Chapter 3. Traffic Volume Forecasting

3.1 Regional Travel Demand Model Evaluation and Selection

Regional travel demand models are used to forecast future transportation demand on specific facilities. They follow the four-step modeling sequence of trip generation, trip distribution, mode choice, and assignment. Trip generation is based on land use, household and employment demographics, and other socioeconomic data that is regionally vetted based on control totals. Trip distribution matches trip origins and destinations using a gravity model in most models. Mode choice assigns trips to a particular transportation mode. Route assignment disperses trips of a mode to a route based on different impedances. Regional travel demand models are a useful tool in understanding travel demand in longer planning horizons.

3.1.1 Available Models

The US Route 1 Quantico study area is on the border of two planning district commissions. The planning district commissions draw membership from counties, cities, and other government bodies within their area. They are responsible for regional planning and develop and maintain regional travel demand models. Prince William County is a part of the National Capital Region Transportation Planning Board (TPB) and the Washington Metropolitan Council of Governments (MWCOG), while Stafford County is a part of the George Washington Regional Commission (GWRC) and the Fredericksburg Area Metropolitan Planning Organization (FAMPO). Both the MWCOG, through the Virginia Department of Transportation (VDOT), and FAMPO provided their most recently adopted travel demand for assessment in relation to the usefulness for the US Route 1 Quantico study. The most recently adopted MWCOG model is version 2.3 with round 8.0 land use forecasts. FAMPO is developing a new model, but does not expect the model to be available until the fall of 2012, at the earliest. A third model was developed by the United States Federal Highway Administration (FHWA) and VDOT for the I-95 High Occupancy Toll (HOT) Lanes Project. This model was a conjunction between the MWCOG and FAMPO models and provided forecast volumes for HOT lane build and no-build conditions.

3.1.2 Model Evaluation

The structure of a travel demand model has two major components: the highway network and the traffic analysis zones (TAZs). A TAZ is a geographic boundary for which socioeconomic data is compiled. TAZs generally are divided by major boundaries such as roads or significant physical or environmental features. They may differ from census boundaries, but often do not. The highway network generally includes all interstates, arterials, and other major streets, depending on the level of detail. Typically, travel demand models will include major collectors, but not minor collectors and local streets. The highway network contains information such as facility type and number of lanes. An important component of the highway network is the system of centroid (or zone) connectors. These connector links are used to load trips from TAZs onto the highway network. They often replicate loosely the system of local streets.

The highway networks of the three travel demand models were compared in order to assess the appropriateness of each model for the study. The highway networks for the MWCOG and FAMPO models in relation to the regional road network are shown in **Figure 3-1**. The highway networks in relation to the study area road network are shown in **Figure 3-2**. The FAMPO model highway network only extends north on US Route 1 to Russell Road. For this reason, the FAMPO model was determined to not be useful for travel forecasting in its current state.

The MWCOG 2.3 model highway network extends well south of the MWCOG boundary and into Stafford County. The HOT Lanes model highway network includes Interstate 95 (I-95) and US Route 1 within the entire study area, but has a limited arterial road network in the study area. Furthermore, the HOT Lanes model highway network has a four-lane US Route 1 south of Russell Road in Stafford County. The MWCOG has six lanes in the year 2030 and year 2040 models, consistent with the Stafford County Comprehensive Plan. Thus, the MWCOG 2.3 model was determined to more appropriate for travel forecasting for the US Route 1 Quantico study.

In addition to the highway network for each model, the future forecast volumes for the MWCOG 2.3 model and the HOT Lanes model were compared in order to select an appropriate model. The model forecasts were compared to each other and to existing recorded volumes for base (years 2007 through 2011), interim (years 2016 through 2018) and build out (years 2030 through 2040) periods. The results are displayed in **Table 3-1**. The HOT lanes are present in the interim and build out periods for all models, but the number of lanes of US Route 1 varies between models and periods. In general, the future volume forecasts for segments on US Route 1 in the HOT lanes model (build and no-build) are significantly lower than those of the MWCOG 2.3 model.

3.1.3 Model Selection

Based on the highway network and model volume forecasts, the MWCOG 2.3 model was the better representation of future traffic on US Route 1 and was chosen for use on this project. From this point forward in the memorandum, references to the model refer to the MWCOG 2.3 model.

Figure 3-1: Regional Travel Demand Model Highway Network

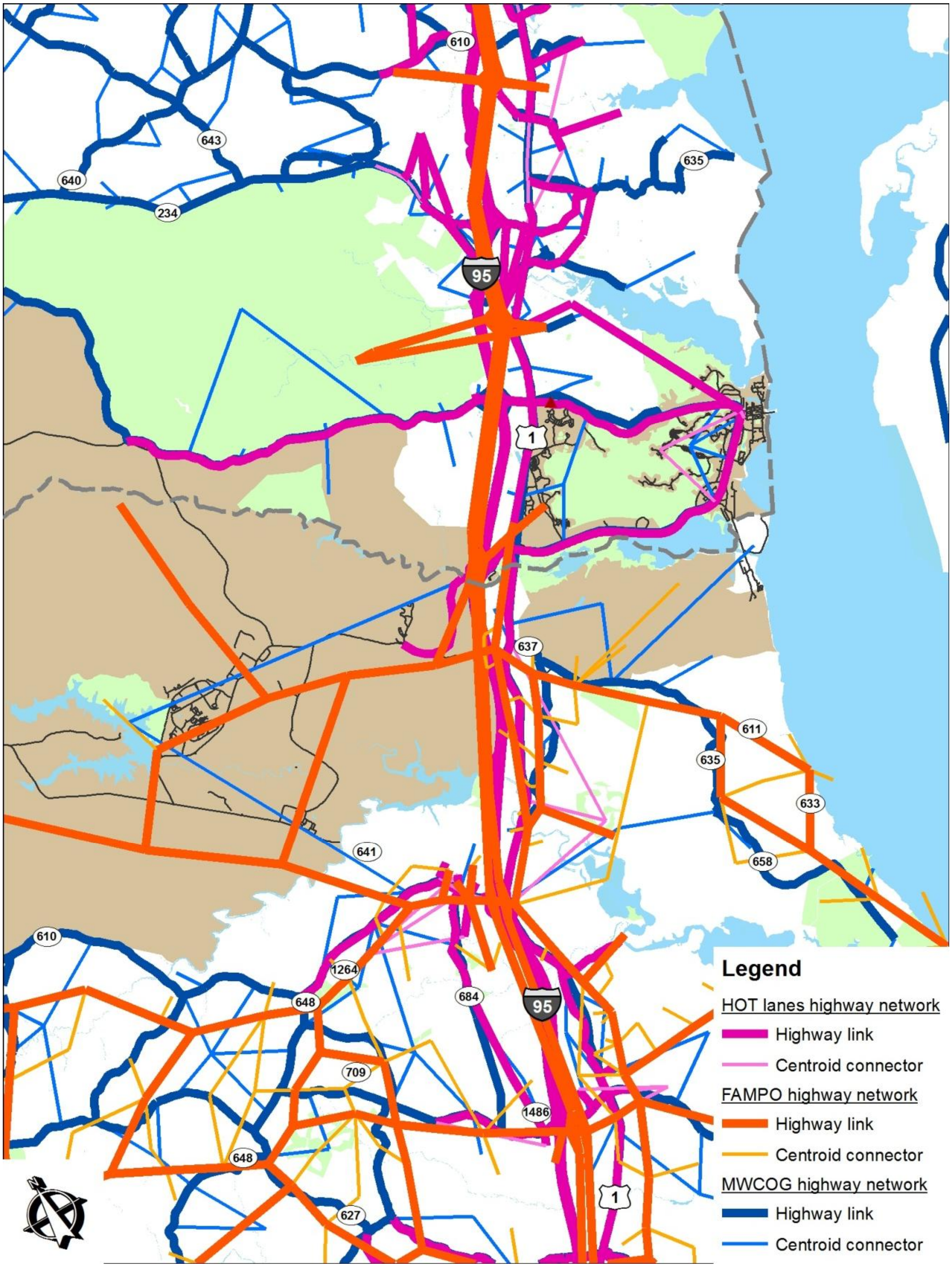


Figure 3-2: Study Area Travel Demand Model Highway Network

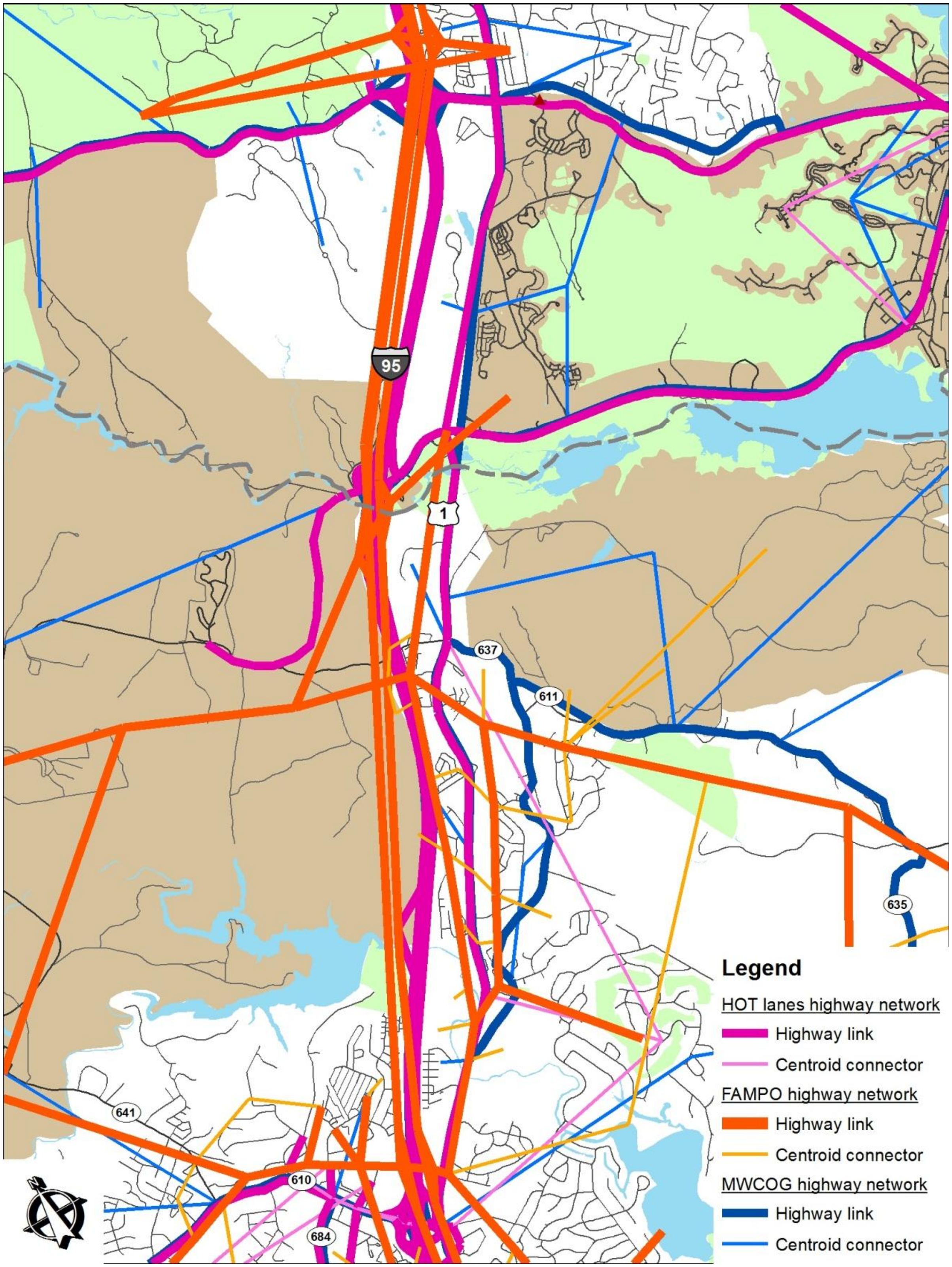


Table 3-1: Travel Demand Model Volume Comparison

					VDOT Recorded Volumes	MWCOG Model 2.3 Volume	HOT Lanes Model Volume	MWCOGModel 2.3 Forecast	HOT Lanes No Build Forecast	Hot Lanes Build Forecast	MWCOG Model 2.3 Forecast	HOT Lanes No Build Forecast	HOT Lanes Build Forecast	MWCOG Model 2.3 Forecast
					Existing			Interim			Build Out			
Segment	Facility	From (North)	To (South)	Period	2009	2007	2011	2016	2018	2018	2030	2035	2035	2040
				I-95 HOT Lanes Present?	*No*	*No*	*No*	*Yes*	*No*	*Yes*	*Yes*	*No*	*Yes*	*Yes*
1	I-95	Joplin Road	Russell Road	24 Hour	144,000	164,000	137,000	216,000	148,000	167,000	237,000	148,000	204,000	248,000
2	I-95	Russell Road	Garrisonville Road	24 Hour	147,000	169,000	143,000	218,000	150,000	166,000	238,000	162,000	199,000	250,000
				US Route 1 Number of Lanes North of Russell Road (Prince William County)	*4*	*4*	*4*	*4*	*4*	*4*	*4*	*4*	*4*	*4*
3	US Route 1	Brady's Hill Road	Joplin Road/ Fuller Road	AM Peak	N/A	4,600	1,500	9,000	1,900	1,800	12,700	3,600	3,700	13,600
				PM Peak	N/A	11,200	2,000	13,400	2,500	2,500	19,800	4,400	5,800	21,600
				24 Hour	20,000	29,400	26,000	40,000	18,200	18,800	58,500	32,500	24,000	68,200
4	US Route 1	Joplin Road/ Fuller Road	Russell Road	AM Peak	3,600	6,700	1,400	1,900	1,700	1,800	10,900	2,600	2,700	11,400
				PM Peak	5,000	9,702	1,900	2,500	3,000	2,300	17,300	4,300	4,800	18,500
				24 Hour	17,000	23,100	30,500	18,200	24,200	19,200	47,600	34,200	17,700	55,400
				US Route 1 Number of Lanes South of Russell Road (Stafford County)	*4*	*4*	*4*	*4*	*4*	*4*	*6*	*4*	*4*	*6*
5	US Route 1	Russell Road	Telegraph Road (North)	AM Peak	4,400	7,700	2,500	8,600	3,600	3,200	13,800	5,100	5,500	15,900
				PM Peak	5,800	11,100	3,200	13,500	4,400	4,400	21,900	8,200	8,100	24,700
				24 Hour	21,000	25,800	37,800	36,200	36,800	31,700	54,500	54,400	46,300	65,300
6	US Route 1	Telegraph Road (North)	Woodstock Lane	AM Peak	5,500	6,200	900	6,600	1,600	1,200	11,100	2,500	4,300	12,400
				PM Peak	6,700	9,600	1,300	11,100	1,900	1,300	18,400	2,500	4,200	19,600
				24 Hour	21,000	21,200	17,400	26,800	17,600	8,800	45,500	28,600	41,200	53,000
7	US Route 1	Woodstock Lane	Garrisonville Road	AM Peak	5,900	7,230	800	7,700	3,300	400	13,300	7,000	3,800	15,400
				PM Peak	7,200	11,300	1,500	13,200	3,400	2,200	21,900	7,200	6,000	24,700
				24 Hour	25,000	26,500	18,400	33,500	22,800	9,600	56,200	41,100	21,800	67,000

3.2 Traffic Volume Forecasting Methodology

3.2.1 Model Validation and Adjustment

In order for the MWCOG 2.3 model to accurately represent the conditions in the study area, manual minor adjustments were made to the model. These adjustments, depicted in **Figure 3-3** primarily consist of adding, removing, or adjusting centroid connectors to better represent the locations where traffic generated on centroid connectors enters the network.

3.2.2 Link Traffic Growth Methodology

Even with the network changes, a comparison of link volumes from the revised MWCOG year 2007 model and traffic volume counts collected as part of this study showed differences that there are some calibration inconsistencies in the immediate study area. Because the future year models likely also reflect these similar discrepancies, the link volumes generated by these models were not used explicitly, but instead were compared against the 2007 link volumes to calculate annual growth rates by direction for each link. Directional link growth rates were applied to the 2011 traffic counts to develop future year directional link volumes for the two horizon years of 2018 and 2040. For years 2011 through 2020, the annual growth rate was derived from the change in link volumes between the year 2007 model and the year 2020 model. For years 2021 through 2040, a different annual growth rate was applied based on the change in link volumes between the year 2020 model and the year 2040 model.

3.2.3 Intersection Turning Movement Volume Development Methodology

Once the link volumes were developed based on these annual growth rates, the National Cooperative Highway Research Program (NCHRP) Report 255 methodology was applied to develop peak hour turning movements at each intersection. The method estimates future year turning movements based on existing turning movement percentages and future year entering and departing link volumes on each approach. Turning movements developed through this process were then manually balanced between study intersections.

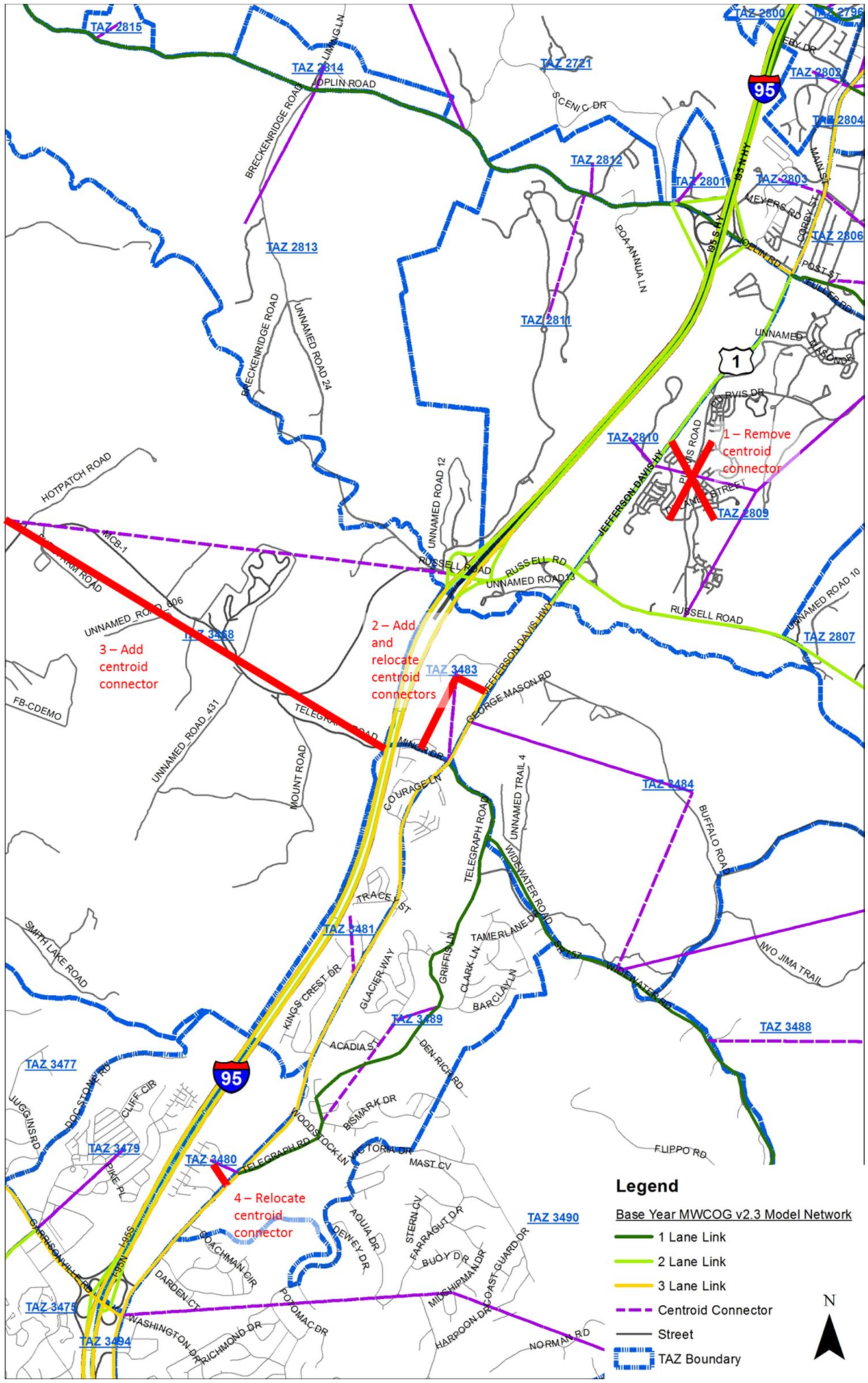
3.2.4 Manual Volume Adjustment Methodology for Approved Land Use Plans

In addition to the network changes, some specific local socioeconomic data inputs to the model do not appear to reflect long-range land use plans. Specifically, the trips generated from TAZ 3483 that includes the Quantico Corporate Center, TAZ 3468 that includes MCB Quantico Westside, and TAZ 2810 that includes the National Museum of the Marine Corps do not represent the approved land use plans. In the case of the Corporate Center, the full build-out land use assumptions consisted of 1.1 million square feet of office and approximately 16,000 square feet of commercial, and a 120-room hotel. This translates to approximately 1,500 peak hour trips in the AM peak hour and 2,000 peak hour trips in the PM peak hour[2]. For the MCB Quantico Westside, planned expansion of Westside including Base Realignment and Closure (BRAC) personnel is approximately 1800 inbound trips and 300 outbound in the AM peak hour and 500 inbound and 1,900 outbound trips in the PM peak hour. For the museum expansion, proposed museum expansion including an artifacts building and administrative offices and a hotel is expected to generate up approximately 270 trips in the AM peak hour and 300 trips in the PM peak hour.

---

[2] Kimley-Horn and Associates, Inc. (2011). *Traffic Impact Analysis Quantico Corporate Center & Corporate Drive Extension.*

Figure 3-3: Travel Demand Model Adjustments



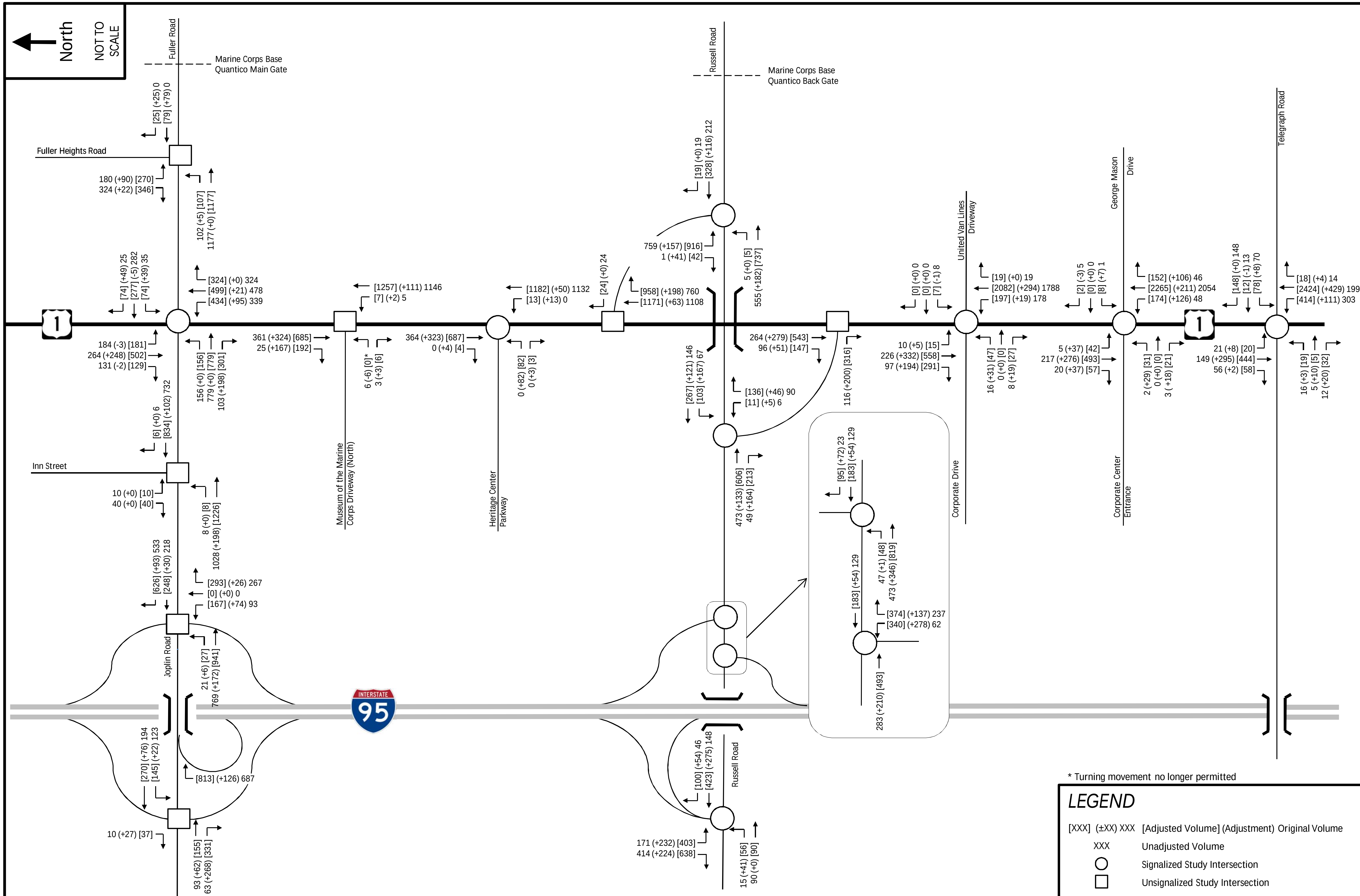
To ensure that these volumes are reflected accurately in the network, these trips were overlaid manually on the balanced future year turning movements already developed. For the Corporate Center and MCB Quantico Westside, it was assumed that full build out would not occur by 2018, but would be in place by 2040. For the Corporate Center, 25 percent of the full build out trips were included in the 2018 volumes. The MCB Quantico Westside trips were assumed to occur on a compounded annual growth rate between 2011 and 2030, which resulted in approximately 50 percent of the full build out trips included in the 2018 volumes. For the museum, 100 percent of the full build out trips were included in the 2018 volumes.

3.3 Future Traffic Volume Forecasts

Based on the methodology described above, 2018 and 2040 AM and PM peak hour turning movement volumes were developed. The resulting volumes are shown in **Figures 3-4** through **Figure 3-7**.

3.4 Conclusions

In the process of developing future traffic volumes for US Route 1 and the surrounding areas, multiple travel demand models were analyzed. It was determined that the MWCOG 2.3 model was to be used because it most accurately represented existing travel patterns and regional comprehensive plans. After manual modifications were made to the model to reflect approved development and roadway configuration in the study area, future traffic volumes were developed. The NCHRP methodology which utilizes existing turning percentages and future link volumes to forecast future turning movements was used. Volumes were developed for the years 2018 and 2040.



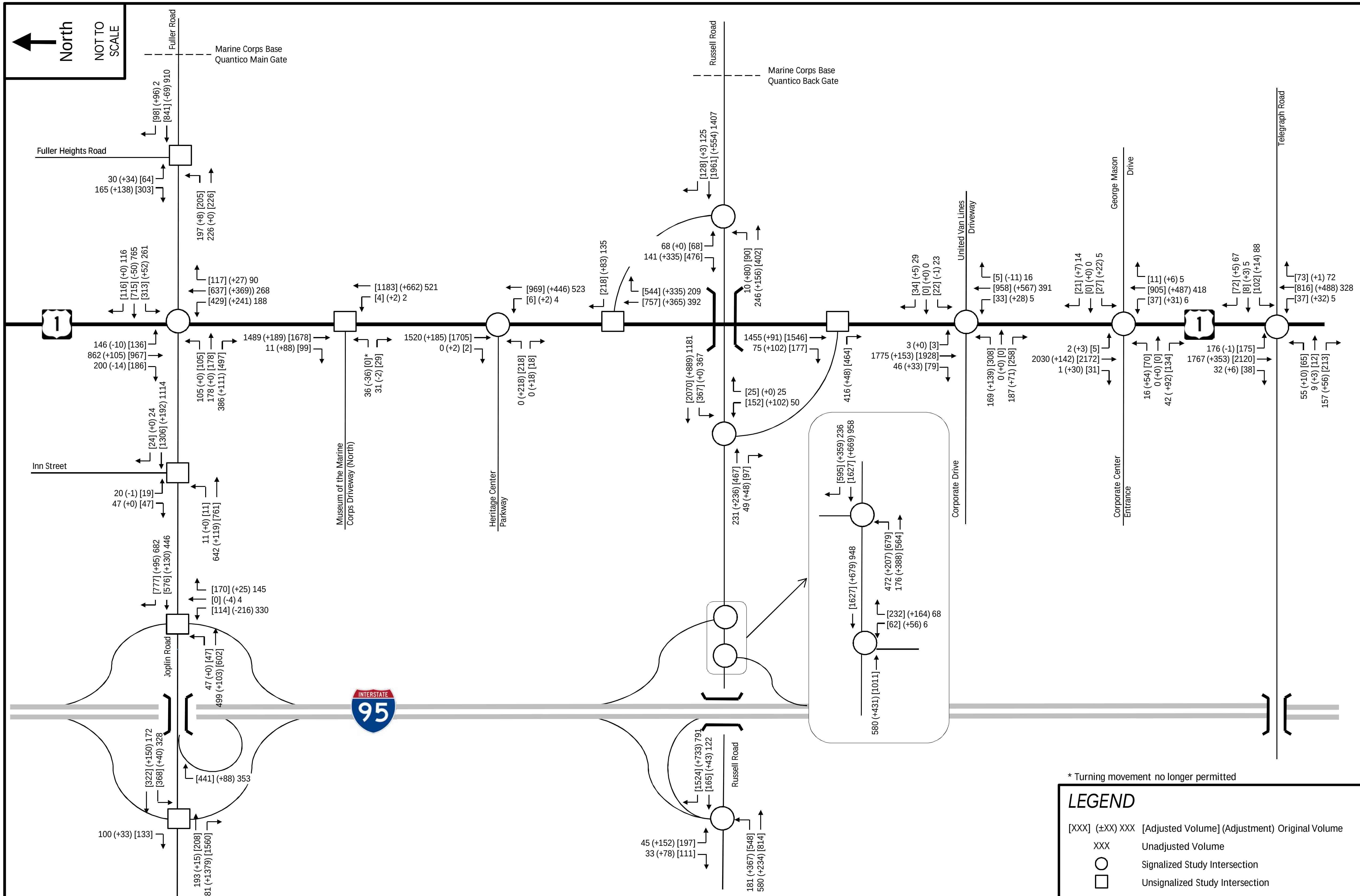
2018 a.m. Peak Hour Traffic Volumes

US Route 1 Corridor at Marine Corps Base Quantico
Planning/Preliminary Engineering Study
Federal Highway Administration
Eastern Federal Lands Highway Division

Kimley-Horn and Associates, Inc.

FIGURE 3-4

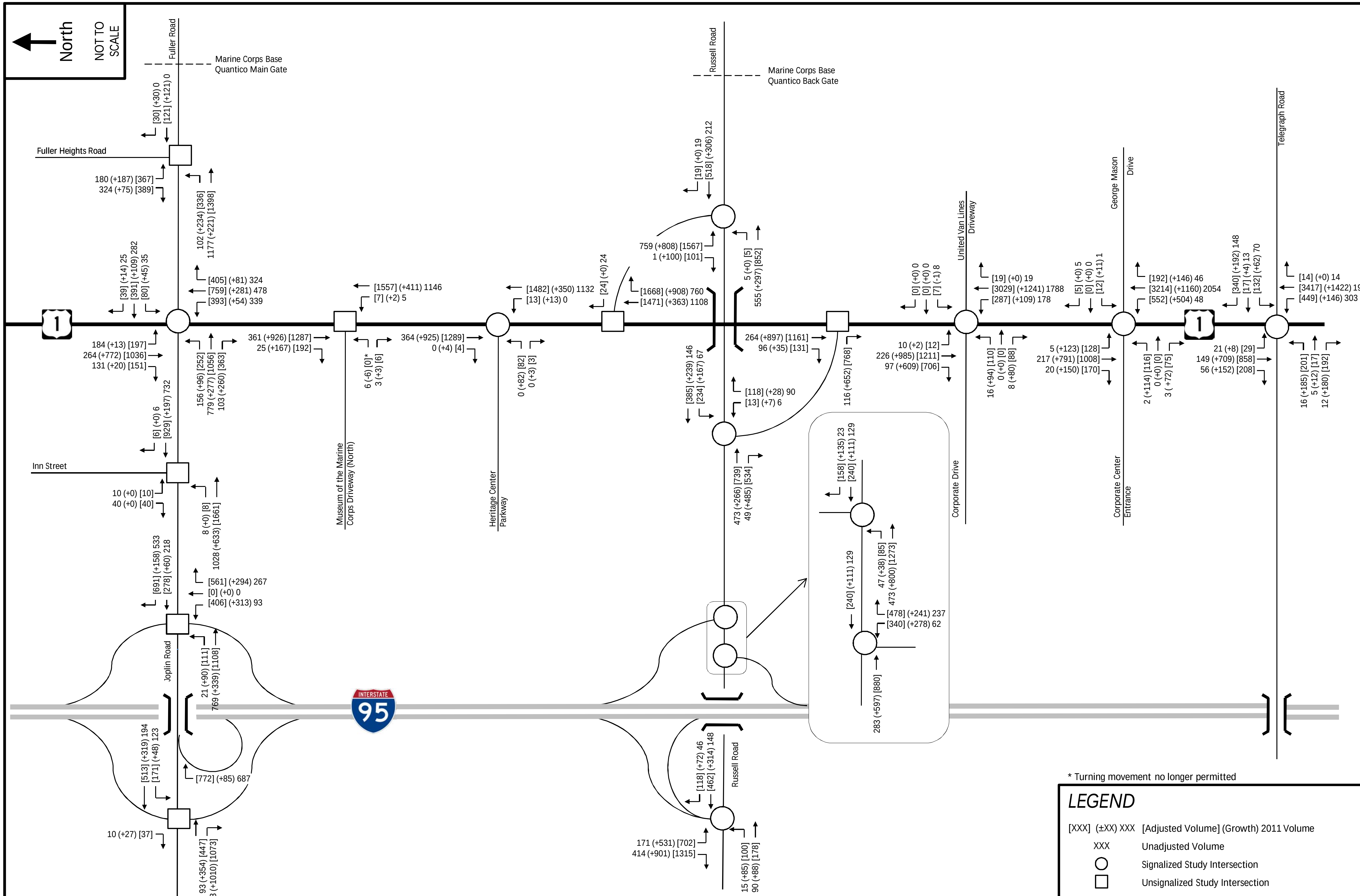
2018 p.m. Peak Hour Traffic Volumes



US Route 1 Corridor at Marine Corps Base Quantico
Planning/Preliminary Engineering Study
Federal Highway Administration
Eastern Federal Lands Highway Division

Kimley-Horn and Associates, Inc.

FIGURE
3-5

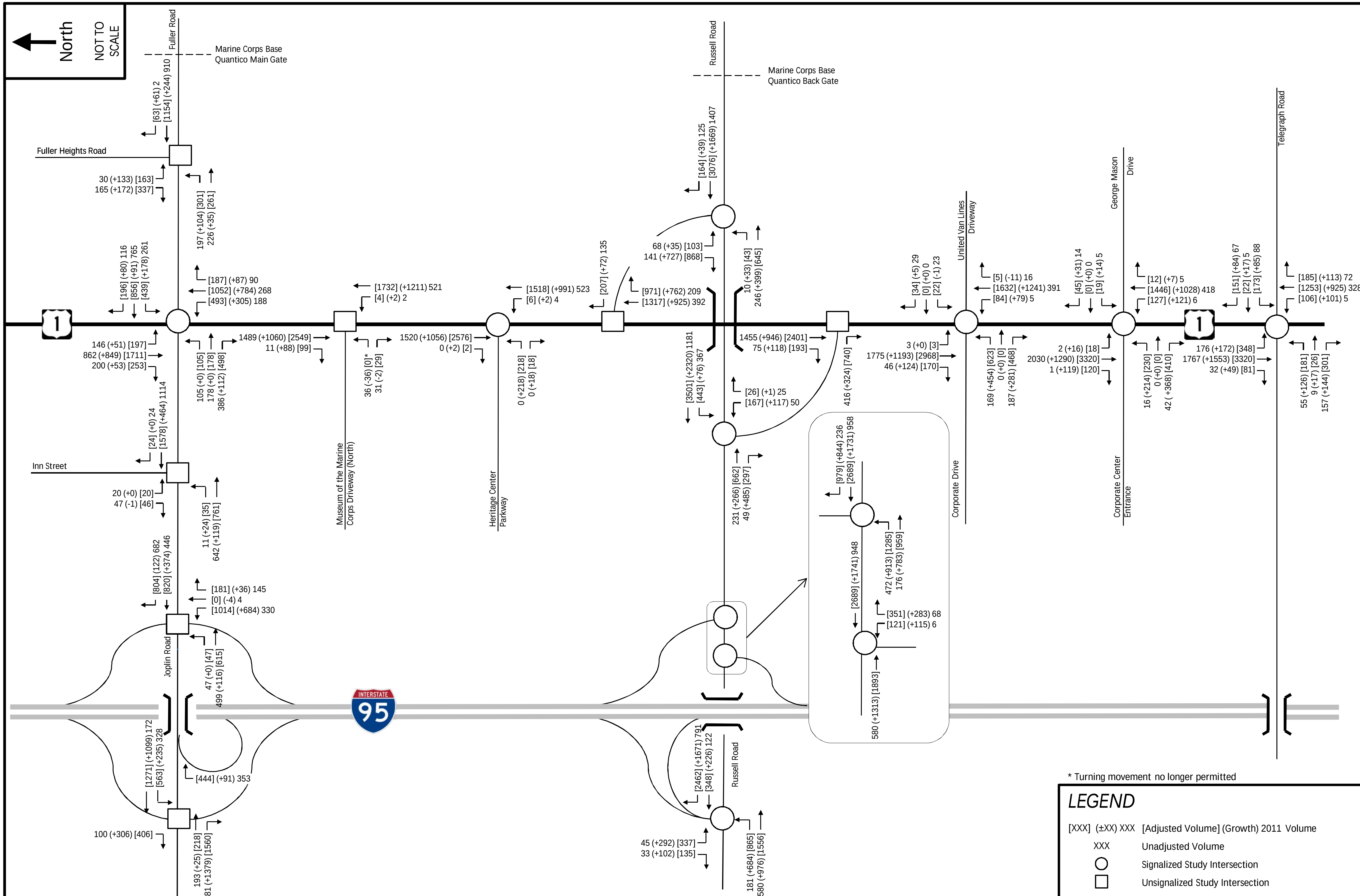


2040 a.m. Peak Hour Traffic Volumes

US Route 1 Corridor at Marine Corps Base Quantico
Planning/Preliminary Engineering Study
Federal Highway Administration
Eastern Federal Lands Highway Division

Kimley-Horn and Associates, Inc.

FIGURE 3-6



2040 p.m. Hour Traffic Volumes

US Route 1 Corridor at Marine Corps Base Quantico
Planning/Preliminary Engineering Study
Federal Highway Administration
Eastern Federal Lands Highway Division

Kimley-Horn and Associates, Inc.

FIGURE 3-7