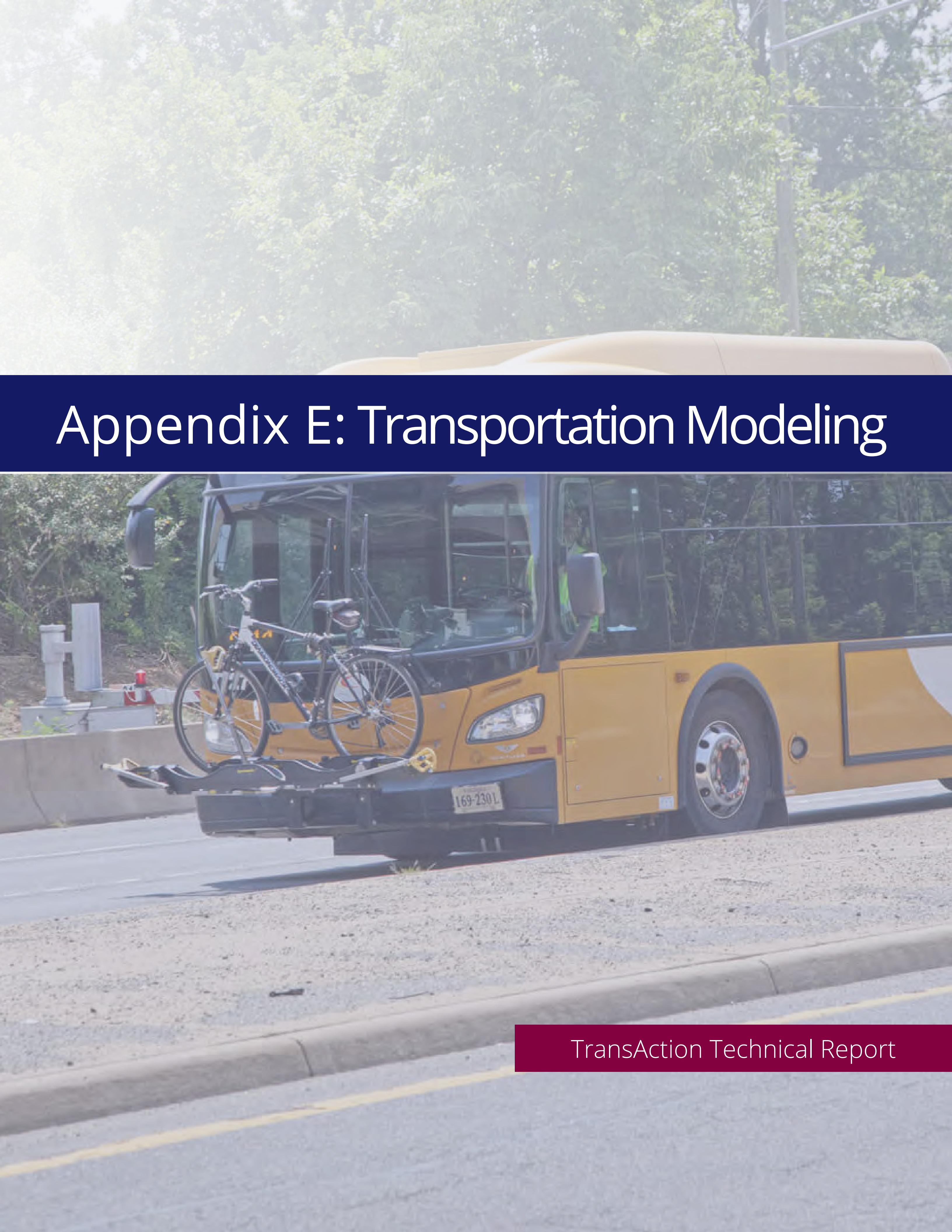

Appendix E: Transportation Modeling

TransAction Technical Report

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INTRODUCTION

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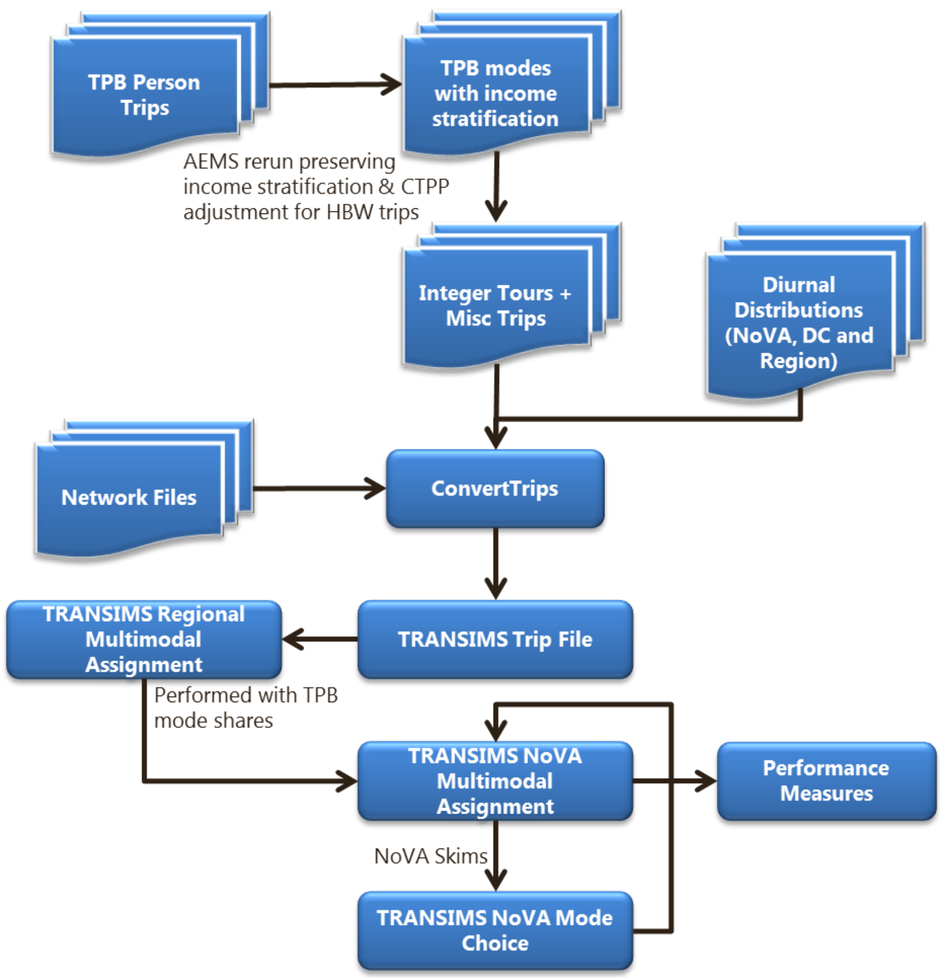
Transportation Modeling

The TransAction Plan uses the transportation network modeled by MWCOG TPB, and applies a more detailed TRANSIMS simulation to more accurately represent the flow of vehicles. The model used for TransAction builds upon the TRANSIMS-based modeling tools developed as part of the 2015-2016 and 2017 HB 599 project evaluation efforts by VDOT.

The HB599 model system was updated with two major changes: 1) incorporation of enhancements to evaluate transit and multimodal projects, and 2) update of the underlying network to include 2016 CLRP changes, and update of the travel demand to include Round 9 of the Cooperative Land Use Forecast. As part of the revision to the regional demand, an early version of the 2016 TPB/COG regional travel model inputs was obtained from MWCOG and run using other inputs from the latest regionally adopted version of the model – Version 2.3.57a.

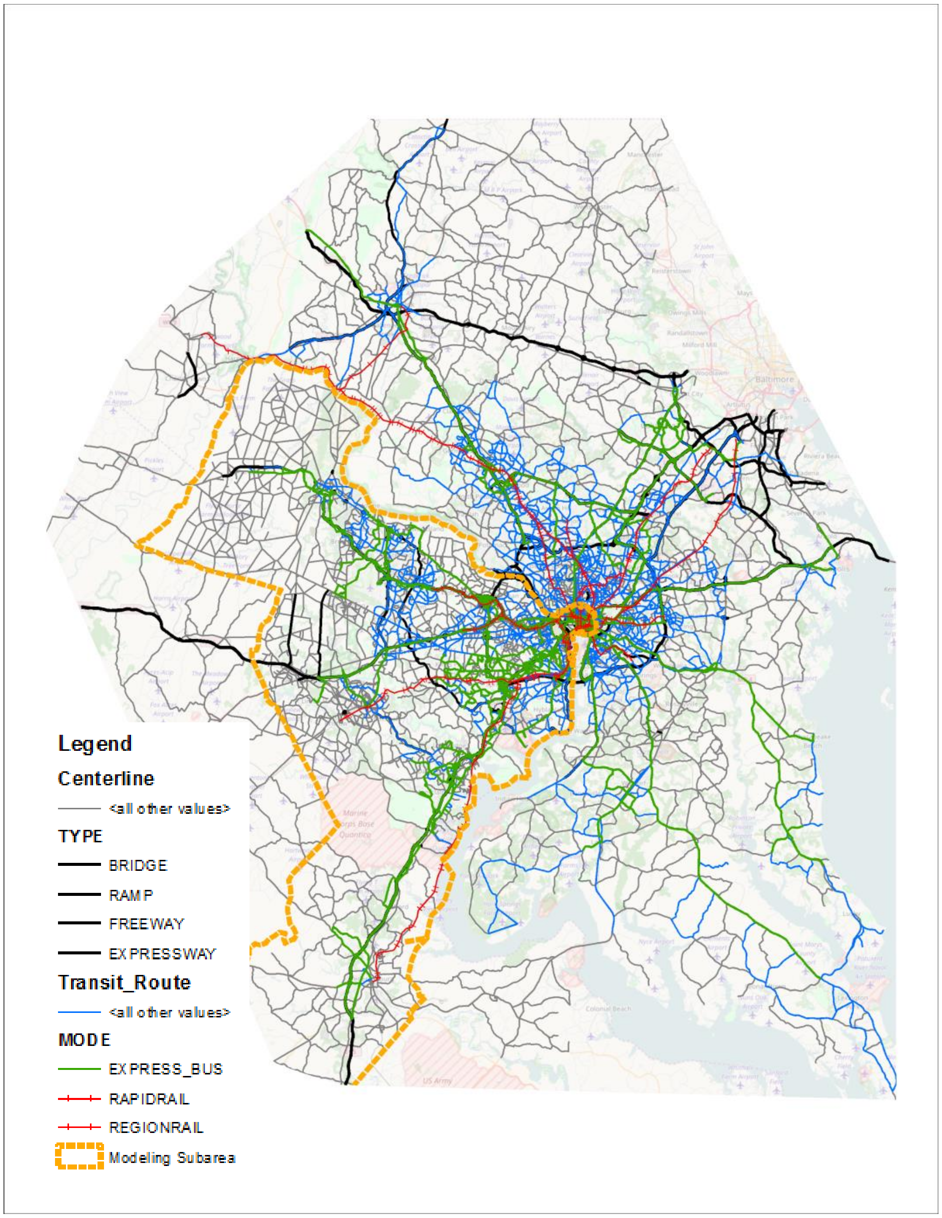
An overview of the modeling process is shown in **Figure A-2**. Note that the TransAction TRANSIMS model works with travel information derived directly from the MWCOG/TPB model.

Figure A-1: Overview of the Modeling Process



The TRANSIMS model is developed at two geographies: at the MWCOG Regional level, and at the Northern Virginia level (NoVA). As shown in **Figure A-3**, the NoVA modeling boundary includes areas beyond the jurisdictions of NVTA, including downtown D.C. and the I-95 corridor through Fredericksburg, to improve the capture of complete trips in the TransAction model.

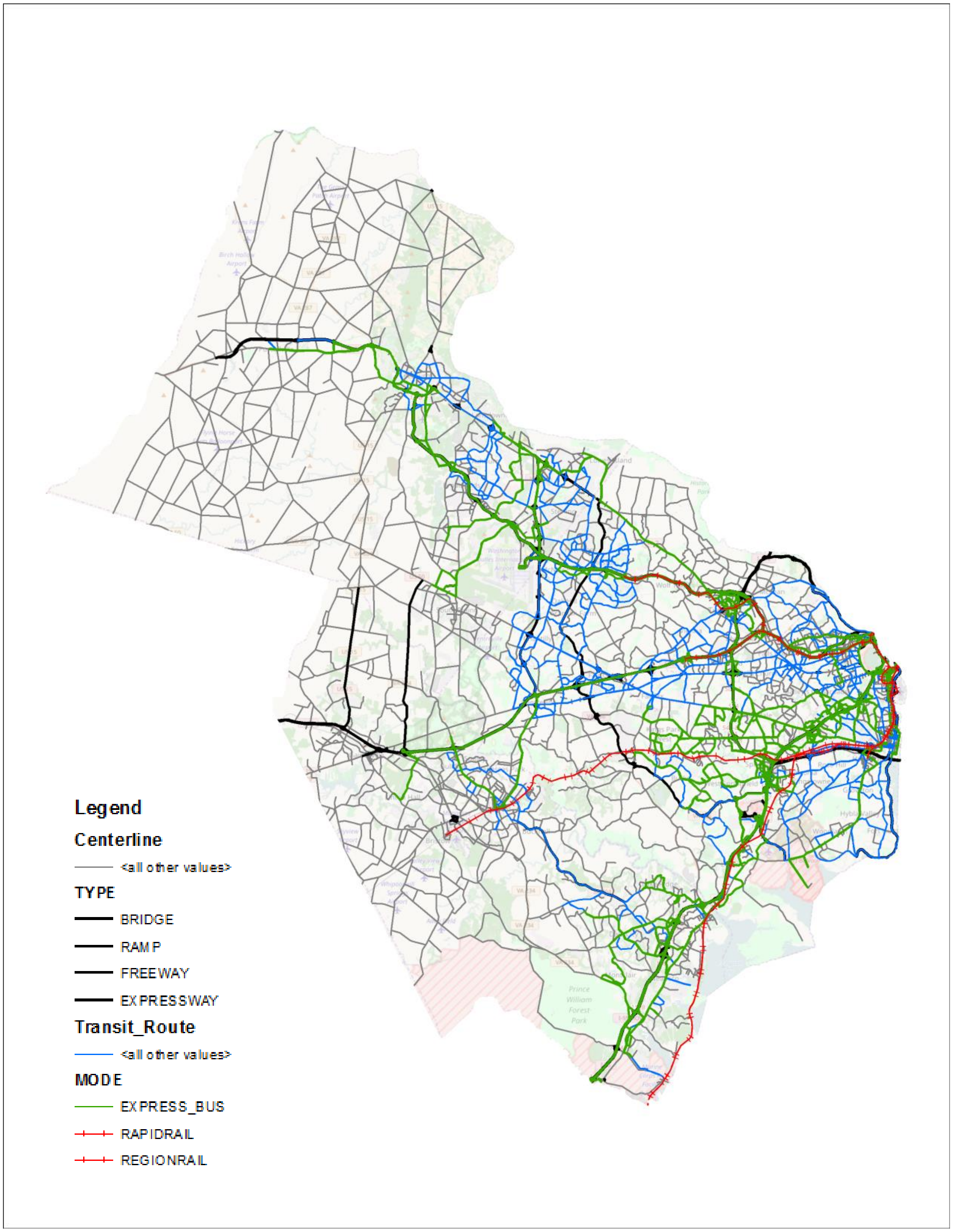
Figure A-2: NVTA TRANSIMS Regional Multimodal Network



The resulting travel times are used in the initial TRANSIMS mode choice application for the NoVA model area. The mode choice results are assigned to the NoVA network using a dynamic user-equilibrium for multimodal paths by minimizing the generalized cost (impedance) while also adjusting tolls on dynamically priced facilities to maintain minimum operating speeds and adjusting the parking and transit penalties by time of day to constrain demand to appropriate capacity levels.

The Northern Virginia network, specific to TransAction, is shown in **Figure A-4**.

Figure A-3: NVTA TRANSIMS Northern Virginia Multimodal Sub-region Network



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VALIDATION REPORT

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1 Overview

1.1 Background

HB 2313 (2013), Virginia‘s landmark transportation funding legislation, provides the Northern Virginia Transportation Authority (NVTA) with a dedicated, sustainable funding stream to address the Northern Virginia region’s transportation challenges.

It has been the NVTA’s practice to update TransAction every five years in order to identify and prioritize regionally significant transportation improvements that can help reduce the effects of congestion throughout Northern Virginia. The current update of the TransAction Plan builds on the vision and goals developed for previous TransAction plans to develop a comprehensive long range transportation plan that reduces congestion and improves the quality of life in Northern Virginia.

However, the current update is under a higher level of scrutiny because this TransAction Update will guide NVTA’s first Six-Year Program for allocating the HB2313 funding.

NVTA is working closely with VDOT to ensure that the evaluation processes conducted as part of TransAction and under the new HB 2313 legislation are compatible with the HB 599 legislation that has been used since 2014 to evaluate and prioritize projects for state and regional funding.

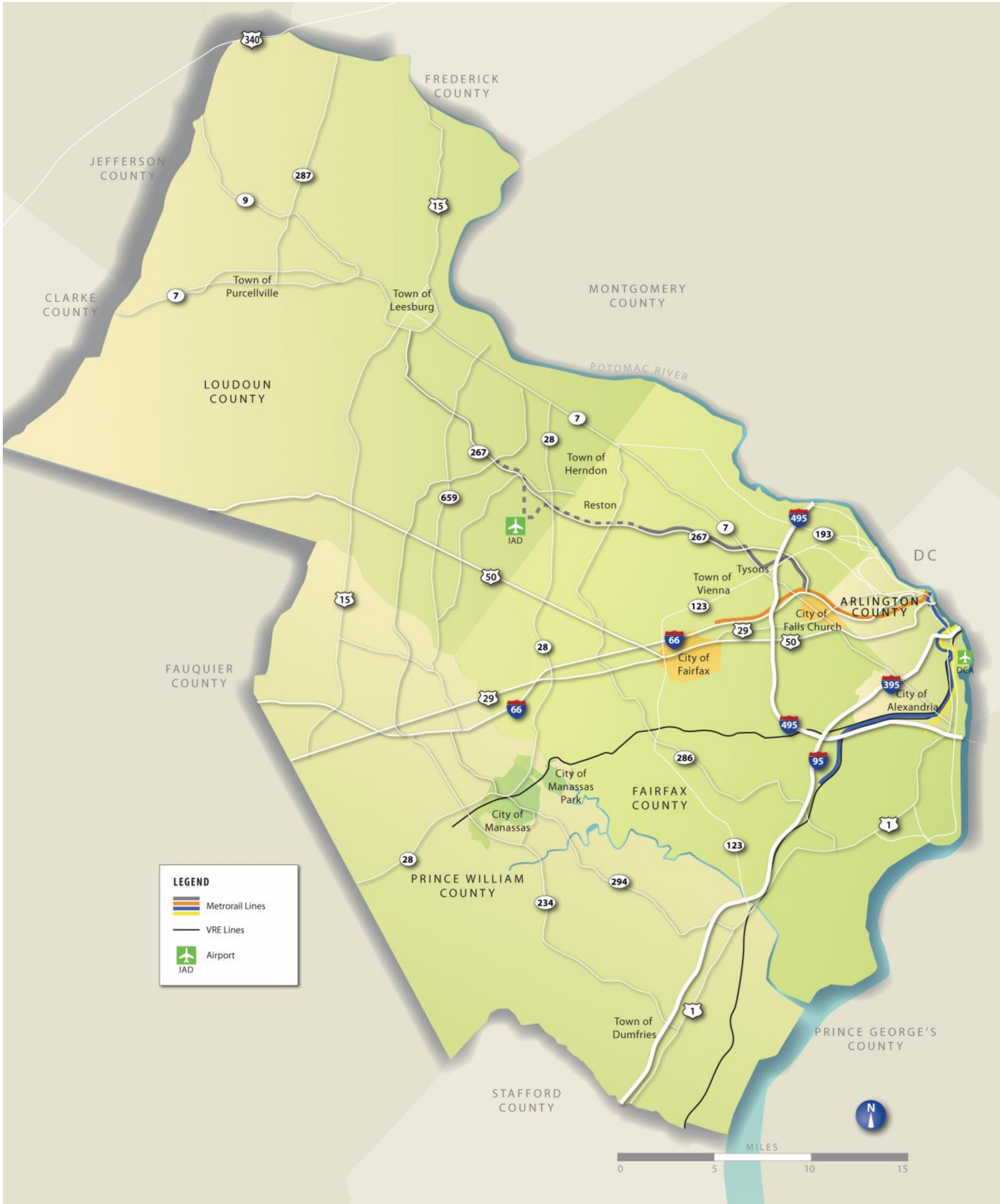
More information about NVTA’s TransAction can be found at: http://nvtatransaction.org/

This document presents an overview of the modeling tool being used for TransAction. The tool is an enhancement of the regional model used for the HB 599 evaluation process. It uses the MWCOG forecasts and highway and transit networks, and adds detail related to dynamic movement of people and traffic through the network.

The summaries of model validation outputs presented below demonstrate that the model represents existing conditions and predicts future conditions with a level of accuracy that is appropriate for the TransAction planning process and subsequent NVTA Six-Year Program process.

Figure 1 shows the jurisdictions included in the NVTA region and significant roadways and transit routes.

Figure 1: NVTA Jurisdictions (Source: nvtatransaction.org)



1.2 Review Meetings with Peer Group

The transportation model used as the basis for TransAction was refined based on a focused peer review effort. The model outputs presented in this document reflect changes based on the peer review comments, along with further enhancements based on observations of early rounds of TransAction forecasting applications.

In developing the HB 599 modeling and analysis process, VDOT actively engaged a large group of local agencies including WMATA, MWCOG, and VRE, and an independent peer review panel of national experts to review and comment on the modeling methods and analysis techniques. The TransAction modeling process builds on this work by calibrating and validating an expanded modeling process to 2016 conditions. The TransAction model was vetted through two model review meetings held with NVTA staff and VDOT's Northern Virginia modeler's group[1]. The first meeting was held in October 2016 and covered an overview of the TransAction modeling approach and preliminary model validation results. It was attended by representatives from the following:

- VDOT
- Prince William County
- Fairfax County
- NVTC
- MWCOG
- NVTA
- Loudoun County
- Arlington County
- AECOM

The second review meeting was held in November 2016 and was focused on updated model validation results based on the group's feedback from the first meeting. It was attended by representatives from the following:

- VDOT
- Fairfax County
- NVTC
- NVTA
- AECOM

[1] VDOT organizes this group, which is open to transportation modelers from the local jurisdictions in the Northern Virginia area. This group meets a few times a year to discuss various aspects of modeling as related to their respective project planning processes.

Prior to the first meeting, a draft version of this report containing preliminary validation results was provided to the group. During the meeting, the presentation included the following topics:

1. Trip- and link- gaps showing model closure by time-of-day
2. Modeled trips at the MWCOG region level and at the Northern Virginia subregional level
3. Comparison of daily modeled volumes against the 2010 MWCOG counts
4. Daily Potomac River crossings, modeled vs. counts
5. Locations and levels of "worst" congestion of AM / PM peak period
6. Side by side comparison of modeled speeds against typical speeds[2] reported on Google Maps at various times on a typical weekday.
7. Comparisons of all-day hourly speed profiles on several key facilities in the region, between INRIX data and modeled speeds.
8. Comparisons of daily Metrorail ridership by station, against 2014 LineLoad[3]and the COG model.
9. Comparisons of daily VRE ridership by station, against 2014 VRE survey and the COG model.

Overall, the group thought the model generated reasonable results. They found the conceptual maps that depict the worst congestion on network links through peak travel periods showed appropriate levels of congestion as perceived by travelers. The group made several valuable observations and provided many key inputs which are summarized below:

1. The group found the temporal patterns in the model to be reasonable, especially given the comparisons of the modeled and observed speeds at high and low speed levels. They also acknowledged the modeling challenge in reproducing congestion in a region such as ours with complex operations. For example, they observed that the model cannot be expected to fully reproduce diurnal distribution curves at 15-minute speed profiles for all trip origins and destinations.
2. The model-generated volumes on the American Legion Bridge were noted to be too low. Since this bridge is an external station for the Northern Virginia model, the regional assignment required improvement to generate realistic volumes on the bridge.
3. A remark was made regarding the 10 percent transit mode-share estimate for Northern Virginia. It was considered high given MWCOG's regional run with all unfunded projects had yielded only 9 percent mode share for the whole region. The

[2] Google Maps® provides an option to show "Typical Traffic" for different days of the week and different times of the day, based on patterns in historical "live" traffic speed data. More information is available at https://support.google.com/maps/answer/3092439?source=gsearch&hl=en
[3] LineLoad is a tool utilized by WMATA in their planning department to estimate loads on Metro trains at various times of day. It utilizes mezzanine-to-mezzanine observed passenger entries and exits, and provides detailed ridership information for current and future years.

modeling team suggested that the difference in geographic scale should not be ignored as the transit share in Northern Virginia is higher than the region as a whole due to higher transit service levels and greater development density. It is also important to note that the Northern Virginia model includes downtown D.C.

4. The group thought that the modeled congestion levels on Route 28 in Manassas were lower than reality.

5. The group cautioned against excessive emphasis on observed data because in their experience data are limited to particular days, may suffer from quality issues, and does not always match observation given day-to-day variations in traffic levels. An example was provided regarding Typical Traffic on Google Maps which did not always match their experience, such as lower than observed congestion on I-95 inbound near the Capital Beltway in the AM peak period. Another example was given where the counts on the American Legion Bridge were shown to vary as much as 10 percent from day to day, hence an exact match to the observed ground count was not required. In a similar context, it was also mentioned that a recently published "HOV study report"[4] suggested the percentage of carpool violators constitute approximately 36 percent of the total traffic on I-66 during restricted hours.

6. While VRE assignments seemed reasonable, some segments in the Metrorail assignments were found to be higher than observed.

7. The group offered to help review the network coding in their respective jurisdictions.

The feedback regarding network reviews and American Legion Bridge volumes proved to be most helpful. Loudoun County and Prince William County provided several targeted refinements to the network coding that were incorporated immediately by the modeling team. The investigation into the low American Legion Bridge volumes was traced to a process issue that had excluded internal-external trips (totaling approximately 900,000 trips or five percent of the regional demand) from the model during import of demand into the TransAction model from the MWCOG model. This issue was specific to the TransAction modeling and did not affect the original HB599 modeling. After the internal-external trips were included, refinements were also made to the speeds and capacities of the roadways adjoining the American Legion Bridge to account for the grade and vertical and horizontal curvatures that affect driver behavior. Furthermore, the transit and parking capacity constraints were reviewed in an attempt to improve the Metrorail and VRE assignments.

The results from the revised model were then presented at the second review meeting. The presentation outlined the actions taken and the corresponding results for all issues raised in the first meeting. Diurnal 15-minute volume profiles for I-66 and several parallel roadways compared modeled volumes to recent counts derived from VDOT's HOV study report. Maps were presented showing the dynamic park-and-ride utilization of rail parking lots in the study area. Additional comparison locations were provided near Manassas and along Route 28 to test observed versus modeled traffic levels.

[4] 2015 Mode Share Study, I-66 Corridor Inside Beltway, Final Report, August 2016, by MWCOG/TPB

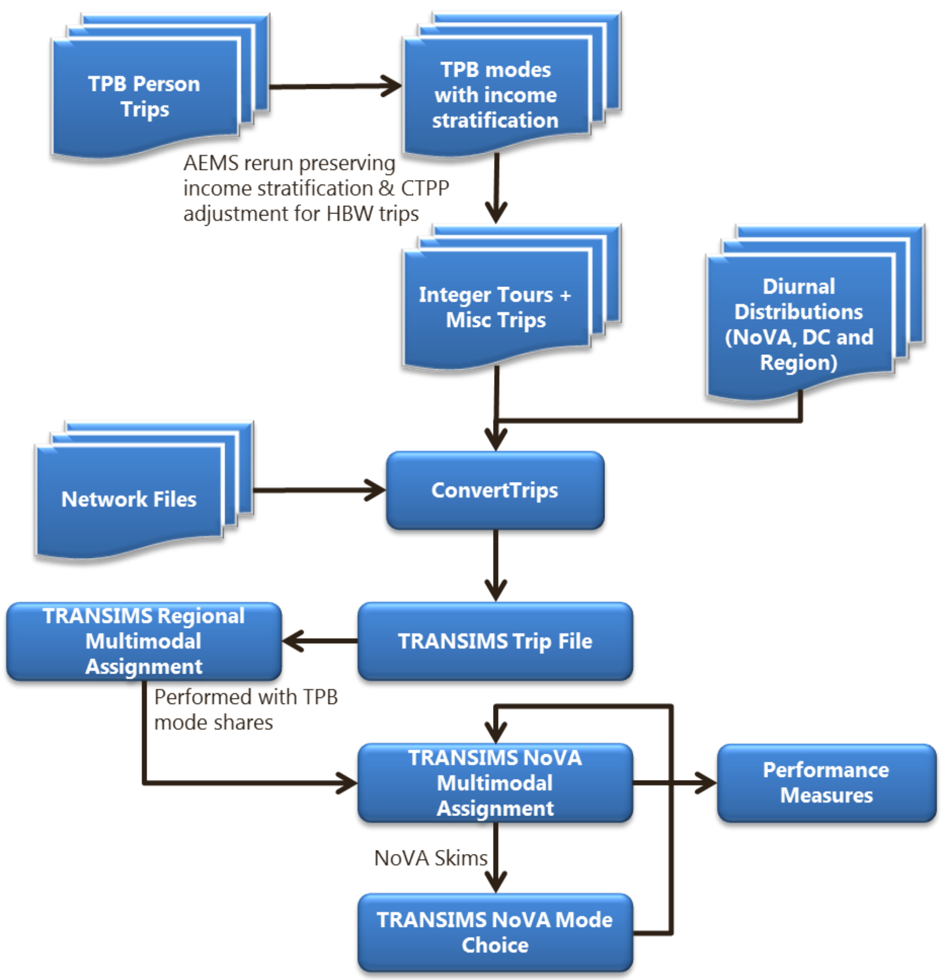
The group found the model calibration/validation to have improved and to be a very reasonable basis for TransAction analysis. The group wanted assurances that the targeted changes to the base year (such as the speed/capacity adjustments near the American Legion Bridge, etc.) were being carried forward to the future year networks. All such changes were carried forward in all model applications. The group also suggested including several additional summaries in the model validation documentation – which have been included and referenced in this document. The results in this document also include further enhancements to the model, beyond the review meetings, based on continued interaction with the stakeholders and observations from preliminary forecasting applications.

1.3 Modeling

TransAction uses and builds upon the TRANSIMS-based modeling tools developed as part of HB599. A more detailed description of the modeling process can be found in the technical reports at http://www.virginiadot.org/projects/northernvirginia/evaluating_significant_projects.asp or directly at http://www.virginiadot.org/Final_Report_-_v10.pdf.

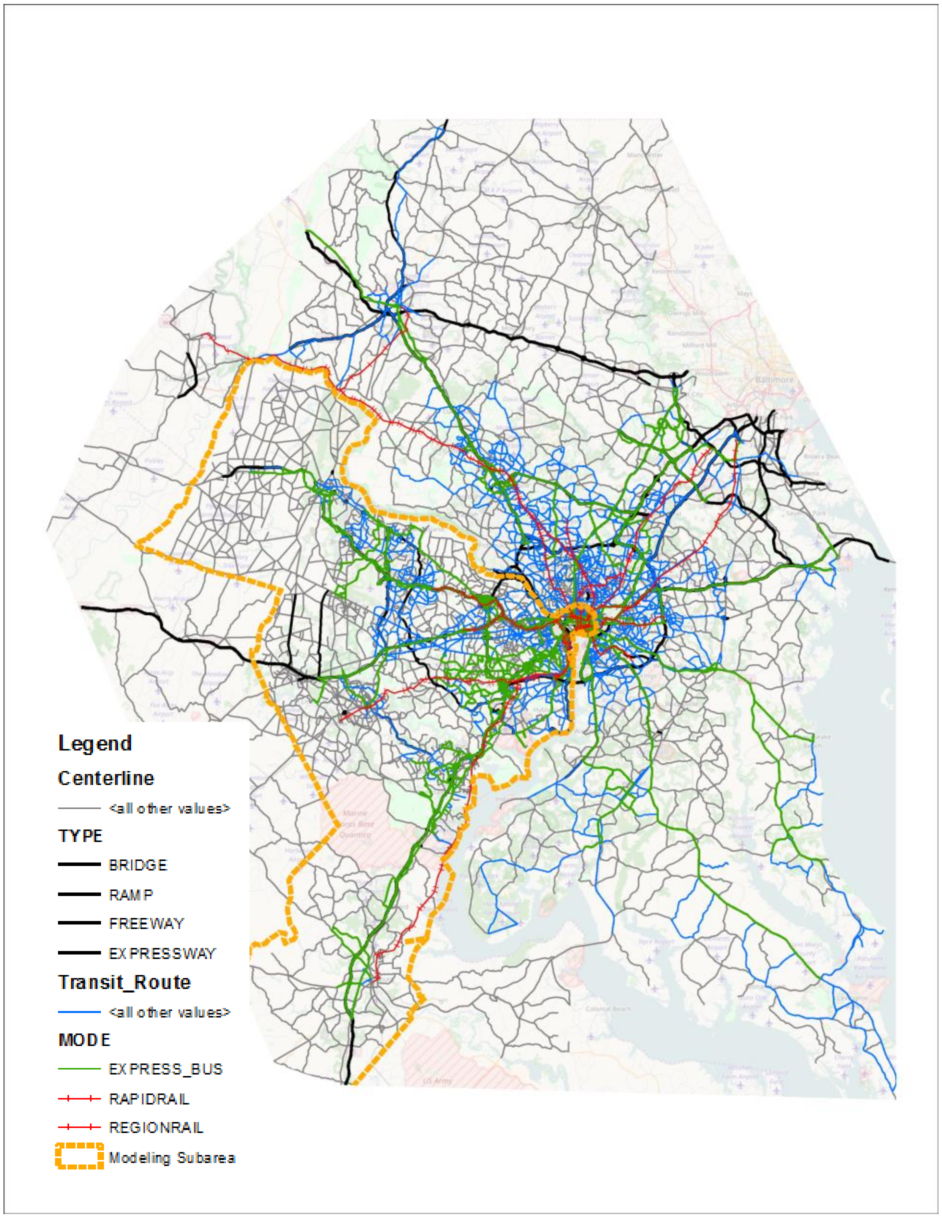
The HB599 model system was updated with two major changes: 1) incorporation of enhancements to evaluate transit and multimodal projects, and 2) update of the underlying network to include 2016 CLRP changes, and update of the travel demand to include Round 9 of the Cooperative Land Use Forecast. As part of the revision to the regional demand, an early version of the 2016 TPB/COG regional travel model inputs was obtained from MWCOG and run using other inputs from the latest regionally adopted version of the model – Version 2.3.57a. An overview of the modeling process is shown in **Figure 2**.

Figure 2: Overview of the Modeling Process



As noticed in the modeling overview from **Figure 2**, the TRANSIMS assignments are performed at two geographies, i.e., at the Regional level and at the Northern Virginia level (NoVA). At the regional level, the assignments are performed with the TPB/COG mode shares, whereas the NoVA assignments are performed with TRANSIMS tour-based mode shares. The regional network and the NoVA modeling boundary (in orange) can be seen in **Figure 3**. The NoVA modeling boundary includes areas beyond the jurisdictions of NVTA, to include downtown D.C. and I-95 corridor through Fredericksburg, to improve the capture of complete trips in the NoVA model.

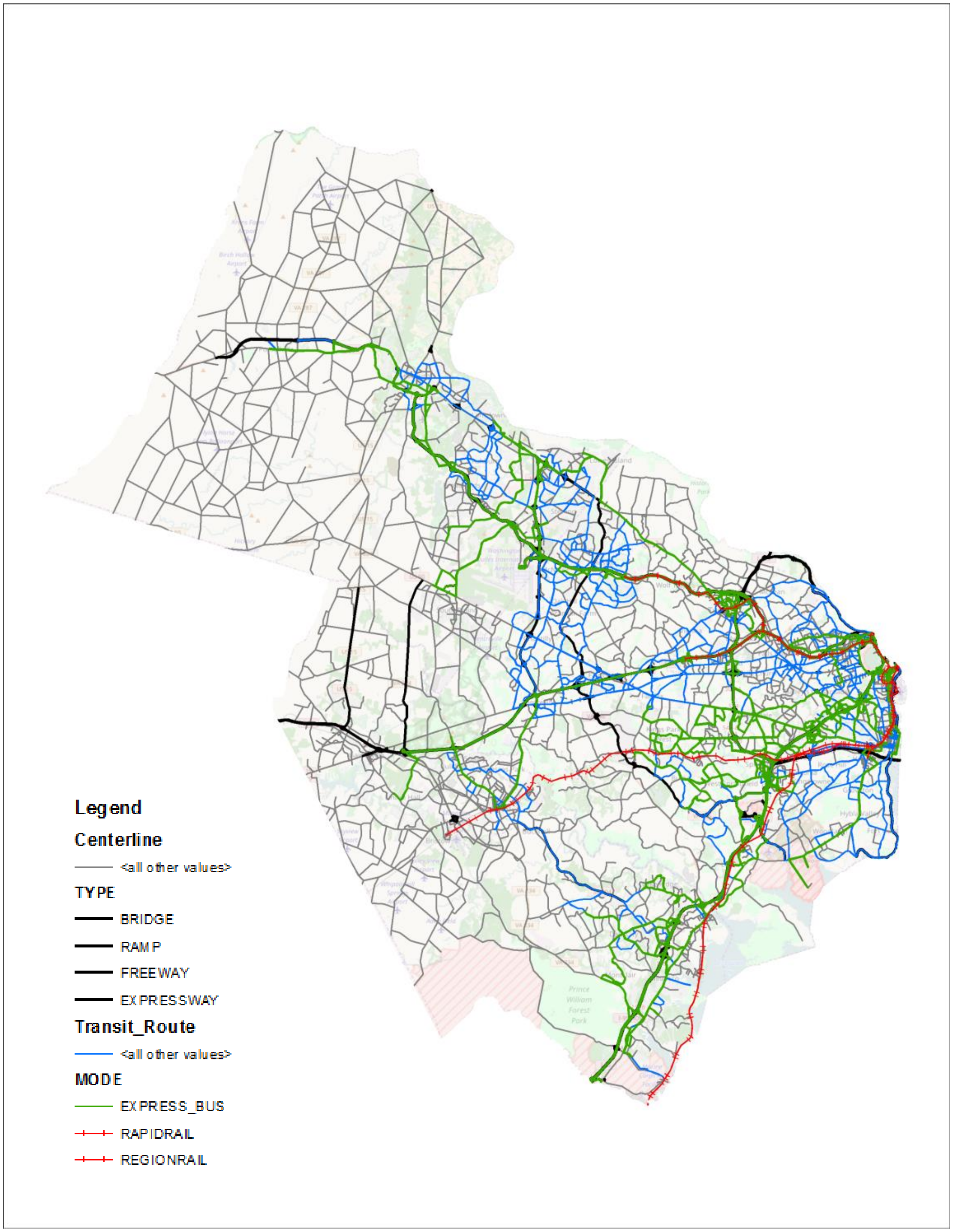
Figure 3: NVTA TRANSIMS Regional Multimodal Network



The demand for the regional assignment is derived from the TPB/COG regional travel model where the income stratification is preserved by rerunning the AEMS mode choice for individual income strata. In addition, as a prior step, a CTPP-based trip distribution adjustment is performed to the home-based-work (HBW) person trips in order to improve the assignment of transit markets. The regional demand is converted to TRANSIMS format using ConvertTrips. As part of this process, the purpose-specific trips are retained in TRANSIMS tour-format by directly using the P-A format trip tables from the TPB/COG mode choice step to improve the handling of outbound and return trips in the TRANSIMS mode choice model. The NoVA assignment is initiated by including only the trips that pass through the NoVA model boundary. This includes all trips that are fully contained within this boundary and portions of trips that pass through the NoVA boundary. The NoVA assignments are initialized with the output of the regional assignment. The resulting travel times are used in the initial TRANSIMS mode choice application for the NoVA model area. The mode choice results are assigned to the NoVA network using a dynamic user-equilibrium for multimodal paths by minimizing the generalized cost (impedance) while also adjusting tolls on dynamically priced facilities to maintain minimum operating speeds and adjusting the parking and transit penalties by time of day to constrain demand to appropriate capacity levels.

The NoVA network can be seen in **Figure 4**. This figure has been adjusted to only show the area covered by the jurisdictions of NVTA. The roadway network can be seen in shades of grey. The local bus routes are shown in blue and the express bus routes are shown in green. The Metrorail and VRE are shown in red.

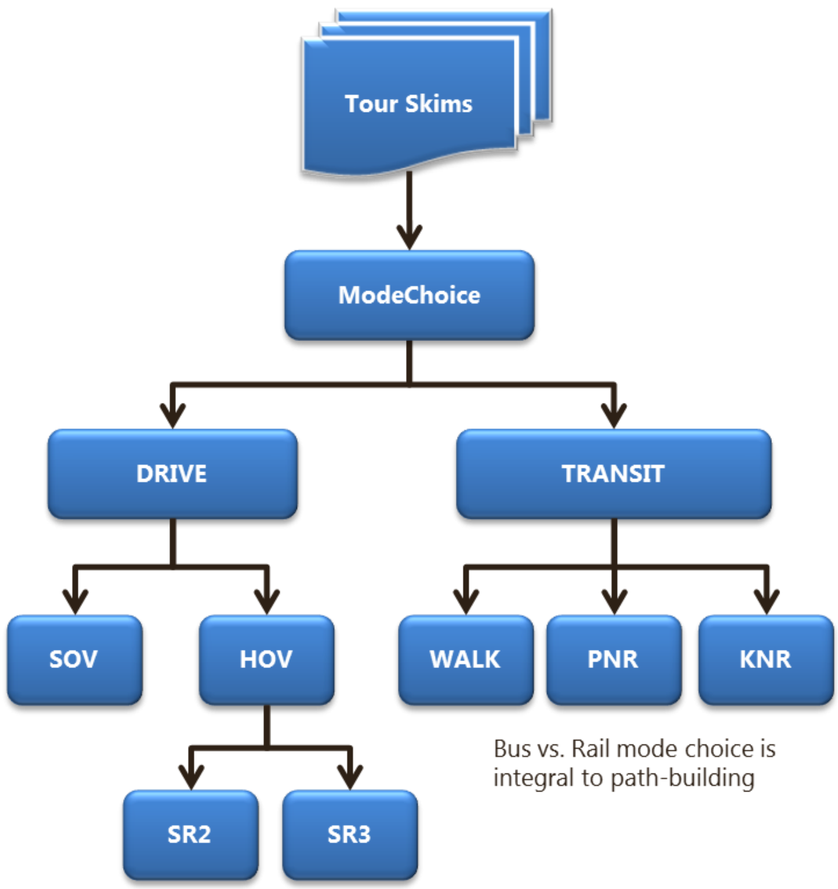
Figure 4: NVTA TRANSIMS Northern Virginia Multimodal Subregion Network



1.4 Mode Choice

Mode choice for the NoVA geography is performed using the TRANSIMS ModeChoice software with the nested logit model structure shown in **Figure 5**. Only the person-based, purpose-specific tour skims from the NoVA assignment are modeled in ModeChoice. Miscellaneous vehicle trips converted from the MWCOG model are not modified.

Figure 5: TRANSIMS Mode Choice Structure

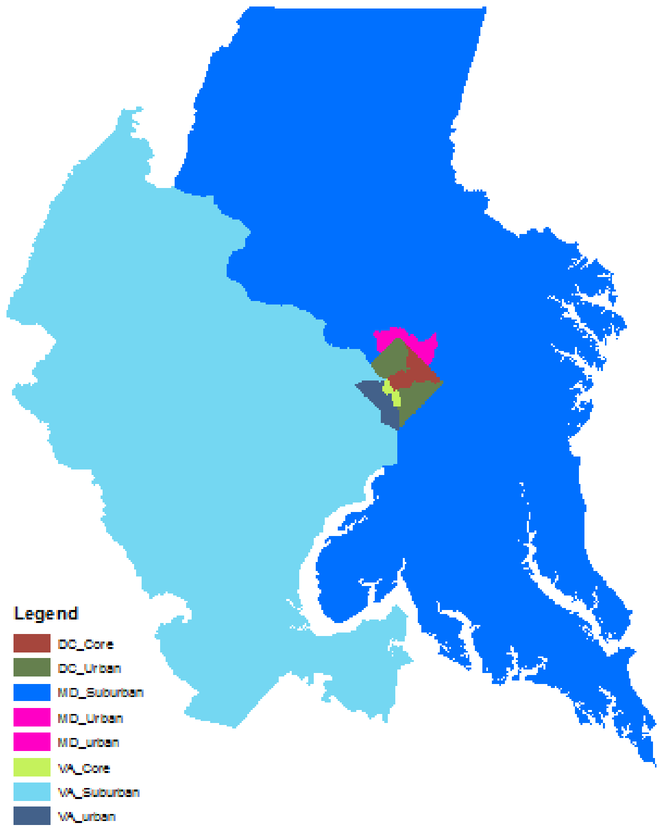


The mode choice calibration was performed with targets compiled for the HB599 work and adjusted to 14 regional travel markets derived from 7 geographic areas ("super districts"). The 14 market segments and the 7 super districts are shown in **Table 5** and **Figure 6**, respectively.

Table 1: 14 Mode Choice Market Segments

From/To	DC_core	DC_urban	MD_suburban	MD_urban	VA_core	VA_suburban	VA_urban
DC_core	1	1	1	1	2	4	3
DC_urban	1	1	1	1	2	4	3
MD_suburban	1	1	1	1	2	4	2
MD_urban	1	1	1	1	2	4	3
VA_core	5	5	5	5	8	9	10
VA_suburban	7	7	7	7	11	12	13
VA_urban	6	6	6	6	8	9	14

Figure 6: Super Districts for Mode Choice Markets



The home-based trip purposes (HBW, HBO and HBS) have 4 income strata, whereas the non-home based trip purposes (NHW and NHO) have no income stratification. **Table 2** presents the mode choice constants for all purpose and mode combinations for each of the 14 market segments. Each of these constants are limited to a range of +8 to -8. The top-level constants for income strata 1 in market segment 1 for HBW trip purpose where constrained to the allowable range, indicating a relatively close fit. However, most of the constrained markets belong to external segments and cover trips that are passing through the modeled NoVA boundary.

Table 3 presents a summary of the average values of various parameters used in the mode choice model. These averages provide a general sense of the relative magnitudes between modes. **Table 4** presents the mode choice summary of trips in the NoVA modeling area by mode and trip purpose. **Table 5** presents the mode choice summary for each of the 14 market segments.

Table 2: Mode Choice Constants

SEG	MODE	HBW1	HBW2	HBW3	HBW4	HBO1	HBO2	HBO3	HBO4	HBS1	HBS2	HBS3	HBS4	NHW	NHO
1	**DRIVE**	**8.0000**	**8.0000**	**8.0000**	**8.0000**	**4.4274**	**2.3404**	**2.3614**	**1.4218**	**1.2690**	**0.5597**	**0.5385**	**0.2415**	**2.5715**	**1.7005**
1	**TRANSIT**	**-8.0000**	**-8.0000**	**-8.0000**	**-8.0000**	**-8.0000**	**-8.0000**	**-8.0000**	**-8.0000**	**-8.0000**	**-8.0000**	**-8.0000**	**-8.0000**	**-8.0000**	**-8.0000**
1	SOV	0.8507	0.6564	0.5318	0.6342	-0.3968	-0.2200	-0.3087	-0.1288	0.5702	0.6763	0.4425	0.3233	2.1901	1.7029
1	HOV	-1.6990	-1.7044	-1.1886	-1.8860	0.2099	0.1663	0.2374	0.1139	-0.3921	-0.5671	-0.2661	-0.1807	-2.0712	-0.7139
1	SR2	0.2664	0.2950	0.0368	0.1088	-0.1421	-0.1969	-0.3330	-0.3554	-0.0047	-0.1330	-0.2331	0.1585	0.6575	0.5918
1	SR3	-0.4289	-1.0650	-0.0803	-0.3150	0.1923	0.3351	0.5769	0.6086	0.0274	0.1663	0.2974	-0.2270	-0.7365	-0.6357
1	WALK	0.1894	0.1608	0.1539	-8.0000	-8.0000	-8.0000	-8.0000	-8.0000	-8.0000	-8.0000	-8.0000	-8.0000	-8.0000	-8.0000
1	PNR	0.0000	-8.0000	0.0000	0.0000	0.0000	-8.0000	-8.0000	0.0000	0.0000	0.0000	0.0000	0.0000	-8.0000	0.0000
1	KNR	-8.0000	0.0000	-8.0000	-8.0000	-8.0000	-8.0000	-8.0000	-8.0000	-8.0000	-8.0000	-8.0000	0.0000	-8.0000	-8.0000
2	**DRIVE**	**0.0551**	**4.3960**	**6.2046**	**8.0000**	**0.1142**	**2.1463**	**3.1911**	**7.8279**	**1.8495**	**0.6446**	**0.7043**	**8.0000**	**1.4333**	**8.0000**
2	**TRANSIT**	**-0.0011**	**-6.2083**	**-8.0000**	**-8.0000**	**-0.1792**	**-8.0000**	**-8.0000**	**-8.0000**	**-1.2548**	**-7.6090**	**-8.0000**	**-8.0000**	**-3.2407**	**-8.0000**
2	SOV	0.7299	0.5690	0.4942	0.5635	-0.5712	-0.5194	-0.4020	-0.1061	0.2222	0.1099	8.0000	8.0000	1.1219	0.5918
2	HOV	-1.0243	-1.0329	-1.0528	-1.2355	0.2598	0.3170	0.4052	0.5693	0.0426	0.1036	4.1330	4.9547	-0.4602	-0.1046
2	SR2	0.1974	0.0885	0.1603	0.1053	-0.2426	-0.3137	-0.2021	-0.1828	-0.0704	0.0750	7.6918	6.0383	0.0028	-0.0062
2	SR3	-0.1626	-0.1177	-0.1206	-0.2096	0.3594	0.4791	0.6680	0.7042	0.3584	0.2848	7.6060	8.0000	0.0238	0.0764
2	WALK	-1.8050	-8.0000	-8.0000	-8.0000	-1.0378	-5.0657	-2.4147	-7.6634	6.3375	0.0883	0.2231	-8.0000	-2.0250	-4.8610
2	PNR	8.0000	8.0000	8.0000	8.0000	8.0000	8.0000	8.0000	8.0000	8.0000	8.0000	0.0000	0.0000	8.0000	8.0000
2	KNR	-3.1558	8.0000	8.0000	8.0000	-2.5173	8.0000	2.0913	8.0000	2.1755	8.0000	0.0000	0.0000	1.4427	8.0000
3	**DRIVE**	**-1.9933**	**-1.4921**	**-1.6815**	**-0.2744**	**-1.7795**	**-0.3048**	**0.7070**	**2.5411**	**1.1212**	**0.7402**	**0.2544**	**0.2273**	**0.2486**	**0.0768**
3	**TRANSIT**	**0.6377**	**0.8985**	**1.1180**	**0.4004**	**2.0826**	**1.2559**	**-0.0639**	**1.7881**	**0.6566**	**-4.0446**	**-2.3164**	**0.0000**	**-0.5359**	**-0.2401**
3	SOV	0.4147	0.3089	0.2920	0.2941	-0.6563	-0.8735	-0.9024	-8.0000	-0.3231	-0.5907	0.0226	0.3644	0.2578	-0.5721
3	HOV	-0.3944	-0.4333	-0.4786	-0.5840	0.3060	0.4773	0.5647	8.0000	0.1874	0.2958	0.4794	0.4002	-0.0887	0.1815
3	SR2	0.2073	0.0858	0.0910	0.0355	-0.2387	-0.2707	-0.1958	0.0077	-0.1812	-0.1393	0.0393	1.6403	-0.0547	-0.1384
3	SR3	0.0229	-0.1048	-0.1273	-0.0062	0.3308	0.5074	0.6427	0.6456	0.3965	0.2432	0.8303	2.4472	0.0652	0.1754
3	WALK	0.1792	0.2377	0.3529	-0.8334	0.2998	0.3071	4.4604	8.0000	4.4043	7.9692	3.5190	0.0000	0.3155	0.4285
3	PNR	0.1480	4.0173	3.2093	8.0000	2.0911	6.8018	8.0000	0.0000	0.0000	0.0000	0.0000	0.0000	3.8932	2.7395

SEG	MODE	HBW1	HBW2	HBW3	HBW4	HBO1	HBO2	HBO3	HBO4	HBS1	HBS2	HBS3	HBS4	NHW	NHO
3	KNR	-8.0000	-5.5350	-8.0000	-0.8441	-8.0000	-6.4959	-1.1058	0.0000	-1.0128	8.0000	0.0000	0.0000	-2.3150	-2.8913
4	**DRIVE**	**1.3751**	**2.2182**	**2.5273**	**2.4835**	**0.3659**	**0.1221**	**0.4972**	**0.2675**	**0.0180**	**0.0669**	**0.2392**	**0.2963**	**1.1024**	**0.4319**
4	**TRANSIT**	**-5.7991**	**-8.0000**	**-8.0000**	**-8.0000**	**-2.4005**	**-8.0000**	**-8.0000**	**-8.0000**	**-0.8623**	**-8.0000**	**-8.0000**	**-8.0000**	**-8.0000**	**-8.0000**
4	SOV	0.5124	0.4161	0.3631	0.3392	-0.5446	-0.5531	-0.5748	-0.5293	-0.1803	-0.1441	-0.0083	-1.0595	0.5422	0.0018
4	HOV	-1.1592	-1.1772	-1.1389	-1.1664	0.3344	0.4196	0.4824	0.5431	0.1461	0.1345	0.2311	0.8140	-0.8451	0.0054
4	SR2	0.1372	0.0847	0.1341	0.0832	-0.2735	-0.2699	-0.3125	-0.2521	-0.2177	-0.2382	0.0561	-0.1720	0.0395	0.0253
4	SR3	-0.2254	-0.1485	-0.3681	-0.1231	0.3686	0.4379	0.5675	0.5122	0.2919	0.3955	0.6174	0.8192	-0.0113	-0.0091
4	WALK	0.3682	0.2558	-0.0223	-0.8165	3.8253	0.7681	0.1264	-8.0000	1.1277	0.2877	0.1335	-8.0000	0.0595	0.3476
4	PNR	6.4270	8.0000	8.0000	8.0000	5.6825	8.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	8.0000	7.5979
4	KNR	0.0000	8.0000	0.0000	0.0000	2.0475	0.0000	0.0000	0.0000	-8.0000	0.0000	0.0000	0.0000	0.0000	0.0000
5	**DRIVE**	**0.2630**	**0.1285**	**0.5128**	**0.4052**	**-7.6031**	**1.9931**	**1.7305**	**0.5445**	**-1.8109**	**7.4004**	**1.3974**	**5.7919**	**1.1667**	**1.3550**
5	**TRANSIT**	**-0.1271**	**-0.0646**	**-0.2140**	**0.0099**	**8.0000**	**-2.0687**	**-1.2059**	**-0.8295**	**8.0000**	**7.0837**	**-1.7870**	**0.9556**	**-2.4550**	**-4.7560**
5	SOV	0.8859	0.5117	0.5129	0.5179	-8.0000	-0.6493	-0.4249	-0.6367	-8.0000	0.0000	4.0030	1.4399	1.8706	1.2773
5	HOV	-1.4443	-0.9643	-0.9274	-0.9031	8.0000	0.9156	0.4051	0.4513	8.0000	8.0000	0.3718	0.0969	-0.9327	-0.2945
5	SR2	0.4854	0.3186	0.3766	0.3887	8.0000	-0.0690	0.0532	-0.0558	8.0000	7.4768	7.8808	1.3052	0.4820	0.5114
5	SR3	-0.3188	-0.3985	-0.0967	-0.3729	7.4892	0.6989	0.5110	0.5796	8.0000	8.0000	7.7066	0.9477	-0.4337	-0.4085
5	WALK	0.7952	1.1546	2.2722	2.9442	2.0854	8.0000	7.3410	4.4919	8.0000	0.0000	8.0000	7.8620	3.7029	6.9639
5	PNR	-8.0000	0.0000	8.0000	-0.3513	0.0000	0.0000	0.0000	8.0000	0.0000	0.0000	0.0000	0.0000	0.8019	8.0000
5	KNR	-2.0972	-2.2295	-1.9640	0.8411	-8.0000	4.2232	3.0047	1.7723	0.0000	8.0000	0.0000	7.8256	2.0641	5.5134
6	**DRIVE**	**-2.2316**	**-1.6629**	**-1.7262**	**-1.6569**	**-8.0000**	**-0.7316**	**-0.4574**	**-0.2432**	**-8.0000**	**3.6950**	**1.1046**	**0.0180**	**0.1380**	**0.1365**
6	**TRANSIT**	**0.7320**	**0.7361**	**0.8153**	**1.1647**	**8.0000**	**1.3076**	**1.0735**	**1.1378**	**-8.0000**	**4.1693**	**-0.6576**	**0.0593**	**-0.1909**	**-0.2394**
6	SOV	0.4593	0.3642	0.2911	0.3105	-8.0000	-0.6699	-0.9134	-1.1523	-8.0000	-8.0000	-0.0149	-0.5034	1.1518	0.2067
6	HOV	-0.2262	-0.4160	-0.3173	-0.3679	8.0000	0.4545	0.5162	0.5232	-8.0000	2.1354	0.1295	0.1918	-0.2882	-0.0135
6	SR2	0.3668	0.1739	0.1476	0.2708	0.7027	0.0118	-0.1806	-0.2535	0.0000	6.9081	-0.0399	-0.1999	0.2845	0.1597
6	SR3	-0.3886	-0.2482	-0.2064	-0.7275	0.9761	0.3499	0.3612	0.4362	-8.0000	8.0000	0.4035	0.2601	-0.1838	-0.0694
6	WALK	0.9083	1.1397	1.2446	1.5543	6.7638	1.4274	1.2912	1.3652	-8.0000	6.9014	7.8822	1.0403	0.5604	0.5670
6	PNR	-6.1340	-2.1249	-2.9241	-0.9878	-8.0000	-0.5054	-0.7883	0.1939	-8.0000	0.0000	0.0000	0.5424	-0.7722	-0.2002

SEG	MODE	HBW1	HBW2	HBW3	HBW4	HBO1	HBO2	HBO3	HBO4	HBS1	HBS2	HBS3	HBS4	NHW	NHO
6	KNR	-5.7038	-2.8434	-3.6287	-1.9365	-8.0000	-2.3213	-2.7803	-2.1696	0.0000	8.0000	8.0000	0.5984	-1.8651	-1.0768
7	DRIVE	-0.5220	-0.2648	-0.2905	-0.4046	-0.6324	-0.2248	-0.0341	-0.0409	0.2179	0.8087	4.8207	0.0317	0.3884	0.3138
7	TRANSIT	0.5875	0.4491	0.5468	1.0795	2.1792	1.0546	0.2608	0.7157	0.0000	-8.0000	1.3782	-2.1283	-3.0551	-1.8435
7	SOV	0.9003	0.7664	0.7900	1.0721	-1.6165	-0.5780	-0.7090	-0.6072	-8.0000	-0.2326	0.8428	0.3483	1.7354	1.1016
7	HOV	-1.2820	-1.3165	-1.4415	-1.9446	0.8881	0.4862	0.4412	0.3494	8.0000	0.3098	-0.2193	-0.2030	-1.1180	-0.3455
7	SR2	0.4791	0.3621	0.2950	0.3771	-0.3373	-0.2695	-0.2161	-0.2439	1.0567	0.2486	1.5102	-0.0964	0.3604	0.3942
7	SR3	-0.5296	-0.5450	-0.5005	-0.6788	0.3954	0.4433	0.3178	0.3458	0.8140	0.2678	1.6298	0.1459	-0.2557	-0.2771
7	WALK	1.4381	1.1918	1.4892	-1.3615	-3.1335	-5.4741	-3.1661	-4.1313	0.0000	-8.0000	0.0000	0.0000	-2.5441	-3.1165
7	PNR	-1.6059	0.3106	0.2787	1.1126	8.0000	4.7549	2.6071	1.8289	0.0000	0.0000	8.0000	2.3460	4.0686	3.0298
7	KNR	-3.0342	-1.5817	-1.6799	-1.9270	-5.1101	-6.5918	-4.1675	-3.8823	0.0000	-8.0000	0.4379	2.0515	-2.5095	-2.3455
8	DRIVE	-8.0000	-6.1911	-6.0251	-2.5327	-4.6265	-0.6541	-0.5133	-0.2275	0.2491	-0.0107	-0.0504	0.0811	-0.1018	-0.0358
8	TRANSIT	3.1083	2.2255	2.3900	2.0125	4.0981	1.4118	1.3176	1.2364	0.5251	0.1224	0.3457	-1.0057	0.2035	0.0746
8	SOV	-0.3140	0.0990	0.0416	0.2744	-6.1616	-1.5510	-1.5755	-1.8376	-1.5231	-1.2811	-1.4636	-1.7282	-0.2606	-1.3284
8	HOV	0.1554	-0.0626	0.0157	-0.2668	0.6590	0.5932	0.6626	0.6875	0.2586	0.3194	0.3266	0.2875	0.0449	0.1318
8	SR2	0.1778	0.1106	0.0561	0.1368	-0.4043	-0.3391	-0.2443	-0.3029	-0.3012	-0.4397	-0.3964	-0.2611	-0.1277	-0.3176
8	SR3	-0.1380	-0.1482	-0.0694	-0.2095	0.5634	0.5417	0.5066	0.4996	0.3682	0.4394	0.4370	0.3428	0.0868	0.2006
8	WALK	2.6476	1.9739	2.0813	1.9217	2.2450	0.7313	0.7903	0.9824	5.2471	1.0111	1.1259	1.7809	0.3684	0.3795
8	PNR	-8.0000	-8.0000	-8.0000	-5.5580	-8.0000	-3.2059	-2.8783	-1.8553	0.0000	-8.0000	-8.0000	0.0000	-2.3250	-1.4135
8	KNR	-8.0000	-8.0000	-8.0000	-4.2781	-8.0000	-2.8724	-3.5046	-2.0986	1.8626	-0.2654	-1.5229	-0.7031	-2.0612	-1.7213
9	DRIVE	-2.5007	-0.6586	-0.5824	-0.2917	-0.7091	0.4581	0.2243	0.1195	-0.0404	0.0468	0.0524	0.1995	0.6100	0.5430
9	TRANSIT	4.0710	2.6406	2.6564	2.8716	3.9559	-2.8675	-3.3796	-5.3463	1.2679	-2.2444	-2.4592	-8.0000	-4.8820	-5.3427
9	SOV	0.5050	0.4350	0.3988	0.3954	-0.5387	-0.5677	-0.6043	-0.6203	-0.2352	-0.3050	-0.3108	-0.4158	0.4348	-0.2958
9	HOV	-1.0453	-0.9872	-0.9891	-0.9200	0.3527	0.4337	0.4781	0.4837	0.1701	0.2239	0.2293	0.2738	-0.5009	0.1916
9	SR2	0.1690	0.1454	0.0818	0.1749	-0.2650	-0.2622	-0.2817	-0.2760	-0.2328	-0.2838	-0.2267	-0.2912	-0.0514	-0.1855
9	SR3	-0.2500	-0.3927	-0.2001	-0.5009	0.3837	0.4616	0.5596	0.4789	0.2967	0.4313	0.3781	0.4192	0.0889	0.2369
9	WALK	8.0000	1.9965	1.8184	1.5886	1.9636	8.0000	6.8865	8.0000	2.4619	2.2856	2.3135	-8.0000	8.0000	8.0000
9	PNR	-8.0000	-8.0000	-8.0000	-8.0000	-8.0000	2.8172	8.0000	0.0000	0.0000	0.0000	-8.0000	-8.0000	0.0000	2.2997

SEG	MODE	HBW1	HBW2	HBW3	HBW4	HBO1	HBO2	HBO3	HBO4	HBS1	HBS2	HBS3	HBS4	NHW	NHO
9	KNR	-8.0000	-8.0000	-8.0000	-8.0000	-8.0000	0.6719	-8.0000	5.4638	-8.0000	-8.0000	-8.0000	-8.0000	1.9173	3.3643
10	**DRIVE**	**-7.5109**	**-1.2254**	**0.5384**	**-1.6613**	**-0.6330**	**1.6470**	**1.2558**	**0.6719**	**-2.3764**	**1.4447**	**0.1858**	**0.3676**	**0.1391**	**1.0603**
10	**TRANSIT**	**2.1553**	**0.8825**	**0.6653**	**1.8188**	**1.5264**	**0.1277**	**-0.3279**	**-2.2839**	**4.0931**	**-1.8672**	**-0.4274**	**-4.4909**	**-0.2041**	**-1.4490**
10	SOV	-8.0000	-1.3837	0.4529	0.2719	-1.0801	-1.4389	-1.7276	-1.8607	6.3690	-1.6313	-1.4463	-0.8730	0.2574	-0.9323
10	HOV	4.1913	1.1452	0.2872	-0.0434	0.6587	0.6228	0.7411	0.6424	5.3504	0.6459	0.4674	0.6740	-0.0791	0.2035
10	SR2	7.7979	0.6545	1.5146	0.8316	-0.2586	-0.2221	-0.3134	-0.2256	7.5009	-0.5257	-0.1074	-0.1593	-0.0264	-0.2379
10	SR3	7.7609	0.0157	1.1100	0.4892	0.8455	0.5498	0.6032	0.5985	7.9465	0.7628	0.4575	0.4277	0.0341	0.2317
10	WALK	8.0000	4.5972	6.6599	1.2918	6.8260	7.4205	6.7967	8.0000	1.6174	7.6573	1.6702	7.5537	0.2866	4.5553
10	PNR	0.0000	0.0000	0.0000	-8.0000	0.0000	0.0000	1.3694	8.0000	0.0000	0.0000	0.0000	0.0000	-2.5064	2.4335
10	KNR	4.6247	-2.4870	0.7127	-3.7120	-1.9195	0.5544	0.6825	3.6464	-8.0000	8.0000	-8.0000	8.0000	-2.2708	1.9932
11	**DRIVE**	**-2.2339**	**-1.0541**	**-0.6764**	**-0.6991**	**-1.2581**	**-0.1021**	**0.0044**	**0.0003**	**0.8741**	**0.2418**	**0.5410**	**0.1239**	**0.2073**	**0.1875**
11	**TRANSIT**	**1.2638**	**1.2930**	**1.1355**	**1.9315**	**2.2340**	**0.4948**	**0.0376**	**0.1227**	**-0.2176**	**-1.5767**	**-3.3316**	**-5.1979**	**-0.9969**	**-0.8161**
11	SOV	0.6362	0.6258	0.7504	1.1284	-0.8539	-1.0700	-1.0866	-0.9596	0.0821	-1.2874	-0.5115	-0.5555	0.7529	-0.8045
11	HOV	-0.6306	-0.9387	-1.2419	-1.8175	0.5391	0.5625	0.5616	0.4683	1.1019	0.3160	0.2150	0.2182	-0.2672	0.1489
11	SR2	0.5349	0.3287	0.3688	0.5006	0.0157	-0.1888	-0.2889	-0.2605	0.2842	-0.2479	-0.0700	-0.2669	-0.0167	-0.3480
11	SR3	-0.4189	-0.4065	-0.5904	-0.7578	0.1782	0.2610	0.3947	0.3572	0.6626	0.3446	0.3229	0.3352	0.0134	0.1958
11	WALK	1.5624	1.6268	2.2484	0.6205	1.5055	0.7337	0.6686	-0.6063	8.0000	2.8322	7.5945	0.0000	0.1375	-0.2690
11	PNR	-2.7172	-0.0518	-0.0844	0.6380	-1.4761	1.2388	1.2806	1.2300	4.8205	2.4881	8.0000	7.1039	0.9993	1.5271
11	KNR	-4.2231	-2.0415	-2.1427	-1.7880	-3.2140	-1.6463	-2.6012	-1.1265	0.0000	1.2994	6.3151	8.0000	-0.8108	-0.9413
12	**DRIVE**	**-0.2853**	**-0.0257**	**-0.0214**	**0.0008**	**-0.0071**	**0.0242**	**0.0090**	**0.0038**	**0.0390**	**0.0166**	**0.0122**	**0.2994**	**0.0410**	**0.0307**
12	**TRANSIT**	**2.0413**	**0.5676**	**0.6145**	**-0.0663**	**0.5381**	**-4.8003**	**-3.9327**	**-6.6563**	**-4.6277**	**-7.9350**	**-8.0000**	**-8.0000**	**-3.2091**	**-4.2098**
12	SOV	0.5360	0.4885	0.4836	0.6002	-0.5107	-0.4900	-0.4835	-0.4301	-0.1859	-0.1986	-0.2014	-0.1790	0.4742	-0.1507
12	HOV	-1.2859	-1.3160	-1.4198	-1.8877	0.3766	0.4217	0.4438	0.4016	0.1670	0.1957	0.2089	0.1835	-0.9593	0.1515
12	SR2	0.1445	0.0807	0.0681	0.0943	-0.2446	-0.2705	-0.2802	-0.2721	-0.2337	-0.2402	-0.2803	-0.2452	-0.0976	-0.1831
12	SR3	-0.3234	-0.2075	-0.1955	-0.2785	0.3720	0.4833	0.5422	0.5199	0.3327	0.4062	0.4934	0.4265	0.1785	0.3242
12	WALK	0.7963	0.7500	0.8272	1.0192	0.5765	4.0863	1.9448	6.0343	7.3016	6.8113	8.0000	8.0000	0.5258	0.4365
12	PNR	-8.0000	-6.9711	-8.0000	-3.4028	-3.6946	2.9756	-0.1145	4.1872	4.6175	5.6588	6.8901	0.0000	-3.4743	-0.8605

SEG	MODE	HBW1	HBW2	HBW3	HBW4	HBO1	HBO2	HBO3	HBO4	HBS1	HBS2	HBS3	HBS4	NHW	NHO
12	KNR	-8.0000	-7.4620	-8.0000	-4.8283	-5.1994	0.3472	-8.0000	0.0000	2.6175	0.0000	6.1969	0.0000	-3.5144	-2.2778
13	**DRIVE**	**-1.8135**	**-0.3085**	**-0.2496**	**-0.2591**	**-0.4135**	**0.0416**	**0.0459**	**0.0144**	**0.5512**	**0.1693**	**0.1079**	**0.0466**	**0.1709**	**0.1598**
13	**TRANSIT**	**1.9301**	**1.1013**	**1.1415**	**1.8834**	**1.8117**	**-0.5472**	**-1.3355**	**-1.3034**	**-1.9633**	**-6.1308**	**-5.9508**	**-6.2415**	**-1.9894**	**-2.2600**
13	SOV	0.7232	0.6064	0.6744	0.9275	-0.5272	-0.5484	-0.5727	-0.4701	-0.2322	-0.3109	-0.2763	-0.2106	0.9295	-0.2122
13	HOV	-1.1524	-1.2496	-1.5332	-2.2010	0.3378	0.4121	0.4502	0.3421	0.1512	0.1832	0.1902	0.1203	-0.6509	0.0791
13	SR2	0.2435	0.2098	0.1209	0.1953	-0.2175	-0.2356	-0.2515	-0.2617	-0.2212	-0.3249	-0.2322	-0.2588	0.0187	-0.1985
13	SR3	-0.3040	-0.4158	-0.2371	-0.4073	0.3174	0.3790	0.4113	0.4205	0.2820	0.4034	0.3407	0.3042	-0.0087	0.1803
13	WALK	1.2334	1.2252	1.7704	0.3188	0.6678	0.3008	0.7656	-1.3281	6.0778	7.2706	8.0000	6.2953	0.1950	-0.6282
13	PNR	-4.4472	-0.2642	-0.4984	0.8475	-2.0717	1.1839	1.1290	1.5876	0.0000	7.3581	5.7227	8.0000	0.7985	1.6941
13	KNR	-4.5898	-1.9887	-2.1511	-1.7739	-2.6614	-1.5335	-2.1695	-1.2808	1.9411	6.9929	8.0000	8.0000	-0.6063	-0.5419
14	**DRIVE**	**-2.4466**	**-1.0850**	**-1.5793**	**-0.9686**	**-1.1115**	**-0.0720**	**-0.0401**	**-0.0014**	**-0.1550**	**0.1606**	**0.2489**	**0.1078**	**0.0603**	**0.1538**
14	**TRANSIT**	**1.6328**	**1.3447**	**1.9134**	**2.2224**	**3.0972**	**0.5115**	**0.3568**	**0.0578**	**1.2299**	**-1.4390**	**-2.4970**	**-4.4651**	**-0.2328**	**-0.9080**
14	SOV	0.3387	0.3289	0.2699	0.3360	-0.6916	-0.7532	-0.8292	-0.9080	-0.3862	-0.5383	-0.6095	-0.6057	0.1428	-0.5108
14	HOV	-0.3227	-0.4409	-0.3408	-0.4925	0.3453	0.4649	0.5146	0.5504	0.1730	0.2684	0.2781	0.2884	-0.0436	0.1450
14	SR2	0.2001	0.0380	0.0573	0.1122	-0.2821	-0.2751	-0.2900	-0.2732	-0.2175	-0.3039	-0.2479	-0.2887	-0.0380	-0.2270
14	SR3	-0.2366	0.0015	-0.1045	-0.2573	0.3565	0.4656	0.5221	0.5265	0.2545	0.3616	0.3811	0.3723	0.0365	0.2055
14	WALK	0.4182	0.4986	0.6182	0.7596	0.4679	0.4237	0.4839	0.6576	0.6527	1.8707	4.3075	4.9353	0.3566	0.3005
14	PNR	-8.0000	-4.3025	-6.3327	-3.3491	-8.0000	-2.2006	-2.7113	-1.5257	0.0000	0.2740	3.2230	0.0000	-1.3131	-0.4631
14	KNR	-8.0000	-3.1948	-5.5298	-2.4445	-8.0000	-3.2051	-3.4727	-3.0942	-3.7557	-0.0843	1.3907	5.4359	-2.1293	-1.7480

Table 3: Average Mode Values

	IMPED	TIME	WALK	AUTO	WAIT	LWAIT	XWAIT	TPEN	TERM	DIST	COST	XFER	DIFF	USER	BIAS	PEF	CBD	Trips
SOV	280.09	30.54	0.55	0.00	0.00	0.00	0.00	0.00	5.72	15.31	119.20	0.00	0.00	107.88	0.00	-0.05	0.00	3,410,648
SR2	221.01	23.27	0.59	0.00	0.00	0.00	0.00	0.00	10.65	12.34	37.22	0.00	0.00	35.35	0.00	-0.02	0.00	1,571,218
SR3	210.67	21.97	0.58	0.00	0.00	0.00	0.00	0.00	15.89	11.81	19.82	0.00	0.00	19.82	0.00	-0.02	0.00	1,206,905
WALK	808.76	29.33	21.54	0.00	12.41	0.00	2.99	3.61	0.00	11.08	495.51	0.72	0.00	0.00	0.00	0.22	0.00	519,599
PNR	1,244.94	62.63	19.64	25.58	12.42	0.00	2.81	3.22	5.00	39.83	1,466.86	0.64	0.00	107.44	0.30	0.19	0.00	114,560
KNR	886.63	38.97	19.85	31.09	10.97	0.00	1.99	2.57	2.00	22.17	801.68	0.51	0.00	130.57	0.03	0.10	0.00	33,393

Table 4: Mode Choice Calibration Summary

MODE	HBW1	HBW2	HBW3	HBW4	HBO1	HBO2	HBO3	HBO4	HBS1	HBS2	HBS3	HBS4	NHW	NHO	Total	%
DRIVE	**215,377**	**473,774**	**408,125**	**564,977**	**298,381**	**587,570**	**512,268**	**716,010**	**151,661**	**246,081**	**206,065**	**268,734**	**648,517**	**891,231**	**6,188,771**	**90.3%**
TRANSIT	**103,446**	**148,558**	**127,392**	**151,654**	**39,530**	**18,824**	**13,524**	**12,220**	**4,222**	**1,278**	**910**	**312**	**33,518**	**12,164**	**667,552**	**9.7%**
SOV	180,847	404,988	348,077	490,841	91,989	202,348	181,724	262,974	62,963	106,503	90,771	117,898	473,795	394,930	3,410,648	49.7%
HOV	34,530	68,786	60,048	74,136	206,392	385,222	330,544	453,036	88,698	139,578	115,294	150,836	174,722	496,301	2,778,123	40.5%
SR2	24,734	52,466	44,872	56,272	107,570	212,524	184,172	252,228	45,112	75,196	61,798	82,394	91,676	280,204	1,571,218	22.9%
SR3	9,796	16,320	15,176	17,864	98,822	172,698	146,372	200,808	43,586	64,382	53,496	68,442	83,046	216,097	1,206,905	17.6%
WALK	97,600	121,852	96,822	82,924	37,852	17,122	11,638	7,512	4,028	1,108	794	148	29,816	10,383	519,599	7.6%
PNR	3,224	20,888	25,984	55,730	410	1,056	1,352	3,616	156	36	48	42	1,200	818	114,560	1.7%
KNR	2,622	5,818	4,586	13,000	1,268	646	534	1,092	38	134	68	122	2,502	963	33,393	0.5%
Total	318,823	622,332	535,517	716,631	337,911	606,394	525,792	728,230	155,883	247,359	206,975	269,046	682,035	903,395	6,856,323	100%
%	4.7%	9.1%	7.8%	10.5%	4.9%	8.8%	7.7%	10.6%	2.3%	3.6%	3.0%	3.9%	10.0%	13.2%	100%	

Table 5: Mode Choice Market Segment Reports

S	Mode	HBW1	HBW2	HBW3	HBW4	HBO1	HBO2	HBO3	HBO4	HBS1	HBS2	HBS3	HBS4	NHW	NHO	Total	%
1	DRV	44,952	80,864	67,178	86,027	46,760	60,777	45,336	54,371	4,493	5,730	3,670	4,282	69,380	44,825	618,645	74.3%
1	TRN	31,338	52,542	42,490	50,028	11,550	6,852	5,318	3,814	250	60	44	18	7,484	2,326	214,114	25.7%
1	SOV	37,550	71,132	55,470	78,727	13,818	23,139	16,730	23,729	2,169	3,200	1,594	1,694	61,027	24,237	414,216	49.7%
1	HOV	7,402	9,732	11,708	7,300	32,942	37,638	28,606	30,642	2,324	2,530	2,076	2,588	8,353	20,588	204,429	24.6%
1	SR2	5,120	8,584	8,442	5,900	17,632	21,416	15,020	15,528	1,146	1,172	876	1,670	5,772	13,508	121,786	14.6%
1	SR3	2,282	1,148	3,266	1,400	15,310	16,222	13,586	15,114	1,178	1,358	1,200	918	2,581	7,080	82,643	9.9%
1	WLK	31,334	52,236	42,484	49,856	11,124	6,762	5,230	3,804	232	54	44	18	6,898	2,144	212,220	25.5%
1	PNR	4	-	6	22	80	-	-	-	8	4	-	-	-	25	149	0.0%
1	KNR	-	306	-	150	346	90	88	10	10	2	-	-	586	157	1,745	0.2%
1	Total	76,290	133,406	109,668	136,055	58,310	67,629	50,654	58,185	4,743	5,790	3,714	4,300	76,864	47,151	832,759	100%
1	%	9.2%	16.0%	13.2%	16.3%	7.0%	8.1%	6.1%	7.0%	0.6%	0.7%	0.5%	0.5%	9.2%	5.7%	100%	
2	DRV	2,547	5,046	3,827	5,134	3,013	2,548	449	180	466	334	38	6	3,226	371	27,185	58.8%
2	TRN	3,264	4,270	3,044	4,142	1,602	806	144	96	84	26	2	4	1,003	539	19,026	41.2%
2	SOV	1,947	4,034	3,045	4,336	701	730	133	76	110	76	10	-	1,337	95	16,630	36.0%
2	HOV	600	1,012	782	798	2,312	1,818	316	104	356	258	28	6	1,889	276	10,555	22.8%
2	SR2	406	768	604	616	1,120	882	140	56	136	120	12	-	706	111	5,677	12.3%
2	SR3	194	244	178	182	1,192	936	176	48	220	138	16	6	1,183	165	4,878	10.6%
2	WLK	3,162	4,220	3,036	4,136	1,574	800	142	96	78	20	2	4	944	526	18,740	40.6%
2	PNR	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.0%
2	KNR	102	50	8	6	28	6	2	-	6	6	-	-	59	13	286	0.6%
2	Total	5,811	9,316	6,871	9,276	4,615	3,354	593	276	550	360	40	10	4,229	910	46,211	100%
2	%	12.6%	20.2%	14.9%	20.1%	10.0%	7.3%	1.3%	0.6%	1.2%	0.8%	0.1%	0.0%	9.2%	2.0%	100%	
3	DRV	876	2,643	2,097	4,261	3,212	3,453	518	354	1,601	1,260	110	45	3,164	1,316	24,910	51.3%
3	TRN	3,514	5,440	3,864	2,976	4,594	1,104	78	-	444	64	4	-	1,218	356	23,656	48.7%
3	SOV	522	1,825	1,531	3,185	768	703	102	130	377	260	30	13	904	206	10,556	21.7%
3	HOV	354	818	566	1,076	2,444	2,750	416	224	1,224	1,000	80	32	2,260	1,110	14,354	29.6%
3	SR2	242	598	454	730	1,222	1,446	208	126	566	532	32	16	1,066	510	7,748	16.0%
3	SR3	112	220	112	346	1,222	1,304	208	98	658	468	48	16	1,194	600	6,606	13.6%
3	WLK	3,476	5,172	3,736	2,658	4,502	1,026	74	-	438	44	4	-	1,094	341	22,565	46.5%
3	PNR	16	104	62	56	28	54	2	-	-	-	-	-	49	5	376	0.8%
3	KNR	22	164	66	262	64	24	2	-	6	20	-	-	75	10	715	1.5%
3	Total	4,390	8,083	5,961	7,237	7,806	4,557	596	354	2,045	1,324	114	45	4,382	1,672	48,566	100%
3	%	9.0%	16.6%	12.3%	14.9%	16.1%	9.4%	1.2%	0.7%	4.2%	2.7%	0.2%	0.1%	9.0%	3.4%	100%	
4	DRV	8,732	12,905	9,169	10,139	15,157	10,865	3,089	3,336	7,426	2,306	205	192	13,537	4,072	101,130	91.2%
4	TRN	2,218	2,090	1,532	1,452	1,150	134	80	38	138	8	2	-	851	98	9,791	8.8%
4	SOV	7,354	11,063	7,971	8,843	4,279	3,565	1,041	1,308	2,812	862	75	66	9,562	1,528	60,329	54.4%

4	HOV	1,378	1,842	1,198	1,296	10,878	7,300	2,048	2,028	4,614	1,444	130	126	3,975	2,544	40,801	36.8%
4	SR2	974	1,382	1,000	1,026	5,364	3,954	1,076	1,172	2,250	688	54	54	2,131	1,362	22,487	20.3%
4	SR3	404	460	198	270	5,514	3,346	972	856	2,364	756	76	72	1,844	1,182	18,314	16.5%
4	WLK	2,218	2,090	1,532	1,452	1,136	134	80	38	138	8	2	-	850	98	9,776	8.8%
4	PNR	-	-	-	-	4	-	-	-	-	-	-	-	1	-	5	0.0%
4	KNR	-	-	-	-	10	-	-	-	-	-	-	-	-	-	10	0.0%
4	Total	10,950	14,995	10,701	11,591	16,307	10,999	3,169	3,374	7,564	2,314	207	192	14,388	4,170	110,921	100%
4	%	9.9%	13.5%	9.7%	10.5%	14.7%	9.9%	2.9%	3.0%	6.8%	2.1%	0.2%	0.2%	13.0%	3.8%	100%	
5	**DRV**	**479**	**1,273**	**507**	**914**	**85**	**159**	**421**	**681**	**1**	**8**	**39**	**110**	**4,018**	**719**	**9,414**	**59.2%**
5	**TRN**	**702**	**1,696**	**1,700**	**834**	**38**	**34**	**164**	**304**	**-**	**-**	**-**	**2**	**924**	**93**	**6,491**	**40.8%**
5	SOV	401	997	407	708	83	39	113	145	1	-	7	46	2,554	248	5,749	36.2%
5	HOV	78	276	100	206	2	120	308	536	-	8	32	64	1,464	471	3,665	23.0%
5	SR2	54	230	66	174	2	74	212	318	-	6	16	42	853	271	2,318	14.6%
5	SR3	24	46	34	32	-	46	96	218	-	2	16	22	611	200	1,347	8.5%
5	WLK	684	1,592	460	734	38	32	160	88	-	-	-	2	848	76	4,714	29.6%
5	PNR	-	82	1,236	12	-	-	-	200	-	-	-	-	3	12	1,545	9.7%
5	KNR	18	22	4	88	-	2	4	16	-	-	-	-	73	5	232	1.5%
5	Total	1,181	2,969	2,207	1,748	123	193	585	985	1	8	39	112	4,942	812	15,905	100%
5	%	7.4%	18.7%	13.9%	11.0%	0.8%	1.2%	3.7%	6.2%	0.0%	0.1%	0.3%	0.7%	31.1%	5.1%	100%	
6	**DRV**	**722**	**2,853**	**3,007**	**5,389**	**173**	**402**	**1,828**	**6,230**	**36**	**18**	**150**	**890**	**3,101**	**1,630**	**26,429**	**34.6%**
6	**TRN**	**4,096**	**12,366**	**12,100**	**14,986**	**166**	**350**	**1,108**	**1,980**	**-**	**4**	**52**	**76**	**1,950**	**719**	**49,953**	**65.4%**
6	SOV	436	1,857	1,915	3,617	141	78	392	1,006	28	2	40	174	1,022	212	10,920	14.3%
6	HOV	286	996	1,092	1,772	32	324	1,436	5,224	8	16	110	716	2,079	1,418	15,509	20.3%
6	SR2	196	708	798	1,402	16	202	856	2,816	8	2	40	290	1,001	549	8,884	11.6%
6	SR3	90	288	294	370	16	122	580	2,408	-	14	70	426	1,078	869	6,625	8.7%
6	WLK	4,056	10,766	10,998	9,304	108	256	816	1,248	-	-	20	30	1,724	531	39,857	52.2%
6	PNR	4	716	510	2,404	4	46	176	394	-	-	-	14	65	62	4,395	5.8%
6	KNR	36	884	592	3,278	54	48	116	338	-	4	32	32	161	126	5,701	7.5%
6	Total	4,818	15,219	15,107	20,375	339	752	2,936	8,210	36	22	202	966	5,051	2,349	76,382	100%
6	%	6.3%	19.9%	19.8%	26.7%	0.4%	1.0%	3.8%	10.8%	0.1%	0.0%	0.3%	1.3%	6.6%	3.1%	100%	
7	**DRV**	**4,739**	**20,095**	**27,679**	**63,394**	**936**	**1,984**	**4,670**	**41,880**	**129**	**148**	**251**	**3,886**	**15,217**	**4,557**	**189,565**	**66.1%**
7	**TRN**	**5,646**	**18,730**	**23,730**	**43,972**	**322**	**434**	**718**	**2,820**	**2**	**-**	**-**	**40**	**670**	**306**	**97,390**	**33.9%**
7	SOV	3,721	16,241	22,617	51,384	252	676	1,282	11,722	79	54	103	1,684	10,545	1,670	122,030	42.5%
7	HOV	1,018	3,854	5,062	12,010	684	1,308	3,388	30,158	50	94	148	2,202	4,672	2,887	67,535	23.5%
7	SR2	672	2,654	3,542	8,656	286	616	1,838	16,318	30	44	74	1,100	2,203	1,449	39,482	13.8%
7	SR3	346	1,200	1,520	3,354	398	692	1,550	13,840	20	50	74	1,102	2,469	1,438	28,053	9.8%
7	WLK	4,698	4,528	5,184	1,534	206	52	40	32	-	-	-	-	128	29	16,431	5.7%
7	PNR	694	12,688	16,582	37,524	56	338	610	2,512	-	-	-	10	349	216	71,579	24.9%
7	KNR	254	1,514	1,964	4,914	60	44	68	276	2	-	-	30	193	61	9,380	3.3%
7	Total	10,385	38,825	51,409	107,366	1,258	2,418	5,388	44,700	131	148	251	3,926	15,887	4,863	286,955	100%

7	%	3.6%	13.5%	17.9%	37.4%	0.4%	0.8%	1.9%	15.6%	0.1%	0.1%	0.1%	1.4%	5.5%	1.7%	100%	
8	**DRV**	**810**	**1,556**	**1,134**	**1,498**	**1,021**	**3,354**	**3,447**	**4,720**	**376**	**858**	**821**	**1,176**	**12,837**	**3,504**	**37,112**	**53.4%**
8	**TRN**	**2,538**	**5,770**	**3,880**	**3,558**	**1,720**	**2,308**	**2,000**	**1,212**	**328**	**274**	**214**	**50**	**6,775**	**1,783**	**32,410**	**46.6%**
8	SOV	226	752	560	896	51	402	425	512	32	82	37	84	1,614	139	5,812	8.4%
8	HOV	584	804	574	602	970	2,952	3,022	4,208	344	776	784	1,092	11,223	3,365	31,300	45.0%
8	SR2	396	616	430	480	338	1,430	1,730	2,262	120	280	304	456	4,298	1,052	14,192	20.4%
8	SR3	188	188	144	122	632	1,522	1,292	1,946	224	496	480	636	6,925	2,313	17,108	24.6%
8	WLK	2,200	5,032	3,432	2,828	1,506	2,106	1,854	962	316	236	206	44	6,322	1,610	28,654	41.2%
8	PNR	66	116	292	308	50	34	28	26	4	-	-	-	37	15	976	1.4%
8	KNR	272	622	156	422	164	168	118	224	8	38	8	6	416	158	2,780	4.0%
8	Total	3,348	7,326	5,014	5,056	2,741	5,662	5,447	5,932	704	1,132	1,035	1,226	19,612	5,287	69,522	100%
8	%	4.8%	10.5%	7.2%	7.3%	3.9%	8.1%	7.8%	8.5%	1.0%	1.6%	1.5%	1.8%	28.2%	7.6%	100%	
9	**DRV**	**6,530**	**17,458**	**12,559**	**14,063**	**16,548**	**27,175**	**12,014**	**8,558**	**11,295**	**12,488**	**5,794**	**3,474**	**29,649**	**24,278**	**201,883**	**86.6%**
9	**TRN**	**7,104**	**6,688**	**4,386**	**2,328**	**6,188**	**1,054**	**334**	**22**	**1,248**	**142**	**44**	**-**	**1,186**	**499**	**31,223**	**13.4%**
9	SOV	5,360	14,446	10,543	11,467	4,912	8,539	3,792	2,718	4,237	4,530	2,036	1,022	18,413	7,979	99,994	42.9%
9	HOV	1,170	3,012	2,016	2,596	11,636	18,636	8,222	5,840	7,058	7,958	3,758	2,452	11,236	16,299	101,889	43.7%
9	SR2	832	2,340	1,526	2,106	5,854	10,158	4,496	3,196	3,498	3,968	1,972	1,198	6,035	8,331	55,510	23.8%
9	SR3	338	672	490	490	5,782	8,478	3,726	2,644	3,560	3,990	1,786	1,254	5,201	7,968	46,379	19.9%
9	WLK	4,324	6,334	4,202	2,224	5,832	1,034	212	18	1,164	138	44	-	1,183	493	27,202	11.7%
9	PNR	1,294	134	56	76	60	14	122	-	84	4	-	-	-	-	1,844	0.8%
9	KNR	1,486	220	128	28	296	6	-	4	-	-	-	-	3	6	2,177	0.9%
9	Total	13,634	24,146	16,945	16,391	22,736	28,229	12,348	8,580	12,543	12,630	5,838	3,474	30,835	24,777	233,106	100%
9	%	5.9%	10.4%	7.3%	7.0%	9.8%	12.1%	5.3%	3.7%	5.4%	5.4%	2.5%	1.5%	13.2%	10.6%	100%	
10	**DRV**	**44**	**104**	**96**	**144**	**133**	**736**	**813**	**706**	**110**	**388**	**358**	**298**	**5,119**	**2,352**	**11,401**	**59.0%**
10	**TRN**	**188**	**556**	**326**	**322**	**914**	**832**	**416**	**96**	**158**	**144**	**66**	**8**	**2,977**	**925**	**7,928**	**41.0%**
10	SOV	16	42	58	96	13	82	79	72	2	16	22	28	1,420	236	2,182	11.3%
10	HOV	28	62	38	48	120	654	734	634	108	372	336	270	3,699	2,116	9,219	47.7%
10	SR2	18	48	28	42	34	322	392	332	54	126	158	140	1,741	913	4,348	22.5%
10	SR3	10	14	10	6	86	332	342	302	54	246	178	130	1,958	1,203	4,871	25.2%
10	WLK	188	552	322	316	910	830	416	90	156	106	62	4	2,865	889	7,706	39.9%
10	PNR	-	2	-	-	-	-	-	2	2	-	4	-	6	2	18	0.1%
10	KNR	-	2	4	6	4	2	-	4	-	38	-	4	106	34	204	1.1%
10	Total	232	660	422	466	1,047	1,568	1,229	802	268	532	424	306	8,096	3,277	19,329	100%
10	%	1.2%	3.4%	2.2%	2.4%	5.4%	8.1%	6.4%	4.2%	1.4%	2.8%	2.2%	1.6%	41.9%	17.0%	100%	
11	**DRV**	**1,132**	**5,763**	**8,397**	**16,207**	**431**	**2,022**	**3,101**	**9,562**	**87**	**438**	**448**	**1,516**	**8,869**	**1,826**	**59,799**	**63.6%**
11	**TRN**	**4,098**	**8,006**	**8,024**	**10,750**	**454**	**552**	**390**	**446**	**36**	**22**	**30**	**10**	**1,183**	**283**	**34,284**	**36.4%**
11	SOV	768	4,297	6,463	12,331	85	432	541	2,040	11	38	66	308	3,071	169	30,620	32.6%
11	HOV	364	1,466	1,934	3,876	346	1,590	2,560	7,522	76	400	382	1,208	5,798	1,657	29,179	31.0%
11	SR2	250	962	1,416	2,754	170	824	1,306	3,866	26	160	136	508	2,088	503	14,969	15.9%
11	SR3	114	504	518	1,122	176	766	1,254	3,656	50	240	246	700	3,710	1,154	14,210	15.1%

11	WLK	3,562	3,204	3,016	784	372	168	88	12	36	16	2	-	386	76	11,722	12.5%
11	PNR	446	3,974	4,236	8,350	40	286	270	316	-	2	24	-	452	142	18,538	19.7%
11	KNR	90	828	772	1,616	42	98	32	118	-	4	4	10	345	65	4,024	4.3%
11	Total	5,230	13,769	16,421	26,957	885	2,574	3,491	10,008	123	460	478	1,526	10,052	2,109	94,083	100%
11	%	5.6%	14.6%	17.5%	28.7%	0.9%	2.7%	3.7%	10.6%	0.1%	0.5%	0.5%	1.6%	10.7%	2.2%	100%	
12	**DRV**	**136,535**	**294,023**	**242,305**	**308,679**	**196,658**	**441,484**	**403,205**	**521,451**	**118,440**	**208,900**	**181,628**	**229,616**	**435,537**	**746,907**	**4,465,368**	**98.7%**
12	**TRN**	**27,232**	**14,850**	**9,466**	**2,190**	**3,072**	**312**	**144**	**38**	**344**	**24**	**28**	**10**	**1,184**	**428**	**59,322**	**1.3%**
12	SOV	117,571	255,769	213,261	275,037	63,268	154,912	147,759	200,397	51,088	93,550	83,164	105,968	344,045	346,543	2,452,332	54.2%
12	HOV	18,964	38,254	29,044	33,642	133,390	286,572	255,446	321,054	67,352	115,350	98,464	123,648	91,492	400,364	2,013,036	44.5%
12	SR2	14,040	28,782	22,188	25,850	70,362	158,394	143,644	181,408	34,822	63,746	53,532	69,090	51,719	233,128	1,150,705	25.4%
12	SR3	4,924	9,472	6,856	7,792	63,028	128,178	111,802	139,646	32,530	51,604	44,932	54,558	39,773	167,236	862,331	19.1%
12	WLK	26,922	14,734	9,420	2,052	3,008	268	140	34	342	20	22	10	1,155	387	58,514	1.3%
12	PNR	226	60	28	88	42	40	4	4	2	4	6	-	7	27	538	0.0%
12	KNR	84	56	18	50	22	4	-	-	-	-	-	-	22	14	270	0.0%
12	Total	163,767	308,873	251,771	310,869	199,730	441,796	403,349	521,489	118,784	208,924	181,656	229,626	436,721	747,335	4,524,690	100%
12	%	3.6%	6.8%	5.6%	6.9%	4.4%	9.8%	8.9%	11.5%	2.6%	4.6%	4.0%	5.1%	9.7%	16.5%	100%	
13	**DRV**	**3,550**	**20,875**	**23,750**	**40,823**	**3,749**	**11,105**	**14,845**	**39,637**	**1,522**	**4,034**	**4,854**	**13,192**	**21,419**	**26,149**	**229,504**	**86.8%**
13	**TRN**	**5,750**	**8,294**	**7,246**	**9,354**	**1,592**	**596**	**242**	**220**	**132**	**30**	**44**	**26**	**716**	**559**	**34,801**	**13.2%**
13	SOV	2,904	17,295	20,152	34,751	1,073	3,459	4,751	13,303	454	1,220	1,642	4,352	12,186	6,414	123,956	46.9%
13	HOV	646	3,580	3,598	6,072	2,676	7,646	10,094	26,334	1,068	2,814	3,212	8,840	9,233	19,735	105,548	39.9%
13	SR2	436	2,626	2,614	4,318	1,248	4,106	5,532	14,324	492	1,208	1,630	4,124	3,995	8,506	55,159	20.9%
13	SR3	210	954	984	1,754	1,428	3,540	4,562	12,010	576	1,606	1,582	4,716	5,238	11,229	50,389	19.1%
13	WLK	5,104	4,548	3,592	984	1,442	318	88	28	132	20	28	2	365	189	16,840	6.4%
13	PNR	438	2,954	2,948	6,834	42	212	118	136	-	6	2	16	159	239	14,104	5.3%
13	KNR	208	792	706	1,536	108	66	36	56	-	4	14	8	192	131	3,857	1.5%
13	Total	9,300	29,169	30,996	50,177	5,341	11,701	15,087	39,857	1,654	4,064	4,898	13,218	22,135	26,708	264,305	100%
13	%	3.5%	11.0%	11.7%	19.0%	2.0%	4.4%	5.7%	15.1%	0.6%	1.5%	1.9%	5.0%	8.4%	10.1%	100%	
14	**DRV**	**2,437**	**5,755**	**4,103**	**6,645**	**9,639**	**20,724**	**17,909**	**23,468**	**4,988**	**8,146**	**7,237**	**9,871**	**22,745**	**28,005**	**171,672**	**78.5%**
14	**TRN**	**5,758**	**7,254**	**5,596**	**4,760**	**6,168**	**3,456**	**2,388**	**1,134**	**1,058**	**480**	**380**	**68**	**5,397**	**3,250**	**47,147**	**21.6%**
14	SOV	1,381	3,761	2,685	4,501	2,069	5,092	4,239	5,312	1,206	1,980	1,681	2,353	5,700	4,830	46,790	21.4%
14	HOV	1,056	1,994	1,418	2,144	7,570	15,632	13,670	18,156	3,782	6,166	5,556	7,518	17,045	23,175	124,882	57.1%
14	SR2	702	1,430	1,110	1,742	3,654	8,490	7,522	10,246	1,716	2,874	2,804	3,646	7,848	9,798	63,582	29.1%
14	SR3	354	564	308	402	3,916	7,142	6,148	7,910	2,066	3,292	2,752	3,872	9,197	13,377	61,300	28.0%
14	WLK	5,672	6,844	5,408	4,062	6,094	3,336	2,298	1,062	996	446	358	34	5,054	2,994	44,658	20.4%
14	PNR	36	52	24	54	4	32	22	26	56	16	12	2	72	73	481	0.2%
14	KNR	50	358	164	644	70	88	68	46	6	18	10	32	271	183	2,008	0.9%
14	Total	8,195	13,009	9,699	11,405	15,807	24,180	20,297	24,602	6,046	8,626	7,617	9,939	28,142	31,255	218,819	100%
14	%	3.8%	6.0%	4.4%	5.2%	7.2%	11.1%	9.3%	11.2%	2.8%	3.9%	3.5%	4.5%	12.9%	14.3%	100%	

1.5 Convergence

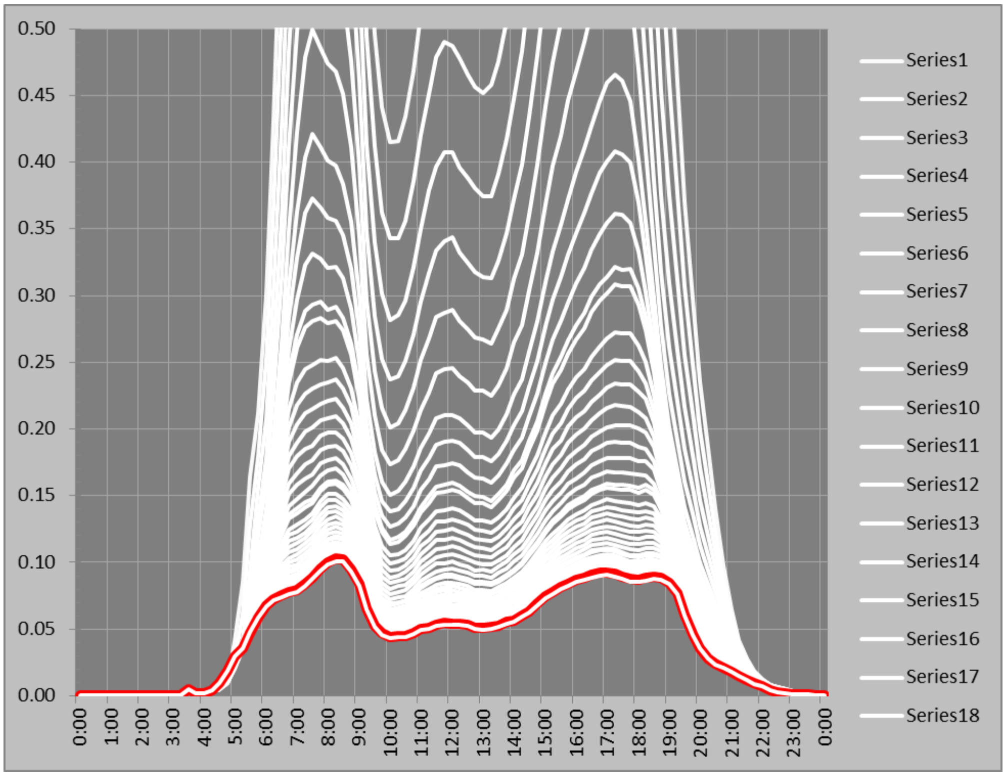
The TRANSIMS DTA assignments track several (convergence) gap measures, namely:

- trip-based gap – the change in trip travel times between successive iterations,
- link-based gap – the change in link travel times between successive iterations,
- toll-gap – the change in dynamic toll rates between successive iterations,
- transit-gap – the change in transit crowding penalties between successive iterations, and
- parking-gap – the change in parking capacity penalties between successive iterations.

These measures are tracked by iteration and time-period with lower values indicating greater stability in the assignment results from one iteration to the next. **Figure 7**, **Figure 8**, **Figure 9**, **Figure 10**, and **Figure 11** present the trip-based gap, link-based gap, toll-gap, transit-gap and parking-gap, respectively. In each figure, diurnal distributions drawn in varying shades of gray show the gap value by time of day for each assignment iteration. The earlier iterations have large magnitudes and are shown with lighter/brighter shades of gray. The final iteration is drawn in red. These figures show that the gaps settle down as the iterations progress. Two charts are shown on each page, the chart on the top corresponds to the gap measures in the regional assignment and the chart on the bottom of each page corresponds to the NoVA assignments. Generally, the NoVA assignments achieve a tighter gap when compared to the regional assignments.

The maximum trip-gap is below 0.10 for the AM peak period for the regional run, whereas the maximum trip-gap is below 0.025 for the NoVA assignment. The link-gap is slightly higher than the trip-gap and is at approximately 0.15 at the regional assignment and at approximately 0.05 for the NoVA assignment. The toll-gaps are well under 0.01 whereas the transit-gaps are relatively unstable but at about 0.20 for the peak periods. The parking-gaps are very high for the regional run but under 0.5 for the NoVA assignment.

Figure 7: Regional and NoVA Trip-Gap by Time and Iteration



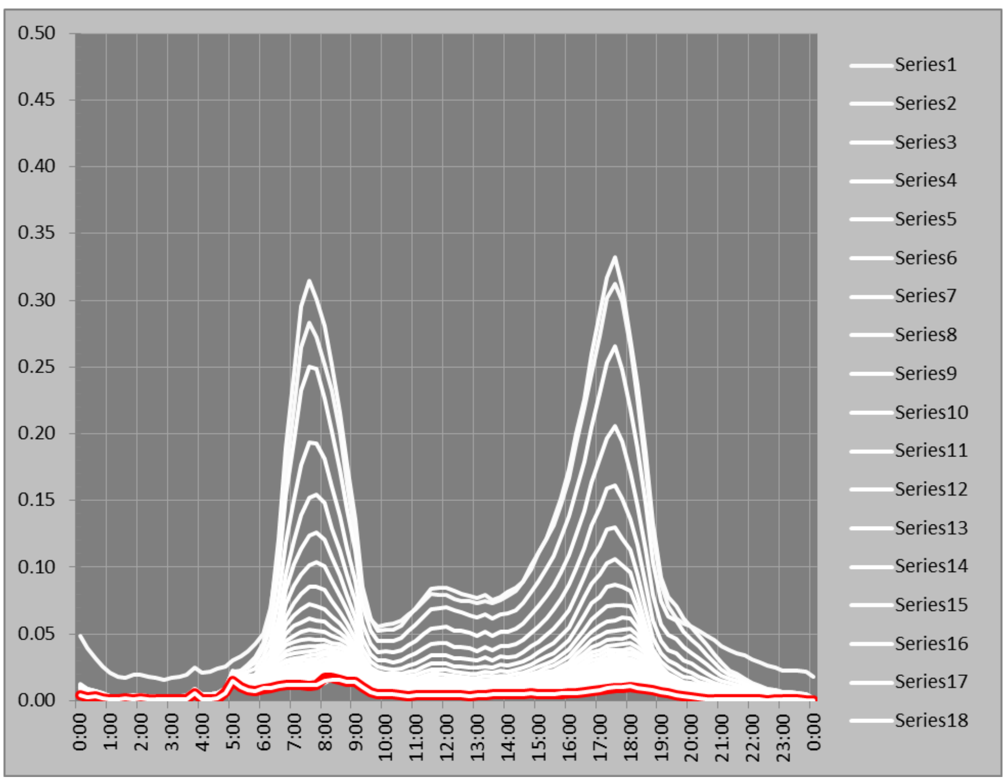
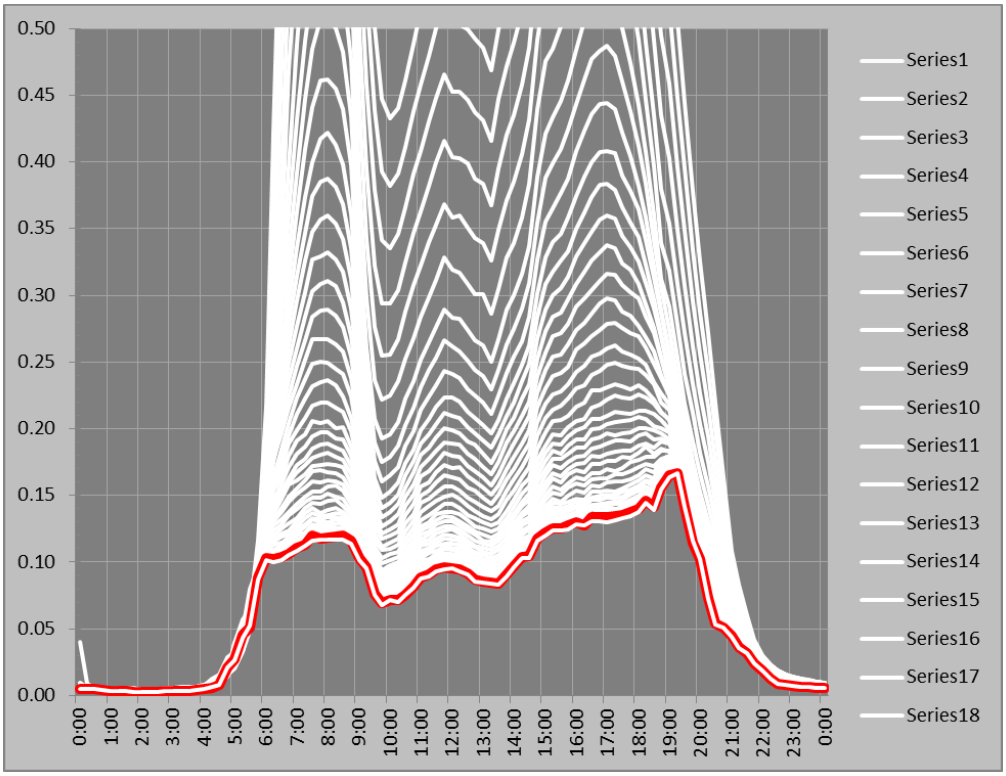


Figure 8: Regional and NoVA Link-Gap by Time and Iteration



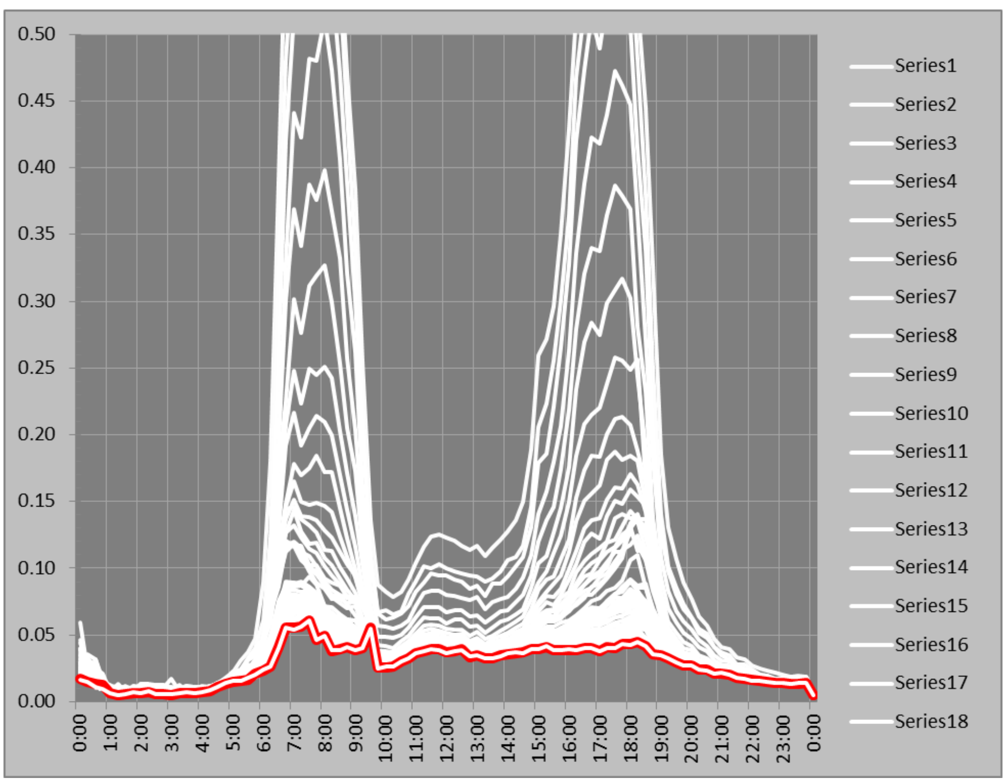
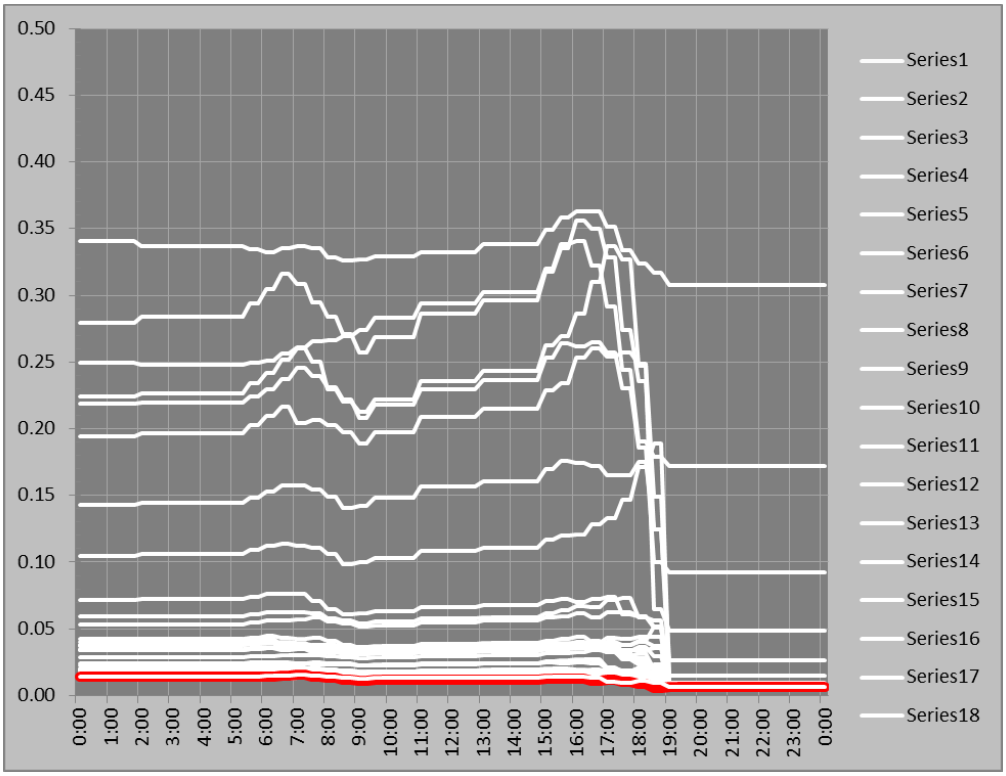


Figure 9: Regional and NoVA Toll-Gap by Time and Iteration



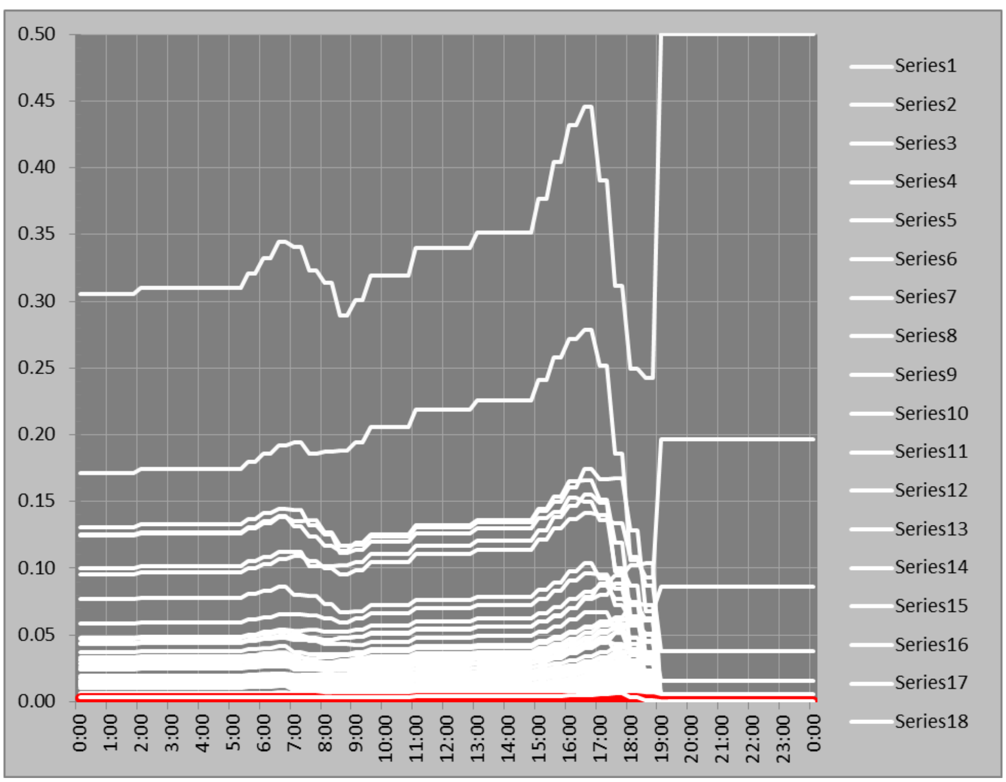
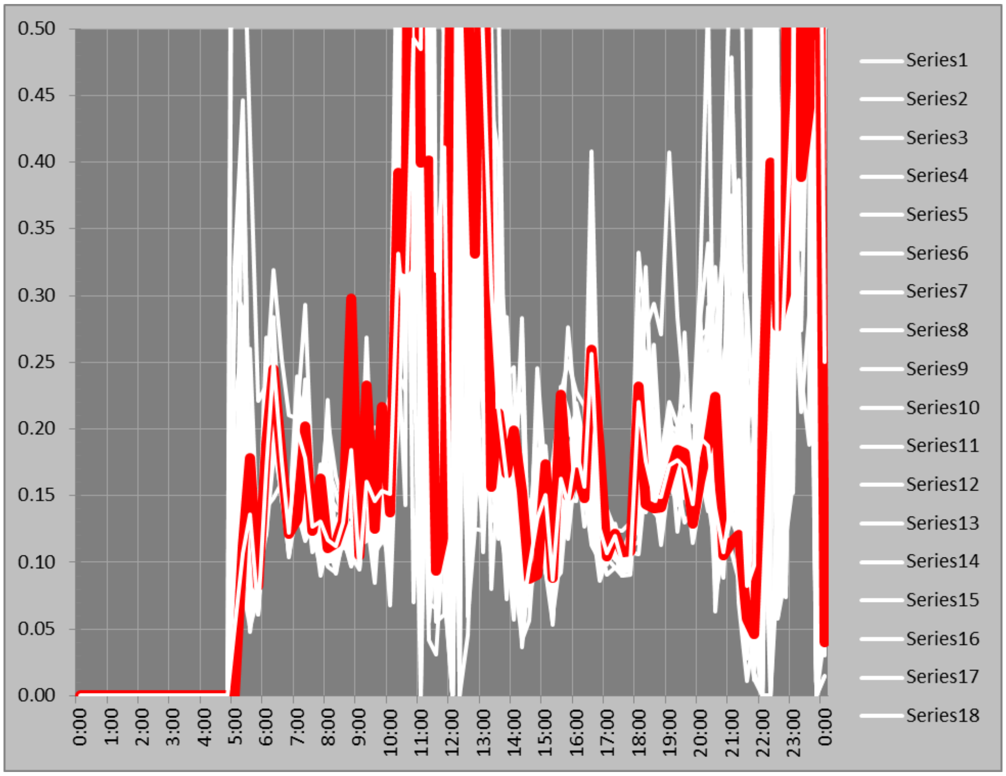


Figure 10: Regional and NoVA Transit-Gap by Time and Iteration



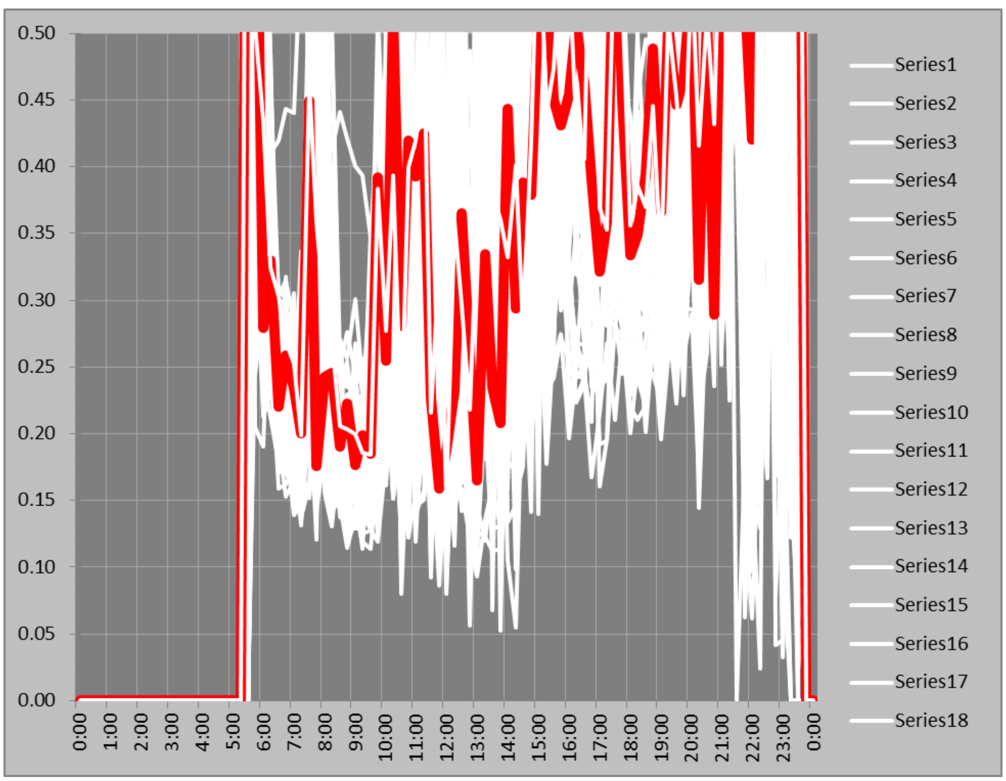
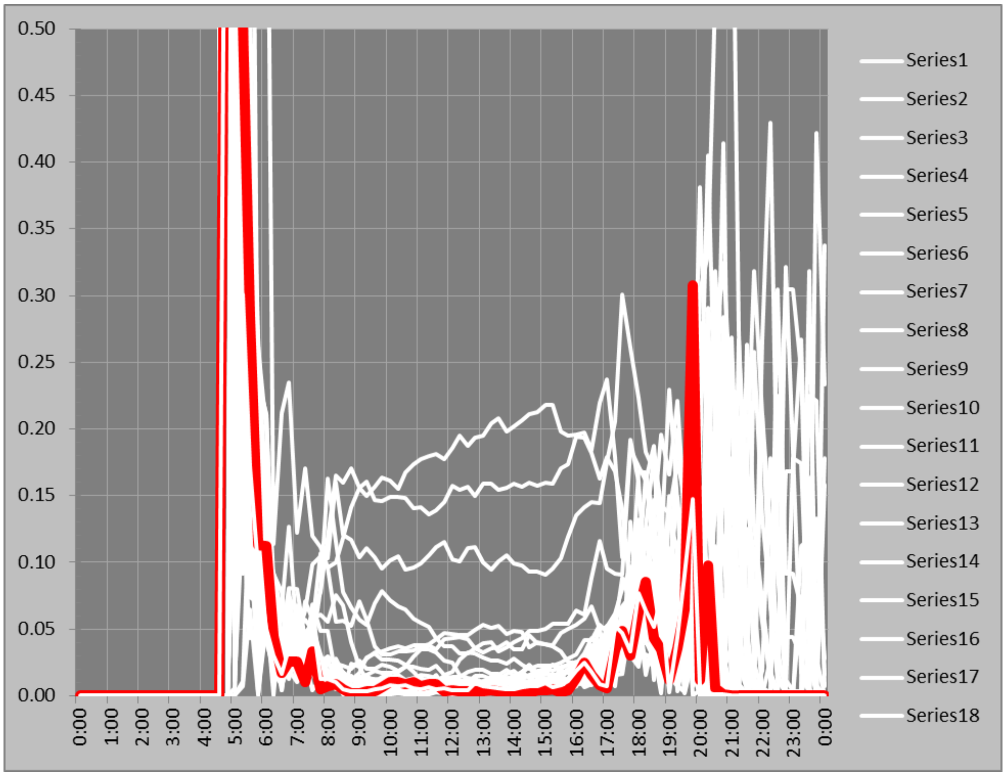
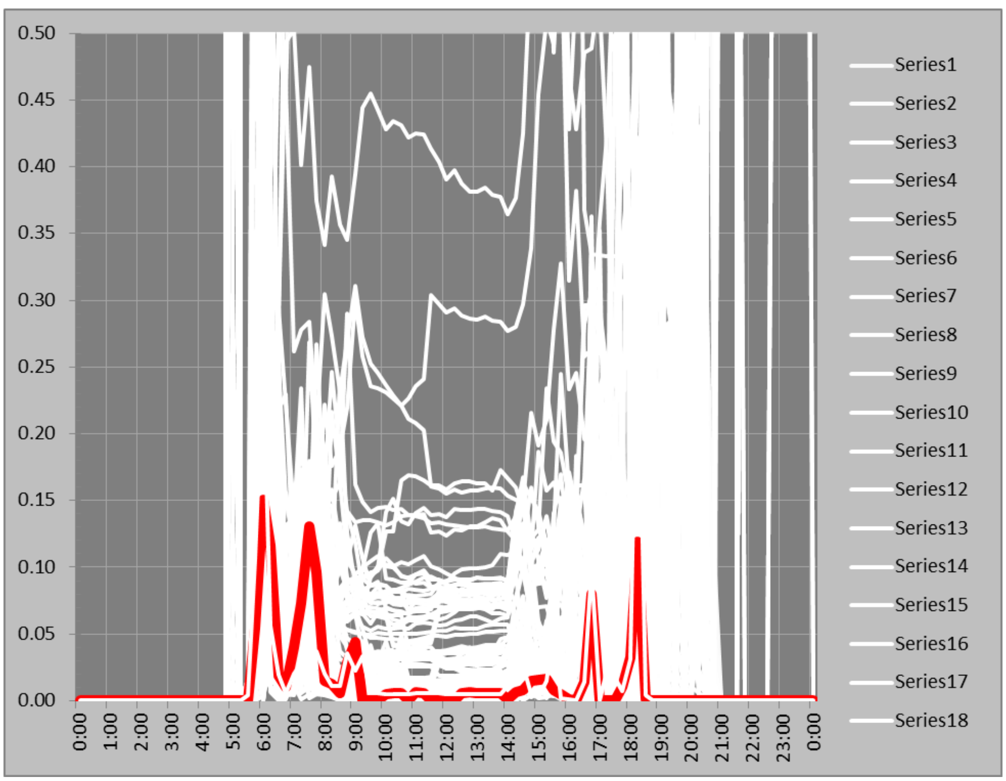


Figure 11: Regional and NoVA Parking-Gap by Time and Iteration





2 Validation

This chapter presents various model outputs and comparisons arranged into five sections: travel-demand, highway validation statistics, highway speed maps, highway speed profiles and transit validation reports.

2.1 Relevant MWCOG Model Documentation

As mentioned earlier, all of the demand inputs to the TRANSIMS model come from MWCOG Model. The MWCOG Model calibration report[5] provides a detailed description of the trip generation and trip distribution steps that define the primary demand inputs.

2.2 Travel Demand

Table 6 presents the total number of trips by time of day, and **Table 7** presents the regional trips as directly converted from the MWCOG model version 2.3.57a based on TPB/COG draft 2016 CLRP Round 9.0 land use inputs. **Figure 12** to **Figure 17** show the diurnal curves by trip purpose that distribute the daily trips to specific departure or arrival times in the TRANSIMS trip file. Each figure has three diurnal curves that depict the distributions of the departure times, mid-trip times and trip arrival times. The diurnal curves were generated from the COG/TPB 2007/2008 Household Travel Survey. The HBW diurnal curves show twin peaks as expected.

Table 8 shows an equivalent of **Table 7** for the NoVA modeling region. **Figure 18** shows the trip distance distribution by trip purpose within the region. Note that the trip distance is the straight-line distance between the origin and destination zones. **Table 9** summarizes the trip distribution by jurisdiction from the TRANSIMS model with adjustments based on the CTPP journey-to-work data, and **Table 10** shows the distribution generated by the MWCOG model. The general jurisdictional distribution is preserved by the TRANSIMS model, but the CTPP adjustments tend to reduce intra-jurisdictional trips and trips to D.C. and increase trips from inner-jurisdictions to outer-jurisdictions.

Table 6: Travel Demand by Time of Day

Modeled Trips	NoVA	REGION
AM Peak Period (6a-9a)	1,679,106	3,268,835
Mid-Day	2,958,217	6,299,792
PM Peak Period (4p-7p)	2,817,065	5,687,109
Rest of Day	1,286,626	2,656,628
Total	**8,741,014**	**17,912,364**

5 Calibration Report for the TPB Travel Forecasting Model, Version 2.3, on the 3,722-Zone Area System. Final Report. Washington, D.C.: National Capital Region Transportation Planning Board, January 20, 2012

Figure 12: Diurnal Curves for HBW Trips

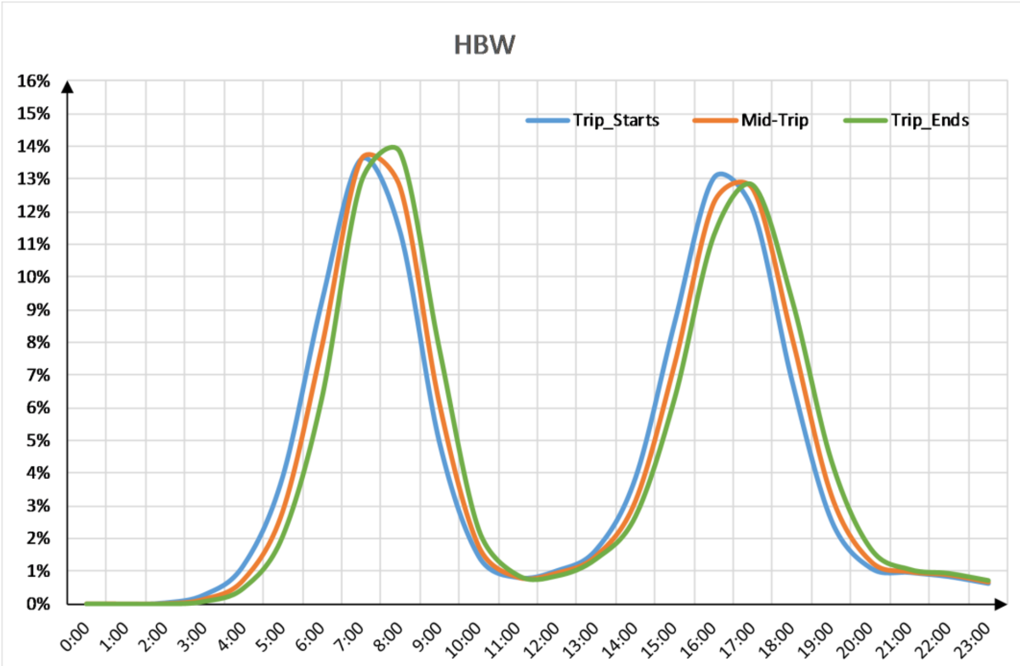


Figure 13: Diurnal Curves for HBO Trips

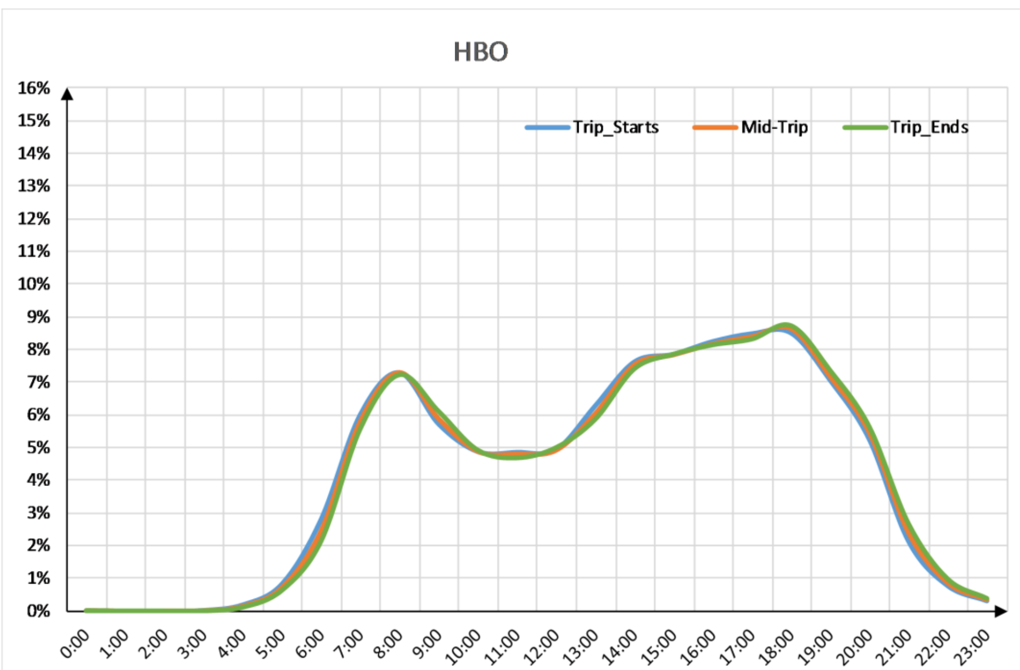


Figure 14: Diurnal Curves for HBS Trips

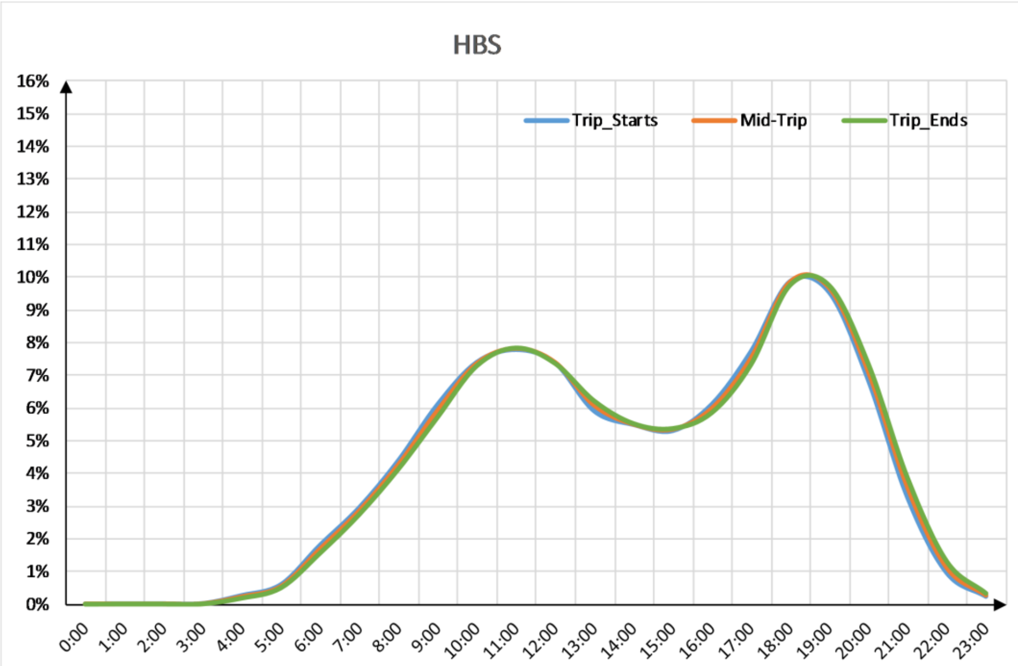


Figure 15: Diurnal Curves for NHO Trips

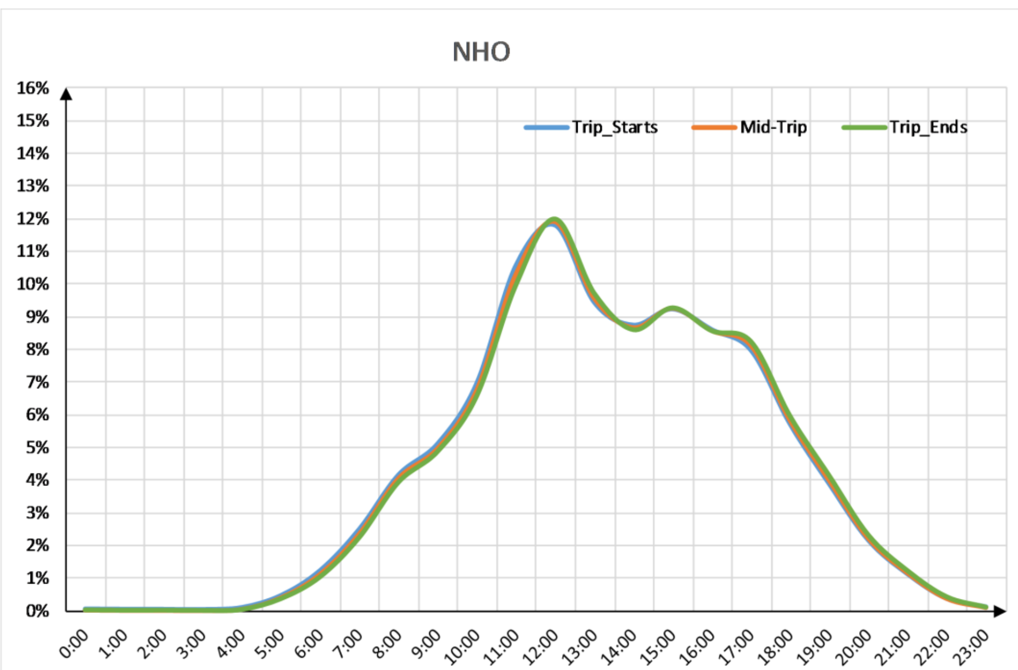


Figure 16: Diurnal Curves for NHW Trips

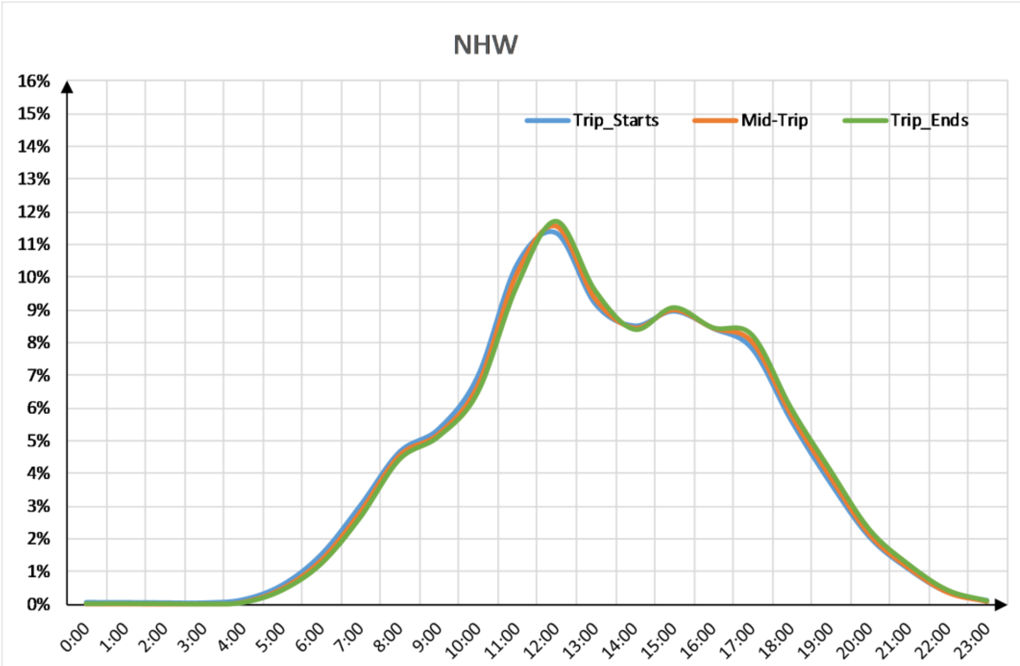


Figure 17: Diurnal Curves for Miscellaneous Trips

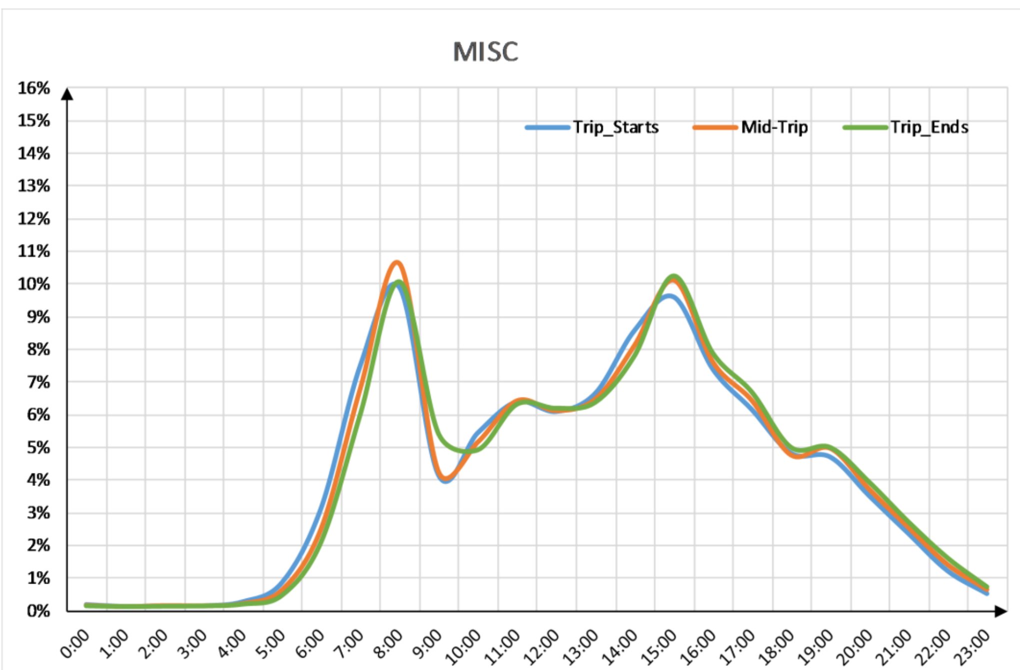


Table 7: Regional trips by purpose and initial mode

Regional Trips	
Highway Vehicle Trips	
Home-based Work	2,895,186
Home-based Other	4,501,622
Home-based Shop	2,045,072
Non-home-based Other	2,232,790
Non-home-based Work	1,330,070
Auto Driver Trip Sub-Total	13,004,740
Miscellaneous Trips	3,654,449
Total Highway Vehicle Trips	**16,659,189**
Transit Person Trips	
Home-based Work	827,954
Home-based Other	203,664
Home-based Shopping	17,776
Non-home-based Work	69,287
Non-home-based Other	26,016
Miscellaneous Trips	108,478
Total Transit Person Trips	**1,253,175**
Total Number of Trips	**17,923,164**

Figure 18: Trip Distance Distribution

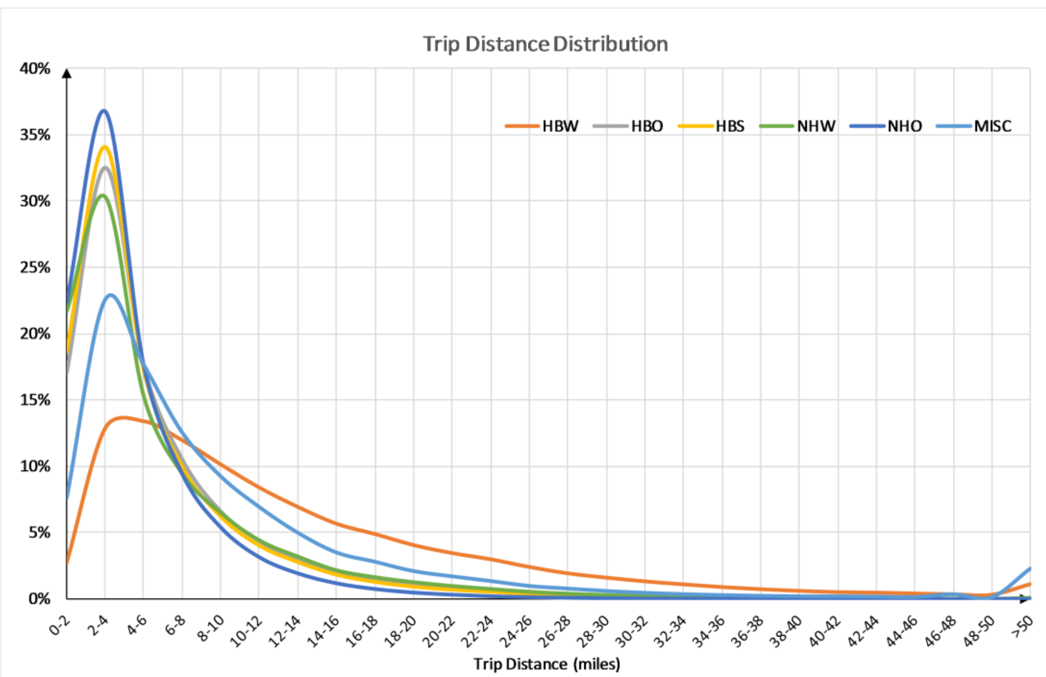


Table 8: NoVA trips by purpose and initial mode

Northern Virginia Trips	
Highway Trips	
Home-based Work	1,619,766
Home-based Other	2,081,279
Home-based Shop	872,492
Non-home-based Other	889,372
Non-home-based Work	631,825
Auto Driver Trip Sub-Total	6,094,734
Miscellaneous Trips	1,767,793
Total Highway Trips	**7,862,527**
Transit Trips	
Home-based Work	599,360
Home-based Other	119,039
Home-based Shopping	5,923
Non-home-based Work	50,011
Non-home-based Other	13,188
Miscellaneous Trips	90,966
Total Transit Trips	**878,487**
Total Number of Trips	**8,741,014**

Table 9: TRANSIMS Trip Distribution with CTPP Adjustment for 2016

	Fairfax	Arlington	Alexandria	Prince William	Loudoun	Outside NVTA	DC	Maryland	External	TOTAL
Fairfax	2,112,820	157,605	98,888	149,350	125,354	33,330	130,980	107,221	72,280	**2,987,828**
Arlington	156,667	287,595	55,781	15,398	9,337	5,660	79,381	59,856	11,941	**681,616**
Alexandria	100,116	55,160	159,369	8,718	3,220	2,098	31,952	22,569	8,012	**391,214**
Prince William	147,769	15,104	7,852	701,498	15,521	48,243	15,981	9,948	24,779	**986,695**
Loudoun	122,267	9,204	3,170	15,411	647,812	22,537	15,095	22,335	24,053	**881,884**
Outside NVTA	33,716	5,755	2,097	49,520	23,039	902,952	6,696	19,694	30,007	**1,073,476**
DC	130,321	78,733	31,365	15,888	15,033	6,668	984,390	528,836	26,896	**1,818,130**
Maryland	105,764	58,401	21,965	10,140	22,217	19,274	522,587	7,591,617	208,151	**8,560,116**
External	85,188	21,399	9,204	22,313	21,555	28,931	69,263	206,209	67,343	**531,405**
TOTAL	**2,994,628**	**688,956**	**389,691**	**988,236**	**883,088**	**1,069,693**	**1,856,325**	**8,568,285**	**473,462**	**17,912,364**

Table 10: MWCOG Model Version 2.3 Trip Distribution for 2016

	Fairfax	Arlington	Alexandria	Prince William	Loudoun	Outside NVTA	DC	Maryland	External	TOTAL
Fairfax	2,018,552	170,167	100,753	129,918	118,010	26,952	153,043	104,385	95,892	**2,917,671**
Arlington	144,162	288,611	55,199	11,614	8,385	3,931	79,630	45,479	21,065	**658,075**
Alexandria	97,808	62,455	158,220	8,459	3,099	1,889	37,739	21,722	11,328	**402,719**
Prince William	131,920	15,264	8,463	859,156	19,139	55,384	17,510	10,916	34,657	**1,152,408**
Loudoun	118,998	10,520	3,150	19,207	657,680	22,460	18,078	22,132	28,304	**900,530**
Outside NVTA	27,280	4,898	2,051	56,142	22,772	913,135	6,423	17,466	35,942	**1,086,108**
DC	94,171	58,697	19,546	10,305	13,103	4,662	949,047	440,570	60,655	**1,650,758**
Maryland	105,663	75,486	24,113	10,434	21,851	17,055	647,627	7,616,052	270,282	**8,788,563**
External	95,711	21,009	11,303	34,602	28,260	35,586	60,481	269,030	79,806	**635,787**
TOTAL	**2,834,264**	**707,107**	**382,799**	**1,139,838**	**892,299**	**1,081,053**	**1,969,577**	**8,547,751**	**637,931**	**18,192,619**

2.3 Highway Validation Statistics

Table 11 presents a comparison of the 2016 assigned volumes against the 2010 TPB/COG counts in the NoVA model area. The comparison shows decent match to the counts with reasonable RMSE values. The percent difference between model volumes and counts for Freeway (6.8%), Expressway (1.8%) and Major arterials (2.7%) are well within the thresholds recommended by the Travel Model Validation and Reasonableness Checking Manual[6].

Table 11: Daily volumes against 2010 TPB counts

Daily Volume by Facility Type							
Facility Type	Links	Estimate	Observed	Diff.	% Diff.	% RMSE	R. Sq.
Freeway	58	3,491,747	3,269,511	222,236	6.8	18.9	0.894
Expressway	22	509,634	500,542	9,092	1.8	31.1	0.693
Major Arterial	110	2,198,959	2,141,318	57,641	2.7	30.1	0.674
Minor Arterial	144	1,369,979	1,183,108	186,871	15.8	51.2	0.533
Collector	100	646,189	512,160	134,029	26.2	59.2	0.773
Bridge	16	785,832	698,472	87,360	12.5	27.3	0.945
Total	**450**	**9,002,340**	**8,305,111**	**697,229**	**8.4**	**33.6**	**0.934**

Table 12 shows a comparison of the 2016 assigned volumes against a compiled list of 2015 AAWDT. The counts for the American Legion, Woodrow Wilson, and Theodore Roosevelt Bridges were obtained from Maryland SHA. The other counts were compiled from 2015 VDOT traffic volume reports and 2014 DDOT traffic volume maps. While the VDOT reports included AAWDT counts, DDOT only showed AADT. The AADT were converted to AAWDT volumes using a MWCOG conversion factor. The comparison indicates about 5 percent higher total bridge traffic than that based on 2015 AAWDT counts. It shows a decent match on the American Legion and Wilson Bridges, but somewhat higher volumes on the 14th Street Bridge.

Table 12: Daily Potomac River crossings

Potomac River Crossing	2016 Estimate	2010 AAWDT	2015 AAWDT	2010 % Diff.	2015 % Diff.
American Legion Bridge	240,993	236,000	244,451	2.1%	-1.4%
Chain Bridge	43,760	18,690	29,295	134.1%	49.4%
Key Bridge	39,341	50,174	50,174	-21.6%	-21.6%
Theodore Roosevelt Bridge	102,399	100,485	95,235	1.9%	7.5%
Arlington Memorial Bridge	52,617	56,595	53,970	-7.0%	-2.5%
14th St. Bridge	228,468	194,000	200,000	17.8%	14.2%
Wilson Bridge	229,380	203,501	214,291	12.7%	7.0%
Total	**936,958**	**859,445**	**887,416**	**9.0%**	**5.6%**

[6] Travel Model Validation and Reasonableness Checking Manual, FHWA, https://www.fhwa.dot.gov/planning/tmip/publications/other_reports/validation_and_reasonableness_2010/ch09.cfm

2.4 Highway Speed Maps

The next several images present the modeled speeds against the “typical” traffic as reported by Google Maps. While Google does not publish the exact breakdown of observed speeds, an attempt was made using time-ratios to generate equivalent maps for several hours of the day in **Figure 21** through **Figure 28**. **Figure 19** and **Figure 20** are conceptual and present the worst congestion for any hour during the AM and PM peak periods, respectively.

The hourly time ratio maps show congestion levels similar to those shown in the Google Typical Traffic maps for major corridors such as I-66, I-95, I-495 near Tysons Corner, and I-495 near the American Legion Bridge during both morning and afternoon peak periods.

Figure 19: Model vs. "Typical" Google Traffic @ AM Worst Congestion

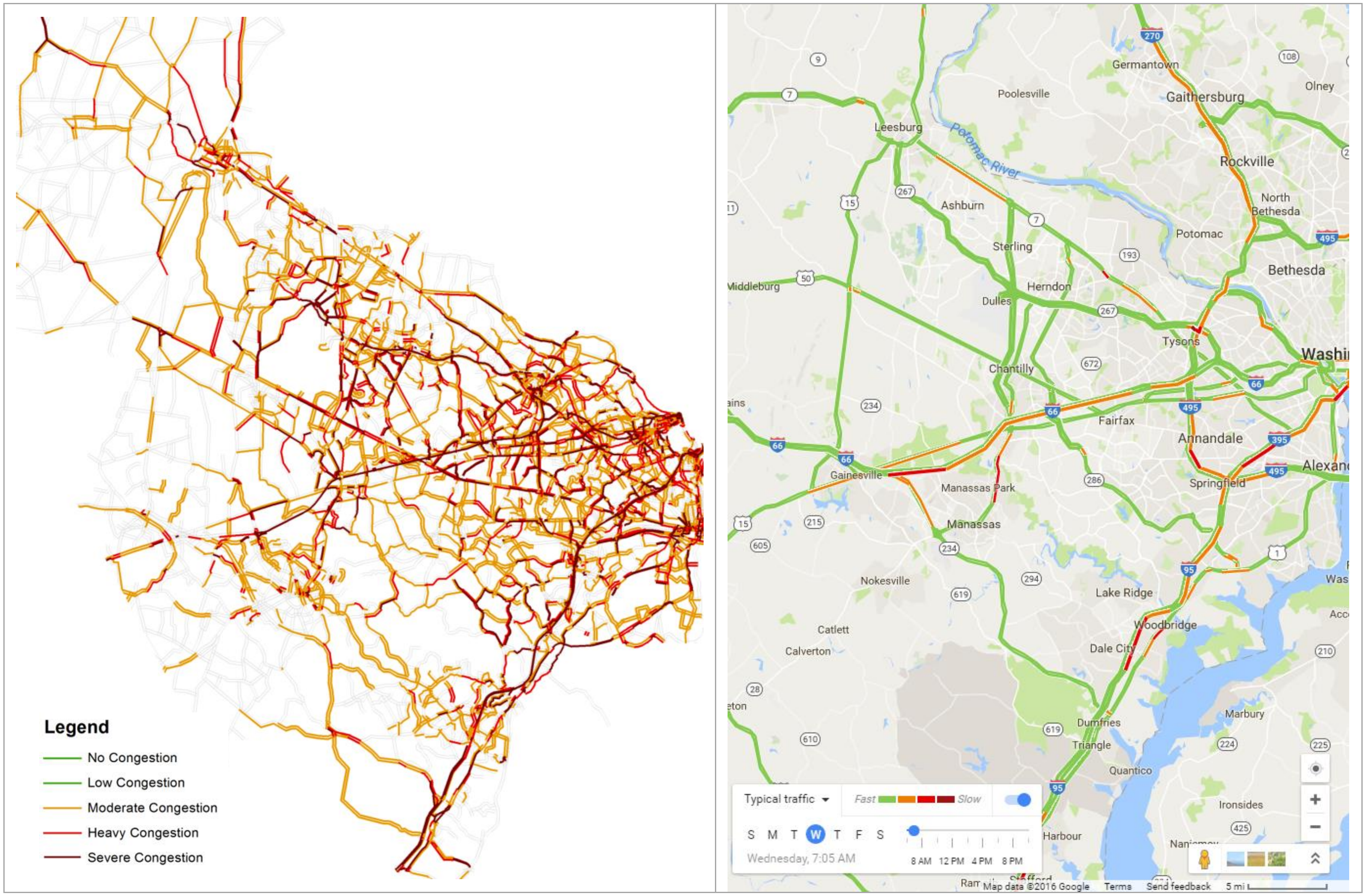


Figure 20: Model vs. "Typical" Google Traffic @ PM Worst Congestion

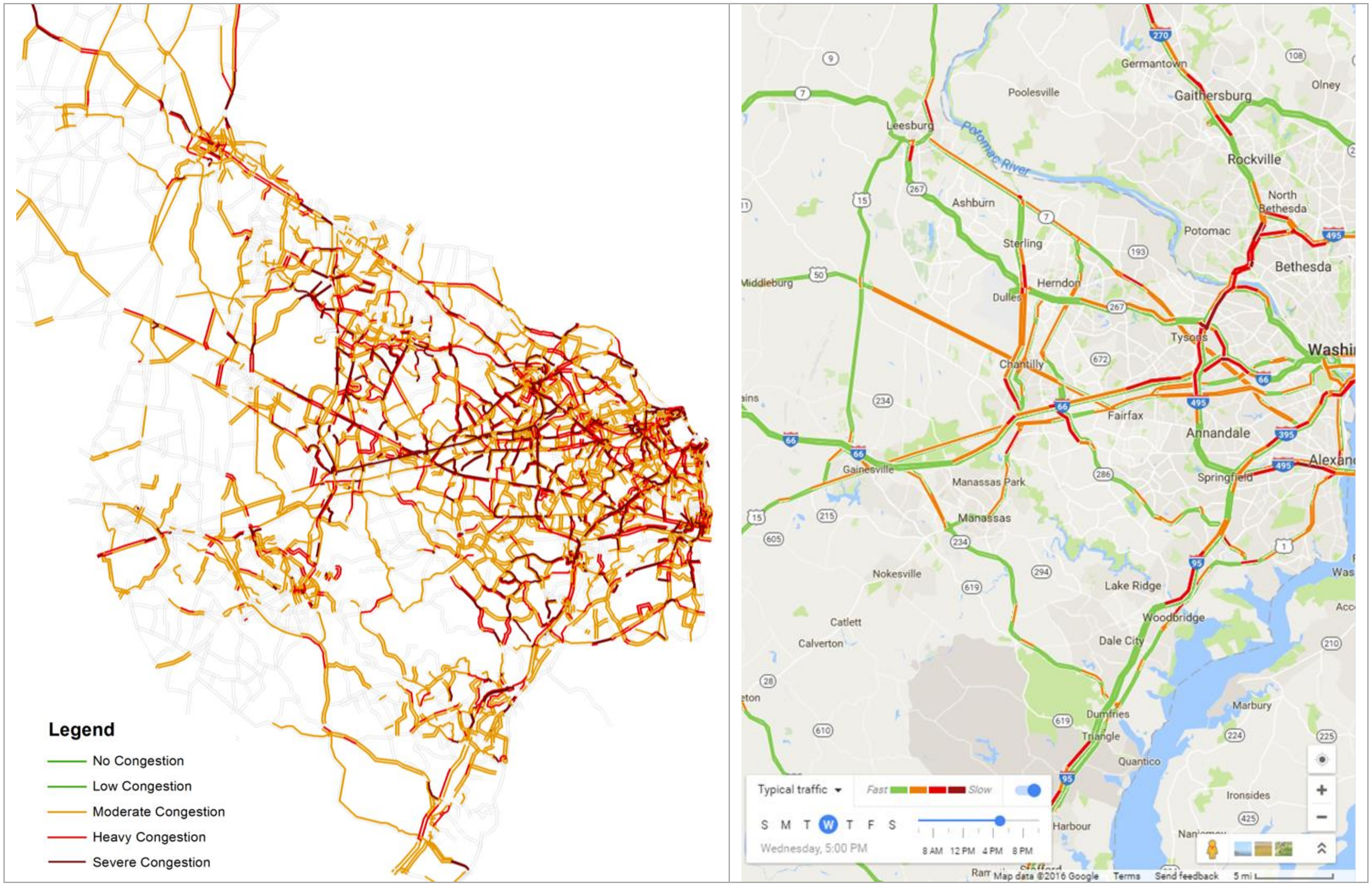


Figure 21: Model vs. "Typical" Google Traffic @ 7:00 AM

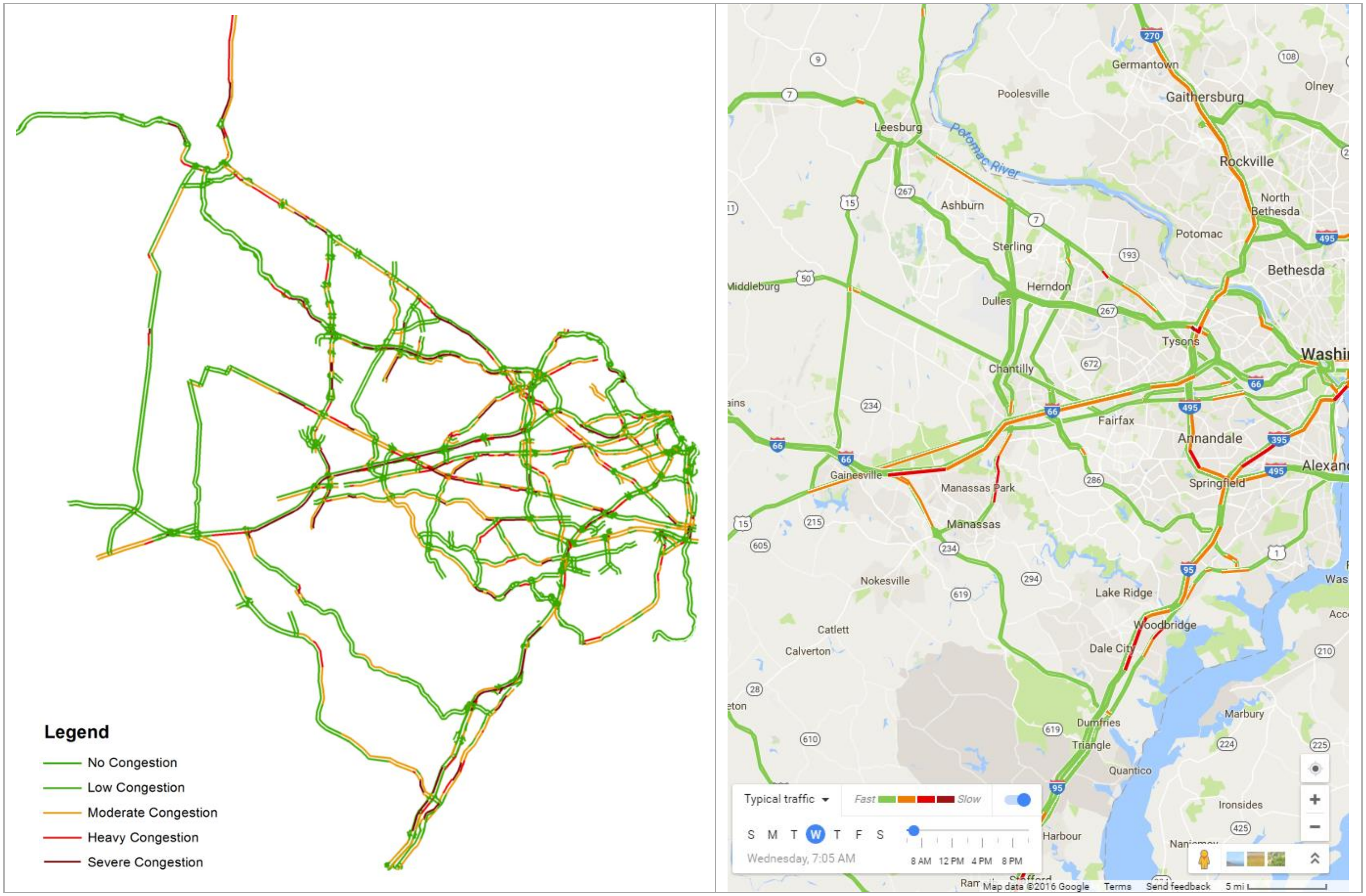


Figure 22: Model vs. "Typical" Google Traffic @ 8:00 AM

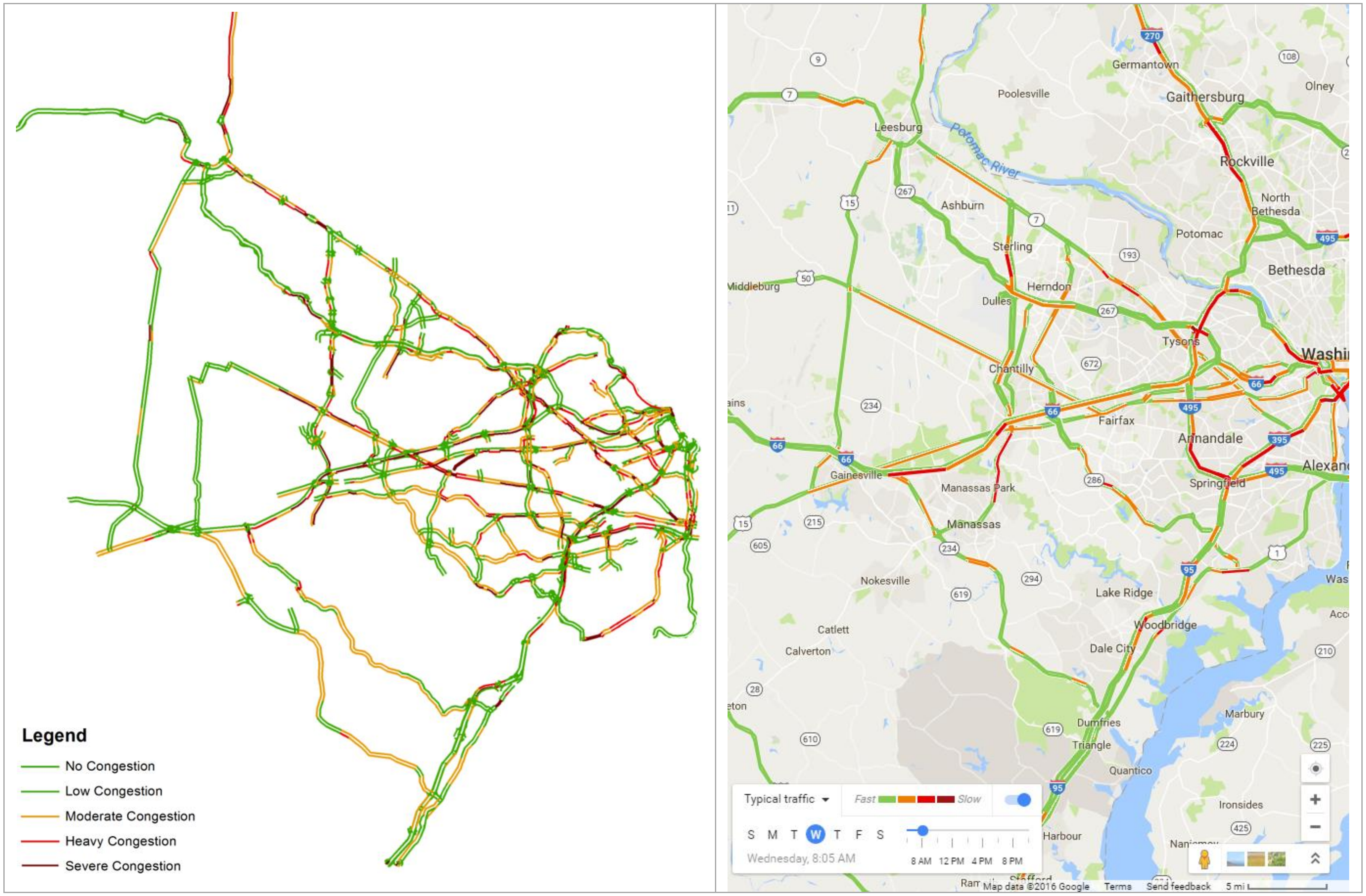


Figure 23: Model vs. "Typical" Google Traffic @ 9:00 AM

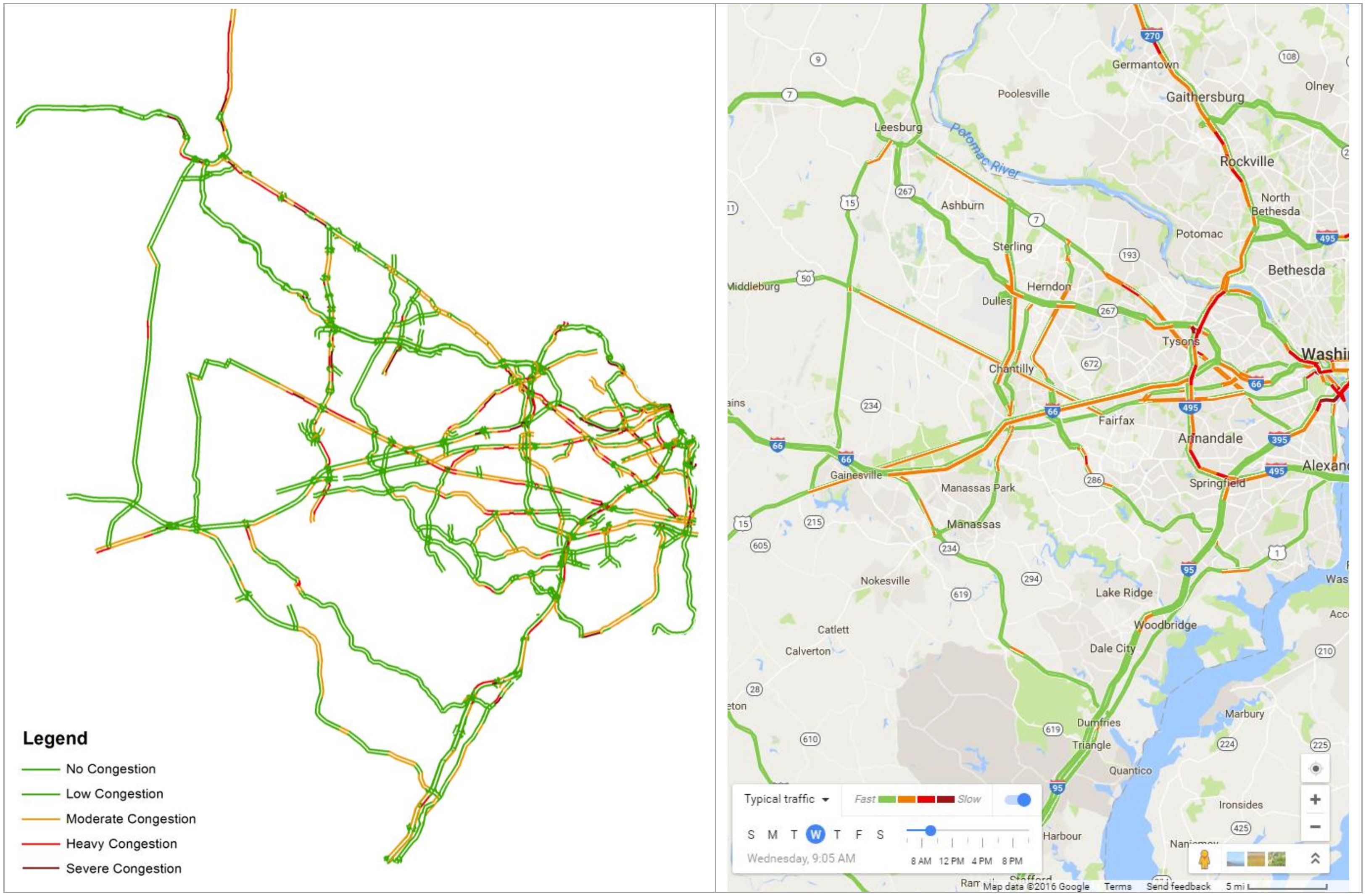


Figure 24: Model vs. "Typical" Google Traffic @ Noon

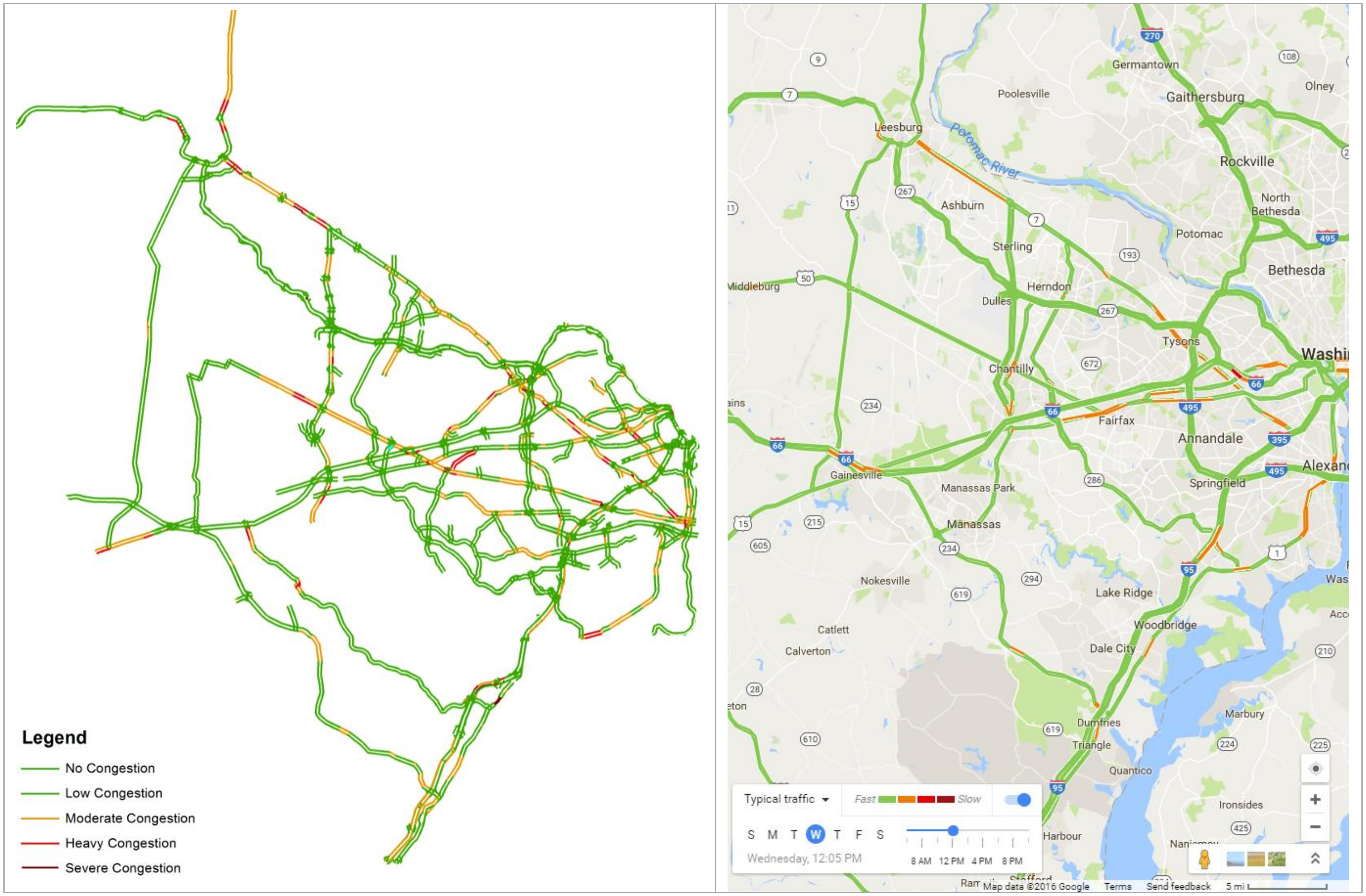


Figure 25: Model vs. "Typical" Google Traffic @ 4:00 PM

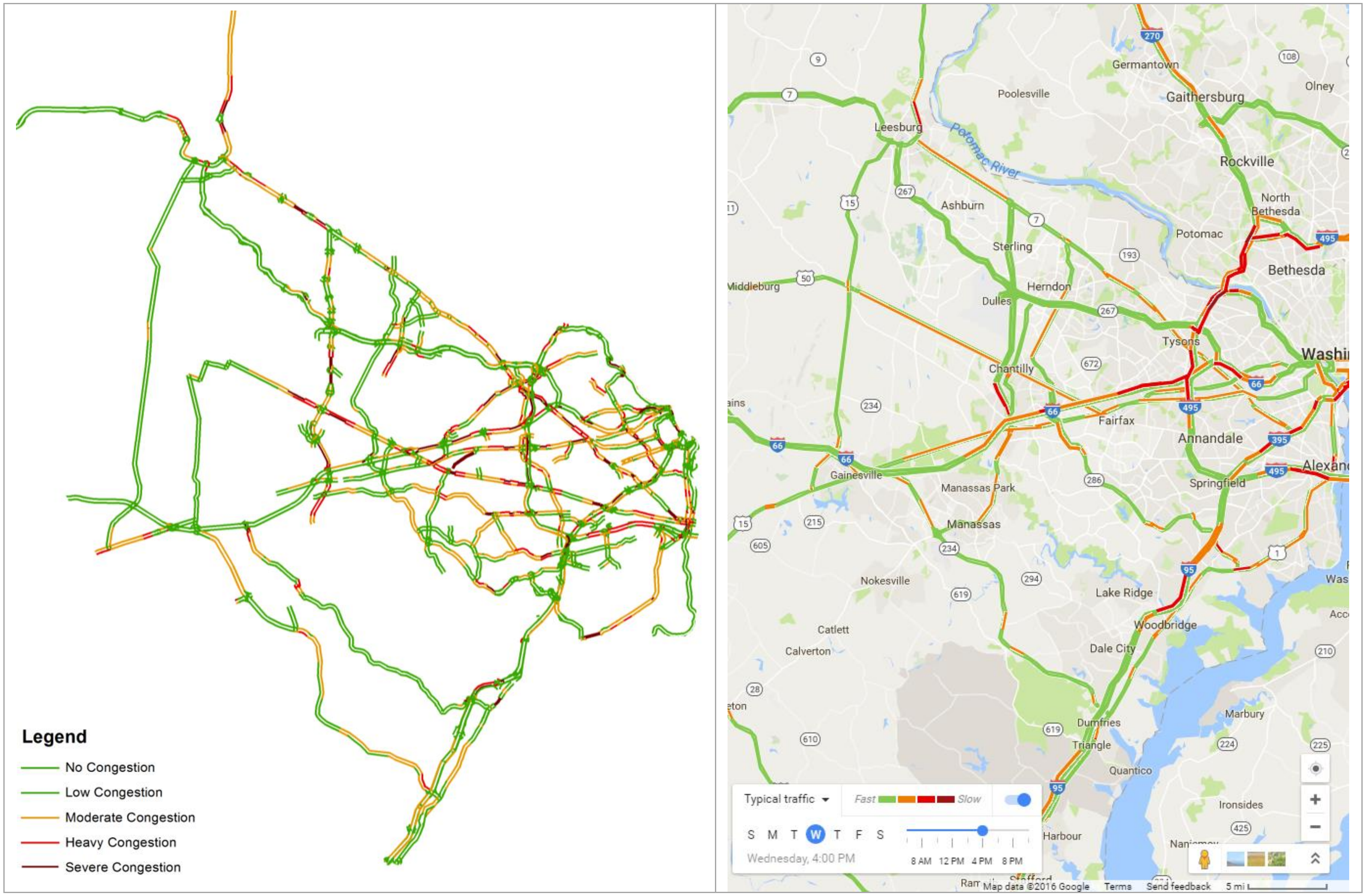


Figure 26: Model vs. "Typical" Google Traffic @ 5:00 PM

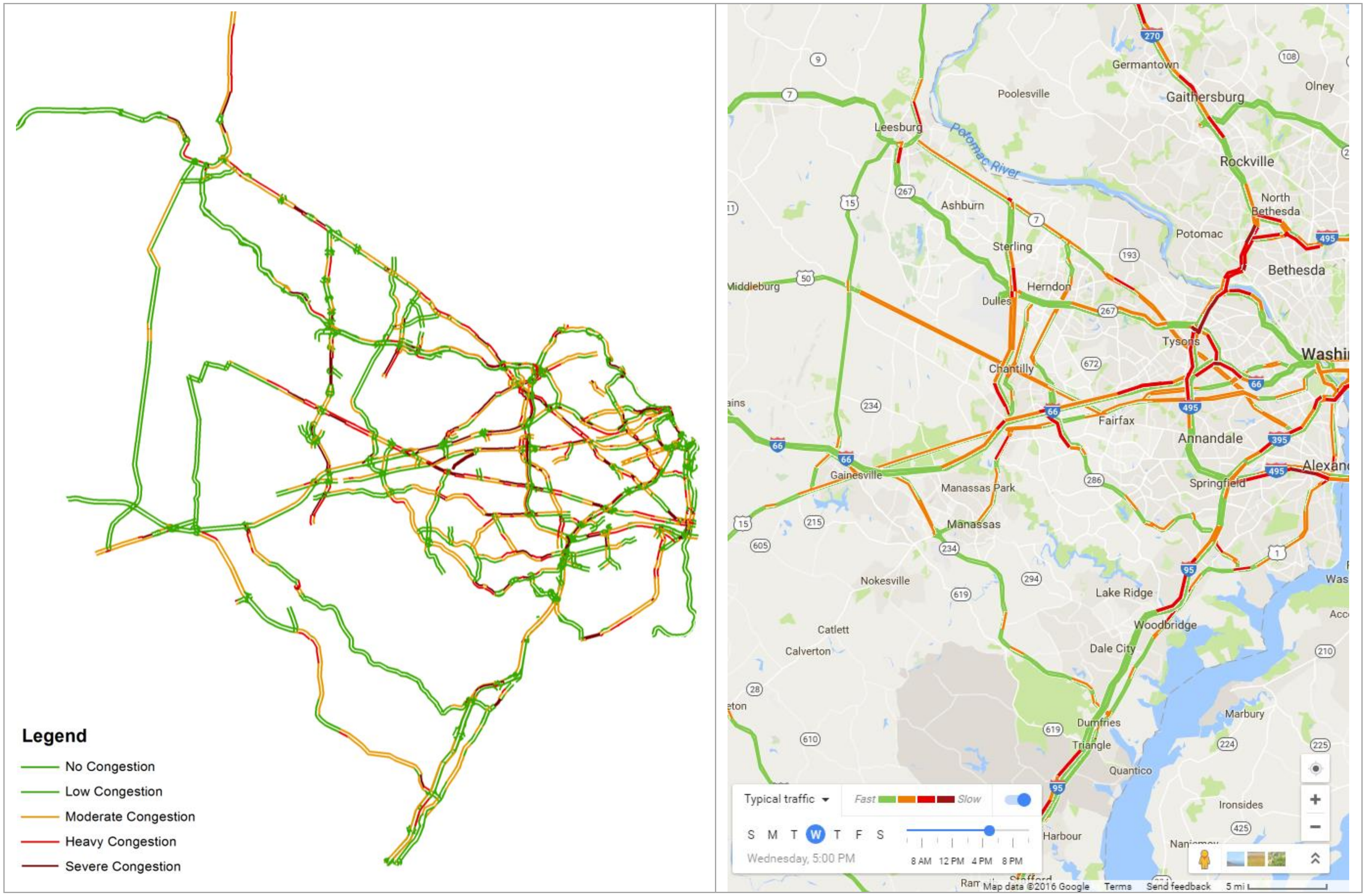


Figure 27: Model vs. "Typical" Google Traffic @ 6:00 PM

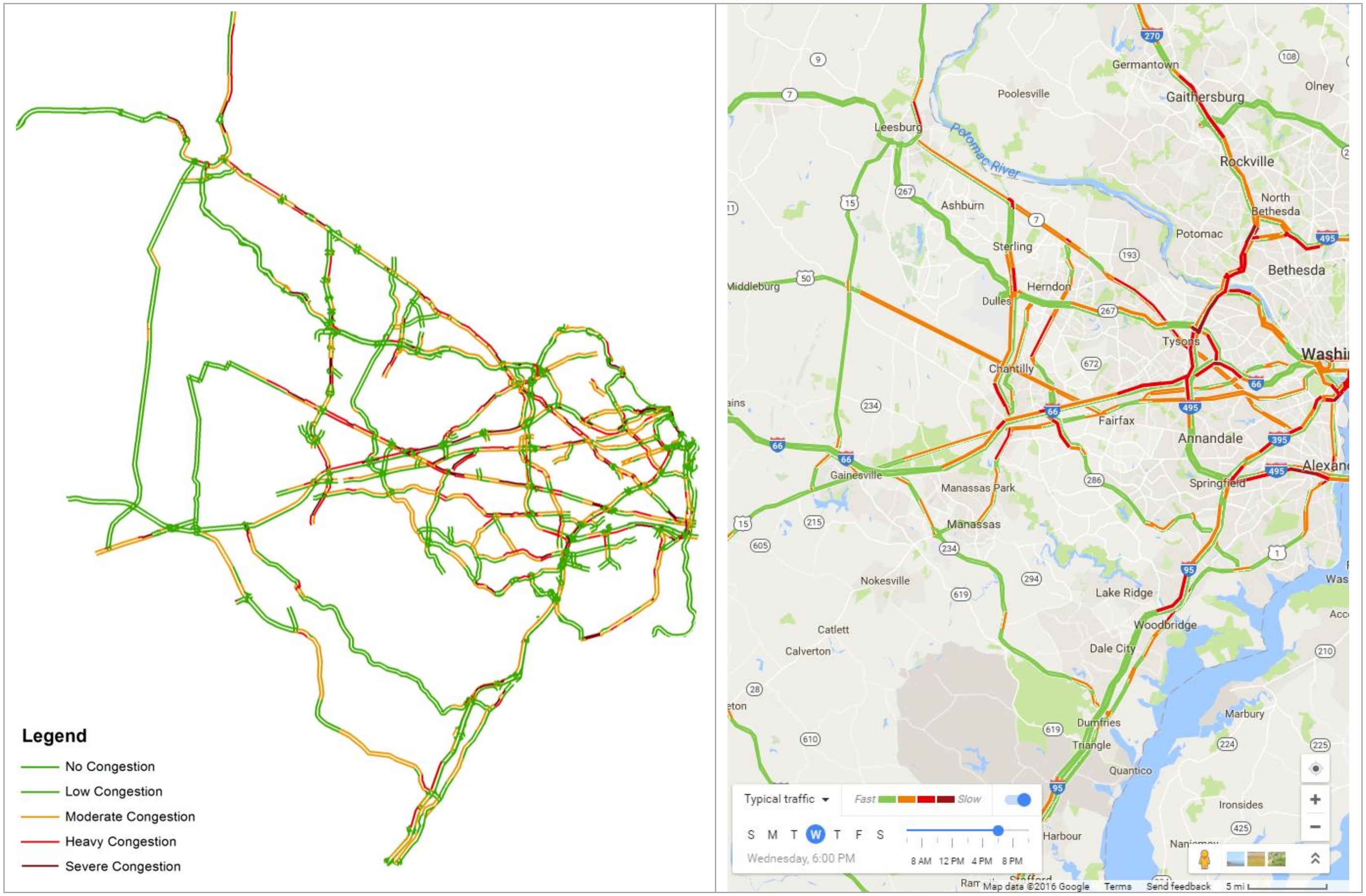
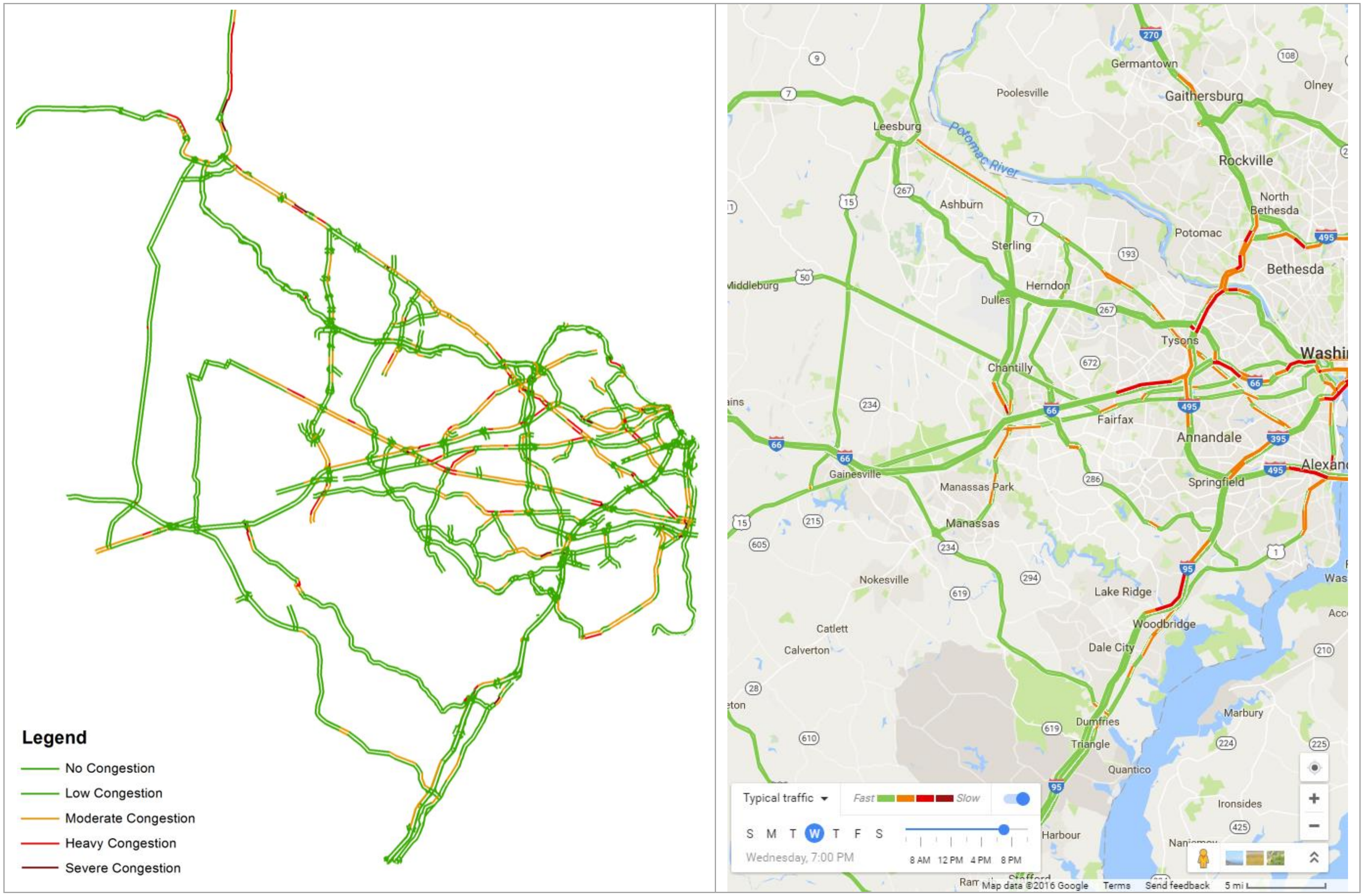


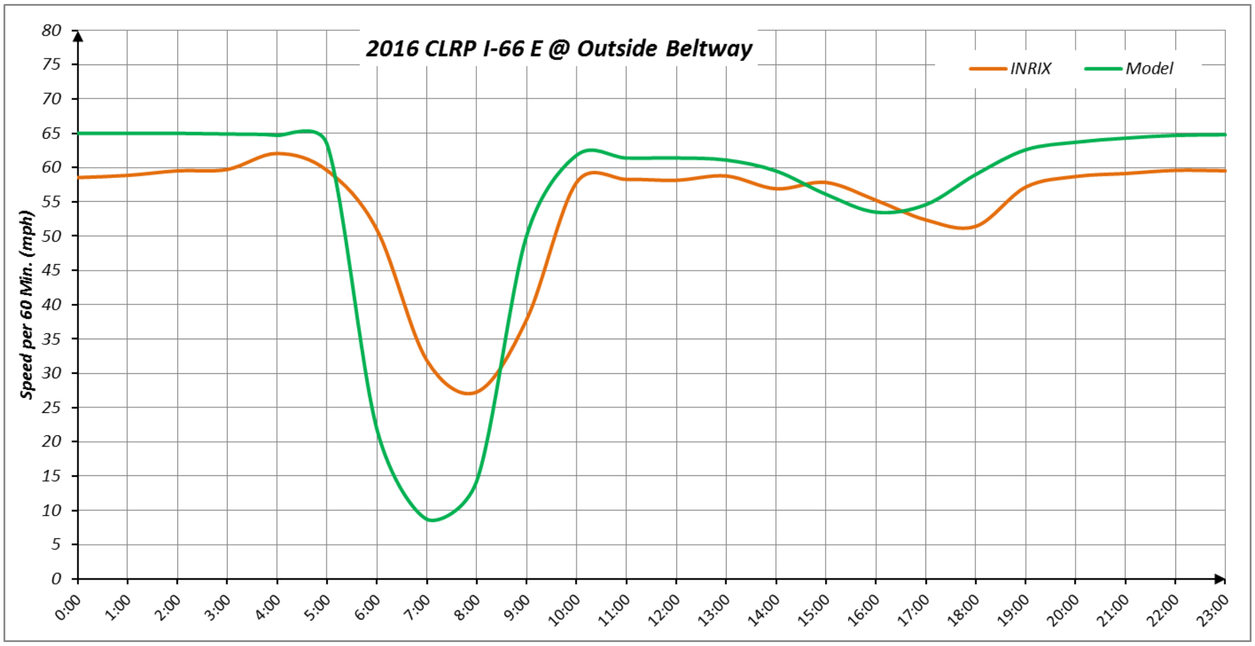
Figure 28: Model vs. "Typical" Google Traffic @ 7:00 PM



2.5 Highway Speed Profiles

This section presents hourly-speed profiles from the model in comparison to the 2013 INRIX speed data at key facilities in our region as shown in **Figure 29** thru **Figure 41**. The modeled speeds are shown in green and the INRIX speed, where available, is shown in orange. The model speed profiles at these locations generally follow the observed speed profiles.

Figure 29: Hourly Speed Profile on I-66 outside Beltway



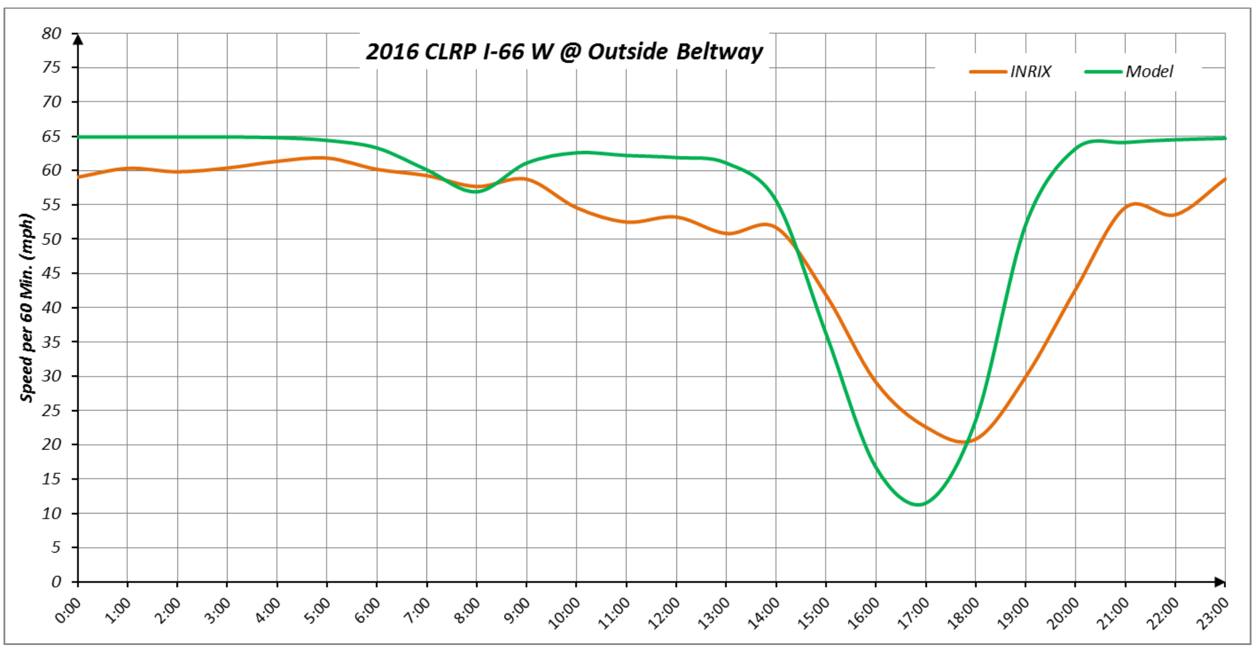
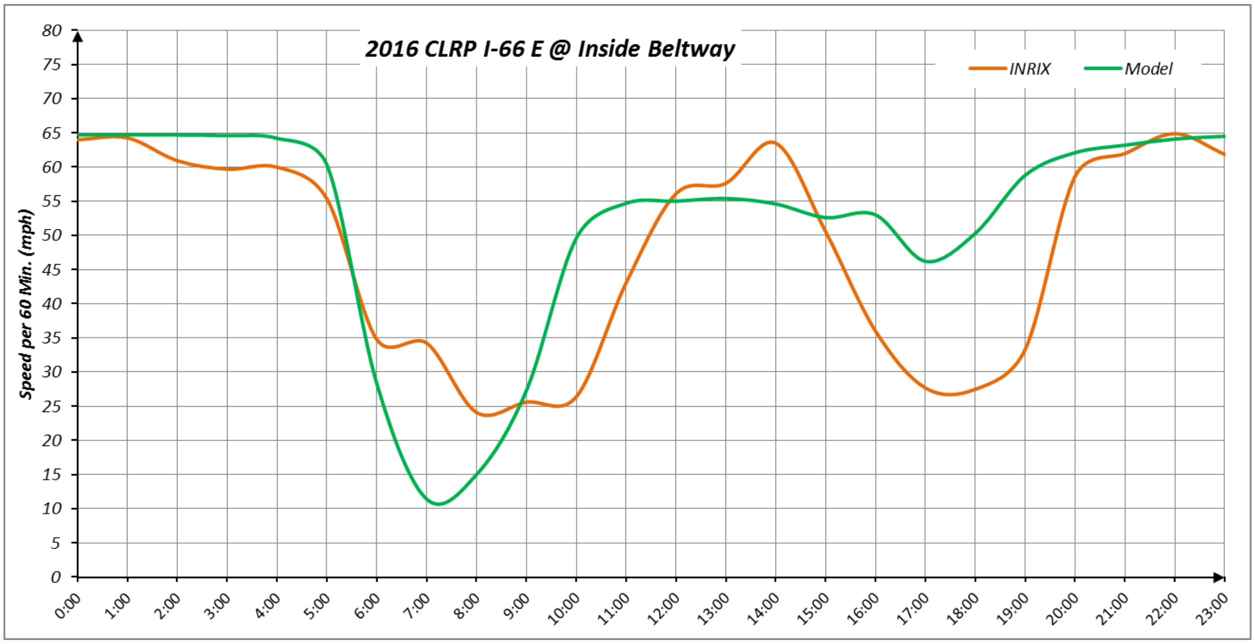


Figure 30: Hourly Speed Profile on I-66 inside Beltway



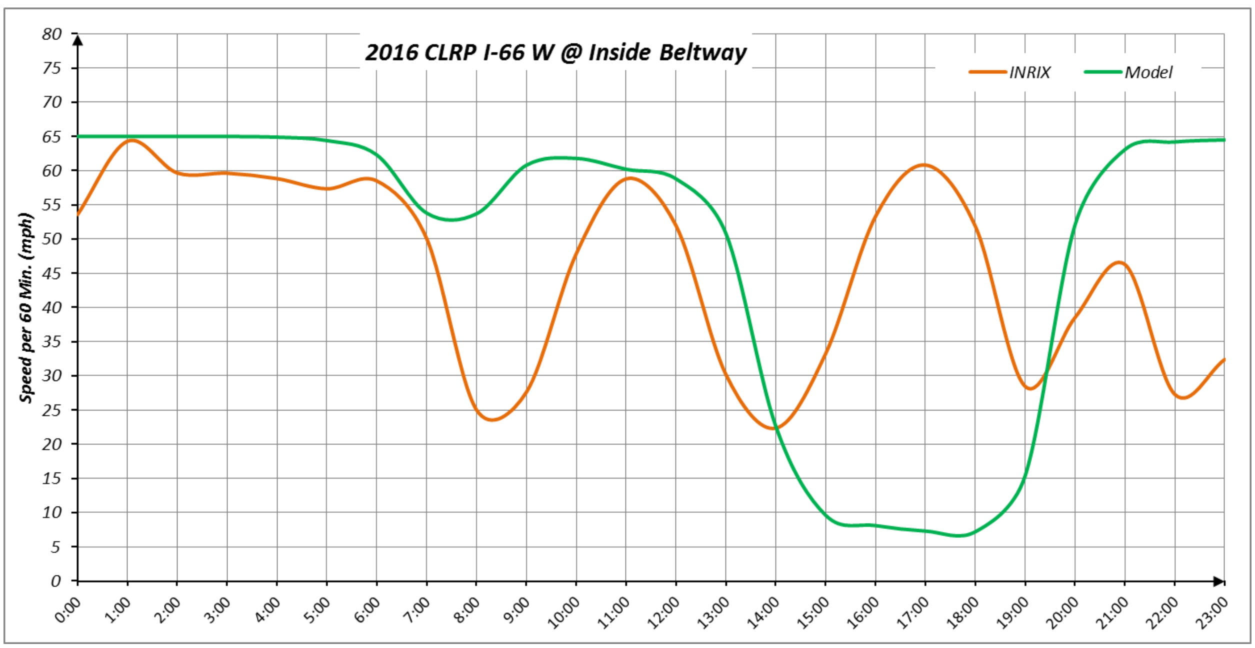
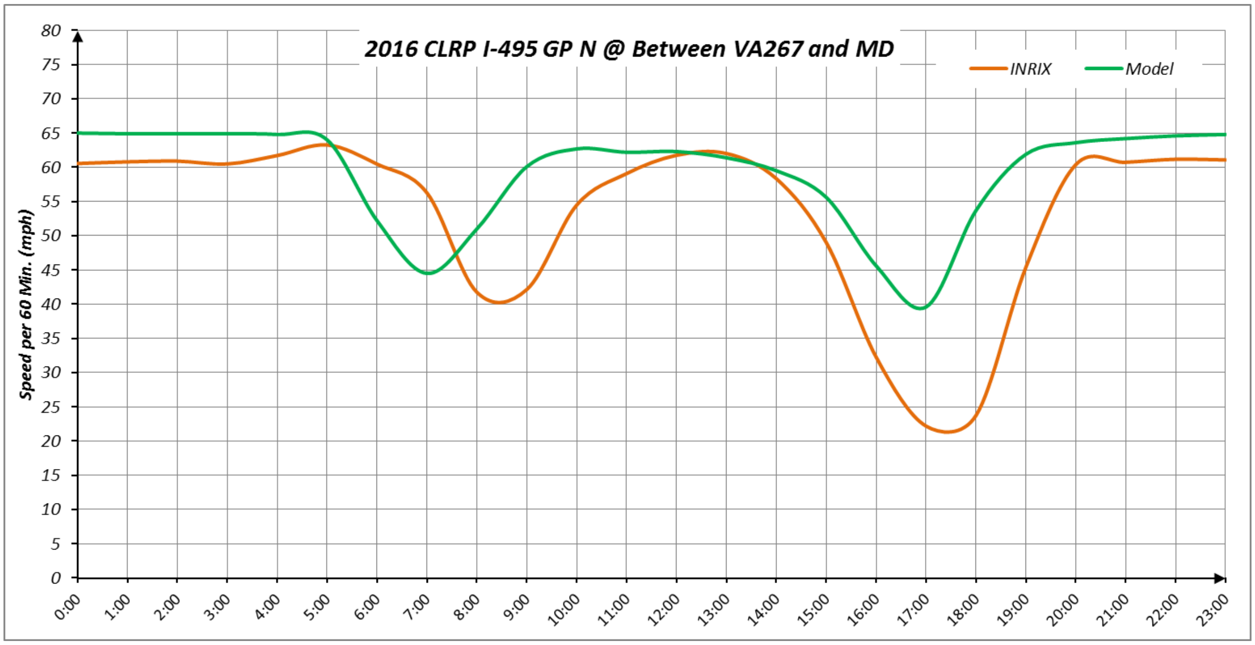


Figure 31: Hourly Speed Profile on Beltway between VA267 and MD



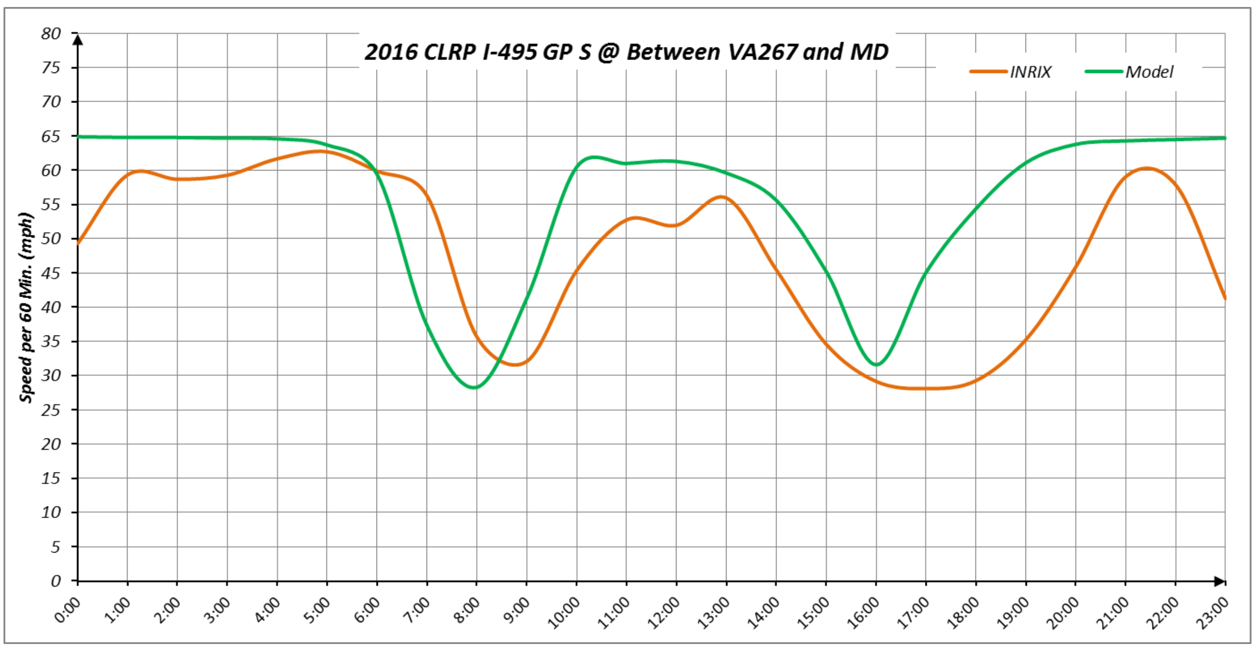
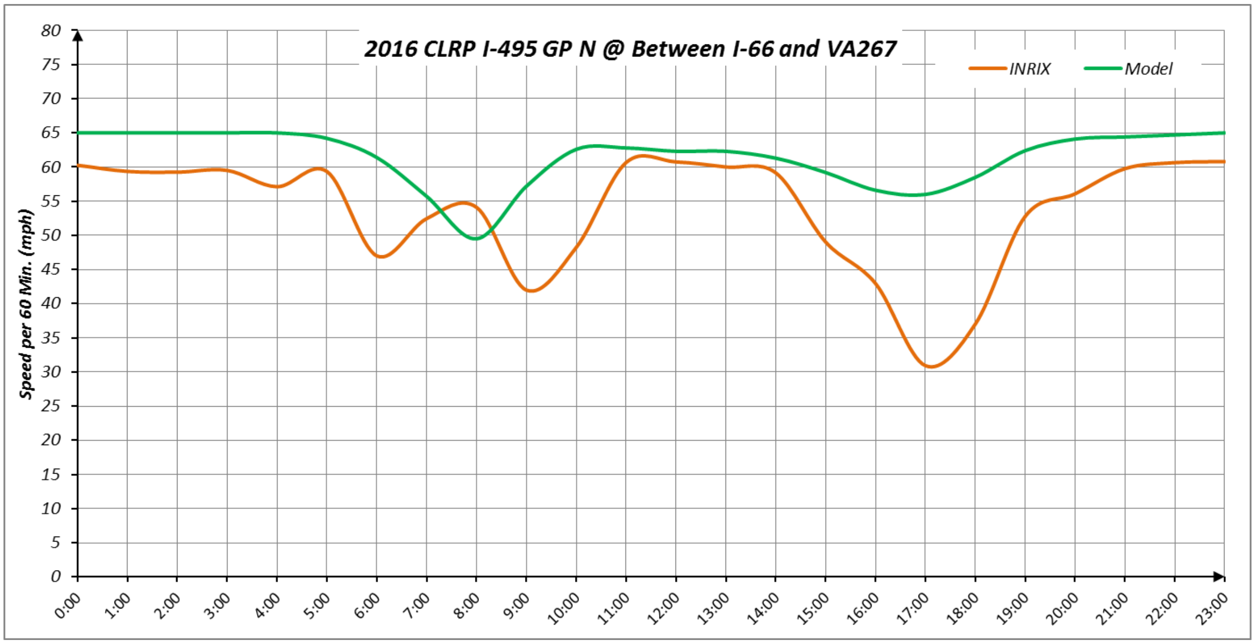


Figure 32: Hourly Speed Profile on Beltway between I-66 and VA267



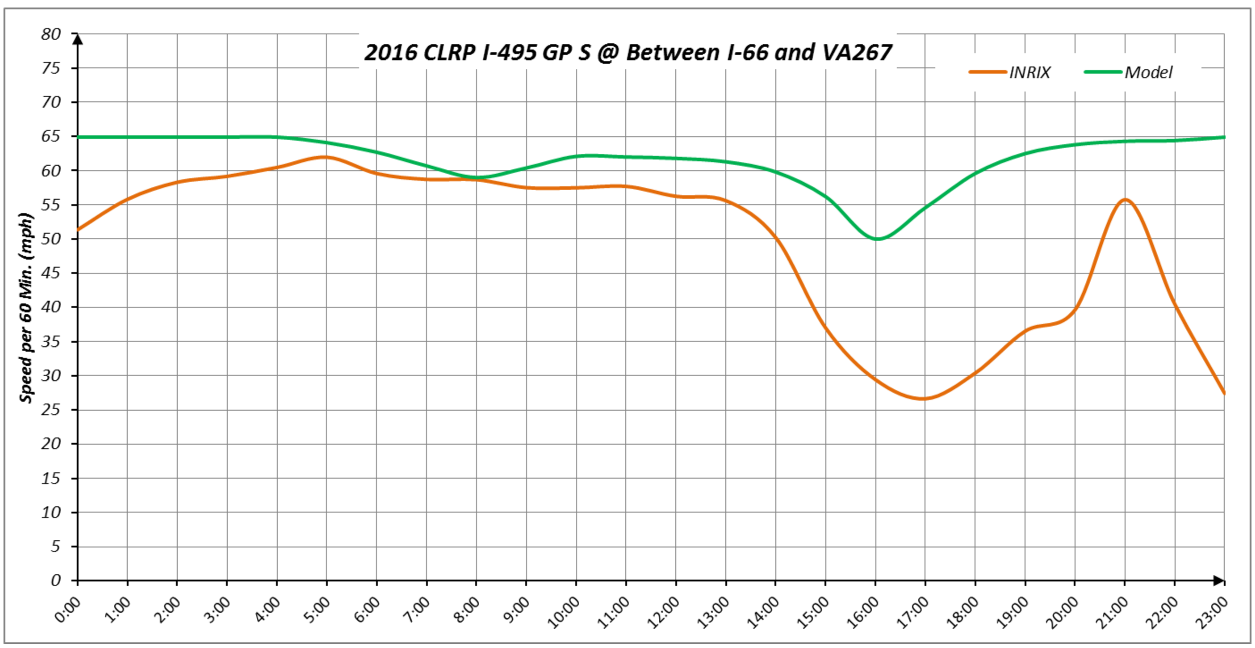
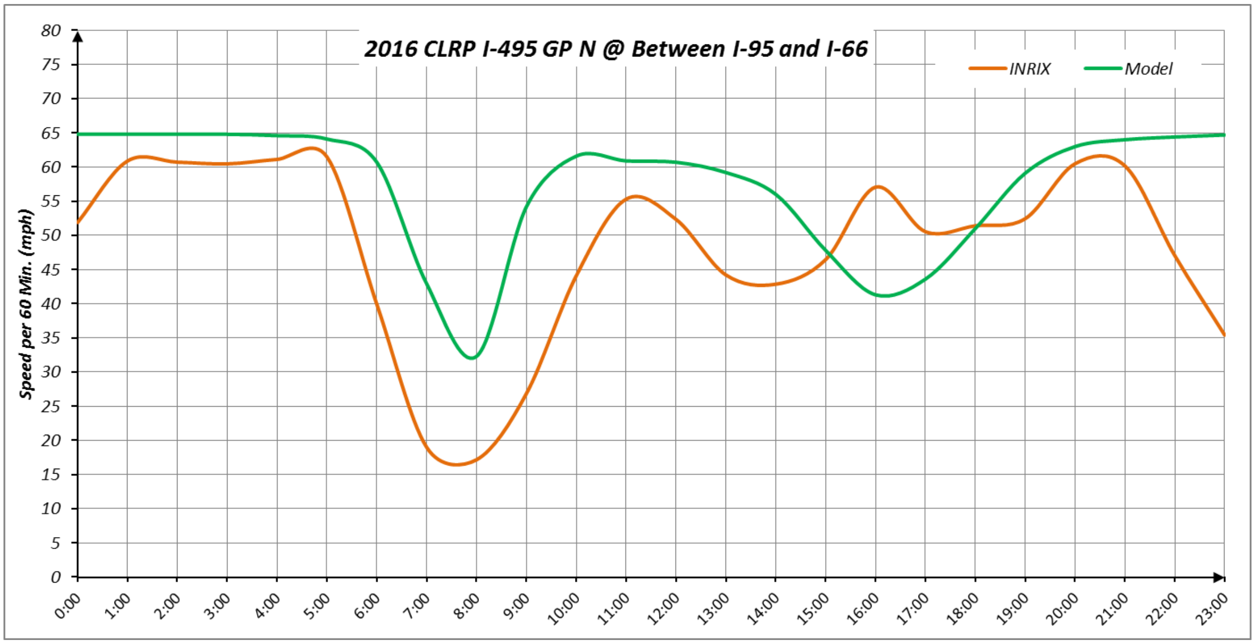


Figure 33: Hourly Speed Profile on Beltway between I-95 and I-66



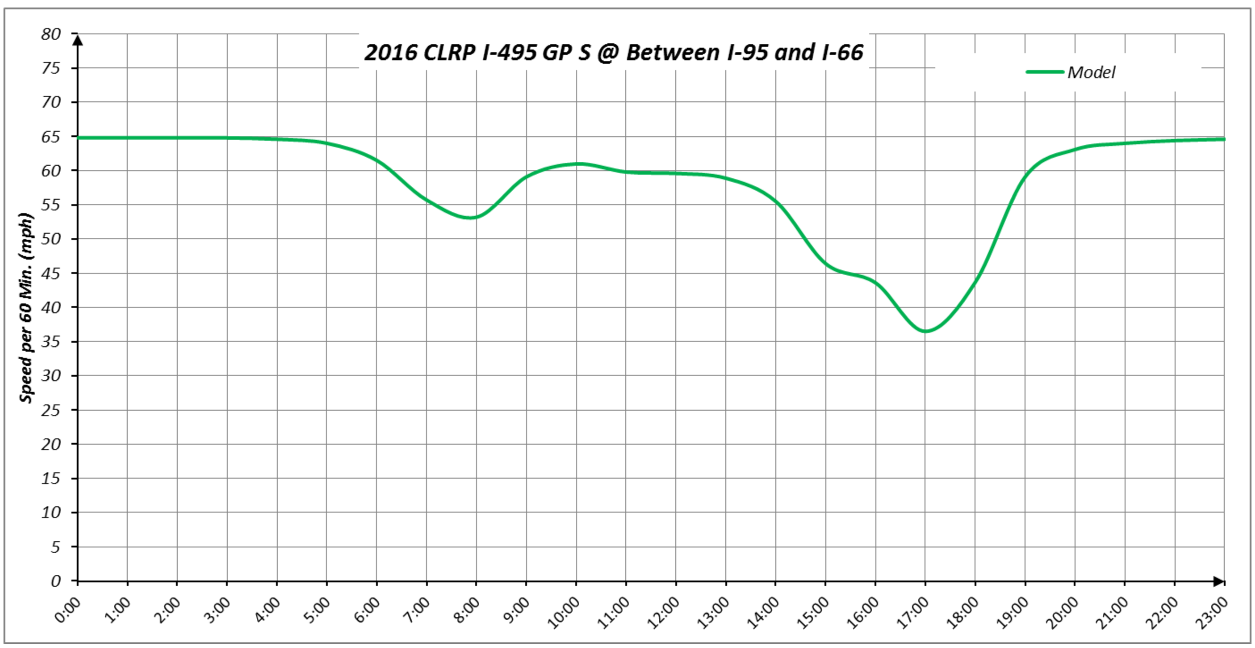
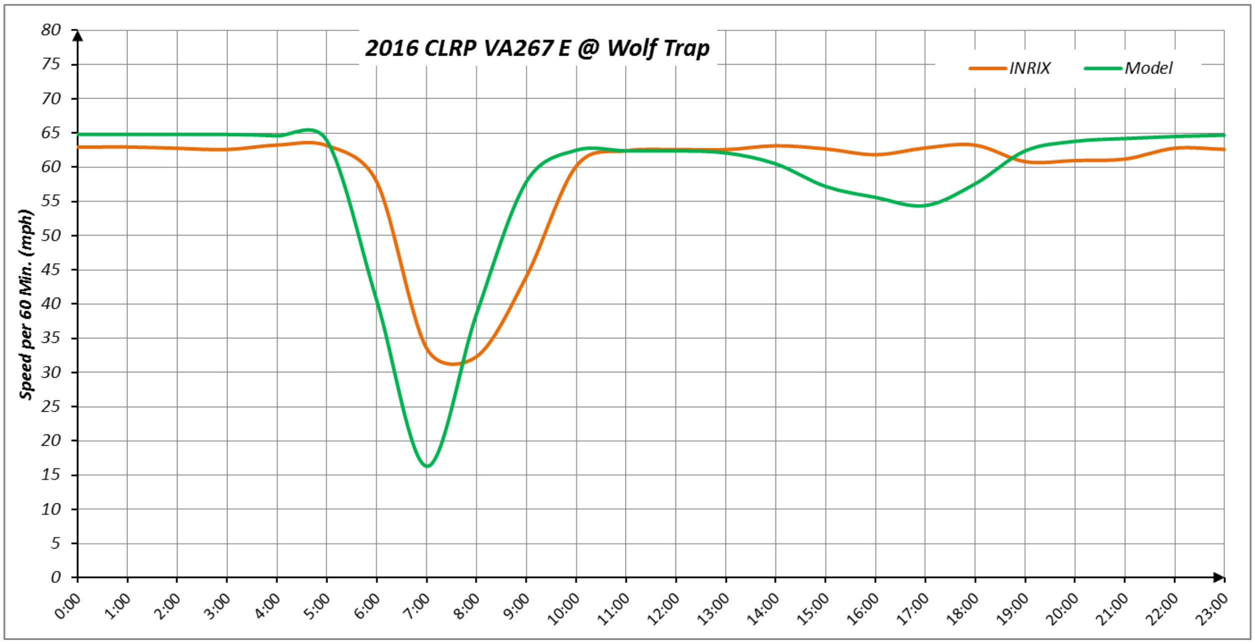


Figure 34: Hourly Speed Profile on VA267 near Wolf Trap



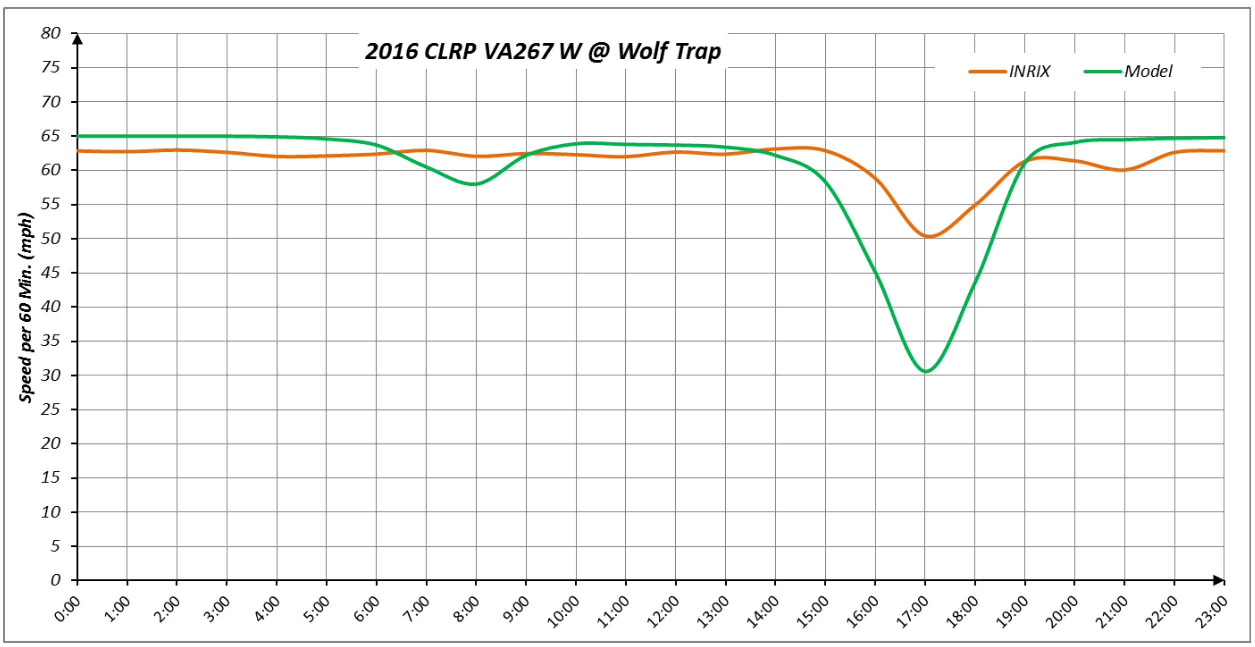
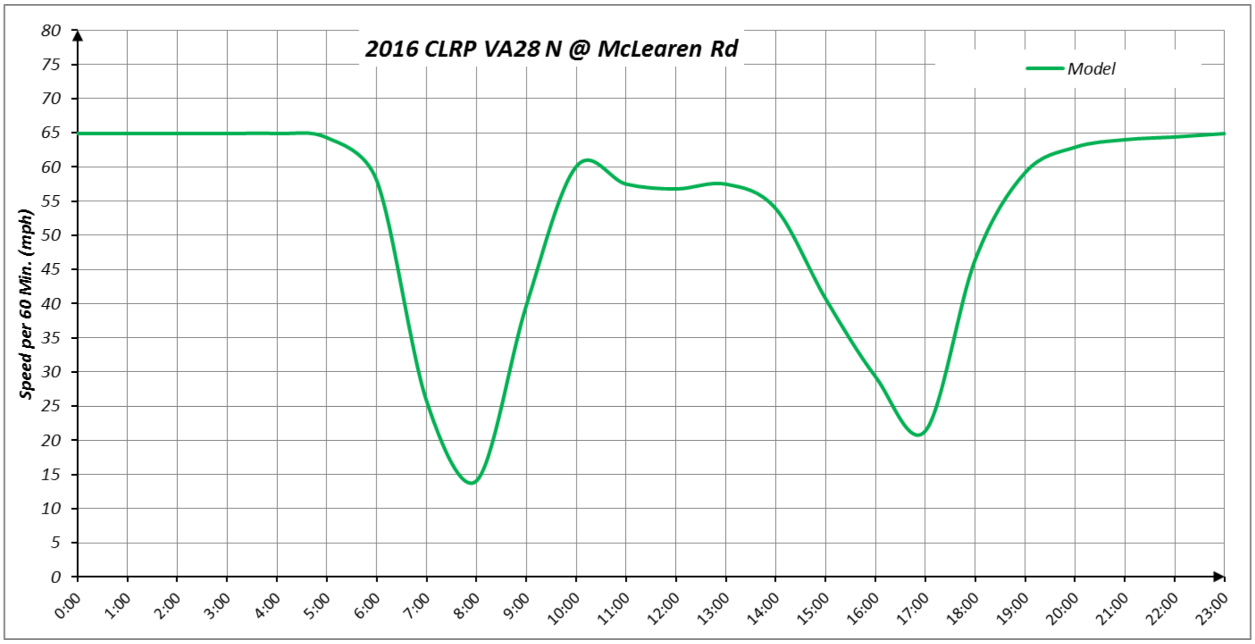


Figure 35: Hourly Speed Profile on VA28 near McLearen Rd



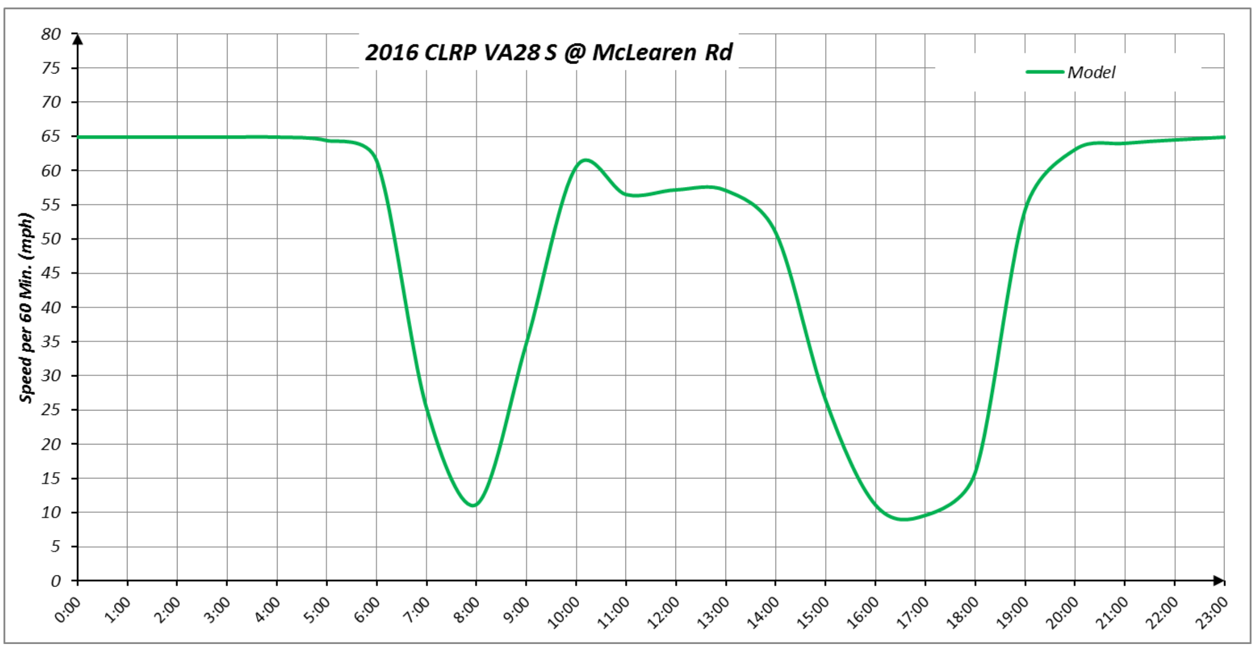
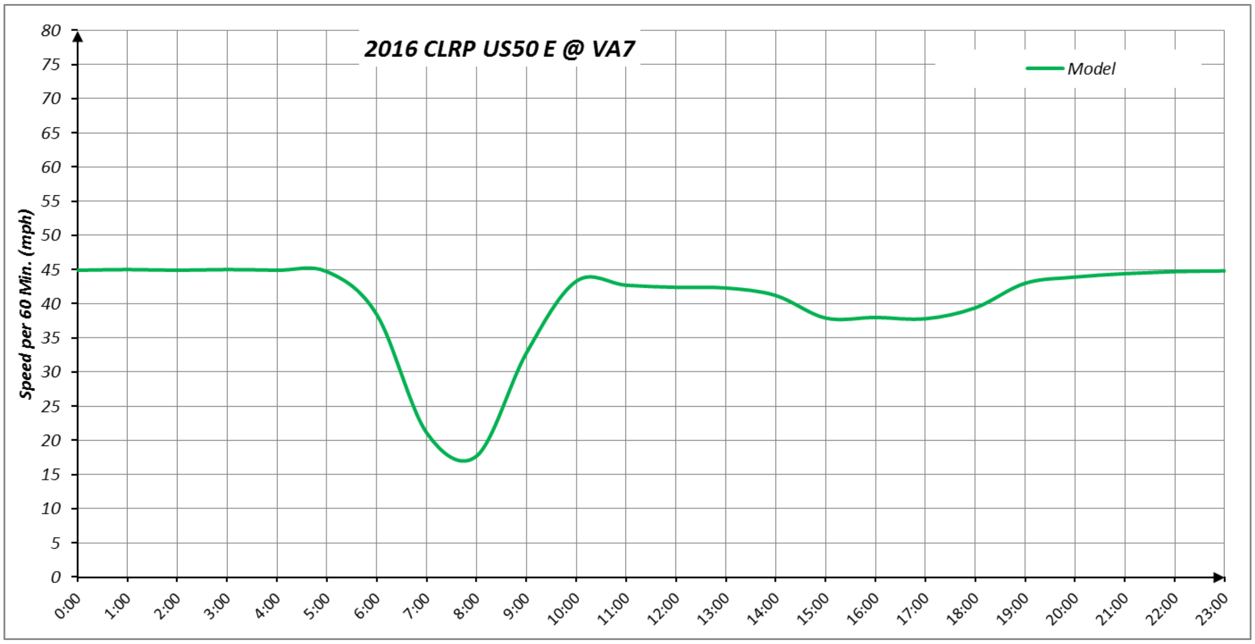


Figure 36: Hourly Speed Profile on US50 near VA7



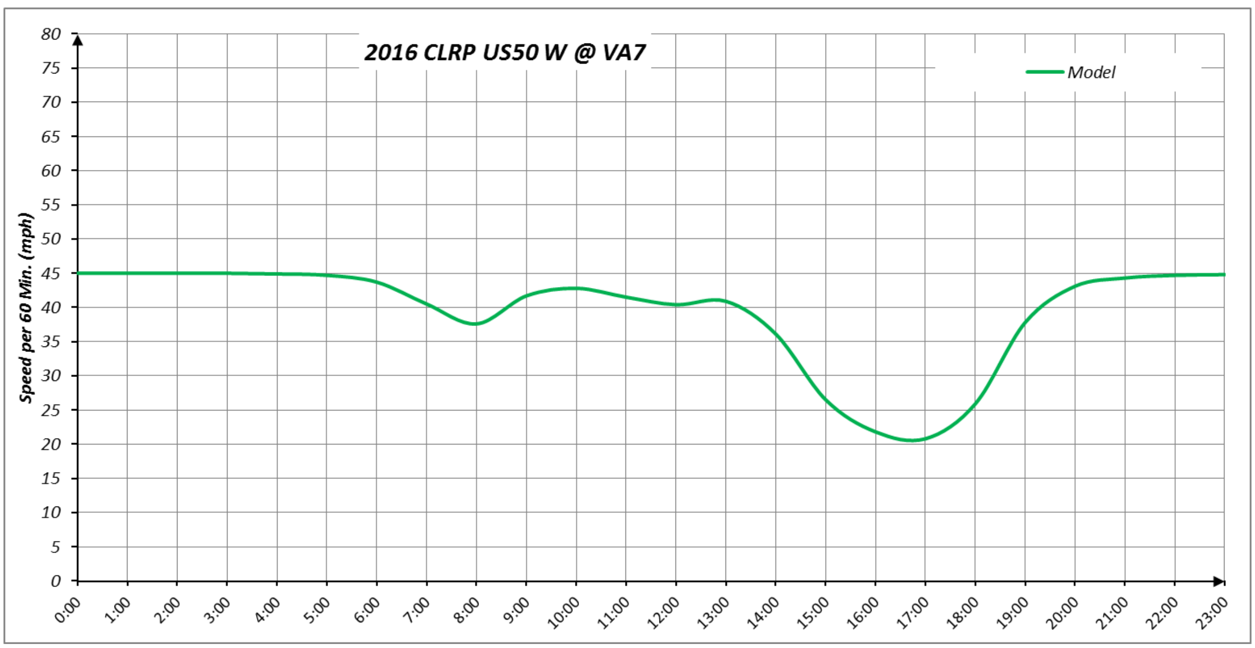
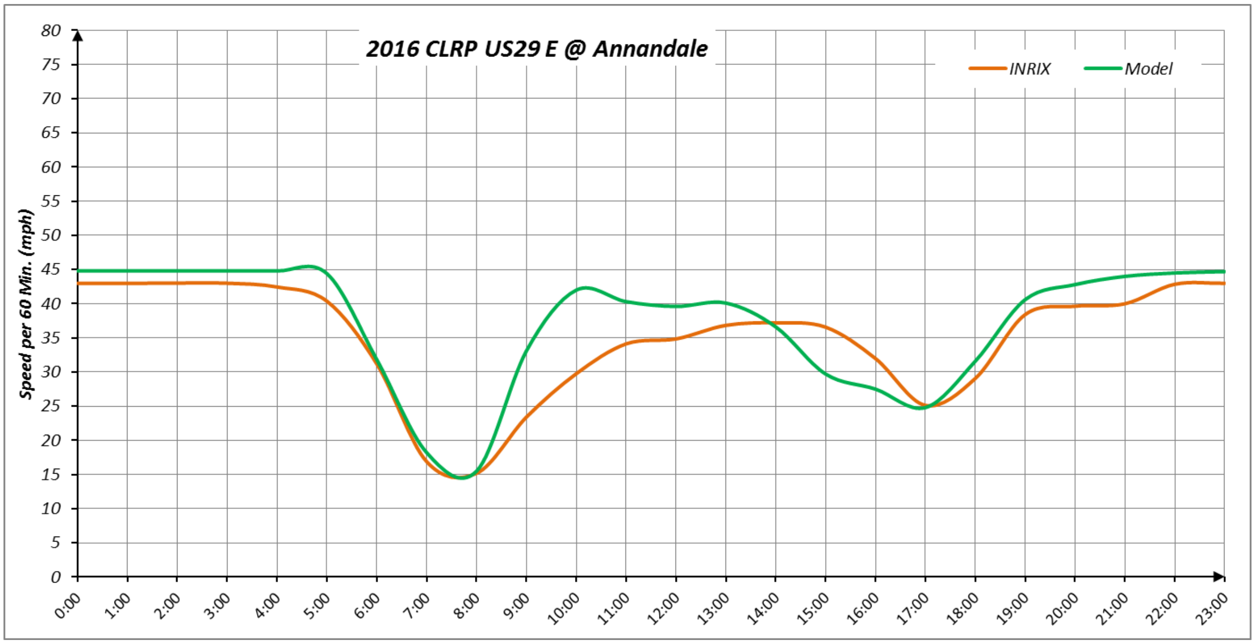


Figure 37: Hourly Speed Profile on US29 near Annadale Rd



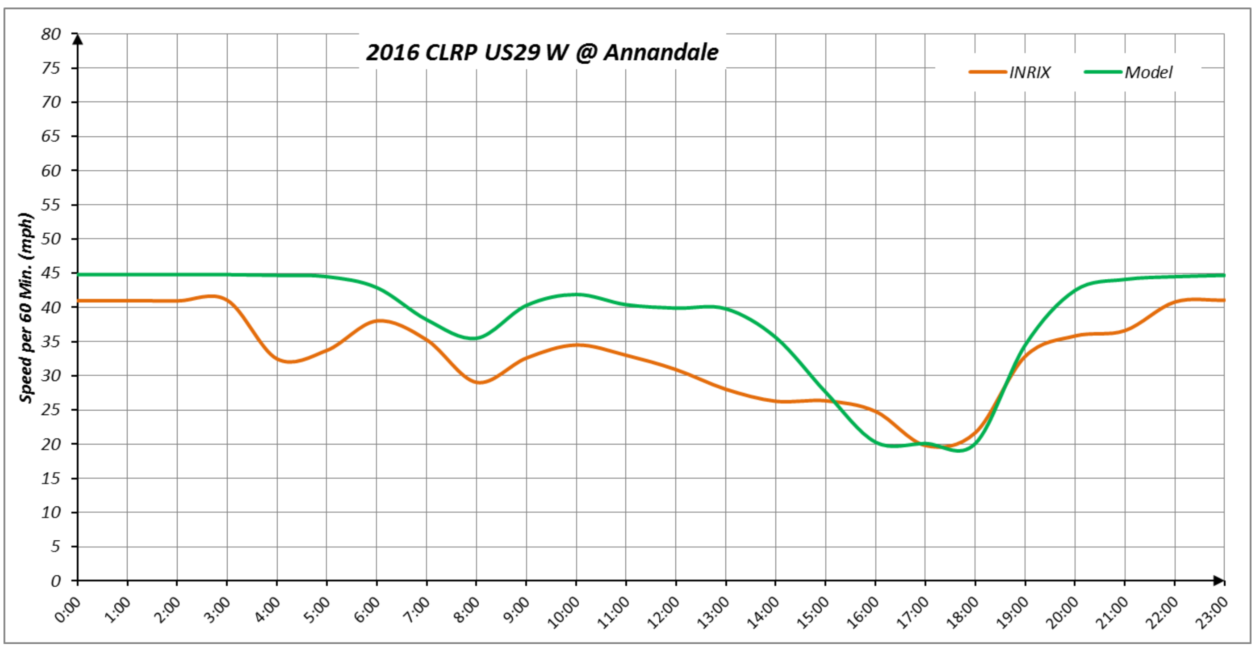
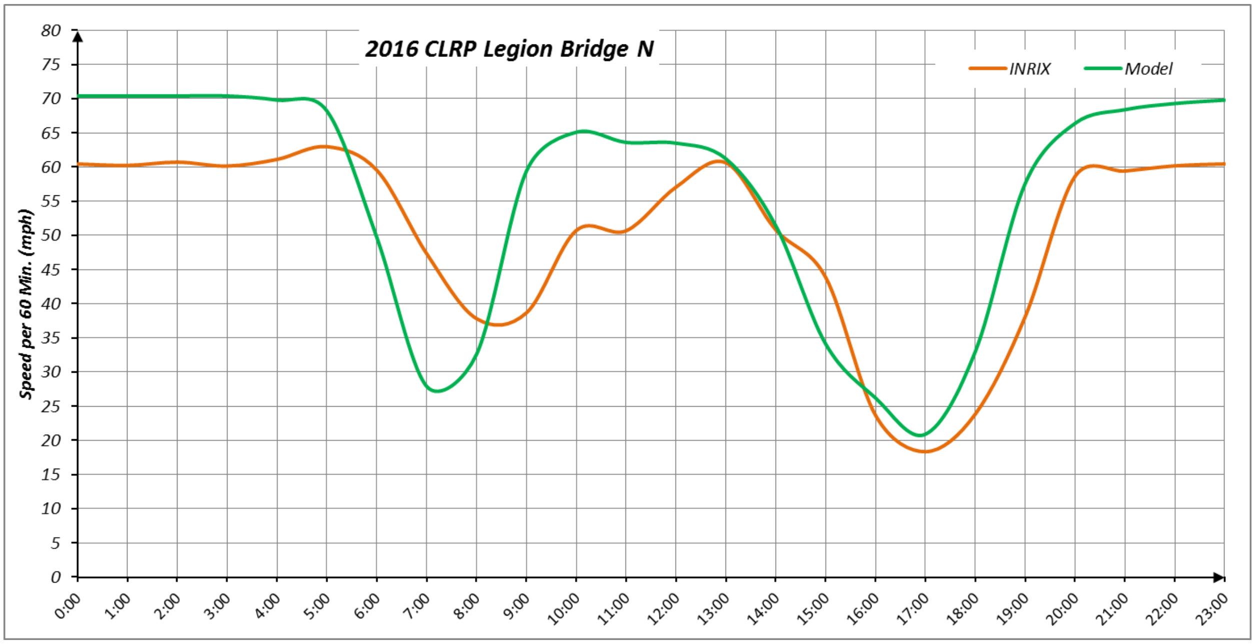


Figure 38: Hourly Speed Profile on American Legion Bridge



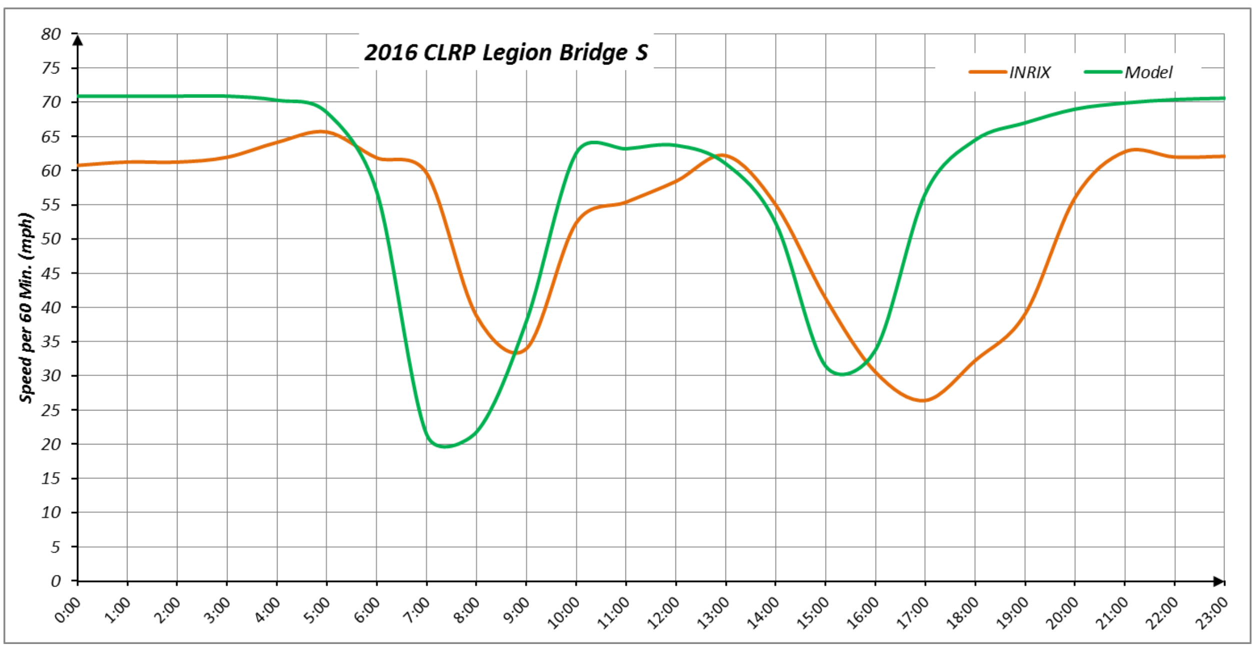
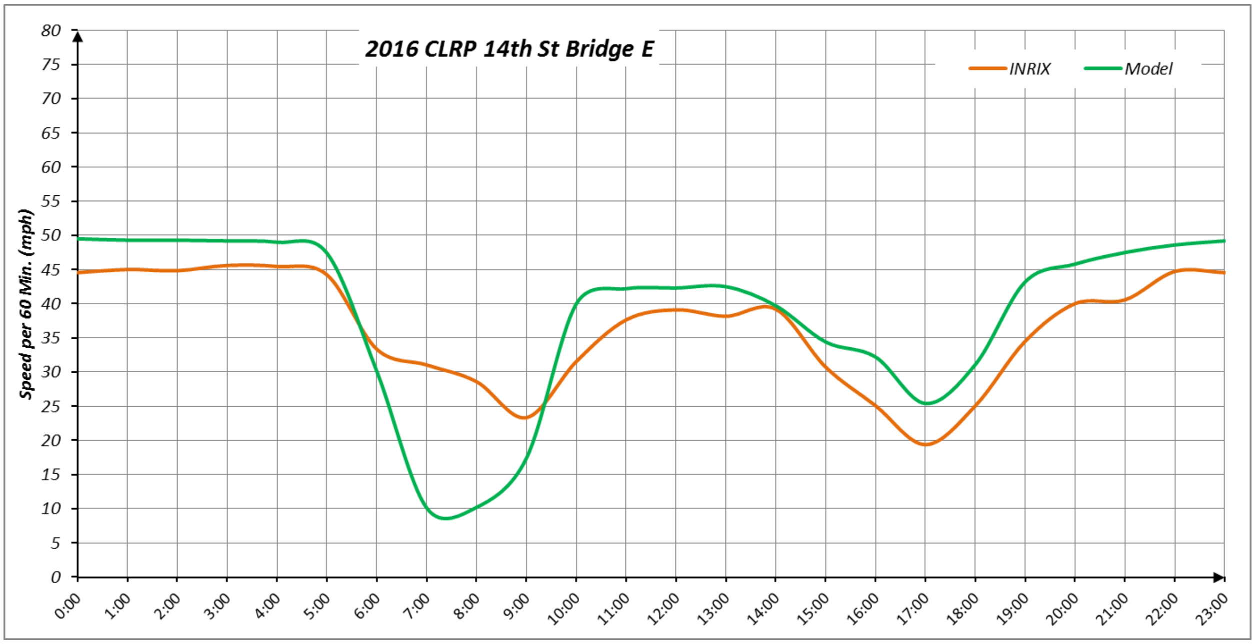


Figure 39: Hourly Speed Profile on 14th Street Bridge



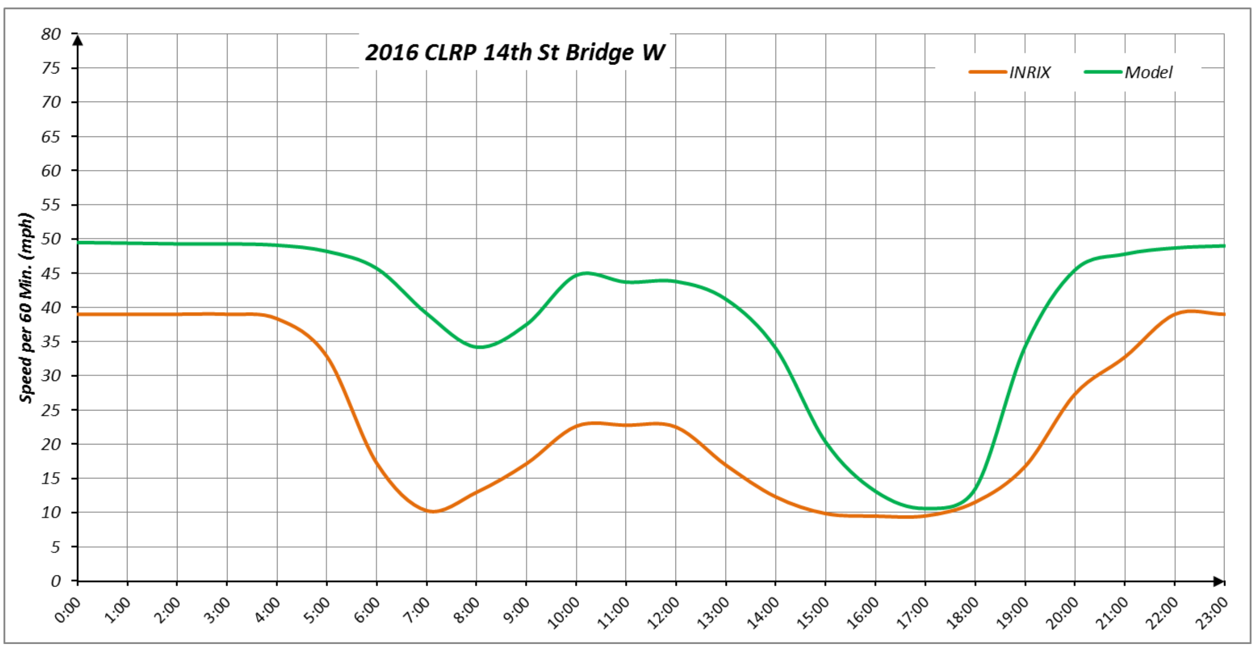
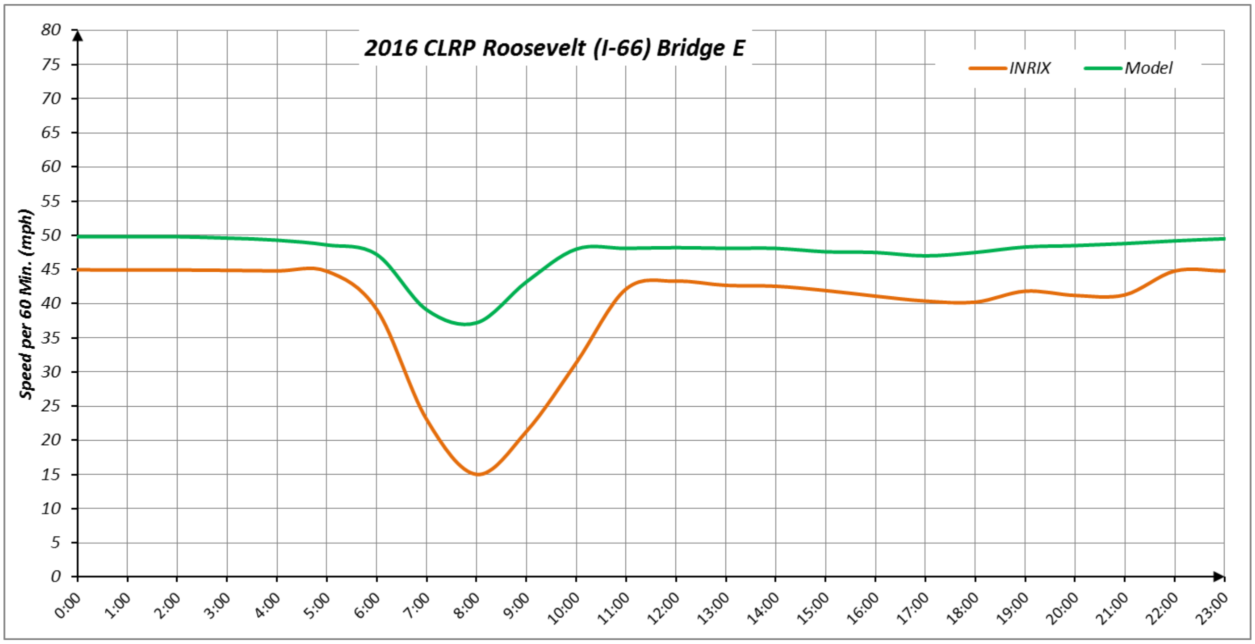


Figure 40: Hourly Speed Profile on Theodore Roosevelt Bridge



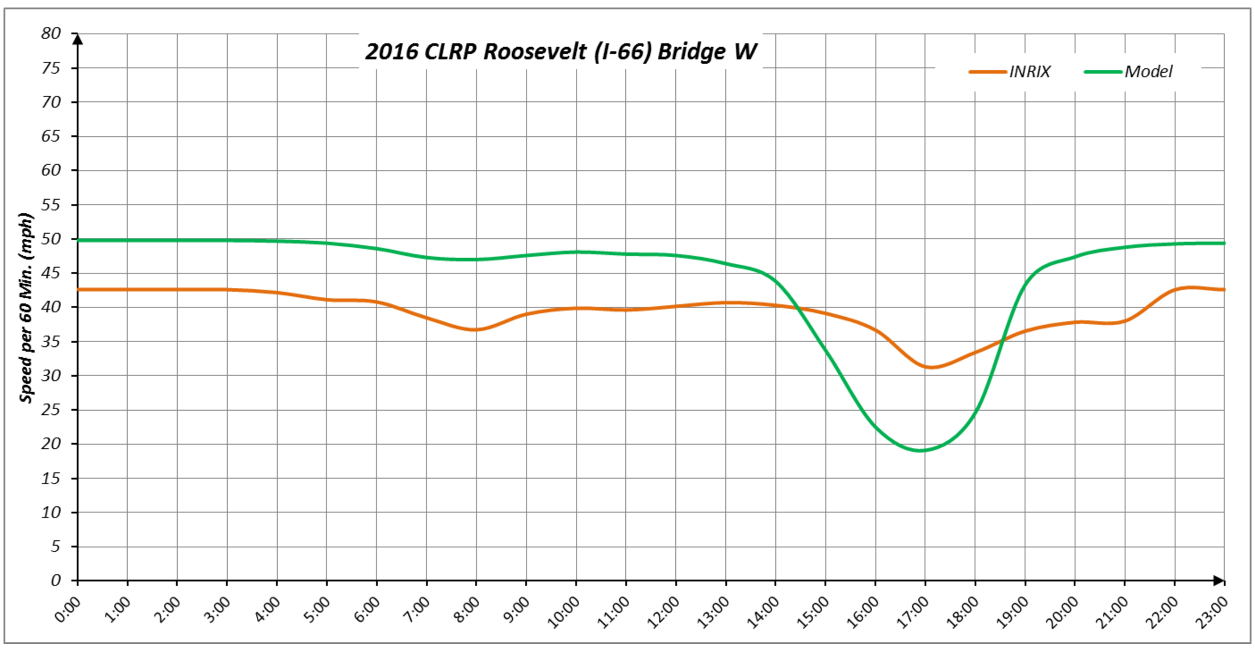
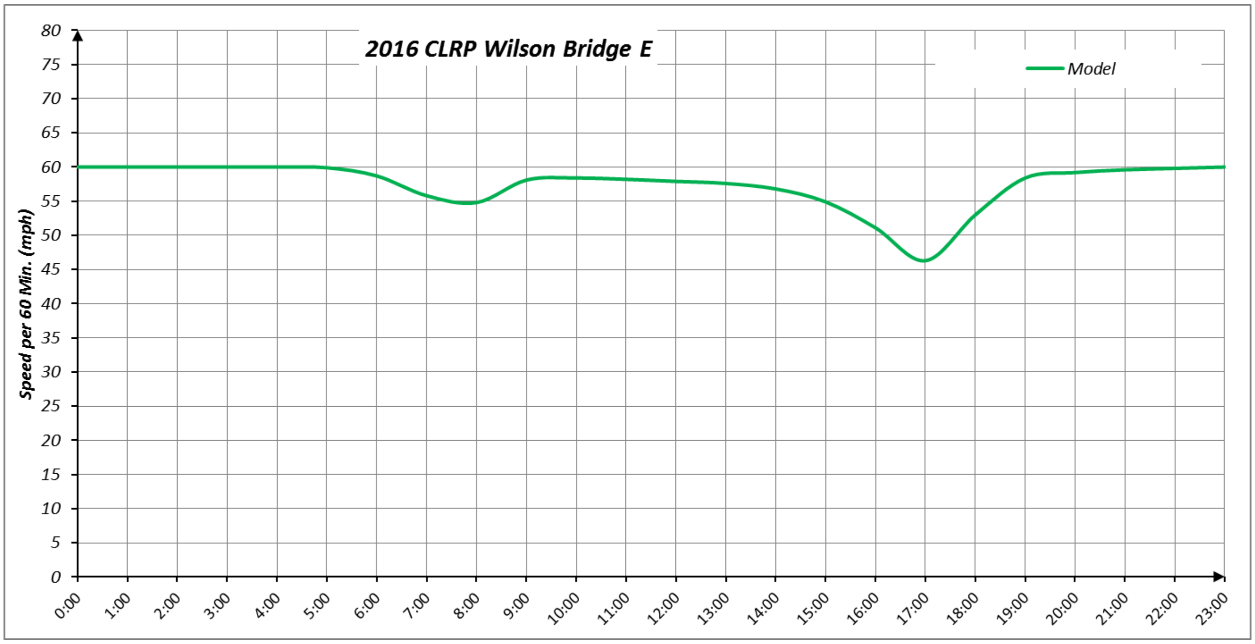


Figure 41: Hourly Speed Profile on Woodrow Wilson Bridge



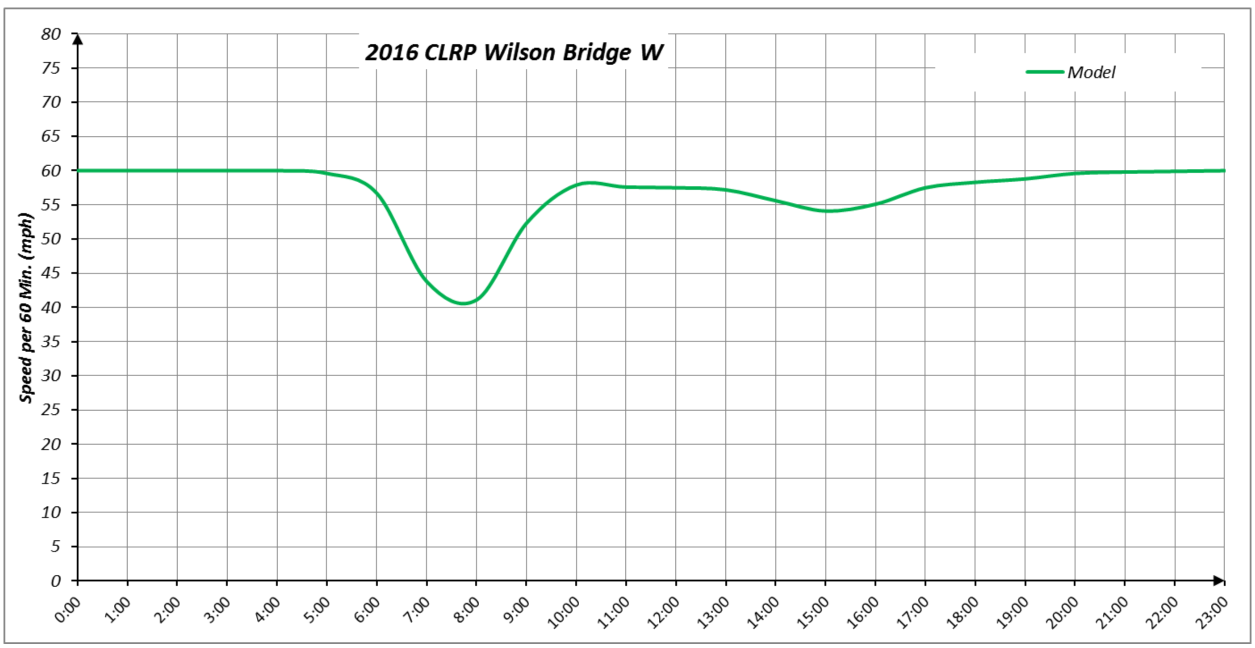
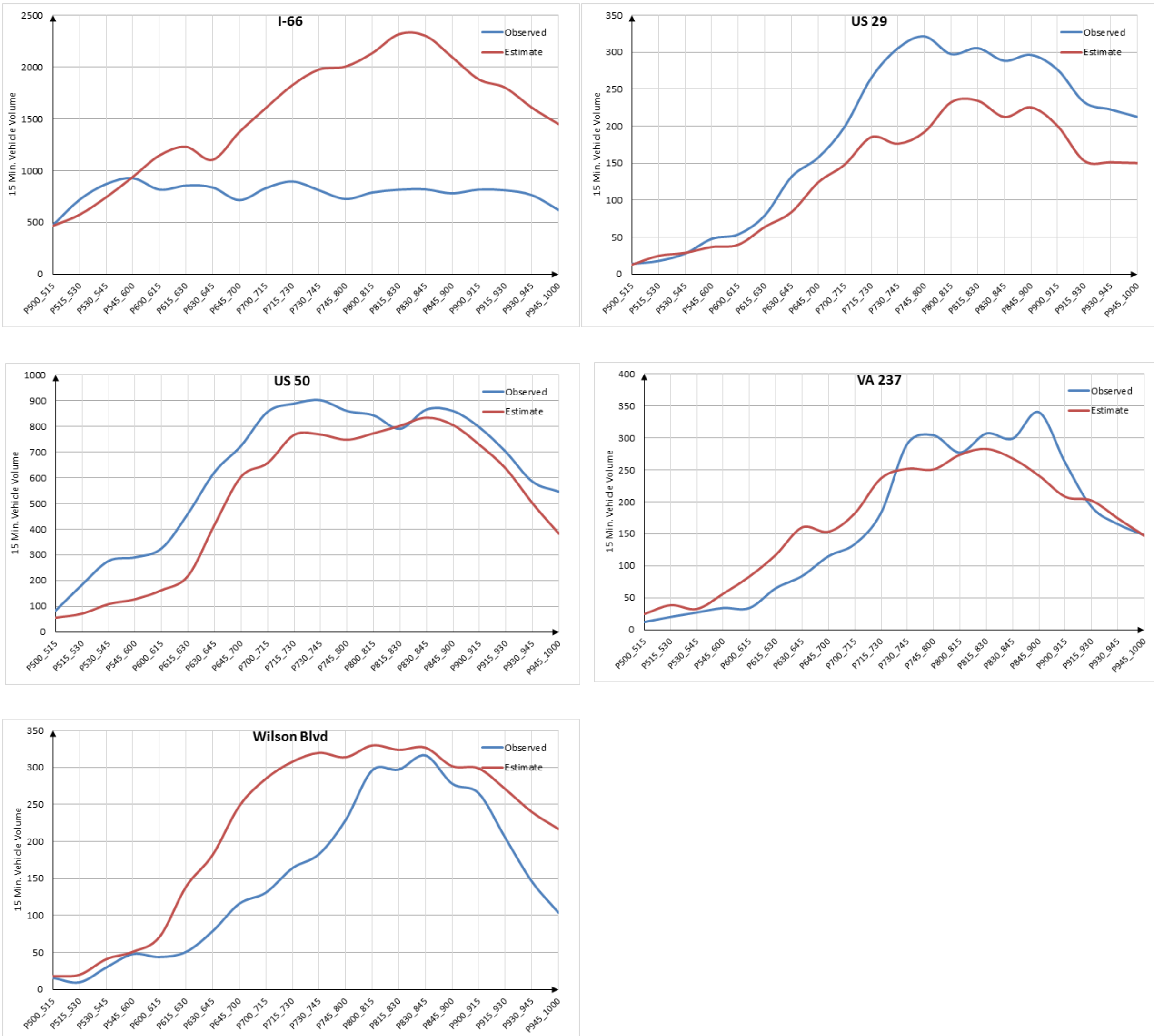


Figure 42 depicts the volume-count comparison for several roads of the I-66 E corridor near Glebe Rd. The data were borrowed from the VDOT report titled "2015 Mode Share Study for I-66 Inside the Beltway". The model volumes matched counts very well on US-29, US-50, VA-237 and Wilson Blvd. The observed volumes on I-66 seem too low, which may indicate a data collection error.

Figure 42: Model Volumes and Counts at Glebe Rd. in I-66 E Corridor



2.6 Transit Validation Reports

The **Table 13** and **Table 14** present the 2016 estimated daily modeled ridership on Metrorail and VRE within Virginia, respectively. **Table 13** compares the assignment results to the 2015 results from the last adopted TPB/COG model and the 2014 "LineLoad" data generated from WMATA mezzanine counts. Similarly, **Table 14** compares the assignment results to the 2015 COG/TPB values and the 2014 VRE ridership survey. Overall, the tables indicate an acceptable match to the two comparison sources. The system-wide metro ridership estimated by the model matches the LineLoad ridership more closely than it does the COG model. The model provides the best match for the section between Ballston-MU station and Rosslyn station. The model provides decent match to the ridership of Manassas line and slightly underestimates the VRE ridership on the Fredericksburg line.

Figure 43 shows a comparison of model versus observed park and ride conditions. High parking demand is shown at major end-of-line stations such as Vienna, Wiehle-Reston and Franconia-Springfield.

Table 13: Daily Metrorail Ridership in Northern Virginia

		Daily Metrorail Ridership				
Group	Metrorail Station	2015 COG/TPB	2014 LineLoad	2016 Estimate	vs. COG/TPB	vs. LineLoad
12	Franconia-Springfield	7,848	7,783	9,993	2,145	2,210
12	Van Dorn Street	5,266	3,333	4,594	-672	1,261
12	Huntington	9,069	7,913	10,613	1,544	2,700
12	Eisenhower Ave	3,866	1,716	4,033	167	2,317
12	King St - Old Town	11,363	12,047	9,892	-1,471	-2,155
12	Braddock Road	7,659	4,838	9,126	1,467	4,288
0	**SUBTOTAL**	**45,071**	**37,628**	**48,250**	**3,179**	**10,622**
13	Arlington Cemetery	66	1,200	34	-32	-1166
13	Pentagon	23,529	18,051	16,192	-7,337	-1,859
13	Pentagon City	7,490	14,541	6,764	-726	-7,777
13	Crystal City	16,377	12,001	17,683	1,306	5,682
13	Ronald Reagan Airport	2,461	6,639	3,982	1,521	-2,657
13	Potomac Yard	-	-	-	-	-
0	**SUBTOTAL**	**49,923**	**52,431**	**44,654**	**-5,269**	**-7,777**
14	Vienna Fairfax-GMU	14,353	11,748	9,585	-4,768	-2,163
14	Dunn Loring Merrifield	5,170	4,634	3,879	-1,291	-755
14	West Falls Church	3,159	3,263	4,695	1,536	1,432
14	East Falls Church	9,840	5,161	6,505	-3,335	1,344
0	**SUBTOTAL**	**32,522**	**24,806**	**24,664**	**-7,858**	**-142**
15	Ballston-MU	18,255	11,898	17,574	-681	5,676
15	Virginia Square-GMU	5,924	3,949	7,883	1,959	3,934
15	Clarendon	8,075	5,003	8,185	110	3,182
15	Court House	11,859	7,680	13,499	1,640	5,819
15	Rosslyn	36,503	23,859	26,692	-9,811	2,833

0	**SUBTOTAL**	**80,616**	**52,389**	**73,832**	**-6,784**	**21,443**
20	Wiehle-Reston East	8,035	8,111	6,491	-1,544	-1,620
20	Spring Hill	2,301	1,345	1,600	-701	255
20	Greensboro	3,003	962	1,277	-1726	315
20	Tysons Corner	5,958	2,837	6,961	1,003	4,124
20	Mclean	3,566	1,518	2,043	-1,523	525
0	**SUBTOTAL**	**22,863**	**14,771**	**18,370**	**-4,493**	**3,599**
0	**Virginia**	**230,995**	**182,024**	**209,770**	**-21,225**	**27,746**

Table 14: Daily VRE Ridership in Northern Virginia

		Daily VRE Ridership				
Group	Metrorail Station	2015 COG/TPB	2014 VRE Survey	2016 Estimate	vs. COG/TPB	vs. VRE Survey
98	VRE Haymarket	-		-	-	-
97	VRE Gainesville	-		-	-	-
96	VRE Sudley Manor	-		-	-	-
99	VRE Broad Run Yard	535	1,231	616	81	-615
100	VRE Manassas	1,313	901	506	-807	-395
101	VRE Manassas Park	471	845	558	87	-287
102	VRE Burke Center	345	983	1,479	1134	496
103	VRE Rolling Road	247	491	598	351	107
104	VRE Backlick Road	333	187	429	96	242
	SUBTOTAL	**3,244**	**4,639**	**4,185**	**941**	**-454**
105	VRE Alexandria	1,288	1,049	1,200	-88	151
106	VRE Crystal City	1,762	2,401	2,017	255	-384
107	VRE L'Enfant Plaza	3,680	3,696	3,363	-317	-333
108	VRE Union Station	1,453	2,033	1,737	284	-296
	SUBTOTAL	**8,183**	**9,179**	**8,316**	**133**	**-863**
109	VRE Franconia	199	298	1,010	811	712
110	VRE Lorton	616	626	760	144	134
111	VRE Woodbridge	1,106	643	1,050	-56	407
112	VRE Rippon	1,286	654	850	-436	196
127	VRE Cherry Hill	-	-	-	-	-
113	VRE Quantico	118	546	290	172	-256
114	VRE Brooke	400	588	298	-102	-290
115	VRE Leeland Road	222	949	126	-96	-823
126	VRE Fredericksburg	1,776	1,523	521	-1,255	-1002
128	VRE Spotsylvania	-	-	-	-	-
	SUBTOTAL	**5,723**	**5,826**	**4,903**	**-820**	**-923**
	GRAND TOTAL	**17,150**	**19,644**	**17,403**	**253**	**-2,241**

Figure 43 shows the parking utilization for major park-and-ride lots in Northern Virginia.

Figure 43: Parking Utilization