Columbia River Crossing

Desktop Review of Traffic and Toll Revenue Forecasts

Final Report

Oregon State Treasury
Debt Management Division

C&M Associates, Inc.

June 2011

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June 30, 2011

Laura Lockwood-McCall
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350 Winter Street, Suite 100
Salem, Oregon 97301

Re: Final Report – Columbia River Crossing Desktop Review of Traffic and Toll Revenue Forecasts

Dear Ms. Lockwood-McCall:

C&M Associates Inc. is pleased to provide you with the Final Report of the Desktop Review of Traffic and Toll Revenue Forecasts for the Columbia River Crossing project. The report presents summaries of the reviewed documentation and information, C&M's findings on the strengths and weaknesses of the forecasts and, provides a qualitative opinion on the impact on revenue forecasts of the identified weaknesses.

The C&M project team, including Sasanka Pulipati, Sandip Faldu, Sruti Marepally and Shahram Bohluli, expresses its gratitude to the Oregon State Treasury for providing the opportunity to participate in this project.

Respectfully,

Carlos M. Contreras, MBA
President

Herbert E. Vargas, P.E.
Project manager

Columbia River Crossing

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Final Report

Prepared For The

Oregon State Treasury
Debt Management Division

By:

C&M Associates, Inc.

June, 2011

The results of this study constitute the opinion of C&M. This opinion is based on information provided by the Oregon State Treasury or published in the Columbia River Crossing project website. No attempt was made to verify the specific information, with the exception of readily available information in the Oregon State and Washington State Departments of Transportation's websites. C&M's review assumed that the material provided was true and accurate and no independent development of traffic and toll revenue estimates was anticipated or provided during this process. C&M utilized normal professional effort with respect to the review, subject to the time and budget constraints of the study's scope of work, and based on the information available to C&M at the time of execution of this study. C&M cannot guarantee or assure future events in connection to this opinion on traffic and revenue forecast.

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1. Introduction

This Desktop Review Report presents findings on the review of traffic and revenue forecasting done by others for the Columbia River Crossing (CRC) project. The purpose of this study consists primarily of documenting the review of the data, assumptions, methods and projections leading to the determination of an opinion on the strengths and weaknesses of the CRC traffic and revenue forecasting.

The traffic and revenue forecasting for the CRC project was performed as a supporting document to the Draft Environmental Impact Statement (DEIS) process and based on the traffic analysis for that process. It is important to note the differences between a traffic forecast for environmental evaluation and a forecast of transactions and revenue for purposes of financing a project. The main purpose of a traffic analysis for an environmental study is to determine daily and peak hour traffic volumes to evaluate project alternatives including a locally preferred alternative. The analysis determines how efficiently the project capacity meets the traffic demand in the existing conditions and the design year of the project. An important second purpose is to forecast the future traffic to evaluate the impacts to the environment, in terms of noise, air quality and others. For these purposes, a DEIS traffic analysis will most likely forecast a peak season average weekday daily traffic and the 30th highest peak hour for the design year.

A traffic and revenue forecast for supporting the project financing, forecasts the most likely traffic to pay tolls from opening year to the term of the financing, usually 30 years after opening year. This forecast considers seasonal conditions, economic conditions, ramp-up periods due to toll adjustments or initiation of tolls, toll diversion and toll avoidance among the most likely factors that differentiate a traffic and revenue forecast from a DEIS traffic analysis. A traffic and revenue analysis will usually report its findings in terms of annual transactions and revenue, while a DEIS traffic analysis will report its forecasts in terms of annual average daily traffic or peak hour volumes.

Both forecasts utilize the historical available data, and the projected socio-economic data for the area of influence of the project. However, a traffic and revenue analysis may take a more critical review of the socio-economic data to determine the rate of growth for an area. In addition, while the project traffic analysis will assume the highest throughput of a constrained highway segment to determine the most likely highest demand of the project; the traffic and revenue forecast may forecast even lower traffic volumes to reflect the loss of value to a prospective toll paying customer due to congested levels of service when compared to other mobility options.

1.1. Study Goals and Objectives

The goals of the CRC Desktop Review are to:

1. Assess the strengths and weaknesses of the financing plan per the directive of the Governors of the State of Oregon and the State of Washington.
2. Determine if the forecast in the traffic and revenue study is consistent with the proposed project and is supported by the socio-economic and traffic conditions

prevalent in the area today and those expected in the future.

Based on the nature of the project and in accordance with professional practices in the field of traffic and revenue engineering, the desktop review focused on the following objectives:

1. Sufficiency and Completeness of Data. The review evaluated the quality and amount of collected traffic data, methodology and validity of origin-destination surveys and stated preference surveys, vehicle classification and vehicle occupancy surveys and travel time and delay studies.
2. Model Statistics and Assumptions. The review evaluated the calibration, validation and methodology for the travel demand model and the traffic operations model.
3. Growth Projections. The review evaluated the socio-economic data utilized for the duration of the traffic and revenue projections, the socio-economic assumptions based on the impacts of the recent recession and the impacts of the project in the growth projections.
4. Traffic and Revenue Forecasts. The review evaluated the assumptions utilized for the toll diversion calculations, the assumptions on the traffic operations resulting from toll diversion, and the ramp-up periods assumed for the forecasts.

1.2. Desktop Review Process

The Desktop Review was based on information provided by the Oregon State Treasury and on information provided or published by the CRC project office. No attempt was made to verify the specific information, with the exception of readily available information in the Oregon State and Washington State Departments of Transportation websites. The Desktop Review assumes material provided is true and accurate and no independent development of traffic and toll revenues estimates were provided during this process. C&M utilized normal professional effort with respect to the review, subject to the time and budget constraints of the study's scope of work, and based on the information available to C&M at the time of execution of this study. C&M cannot guarantee or assure future events in connection to this opinion on traffic and revenue forecast.

1.3. Description of the Columbia River Crossing Project

CRC project consists of improving the current bridge crossing along Interstate Highway 5 (I-5) over the Columbia River connecting the States of Oregon and Washington. The original bridge was built in 1917 and expanded in 1958 through the construction of a second structure. The interstate bridge, based on 2010 Oregon Department of Transportation traffic counts carries an Annual Average Daily Traffic (AADT) of 123,000 vehicles with traffic congestion during the morning and evening peak periods. The CRC project is a multimodal project focused on improving safety, reducing congestion, and increasing mobility of motorists, freight, transit riders, bicyclists, and pedestrians along a five-mile section of the I-5 corridor connecting Vancouver, Washington and Portland, Oregon, as shown in Figure 1. The project area extends from north of Columbia Boulevard in Portland to State Route 500 (SR 500) in northern Vancouver. I-5 is the

only continuous north-south interstate highway on the West Coast, linking the United States, Canada, and Mexico.

Figure 1. Project Location

2. Documents Review

The Office of the State Treasurer provided the documents for review by C&M. In addition, the CRC project Office website has a library of documents related to the project. Additional information, such as recent traffic data, was provided by the Oregon Department of Transportation and complemented with information at the Washington Department of Transportation website. The following briefly describes the documents reviewed as they relate to the forecast of traffic and revenue for the CRC project.

2.1. Interstate 5 Columbia River Crossing Traffic Technical Report

The Interstate 5 CRC Traffic Technical Report (Traffic Report) submitted on January 2008 by Parisi Associates with contributions from David Evans & Associates documents the data gathering and analytical methods for the evaluation of the alternatives considered during the DEIS process, including the Locally Preferred Alternative (LPA). The alternatives consisted of highway, transit and other transportation choices. Among these choices, the most significant for the traffic and revenue forecast are the system-level choices, such as the tolling scenarios, transit options and the river crossing types. While the desktop review considered the various alternatives in the DEIS, the review focused on the LPA, which consists of the Replacement Alternative, assuming three through lanes and two auxiliary lanes in each direction for motorized vehicles complemented with light rail transit and bicycle and pedestrian facilities at the river crossing.

The CRC Traffic Technical Report identified a five-mile segment of I-5 as the Bridge Influence Area, including seven interchanges from Interstate Avenue / Victory Boulevard in Portland to State Route 500 in Vancouver. The study analyzed the traffic effects of the CRC project through a larger 23-mile-long study area from Marquam Bridge, where I-5 crosses the Willamette River near downtown Portland to Pioneer Street/SR 501 in Ridgefield. The study area included a nine-mile segment of I-205 from I-84 in Portland to SR 500 in Vancouver. I-205 is the only other existing river crossing between Portland and Vancouver across the Columbia River. The traffic study focused on existing conditions (2005 to 2007) and projected year 2030 conditions. The peak period analysis was focused on weekdays between 6:00 a.m. and 10:00 a.m. for the southbound direction and between 3:00 p.m. and 7:00 p.m. for the northbound direction. The study utilized the Metro's regional travel demand model. The model is calibrated to year 2005 and it was used to predict 2030 conditions.

Traffic data for the analysis was primarily collected during the fall of 2005. Data included traffic volumes along the highway and at ramp terminals, local intersection turning movement counts, vehicle classification surveys, travel lane utilization surveys, travel speeds, vehicle occupancy counts, vehicle origin-destination data and bicycle and pedestrian counts. The analysis utilized the EMME/2 Metro travel demand model, VISUM for traffic assignment, VISSIM for microscopic traffic operations analysis, and Synchro/SimTraffic for optimizing traffic signal timing and performing roadway and intersection capacity analysis. The operational models were calibrated to the existing

conditions.

The effects of tolling I-5 traffic on daily volumes were estimated utilizing the generalized cost methodology in the travel demand model. Exhibit 4-31 of the Traffic Report estimates that I-5 daily traffic would increase from 134,000 vehicles (2005) to 178,000 vehicles in 2030 if I-5 is tolled and to 210,000 vehicles if I-5 is not tolled. The increase in volumes is primarily attributed to the growth in the Metro area. The additional auxiliary lanes provide the additional capacity which is utilized by traffic entering or exiting within the five-mile bridge influence area. Exhibit 5-6 indicates that in the southbound direction, 25% of the trips are through trips that enter and exit I-5 outside the bridge area of influence, 24% enter and exit within the bridge area of influence, while 40% enter I-5 north of the CRC and south of State Route 500 and exit south of Victory Boulevard and 11% enter north of SR 500 but exit south of the CRC before Victory Boulevard. Exhibit 5-7 indicates that in the northbound direction 32% of the trips are through trips originating and exiting I-5 outside the bridge influence area, 38% of the trips enter and exit I-5 within the bridge influence area, and 30% either enter or exit within the bridge influence area. The auxiliary lanes proposed for the LPA are intended to meet the demand resulting from the trips entering or exiting I-5 within the bridge influence area. Capacity north of CRC has been improved through previous widening projects of I-5. As part of the Delta Park I-5 improvement project, capacity on I-5 south of CRC was increased by widening from two through lanes to three through lanes in the Delta Park area. This last project was completed fall 2010.

Section 9.2 I-5 and I-205 Performance of the technical report discusses the tolling alternatives evaluated during the DEIS, such as No-build, No-toll, tolling I-5 only and tolling both I-5 and I-205. In 2030, tolling I-5 only would result in a decrease of 32,000 vehicles daily on I-5 when compared to the No-toll alternative. I-205 crossing would increase by 13,000 vehicles under that scenario. If I-5 and I-205 are both tolled, I-5 volumes would decrease by 14,000 when compared to the No-toll scenario. I-205 traffic would decrease by 30,000 vehicles when compared to the No-toll scenario. The analysis considered electronic toll collection and a variable pricing structure with a toll of $2.00 (2006 dollars) for passenger cars with transponders during peak periods, $1.50 during shoulder peak periods and $1.00 during the off-peak period. Medium trucks would be charged twice the rate of passenger cars and heavy trucks would pay four times the passenger car rates.

2.2. Traffic and Revenue Report

The report titled CRC Description of Revised Toll Model and Traffic and Gross Revenue Projections for Tolling Scenarios, submitted on January 2010, documents the assumptions, methodologies and results of the traffic and gross revenue forecasts. As stated in Section 1.1 Purpose of Report, it

(a) “documents modifications to and validations of the modeling process used to forecast the impacts of toll rate scenarios on traffic volumes on I-5 and I-205 and the amount of gross toll revenues; and

(b) illustrates the sensitivity of traffic and revenue projections for the CRC Project to various toll rate structures.”

The study evaluated whether only the I-5 bridge is tolled or whether both, the I-5 and I-205 bridges are tolled. It evaluated different rates for given hours of the day for both bridges or for I-5 alone, and evaluated a pre-completion tolling scenario. The toll rate structures were not a result of the study; rather they were established by the project partners through meetings. The initial step in the forecasting process consisted of utilizing the regional travel demand model developed and operated by Metro, the MPO for the study area. This model utilizes EMME-2 as its platform. The model was modified to reflect the value of time determined for the study for the tolling alternatives. The method utilized is referred in the industry as "generalized cost", and it is utilized frequently when studies are based on regional travel demand models. The method consists of converting the toll rate into a "time-equivalent" based on the value of time, and adding this extra time to the highway link travel time to reflect the toll rate. The value of time for this study was obtained through a Stated Preference Survey. The regional travel demand model is developed to analyze the mobility of the whole region and is not project specific. Based on the outputs from the regional model, the study developed a project specific traffic assignment model in VISUM to evaluate forecasts in the study area. The volumes were further refined to reflect capacity constraints in the project area by utilizing VISSIM, a microsimulation software.

The study utilized October 2005 traffic profiles for traffic counts, hourly traffic trends and vehicle classifications. Based on this traffic data, models were calibrated and toll rates were determined for different time periods. Validation of the models was based on a 2009 origin destination survey. All the three models, the regional Metro model, the VISUM model and the VISSIM microsimulation model were validated. The value of travel time was determined based on the 2009 Stated Preference Survey performed by Resource System Group (RSG). The value of time obtained from the RSG study was adjusted to reflect vehicle occupancy characteristics of the CRC project. Traffic and revenue were forecasted for a range of options considering the Metro model and a post-processing method utilizing the results of the VISSIM model that consider operational capacity constraints.

The toll scenarios analyzed included a Build-No-Toll scenario, a pre-completion toll scenario and ten post-completion toll scenarios. Traffic and revenue forecasts were developed for all these scenarios by calculating 2015 and 2030 traffic and revenue and then interpolating and extrapolating from both values to the forecast period of 2019-2059. The traffic and revenue study developed two sets of forecasts. The first forecast is based on the metro travel demand model and the second set is based on post-processing utilizing trends from the VISSIM simulation model. The gross revenue forecasts were developed for a base case scenario and a 15% bandwidth scenario.

2.3. Stated Preference Survey

RSG conducted the CRC Stated Preference (SP) Survey in July 2009 for Stantec, Inc. The purpose of the SP survey was to estimate values of time or values of toll sensitivity of travelers who currently use either I-5 or I-205 to cross the Columbia River. The survey collected data on current travel behaviors, presented respondents with information about the CRC project, and used industry practices to estimate value of time for automobile travelers and commercial vehicle drivers and non-driver decision trip-

makers. The survey was administered via laptop computers at a wide variety of activity sites in the Portland-Vancouver area. In addition, surveys were available online via e-mail invitation to target audiences such as those that participated in a previous origin-destination study or whose license plates were captured utilizing the bridges. Commercial drivers were intercepted at truck stops and travel centers, while trip decision makers were contacted via telephone.

Automobile respondents were screened to travelers who utilized the I-205 or the 1-5 bridges within two weeks prior to the survey, and who were residents of Oregon or Washington. Screening questions consisted of day of the week for the trip, purpose, origin, destination, begin time, travel time, estimated delays, number of passengers in the car for their trip, flexibility in trip timing, and trip frequency. Prior to the SP questions, the survey provided information about the CRC potential improvements. Then, the survey gave travel choices by crossing I-5, crossing I-205 or crossing by transit. The choices varied the cost of toll or transit fare, and trip travel time. Then, the survey continued with debrief and opinion questions, gauging familiarity with public transit and, potential utilization of ETC transponders. The opinion questions included gauging attitudes toward climate change and carbon emissions, familiarity with public transit, biases toward paying tolls, using toll roads and changing travel behavior. The survey concluded with demographic questions including household size, vehicle and bicycle ownership, gender, age, employment status, and annual pre-tax income. A total of 1,942 respondents completed the automobile survey. The value of time was based on 1,744 responses after removing incomplete surveys.

Commercial vehicle respondents were screened to include decision makers on route selection for the trip and those who crossed the Columbia River in a recent trip. Information gathered consisted of day of week for the trip, reason for utilizing the specific bridge crossing, origin and destination, time of the trip, trip duration, vehicle type and number of axles. The SP questions provided choices on utilizing either, the I-5 or the I-205 bridge crossing. A total of 318 respondents completed the commercial vehicle survey. The data analysis was based on 232 records.

The study determined mean values of time for aggregate auto and commercial vehicles, and for traveler market segments such as time of day, trip purpose and state of residence. Similarly, the study provided model coefficients for aggregate and traveler market segments.

2.4. Metro Travel Forecasting Methodology Report

The traffic and revenue forecasts are based on the EMME-2 Metro Travel Forecasting Model. C&M has reviewed the February 2007 Metro Travel Forecasting 2005 Trip-Based Demand Model Methodology Report. The report includes descriptions of the model structure, model application, the variables employed in model equations and their coefficients. The model uses the person trip as the unit of analysis.

The socio-economic and land use data input consists of 64 categories of households based on household size, income classification in 1994 dollars and age of household head. Additional model inputs are employment as categorized by the two-digit OSHA Standard Industrial Classification (SIC) and number of local intersections. Composite

accessibility measures are developed to account for both the relative magnitudes and the interactions between household density, employment density and intersection density. Zone to zone travel times are calibrated based on available data and based on weekday travel time matrices to reflect peak and off-peak conditions. The model utilizes eight trip purposes and the proportion of trips during peak and off-peak conditions are determined based on household surveys. Trip costs calculated in 1994 dollars are an input to the mode choice model.

Pre-generation models are run to determine the probable number of workers, cars and children in each Traffic Analysis Zone (TAZ). Average weekday person trips are generated for the eight trip purposes. Most home based trips are generated by production zone and are attached to an attraction zone within the destination choice models. Non-home based trips allocate trip productions to zones according to their total number of households and employment. School and college generation models incorporate trip attraction. Home based shop, Home based recreation and Home based other incorporate trip production to trip attractions through the destination choice models.

The Metro model utilizes nine discrete modes: drive alone, drive with passenger, auto passenger, bus only by walk access, LRT only by walk access, Bus/LRT by walk access, Transit by park and ride access, bike and walk. Modal accessibility functions are estimated for use in the destination choice model. The destination choice models are developed using a multinomial logit estimation procedure that considers household income, employment classification, and trips across the Columbia and Willamette Rivers.

Time of day travel is based on start time data from the 1994-95 household activity survey. Time of day travel is estimated by utilizing various factors for auto and transit. The factors are direction-specific. The model is developed in EMME/2. It utilizes a full capacity-restrained equilibrium path-finding algorithm. Autos and trucks are first assigned to the network, and then a transit multipath assignment follows. External trips are calculated based on average weekday target traffic volumes for each cordon station and by calculating average weekday target volumes for five trip components at each station utilizing percentages from the 1987 external travel survey. Truck assignments are based on data from a strategic model database that report freight in tons and stratified by commodity group, primary mode, origin, destination, truck sub-mode, containerized/non-containerized and year. The model does not assume seasonal adjustment for the truck model and assumes 264 days to convert the annual data into a weekday data. Portland International Airport trips are modeled based on the Hugo Airport model and is based on 2005 data.

2.5. Travel Demand Model Review Panel Report

In October 2008, the CRC Travel Demand Model Review report was prepared to document the background information considered by the panelists conducting an independent review of the CRC travel demand model. The panel consisted of four experts with substantial experience in travel demand modeling in large metropolitan areas: Maren Outwater, Director of Data Systems and Analysis at the Puget Sound Regional Council; Bruce Griesenbeck, Principal Transportation Analyst for the

Sacramento Council of Governments; Arash Mirzaei, Travel Model Development Program Manager for the North Central Texas Council of Governments; and Guy Rousseau, Modeling Manager for the Atlanta Regional Commission. As part of the review, the panel was requested to address the following questions:

- Are fuel price and vehicle operating cost assumptions used in the model reasonable?
- Are the tolling methods used in the model reasonable?
- Are the traffic projections for I-5 and I-205 from the model reasonable?
- Are the vehicle miles travelled results reasonable?
- Are the bridge auxiliary lanes modeled correctly?
- Was the approach used to estimate induced growth reasonable?
- Were the induced growth finding reasonable?

The following is an excerpt of the report that summarizes the findings:

"The travel Demand Review Panel concluded that the Travel Demand Model used by the region is an advanced trip-based tool and that it represents a valid tool for a project of this type:

- The destination choice features of the trip distribution model used for all trip purposes is a positive and allows for fuller consideration of accessibility and policy variables in the analysis.
- The peak factors applied to skims is a better way to represent weighted averages than standard practice, which assumes peak conditions for work trips and off-peak conditions for non-work trips.
- The use of VISSIM offers a more rigorous evaluation of congestion than is possible with a regional planning model.
- The use of Metroscope as one method to evaluate induced growth is an advanced practice for a project evaluation. Normally this type of analysis is used for systemwide/regional transportation planning efforts and not specific project evaluations."

The panel provided additional recommendations for long-term regional model improvements. The report did not consider these recommendations as significant to project outcomes. Among these recommendations are:

- The household survey is from 1994 and suggested the region to consider conducting a new survey.
- Nested logit models can provide a more accurate representation of tradeoffs between modes that are similar than the utilized multinomial mode choice factors.
- Destination choice should consider a Central Business District dummy variable instead of deleting the full cost from destination choice. This was a result of

calibration, and inclusion of full costs such as tolls, parking, fares may require recalibration of the destination choice models.

- The use of fixed time factors are a limitation for evaluation of variable pricing, as it may not consider time travel shifts resulting from variable tolls.
- The region should consider testing the use of the activity-based model for evaluation of tolls for future analysis. The disaggregate nature of activity-based models, can identify individual responses to tolls and value of time more accurately than trip-based models.
- The region should consider inclusion of the full cost of tolls in destination choice. As well, introducing tolls after the last equilibration model loop should be fully tested and compared to full feedback with tolls.
- Consider segmenting value of time in the model assignment by income and purpose, and an updated VOT should be explored based on recent SP surveys.
- Consider "splitting-out" transit riders from all other toll trips, so that transit trips are not "penalized" by additional time crossing the river.

2.6. VISSIM Model Calibration and Validation Report

The August 2006 VISSIM Calibration and Validation Technical Report documents the components of the VISSIM model development and the calibration process and provides a summary of validation results. The AM and PM peak periods were modeled and the calibration included peak and off-peak directions. The limits of the VISSIM model extend on I-5 from Marquam Bridge in Portland, Oregon to the Pioneer Street Interchange in Ridgefield, Washington. The AM peak period extends from 6:00 a.m. to 10:00 a.m. and the PM peak period from 3:00 p.m. to 7:00 p.m.

The development of VISSIM model included extensive field data collection and the calibration involved comparing model results to the field data in terms of link traffic volumes, extent of the queues, and other measures of effectiveness such as travel times and average speed. The origin-destination field data used in VISSIM model was supplemented by the information from macroscopic modeling with VISUM. The VISSIM model included ramp meters, HOV lane simulation, lane drops and several interacting bottlenecks.

2.7. Draft Environmental Impact Statement

The May 2008 Draft Environmental Impact Statement (DEIS) documents the purpose and need for the CRC project, the alternatives studied, the transportation performance and potential community and environmental impacts of these alternatives, and their financial feasibility and cost-effectiveness. Based on the DEIS, the CRC project seeks to address six problems:

1. Growing travel demand and congestion;
2. Impaired freight movement;
3. Limited public transportation operation, connectivity, and reliability;

4. Safety and vulnerability to incidents;
5. Substandard bicycle and pedestrian facilities; and
6. Seismic vulnerability.

The DEIS documents the technical evaluation of five alternatives including the No-Build alternative, two replacement alternatives and two supplemental alternatives. The DEIS evaluated alternative 3 with tolls and without tolls on the bridge. Alternative 3 consists of a replacement bridge that includes a high capacity transit system such as light-rail. The financial plan in the DEIS assumes that tolling will likely be necessary to generate the local revenue needed to help pay for the CRC project. As discussed in the traffic and revenue study, the DEIS evaluated various tolling scenarios including tolling I-5 alone or tolling both I-5 and I-205 crossings. For 2030 the DEIS concludes that the CRC under the No-Build alternative will have 184,000 vehicles per day; while, under Alternative 3, the traffic will be 178,000 vehicles per day. The DEIS estimates that under No-build conditions, traffic congestion will be present during 15 hours every weekday and that under Alternative 3, traffic congestion will be present during 3.5 to 5.5 hours every weekday. Chapter 4 of the DEIS estimates capital costs ranging from $3.7B to $4.1B for the replacement alternatives. The financing analysis indicates that the toll revenues from I-5 alone, may support from $750 million to $1,350 million of financing for the replacement crossings and from $640 million to $1,160 million of financing for the supplemental crossings depending on whether 40-year non-recourse bonds, 40-year non-recourse bonds with TIFIA loan or 30-year state backed bonds are utilized as a financing instrument. DEIS analysis shows that tolling both I-5 and I-205 could support up to $2.8B of financing.

2.8. CRC Project Sponsors Council

On September 13, 2010 the CRC Project Sponsors Council (PSC) presented a final report with a set of recommendations to Governor Gregoire and Governor Kulongoski. Among them, the PSC recommends further refining the locally preferred alternative to include a 10-lane permanent bridge with 12 foot shoulders, with northbound and southbound lane configurations according to the Phase I Locally Preferred Alternative design. City of Portland retained URS to conduct an evaluation of the potential to reduce the number of lanes on the I-5 Bridge. The evaluation concluded that CRC will have similar performance characteristics whether the crossing is a 12-lane cross section or a 10-lane cross section.

2.9. CRC Design Refinements – City of Portland

On July 7, 2010, URS Corporation (URS) issued a report prepared for City of Portland that evaluated the CRC alternatives and provided recommendations with a goal to maximize the benefits of the project for the least cost. The report concluded that a 10-lane bridge cross section would operate with similar characteristics to a 12-lane bridge. This finding was based on a review of the VISSIM traffic operations analysis described in the DEIS Traffic Technical Report.

3. Desktop Review Findings

3.1. Initial Findings Report

Upon review of the documents, C&M submitted an Initial Findings Report to the Oregon State Treasury Debt Management Services Division. The initial findings consisted of an initial assessment of the studies in terms of evaluating strengths and weakness of the process and the ability of the project to support the toll revenues identified in the financial plan. The initial findings were discussed with the Oregon State Treasury Debt Management Services Division staff and CRC project staff at a meeting held at the CRC project offices on June 2, 2011. At this meeting, the Desktop Review Team of C&M Associates, Inc. concurred with the statement of the Traffic and Revenue Study in that the purpose of the DEIS documents were to develop traffic forecasts for environmental assessment purposes. The gross revenues developed in the traffic and revenue study were for purposes of assessing the financial feasibility of the project, and should not be considered as gross revenues to obtain project financing. Traffic forecasts for environmental purposes generally tend to present scenarios on the upper range of what is possible in order to reflect the extent of the effects on the environment. The traffic and revenue study presented a post-processing approach on the forecast traffic volumes to determine the potential revenues. The next level, a comprehensive or investment grade study, is usually performed prior to issuance of bonds or for financing purposes. At this level, an effort is made to determine the traffic levels that are most likely to be achieved in order to support debt repayment. Based on this meeting and consistent with the initial scope of the Desktop Review, C&M was requested to provide a qualitative assessment of the weaknesses and strengths of the DEIS revenue forecasts and how they could differ with a revenue forecast for financing purposes.

Based on peer reviews of the work to date and based on the initial review of the documents, the approach appears sound and reasonable for purposes of the DEIS. The documents reviewed show a high level of scrutiny by peer review panels and a high level of coordination among the project stakeholders during the DEIS process. The methods to forecast traffic and revenue vary depending on the specific project, available regional travel demand models and available toll-related data in the geographical area. Forecast of traffic and revenue consists of providing an opinion of the potential to generate revenues based on available information and standards of practice developed through experiences. As information is fluid and technological advances in numerical modeling are always ongoing, it is difficult to determine that a traffic and revenue study is complete. The purpose of this desktop review is to identify potential issues that could be significant in the determination of traffic and revenue forecasts and that may be readily addressed based on existing data and availability of analysis tools. However, a more detailed analysis may determine that the issues, while relevant, may not be significant in terms of assessing the traffic and revenue estimates. The following describes the results of the desktop review.

3.2. Sufficiency and Completeness of Data

The data collection efforts from 2005 to 2010 have been extensive and included daily and hourly traffic counts, vehicle occupancy, vehicle classification, origin-destination surveys and stated preference surveys. The duration of the environmental clearance process and changes in the economy, traffic patterns and improvement projects may have dated the applicability of all the data collected. The following text discusses strengths and weaknesses of the data collection efforts for this study.

Strengths:

1. The depth of data collection such as the stated preference surveys is typical of traffic and revenue forecasts for financing purposes and more detailed than what is typically used for environmental purposes.
2. The origin-destination data and traffic counts were comprehensive for the Bridge Influence Area.
3. The data collection and VISSIM models included the I-205 corridor, and the study analysis considered diversion and interaction between the I-5 and the I-205 river crossings.

Weakness:

During the process of the DEIS, the widening of I-5 in the Delta Park area was in progress. The Delta Park project increased the capacity of I-5 in the southbound direction by adding a mainline lane to the previously existing two lanes. The Delta Park I-5 improvement project began in spring 2008 and was completed in fall 2010. Prior to the project, the reduction from three lanes to two lanes resulted in the morning peak period traffic initial bottleneck for the southbound direction. The construction project caused additional delays that may have resulted in a decrease of traffic volumes on I-5 with a diversion to I-205. Table 1 shows the monthly average daily traffic for I-5 from 2005 through 2011. Table 2 shows the monthly average daily traffic for I-205 during the same period. It can be observed that year-to-year traffic volumes on I-5 decreased beginning in March 2008, and increased beginning in July 2010. This period coincides with the construction period of the Delta Park area. On the other hand, I-205 shows a decrease in traffic beginning December 2007. Traffic increases beginning April 2009, and decreases again beginning February 2011. Table 3 shows the combined I-5 and I-205 traffic across the river. As it can be seen, there is a decrease in traffic beginning in December 2007 with a recovery beginning in July 2010 that coincides with the economic trends of the region and the completion of the Delta Park I-5 improvements. It should be noted that the winter months traffic is dependent on weather conditions. In conclusion, the data appears to indicate that the traffic loss on I-5 is a result of the Delta Park traffic congestion and the impact of the economic recession in the area. The DEIS reports do not consider the impacts of the construction traffic. However, as shown by the traffic counts, this impact is temporary and the traffic volumes are increasing. It may take until fall 2011 for the diverted traffic to come back to I-5. C&M considers that the effects of the construction project on forecast revenues will be insignificant by 2018, opening year of the project as the traffic models considered the improved lanes of I-5 in

the models.

Table 1. I-5 Average Daily Traffic Volumes

Month	AVERAGE DAILY TRAFFIC						
	2005	2006	2007	2008	2009	2010	2011
JAN	116,700	119,500	114,400	115,000	113,300	113,200	116,600
FEB	124,700	124,800	124,600	123,100	119,500	119,500	120,200
MAR	126,600	127,200	127,000	124,100	121,500	121,600	124,300
APR	126,600	128,700	128,100	124,900	123,100	122,100	125,000
MAY	126,800	126,200	127,100	123,700	124,100	124,200	
JUN	133,300	131,900	132,300	127,000	127,400	126,900	
JUL	133,900	132,100	133,300	127,300	126,200	128,700	
AUG	135,300	135,300	134,500	128,500	126,100	131,600	
SEP	127,700	127,400	127,400	123,000	122,200	126,600	
OCT	126,200	127,800	127,200	122,300	119,700	124,700	
NOV	123,600	122,100	122,900	118,700	116,700	118,400	
DEC	123,100	124,900	120,400	99,300	113,800	120,800	

Table 2. I-205 Average Daily Traffic Volumes

Month	AVERAGE DAILY TRAFFIC						
	2005	2006	2007	2008	2009	2010	2011
JAN	126,600	127,600	124,700	128,900	127,000	129,100	132,000
FEB	136,000	135,000	135,200	135,700	132,000	136,100	134,500
MAR	137,700	137,300	139,000	136,700	134,000	138,400	137,500
APR	137,900	140,300	140,600	138,000	138,300	140,600	140,300
MAY	138,600	138,600	139,500	136,700	138,600	135,900	
JUN	145,200	144,500	145,400	140,800	143,400	141,800	
JUL	144,100	144,100	144,200	140,200	142,600	141,800	
AUG	147,200	147,100	150,600	142,000	145,300	144,000	
SEP	138,100	141,700	144,700	137,400	139,600	140,500	
OCT	138,300	140,800	140,300	134,800	135,700	141,000	
NOV	133,100	132,500	136,000	130,800	132,200	133,500	
DEC	134,200	136,100	134,900	109,000	133,500	134,900	

Table 3. I-5 and I-205 Average Daily Traffic Volumes

Month	AVERAGE DAILY TRAFFIC						
	2005	2006	2007	2008	2009	2010	2011
JAN	243,300	247,100	239,100	243,900	240,300	242,300	248,600
FEB	260,700	259,800	259,800	258,800	251,500	255,600	254,700
MAR	264,300	264,500	266,000	260,800	255,500	260,000	261,800
APR	264,500	269,000	268,700	262,900	261,400	262,700	265,300
MAY	265,400	264,800	266,600	260,400	262,700	260,100	
JUN	278,500	276,400	277,700	267,800	270,800	268,700	
JUL	278,000	276,200	277,500	267,500	268,800	270,500	
AUG	282,500	282,400	285,100	270,500	271,400	275,600	
SEP	265,800	269,100	272,100	260,400	261,800	267,100	
OCT	264,500	268,600	267,500	257,100	255,400	265,700	
NOV	256,700	254,600	258,900	249,500	248,900	251,900	
DEC	257,300	261,000	255,300	208,300	247,300	255,700	

3.3. Model Statistics and Assumptions

The travel demand model forecasts traffic across state boundaries and required coordination among project stakeholders. The following are the strengths and weaknesses resulting from the desktop review:

Strengths:

1. The travel demand model and the microsimulation model appeared to have gone through extensive peer review and detailed calibration/validation process.
2. The study complemented the Metro Travel Demand Model in EMME/2 with the VISUM traffic assignment model to better analyze the interaction of the I-5 and I-205 crossings and evaluate traffic operations beyond the Bridge Influence Area.
3. The study developed VISSIM models to analyze impacts of traffic operations upstream and downstream of the Bridge Influence Area to better reflect the traffic demand at the project area.

Weaknesses:

1. As the travel demand model peer review panel indicated, many factors in the travel demand model are based on the 1994 household survey. These factors may be dated, as an example; people may be more prone to longer trip lengths today when compared to 1994. This may result in a higher demand across the bridge. Other factors may result in demand reduction. Even though, the factors may be dated, the impact is unknown until a new household survey is performed and results incorporated in the model update. This process usually lasts two to three years. C&M assumes this issue may increase or decrease traffic and

revenue forecasts, therefore it is deemed as not significant for purposes of the review.

2. Generalized cost (deterministic approach) and logit (probabilistic approach) are two common toll forecasting methods utilized by the industry. For purposes of the DEIS, the generalized cost approach in the travel demand model with the post-processing utilizing VISSIM microsimulation appears adequate for the forecast of traffic and revenue. A toll diversion model utilizing logit in the mode choice model prior to assignment would require extensive calibration of the travel demand model and the analysis will still require utilization of the VISSIM model because of the capacity constraints on the existing I-5 and I-205 corridors. Generalized cost, as pointed out by the peer review panel, tends to apply the toll time-penalties to transit and in a general way to all income categories and trip purposes. The logit model in mode choice would apply the tolls based on value of time determined by the stated preference survey according to income and trip purposes. Based on this desktop review, it is C&M's opinion that the generalized cost methodology utilized provides reliable traffic and revenue forecasts for the purposes of the DEIS financial plan. If the project requires financing based on toll revenues at a later time, then the methodology may include tools to consider income stratification. The application of generalized cost in the travel demand model tends to assign trips to the most efficient route in a deterministic approach. The post-processing utilized in the study mitigated the impacts of this approach characteristic of the generalized cost methodology. A method combining the deterministic approach of generalized cost with a probabilistic approach may result in moderate increases to I-5 traffic and revenue as the major employment centers in the future will be located in Washington County, which is more readily accessible by I-5.

3. There is a concern that the model did not consider the gas price increases since 2005. The travel demand model that considers trip costs including fuel prices was calibrated for 2005 conditions. Even though the model considers trip costs; trip generation and trip distributions are primarily based on the magnitude of trip productions and attractions. Portland gasoline prices are slightly higher than the U.S. average and follow the national price fluctuations. Figure 2 shows a comparison of monthly average daily traffic for the I-5 and I-205 crossings over the Columbia River from 2005 to April 2011 to the U.S. average gas price. Due to the seasonal traffic fluctuations, it is difficult to determine a relationship of gas prices on traffic. Figure 3 shows a comparison of the moving 12-month average daily traffic to gas prices from January 2005 through October 2011. The 12-month moving average is calculated with the month graphed as the sixth month of the 12-month period. For example June 2010 would show the average of the monthly average daily traffic volumes for all 12 months in 2010. In this graph, it can be noticed that gas prices do not have a significant impact on daily traffic. The drop in traffic volumes was more of a consequence of the Delta Park construction project on I-5 and the economy.

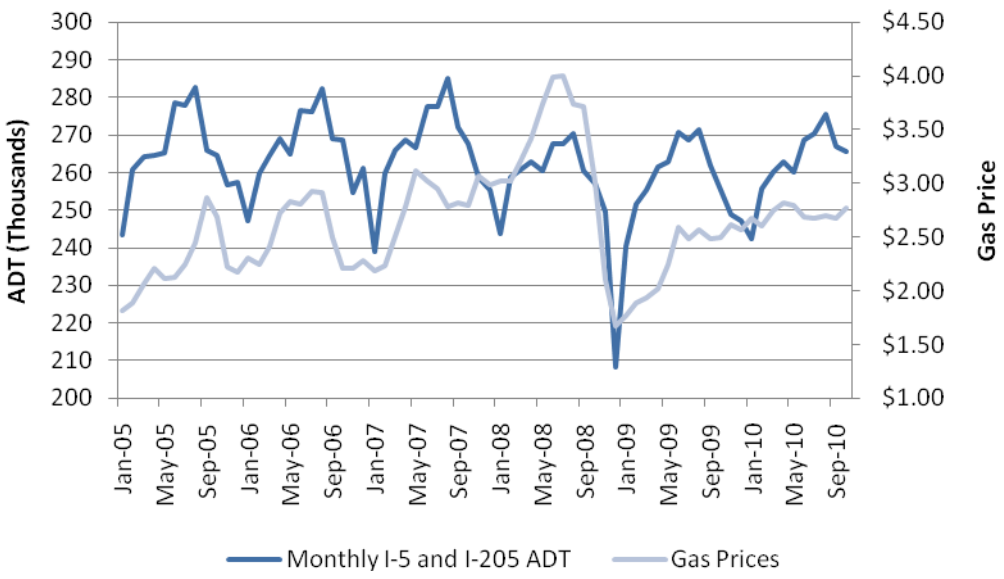

Figure 2. Comparison of I-5 and I-205 ADT and Gas Prices

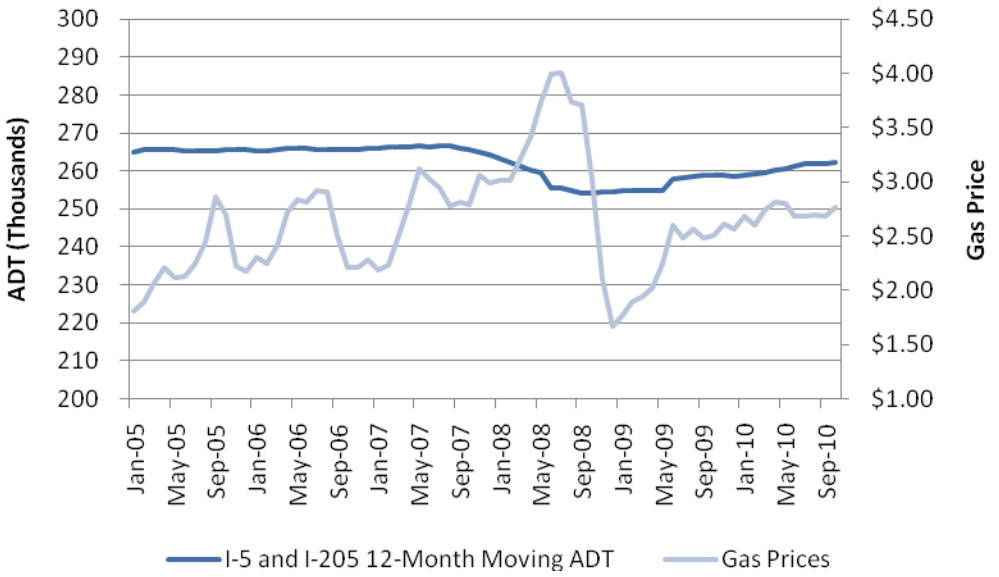

Figure 3. Comparison of 12-month Moving Average ADT and Gas Prices

4. Toll rates were established by consensus among project stakeholders and are not based on specific analysis of the relationship of toll rates to mobility optimization. The analysis performed utilizing the generalized cost methodology provides for higher elasticity due to the deterministic nature of the methodology. A probabilistic approach considering income stratification, proximity from the zones to the bridge crossings and value of time may provide a better tool to study the maximization of mobility. This approach may provide for additional toll rate scenarios, such as lower rates for off-peak direction if that increases revenue and enhances mobility, or higher peak hour toll rates to spread the peak period and

maximize the utilization of the three-lane cross section south of Victory Boulevard. Overall, a maximization of mobility utilizing tolls as a congestion pricing mechanism may result in higher revenues and enhanced mobility

3.4. Growth Projections

Socio-economic forecasts for environmental clearance of projects and for project financing may differ depending on the project area of influence. The environmental clearance projects, the federal EIS process and individual state processes mandate for the project traffic analysis to be consistent with the metropolitan planning organization plans. This mandate means that the project environmental clearance has to utilize the planning tools of the MPO. The CRC project is consistent with these policies, and it is the desktop review team's opinion that the project stakeholders and the MPO have extensively and diligently worked to achieve a consensus on socio-economic set of data for the CRC project. The goal of that data is to evaluate the environmental impacts of the project and assumes employment and population projections consistent with policies, programs and projects of the communities in the Portland and Vancouver metropolitan areas. It should be noted that the process started in 2005, and since then the economic recession, which began in December 2007 in the Metro area has significantly altered the economic growth of the region.

Traffic and revenue studies for purposes of project financing usually start from the socio-economic projections of the local MPOs, but then utilize various tools to evaluate whether the MPO socio-economic projections are consistent with the expected market behavior. These tools may consist of independent economists evaluating the growth in the traffic analysis zones and/or utilizing reports from economic agencies or companies. For the desktop review, reports from the Office of Economic Analysis and from IHS Global Insight were utilized. The economic recession, which began in December 2007 for the Metro Portland area is significant for the projection of traffic and revenue.

The following is a discussion of the strengths and weaknesses identified by the desktop review:

Strengths:

1. The growth projections in the study appear to be sound and reasonable based on the peer review panel.
2. Traditionally, Clark County is the "bedroom community" or residential area, while Portland is the employment and retail area. Difference in tax laws between Oregon and Washington State result in traffic trends unique to the Portland-Vancouver metropolitan area. As per the meetings held with MPO staff, this trend is expected to continue. However, as shown in Figure 4, the Clark County area is forecasted to have a larger increase in employment. This employment increase may result in higher reverse commuting patterns, meaning that the off-peak direction of the CRC may experience an increase in demand. The travel demand model has included the growth shown in Figure 4, and the toll rates for the peak period apply to both directions.

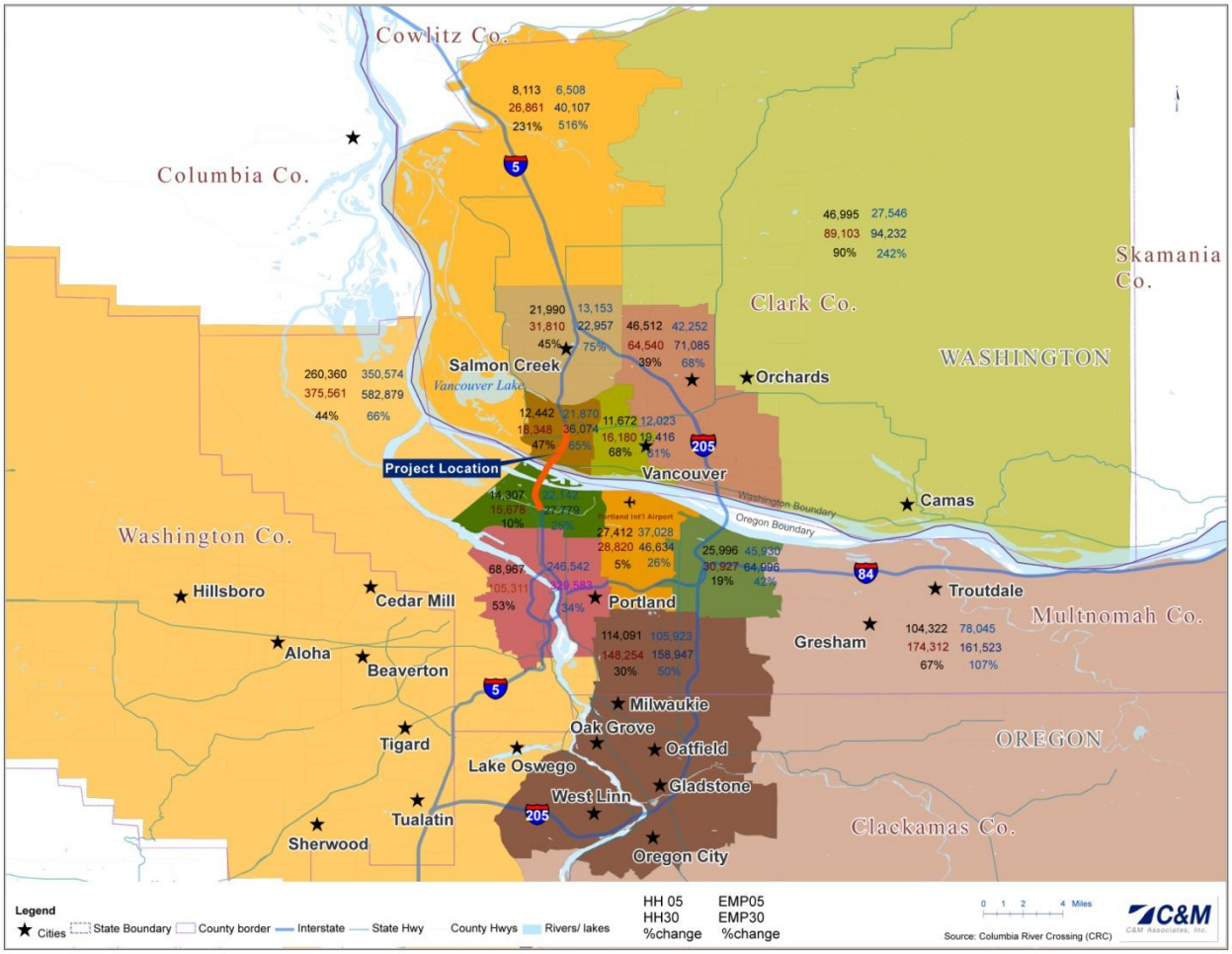

Figure 4. Employment and Population Growth

3. Clark County 2010 census data, published in 2011, indicates a population of 425,363 with a household count of 158,099. These numbers are consistent with the 2007 projections and indicate that the area is growing at a pace consistent with population forecasts.

4. The socio-economic data utilized by the CRC travel demand model is a result of collaboration among the planning agencies in the Vancouver and Portland areas. The desktop review team met independently with the metropolitan planning agencies and verified that the assumptions in the travel demand model are consistent with the growth expectations in the area.

5. The MPO and the local governments are encouraging a reduction in greenhouse gas emissions and looking for a reduction in vehicle miles travelled through education and incentives to share rides and utilize transit. The DEIS documents an increase of people throughput at a faster rate than vehicle throughput consistent with the policies of the local area. The proposed construction of the light-rail transit and pedestrian/bikeways are consistent with these policies. The travel demand model and the operational analysis models have considered these alternative modes of transportation.

Weaknesses:

1. The recession caused a delay in the economic growth of the area. From 2007 through 2009, the State of Oregon lost 8.46 % of jobs according to the Office of Economic Analysis for the State of Oregon May 2011 Oregon Economic and Revenue Forecast. The forecast indicates that the State of Oregon is staging a stronger recovery relative to other states. Oregon is ranked 7th in year to year job growth. A recent IHS Global Insight report indicates that Metro Portland may recover the number of jobs it had prior to 2007 by mid 2014. At the meeting with Metro staff, it was stated that the economic forecasts utilized in the T&R study may need to be delayed by three years as a result of the recession, meaning that employment and population forecasts currently forecasted for 2030 may not occur until 2033. Employment growth projections by IHS Global Insight and by Moody's Analytics are significantly lower than those utilized in the DEIS process. This is expected as the DEIS projections estimate the ceiling of potential development in the area, while the economic forecast from IHS Global Insight and Moody's Analytics assume the "most likely to occur" population and employment projections and have been adjusted by recent developments such as the recession. Table 4 shows a comparison of households and employment between the Metro socio-economic database developed in 2005 and Moody's Analytics and IHS Global Insight June 2011 reports. It should be noted that while Metro projects slightly higher growth rates for households and thus population, the employment forecasts differ substantially. The lower rate of employment would result in a significantly lower traffic demand which may result in lower traffic and revenues for the project.

Table 4. Socioeconomic Projections

Socioeconomic Data	Source		
	Metro	Moody's	Global Insight
Households			
2005	767,000	805,000	815,300
2030	1,134,100	1,240,000	1,180,500
Growth	48%	54%	45%
Population			
2005	1,906,600	2,074,400	2,072,300
2030	2,853,900	3,142,700	2,977,800
Growth	50%	51%	44%
Employment			
2005	1,032,200	987,200	987,200
2030	1,691,900	1,262,100	1,292,200
Growth	64%	28%	31%

2. The Metro model shows an increase of 4,000 jobs in the area south of the Columbia River and north of Columbia Boulevard between Martin Luther King Jr. Boulevard and the Portland International Airport. The employment growth is assumed to occur through development of vacant lands zoned as Industrial

underneath the flight path of the airport. The employment growth in this area is significant and may contribute to the high traffic demand at the interchange of Marine Drive and I-5 in the future. The desktop review considers this employment growth as aggressive for this area due to the building height limitations imposed by the zoning, and the impacts resulting from airport operations. A lower rate of employment growth in this area may result in a moderate reduction of traffic and revenue forecasts at the CRC.

3.5. Traffic and Revenue Projections

The traffic and revenue estimates are consistent with the application of industry standards for the generalized cost approach. The following provide a discussion of strengths and weaknesses of the traffic and revenue projections:

Strengths:

1. The traffic and revenue study presented for the CRC has included a detailed stated preference survey that provides value of time based on income and trip purpose segmentations.
2. The utilization of VISUM and VISSIM to assist in the post-processing provides an estimate of the traffic and revenue forecasts considering the operational constraints of the highway network.
3. The project proposes the utilization of electronic toll collection with annual adjustments to the toll rate based on inflation rates

Weaknesses:

1. For the purposes of the DEIS, the adjustment to the SP value of time determinations to reflect vehicle occupancy rates appears reasonable. However, for purposes of the financing plan, it is recommended to utilize the actual SP values of time, as the drivers of the HOV vehicles may not associate their value of time to the fact that they share the ride, when making a decision to use the toll bridge or not. Value of time is a perception value, and not necessarily a mathematical value. The adjustment of the value of time to the RSG SP values for HOV drivers may result in a moderate decrease of traffic and revenue forecasts.
2. The methodology of the traffic and revenue utilized the average weekday traffic projections and then annualized these projections by applying a factor of 315 days. This approach is consistent with practices in the forecast of traffic and revenues for typical toll facilities, and accounts for the lower demand during weekends and holidays. However, in the case of the CRC, the factor was applied to calculate both the annual revenue and the annual transactions. Due to the nature of variable pricing, calculation of transactions should include a higher factor than the one utilized for revenue estimation. The factor for revenue annualization was determined assuming that the weekday traffic volume generated for DEIS purposes is similar to the annual average weekday daily traffic. It appears that the methodology to forecast weekday traffic volume, utilizing VISSIM and VISUM models, would provide a peak season weekday

average daily traffic. Application of a lower annualization factor may result in a moderate decrease of traffic and revenues.

3. The travel demand model forecasts traffic based on socio-economic data. As discussed previously, Moody's Analytics and Global Insight forecast a lower rate of employment growth than Metro did in 2005. The majority of this decrease is a result of the loss of jobs between 2007 and 2010. Although, the region is now in the process of recovery, the base for future growth is now lower than the base assumed by Metro socio-economic forecasters. Based on field observations during the peak periods, there seems to be latent demand reflected by delays in the southbound direction during the morning peak period and by delays in the northbound direction during the evening peak period. The addition of auxiliary lanes as part of the project is expected to result in additional traffic volumes than those existing today or in 2005. However, traffic volumes for opening year may be significantly lower than those in the study as a result of the lingering effects of the recession. Even though, Moody's Analytics and Global Insight forecast lower growth rates than Metro; it should be noted that these reports concur on employment and population growth for the area.

4. Conclusion

The methodology, approach and documentation of the traffic and revenue forecasts for the I-5 CRC project are adequate for the DEIS process. As the project enters a stage where more detailed financial planning is required, C&M recommends consideration of the adjustments shown in Table 5. These adjustments apply to all scenarios, not only to the Locally Preferred Alternative with Scenario 1A toll rates. Quantification of the impacts on the traffic and revenue forecasts will depend on the specific calculations performed for each scenario. The qualifications below consist of an opinion based on documentation and information received during the desktop review.

Table 5. Significance of Findings on Traffic and Revenue Forecast

Suggested Improvement	Increases traffic and revenue	Decreases traffic and revenue
Decrease of traffic volumes due to Delta Park construction project		Insignificant
Decrease of traffic volumes due to economic recession and lower employment forecasts		Significant
Gas prices increase		Insignificant
Model factors based on 1994 household survey		Insignificant
Toll diversion methodology to include probabilistic approach	Moderate	
Toll rates optimization	Moderate to Significant	
Development west of Portland International Airport		Moderate
Value of time adjustment to per vehicle rather than per person		Moderate
Annualization factor		Moderate

Consideration of the above factors results in a qualitative assessment that the revenues, based on the toll rates considered in the traffic and revenue study, may need to be adjusted to reflect the significant impacts of the December 2007 to mid-2010 economic recession on employment growth for the area, and the moderate impacts from considering value of time adjustments, development west of Portland International Airport and annualization factors.