RSG INC.
TRANSPORTATION

I-5 Columbia River Crossing Stated Preference Travel Study Report

Prepared for CDM Smith

DRAFT

November 2013

DATA ■ ANALYSIS ■ SOLUTIONS

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1.0 EXECUTIVE SUMMARY

The Interstate 5 (I-5) Columbia River Crossing (CRC) project is a transportation project focused on improving travel along a five mile segment of I-5 between Portland, Oregon and Vancouver, Washington. This bi-state project is jointly owned by the Oregon Department of Transportation (ODOT) and the Washington State Department of Transportation (WSDOT) and will replace the current I-5 bridge with a new tolled bridge and improve five miles of I-5 between SR 500 in Vancouver, Washington and Victory Boulevard in North Portland, Oregon. The proposed improvements will, among other things, improve driver safety, eliminate the need for bridge lifts, and provide better protection in the event of an earthquake.

The implementation of tolling on the new I-5 bridge is being evaluated to help fund the proposed improvements. The CRC team and CDM Smith are conducting an investment-grade traffic and revenue study to forecast toll traffic and revenue on the new bridge. In April 2013, Resource Systems Group, Inc. (RSG) conducted a stated preference (SP) survey for passenger vehicle and commercial vehicle drivers in the region to support the investment-grade forecasts. The primary purpose of the survey was to estimate the willingness to pay for travel time savings, or value of time (VOT), of travelers in the study region who currently use the toll-free I-5 bridge. Estimates of travelers' value of time are a key input to the travel demand and route diversion modeling that will be conducted as part of the investment-grade forecast.

Two stated preference survey questionnaires were designed to gather information from passenger and commercial vehicle travelers. The questionnaires collected data on current travel behaviors, presented respondents with information about the proposed I-5 replacement bridge, and used stated preference experiments to collect data that were used to estimate travelers' value of time and propensity to use the new bridge under a range of possible future conditions.

The survey approach employed a computer-assisted self-interview (CASI) technique developed by RSG. The stated preference survey instrument was customized for each respondent by presenting questions and modifying wording based on respondents' previous answers. These dynamic survey features provide an accurate and efficient means of data collection and allow presentation of realistic future conditions that correspond with the respondents' reported experiences. The customized, proprietary software was programmed by RSG for online administration to a targeted sample of residents and workers in the study region.

The passenger vehicle survey was administered over the Internet to travelers using three methods: through in-person intercepts at sites located at either end of the corridor; through an email recruit to respondents who had recently completed an origin-destination (OD) survey; and through an email recruit to members of an online market research panel. The commercial vehicle survey was administered to travelers through in-person intercepts at sites located at either end of the corridor. A total of 1,906 passenger vehicle and 333 commercial vehicle travelers completed the stated preference survey.

Data from these travelers were analyzed using advanced statistical methods to estimate travelers' value of time and propensity to use I-5 tolled bridge under a variety of potential future conditions. The passenger vehicle stated preference data were used to develop choice models to produce estimates of the value of time of travelers for two sets of market segments. The first set included five segments, consisting of peak work, peak non-work, off-peak work, off-peak non-work, and weekend travelers, while the second set included three segments, consisting of peak, off-peak, and weekend segments. The magnitude and signs of the coefficient values are reasonable and intuitively correct, and the values of time ranged from a low of

$10.84/hr. for the off-peak non-work trips to a high of $14.76/hr. for the peak work trips when evaluated at the segment median income. The commercial vehicle stated preference data were also used to develop choice models to produce estimates of the value of time of travelers for two market segments: medium trucks (2-4 axles) and heavy trucks (5+ axles). The magnitude and signs of the coefficient values are reasonable and intuitively correct, and the values of time ranged from $17.36/hr. for medium trucks and $30.33/hr. for heavy trucks.

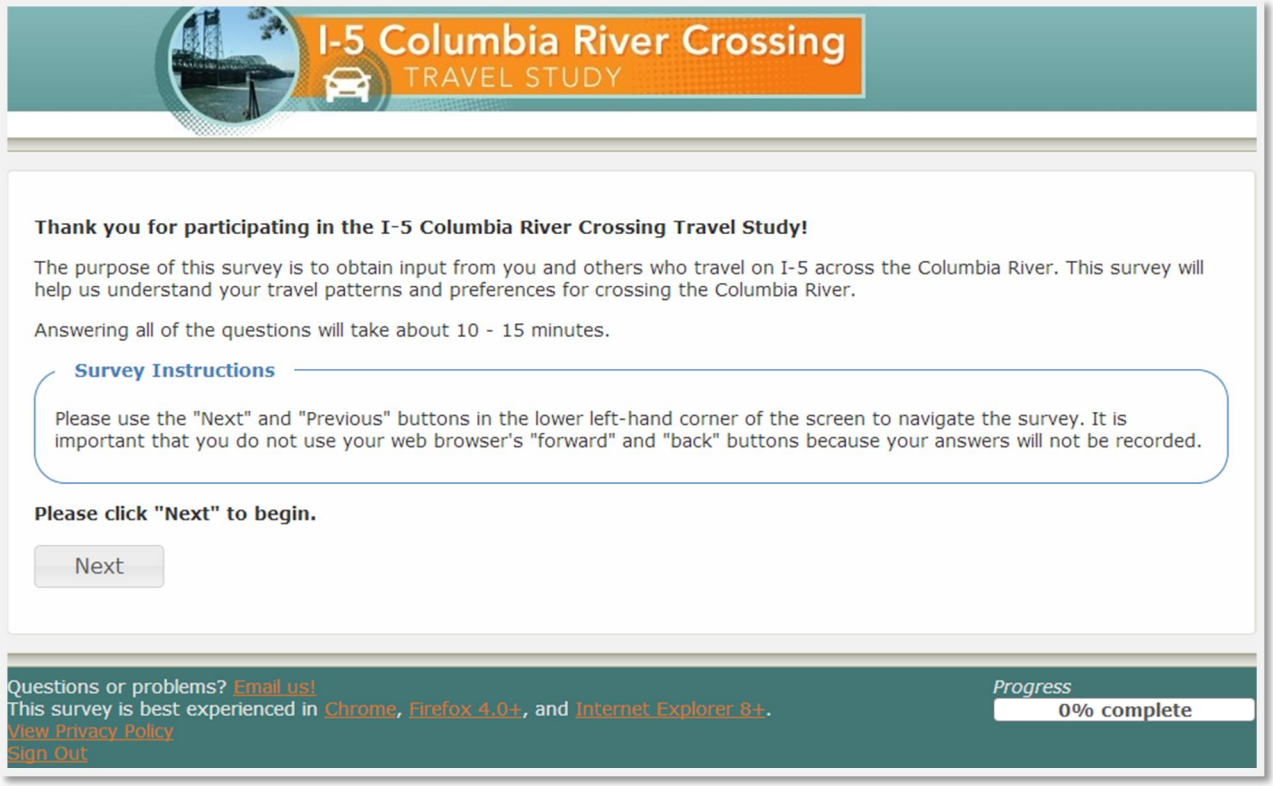
This report summarizes the development and administration of the survey questionnaires, presents the results of the surveys, and documents the methodologies and findings of the discrete choice models. A full set of survey screen captures, response tabulations, and respondents' comments about the project are included as separate appendices.

2.0 SURVEY QUESTIONNAIRES

RSG developed two separate stated preference questionnaires to meet the objectives of this study—one for passenger vehicle drivers and one for commercial vehicle drivers. The questionnaires were designed to collect the information necessary to estimate values of time for different traveler market segments of interest. Both questionnaires followed the same general approach and outline, although individual questions were customized depending on the type of respondent.

At the beginning of each survey questionnaire, respondents were presented with an introduction page describing the purpose of the survey, the time required to complete the survey, and instructions for how to navigate through the online instrument. A project email address was provided at the bottom of each screen in the event that respondents had technical questions about the survey. Each screen also included a link to RSG's privacy policy and a progress bar showing the approximate position of each question in the survey ().

Figure 2-1: Survey Screen – Introduction and Instructions



Subsequent questions varied depending on vehicle type and are described separately for passenger and commercial vehicles in more detail below. A complete set of survey screen captures for the passenger and commercial vehicle surveys can be found in **Appendix A**.

2.1 Passenger Vehicle Survey Questionnaire

The passenger vehicle survey questionnaire was designed to collect information about a recent trip that the respondent made using the existing I-5 bridge and to find out how they might make that same trip if the bridge were tolled in the future. The survey questions were grouped into four main sections:

1. Screening and trip detail questions
2. Stated preference questions
3. Debrief and opinion questions
4. Traveler information questions

2.1.1 Screening and Trip Detail Questions

To qualify for the survey, respondents must have made a recent passenger vehicle trip that met the following conditions:

- Used the I-5 bridge to cross the Columbia River
- Was made within the past three months
- Was made in a personal vehicle

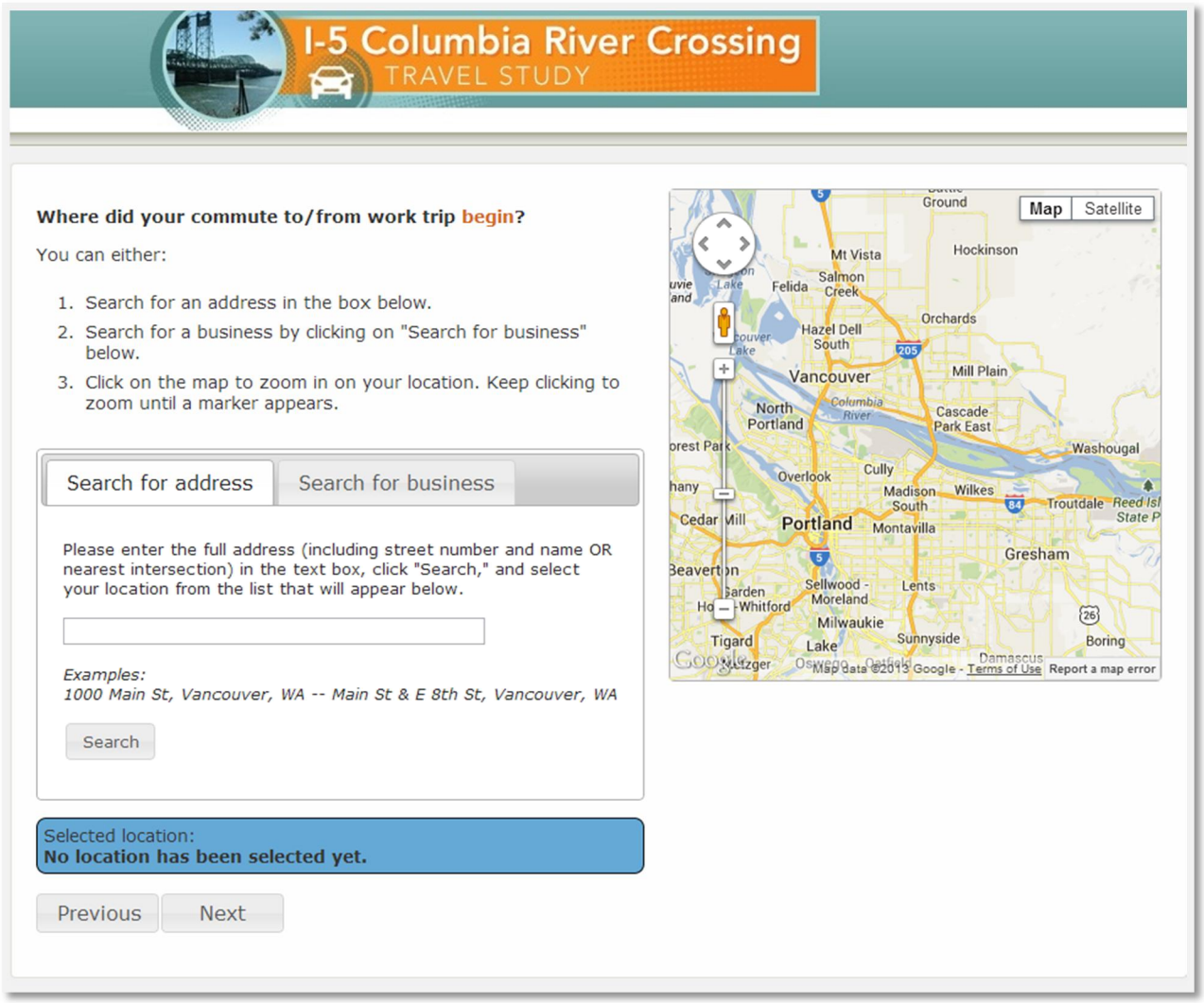
Respondents who indicated that they had not made a trip that met all of these criteria were terminated from the survey. Qualifying respondents were asked to focus on their most recent trip that met all of the screening criteria as they continued through the survey. This most recent trip—referred to as the respondent's reference trip—formed the contextual basis for the rest of the questions in this section of the survey.

Respondents were instructed to think of the one-way portion of their trip, rather than their entire round trip, and were asked a series of questions regarding the specific details of their reference trip, including:

- Date trip was made
- Purpose of trip
- Beginning and ending locations
- Departure time
- Travel time
- Travel delays due to traffic congestion
- Flexibility in arrival time
- Vehicle occupants
- Use of I-205 as an alternate bridge
- Trip frequency
- Transponder ownership

In addition, respondents were asked to report where their trip began and ended using a Google Maps interface. Respondents provided details about their trip origin and destination by either entering a business name, street intersection, or full address or by using an interactive map shown in **Figure 2-2**.

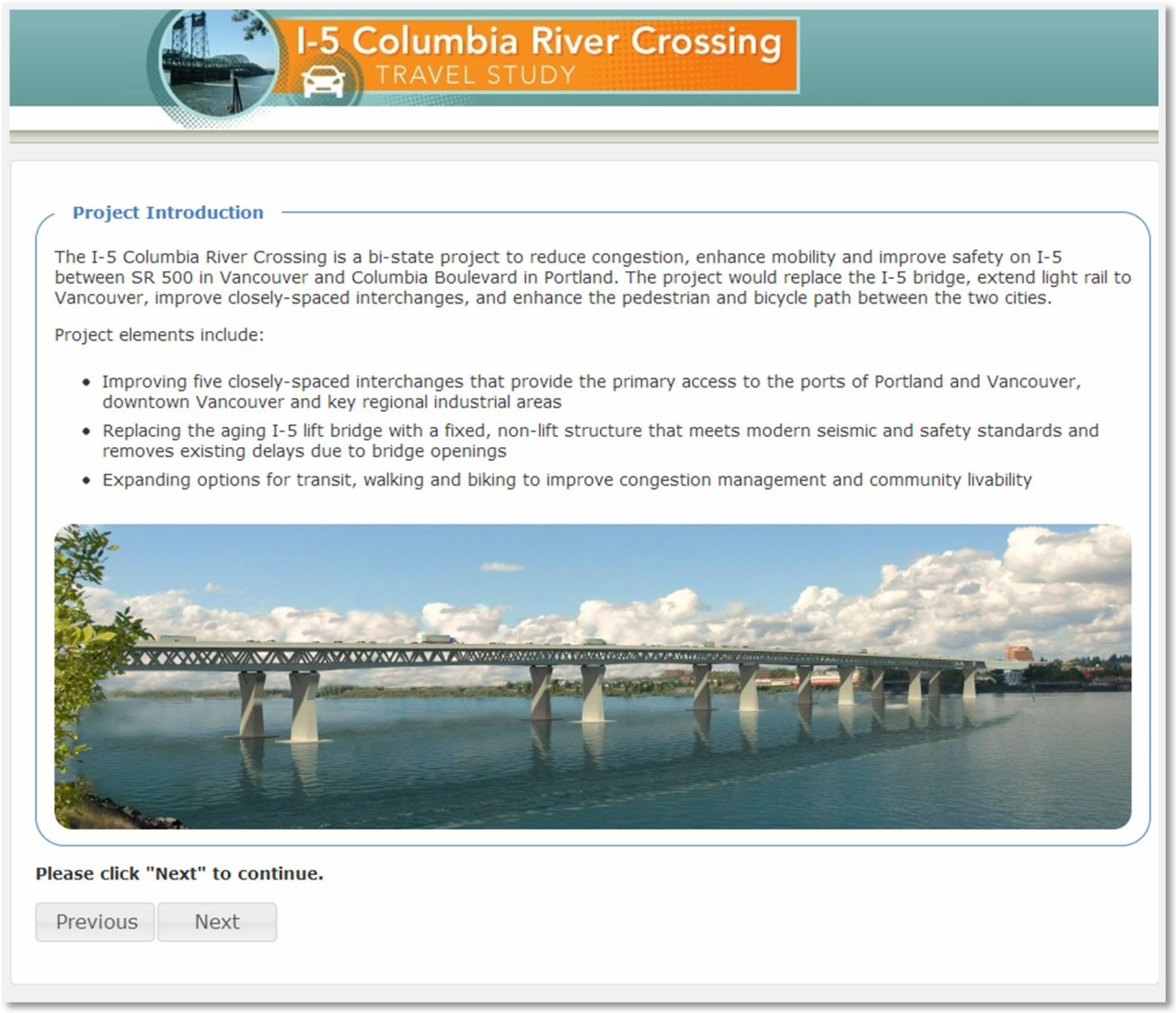
Figure 2-2: Passenger Vehicle Survey Screen – Beginning Location Address Form and Map Interface



2.1.2 Stated Preference Questions

Before the stated preference questions were administered, respondents were provided with details about the I-5 bridge replacement project (**Figure 2-3**) as well as toll payment options (transponder or video tolling) that would be available on the new bridge. Respondents also received brief instructions about how to answer the stated preference questions.

Figure 2-3: Passenger Vehicle Survey Screen – Project Introduction



The stated preference questions were designed to construct quantitative experiments to estimate respondents' travel preferences and behavioral responses under hypothetical future conditions. The details of each respondent's reference trip were used to build a custom set of ten stated preference questions that included up to five travel alternatives for making their trip in the future. The specific alternatives presented to each respondent depended on the details of their reference trip. All respondents saw the following two alternatives:

1. Make your trip using the tolled I-5 bridge at current departure time
2. Make your trip using the toll-free I-205 bridge at current departure time

Respondents who reported a trip with a peak period departure time (6 AM-10 AM or 3 PM-7 PM) were shown a third alternative:

3. Make your trip using the tolled I-5 bridge, departing before or after a specified peak period

Respondents who reported a trip with fewer than three vehicle occupants (SOV or HOV2) were shown a fourth alternative:

4. Make your trip using the tolled I-5 bridge at current departure time with additional passenger(s)

Finally, respondents who reported a local trip (with total distance of less than 30 miles) were shown a fifth alternative:

5. Make your trip using public transit (bus or light rail) at current departure time

Each alternative was described by several attributes (**Table 2-1**). All five alternatives included attributes for travel time and travel cost (either toll cost or transit fare). An attribute for departure time was included for respondents who reported a trip during a peak period, and an attribute for the number of passengers required to get an HOV discount was included for respondents who traveled alone or with only one passenger. The transit alternative was described by three attributes: travel time, fare cost, and transit type (bus or light rail). The values of the attributes varied across the ten questions, and respondents were asked to select the alternative they preferred the most under the conditions that were presented.

Table 2-1: Passenger Vehicle Survey Stated Preference Alternatives and Attributes

Alternative	Availability	Attribute					
		Travel Time	Toll Cost	Trip Departure Time	Additional Passengers	Transit Mode (bus or rail)	Transit Fare
1. I-5 (tolled)	All respondents	X	X	X			
2. I-205 (toll-free)	All respondents	X		X			
3. I-5 off-peak	If peak period trip	X	X	X			
4. I-5 HOV	If SOV or HOV2	X	X	X	X		
5. Transit	If distance < 30 miles	X		X		X	X

The tolled I-5 alternative was based on respondents' reported travel time from their reference trip and featured a travel time equal to or faster than their current time to reflect decreased traffic and congestion on I-5 under tolled conditions. The I-205 alternative featured longer travel times to account for longer trip distances and potentially higher congestion due to diversion from I-5. This alternative was always presented as toll-free. The I-5 departure time shift alternative presented slightly faster travel times and discounted tolls compared to the tolled peak period I-5 alternative to reflect off-peak traffic conditions and pricing policies. The I-5 carpool option showed similar or slightly longer travel times compared to the I-5 alternative to reflect the time required for carpool formation, but also featured a toll discount to reflect potential future HOV toll policies. The transit alternative featured slightly longer travel times than the tolled I-5 option to reflect access and egress time, headway time, and potentially slower average speeds as a result of stops made along the way. The transit fare varied between $1.00 and $5.00. A complete description of the levels used in the experiments can be found in **Table 2-2** below.

Figure 2-4 and **Figure 2-5** show example stated preference scenarios with varying attribute values. In order to avoid potential bias associated with the layout of the alternatives, the order of these alternatives was randomized for each respondent.

Figure 2-4: Passenger Vehicle Survey Screen – Example Stated Preference Question 1

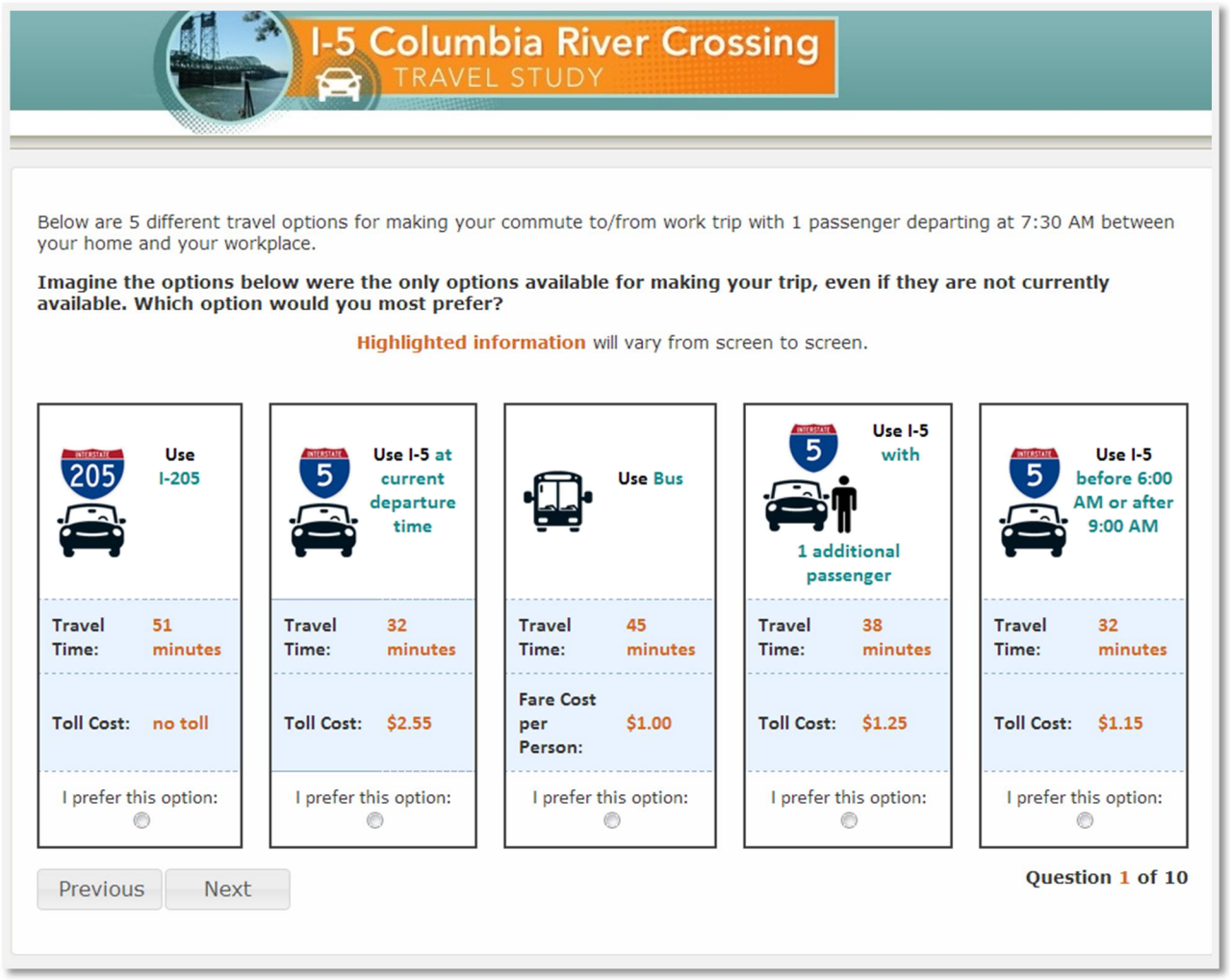
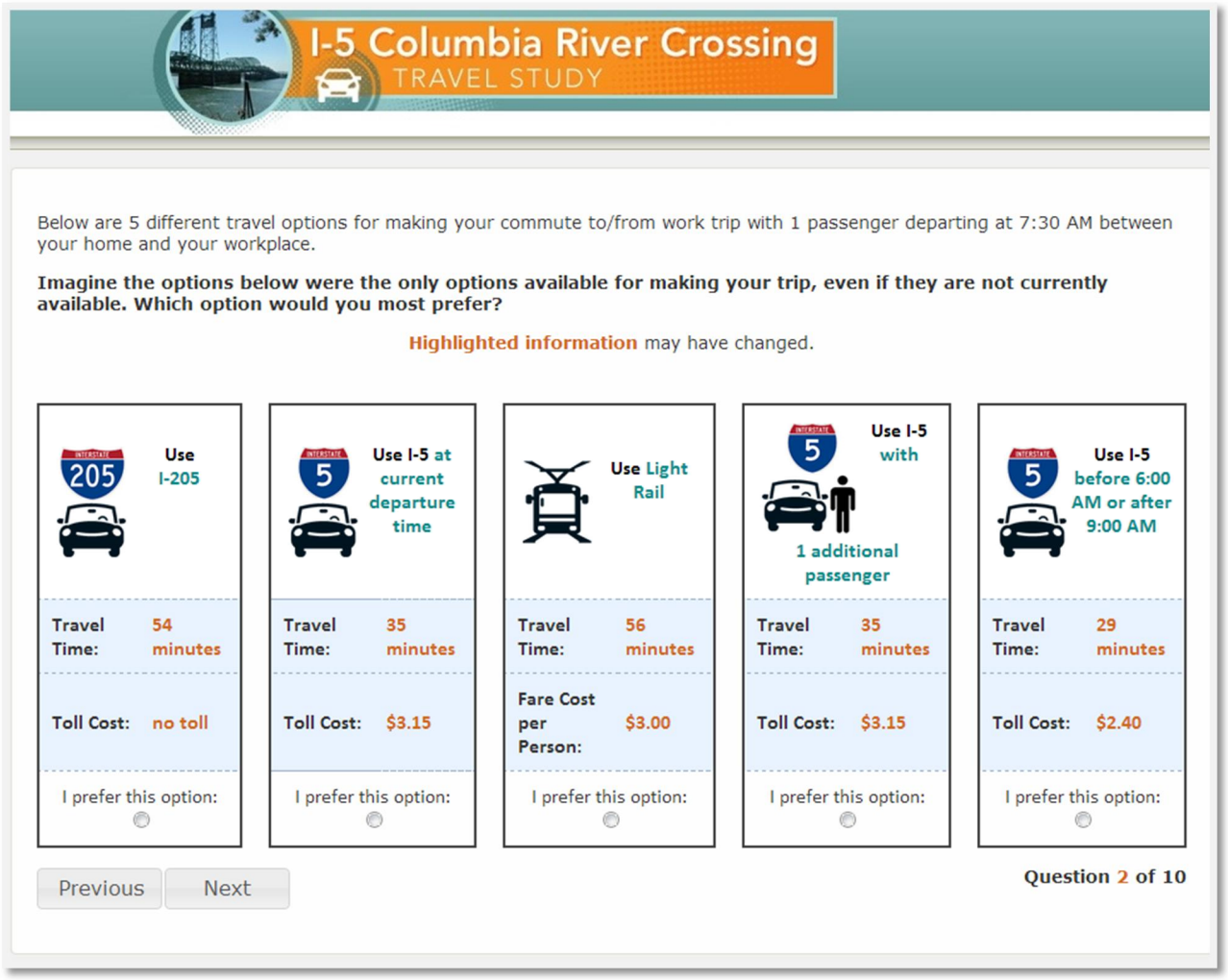


Figure 2-5: Passenger Vehicle Survey Screen – Example Stated Preference Question 2



The attribute values presented in each question varied around a set of base values. To ensure that the scenarios were realistic, the trip characteristics of each respondent's reference trip were used to calculate the base values for travel time and toll/fare cost. The base values for the attributes were varied by multiplying, subtracting, or adding one of several factors according to the experimental design for that particular scenario. By varying the attributes, the respondent was faced with different time savings for different costs, allowing them to demonstrate their travel preferences across a range of values of time. **Table 2-2** details the formulas that were used to calculate the attribute values.

Table 2-2: Passenger Vehicle Survey – Stated Preference Attribute Levels

Attribute	Alternative 1: Use tolled I-5 bridge		Alternative 2: Use tolled I-5 bridge before or after peak period		Alternative 3: Use non-tolled I-205 bridge		Alternative 4: Use tolled I-5 bridge with additional passenger(s)		Alternative 5: Use transit (bus or light rail)	
	Description	Level	Description	Level	Description	Level	Description	Level	Description	Level
Travel Time[1]	(Reported Travel Time) + (Level)	-10	(Alt 1 Travel Time) + (Level)	-8	(Reported Travel Time) + (Base Difference[2]) + (Level)	-3	(Alt 1 Travel Time) + (Level)	0	(Alt 1 Travel Time * Level) + 10	1.10
		-8		-6		0		2		1.10
		-5		-4		3		4		1.20
		-2		-2		6		6		1.30
		0		0		9		8		1.40
Cost	(Alt 3 Travel Time – Alt 1 Travel Time) * (Level[3]/60)	$2/hr.	(Alt 1 Cost) * (Level)[4]	0.45	Toll-free		(Alt 1 Cost) * (Level)	0.00	Level	$1.00
		$4/hr.		0.55				0.25		$2.00
		$6/hr.		0.65				0.50		$3.00
		$8/hr.		0.75				0.75		$4.00
		$10/hr.		0.85				1.00		$5.00
		$14/hr.								
		$18/hr.								
		$22/hr.								
		$26/hr.								
		$30/hr.								
Peak Period Duration			Level	1 hr.						
				2 hrs.						
				3 hrs.						
				4 hrs.						
Occupancy							(Reported Occupancy) + (Level)[6]	1		
								2		
Transit Mode									Level	Bus
										Rail

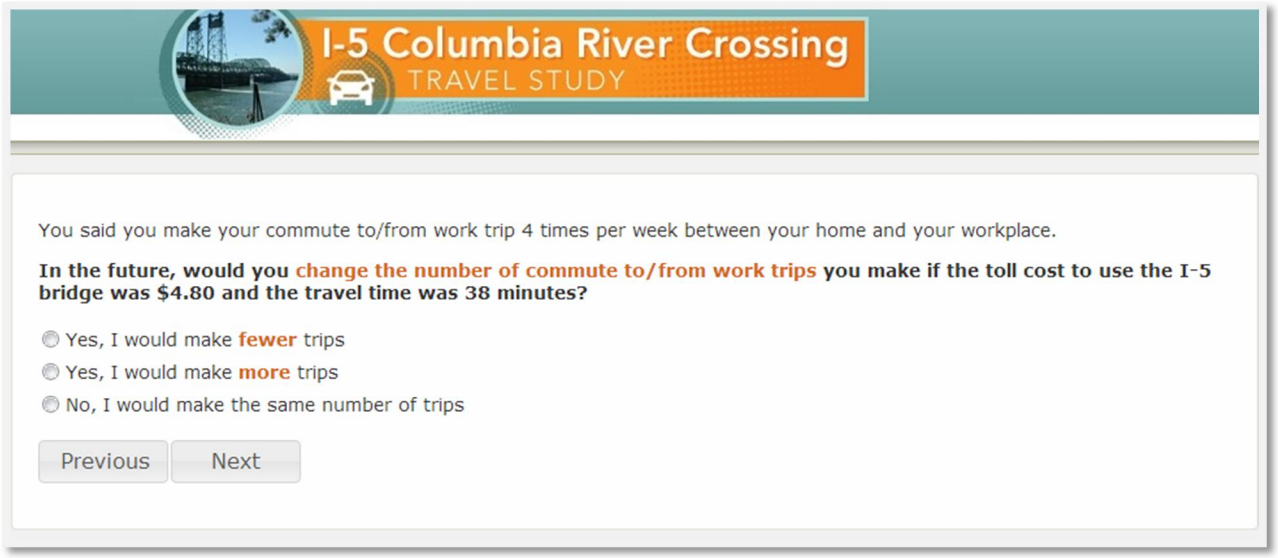
1. *The minimum reported travel time that was allowed was five minutes; as a result, the minimum travel time shown across all alternatives was five minutes.*
2. *The Base Difference was calculated by taking the travel time difference between a respondent's trip using the I-5 bridge and the I-205 bridge (travel times extracted from Google Maps). This difference was capped at a minimum of 5 minutes and a maximum of 30 minutes.*
3. *The level used to calculate the toll cost for Alternative 1 is the value of time tradeoff presented in the experiment. A minimum toll cost of $0.50 and a maximum toll cost of $9.00 were shown for Alternative 1.*
4. *A minimum toll cost of $0.25 was shown for Alternative 2.*
5. *The duration of the peak period (1, 2, 3 or 4 hrs.) was randomly assigned for each respondent and was used across all experiments for a respondent.*
6. *If reported occupancy was one (driver only or SOV), respondent would see both levels; if reported occupancy was two (driver plus one occupant or HOV2), respondent would only see one additional passenger (Level = 1) across all experiments.*

An orthogonal experimental design determined which combination of the factors would be used for each attribute calculation in each of the ten scenarios. The orthogonal design that was used for this survey included 100 experiments which were divided into ten groups of ten. One of the ten groups was chosen at random and the ten experiments within the chosen group were used to build the tradeoff scenarios that were presented to respondents in a random order. The orthogonal nature of the experimental design ensures that the attribute values vary independently of one another. This helps to minimize the correlation between attributes and maximizes the statistical efficiency of the design.

2.1.3 Debrief and Opinion Questions

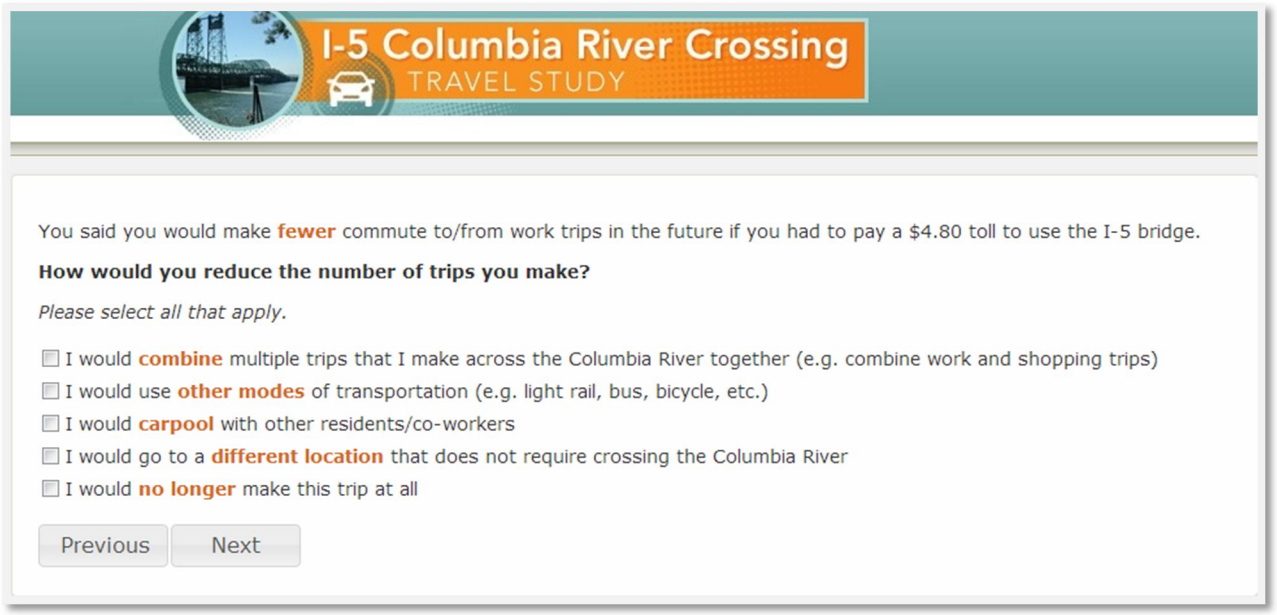
To understand how respondents could change their travel in the future once the I-5 bridge is tolled, follow-up questions were asked to understand if, given a certain travel time and toll cost, respondents would change the frequency of their reference trip and, if so, how they would change their trips. All respondents were asked if they would make more trips, fewer trips, or would not make any changes to their travel in the future, given the time and cost conditions for the I-5 bridge from their tenth stated preference scenario (**Figure 2-6**).

Figure 2-6: Passenger Vehicle Survey Screen – Trip Suppression



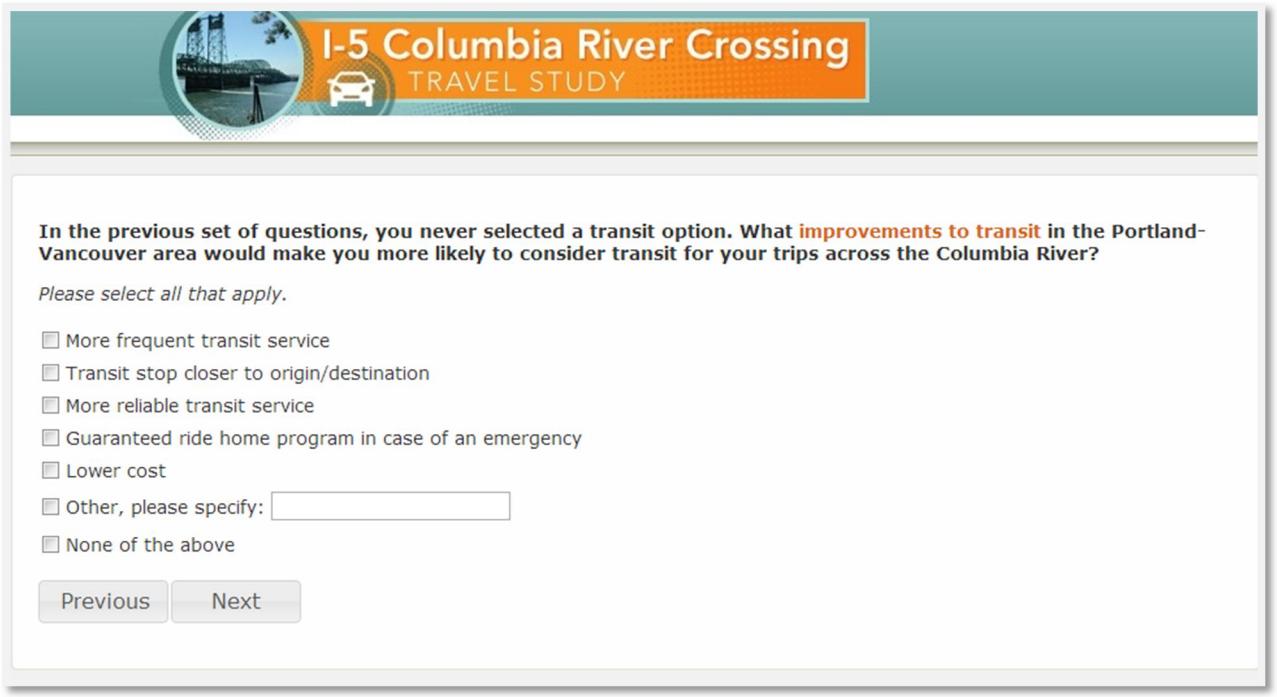
If respondents indicated that, given the conditions, they would change the number of trips they make, they were prompted to report by what percentage they would reduce/increase their current number of trips. Next, respondents who indicated that they would make fewer trips were asked to indicate how they would reduce their trips, either through trip chaining, carpooling, changing destination, or eliminating the trip altogether (**Figure 2-7**).

Figure 2-7: Passenger Vehicle Survey Screen – How Trips Will Be Reduced



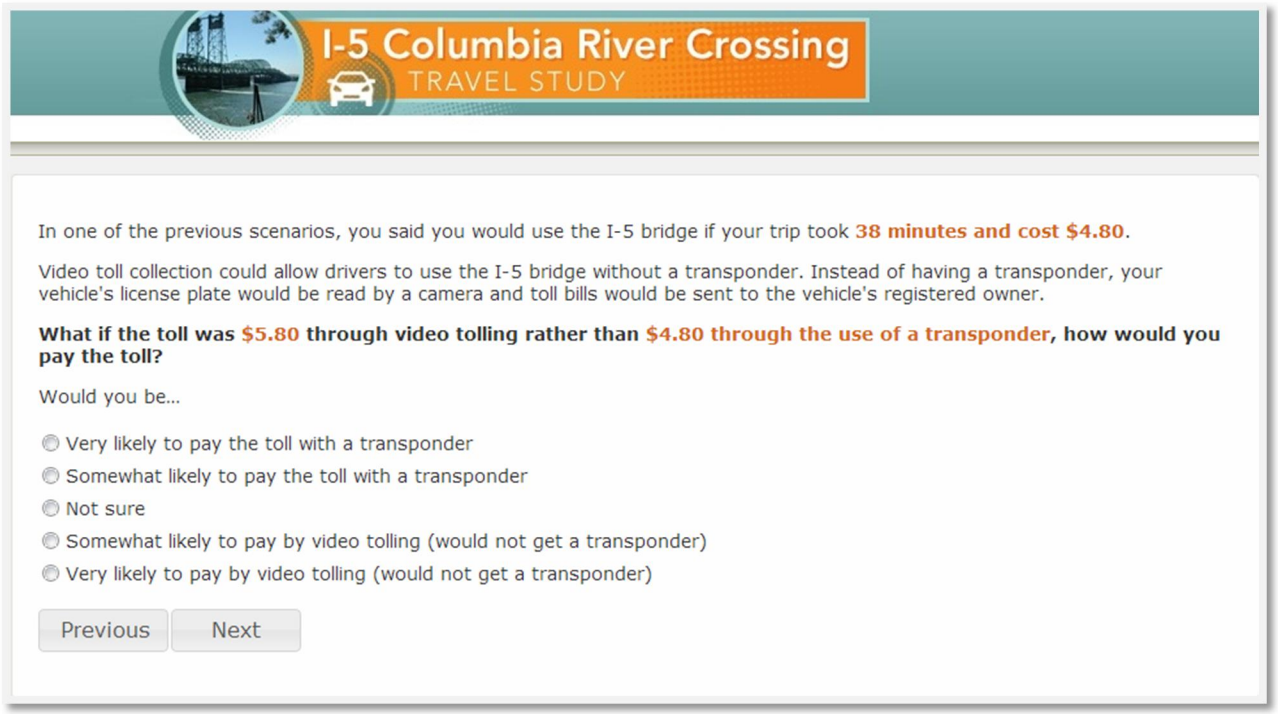
Next, respondents were asked specific debrief questions based on their choices in the stated preference section. Respondents who never selected a tolled I-5 option in the SP section were asked to indicate the primary reason for their choices. If respondents selected at least one time shift alternative in the SP section, they were prompted to indicate the direction they would prefer to shift their trip, either before or after the peak period. Similarly, if respondents saw a time shift alternative in the SP section and never selected one, they were asked to indicate the primary reason why they never chose to travel in the off-peak period. Respondents who chose at least one carpool option in the stated preference section were asked to indicate how frequently they would be able to carpool. Finally, respondents who never chose the transit option in the stated preference section were asked to indicate conditions that would make them more likely to use transit for their reference trip (**Figure 2-8**).

Figure 2-8: Passenger Vehicle Survey Screen – Conditions That Would Increase Likelihood of Using Transit



Next, if a respondent did not own a transponder and chose at least one tolled option in the SP section, they were asked which method of payment—video tolling or a transponder—they would be most likely to use in the future. One of the stated preference scenarios in which the respondent chose a tolled option was selected at random, and the time and cost conditions were presented on-screen. The toll rate presented for video tolling was shown with a randomly selected additional fee of $0.50, $1.00, $1.50, or $2.00 (**Figure 2-9**).

Figure 2-9: Passenger Vehicle Survey Screen – Likelihood of Purchasing a Transponder



Those respondents who said that they were somewhat or very unlikely to purchase a transponder were asked to choose among several options or enter their own reason for why they would be unlikely to pay the toll with a transponder. All respondents were then asked how likely they would be to use the tolled I-5 bridge before 5 AM or after 8 PM if it were toll-free during that nine-hour period.

After answering the toll payment questions, respondents were asked to indicate, based on the information provided in the survey, their opinions toward the proposed tolling of the I-5 Columbia River Crossing. If respondents were somewhat or strongly in favor of the tolling they were asked in a follow-up question to indicate their primary reason for favoring the tolling of the I-5 Columbia River Crossing. Similarly, respondents who were somewhat or strongly opposed to the tolling of the project were asked to indicate their primary reason for opposing the tolling.

Finally, respondents were asked to indicate their familiarity with the public transit systems in Portland and Vancouver and their frequency of transit use in the study area. They were also asked to indicate their frequency of using a bike for transportation in the study area and their likelihood using a bicycle on the new I-5 bridge given the proposed improvements that would be implemented for cyclists.

2.1.4 Traveler Information Questions

In the final section of the survey, demographic information was collected in order to classify respondents, identify differences in responses among traveler segments, and confirm that the sample contained a diverse cross section of the traveling population that is served by the I-5 bridge between Portland, Oregon and Vancouver, Washington.

All respondents answered demographic questions relating to the following topics:

- ZIP code

- Gender
- Age
- Employment status
- Household size
- Vehicle ownership
- Annual household income

Before finishing the survey, respondents had the opportunity to leave any comments about the survey or the tolling of the I-5 Columbia River Crossing. These open-ended statements are provided in **Appendix C**.

2.2 Commercial Vehicle Survey Questionnaire

Similar to the passenger vehicle questionnaire, the commercial vehicle questionnaire was designed to collect information about a recent trip the respondent made using the existing I-5 bridge and to find out how they might make that same trip if the replacement I-5 bridge were tolled in the future. The survey questions were grouped into four main sections:

1. Screening and trip detail questions
2. Stated preference questions
3. Debrief and opinion questions
4. Company information questions

2.2.1 Screening and Trip Detail Questions

The commercial vehicle survey began by asking respondents to indicate their role as a driver: either an owner-operator, contract owner-operator, fleet driver, or other. All respondents were asked to identify the person responsible for making vehicle routing decisions at their company. Those who indicated that someone else makes the routing decisions were asked whether or not they could describe the routing decisions made by others. Respondents who could not describe the routing decisions of vehicles were thanked and kindly terminated from the survey.

To qualify for the survey, respondents must have made a recent trip that met the following conditions:

- Used the I-5 bridge to cross the Columbia River
- Made within the past three months

Respondents who indicated that they had not made a trip that met all of these criteria were terminated from the survey.

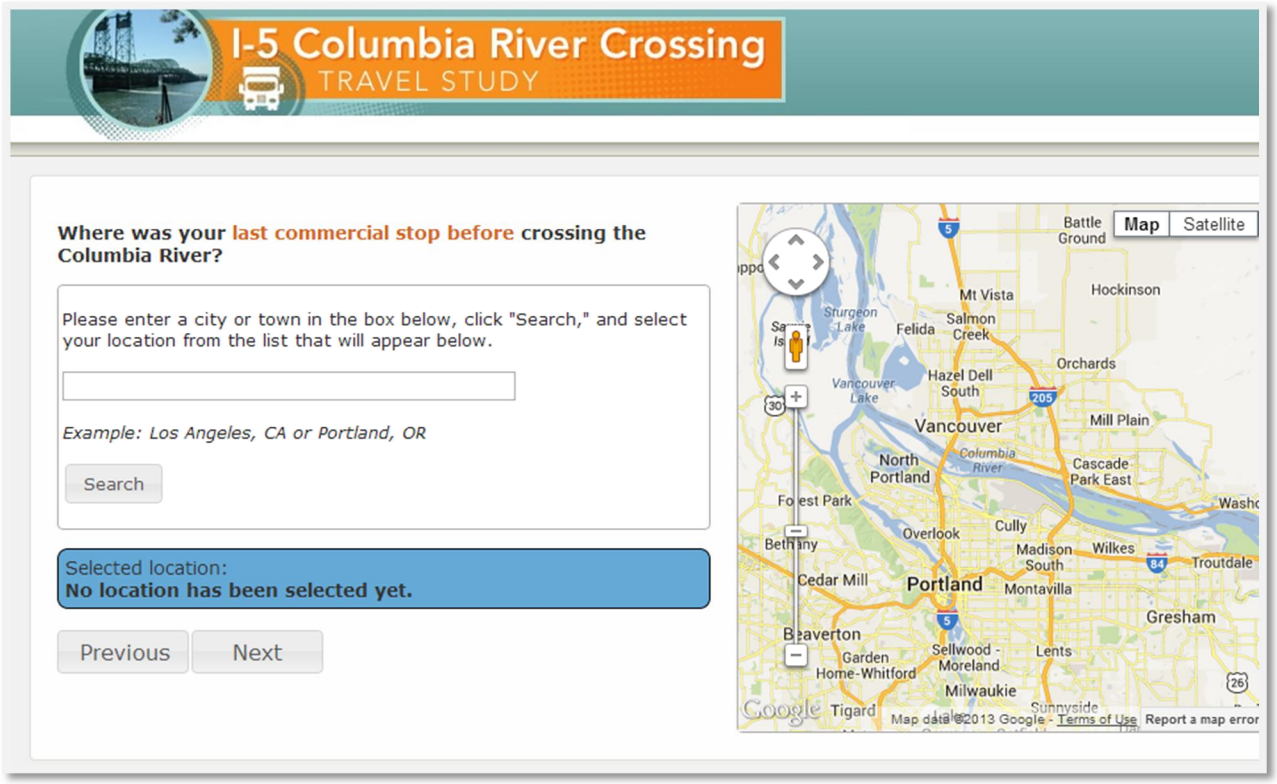
Qualifying respondents were asked to focus on their most recent trip that met all of the screening criteria as they continued through the survey. This most recent trip formed the contextual basis for the rest of the survey. Respondents were instructed to think of their trip as the travel between the last commercial stop they made before crossing the Columbia River on the I-5 bridge and the first commercial stop they made after crossing the I-5 bridge. Respondents were asked a series of questions regarding the specific details of their reference trip, including:

- Date trip was made
- Trip length (number of days)

- Trip distance
- Travel time
- Time of crossing using I-5 bridge
- Travel delays due to traffic
- Number of vehicle axles
- Trip frequency
- Tolls paid
- Transponder ownership

In addition to these questions, respondents were asked to report the approximate location of their last commercial stop before using the I-5 bridge and their next commercial stop after crossing the bridge using a Google Maps interface. Unlike passenger vehicle respondents, commercial vehicle respondents were only asked to indicate the city and state/province for their locations instead of the exact address (**Figure 2-10**).

Figure 2-10: Commercial Vehicle Survey Screen – Beginning Location Address Form and Map Interface



2.2.2 Stated Preference Questions

As in the passenger vehicle survey, the commercial vehicle stated preference questions were designed to construct quantitative experiments to estimate respondents' travel preferences and behavioral responses under hypothetical future conditions on the proposed I-5 replacement bridge.

Before the stated preference (SP) questions were administered, respondents were provided with details about the replacement I-5 bridge project as well as toll payment options (transponder or video tolling) that

would be available on the new bridge. Respondents also received brief instructions about the stated preference questions.

Next, the details of each respondent's reference trip were used to build a set of ten stated preference scenarios that included two travel alternatives for making their trip in the future:

1. Trip using the tolled I-5 bridge
2. Trip using the toll-free I-205 bridge

Each alternative was described by attributes of travel time and toll cost. The values of the attributes varied across the ten questions, and respondents were asked to select the alternative they preferred the most under the conditions that were presented. The travel time for the tolled I-5 alternative was always presented as faster than the toll-free I-205 alternative. **Figure 2-11** and **Figure 2-12** show example stated preference scenarios with varying attribute values. In order to avoid potential bias associated with the layout of the alternatives, the order of these alternatives was randomized for each respondent.

Figure 2-11: Commercial Vehicle Survey Screen – Example Stated Preference Question 1

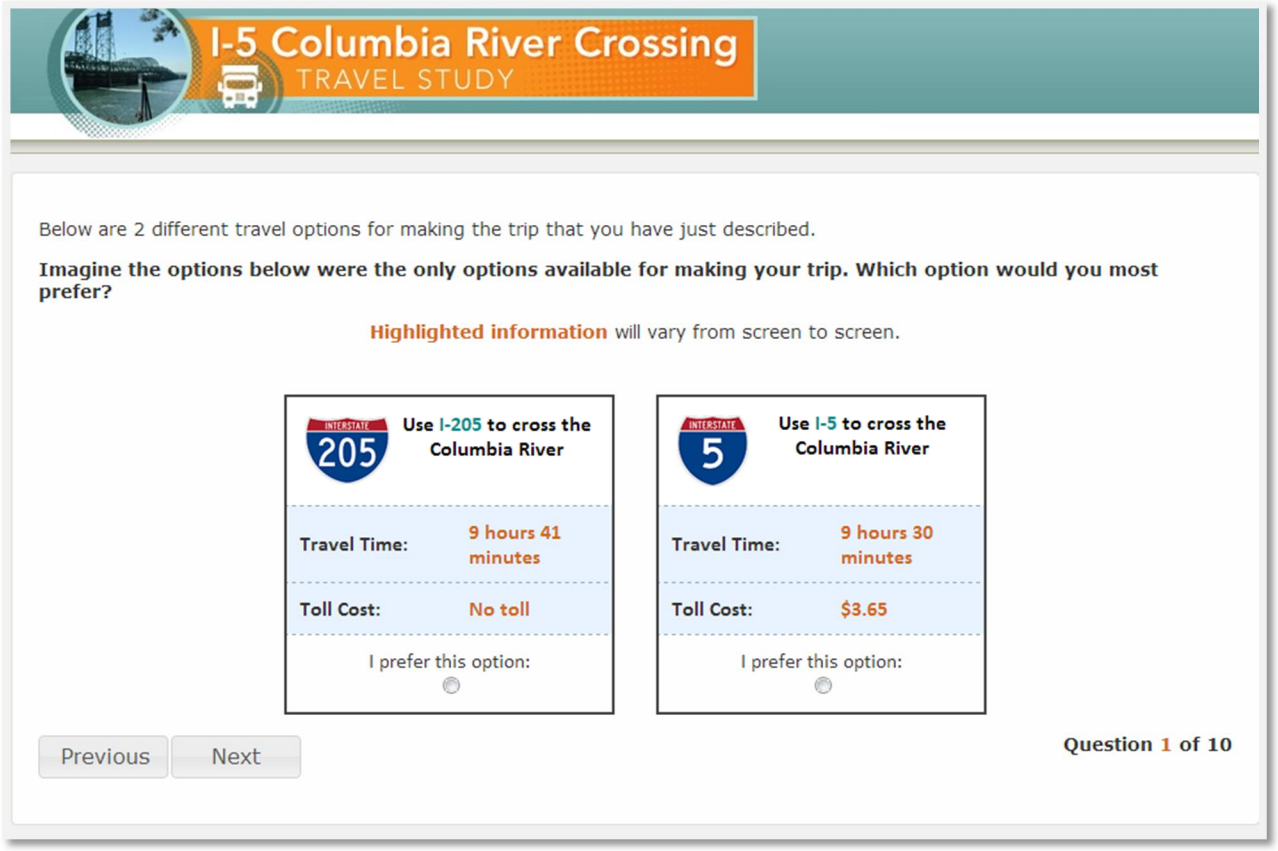
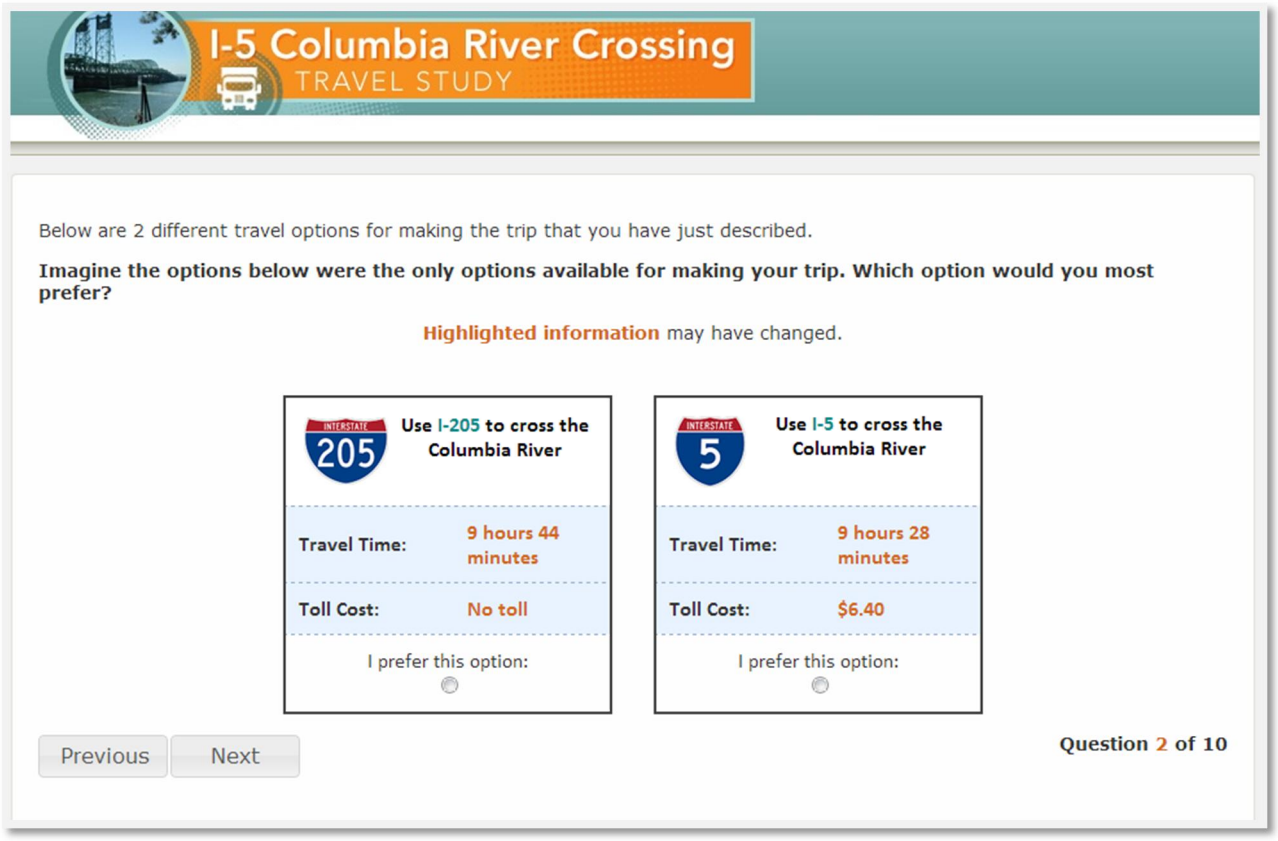


Figure 2-12: Commercial Vehicle Survey Screen – Example Stated Preference Question 2



The attribute values presented in each alternative varied independently over the set of ten experiments according to an orthogonal experimental design. The travel time values shown on-screen were generated by combining the respondents' reported travel time with one of five values provided by the experimental design. Similarly, the I-5 bridge toll cost was based on the number of axles the reference trip's commercial vehicle had and was generated based on one of the ten levels in the experimental design. **Table 2-3** details the formulas that were used to calculate the attribute values.

Table 2-3: Commercial Vehicle Survey – Stated Preference Attribute Levels

Attribute	Alternative 1: Use I-5 bridge				Alternative 2: Use I-205 bridge	
	Description	Level			Description	Level
Travel Time[1]	(Reported Travel Time) + (Level)	-3			(Reported Travel Time) + (Base Difference)[2] + (Level)	-10
		0				-8
		3				-5
		6				-2
		9				0
		2 axles	**3-4 axles**	**5-8 axles**		
Cost	(Alt 2 Travel Time – Alt 1 Travel Time) * (Level[3]/60)	$2/hr.	$3/hr.	$5/hr.	Toll-free	
		$4/hr.	$6/hr.	$9/hr.		
		$6/hr.	$9/hr.	$12/hr.		
		$8/hr.	$12/hr.	$16/hr.		
		$10/hr.	$15/hr.	$20/hr.		
		$14/hr.	$18/hr.	$24/hr.		
		$18/hr.	$20/hr.	$28/hr.		
		$22/hr.	$25/hr.	$35/hr.		
		$26/hr.	$30/hr.	$40/hr.		
		$30/hr.	$40/hr.	$50/hr.		

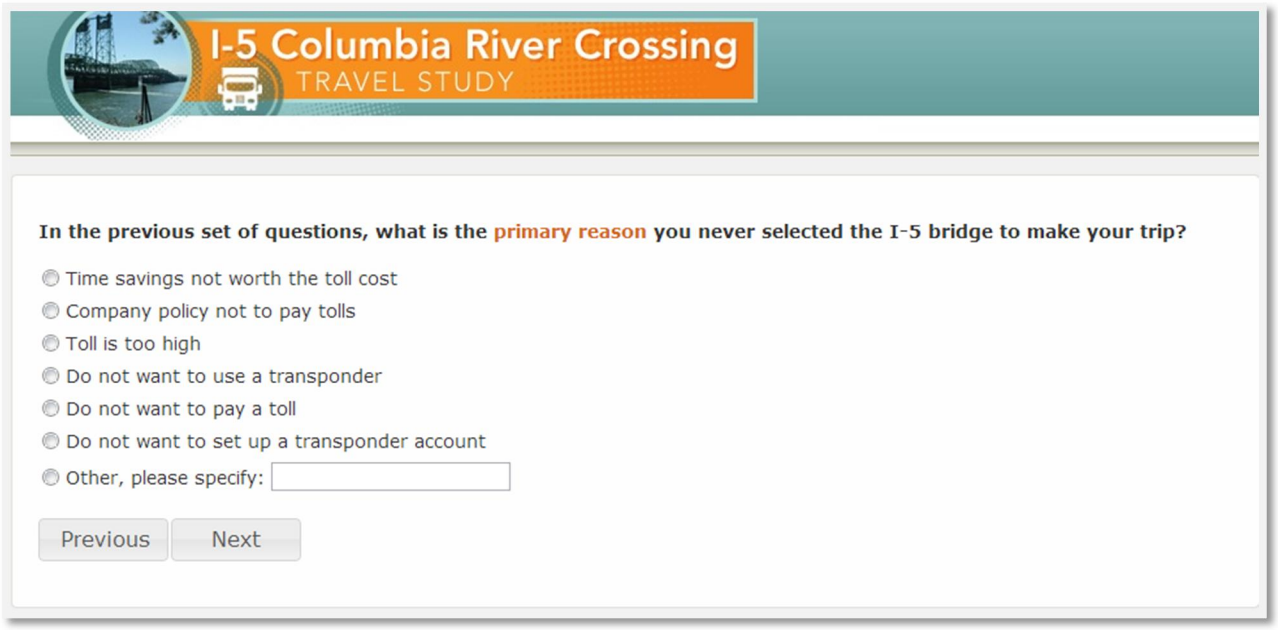
1. *The minimum reported travel time that was allowed was five minutes; as a result, the minimum travel time shown across all alternatives was five minutes.*
2. *The Base Difference was calculated by taking the travel time difference between a respondent's trip using the I-5 bridge and the I-205 bridge (travel times extracted from Google Maps). A minimum of five and a maximum of 30 minutes were used for the base difference.*
3. *The level used to calculate the toll cost for Alternative 1 is the value of time tradeoff presented in the experiment. A minimum toll cost of $0.50 and a maximum toll cost of $25.00 were shown for Alternative 1.*

An orthogonal experimental design determined which of the factors would be used for each attribute calculation in each of the ten scenarios. The orthogonal design that was used for this survey included 50 experiments which were divided into five groups of ten. One of the five groups was chosen at random and the ten experiments within the chosen group were used to build the tradeoff scenarios that were presented to respondents in a random order.

2.2.3 Debrief and Opinion Questions

After completing the stated preference questions, respondents were asked specific debrief questions based on their choices in the stated preference section. Respondents who never selected a tolled I-5 option in the SP section were asked to indicate the primary reason for their choices (Figure 2-13).

Figure 2-13: Commercial Vehicle Survey Screen – Reason for Never Selecting I-5



Finally, respondents were asked to indicate, based on the information provided in the survey, their opinion of the proposed tolling of the I-5 Columbia River Crossing. If respondents were somewhat or strongly in favor of the tolling they were asked in a follow-up question to indicate their primary reason for favoring the tolling of the I-5 Columbia River Crossing. Similarly, respondents who were somewhat or strongly opposed to the tolling of the project were asked to indicate their primary reason for opposing the tolling.

2.2.4 Company Information Questions

To ensure that the survey collected responses from a representative range of travelers, all respondents answered a set of background questions related to their trucking company. All respondents reported:

- Company location
- Company size (number of vehicles)
- Average trip length
- Type of delivery schedule (fixed or flexible)
- Timeframe structure (penalty or incentive)
- Party responsible for paying tolls
- If and how the company charges customers for tolls
- Information sources used for routing decisions

The survey concluded with an opportunity to leave comments about the survey and/or travel within the region. These open-end comments are provided in **Appendix C**.

3.0 SURVEY ADMINISTRATION

RSG worked closely with the project team to design an administration plan to produce a generally representative sample of automobile and commercial vehicle travelers in the study region in an efficient, timely, and cost-effective way. The sampling plan was designed to include a sufficient range of travelers and trip types to support the statistical estimation of the coefficients of a choice model. By collecting data from a range of traveler and trip types, it is possible to identify the ways in which different characteristics affect route and mode choice behavior. These differences can then be reflected in the structure and coefficients of the resulting choice model.

The passenger and commercial vehicle surveys were administered entirely online through RSG's rsgsurvey.com website. Three methods were used to recruit potential respondents to the survey website, including:

1. In-person recruitment at intercept locations at either end of the I-5 bridge (passenger and commercial vehicle surveys)
2. Email invitation to travelers who had recently completed an origin-destination (OD) survey and agreed to participate in a follow-up survey (passenger vehicle survey only)
3. Email invitation to members of an online research panel (passenger vehicle survey only)

RSG began administration on April 5, 2013 and concluded on April 29, 2013. A total of 1,985 passenger vehicle drivers and 368 commercial vehicle drivers completed the stated preference survey during this time. The administration methods and number of complete surveys by survey type are presented in **Table 3-1**.

Table 3-1: Responses by Recruitment Source

Data Source	Passenger Surveys	Commercial Surveys
In-person intercept	525	368
OD survey respondents	1,158	0
Online research panel	302	0
Total	**1,985**	**368**

3.1.1 In-person Intercept

RSG assembled a team that traveled to the Portland-Vancouver area to intercept local travelers and invite them to take the passenger and commercial vehicle stated preference surveys. The surveys were administered at sites with high pedestrian traffic and a high incidence of people likely to meet the screening criteria for the survey. Sites were chosen that would allow a cross-section of the population to be intercepted in terms of both trip types and demographics. The onsite intercept locations were distributed within the greater Portland, Oregon and Vancouver, Washington areas at either end of the I-5 bridge. The RSG team set up sites for local travelers to take the survey at a variety of locations including libraries, community centers, travel centers, book stores, grocery stores, malls, and auto licensing departments (**Table 3-2**).

RSG began administration on April 10, 2013 and concluded on April 16, 2013. Survey administration consisted of 20 laptop computers distributed across four activity sites per day. Each activity site was staffed by three interviewers who were responsible for approaching and screening potential respondents, escorting respondents to interview stations, and assisting them in completing the survey. A framed poster mounted on

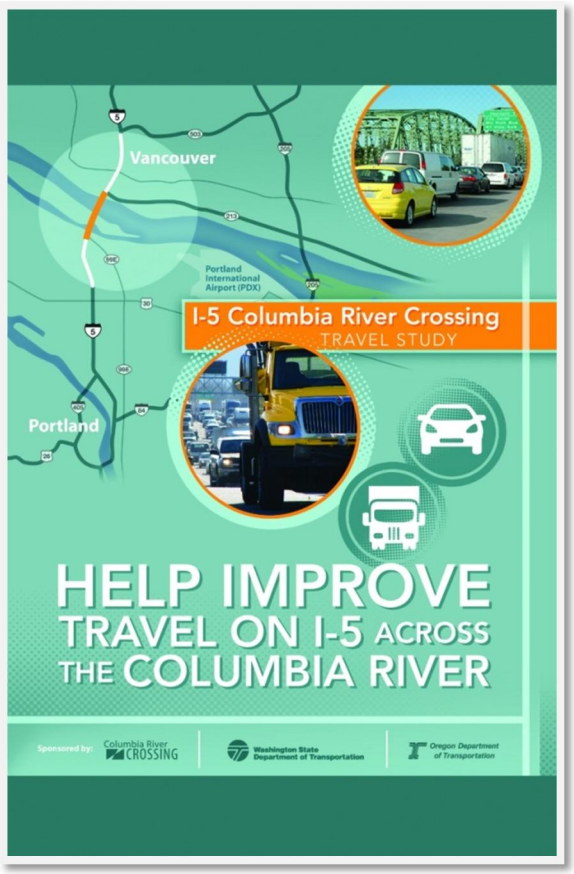
an easel was positioned near the interview stations to help attract respondents (**Figure 3-1**). Great care was taken by the attendants to represent the project team in a polite and courteous manner at all times.

A total of 525 passenger vehicle drivers and 368 commercial vehicle drivers completed the stated preference survey through this intercept recruitment method.

Table 3-2: Survey Intercept Locations

Survey Type	Site	Location	Complete Surveys
Passenger	Clark County Auditor's Auto Licensing Department	Vancouver	129
	Hazel Dell Auto Licensing	Vancouver	18
	Lloyd Center Mall	Portland	33
	Marshall Community Center	Vancouver	47
	Multnomah County Library Central Branch	Portland	44
	Neighbors Market	Vancouver	10
	Orchards Auto Licensing	Vancouver	20
	Peninsula Park Community Center & Pool	Portland	22
	Powell's City of Books	Portland	45
	St John's IGA Grocery	Vancouver	35
	Three Creeks Library	Vancouver	41
	Vancouver Community Library	Vancouver	81
Commercial	Jubitz Service Center	Portland	207
	TA Travel Center	Aurora	161

Figure 3-1: Activity Site Poster



3.1.2 Email Recruit to Origin-Destination Survey Respondents

RSG worked with the project team to coordinate an email invitation to approximately 3,500 travelers who had previously completed an origin-destination study conducted by CDM Smith. The OD survey was conducted using a license plate capture mail-out approach where license plates of vehicles traveling across the I-5 bridge were photographed and survey cards were mailed to the vehicles' registered addresses. At the end of the OD survey, respondents were asked to provide their email address if they would be willing to participate in a follow-up survey. RSG distributed email invitations to the 3,498 OD respondents who provided a valid email address. The email invitation contained a brief description of the study and instructions for completing the online survey, as well as a unique survey link for each respondent. This method of recruitment resulted in 1,158 complete responses, for a response rate of approximately 33%.

3.1.3 Online Market Research Panel

RSG contracted with ResearchNow, an online market research panel, to provide additional stated preference survey respondents. Panel members with a home ZIP code in Portland, Oregon or Vancouver, Washington were sent an email invitation to the survey that contained a link with a unique identifier. Respondents completed the survey on RSG's server before being redirected back to the panel provider's website. The recruitment method yielded a total of 302 complete surveys.

4.0 SURVEY RESULTS

Summary tabulations and statistics are presented below for select questions for the passenger and commercial vehicle surveys. A complete set of survey tabulations for each question in both surveys can be found in **Appendix B.**

4.1 Passenger Vehicle Results

A total of 1,985 respondents completed the passenger vehicle survey in April of 2013. The number of records was reduced to 1,906 after completing data checks and outlier analysis during the model estimation work, which is described in more detail in **Section 5.0** of this report. The descriptive analysis of the data presented in this section of the report is based on the 1,906 respondents who were included in the model estimation and is provided in four sections: trip detail questions, stated preference questions, debrief and opinion questions, and traveler information questions.

For the purposes of statistical modeling, respondents were grouped into two groups of market segments with each group containing the 1,906 final responses:

1. Five market segments by trip departure time, and trip purpose:
    a. Peak work trips
    b. Peak non-work trips
    c. Off-peak work trips
    d. Off-peak non-work trips
    e. Weekend trips
2. Three market segments by trip departure time:
    a. Peak trips

b. Off-peak trips

c. Weekend trips

The peak trip segment contains travelers who indicated their trip began on a weekday either during the AM peak period (6:00-9:59 AM) or the PM peak period (3:00-6:59 PM) while off-peak trips occurred at all other time periods (**Table 4-1**). Work trip segments include both commute and business-related trips, while all other trip purposes are classified as non-work trips. The peak trip segment includes both peak work and peak non-work trips, and similarly, the off-peak trip segment includes both off-peak work and off-peak non-work trips. The weekend travel segment includes all trip purposes and departure times. Complete sets of tabulations of the survey questions by both groups of market segments are shown in **Appendix B**.

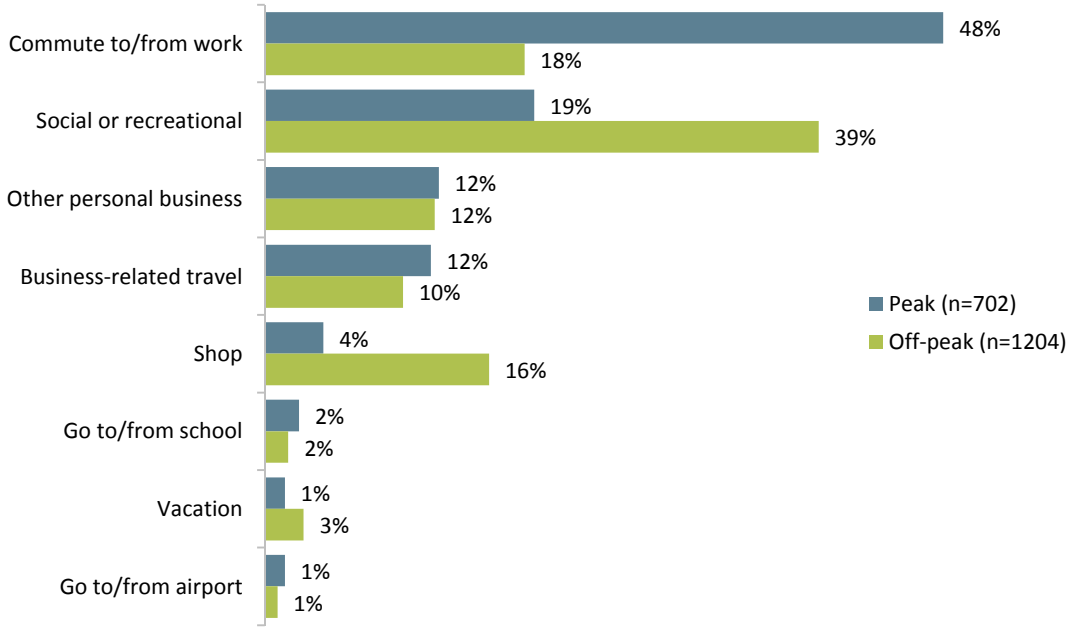
Table 4-1: Passenger Vehicle Survey – Definition of Market Segments

Market Segment	Day of Week	Trip Departure Time	Trip Purpose
Peak Work Trips (n=417)	Monday-Friday	1. 6:00 AM to 9:59 AM 2. 3:00 PM to 6:59 PM	1. Commute trips 2. Business-related trips
Peak Non-Work Trips (n=285)	Monday-Friday	1. 6:00 AM to 9:59 AM 2. 3:00 PM to 6:59 PM	1. School trips 2. Airport trips 3. Shopping trips 4. Social/recreational trips 5. Other personal business trips 6. Vacation trips
Off-Peak Work Trips (n=190)	Monday-Friday	1. 10:00 AM to 2:59 PM 2. 7:00 PM to 5:59 AM	1. Commute trips 2. Business-related trips
Off-Peak Non-Work Trips (n=393)	Monday-Friday	1. 10:00 AM to 2:59 PM 2. 7:00 PM to 5:59 AM	1. School trips 2. Airport trips 3. Shopping trips 4. Social/recreational trips 5. Other personal business trips 6. Vacation trips
Peak Trips (n=702)	Monday-Friday	1. 6:00 AM to 9:59 AM 2. 3:00 PM to 6:59 PM	All purposes
Off-peak Trips (n=583)	Monday-Friday	1. 10:00 AM to 2:59 PM 2. 7:00 PM to 5:59 AM	All purposes
Weekend Trips (n=621)	Saturday or Sunday	All departure times	All purposes

4.1.1 Screening and Trip Detail Questions

The distribution of trip purpose for all respondents is shown in **Figure 4-1**, where weekend trips are considered off-peak trips. The majority of all reported trips were either social or recreational trips or commute trips, although work commute trips were more frequently made during the peak period and social or recreational trips were more frequently made during the off-peak period.

Figure 4-1: Passenger Vehicle Survey – Trip Purpose by Trip Departure Time



The latitude and longitude coordinates for each trip's origin-destination pair were used to calculate the trip distance and expected trip travel times using a Google Maps travel direction driving algorithm. Mean and median trip distances, as well as respondent-reported travel times, are displayed in **Table 4-2** by market segment. Work trips tended to be shorter in both time and distance compared to other segments, while peak non-work and weekend trips tended to be longer.

Table 4-2: Passenger Vehicle Survey – Trip Travel Time and Trip Distance by Segment

Market Segment	Trip Travel Time (minutes)		Trip Distance (miles)	
	Mean	Median	Mean	Median
Peak work	47	40	27	18
Peak non-work	59	40	38	18
Off-peak work	43	30	29	18
Off-peak non-work	50	30	34	17
Peak	52	40	31	18
Off-peak	48	30	32	17
Weekend	61	40	40	18

Trip origins and destinations, stratified by distance traveled, are displayed in **Figure 4-2** and **Figure 4-3**. **Figure 4-2** shows respondents' trip origins are scattered primarily north-south with most small-to-medium distances trips clustered around Vancouver, WA and long distance trips around the Portland area. The vast majority of trips that began at the extremities of the study corridor tend to be over 20 miles in distance. Similarly, trip destinations in **Figure 4-3** show that a large number of respondents reported trip destinations that are clustered around Portland, OR and Vancouver, WA, while longer distance trips tend to terminate outside these cities.

Figure 4-2: Passenger Vehicle Survey – Map of Trip Origins by Trip Distance

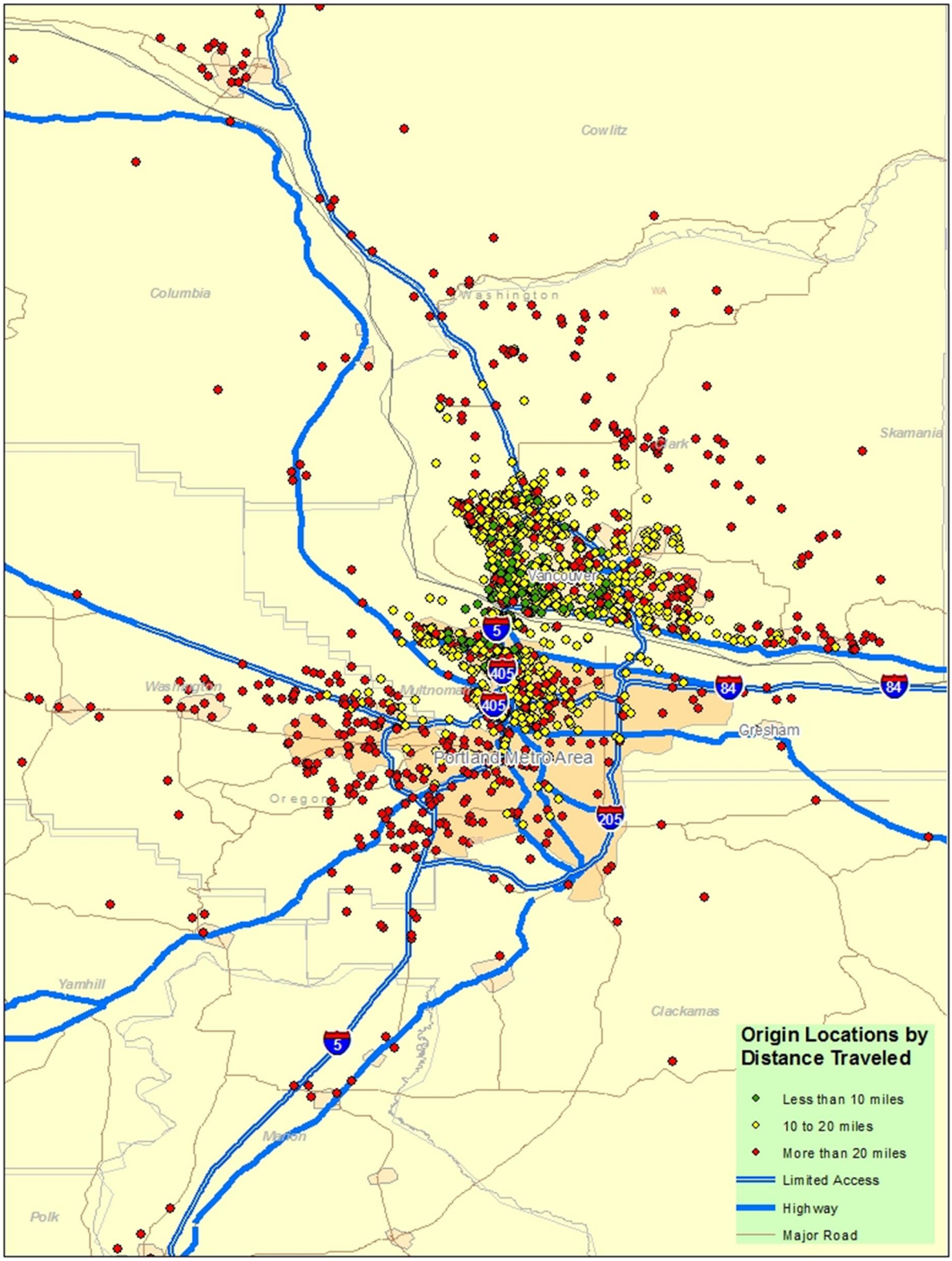
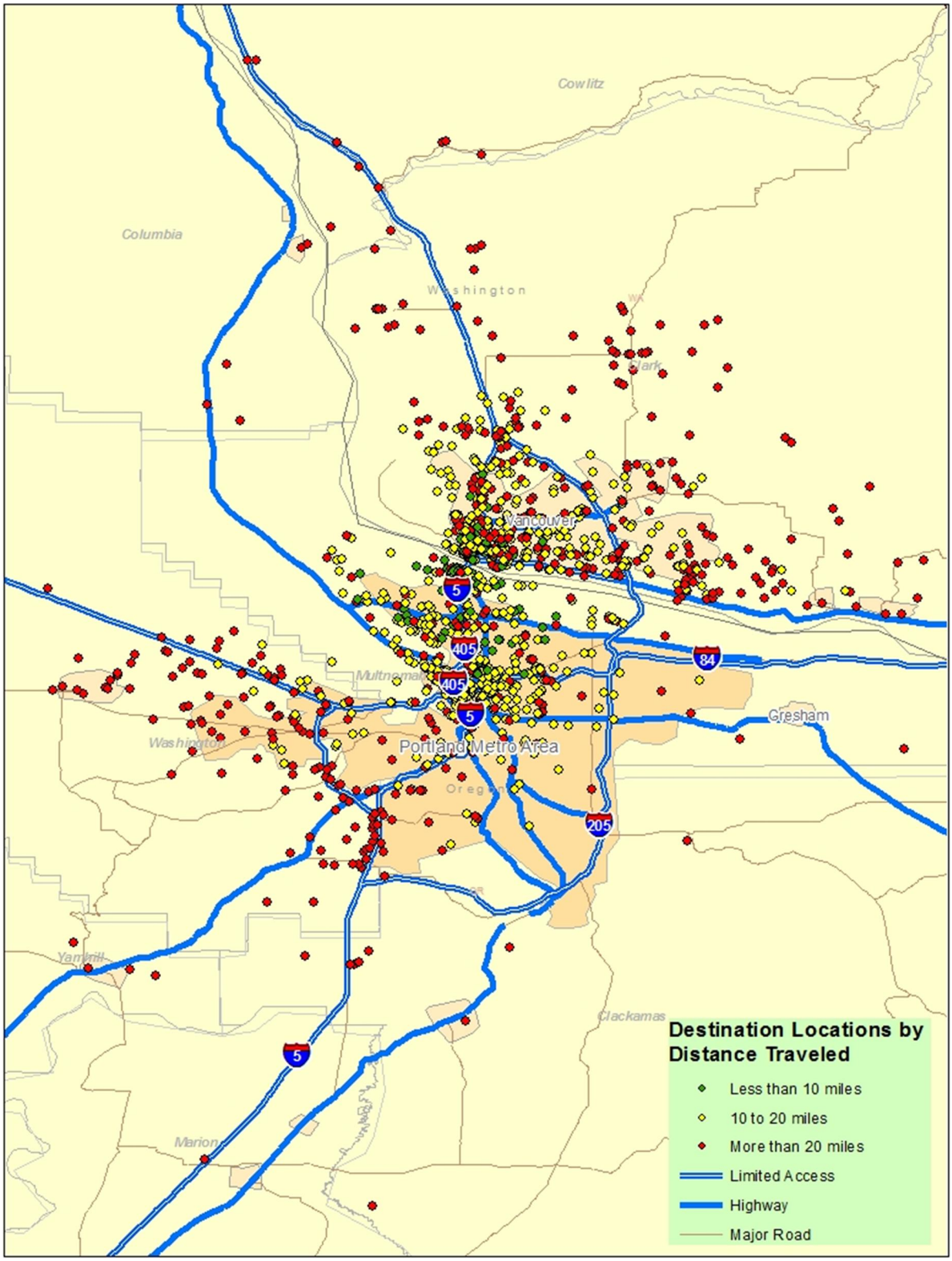
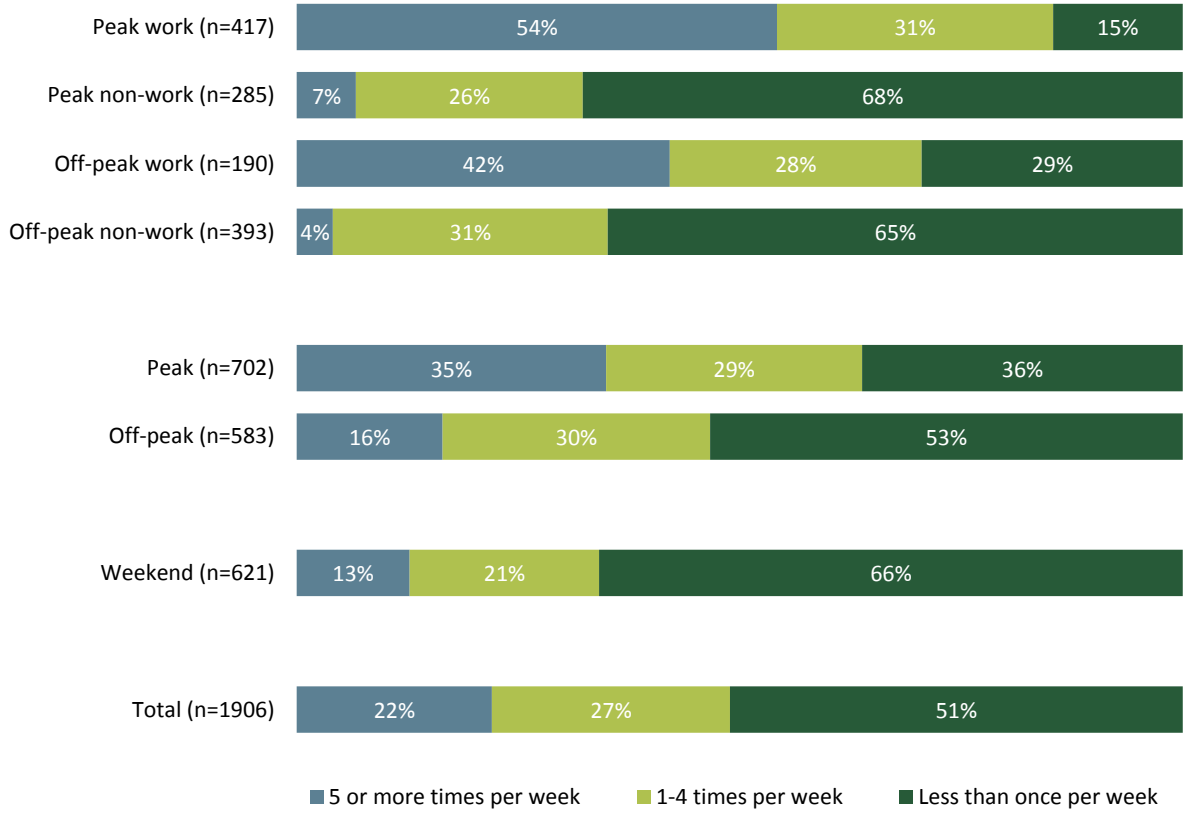


Figure 4-3: Passenger Vehicle Survey – Map of Trip Destinations by Trip Distance



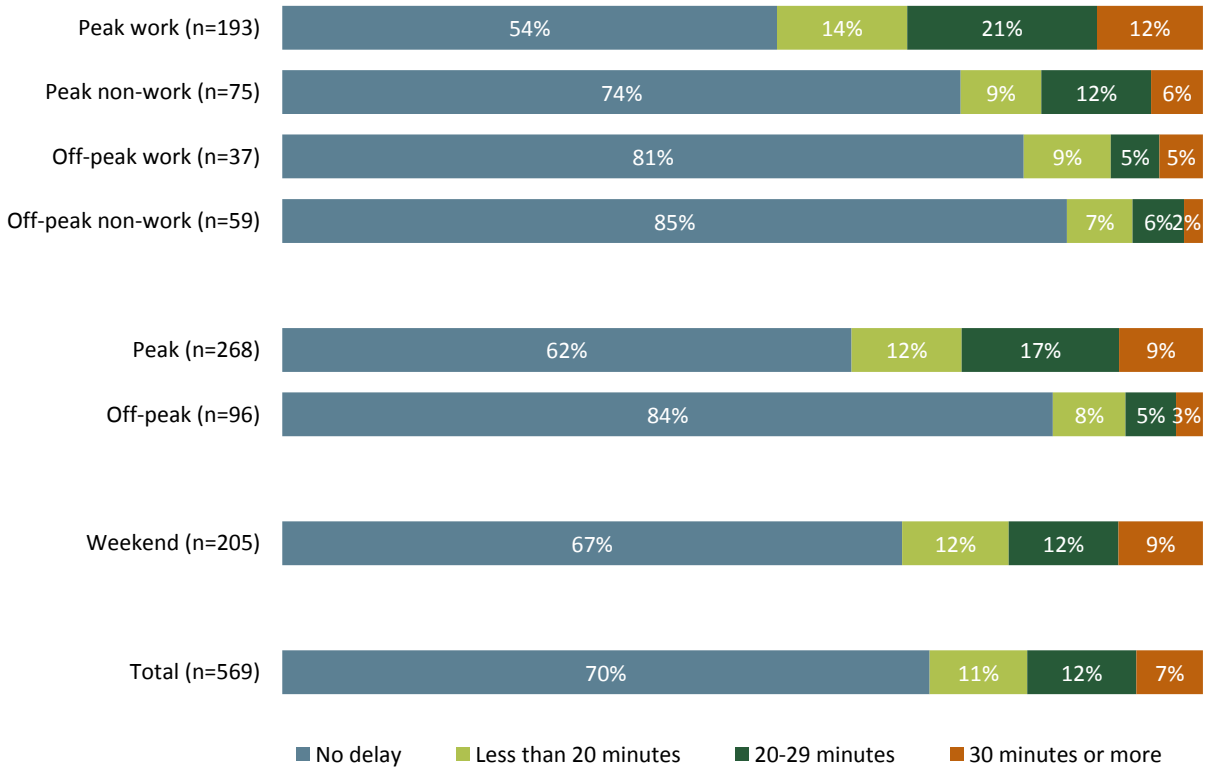
The frequency of trips, defined as the number of times per week that a respondent makes their reference trip, is illustrated in **Figure 4-4**. Fifty-one percent of all reported trips are made less than one time per week, although there are significant variations across the different trip purposes. As expected, work trips were the most frequent with 54% of peak work travelers indicating they make the same trip at least five times per week. Non-work and off-peak trips tended to be made less frequently.

Figure 4-4: Passenger Vehicle Survey – Trip Frequency by Segment



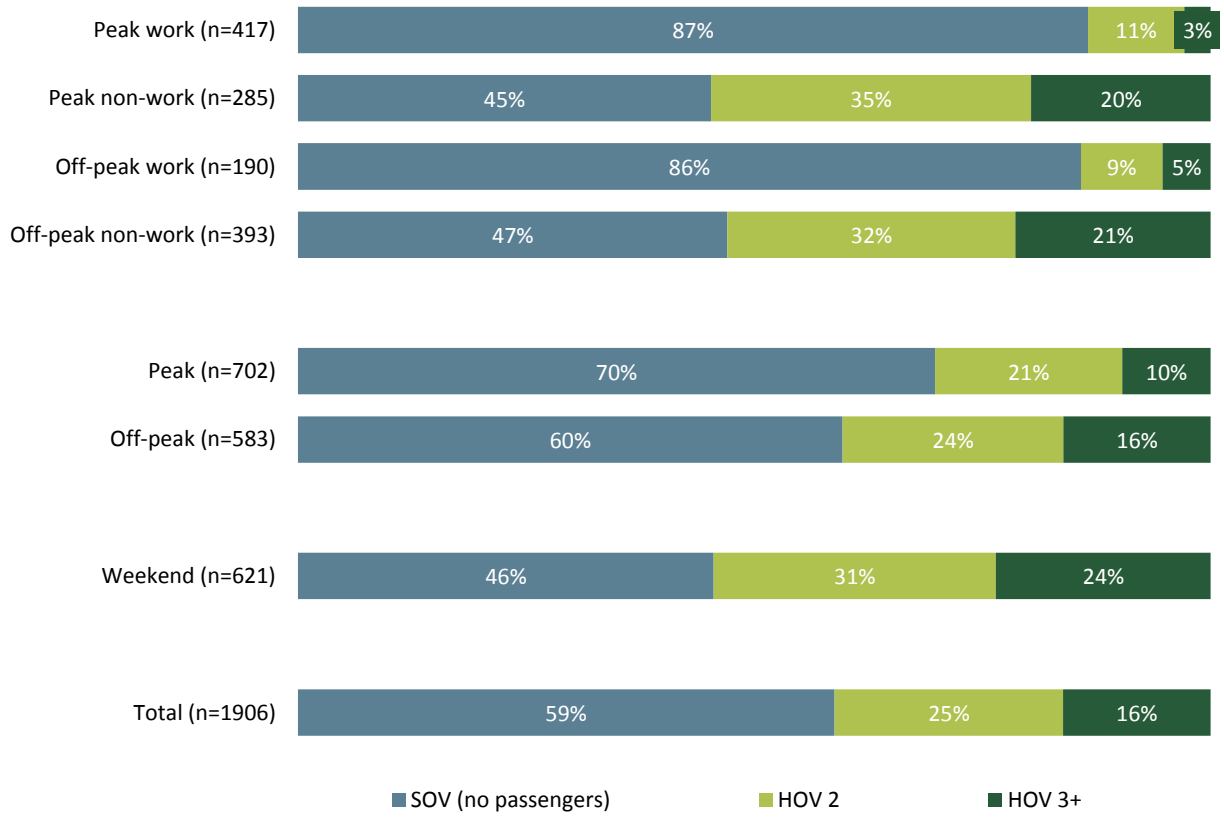
Respondents were asked to report the amount of traffic congestion they experienced on their trip as a result of congestion related to the I-5 bridge. The amount of delay due to traffic congestion is presented by market segment in **Figure 4-5**. Overall, seventy percent of respondents did *not* experience any delay during their trip. Respondents reporting a trip made during the peak period were much more likely to experience delay than those traveling in off-peak periods or on the weekend.

Figure 4-5: Passenger Vehicle Survey – Amount of Reported Delay Due To Traffic Congestion by Segment



Reported total vehicle occupancy by market segment is shown in **Figure 4-6**. Eighty-six percent of work trips were made in single occupant vehicles (SOV), while only 41% of non-work trips were SOV. Overall, the mean occupancy was 1.70 people per vehicle.

Figure 4-6: Passenger Vehicle Survey – Vehicle Occupancy by Segment



4.1.2 Stated Preference Questions

Out of the 19,060 total stated preference experiments administered in the survey, respondents in this study chose the I-205 alternative 9,620 times which represents 50% of all choices (**Table 4-3**). Respondents chose the I-5 alternative 4,231 times, representing 22% of all choices. Analysis of the stated preference data will be described in more detail in the **Section 5.0 (Model Estimation)** section of this report.

Table 4-3: Passenger Vehicle Survey – Stated Preference Choices by Alternative Availability

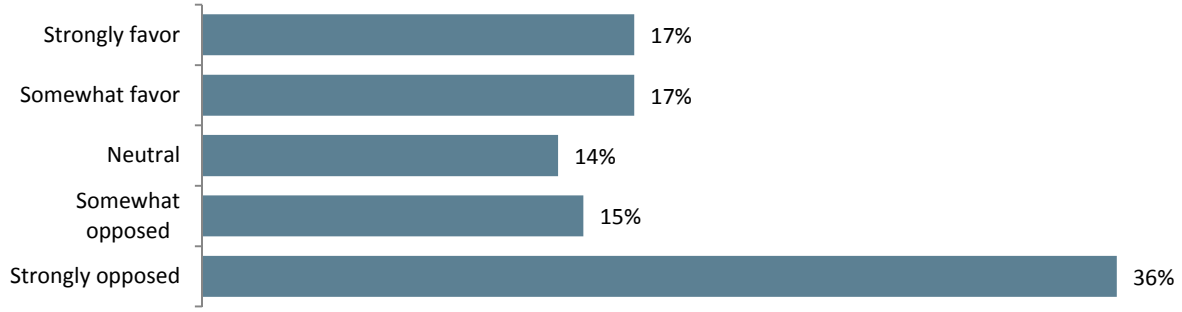
Alternative	Number of Times Alternative Selected	Number of Times Alternative Shown	Percent Selected
Trip using tolled I-5 bridge	4,231	19,060	22%
Trip using tolled I-5 bridge at different trip departure time	1,319	8,610	15%
Trip using toll-free I-205 bridge	9,620	19,060	50%
Trip using tolled I-5 bridge as high-occupancy vehicle	2,388	15,980	15%
Trip using public transit	1,502	14,710	10%

4.1.3 Debrief and Opinion Questions

Upon completing the stated preference scenarios, respondents were asked to answer a series of debrief questions to understand the underlying reasons for their choices during the hypothetical trade-offs. Opinion

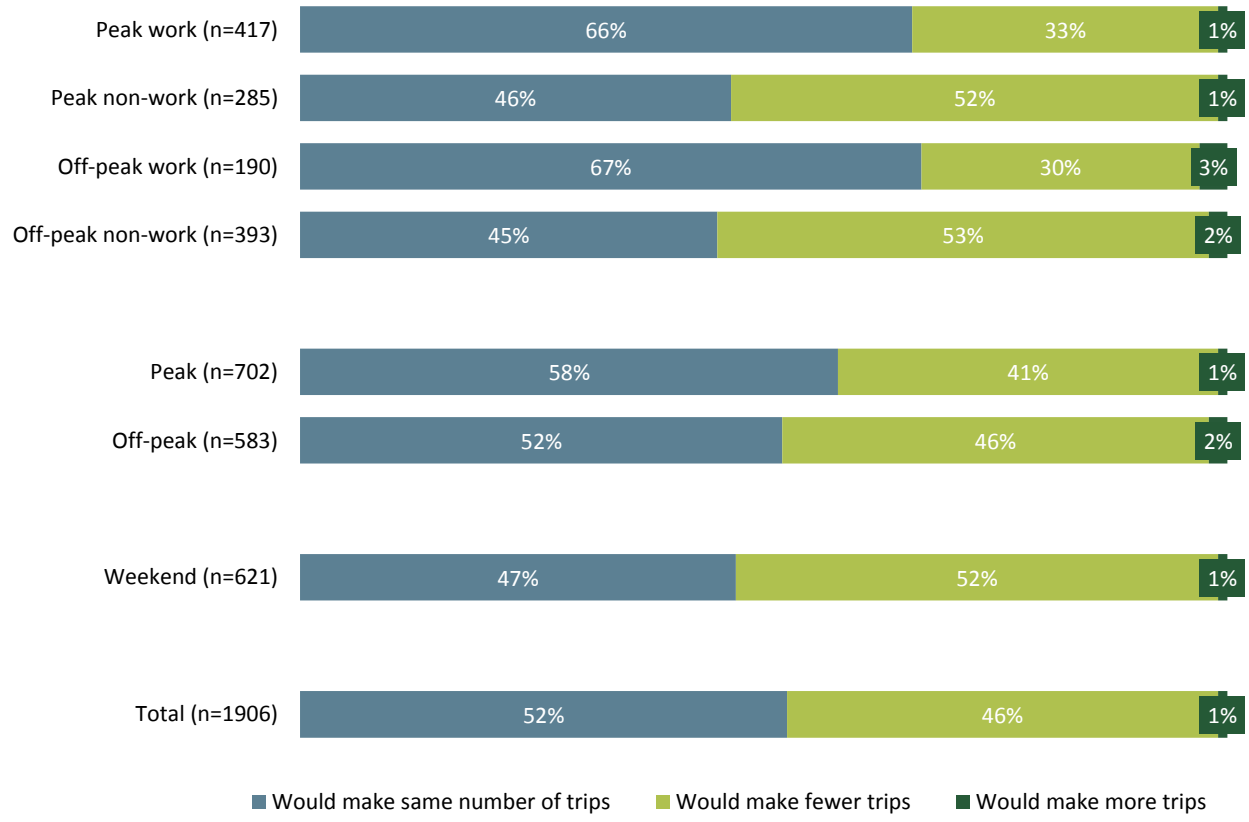
questions were included to help identify those respondents in the sample who may have responded to the stated preference scenarios in a strategic fashion that does necessarily reflect how they would actually behave if the CRC Bridge Project were completed. Overall, more than half (51%) of respondents indicated that they are opposed to the tolling of the I-5 Columbia River Crossing.

Figure 4-7: Passenger Vehicle Survey – Opinion of Tolling of the I-5 Columbia River Crossing



Respondents reported how they would change the number of trips they make in the future if pricing were implemented on the I-5 bridge given a certain travel time and toll cost. Overall, 46% of respondents indicated that they would reduce the number of trips they make in the future and 52% indicated that they would not change their current number of trips (**Figure 4-8**), although trips for work purposes were less likely to be reduced than trips for non-work purposes. A regression analysis was conducted using the trip suppression data to identify trip reduction rates under different travel time and toll cost conditions. The methodology and results of this analysis are presented in **Section 5.6** below.

Figure 4-8: Passenger Vehicle Survey – Trip Suppression by Segment

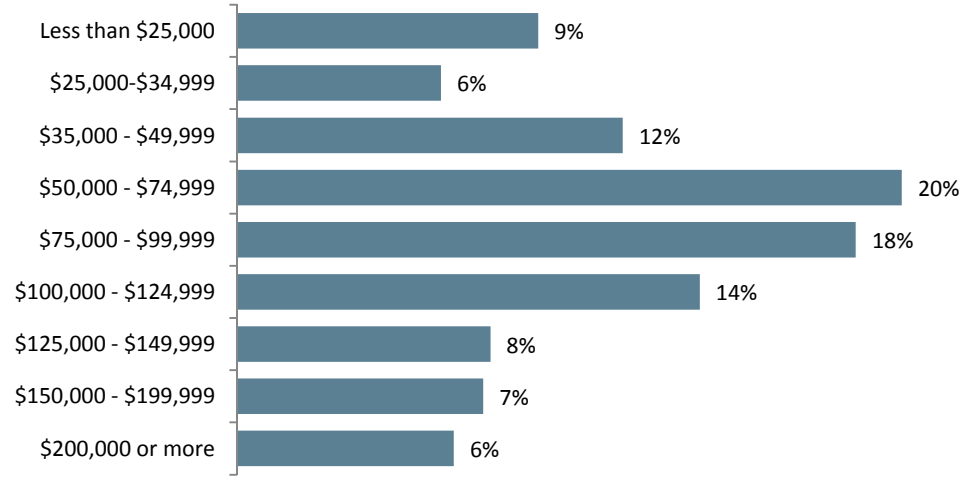


Finally, to understand current public transportation use, all respondents were asked to indicate how frequently they use public transportation in the Portland-Vancouver area. Eighty-nine percent of respondents were familiar with public transportation in the Portland-Vancouver region and, of those, 40% indicated that they never use public transportation, 47% use it less than one time per week, and 13% use it one time per week or more. Additional questions were asked to understand current bike use for transportation purposes and how likely respondents would be to use the proposed bike lane on the I-5 bridge. Approximately 21% of respondents indicated that they ride a bicycle for transportation at least one time per week or more frequently. Of these, half (50%) said that they would be very or somewhat likely to bike across the new bridge by bicycle.

4.1.4 Traveler Information Questions

Fifty-eight percent of respondents reported that they reside in Washington, while 41% reside in Oregon. The dataset also includes a wide range of ages, with a median age category of 45-54 years of age. Fifty-four percent of survey takers were male, fifty-four percent of respondents were employed full time, 47% live in a two-person household, and forty-eight percent of households had two cars. **Figure 4-9** shows the income distribution for the entire sample; the median household income falls into the $75,000-99,999 range.

Figure 4-9: Passenger Vehicle Survey – 2012 Household Income, Before Taxes



4.2 Commercial Vehicle Results

A total of 368 respondents completed the commercial vehicle survey in April of 2013. The number of records was reduced to 333 after completing data checks and outlier analysis during the model estimation work, which is described in more detail in **Section 5.0** below. The descriptive analysis of the data presented in this section of the report is based on the 333 respondents who were included in the model estimation and is provided in four sections: trip detail questions, stated preference questions, debrief and opinion questions, and company information questions.

4.2.1 Screening and Trip Detail Questions

Over half (56%) of respondents surveyed were fleet drivers. Owner-operators (23%) constituted the second largest group. A majority (59%) made their own routing decisions, while about one-quarter (27%) made some, but not all routing decisions.

The trip detail section defined the respondent's trip as the one-way trip between their last commercial stop before crossing the Columbia River using the I-5 bridge to their next commercial stop after crossing the Columbia River bridge. Respondents were asked to provide the city, state/province, and country where they began and ended their trip. The most frequently reported trip was from Oregon to Washington (41%), while the second most frequent trip was from Washington to Oregon (26%). Only three percent of trips began or ended outside of the United States, specifically in Canada (**Table 4-4**).

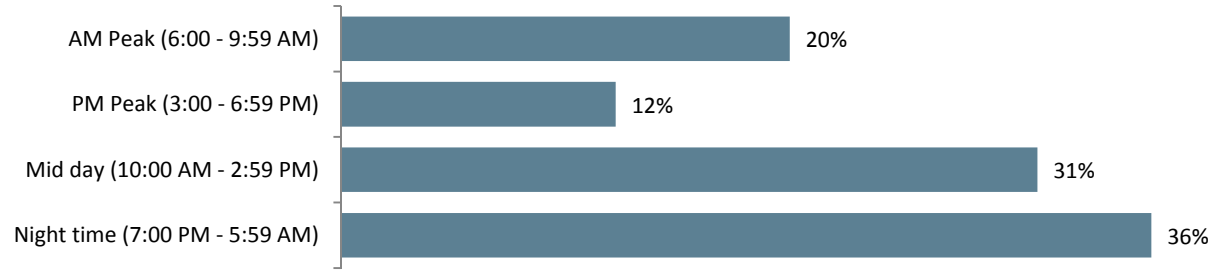
Table 4-4: Commercial Vehicle Survey – Origin and Destination Locations

	Destination				
Origin	**Oregon**	**Washington**	**Other US**	**Canada**	**Total**
Oregon	1.2%	41.4%	2.7%	0.9%	46.2%
Washington	25.5%	1.2%	11.4%	0.3%	38.4%
Other US	1.2%	11.7%	0.6%	0.3%	13.8%
Canada	1.2%	0.0%	0.3%	0.0%	1.5%
Total	29.1%	54.4%	15.0%	1.5%	100.0%

Fifteen percent of trips were multiday trips which were typically two or three days in length. Forty-two percent of all trips were at least 500 miles in total length and half (50%) of all trips were at least seven hours in total travel time.

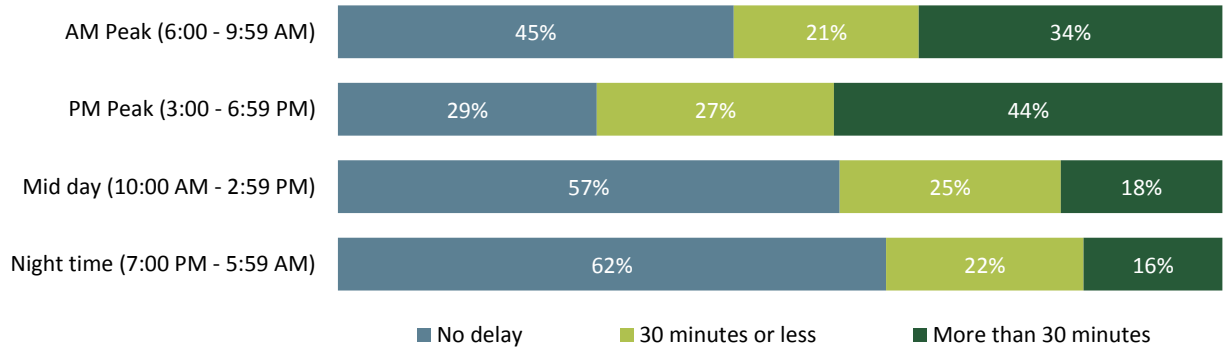
Respondents reported the time at which they crossed the Columbia River using the I-5 bridge. Thirty-two percent of travelers reported crossing the river during a peak period (weekdays 6:00 to 9:59 AM or 3:00 to 6:59 PM) while the remaining 68% crossed during off-peak times (**Figure 4-10**).

Figure 4-10: Commercial Vehicle Survey – Crossing Time



Overall47% of the sample reported having experienced delay due to traffic congestion related to the I-5 bridge. Delays were reported more frequently and were of longer duration during the AM and PM peak periods than during off-peak periods (**Figure 4-11**).

Figure 4-11: Commercial Vehicle Survey – Delay due to Traffic Congestion by Crossing Time



To conclude this section, respondents were asked if they paid a toll during their trip. A vast majority (92%) did not report having paid a toll. Additionally, thirty-five percent of respondents' vehicles were equipped with an ETC transponder. Among those, 10% had a *GoodToGo!* transponder and the other 25% reported having another type of transponder.

4.2.2 Stated Preference Questions

After completing the trip detail portion of the survey, respondents answered ten stated preference tradeoff exercises, each tailored to their reported trip. Overall, respondents were far more likely to choose the toll-free alternative—77% of the total 3,330 choices made (**Table 4-5**). Analysis of the stated preference data will be described in more detail in the **Section 5.0** below.

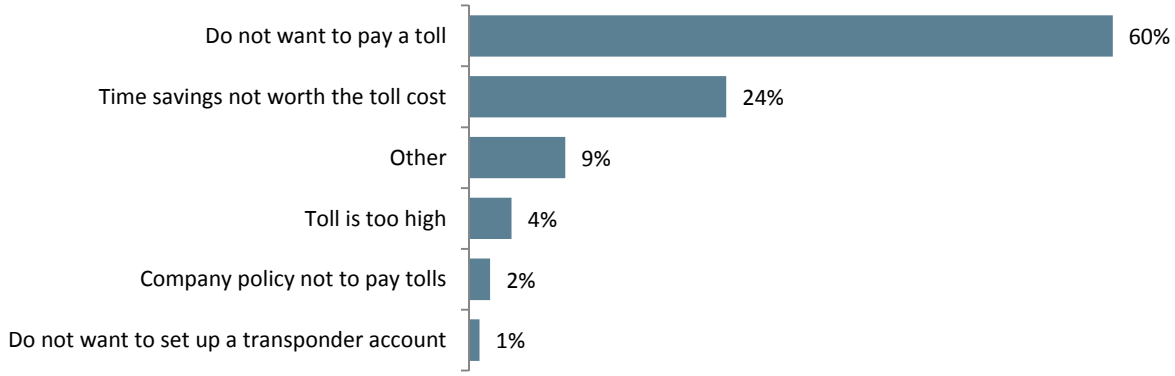
Table 4-5: Commercial Vehicle Survey – Stated Preference Choices by Alternative Availability

Alternative	Number of Times Alternative Selected	Number of Times Alternative Shown	Percent Selected
Trip using tolled I-5 bridge	752	3,330	23%
Trip using toll-free I-205 bridge	2,578	3,330	77%

4.2.3 Debrief and Opinion Questions

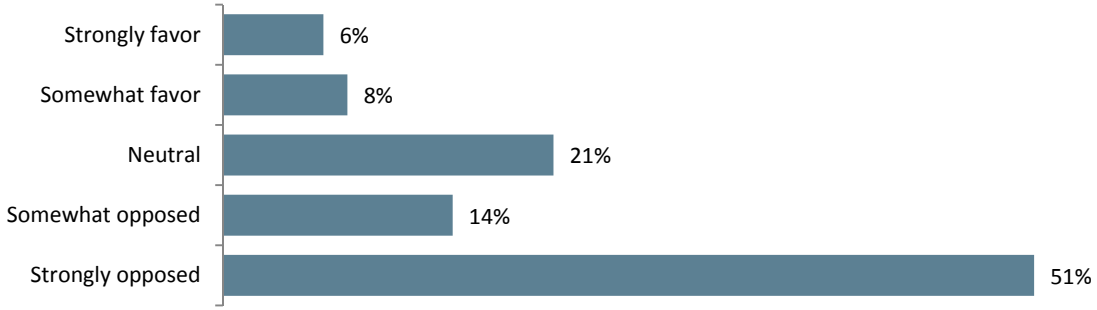
After completing the stated preference tradeoff exercises, respondents were asked to answer a set of debrief questions aimed at better understanding the reasoning behind their choices. First, the 168 respondents who never chose the tolled route alternative were asked to provide an explanation (**Figure 4-12**). The majority, 60%, cited they 'do not want to a pay a toll' as their primary reason.

Figure 4-12: Commercial Vehicle Survey – Primary Reason for Never Selecting a Tolled I-5 Alternative



Next, respondents provided their opinion of the tolling of the I-5 Columbia River Crossing. The majority of respondents (65%) were somewhat or strongly opposed, while only fourteen percent were somewhat or strongly in favor (**Figure 4-13**).

Figure 4-13: Commercial Vehicle Survey – Opinion of Proposed Tolling



The most common reason for favoring the tolling of the I-5 project was 'shorter travel time.' Almost half (49%) who opposed the tolling cited general opposition to paying tolls as the primary reason.

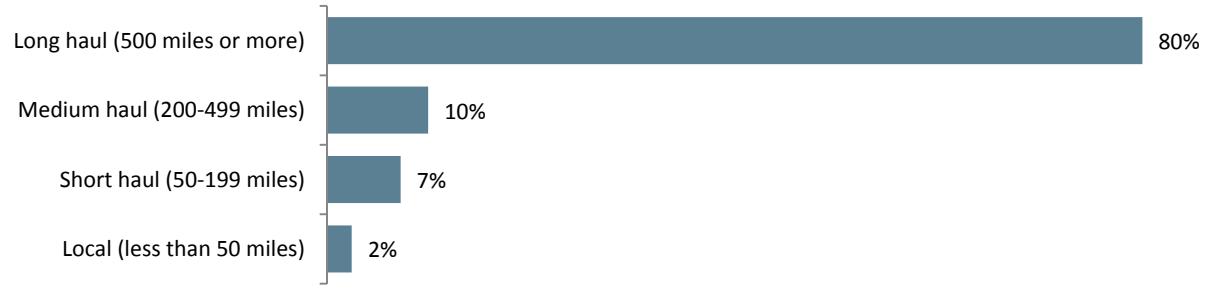
4.2.4 Company Information Questions

The last section of the commercial vehicle survey collected company information. Thirty-eight percent of travelers indicated that their company's base of operations is located in Oregon or Washington and an additional 59% have bases outside of Oregon and Washington, but within the U.S. A range of fleet sizes was

represented. Almost one-third (32%) of the drivers who were fleet drivers worked for large companies with fleet sizes of 500 or more vehicles. Another 23% of respondents worked for companies operating fleets of 20 to 99 vehicles and just over 27% reported a fleet size of 19 vehicles or fewer.

Respondents were asked to provide an estimate of average company trip length and how often they make their reference trip. Average company trip length exceeded 500 miles for 80% of the sample. **Figure 4-14** shows the distribution of trip frequencies.

Figure 4-14: Commercial Vehicle Survey – Typical Trip Length



Respondents reported how much flexibility they have in their delivery schedule. Almost two-thirds (63%) reported having a flexible delivery schedule with one-quarter of those respondents reporting having 6 or more hours of flexibility. Over half (56%) reported not have a penalty or incentive time frame structure for deliveries. Finally, respondents reported how toll costs, if incurred, are paid for. Thirty-five percent reported that they pay tolls out of pocket, while 57% reported their company pays tolls directly or they are reimbursed by their company for tolls. The remaining eight percent of respondents reported never using toll roads.

5.0 MODEL ESTIMATION

5.1 Methodology and Alternatives

The objective of the stated preference surveys was to estimate reliable values of time (VOT) for passenger and commercial vehicle travelers who use the I-5 bridge to cross the Columbia River. These VOT estimates will support estimates of traffic and revenue for this project.

The 10 responses from the stated preference experiments were combined into passenger and commercial vehicle datasets for the purpose of estimating discrete choice models. The statistical estimation and specification testing were completed using a conventional maximum likelihood procedure that estimated a set of coefficients for a multinomial logit (MNL) model[1]. Separate models were estimated for passenger vehicle respondents and commercial vehicle respondents. The model coefficients provide information about the respondents' sensitivities to the attributes that were tested in the tradeoff scenarios, such as travel time and toll cost. The sensitivities will serve as inputs into a regional travel demand model to forecast behavioral response, traffic, and revenue for the proposed project.

5.1.1 Passenger Vehicle Survey Alternatives

In each of the ten stated preference experiments, passenger vehicle respondents were presented with between two and five hypothetical alternatives for making their future trip. The alternatives were described by attributes of travel time, toll/fare cost, departure time, the number of additional passengers, and transit mode. The attributes and the alternatives to which they apply are shown below in **Table 5-1**.

Table 5-1: Passenger Vehicle Survey – Stated Preference Alternatives and Attributes

Alternative	Availability	Attributes					
		Travel Time	Toll Cost	Trip Departure Time	Additional Passengers	Transit Mode (bus or rail)	Transit Fare
6. I-5 (tolled)	All respondents	X	X	X			
7. I-205 (toll-free)	All respondents	X		X			
8. I-5 off-peak	If peak period trip	X	X	X			
9. I-5 HOV	If SOV or HOV2	X	X	X	X		
10. Transit	If distance < 30 miles	X		X		X	X

[1] The multinomial logit model has the general form $p(i) = \frac{e^{U_i}}{\sum_{AllModes} e^{Uj}}$, where *p(i)* is the probability that mode i will be chosen and U_i is the "utility" of mode *i*, a function of service and other variables. See, for example, M. E. Ben-Akiva and S. R. Lerman, *Discrete Choice Analysis*, MIT Press, 1985 for details on the model structure and statistical estimations procedures.

The tolled I-5 alternative presented to respondents was based on the reported travel time from their reference trip and featured a travel time equal to or faster than their current time to reflect decreased traffic and congestion under tolled conditions. The I-205 alternative featured longer travel times to account for the longer trip distance and potentially higher congestion due to diversion from I-5. This alternative was always presented as toll-free. The I-5 departure time shift alternative presented slightly faster travel times and discounted tolls compared to the tolled peak period I-5 alternative to reflect off-peak traffic conditions and pricing policies. The I-5 carpool option showed similar or slightly longer travel times compared to the I-5 alternative to reflect the time required for carpool formation, but also featured a toll discount to reflect potential future HOV policies. The transit alternative featured slightly longer travel times than the tolled I-5 option to reflect access and egress time, headway time, and potentially slower average speeds as a result of stops made along the way. The transit fare was varied between $1.00 and $5.00. A complete description of the levels used in the experiments can be found in **Table 2-2** above.

5.1.2 Commercial Vehicle Survey Alternatives

In each of the ten stated preference experiments shown to commercial vehicle respondents, two alternatives were shown for making their trip in the future—using I-5 or I-205 to cross the Columbia River. Each of these alternatives was described by two attributes: travel time and toll cost (**Table 5-2**). The travel time for the tolled I-5 alternative was equal to or faster than their current reported travel time and always presented as faster than the travel time for the toll-free I-205 alternative.

Table 5-2: Commercial Vehicle Survey – Stated Preference Alternatives

Alternative	Availability	Travel Time	Toll Cost
1. Trip using I-5 (tolled)	All respondents	X	X
2. Trip using I-205 (toll-free)	All respondents	X	

More information about the design of the stated preference scenarios can be found in **Section 2**.

5.2 Identification of Outliers

The choice data were screened to ensure that all observations included in the model estimation represented realistic trips and reasonable trade-offs in the stated preference exercises. Several variables were used for screening purposes, including an examination of origin and destination locations, reported travel times, total survey duration and stated preference question duration.

5.2.1 Passenger Vehicle Survey Outliers

After reviewing variables in the passenger vehicle survey and the effects that extreme values had on the models, it was determined that respondents who met the following conditions should be excluded from the final analysis (the categories are not mutually exclusive):

- Origin and destination combinations that indicated a trip would not qualify for this study (32 instances).
- Difference between Google Maps estimated travel time and reported travel time was greater than 30 minutes and reported travel time is greater than or equal to four hours (32 instances).
- An implied speed (60*trip distance/travel time) greater than 120 mph or less than 5 mph (23 instances).

- A total amount of delay equal to or greater than 80% of reported travel time (8 instances).
- A total survey duration of less than seven minutes or duration for the stated preference exercises of less than 30 seconds, or 3 seconds per SP experiment (6 instances).
- Vehicles with a total occupancy greater than nine (3 instances).

Based on this outlier analysis, a total of 1,906 respondents (19,960 observations) were used to estimate the models presented in this report.

5.2.2 Commercial Vehicle Survey Outliers

A similar data screening process was used for the commercial vehicle data. Outliers were identified and removed from the final dataset based on the following criteria:

- Origin and destination combinations that indicated a trip would not qualify for this study (12 instances).
- An implied speed (60*trip distance/travel time) greater than 200 mph or less than 2 mph (16 instances).
- A survey duration of less than seven minutes or SP section duration less than 30 seconds, or 3 seconds per SP experiment (6 instances).
- A total number of trip travel days of 300 (1 instance).

After excluding these respondents, a total of 333 respondents (3,330 observations) were used to estimate the model presented in this report.

5.3 Multinomial Logit Model Specification

Multinomial logit models were estimated using the cleaned passenger and commercial vehicle datasets. The multinomial logit model estimates a choice probability for each alternative presented in the stated preference tradeoff exercises. The alternatives are represented in the model by observed utility equations of the form:

$U_1 = \beta_1 X_1 + \beta_2 X_2 + \ldots + \beta_n X_n$

Where each X represents a variable specified by the researcher and each β is a coefficient estimated by the model that represents the sensitivity of the respondents in the sample to the corresponding variable.

Several utility equation structures were tested using the variables included in the stated preference scenarios, as well as trip characteristics, attitudinal indicators, and demographic variables. The models presented in this section are final model specifications, only including variables that proved statistically significant.

5.3.1 Passenger Vehicle Model Specification

Specification testing for the passenger vehicle survey included the evaluation of various trip characteristic and demographic variables, alternative-specific constants, bias-removing variables, and transformations of toll cost and travel time by household income. The trip characteristic and demographic variables that were tested included:

- Trip purpose
- Time of day

- Vehicle occupancy
- Opinion of tolling
- Household Income
- Trip distance

After reviewing the significance of each variable, the final model specifications were chosen based on model fit, the intuitiveness and reasonableness of the model coefficients, and the expected application of the model results. In the final specification, coefficients were determined for auto travel time, auto toll cost, trip departure time, vehicle occupancy, transit travel time, transit cost, and transit mode. Time and cost coefficients were also specified in order to capture strategic bias in the stated preference responses, and alternative-specific constants were specified for all alternatives except the I-5 toll option (Alternative 1).

The toll cost variable was transformed by household income in order to reflect the relationship between household income and sensitivity to toll cost. After testing several different interactions between toll cost and household income, the transformation that resulted in the best improvement in model fit (the highest log likelihood) was found to be dividing the toll cost variable by the natural log of household income in thousands of dollars as described in **Equation 5-1** below:

Equation 5-1: Toll Cost and Household Income Interaction

$$\beta_{cost} * \frac{Toll\ Cost}{LN(\frac{Income}{1000})}$$

Trip purpose and time of day were also found to be significant variables. As a result, three model specifications were selected:

1. An aggregate model including all observations
2. A segmented model with travel time and toll cost separated into five market segments by trip departure time, day of travel, and trip purpose:
    a. Peak work trips
    b. Peak non-work trips
    c. Off-peak work trips
    d. Off-peak non-work trips
    e. Weekend trips
3. A segmented model with travel time and toll cost separated into three market segments by trip departure time and day of travel:
    a. Peak trips
    b. Off-peak trips
    c. Weekend trips

The definition for each segment is provided in Table 5-3 below:

Table 5-3: Passenger Vehicle Survey – Definition of Market Segments

Market Segment	Day of Week	Trip Departure Time	Trip Purpose
Peak Work Trips (n=417)	Monday-Friday	1. 6:00 AM to 9:59 AM 2. 3:00 PM to 6:59 PM	1. Commute trips 2. Business-related trips
Peak Non-Work Trips (n=285)	Monday-Friday	1. 6:00 AM to 9:59 AM 2. 3:00 PM to 6:59 PM	1. School trips 2. Airport trips 3. Shopping trips 4. Social/recreational trips 5. Other personal business trips 6. Vacation trips
Off-Peak Work Trips (n=190)	Monday-Friday	1. 10:00 AM to 2:59 PM 2. 7:00 PM to 5:59 AM	1. Commute trips 2. Business-related trips
Off-Peak Non-Work Trips (n=393)	Monday-Friday	1. 10:00 AM to 2:59 PM 2. 7:00 PM to 5:59 AM	1. School trips 2. Airport trips 3. Shopping trips 4. Social/recreational trips 5. Other personal business trips 6. Vacation trips
Peak Trips (n=702)	Monday-Friday	1. 6:00 AM to 9:59 AM 2. 3:00 PM to 6:59 PM	All purposes
Off-peak Trips (n=583)	Monday-Friday	1. 10:00 AM to 2:59 PM 2. 7:00 PM to 5:59 AM	All purposes
Weekend Trips (n=621)	Saturday or Sunday	All departure times	All purposes

5.3.2 Commercial Vehicle Model Specification

Specification testing for the commercial vehicle data was conducted in a similar manner to the passenger vehicle data. Utility equations were specified for each alternative using the variables tested in the stated preference exercises (travel time and toll cost), as well as certain trip detail, attitude, and company information variables that could have explanatory power in the model, including:

- Number of axles
- Trip distance
- Trip frequency
- Opinion of tolling

The final model specifications for the commercial vehicle survey include separate variables for travel time and toll cost. A travel time coefficient was also specified in order to capture strategic bias in the stated preference responses. An alternative-specific constant is included on the toll-free I-205 alternative to capture the utility (or disutility) for the alternative that cannot be attributed to any other variables in the model. Vehicle size was found to have an influence on willingness to pay for travel time savings. As a result, two MNL specifications were selected after testing several model specifications, an aggregate model and a model where the toll cost coefficient was interacted with the number of vehicle axles.

5.4 Coefficient Estimates

The results of the final model specifications are presented below and include coefficient values for the passenger and commercial vehicle models. The coefficient values, robust standard errors, robust t-statistics, and general model statistics are presented in **Table 5-4** through **Table 5-8**.

The coefficient values are the values estimated by the choice model that represent the relative importance of each of the variables. It should be noted that these values are unit-specific and the units must be accounted for when comparing coefficients. The sign of the coefficient indicates a positive or negative relationship between utility and the associated variable. For example, a negative travel time coefficient implies that utility for a given travel alternative will decrease as the travel time associated with that alternative increases.

The standard error is a measure of error around the mean coefficient estimate. The t-statistic is the coefficient estimated divided by the standard error, which can be used to evaluate statistical significance. A t-statistic greater/less than ±1.96 indicates that the coefficient is statistically significantly different from 0 (unless otherwise reported) at the 95% level.

The model fit statistics that are presented include the number of observations, the number of estimated parameters, the initial log-likelihood, the log-likelihood at convergence, rho-squared, and adjusted rho-squared. The log-likelihood is a model fit measure that indicates how well the model predicts the choices observed in the data. The null log-likelihood is the measure of the model fit with coefficient values of zero. The final log-likelihood is the measure of model fit with the final coefficient values at model convergence. A value closer to zero indicates better model fit. The log-likelihood cannot be evaluated independently, as it is a function of the number of observations, the number of alternatives, and the number of parameters in the choice model. The rho-square model fit measure accounts for this to some degree by evaluating the difference between the null log-likelihood and the final log-likelihood at convergence. The adjusted rho-square value takes into account the number of parameters estimated in the model.

5.4.1 Passenger Vehicle Model Coefficients

Table 5-4: Passenger Vehicle Survey – Aggregate MNL Model

Coefficient	Alternatives					Coefficient Values		
	1: I-5, Tolled	2: I-5 Tolled, Shift	3: I-205, Free	4: I-5, HOV	5: Transit	Value	Robust Std. Error	Robust T-Test (0)
Travel Time								
Travel time	X	X	X	X		-0.072	0.004	-19.34
Travel time – strategic bias	X	X	X	X		-0.030	0.004	-8.16
Toll Cost*								
Toll cost	X	X		X		-1.500	0.060	-25.09
Toll cost – strategic bias	X	X		X		-0.607	0.034	-18.13
Transit								
Transit travel time					X	-0.052	0.005	-10.69
Transit fare					X	-0.397	0.023	-17.54
Transit mode					X	-1.250	0.081	-15.58
Vehicle Occupancy								
1 additional passenger				X		-1.570	0.095	-16.49
Departure Time Shift								
Shift earlier		X				-0.022	0.003	-6.39
Shift later		X				-0.014	0.002	-7.11
Constants								
I-5 shift constant		X				-0.508	0.133	-3.81
I-205 constant			X			0.219	0.073	3.01
I-5 HOV constant				X		0.993	0.124	8.00
Transit constant					X	1.160	0.228	5.10

Model Statistics	
Number of estimated parameters	14
Number of observations	19060
Number of individuals	1906
Initial log-likelihood	-28034.24
Final log-likelihood	-19954.55
Rho-square	0.29
Adjusted rho-square	0.29

Table 5-5: Passenger Vehicle Survey – Segmented MNL Model, Five Market Segments

Coefficient	Alternatives					Coefficient Values		
	1: I-5, Tolled	2: I-5 Tolled, Shift	3: I-205, Free	4: I-5, HOV	5: Transit	Value	Robust Std. Error	Robust T-Test (0)
Travel Time								
Travel time – peak work	X	X	X	X		-0.080	0.005	-17.64
Travel time – peak non-work	X	X	X	X		-0.074	0.005	-13.71
Travel time – off-peak work	X	X	X	X		-0.059	0.006	-10.51
Travel Time – off-peak non-work	X	X	X	X		-0.069	0.005	-14.46
Travel Time – weekend	X	X	X	X		-0.073	0.004	-16.76
Travel time – strategic bias	X	X	X	X		-0.030	0.004	-8.27
Toll Cost*								
Toll cost – peak work	X	X		X		-1.460	0.120	-12.18
Toll cost – peak non-work	X	X		X		-1.550	0.126	-12.23
Toll cost – off-peak work	X	X		X		-1.270	0.165	-7.74
Toll cost – off-peak non-work	X	X		X		-1.570	0.111	-14.12
Toll cost – weekend	X	X		X		-1.510	0.094	-16.05
Toll cost – strategic bias	X	X		X		-0.608	0.034	-18.13
Transit								
Transit travel time					X	-0.052	0.005	-10.71
Transit fare					X	-0.398	0.023	-17.53
Transit mode					X	-1.260	0.081	-15.58
Vehicle Occupancy								
1 additional passenger				X		-1.570	0.095	-16.48
Departure Time Shift								
Shift earlier		X				-0.022	0.003	-6.39
Shift later		X				-0.014	0.002	-7.12
Constants								
I-5 shift constant		X				-0.524	0.133	-3.92
I-205 constant			X			0.216	0.073	2.98
I-5 HOV constant				X		0.991	0.124	7.99
Transit constant					X	1.190	0.227	5.22

Model Statistics	
Number of estimated parameters	22
Number of observations	19060
Number of individuals	1906
Initial log-likelihood	-28034.24
Final log-likelihood	-19922.58
Rho-square	16223.31
Adjusted rho-square	0.29

Table 5-6: Passenger Vehicle Survey – Segmented MNL Model, Three Market Segments

	Alternatives					Coefficient Values		
Coefficient	1: I-5, Tolled	2: I-5 Tolled, Shift	3: I-205, Free	4: I-5, HOV	5: Transit	Value	Robust Std. Error	Robust T-Test (0)
Travel Time								
Travel time – peak	X	X	X	X		-0.077	0.004	-18.37
Travel time – peak off-peak	X	X	X	X		-0.066	0.004	-15.42
Travel Time – weekend	X	X	X	X		-0.073	0.004	-16.71
Travel time – strategic bias	X	X	X	X		-0.030	0.004	-8.24
Toll Cost*								
Toll cost – peak	X	X		X		-1.500	-1.500	-16.86
Toll cost – off-peak	X	X		X		-1.490	-1.490	-15.72
Toll cost – weekend	X	X		X		-1.510	-1.510	-16.04
Toll cost – strategic bias	X	X		X		-0.608	-0.608	-18.14
Transit								
Transit travel time					X	-0.052	0.005	-10.70
Transit fare					X	-0.397	0.023	-17.55
Transit mode					X	-1.260	0.081	-15.57
Vehicle Occupancy								
1 additional passenger				X		-1.570	0.095	-16.49
Departure Time Shift								
Shift earlier		X				-0.022	0.003	-6.40
Shift later		X				-0.014	0.002	-7.12
Constants								
I-5 shift constant		X				-0.522	0.134	-3.91
I-205 constant			X			0.215	0.072	2.97
I-5 HOV constant				X		0.991	0.124	8.00
Transit constant					X	1.170	0.226	5.18

Model Statistics	
Number of estimated parameters	18
Number of observations	19060
Number of individuals	1906
Initial log-likelihood	-28034.24
Final log-likelihood	-19933.79
Rho-square	0.29
Adjusted rho-square	0.29

5.4.2 Commercial Vehicle MNL Coefficients

Table 5-7: Commercial Vehicle Survey – Aggregate MNL Model

	Alternatives		Coefficient Values		
Coefficient	**1: I-5, Tolled**	**2: I-205, Free**	**Value**	**Robust Std. Error**	**Robust T-Test (0)**
Travel Time					
Travel time	X	X	-0.077	0.010	-7.47
Travel time – strategic bias	X	X	0.044	0.018	2.53
Toll Cost*					
Toll cost	X		-0.161	0.018	-8.89
Constants					
I-205 constant		X	0.825	0.203	4.06

Model Statistics	
Number of estimated parameters	4
Number of observations	3330
Number of individuals	333
Initial log-likelihood	-2308.18
Final log-likelihood	-1425.30
Rho-square	0.38
Adjusted rho-square	0.38

Table 5-8: Commercial Vehicle Survey – Segmented MNL Model

	Alternatives		Coefficient Values		
Coefficient	**1: I-5, Tolled**	**2: I-205, Free**	**Value**	**Robust Std. Error**	**Robust T-Test (0)**
Travel Time					
Travel time	X	X	-0.0819	0.0104	-7.84
Travel time – strategic bias	X	X	0.0416	0.0174	2.39
Toll Cost*					
Toll cost – 2-4 axles	X		-0.283	0.062	-4.57
Toll cost – 5 or more axles	X		-0.162	0.0176	-9.23
Constants					
I-205 constant		X	0.842	0.204	4.14

Model Statistics	
Number of estimated parameters	5
Number of observations	3330
Number of individuals	333
Initial log-likelihood	-2308.18
Final log-likelihood	-1416.44
Rho-square	0.39
Adjusted rho-square	0.38

5.5 Values of Time

One way to evaluate the sensitivities that are estimated in the MNL models is to calculate the marginal rates of substitution for different attributes of interest. In basic economic theory, the marginal rate of substitution is the amount of one good (e.g., money) that a person would exchange for a second good (e.g., travel time), while maintaining the same level of utility, or satisfaction. In this analysis, the marginal rate of substitution between the travel time and toll cost coefficients provides the implied toll value that travelers would be willing to pay for a given amount of travel time savings on the proposed tolled bridge crossing. This value of time can be calculated by simply dividing the travel time coefficient by the toll cost coefficient after taking into account the income transformation on the toll cost variable. The resulting value of time is in units of dollars per minute; multiplying by 60 will convert this into the more commonly cited units of dollars per hour. **Equation 5-2** and **Equation 5-3** detail the value of time calculations for the passenger and commercial vehicle MNL models.

Equation 5-2: Passenger Vehicle Value of Time Calculation

$$VOT = 60 * \frac{\beta_{Time}}{\beta_{Cost}} * LN\left(\frac{Household\ Income}{1000}\right)$$

Equation 5-3: Commercial Vehicle Value of Time Calculation

$$VOT = 60 * \frac{\beta_{Time}}{\beta_{Cost}}$$

The resulting values of time (VOT) for the passenger and commercial vehicle surveys are shown below in **Table 5-9** and **Table 5-10**.

Table 5-9: Passenger Vehicle Values of Time

Segment	Median Income	VOT
Aggregate sample	$ 87,500	$ 12.93
Peak work	$ 87,500	$ 14.76
Peak non-work	$ 87,500	$ 12.79
Off-peak work	$ 87,500	$ 12.55
Off-peak non-work	$ 62,500	$ 10.84
Weekend	$ 87,500	$ 12.99
Peak	$ 87,500	$ 13.83
Off-peak	$ 87,500	$ 11.94
Weekend	$ 87,500	$ 12.94

Table 5-10: Commercial Vehicle Values of Time

Segment	VOT
Aggregate sample	$ 28.66
2-4 axles	$ 17.36
5 or more axles	$ 30.33

5.6 Trip Suppression

In addition to the multinomial logit models that were estimated, linear regression models were estimated to forecast trip reduction rates for passenger vehicles under various pricing conditions. These models were estimated for the same traveler segments as the MNL models: peak work, peak non-work, off-peak work, off-peak non-work and weekend trips.

5.6.1 Trip Suppression Methodology

As described in **Section 2.0** above, respondents were asked to indicate how they might change the frequency of their trip under a hypothetical future pricing strategy. They were presented with a possible new travel time and cost for their same trip in the future and asked how many fewer or more trips they would make under the new conditions. The travel time and toll cost presented for the future conditions were taken from the first alternative of the tenth stated preference scenario presented to the respondent. Respondents who said that they would make fewer trips were asked how they would reduce their trips – either by making the trip to a different destination, by combining some trips with trips they already make (trip chaining), or by eliminating some trips altogether.

Trips that would be shifted to another route were not included in this analysis. These trips will already be accounted for in the route choice phase of the travel demand model. In addition, trips that would be eliminated by trip chaining were factored down by 50% to reflect the fact that trip chaining does not eliminate a trip entirely, but instead shifts one trip to be a sub-segment of another existing trip.

After accounting for these factors, the following information was available for each respondent's current trip (before pricing) and their future trip (after pricing):

1. Travel time, toll cost, and trip frequency before pricing
2. Travel time, toll cost, and adjusted trip frequency after pricing

To estimate the regression model, the differences in travel time and toll cost before and after pricing were converted into a difference in utility using the coefficients from the multinomial logit models.

Equation 5-4: Trip Reduction Difference in Utility Calculation

$$\Delta V = \beta_{Time} * \left(Time_{before} - Time_{After}\right) + \beta_{Cost} * \frac{\left(Cost_{before} - Cost_{after}\right)}{LN\left(\frac{Income}{1000}\right)}$$

Where:

- ΔV is the difference in utility
- B_{Time} is the segment-specific travel time coefficient from the MNL model
- B_{Cost} is the segment-specific toll cost coefficient from the MNL model
- $Time_{before}$ is respondent's travel time before pricing (reported travel time)
- $Time_{after}$ is the respondent's travel time after pricing
- $Cost_{before}$ is the respondent's toll cost before pricing (reported toll cost, if any)
- $Cost_{after}$ is the respondent's toll cost after pricing
- $Income$ is the segment median income

This difference in utility was then used to estimate a linear regression model to evaluate the relationship between utility and trip reduction. The dependent variable in the regression model was the percent of trips reduced after pricing, while the independent variable was the utility difference divided by the natural log of trip distance (a constant of 1 was added to avoid the potential of dividing by zero)

Equation 5-5: Trip Reduction Regression Equation

$$\Delta Tr = m * \frac{\Delta V}{LN(d+1)}$$

Where:

- ΔTr is the percentage difference in the number of trips
- m is the regression coefficient
- ΔV is the difference in utility
- d is the trip distance in miles

5.6.2 Trip Suppression Results

The results of the regression models for each traveler segment are presented below in Table 5-11.

Table 5-11: Trip Suppression Regression Model Results

Suppression Model	Coefficient	Std. Error	T-Stat	P-value	R^2
Peak Work	-0.195	0.020	-9.679	<2e-16	0.20
Peak Non-Work	-0.276	0.026	-10.806	<2e-16	0.33
Off-Peak Work	-0.199	0.032	-6.164	6.70E-09	0.19
Off-Peak Non-Work	-0.292	0.020	-14.745	<2e-16	0.41
Weekend	-0.268	0.017	-15.913	<2e-16	0.33

The regression coefficients, along with the sensitivities from the MNL models, can be used to calculate trip suppression rates for different amounts of travel time savings and toll costs at any household income level and trip distance. **Table 5-12** through **Table 5-16** present the resulting trip suppression rates at a number of travel time and toll cost differences at an annual household income of $87,500 and a trip distance of 18 miles. The regression results show no trip reduction if current conditions are maintained (the facility remains toll-free and travel conditions do not change). However, as toll costs increase, trip reduction rates increase sharply, particularly for non-work trip purposes. This trip reduction is offset somewhat if the toll increases result in a reduction in delay and improvement in travel times on the proposed bridge. For example, given the combination of a $2.00 toll and a 15 minute reduction in travel time, the regression results indicate there would be no reduction in the total number of vehicle trips on the I-5 bridge.

Table 5-12: Peak Work Trip Reduction

Toll Difference	Travel Time Difference (minutes)			
	0	-5	-10	-15
$0.00	0.0%	0.0%	0.0%	0.0%
$2.00	4.3%	1.7%	0.0%	0.0%
$4.00	8.6%	6.0%	3.3%	0.7%
$6.00	13.0%	10.3%	7.7%	5.0%
$8.00	17.3%	14.6%	12.0%	9.3%

Values calculated at a household income of $87,500 and trip distance of 18 miles

Table 5-13: Peak Non-work Trip Reduction

Toll Difference	Travel Time Difference (minutes)			
	0	-5	-10	-15
$0.00	0.0%	0.0%	0.0%	0.0%
$2.00	6.5%	3.0%	0.0%	0.0%
$4.00	13.0%	9.5%	6.1%	2.6%
$6.00	19.5%	16.0%	12.6%	9.1%
$8.00	26.0%	22.5%	19.1%	15.6%

Values calculated at a household income of $87,500 and trip distance of 18 miles

Table 5-14: Off-peak Work Trip Reduction

Toll Difference	Travel Time Difference (minutes)			
	0	-5	-10	-15
$0.00	0.0%	0.0%	0.0%	0.0%
$2.00	3.8%	1.8%	0.0%	0.0%
$4.00	7.7%	5.7%	3.7%	1.7%
$6.00	11.5%	9.5%	7.5%	5.5%
$8.00	15.4%	13.3%	11.3%	9.3%

Values calculated at a household income of $87,500 and trip distance of 18 miles

Table 5-15: Off-peak Non-work Trip Reduction

Toll Difference	Travel Time Difference (minutes)			
	0	-5	-10	-15
$0.00	0.0%	0.0%	0.0%	0.0%
$2.00	7.0%	3.6%	0.2%	0.0%
$4.00	13.9%	10.5%	7.1%	3.7%
$6.00	20.9%	17.5%	14.1%	10.7%
$8.00	27.9%	24.5%	21.1%	17.7%

Values calculated at a household income of $87,500 and trip distance of 18 miles

Table 5-16: Weekend Trip Reduction

Toll Difference	Travel Time Difference (minutes)			
	0	-5	-10	-15
$0.00	0.0%	0.0%	0.0%	0.0%
$2.00	6.1%	2.8%	0.0%	0.0%
$4.00	12.3%	9.0%	5.6%	2.3%
$6.00	18.4%	15.1%	11.8%	8.5%
$8.00	24.6%	21.3%	17.9%	14.6%

Values calculated at a household income of $87,500 and trip distance of 18 miles

6.0 CONCLUSIONS

RSG successfully developed and implemented two stated preference survey questionnaires that gathered information from 1,906 automobile travelers and 333 commercial vehicle travelers who currently use the I-5 bridge to cross the Columbia River between Portland, OR and Vancouver, WA. The questionnaires collected data on current travel behavior, presented respondents with information about the proposed changes to the new I-5 bridge, and engaged the travelers in a series of stated preference scenarios. Choice models were developed to produce estimates of values of time for travelers in the region. The magnitude and signs of the sensitivity estimates are reasonable and intuitively correct, and the values of time that were estimated are within the ranges found in other major metropolitan areas across the country. The results are also generally consistent with a survey that RSG conducted in the fall of 2009 for the same crossing. For passenger vehicle travelers, average values of time varied by trip purpose and time of day, and generally fell within a range of $10.84/hr. to $14.76/hr. For commercial vehicles, the value of time for small trucks (2-4 axles) was estimated to be $17.36/hr., whereas the value of time for large trucks (5 or more axles) was estimated to be $30.33/hr.

Rates of trip suppression were also estimated from the survey data to understand how overall travel may be reduced across the Columbia River if the I-5 bridge were tolled. The amount of trip suppression depends on a number of factors including trip type (trip purpose and time of day), trip distance, and traveler income. The results indicate that trip suppression rates could be significant at very high toll levels without a corresponding improvement in travel time across the bridge.

Overall, the survey and choice model results indicate that travel time savings and toll costs can have a significant impact on individuals' travel behaviors. The results of this work will help CDM Smith and the Oregon Department of Transportation (ODOT) to evaluate a range of tolling scenarios and travel conditions related to the proposed tolling on I-5 bridge between Portland, OR and Vancouver, WA.