastbound/ westbound). In addition, it is recommended that the proposed parking spaces in front of the loading area curb cut be removed to ensure no conflicts would occur.**

Comment 6.9: On-street parking spaces along Unnamed Road would be designated as a loading and shuttle service area for Building 7. With Building 7 proposed to be the transportation hub, it is expected that there will be heavy activity and conflicts in this area along Unnamed Road. **It is recommended that these areas be signed to indicate separate areas and that consideration be given to removing the bump-out area between the loading area and the drop off/pick up area to provide more storage.**

Comment 6.10: For Building 8, the driveway on Needham Street would be maintained for access to the existing loading dock (north of Charlemont Street). **A description and details should be provided as to how delivery trucks would access the loading dock (e.g., back in from Needham Street or back out onto Needham Street).**

Comment 6.11: Service and loading activity for Buildings 9 through 13 are proposed to be conducted within the abutting on-street parking spaces along Pettee Lane. **For Building 13, a description and details should be provided as to how delivery trucks would ingress and egress that parking area access (e.g., enter parking area off Pettee Lane, align parallel to Building 13, and then back out onto Pettee Lane).**

7.0 Transportation Demand Management Strategies

7.1 Mobility Hub (Located on-site in Building 7)

Comment 7.1: **Wi-Fi should also be provided, along with security (e.g., CCTV) appropriate for the operation. The Applicant should define the commitment to staff and maintain the Hub.**

Response: *Wi-Fi and security will be provided in the Mobility Hub. The Proponent will staff and maintain the Hub.*

7.2 Shuttle System

Comment 7.2: **Fare structure: to assess the long-term feasibility of the service and its ability to attract and sustain ridership, starting assumptions need to be made regarding the fare and costs. These include:**

- **What is the base fare; will it vary by peak/off-peak; by distance; by week day/weekend; by resident/non-resident?**
- **Will there be discounts, monthly passes, etc.**
- **Transit services almost always require a subsidy; what is the source of the subsidy and what is the commitment to continuing the subsidy?**
- **Related to the previous item, is there a target fare recovery ratio?**
- **Capital costs for the fleet will be substantial (and discussed in a following section); what is the commitment to acquiring/leasing the fleet?**

Response: *128 Business Council's system funding model, which Northland understands and supports, is that member organizations themselves bear the cost of shuttle services, to be paid up-front at the beginning of each operating year. Fares are set aside to guarantee a consistent or improved level of service throughout the year. Given this funding model, 128BC has not found fare structure to be determinant of service feasibility, since the fare is not expected to fund that service.*

Also given this funding model, it was not judged critical at this stage of planning to fix a specific fare structure. However, 128BC would be open to working with Northland to determine a tentative fare structure if deemed necessary by the city.

Comment 7.3: Service phasing: A new service requires time to mature and demonstrate its effectiveness. The Implementation Plan is correct that the shuttle system will need to be adjusted in response to actual ridership and ability to adhere to schedules and headways. **Questions include:**

- **How will service development be coordinated/phased with development and occupancy of the site?**
- **What are the metrics that Newton will use to monitor the shuttle system and determine whether it is meeting trip reduction goals?**
- **What is the consultation process between Northland and Newton to discuss changes to the system and fare structure?**

<u>Response</u>: *The four routes proposed in 128BC's Implementation Plan represent "Phase 1" of the shuttle system. 128 Business Council will monitor daily ridership on a stop-by-stop basis and has proposed the following benchmarks for defining system 'success': 75% capacity for on-peak runs and 30% capacity for off-peak runs after 6-12 months for Route 1, and 60% capacity for on-peak runs and 20% capacity for off-peak runs for Routes 2, 3 & 4. In order to contextualize achieved ridership, 128BC has offered a commitment to yearly surveying of all shuttle riders, to begin 3-6 months after service roll-out, and bi-yearly surveying of the surrounding community, to begin 3-6 months before service roll-out. The goal of this surveying would be to assist in determining whether ridership below the defined benchmarks is a result of behavioral, service, route, or mode issues, and then adjust accordingly. 128BC and Northland are open to suggestions from the city regarding a specific process for sharing and responding to this ridership and survey data. Northland does not doubt that the service will require and be enhanced by adjustments to routes, timetables, operations and equipment over time. In addition the technology today is different from the technology of 5 years ago, and Northland expects it to be different in another 5 years.*

Comment 7.4: Emergency Ride Home: This is an important feature of the Implementation Plan; it provides shuttle system users with the assurance that in the event of personal illness or family emergency they will have access to transportation. Although the program may not be extensively used, it provides a critical level of confidence to transit and TDM users. **What is the long-term commitment to the program and how will the service be funded?**

<u>Response:</u> *This program is funded using 128BC TMA membership fees, to which Northland would contribute.*

Comment 7.5: Connectivity and Schedules: An important feature of the shuttle system is connectivity to MBTA services, particularly commuter rail and the Green Line. The shuttle system will need to be flexible in order to respond to MBTA service delays. The 128 Business Council has an active dispatch capability that can adjust operations in response to MBTA system delays. **Will this system be used for the project shuttles?**

<u>Response:</u> *Yes, all of 128BC services rely on live shuttle dispatch, which is supported by GPS shuttle tracking visible to both riders and operations staff.*

Comment 7.6: **Passenger surveys: To align the schedules and routes with demand, regular passenger surveys should be conducted to refine the service; this may result in revisions to the existing service or identification of new destinations.**

<u>Response:</u> *As mentioned in the response to 7.3, 128 Business Council has offered a commitment to yearly surveying of all shuttle riders, to begin 3-6 months after service roll-out, and bi-yearly surveying of the surrounding community, to begin 3-6 months before service roll-out.*

7.2.1 Proposed Shuttle System-Newton Circulator

Comment 7.7: This route provides several connections to MBTA service, including the Green Line and Worcester-Framingham commuter rail. Accessibility for those with physical disabilities is a challenge at the Highlands stop and at Newtonville. This route may also serve local personal and shopping trips. **A 45-minute service offers only a moderate level of service. For a route that will serve multiple trip purposes, 30-minute service is recommended.**

Response: *The schedules included in the Implementation Plan were intended to be conservative, especially in light of the unknowability of future traffic conditions at the time of system roll-out. 128 Business Council has asked one of its shuttle vendor partners to test the routes as currently designed under current traffic conditions, to determine whether a higher frequency can be promised.*

7.2.2 Proposed Shuttle System-Needham Commuter

Comment 7.8: **The schedule and frequency should pivot off of the commuter rail schedule; although there is a gap in mid-day rail service. The Emergency Ride Home program can serve as an on-demand alternative for those who have a valid need to return from Boston midday.**

Response: *The schedule as currently designed is structured around the commuter rail schedule and will be updated should that schedule change. The Emergency Ride Home program traditionally utilizes either TNCs or local livery services in order to meet unusual and emergency needs; there are not dedicated vehicles reserved for Emergency Ride Home. This is distinct from an on-demand service.*

7.2.3 Proposed Shuttle System-Cambridge Express

Comment 7.9: The Kendall Square area is an important regional employment center for technology and research. As such, this service is likely to be attractive to many residents. One challenge will be maintaining headways, since the shuttles will use a road network that is congested during peak periods. **The 60-minute service is not likely to offer a competitive service. The proposed shuttle would also provide a similar level of service on weekends. One revision to consider would be to curtail weekend service and re-deploy bus hours to weekday service at 30-minute headways. A cover bus should also be available in order to maintain service headways.**

Response: *Comments have been noted. A back-up vehicle is included in the current system plan. 128BC does not recommend curtailing weekend service, as this would limit the ability of riders to choose to not own a personal vehicle. As mentioned above, 128 Business Council has asked one of its shuttle vendor partners to test the routes as currently designed under current traffic conditions, to determine whether a higher frequency can be promised.*

7.2.4 Proposed Shuttle System-Boston Express

Comment 7.10: This has the potential to be a heavily used route; the rapid increase in jobs and housing in the Seaport district makes this an attractive destination. The route would also provide connections to the MBTA at South Station, including the Red and Silver Lines. **Again, road congestion will be a**

challenge and it may be necessary to have a cover bus to maintain headways, even at 60 minutes.

Response: *We agree that road congestion will be a challenge. As noted above, a back-up vehicle is included in the current system plan.*

7.2.5 Estimated Ridership

Comment 7.11: The Traffic Impact and Access Study presents trip generation estimates; Table 7 on page 52 indicates peak trips (weekday morning + weekday evening) of 363 transit trips. **The Applicant's transportation planning team should coordinate their transit trip and shuttle ridership estimates and present a unified estimate of ridership and expected future mode share.**

Response: *The TIA developed by VHB and the Transportation Implementation Plan developed by the 128 Business Council do not present a unified estimate of ridership on the proposed shuttle system because the TIA only looks at transit ridership that is expected to be generated by the Site, while the Transportation Implementation Plan looks at all potential riders that may use the shuttle system. It is expected and encouraged that the shuttle service will be used by existing residents who live and work in the area and see the shuttle as an attractive commuting option, and the Transportation Implementation Plan includes these additional riders in their ridership estimates. The TIA only looks at ridership that will be generated by the proposed Project*

Comment 7.12: There needs to be a thorough discussion and assessment of TNC impact on shuttle bus ridership. Several studies have recently documented the effect of TNC on transit use.[4] TNCs compete mainly with public transportation, walking, and biking, drawing customers from these non-auto modes based on speed of travel, convenience, and comfort.

Response: *Comment has been noted. According to the Department of Public Utilities, 1,051,030 TNC trips were started in Newton in 2017, which comes out to 12.34 trips per resident. (1,073,900 TNC trips ended in Newton during the same period.) Most of these trips are relatively local, as the average length of TNC journey is 4.5 miles. Given the challenge presented by this data and the lack of industry standards regarding TNC management, TNC usage is a major subject of all current and future 128BC studies and surveying.*

7.2.6 Build Condition Mode Share

Comment 7.13: **A better assessment of possible change in mode share under the "robust" system could be accomplished with:**

- **More information on the fare structure**

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[4] "The New Automobility: Lyft, Uber and the Future of American Cities", Schaller Consulting, July 25, 2018

- **Details on the long-term commitment by Northland to support the capital and operating costs of the shuttle service**
- **Examples of transit mode share from other similar mixed-use developments with shuttle service**

Response: *See our comments on fare structure under 7.3. 128 Business Council is unaware of any similar mixed-use developments with shuttle systems of this scale.*

7.2.7 Fleet and O & M Cost Estimates

Comment 7.14: **Alternative fuel vehicles should be considered; options include CNG and hybrid diesel-electric; all electric may become available in the future. Vehicles should meet ADA requirements and include bike racks and Wi-Fi service.**

Response: *Comments have been noted. 128BC has followed the MBTA's lead in the research and piloting of hybrid and electric propulsion systems. In addition, 128BC is working with MassDOT to understand how VW settlement funds might best be used to help advance the infrastructure for future propulsion systems. The fleet proposed for this project meets ADA requirements, and will include bike racks (see above) and onboard Wi-Fi.*

7.2.8 Shuttle Bus System Conclusion

Comment 7.15: **Ridership, Route Planning and Mode Share:**

- **VHB and the 128 Business Council should prepare an addendum that presents a coordinated and internally consistent estimate of transit trips and ridership.**
- **Consider a route to serve the I-95/Route 128 corridor: develop ridership estimates and service characteristics for this route.**
- **Provide detailed supplemental documentation and calculations on the feasibility of achieving a 30% transit mode share.**
- **Prepare an analysis of the impact of TNCs on the shuttle system and how pick-up/drop-off activity will be managed. The emergence of TNCs as an alternative to transit should not be overlooked; this may have implications for the ultimate mode share that can be attained by this development.**

Response: *In regard to serving the I-95/Route 128 corridor, 128BC has been unable to find any data sets that establish sufficient destination density around which to build a route. However, 128BC is currently undertaking a survey of the Waltham-Lexington area, including the collection of origin-destination pairs, and can provide the city with the result when they become available.*

Data regarding TNC usage is not sufficiently granular to allow us to analyze the impact on this specific shuttle system. However, once we undertake system-specific surveying, we will gather information about TNC usage.

The plans for the Transportation Hub and surrounding streetscape include a designated TNC pick-up/drop-off location, which will be advertised throughout the development. The example of Massport is instructive; by designating a TNC pick-up area, riders know exactly what address to enter, and drivers know exactly where to go.

Comment 7.16: **Financial:**

- **The shuttle bus system represents substantial capital expenditures and continuing operating costs (Table 4); it is important to confirm the commitment (financial and duration) to the service.**
- **Develop an initial fare structure for the city to review.**
- **Develop a 5-year operating plan that estimates service hours and operating costs for the shuttle and capital costs/lease for the fleet; the operating plan should also identify the costs of maintaining and staffing the Hub, including a budget for the TDM coordinator position.**

Response: *Comments noted. The $90 estimated hourly rate provided by 128 Business Council to BETA includes capital expenditures and operating costs over a 5-year contact period. These are not treated as separate costs.*

As noted above, 128BC has not found fare structure to be determinant of service feasibility, since the fare is not expected to fund that service. However, 128BC would be open to working with Northland to determine an initial fare structure if deemed necessary by the city.

Comment 7.17: **Monitoring:**

- **Require regular reporting of mode share and system ridership**.

Response: *As described above, ridership is tracked on a daily basis by 128 Business Council across all of its services. Ridership is then totaled across stops, routes, and systems and made available to member organizations and partners.*

Comment 7.18: If the targets are not met, then additional mitigation is implemented**:**

- **Identify mode share goals and other metrics to be used to evaluate the shuttle operation at 6- and 12-month intervals for at least five years. A starting point for metrics would be the projected ridership summarized on page 56 of the Implementation Plan.**
- **Identify potential mitigation if goals are not met.**

Response: *Page 56 of the Implementation Plan shows ridership goals, not projected ridership. Since 128BC is not making an adjustment to an existing service, but rather establishing a new system, no data exists regarding projected percentage ridership gain. The MBTA itself struggles to predict accurate ridership in corridors without existing service. Northland intends that both the ridership of the shuttles and the traffic generation of the project be monitored and that the Special Permit will contain procedures to evaluate and respond to future circumstances.*

7.3 Transportation Coordination

Comment 7.19: **As part of the monitoring and reporting process, a quarterly summary should be provided to the City of Newton that includes daily shuttle bus ridership by route, revenue and cost information, carpool/vanpool ridership, car share and bike share usage.**

Response: *Northland can provide a quarterly summary of daily shuttle bus ridership by route, revenue and cost information, carpool/vanpool ridership, and car share and bike share usage.*

Comment 7.20: **The Transportation Coordinator should conduct an annual transportation survey of residents and employees and report results to the City of Newton.**

Response: *Northland can conduct an annual transportation survey of residents and employees and report results to the City.*

7.5 Additional TDM Measures (TIAS PROVIDES FULL LIST OF MEASURES)

Comment 7.21: **The 128 Business Council and VHB should prepare an addendum that provides a more detailed analysis of TNC operations, both in terms of pick-up and drop-off locations, as well as the relative attractiveness of TNCs compared with shuttle operations.** While the site plan may designate specific curb pick-up and drop-off locations for TNCs, these services use apps that have algorithms that would direct the driver to pick-up at the location from where the ride request is originating. Similarly, drop-off would be at the location that the rider entered into the app when booking the ride. **The applicant should clarify how this activity can be managed effectively.**

Response: *Specifying a designated pick-up/drop-off address has been shown to be effective at Massport, as well as similar locations in other municipalities.*

Comment 7.22: The Transportation Implementation Plan 128 indicates that the Northland development will begin with four shared vehicles for a pilot period of six months. **When will the six month pilot occur: at first phases of project or at project completion? Will they be available to the general public? What if there is low demand during the pilot period, will shared vehicles still be provided on-site? Where will the shared vehicles be located?**

Response: *The Zipcar (or equal) pilot period would begin as soon as residential units are occupied. The vehicles would be available to the general public. Shared vehicles would be located in the parking garage.*

Comment 7.23: **Indicate how many carpool and vanpool spaces will be provided on-site and in what locations.**

Response: *The number spaces will be determined based on demand. As the Transportation Demand Management Plan is finalized, the number, types of spaces and location(s) will be determined.*

Comment 7.24: **Indicate how many EV charging stations are proposed and what locations including preferential parking spaces.**

Response: *Northland will be providing a minimum of 2% of total parking spaces as EV charging stations in preferential locations per LEED requirements. The spaces will be allocated proportionally for residential parking, office parking and retail parking.*

Comment 7.25: **Explain how paid parking charged directly to employers will work.**

Response: *Employers will be allocated a certain number of spaces based on the amount of space they are leasing. The cost of the spaces will be included in their lease rate.*

Comment 7.26: **Will visitors have to pay for parking on-site in garage and surface spaces?**

Response: *We will prepare a comprehensive and flexible parking management plan that encompasses the many types of parkers (office, retail, residential, visitors, short/long-term) at the project. The plan will determine, when, if necessary, a charge will need to be applied to parkers.*

8.0 Consistency with Newton Street Design Guides

8.1 Sidewalks

Comment 8.1: **Confirm that amenity zones are at least 2 feet wide on-site. The amenity zones around the inside of the Village Green appear to be approximately 2 feet wide. Consideration should be given to widening the amenity zone around the Village Green.**

Response: *As shown in the "Streetscape" section of the Master Plan and Design Guidelines, most of the "amenity zones" are a minimum of 6' wide.*

Comment 8.2: **Confirm that all on-site sidewalks are at least 5 feet wide.**

Response: *Confirmed*

Comment 8.3: **Confirm that all offset dimensions listed above are met.**

Response: *The recommended dimensions listed in 8.1 of the BETA report will be considered in the final design process.*

8.2 Roadways

Comment 8.4: **Indicate if posted speed limits are proposed for the on-site roadways.**

Response: *Speed limit signage will be posted at key locations near the vehicular entrances to the site.*

Comment 8.5: Roadway center lines on-site are shown on the site plans only at the intersections of Charlemont Street/Needham and Pettee Lane/Oak Street. Charlemont Street, Unnamed Road, and Tower Road are shown to have 22 feet for two travel lanes. The 22 feet proposed for travel lanes may be appropriate for Unnamed Road (moderate to heavy traffic volumes due to drop-offs/picks, and shuttle buses) and Charlemont Street (heavy traffic volumes and width needed for loading). **Center lines should be considered for these roadways. The Applicant should consider narrowing the travel lane width on Tower Road from 22 feet to 20 feet.**

Response: Comment has been noted.

Comment 8.6: **Indicate if the recommended 26-28-foot curb-to-curb width for a two-way yield street is not appropriate for on-site roadways given the lack of driveway spacing and on-street parking utilization that is expected to be above 50 percent during most periods.**

Response: Please clarify comment.

Comment 8.7: The one-way loop roadway around the Village Green is shown to be 20 feet wide. This width appears excessive. **Consideration should be given to providing a 16 or 18-foot wide roadway.**

Response: *Noted.*

Comment 8.8: **Confirm that there is no on-street parking at least 20 feet in advance of proposed crosswalks on-site.**

Response: *Noted.*

Comment 8.9: **The applicant should consider reverse-angle spaces on the Village Green to reduce conflicts with pedestrians when backing out of the spaces.**

Response: *Angled spaces are no longer proposed on the Village Green. See Response Plan.*

8.3 Bikeways

Comment 8.10: The shared use bike path meets the minimum required width of 8 feet. **The Applicant should consider widening the path to at least 11 feet as recommended in the Newton Street Design Guide, June 2018, to better accommodate two-direction travel for pedestrians and bicyclists.**

Response: *Comment will be considered.*

Comment 8.11: The shared use bike path has a buffer of at least 4-feet wide on the north side of Charlemont Street that exceeds the recommended 3-foot width. **This is acceptable.**

Response: *No Response Necessary.*

Comment 8.12: **Confirm that a planned shared use path along Charlemont Street east of Needham Street and connecting with Christina Street will meet standards in the Newton Street Design Guide.**

Response: *This is the intent as to the roadway. The crossing of private land may be different.*

8.4 Traffic Calming Measures

Comment 8.13: **What is the design speed of the raised intersections? For this type of setting, a design speed of 20 MPH may be appropriate**.

Response: *Comment has been noted.*

Comment 8.14: Will the full reveal height of the raised intersections be 6-inches?

Response: *Yes.*

8.5 Intersections and Crossings

Comment 8.15: The Site Detail Plan (C-10.1) shows a pedestrian crosswalk detail with 1-foot wide lines, 2-foot spacing between lines, and 8-foot long lines. **All on-site crosswalks should be designed to meet the Newton Street Design Guide standards noted above.**

Response: *This is acceptable*.

Comment 8.16: **Intersection corner radius should be designed to meet the Newton Street Design Guide standards noted above.**

Response: *This is acceptable.*

9.0 Consistency with Needham Street Vision Plan

9.2 Improve Health of Existing Open Space and Create Diversity in New Open Space

Comment 9.1: **Indicate if the open spaces proposed on-site will be accessible to the public.**

Response: *All open space on Site will be accessible to the public and public use will be encouraged.*

Comment 9.2: The Planting Plan does not show any street trees at Building 1 on both Needham Street and Oak Street. **The Applicant should consider providing street trees in this area to enhance the pedestrian walking environment**.

Response: *There is no feasible location for street trees adjacent to Building 1 along Oak Street. There are existing trees in the State ROW at the top of a very steep slope along Needham Street at the east end of Building 1.*

9.3 Provide Ready Access

Comment 9.3: **In addition to providing new connections on the site to the Greenway, the Applicant should consider providing walking/biking amenities as listed above.**

9.4 Improve Safety and Accessibility

Comment 9.4: **The Applicant should consider performing a speed study on the Upper Falls Neighborhood roadways to measure average and 85th percentile vehicles speeds, identify measures, and provide traffic calming devices as needed to improve safety for pedestrians and bicyclists. Roadways should include Chestnut Street between Oak and Elliot Streets; Chestnut Street east of Oak Street; and Linden Street, Ossipee Street, and Mechanic Street.**

Response: We have not heard from the neighborhood any particular concerns about the need for traffic calming. Should the City require such studies as mitigation for the project, then they will be conducted.

9.5 Expand and Enhance Transit Connections along Needham Street

Comment 9.5: **Will the proposed shuttle buses have the ability to make additional stops along the Needham Street corridor? (which will help to reduce auto trip making between destinations).**

Response: *Additional stops could be added where it is safe to board and alight passengers, and so long as it did not negatively affect service. The City needs to approve shuttle routes and stops. More in general, it is envisioned that the system would expand with the addition of partners and connecting services.*

Comment 9.6: A short-term action in the Vision Plan is to encourage and/or require use of electric or hybrid shuttle buses. **Will the Applicant provide shuttle buses with electric or hybrid propulsion?**

Response*:* *At this time the costs and ranges of these vehicles are not practical for our shuttle use.*

Comment 9.7: A long-term action in the Vision Plan is to institute transit signal priority (TSP) between the Newton Highlands Station and the Needham border to improve reliability of buses and shuttles. **Will the applicant provide or contribute to providing TSP to improve travel time and reliability for project shuttle buses, MBTA buses, and others?**

Response: *It is our understanding that the MassDOT Needham Street project includes TSP adaptable signal controls. The Proponent will evaluate the cost/benefit of employing optical readers on its shuttles in coordination with the city and MassDOT.*

9.6 Convert Needham Street from an Isolated to a Connected Roadway

Comment 9.8: **Indicate if the Applicant will provide wayfinding signage to amenities and visitor parking on-site and to the connections to the Greenway?**

Response: *The Proponent will provide appropriate wayfinding signage on-Site to different amenities, visitor parking locations, and the Upper Falls Greenway. Please see the "Signage, Branding and Navigation" section (pages 109-114) of the Northland Newton Master Plan & Design Guidelines" for a conceptual overview.*

9.8 Prepare for Future Tech: Shared, Electric, Autonomous Vehicles

Comment 9.9: The site plans show residence drop-off/pick-up areas on the Unnamed Road. **Provide information on potential levels of demand for transportation network companies (Uber, Lyft) and if this level of demand can be accommodated in the designated areas without impacting shuttle bus, private drop-off/pick operations, and loading. Indicate if the proposed drop-off/pick-up curb areas can be expanded and/or if additional areas can be provided if required.**

Response: *Additional TNC drop-off/pickup areas will be considered as demand requires.*

Comment 9.10: The Transportation Implementation Plan recommends that the project begin a car share program with four vehicles for a pilot period of six months. **Provide information on any discussions or arrangements made with car share companies (e.g., ZipCar) as to the potential demand on-site and within the Needham Street corridor and the ability to expand the program as demand warrants.**

Response: *This Project area is not an established market for ZipCar or similar carshare programs; however, in 128BC's work with ZipCar, they have shown a willingness to place vehicles in new areas so long as they are guaranteed a certain monthly revenue – hence the pilot period. Once carshare demand is established, it would be up to ZipCar to measure and respond to that demand.*

9.13 Utilize Design to Encourage Active Community Life

Comment 9.11: **Indicate if pedestrians can enter retail shops and restaurants directly from Needham Street. Also, see Comment 9.1 above.**

Response: *There will be entrances accessible directly from Needham Street at Building 7.*

10.0 Other Comments

Comment 10.1: On October 6, 2017, The Executive Office of Energy and Environmental Affairs submitted a Certificate of The Secretary of Energy and Environmental Affairs on the Environmental Notification Form for the Northland Needham Street Redevelopment project (EEA #15757). The Certificate states, "I have reviewed the Environmental Notification Form (ENF) and hereby determine that this project requires the preparation of a Mandatory Environmental Impact Report (EIR). The Proponent should submit a Draft EIR (DEIR)…" **The Applicant should provide information on the status of the required DEIR.**

Response: *The Proponent will prepare a DEIR as requested by the Secretary of Energy and Environmental Affairs. The DEIR has not yet been submitted and the anticipated schedule is not known at this time.*

Comment 10.2: As proposed, the Applicant is looking to include a shuttle bus program with direct connections to nearby transit stations and to Cambridge and Boston. The intent of this transportation management technique is to encourage residents, employees, and patrons to use the shuttle service instead of driving to the site. **As such, a monitoring program is recommended to be conducted as the level of success for the shuttle system is unknown. In accordance with MassDOT guidelines, the monitoring program should include, but not limited to, the following:**

- **Monitoring of trip-making and mode share relative to the mode share assumptions and goals in the traffic study (to both the Existing Mode Share and the Robust Shuttle Service).**

- **Verification of infrastructure elements, including transportation system improvements (on-site and off-site), parking accommodations, and on-site amenities, as well as measures of infrastructure utilization.**

- **Incentive- and education-based measures, including measures provided, uptake/participation by on-site residents/employees/patrons, and outcomes of measures implemented.**

If the transportation monitoring program indicates that the shuttle service system is not as effective as evaluated (to both the Existing Mode Share and the Robust Shuttle Service), the Applicant should be held responsible for: (1) identifying and implementing operational improvements at constrained locations, or (2) providing a financial contribution to the City of Newton for improvements. The improvements could involve capacity and mobility measures, traffic signal timing and phasing modifications and further refinement of the transportation management program to reduce vehicle trips to/from the site. The Applicant should submit annual transportation monitoring program reports to the City of Newton on the implementation of the program for the first 5 years of operation after full project occupancy. Upon review, the City will provide necessary adjustment recommendations for the Applicant to implement or require the Applicant to conduct appropriate improvement measures.

Response: *Applicant will work with the City to develop an effective monitoring program.*