2016 KMPO Base Calibration
Travel Demand Model Update

Final Documentation

With Assistance from: PTV Group

Revised November 2018

Approved by KMPO Board December 13, 2018

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Table of Contents

Introduction **4**

1.0 2016 Model Geography **6**

2.0 2016 KMPO Model Data Sources **7**

3.0 2016 KMPO Model Background **8**

4.0 KMPO Model Procedures **9**

4.1 KMPO Calculate Procedures (Step by Step) 9
4.2 KMPO Calculate Procedures Parameter Files 9
4.3 KMPO Final Model Version Output File 10
4.4 KMPO Calculate Procedures Model Run Comments 10

5.0 2016 KMPO Land Use Update **11**

5.1 2016 Dwelling Unit Estimation 11
5.2 2016 Land Use Summary 11

6.0 2016 AM & PM Peak Hour Trip Generation Rates **155**

7.0 2016 KMPO Auto Network Enhancements **188**

7.1 2016 External Trip Update 1818
7.2 2016 Link Traffic Count Update 188
7.3 Model's External Traffic Analysis Zone (TAZ) Update 188

8.0 Traffic Counts **222**

9.0 AM/PM Peak Hour Trip Generation **233**

9.1 AM Peak Hour Trip Generation Validation 233
9.2 PM Peak Hour Trip Generation Validation 233

10.0 AM/PM Peak Hour Trip Distribution **255**

10.1 Gravity Model Calibration/Validation Results 255

11.0 AM/PM Peak Hour Traffic Assignments **288**

11.1 Traffic Assignment Method Update 288

12.0 AM/PM Peak Hour Traffic Screenline Validation **31**

12.1 Allowable Deviation Standards 32

13.0 Model Limitations and Improvements **366**

List of Tables

Table 1 2016 KMPO Land Use Data Summary 14
Table 2 Updated AM Peak Hour Trip Rates in 2016 KMPO AM Model..... 16
Table 3 Updated PM Peak Hour Trip Rates in 2016 KMPO PM Model..... 17
Table 4 2016 AM/PM Peak Hour Counts at External TAZs……..…….. 19
Table 5 2016 AM Peak Hour External-External Through Traffic Volumes 20
Table 6 2016 PM Peak Hour External-External Through Traffic Volumes 21
Table 7 2016 AM Peak Hour Trip Generation Validation Results 23
Table 8 2016 PM Peak Hour Trip Generation Validation Results 24
Table 9 Trip Distribution Utility Paramters AM PK HR 25
Table 10 Trip Distribution Utility Paramters PM PK HR 25
Table 11 2016 AM Peak Hour Average Trip Time (Minutes) Model vs. Google 26
Table 12 2016 PM Peak Hour Average Trip Time (Minutes) Model vs. Google 26
Table 13 2016 KMPO Model AM/PM Peak Hour Screenline Summary Results 31

List of Figures

Figure 1 KMPO Calculate Procedures (Step by Step) 9
Figure 2 KMPO Calculate Procedures Model Run Comments..... 10
Figure 3 KMPO Land Use Classifications.....12
Figure 3 Model Flow Bundle to Calculate Travel Time (TT) 27
Figure 4 Change to model assignment method within procedure sequence 28
Figure 5 2016 KMPO VISUM Model AM Peak HourAssignment Results 29
Figure 6 2016 KMPO VISUM Model PM Peak Hour Assignment Results..... 30
Figure 7 2016 KMPO VISUM Model AM Peak Hour Traffic Forecast Screenline Results.. 33
Figure 8 2016 KMPO VISUM Model PM Peak Hour Traffic Forecast Screenline Results.. 34
Figure 9 2016 KMPO Model AM Peak Hour Screenline Error Range 35
Figure 10 2016 KMPO Model PM Peak Hour Screenline Error Range 35

Appendices – Attached

Appendix 1A: KMPO Project dir file.pdf A-2
KMPO Project directory file that directs the model to the proper file location

Appendix 1B: KMPO-Final Calculate Procedures File AM_PM.par A-4
A combined parameter file for the AM & PM peak hour KMPO Models

Appendix 1C: 2016 KMPO Model AM Peak Hour Screenline Validation Spreadsheets..... A-6

Appendix 1D: 2016 KMPO Model PM Peak Hour Screenline Validation Spreadsheets..... A-19

Appendix 1E: Final Model Results "Assignment Analysis" Comparison..... A-31

Introduction

In 2018, the Kootenai Metropolitan Planning Organization (KMPO) completed the update of their 2010 Travel Demand Forecasting VISUM Model. This 2016 update has improved the previous 2010 base model.

The KMPO Model provides the existing 2016 AM and PM peak hour traffic volumes and is used as a base model to project future traffic forecasts for the AM and PM peak hour traffic in the Kootenai County-wide area.

KMPO staff performed the 2016 model update calibration/validation with guidance and assistance from PTV Group. The 2010 KMPO base model was updated to become the 2016 KMPO base model. The majority of the 2016 modeling components were left as they were in the last update. This documentation outlines what has been changed since the last 2010 model update.

Travel demand forecasting models update the existing base year model every year or every other year or every five years depending on the land use growth and transportation improvements in the modeling area. This is because the traffic volume on streets and roadways change due to the changes in the land use and the transportation system.

The 2016 KMPO model update is expected to revalidate the 2010 existing base year model to reflect the most current conditions. Basic technical information about the 2010 KMPO VISUM model is provided in the "Kootenai County (KMPO) – 2010 KMPO Base Calibration Travel Demand Model Update Documentation." This report is focused on the 2016 KMPO travel demand model update, including methodology and enhancements.

In this KMPO 2016 model update, KMPO technical staff made the following changes, which are addressed in the thirteen sections of this report as shown below:

1. 2016 Model Geography
2. 2016 KMPO Model Data Sources
3. 2016 KMPO Model Background
4. KMPO Model Procedures
5. 2016 KMPO Land Use Update
6. 2016 AM & PM Peak Hour Trip Generation Rates
7. 2016 KMPO Auto Network Enhancements
8. Traffic Counts
9. AM/PM Peak Hour Trip Generation
10. AM/PM Peak Hour Trip Distribution
11. AM/PM Peak Hour Traffic Assignments
12. AM/PM Peak Hour Traffic Screenline Validation
13. Model Limitations and Improvements

More detailed technical specifications and model update descriptions are provided to assist the KMPO model users in their understanding of the model applications, data input and output, and validation results. Attached appendices illustrate even more

technical information related to the VISUM model parameter files and the 2016 AM/PM peak hour detailed screenline validation spreadsheets.

1.0 2016 Model Geography

- Kootenai County Area
- 2016 County Population estimate: 160,901
- Model Vehicle Miles Traveled (VMT) estimate: 355,543 miles in the PM peak hour
- Model Vehicle Hours of Travel (VHT) estimate: 10,460 hours in the PM peak hour
- Total 2016 Occupied Dwelling Units Estimate: 62,805

2.0 2016 KMPO Model Data Sources

Data from many agencies are compiled and analyzed for input into the travel demand model. The model is used for transportation travel demand forecasting. Ensuring that the most accurate, reliable and available data is used as well as having a well calibrated and validated model, is vitally important for accurate travel demand forecasting. KMPO uses the following data sources for input into the model:

- A regional household survey is used to estimate current travel behavior. KMPO's most recent survey was performed in 2005 and can be found on our website (www.kmpo.net), listed under Maps/Data/Publications/Spokane and Kootenai County Regional Travel Survey 2005. Household surveys are typically done every 10 years
- US Census Bureau Decennial data (every 10 years) for Transportation Analysis Zones (TAZ's) information based currently on the block level. The 2016 updated used 2016 American Community Survey 5-Year Estimates for reasonableness checks. The forecast years are calculated based on historical growth rates adopted in 2012.
- Idaho Department of Labor for current employment data
- Kootenai County for current housing statistics and Geographical Information Systems (GIS) data
- Building Permits from local jurisdictions
- Additional information that is not readily available is obtained from local sources such as: school & college enrollment, number of rooms in hotels/motels, casino parking spaces, recreation number of camping spaces, etc.)
- Comprehensive Plans from Kootenai County and Local Jurisdictions
- Traffic Counts
- Real Estate Reports and other verified published professional reports for reasonableness checks

3.0 2016 KMPO Model Background

The Kootenai Metropolitan Planning Organization (KMPO) was formed in 2003. The first KMPO traditional four-step travel demand model for the AM Peak Hour and the PM Peak Hour was developed by KMPO staff and PTV Group in 2003.

The typical gravity demand model is called a four-step model and is based upon: Trip Generation, Trip Distribution, Mode Choice and Route Assignment. Mode choice is made up of private cars, public transit such as buses, and/or non-motorized travel. The KMPO model is currently a three-step model, having only one mode choice which is private vehicles. This mode choice feature is planned to be expanded upon in the future adding other mode choices.

The model was updated in 2005 by PTV Group with completion of the 2005 Household travel survey to incorporate statistically valid data for Kootenai County travel behavior.

In 2007, the model was updated by HDR Inc. In 2010, the model was updated by KMPO staff with assistance from Eco Resource Management Systems Inc. and PTV Group to incorporate Census related data as it became available.

KMPO staff updated the model using data collected in 2016, with additional assistance from PTV Group.

4.0 KMPO Model Procedures

4.1 KMPO Calculate Procedures (Step by Step)

As shown in Figure 1, the KMPO “Calculate Procedure” (a step by step procedure) is used for output files for the AM and PM peak hour traffic forecasts in the Kootenai County area. Using the Calculate Procedures allows partial model runs (such as only the AM Peak hour), as well as visual checks to see and understand how each step is performing.

Count: 125	Execution	Active	Procedure	Reference object(s)	Variant/file	Comment	Success
2		☒	Initialize all filter settings				☒
3		☒	Read filter		TSysCar.fil		☒
4		☒	Edit attribute	Links - CapPrT		Set Link Capacity, Lanes * Cap/Lane	☒
5		☒	Edit attribute	Connectors - T0_TSys(C)		Test to set Connector Time	☒
6		☒	Read filter		TWLTL-3Lane.fil	3 Lane Road	☒
7		☒	Edit attribute	Links - CapPrT		Add 300 directional capacity	☒
8		☒	Read filter		TWLTL-5Lane.fil	5 Lane Road	☒
9		☒	Edit attribute	Links - CapPrT		Add 150 directional capacity	☒
10		☒	Read filter		Fwy_GT_2_Lanes.fil	3+ Lane Fwy	☒
11		☒	Edit attribute	Links - CapPrT		Add Cap for 3 Lane + Fwy	☒
12		☒	Edit attribute	Nodes - K4		Set All K4 = 1.0	☒
13		☒	Read filter		ActiveLinksNodes.fil	Start Node Computations	☒
14		☒	Edit attribute	Nodes - CapPrT		Add all outbound link capacities	☒
15		☒	Read filter		ActiveLinksNodes-3plusLegs.fil	3 Plus Leg Nodes	☒
16		☒	Edit attribute	Nodes - K4			☒
17		☒	Read filter		ActiveLinksNodes-2Leg.fil		☒
18		☒	Edit attribute	Nodes - K4			☒
19		☒	Read filter		ActiveLinksNodes-3Leg.fil		☒
20		☒	Edit attribute	Nodes - K4			☒
21		☒	Read filter		ActiveLinksNodes-4Leg.fil		☒
22		☒	Edit attribute	Nodes - K4			☒
23		☒	Read filter		ActiveLinksNodes-5Leg.fil		☒
24		☒	Edit attribute	Nodes - K4			☒
25		☒	Read filter		NodeCapacityFinalComputations.fil		☒
26		☒	Edit attribute	Nodes - CapPrT			☒
27		☒	Read filter		Turns-LT-TH-RT-Only.fil	Turns-LT-TH-RT-Only.fil	☒
28		☒	Edit attribute	Turns - CapPrT		Reset Turn Capacities	☒
29		☒	Edit attribute	Turns - t0PrT		Reset Turn T0=0	☒
30		☒	Read filter		SingleLeftTurnsSignalsTwoWayStops.fil	Single Left Turns	☒
31		☒	Edit attribute	Turns - t0PrT		T0=6Secs	☒
32		☒	Edit attribute	Turns - CapPrT		TurnCap=300	☒
33		☒	Read filter		DualLeftTurnsSignalsTwoWayStops.fil	Dual Left Turns	☒
34		☒	Edit attribute	Turns - CapPrT		TurnCap=275*NumLanes	☒
35		☒	Read filter		Uncontrolled_Intersections.fil	Set Uncontrolled Controls	☒
36		☒	Edit attribute	Nodes - ControlType		1-Uncontrolled	☒
37		☒	Read filter		Stop_2_Way_Intersections.fil	Set 2 Way Stop	☒
38		☒	Edit attribute	Nodes - ControlType		2-Partial Stop	☒
39		☒	Read filter		Yield_2_Way_Intersections.fil	Set Yield	☒
40		☒	Edit attribute	Nodes - ControlType		6-Yield	☒
41		☒	Read filter		Stop_All_Way_Intersections.fil	Set All Way Stop	☒
42		☒	Edit attribute	Nodes - ControlType		4-All Way Stop	☒

Figure 1: KMPO Calculate Procedures (Step by Step)

4.2 KMPO Calculate Procedures Parameter Files

Project directory – KMPO Project dir file.pfd (shown in Appendix 1A) is a VISUM project directory file, which specifies where the model runs.

Base Version – KMPO_2016_BASE_FINAL 11-9-18.ver is a 2016 Base KMPO VISUM Model version file in the project directory. The base model was validated and saved in VISUM Version 17.01-08. This includes the updated 2016 land uses and 2016 existing roadway network.

4.3 KMPO Final Model Version Output File

Final Version – "KMPO_2016_BASE_FINAL_11-9-18" is a final 2016 Base KMPO VISUM Model version file saved in the project directory after the completed AM/PM Peak Hour Model runs.

4.4 KMPO Calculate Procedures Model Run Comments

After the completed final model run, the Calculate Procedures comment area displays comments shows whether the model executed properly with success along with; start time, end time, duration, and any comments showing changes found or errors encountered. The final base model ran correctly with no errors or comments as shown in Figure 2 below:

Count: 125	Comment	Success	StartTime	EndTime	Duration	Messages	ResultMessage
1	Capacity calculation - Calculate Procedure	☒	11/9/2018 9:46:14 AM	11/9/2018 9:46:14 AM	0min	✓	
2		☒	11/9/2018 9:46:14 AM	11/9/2018 9:46:14 AM	0min	✓	
3		☒	11/9/2018 9:46:14 AM	11/9/2018 9:46:15 AM	1s	✓	
4	Set Link Capacity, Lanes * Cap/Lane	☒	11/9/2018 9:46:15 AM	11/9/2018 9:46:16 AM	1s	✓	Links: 5283 objects were changed.
5	Test to set Connector Time	☒	11/9/2018 9:46:16 AM	11/9/2018 9:46:17 AM	0min	✓	Connectors: 2064 objects were changed.
6	3 Lane Road	☒	11/9/2018 9:46:17 AM	11/9/2018 9:46:17 AM	0min	✓	
7	Add 300 directional capacity	☒	11/9/2018 9:46:17 AM	11/9/2018 9:46:18 AM	0min	✓	Links: 282 objects were changed.
8	5 Lane Road	☒	11/9/2018 9:46:18 AM	11/9/2018 9:46:18 AM	0min	✓	
9	Add 150 directional capacity	☒	11/9/2018 9:46:18 AM	11/9/2018 9:46:19 AM	0min	✓	Links: 420 objects were changed.
10	3+ Lane Fwy	☒	11/9/2018 9:46:19 AM	11/9/2018 9:46:19 AM	0min	✓	
11	Add Cap for 3 Lane + Fwy	☒	11/9/2018 9:46:19 AM	11/9/2018 9:46:19 AM	0min	✓	Links: 64 objects were changed.
12	Set All K4 = 1.0	☒	11/9/2018 9:46:20 AM	11/9/2018 9:46:21 AM	1s	✓	Nodes: 2471 objects were changed.
13	Start Node Computations	☒	11/9/2018 9:46:21 AM	11/9/2018 9:46:21 AM	0min	✓	
14	Add all outbound link capacities	☒	11/9/2018 9:46:21 AM	11/9/2018 9:46:22 AM	1s	✓	Nodes: 2391 objects were changed.
15	3 Plus Leg Nodes	☒	11/9/2018 9:46:22 AM	11/9/2018 9:46:23 AM	0min	✓	
16		☒	11/9/2018 9:46:23 AM	11/9/2018 9:46:23 AM	0min	✓	Nodes: 670 objects were changed.
17		☒	11/9/2018 9:46:24 AM	11/9/2018 9:46:24 AM	0min	✓	
18		☒	11/9/2018 9:46:24 AM	11/9/2018 9:46:24 AM	0min	✓	Nodes: 33 objects were changed.
19		☒	11/9/2018 9:46:24 AM	11/9/2018 9:46:25 AM	0min	✓	
20		☒	11/9/2018 9:46:25 AM	11/9/2018 9:46:25 AM	0min	✓	Nodes: 405 objects were changed.
21		☒	11/9/2018 9:46:25 AM	11/9/2018 9:46:26 AM	0min	✓	
22		☒	11/9/2018 9:46:26 AM	11/9/2018 9:46:26 AM	0min	✓	Nodes: 243 objects were changed.
23		☒	11/9/2018 9:46:26 AM	11/9/2018 9:46:27 AM	0min	✓	
24		☒	11/9/2018 9:46:27 AM	11/9/2018 9:46:27 AM	0min	✓	Nodes: 3 objects were changed.
25		☒	11/9/2018 9:46:27 AM	11/9/2018 9:46:28 AM	0min	✓	
26		☒	11/9/2018 9:46:28 AM	11/9/2018 9:46:28 AM	0min	✓	Nodes: 689 objects were changed.
27	Turns-LT-TH-RT-Only.fil	☒	11/9/2018 9:46:28 AM	11/9/2018 9:46:29 AM	0min	✓	
28	Reset Turn Capacities	☒	11/9/2018 9:46:29 AM	11/9/2018 9:46:29 AM	0min	✓	Turns: 8089 objects were changed.
29	Reset Turn T0=0	☒	11/9/2018 9:46:30 AM	11/9/2018 9:46:30 AM	0min	✓	Turns: 8089 objects were changed.
30	Single Left Turns	☒	11/9/2018 9:46:30 AM	11/9/2018 9:46:30 AM	0min	✓	
31	T0=6Secs	☒	11/9/2018 9:46:31 AM	11/9/2018 9:46:31 AM	0min	✓	Turns: 1624 objects were changed.
32	TurnCap=300	☒	11/9/2018 9:46:31 AM	11/9/2018 9:46:31 AM	0min	✓	Turns: 1624 objects were changed.
33	Dual Left Turns	☒	11/9/2018 9:46:32 AM	11/9/2018 9:46:33 AM	1s	✓	
34	TurnCap=275*NumLanes	☒	11/9/2018 9:46:33 AM	11/9/2018 9:46:33 AM	0min	✓	Turns: 29 objects were changed.
35	Set Uncontrolled Controls	☒	11/9/2018 9:46:33 AM	11/9/2018 9:46:34 AM	0min	✓	
36	1-Uncontrolled	☒	11/9/2018 9:46:34 AM	11/9/2018 9:46:34 AM	0min	✓	Nodes: 1702 objects were changed.
37	Set 2 Way Stop	☒	11/9/2018 9:46:34 AM	11/9/2018 9:46:34 AM	0min	✓	
38	2-Partial Stop	☒	11/9/2018 9:46:35 AM	11/9/2018 9:46:35 AM	0min	✓	Nodes: 451 objects were changed.
39	Set Yield	☒	11/9/2018 9:46:35 AM	11/9/2018 9:46:35 AM	0min	✓	
40	6-Yield	☒	11/9/2018 9:46:35 AM	11/9/2018 9:46:36 AM	0min	✓	Nodes: 64 objects were changed.
41	Set All Way Stop	☒	11/9/2018 9:46:36 AM	11/9/2018 9:46:36 AM	0min	✓	
42	4-All Way Stop	☒	11/9/2018 9:46:36 AM	11/9/2018 9:46:36 AM	0min	✓	Nodes: 23 objects were changed.
43	Set Signals	☒	11/9/2018 9:46:36 AM	11/9/2018 9:46:37 AM	0min	✓	

Figure 2: KMPO Calculate Procedures Model Run Comments

5.0 2016 KMPO Land Use Update

KMPO utilizes 23 land use categories to classify land use within the model based on NAICS codes. This allows KMPO to more easily match up to the Idaho DOL labor statistics for comparisons. No changes were made to the land use classifications during this update.

Land use data are important inputs to travel demand forecasting models because land uses generate travel activities and demands. To make accurate travel demand forecasts, modelers should strive to verify the accuracies of land use data in the traffic analysis zones (TAZ). KMPO staff took several rounds of land use reviews and verifications with local jurisdictions to ensure no errors exist in the land use data by TAZ.

5.1 2016 Dwelling Unit Estimation

The estimation of current and forecast dwelling units was challenging due to the lack of precise data between decennial census years. Total dwelling units were taken from Kootenai County's GIS structure shapefile. Since these are geocoded to the location of actual structures throughout the County, this data seemed more reliable than the US Census American Community Survey (ACS) 5-Year Estimates, even though the numbers were slightly higher.

While KMPO staff utilized 2010 jurisdictional growth rates and the number of persons per household used during the 2010 update, it was not appropriate to use the 2010 vacancy rates due to current economic conditions in the County. To determine the number of vacant dwelling units in the County, two methods were utilized. Based off of local real estate reports, a 1.5% blanket vacancy rate was used to reflect current conditions, particularly for multi-family units. Additionally, it was made apparent that some TAZs had much higher vacancy rates due to seasonal residency. KMPO staff compared historic vacancy rates for TAZs from 2000 and 2010 and determined that 23 TAZs had high seasonal residency (vacancy rates of ~30% and greater). For these TAZs, the 2010 vacancy rates were used to better calculate vacancy in these areas. This resulted in an average vacancy rate of 6.7% County-wide.

5.2 2016 Land Use Summary

KMPO uses 23 land use classifications to categorize land use within the KMPO model and apply appropriate trip generation rates. These land use classifications are based on NAICS codes to better match the Idaho Department of Labor's employment data. The 2016 model update utilized the same classifications from the 2010 model. For the 2016 update, additional NAICS codes were added for LU 22 and LU23 and further clarification was added to differentiate Land Use categories 1 and 9. Descriptions of the land use classifications are included in Figure 3.

After KMPO staff updated the 2016 land use by TAZ, a control total check was made to ensure that the primary residential dwelling units matched the current and projected population totals. Future population totals were compounded annually from 2016 data using the growth rates adopted by the KMPO Board March 8,2012. Table 1 is a summary of the 2016 land uses and totals obtained from the Kootenai County building permits, the Idaho Department of Labor and other sources manually obtained by KMPO staff through email correspondence, phone calls or the internet.

Figure 3: KMPO Land Use Classifications

2016 KMPO Land Use Update – DRAFT 05-04-2017

LU1 – (SFDU) Single Family Residential includes those lands occupied by a single family home, duplex, or a manufactured home on a single lot. During calibration, this category was divided and single family uses in "outer zones" (outside of cities ACI's) moved to Land Use category LU9 – Outer SFDU. LU1 is measured in single family dwelling units.

LU2 – (MFDU) Multi-Family Residential uses contain three or more residential units on a parcel of land. This category also includes mobile home parks, apartment buildings, and condominiums. LU2 is measured in multi-family dwelling units.

LU3 – (RET) Retail includes a broad range of establishments which sell goods directly to the general public, such as general commercial, home furnishings, food stores, direct selling establishments or other products. NAICS codes 441110 - 448320 & 451110 - 454390. LU3 is measured in employees.

LU4 – (FIRES) Finance, Insurance, Real Estate Rental & Leasing includes Commercial banking, financing, investment brokers, savings institutions, credit unions, investment advice, insurance carriers, real estate, rental and leasing, passenger car rental, recreational rentals, commercial air rail and water transportation, video tape and disc rental and other related companies. NAICS codes 521110 – 525990 & 531110 - 533110. LU4 is measured in employees.

LU5 – (INDUST) Industrial includes Mining, Manufacturing and Wholesale sectors which comprises establishments engaged in the mechanical, physical, or chemical transformation of materials, substances, or components into new products. This also includes the wholesale trade sector which comprises establishments engaged in wholesaling merchandise, generally without transformation, and rendering services Incidental to the sale of merchandise. The categories are mining operations, processing plants, packaging, mills, foundries, machining, wholesale goods merchants and wholesale trade agents and brokers. NAICS codes include 211111 – 213115, 311111 – 316998, 321113 – 327999, 331110 – 339999 & 423110 - 425120. LU5 is measured in number of employees.

LU6 – (SCH) Schools which include elementary and secondary schools. LU6 is measured in number of students, (manually derived).

LU7 – (ACCOM) Accommodations includes all hotel and motel establishments. NAICS codes 721110 - 721214. Hotels, Motels, bed/breakfast inns and room/board houses. Measured by number of rooms (manually derived).

LU8 – (AER) Arts, Entertainment and Recreation includes theater companies and dinner theatres, musical groups and artists, sports teams and clubs, racetracks, museums, zoos, amusement and theme parks, casinos, marinas, golf courses, recreation centers, bowling centers, RV Parks and campgrounds and other amusement and recreation industries. NAICS codes 711110 - 713990. Measured by number of spaces (manually derived).

LU9 – (OSFDU) Outer Single Family Residential includes those lands occupied by a single family home, duplex, or a manufactured home on a single lot outside the cities ACI areas. Units from classification LU1 were moved to this category for zones 1-17, 182-185, 187, 188, 192-213, and 215. LU9 is measured in outer single family dwelling units (rural).

LU10 – (PSS) Post-Secondary School included Colleges, Universities, Computer, Trade, and Other Professional Schools. LU10 is measured by number of students (manually derived).

LU11 – (AGRI) Agriculture includes NAICS code 111110 – 115310 and is measured in number of acres.

LU12 – (WFRT) Waterfront Units includes dwelling units on the water such as houseboats. LU12 is measured in dwelling units. Not included in Land Use at this time (future).

LU13 – (POL) Publicly owned land includes that land that is owned by the public, such as forest and BLM land. LU13 is measured in acres. KMPO used Kootenai County GIS parcel data to establish acreages within each TAZ area.

LU14 – (TRNWH) Transportation & Warehousing includes the Postal Service, Couriers and express delivery services, local messengers and delivery, general, farm & refrigerated warehousing and storage. This category includes the Transportation and Warehousing sector which comprises industries providing transportation passengers and cargo, warehousing and storage for goods, scenic and sightseeing transportation, and support activities related to modes of transportation. NAICS codes 481111 – 488999 & 491110 - 493190. LU14 is measured in employees.

LU15 – (MED) Medical is described in as the Health Care and Social Assistance sector which comprises establishments providing health care and social assistance for individuals. NAICS codes 621111 - 624410 (Note: Kootenai Medical

Figure 3: KMPO Land Use Classifications (Continued)

2016 KMPO Land Use Update – DRAFT 05-04-2017

Center -KMC Employees are not reported under this section by DOL, but instead are under LU 16 Government). In the travel demand model, KMC employees will remain in LU 15 (MED) to maintain the same trip generation rates. LU15 is measured in number of employees.

LU16 – (GOVT) Government includes establishments of federal, state, and local government agencies that administer, oversee, and manage public programs and have executive, legislative, or judicial authority over other institutions within a given area (KMC medical employees are reported under this LU, by Idaho DOL), Measured in number of employees. NAICS codes 921110 – 928120.

LU17 – (ASWMR) Administrative and Support and Waste Management and Remediation Services includes office administrative services, temporary help services, telemarketing, collection agencies, visitors' bureaus, locksmiths, landscaping services, solid waste collection, landfills, incinerators, septic tank services and related industries. Measured in number of employees. NAICS codes 561110 – 562998.

LU18 – (PSTMC) Professional, Scientific & Technical Services & Management of Companies & Enterprises includes Offices of Notaries, Payroll services, testing laboratories, technical design services, outdoor advertising, etc. Measured in number of employees. NAICS codes 541110 – 541990 & 551111 – 551114.

LU19 – (EDUSRV) Education Services include support staff in elementary and secondary schools, junior colleges, business and secretarial schools, miscellaneous training schools and education support services. Measured in number of employees. NAICS codes 611110 – 611710.

LU20 - OTHER Services (Except Public Administration) includes automotive repair, appliance repair and maintenance, diet centers, funeral homes, laundry services, photo finishing laboratories, religious organizations, civic and social organizations, business associations, political organizations, parking lots and garages and other miscellaneous services. NAICS codes 811111 – 814110. Measured in employees.

LU21 – (INFO) Information includes newspaper companies, software publishers, recording studios, radio stations, telecommunications and libraries. Measured in number of employees. NAICS codes 511110 – 519190.

LU22 – (UTLCONST) Utilities & Construction includes power generation, transmission and distribution by: hydroelectric, fossil, solar, wind, geothermal, biomass, electric, gas and other. Also, includes water supply, steam and air-conditioning supply and sewage treatment facilities, construction of new homes, highway, street and bridge construction, contractors for: structural steel framing, roofing, siding, painting, flooring, site preparation and all other specialty trade contractors. NAICS codes 221111 – 221330 & 236115 - 238992. Measured in number of employees.

LU23 – (FS) Food Services includes caterers, mobile food services, full service restaurants, drive-through, bars, cafeterias and buffets. NAICS codes 722110 – 722410 & 722511 - 722515, measured by number of employees.

Updates to Final Board Approved Land Use August 9, 2012

Table 1: 2016 KMPO Land Use Data Summary

Land Use Type	Total Units in KMPO Area	Units of Measurement
LU1: SFDU (Single Family Dwelling Units)	48,825	Dwelling Units
LU2: MFDU (Multi-Family Dwelling Units)	7,904	Dwelling Units
LU3: Retail	8,461	Employees
LU4: Commercial (FIRES)	2,851	Employees
LU5: Industrial	6,292	Employees
LU6: Schools	24,156	Students
LU7: Accommodations	2,932	Rooms
LU8: Arts, Entertainment & Recreation	19,592	Spaces
LU9: Reserved for Outer Zone SFDU	10,372	Dwelling Units
LU10: Post-Secondary Schools	21,219	Students
LU11: Agriculture	329,888	Acres
LU12: Waterfront Units	Not Used	Dwelling Units
LU13: Publicly-owned Lands	279,072	Acres
LU14: Transportation & Warehousing	785	Employees
LU15: Medical	9,966	Employees
LU16: Government	2,542	Employees
LU 17: Administration & Support	3,524	Employees
LU 18: Professional, Science & Technology	2,267	Employees
LU19: Educational Services	3,921	Employees
LU 20: Other Services	1,307	Employees
LU 21: Information	611	Employees
LU 22: Utilities & Construction	4,742	Employees
LU 23: Food Services	5,697	Employees

Note: FIRES stands for Finance, Insurance, Real Estate and Services

6.0 2016 AM & PM Peak Hour Trip Generation Rates

Table 2 shows the AM peak hour trip generation rates, based on ITE trip generation rates, which are applied in the “calculate procedures” parameter file under the 2016 KMPO AM Peak Hour Model Run.

Table 3 shows the PM peak hour trip generation rates, based on ITE trip generation rates, which are applied in the “calculate procedures” parameter file under the 2016 KMPO PM Peak Hour Model Run.

No changes were made to the trip generation rates in the 2016 model update.

Table 2: AM Peak Hour Trip Rates in 2016 KMPO AM Model

LU	ATT	HW-O	HW-D	WH-O	WH-D	HR-O	HR-D	RH-O	RH-D	HO-O	HO-D	OH-O	OH-D	HS-O	HS-D	SH-O	SH-D	NHB-O	NHB-D	Total-O	Total-D	TOT O+D
1	SFDU	0.2195	0	0	0.02376	0.0353	0	0	0.01368	0.1425	0	0	0.1062	0.1607	0	0	0.036	0.012	0.0004	0.57	0.18	0.75
2	MFDU	0.1435	0	0	0.01154	0.0231	0	0	0.00664	0.0894	0	0	0.05157	0.1118	0	0	0.0175	0.0048	0.0002	0.3726	0.0874	0.46
3	RETAIL	0	0.11742	0.026574	0	0	0.11742	0.0487	0	0	0	0	0	0	0	0	0	0.3676	0.3523	0.4429	0.5871	1.03
4	FIRES	0	0.14014	0.004784	0	0.006	0.02402	0	0	0	0.12	0.0598	0	0	0	0	0	0.049	0.1161	0.1196	0.4004	0.52
5	INDUST	0	0.153	0.006	0	0	0	0	0	0	0.102	0.024	0	0	0	0	0	0.03	0.085	0.06	0.34	0.4
6	SCH	0	0.02285	0.002688	0	0	0	0	0	0	0	0	0	0	0.26275	0.0672	0	0.0645	0	0.1344	0.2856	0.42
7	ACCOM	0.0144	0.0162	0.0144	0	0	0	0	0	0	0.049	0.0432	0	0	0	0	0	0.216	0.0972	0.288	0.162	0.45
8	AER	0	0.05513	0.00105	0	0	0	0	0	0	0.063	0.0341	0	0	0	0	0	0.0173	0.0394	0.0525	0.1575	0.21
9	OSFDU	0.1389	0	0	0.01045	0.0224	0	0	0.00602	0.0902	0	0	0.04673	0.1017	0	0	0.0158	0.0076	0.0002	0.3608	0.0792	0.44
10	PSS	0	0.00984	0.000432	0	0	0	0	0	0	0	0	0	0	0.08856	0.0108	0	0.0104	0	0.0216	0.0984	0.12
11	AGRI	0	0.00158	0.000075	0	0	0	0	0	0	9E-04	0.0006	0	0	0	0	0	0.0008	0.0011	0.0015	0.0035	0.005
12	Not Used	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
13	POL	0	0.0002	2.15E-05	0	0	0	0	0	0	2E-04	0.0003	0	0	0	0	0	0.0001	0.0002	0.0004	0.0006	0.001
14	TRNWH	0	0.1862	0.0228	0	0	0	0	0	0	0.16	0.0912	0	0	0	0	0	0.114	0.1862	0.228	0.532	0.76
15	MED	0	0.1575	0.045	0	0	0	0	0	0	0.135	0.27	0	0	0	0	0	0.135	0.1575	0.45	0.45	0.9
16	GOVT	0	0.18788	0.00366	0	0	0	0	0	0	0.161	0.0476	0	0	0	0	0	0.022	0.1879	0.0732	0.5368	0.61
17	ASWMR	0	0.14469	0.004664	0	0.0058	0.02067	0	0	0	0.124	0.0583	0	0	0	0	0	0.0478	0.124	0.1166	0.4134	0.53
18	PSTMC	0	0.14469	0.004664	0	0.0058	0.02067	0	0	0	0.124	0.0583	0	0	0	0	0	0.0478	0.124	0.1166	0.4134	0.53
19	EDUSRV	0	0.14469	0.004664	0	0.0058	0.02067	0	0	0	0.124	0.0583	0	0	0	0	0	0.0478	0.124	0.1166	0.4134	0.53
20	OTHER	0	0.14469	0.004664	0	0.0058	0.02067	0	0	0	0.124	0.0583	0	0	0	0	0	0.0478	0.124	0.1166	0.4134	0.53
21	INFO	0	0.14469	0.004664	0	0.0058	0.02067	0	0	0	0.124	0.0583	0	0	0	0	0	0.0478	0.124	0.1166	0.4134	0.53
22	UTLCONST	0	0.1862	0.0228	0	0	0	0	0	0	0.16	0.0912	0	0	0	0	0	0.114	0.1862	0.228	0.532	0.76
23	FS	0	0.11742	0.026574	0	0	0.11742	0.0531	0	0	0	0	0	0	0	0	0	0.3632	0.3523	0.4429	0.5871	1.03
	XI-O-AM	0.19	0	0.08	0	0.05	0	0.03	0	0.22	0	0.1	0	0.18	0	0.06	0	0.09	0	1	0	1

Note: Numbers rounded in table

Table 3: PM Peak Hour Trip Rates in 2016 KMPO PM Model

LU	ATT	HW-O	HW-D	WH-O	WH-D	HR-O	HR-D	RH-O	RH-D	HO-O	HO-D	OH-O	OH-D	HS-O	HS-D	SH-O	SH-D	NHB-O	NHB-D	Total-O	Total-D	TOT O+D
1	SFDU	0.01446	0	0	0.1714	0.054	0	0	0.0932	0.2939	0	0	0.3805	0.0019	0	0	0.0219	0.0214	0.01851	0.38565	0.6856	1.07125
2	MFDU	0.00757	0	0	0.09801	0.0283	0	0	0.0533	0.1539	0	0	0.2176	0.001	0	0	0.0129	0.01121	0.01019	0.20196	0.39204	0.594
3	RETAIL	0	0.02208	0.1196	0	0	0.15456	0.2392	0	0	0.1546	0.0718	0	0	0	0	0	0.76544	0.7728	1.196	1.104	2.3
4	FIRES	0	0.00721	0.13992	0	0	0.01802	0.06996	0	0	0.2523	0.4198	0	0	0	0	0	0.06996	0.08289	0.6996	0.3604	1.06
5	INDUST	0	0.00666	0.0407	0	0	0	0	0	0	0.0833	0.1018	0	0	0	0	0	0.06105	0.07659	0.2035	0.1665	0.37
6	SCH	0	0.0012	0.0189	0	0	0	0	0	0	0.015	0.009	0	0	0.0018	0.0315	0	0.0306	0.042	0.09	0.06	0.15
7	ACCOM	0	0.00508	0.04324	0	0	0	0	0	0	0.1523	0.1405	0	0	0	0	0	0.03243	0.09644	0.2162	0.2538	0.47
8	AER	0	0.00142	0.01539	0	0	0	0	0	0	0.0497	0.05	0	0	0	0	0	0.01154	0.01989	0.07696	0.07104	0.148
9	OSFDU	0.00591	0	0	0.07313	0.0221	0	0	0.0398	0.12	0	0	0.1623	0.0008	0	0	0.0094	0.00874	0.0079	0.1575	0.2925	0.45
10	PSS	0	0.00154	0.00907	0	0	0	0	0	0	0.0192	0.0043	0	0	0.0023	0.0151	0	0.01469	0.05376	0.0432	0.0768	0.12
11	AGRI	0	1.5E-05	0.0007	0	0	0	0	0	0	0.0006	0.0014	0	0	0	0	0	0.0014	0.00089	0.0035	0.0015	0.005
12	WFRT	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
13	POL	0	4.3E-06	0.00011	0	0	0	0	0	0	0.0003	0.0004	0	0	0	0	0	5.7E-05	0.00012	0.00057	0.00043	0.001
14	TRNWH	0	0.00456	0.1292	0	0	0	0	0	0	0.057	0.323	0	0	0	0	0	0.1938	0.05244	0.646	0.114	0.76
15	MED	0	0.02017	0.14514	0	0	0	0	0	0	0.353	0.4354	0	0	0	0	0	0.14514	0.13112	0.7257	0.5043	1.23
16	GOVT	0	0.00324	0.09322	0	0	0	0	0	0	0.2267	0.2797	0	0	0	0	0	0.09322	0.09393	0.4661	0.3239	0.79
17	ASWMR	0	0.0036	0.13992	0	0	0.01802	0.06996	0	0	0.2523	0.4198	0	0	0	0	0	0.06996	0.0865	0.6996	0.3604	1.06
18	PSTMC	0	0.0036	0.13992	0	0	0.01802	0.06996	0	0	0.2523	0.4198	0	0	0	0	0	0.06996	0.0865	0.6996	0.3604	1.06
19	EDUSRV	0	0.0036	0.13992	0	0	0.01802	0.06996	0	0	0.2523	0.4198	0	0	0	0	0	0.06996	0.0865	0.6996	0.3604	1.06
20	OTHER	0	0.0036	0.13992	0	0	0.01802	0.06996	0	0	0.2523	0.4198	0	0	0	0	0	0.06996	0.0865	0.6996	0.3604	1.06
21	INFO	0	0.0036	0.13992	0	0	0.01802	0.06996	0	0	0.2523	0.4198	0	0	0	0	0	0.06996	0.0865	0.6996	0.3604	1.06
22	UTLCONS	0	0.0057	0.1292	0	0	0	0	0	0	0.0798	0.323	0	0	0	0	0	0.1938	0.0285	0.646	0.114	0.76
23	FS	0	0.01104	0.1196	0	0	0.16556	0.2392	0	0	0.1656	0.0718	0	0	0	0	0	0.76544	0.76176	1.196	1.104	2.3
	XI-O-PM	0.03	0	0.14	0	0.06	0	0.1	0	0.24	0	0.3	0	0	0	0.01	0	0.12	0	1	0	1
	IX-D-PM	0	0.03	0	0.13	0	0.1	0	0.06	0	0.3	0	0.24	0	0	0	0.01	0	0.13	0	1	1

Note: Numbers rounded in table

7.0 2016 KMPO Auto Network Enhancements

Between 2010 and 2016, several roadway improvement projects were made in the KMPO area. The 2016 roadway network should include these improvements to reflect what is on the ground in 2016. Updates were made to the project list by the jurisdictions and the changes were reflected in the base model network for any projects already existing in the year 2016.

7.1 2016 External Trip Update

In the 2016 KMPO model, the trips coming from and to external areas are not based on the land use data for trip generation but instead are based on the existing 2016 directional traffic counts at the external stations. Fifteen external stations (TAZ 576 – TAZ 592) were used in the 2016 KMPO model to conceptually represent external TAZs. An additional external station (TAZ 592) was added where Elder Road enters Washington state.

Table 6 lists all of AM and PM peak hour directional traffic count data at each of the external TAZs. Note X-I stands for “from External to Internal” and vice versa.

Table 7 and Table 8 respectively list the 2016 AM and PM peak hour external-external through trips, which were also extracted from the external traffic counts.

7.2 2016 Link Traffic Count Update

The 2016 AM and PM peak hour traffic counts were coded by KMPO staff in the KMPO model for the purpose of model validation. Regression analyses can be directly performed by using the model volumes to compare with the peak hour traffic counts.

7.3 Model’s External Traffic Analysis Zone (TAZ) Update

The external stations exist at the model borders and are used to simulate traffic entering and exiting the travel demand model. Actual traffic counts were used at each external TAZ station and then adjusted to correct the internal model matrices to match the counts. A travel demand model uses matrices to calculate the trip generation and distribution from a trip origin to a trip destination. Table 4 shows the adjusted counts at the external to internal (X-I) and internal and external (I-X) count locations for both the AM PK Hr and PM PK Hr time frames. Tables 5 and 6 respectively show the internal matrices that correspond to the external to external TAZ’s (travel beginning at one external TAZ and exiting at the other external TAZ location).

Table 4: 2016 AM/PM Peak Hour Counts at External TAZs

TAZ #	Location	XI-O-AM	IX-D-AM	XI-O-PM	IX-D-PM
576	State Hwy. 41 - N. County Line	84	169	240	355
577	US 95 - N. County Line	216	206	349	426
578	Bayview Road - N. County Line	22	12	25	19
580	E. Canyon Road - E. County Line	16	18	27	26
581	I-90 - E. County Line	228	232	483	348
582	Future	0	0	0	0
583	State Hwy. 3 - S. County Line	41	72	86	43
584	Heyburn Rd. - S. County Line	12	7	10	15
585	US 95 - S. County Line	296	279	450	465
586	W. Worley West Rd. - W. County Line	1	2	1	2
587	State Hwy. 58 (E. Hoxie Rd.) - W. County Line	42	57	110	160
588	W. Riverview Drive - W. County Line	61	87	51	56
589	I-90 - W. County Line	1760	2532	3100	2410
590	Seltice Way - W. County Line	378	388	478	458
591	State Hwy. 53 (Trent Ave.) - W. County Line	206	390	649	332
592	Elder Rd. – E. County Line	22	49	39	58
TOTALS		3385	4500	6098	5173

Table 5: 2016 AM Peak Hour External-External Through Traffic Volumes

TAZ No.	Name	576	577	578	580	581	582	583	584	585	586	587	588	589	590	591	592
576	State Hwy 41 - North County Line	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.90	0.00	0.15	148.18	0.00
577	US 95 - North County Line	0.00	0.00	0.00	10.12	69.88	0.00	0.11	0.00	4.10	0.00	0.96	0.00	0.00	0.00	0.00	0.00
578	Bayview Rd. - North County Line	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
580	East Canyon Rd. - East County Line	0.00	0.08	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.89	0.00	0.00	0.00
581	I-90 East County Line	0.00	0.38	0.00	0.00	0.00	0.00	0.02	0.00	0.00	0.00	0.00	0.00	79.25	0.00	0.00	0.00
582	FUTURE (Not Used)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
583	State Hwy 3 - South County Line	0.00	0.08	0.00	0.44	2.77	0.00	0.00	0.00	0.00	0.00	0.00	0.00	5.51	0.00	0.00	0.00
584	Heyburn Rd. - South County Line	0.00	0.05	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.02	0.00	0.00	0.00	0.00	0.00
585	US 95 - South County Line	0.00	66.94	0.00	0.00	4.99	0.00	0.00	0.00	0.00	0.00	21.59	0.54	1.93	0.00	0.00	0.00
586	Worley West Road - West County Line	0.00	1.19	0.00	0.00	0.00	0.00	0.00	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
587	State Hwy 58 (East Hoxie Rd.) West County Line	0.00	26.54	0.00	0.00	0.00	0.00	0.00	0.00	36.49	0.00	0.00	0.23	0.00	0.00	0.00	0.00
588	West Riverview Drive - West County Line	0.00	3.34	0.00	0.03	0.16	0.00	0.00	0.00	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00
589	I-90 West County Line	0.00	0.00	0.00	0.33	29.52	0.00	0.00	0.00	0.23	0.00	0.00	0.00	0.01	0.00	0.00	0.00
590	Seltice Way - West County Line	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
591	State Hwy 53 (Trent Ave.) West County Line	33.29	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
592	Elder Rd. – East County Line	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

Table 6: 2016 PM Peak Hour External-External Through Traffic Volumes

TAZ No.	Name	576	577	578	580	581	582	583	584	585	586	587	588	589	590	591	592
576	State Hwy 41 - North County Line	0.00	0.00	0.00	0.08	0.10	0.00	0.07	0.04	0.08	0.03	0.09	0.18	0.11	0.18	0.77	0.00
577	US 95 - North County Line	0.00	0.00	0.00	0.99	1.42	0.00	0.17	0.54	0.48	0.37	0.33	0.14	0.54	0.01	0.03	0.00
578	Bayview Rd. - North County Line	0.00	0.00	0.00	0.20	0.03	0.00	0.17	0.11	0.19	0.07	0.22	0.14	0.00	0.00	0.01	0.00
580	East Canyon Rd. - East County Line	0.09	0.46	0.12	0.00	0.00	0.00	0.45	0.00	0.00	0.00	0.00	0.18	1.96	0.36	0.27	0.00
581	I-90 East County Line	0.11	0.70	0.01	0.00	0.00	0.00	0.16	0.02	0.24	0.00	0.14	0.06	74.70	0.34	0.29	0.00
582	FUTURE (Not Used)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
583	State Hwy 3 - South County Line	0.05	0.07	0.06	0.28	0.14	0.00	0.00	0.00	0.00	0.00	0.00	0.01	8.46	0.04	0.03	0.00
584	Heyburn Rd. - South County Line	0.11	0.51	0.13	0.00	0.30	0.00	0.00	0.00	0.00	0.57	0.47	0.01	0.35	0.03	0.02	0.00
585	US 95 - South County Line	0.38	1.03	0.44	0.00	0.83	0.00	0.00	0.00	0.00	0.00	0.32	0.00	7.97	0.04	0.04	0.00
586	Worley West Road - West County Line	0.07	0.31	0.08	0.00	0.00	0.00	0.00	0.52	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
587	State Hwy 58 (East Hoxie Rd.) West County Line	0.41	0.37	0.47	0.00	0.00	0.00	0.00	0.84	0.15	0.00	0.00	0.01	0.24	0.01	0.02	0.00
588	West Riverview Drive - West County Line	0.16	0.00	0.00	0.12	0.06	0.00	0.01	0.13	0.05	0.00	0.00	0.00	0.00	0.00	0.01	0.00
589	I-90 West County Line	0.47	0.68	0.01	0.87	74.64	0.00	10.01	1.13	24.85	0.11	0.00	0.00	0.00	0.00	0.00	0.00
590	Seltice Way - West County Line	1.15	0.02	0.01	0.18	0.23	0.00	0.03	0.15	0.13	0.00	0.09	0.00	0.00	0.00	0.00	0.00
591	State Hwy 53 (Trent Ave.) West County Line	1.28	0.03	0.01	0.09	0.15	0.00	0.02	0.00	0.05	0.00	0.03	0.01	0.00	0.00	0.00	0.00
592	Elder Rd. – East County Line	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

8.0 Traffic Counts

Existing traffic counts from 2016, as well as counts from 2013, 2014, and 2015 grown to the update year, were used for the 2016 KMPO base model validation. Some traffic counts from 2017 were also used for locations missing data. The existing traffic count data had previously been collected during normal travel patterns.

Traffic counts are checked for errors and consistency to ensure they are accurate. Traffic counts taken exclude: weekends, holidays, vacation days, and construction. When available, three out of the five days of data are then averaged for each of the following model periods: AM period (6 AM – 9AM), AM peak hour, PM period (3 PM – 6 PM), and PM Peak hour. There were some locations where only one or two days of data was available. In these cases, care was taken to validate the data, such as comparing it to adjacent locations, to ensure these counts reflected average conditions. Any suspect counts (example: tube malfunctioned or limited data) during that time period are excluded and, if available, another day or year's will be used to calculate the average. The AM Peak Hour, PM Peak Hour, AM Period and PM Period actual traffic counts are used to validate the modeled traffic volumes and are discussed later in the "Screenline Validation" section of this documentation.

A traffic count analysis was also performed using the Idaho Transportation Department's (ITD) Automatic Traffic Recorder (ATR) data analysis, over the last 20-year period from 1996 to 2016. During the five-year period from 2011 to 2016, the analysis showed an average growth rate of 3.17% per year and the more recent analysis between the years 2014 to 2016 showed an average growth rate of 5.13% per year. While the ATR count data reflects the mainline regional traffic growth, it may not accurately reflect local roadway network growth. The 20-year growth rate of 1.65% per year was used to grow the existing traffic counts to 2016. The external-external matrices were also grown from 2010 using this growth rate.

9.0 AM/PM Peak Hour Trip Generation

The KMPO VISUM model trip generation is categorized by four primary trip purposes. After the AM and PM peak hour trip generation model is run, the total KMPO region-wide trip productions and attractions are summarized to compare with the expanded travel survey samples reported in the "Spokane and Kootenai County Regional Travel Survey Final Report."

9.1 AM Peak Hour Trip Generation Validation

Table 7 lists the 2016 AM peak hour trip generation model percentages results compared with the actual AM peak hour (7 AM – 8 AM) trips as reported by NuStats.

The AM peak hour model results show reasonable comparison with the survey results as the percentage of modeled vehicle trips that exclude the external inbound, outbound, and through trips. The 2005 Kootenai County/Spokane Travel survey percentages were used to calculate the trip generation rates in the model.

Table 7: 2016 AM Peak Hour Trip Generation Validation Results

TRIP PURPOSE	AM-PK HR % of Trips Modeled 2016 Base Model	AM PK HR of 2005 Trips Reported by NuStats
Home Based Work	23.8%	25.2%
Home Based Retail	5.3%	5.3%
Home Based Other	29.9%	28.2%
Non-Home Based	20.8%	20.7%
School – not included in other trip purposes	20.2%	20.6%
Total	100%	100%

9.2 PM Peak Hour Trip Generation Validation

Table 8 lists the 2016 PM peak hour trip generation model percentages results compared with the actual PM peak hour (5 PM – 6 PM) trips as reported by NuStats.

The PM peak hour model results show reasonable comparison with the survey results as the modeled vehicle trips that exclude the external inbound, outbound and through trips. The 2005 Kootenai County/Spokane Travel survey percentages were used to calculate the trip generation in the model. The trip generation rates were then checked against the 2005 Kootenai County/Spokane County travel survey results.

Table 8: 2016 PM Peak Hour Trip Generation Validation Results

TRIP PURPOSE	PM-PK HR % of Trips Modeled 2016 Base Model	PM PK HR of 2005 Trips Reported by NuStats
Home Based Work	13.5%	13.4%
Home Based Retail	11.1%	10.6%
Home Based Other	48.2%	48.1%
Non-Home Based	25.5%	26.2%
Schools - not included in other trip purposes	1.7%	1.7%
Total	100%	100%

10.0 AM/PM Peak Hour Trip Distribution

The KMPO VISUM model utilizes five primary trip purposes for trip distribution. These trip purposes are based on Gravity Model functions. The a, b, and c parameters in the Gravity Model functions are calibrated in the 2016 KMPO model to fit the trip length distribution patterns in terms of frequencies and average travel times reported in the "Spokane and Kootenai County Regional Travel Survey Final Report." No changes were made to the trip distribution parameters during the 2016 model update.

Table 9: Trip Distribution Utility Parameters AM PK HR

Trip Purpose	Trip Distribution Parameter		
	a	b	c
HB-Work	-0.1	1.7	5
HB-Retail	0	2.7	0
HB-Other	0	2.7	0
Non-Home Based	0	2.8	0
HB-School	0	2.7	0

Table 10: Trip Distribution Utility Parameters PM PK HR

Trip Purpose	Trip Distribution Parameter		
	a	b	c
HB-Work	-0.1	1.4	5
HB-Retail	0	2.4	0
HB-Other	0	2.4	0
Non-Home Based	0	2.5	0
HB-School	0	2.4	0

10.1 Gravity Model Calibration/Validation Results

A random sampling of travel times from one traffic analysis zone (TAZ) to another was extracted from the model using flow bundles. The same path was input into Google Maps to estimate actual travel times during the AM PK hour and PM PK hours. It is important to note that the travel times via Google maps are subject to change at any point due to actual roadway and traffic conditions. This may cause variations in route choice and travel time that differ from the model outputs.

As shown in Table 11 and 12, the average model travel time roughly matches the average observed Google travel time for overall KMPO region-wide, despite some average travel time variations.

Table 11: 2016 AM Peak Hour Average Travel Time (Minutes) – 2016 Base Model Vs. Google Estimated Travel Times (In Current Traffic when available)

O Zone	D Zone	From Place	To Place	Length	t0	tCur	Google TT	Difference
401	20	Cabela's	Rathdrum	12.04mi	15min	16min	23min	7min
401	10	Cabela's	Silverwood Vic.	21.82mi	25min	28min	35min	7min
424	10	KMPO	Silverwood Vic.	20.16mi	24min	29min	33min	4min
589	161	State Line	Kootenai Health	13.26mi	13min	16min	17min	1min
589	581	State Line	Kootenai East Border	44.07mi	37min	40min	42min	2min
589	204	State Line	Worley	41.84mi	36min	46min	44min	2min
204	11	Worley	Athol	49.30mi	51min	60min	56min	4min
400	424	Hauser Lake	Downtown CDA	16.97mi	19min	23min	24min	1min

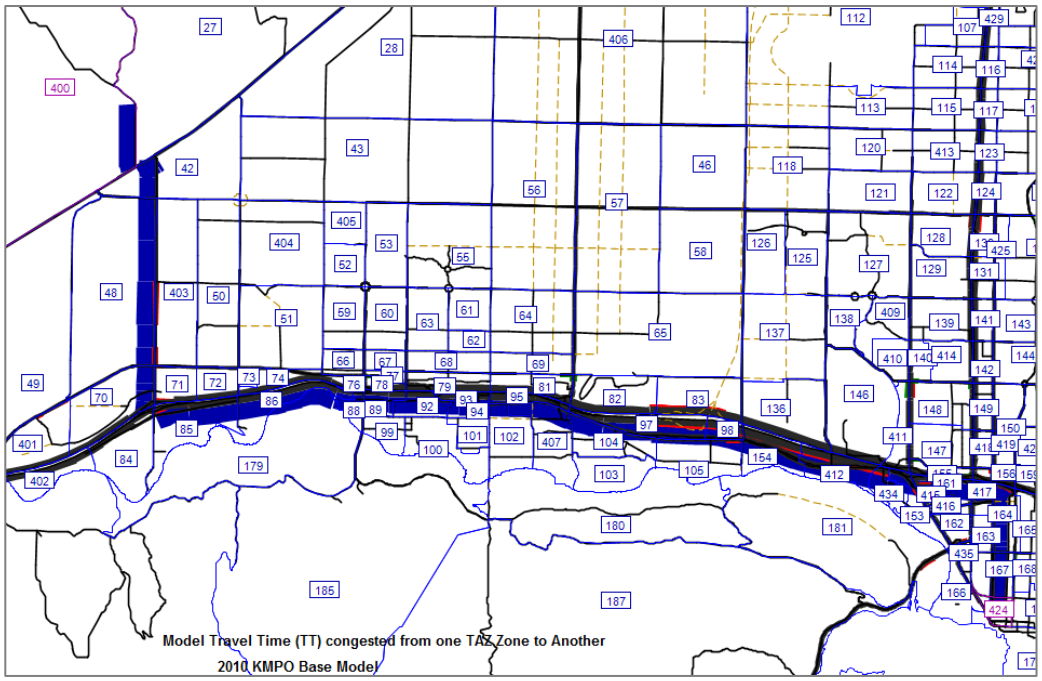
Legend: TT= Travel Time, O Zone = OriginZone, D Zone = Destination Zone, t0= Free flow TT, tCur (Congested TT).

Table 12: 2016 PM Peak Hour Average Travel Time (Minutes) – 2016 Base Model Vs. Google Estimated Travel Times (In Current Traffic when available)

O Zone	D Zone	From Place	To Place	Length	t0	tCur	Google TT	Difference
401	20	Cabela's	Rathdrum	12.11mi	15min	17min	23min	6min
401	10	Cabela's	Silverwood Vic.	21.89mi	25min	29min	36min	7min
424	10	KMPO	Silverwood Vic.	20.03mi	24min	35min	34min	1min
589	161	State Line	Kootenai Health	13.24mi	12min	20min	17min	3min
589	581	State Line	Kootenai East Border	44.07mi	37min	43min	41min	2min
589	204	State Line	Worley	41.84mi	36min	49min	43min	6min
204	11	Worley	Athol	49.38mi	51min	66min	60min	6min
400	424	Hauser Lake	Downtown CDA	16.80mi	19min	26min	24min	2min

Legend: TT= Travel Time, O Zone = OriginZone, D Zone = Destination Zone, T0= Free flow TT, TCur (Congested TT).

Figure 4: Model Flow Bundle to Calculate Travel Time



The model flow bundle path to calculate the congested average travel time (tCur) from one TAZ zone to another.

11.0 AM/PM Peak Hour Traffic Assignments

The 2016 AM peak hour KMPO Model traffic assignments are displayed in Figure 6 and the 2016 PM peak hour KMPO Model traffic assignments are displayed in Figure 7.

The traffic assignment figures provide a snapshot of directional traffic volumes for the AM and PM peak hour in the urbanized KMPO area.

Since the directional traffic forecasts need to be evaluated for statistical accuracy and confidence, screenline validation analysis is performed for both AM and PM peak hour conditions. Appendix 1C and Appendix 1D show the 2016 KMPO Model AM/PM peak hour screenline spreadsheets, respectively.

11.1 Traffic Assignment Method Update

The traffic assignment method was changed in the 2016 Base Model from Equilibrium assignment to Bi-conjugate Frank Wolfe assignment (Figure 5). This was done for two reasons. First, this assignment method produces more consistent route flows (i.e. proportionality for select link analysis). Second, it is better/more equitable at scaling of Origin-Destination flows when using Origin-Destination Matrix Estimation (ODME) to develop correction factors.

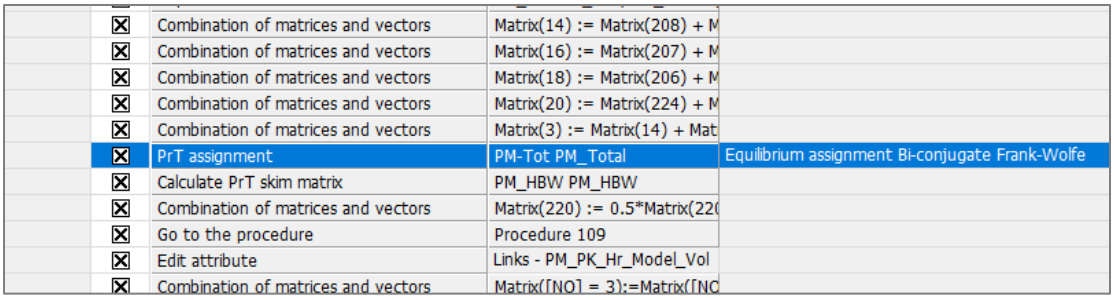


Figure 5: Change to model assignment within procedure sequence

In order to smooth out the model assignment outputs to better match actual traffic flows, PTV Group carried out an Origin-Destination Matrix Estimation (ODME) for both AM and PM time periods. Based on this estimation, an adjustment factor matrix was computed and the adjusted flows were re-assigned to the network. This was done to bring the model flows in closer agreement with counted flows. The adjustment calculations used were based off of the ratio method in the NCHRP Report 255 guidelines. This adjustment is also proportionally applied to the forecast condition to produce flows that account for current model bias/error. Additional link attributes were created to store unadjusted model flows, as well as adjusted model flows, in order to allow model users to summarize and juxtapose both flows and exercise judgement in interpretation of model results.

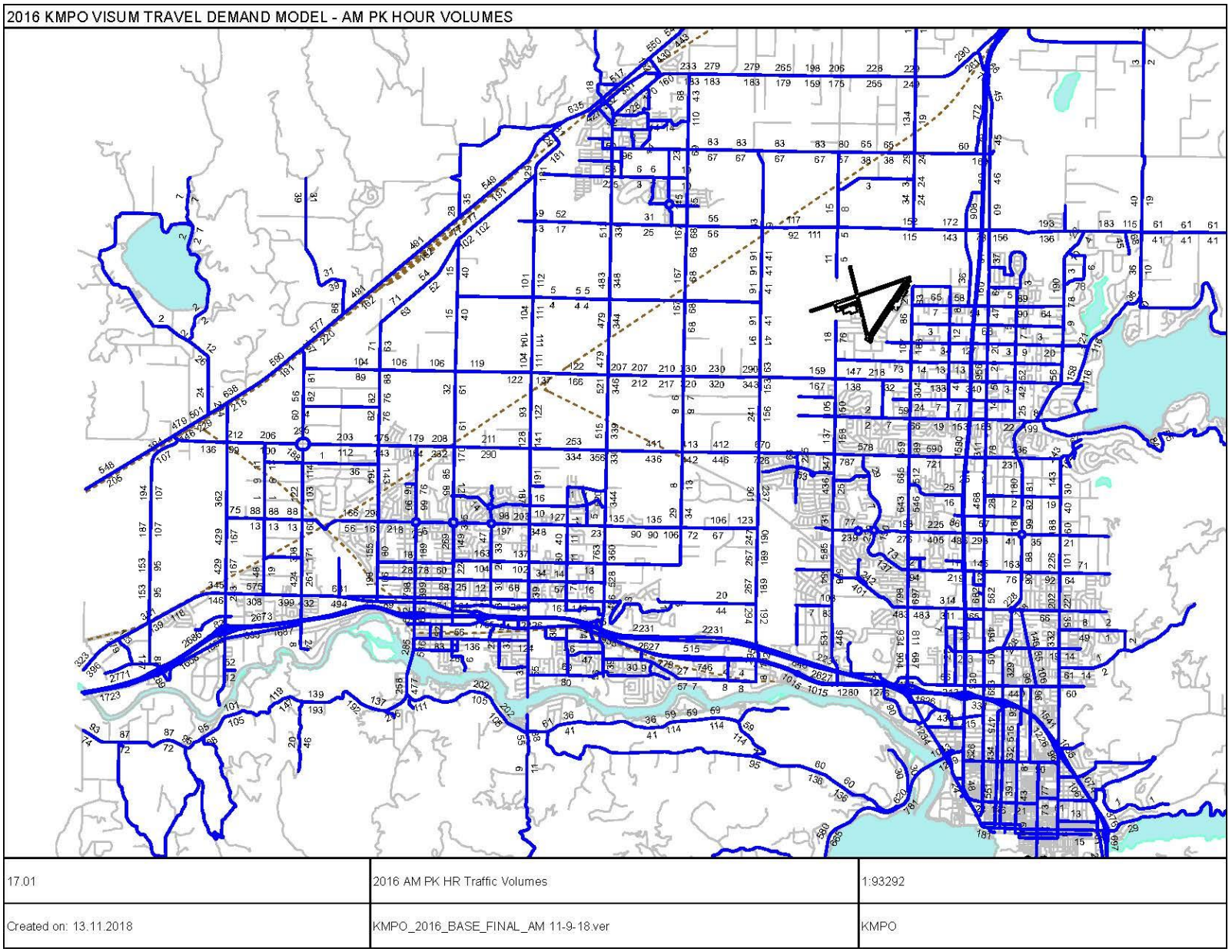


Figure 6: 2016 KMPO VISUM Model AM Peak Hour Traffic Assignment Results

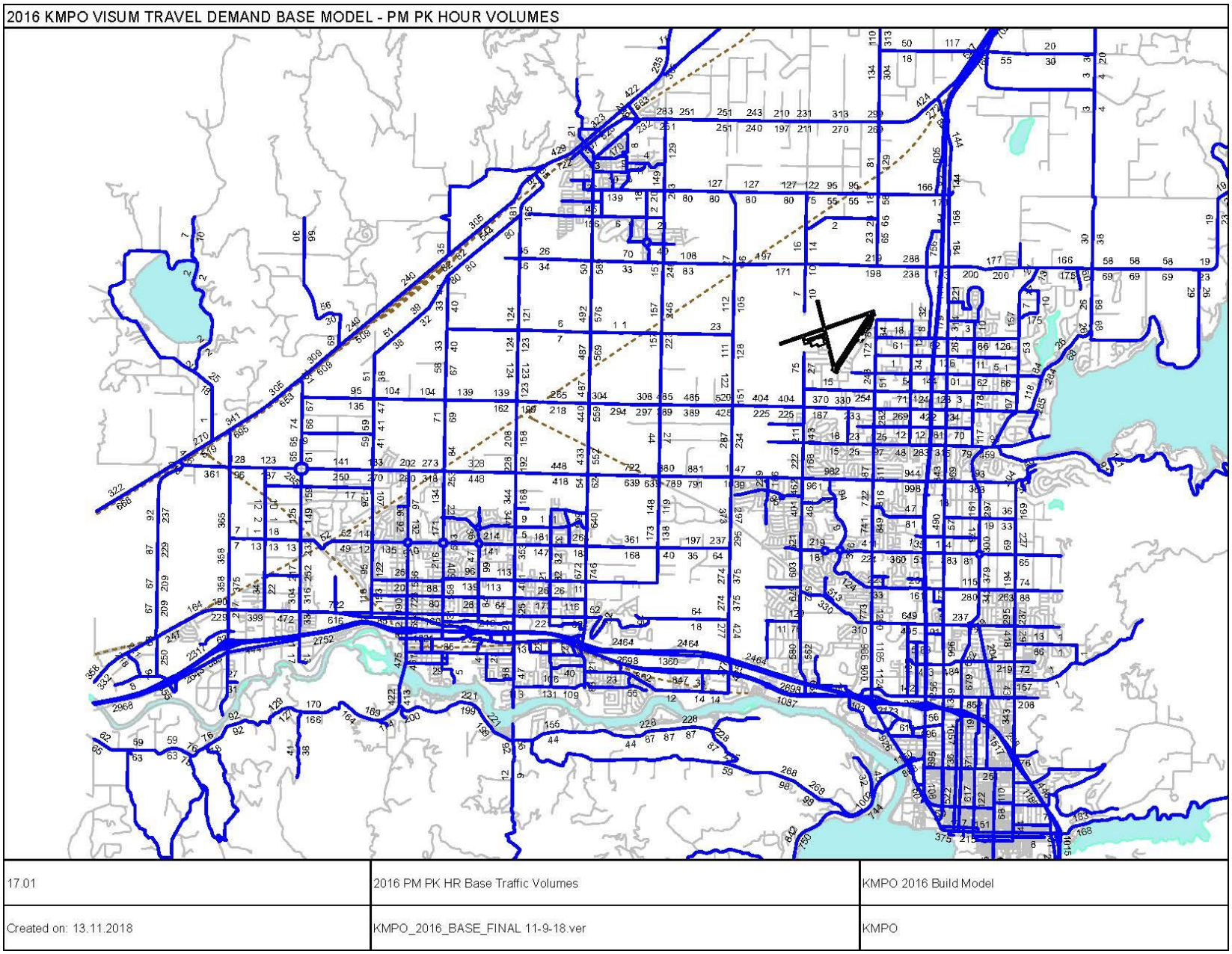


Figure 7: 2016 KMPO VISUM Model PM Peak Hour Traffic Assignment Results

12.0 AM/PM Peak Hour Traffic Screenline Validation

As shown in the following Figure 8 and Figure 9, twenty-eight screenlines are drawn to display ratios of the 2016 KMPO model AM and PM peak hour traffic modeled volumes over their corresponding traffic counts. Table 13, below, shows a summary of the screenline results.

Table 13: 2016 KMPO Model AM/PM Peak Hour Screenline Summary Results

Screenline Location and No.	***AM Peak Hour Model/Count Ratio***	***PM Peak Hour Model/Count Ratio***
Spokane River Crossing Screenline #1	No data	No data
Seltice Screenline #2	1.13	1.17
Harrison Avenue Screenline # 3	1.00	1.10
Appleway Ave/Best Screenline #4	1.03	0.88
Seltice/Mullan Rd/Kathleen Screenline #5	1.11	1.01
Poleline Road Screenline #6	1.06	1.04
Prairie Road Screenline #7	1.03	1.05
Hayden Avenue Screenline #8	0.97	0.91
Lancaster Road Screenline #9	0.82	0.85
SH 53 – US 95 Screenline #10	1.10	1.11
Twin Lakes to National Forest Screenline #11	1.37	1.15
US 95 to SH 3 South Screenline #12	0.84	0.87
SH 95 to LaTour Creek Rd Screenline #13	1.25	1.59
Spirit Lake Pend'O Reille Screenline #14	1.01	0.98
Pleasant View Road Screenline #15	No data	1.27
McGuire Road Screenline #16	No data	1.31
Chase Road Screenline #17	No data	1.18
Spokane Street Screenline #18	No data	1.14
Idaho Street Screenline #19	1.04	1.08
Greensferry Road Screenline #20	0.76	1.21
SH 41 Screenline #21	1.05	0.95
Huetter Road Screenline #22	1.46	1.48
Ramsey Road Screenline #23	1.01	1.08
US 95 Screenline #24	1.05	1.00

West Side KMPO Screenline #25	1.08	0.88
East Side KMPO Screenline #26	1.05	0.98
Government Way Screenline #27	1.17	1.12
I-90 Ramps Screenline #28	1.14	0.91
Overall Average Screenline	**1.07**	**1.09**

12.1 Allowable Deviation Standards

The closer the model/count ratios by screenlines approach 1.00, the better matches the screenline traffic volumes are compared with the traffic counts. The Federal Highway Administration (FHWA) developed a maximum allowable screenline validation error range and formula as shown below:

% Allowable Deviation per TMIP FHA

For volumes less than 100,000:
Tol (%) = 1/100 * [(-0.00005*(V)^3 + 0.013*(V)^2-1.1822*(V)+65.465)]
For over 100,000:
Tol (%) = 2.1783*(V)^-0.4784
Where V is volume in thousands

By using the formula, the screenlines can be evaluated to see if they meet the percent allowable deviation ranges. Figure 10 and Figure 11 display the screenline validations against FHWA Maximum Allowable Error Range (Source: Figure 7-2 Maximum Desirable Deviation in Total Screenline Volumes in the *Model Validation and Reasonableness Checking Manual* published by FHWA Travel Model Improvement Program).

By the FHWA standards, the 2016 KMPO Model is validated for both AM peak hour and PM peak hour and can be used to build future year travel demand models in KMPO areas.

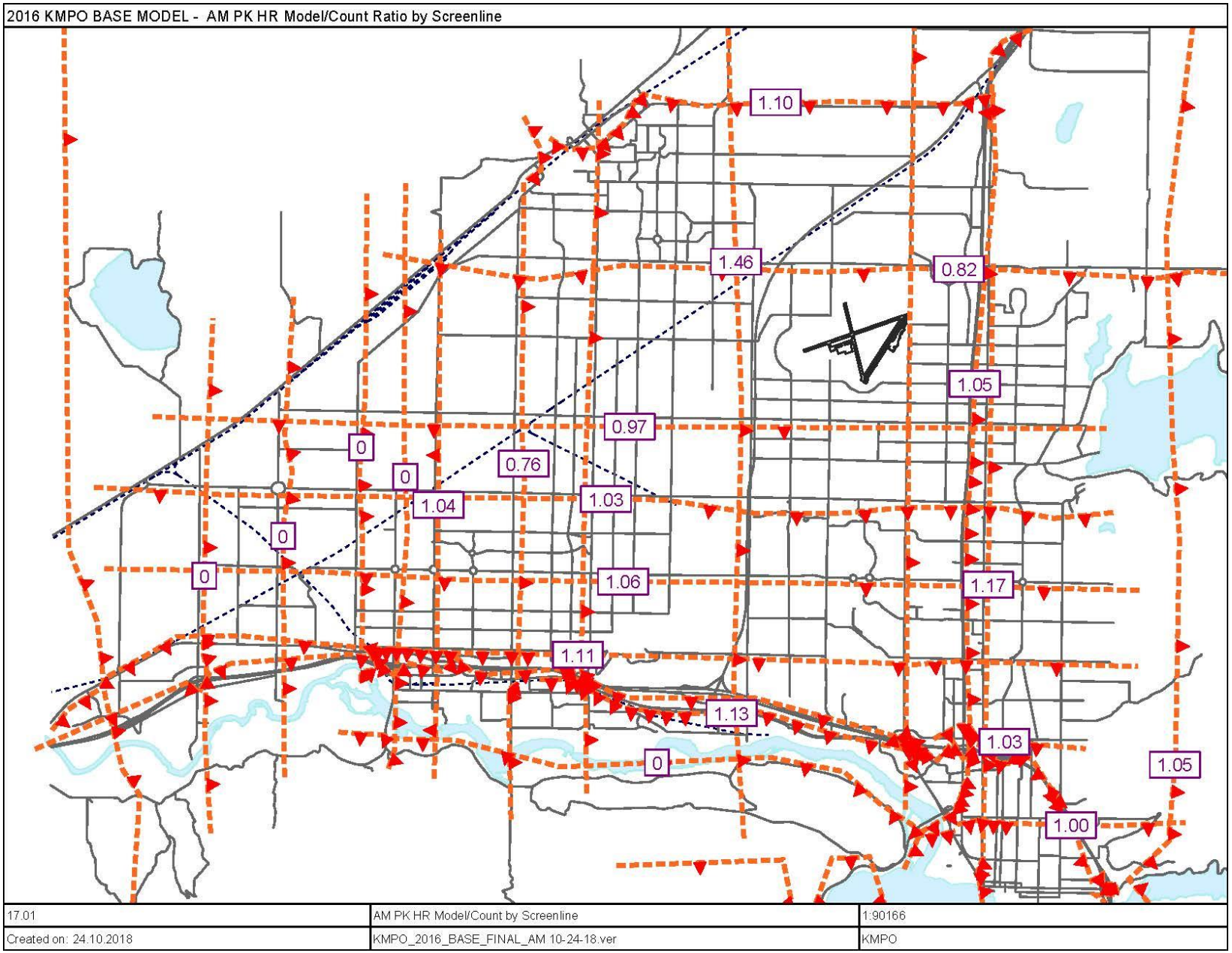


Figure 8: 2010 KMPO VISUM Model AM Peak Hour Traffic Forecast Screenline Results

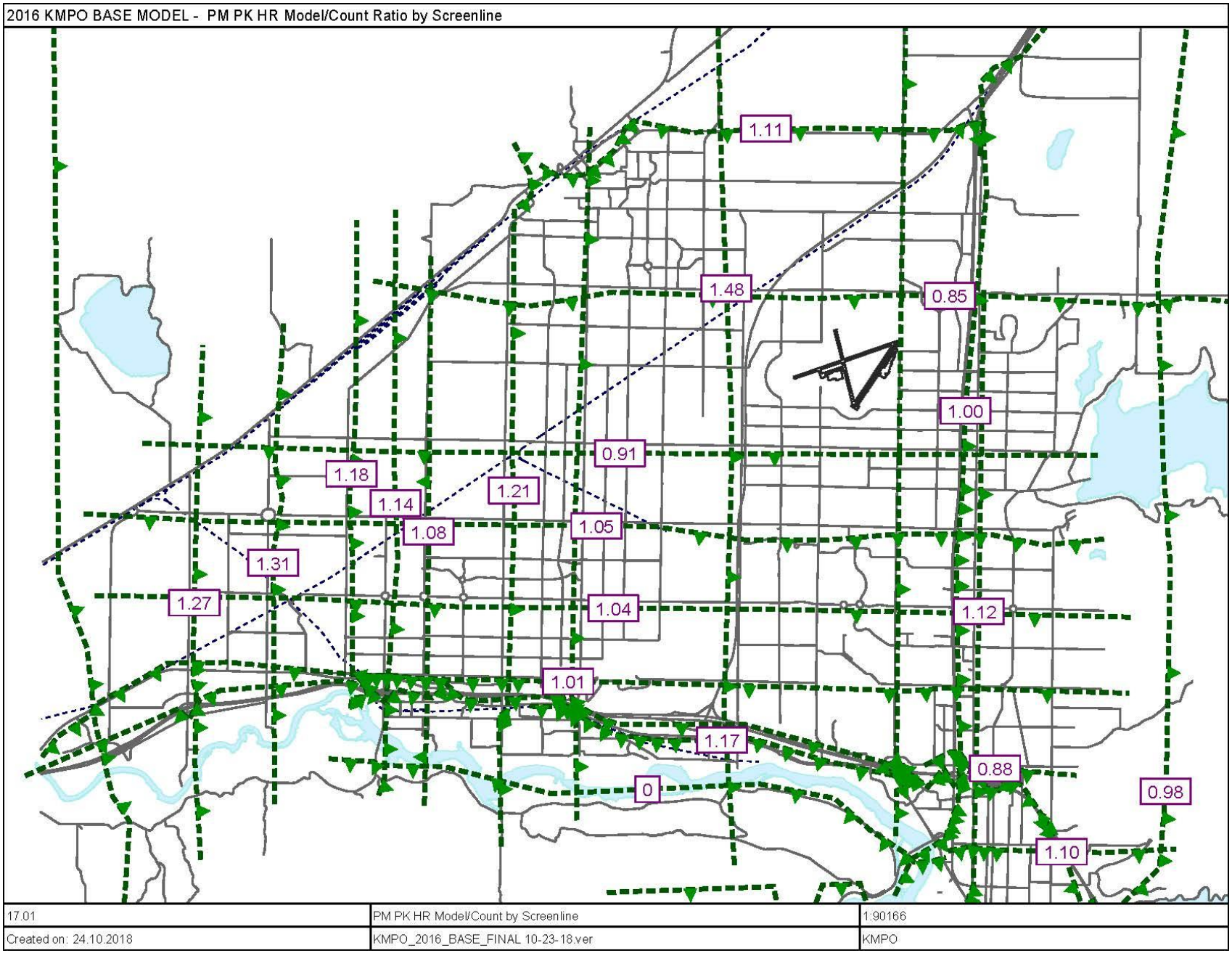


Figure 9: 2016 KMPO VISUM Model PM Peak Hour Traffic Forecast Screenline Results

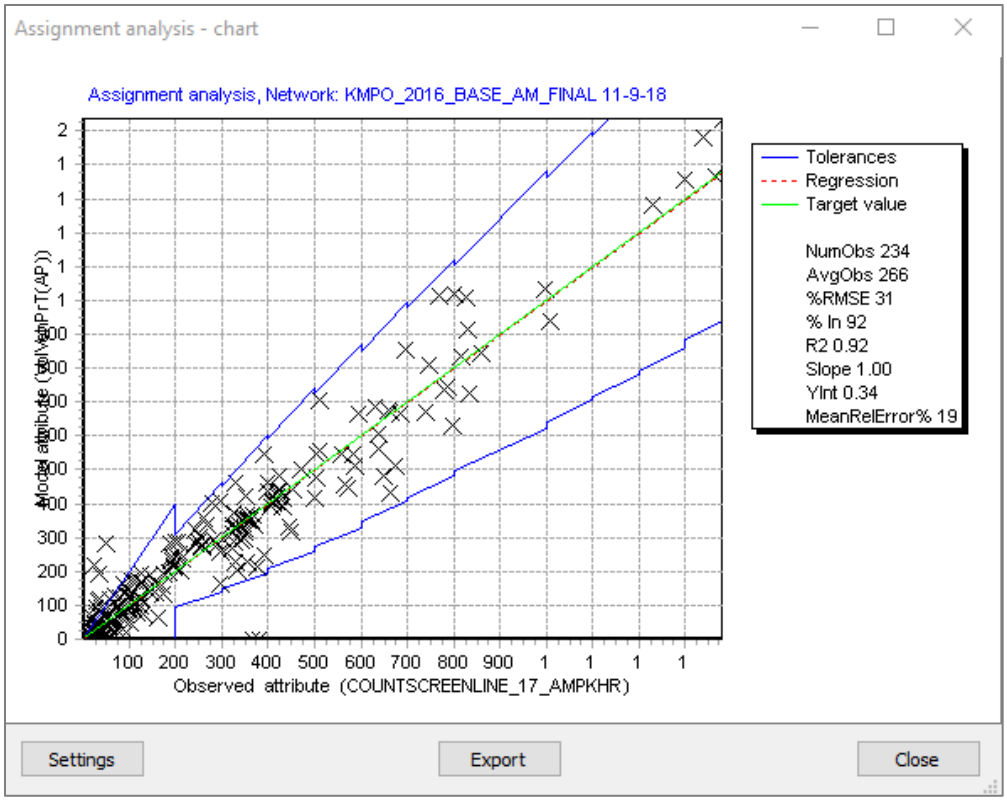


Figure 10: 2016 KMPO Model AM Peak Hour Screenline Error Range

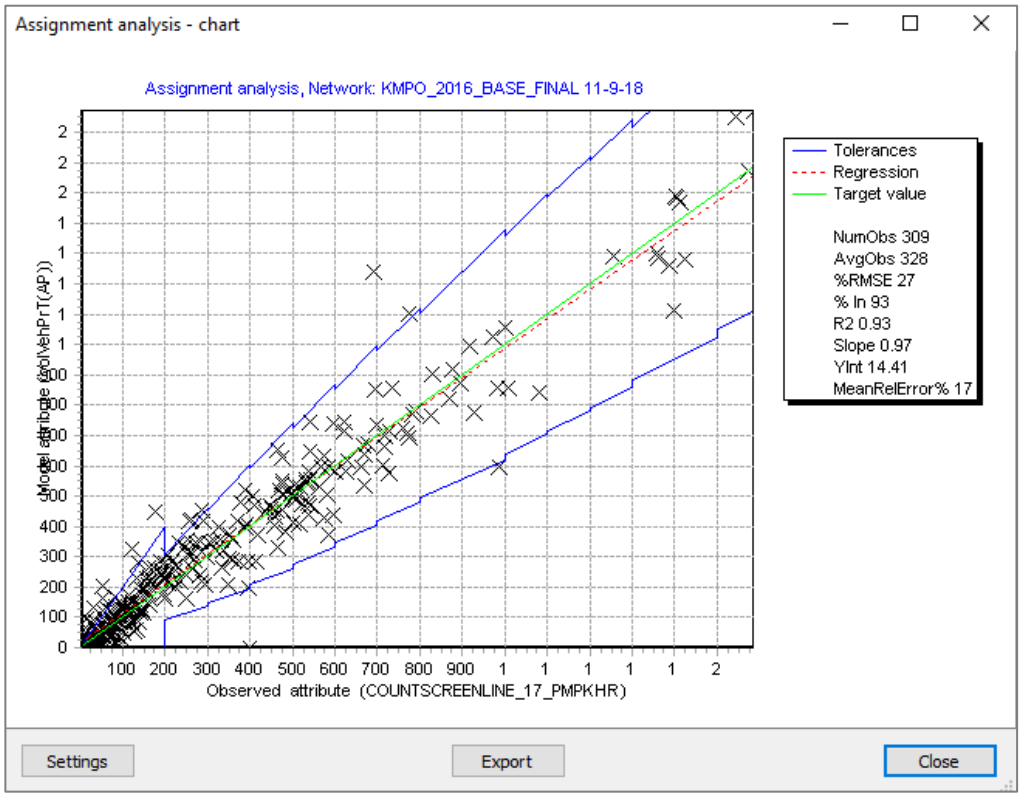


Figure 11: 2016 KMPO Model PM Peak Hour Screenline Error Range

13.0 Model Limitations and Improvements

Similarly to the 2010 model, the 2016 KMPO model has some limitations that lead to potential improvements in the future.

- The KMPO model is a vehicle-based travel demand forecasting model and does not have multimodal forecasting capability, as the model only follows the three steps of the traditional four-step modeling procedures: trip generation, trip distribution, and trip assignment without the mode choice modeling step.
- The model trip generation rates are simply based on the ITE Trip Generation Manual but not based on the regional travel survey data, although the total trips generated by purpose are calibrated against the 2005 Kootenai/Spokane expanded travel survey results.
- The model produces better traffic forecasts in the urbanized area with higher traffic volume than in the rural area with lower traffic volumes possibly because of the larger zones and less street network in rural areas, or because the rural areas have lower trip generation rates than the ITE urban and suburban trip generation rates used in the KMPO model. Further statistical analysis of the rural and urban area travel behaviors will help evaluate this hypothesis.
- The trip distribution patterns roughly match with the 2005 regional travel survey; the statistical results were extracted from the travel survey for the AM and PM conditions, by NuStats as requested by KMPO staff during this 2010 model update; therefore, the statistical analysis results are based on the “2005 Spokane and Kootenai County Regional Travel Survey”.
- Intersection level of service calculation can be implemented by using the VISUM module TRAFFIX based on the Highway Capacity Manual but was not done at this update and should be implemented for operational analysis in the future.
- Some local zonal details or network details may not be sufficient to reflect the traffic forecast conditions in the local sub-area transportation study and planning, or project specific sites and should be enhanced further to meet the local travel demand modeling needs in the future.

Appendices

Appendix 1A: KMPO Project dir file.pfd – KMPO Project directory file that directs the model to the proper file directory location

Edit project directories

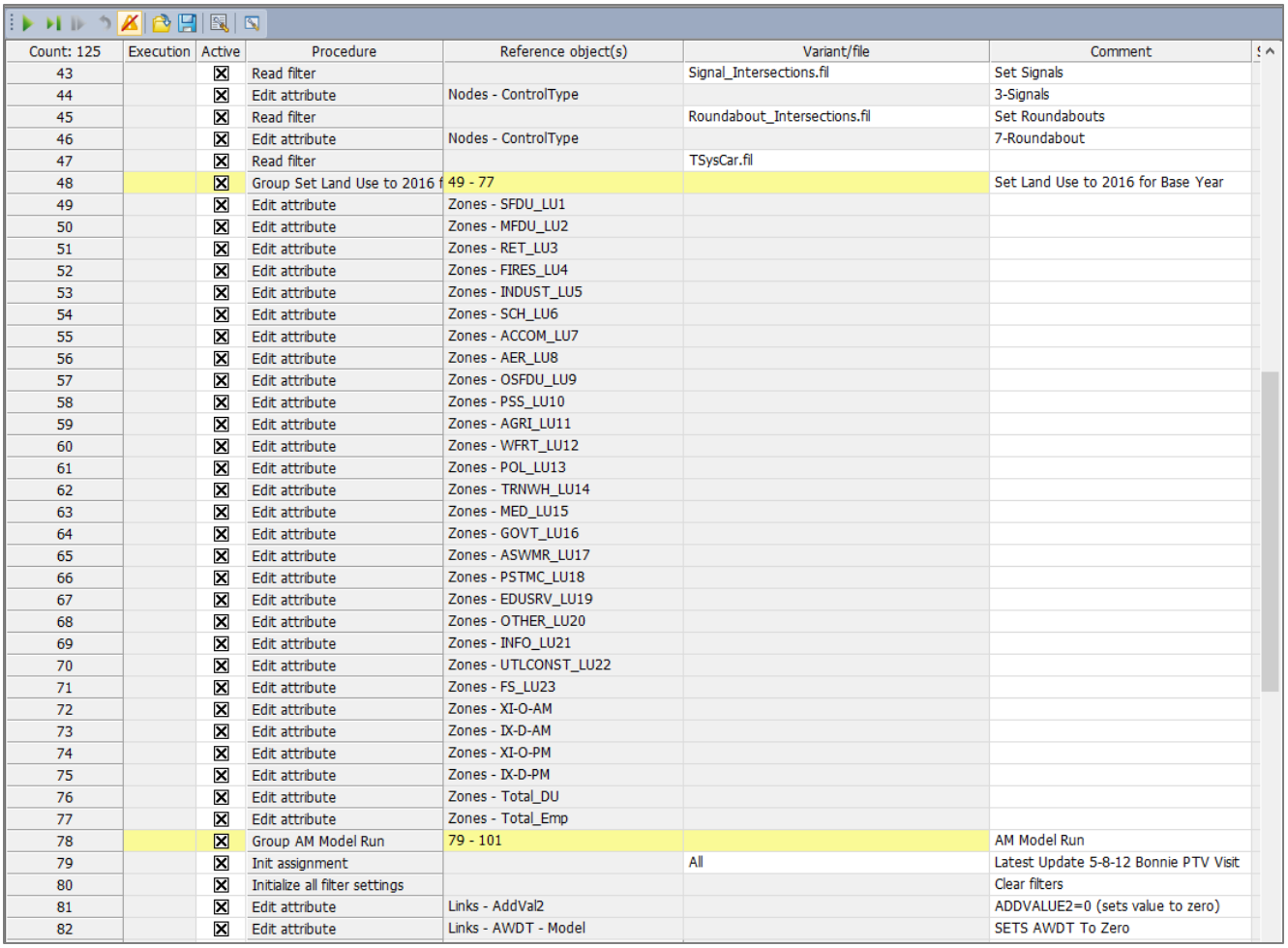
Multiple extensions can be separated by ';'

Number: 60	Type	Path		Extension(s)
1	Project directories	C:\Users\Bgow\Desktop\KMPO MODELS\KMPO 2016 New Procedures\	...	pfd
2	Version	C:\Users\Bgow\Desktop\KMPO MODELS\KMPO 2016 New Procedures\	...	ver
3	Global layout	C:\Users\Bgow\Desktop\KMPO MODELS\KMPO 2016 New Procedures\	...	lay
4	Network	C:\Users\Bgow\Desktop\KMPO MODELS\KMPO 2016 New Procedures\	...	net
5	OD demand data	C:\Users\Bgow\Desktop\KMPO MODELS\KMPO 2016 New Procedures\	...	dmd
6	Scenario management project	C:\Users\Bgow\Desktop\KMPO MODELS\KMPO 2016 New Procedures\	...	vpdb;vpdbx
7	Matrix	C:\Users\Bgow\Desktop\KMPO MODELS\KMPO 2016 New Procedures\	...	mtx;mx;fma;*
8	Access database	C:\Users\Bgow\Desktop\KMPO MODELS\KMPO 2016 New Procedures\	...	mdb
9	Access 2007 database	C:\Users\Bgow\Desktop\KMPO MODELS\KMPO 2016 New Procedures\	...	accdb
10	Model transfer file	C:\Users\Bgow\Desktop\KMPO MODELS\KMPO 2016 New Procedures\	...	tra
11	ESRI shapefile	C:\Users\Bgow\Desktop\KMPO MODELS\KMPO 2016 New Procedures\	...	shp
12	Attributes	C:\Users\Bgow\Desktop\KMPO MODELS\KMPO 2016 New Procedures\	...	att
13	Active network objects	C:\Users\Bgow\Desktop\KMPO MODELS\KMPO 2016 New Procedures\	...	ane
14	Filter	C:\Users\Bgow\Desktop\KMPO MODELS\KMPO 2016 New Procedures\	...	fil
15	Procedure parameters	C:\Users\Bgow\Desktop\KMPO MODELS\KMPO 2016 New Procedures\	...	par;xml
16	AddIn	%APPDATA%\Visum\125\AddIns\	...	vai
17	Script	C:\Users\Bgow\Desktop\KMPO MODELS\KMPO 2016 New Procedures\	...	vbs;js;pys;py;rb;pl;tcl
18	Other input data	C:\Users\Bgow\Desktop\KMPO MODELS\KMPO 2016 New Procedures\	...	*
19	Other output data	C:\Users\Bgow\Desktop\KMPO MODELS\KMPO 2016 New Procedures\	...	*
20	Graphic parameters	C:\Users\Bgow\Desktop\KMPO MODELS\KMPO 2016 New Procedures\	...	gpa;gpax
21	Background	C:\Users\Bgow\Desktop\KMPO MODELS\KMPO 2016 New Procedures\	...	emf;wmf;bmp;dwg;dxf;ecw;jp2;jp
22	Texts	C:\Users\Bgow\Desktop\KMPO MODELS\KMPO 2016 New Procedures\	...	txt
23	Image	C:\Users\Bgow\Desktop\KMPO MODELS\KMPO 2016 New Procedures\	...	bmp;jpg;wmf;emf;gif;tiff;png
24	SVG file	C:\Users\Bgow\Desktop\KMPO MODELS\KMPO 2016 New Procedures\	...	svg
25	DXF file	C:\Users\Bgow\Desktop\KMPO MODELS\KMPO 2016 New Procedures\	...	dxf
26	Screenshot	C:\Users\Bgow\Desktop\KMPO MODELS\KMPO 2016 New Procedures\	...	jpg;wmf;emf;bmp;gif;tiff;png
27	Exported turn volumes	C:\Users\Bgow\Desktop\KMPO MODELS\KMPO 2016 New Procedures\	...	jpg;png;gif;wmf;emf;bmp;tiff;svg
28	Legend parameters	C:\Users\Bgow\Desktop\KMPO MODELS\KMPO 2016 New Procedures\	...	lgd
29	Timetable graphic parameters	C:\Users\Bgow\Desktop\KMPO MODELS\KMPO 2016 New Procedures\	...	gpt;gpbe;gpgt;gptt
30	Signal time-space diagram graphic parameters	C:\Users\Bgow\Desktop\KMPO MODELS\KMPO 2016 New Procedures\	...	gptsd
31	Matrix editor graphic parameters	C:\Users\Bgow\Desktop\KMPO MODELS\KMPO 2016 New Procedures\	...	gpm
32	Schematic line diagram graphic parameters	C:\Users\Bgow\Desktop\KMPO MODELS\KMPO 2016 New Procedures\	...	gpsld
33	Transfers display of regular services - graphic parameters	C:\Users\Bgow\Desktop\KMPO MODELS\KMPO 2016 New Procedures\	...	gpta
34	Timetable layout	C:\Users\Bgow\Desktop\KMPO MODELS\KMPO 2016 New Procedures\	...	tly;tlbe;tltt;tlgt;tlls;tlbs
35	List layout	C:\Users\Bgow\Desktop\KMPO MODELS\KMPO 2016 New Procedures\	...	lla
36	Quickview layout	C:\Users\Bgow\Desktop\KMPO MODELS\KMPO 2016 New Procedures\	...	qla
37	Matrix editor layout	C:\Users\Bgow\Desktop\KMPO MODELS\KMPO 2016 New Procedures\	...	mly
38	Survey data	C:\Users\Bgow\Desktop\KMPO MODELS\KMPO 2016 New Procedures\	...	*
39	PuT connections	C:\Users\Bgow\Desktop\KMPO MODELS\KMPO 2016 New Procedures\	...	con
40	PrT routes	C:\Users\Bgow\Desktop\KMPO MODELS\KMPO 2016 New Procedures\	...	rim
41	EMME project	C:\Users\Bgow\Desktop\KMPO MODELS\KMPO 2016 New Procedures\	...	emme
42	PuT interfaces project	C:\Users\Bgow\Desktop\KMPO MODELS\KMPO 2016 New Procedures\	...	putp;puti;haf
43	Network merge parameters	C:\Users\Bgow\Desktop\KMPO MODELS\KMPO 2016 New Procedures\	...	nmp
44	Parameters for 'Read network additively'	C:\Users\Bgow\Desktop\KMPO MODELS\KMPO 2016 New Procedures\	...	anrp
45	Parameters for 'Read demand additively'	C:\Users\Bgow\Desktop\KMPO MODELS\KMPO 2016 New Procedures\	...	adrp
46	Subnetwork generator parameters	C:\Users\Bgow\Desktop\KMPO MODELS\KMPO 2016 New Procedures\	...	xml
47	Parameters for matrix operations	C:\Users\Bgow\Desktop\KMPO MODELS\KMPO 2016 New Procedures\	...	xml;cod
48	ICA file	C:\Users\Bgow\Desktop\KMPO MODELS\KMPO 2016 New Procedures\	...	*
49	External control	C:\Users\Bgow\Desktop\KMPO MODELS\KMPO 2016 New Procedures\	...	nse;rbc;sig
50	RASW file	C:\Users\Bgow\Desktop\KMPO MODELS\KMPO 2016 New Procedures\	...	rwf
51	ANM network	C:\Users\Bgow\Desktop\KMPO MODELS\KMPO 2016 New Procedures\	...	anm
52	ANM export parameters	C:\Users\Bgow\Desktop\KMPO MODELS\KMPO 2016 New Procedures\	...	anmp
53	ANM routes	C:\Users\Bgow\Desktop\KMPO MODELS\KMPO 2016 New Procedures\	...	anmRoutes
54	Log file	C:\Users\Bgow\Desktop\KMPO MODELS\KMPO 2016 New Procedures\	...	*
55	Combination	C:\Users\Bgow\Desktop\KMPO MODELS\KMPO 2016 New Procedures\	...	*
56	Projection	%APPDATA%\Visum\125\Projections\	...	prj
57	Script menu file	C:\Users\Bgow\Desktop\KMPO MODELS\KMPO 2016 New Procedures\	...	xml
58	User-defined VD function DLLs	%APPDATA%\Visum\125\UserVDF-DLLs\	...	dll
59	Intervals	C:\Users\Bgow\Desktop\KMPO MODELS\KMPO 2016 New Procedures\	...	att;cod
60	User preferences	C:\Users\Bgow\Desktop\KMPO MODELS\KMPO 2016 New Procedures\	...	xml

Appendix 1B: Final Calculate Procedures File AM_PM_11-9-18.par - An AM/PM combined parameter file for the AM/PM peak hour KMPO Model (Procedures 1 – 42)

Count: 125	Execution	Active	Procedure	Reference object(s)	Variant/file	Comment
1		☒	Group Capacity calculation - Ca	2 - 47		Capacity calculation - Calculate Procedure
2		☒	Initialize all filter settings			
3		☒	Read filter		TSysCar.fil	
4		☒	Edit attribute	Links - CapPrT		Set Link Capacity, Lanes * Cap/Lane
5		☒	Edit attribute	Connectors - T0_TSys(C)		Test to set Connector Time
6		☒	Read filter		TWLTL-3Lane.fil	3 Lane Road
7		☒	Edit attribute	Links - CapPrT		Add 300 directional capacity
8		☒	Read filter		TWLTL-5Lane.fil	5 Lane Road
9		☒	Edit attribute	Links - CapPrT		Add 150 directional capacity
10		☒	Read filter		Fwy_GT_2_Lanes.fil	3+ Lane Fwy
11		☒	Edit attribute	Links - CapPrT		Add Cap for 3 Lane + Fwy
12		☒	Edit attribute	Nodes - K4		Set All K4 = 1.0
13		☒	Read filter		ActiveLinksNodes.fil	Start Node Computations
14		☒	Edit attribute	Nodes - CapPrT		Add all outbound link capacities
15		☒	Read filter		ActiveLinksNodes-3plusLegs.fil	3 Plus Leg Nodes
16		☒	Edit attribute	Nodes - K4		
17		☒	Read filter		ActiveLinksNodes-2Leg.fil	
18		☒	Edit attribute	Nodes - K4		
19		☒	Read filter		ActiveLinksNodes-3Leg.fil	
20		☒	Edit attribute	Nodes - K4		
21		☒	Read filter		ActiveLinksNodes-4Leg.fil	
22		☒	Edit attribute	Nodes - K4		
23		☒	Read filter		ActiveLinksNodes-5Leg.fil	
24		☒	Edit attribute	Nodes - K4		
25		☒	Read filter		NodeCapacityFinalComputations.fil	
26		☒	Edit attribute	Nodes - CapPrT		
27		☒	Read filter		Turns-LT-TH-RT-Only.fil	Turns-LT-TH-RT-Only.fil
28		☒	Edit attribute	Turns - CapPrT		Reset Turn Capacities
29		☒	Edit attribute	Turns - t0PrT		Reset Turn T0=0
30		☒	Read filter		SingleLeftTurnsSignalsTwoWayStops.fil	Single Left Turns
31		☒	Edit attribute	Turns - t0PrT		T0=6Secs
32		☒	Edit attribute	Turns - CapPrT		TurnCap=300
33		☒	Read filter		DualLeftTurnsSignalsTwoWayStops.fil	Dual Left Turns
34		☒	Edit attribute	Turns - CapPrT		TurnCap=275*NumLanes
35		☒	Read filter		Uncontrolled_Intersections.fil	Set Uncontrolled Controls
36		☒	Edit attribute	Nodes - ControlType		1-Uncontrolled
37		☒	Read filter		Stop_2_Way_Intersections.fil	Set 2 Way Stop
38		☒	Edit attribute	Nodes - ControlType		2-Partial Stop
39		☒	Read filter		Yield_2_Way_Intersections.fil	Set Yield
40		☒	Edit attribute	Nodes - ControlType		6-Yield
41		☒	Read filter		Stop_All_Way_Intersections.fil	Set All Way Stop
42		☒	Edit attribute	Nodes - ControlType		4-All Way Stop

Appendix 1B (Continued): Final Calculate Procedures File AM_PM_11-9-18.par (Procedures 43-82)



Count: 125	Execution	Active	Procedure	Reference object(s)	Variant/file	Comment
43		☒	Read filter		Signal_Intersections.fil	Set Signals
44		☒	Edit attribute	Nodes - ControlType		3-Signals
45		☒	Read filter		Roundabout_Intersections.fil	Set Roundabouts
46		☒	Edit attribute	Nodes - ControlType		7-Roundabout
47		☒	Read filter		TSysCar.fil	
48		☒	Group Set Land Use to 2016 f	49 - 77		Set Land Use to 2016 for Base Year
49		☒	Edit attribute	Zones - SFDU_LU1		
50		☒	Edit attribute	Zones - MFDU_LU2		
51		☒	Edit attribute	Zones - RET_LU3		
52		☒	Edit attribute	Zones - FIRES_LU4		
53		☒	Edit attribute	Zones - INDUST_LU5		
54		☒	Edit attribute	Zones - SCH_LU6		
55		☒	Edit attribute	Zones - ACCOM_LU7		
56		☒	Edit attribute	Zones - AER_LU8		
57		☒	Edit attribute	Zones - OSFDU_LU9		
58		☒	Edit attribute	Zones - PSS_LU10		
59		☒	Edit attribute	Zones - AGRI_LU11		
60		☒	Edit attribute	Zones - WFRT_LU12		
61		☒	Edit attribute	Zones - POL_LU13		
62		☒	Edit attribute	Zones - TRNWH_LU14		
63		☒	Edit attribute	Zones - MED_LU15		
64		☒	Edit attribute	Zones - GOVT_LU16		
65		☒	Edit attribute	Zones - ASWMR_LU17		
66		☒	Edit attribute	Zones - PSTMC_LU18		
67		☒	Edit attribute	Zones - EDUSRV_LU19		
68		☒	Edit attribute	Zones - OTHER_LU20		
69		☒	Edit attribute	Zones - INFO_LU21		
70		☒	Edit attribute	Zones - UTLCONST_LU22		
71		☒	Edit attribute	Zones - FS_LU23		
72		☒	Edit attribute	Zones - XI-O-AM		
73		☒	Edit attribute	Zones - IX-D-AM		
74		☒	Edit attribute	Zones - XI-O-PM		
75		☒	Edit attribute	Zones - IX-D-PM		
76		☒	Edit attribute	Zones - Total_DU		
77		☒	Edit attribute	Zones - Total_Emp		
78		☒	Group AM Model Run	79 - 101		AM Model Run
79		☒	Init assignment		All	Latest Update 5-8-12 Bonnie PTV Visit
80		☒	Initialize all filter settings			Clear filters
81		☒	Edit attribute	Links - AddVal2		ADDVALUE2=0 (sets value to zero)
82		☒	Edit attribute	Links - AWDT - Model		SETS AWDT To Zero

Appendix 1B (Continued): Final Calculate Procedures File AM_PM_11-9-18.par (Procedures 83-125)

Count: 125	Execution	Active	Procedure	Reference object(s)	Variant/file	Comment
83		☒	Trip generation	AM_H-O AM_H-O, AM_H-R AM_H-R,		
84		☒	Calculate PrT skim matrix	AM_HBW AM_HBW		TT0 - Free flow skim
85		☒	Trip distribution	AM_H-O AM_H-O, AM_H-R AM_H-R,		
86		☒	Combination of matrices and v	Matrix(13) := Matrix(215) + Matrix(2		
87		☒	Combination of matrices and v	Matrix(15) := Matrix(214) + Matrix(2		
88		☒	Combination of matrices and v	Matrix(17) := Matrix(213) + Matrix(2		
89		☒	Combination of matrices and v	Matrix(19) := Matrix(222) + Matrix(2		
90		☒	Combination of matrices and v	Matrix(1) := Matrix(13) + Matrix(15)		
91		☒	PrT assignment	AM-Tot AM Total	Equilibrium assignment Bi-conjugate Frank-Wolfe	Assign model flows
92		☒	Calculate PrT skim matrix	AM_HBW AM_HBW		TTC - update congested skims
93		☒	Combination of matrices and v	Matrix(2) := 0.5*Matrix(2) + 0.5*Mat		TT0=0.5*TTC+0.5*TT0 Average skims
94		☒	Go to the procedure	Procedure 85		
95		☒	Edit attribute	Links - AM_PK_Hr_Model_Vol		AM_PK_HR_Model_Vol=VolVehPrT
96		☒	Combination of matrices and v	Matrix([NO] = 1):=Matrix([NO] = 22		Apply adjustment factors
97		☒	PrT assignment	AM-Tot AM Total	Equilibrium assignment Bi-conjugate Frank-Wolfe	Assign adjusted flow matrix
98		☒	Edit attribute	Links - AM_PK_HR_Adjusted_Vol		Move adjusted assignment flows to UDA
99		☒	Territory indicators			
100		☒	Edit attribute	Links - AddVal2		AM Model Deviation
101		☒	Assignment analysis			AM Analysis
102		☒	Group PM Model Run	103 - 125		PM Model Run
103		☒	Init assignment		All	
104		☒	Initialize all filter settings			Clear filters
105		☒	Edit attribute	Links - AddVal3		ADDVALUE3=0 (Sets value to zero)
106		☒	Edit attribute	Links - AWDT - Model		SETS AWDT TO Zero
107		☒	Trip generation	PM_H-O PM_H-O, PM_H-R PM_H-R, P		Updated 10-10-12 R.S/B.G.
108		☒	Calculate PrT skim matrix	PM_HBW PM_HBW		TT0
109		☒	Trip distribution	PM_H-O PM_H-O, PM_H-R PM_H-R, P		
110		☒	Combination of matrices and v	Matrix(14) := Matrix(208) + Matrix(2		
111		☒	Combination of matrices and v	Matrix(16) := Matrix(207) + Matrix(2		
112		☒	Combination of matrices and v	Matrix(18) := Matrix(206) + Matrix(2		
113		☒	Combination of matrices and v	Matrix(20) := Matrix(224) + Matrix(2		
114		☒	Combination of matrices and v	Matrix(3) := Matrix(14) + Matrix(16)		
115		☒	PrT assignment	PM-Tot PM_Total	Equilibrium assignment Bi-conjugate Frank-Wolfe	
116		☒	Calculate PrT skim matrix	PM_HBW PM_HBW		TTC
117		☒	Combination of matrices and v	Matrix(220) := 0.5*Matrix(220) + 0.5		TT0=TTC+TT0
118		☒	Go to the procedure	Procedure 109		
119		☒	Edit attribute	Links - PM_PK_Hr_Model_Vol		PM_PK_HR_Model_Vol=VolVehPrT
120		☒	Combination of matrices and v	Matrix([NO] = 3):=Matrix([NO] = 23		Apply adjustment factors
121		☒	PrT assignment	PM-Tot PM_Total	Equilibrium assignment Bi-conjugate Frank-Wolfe	Assign adjusted flow matrix
122		☒	Edit attribute	Links - PM_PK_HR_Adjusted_Vol		Move adjusted assignment flows to UDA
123		☒	Territory indicators			
124		☒	Edit attribute	Links - AddVal3		PM Model Deviation
125		☒	Assignment analysis			PM Analysis

Appendix 1C: 2010 KMPO Model AM Peak Hour Screenline Validation Spreadsheets

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Appendix 1D: 2016 KMPO Model PM Peak Hour Screenline Validation Spreadsheets

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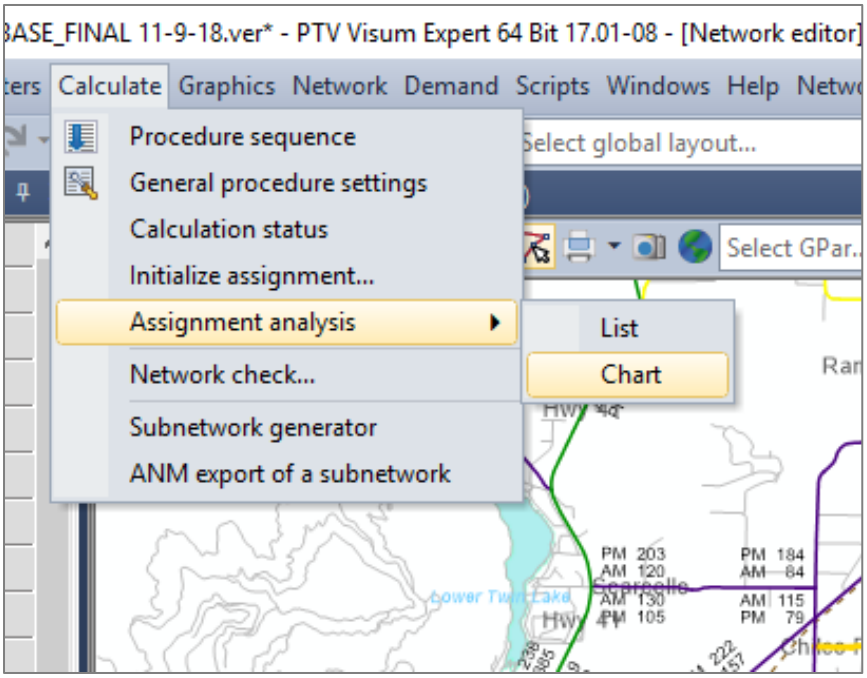
Appendix 1E: Final Model Results Assignment Analysis Comparison

The 2010 KMPO Base Model PM PK HR **"assignment analysis"** is reported internally within the model and shows the final AM/ PM PK HR model results. The formula the program measures the observed traffic counts against the modeled traffic volumes.



The (GEH) formula used was created by Geoffrey E. Havers, is a statistical mathematical formula that is used internally within the VISUM assignment analysis graph calculations that checks the model calibration. The assignment analysis uses this formula and graphs a plot that tells you how accurately the traffic volumes match the modeled volumes.

This widely accepted approach compares the actual traffic counts taken in the field to the modeled output volumes using the GEH formula:

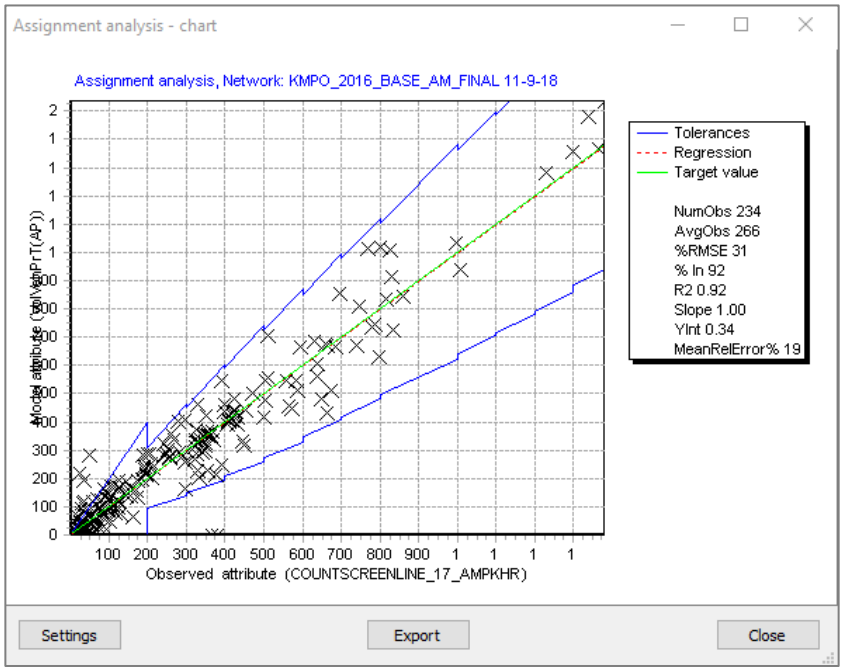
For hourly flows, the GEH formula is:

$$GEH = \sqrt{\frac{2(m-c)^2}{m+c}}$$

Notes:

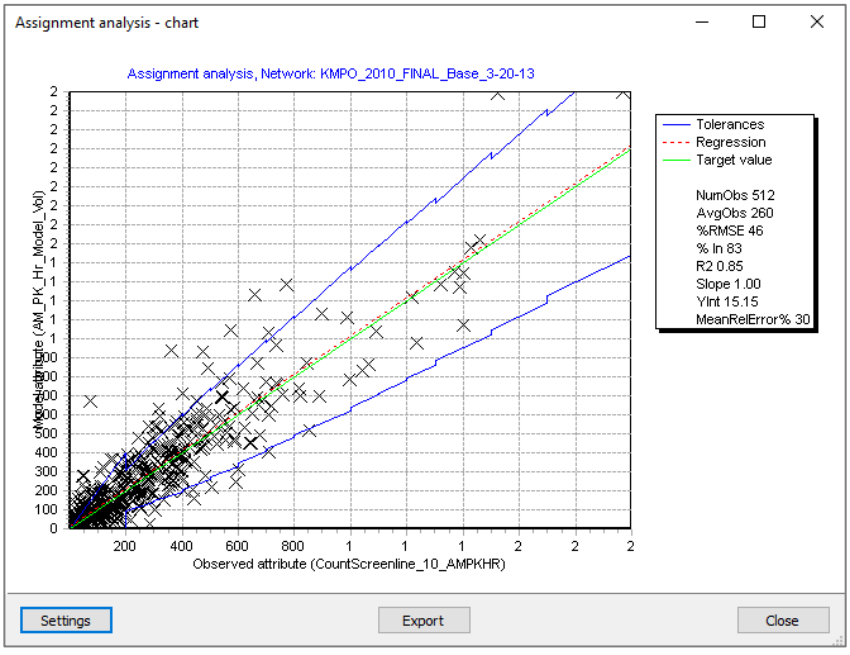
m = output traffic volume from the simulation model (vph)
c = input traffic volume (vph)

The graph below displays the final 2016 KMPO Base Model AM PK HR “assignment analysis” of the network reported inside the model for AM PK HR results.



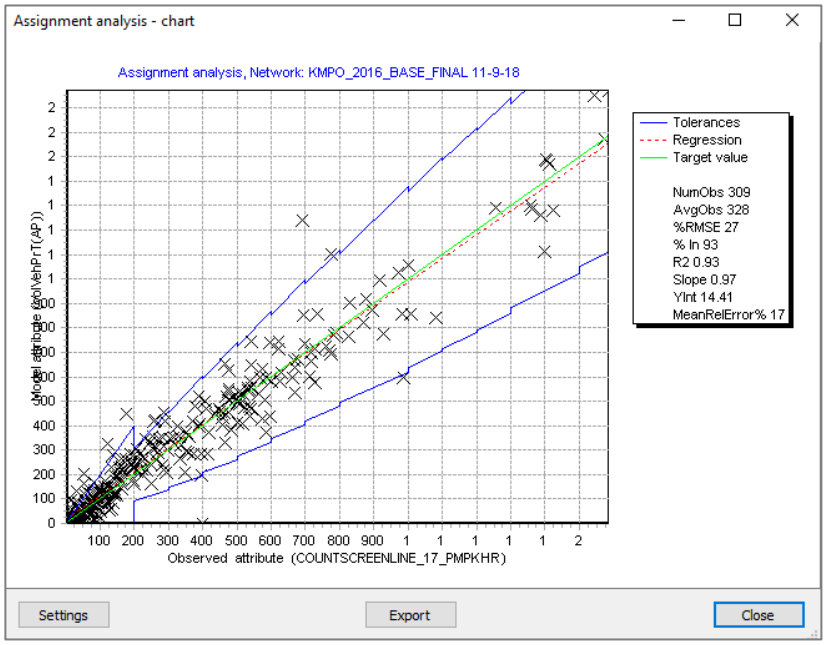
2016 KMPO AM PK HR Final Base Model Assignment Analysis Chart

The graph below is from the final 2010 KMPO Base Model AM PK HR “assignment analysis” reported inside the model for AM PK HR results This is used for comparison only. Comparison of the two assignment results shows that there is improvement from the previous 2010 base model to the updated 2016 base model.



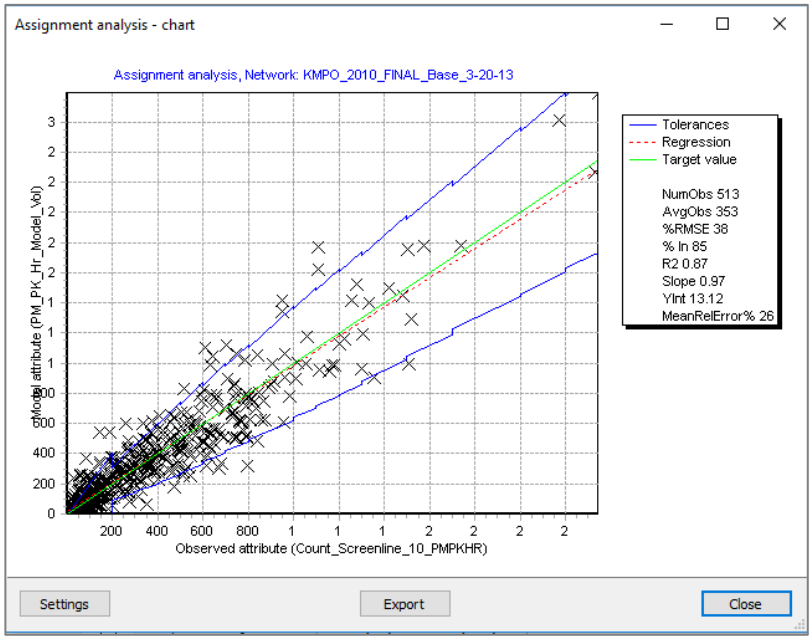
2010 KMPO Previous AM PK HR Final Base Model Assignment Analysis Chart (for comparison only)

The graph below displays the final 2016 KMPO Base Model PM PK HR “assignment analysis” of the network reported inside the model for PM PK HR results.



2016 KMPO PM PK HR Final Base Model Assignment Analysis Chart

The graph below is from the final 2010 KMPO Base Model PM PK HR “assignment analysis” reported inside the model for PM PK HR results This is used for comparison only. Comparison of the two assignment results shows that there is improvement from the previous 2010 base model to the updated 2016 base model.



2010 Previous PM PK HR Final Base Model Assignment Analysis Chart (for comparison only)