Spokane Regional Transportation Council (SRTC)

Peer Review

February 2016

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16. Abstract This report details the proceedings of a peer review of the Spokane Regional Transportation Council's (SRTC) transportation model. The primary objective of the SRTC peer review was for SRTC to better understand the capabilities and limitations of the current model and help SRTC decide how to proceed with model improvements.		
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1.0 Introduction

1.1 Disclaimer

The views expressed in this document do not represent the opinions of FHWA and do not constitute an endorsement, recommendation or specification by FHWA. The document is based solely on the discussions that took place during the peer review sessions and supporting technical documentation provided by Spokane Regional Transportation Council (SRTC).

1.2 Acknowledgments

The FHWA would like to acknowledge the peer review members for volunteering their time to participate in this peer review. Panel members include:

- Aaron Breakstone – Portland Metro;
- Alan Horowitz— University of Wisconsin - Milwaukee;
- Jeremy Raw— Federal Highway Administration (FHWA);
- Aichong Sun—Pima Association of Governments (PAG);
- Ken Cervenka (Peer Review Advisor)—Federal Transit Administration (FTA).

Additional biographical information of each peer review panel member is located in appendix C.

1.3 Report Purpose

This peer review was supported by the Travel Model Improvement Program (TMIP), sponsored by FHWA. TMIP sponsors peer reviews so planning agencies can receive guidance from and ask questions of officials from other planning agencies across the nation. The peer review process is specifically aimed at providing feedback to agencies on travel modeling endeavors.

The primary objective of the SRTC peer review was for SRTC to better understand the capabilities and limitations of the current model and help SRTC decide how to proceed with model improvements.

The peer review panel convened for one day (November 2, 2015). During that time, SRTC presented background information and asked for guidance in all areas of their modeling practices, and the panel discussed these items and offered a series of formal recommendations to SRTC.

1.4 Report Organization

The remainder of this report is organized into the following sections:

- **Overview of the Spokane Regional Transportation Council (SRTC)—**This section highlights the responsibilities of the council as well as some key characteristics of the Spokane region.
- **Development of the SRTC Model—**This section discusses SRTC's existing model, future model updates, and the agency's goals for the current peer review.
- **Peer Review Discussion—**This section details the key discussions of the peer review panel with SRTC over the course of the one-day peer review meeting.
- **Peer Review Recommendations—**This section highlights the official recommendations made by the peer review panel. Some of the key discussion points are revisited here, but some new details also are added.

Four appendices also are included:

- Appendix A—List of Peer Review Panel Participants;
- Appendix B—Peer Review Panel Meeting Agenda;
- Appendix C—Peer Review Panel Member Biographies; and
- Appendix D—Documentation Provided to Panel Members by SRTC and Documents referenced in this report.

2.0 Overview of Spokane Regional Transportation Council (SRTC)

2.1 SRTC Role and Responsibilities

Spokane Regional Transportation Council (SRTC) is the federally designated Metropolitan Planning Organization (MPO) and state designated (under the Washington State Growth Management Act) Regional Transportation Planning Organization (RTPO) for Spokane County, Washington. SRTC is also the designated Transportation Management Association (TMA) for the Spokane, WA urbanized area (UZA).

The primary purpose of a travel demand model is to "help in making well-informed transportation policy decisions by showing the likely effects of policy changes on the transportation network. They can also show how changes in employment, population, land use, and development patterns, as well as investments in transportation infrastructure, might affect travel in a region."[1] The SRTC model is used to answer transportation planning questions and inform policy decisions in the Spokane region. Some of these include:

- Transportation Air Quality Conformity (Maintenance Plans for CO and PM10)
- Metropolitan Transportation Plan (MTP)/Regional Transportation Plan (RTP).
- MAP-21 Performance Measures and Targets
- Congestion Management Process
- Transportation Improvement Program (TIP)
- Inform other policy decisions
- Support other studies and plans including:
    - Subarea and corridor studies/plans
    - SRTC projects
    - Member jurisdiction projects (e.g. Interchange Justification Reports, regionally significant road projects, bike/pedestrian mode share, major transit service changes and projects, etc.)

2.2 Regional Characteristics

The 2010 Census population for Spokane County was just over 471,000 (approximately 187,000 households) and is forecasted to grow 35% to 636,000 by the year 2040. Current population growth of 2.8% over the last four years is slow compared to Washington State which grew by 5%. The SRTC jurisdiction is 1,764 square miles with 267 persons per square mile. Spokane is not a dense area but is becoming more dense in core areas. The median household income for Spokane is $50,432 which is lower than the National average of $53,046.

The SRTC region has very little traffic congestion. A small amount of delay occurs on Interstate 90 (I-90) and on some arterials during the AM and PM peak hour. As shown on Figure 1, I-90 is the main East-West corridor traversing the region. Most of the congestion that does occur in the region is during non-recurring and unplanned events such as inclement weather.

[1] Peer Review Process Guide: How to Get the Most Out of Your TMIP Peer Review. FHWA, Travel Model Improvement Program.

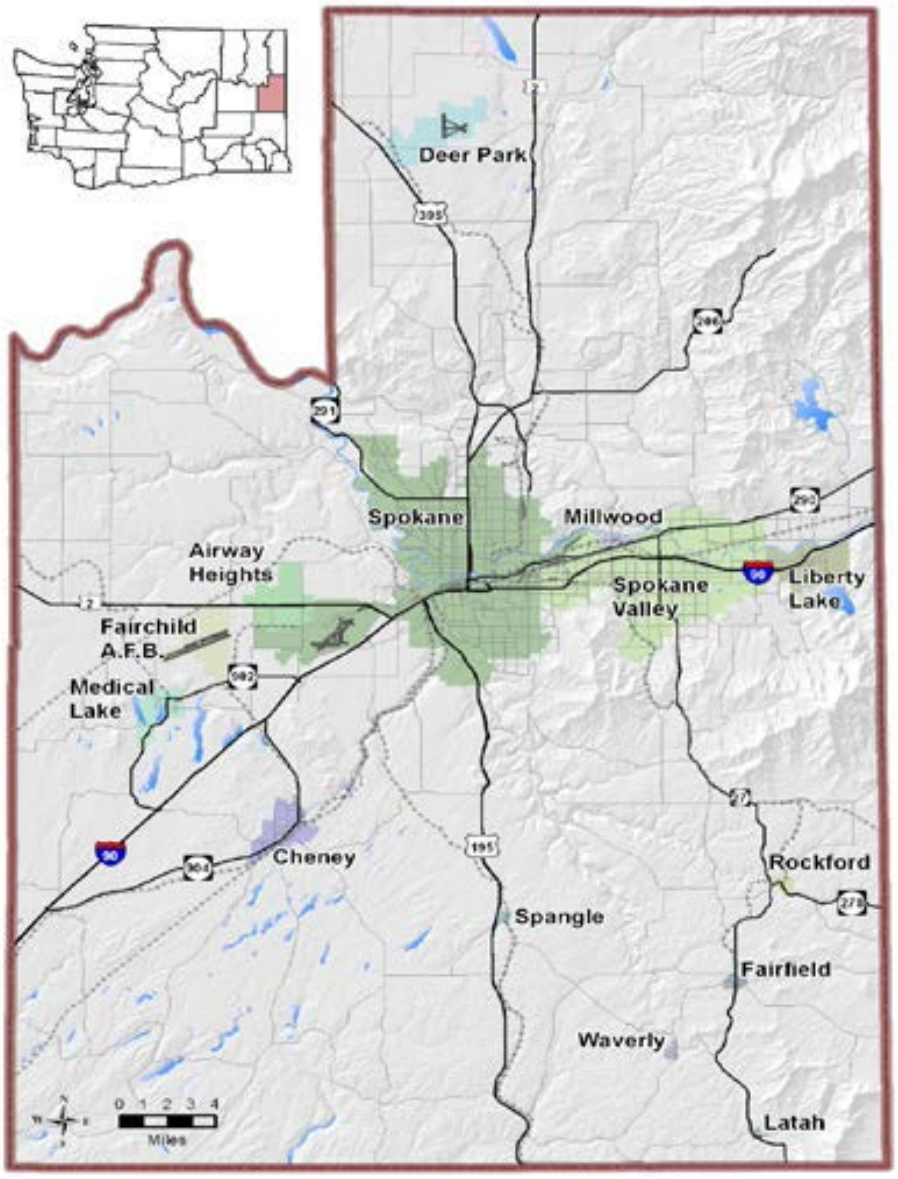

Figure 1 SRTC Regional Boundary
(Source: SRTC, November, 2015.)

3.0 Development of the SRTC Model

3.1 Existing Model

SRTC currently uses a traditional trip-based four step model on the PTV VISUM (version 12) software platform. Previously, SRTC used TMODEL and then transitioned to EMME/2 specifically to support Federal Transit Administration (FTA) New/Small Starts analysis. The most recent regional travel survey was conducted in 2005 with a sample size of more than 1,200 households. The model was most recently calibrated and validated in 2012 for the 2010 base model. When the 2010 base model was built, it was enhanced to include more robust transit assignment capabilities, trip generation rates were recomputed, model run procedures were streamlined, a combined bike/walk mode was added to the nested mode choice structure, and the volume delay function was updated among other refinements. An assessment of the performance of the 2040 forecast model was also conducted during the development of Horizon 2040, the region's long range regional and metropolitan transportation plan, which was approved by the SRTC Policy Board in 2013. SRTC also has forecast year models for Years 2020 and 2030.

3.1.1 Socioeconomic and Land-Use Inputs

There are 565 transportation analysis zones (TAZs) including 34 external zones and 12 park & ride zones in the SRTC model. The model has the following land-use and employment categories:

- Single family residential
- Multi-family residential
- Hotel/motel
- Non-CBD retail trade
- CBD retail trade
- Services and offices
- Agriculture, forestry, mining, industrial, manufacturing, and wholesale
- Higher education commuter students
- University employees
- Education employees
- Medical, and
- Finance, insurance, and real estate services.

SRTC does not have a land-use model. The land-use and population forecasts are developed via a manual process of allocating population growth based on discussions with local agencies. There is not one agency that does coordinated socio-economic forecasts. Employment is assumed to grow at the same rate as population.

3.1.2 Trip Generation, Distribution, and Time-of-Day

The model includes the following trip purposes:

- Home-Based Work,
- Home-Based Retail,
- Home-Based School,
- Home-Based College,
- Home-Based Other,
- Non Home-Based (private auto person trips), and

- Non Home-Based (commercial vehicle trips).

The periods included in the model procedures are AM (6am-9am), Mid-day (9am-3pm), PM (3pm-6pm) and Night (6pm-6am) with two peak hours AM (7am-8am) and PM (5pm-6pm). The trip distribution model uses a gravity model formulation with no k-factors.

3.1.3 Mode Choice

The mode choice model is a nested logit model with auto, transit, and non-motorized travel at the upper level nest. The lower level nest has drive alone and shared ride grouped under auto, and walk access and drive access grouped under transit. Currently, the only transit available in the region is local bus. There is a placeholder for a light-rail mode also included in the model. This placeholder creates a third-level nesting structure by splitting walk access into walk to bus and walk to light-rail and splitting drive access into drive to bus and drive to rail.

3.1.4 Network Characteristics and Assignment

The model's vehicular network contains I-90, U.S. highways, state routes, principal arterials and a few minor arterials, collectors and local roads as necessary. In the 2010 model there are about 2 million person trips and 1.4 million vehicular trips on an average weekday with 8.4 million vehicle miles traveled (VMT) and 227,000 vehicle hours of travel (VHT). The model's transit network is comprised of 38 fixed bus routes with about 1,700 bus stops and 41,000 unlinked passenger trips per day. There are five express routes, one of which is primarily utilized by university students. A combined bike/walk mode is incorporated in the nested model choice model, but biking and pedestrian trips are not assigned to a network.

3.2 Future Model Update

SRTC is currently well positioned for an update to the regional travel demand model. A major focus of the agency recently has been developing a performance management system to implement Horizon 2040, called the Horizon 2040 Implementation Toolkit, while meeting MAP-21 requirements. The model will play an integral role in informing this toolkit. The next iteration of Horizon 2040 will be updated by December of 2017 and the model will be used for scenario evaluation, project prioritization and other analysis as necessary. An updated travel survey and enhanced model are important to support the development of the plan and other SRTC activities. SRTC wants to enhance the travel demand model while continuing to address on-going needs. SRTC is considering the following model updates, but understands that not all of these enhancements are necessary or even desirable:

- Undertake a new household travel survey to provide better model input data,
- Develop a land-use and economic model,
- Implement a freight model,
- Update trip generation rates,
- Replace the gravity model with a destination choice model,
- Improve modeling of non-motorized travel, and
- Refine traffic and transit assignment.

3.3 SRTC's Goals for the Current Peer Review

The primary reasons that SRTC is pursuing a model peer review are to:

- Build and reinforce confidence in model with agency leadership/staff, policy-makers, partner jurisdictions, the business community and the public;

- Conduct an objective assessment of the model in comparison to the state of the travel demand modeling practice;
- Better understand the capabilities and limitations of the current model;
- Ascertain the model's role in supporting the mission and vision of the agency; and
- Help SRTC decide how to proceed with model improvements keeping in mind the following:
    - Implications of model improvements,
    - Benefit/cost,
    - Legal and/or regulatory issues, and
    - Risks involved with model changes.

4.0 Peer Review Discussion

The first half of the peer review was spent by SRTC staff members making presentations on specific items to the peer review panel. During these presentations, many topics came up which initiated discussion among peer review panel members and between panel members and SRTC. This section documents the key points that arose during these presentations.

4.1 Model Application and Policy Implications

The SRTC model is used to answer transportation planning questions and inform a wide variety of policy decisions in the Spokane region such as:

- Project evaluation and prioritization
- Congestion analysis and corridor screening
- Scenario planning and sub-area plans

There is an increasing desire by the SRTC board to evaluate policy decisions via a quantitative assessment of the options rather than through qualitative and subjective analysis.

4.1.1 Project Evaluation and Prioritization

SRTC only identified regionally significant transportation projects for detailed analysis and discussion within Horizon 2040. The model was not used to prioritize projects, and instead many of the projects listed in the current regional plan were carried over from the previous plan. The North Spokane Corridor is currently the only large-scale transportation project under development. It is a limited access highway that will provide a better north-south connection through the region. Recently the last 5 miles of the highway has been funded. There are also a few transit improvements underway such as the planned central city line . Bridging the Valley is an initiative to separate vehicle traffic from freight traffic through the region by removing at-grade crossings. Currently approximately 80 trains/day pass through the region. The Inland Pacific Hub (IPH) project identified transportation related investments to increase economic growth in the State of Washington and Idaho. An economic impact analysis (EIA) and cost-benefit analysis was done on Bridging the Valley as part of the IPH.

The SRTC model is used to evaluate how planned transportation projects will impact the regional transportation system. SRTC reviews the following model outputs of a build scenario compared to a no-build scenario:

- VMT/VHT
- Loaded network speeds
- Average travel time
- Transit ridership
- Non-motorized mode share
- Number of person and vehicular trips

SRTC has a desire to develop a toolkit for project prioritization. This toolkit would be used for prioritizing projects in Horizon 2040 as well as application for Surface Transportation Program (STP), Congestion Mitigation and Air Quality Improvement (CMAQ), and Transportation Alternatives Program (TAP) funding. SRTC questioned how the outputs of the model can be better used to evaluate and prioritize projects and what performance metrics can be developed to review the results. The panel suggested to think about how SRTC recognizes a problem and

then identify the measures based on what will be useful to SRTC's policy makers by answering the following questions:

- What is SRTC trying to measure today?
- What does the data tell SRTC about the problems?

The panel cautioned that metrics developed at the national level may not as useful as metrics developed specifically for SRTC. Many of the national level metrics require a lot of new data collection that may not be feasible for SRTC.

The panel also suggested looking toward other non-model tools to help with project prioritization and long-range planning, as the travel demand model can only go so far. It is important for SRTC to understand the set of tools needed to accomplish the objectives SRTC has for transportation planning. Once the objectives are identified, performance measures can be laid out and then from there SRTC can figure out what can be evaluated via the travel demand model and what should be evaluated using additional tools.

4.1.2 Congestion Analysis and Corridor Screening

The travel time index is used by SRTC as a metric for identifying the top urban transportation corridors within the region. A travel time index is used to measure congestion. The travel time index is measured as congested travel time over free flow travel time using INRIX data and is used for short-term analysis. The AM peak and PM peak periods are reviewed separately. V/C ratio is not used since the model is not sensitive to it.

Collision data, land-use data, VMT, VHT, and bridge conditions is also used to identify high risk corridors. GIS analysis is also performed using output from the model. The top corridors are identified so that the limited funds can be used to improve these top corridors. However, any capacity increasing project must undergo a strict process to show that other lower cost strategies have been considered.

4.1.3 Scenario Planning and Sub-Area Plans

SRTC also uses the travel demand model to do scenario planning and support sub-area plans. The model is used to support land-use policy analysis, such as evaluating transit-oriented development versus traditional suburban growth. Alternative sociodemographic forecast scenarios are run through the model and travel times and volumes are analyzed. SRTC does revisit the TAZ structure with local jurisdictions on a fairly regular basis to ensure that it matches local comprehensive plans. The panel agreed that the comprehensive plan should be used as a guide for developing land-use forecasts.

4.2 Model Issues

Another presentation made by SRTC to the peer review panel focused on assessing issues with the current model. The discussion focused on the household travel survey, trip generation, traffic assignment, and transit assignment.

4.2.1 Outdated Household Travel Survey

The most recent regional household travel survey was conducted in spring 2005 with a sample size of more than 1,200 households. Since 2005 the socio-demographics and the travel behavior of the population has changed. For example, families with children have decreased over the past ten years while families without children or non-family multi-person households has increased. In addition, transit ridership with Spokane is experiencing record high ridership.

In 2012 when the latest version of the model was calibrated, the household travel survey was reweighted to Census 2010 to account for the changing demographics.

The panelists noted that a household travel survey that has very low regional transit mode shares can pose a challenge when it comes to properly modeling mode choice and transit assignment. The panelists agreed with SRTC that a traditional area of underrepresentation in regional travel surveys are the population groups that use transit, such as the college student population.

SRTC should contact the local colleges and universities to partner in data collection and sharing of travel data. Typically, household travel survey can only reach the college students living in households. The most effective way to reach the other college students living in dormitories and apartments, or with any other arrangements, is to survey them on the attraction end (i.e. the college campus). More specifically, SRTC may collaborate with the colleges to conduct a web-based survey to ask the college students the questions related to their residence type and location, and campus oriented trips. Ten percent response rate should be sufficient to develop fairly reliable statistics, such as residence type and location distribution, trip rates and transportation mode usage. The collected data can be further connected with the other supplemental information, such as on-campus parking, to estimate various models for college student travel. This information should then be used to develop and calibrate a home-to-college trip purpose.

4.2.2 Trip Generation

SRTC is concerned that the current base model which was calibrated to Year 2010 conditions based on travel behavior from a 2005 household travel survey does not properly represent the trip generation rates that will occur in forecast years. Similar to the rest of the nation, the percentage of the population that is older will increase significantly from Year 2010 to Year 2040. SRTC was interested to learn if there were other sources of data, besides or in addition to conducting a new household travel survey, that could help with developing new trip generation rates.

The panel agreed that an updated household travel survey is necessary to successfully update the trip generation rates. They noted that the overall trip generation methodology was sound. They also noted that for those socio-economic groups represented in a base year (calibration year) model, it is common practice to not change person trip generation rates from that year to a future year. For example, if the represented group contains all people from a household of size two, regardless of age breakdowns in the household, the same average rate per household that is used in model calibration is also used for any future-year prediction involving households of size two. One approach for exploring the impacts of different assumptions on an average person trip rate is through well-documented scenario planning.

SRTC, during validation, should adjust trip generation rates intelligently to match count data, not through such methods as adjusting the vehicle occupancy rate unless there is survey data to support such a change. Traditional household travel surveys that do not include a GPS component tends to underreport the trips made by people, which will lead to underestimated trip rates. Vehicle occupancy rate, if also derived from the household travel survey, is calculated based on reported trips. Unless it is believed that the non-reported trips have totally different vehicle occupancy rate than the reported ones, vehicle occupancy rate, as a derived statistic from the household travel survey, is relatively reliable. This is why the panel suggests to adjust trip rates, but not vehicle occupancy rates.

4.2.3 Traffic Assignment

For validation, SRTC uses the *Travel Model Validation and Reasonableness Checking Manual* as a guide. They do collect traffic counts on a regular basis, but are interested in confirming the best location for collecting these counts for ideal validation (i.e. validating to screenlines, cutlines, or cordon lines). SRTC relies on the Washington Department of Transportation (WSDOT) for most of their counts, but in the past have paid to have additional counts collected for model validation. For nineteen out of the twenty-two screenlines the model is under-estimating current traffic levels. The screenlines were collected from a variety of jurisdictions including WSDOT and Idaho DOT.

The panel evaluated in detail the traffic assignment setting within VISUM. They noted that the model had the following issues:

- Maximum gap setting is too high. It should be in the range of 0.0001, rather than the current setting of 0.001.
- Multi-point assignment (MPA) is configured, but may show few benefits due to inconsistent VISUM settings
- The default speed limits are too high; however, it is possible that the speed limits have been manually adjusted from the default.

The panel had an extensive discussion concerning whether the conical volume delay function, currently being used in the model, was accounting for delay properly. For most urban arterials, there are two types of delay, link delay and node delay. Link delay is largely determined by the capacity of the roadway and the traffic operating on it (i.e. V/C ratio). Node delay is caused by the traffic controls implemented at the intersection, yield and stop signs and more often traffic signals. Link delay is also the function of link length, but node delay is not. Suppose two identical roadway links of different length, 1 mile vs. 5 miles, carry exactly same amount of traffic and are controlled by exactly the same traffic signals with the same configuration (e.g. cycle length, phasing, G/C ratio), the average travel speed of the shorter link will naturally be lower because its node delay from the traffic signal will take a larger percentage of the total delay. However, BPR and conical functions may suggest the same travel speeds unless the link capacity is a function of link length, which is not very common. A good volume-delay function ideally should have both link delay and node delay components. If, as in many travel demand models, assigning the right amount of traffic on roads is the only role of the volume-delay function, and the accuracy of estimated travel speeds is not a concern, then BPR and conical functions work just fine, particularly for the transportation facilities serving uninterrupted traffic flow, such as freeways and parkways. However, for the model to be useful for project level work, node delays will be necessary in addition to conical delay functions.

The panel was also concerned that if the model is only based on the household travel survey, which does not model certain trips (i.e. freight), then the assignment is missing trips. It may be necessary to intelligently add “fudge factors” to account for missing trips. They suggested a review of the section of *NCHRP 365: Travel Estimation Techniques for Urban Planning* that discusses the correlation of free flow speed to speed limit. The report suggests increasing the free flow speed by a few miles per hour in relation to the speed limit on highways. While two of the panelists stressed the importance of accurately forecasting travel speeds, one panelist noted that since congestion is not predicted to increase significantly in the future, it is not important to forecast speeds directly. Instead, current condition speeds can be transferred to the forecast years.

4.2.4 Transit Assignment

With regard to transit validation, the model does a good job at matching system ridership but is not very accurate at the route level. Spokane Transit Authority (STA) currently is testing collecting automated passenger counts (APC), but it has not yet been deployed systemwide. STA uses on-board survey data for planning purposes as well as providing it to SRTC for model validation. STA also has data from their fareboxes that SRTC can use for validation.

SRTC noted that the model is not correctly evaluating the number of park and ride trips, which may be due to the fact that assignment is only conducted for the AM and midday periods, and so return park and ride trips are not easily evaluated. The model currently uses headway, rather than timetable, assignment, and SRTC questioned whether they should move toward timetable assignment as well as all-day assignment.

The panel noted that most travel agencies will move toward schedule-based assignment within the next ten years, but that does not mean that it is the right approach for SRTC. They suggested that SRTC talk to other agencies who are moving toward schedule-based assignment, such as the Delaware Valley Regional Planning Commission (DVRPC), to see if it is an approach that will work for SRTC. The panel stated that with SRTC's existing software, VISUM, they can try out different settings to obtain a schedule-based approach; however, given the low transit ridership within a region, another tool may be more appropriate for transit project evaluation, such as STOPS. The panel pointed out that the low transit share of 2-3% suggests that these transit riders are mostly captive riders. Therefore, using an advanced transit mode choice model and assignment may not be productive. Instead, the focus of model development should be to build a model that focuses on assigning these captive riders to the correct route.

5.0 Peer Review Panel Recommendations

On the last half day of the meeting, the peer review panel spent about one-and-one-half hours in an executive session, closed to all other participants of the meeting. The reason for this closed session was to allow panel members to speak freely and openly among themselves while developing formal recommendations. This section details those panel recommendations.

5.1 Model Inputs and Observed Data

The panel provided guidance for updating model inputs and observed data, including socioeconomic, land-use, and economic data, household travel survey data, and observed transit and traffic data.

5.1.1 Socioeconomic, Land-use, and Economic Data

The panel agreed that SRTC does not need to develop a land-use or economic model. However, they do need to develop consistent procedures across jurisdictions for developing economic, land-use, and socioeconomic forecasts. SRTC should seek out expert opinion to ensure that the developed procedures are valid. The panelists encouraged SRTC to make use of the State of Washington's purchased REMI data, but cautioned SRTC to make sure the data units are consistent with what is needed for the SRTC model. SRTC should regularly review local jurisdiction comprehensive plans to ensure that SRTC's land-use forecasts match-up to local land-use forecasts. SRTC should improve its methodology for developing economic forecasts. It is state-of-the-practice to develop economic forecasts independently and before population forecasts and then base population forecasts off of the economic forecasts. SRTC's current practice of basing employment forecasts directly off of population forecasts based on historical trends in the data may work for near term forecasts but not for long-term forecasts. In the short term, the ratio of population and employment may be held constant, but this ratio may vary substantially 20 or 30 years later due to several factors, such as population aging, productivity improvement, economy structure change, which are all in the domain of economic forecasting.

5.1.2 Household Travel Survey

The panel recommended that SRTC move forward with collection of new household travel survey data using a reputable and experienced consultant. They suggested that SRTC should collaborate with local universities on data collection to ensure that University travel is appropriately surveyed. They also suggested that SRTC review the travel behavior, such as trip rates and lengths, from the existing 2005 household travel survey. They should review trends between Year 2005 to 2016 in trip rates and sociodemographic characteristics from ACS, NHTS and from cities similar to Spokane. They should also review Spokane's current socioeconomic profile, transportation system, and spatial distribution of population and employment to see the region has changed substantially from 2005. Some aspects of travel patterns, such as trip rates, revealed by household travel surveys are largely driven by demographics and socioeconomics. The others, such as mode share and trip length, are also affected by the changes of transportation system and spatial distribution of population and employment. Therefore, if the regional demographics and socioeconomics have not changed substantially since the last survey, and the population and employment growth has occurred in the same manner as in the past, SRTC may not need a new survey. If they are comfortable that trip rates and lengths have not changed significantly over the past ten years, then they could update the travel demand model using existing survey data in conjunction with pursuing new household

travel survey data collection. However, if SRTC believes travel behavior has changed substantially, then they should collect household travel survey data first before performing significant updates of the model.

5.1.3 Observed Transit and Traffic Data

The panel encouraged continued collection of transit on-board survey data and APC deployment, as that data is an essential resource for model validation. They also suggested to incorporate periodic tablet-based surveys into SRTC's data collection plan.

The panel assumed that the current observed traffic count data collection was adequate, but stressed the importance of these counts for model validation. They did suggest to make sure that when a Bluetooth survey is conducted for OD analysis that SRTC gets hold of the data before it is thrown out. They also suggested looking into private aggregate speed data providers.

5.2 Model Updates

In response to SRTC's request for guidance on model improvements the peer review panel made recommendations on each component of the travel demand model.

5.2.1 Trip Generation and Trip Distribution

The peer review panel made several recommendations to SRTC to improve their trip generation and trip distribution models:

- Trip generation rates should be adjusted intelligently to match observed data.
- Close attention must be paid to development of survey expansion factors for existing and new surveys.
- Trip generation should be enhanced by the incorporation of special generators such as the airport, university campuses, open spaces, and parkland.
- The gravity model should continue to be used for trip distribution.
- Transit impedances should not be included in trip distribution utilities. Adding transit impedances would add additional and unnecessary complexity to the model. Given that current transit mode share is low, trip distribution will most likely not be sensitive to transit impedance.

5.2.2 Mode Choice

The peer review panel recommended continued use of a nested logit model for mode choice application. They recommended that bike and walk should be split into separate modes, but there is no need to assign these trips. The light rail placeholder should be removed. With regard to the transit mode, the panel assured SRTC that locally adjusted asserted transit parameters are acceptable and to make sure to review the alternative specific constants when reviewing household travel survey weights. The panel also suggested that captive ridership is hard to express in mode choice utility functions, and the model might do better estimating ridership levels in other ways (e.g. with STOPS). A failure to include captivity may cause too great a sensitivity to service improvements, since captives are, by definition, relatively insensitive to LOS parameters. One way to

capture transit captivity is to base transit captivity on the number of zero-auto households (there is a much lower percentage of captive riders than households without cars), then allocate this captive percent directly to the transit system (if there is access). Then add choice riders as necessary. A good check on the captive/choice ridership ratio is the transfer percentage, since captive riders transfer at a higher rate than choice riders.

5.2.3 Traffic Assignment

The peer review panel recommended several improvements to traffic assignment model including the following:

- Explore assignment algorithms that allow multi-threading capability to reduce computation time.
- Pursue a tighter convergence threshold of approximately 0.0001 and test the relative gap against RMSE,
- Consider assignment on the following one hour time periods:
  - AM peak hour
  - PM peak hour
  - Midday
  - All other periods
- Improve delay estimation by moving toward a more complete representation of traffic delay, including intersection delay, but retaining the method of successive averages (MSA) as the assignment method.
- Continue to iterate from assignment back to prior model stages.
- Simplifying the network by removing unnecessary nodes.
- Pursue DTA only for addressing non-recurring congestion and episodic railway crossings.

5.2.4 Transit Assignment

The peer review panel suggested that SRTC continue to use headway-based assignment. However, they did suggest to consider a targeted investigation of the region's bus schedules to see where a headway-based model may fail to adequately measure transfer time. They encouraged SRTC to investigate the best process for revising the transit assignment time periods. They also noted that SRTC should check to make sure that wait time is capped at 30 minutes.

5.3 Other Recommendations

The peer review panel made several additional recommendations to SRTC related to improvements of their travel demand model:

- Pursue a modest truck-based freight component that follows the Quick Response Freight Manual (QRFM v2).
- Closely relate performance measures to plan objectives and closely relate model outputs (i.e. tangible data) to performance measures.
- Review *NCHRP 765: Analytical Travel Forecasting Approaches for Project-Level Planning and Design* for guidance on model refinement.

- Pursue model updates via a reputable consultant who in addition to updating the model should:
    - Provide training to SRTC so that SRTC can make modest changes to model structure,
    - Produce detailed documentation on model estimation, calibration, and validation, and,
    - Develop a sufficient user guide.

Appendix A List of Peer Review Panel Participants

This section lists all individuals who attended the meetings, including panel members, SRTC staff and affiliated agencies, and peer review support staff.

A.1 Peer Review Panel Members

Panel Member	Affiliation
Aaron Breakstone	Portland Metro
Alan Horowitz	University of Wisconsin - Milwaukee
Jeremy Raw	Federal Highway Administration (FHWA)
Aichong Sun	Pima Association of Governments (PAG)
Ken Cervenka (Peer Review Advisor)	Federal Transit Administration (FTA)

A.2 SRTC and Affiliated Agency Staff

Name	Affiliation
Ryan Stewart	Spokane Regional Transportation Council (SRTC)
Anna Ragaza-Bourassa	Spokane Regional Transportation Council (SRTC)
Staci Lehman	Spokane Regional Transportation Council (SRTC)
Kevin Shipman	Spokane Regional Transportation Council (SRTC)
Kevin Wallace	Spokane Regional Transportation Council (SRTC)
Mike Bjordahl	Washington State Department of Transportation (WSDOT)
Bonnie Gow	Kootenai Metropolitan Planning Organization (KMPO)
Eve Nelson	Spokane Regional Transportation Council (SRTC)
Barry Greene	Spokane County

A.3 TMIP Peer Review Support Staff

Name	Affiliation
Sarah Sun	Federal Highway Administration (FHWA)
Rachel Copperman	Cambridge Systematics, Inc.

Appendix B Peer Review Panel Meeting Agenda

Table B-1: November 2, 2015 Agenda

Time	Description
8:30 - 8:45	Welcome and introductions
8:45 - 9:00	Peer review process overview (panel chair – Dr. Alan J. Horowitz, PE, AICP)
9:00 - 9:30	SRTC model overview (SRTC – Ryan Stewart)
9:30 - 10:00	SRTC model issues (SRTC – Ryan Stewart)
10:00 - 10:15	Break
10:15 - 10:30	SRTC model expectations (SRTC – Ryan Stewart)
10:30 - 11:00	Feedback from SRTC model users (moderated by panel chair)
11:00 - 11:45	Panel Q&A and discussion (moderated by panel chair)
11:45 - 12:00	Break/Lunch prep
12:00 - 1:30	Lunch - continuing panel discussion and Q&A (moderated by panel chair)
1:30 - 1:45	Break
1:45 - 3:45	Panel executive session (moderated by panel chair)
3:45 - 4:00	Break
4:00 - 5:00	Panel recommendations and open panel discussion (moderated by panel chair)
5:00	Concluding comments and adjournment (panel chair)

Appendix C Peer Review Panel Member Biographies

C.1 Aaron Breakstone, Portland Metro

Aaron Breakstone is a Senior Transportation Modeler at Portland Metro. His responsibilities span a range of model development and application efforts, including periodic model application code updates, major high-capacity transit corridor studies, bicycle modeling, and vehicle emissions modeling. He holds a Master's degree in Urban and Regional Planning from Portland State University.

C.2 Alan Horowitz, University of Wisconsin-Milwaukee

Alan J. Horowitz is a transportation engineer and an urban planner. His research spans the areas of travel forecasting and traffic impacts. Since coming to the University of Wisconsin-Milwaukee in January 1979, Professor Horowitz has been continuing his research into values of time, and conducting new research about urban trip tours, land-use impact assessment, single-route ridership forecasting, trip assignment, subarea focusing, ride quality of highways, intermodal passenger transfer facilities, transportation benefits, freight planning, applications of GIS to transportation networks, hazardous materials routing, intelligent transportation systems, and travel forecasting. Dr. Horowitz is the author of the Quick Response System II travel forecasting software platform.

C.3 Jeremy Raw, Federal Highway Administration

Jeremy Raw, P.E., works in the Federal Highway Administration Office of Planning where he conducts research, development and deployment of modeling and data analysis tools, and provides related technical assistance to Metropolitan Planning Organizations and state transportation agencies. Jeremy has worked for local, regional and state transportation agencies in North Carolina and Virginia, including the Virginia Department of Transportation from 2006 to 2010. He has built and evaluated travel models for many agencies, and has worked extensively with statewide travel models, as well as freight and toll models. Jeremy's current research includes developing suitable analytic tools to support the increasing national emphasis on performance-based planning.

C.4 Aichong Sun, Pima Association of Governments

Aichong Sun is the regional modeling manager at the Pima Association of Governments (PAG) since 2007. His major responsibility is to oversee the regional modeling program at PAG to develop and maintain travel demand models, including Activity-Based Model and Dynamic Traffic Assignment model, that support and promote the best possible forecasting of future travel for the Tucson region; maintain regional travel related databases for analyses, assessments and studies in related program areas; develop and maintain land use model and land use databases; develop and maintain air quality model; and, prepare population/socioeconomic estimates and forecasts, and analyze and disseminate census data. He also worked as the senior transportation modeler at PAG between 2005 and 2007. Prior to joining PAG, Aichong worked as a transportation modeler/planner/engineer in Beijing, China for

five years, and then he acquired his Ph.D. in Civil Engineering from the University of Arizona in 2005.

C.5 Ken Cervenka, Federal Transit Administration

Ken Cervenka is a Community Planner at the FTA, where has worked since 2007. His major responsibilities include technical assistance to MPOs, transit providers, and other agencies interested in preparing transit rider "on-board" surveys and transit ridership forecasts. For forecasts submitted by project sponsors in support of New Starts and Small Starts projects, his responsibilities include a formal assessment of the plausibility of those forecasts for use in FTA's project evaluation process. Prior to joining FTA, Ken worked as the Travel Forecasting Manager at the North Central Texas Council of Governments, the MPO for the Dallas-Fort Worth area.

Appendix D Documentation Provided to Panel Members by SRTC and Documents Referenced in this Report

2005 SRTC Regional Travel Demand Model: Methodology and Validation Results
Prepared by PTV America, dated September 2006.
Provides documentation of the SRTC travel demand model.

Analysis and Recommendations for Revisions to Trip Generation Module Memorandum
Prepared by DKS Associates, dated January, 2012.
Summarizes recommendations to the trip generation module within the travel demand model.

Inquiries About SRTC Model Vehicle Trips and VMT Variation Memo
Prepared by DKS Associates, dated March 2013.
Compares and explains the SRTC travel demand model decreases in vehicle trips and vehicle miles of travel (VMT) when compared to prior versions of the travel model prior to 2008.

Horizon 2040 Spokane Metropolitan Transportation Plan: Moving Forward Brochure
Prepared by SRTC, dated April 2014.
Provides information on the 2040 Regional Transportation Plan.

NCHRP Report 765: Analytical Travel Forecasting Approaches for Project-Level Planning and Design
Prepared by CDM Smith, Alan Horowitz, Tom Creasey, Ram Pendyala, Mei Chen.
Transportation Research Board, 2014.

Spokane and Kootenai County Regional Travel Survey Final Report
Prepared by NuStats, dated July 2005.
Provides a summary of the 2005 regional travel survey.

Spokane Transit Authority On-Board Rider Survey Detailed Observations Report
Prepared by Robinson Research, dated April 2009.
Provides an analysis of the transit on-board rider survey.

SRTC Model 2040 Forecast Review Memo
Prepared by DKS Associates, dated February 2013.
Provides a findings of a review of the 2040 future year SRTC model calculations and results.

STA Onboard Survey HST Plan Update Information
Prepared by Moore Information, dated 2014.
Summary of 2013 on-board survey data.

TMIP Peer Review Process Guide: How to Get the Most Out of Your TMIP Peer Review
Prepared by John A. Volpe National Transportation Systems Center for Federal Highway Administration, 2010.

TMIP Travel Model Validation and Reasonableness Checking Manual (Second Edition)
Prepared by Cambridge Systematics, Inc. for Federal Highway Administration, 2010.

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