November 30, 2018

Memorandum #2018-144

TO: **Regional Connectors Study Working Group**

BY: **Robert A. Crum, Jr., Executive Director**

RE: **Regional Connectors Study**

Attached is the agenda for the **Regional Connectors Study Working Group meeting** scheduled for **Thursday, December 6, 2018 at 10:00 am** at The Regional Building, Conference Room D, located at 723 Woodlake Drive, Chesapeake 23320.

MK/sc

Voting Members:
Earl Sorey (CH)
Angela Rico (HA)
Bryan Stilley (NN)
Brian Fowler (NO)
Jason Souders (SU)
James Wright (PO)
Phil Pullen (VB)

Nonvoting Members:
Jason Flowers (Army Corps)
George Janek (Army Corps)
Robert Pruhs (Army Corps)
Ivan Rucker (FHWA)
Kevin Page (HRTAC)
Rhonda Murray (US NAVY)
Tim Dolan (US Coast Guard)
Gene Leonard (US Coast Guard)
Tony Gibson (VDOT)
Scott Smizik (VDOT)
Kit Chope (VPA)

Staff:
Bob Crum (HRTPO)
Mike Kimbrel (HRTPO)
Rob Case (HRTPO)
Keith Nichols (HRTPO)
Dale Stith (HRTPO)

Project Coordinator:
Camelia Ravanbakht

Agenda

Regional Connectors Study

Working Group Meeting

December 6, 2018

10:00 AM

The Regional Building, Conference Room D, 723 Woodlake Drive, Chesapeake, Virginia

1. Call to Order

2. Welcome and Introductions

3. Public Comment Period (Limit 3 minutes per individual)

4. Minutes

    Summary Notes from November 8, 2018 Working Group Meeting – Attachment 4

    - Recommended Action: For Approval

5. Update on RCS Phase 1 Study Tasks: Craig, Eddy, MBI

    - Recommended Action: For Information and Discussion

6. Travel Demand Model Technical Memo: Craig Eddy & Modeling staff, MBI

    Final Travel Demand Model Technical Memo Document – Attachment 6

    - Recommended Action: For Review and Approval

7. Regional Survey – Summary of Results: Craig Eddy, MBI

    - Recommended Action: For Information and Discussion

8. Stakeholders Interviews – Summary and Highlights: Craig Eddy, MBI

    - Recommended Action: For Information and Discussion

9. Schedule and Next Meetings:

    - **Working Group: January 31, 2019 – 10 AM**

      Items for discussion:

      a-Completion of Phase 1 Tasks

b-Discussion and Recommendation for Approval of Phase 2 Scope of Work/ Budget.

- **Steering (Policy) Committee**: Meeting to be scheduled in Early February 2019.

10. Adjournment

Regional Connectors Study (RCS) Working Group 11-8-18 Minutes

<u>Attendance (alphabetically)</u>

Dawn Best	F&R Engineering
Keith Cannady	HRPDC
Rob Case	HRTPO
Craig Eddy	Michael Baker
Troy Eisenberger	Chesapeake
Brian Fowler	Norfolk
George Janek	US Army COE
Mike Kimbrel	HRTPO
Michael King	US Navy
Barbara Nelson	Port of Virginia
Keith Nichols	HRTPO
Lorna Parkins	Michael Baker
Camelia Ravanbakht	Project Coordinator
Angela Rico	Hampton
Brian Solis	Va. Beach
Jason Souders	Suffolk
Bryan Stilley	Newport News
Dale Stith	HRTPO

<u>Agenda</u>

1. Call to Order

    Mike Kimbrel (HRTPO) called the meeting to order at 10:05am.

2. Welcome and Introductions

    All attendees introduced themselves.

3. Public Comment Period

    No public comments.

4. Minutes

    Minutes of Aug. 27, 2018 meeting were approved.

5. Study Progress

    Craig Eddy (Michael Baker) presented study status using slides.

Stakeholder interviews are almost done. Of the additional stakeholders suggested by those on original stakeholder list, Craig intends to interview HRT and Jim Koch (of State of the Region), with communication to others on list (attached to agenda).

Website is under development.

20,000 surveys were mailed out, and Craig is expecting statistically valid results.

Regional model technical memorandum is nearing completion.

6. Scenario Planning

Dale Stith (HRTPO) presented HRTPO 2045 long-range transportation planning (LRTP) efforts, particularly research—and discussion with LRTP subcommittee—on scenario planning, using slides. She indicated a desire to coordinate scenario planning between the LRTP and RCS.

Lorna Parkins (Michael Baker) presented proposed scenario planning under the RCS contract, using slides. She indicated that the measures of success should support both the LRTP and the RCS. Lorna presented the nine (9) planned scenario planning tasks included in the draft scenario planning scope of work attached to the agenda.

Brian Fowler stated a desire that all study segments be retained for analysis. Camelia Ravanbakht (Project Coordinator) stated that the study's memorandum of understanding (MOU)—between HRTAC, HRTPO, and VDOT—requires that the study screen out proposed highway projects which are likely to not receive environmental permits.

Comments on this scope are due to Camelia by Friday Nov. 16, 2018 COB.

7. Schedule and Next Meetings

Meetings of the working group are planned for Dec. 6, 2018 and Jan. 31, 2019.

8. Adjournment

The meeting was adjourned at 11:40am.

Technical Memorandum

To: File

From: Michael Baker International

Date: November 9, 2018

Re: Hampton Roads Transportation Planning Organization (HRTPO) Regional Connectors Study

Task 2 FINAL Memo – Evaluate Regional Travel Demand Model

Current Hampton Roads Modeling Process

The Hampton Roads regional travel demand model represents an advanced practice four-step forecasting model to support air quality analysis and project planning in the Hampton Roads region.[1] Michael Baker International (MBI) gathered available files, data, and documentation describing the Hampton Roads model. Files and data describing the travel model were obtained from the Virginia Department of Transportation (VDOT) and directly from HRTPO. Documentation was obtained from VDOT's website and includes the following issued from the Transportation & Mobility Planning Division:

- Hampton Roads Model Methodology Report (Ver. 1.0), December 2013
- Hampton Roads Model User's Guide (Ver. 1.0), August 2013
- Hampton Roads Model Release Notes (Ver. 1.2), September 2014

MBI initially submitted a formal request to VDOT's Transportation & Mobility Planning Division for the most contemporary Hampton Roads model sets and supporting data. VDOT responded to the request and provided two (2) model sets; one representing 2009 (base year) and the other year 2040. The current model version release by the Virginia Department of Transportation (VDOT) is '1.2'. Version 1.0 was released in December 2013 and was subsequently updated in June 2014 to reflect revisions to toll facility coding for future year networks, capacity and free flow speed on some links, and changes to the external travel model. Version 1.2, released in September 2014, incorporates these revisions; but reflects the elimination of the Route 460 expressway in future year networks.

MODEL STRUCTURE/PROCEDURES

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[1] Hampton Roads Model Methodology Report (Ver. 1.0), AECOM, December 2013.

MBI has acquired all HRTPO travel model files and available documentation and below summarizes the model structure, modeling procedures, software, and data flows associated with the model. The HRTPO travel model estimates automobile (single-occupant, carpool) and heavy truck trips to the highway network and bus, light rail, and fringe parking trips to the transit network producing time-of-day estimates of average weekday travel in the Hampton Roads region. Travel estimation for the thirteen jurisdiction HRTPO travel model region is based on a "four-step", trip-based, transportation model formulation developed by using CUBE/Voyager as the development platform[2]. The four steps include trip generation, trip distribution, mode choice and trip assignment. Time-of-day estimation in the HRTPO model manifests itself through two (2) separate components for passenger vehicles and light trucks: one for "peak" and one for "off-peak" travel – determining trip distribution and mode choice. Highway trip assignment is further divided into two (2) periods for the peak component, 6-9AM and 3-6PM; and two (2) periods for the off-peak component, 9AM-3PM and 6PM-6AM. A separate four-step model estimates heavy trucks using the same time-of-day partitioning as the previously described passenger vehicle and light truck model. Figure 1 below illustrates the relationship between these steps and the associated data flows.
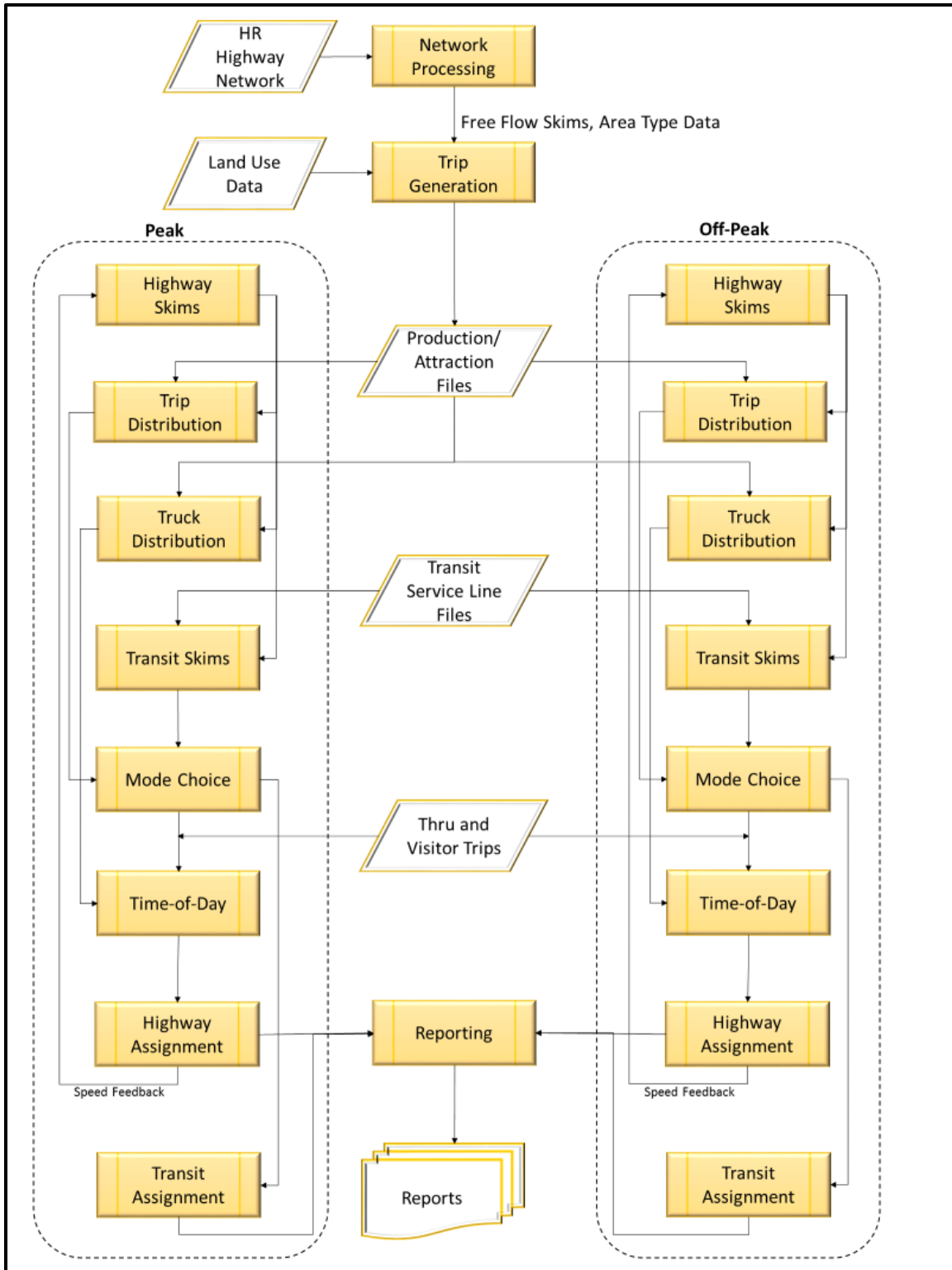
The HRTPO travel model provides estimates for 2009 and 2040 based on 2009 household and employment data and 2040 land use forecasts provided by HRTPO. The model was validated to 2009 data. The CUBE Catalog and Application environment facilitates model execution and maintenance. A brief overview of the modeling process follows. Reference documentation cited above provide a more in-depth discussion.

Trip generation estimates person trip productions and attractions for six (6) travel purposes: home-based work (HBW), home-based shopping (HBS), home-based social/recreation (HBSR), home-based other (HBO), non-home-based work (NHBW), and non-home-based other (NHBO). These purposes are then combined into four (4) purposes moving forward to the next steps in the model: HBW, HBS, HBO (HBO+HBSR), and NHB (NHBW+NHBO). The person trip productions are estimated by applying household trip rates to the number of households in a traffic analysis zone (TAZ) stratified by household size and auto ownership. Person trip attractions are estimated based on a linear relationship which is a function of employment (retail, non-retail) and number of households in a TAZ; and the accessibility of any given TAZ[3]. The magnitude of heavy truck trips is estimated separately and are based on a linear relationship which is a function of employment (industrial, retail, office) and number of households in a TAZ as well as development density. Another available adjustment to the magnitude of truck trips generated is through the designation of "truck zones". TAZs with this designation have their trip ends factored to account for truck generation rates likely to be higher than the regional average. Resulting productions and attractions for persons and trucks are then separated into "peak" and "off-peak" for input into the two separate time-of-day components of the model.

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[2] Citilabs software, version 5.1.3.
[3] Accessibility variable used for calculation of HBW attractions only.

Figure 1: HRTPO Modeling Process

 Trip distribution employs gravity models calibrated to distribute person trips and heavy truck trips by time-of-day. Impedances used by the gravity models are a weighted sum of highway travel time and tolls to reflect out of-pocket trip cost. Travel time includes running time, terminal time, and penalties for major river crossings. Toll costs are included for all non-work trips and included optionally for work related trips. A speed feedback process updates the time component of impedance based on the change in travel speeds in response to congestion, as a result of highway trip assignment towards the end of the modeling process. Each person trip purpose and heavy trucks use separate gravity models to distribute trips.

There is also a separate gravity model calibrated for distributing internal/external vehicle trips (trips with one end inside and one end outside the region). Relationships were initially developed between internal person trip ends and external stations using a Monte Carlo simulation process based on locations of origin and destination zones[4] and traffic counts at each external station.

A nested logit model determines mode choice for HBW and non-work trips (HBS, HBO, and NHB) for the available modes: auto, transit, and fringe parking[5]. In addition to these main modes, the choice model estimates three levels of auto occupancy (drive alone, two-person carpools, three plus-person carpools), two types of transit access (walk and drive), and three types of fringe parking egress (walk, shuttle bus, and transit). The impedances of competing highway and transit services and household automobile ownership determine the mode shares for any given TAZ-to-TAZ volume of person trips. There are separate models for peak and off-peak time periods, and for each trip purpose by auto ownership.

Four (4) travel impedance components for the transit modes provide input to the HRTPO mode choice model. These are run time (total in-vehicle time), "excess" time (total out-of-vehicle time), number of transfers, and walk time. These components are weighted based on parameters used for previous forecasts[6] in the region and are consistent with FTA national experience. The impedances are based on restrained highway travel times and available transit service for the respective times-of-day. Calculation of "best path" transit impedances differentiate walk to transit and drive to transit paths for both peak and off-peak periods as well as fringe parking paths for the peak period.

 An estimate of through trips (vehicle trips with both ends outside the region) is the final component of trips needed for the regional trip matrices. The HRTPO model uses a synthesized external-external trip table. The trip table was developed based on external station volumes and identification and weighting of likely station-to-station movements.

Highway trip assignment assigns vehicle trips to the highway networks with a multi-iteration user-equilibrium assignment process which includes capacity restraint[7] after each iteration.   The highway

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[4] NHTS data.
[5] Available only to HBW peak period trips.
[6] Norfolk LRT Project Final Design Patronage Forecasting Report, 2007.
[7] Conical functions by facility type based on research by the Virginia Modeling, Analysis and Simulation Center.

assignment procedure is a multi-class and is sensitive to the presence of high-occupancy vehicle (HOV) facilities in the highway network and permits only HOV trips to use HOV facilities. The impedances used for capacity restraint are highway-based costs, specifically the sum of highway travel time and tolls. The assignment procedure accommodates different toll values for autos and trucks, and accounts for their different values-of-time. Trucks and passenger vehicles are assigned together. The highway assignment procedure provides time-of-day roadway volume estimates for AM peak (6-9AM), Midday (9AM-3PM), PM peak (3PM-6PM), and Night (6PM-6AM).

Transit assignment uses output from the mode choice procedure in the last feedback iteration to assign trips to peak and off-peak periods. Within each period there are separate assignments for each transit access mode (walk and drive). There are also separate assignments for each fringe parking egress mode for the peak period (walk, shuttle, transit).

Free-flow highway speeds and link capacities are selected from a look-up table that is stratified by roadway facility type and area type. In general, free-flow speed and capacity decreases with increasing development density. There is an area type model that provides an automated procedure for updating area type codes in the network based on changes in existing and future development densities.

REVIEW OF MODEL PERFORMANCE

The MBI team executed the model sets received from VDOT based on the request submitted in July 2018. MBI verified documented highway assignment performance of the 2009 model set as detailed on pages 3-4 in the Hampton Roads Model, Ver 1.2, Release Notes (September 2014). Tables 1-3 below compare the validation as documented with results calculated from the executed model set received from VDOT. Validation reflects daily estimated model volumes as compared to counts.

Table 1: Model Validation Comparison by Volume Group

Roadway Volume Range	Number of Records	Root Mean Square Error (%)		Volume-to-Count Ratio	
		Documented	Calculated	Documented	Calculated
1 - 5,000	1,599	72.16	72.16	1.15	1.15
5,000 - 10,000	754	42.70	42.57	1.06	1.06
10,000 - 20,000	639	28.32	29.00	1.01	1.00
20,000 - 30,000	172	25.60	25.70	0.94	0.94
30,000 - 40,000	55	19.03	19.27	1.00	1.01
40,000 - 50,000	45	14.22	15.87	0.97	0.99
50,000 - 60,000	19	21.65	21.93	0.96	0.96
60,000 - 70,000	3	22.19	22.22	0.90	0.90
70,000 - 80,000	3	13.47	13.90	0.88	0.87
All	**3,289**	**39.45**	**40.05**	**1.02**	**1.02**

Table 2: Model Validation Comparison by Facility Type

Roadway Volume Range	Number of Records	Root Mean Square Error (%)		Volume-to-Count Ratio	
		Documented	Calculated	Documented	Calculated
Interstate	150	19.30	20.74	1.03	1.03
Minor Freeway	72	26.70	26.73	0.98	0.98
Principal Art	394	29.96	30.00	1.05	1.05
Major Art	180	38.20	38.31	0.96	0.97
Minor Art	1,248	40.54	40.48	1.01	1.01
Major Collector	228	75.94	76.19	0.96	0.96
Minor Collector	974	60.72	60.69	1.03	1.02
Local	36	65.30	65.18	1.08	1.08
High Speed Ramp	1	17.84	14.20	0.82	0.86
Low Speed Ramp	6	56.66	56.82	0.98	0.98
All	**3,289**	**39.44**	**39.93**	**1.02**	**1.02**

Table 3: Model Validation Comparison by Area Type

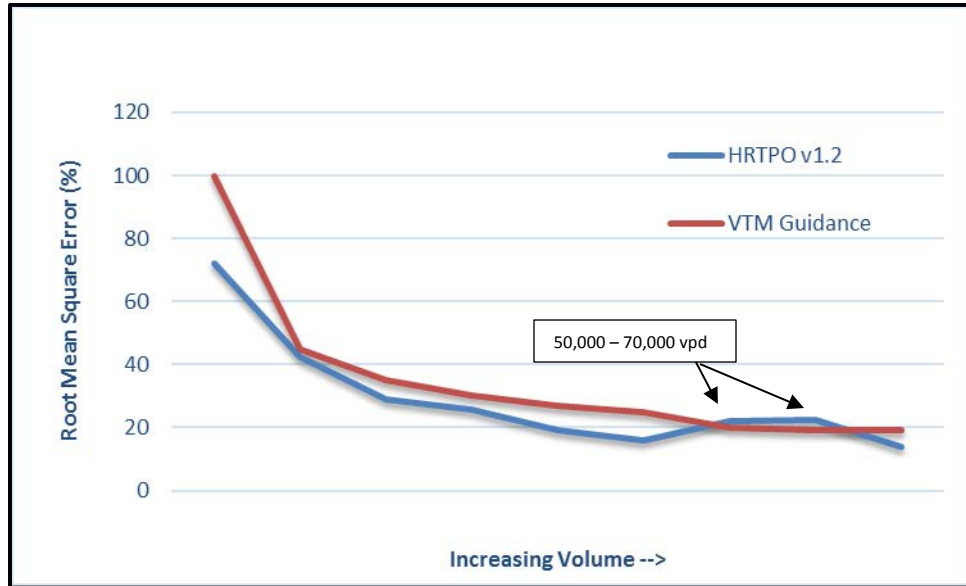| Roadway Volume Range	Number of Records	Root Mean Square Error (%)		Volume-to-Count Ratio	
		Documented	Calculated	Documented	Calculated
CBD	10	65.91	66.21	0.51	0.51
OBD	525	36.87	38.99	1.01	1.01
Urban	702	35.93	36.47	1.01	1.01
Sub Urban	781	39.57	39.67	0.99	0.99
Rural	1,271	41.58	41.46	1.07	1.07
All	3,289	39.45	40.05	1.02	1.02

Tables 1-3 show that the results calculated from the 2009 model set received from VDOT almost identically match highway assignment validation results documented. Differences may be attributed to execution of the model using a different version of CUBE/Voyager[8] from that used by VDOT.

MBI also compared highway assignment performance of the HRTPO model with guidelines specified in the VTM Policies and Procedures Manual (version 2.0). Figure 2 below indicates that highway assignment accuracy is generally within VTM guidelines. The exceptions are a few relatively high-

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[8] HRTPO Model user's guide specifies use of version 5.1.3. Model obtained from VDOT was executed by MBI using version 6.1.2, which is consistent with the version HRTPO uses.

volume roadway segments[9] carrying 50,000 to 70,000 vehicles per day (vpd). The accuracy of assignment to these segments is slightly less than recommended by VTM guidance.

Figure 2: Accuracy of Regional Daily Roadway Segment Assignments

There are 28 screen lines defined in the HRTPO Model for the region. Figure 3 below shows the locations of these screen lines.[10] Figure 4 below shows the accuracy of estimated daily assigned volumes vs. observed volumes for the individual screen lines. While the model estimated volumes over all screen lines is within 3.1% of the observed volume, there are a considerable number of screen lines that exceed the recommended deviation of VTM guidance.

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[9] I-64 between Mallory St and Woodland Rd; I-64 between I-264 and Indian River Rd; I-64 between Oak Grove Connector and Battlefield Blvd; and Berkley Bridge over the Elizabeth River.
[10] p. 106, Hampton Roads Model Methodology Report (Ver. 1.0), December 2013

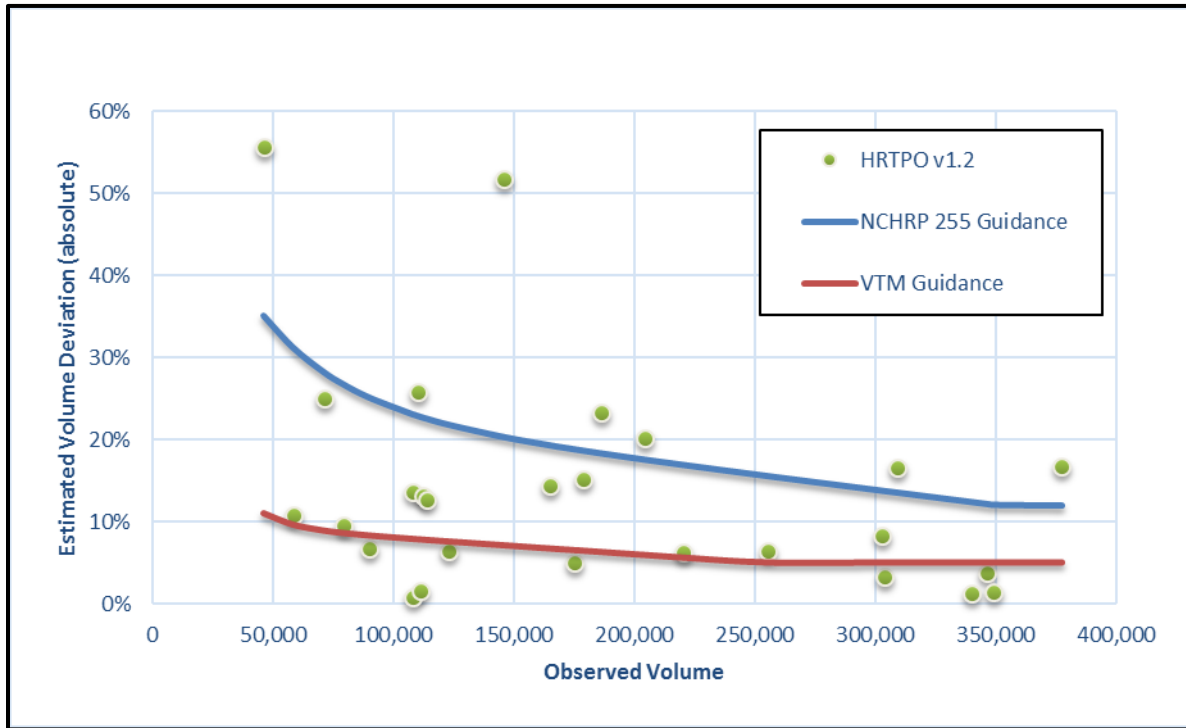**Figure 3: Locations of Regional Screen lines**

Figure 4: Accuracy of Daily Screen Line Assignments

Nearly half of the screen lines meet or are very close to the accuracy requirements specified by VTM guidance. Of the remaining screen lines that do not meet VTM guidance, about half do not meet the less stringent NCHRP 255[11] criteria for volume deviation. While the accuracy of regional link assignments may generally meet VTM guidelines, the model may not explain well the travel patterns and associated magnitudes captured by some screen lines. Although in aggregate trip generation and distribution perform reasonably on a regional basis, as indicated in the methodology report, this accuracy may need examination on a finer geographic level.

RECOMMENDATIONS

One of the centerpieces of the Regional Connectors Study is the measurement of transportation benefits associated with the inclusion of several major roadway segments not included in the HRCS SEIS Preferred Alternative. The HRTPO model will need to display a sensitivity to congestion, travel time reliability, and accessibility in the context of scenario planning. The model will also need to assess the reaction of travelers of different income levels to specific scenarios; enabling the evaluation of social and economic justice, and in part economic impacts. Considering these needs, a review of national best practices, model enhancements in other regions, and discussions with the Citilabs software vendor; MBI has developed a list of potential enhancements to the modeling process that will address the needs of

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[11] Highway Traffic Data for Urbanized Area Project Planning and Design, Transportation Research Board, December 1982.

the Study, as well as broaden the model's analysis capabilities. Table 4 below lists candidate actions for improving the current HRTPO model for use in this Study, as well as addressing future planning challenges.

Some of these recommendations overlap with HRTPO model modifications currently underway by VDOT and its consultants, including a base year update to Year 2015 - accommodating HRTPO's long range planning process. MBI is actively coordinating with VDOT and their consultants to incorporate recommendations that MBI deems critical to the Regional Connectors Study in this model update (highlighted in bold type in the table below). Determination as to whether a recommended action is "critical" balances the gain in analytical capability due to implementing the action versus time added to the schedule for the VDOT updates underway. Notes below the table explain the rationale for the critical recommendations.

Table 4: Candidate Recommended Actions

Model Component	Description of Action
General	- Expand segmentation of non home-based trip purposes. - Accommodate sensitivity to the presence of connected/autonomous vehicles. - Accommodate sensitivity to new modes enabled by technology (ride hailing…). - Account for induced demand due to added roadway capacity. **Evaluate travel patterns associated with major facilities and harbor crossings with information from GPS origin-destination (O-D) data including Streetlight and Airsage.[1]**
Trip Generation	- Assess need for special generator representation using available surveys and cell phone/GPS data ("big data"). **Evaluate and update external travel (XX, XI, IX) based on information from the Virginia Statewide travel demand model and/or information from GPS origin-destination (O-D) data including Streetlight and Airsage.[2]**
Truck Trip Generation/ Distribution	**Assess need for special generator representation using available surveys and cell phone/GPS data ("big data").[3]**

Model Component	Description of Action
Trip Distribution	- Implement income stratification. - Revisit impedance/generalized cost functions (sensitivity to traveler values-of-time by trip purpose, treatment of transit captives…). - Evaluate integration of "matrix estimation" or "adaptable assignment" routines to revise trip tables to better match validation traffic counts.
Auto/Truck Trip Assignment	- Develop/implement standardized assignment validation/performance summary reporting. **Assign trips by purpose and income accounting for different values-of-time.**[4] **Incorporate a toll choice model.**[5] - Account for travel time reliability in route choice.

Notes

1- As indicated by the discussion on page 8 of this memo regarding screen line assignment accuracy, travel patterns and magnitudes estimated by the model will need further investigation. With respect to this study, it will be particularly important to understand and have the model represent well the travel markets that use the Harbor crossings.

2- The methodology report (p.44) indicates a need for survey or other data for estimating external-external travel apart from the synthetic approach currently used. The associated GPS data could also aid in estimating the other external travel components. Moreover, this data can increase understanding of how prevalent external travel is in the markets served by the Harbor crossings and major facilities in the region.

3- This data will provide additional information to validate trip generation and distribution to/from ports and truck terminals in the region. Refining the truck model may improve truck trip assignment performance and yield additional insight into future demand.

4- This refinement will facilitate environmental justice and economic impact analysis and improve sensitivity of the model to congestion. Route choice will be sensitive to travelers' values-of-time in response to congestion. This refinement will also allow tabulation of assignments by income groups, providing a clearer understanding of benefits.

5- The model's current method of accounting for travelers' reactions to tolls is not adequate for forecasting the use of express (HOT) lanes, which will be a prevalent feature of the regional highway network into the future. Income/trip purpose stratification described in Note 4 will complement the toll choice model.

HRTPO

REGIONAL CONNECTORS STUDY

STATUS REPORT

December 6, 2018

Phase 1 Tasks

- **Task 1 – Develop and Initiate Engagement Program**
  - Subtask 1.1A – Conduct One-on-One Interviews with Local Governments
  - Subtask 1.1B – Conduct One-on-One Interviews with other Local Agencies
  - Subtask 1.2 – Prepare Study Engagement /Outreach Plan
  - Subtask 1.3 – Develop and Maintain Study Website
  - Subtask 1.4 – Develop and Conduct Regional Survey

- **Task 2 – Evaluate Regional Travel Demand Model**

- **Task 3 – Determine Scenario Planning Effort**

- **Task 4 – Update Existing Conditions Information**

- **Task 5 – Present Findings to Working Group**

Task 1 – Develop and Initiate Engagement Program

- Task 1.1.A and Task 1.1.B – vast majority of stakeholder interviews have been conducted

- Task 1.2 – Draft Engagement/Outreach Plan nearing completion

- Task 1.3 – Website content and design nearing completion

- Task 1.4 – Results highlighted on following slides

DELIVERABLES
Engagement/Outreach Plan, establish website with usage statistics, summary of interview and survey results – website still under development, interview and survey results compilation complete.

What is heard most from constituents/members as concerns regarding transportation in the region?

- Commuters paying tolls feel the commute time is getting longer (not worth the cost and charges occurring outside of peak hours)

- Unpredictability of travel times throughout the region

- Lack of alternative routes and lack of public transit options

- Sailors and lower income individuals struggle financially with the toll costs (HOV, Express – HOT/Toll); consider incentives or discounts to help

- HOV lanes have not been beneficial; difficult to carpool with various work schedules and need to get the public to understand the benefits

- Use tax dollars to make congestion relief projects that are free to use and publicly available (could alleviate some congested areas)

- Bus system – more coverage and greater frequency

- Consider building more sidewalks, bike/pedestrian trails/lanes to help connectivity

- Consider more parking for Shipyard workers

- The light rail is internal to Norfolk; lacking connectivity elsewhere through the region

Transportation & Regional Economic Vitality & Quality of Life

- Advantages – access to water, tourism (historic resources), military

- Disadvantages - geographically isolated, sea level rise, lack of transit options, roadway congestion (delays, unreliability, cut through traffic), jurisdictions not working together, restrictions imposed by water

- Dependent upon: tourism, the port, government/defense

- Connecting the 'Southside and the Peninsula' is critical for growth in the region

Strengths & Weaknesses of current Transportation System

Strengths

- There's expandability and multiple options available across the region to be a multimodal system
- I-64 capacity improvements
- The Tide as a backbone to other modal solutions

Weaknesses

- Gap in I-64 on Peninsula to complete widening to Richmond
- Lack of transit connectivity, predictability, coverage, and frequency
- Congestion (car dependent region)
- Link SmartScale, HRTAC and TPO processes to compare projects and their needs

Trends observed in the Hampton Roads Region

- Aging Population – less inclined to go longer distances and face traffic

- Funding – will it continue to be focused on regional mega projects or trickle down to the localities for secondary projects? Suggest finding alternative sources.

- Quality of life impacted by congestion

- Collaboration of localities improving to help move people throughout the region

- Climate Change/Sea Level Rise being involved with land use discussions (impacts to military installations)

- Mixed-Use Areas being discussed to provide live-work-play options

Specific Study Questions & Measures of Success

- Project(s) Supported by stakeholders
  - Widening of I-64

- Data/Performance measures stakeholders would like included in the Regional Connectors Study
  - Travel time
  - Accessibility
  - Sea level rise/climate change
  - Movement of people, goods and services
  - Regional benefits vs. local jurisdiction benefits

- Additional segments HRTPO should consider:
  - Improving Route 17
  - Separate/adjacent tunnel for traffic out of NIT
  - New crossing just east of Williamsburg with connection to US 17, I-664, or US 460/17 on southside
  - Ferry Service – Hampton, Norfolk, Newport News connections
  - I-87 to NC
  - Western extension of proposed I-664 Connector to US 17

What is your vision for a Regional Transportation System in Hampton Roads?

- **Improved multimodal transportation infrastructure, services, and connectivity**
  - Every mode has a role to play in the system, determine the right role in the right places and engage <u>ALL</u> localities

- **Enhanced transit services – better reliability, accessibility, and frequency**

- **Better connections between Southside and the Peninsula**

REGIONAL CONNECTORS STUDY

HRTPO

REGIONAL SURVEY RESULTS

Purpose

- The Hampton Roads Transportation Planning Organization (HRTPO) conducted the regional survey to help inform a regional long-term vision for 21st century transportation options for the Hampton Roads region. The survey was developed to better understand the priorities and travel experiences of people in the Hampton Roads region.

Methods

- Statistically valid survey mailed to 20,000 randomly selected households within the Hampton Roads region (see Appendix B).

- Follow-up reminder postcard mailed one week after the survey mailing.

- Respondents could choose to take the survey online (available in English, Spanish, and Tagalog).

- Most were completed by mail (73%) and 23% were completed online.

- An unweighted total of 1,612 people responded to the survey invite, for a response rate of 9%.

- The following demographics were underrepresented – African Americans, those with incomes under $25,000, and those under 35 years of age. To ensure these diverse groups were represented, a total of 120 respondents from the Precision Sample online panel completed the online version of the survey.

- To ensure demographic representation, data were weighted by age using the 2012 – 2016 American Community Survey (ACS) data to match the demographic profile of the Hampton Roads region.

- Overall, an unweighted total of 1,732 people completed the survey for a margin of error of +/- 2.4%.

- Figures in the report summarize frequencies for the survey questions.

- Note that some totals in the charts may add up to somewhat less or somewhat more than 100% due to rounding, and in some cases where respondents provided multiple responses.

- Only statistically significant relationships are discussed throughout the report. To achieve the cut-off for statistical significance, regressions must have a 0.05 significance level (a 95 percent confidence level).

Key Findings

Respondents were generally content with their commute, but transportation is a top issue in the region.

- The majority of respondent thought reducing crime (55%), long term job creation (48%), and making traffic faster (47%) are the most important issues facing the region.

- People pointed to a variety of transportation problems in the region, but the most concerning for respondents were the aging roads/bridges (51%), slow traffic (49%), and tolls (45%).

- Many people are driving in the region. Within the last 7 days, 89% reporting driving alone at least once and one–third (33%) carpooled.

- 69% said they traveled in the region for their commute to and from work. However a majority (64%) thought their commute needs either no improvement or only a little improvement (33%).

- 1 in 5 (20%) respondents telecommuted at least one day in the last week.

- Over half (52%) who reported having access to public transit did not use it. Some cited the inconvenience of transit (doesn't stop where needed or takes too much time) as the reasoning for not using it. 56% said they simply prefer driving their own car.

Congestion was top of mind for many respondents.

- Regardless of whether it was weekend or weekday, most saw the slow traffic in the region limit their fun activities either rarely (44%) or often (39% on weekdays, 38% on weekends).

- When asked the best way to reduce congestion, the most popular responses included either improving how existing roads work (57%) or matching transportation improvements with plans for future growth & development (54%).

Commutes between the Peninsula and Southside were negatively reviewed.
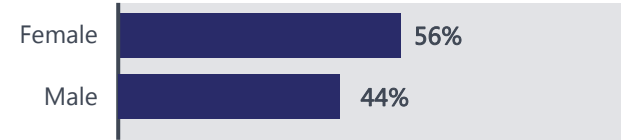
- In both the Hamptons Road region (89%) and the connectors between the Peninsula and the Southside (45%), driving alone was the most popular method for traveling within the last 7 days. In both areas, most people commonly travel these areas to run errands and shop.

- The majority (86%) of respondents said that the roadways connecting the Peninsula to the Southside were slow to some degree, with 41% calling the roads very slow.

- Over half (55%) had made a housing or employment decision to avoid using connecting roads between the Peninsula and the Southside.

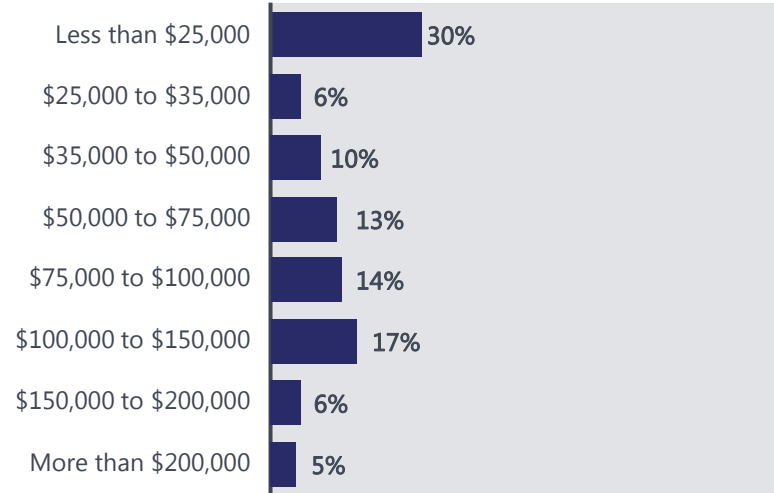## Respondents liked various methods for communicating plans to improve roadways.

- People preferred television (71%) as the best method to communicate planned improvements to the roadways. Other popular ways included social media (51%) and the radio (46%).

Demographic Profile – Part 1

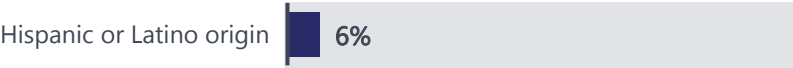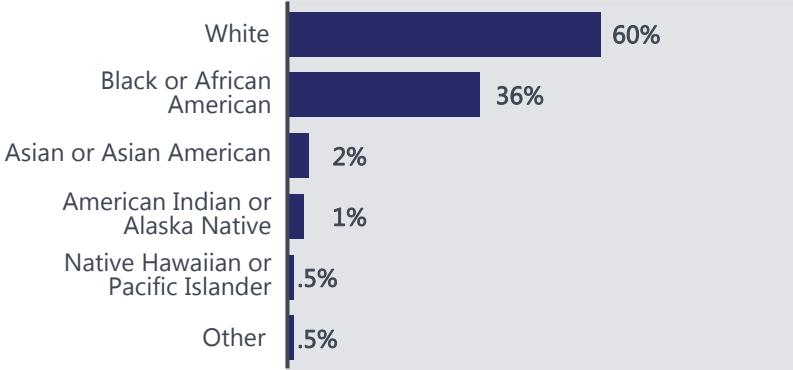## Gender

Female	56%
Male	44%

Household Income

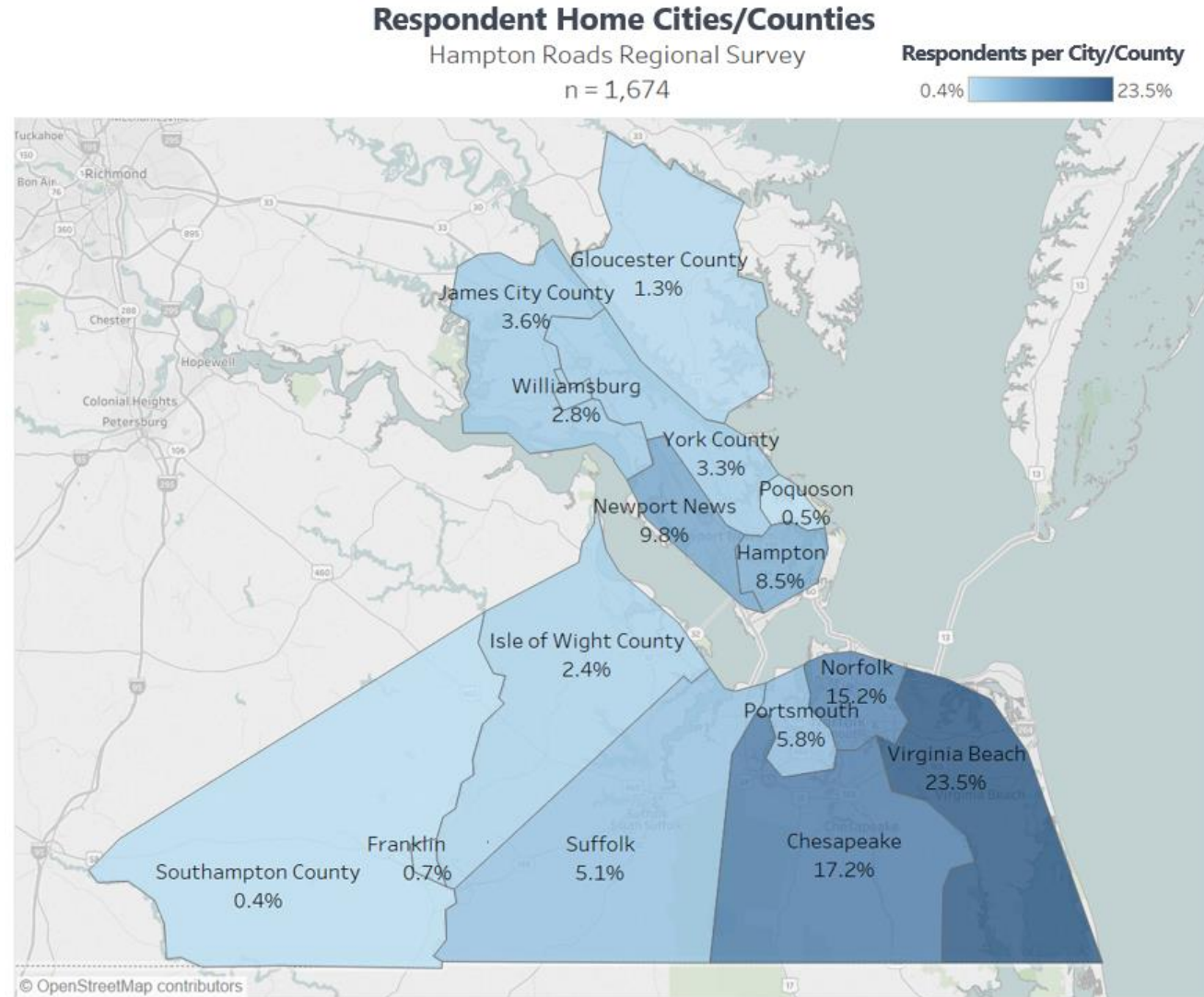|	
Less than $25,000	30%
$25,000 to $35,000	6%
$35,000 to $50,000	10%
$50,000 to $75,000	13%
$75,000 to $100,000	14%
$100,000 to $150,000	17%
$150,000 to $200,000	6%
More than $200,000	5%

See Appendix C (pg. 39) for comparison to the Census's American Community Survey

Due to rounding, or options where participants could select multiple answers, percentages may not sum to 100%. Rounding occurs on all demographic slides.

Ethnicity
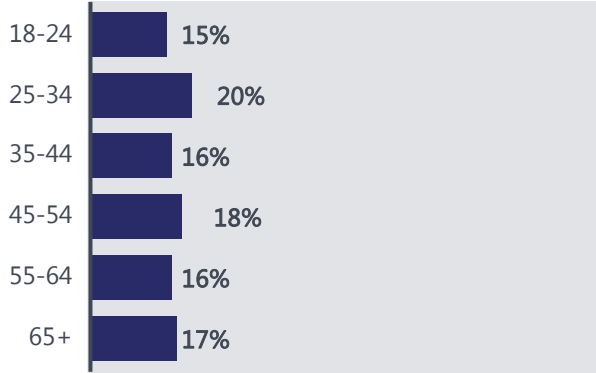
Hispanic or Latino origin	6%

Race

White	60%
Black or African American	36%
Asian or Asian American	2%
American Indian or Alaska Native	1%
Native Hawaiian or Pacific Islander	.5%
Other	.5%

Age

18-24	15%
25-34	20%
35-44	16%
45-54	18%
55-64	16%
65+	17%
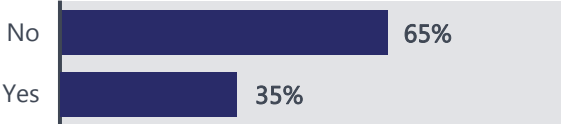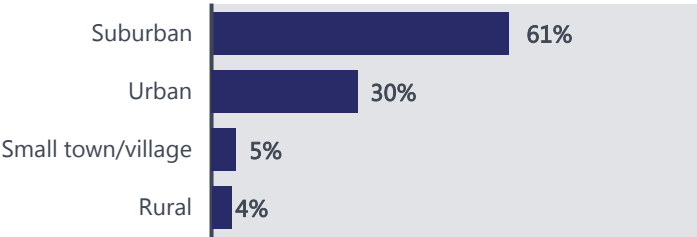
Demographic Profile – Part 2

Demographic Profile: Respondent Home City/County

Respondent Home Cities/Counties
Hampton Roads Regional Survey
n = 1,674

Respondents per City/County
0.4% — 23.5%

Gloucester County 1.3%
James City County 3.6%
Williamsburg 2.8%
York County 3.3%
Poquoson 0.5%
Newport News 9.8%
Hampton 8.5%
Isle of Wight County 2.4%
Norfolk 15.2%
Portsmouth 5.8%
Virginia Beach 23.5%
Franklin 0.7%
Suffolk 5.1%
Chesapeake 17.2%
Southampton County 0.4%

© OpenStreetMap contributors

Detailed Findings

How to Read Findings in This Report

Charts in this report include total results for all respondents. In the example below, we identify some important chart elements to facilitate interpreting them.

Base: people who answered the question, which is used to calculate the overall percentages.

What are the TOP 3 transportation problems you are most concerned about in the Hampton Roads region?

Base: all respondents. Multiple responses allowed. Percentages add to more than 100%.

Looking deeper

- Statistically significant relationships appear on the same page or on a subsequent page. The magnifying glass icon denotes these findings.
- Relationships consider all else (e.g., demographics) to be equal. In this example, respondents who thought limited public transportation was one of the top 3 transportation problems in the region were more likely to have identified as Hispanic/Latino, even when accounting for influences like other demographics.

Category	%
Age of and poor condition of roads, bridges (n = 1,604)	51%
Slow traffic (n = 1,564)	49%
Tolls (n = 1,552)	45%
Safety (n = 1,565)	37%
Rising transportation costs (n = 1,538)	33%
Limited public transportation (n = 1,525)	28%
Limited biking/walking options (n = 1,514)	24%
Mobility needs of elderly and disabled residents (n = 1,533)	12%
Impacts to the environment (n = 1,506)	11%
Movement of freight (n = 1,497)	5%
Other (n = 1,491)	3%

0% 10% 20% 30% 40% 50% 60%

Crime, job creation, and traffic are top of mind as the most important issues for the Hampton Roads region.

- Over half of respondents thought reducing crime (55%) was the most pressing issue facing the region.

- Almost half cited long term job creation (48%) and making traffic faster (47%) as important issues as well.
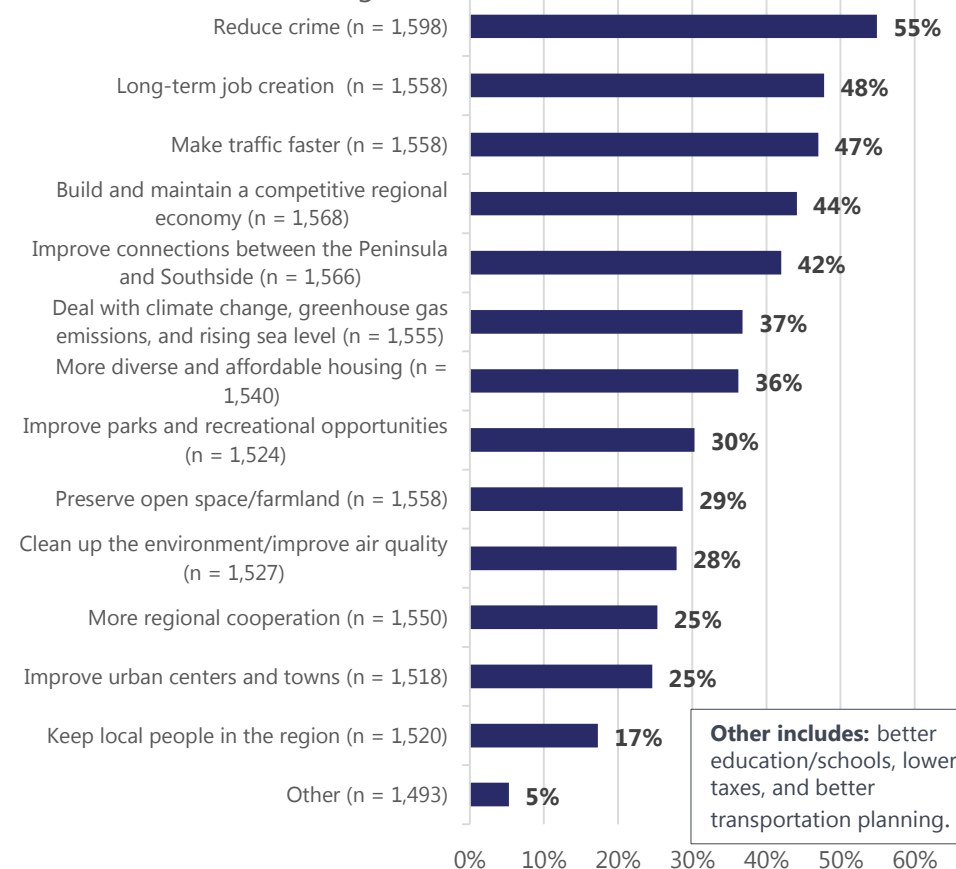
Statistically significant relationships on next page.

What are the TOP 5 most important issues facing the Hampton Roads region?
Base: all respondents. Multiple responses allowed. Percentages add to more than 100%.

Issue	Percentage
Reduce crime (n = 1,598)	55%
Long-term job creation (n = 1,558)	48%
Make traffic faster (n = 1,558)	47%
Build and maintain a competitive regional economy (n = 1,568)	44%
Improve connections between the Peninsula and Southside (n = 1,566)	42%
Deal with climate change, greenhouse gas emissions, and rising sea level (n = 1,555)	37%
More diverse and affordable housing (n = 1,540)	36%
Improve parks and recreational opportunities (n = 1,524)	30%
Preserve open space/farmland (n = 1,558)	29%
Clean up the environment/improve air quality (n = 1,527)	28%
More regional cooperation (n = 1,550)	25%
Improve urban centers and towns (n = 1,518)	25%
Keep local people in the region (n = 1,520)	17%
Other (n = 1,493)	5%

Other includes: better education/schools, lower taxes, and better transportation planning.

🔍 Relationships: Pressing issues for Hampton Roads

- Respondents who consider building and maintaining a competitive regional economy to be one of the top issues facing the Hampton Roads region were:
  - 2 times less likely to be Hispanic/Latino
  - More than 2 times more likely to be White
  - 2 times more likely to say newspaper is the best way to keep people informed

- Respondents who consider more diverse and affordable housing to be one of the top issues facing the Hampton Roads region were:
  - 3 times more likely to be People of Color
  - 2 times more likely to say newspaper is the best way to keep people informed.

- Respondents who consider improving urban centers and towns to be one of the top issues facing the Hampton Roads region were:
  - 2 times more likely to say television and direct mail are the best way to keep people informed

- Respondents who consider keeping local people in the region to be one of the top issues facing the Hampton Roads region were:
  - 2 times more likely to say newspaper and direct mail are the best way to keep people informed

- Respondents who consider an option not listed on this survey to be one of the top issues facing the Hampton Roads region were:
  - More than 8 times more likely to be White

A majority of respondents asked for a balance between developing within city and non-city areas.

- A majority (56%) of respondents preferred balancing new development between cities and outside the cities.

When considering the location of new development, which do you prefer?
Base: all respondents (n = 1,476).

Category	Percentage
Balance priorities between cities and outside the cities	56%
More development in cities	22%
Neither area - no new development	15%
More development outside cities	7%
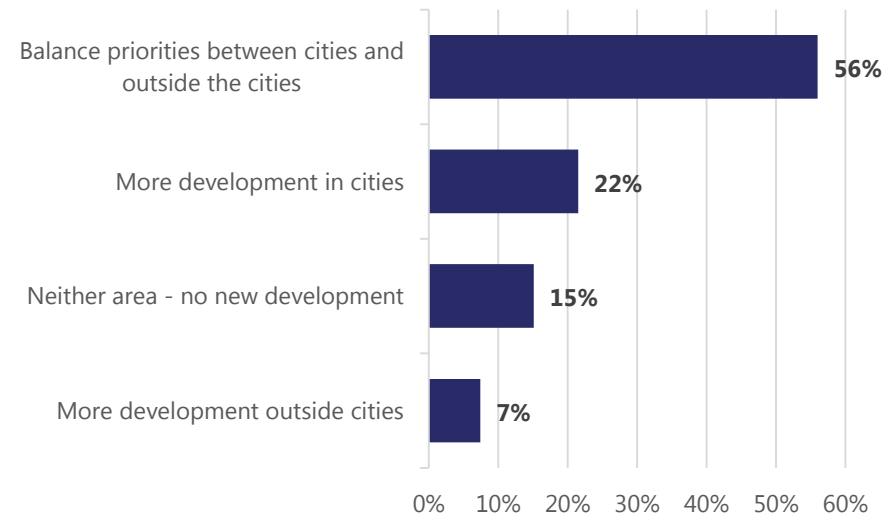
Aging conditions, slow traffic, and tolls were the most concerning transportation problems.

- Overall, respondents were most concerned with aging roads/bridges (51%), slow traffic (49%), and tolls (45%).

- Rising transportation costs (33%) as well as the limited options for public transportation (28%) and biking/walking (24%) were also a concern for some.

🔍 **Statistically significant relationships on next page.**

What are the TOP 3 transportation problems you are most concerned about in the Hampton Roads region?
Base: all respondents. Multiple responses allowed. Percentages add to more than 100%.

Problem	Percentage
Age of and poor condition of roads, bridges (n = 1,604)	51%
Slow traffic (n = 1,564)	49%
Tolls (n = 1,552)	45%
Safety (n = 1,565)	37%
Rising transportation costs (n = 1,538)	33%
Limited public transportation (n = 1,525)	28%
Limited biking/walking options (n = 1,514)	24%
Mobility needs of elderly and disabled residents (n = 1,533)	12%
Impacts to the environment (n = 1,506)	11%
Movement of freight (n = 1,497)	5%
Other (n = 1,491)	3%

Other includes: timing traffic lights, benches & shelters at bus stops, and bad driver behavior.

0% 10% 20% 30% 40% 50% 60%
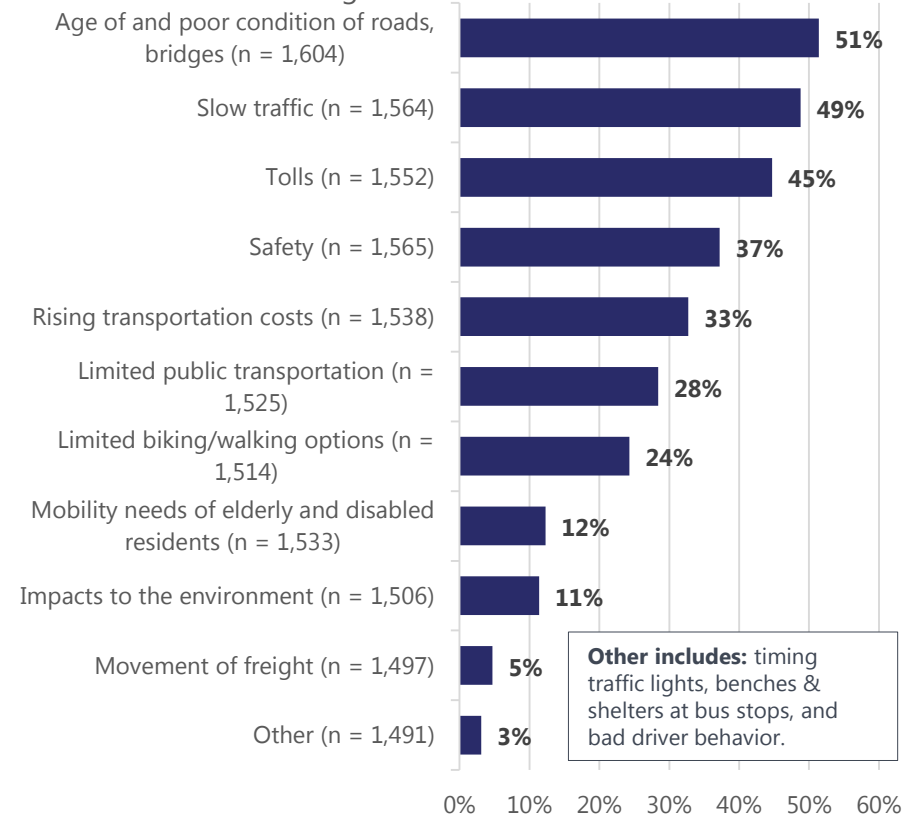
🔍 Relationships: Top regional transportation problems

- Respondents who selected tolls were:
  - More than 2 times less likely to be Hispanic/Latino

- Respondents who selected rising transportation costs were:
  - More than 2 times more likely to think television is the best way to keep people informed.

- Respondents who selected limited public transportation were:
  - More than 2 times more likely to be Hispanic/Latino
  - More than 2 times more likely to think websites or social media are the best way to keep people informed

- Respondents who selected limited biking/walking options were:
  - More than 2 times more likely to be Hispanic/Latino
  - More than 2 times more likely to travel for recreation

- Respondents who selected "other" were:
  - More than 2 times more likely to travel for work
  - More than 2 times less likely to say television was the best way to keep people informed

- Respondents who selected mobility needs of elderly and disabled residents were:
  - More than 2 times more likely to be male
  - More than 2 times more likely to say newspaper or websites were the best way to keep people informed
  - More than 2 times less likely to travel for work in the last 7 days

- Respondents who selected impacts to the environment were:
  - More than 2 times less likely to say television is the best way to keep people informed
  - 2 times more likely to say email is the best way to keep people informed

- Respondents who selected moving freight were:
  - More than 3 times more likely to say newspapers or email were the best ways to keep people informed.

Most respondents reported driving alone in the region.

- Half of respondents (50%) drove alone everyday in the Hampton Roads region within the last 7 days. A quarter (25%) said they drove alone 4 – 6 days of that last 7 days.

- Walking, busing, and carpooling were also popular among respondents. At least once in the last 7 days: 49% walked, 33% carpooled, and 15% took the bus.

Statistically significant relationships on next page.

In the last 7 days, how many days did you use each of the following ways to travel in the Hampton Roads region? Base: all respondents.	0 Days	1 day	2 days	3 days	4 days	5 days	6 days	7 days
Drive alone (n = 1,624)	11%	5%	4%	6%	6%	12%	7%	50%
Walk (n = 1,256)	51%	11%	9%	8%	5%	4%	2%	10%
Carpool (n = 1,201)	66%	7%	11%	4%	4%	3%	1%	4%
Bus (n = 1,166)	85%	4%	2%	2%	2%	2%	0.4%	3%
Uber or Lyft (n = 1,160)	79%	6%	6%	3%	1%	2%	1%	2%
Bicycle (n = 1,179)	81%	7%	4%	2%	2%	2%	1%	1%
Light Rail (n = 1,160)	90%	3%	2%	2%	1%	2%	0.3%	1%
Vanpool (n = 1,150)	94%	1%	1%	1%	1%	1%	0.3%	1%
Taxi (n = 1,157)	90%	5%	2%	1%	1%	1%	0.3%	1%
Passenger Ferry (n = 1,159)	92%	4%	1%	1%	1%	0.2%	0.0%	1%
Work from home (n = 1,143)	78%	6%	4%	2%	2%	3%	1%	3%
Other (n = 22)	49%	8%	6%	16%	7%	0.0%	0.0%	14%

Other includes: paratransit, motorcycle, as passenger.

Relationships: How did you travel in the Hampton Roads region within the past 7 days?

- Respondents who drove alone were:
  - 3 times more likely to have traveled for work in the past 7 days

- Respondents who used light rail were:
  - 2 times less likely to be Hispanic/Latino

- Respondents who used passenger ferries were:
  - 4 times less likely to be Hispanic/Latino
  - 2 times less likely to travel in the Hampton Roads region for work in the last 7 days

- Respondents who used a taxi were:
  - 3 times more likely to be Hispanic/Latino or People of Color

- Respondents who used Uber or Lyft were:
  - More than 2 times more likely to be Hispanic/Latino

- Respondents who biked were:
  - More than 3 times more likely to be Hispanic/Latino

Errands and shopping were the most common activity for traveling in the Hampton Roads region.

- In the last 7 days, 85% of respondents reported traveling in the Hampton Roads region for errands/shopping.

- Traveling to or from work accounted for 69% of respondents reasons for traveling.

- About half of respondents had traveled in the region to visit family or friends (57%), medical appointments (48%), or recreational activities or vacation (44%).

🔍 Looking deeper

- Respondents who traveled to school were:
  - 2 times more likely be younger
  - 3 times more likely to be Hispanic/Latino
- Respondents who traveled for errands/shopping were:
  - 2 times more likely to say the radio is the best way to keep people informed
- Respondents who traveled for recreation/vacation were:
  - More than 2 times more likely to be White

In the last 7 days, why did you travel in the Hampton Roads region?
Base: all respondents. Multiple responses allowed. Percentages add to more than 100%.

Category	Percentage
Errands/shopping (n = 1,566)	85%
Travel to or from work (n = 1,503)	69%
Visit family or friends (n = 1,664)	57%
Medical appointments (n = 1,522)	48%
Recreational activities or vacation (n = 1,563)	44%
Non-commute work-related travel (n = 1,593)	22%
Travel to or from school (n = 1,595)	17%
Travel to airports (n = 1,502)	9%
Other (n = 1,494)	3%

Other includes: volunteering, traveling to church, and moving.
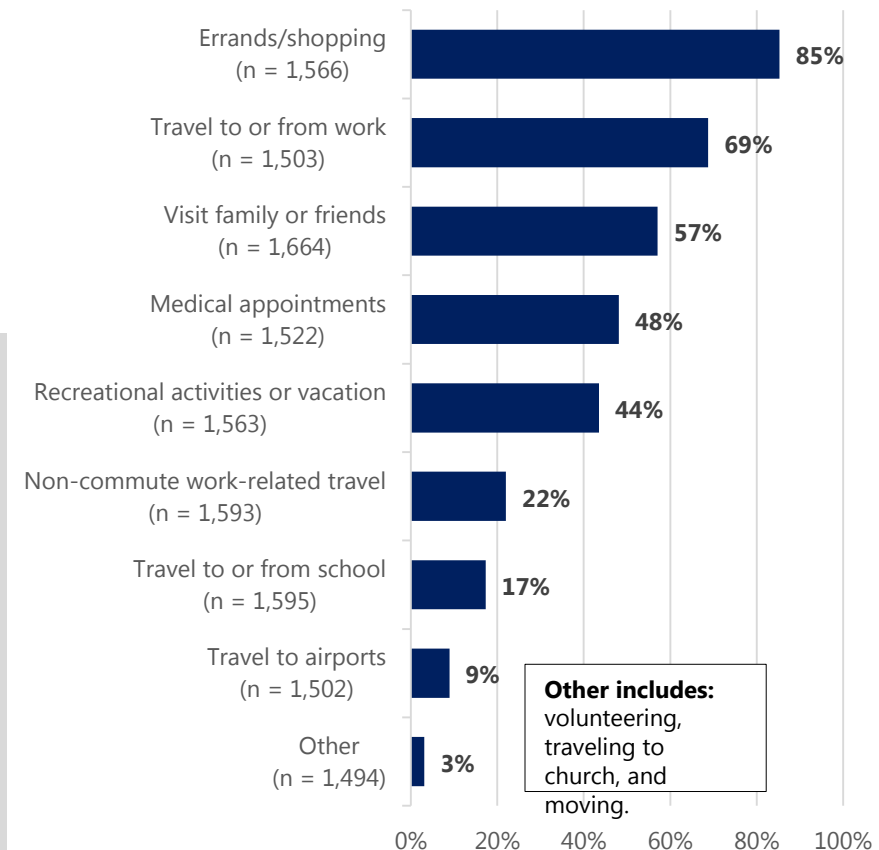
Commute time for work varied among respondents.

Is your main place of employment at home?
Base: all respondents who have traveled to work in the Hampton Roads region within the last 7 days (n = 322).

■ No   ■ Yes

14%
86%
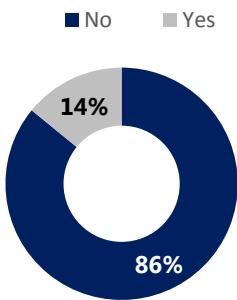
- Most people (86%) who reported traveling to work, have a main place of employment outside their home. Other respondents worked from home within the last 7 days.

- The time it takes respondents to commute either to or from work was distributed over the time categories, with no commute category having more than 15% of responses.

How many minutes does it typically take you to commute from home to work AND from work to home?
Base: all respondents who have traveled to work in the Hampton Roads region within the last 7 days and who do not work from home (n = 883).

■ Commute from home to work   ■ Commute from work to home

Time	Home to work	Work to home
Less than 10 minutes	14%	13%
10 - 14 minutes	14%	11%
15-19 minutes	15%	13%
20-24 minutes	13%	12%
25-29 minutes	8%	9%
30-34 minutes	12%	10%
35-44 minutes	12%	12%
45-59	7%	10%
60+ minutes	5%	9%
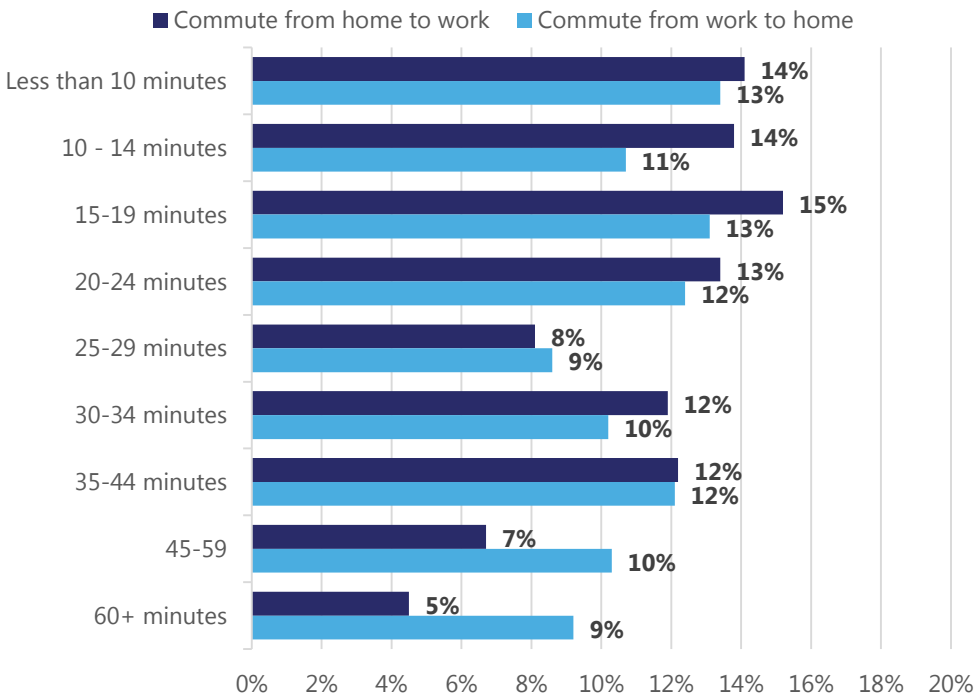
The majority of respondents live near their place of work.

- 61% of respondents reported living within 15 miles of their work.

- However, almost a quarter (23%) of respondents lived over 20 miles away from their work

See Appendix A (pg. 34) for frequency of workplace by city and zip code.

What is the approximate one-way distance in miles between your home and your work?
Base: all respondents who have traveled to work in the Hampton Roads region within the last 7 days and their main placement of employment is not at home (n =883).

Distance	Percentage
0-5 miles	21%
6-10 miles	25%
11-15 miles	15%
16-20 miles	15%
21-25 miles	7%
26-30 miles	7%
31-35 miles	4%
36-40 miles	1%
41-45 miles	1%
46-50 miles	1%
51 or more miles	2%
I work from home	1%

REGIONAL CONNECTORS STUDY

the heartbeat of HAMPTON ROADS TPO
TRANSPORTATION PLANNING ORGANIZATION
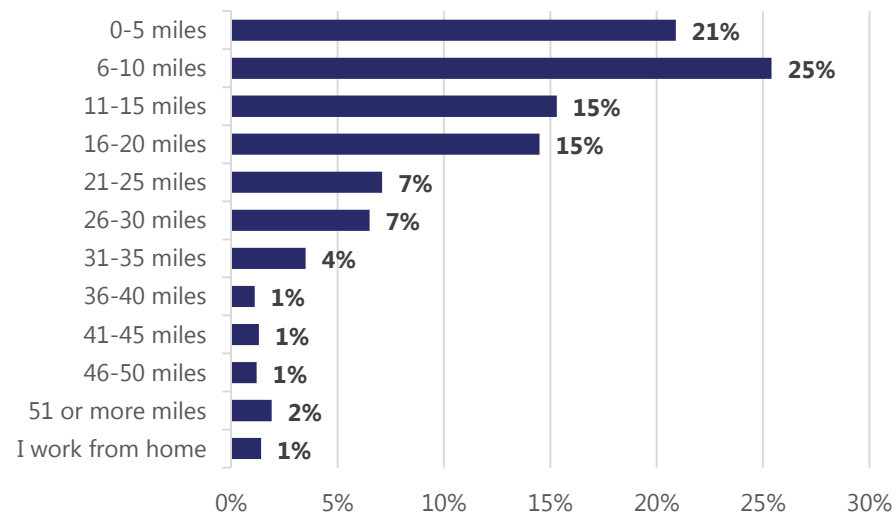
Respondents are split on their opinions concerning commuting to work in the region.

The time it takes you to commute to work:
Base: all respondents who have traveled to work in the Hampton Roads region within the last 7 days and their main placement of employment is not at home (n=874).

■ Needs no improvement   ■ Needs a little improvement   ■ Needs moderate improvement   ■ Needs a lot of improvement

31%	33%	20%	15%
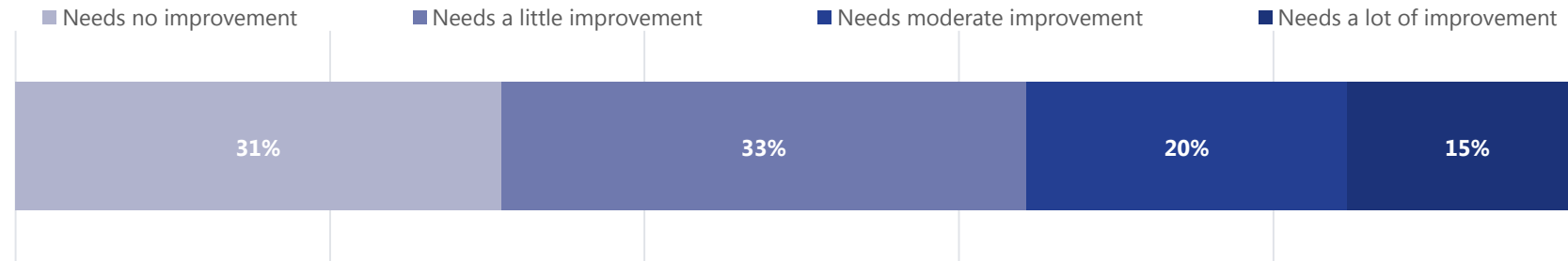
- Almost two thirds (64%) of respondents think their commute to work needs either no improvement (31%) or only a little improvement (33%).

The majority of respondents have access to transit, but don't use it.

- Almost half (52%) of respondents have access to transit but do not use it, while a quarter (26%) have no transit access in the Hampton Roads region.

How do you use public transit services (bus, light rail, ferry) in the Hampton Roads region?
Base: all respondents (n = 1,605).
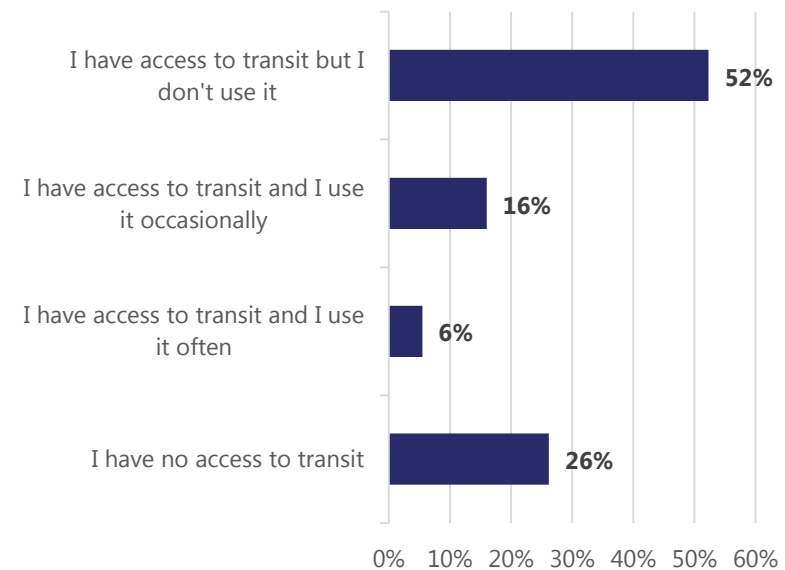
Respondents prefer taking their own car instead of transit.

- A majority of respondents (56%) prefer driving their own car.

- Some cited bus routes as a barrier for using public transit. 38% said it does not stop near their home. 35% said it does not go near their destination.

- Time commitment was another concern with 41% reporting that transit takes too much time.

🔍 Looking deeper

- Respondents who said transit does not stop near their home were:
  - 2 times more likely to live in urban or suburban communities
- Respondents who said using transit is not safe were:
  - More than 2 times more likely to be younger
  - More than 2 times more likely to say the radio is the best way to keep people informed

What are the TOP 3 barriers to you using the transit services or using them more frequently?
Base: all respondents. Multiple responses allowed. Percentages add to more than 100%.

Barrier	Percentage
I simply prefer driving my own car (n = 1,559)	56%
Transit takes too much time (n = 1,551)	41%
Transit does not stop near my home (n = 1,521)	38%
Transit does not go where I need it to go (n = 1,500)	35%
I don't know enough about using transit (n = 1,538)	24%
Transit does not come frequently enough (n = 1,497)	23%
Transit does not come early enough or run late enough…	14%
Transit is not comfortable (n = 1,603)	10%
Using transit is not safe (n = 1,517)	7%
Other (n = 1,491)	5%

Other includes: unable to accomplish errands, buses not on schedule, driving is quicker, complicated commute, and difficult for older adults.

People feel that slow traffic can limit recreational travel, but the extent of the impact is split.

How often does slow traffic limit your travel for fun activities during...
Base: all respondents.

■ Never ■ Rarely ■ Often ■ Always

Category	Never	Rarely	Often	Always
Weekdays (n = 1,641)	7%	44%	39%	11%
Weekends (n = 1,635).	8%	44%	38%	11%

0% 20% 40% 60% 80% 100%
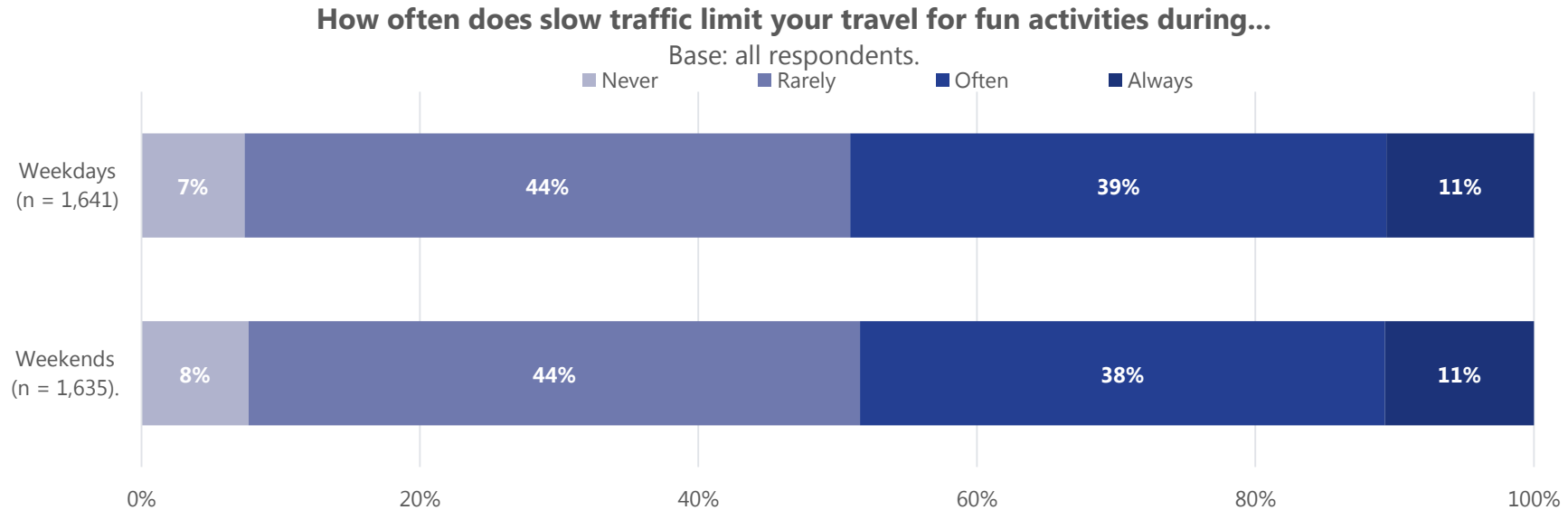
- Regardless of whether it is weekday or weekend, a majority of respondents felt that slow traffic limited recreational travel either rarely (44%) or often (39% for weekdays and 38% on weekends).

- Few people cited the extremes of either never (7% for weekdays and 8% on weekends) or always (11%) feeling that slow traffic limits travel for recreational activities.

Majority of respondents think improving roads and planning for future growth will reduce congestion.

- Improving how existing roads work (57%) and matching transportation improvements with plans for future growth & development (54%) were the most popular ways to reduce congestion.

🔍 **Looking deeper**

- Respondents who prefer more/wider freeways are 2 times less likely to be Hispanic/Latino.
- Respondents who prefer matching transportation improvements with plans for future growth are 2 times more likely to think direct mail is the best way to keep people informed.
- Respondents who prefer improving existing roads are 2 times more likely to be White.

What do you think are the 5 BEST WAYS to reduce congestion in the Hampton Roads region?

Base: all respondents. Multiple responses allowed. Percentages add to more than 100%.

Improve how existing roads work (n = 1,587)	57%
Match transportation improvements with plans for future growth and development (n = 1,586)	54%
More or wider freeways (n = 1,563)	44%
Clear crashes faster (n = 1,543)	41%
More or wider non-freeway roads (n = 1,540)	34%
More public transit (e.g. bus, light rail, ferry, etc) (n = 1,534)	30%
Provide more passenger rail service between cities (n = 1,535)	28%
Provide faster and more reliable passenger rail service between cities (n = 1,534)	28%
Add turn lanes at intersections (n = 1,550)	26%
Improve how public transit works (n = 1,522)	23%
Improve traveler information (n = 1,531)	20%
Provide more bike lanes and sidewalk (n = 1,518)	19%
Add traffic circles/roundabouts (n = 1,503)	14%
Improving ways to avoid driving alone (carpooling) (n = 1,504)	10%
Other (n = 1,491)	7%

Other includes: increasing law enforcement, focus on tunnel congestion, and better on/off ramps.

The most popular way to travel between the Peninsula and the Southside is by driving alone.

- Almost half (45%) reported driving alone between the Peninsula and the Southside at least one day within the last 7 days. 10% said they drove alone everyday.
  - In contrast, 50% of respondents drove alone *everyday* in the general Hampton Roads region.

🔍 **Looking deeper**

- Respondents who use the bus were:
  - More than 5 times more likely to be People of Color
  - More than 2 times less likely to say the radio or social media are the best way to keep people informed
  - More than 2 times less likely to live in rural or small town communities
- Respondents who use Uber or Lyft were:
  - More than 3 times more likely to be Hispanic/Latino

In the last 7 days, how many days did you use each of the following ways to travel between the Peninsula and the Southside?
Base: all respondents.

	0 Days	1 day	2 days	3 days	4 days	5 days	6 days	7 days
Drive Alone (n = 1,489)	55%	12%	9%	5%	3%	4%	2%	10%
Bus (n = 1,205)	90%	3%	0.2%	2%	1%	1%	0.4%	2%
Uber or Lyft (n = 1,193)	88%	4%	3%	1%	1%	1%	1%	2%
Carpool (n = 1,226)	85%	7%	4%	1%	2%	1%	0.4%	1%
Vanpool (n = 1,193)	94%	2%	1%	1%	0.3%	1%	1%	0.3%
Taxi (n = 1,192)	93%	3%	2%	1%	1%	1%	0.0%	1%
Other (n = 21)	31%	40%	15%	7%	4%	0.0%	0.0%	4%

Other includes: company car, travel with children, and wheelchair.

People travel between the Peninsula and the Southside for errands/shopping and visiting friends or family.

- Similar to the Hampton Roads region in general, people most commonly traveled between the Peninsula and the Southside for errands/shopping (23%) and visiting family or friends (22%).

Statistically significant relationships on next page.

In the last 7 days, why did you travel between the Peninsula and the Southside?
Base: all respondents. Multiple responses allowed. Percentages add to more than 100%.

Category	Percentage
Errands/shopping (n = 1,515).	23%
Visit family or friends (n = 1,513)	22%
Recreational activities or vacation…	17%
Travel to or from work (n = 1,500)	16%
Medical appointments (n = 1,511)	12%
Non-commute work-related travel…	9%
Travel to or from school (n = 1,488)	5%
Travel to airports (n = 1,490)	3%
Other (n = 1,488)	9%

Other includes: church and volunteer.
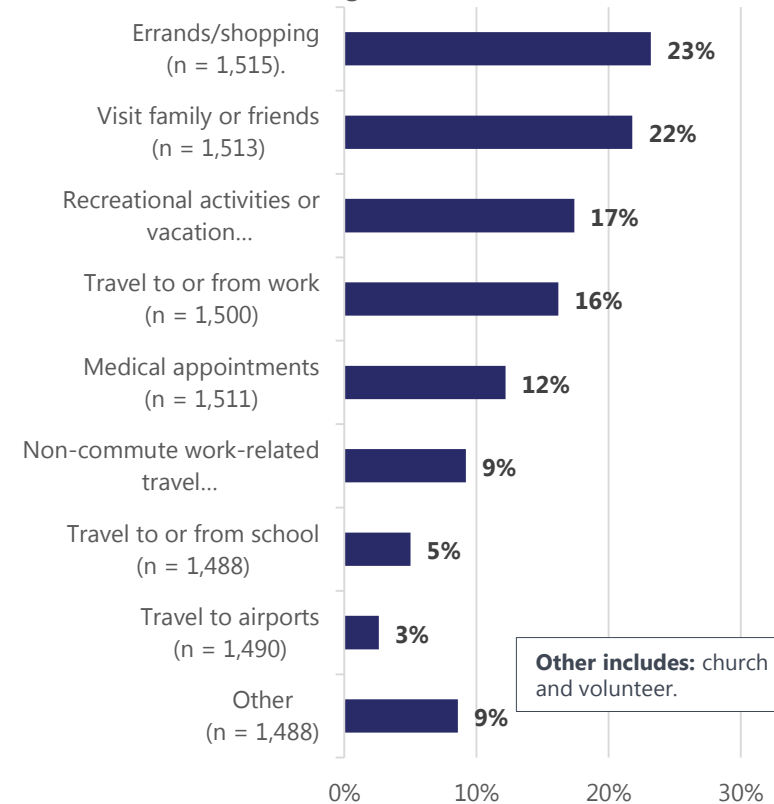
Relationships: Reasons for traveling between the Peninsula and the Southside in the last 7 days

Respondents generally did not travel between the Peninsula and the Southside in the last 7 days. However, there were some key statistically significant relationships.

- Respondents who traveled between the Peninsula and the Southside for school were:
  - More than 8 times more likely to be Hispanic/Latino

- Respondents who traveled between the Peninsula and the Southside for non-commute work-related travel were:
  - 2 times more likely to say newspaper is the best way to keep people informed
  - 4 times more likely to have traveled though the Hampton Roads region for recreation in the past 7 days

- Respondents who traveled between the Peninsula and the Southside for airport-related travel were:
  - More than 3 times less likely to say direct mail or social media are the best ways to reach people
  - 3 times more likely to have traveled though the Hampton Roads region for work in the past 7 days

- Respondents who traveled between the Peninsula and the Southside for Other-related travel were:
  - More than 2 times less likely to have traveled though the Hampton Roads region for recreation in the past 7 days

Many respondents believe the roadways connecting the Peninsula to the Southside are slow and impactful.

- 86% of respondents said the roadways connecting the Peninsula to the Southside were slow to some degree. 41% thought they were very slow, 32% moderately slow, and only 13% thought they were slightly slow.

How slow are the roadways (bridges, tunnels) that connect the Peninsula to the Southside?
Base: all respondents (n = 1,637)
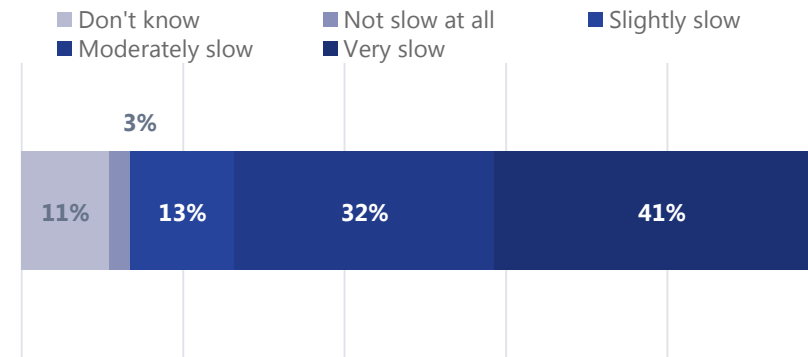
■ Don't know ■ Not slow at all ■ Slightly slow
■ Moderately slow ■ Very slow

11%	3%	13%	32%	41%

Have you ever made a housing or employment decision to avoid needing to use the roadways that connect the Peninsula to the Southside?
Base: all respondents (n = 1,643).

Yes	55%
No	46%

0% 10% 20% 30% 40% 50% 60%
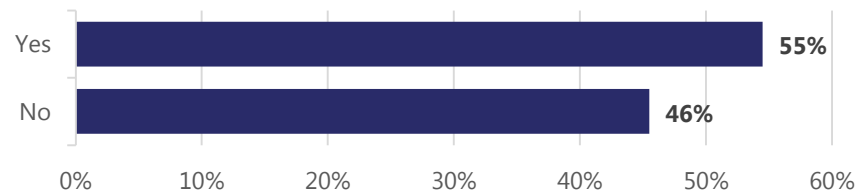
- A majority of respondents (55%) said that they have made a housing or employment decision to avoid needing to use the roadways that connect the Peninsula to the Southside.

Respondents were split on how the certainty of travel time would impact their use of the crossings

If you were more certain of the travel time on the roadways that connect the Peninsula to the Southside, how much more often would you use the crossings?

Base: all respondents (n = 1,646).

■ Don't know ■ No more often ■ Slightly more often ■ Moderately more often ■ Much more often

13%	18%	30%	23%	17%
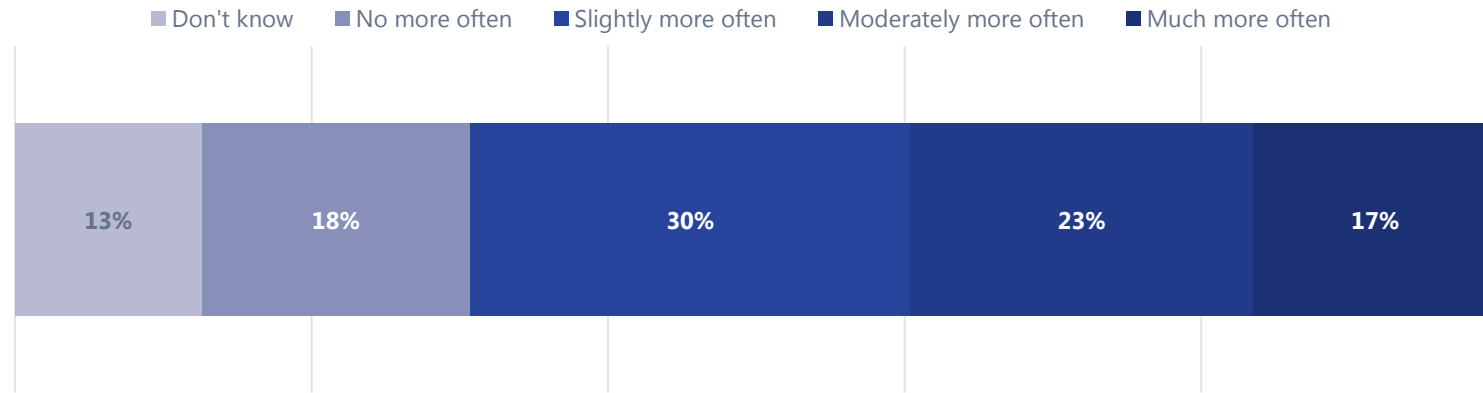
- 70% said they would use the crossings more often if they were more certain of travel times on the roadways connecting the Peninsula to the Southside. However, the extent to which they would use the crossings varied. Many (40%) respondents said they would use the crossings at least moderately more often. 30% reported they would use the crossings slightly more often, and 31% said they would not use the crossings more often or that they were unsure.

Respondents like to stay informed through television.

- The 3 most popular ways to receive information on planned improvements to the roadways are through: television (70%), social media (51%), and radio (46%).

What do you think are the 3 BEST WAYS to keep the public informed about planned improvements to the roadways in the Hampton Roads region?
Base: all respondents. Multiple responses allowed. Percentages add to more than 100%.

Television (n = 1,652) — 70%
Social media (such as Facebook, Twitter) (n = 1,534) — 51%
Radio (n = 1,558) — 46%
Direct mail (n = 1,556) — 38%
Newspaper (n = 1,587) — 30%
Websites (n = 1,536) — 31%
Email (n = 1,518) — 25%
Other (n = 1,489) — 2%

Other includes: roadway alerts/billboards, text message notifications, and VDOT 511.
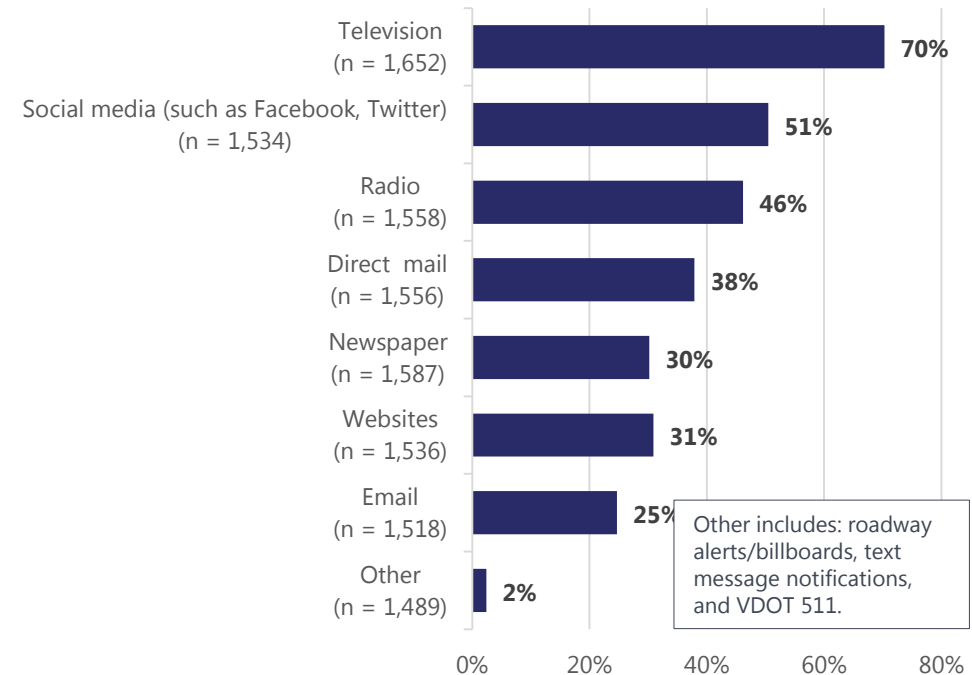
Appendices

Appendix A: Primary Workplace (City/County)

Where is your primary workplace (City/County)?
Base: all respondents who have traveled to work in the Hampton Roads region within the last 7 days and who do not work from home (n = 276).

Norfolk	28%
Virginia Beach	21%
Hampton	13%
Chesapeake	12%
Newport News	7%
Portsmouth	7%
Williamsburg	5%
Suffolk	3%
North Charleston, SC	1%
Gloucester	1%
Cofield, NC	1%
James City	1%
Fort Eustis	0.3%
Glen Allen	0.3%
Elizabeth City, NC	0.1%
Fort Lee	0.1%
Phoebus	0.1%
Surry	0.1%

Appendix A: Primary Workplace (Zip Code)

Where is your primary workplace (Zip Code)? Base: all respondents who have traveled to work in the Hampton Roads region within the last 7 days and who do not work from home (n = 276).							
23666	8%	**23323**	2%	**23451**	1%	**23692**	0.1%
23320	7%	**23702**	2%	**23703**	1%	**23701**	0.1%
23462	6%	**23606**	2%	**23704**	1%	**23801**	0.1%
23185	5%	**23605**	1%	**23608**	1%	**23883**	0.1%
23511	5%	**23456**	1%	**23661**	1%	**27909**	0.1%
23510	4%	**23669**	1%	**23707**	1%	**23060**	0.3%
23508	4%	**23322**	1%	**23245**	1%	**23461**	0.3%
23505	4%	**23507**	1%	**23434**	1%	**23601**	0.3%
23454	3%	**23188**	1%	**23681**	1%	**23651**	0.3%
23452	3%	**23455**	1%	**27922**	1%	**23708**	0.3%
23453	3%	**23360**	1%	**20371**	0.1%	**27011**	0.3%
23502	3%	**25456**	1%	**22520**	0.1%	**23061**	0.4%
23435	2%	**29401**	1%	**22910**	0.1%	**23315**	0.4%
23464	2%	**23459**	1%	**23321**	0.1%	**23445**	0.4%
23504	2%	**23513**	1%	**23437**	0.1%	**23450**	0.4%
23665	2%	**23602**	1%	**23509**	0.1%	**23460**	0.4%
23709	2%	**23604**	1%	**23517**	0.1%	**23503**	0.4%
23607	2%	**23324**	1%	**23518**	0.1%	**23551**	0.4%
				23663	0.1%	**23668**	0.4%

Appendix B: Survey Instrument (Introduction)

PLACE TAPE HERE

Hampton Roads Regional Survey

This survey will help to inform a regional long-term vision for the Hampton Roads region. Your address was randomly selected to participate in this survey to make sure all areas of the Hampton Roads region are included. Answering the survey questions is optional, but we hope you will participate. Your answers are confidential and reported only in combination with other people. By taking a few minutes (less than 10) to complete the survey you will be making sure your voice is heard, providing information to improve travel in the Hampton Roads region, and helping to keep the Hampton Roads region a great place to live!

After answering the questions, simply fold so that the return address to PRR, Inc. shows. Please secure with one small piece of tape and drop in the mail. No postage needed. Please mail no later than October 12, 2018. If you prefer, you can complete the survey online at: http://sgiz.mobi/s3/Hampton-Roads-Regional-Survey.

If you have any questions about the survey, please contact research@prrbiz.com.

Online survey access code

PMK483

We thank you in advance for your participation!

Please continue on next page ➡

Please indicate your choices like this: ☒

Please tell us about your travel in the Hampton Roads region

1. What are the TOP THREE transportation problems you are most concerned about in the Hampton Roads region? (SELECT ONLY YOUR TOP 3)

Slow traffic ☐	Tolls ☐
Limited public transportation (bus, light rail, etc.) ☐	Age of and poor condition of roads, bridges ☐
Limited biking/walking options (bike lanes, sidewalks, crosswalks, etc.) ☐	Impacts to the environment ☐
Safety (e.g., speeding, red light running, accidents, etc.) ☐	Movement of freight ☐
Rising transportation costs (fuel costs, transit fares, parking costs, etc.) ☐	Mobility needs of elderly and disabled residents ☐
	Other (please specify):_____ ☐

2. In the last seven days, how many days did you use each of the following ways to travel in the Hampton Roads region?

	0	1	2	3	4	5	6	7
❖ Drive alone	☐	☐	☐	☐	☐	☐	☐	☐
❖ Carpool	☐	☐	☐	☐	☐	☐	☐	☐
❖ Vanpool	☐	☐	☐	☐	☐	☐	☐	☐
❖ Bus	☐	☐	☐	☐	☐	☐	☐	☐
❖ Light rail	☐	☐	☐	☐	☐	☐	☐	☐
❖ Passenger ferry	☐	☐	☐	☐	☐	☐	☐	☐
❖ Taxi	☐	☐	☐	☐	☐	☐	☐	☐
❖ Uber or Lyft	☐	☐	☐	☐	☐	☐	☐	☐
❖ Bicycle	☐	☐	☐	☐	☐	☐	☐	☐
❖ Walk	☐	☐	☐	☐	☐	☐	☐	☐
❖ Telecommute instead of traveling in the region (work from home)	☐	☐	☐	☐	☐	☐	☐	☐
❖ Other (please specify):_____	☐	☐	☐	☐	☐	☐	☐	☐

3. In the last seven days, why did you travel in the Hampton Roads region? (CHECK ALL THAT APPLY)

Travel to or from work ☐	Non-commute work-related travel ☐	Medical appointments ☐
Travel to or from school ☐	Recreational activities or vacation ☐	Travel to airports ☐
Errands/shopping ☐	Visit family or friends ☐	Other (please specify):_____ ☐

<u>PLEASE ANSWER Q4, Q5, Q6 AND Q7 ONLY IF YOU CHOSE "TRAVEL TO OR FROM WORK" IN Q3.</u>

4. How many minutes does it typically take you to commute from home to work AND from work to home?

I work from home ☐

	<10 mins	10-14	15-19	20-24	25-29	30-34	35-44	45-59	60+ mins
❖ Commute from *home to work*	☐	☐	☐	☐	☐	☐	☐	☐	☐
❖ Commute from *work to home*	☐	☐	☐	☐	☐	☐	☐	☐	☐

5. What is the approximate *one-way* distance in miles between your home and your work?

I work from home ☐	6-10 miles ☐	16-20 miles ☐	26-30 miles ☐	36-40 miles ☐	46-50 miles ☐
0-5 miles ☐	11-15 miles ☐	21-25 miles ☐	31-35 miles ☐	41-45 miles ☐	51 or more miles ☐

6. The time it takes you to commute to work:

Needs no improvement ☐   Needs a little improvement ☐   Needs moderate improvement ☐   Needs a lot of improvement ☐

7. Where is your primary workplace? City: _____ Zip code (5 digits): __ __ __ __ __

8. How do you use public transit services (bus, light rail, ferry) in the Hampton Roads region?

I have access to transit but I don't use it ☐	I have access to transit and I use it often ☐
I have access to transit and I use it occasionally ☐	I have no access to transit ☐

9. What are the TOP THREE barriers to you using the transit services or using them more frequently? (SELECT ONLY YOUR TOP 3)

Transit does not stop near my home ☐	Transit is not comfortable ☐
Transit does not go where I need it to go ☐	Using transit is not safe ☐
Transit does not come frequently enough ☐	I simply prefer driving my own car ☐
Transit does not come early enough or run late enough ☐	I don't know enough about using transit ☐
Transit takes too much time ☐	Other (please specify):_____ ☐

10. In the last seven days, how many days did you use each of the following ways to travel *between the Peninsula and the Southside*?

	0	1	2	3	4	5	6	7
❖ Drive alone	☐	☐	☐	☐	☐	☐	☐	☐
❖ Carpool	☐	☐	☐	☐	☐	☐	☐	☐
❖ Vanpool	☐	☐	☐	☐	☐	☐	☐	☐
❖ Bus	☐	☐	☐	☐	☐	☐	☐	☐
❖ Taxi	☐	☐	☐	☐	☐	☐	☐	☐
❖ Uber or Lyft	☐	☐	☐	☐	☐	☐	☐	☐
❖ Other (please specify):_____	☐	☐	☐	☐	☐	☐	☐	☐

11. In the last seven days, why did you travel *between the Peninsula and the Southside*? (CHECK ALL THAT APPLY)

Travel to or from work ☐	Non-commute work-related travel ☐	Medical appointments ☐
Travel to or from school ☐	Recreational activities or vacation ☐	Travel to airports ☐
Errands/shopping ☐	Visit family or friends ☐	Other (please specify):_____ ☐

Stuck in traffic? Help us understand your experience with slow traffic.

12. How often does slow traffic *during weekdays* limit your travel for fun activities?

Never ☐   Rarely ☐   Often ☐   Always ☐

13. How often does slow traffic *during weekends* limit your travel for fun activities?

Never ☐   Rarely ☐   Often ☐   Always ☐

14. What do you think are the FIVE BEST WAYS to improve traffic flow *in the Hampton Roads region*? (SELECT ONLY YOUR TOP 5)

More or wider freeways ☐
More or wider non-freeway roads ☐
More public transit (e.g., bus, light rail, ferry, etc.) ☐
Match transportation improvements with plans for future growth and development ☐
Improve how existing roads work (e.g., coordinating traffic signals) ☐
Improve how public transit works ☐
Improve traveler information (e.g., electronic message signs, 511, highway advisory radio) ☐
Improve education on carpooling and other ways to avoid driving alone ☐
Clear crashes faster ☐
Add turn lanes at intersections ☐
Add traffic circles/roundabouts ☐
Provide more bike lanes and sidewalks ☐
Provide more passenger rail service between cities ☐
Provide faster and more reliable passenger rail service between cities ☐
Other (please specify):_____ ☐

15. How slow are *the roadways (bridges, tunnels) that connect the Peninsula to the Southside*?

Not slow at all ☐   Slightly slow ☐   Moderately slow ☐   Very slow ☐   Don't know ☐

16. Have you ever made a housing or employment decision to avoid needing to use *the roadways that connect the Peninsula to the Southside*?

No ☐   Yes ☐

17. If you were more certain of the travel time on *the roadways that connect the Peninsula to the Southside*, how much more often would you use the crossings?

No more often ☐   Slightly more often ☐   Moderately more often ☐   Much more often ☐   Don't know ☐

18. What do you think are the THREE BEST WAYS to keep the public informed about planned improvements to *the roadways in the Hampton Roads region*? (SELECT ONLY YOUR TOP 3)

Radio ☐	Television ☐	Direct mail ☐		Email ☐
Newspaper ☐	Websites ☐	Social media (such as Facebook, Twitter) ☐	Other (please specify):_____ ☐

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Appendix B: Survey Instrument (Questions 19-29)

Please tell us what you think

19. What are the TOP FIVE most important issues facing the Hampton Roads region? (SELECT ONLY YOUR TOP 5)

Build and maintain a competitive regional economy ☐	Improve connections between the Peninsula and Southside ☐	
Clean up the environment/improve air quality ☐	Improve parks and recreational opportunities ☐	
Preserve open space/farmland ☐	Reduce crime ☐	
Deal with climate change, greenhouse gas emissions, and rising sea level ☐	Improve urban centers and towns ☐	
Make traffic faster ☐	Keep local people in the region ☐	
More diverse and affordable homes ☐	Long-term job creation ☐	
More regional cooperation ☐	Other (please specify):_____ ☐	

20. When considering the location of new development, which do you prefer?

More development in cities ☐	Balance development between cities and outside the cities ☐
More development outside cities ☐	Neither– no new development ☐

Please tell us about yourself

We have a few questions about yourself and your household. Your answers are confidential and will be combined with those of other respondents. Answering these questions helps us to make sure we have heard from all types of people who live in the Hampton Roads region.

21. What type of community do you live in?

- Urban (e.g., downtown Norfolk, downtown Hampton) ☐
- Suburban (e.g., Great Bridge neighborhood – Chesapeake, Kingsmill neighborhood – James City County) ☐
- Rural (e.g., Gloucester County) ☐
- Small town/village (e.g., Franklin, Windsor) ☐

22. Where do you live?

Chesapeake ☐	James City County ☐	Southampton County ☐
Franklin ☐	Newport News ☐	Suffolk ☐
Gloucester County ☐	Norfolk ☐	Virginia Beach ☐
Hampton ☐	Poquoson ☐	Williamsburg ☐
Isle of Wight County ☐	Portsmouth ☐	York County ☐

23. What is the zip code of your *home* (5 digits)? ___ ___ ___ ___ ___

24. How do you identify?   Male ☐   Female ☐   Gender(s) not listed here ☐

25. What is your age?   18 to 24 ☐   25 to 34 ☐   35 to 44 ☐   45 to 54 ☐   55 to 64 ☐   65 and older ☐

26. Do you have children under 18 years of age living at home?   No ☐   Yes ☐

27. Are you of Hispanic or Latino origin?   No ☐   Yes ☐

28. How do you identify? *(CHECK ALL THAT APPLY)*

Black/African American ☐	Asian/ Asian American ☐
White/Caucasian ☐	Native Hawaiian or other Pacific Islander ☐
American Indian or Alaska Native ☐	Race(s) not listed here *(please specify)*: _____ ☐

29. What was your 2017 total household income before taxes?

Less than $25,000 ☐	$50,000 to less than $75,000 ☐	$150,000 to less than $200,000 ☐
$25,000 to less than $35,000 ☐	$75,000 to less than $100,000 ☐	$200,000 and over ☐
$35,000 to less than $50,000 ☐	$100,000 to less than $150,000 ☐	

Thank you for your participation!   FOR OFFICE USE ONLY

Appendix C: Comparison to the American Community Survey

	Demographics	Survey Sample	Census
Gender	Female	56%	51%
	Male	44%	49%
Age	18-24	15%	15%
	25-34	20%	20%
	35-44	16%	16%
	45-54	18%	17%
	55-64	16%	16%
	65+	17%	17%
Ethnicity	Hispanic	6%	6%
Race	White/Caucasian	60%	62%
	Black/ African American	36%	29%
	Asian/Asian American	2%	4%
	American Indian or Alaskan Native	1%	0.3%
	Native Hawaiian or other Pacific Islander	.5%	0.1%
	Race(s) not listed here (please specify)	.5%	1%
	2 or more races	6%	2%
Household Income	Less than $25,000	30%	19%
	$25,000 to less than $35,000	6%	9%
	$35,000 to less than $50,000	10%	14%
	$50,000 to less than $75,000	13%	20%
	$75,000 to less than $100,000	14%	14%
	$100,000 to less than $150,00	17%	15%
	$150,000 to less than $200,000	6%	6%
	$200,000 and over	5%	4%

Due to rounding, or options where participants could select multiple answers, percentages may not sum to 100%. Rounding occurs on all demographic slides.

Appendix C: Comparison to the American Community Survey

	Demographics	Survey Sample	Census
Home County	Chesapeake	17%	13%
	Franklin	1%	0.5%
	Gloucester County	1%	2%
	Hampton	9%	8%
	Isle of Wight County	2%	2%
	James City County	4%	4%
	Newport News	10%	11%
	Norfolk	15%	15%
	Poquoson	1%	1%
	Portsmouth	6%	6%
	Southampton County	0%	1%
	Suffolk	5%	5%
	Virginia Beach	24%	26%
	Williamsburg	3%	1%
	York County	3%	4%

Due to rounding, or options where participants could select multiple answers, percentages may not sum to 100%. Rounding occurs on all demographic slides.

Task 2 – Evaluate Regional Travel Demand Model

- Reviewed model sets

- Assessed support capability

- Assessed data

- Coordinated with TPO and VDOT regarding planned model updates

- Identified model enhancements required

DELIVERABLES
Recommendations memorandum – technical memorandum complete.

Travel Demand Model

Technical Memorandum

To: File

From: Michael Baker International

Date: November 9, 2018

Re: Hampton Roads Transportation Planning Organization (HRTPO) Regional Connectors Study

Task 2 FINAL Memo – Evaluate Regional Travel Demand Model

Current Hampton Roads Modeling Process

The Hampton Roads regional travel demand model represents an advanced practice four-step forecasting model to support air quality analysis and project planning in the Hampton Roads region.[1] Michael Baker International (MBI) gathered available files, data, and documentation describing the Hampton Roads model. Files and data describing the travel model were obtained from the Virginia Department of Transportation (VDOT) and directly from HRTPO. Documentation was obtained from VDOT's website and includes the following issued from the Transportation & Mobility Planning Division:

- Hampton Roads Model Methodology Report (Ver. 1.0), December 2013
- Hampton Roads Model User's Guide (Ver. 1.0), August 2013
- Hampton Roads Model Release Notes (Ver. 1.2), September 2014

MBI initially submitted a formal request to VDOT's Transportation & Mobility Planning Division for the most contemporary Hampton Roads model sets and supporting data. VDOT responded to the request and provided two (2) model sets; one representing 2009 (base year) and the other year 2040. The current model version release by the Virginia Department of Transportation (VDOT) is '1.2'. Version 1.0 was released in December 2013 and was subsequently updated in June 2014 to reflect revisions to toll facility coding for future year networks, capacity and free flow speed on some links, and changes to the external travel model. Version 1.2, released in September 2014, incorporates these revisions; but reflects the elimination of the Route 460 expressway in future year networks.

MODEL STRUCTURE/PROCEDURES

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[1] Hampton Roads Model Methodology Report (Ver. 1.0), AECOM, December 2013.

MBI has acquired all HRTPO travel model files and available documentation and below summarizes the model structure, modeling procedures, software, and data flows associated with the model. The HRTPO travel model estimates automobile (single-occupant, carpool) and heavy truck trips to the highway network and bus, light rail, and fringe parking trips to the transit network producing time-of-day estimates of average weekday travel in the Hampton Roads region. Travel estimation for the thirteen jurisdiction HRTPO travel model region is based on a "four-step", trip-based, transportation model formulation developed by using CUBE/Voyager as the development platform[2]. The four steps include trip generation, trip distribution, mode choice and trip assignment. Time-of-day estimation in the HRTPO model manifests itself through two (2) separate components for passenger vehicles and light trucks: one for "peak" and one for "off-peak" travel – determining trip distribution and mode choice. Highway trip assignment is further divided into two (2) periods for the peak component, 6-9AM and 3-6PM; and two (2) periods for the off-peak component, 9AM-3PM and 6PM-6AM. A separate four-step model estimates heavy trucks using the same time-of-day partitioning as the previously described passenger vehicle and light truck model. Figure 1 below illustrates the relationship between these steps and the associated data flows.

The HRTPO travel model provides estimates for 2009 and 2040 based on 2009 household and employment data and 2040 land use forecasts provided by HRTPO. The model was validated to 2009 data. The CUBE Catalog and Application environment facilitates model execution and maintenance. A brief overview of the modeling process follows. Reference documentation cited above provide a more in-depth discussion.
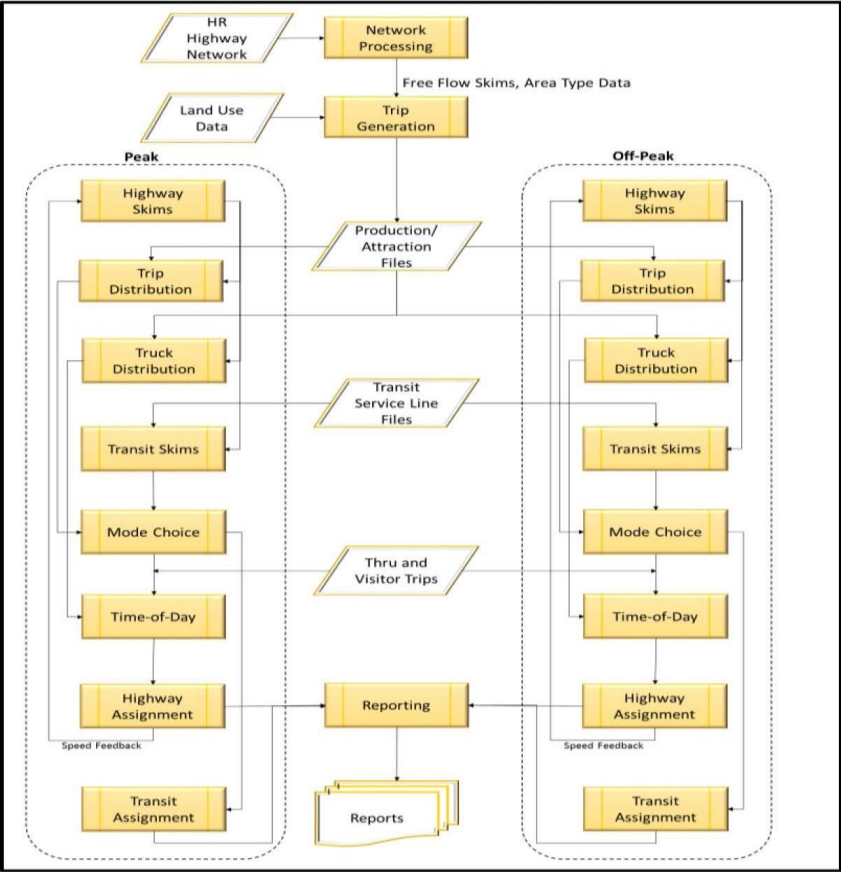
Trip generation estimates person trip productions and attractions for six (6) travel purposes: home-based work (HBW), home-based shopping (HBS), home-based social/recreation (HBSR), home-based other (HBO), non-home-based work (NHBW), and non-home-based other (NHBO). These purposes are then combined into four (4) purposes moving forward to the next steps in the model: HBW, HBS, HBO (HBO+HBSR), and NHB (NHBW+NHBO). The person trip productions are estimated by applying household trip rates to the number of households in a traffic analysis zone (TAZ) stratified by household size and auto ownership. Person trip attractions are estimated based on a linear relationship which is a function of employment (retail, non-retail) and number of households in a TAZ; and the accessibility of any given TAZ[3]. The magnitude of heavy truck trips is estimated separately and are based on a linear relationship which is a function of employment (industrial, retail, office) and number of households in a TAZ as well as development density. Another available adjustment to the magnitude of truck trips generated is through the designation of "truck zones". TAZs with this designation have their trip ends factored to account for truck generation rates likely to be higher than the regional average. Resulting productions and attractions for persons and trucks are then separated into "peak" and "off-peak" for input into the two separate time-of-day components of the model.

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[2] Citilabs software, version 5.1.3.
[3] Accessibility variable used for calculation of HBW attractions only.

2 | P a g e

Travel Demand Model

Figure 1: HRTPO Modeling Process

Trip distribution employs gravity models calibrated to distribute person trips and heavy truck trips by time-of-day. Impedances used by the gravity models are a weighted sum of highway travel time and tolls to reflect out of-pocket trip cost. Travel time includes running time, terminal time, and penalties for major river crossings. Toll costs are included for all non-work trips and included optionally for work related trips. A speed feedback process updates the time component of impedance based on the change in travel speeds in response to congestion, as a result of highway trip assignment towards the end of the modeling process. Each person trip purpose and heavy trucks use separate gravity models to distribute trips.

There is also a separate gravity model calibrated for distributing internal/external vehicle trips (trips with one end inside and one end outside the region). Relationships were initially developed between internal person trip ends and external stations using a Monte Carlo simulation process based on locations of origin and destination zones[4] and traffic counts at each external station.

A nested logit model determines mode choice for HBW and non-work trips (HBS, HBO, and NHB) for the available modes: auto, transit, and fringe parking[5]. In addition to these main modes, the choice model estimates three levels of auto occupancy (drive alone, two-person carpools, three plus-person carpools), two types of transit access (walk and drive), and three types of fringe parking egress (walk, shuttle bus, and transit). The impedances of competing highway and transit services and household automobile ownership determine the mode shares for any given TAZ-to-TAZ volume of person trips. There are separate models for peak and off-peak time periods, and for each trip purpose by auto ownership.

Four (4) travel impedance components for the transit modes provide input to the HRTPO mode choice model. These are run time (total in-vehicle time), "excess" time (total out-of-vehicle time), number of transfers, and walk time. These components are weighted based on parameters used for previous forecasts[6] in the region and are consistent with FTA national experience. The impedances are based on restrained highway travel times and available transit service for the respective times-of-day. Calculation of "best path" transit impedances differentiate walk to transit and drive to transit paths for both peak and off-peak periods as well as fringe parking paths for the peak period.

An estimate of through trips (vehicle trips with both ends outside the region) is the final component of trips needed for the regional trip matrices. The HRTPO model uses a synthesized external-external trip table. The trip table was developed based on external station volumes and identification and weighting of likely station-to-station movements.

Highway trip assignment assigns vehicle trips to the highway networks with a multi-iteration user-equilibrium assignment process which includes capacity restraint[7] after each iteration. The highway

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[4] NHTS data.
[5] Available only to HBW peak period trips.
[6] Norfolk LRT Project Final Design Patronage Forecasting Report, 2007.
[7] Conical functions by facility type based on research by the Virginia Modeling, Analysis and Simulation Center.

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assignment procedure is a multi-class and is sensitive to the presence of high-occupancy vehicle (HOV) facilities in the highway network and permits only HOV trips to use HOV facilities. The impedances used for capacity restraint are highway-based costs, specifically the sum of highway travel time and tolls. The assignment procedure accommodates different toll values for autos and trucks, and accounts for their different values-of-time. Trucks and passenger vehicles are assigned together. The highway assignment procedure provides time-of-day roadway volume estimates for AM peak (6-9AM), Midday (9AM-3PM), PM peak (3PM-6PM), and Night (6PM-6AM).

Transit assignment uses output from the mode choice procedure in the last feedback iteration to assign trips to peak and off-peak periods. Within each period there are separate assignments for each transit access mode (walk and drive). There are also separate assignments for each fringe parking egress mode for the peak period (walk, shuttle, transit).

Free-flow highway speeds and link capacities are selected from a look-up table that is stratified by roadway facility type and area type. In general, free-flow speed and capacity decreases with increasing development density. There is an area type model that provides an automated procedure for updating area type codes in the network based on changes in existing and future development densities.

REVIEW OF MODEL PERFORMANCE

The MBI team executed the model sets received from VDOT based on the request submitted in July 2018. MBI verified documented highway assignment performance of the 2009 model set as detailed on pages 3-4 in the Hampton Roads Model, Ver 1.2, Release Notes (September 2014). Tables 1-3 below compare the validation as documented with results calculated from the executed model set received from VDOT. Validation reflects daily estimated model volumes as compared to counts.

Table 1: Model Validation Comparison by Volume Group

Roadway Volume Range	Number of Records	Root Mean Square Error (%)		Volume-to-Count Ratio	
		Documented	Calculated	Documented	Calculated
1 - 5,000	1,599	72.16	72.16	1.15	1.15
5,000 - 10,000	754	42.70	42.57	1.06	1.06
10,000 - 20,000	639	28.32	29.00	1.01	1.00
20,000 - 30,000	172	25.60	25.70	0.94	0.94
30,000 - 40,000	55	19.03	19.27	1.00	1.01
40,000 - 50,000	45	14.22	15.87	0.97	0.99
50,000 - 60,000	19	21.65	21.93	0.96	0.96
60,000 - 70,000	3	22.19	22.22	0.90	0.90
70,000 - 80,000	3	13.47	13.90	0.88	0.87
All	3,289	39.45	40.05	1.02	1.02

Table 2: Model Validation Comparison by Facility Type

Roadway Volume Range	Number of Records	Root Mean Square Error (%)		Volume-to-Count Ratio	
		Documented	Calculated	Documented	Calculated
Interstate	150	19.30	20.74	1.03	1.03
Minor Freeway	72	26.70	26.73	0.98	0.98
Principal Art	394	29.96	30.00	1.05	1.05
Major Art	180	38.20	38.31	0.96	0.97
Minor Art	1,248	40.54	40.48	1.01	1.01
Major Collector	228	75.94	76.19	0.96	0.96
Minor Collector	974	60.72	60.69	1.03	1.02
Local	36	65.30	65.18	1.08	1.08
High Speed Ramp	1	17.84	14.20	0.82	0.86
Low Speed Ramp	6	56.66	56.82	0.98	0.98
All	3,289	39.44	39.93	1.02	1.02

Table 3: Model Validation Comparison by Area Type

Roadway Volume Range	Number of Records	Root Mean Square Error (%)		Volume-to-Count Ratio	
		Documented	Calculated	Documented	Calculated
CBD	10	65.91	66.21	0.51	0.51
OBD	525	36.87	38.99	1.01	1.01
Urban	702	35.93	36.47	1.01	1.01
Sub Urban	781	39.57	39.67	0.99	0.99
Rural	1,271	41.58	41.46	1.07	1.07
All	3,289	39.45	40.05	1.02	1.02

Tables 1-3 show that the results calculated from the 2009 model set received from VDOT almost identically match highway assignment validation results documented. Differences may be attributed to execution of the model using a different version of CUBE/Voyager[8] from that used by VDOT.

MBI also compared highway assignment performance of the HRTPO model with guidelines specified in the VTM Policies and Procedures Manual (version 2.0). Figure 2 below indicates that highway assignment accuracy is generally within VTM guidelines. The exceptions are a few relatively high-

[8] HRTPO Model user's guide specifies use of version 5.1.3. Model obtained from VDOT was executed by MBI using version 6.1.2, which is consistent with the version HRTPO uses.

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volume roadway segments[9] carrying 50,000 to 70,000 vehicles per day (vpd). The accuracy of assignment to these segments is slightly less than recommended by VTM guidance.

Figure 2: Accuracy of Regional Daily Roadway Segment Assignments

There are 28 screen lines defined in the HRTPO Model for the region. Figure 3 below shows the locations of these screen lines.[10] Figure 4 below shows the accuracy of estimated daily assigned volumes vs. observed volumes for the individual screen lines. While the model estimated volumes over all screen lines is within 3.1% of the observed volume, there are a considerable number of screen lines that exceed the recommended deviation of VTM guidance.

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[9] I-64 between Mallory St and Woodland Rd; I-64 between I-264 and Indian River Rd; I-64 between Oak Grove Connector and Battlefield Blvd; and Berkley Bridge over the Elizabeth River.
[10] p. 106, Hampton Roads Model Methodology Report (Ver. 1.0), December 2013

Figure 3: Locations of Regional Screen lines

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Figure 4: Accuracy of Daily Screen Line Assignments
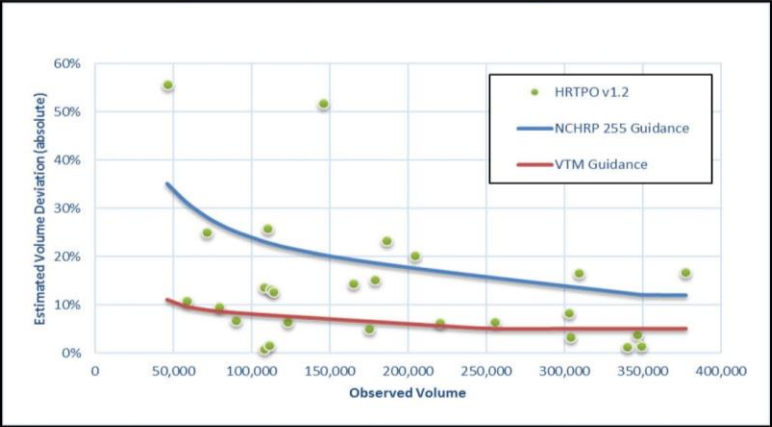
Nearly half of the screen lines meet or are very close to the accuracy requirements specified by VTM guidance. Of the remaining screen lines that do not meet VTM guidance, about half do not meet the less stringent NCHRP 255[11] criteria for volume deviation. While the accuracy of regional link assignments may generally meet VTM guidelines, the model may not explain well the travel patterns and associated magnitudes captured by some screen lines. Although in aggregate trip generation and distribution perform reasonably on a regional basis, as indicated in the methodology report, this accuracy may need examination on a finer geographic level.

RECOMMENDATIONS

One of the centerpieces of the Regional Connectors Study is the measurement of transportation benefits associated with the inclusion of several major roadway segments not included in the HRCS SEIS Preferred Alternative. The HRTPO model will need to display a sensitivity to congestion, travel time reliability, and accessibility in the context of scenario planning. The model will also need to assess the reaction of travelers of different income levels to specific scenarios; enabling the evaluation of social and economic justice, and in part economic impacts. Considering these needs, a review of national best practices, model enhancements in other regions, and discussions with the Citilabs software vendor; MBI has developed a list of potential enhancements to the modeling process that will address the needs of

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[11] Highway Traffic Data for Urbanized Area Project Planning and Design, Transportation Research Board, December 1982.

the Study, as well as broaden the model's analysis capabilities. Table 4 below lists candidate actions for improving the current HRTPO model for use in this Study, as well as addressing future planning challenges.

Some of these recommendations overlap with HRTPO model modifications currently underway by VDOT and its consultants, including a base year update to Year 2015 - accommodating HRTPO's long range planning process. MBI is actively coordinating with VDOT and their consultants to incorporate recommendations that MBI deems critical to the Regional Connectors Study in this model update (highlighted in bold type in the table below). Determination as to whether a recommended action is "critical" balances the gain in analytical capability due to implementing the action versus time added to the schedule for the VDOT updates underway. Notes below the table explain the rationale for the critical recommendations.

Table 4: Candidate Recommended Actions

Model Component	Description of Action
General	• Expand segmentation of non home-based trip purposes. • Accommodate sensitivity to the presence of connected/autonomous vehicles. • Accommodate sensitivity to new modes enabled by technology (ride hailing...). • Account for induced demand due to added roadway capacity. • **Evaluate travel patterns associated with major facilities and harbor crossings with information from GPS origin-destination (O-D) data including Streetlight and Airsage.**[1]
Trip Generation	• Assess need for special generator representation using available surveys and cell phone/GPS data ("big data"). • **Evaluate and update external travel (XX, XI, IX) based on information from the Virginia Statewide travel demand model and/or information from GPS origin-destination (O-D) data including Streetlight and Airsage.**[2]
Truck Trip Generation/ Distribution	• **Assess need for special generator representation using available surveys and cell phone/GPS data ("big data").**[3]

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Model Component	Description of Action
Trip Distribution	• Implement income stratification. • Revisit impedance/generalized cost functions (sensitivity to traveler values-of-time by trip purpose, treatment of transit captives…). • Evaluate integration of "matrix estimation" or "adaptable assignment" routines to revise trip tables to better match validation traffic counts.
Auto/Truck Trip Assignment	• Develop/implement standardized assignment validation/performance summary reporting. • **Assign trips by purpose and income accounting for different values-of-time.[4]** • **Incorporate a toll choice model.[5]** • Account for travel time reliability in route choice.

Notes

1- As indicated by the discussion on page 8 of this memo regarding screen line assignment accuracy, travel patterns and magnitudes estimated by the model will need further investigation. With respect to this study, it will be particularly important to understand and have the model represent well the travel markets that use the Harbor crossings.

2- The methodology report (p.44) indicates a need for survey or other data for estimating external-external travel apart from the synthetic approach currently used. The associated GPS data could also aid in estimating the other external travel components. Moreover, this data can increase understanding of how prevalent external travel is in the markets served by the Harbor crossings and major facilities in the region.

3- This data will provide additional information to validate trip generation and distribution to/from ports and truck terminals in the region. Refining the truck model may improve truck trip assignment performance and yield additional insight into future demand.

4- This refinement will facilitate environmental justice and economic impact analysis and improve sensitivity of the model to congestion. Route choice will be sensitive to travelers' values-of-time in response to congestion. This refinement will also allow tabulation of assignments by income groups, providing a clearer understanding of benefits.

5- The model's current method of accounting for travelers' reactions to tolls is not adequate for forecasting the use of express (HOT) lanes, which will be a prevalent feature of the regional highway network into the future. Income/trip purpose stratification described in Note 4 will complement the toll choice model.

REGIONAL CONNECTORS STUDY

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TRANSPORTATION PLANNING ORGANIZATION

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Task 3 – Determine Scenario Planning Effort

- Consultant team and HRTPO staff collaboration completed

- Scope of work for Phase 2 developed. Costs under negotiation.

DELIVERABLES

Memorandum of understanding defining roles and outcomes – draft memorandum completed

Task 4 – Update Existing Conditions Information

- Summary pages completed and submitted for HRTPO staff comments

DELIVERABLES

One-page summaries of limited-access roadway segments – revised draft summary pages under development.

Task 5 – Present Findings at Working Group Meeting

- December 6 - status update

DELIVERABLES

Today's Phase 1 status update presentation, Phase 2 draft scope – initiated, anticipate draft scope and costs approval at next Working Group meeting (Jan 31).

Schedule

	PHASE 1																													
		Week of																												
		June		July					August				September				October					November				December					January			
Task No.	Task Name	18	25	2	9	16	23	30	6	13	20	27	3	10	17	24	1	8	15	22	29	5	12	19	26	3	10	17	24	31	7	14	21	28
1.1	Prepare Study Engagement/Outreach Plan																																	
1.2	Develop and Maintain Study Website																																	
1.3	Conduct One-On-One Interviews																																	
1.4	Develop and Conduct Regional Survey																																	
2.0	Evaluate Regional Travel Demand Model																																	
3.0	Determine Scenario Planning Effort																																	
4.0	Update Existing Conditions Information																																	
5.0	Present Findings at Working Group Meeting																																	
	Prepare Phase 2 Scope of Work																																	

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Next Steps

- Complete Phase 1 tasks

- Collaborate with Working Group to determine scope of Phase 2

- Develop costs associated with Phase 2 scope

- Gain Working Group approval of Phase 2 scope and costs (Jan 31)

- Gain Steering Committee approval of Phase 2 scope and costs (early Feb)

- Submit Phase 2 scope and costs for HRTPO Board approval (Feb 21)