WDC EIS Technical Report 6 Supplemental

Existing Conditions

UDOT Project No. S-0067(14)0

June 29, 2016

Version 8.1 Travel Demand Model

Table of Contents

List of Figures

List of Tables

Revision Dates: First Draft – September 14, 2015
Version 8.1 TDM – June 29, 2016

Purpose of this Supplemental Technical Report

The original existing conditions report for the West Davis Corridor (WDC) Environmental Impact Statement, dated September 14, 2011, was based on version 7.0 of the regional travel demand model (TDM). Wasatch Front Regional Council (WFRC) and Mountainland Association of Governments (MAG) released version 8.0 of the TDM in July 2015. This new version of the TDM had many significant changes including, but not limited to: updates to base roadway capacities, additional employment types, socioeconomic data based on the 2010 census, incorporation of new travel survey data, and the inclusion of truck data within the model. Version 8.1 Beta was released in early 2016 and included the ability to model managed motorways. The purpose of this supplemental technical report is to update the relevant tables and figures of the original report with output from version 8.1 of the TDM.

Appendix A, provides a comparison of version 7.0 and 8.1 of the TDM.

Travel Demand Modeling

Citilabs released version 6.4.1 of the Cube software package in October 2015. This is currently the latest version of the software and will be used to run version 8.1 of the model for the study. References to "the model" in this report refer to the scripts and data maintained by WFRC and MAG, not to the Cube software.

Model Version and Study Years

Version 7.0 of the WFRC/MAG TDM was calibrated to 2007 and used 2040 as the forecast year. The original report used 2009 as the existing conditions model for comparison with the 2009 traffic count data. Version 8.1 of the TDM was calibrated to 2011, which will also be the year this report will analyze. This model was used to perform a Root Mean Squared Error (RMSE) analysis and screen line analysis as described in the "Model Verification" section below. An existing conditions model will be used in future phases of the EIS for calculating intersection turn volumes as described in the UDOT document "Utah Travel Demand Forecasting," which follows Chapter 8 of the National Cooperative Highway Research Program's (NCHRP) Report 255.

Traffic Analysis Zones

The base version 8.1 TDM used essentially the same traffic analysis zone (TAZ) structure as version 7.0. The only differences in structure occurred in Utah County where a few TAZ were split. The WDC EIS performed several TAZ splits in Weber and Davis Counties as described in the original report, and the version 8.1 TAZ were split in the same manner. Only the TAZ numbering was modified slightly to accommodate the additional TAZ in Utah County.

The socioeconomic data from the original v8.1 TAZ were distributed into the new zones using aerial photography and the previous version 7.0 splits as guides. Care was taken to observe the original "developable" areas, and new developable areas were estimated for the smaller TAZ. It was assumed that variables such as income and household size for the smaller TAZ were the same as the original TAZ.

2011 Socioeconomic Data

Land use data in the model includes population, dwelling units, household size, and employment information. County-wide comparisons between the original WFRC/MAG 2011 data and the West Davis Corridor EIS (WDC) 2011 data are shown in Table 1. The same comparison for the study area is shown in Table 2. These comparisons verify that the TAZ splits and socioeconomic data allocation did not significantly change control totals. The differences shown in the study area are due to the TAZ boundaries being slightly different for the unmodified WFRC model.

Table 1: County Comparison of Version 8.1 Socioeconomic Data

County	Population			Households			Employment		
	WFRC 2011	WDC 2011	Change	WFRC 2011	WDC 2011	Change	WFRC 2011	WDC 2011	Change
Weber	225,224	225,224	0.0%	77,917	77,917	0.0%	110,364	110,362	0.0%
Davis	308,837	308,837	0.0%	95,545	95,545	0.0%	146,467	146,458	0.0%
Salt Lake	1,028,282	1,028,282	0.0%	348,554	348,554	0.0%	701,903	701,903	0.0%
Utah	518,284	518,284	0.0%	147,001	147,001	0.0%	241,607	241,607	0.0%
Totals	2,080,627	2,080,627	0.0%	669,017	669,017	0.0%	1,200,341	1,200,330	0.0%

Table 2: Study Area Comparison of Version 8.1 Socioeconomic Data

Study Area	Population			Households			Employment		
	WFRC 2011	WDC 2011	Change	WFRC 2011	WDC 2011	Change	WFRC 2011	WDC 2011	Change
	168,810	168,070	-0.4%	49,678	49,430	-0.5%	57,295	57,210	-0.1%

Diurnal Traffic Distribution

The original existing conditions report performed an analysis using traffic count data to show that the PM period within the study area was 26 percent of the total daily traffic. A summary of the diurnal distribution for version 8.1 of the model within the study area is shown in Table 3. The PM period in the new model matches the expected 26 percent, so no additional adjustment were made.

Table 3: Summary of v8.1 Diurnal Distribution within the WDC Study Area

Study Area	v8.1 2011 TDM	
	VMT	% Total
AM Period (6:00 AM to 9:00 AM)	709,100	18%
Mid-Day Period (9:00 AM to 3:00 PM)	1,223,900	32%
PM Period (3:00 PM to 6:00 PM)	994,600	26%
Evening Perion (6:00 PM to 6:00 AM)	911,000	24%
Total	3,838,600	100%

Model Roadway Network

The regional TDM generally includes the large collector and arterial-type facilities in its roadway network. The West Davis Corridor EIS used this same network as a base but added existing roads as appropriate for the TAZ splits and for existing conditions. The base 2011 network came from the variables LN_2011 and FT_2011 in the master network file. Roadways were added to match the previous v7.0 modifications. In addition, new projects that had been constructed between 2009 and 2011 were included.

In some instances, additional modifications to speed and/or capacity were made to the network links as a means of calibrating to existing traffic count data. The modifications were done using best engineering judgment in cases where the 2011 model results were substantially different from the 2011 count data. The objective is to not perpetuate model errors to the future model that are in the existing model. The adjustments are assumed to apply to the future network as well.

2011 Traffic Count Volumes

The original count data for calibrating the WDC version 7.0 model was for the year 2009. These counts were also used for version 8.1, but they were factored up by four percent to estimate the 2011 volumes and account for growth in the area. The UDOT permanent counters near the study area were used to calculate this growth factor. Additionally, other sources of traffic volume data were used to supplement and/or replace the factored 2009 data. These sources included PeMS, Traffic on Utah Highways, and the observed counts included with the model in the OBS_VOL_DY field.

Model Transit Network

The transit network used in the 2011 travel demand model was obtained from the base WFRC TDM. No significant changes were made to the transit network.

After the 2011 model was run, an analysis was performed to determine the amount of trips the model assigned to transit within the study area and within Weber and Davis Counties. A comparison was made between all trip types (comprising all motorized and non-motorized trips) and the Home Based Work (HBW) trips. A summary of this analysis is provided in Table 4 below. For each case, the HBW transit trips showed a higher percentage of transit use than the "all trip types" category. This suggests that as a percentage of trips, the HBW commuters are more likely than other trip types to use transit. In addition, a comparison was made with the U.S. Census Bureau's American Community Survey (ACS) data that was obtained between 2007 and 2011. The ACS data showed HBW transit use of 1.7 percent in Weber County and 2.8 percent in Davis County. The TDM resulted in 2.7 percent in Weber County and 2.4 percent in Davis County. The differences are likely due to a combination of survey margin of error, modeling error, and changes in transit routes between 2007 and 2011. The study area transit use is lower than either of the county transit use values. This may be due to fewer transit routes within the study area relative to the rest of the county areas.

Table 4: 2011 Modified TDM Transit Trips Summary

	Weber County Trips		Davis County Trips		Study Area Trips	
	All Types	HBW	All Types	HBW	All Types	HBW
Model Total Trips	929,700	190,300	1,251,800	272,000	683,000	141,200
Model Transit Trips	10,700	5,100	11,900	6,600	5,100	3,000
Model Percent Transit	1.2%	2.7%	1.0%	2.4%	0.7%	2.1%
ACS*	N/A	1.7%	N/A	2.8%	N/A	N/A

*Source: U.S. Census Bureau American Community Survey, 2007-2011

Model Verification

The changes that were made to the base WFRC model were done in an effort to increase its accuracy within the study area. An analysis using RMSE in the surrounding area for the updated 2011 model and 2011 count data was performed to verify that the updated model remains a valid tool. WFRC/MAG model documentation for v6.0 states, "[t]he RMSE is used to calculate the effectiveness of individual link and node modifications, as well as general changes in trip generation and distribution and assignment parameters." The documentation for v7.0 states, "[t]he percent RMSE should generally be less than 40%, overall, with higher values acceptable for low volume links and lower values expected for high volume links." Table 5 contains a comparison of the RMSE values from the base 2011 unmodified model with the modified model in which all the updates described previously have been applied.

Table 5: Root Mean Squared Error within the Study Area for 2011

Roadway Volume	Number of Data Locations	Unmodified Model RMSE	Modified Model RMSE
Less Than 15,000	92	52%	36%
15,000 to 30,000	62	32%	20%
Over 30,000	22	13%	9%
Combined	176	30%	20%

Table 5 shows considerable improvement for the modified 2011 model compared with the original unmodified model. The volume categories show that the model may be performing better for roadways with larger volumes than for roadways with lower volumes. However, with the modified model, even the lower volume roadways overall appear to more accurately reflect the count data within the study area. These results should provide a higher degree of confidence for future year traffic volume projections.

In addition to the RMSE analysis, screen lines were established to compare overall traffic volumes for north-south and east-west travel within and across the study area boundary. Figure 1 shows the screen line locations. Screen Line A is north of 4000 South, Screen Line B is south of 1800 North, Screen Line C is north of 200 North, Screen Line D crosses Legacy Parkway and I-15 north of Parrish Lane, and Screen Line E parallels the west side of I-15.

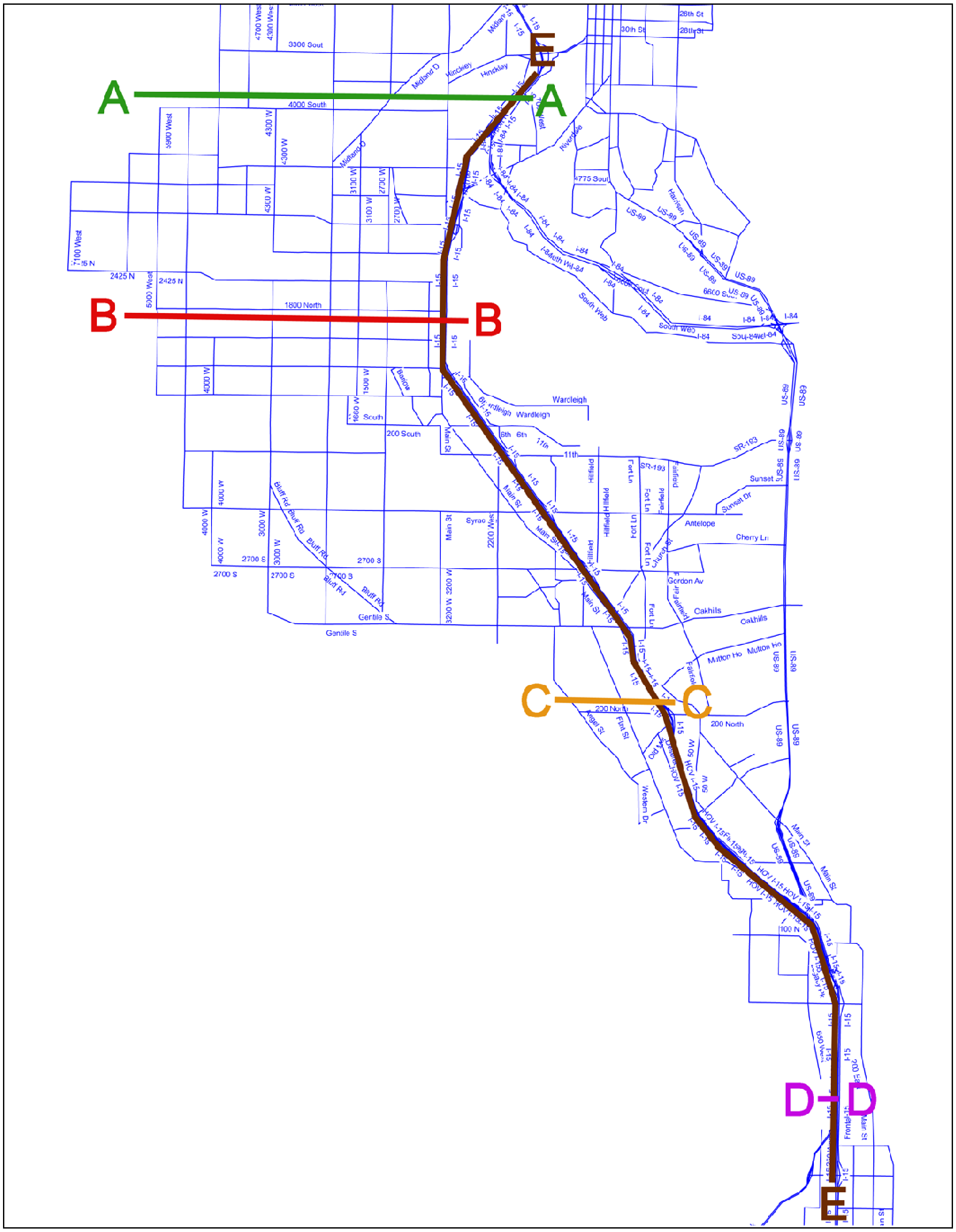

Figure 1: Screen Line Locations

Volumes from the modified West Davis Corridor model and the unmodified WFRC model were compared against 2011 traffic count data. In some cases, for non-UDOT roadways, no 2011 traffic data was available. For these links, it was assumed that the "count" volume was an average of the two modeled volumes. A summary of the Average Weekday Traffic (AWDT) volumes is shown in Table 6.

Table 6: 2011 Travel Demand Model AWDT Screen Line Summary

	2011 AWDT Screenline Summary				
Screenline	Count Data	Unmodified Model	% Change from Count	Modified Model	% Change from Count
A (N-S Traffic: North of 4000 South)	155,300	150,600	-3.0%	151,000	-2.8%
B (N-S Traffic: South of 1800 North)	181,910	189,100	4.0%	182,100	0.1%
C (N-S Traffic: North of 200 North Kaysville)	142,650	136,800	-4.1%	134,600	-5.6%
D (N-S Traffic: North of Parrish Lane)	165,200	164,700	-0.3%	163,500	-1.0%
E (E-W Traffic: West of I-15)	283,700	320,600	13.0%	311,500	9.8%
Total all Screen Lines	928,760	961,800	3.6%	942,700	1.5%

The total combination of all screen lines showed the unmodified model volumes as 3.6 percent greater than the count volumes and the modified model volumes as 1.5 percent greater. Both models are matching the count data fairly well, but the overall modified model shows an improvement over the original model.

Travel Demand Modeling MOE Summary

Several Measures of Effectiveness (MOEs) were calculated in the study area from the 2011 Travel Demand Model. A key focus was on congested roadways, which were assumed to be those with Volume-to-Capacity (V/C) ratios greater than or equal to 0.9 as calculated by the TDM or ramps with ramp meter delays greater than 1.2 minutes. The MOEs for congestion include: roadway lane-miles, Vehicle Miles Traveled (VMT), and Vehicle Hours Traveled (VHT). Other MOEs include: average speeds in miles-per-hour (mph), total VMT, total VHT, and total daily delay in hours. The roadway lane-miles MOE is divided into east-west roads and north-south roads. It represents the physical length of roadway lanes that have poor traffic operations. The VMT in congestion represents the cumulative length of roadway miles that drivers experience with poor traffic operations. The MOE values will be useful to compare with the future 2040 MOEs. Table 7, Table 8, and Table 9 summarize the Travel Demand Model MOE's for the AM 3-Hr period, PM 3-Hr period, and daily traffic, respectively.

Table 7: 2011 Travel Demand Model MOE Summary for WDC Study Area – AM 3-Hr Period

WDC Study Area MOEs	AM 3-Hr Period				
	Freeway	Arterial	Collector	Ramps	All Roads
East-West Road Lane-Miles in Congestion	0.0	1.9	0.3	0.0	2.2
Total East-West Lane-Miles	1.4	92.5	133.4	2.8	230.1
Percent East-West Lane-Miles in Congestion	0%	2%	0%	0%	1%
North-South Road Lane-Miles in Congestion	23.3	0.5	0.4	0.7	25.0
Total North-South Lane-Miles	183.4	73.0	153.8	11.8	422.0
Percent North-South Lane-Miles in Congestion	13%	1%	0%	6%	6%
VMT in Congestion	104,500	5,700	1,200	2,100	113,600
Total VMT	486,400	137,000	70,800	14,900	709,100
Percent VMT in Congestion	21%	4%	2%	14%	16%
VHT in Congestion	2,050	380	70	140	2,640
Total VHT	8,140	4,580	2,600	720	16,040
Percent VHT in Congestion	25%	8%	3%	19%	16%
Average Speed (mph)	59.7	29.9	27.3	20.8	44.2
Total Delay (Hr)	770	440	160	110	1,490
Note: Excludes Centroid Connectors					

Table 8: 2011 Travel Demand Model MOE Summary for WDC Study Area – PM 3-Hr Period

WDC Study Area MOEs	PM 3-Hr Period				
	Freeway	Arterial	Collector	Ramps	All Roads
East-West Road Lane-Miles in Congestion	0.0	6.7	1.8	0.0	8.5
Total East-West Lane-Miles	1.4	92.5	133.4	2.8	230.1
Percent East-West Lane-Miles in Congestion	0%	7%	1%	0%	4%
North-South Road Lane-Miles in Congestion	60.3	5.8	1.8	1.0	68.9
Total North-South Lane-Miles	183.4	73.0	153.8	11.8	422.0
Percent North-South Lane-Miles in Congestion	33%	8%	1%	8%	16%
VMT in Congestion	298,900	29,700	6,100	2,800	337,500
Total VMT	651,800	202,700	121,000	19,200	994,600
Percent VMT in Congestion	46%	15%	5%	15%	34%
VHT in Congestion	7,430	1,720	400	190	9,740
Total VHT	13,230	7,440	4,660	950	26,280
Percent VHT in Congestion	56%	23%	9%	20%	37%
Average Speed (mph)	49.3	27.2	26	20.3	37.9
Total Delay (Hr)	3,320	1,330	510	170	5,330
Note: Excludes Centroid Connectors					

Table 9: 2011 Travel Demand Model MOE Summary for WDC Study Area – Daily Traffic

WDC Study Area MOEs	Daily MOE Statistics				
	Freeway	Arterial	Collector	Ramps	All Roads
East-West Road Lane-Miles in Congestion	0.0	8.8	2.2	0.0	11.0
Total East-West Lane-Miles	1.4	92.5	133.4	2.8	230.1
Percent East-West Lane-Miles in Congestion	0%	10%	2%	0%	5%
North-South Road Lane-Miles in Congestion	83.6	6.3	2.5	2.0	94.4
Total North-South Lane-Miles	183.4	73.0	153.8	11.8	422.0
Percent North-South Lane-Miles in Congestion	46%	9%	2%	17%	22%
VMT in Congestion	403,400	36,200	8,400	6,100	454,000
Total VMT	2,531,600	793,600	432,200	81,200	3,838,600
Percent VMT in Congestion	16%	5%	2%	8%	12%
VHT in Congestion	9,470	2,170	540	400	12,590
Total VHT	42,410	26,100	15,710	3,700	87,920
Percent VHT in Congestion	22%	8%	3%	11%	14%
Average Speed (mph)	59.7	30.4	27.5	21.9	43.7
Total Delay (Hr)	4,220	2,160	840	400	7,630
Note: Excludes Centroid Connectors					

Travel Pattern Analysis

To analyze the travel patterns within the West Davis Corridor study area, an origin-destination study was conducted using the Travel Demand Model. The purpose of this study was to determine the percentage of traffic within the study area that travels a north-south direction versus an east-west direction. To perform this study, the entire travel demand model was divided into districts. WFRC already has the model divided into large, medium, and small districts; however, they did not match the needs of the West Davis Corridor study area. Therefore, the WFRC medium districts were divided or combined into larger districts for use specifically in the West Davis Corridor EIS traffic analysis. Figure 2 shows a comparison of the WFRC medium districts and the West Davis Corridor EIS districts. Districts 1 and 2 of the West Davis Corridor Districts represent the study area.

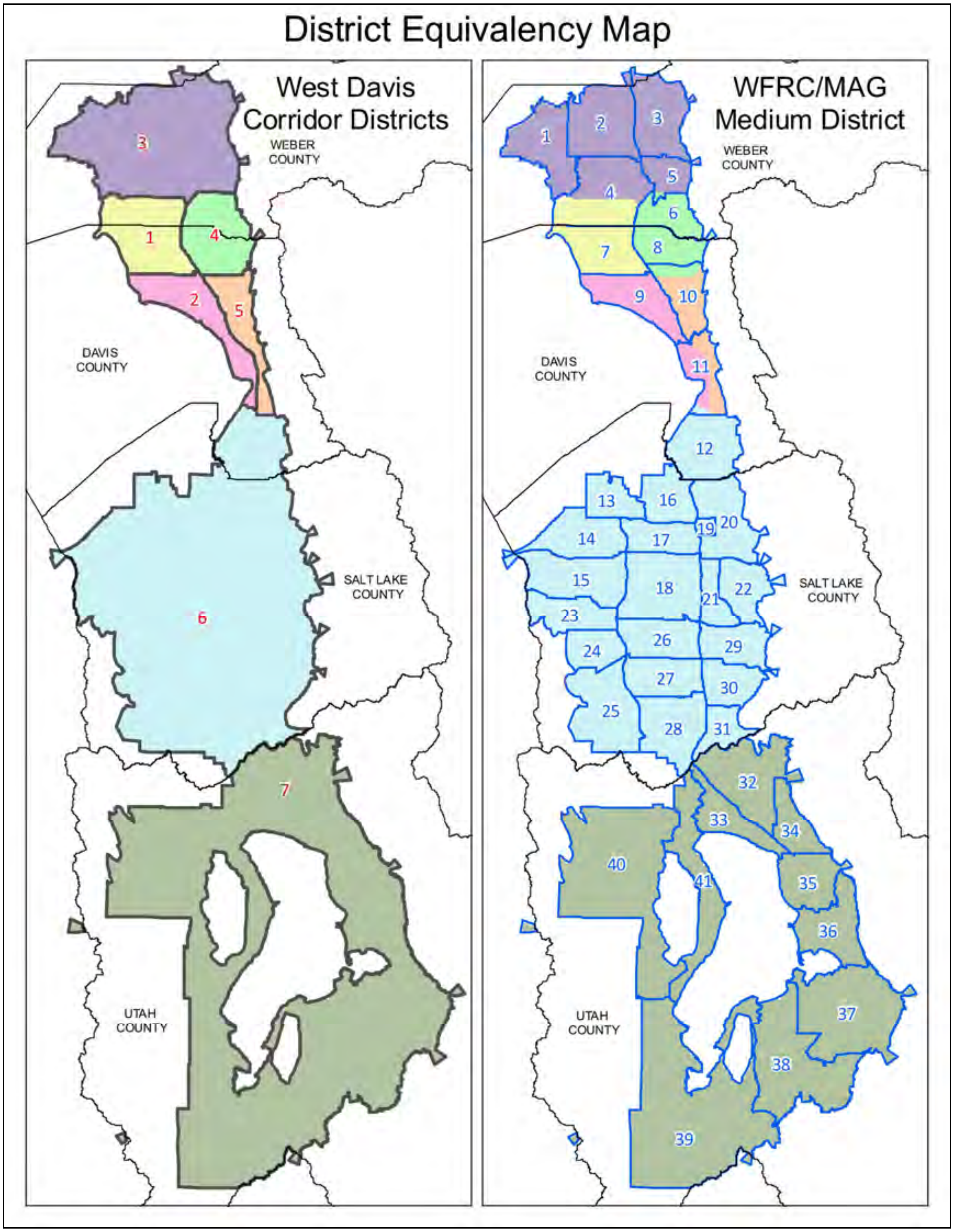

Figure 2: District Equivalency Map

Using these district definitions, the model generated statistics regarding trip origins and destinations. More specifically, the model calculates "productions and attractions," but for simplification, these will be referred to as "trips". Figure 3 shows the 2011 Home Based Work (HBW) trips originating from the study area, and Figure 4 shows all trip types.

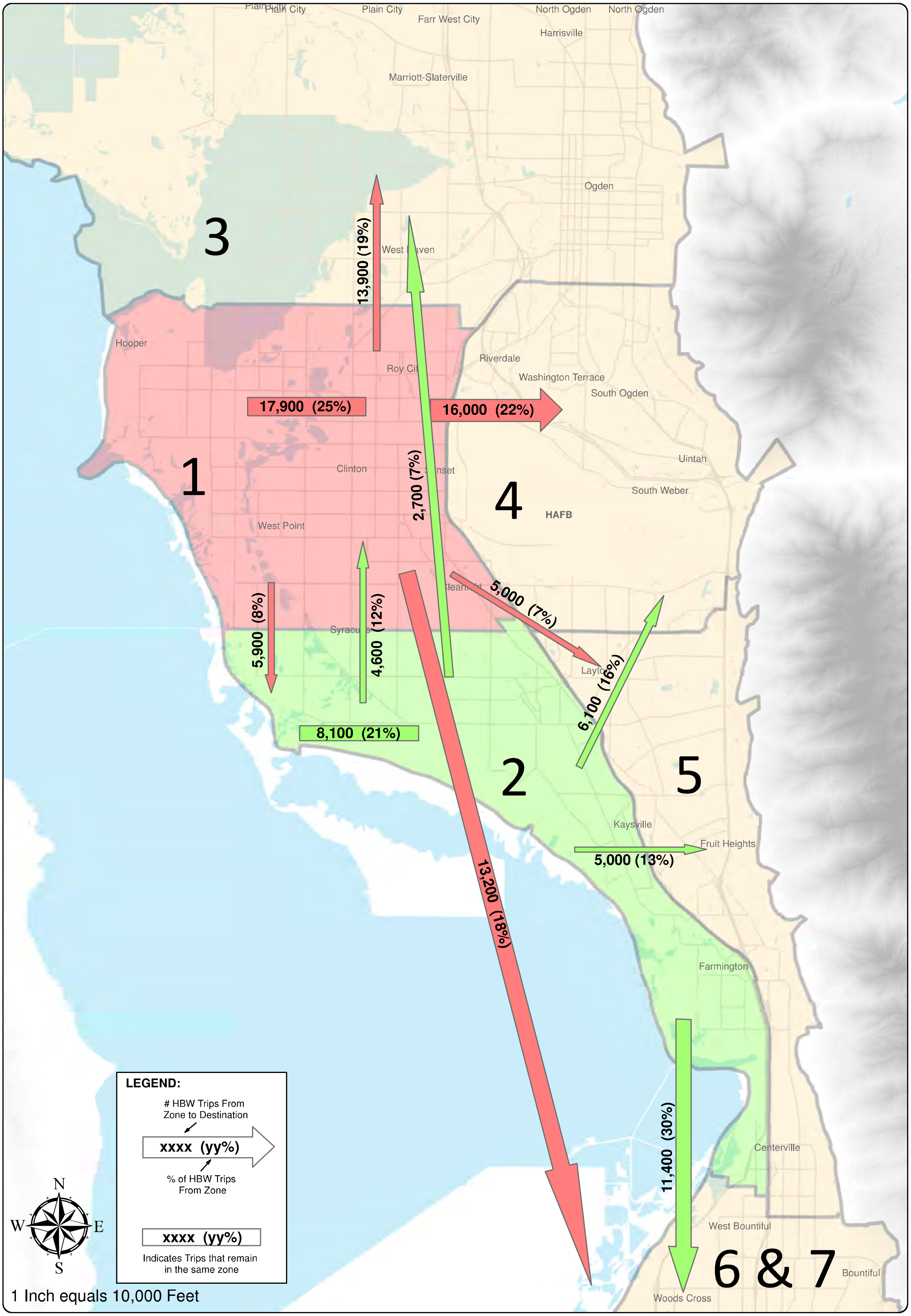

Figure 3. 2011 Home-Based Work Person-Trips Originating in the Study Area

West Davis Corridor

06/29/2016

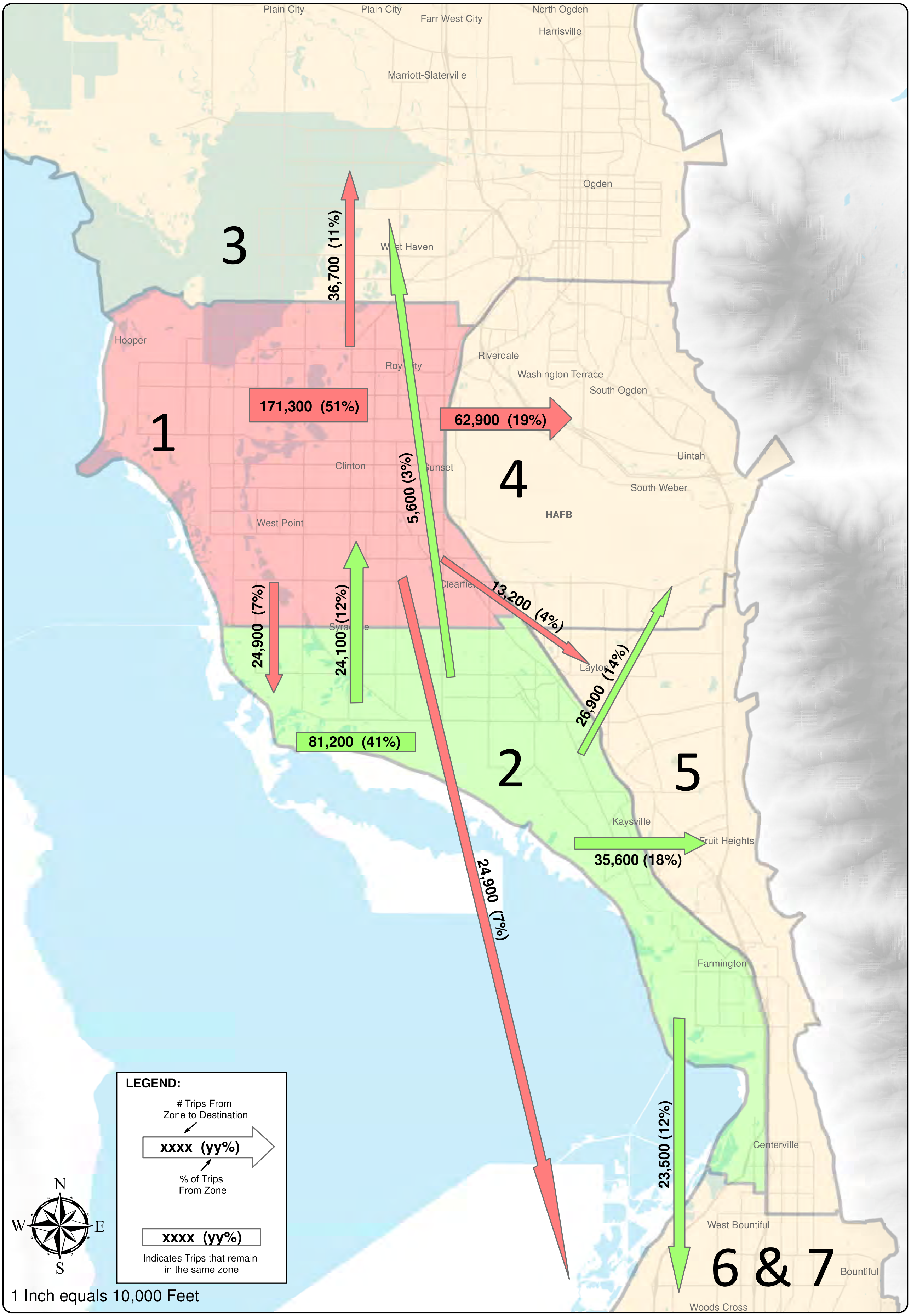

Figure 4. 2011 All Person-Trips Originating in the Study Area
West Davis Corridor

06/29/2016

Based on the results of the origin-destination study, the HBW trips originating in District 1 show 53 percent traveling north-south, 22 percent traveling east-west, and 25 percent staying within the district. The HBW trips originating in District 2 show 65 percent traveling north-south, 13 percent traveling east-west, and 21 percent staying within the district. When considering all trip types, those originating in District 1 show 30 percent traveling north-south, 19 percent traveling east-west, and 51 percent staying within the district. With all trips originating in District 2, 41 percent travel north-south, 18 percent travel east-west, and 41 percent stay within the district. It should be noted that the percentages may not add to 100 percent due to rounding.

Existing Number of Lanes

Figure 5 shows the 2011 number of travel lanes in each direction for all the major roadways within the study area. The number of lanes for each roadway shown is based on the WFRC travel demand model.

Existing Road Segment Level of Service

Figure 6 and Figure 7 show the 2011 V/C ratios and LOS estimates during the AM and PM peak 3-hour periods, respectively. The V/C ratios shown on each map were determined using the WFRC TDM, which was modified as described previously in this report. LOS was estimated to be LOS F for V/C greater than or equal to 1.0, LOS E for V/C between 1.0 and 0.9, and LOS D or better for V/C less than 0.9. The LOS for individual intersections may vary from the road segment LOS due to the different criteria methodology used to estimate it.

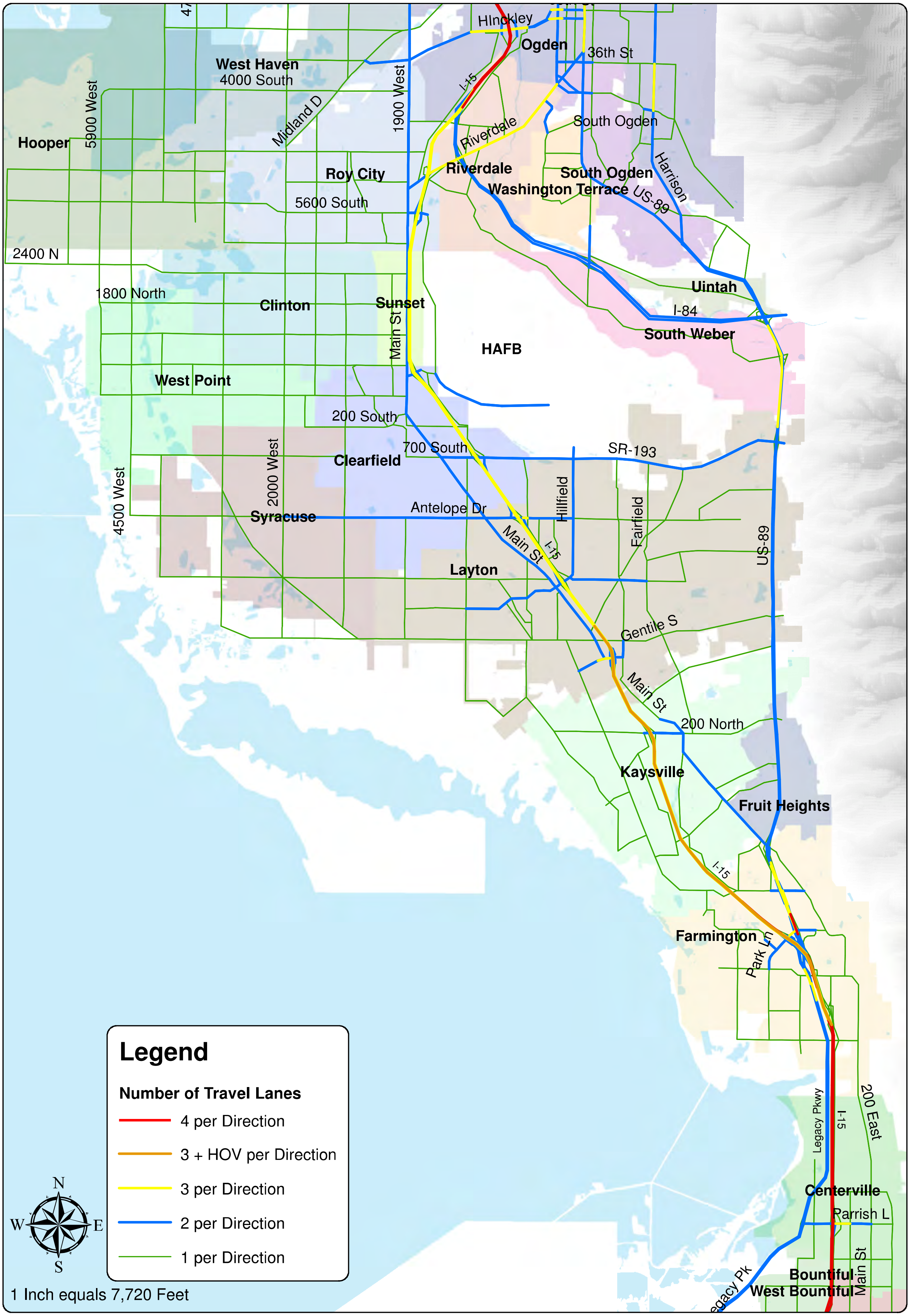

Figure 5. Number of Travel Lanes

West Davis Corridor - Existing Conditions

6/29/2016

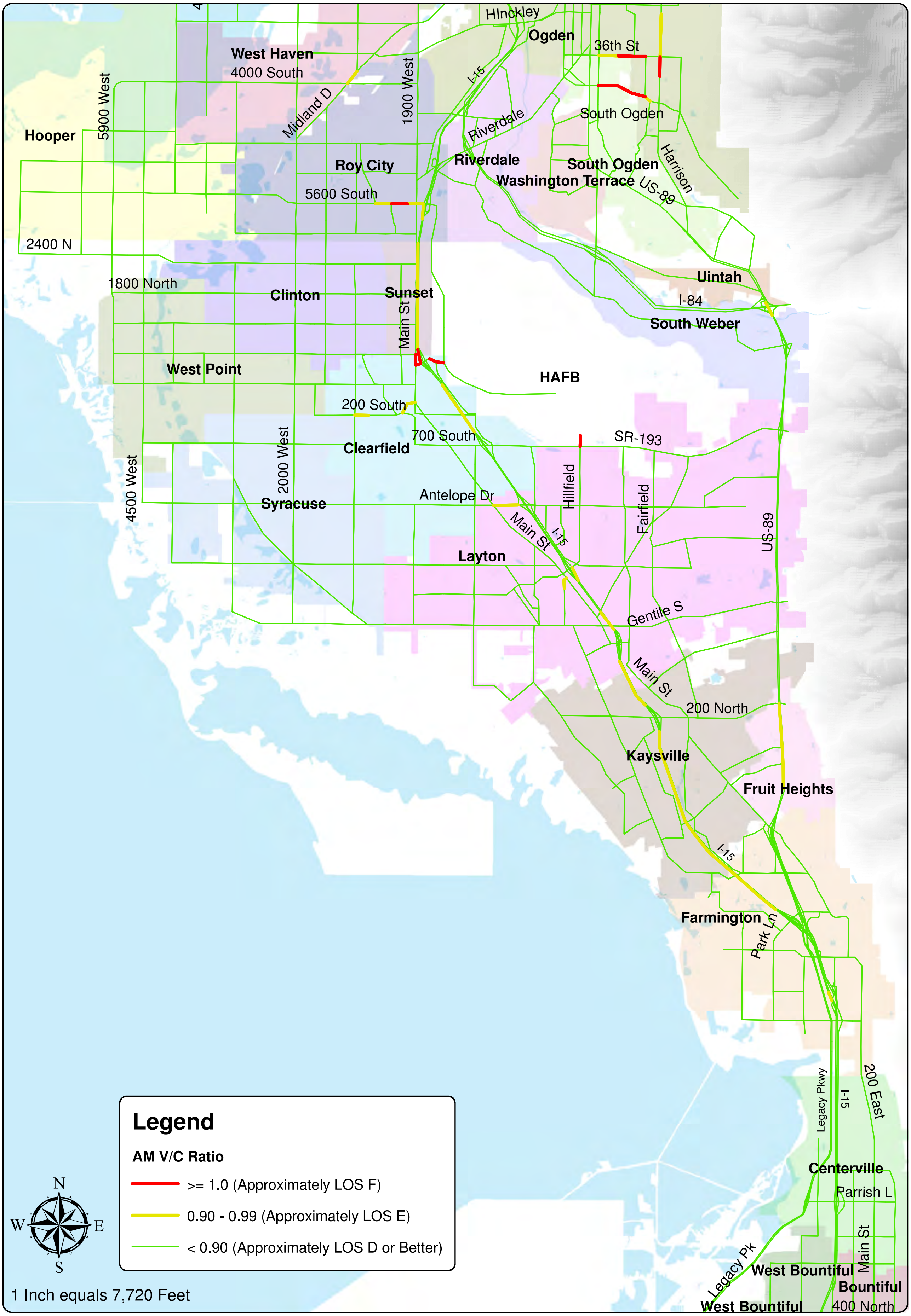

Figure 6. 2011 AM 3-Hr Peak V/C Ratios

West Davis Corridor - Existing Conditions

6/29/2016

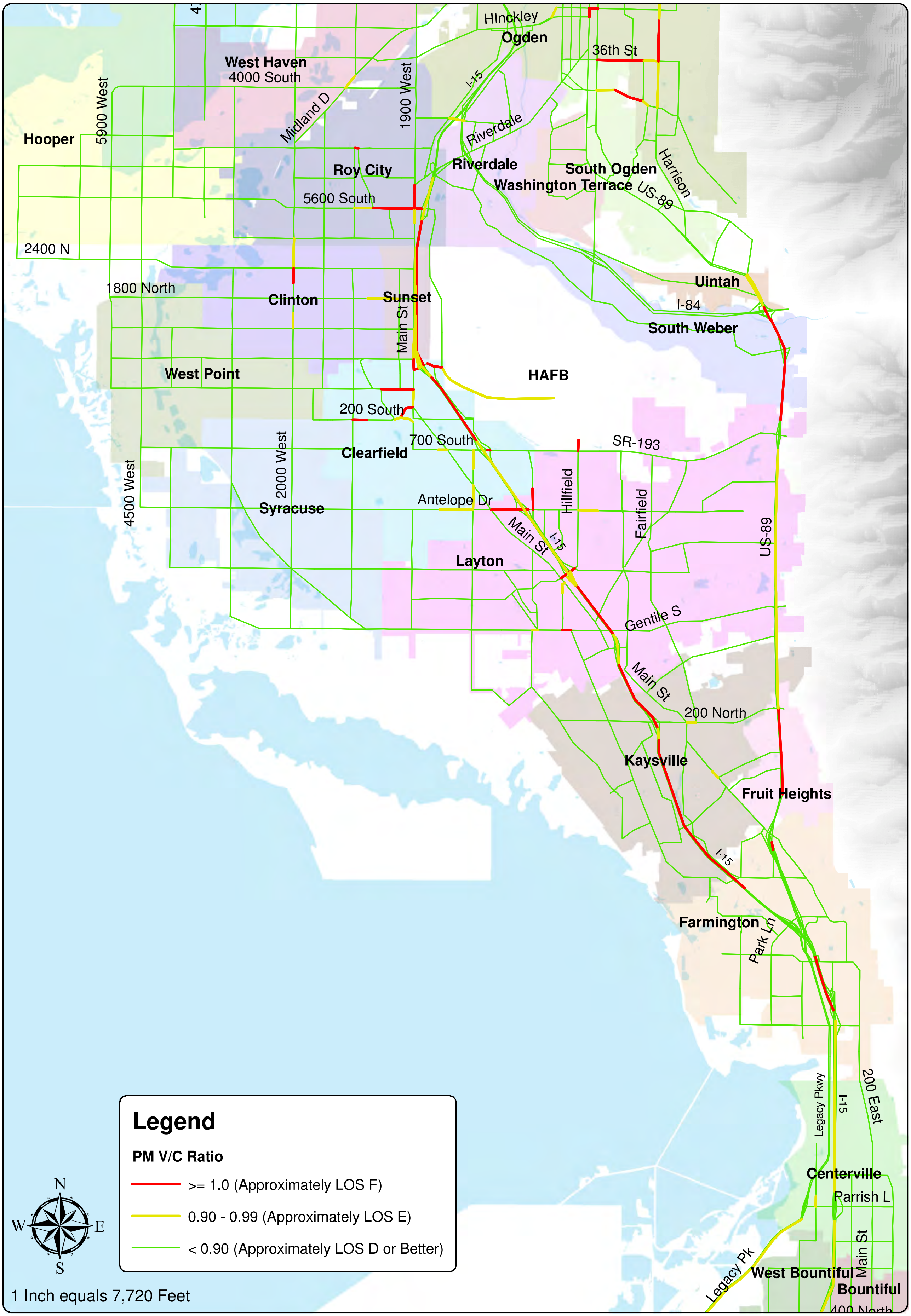

Figure 7. 2011 PM 3-Hr Peak V/C Ratios

West Davis Corridor - Existing Conditions

6/29/2016

Appendix A - Supplemental Data Comparing Changes in v7 and v8.1 Travel Demand Models

Throughout the Environmental Impact Statement (EIS) process, UDOT has relied on the latest version of the Wasatch Front Regional Council (WFRC) Travel Demand Model (TDM) for its Purpose and Need and Level 1 Alternative Screening analyses. When the EIS started in 2010, UDOT used version 6 of the TDM. In 2011, Version 7 of the TDM was released along with the new Regional Transportation Plan (RTP). At that time, in order to utilize the most current information in the EIS process, UDOT updated the WDC traffic analyses with Version 7 of the TDM for the Draft EIS which was released in May 2013 to the public. At that time, the Measures of Effectiveness (MOEs) for the No-Build Alternative were as follows:

Table 1: Version 7 No-Build MOEs

Scenario Name	Description	Daily Total Delay (Hr)	N-S Lane-Miles with PM Period in Congestion	E-W Lane-Miles with PM Period in Congestion	VMT with PM Period in Congestion	VHT with PM Period in Congestion
v7 No Build	No action alternative using version 7.0 of the TDM	10,760	43.5	26.9	245,500	9,490

In 2015, WFRC and the Mountainland Association of Governments (MAG) approved the 2015 RTP and released Version 8.0 of the TDM. This version incorporated many improvements to the model that WFRC had been working on for many years. These are summarized in the attached memorandum from WFRC. As the new RTP was released in 2015, UDOT and WFRC were engaged in a study of the Managed Motorways (MM) concept as a congestion management strategy for Utah's freeways. This concept was also suggested by the Shared Solution Coalition as part of its comments on the WDC Draft EIS. In January 2016, the MM concept was adopted into the RTP and shortly thereafter the TDM was updated to reflect this strategy in Version 8.1. To once again be able to use the most current TDM in the EIS, UDOT updated its traffic analyses in the EIS with Version 8.1. The MOEs for the No-Build Alternative changed significantly from the previous values given by Version 7 of the TDM and used in the Draft EIS as shown below:

Table 2: Version 7 and Version 8.1 No-Build MOEs

Scenario Name	Description	Daily Total Delay (Hr)	N-S Lane-Miles with PM Period in Congestion	E-W Lane-Miles with PM Period in Congestion	VMT with PM Period in Congestion	VHT with PM Period in Congestion
v7 No Build	No action alternative using version 7.0 of the TDM	10,760	43.5	26.9	245,500	9,490
v8.1 No Build	No action alternative using version 8.1 of the TDM; Includes Managed Motorways	18,310	116.2	30.5	642,000	20,770

Though the MOE values differed greatly from the previous TDM version, UDOT observed that the conclusions of the Level 1 Screening Analysis were essentially the same whether Version 7, Version 8.1, or even Version 6 were used. The better performing alternatives were consistent from one model to the next. However, to better understand what led to these differences in the MOE values, UDOT performed an iterative modeling analysis to identify the sources of the variability between Version 7 and Version 8.1.

To quantify the changes in MOE values from Version 7 to Version 8.1 of the TDM, a series of models were run. Starting with the base model, updates to Version 8.1 of the TDM were successively removed and changed back to match Version 7 conditions and values as closely as feasible. The following is a brief description of each of the model scenarios and the changes to the TDM:

1. v81 No Build: This is the base No Action alternative which included all updates and new features to the Version 8.1 TDM. Managed Motorway ramp metering was applied to the I-15 corridor.
2. v81 without MM: This scenario was the same as the base condition described in scenario 1, except Managed Motorway ramp metering was removed from the I-15 corridor.
3. v81 with v7 Capacity: This scenario was the same as scenario 2, except the roadway capacities were changed back to Version 7 values. The Version 8.1 model decreased freeway capacities by an average of 20 percent less than Version 7 and for some freeway types the decrease was over 30 percent. The idea was that Version 7 was over estimating capacity because freeways break down significantly during congestion and cannot maintain the high throughput. If the links have less capacity but still high volumes then they experience greater congestion and delay. Arterial and collector streets also had capacity modifications, but they were less significant than the freeways.
4. Plus v7 VDF: This scenario was the same as scenario 3, except the VDF (volume-delay function) curves were changed back to Version 7 values. VDF curves define how speeds are impacted by congestion. As the volume-to-capacity (V/C) increases (i.e. more congestion), speeds will decrease resulting in higher delay. The freeway VDF curve for Version 8.1 begins dropping sooner than in Version 7. This means that the freeways start experiencing delay sooner than they did in Version 7. The other roadway types vary in their VDF curve change. Expressways look a little flatter in Version 8.1 which would decrease delay. Arterials look about the same. Collectors have steeper curves which increases delay, and Ramps have flatter curves which decrease delay.
5. Plus v7 Spd: This scenario was the same as scenario 4, except the free flow speed definitions were changed back to Version 7 values. Free flow speeds should have little direct impact on delay because delay is just the difference between the free flow speed and the congested speed, but it did account for about 4% of the delay increase. The Version 8.1 has higher free flow speeds for arterials and collectors than Version 7. This could potentially increase delay because these streets can drop farther in speeds as congestion increases which would mean a higher delay with the same congested V/C. Another possible explanation for higher delays is that traffic routes shifted to higher speed roads which would then have increased congestion and delay on those streets.
6. Plus v7 SE: This scenario was the same as scenario 5, except the socioeconomic (SE) data were changed back to Version 7 values. The location of households and jobs in the model impacts productions and attractions which is used when calculating trip origins and destinations. Generally for Version 8.1, the central and western portions of the study area showed household increases and employment decreases compared with Version 7 SE data. Also total employment in the overall study area decreased slightly. Both of these could mean more trips traveling through or within the study area or longer trips going outside the study area.
7. Plus No PCE: This scenario was the same as scenario 6, except the passenger car truck equivalencies (PCE) were removed from the model. Version 8.1 included a truck, or freight, module and Version 7 did not. The trucks on the links in Version 8.1 were converted to passenger car equivalents when computing V/C ratios based on equivalency factors. This effectively increases the volume of passenger cars on the links and creates additional congestion.
8. Plus v7 Network: This scenario was the same as scenario 7, except the roadway network was modified to be compatible with Version 7 conditions. The overall network and RTP projects were different between Version 7 and Version 8.1. Some of the changes included roadway functional type changes, operational improvements, various speed adjustments, and HOT/HOV updates. Each of these were changed in Version 8.1 to represent Version 7 conditions as closely as feasible.

Each of the above scenarios were run and the MOE values were calculated to compare with the Level 1 screening criteria. Scenario 8, which had all the major Version 8.1 modifications and updates removed and replaced with Version 7 values, shows nearly identical MOEs as the original Version 7 Level 1 screening criteria. Additional differences in the MOEs can be attributed to minor changes or adjustments in the model and/or the inability to exactly represent Version 7 values in the Version 8.1 model. The following table and charts represent the results of the analysis.

Table 3: Summary Comparison of MOEs

Scenario Name	Description	Daily Total Delay (Hr)	N-S Lane-Miles with PM Period in Congestion	E-W Lane-Miles with PM Period in Congestion	VMT with PM Period in Congestion	VHT with PM Period in Congestion
v7 No Build	No action alternative using version 7 of the TDM	10,760	43.5	26.9	245,500	9,490
v8.1 No Build	No action alternative using version 8.1 of the TDM; Includes Managed Motorways	18,310	116.2	30.5	642,000	20,770
v81 without MM	v8.1 No Build Scenario; Without Managed Motorways	21,790	135.4	28.6	696,400	24,430
v81 with v7 Capacity	v81 without MM Scenario; Using Version 7 capacities	19,050	119.8	35.4	661,600	22,020
Plus v7 VDF	v81 with v7 Capacity Scenario; Using Version 7 VDF curves	16,920	133.6	33.3	706,900	21,140
Plus v7 Spd	Plus v7 VDF Scenario; Using Version 7 free flow speeds	16,850	133.8	33.5	708,800	21,200
Plus v7 SE	Plus v7 Spd Scenario; Using Version 7 SE Data	15,030	132.9	32.5	663,000	19,150
Plus No PCE	Plus v7 SE Scenario; Remove truck PCE calculation	12,250	85.0	25.7	458,800	13,400
Plus v7 Network	Plus No PCE Scenario; Match Version 7 network conditions as closely as feasible	11,130	43.3	26.4	248,400	9,350

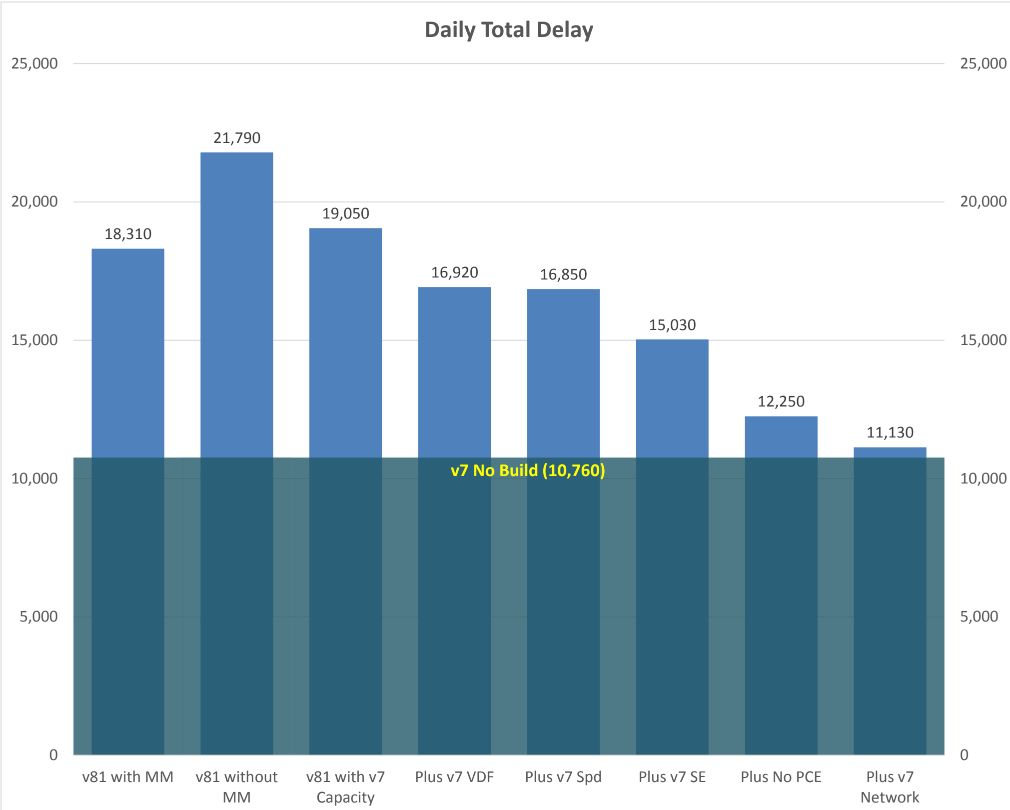

Figure 1: Daily Total Delay Summary

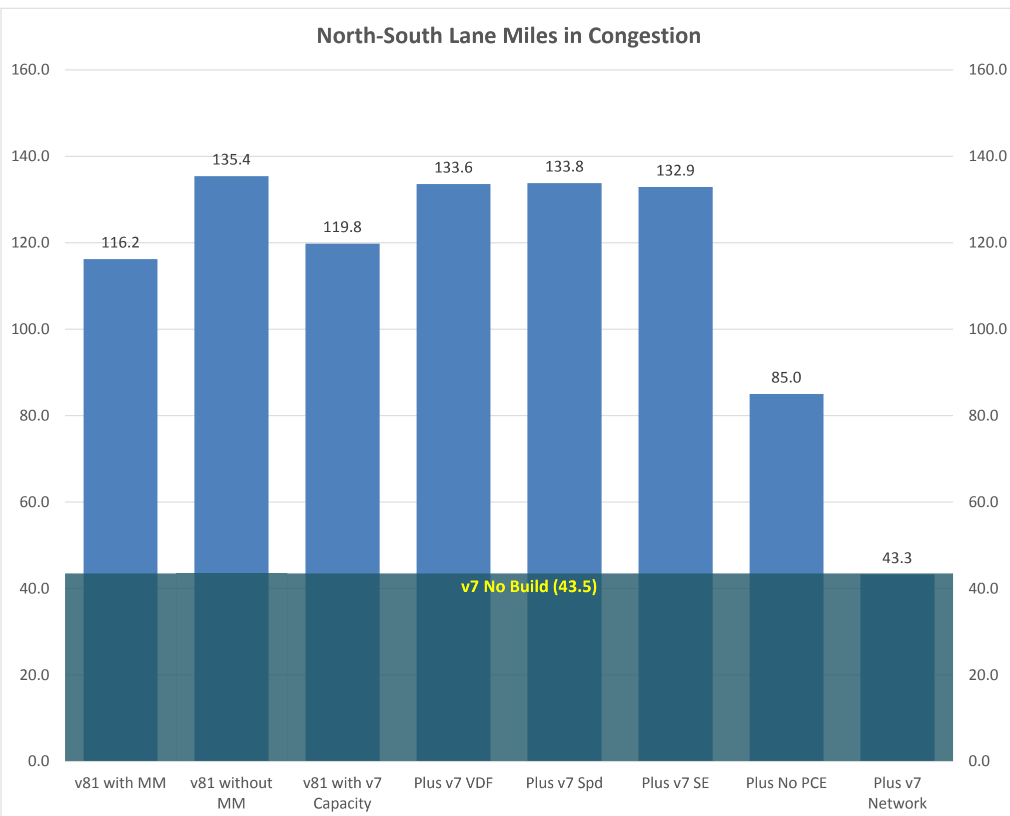

Figure 2: North-South Lane Miles in Congestion Summary

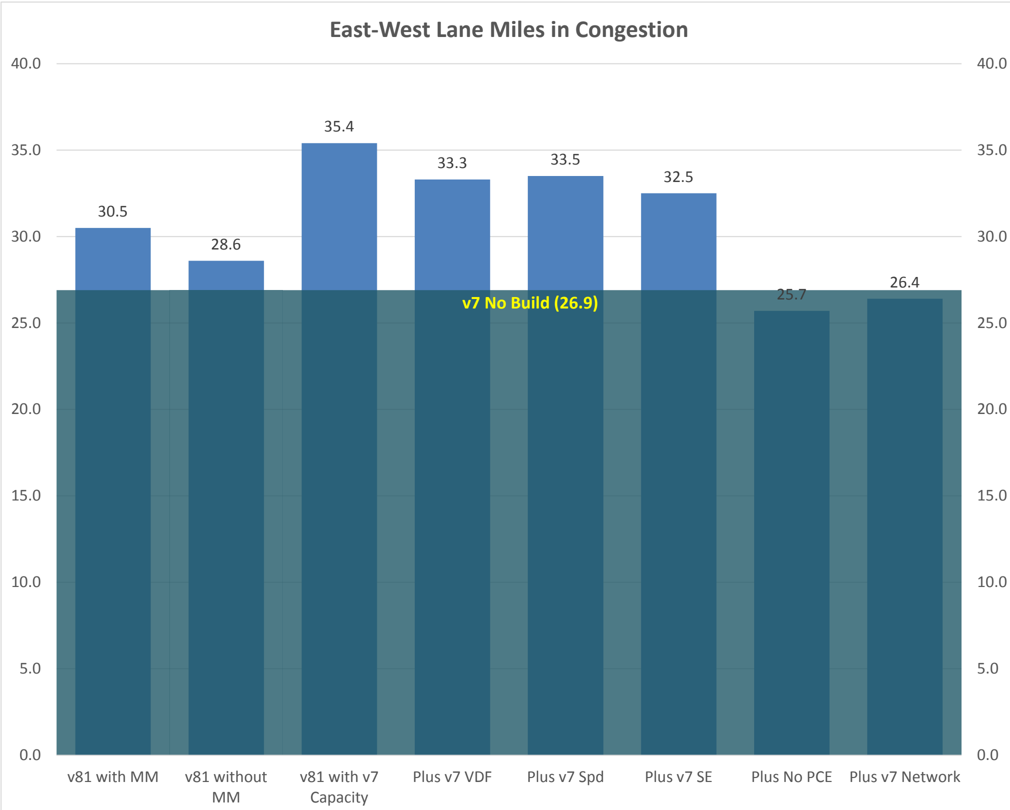

Figure 3: East-West Lane Miles in Congestion Summary

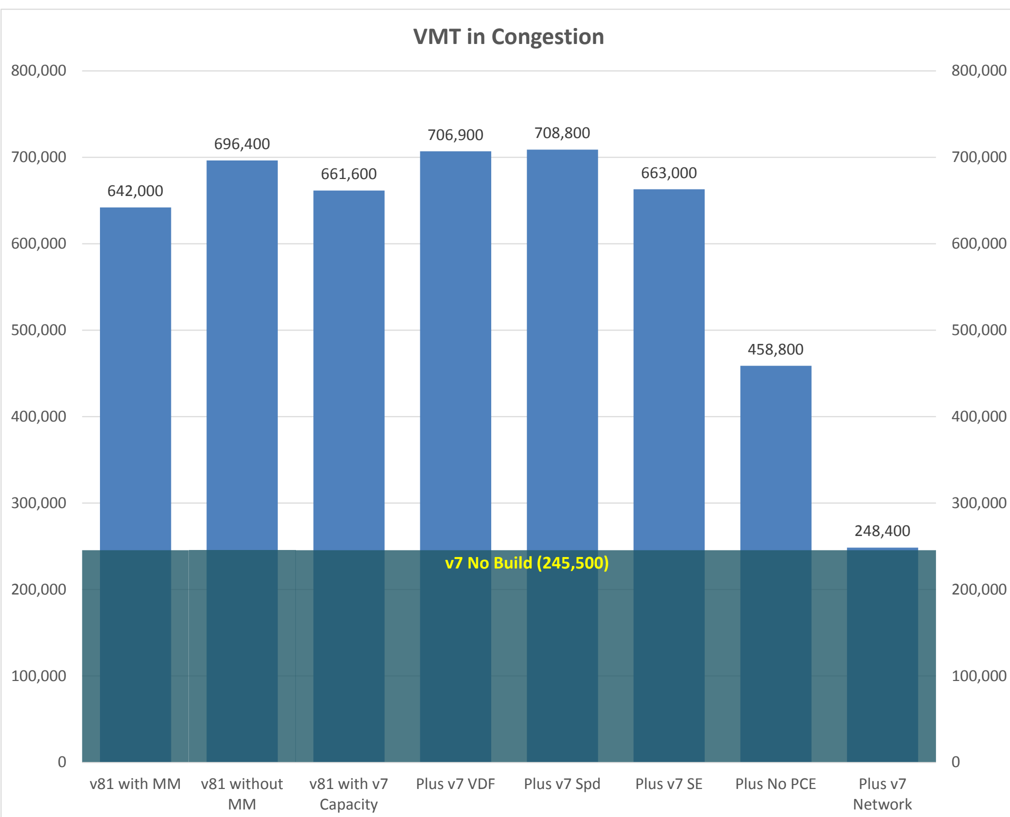

Figure 4: VMT in Congestion Summary

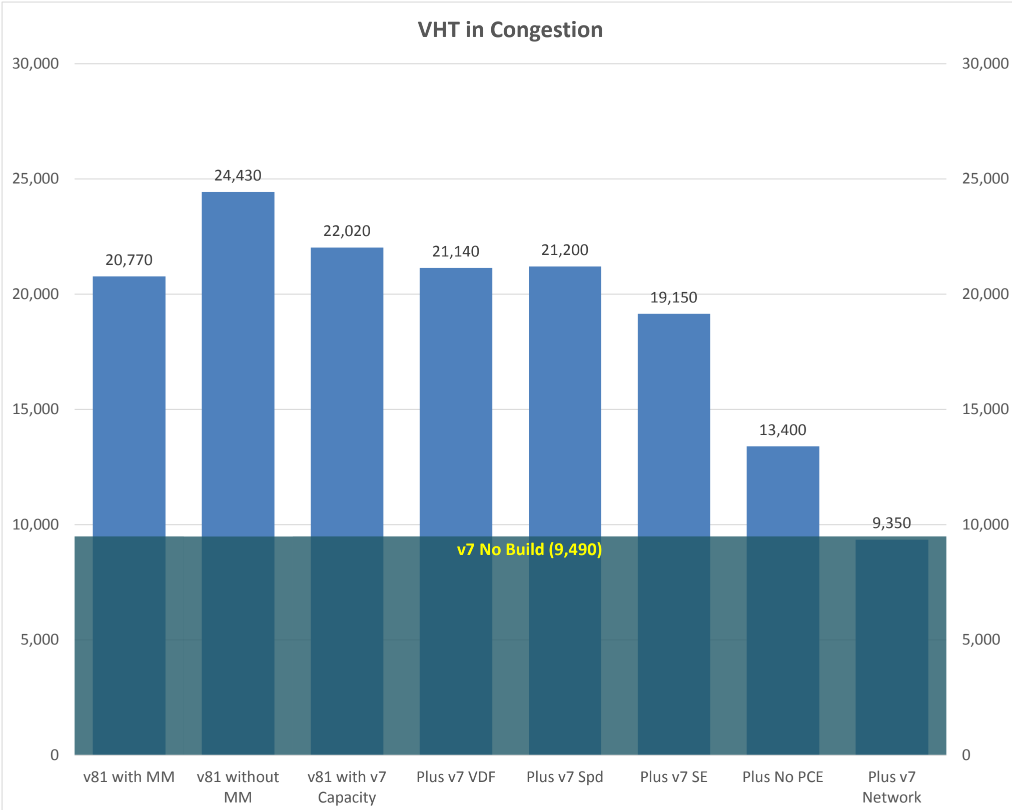

Figure 5: VHT in Congestion Summary

Attachment: WFRC-MAG Travel Demand Model Version 8.0 "What's New"

WASATCH FRONT REGIONAL COUNCIL

MEMORANDUM

To: Travel Model User Community

From: Jon Larsen, PE and Andy Li, PhD

Date: July 20, 2015

Subject: WFRC-MAG Travel Demand Model Version 8.0 “What’s New”

A new version of the WFRC-MAG Travel Demand Model (“the model”) was released in June 2015. This release represents Version 8.0 of this model, which has been under continuous development for decades.

The WFRC / MAG Travel Demand Model (“the model”) is an integrated transportation and air quality model. The model estimates the travel patterns of people, based on demographic characteristics, where they live and work, as well as on the transportation facilities available to them. The model forecasts where and by what mode (e.g. single occupant autos, active transportation, local bus, light rail, etc.) people are likely to travel and assigns these trips onto facilities that represent the best route for each particular trip. Travel model output is used to evaluate transportation corridors where the future travel demand is likely to exceed the capacity of the facilities in the corridor, to identify and assess projects that meet the travel demand, and to analyze the air quality impacts of the transportation system. This model is used as the principal source for forecasting travel demand for virtually every major highway and transit project in the region.

The model covers all of the developable area of Utah, Salt Lake, Davis and Weber counties. This excludes the canyons and the mountains to the east of the urbanized areas. Southern Box Elder County was recently added to the WFRC region, and it is anticipated that this region will be added to the model within the next year.

The following is a highlight of the changes made to the regional travel demand model as part of this update:

Update	Description
Recalibration using the 2012 Utah Household Travel Survey.	This recalibration included updating the trips per household, trip distance by trip type, and mode choice preferences.
Addition of a life cycle variable	Households in the model are now categorized into three groups: working with no children, working with children, and retired, with or without children. Based on the results of the Travel Survey, we found distinctive trip behaviors among these three categories.
New freight module	The freight module now allows for more detailed and robust forecasting of commercial trips, including the ability to forecast long haul, short haul, and light duty commercial trips.

Update	Description
K-12 school trips now explicitly modeled	Trips for K-12 schools used to be included in the "home-based other" category. These trips are now explicitly included in the model, with sensitivity to elementary versus secondary schools.
Expansion of employment categories from 3 to 11	The model used to only have "retail", "industrial", and "other" categories. It now has "retail," "food," "manufacturing," "wholesale," "office," "government/education," "healthcare," "other," "mining," "agriculture," and "construction." This expansion allows the model to be more sensitive to the different trip generation characteristics of these differing employment centers.
Updated freeway capacities	Freeway capacities were lowered by 10-20% in order to reflect the "operational capacity" of these facilities. We have found that the "true" capacity is only sustained for a short period of time before conditions break down and the throughput drops by 10-20%. Switching to the operational capacity is an attempt to replicate real world traffic conditions over the course of the entire peak period. This allowed for a cleaner calibration and validation of the model. In previous versions of the model, we had to add heavy ramp penalties and a county-to-county "K factor" to get the base year model to validate to observed counts. In Version 8.0, we were able to eliminate the K-factors, and reduce the ramp penalties in half. Any time you add K-factors and penalties to the model, you're forcing the model to account for things which it cannot explain, and are thus reducing the model's predictive power.
Transit module upgraded	We were one of the first regions in the country to incorporate an updated transit submodule recently offered by the software vendor. This submodule allows for more robust analysis of transit scenarios, such as providing the ability to test distance-based fare scenarios.
Integration with the Utah Statewide Travel Model	The model is set up to take advantage of UDOT's Statewide Model. This allows for improved forecasts of trips entering, leaving, or passing through the WFRC-MAG model area.
Peak hour assignment	The model has historically provided forecasts for four time periods, with a three-hour morning peak and a three-hour evening peak. The model now has the option to perform an additional traffic assignment for a one-hour evening peak.

All of these changes were implemented with input and feedback from the Model Advisory Committee, which meets quarterly. This committee is comprised of technical staff from WFRC, MAG, UDOT, UTA, and key model users from within the consultant and academic communities.