Appendix A

Model Documentation

DRAFT MEMORANDUM

Date: November 26, 2014

To: City of Tacoma, Department of Public Works

From: Chris Breiland, Fehr & Peers

Subject: **City of Tacoma Travel Demand Forecasting Model Development**

SE13-0313

INTRODUCTION

Fehr & Peers has worked with the City of Tacoma to develop a new travel demand forecasting model to support a variety of transportation planning and engineering projects in the City. This model, which has a base year of 2014 and a future year of 2040, is well suited for the following types of tasks:

- Development review
- Traffic engineering
- Temporary closure/detour analysis
- Sub-area planning
- Environmental Impact Reports
- Long range planning
- Transportation LOS/concurrency assessments
- Transportation performance monitoring
- Mode split evaluations
- Transit planning

The Tacoma Travel Model (TTM) is based on the Puget Sound Regional Council's (PSRC) Regional Travel Demand Model, Version 1.00b. The PSRC has extensive model documentation and a User's Guide that have already been submitted to City staff. Rather than re-write the PSRC documentation, this memorandum summarizes the changes Fehr & Peers made to the PSRC model to develop the TTM. These changes include major updates to the following:

- Major expansion of traffic analysis zone (TAZ) detail in Tacoma and the UGA
- Added detail and refined the roadway network
- Updated transit network to include current Pierce Transit and Sound Transit routes and service levels
- Updated park-and-ride component of the model
- Included Tideflats truck trip generation component
- Updated demographic inputs from the 2010 Census and employment data from the Washington State Employment Security Department
- Revised trip generation rates based on the PSRC 2006 Household survey
- Updated assignment methods for traffic, transit, and park-and-ride lots
- Model validation results

The following sections describe the specific changes that were made to develop the TTM, why they are relevant for the model, and provide some details about key input and output files.

TAZ UPDATES

Traffic analysis zones (TAZ) organize land use development data into specific geographic areas. Ultimately all the land use that is within a TAZ polygon is represented as a point (centroid) in the travel model. The travel model then assigns trips to and from the TAZ centroid point when developing travel forecasts.

The original PSRC model has a relatively coarse TAZ structure since the model is regional in nature and is focused on generating travel forecasts across all of Snohomish, King, Pierce, and Kitsap Counties. To provide more refined travel forecasts in Tacoma, the PSRC zones were split as part of the TTM development. The finer TAZ structure allows for traffic forecasts to be generated on smaller roadways, improves the estimates of non-auto mode trips, and provides the ability to extract turning movement forecasts at key intersections. **Figure 1** shows the additional TAZ detail in the TTM compared to the original PSRC model. In total, Fehr & Peers added approximately 400 TAZs to Tacoma and the surrounding area, representing roughly a one-to-five split of the PSRC zones.

PSRC 4K MODEL

The PSRC is actively developing an update to the regional travel demand forecasting model that will eventually replace Version 1.00b. This new model is named 4K by PSRC because it has approximately 4,000 TAZs—which is a much higher level of detail compared to the current version of the model. While draft forms of the 4K model are available, it was not chosen as the basis of the TTM because many of the model elements are not net finalized and may not produce reliable travel forecasts.

To build in as much future flexibility as possible, the TTM was constructed with several elements of the 4K model, including the high TAZ detail in and around the City of Tacoma, the latest sociodemographic data from the US Census, and updated trip generation rates. Although the 4K model has higher TAZ detail, most of the procedures and modules in 4K are the same as the 1.00b version.

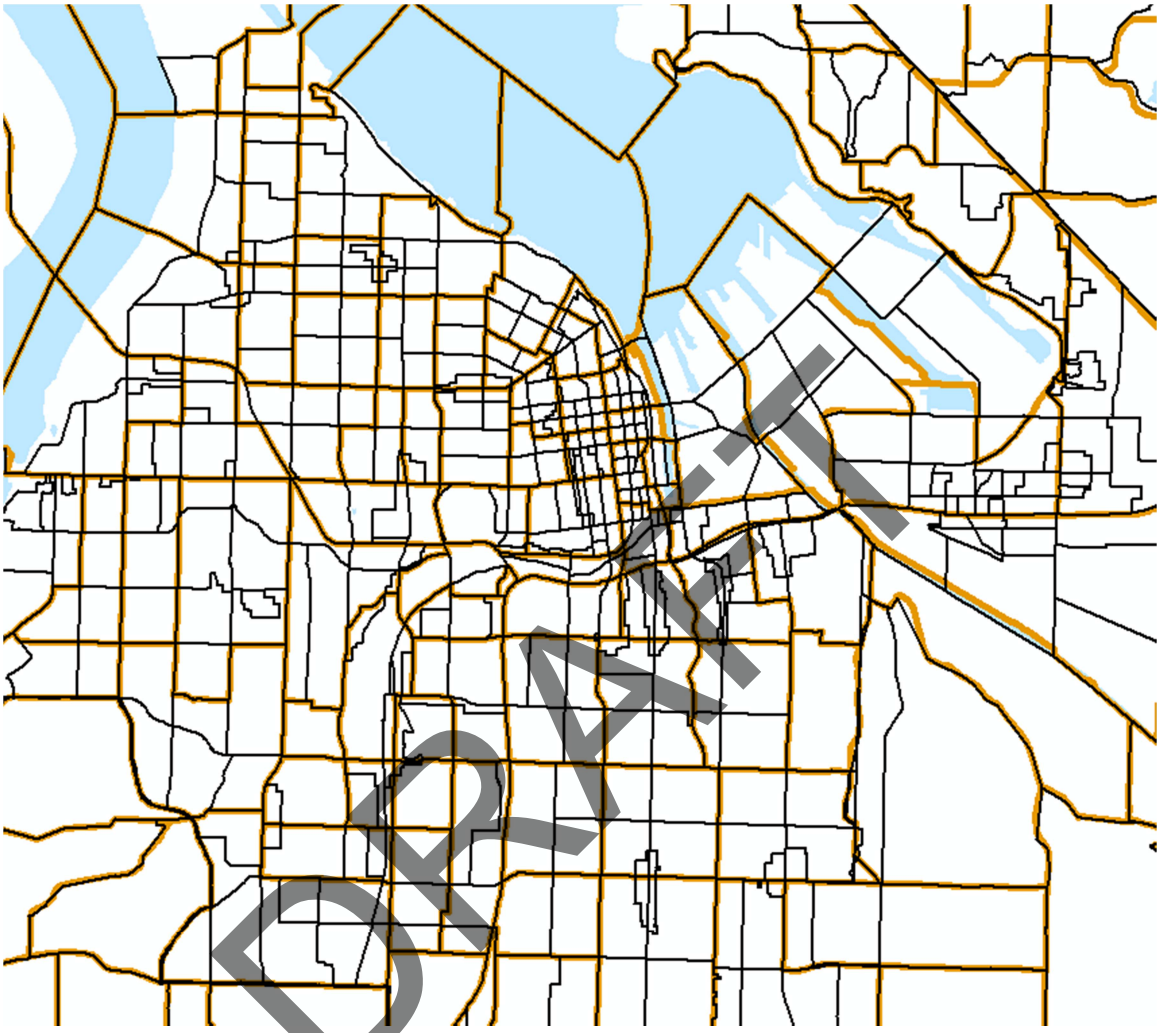

Figure 1 – PSRC TAZ Boundaries (orange) and Tacoma Travel Model TAZs (black)

The new TTM TAZ network in also consistent with PSRC's upcoming travel model platform, PSRC 4k. PSRC 4k has roughly 4,000 TAZs in the region, and includes much more detail in Tacoma. The TTM TAZs nest fully within the 4k TAZ structure so as PSRC releases future land use data in the 4k format, it will be simple to allocate the land use data into the TTM TAZ structure.

The TTM TAZs also follow the Mixed-Use Center boundaries so that growth in the centers can be isolated from the surrounding neighborhoods. **Figure 2** shows the TTM TAZ boundaries near the Proctor Mixed Use Center.

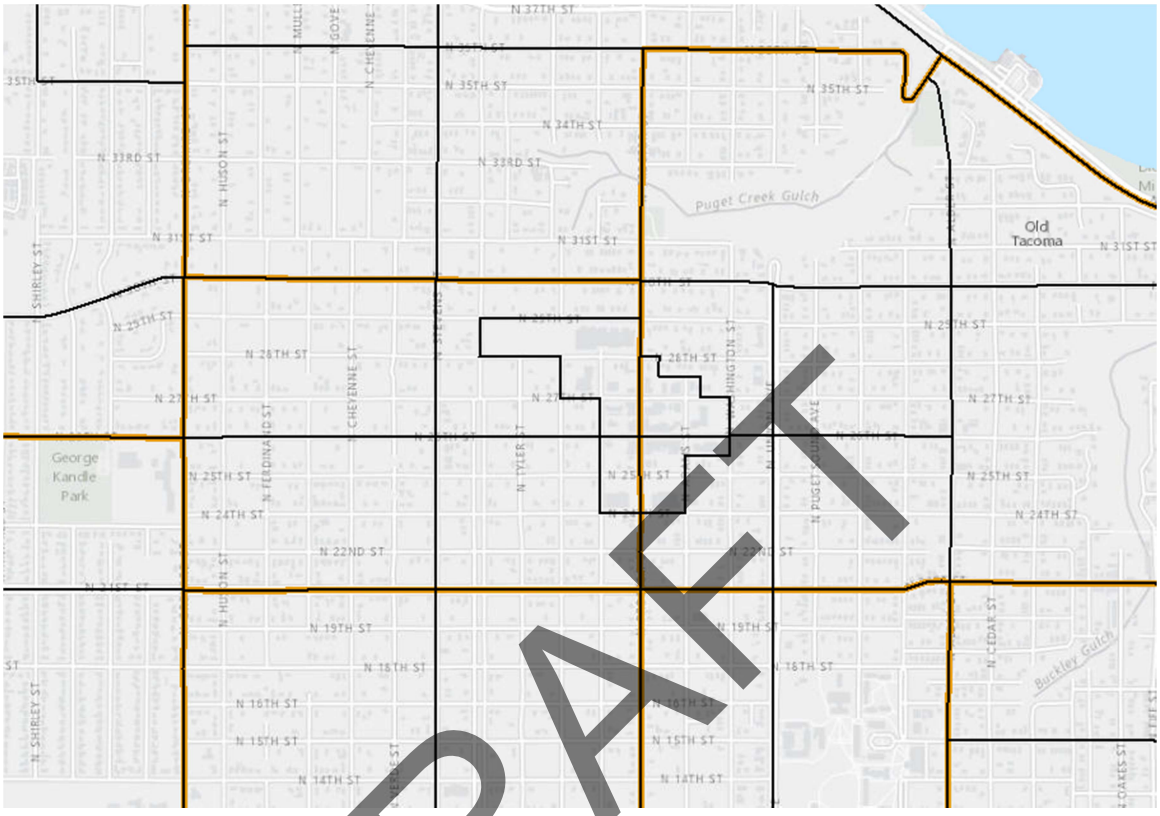

Figure 2 –Tacoma Travel Model TAZs Boundaries Around the Proctor Mixed-Use Center

Zone Numbering

For much of the region, the PSRC TAZ numbering was not changed when developing the TTM, however when splitting the TAZs in and around Tacoma, new TAZ numbers were assigned. To facilitate identification of TAZ numbers when editing the land use file or using GIS for data analysis, the following TAZ ranges cover the Tacoma area:

- Port/Tideflats Area: 668-671, 676-678, 680, 880-883, 910, 915, 939-949
- Tacoma: 22754-26503 (except for TAZs above 22000 listed elsewhere)
- University Park/Fircrest: 22994-22996, 22999, 23001, 23003, 23005, 23007-23013, 23049, 23051-23063, 23070, 23071, 23073, 23075
- Tacoma UGA north of SR 512: 23416, 23428, 23430, 23432, 23434-23436, 23487, 23490, 23492, 23493, 23496, 23499-23501, 23504, 23505, 23508, 23590
- Tacoma UGA south of SR 512: 789-791, 794-797, 803, 804, 23491

Land Use

The land use data used in the TTM includes housing and employment by sector. The housing data is derived from the US Census at the Block Group level. 2010 Census data were collected, supplemented with City of Tacoma building permit data to develop a 2012 base year housing estimate. The employment data is based on information provided by the PSRC and is based on year 2012 data. As noted in the PSRC model documentation, households are then allocated into income quartiles and employment into five categories: manufacturing; wholesale, transportation, communications, and utilities (WTCU); finance, insurance, real estate, and services (FIRES); government and education; and retail. **Appendix A** presents the 2012 land use data for the City of Tacoma TAZs.

TRANSPORTATION NETWORKS

Highway networks

The highway network developed for the base year TTM was created by updating the base PSRC travel model highway network with additional detail in the Tacoma area. Much of the highway network modification was done to accommodate the additional TAZs in and around Tacoma. **Figure 3** highlights the additional network detail in the Tacoma area. A generalized summary of the modifications made to the TTM highway network is shown in **Table 1**.

Figure 3 – Comparison of PSRC (left) and Tacoma Travel Model (right) Highway Networks

Table 1 – Tacoma Travel Model Network Modifications

Network Attributes	Modifications
Zone Connectors	The PSRC TAZs that were split into TTM TAZs required coding new TAZ connectors to the highway network. Any TAZ connectors that were connected to intersections were moved to mid-block. Driveway locations were identified with aerial photos and centroid connectors were located appropriately for the small mixed-use center TAZs. Walk access links were coded in downtown Tacoma and to park-and-ride lots.
Additional Arterials	Additional base year network detail was added to support the screenline validation effort and future year network assumptions.
Lanes	Modified lanes based on review of aerial photos and field visits. Major changes included coding of center turn lanes (adding 0.2 lanes per the common convention in the area-e.g., a three-lane road is coded as having 1.2 lanes in each direction).
Speed	Speed limits for arterials and collectors in Tacoma were set to match field conditions.
Capacity	Roadway capacities were set to consistent values across the Tacoma area (e.g., removing inconsistent coding from the PSRC model). See **Figures 4 and 5** for additional details.
Freeway Interchanges	Modified intersection geometries at SR 16 and I-5 interchanges to match actual ramp configurations.
Turn Prohibitions	Added turning restrictions at various locations near interchanges.
Tolls	Updated SR 16 toll to match current rates. Toll rates are in year 2000 dollars – SR 16 rate increased from $2.50 to $3.38 (which is a blended rate based on a mix of cash and GoodToGo pass usage). Toll rates are set in the following input files: AMTOLLS.WSF, MDTOLLS.WSF, PMTOLLS.WSF, EVTOLLS.WSF, NITOLLS.WSF

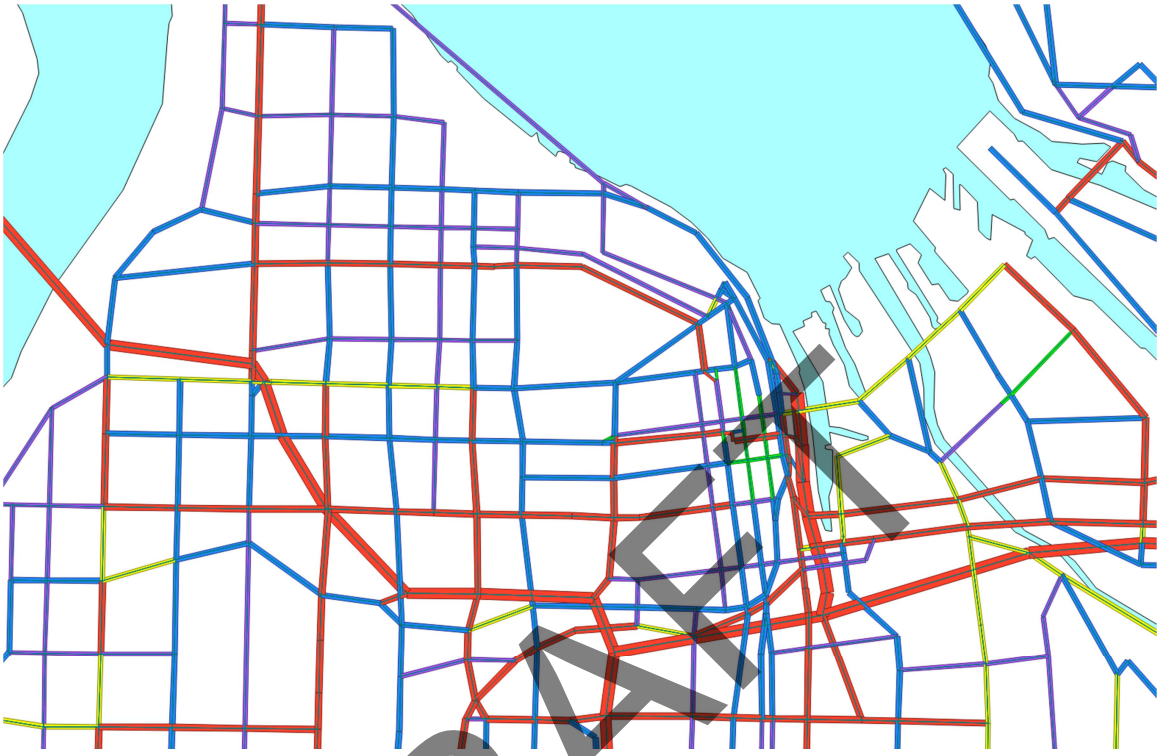

Figure 4 –PSRC Version 1.00b Capacities

Figure 4 shows the roadway capacities in the original PSRC 1.00b network in the Tacoma area. The colors are as follows:

- Greater than 1,000 vehicles per hour (vph) – red
- 900 vph – blue
- 800 vph – yellow
- 700 vph – purple
- 600 or lower vph (green)

Note that many non-freeway roads in Tacoma (e.g., N 21st Street, S 12th Street) have very high capacities (over 1,000 vph). There are also roads like S Jackson Avenue that have inconsistent coding in the PSRC model (varying from less than 600 vph to more than 1,000 vph from block-to-block). **Figure 5** shows how Fehr & Peers updated the capacities in the Tacoma area to be more representative of field conditions and to correct PSRC coding errors.

Figure 5 –TTM Capacities

Transit Networks

The transit network and operations inputs for the TTM were updated to reflect 2014 service characteristics from Pierce Transit and Sound Transit. Transit itineraries (routes and headways) were modified for all Pierce Transit and Sound Transit routes in Pierce County. The modifications were made for peak period and off peak service. **Figure 6** shows a screenshot of the transit coding in the TTM. **Appendix B** provides a list of the peak and off-peak transit routes and headways for all routes serving Tacoma.