

Transportation Demand Management

Final Report Draft



JBK Environmental Professionals

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1. Executive Summary

The purpose of the Transportation Demand Management (TDM) project was to develop a reproducible baseline study of the transportation modal split at Royal Roads University (RRU). It includes an online qualitative survey of faculty, staff and full-time students, a quantitative assessment of transportation onto campus using field sampling techniques and a literature review of comparable institutions.

The modal split determined from the data collected during the eight sampling dates at 3 sample locations on the RRU campus are as follows: single occupancy vehicles (SOV) 63%; carpool with two occupants 10%; carpool with three or more occupants 2%; pedestrians 13%; public transportation 6%; cycling 3%; taxi services 1%; and utility vehicles 2%. These results were not expected, as the Boulevard Transportation Group TDM study (2007) indicated the following modal split: SOV 90%; carpool 3%; pedestrians 1%; public transportation 4%; and cycling 2%. According to the Boulevard's 2007 TDM and since the introduction of the U-Pass, the use of public transportation has doubled and SOV have decreased by 27%. However, this is not a direct comparison as the methodologies between the two assessments may differ. Results from the qualitative survey found the biggest factor influencing commuter travel choice is frequency and convenience of transit service. Furthermore, an overwhelming number of survey participants said that they are not aware of Coastal Cycle bike rentals and Jack-Bell Ride Share Program offered through the RRU website.

Primary recommendations include establishing a realistic modal split benchmark (target percentages), increase parking pass price, develop partnerships with the City of Colwood (No current plan is in place for parking), shorter work weeks, smart scheduling or telecommuting to limit the amount of times that staff have to commute to campus, incentives for carpooling, prior to moving here new students should be given incentive to live closer, have the bus schedule and bike and car-share programs (such as the Jack-Bell & Coastal Cycle bike rentals) provided to them, set up an RRU bike rental/share program at the gym and improvements for campus safety/ community feel (include marked trails).

2. Acknowledgements

JBK Environmental Professionals would like to thank everyone who has made this project possible. The support offered by these individuals has ensured the success of this project. An extra special thanks to our classmates for their support in helping troubleshoot the *LimeSurvey*, including Sunny Dadhwal, Dione Hunter, Tysha Murphy and Anya Weare. The following individuals are in no particular order:

Sponsors: Lyn Joly, Associate Vice President Human Resources; Nancy Wilkin, Director, Office of Sustainability; Jordan Kummerfield, Research Assistant, Office of Sustainability.

Faculty Advisor: Dr. Jonathan Moran, School of Environment and Sustainability RRU.

Extra Support: Moshi Charnell, Associate Faculty; Amy Dove, Communication Co-ordinator, Community Relations and Advancement; Foluso Fagbanive, Research Ethics Reviewer, Office of Research; Colleen Hoppins, Research Ethics Coordinator, Office of Research; Dr. Leslie King, School of Environment and Sustainability RRU; Dr. Rick Kool, School of Environment and Sustainability RRU; Kyla McLeod, Director, Student Services; Heather Wanke, Program Coordinator, School of Environment and Sustainability RRU.

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5. Glossary of Terms

Modal split	Quantitatively describes the percentages of different modes of transportation taken to campus and is divided into single occupancy vehicles, carpool/rideshare, pedestrian, cycling and public transportation.
Pro-Pass	RRU staff bus pass, available for purchase at a discounted rate of \$77.00 per month.
Qualitative research	“An approach that aims to understand how people think about the world and how they act and behave in it. This approach requires researchers to understand phenomena based on discourse, actions, and documents, and how and why individuals interpret and ascribe meaning to what they say and do, and to other aspects of the world (including other people) they encounter”(Tri- Council Definition, Tri council Ethics tutorial, 2010).
Quantitative research	“The use of sampling techniques (such as consumer surveys) whose findings may be expressed numerically, and are amenable to mathematical manipulation enabling the researcher to estimate future events or quantities” (Bussiness Dictionary, 2013).
Telecommuting	The arrangement between an employee and employer which allows the employee to work from home and communicate via different mobile technologies, such as email, video chat and conference calling.
U-Pass	RRU student bus passes available to all full-time students, paid for through ancillary fees.
Utility vehicle	Non-commuter vehicles, such as marked RRU fleet vehicles (e.g. security and maintenance), as well as marked company vehicles providing services to RRU (e.g. fire alarm systems, garbage pickup, etc.).
Walkable	The ability to walk a community or campus; pedestrian friendly.

6. Acronyms & Abbreviations

EBP	Employee Bus Pass Program
RRU	Royal Roads University
SFU	Simon Fraser University
SOV	Single Occupancy Vehicle
TRU	Thompson Rivers University
TDM	Transportation Demand Management
UVic	University of Victoria

7. Introduction

The purpose of the Transportation Demand Management (TDM) project was to provide a reproducible baseline study for the distribution of transportation modes at Royal Roads University (RRU). The ultimate goal of the study was to determine ways to reduce the amount of single occupancy vehicles (SOV) on campus and to assess whether or not implementing the U-Pass in 2011 has shifted the modal split toward public transportation.

7.1. Scope

The scope of this project included a literature review to consider current best management practices and techniques used by other Canadian institutions, an online qualitative survey and quantitative assessment with field sampling; this includes detailed data analysis of each qualitative and quantitative elements. The information used in this project was also used to compile an Executive Summary that will contribute to a comprehensive Business Case in order to acquire support for strategies to reduce the use of SOV. The Business Case compiled by the Office of Sustainability will address the following issues:

1. Why the Commuter Travel Plan should be undertaken;
2. Why RRU Executives should invest in it; and
3. Why the project represents a worthy expenditure of funds.

The differences documented between the use of public transportation before and after the introduction of the U-Pass are explored later in this report.

One of the limitations of this project was that major project days were only scheduled on Tuesdays; this limited the sampling days, meeting times and amount of time put into the project. Based on the nature of the Bachelor of Science (BSc.) Program, time constraints were another limitation. There were only 4 members of JBK Environmental Professionals, and therefore the scope was limited for this project.

7.2. Research Questions

The ultimate purpose of this project was to determine the modal split and the behaviours that influence transportation choices, in hopes to apply strategies to reduce the use of SOV on campus. Therefore, the following four questions were be addressed:

1. How many people are coming onto the RRU campus using SOV on a regular basis?
2. How many people are walking, biking, carpooling or bussing onto the RRU campus?
3. How can RRU reduce the use of SOV?
4. Has the U-Pass shifted the transportation modal split toward commuters using the transit system?

There were no assumptions or hypotheses made regarding the results of this project.

7.3. Ethical Review

Due to the nature of JBK Environmental Professionals' data collection methods and since the research consisted of field sampling and human behaviour analysis, an ethical review was required. The collection of data was not permitted until the ethical review was approved on March 5, 2013. Please refer to Appendix A for the approved Ethical Review. Also required by the Ethical Review board were the Field Observation Notification (Appendix B), and the Survey Preamble (Appendix C).

7.4. Background Information

In 2007, Boulevard Transportation Group conducted a study at RRU. They concluded that the modal split at RRU consisted of 90% SOV, 3% rideshare, 4% transit, 2% cyclists and 1% pedestrians. Since the methodology of this study was not outlined it is difficult to compare the results of this study to other study results. JBK Environmental Professionals has taken on the responsibility of providing RRU with a baseline study and methodologies that may be built upon in future studies.

The RRU Sustainability Plan has outlined priorities as high, medium or low based on the recommendations that Boulevard Transportation Group had given in their 2007 report. One of the main recommendations, which will also be recommended in this study, was to implement a

new parking fee structure. The RRU Sustainability Plan has noted this as having a high priority and should have been considered in 2009; however, according to Nancy Wilkin the parking pass has not been raised since the introduction of the harmonized sales tax (HST) in 2010. The Sustainability plan ranked both the implementation of a realistic travel modal split benchmark and transportation demand management measures as having low priorities. The TDM include measures designed to reduce the number of vehicles arriving on campus and establishing a TDM coordinator, improved cycling facilities, improved walking infrastructure, improved transition facilities, promoting and encouraging ride-matching services, and car-sharing options or fleet vehicles (Royal Roads University, 2008).

7.4.1. Background Information on Sponsor

The Office of Sustainability at RRU is committed to addressing the current transportation issues on campus, as well as addressing the future needs of the university. The RRU Sustainability Plan was created by the Office of Sustainability to establish Royal Roads as a leader in sustainability initiatives and allows the institution to link education and research with sustainability policy. The plan is also charged with the responsible preservation of the Hatley Park National Historic site, on which the university is located (Royal Roads University, 2008).

Preserving the Hatley Park old growth forests has forced the university to limit the expansion of internal transportation on campus, as well as areas designated for parking. This has necessitated the consolidation of parking on campus, re-routing the traffic circulation pattern to one-way roads, creating new bus turnarounds, increasing the number of bike racks located at the top of the hill, the involvement in the Jack Bell Ride-Share program, the recent involvement in the U-Pass program, formation of a bike rental program through Coastal Cycles, and the instalment of showers at the LIC for those biking to campus (Royal Roads University, 2008). The Office of Sustainability, as part of their commitment to offset greenhouse gasses as outlined in the Sustainability Plan, has also recently installed electric car charge stations on campus to encourage the use of electrically-powered vehicles.

7.4.2. Background on TDM at Royal Roads University

RRU is located in Victoria, B.C. and has approximately 500 full-time, on-campus students and 455 employees according to the registers office for the 2013 school year. The parking pass at the University is \$123.20 per year. Between 700 and 750 parking passes were purchased for 2012/2013. RRU currently participates in both the Jack Bell Rideshare Program and a bike rental program with Coastal Cycle. There are currently no initiatives for carpool. In 2011 RRU implemented the use of the U-Pass, making bus passes free to all on-campus students (paid for through ancillary fees).

7.4.3. JBK Environmental Professionals & Contact Information

JBK Environmental Professionals is a non-profit team of students completing their BSc Degree program in Environmental Science at RRU. JBK stands for Jenna, John, Brandon and Kathryn; after the four group members. The team was established in order to complete a TDM study for the Office of Sustainability at RRU in order to obtain a credit for the Major Project segment of the one-year degree program (ENSC 420), which runs from September 2012 to August 2013. The Faculty Advisor, Dr. Jonathan Moran, was tasked with the job of providing consistent support and feedback for the work completed, as well as being available for consultation when required. The overall sponsor for the TDM is Lynn Joly; however, it was conducted through the Office of Sustainability, of which Nancy Wilkin is the Director and Jordan Kummerfield is the Research Assistant. Table 1 indicates the contact information for all project members.

Table 1 – Contact information for JBK Environmental Professionals, the faculty advisor and the sponsors.	
JBK Environmental Professionals	Contact Information (Email)
Brandon Cassidy	Brandon1.Cassidy@royalroads.ca
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Sponsors	
Nancy Wilkin	Nancy.Wilkin@royalroads.ca
Jordan Kummerfield	Jordan.Kummerfield@royalroads.ca
Lynn Joly	Lynn.Joly@royalroads.ca

7.5. Study Methods Used

There were two study methods implemented in order to determine the modal split and ways to reduce the amount of SOV. The qualitative survey was set up to determine the reasons people use their specific mode of transportation and outline any suggestions commuters may have to improve current alternative transportation methods, and the quantitative assessment was conducted to determine the actual modal split.

7.5.1. Qualitative Survey

The primary aim of the qualitative survey was to determine the motives for commuter behaviours and why students and staff at RRU use SOV. The online *LimeSurvey* consists of 19 general questions for everyone, 2 for those who use public transportation as their primary mode of transportation, and 9 targeted toward commuters who primarily use motorized vehicles. There were also three sections which solicited information from survey participants regarding changes to the current practices which could potentially shift behaviours toward alternative transportation choices. The data analysis primarily focuses on why commuters use specific modes of transportation and whether implementing the U-Pass in 2011 has shifted more commuters towards public transportation. Additionally, by separating the results into the different transportation modes, any issues that shift the split towards SOV can be highlighted and recommendations can be made.

Some of the questions outlined in the survey include the mode of transportation used, demographic of the survey participant, distance travelled to the campus, and awareness of programs to reduce SOV. The main questions were used to elicit the motivation for transportation decisions, including identification of barriers and benefits. The full list of the questions is in Appendix D.

7.5.2. LimeSurvey

LimeSurvey is a company based out of Germany and South America that supports a range of different survey software. It is an extremely easy to use program which allows users to input questions with a range of different response options, such as short answer, Likert scale and yes or no. Initially an account was going to be set up specifically for the TDM survey; however, it

was determined that it would be a considerable cost for the sponsor, as *LimeSurvey* charges per survey response; therefore, it was more economical to set up the survey through the Office of Sustainability's administrative account. Due to the simplicity of the survey, it was found to take participants less than 10 minutes to complete all 19 questions, including the comments sections.

7.5.3. Quantitative Assessment

The quantitative assessment was the way in which the modal split was determined for RRU. It consisted of eight field-sampling days between March 26 and June 18, 2013 and was conducted during morning peak travel times over the course of the sampling periods. Commuter modes of travel were split in to 14 categories: SOV, carpool with 2, carpool with 3+, taxi with single occupant, taxi carpool with 2, taxi carpool with 3+, utility vehicle, pedestrians from the main, east or west entrance, public transportation from south or north Sooke Road and University Drive, motorcycle or scooter and bicycles. The data collected was used to calculate the percentage of commuters using that particular mode of transportation.

7.5.4. Literature Review

Literature reviews are conducted in order to determine current knowledge on a particular subject, such as what are the best practices currently being used in a particular industry. For the purposes of the TDM, a literature review was conducted on Canadian institutions that have published TDM plans, as well as the current sustainability plan for RRU. Of the Canadian institutions that were reviewed, the four that offered the best information relevant to the RRU campus, and were therefore written up for the report, were Thompson River University (TRU), Laval University, University of Victoria (UVic), Camosun College and Simon Fraser University. There were methodologies outlined in some of the literature; however, in order to get the most efficient results specific for the RRU campus the qualitative and quantitative methods for this project were outlined independent of the literature review.

7.6. Budget

As expected, no expenses were incurred outside of the original budget proposal at the beginning of the year, and since there were not printing cost throughout the project the

projected cost of \$50 was not required. The final financial statement was submitted to Heather Wanke on August 16th, 2013.

8. Methodology

The methodology for this project is broken down into three parts: Literature Review, Qualitative Survey and Quantitative Assessment. Due to the fact that this is a baseline study, there are no criteria to be compared; however, a general comparison was made with the 2007 Boulevard Transportation Group TDM.

8.1. Qualitative Survey

Since the purpose of the *LimeSurvey* was to determine the motives for commuter behaviours, why commuters used specific modes of transportation and how the use of SOV could be limited to RRU, specific questions were generated that would best answer each element. The following is a list of the process taken:

- The first set of questions were generated;
- The group read through the questions together and determined if they were clear and concise while also providing responses that were indicative of transportation choices;
- After each question was reviewed, professional opinions were sought from Dr. Leslie King and Dr. Jonathan Moran;
- Alterations were completed and the set of questions were finalized;
- Questions were sent to Nancy Wilkin and Jordan Kummerfield for approval.

The qualitative survey was compiled using *LimeSurvey* software. The process for setting up the survey is outlined below:

- A new survey was created and given the title “Transportation Demand Management at RRU”;
- A “question group” was created for each different element of the study prior to typing in the question; the following are the seven question groups, which represent different behavioural aspects:
 1. **Demographics** – Indicates whether the survey participant gender, age and approximate distance of their commute;

2. **Access information** – Indicates which modes of transportation the survey participant has access to, whether they purchased a parking pass, as well as RRU programs they are aware of;
3. **Influences** – Indicates the factors which affect the survey participants transportation choices;
4. **Commute information** – Indicates how often the survey participant commutes to campus and their primary mode of transportation;
5. **Public transportation** – Indicates the frequency and applications of uses for both U-Pass and Pro-Passes;
6. **Motorized vehicle** – Indicates what type of vehicle is being driven, amount of occupants, the range of price people are willing to pay for annual parking passes and ways to influence them to take alternative transportation;
7. **Exit question** – Section for survey participant’s comments associated with their thoughts on the survey and ways they consider helpful to implementing the TDM at RRU.

- Each question was typed into the “question group” separately and a response type was specified; for instance, a Likert scale was used when a graded response was required;
- Likert scale questions were constructed with an even number of choices to allow directly positive or negative response; the following were the response choices:
 1. Strongly disagree;
 2. Disagree;
 3. Agree;
 4. Strongly agree.
- Every question was made mandatory, with the exception of the comment boxes;
- The survey was split into three categories after question 19, based on their primary mode of transportation; the following were the three categories:
 1. Bicycles & walking → The survey ended for these participants and they were navigated to the exit question;
 2. Public transportation → The participants were navigated to the remaining 2 questions targeted for public transportation commuters;
 3. Motorized vehicles → The participants were navigated to the remaining 9 questions targeted for motorized vehicle commuters.
- A final comment box was placed at the very end of the survey (exit question) in order to elicit as much feedback as possible from commuters of each mode of transportation.

The survey was completed by all group members to ensure it answered the desired questions and had a good flow. The survey was then attempted as a trial run by four cohort members to ensure clarity, determine the approximate time required to complete it and provide any additional feedback.

It was decided that the best way to get responses was if each person received the survey link through their email. However, in order to have as many responses as possible, participants were first introduced to the project concepts via email in order to recognize the survey title and so JBK Environmental Professionals could relay the importance of their participation. Therefore, the following actions were taken:

- The survey was introduced to students in January by an email notifying them that the survey would be send out in May and invited them to participate;
- An invitation for staff to participate was posted on Road Spiel in February;
- A link to the qualitative survey was sent by Kyla McLeod via email to all students on May 15, 2013;
- A link to the qualitative survey was sent by Amy Dove to all staff members on May 28, 2013.

8.2. Quantitative Assessment

The quantitative section of the study was used to determine the modal split; therefore, a direct counting method was employed for all motorized vehicles coming in the front gate, people getting off the buses and bicycles parked at the racks. Field sampling was conducted in three locations between 7:30am and 11:00am, with results recorded in half hour increments. The sample locations and modes to be sampled at each location are outlined in Table 2 and illustrated in Appendix E; bike racks with corresponding sample locations is located in Appendix F; sample spreadsheet for data collection is located in Appendix G.

Although a trial run was conducted prior to the first field sampling date, there were some questions that arose regarding how to classify specific vehicles after the first field sampling day. The following are the decisions made regarding the classification of vehicles:

- Taxis
 - Taxis with only a driver are not counted;
 - Taxis with one passenger are counted as “Taxi single”;
 - Taxis with two passengers are counted as “Taxi 2”;
 - Taxis with three or more passengers are counted as “Taxi 3 or more”.
- Utility vehicles are considered to be (but not limited to) any of the following vehicles:
 - RRU marked vehicles (including Truffles catering);
 - Mail delivery (Purolator, Canada Post, etc.);
 - Vehicles with company logos (fire alarm systems, security system, etc.); and

- Garbage collection vehicles.

Table 2 – Sampling locations for quantitative assessment where RRU modes of transportation were observed.

Location	Description	Counts
1 Main Gate	Main access point for RRU campus; primary vehicle access. Two people were stationed here to observe all modes of transportation	<ul style="list-style-type: none"> • Number of cars and passengers per car • Number of pedestrians • Number of transit users • Number bikes on the rack behind Arbutus Building and locked to trees
2 East College Drive	From this position cyclists and the bus stop (#39) were observed	<ul style="list-style-type: none"> • Number of transit users • Number of bikes on bike racks around LIC, Grant, Nixon and Millward Buildings
3 West College Drive	Main entry point to campus center for cyclists and pedestrians entering from the West of campus	<ul style="list-style-type: none"> • Number of pedestrians • Number of bikes on racks at the Cedar Building and Mews Building • Number of transit users (Handy-Dart)

Adapted from sampling methods by Jordan Kummerfield, RRU Office of Sustainability

8.3. Literature Review

The Literature Review consisted of online research of other Canadian institutions that had published TDM plans, as well as the current sustainability plan for RRU. This was conducted to determine the current knowledge regarding TDM plans and the best management practices in order to assist with providing recommendations on how RRU can limit the amount of SOV to campus. This research was conducted only using Internet research; the institutions were not contacted directly.

9. Results

9.1. Qualitative Survey

Table 3 outlines the results from the qualitative *LimeSurvey* for questions pertaining to demographics and commute distance. This data were used to produce Figures 1, 2 and 3 that illustrate the gender of respondents, staff vs. student, and age demographic, respectively. The data indicate that 83.57% of survey participants were staff members, 69.01% were female, and 34% were between the ages of 30 to 39; these were the highest percentages for each category.

	Question	Response
	The following best describes me:	
Demographics	Full time student	16.43%
	Staff	83.57%
	Male	30.99%
	Female	69.01%
	Age	
	Under 20 years old	0.94%
	Between 20 and 29 years old	11.74%
	Between 30 and 39 years old	25.82%
	Between 40 to 49 years old	34.27%
	Over 50 years old	27.23%
	The approximate distance (km) I travel one way to campus is:	
	Approximate distance of commute (minimum)	0km
	Approximate distance of commute (mean)	43.21km
	Approximate distance of commute (median)	13.6km
	Approximate distance of commute (maximum)	4200km
	Approximate distance of commute (standard deviation)	302.12km
	Adjusted mean for approximate distance of commute*	17.69km
*Note: two responses (4200 and 1252km) as commute distances were deleted and a new average was calculated.		

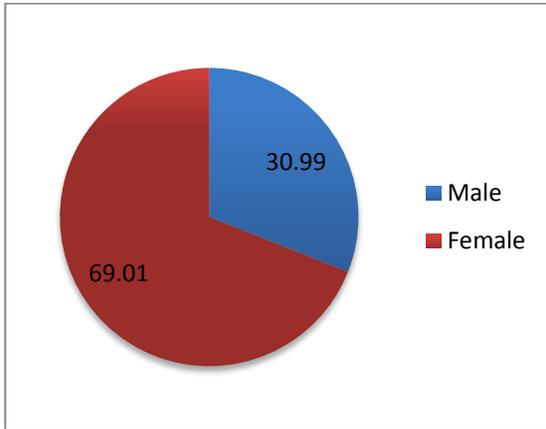


Figure 1 – LimeSurvey results for gender of survey respondents.

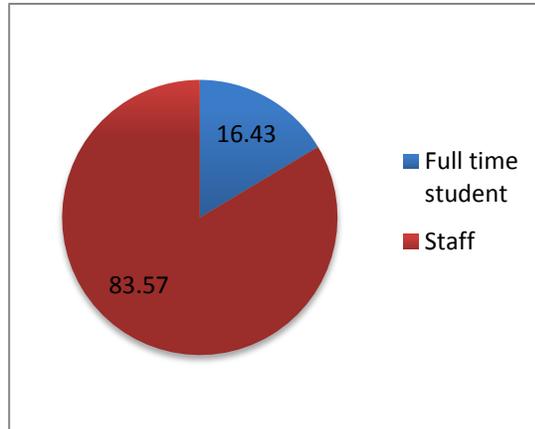


Figure 2 – LimeSurvey results for category of survey respondents (staff vs. student).

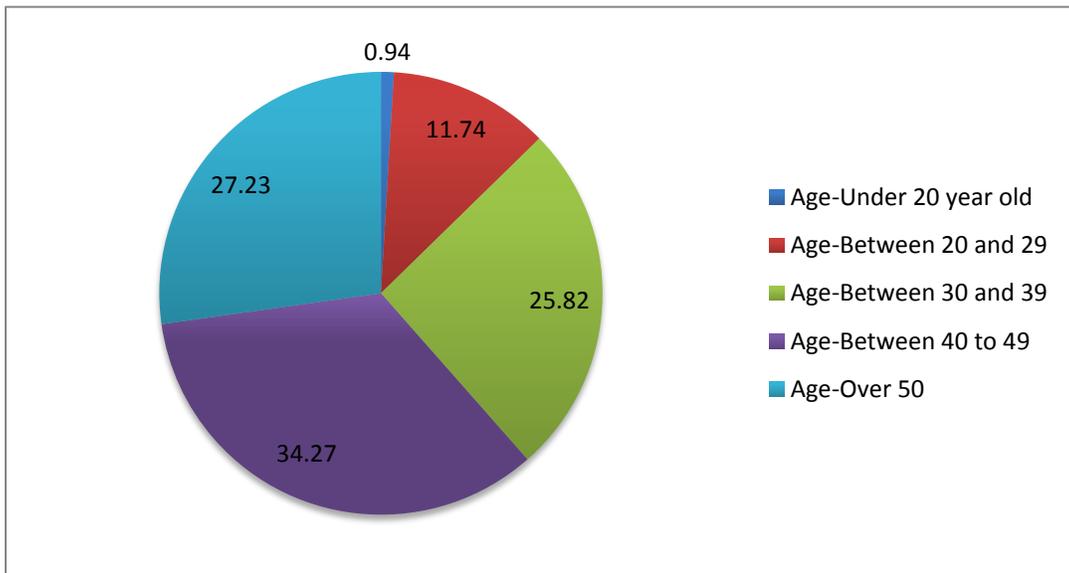


Figure 3 – LimeSurvey results for age group of survey

Table 4 outlines the results obtained from the *LimeSurvey* question that indicates the number of respondents that have access to different types of transportation, as well as programs to promote alternative transportation modes. The majority of participants were not aware of the programs offered through Coast Cycle (70%) and Jack Bell rideshare program (69%). The majority of participants also have access to a motorized vehicle (85%) and have purchased an annual parking pass (73%). The majority of respondents also have access to a bike (67%) but do not have a bus pass (86%). 50% of survey respondents have used public transportation in the past 12 months.

Table 4 – Results from the qualitative <i>LimeSurvey</i> for questions regarding which modes of transportation the survey participant has access to, whether they purchased a parking pass, as well as RRU programs they are aware of.			
	Question	Response %	
		Yes	No
Access Information	Aware of Coastal Cycle bike rental program?	29.58	70.42
	Aware of Jack Bell ride share program?	31.46	68.54
	Access to a motorized vehicle?	85.45	14.55
	Access to a bicycle?	67.14	32.86
	Purchased an annual parking pass?	73.24	26.76
	Have a U-Pass/Pro-Pass?	14.08	85.92
	Used public transportation in the last 12 months?	50.23	49.77

Figure 4 shows the percentage of survey participants that are aware and unaware of alternative transportation services at RRU and that have access to cars, bikes, and bus passes. The highest percentage of survey respondents answered ‘yes’ to having a vehicle and ‘no’ to having a U-Pass/Pro-Pass.

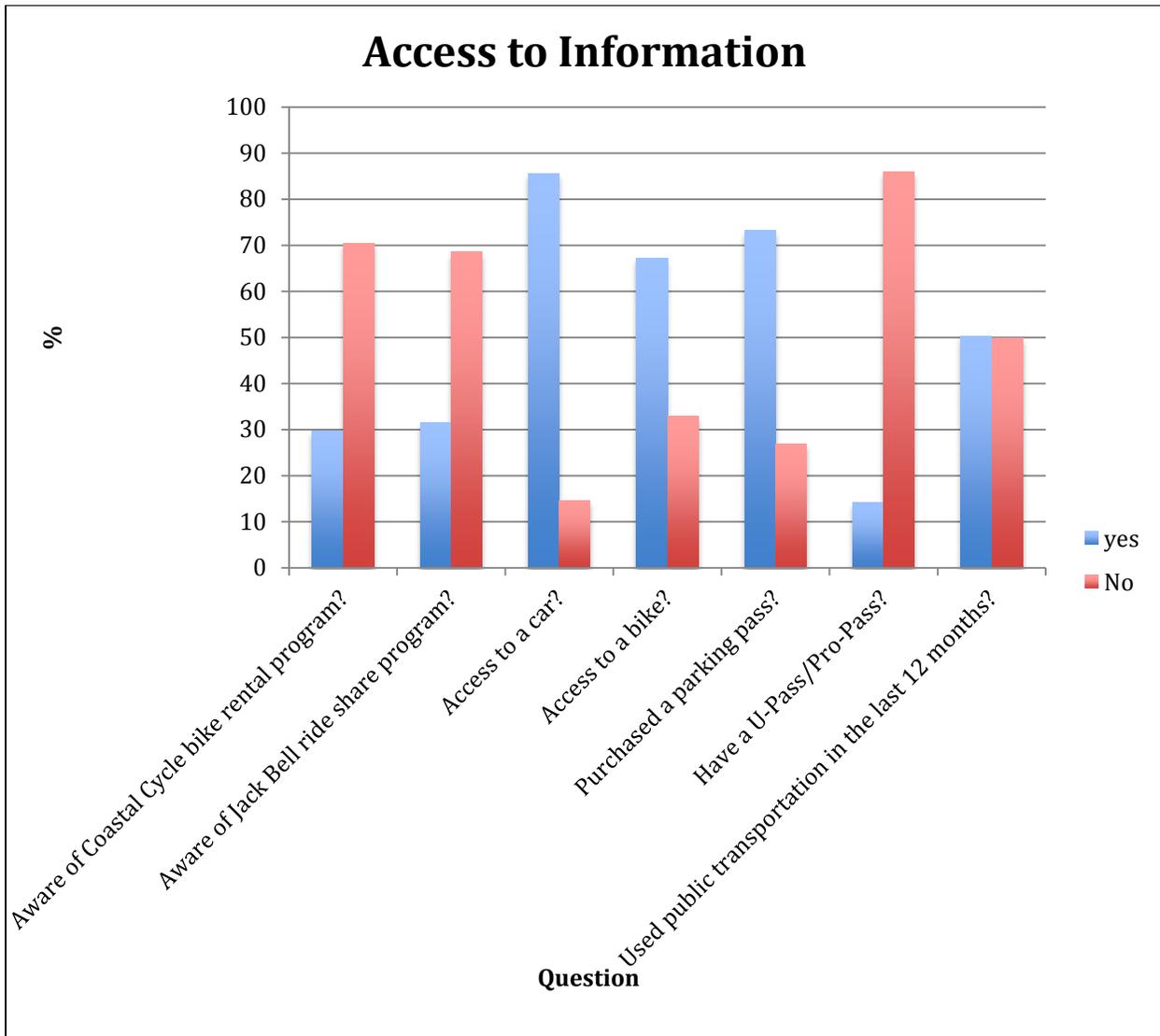


Figure 4 – LimeSurvey responses for access to information questions.

Table 5 outlines the results obtained from survey participants regarding the influences on their transportation decisions. The majority of respondents indicated that they strongly agreed that convenience (64%), distance (44%), amount of travel time (56%) and daily errands (52%) influence their decision. The majority of respondents agreed that weather (40%), safety (37%) and environmental impacts/benefits (45%) influence their decisions. The majority of respondents disagreed that physical limitations impact (42%) their decision. The majority of respondents to some degree (i.e. agreed and strongly agreed) that the cost of travel influences their decisions (44% + 13%= 57%).

Table 5 – Results from the qualitative *LimeSurvey* for questions regarding which factors influence their transportation choice and to what degree, including the amount of responses collected for the comments section.

Influences	The following factors influence my transportation choice:				
	Question	Response %			
		Strongly disagree	Disagree	Agree	Strongly agree
	Convenience of transportation mode	2.35	4.23	29.58	63.85
	Distance travelled	2.35	12.21	41.31	44.13
	Amount of time it takes to travel	2.82	7.51	33.8	55.87
	Weather conditions	6.57	17.84	39.91	35.68
	Concerns for safety	11.27	29.58	37.09	22.07
	Daily activities (errands, picking up kids, etc.)	2.82	11.27	33.8	52.1
	Physical limitations or health concerns	26.76	41.78	22.54	8.92
	Environmental impacts/benefits	8.45	36.15	44.6	10.8
	The costs of travel	6.57	39.91	40.85	12.68
	58 responses (23.3%) were retrieved for “other factors that strongly influence my transportation choices” (Appendix H)				

Table 6 outlines the results from the *LimeSurvey* indicating the number of days per week survey participants travel to campus and their primary mode of transportation. The majority of respondents travel to campus between 5 and 7 days per week (76%) and the primary mode of transportation is motorized vehicle (80%).

Table 6 – Results from the qualitative <i>LimeSurvey</i> for questions regarding the amount of days per week participants commute to campus, as well as their primary mode of transportation.			
Commute Information	Question		Response %
	Days commuted per week		
		0-1	3.76
		2-4	21.6
		5 or more	74.65
	Primary mode of transportation		
		Motorized vehicle	80.28
		Bicycle	8.45
		Public transit	7.04
		Walk	4.23

Table 7 outlines the number of days per week survey participants who selected public transportation as their primary mode of transportation used their U-Pass/Pro-Pass to get to campus, as well as how often they used it for transport beyond the campus. Most individuals used their bus pass 5 days a week to get to campus (2.35%) and most used their bus pass 5 days per week for transport beyond getting to campus (3.29%).

Table 7 – Results from the qualitative <i>LimeSurvey</i> for questions regarding the use of public transportation, the U-Pass and Pro-Pass.		
	Question	Response %
	Public Transportation	
0		2.35
1		0
2		0
3		0.47
4		0.47
5		2.35
6		0
7		1.41
Days per week using U-Pass or Pro-Pass beyond getting to campus		
0		2.35
1		0
2		0.47
3		0.47
4		0.47
5 or more		3.29

Table 8 outlines the results from respondents that selected motorized vehicles as their primary mode of transportation, indicating the type of motorized vehicle, number of occupants in the vehicle and the maximum price that they would pay for a parking pass. The majority of respondents commute via car, truck or van (80%) and 64% are SOV. The mean price that respondents would pay for a parking pass was \$179.37.

Table 8 – Results from the qualitative *LimeSurvey* for questions targeted to survey participants who use motorized vehicles as their primary mode of transportation regarding the type of vehicle they drive, whether they carpool and the maximum amount they are willing to pay for an annual parking pass.

Motorized Vehicle	Question	Response %
		I drive a car, truck or van
	I drive a motorcycle or scooter	0.47
	How many occupants?	
	1	63.85
	2	11.74
	3	4.23
	4	0.47
	5 or more	0
	Maximum price for an annual parking pass	
	Max purchase price (Min.)	\$0
	Max purchase price (median)	\$150
	Max purchase price (mean)	\$179.37
	Max purchase price (Max.)	\$999
	Max purchase price (St. Dev.)	\$121.05
	Adjusted mean for max purchase price (mean)*	\$171.7
	*Note: four responses (\$999, \$999, \$0 and \$0) as maximum purchase prices were deleted and a new average was calculated.	

Table 9 outlines the results from respondents who selected motorized vehicles as their primary mode of transportation to indicate ways to help influence them to select alternative transportation choices. The majority of respondents disagreed that rideshare matching services (34%), less crowded or more comfortable buses (47%), more comfortable or safer bus stops (45%), improved cycling infrastructure or cycling paths (33% and 37%, respectively) and improved walking paths (42%) would influence their decision.

Table 9 – Results from the qualitative *LimeSurvey* for questions targeted to survey participants who use motorized vehicles as their primary mode of transportation regarding any changes that could be made to influence drivers to use alternative transportation, including the amount of responses collected for the comments section.

Motorized Vehicle	If the following changes are made, I could be influenced to take alternative transportation, rather than driving a vehicle				
	Question	Response %			
	Changes to encourage alternative transportation	Strongly disagree	Disagree	Agree	Strongly agree
	Ride-share matching service	15.02	33.8	24.41	7.04
	Less crowded/more comfortable buses	17.84	46.95	13.62	1.88
	More comfortable/safer bus stops	19.72	44.6	15.02	0.94
	Improved/maintained cycling paths	19.25	36.62	22.07	2.35
	Improved infrastructure (bike kitchen, bike racks, change /shower facilities)	19.72	33.33	21.13	6.1
	Improved/maintained walking paths/sidewalks	20.19	41.78	15.96	2.35
	75 responses (35.21%) were retrieved for “Other changes that could be made to strongly influence me to take alternative transportation, rather than driving a vehicle.” (Appendix H)				

Table 10 outlines the amount of comments collected from the comments section, where respondents were given the opportunity to provide their feedback. This data was used to produce Figures 5, 6 and 7.

Table 10 – Results from the qualitative <i>LimeSurvey</i> for the amount of responses collected for the exit question.	
Exit Question	Are there any additional suggestions or comments you would like to make?
	80 responses (37.56%) were retrieved for “additional suggestions or comments you would like to make” (Appendix H)

Figure 5 illustrates the top three comments from survey participants regarding the main factors which influence their transportation choice. The highest number of survey respondents answered that the bus schedule (e.g. bus service was too infrequent in their area, or bus service did not reach their area) was the biggest factor in influencing their choice of transportation. Living a healthy lifestyle was a positive factor that influenced the use of alternative transportation modes whereas bus schedule and a varying work schedule were negative factors that influenced alternative transportation modes.

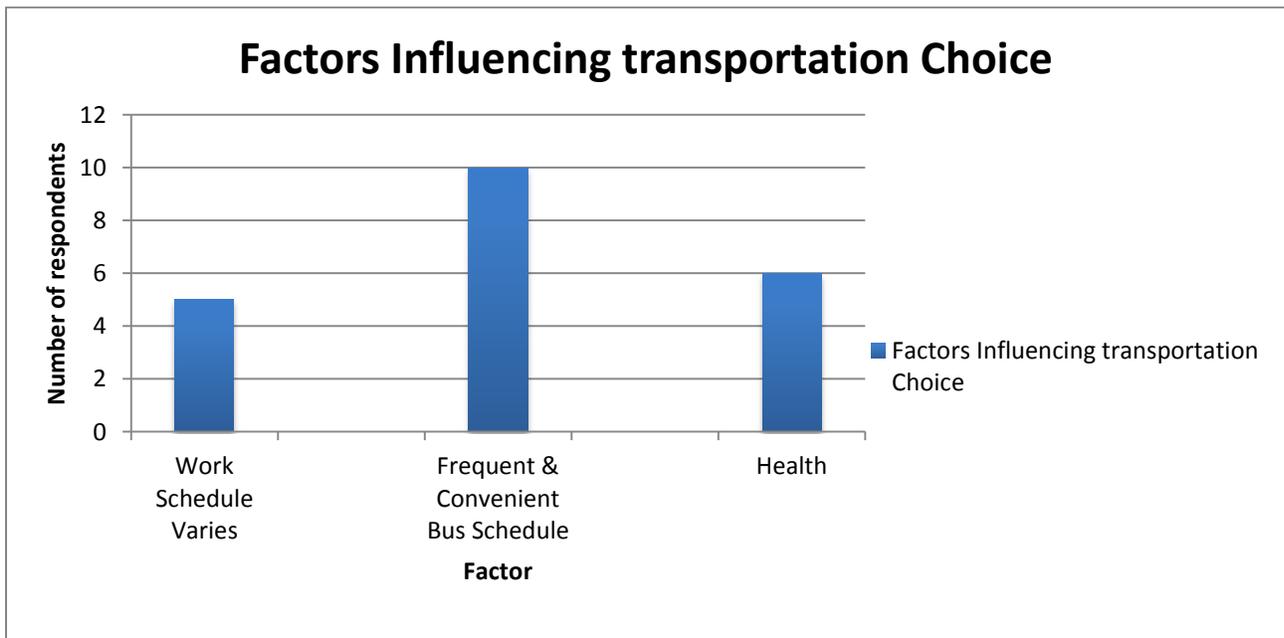


Figure 5 – *LimeSurvey* results for top three comments submitted by survey participants regarding factors which influence their transportation choice.

Figure 6 shows the top three comments from survey participants regarding changes that would encourage alternative transportation. Again, the highest number of survey respondents answered that a better bus schedule would positively influence their choice of transportation toward alternative modes. Changes to affordable bike rental programs and increased access to a carpool/car share program were also mentioned as factors encouraging alternative modes of transportation.

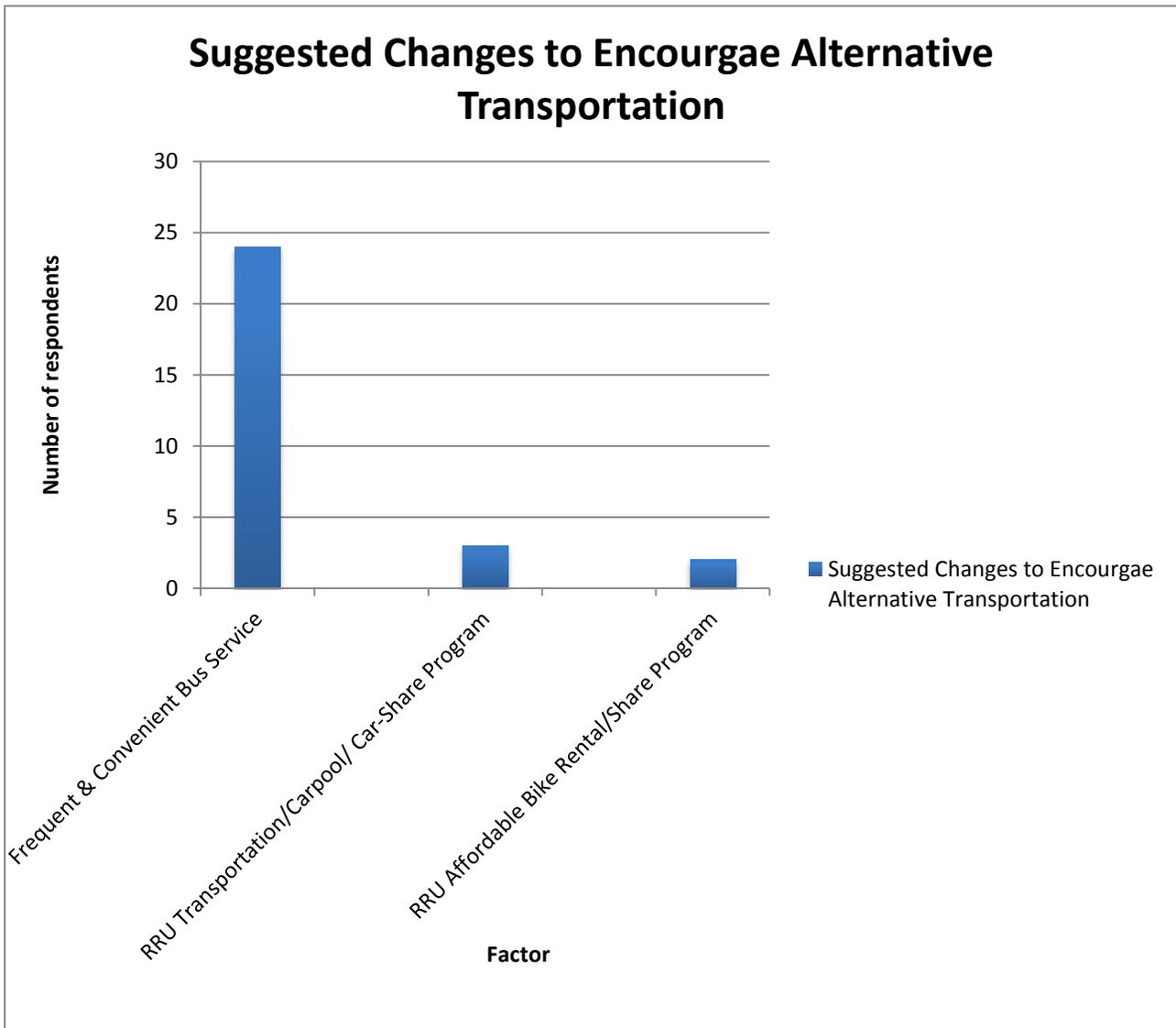


Figure 6 – LimeSurvey results for top three comments submitted by survey participants regarding suggested changes to encourage alternate transportation responses.

Figure 7 illustrates the top seven comments from survey participants regarding additional comments for the exit question. Once again, changes in the bus schedule to a more frequent and convenient service was by far the most common response, which was followed by requests for a car-share program and telecommuting or more convenient scheduling for staff.

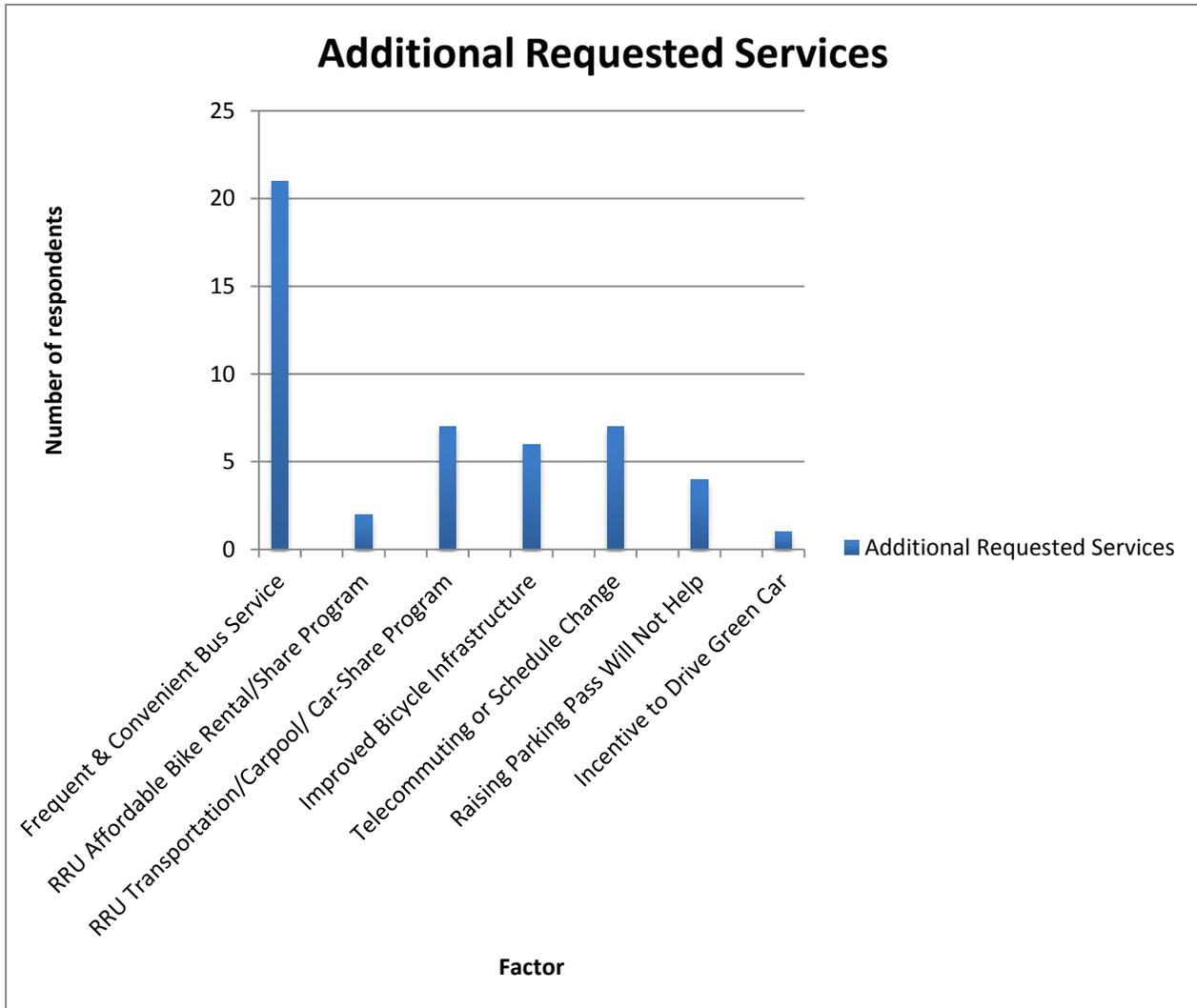


Figure 7 – LimeSurvey results for top seven comments from survey participants regarding additional comments for the exit question.

9.2. Quantitative Assessment

The modal split was determined through the quantitative assessment of field sampling at three different locations, as outlined previously in Table 2; Table 11 and Figure 8 illustrated the results. The data illustrates that SOV were the most used mode of transportation, followed by carpools and pedestrian, and that the least used mode of transportation was the combined results for taxis. The complete list of data is available in Appendix I.

Table 11 – Modal split for Royal Roads University based on 8 sampling days between April 2 and June 18, 2013.		
Mode of Transportation	Number Individuals	% Modal Split
Single occupancy vehicles	2880	62.96
Carpool (2)	456	9.97
Carpool (3+)	97	2.12
Taxi Single Occupancy	42	0.92
Taxi Carpool (2)	11	0.24
Taxi Carpool (3+)	5	0.11
Utility Vehicle	113	2.47
Pedestrian	578	12.64
Public Transportation	260	5.68
Bicycles	132	2.89
Total number of Individuals	4574	100.00

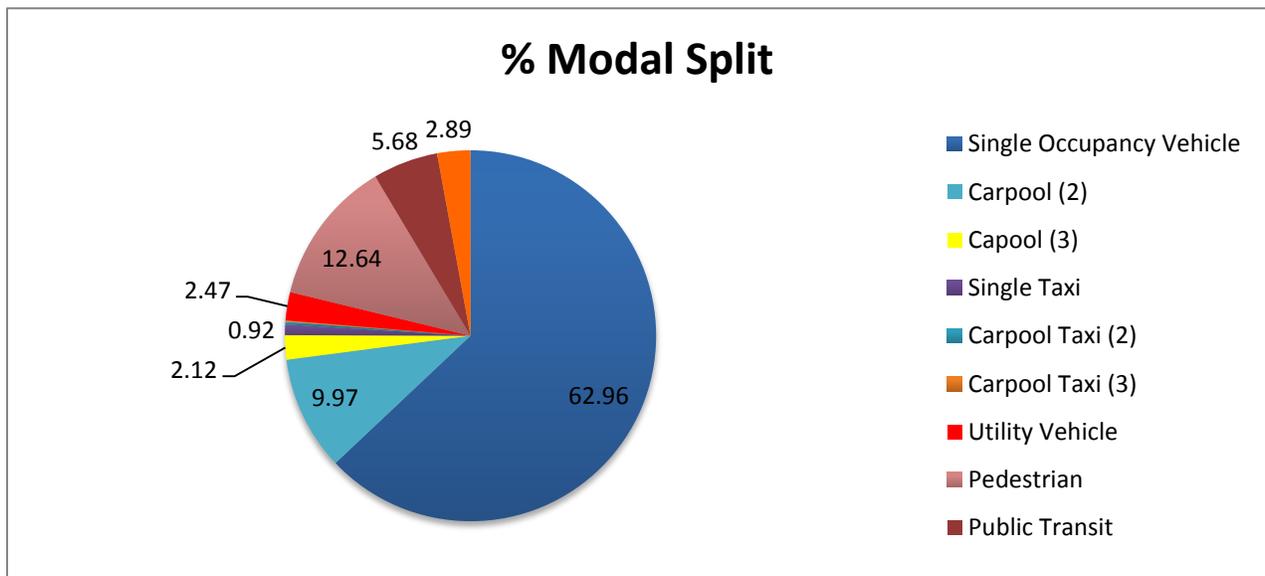


Figure 8 – Modal split for Royal Roads University based on the quantitative assessment of eight sampling days between April 2 and June 18, 2013.

9.2.1. Peak Travel Times

The peak travel times were determined by casual observation on April 2, 2013. However, the true peak times were determined by calculating the average number of individuals entering the campus from all 8 sampling days, as illustrated in Figure 9. The peak morning traffic times for RRU between April 2, 2013 and June 18, 2013 was determined to be between 7:30 am and 9:30 am.

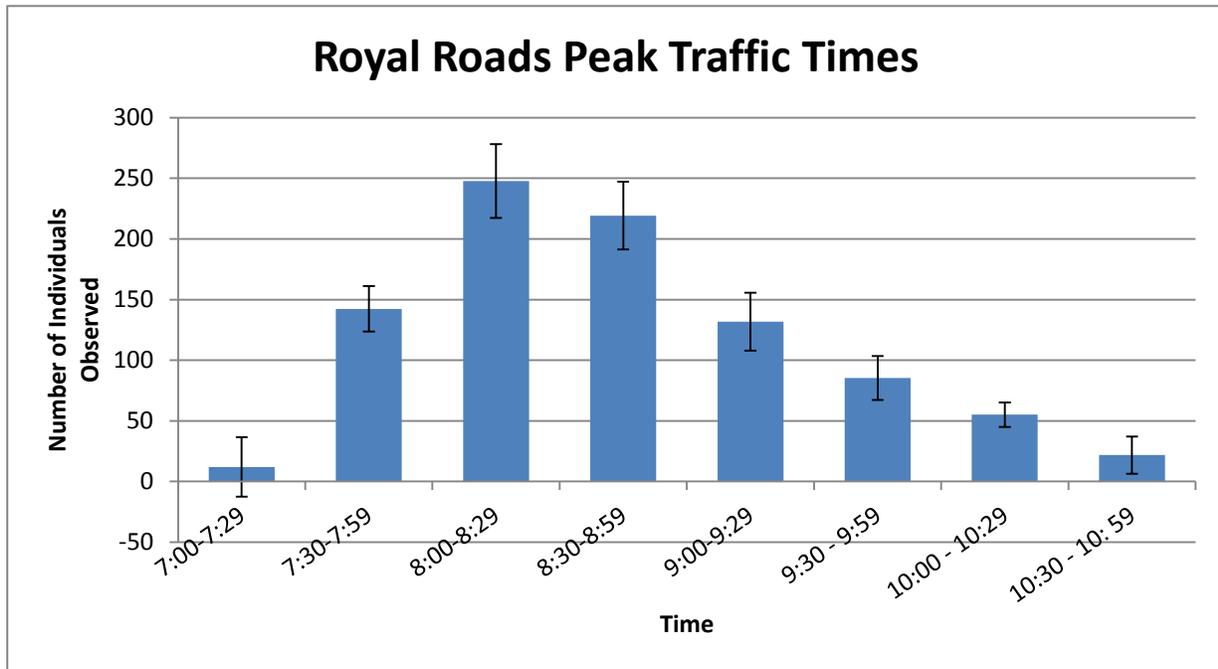


Figure 9 – Peak traffic times at Royal Roads University determined from the quantitative assessment of eight sampling days between April 2, 2013 and June 18, 2013.

9.3. Literature Review

The literature review was conducted in order to see what initiatives were taken by other Canadian institutions in order to minimize SOV to campus. All research was conducted online from published TDM plans and relevant internet sites; therefore, no institutions were contacted directly. This method of collecting data was used to determine some of the current best management practices that could be implemented at RRU in a cost effective manner. With the information gathered from the literature review, combined with the data collected from the

qualitative and quantitative studies the best methods to sway people into using alternative modes of transportation specific to RRU could be determined.

9.3.1. Thompson Rivers University

Thompson Rivers University (TRU) is located in Kamloops, B.C. accommodates approximately 7,400 students and 1,100 staff. TRU's detailed TDM study was available as a PDF on their website. The following is an outline of TRU's TDM:

“the development and implementation of a combination of programs, policies, and investments to redistribute travel demand to different, more sustainable modes of travel as well as different times of day to encourage a more sustainable use of limited transportation resources. TDM strategies use a balance of incentives and disincentives to increase the relative attractiveness of non-auto modes while simultaneously decreasing the attractiveness of the single-occupant vehicle” (Thompson Rivers University, 2012, p. 1, para 3).

Furthermore, TRU identifies their TDM strategy as a means of addressing and mitigating issues involving traffic congestion, transportation infrastructure needs, and greenhouse gas emissions along with impacts on economic, social and environmental sustainability (Thompson Rivers University, 2013).

Much like Royal Roads University, TRU has adopted the U-Pass for students and the Pro-Pass for faculty. TRU charges their students \$51.04 per semester as a part of their tuition fee and they estimate that this will save a student \$483 each year; however, as this does not mention if the amount of money the students saves is based on taking the bus every day, this has been assumed. The Pro-Pass is available to all staff and faculty at the university and costs \$44 a month, which they estimate will save them \$108 per year; once again no assumptions are mentioned in regards to how many days a year they would be traveling via public transit. Staff purchasing the Pro-Pass are required to purchase a minimum of 4 months (Thompson Rivers University, 2013).

Another incentive that TRU offers to staff and students to cut down on the use of SOV is a carpool initiative, in which a minimum of two participants per car are required to sign up. This incentive lets participants park their vehicles in prime parking spots at the University, and effectively cuts the cost of a parking pass in half. Participants, however, cannot drop people off before parking, as the spots are monitored for multiple occupants. This is enforced to ensure single occupancy users do not take advantage of these prime parking spots (Thompson Rivers University, 2013).

TRU also has a bicycle repair shop along with covered bicycle storage in which they charge staff, students and faculty \$10 per semester to store their bikes on a daily basis. Furthermore, there are many bicycle racks stationed around campus, as well as showers and lockers that are available at the school gymnasium. TRU also offers electric bike rentals and charging stations for people who have trouble cycling in a mountainous city (Thompson Rivers University, 2013).

In addition to these initiatives TRU also has a very walkable campus. Moreover, for the health of the University's staff, students and faculty, as well as to help reduce greenhouse gas (GHG) emissions, TRU has made their campus an idle-free zone with signs posted throughout the area. However, it is not mentioned how this rule is enforced in terms of fines or other penalties (Thompson Rivers University, 2013).

TRU offers several reasons why a TDM study/program is necessary. These reasons include supporting the implementation of their Campus Master Plan, helping TRU meet its commitments to be a more sustainable institution, enabling continued expansion of TRU, support the "University Village" concept, helping TRU respond to demand for sustainable transportation alternatives, providing guidance on how to reduce the campus' GHG emissions and supporting the implementation of various City-led plans and responding to TRU's impact on community resources (Thompson Rivers University, 2013).

In order for a program to be successful, the University's master plan should be considered an essential element. This is mainly to ensure that the two programs are relatively synonymous and therefore, are not contradictory of one another. Furthermore, TRU identifies a successful

TDM as one that will consider continued expansion along with the current population in order to assess the changes in demand for transportation infrastructure. Along with considering increased population demands, a successful TDM should consider a vision the University would like to achieve. TRU is looking to create a village-like campus in the future to compensate for increased population, demand and transportation infrastructure and includes the implementation of on-campus shops, offices, student space and residencies. TRU envisions this “village” as one that would not only increase community vitality at the campus, but also would generate revenue for the University. TRU stresses that increased population does not have to include increased transportation infrastructure, but rather increasing the efficiency of existing infrastructure by incentivizing people to make more sustainable transportation choices. In addition to this, TRU considers its impact on the city of Kamloops and addresses the need for developing partnerships with not only the city, but with local businesses to ensure further success of TRU’s master plan, as well as, the University’s TDM program (Thompson Rivers University, 2013).

9.3.2. Laval University

Laval University in Quebec City, Quebec has conducted a TDM study with the intent of understanding what incentives would be most effective when trying to sway University staff and students to use sustainable modes of transportation. Furthermore, the study looked at the impact of the U-Pass since its implementation in regards to shifting the modal split towards students taking public transit (Barla, Ricardo, Alvarez , & Herrmann, 2012).

Laval University consists of approximately 35,000 full time students and has more than 5,000 employees. The core of the campus is located approximately 6 km from downtown Quebec City and is served by several bus routes, including a few high frequency routes. Laval has approximately 8,000 parking spaces in 50 lots, costing anywhere from \$34 to \$68 depending on the duration and area of desired parking (Barla et al., 2012).

The Laval TDM conducted surveys with 705 participants, aimed at understanding why people make the choices they do with regards to transportation. Moreover, the survey has broken its participants up into several categories based on income, distance of travel to and

from school, and whether they are staff, students or professors. All results were analyzed comparing correlations between different answers to questions asked throughout the categories mentioned. The survey found that as travel time by car increased the probability of people choosing that mode of transportation significantly decreased; however, the results vary with different categories, such as people who live 10 km or farther from the school. Laval assessed the correlation between increased parking rates and the amount of people who would switch from SOV as their primary mode of transportation and determined that increasing the price of the parking pass would discourage SOV use. This is a useful style of analysis in that it gives a better understanding of the effects that different TDM strategies would have across different income levels. Furthermore, it gives a tool to assess if one strategy is biased towards affecting different categories of people. Another interesting finding of this survey was an 18% shift in SOV drivers being swayed to use public transit with the implementation of the U-Pass (Barla et al., 2012).

The survey also looked at what improvements could be made to the public transit system in order to influence more people into using it. The five main scenarios selected by survey participants were:

1. Implementation of a free transit system;
2. A 60% increase in parking pass price;
3. An equal travel time scenario between cars and busses;
4. A combination of 1 and 2, 2 and 3, 1 and 3 or all of the above; and,
5. Attitude changes towards the different modes of transportation.

Attitude changes included increasing awareness of the main issues associated with the use of SOV, such as traffic congestion and GHG emissions. This category seemed to have the least impact on swaying people away from SOV with the highest percentage change coming from students at 5%. The most influential option was determined to be the implementation of a free transit system, with all categories reporting over a 10% decrease in the use of SOV; however, it is apparent that a combination of options 1, 2 and 3 would have the most significant impact on swaying commuters away from SOV use with an estimated 82% overall reduction in the use of

SOV averaged from all categories of participants. As mentioned, this type of data collection is useful for comparing different demographics. It appears that professors and individuals with higher incomes are the hardest to sway when compared to all other categories (Barla et al., 2012).

9.3.3. University of Victoria

UVic has experienced a great deal of success with the implementation of its TDM strategy in 1996. As of 2011, traffic volume has been reduced by 20% despite a 15% campus population growth; SOV make up less than 50% of all student transportation to campus and between 25 and 35% of parking spaces on campus are unoccupied during peak travel hours. This has been achieved through five major approaches, consisting of market-based parking fees, financial incentives for transit use, cycling facilities and education, range of transportation options and sustainable campus planning (University of Victoria, 2011).

Since 2005 parking permit fees at UVic have experienced a 40% increase in order to discourage SOV. In 2006 the parking fees were increased an additional 20%. The proceeds from the parking passes are used to fund future parking solutions and expand the TDM program on campus (University of Victoria, 2011).

The introduction of the university bus pass program (U-Pass) in 1999 helped to increase bus ridership more than 26% for all trips to and from campus. The U-Pass allows students unlimited access to transit in Greater Victoria and is paid for using a mandatory fee applied to UVic students at registration. This has resulted in a decrease in demand for parking on campus, as now only 18% of registered students purchase an annual parking pass. Furthermore, the introduction of the Employee Bus Pass program (EBP) in 2005/2006 has increased bus ridership of university employees. The EBP is subsidized by UVic, as well as BC Public Transit (University of Victoria, 2011).

UVic currently provides shower and change facilities in all of its new buildings for the users of over 3,000 bicycle parking spots. Other incentives for encouraging the use of cycling as a mode of transportation to campus include secure bike lockers, free commuter cycling skills

workshops, bike repair kiosks, charging stations for electric assist bikes, a bike bursary program (SPOKES) that provides students with a bike for up to a year and bicycles provided to maintenance and facility staff to reduce the need for motor vehicle use on campus (University of Victoria, 2011).

UVic offers many rideshare and carpool/vanpool programs and allocates specific preferential parking spaces reserved for users until 10:00am daily. Care-Share Co-ops are also well advertised in order to give all students flexible options to discourage demand for SOV. Many improvements for pedestrian travel have also been made by the university, including improvements to crosswalks, roadway, and walkway signage (University of Victoria, 2011).

With a strong commitment to sustainable campus management, UVic has adopted a Campus and Strategic Plan for the long-term management of the TDM program. This includes maintaining a mainly pedestrian-oriented campus, providing on-campus housing, having preserved green spaces throughout the campus and adopting a budget framework that acts to provide funding for subsidies for bus passes and cycling infrastructure (University of Victoria, 2011).

9.3.4. Camosun College

Recommendations for improving alternate transportation were made based on survey respondent comments. The most significantly requested improvement by respondents was an increase in bus service at peak travel times (Camosun College, 2011). RRU does not presently have enough on-campus students to request an increase in bus service (N. Wilkin, personal communication, 2013).

9.3.5. Simon Fraser University

Simon Fraser University (SFU) is a challenging campus to commute to, as it is located at the top of Burnaby Mountain; however, recent transportation strategies have been implemented to make transportation alternatives more accessible to students who do not have the option of driving to campus. Full time students have access to the U-Pass program, as well as being

provided with information about the vanpool/carpool and rideshare program currently implemented at SFU. Moreover, students who prefer to cycle to campus are offered campus bike trail maps and bike rack locations, including the overall distance needed to travel to campus. Full time students are also eligible for the Jack Bell Rideshare program through the university (Simon Fraser University, 2012).

In 2010, SFU students voted in a referendum which approved a sustainability fee of \$2 per full-time student each semester and \$1 per part-time student each semester. The money generated by the fees is used to fund overall campus sustainability projects, such as upgrading roads, bike paths, pedestrian walkways, and building upgrades. 2010 was also the year in which SFU launched the Green Grants program. This program also aims to fund sustainability programs and initiatives to green the university's overall operations. In April of 2012, SFU introduced its first annual Sustainability Awards to celebrate campus achievements by students, faculty, and staff (Simon Fraser University, 2012).

10. Discussion

In this section, findings from the modal split and U-Pass introduction, as well as any other relevant data found from the study, have been discussed so that recommendations could be made. This section also discusses how future infrastructure could be expected to change the modal split further, such as the bus turn around area, which is expected to increase the use of public transportation after it begins running. The projected date that the bus turn around should be operational is September, 2013.

10.1. Qualitative Survey

10.1.1. Demographics

Table 3, as well as Figure 3 indicate that the majority of survey participants were female (69%), staff members (84%) and mostly between 40 and 49 years old (34%). There were approximately equal amount of respondents between 30 and 39 (26%) and over 50 years old (27%). Most of these results were expected. It was expected that the staff, who would be most affected by a TDM than students who are here for only a prescribed amount of time, would be most likely to participate in the survey (Figure 2). Additionally, students may have also had less time to commit to the survey. These results support the age groups identified, since the two lowest response groups were under 20 (0.94%) and between 20 and 29 years old (12%). It was also expected that the majority of respondents would be female (Figure 1), as many of the university administration staff are female.

The average distance travelled (km) one way to campus was determined to be 43km, which was not an expected distance. However, after examining the data it was observed that a few participants indicated unlikely commute distances, such as 4200km and 1252km, which is very unlikely and would skew the average to be higher than actual. Therefore, if the maximum responses (4200km and 1252km) were taken out, a new average distance could be calculated to be 18km; the calculation is illustrated below:

$$\text{Adjusted mean km} = \frac{(\text{total sum of km} - \text{response deleting})}{\text{Total survey participants}}$$

$$\text{Adjusted mean km} = \frac{(9203.2 - 4200 - 1252)}{212}$$

$$\text{Adjusted mean km} = 17.69\text{km}$$

The adjusted average distance travelled (18km) seems a more likely result. Therefore, the recommendations section will reflect that the maximum amount of digits for this answer should be two.

10.1.2. Access Information

Table 4 and Figure 4 indicate that the majority of survey participants are not aware of the RRU Coastal Cycle bike rental program (70%) or the Jack Bell ride share program (69%), most have access to both a motorized vehicle (85%) and a bicycle (67%) and purchased an annual parking pass (73%). The amount of participants with a U-Pass or Pro-Pass was low (14%), yet half the participants have used public transportation in the last 12 months (50%). It was expected that the majority of people were unaware of the programs RRU offers to assist with alternative transportation and ride-share options, as they were very difficult to find on the RRU website and there is no formal advertising for them. Since the majority of the participants were staff member, it is expected that most would have access to a vehicle, as they are likely permanent residents of Victoria. Students, however, may only be residing in Victoria to attend school and may not be in a financial position to own a motorized vehicle. The low percentage of people who have a U-Pass/Pro-Pass could be attributed to the fact that 84% of the survey respondents were staff or faculty. The Pro-Pass is not supplied to staff or faculty, but must be purchased (\$77 per month). This gives little incentive for staff or faculty to use public transportation.

10.1.3. Influences

Table 5 indicates that the majority of survey participants strongly agree with the reasons that influence their transportation choices (convenience 64%, amount of time it takes to travel 56%, daily activities, such as errands and picking up their kids 52% and distance travelled 44%). This suggests that these are the main motivators for transportation choices. These were predicted to be the main motivators of transportation choices. Based on the fact that the

majority of survey participants were faculty and staff, it was expected that they have families and additional responsibilities outside of their career. 40%, 37%, and 45% agreed that weather conditions, safety concerns and environmental impacts and/or benefits influence their decisions, respectively. This was also expected, based on the climate and location of the RRU campus. 42% of respondents disagreed that physical limitations or health concerns influenced their transportation choices. 40% disagreed that the cost of travel influenced their choices; however, 41% agreed that cost did influence their choice. Cost was expected to have more of an influence on transportation choices; however many of the respondents were faculty and staff and likely have a higher income. If more students had completed the survey it would be expected that cost would have had a greater influence on transportation choices.

10.1.4. Commute Information

Table 6 indicates that the majority of the survey participants (75%) commute to campus 5 or more days per week, while 22% commute between 2 and 4 days and only 4% of participants commute between 0 and 1 day per week. The primary mode of transportation was determined to be motorized vehicle (80%), followed by bicycle (8%), public transportation (7%) and walking (4%). These results reflected more alternative transportation than expected, since the Boulevard Transportation Group TDM indicated a higher amount of SOV. However, it was expected that motorized vehicles would be the primary mode of transportation since the majority of the survey participants were RRU staff (84%) who commute to campus 5 or more days per week (75%), and who are most likely in a higher income bracket than students as well as permanent residents of Victoria.

10.1.5. Public Transportation

Table 7 indicates that the amount of days per week that the U-Pass or Pro-Pass was used most to get to campus was 0 days and 5 days per week (2.4%), followed by 7 days per week (1.4%), 3 and 4 days per week (0.5%) and the least indicated was 1, 2 and 6 days per week (0%). The amount of days per week that the U-Pass or Pro-Pass was used most beyond getting to campus was 5 or more days per week (3.3%), followed by 0 days per week (2.4%), 2, 3 and 4 days per week (0.5%) and the least indicated was 1 day per week (0%). There was no

expectations set for this data, as these results were obtained to better understand the use of the U-Pass and Pro-Pass.

10.1.6. Motorized Vehicle

Table 8 indicates that the majority of survey participants who drive motorized vehicles (80%) drive a car, truck or van (79.5%); while very few drive a motorcycle or scooter (0.5%). The majority of participants (64%) drive SOV, followed by carpools with 2 passengers (12%), 3 passengers (4%), 4 passengers (0.5%) and the least indicated was 5 or more passengers (0%).

The average maximum price participants were willing to pay for an annual parking pass was determined to be \$179, which did not seem an unreasonable price. However, after examining the data it was observed that two participants indicated that their maximum purchase price was \$999 and two others indicated \$0, which are unlikely responses and would skew the average to be higher than actual with the \$999 and lower than actual with \$0. Therefore, if the four unlikely maximum purchase price discussed were taken out, a new average could be calculated to be \$172; the calculation is illustrated below:

Adjusted mean max. purchase price

$$= \frac{\text{(sum of maximum purchase price – response deleting)}}{\text{Total survey participants}}$$

$$\text{Adjusted mean max. purchase price} = \frac{(30672 - 999 - 999)}{(169 - 2)}$$

$$\text{Adjusted mean max. purchase price} = 171.7$$

The adjusted average maximum purchase price (\$172) seems just as plausible as the initial average of \$179. There were many responses which indicated a maximum purchase price above the current price (\$123), such as \$200, \$300, \$500, and one response was \$800. These are expected relatively expected responses, since as indicated in the literature review RRU parking is the lowest compared to other institutions and the price has not been raised since 2010.

Table 9 indicates that the majority of survey participants disagree with the all changes that could be made to influence them to take alternative transportation (ride-share 34%, less crowded bus 47%, more comfortable buses 45%, improved cycling paths 37%, improved cycling infrastructure 33% and improved walking paths 42%). This indicates that there are elements in their life that require them to commute by SOV. It was also expected that there would be behaviours that survey participants were unwilling to change.

Although it was observed that the majority of participants disagreed with most of the changes being able to influence their transportation choices, there were still relatively large percentages who would agree with some of the changes. Three of the second most frequent responses were ride-share 24%, improved cycling paths 22%, improved cycling infrastructure 21% and improved walking paths 42%. However, even the other responses for agree were significant, such as less crowded bus 14%, more comfortable buses 15% and improved walking paths 16%. These results indicate that there are still quite a few participants who could be influenced to take alternative modes of transportation.

10.1.7. Survey Participant's Comments

There were three sections for survey participants to make comments. The first comments section targeted all survey participants and was related to the question about factors which influence transportation choices, for which there were 58 responses (23% of participants made comments) (Appendix H). Figure 5 illustrates that the three most frequent comments were regarding more frequent and convenient bus service (10), followed by health factors (6) and variations in their schedule (5). However, it should be noted that "Convenience of transportation mode" and "Physical limitations or health concerns" are both listed in the survey questions, so these should be taken as support for those factors influencing participant's transportation choices.

The second comments section was targeted to commuters who used a motorized vehicle as their primary mode of transportation. The section was related to the question about changes that could be made to influence them to take alternative transportation, rather than driving, for which there were 75 responses (35% of participants made comments) (Appendix H).

Figure 6 illustrates that the three most frequent comments were regarding more frequent and convenient bus service (24), followed by having an RRU carpool or car-share program (3) and having an affordable bike rental program at RRU. However, it should be noted that “Easier access to the ride-share matching service” is already listed in the survey questions, so those responses should be taken as support for that factor which could be influencing participants into using alternative transportation. Therefore, “frequency and convenience of bus services” and “RRU affordable bike rental/share program” should be added to the list of changes that could influence behavioural changes in future surveys.

The third comments section targeted all survey participants and asked whether there were any additional suggestions or comments they would like to make, for which there were 80 responses (38% of participants made comments) (Appendix H). This was a broad question and elicited comments on changes that could be made regarding the TDM, suggestions on how to increase the use of alternative transportation at RRU as well as some comments which illustrated gaps in the survey and suggestions on how to increase the clarity. Figure 7 illustrates that the seven most reoccurring comments were frequent and convenient bus service (21), followed by RRU transportation/carpool/car-share program and Telecommuting or schedule change (i.e. four 10 hour days) (7), improved bicycle infrastructure (6), raising parking pass will not help (4), RRU affordable Bike rental/share program (2) and incentives to drive a green car (1).

It was expected that there would be a lot of suggestions on how improvements could be made that pertain to personal experience. The overall trend between all of the comments sections was that the most frequent comments are regarding the frequency and convenience of bus service. Although there is currently regular bus service to campus, it was explained that with the start and end times of shifts, it was often necessary to leave over an hour before the shift to catch the bus and get there on time and then wait for up to an hour for the bus after the shift ended. One person relayed that their main barrier was the time it took them to take the bus, stating it would take them an hour and a half each way. One person stated that it took them approximately two hours to get home at the end of the day when they took the bus,

but by car it was approximately 30 minutes. One comment suggested that there should be pressure put on the BC Transit, politicians or respective authorities to make use of the dormant railway tracks, for instance the commuter train from up-island, in the mornings. Apparently, BC Transit wants to push for elevated light rail transit (LRT), but is not making use of the existing tracks which may be perfectly capable of use for commuters.

From reading the statements, it was apparent that a lot of participants were willing to consider taking public transportation. Perhaps a recommendation could be put forth to the transportation board to ramp up the service in the morning and in the late afternoon when shifts are likely to be ending. Additionally, shift flexibility could be proposed for personnel who choose to take public transportation. This could be as simple as a 15 minute grace period or a complete change in shift schedule to align with the bus schedule.

A parallel between the last two comment sections was an RRU transportation/carpool/car-share program, which was the second most frequent comment for both. Some specific comments were regarding having an RRU social board which has a live carpooling spreadsheet of people wishing to carpool. The sheet would have their name, email, home or rendezvous location and work schedule. One participant stated that there is a car on their street with an RRU staff parking pass in the rear-view mirror, but that they did not know who the person was to ask whether they want to carpool. Another comment stated that having a more flexible start time allowed them to carpool, specifically saying that not having to start at exactly 8:30 allowed them this option. Having a more flexible schedule or telecommuting was also the second most frequent comment for the exit question. It was suggested that where possible, personnel could be offered the option of working four 10 hour shifts per week instead of five 8 hour shifts, which would cut out a day of driving. One participant said they currently telecommute one day per week but would welcome the opportunity to increase that to four days of telecommuting to one day on campus. Additionally, another participant stated that they produced a report for RRU in 2003 on implementing a telecommuting program and suggested that it would probably still be on file in the Human Resources office if the Office of Sustainability was interest in referring to it.

The third most frequent comment in the exit question was regarding improved bicycle infrastructure. One participant stated that they rode their bike often but that they were annoyed because the sprinkler system would spray water on their bike throughout the day and their seat would get wet; they were not specific as to the location but said they often tried to park their bike outside the Millward Building. One participant had a specific concern regarding the showers in the basement of LIC, specifically regarding the isolated nature of them and because the main door can be locked from the inside. Although there is likely a necessity for being able to lock the door from the inside, it could be a significant safety concern for an individual who wishes to shower after riding their bike to school. Another participant noted that there were a lot of covered bike racks between the Grant Building and Nixon Building which were under-utilized and suggested that some be moved to higher traffic areas.

It should also be noted that there was some concern expressed about raising the cost of the parking pass and how that would not change people's choice to drive but instead put undue stress on those who required a motorized vehicle for commuting. Some participants also conveyed their thoughts about how they should not be made to feel guilty for needing to drive a car to work. The intention of this qualitative assessment is not to undermine or dismiss the reality that cars are a real part of daily life and there are some legitimate reasons which require their use. The intention is to determine ways to make using alternative transportation methods more accommodating and convenient for those who would prefer to utilize them.

A reoccurring comment was that survey participants often drive when the weather is bad (so during most of the wet winter months), but choose to bike in the better weather. A specific comment was that although their primary mode of transportation was as a SOV, they do try to ride their bike two days per week. Therefore, the data will be skewed to reflect more SOV than actual. Additionally, since the survey lumped two and four days together when asking how many days per week a person commuted, if someone only comes two days per week, they were just put as the same amount of time as a person who commutes four days per week which is twice as much. It was suggested that this question be changes so that the range could be narrowed to one day at a time. Therefore, future surveys should be made more specific to the

participant's mode of transportation and not restrict them to one mode or another and the amount of days they commute should be broadened to include each possible value between zero and seven. Perhaps they can be given seven days and they could fill in what mode of transportation they used and on what day, this may better reflect the data.

10.2. Quantitative Assessment

10.2.1. Introduction of U-Pass

Table 11 and Figure 8 illustrate that SOV were the most used mode of transportation (63%), followed by pedestrian (13%), carpools (12) and the least used mode of transportation was the combined results for taxis (1%). There was no information available in the Boulevard Transportation Group TDM for the broader range of vehicles counted, such as the utility vehicles or taxis; therefore only an indirect comparison could be conducted. These are new elements that can both enrich the study and be available for future TDM studies, or if they are too specific for the needs of the Office of Sustainability, they can easily be added to related categories.

Although a direct comparison cannot be conducted with the Boulevard Transportation Group TDM, JBK Environmental Professionals have provided an indirect comparison; refer to Table 12 and Figure 10. The current data indicate a reduction in SOV usage of approximately 27% and an increase in the other modes of transportation from 2007 to 2013 (Figure 10). The data illustrate an increase in carpooling of 9%, a 2% increase in transit usage, a 1% increase in cycling and a 12% increase of pedestrians. The reduction in SOV usage may be attributable to the recent introduction of the U-Pass and Pro-Pass; however, to the absence of a methodology in the 2007 Boulevard Transportation Group TDM study makes a proper comparison impossible.

The large increase in pedestrian traffic observed between the two studies may be attributable to the time of year when sampling was conducted. The values for the Boulevard Transportation Group TDM were obtained between October and November, when the weather was colder and rainier than the months of May and June, when the JBK Environmental

Professionals study was conducted. The colder, rainier months may have discouraged those with access to other modes of transportation in favour of a motorized vehicle. Moreover, non-student/faculty using the campus for recreational purposes may have been counted as pedestrians in JBK Environmental Professionals’ study, skewing the results further. The differences in the carpool figures may be a result of an individual being dropped-off but counted as multiple occupancy vehicles, resulting in a higher observed value for carpool in the 2013 study.

Mode of Transportation	RRU 2013 JBK Environmental Study	RRU 2007 Boulevard Study
Single Occupancy Vehicle	63%	90%
Carpool	12%	3%
Transit	6%	4%
Cycling	3%	2%
Pedestrian	13%	1%

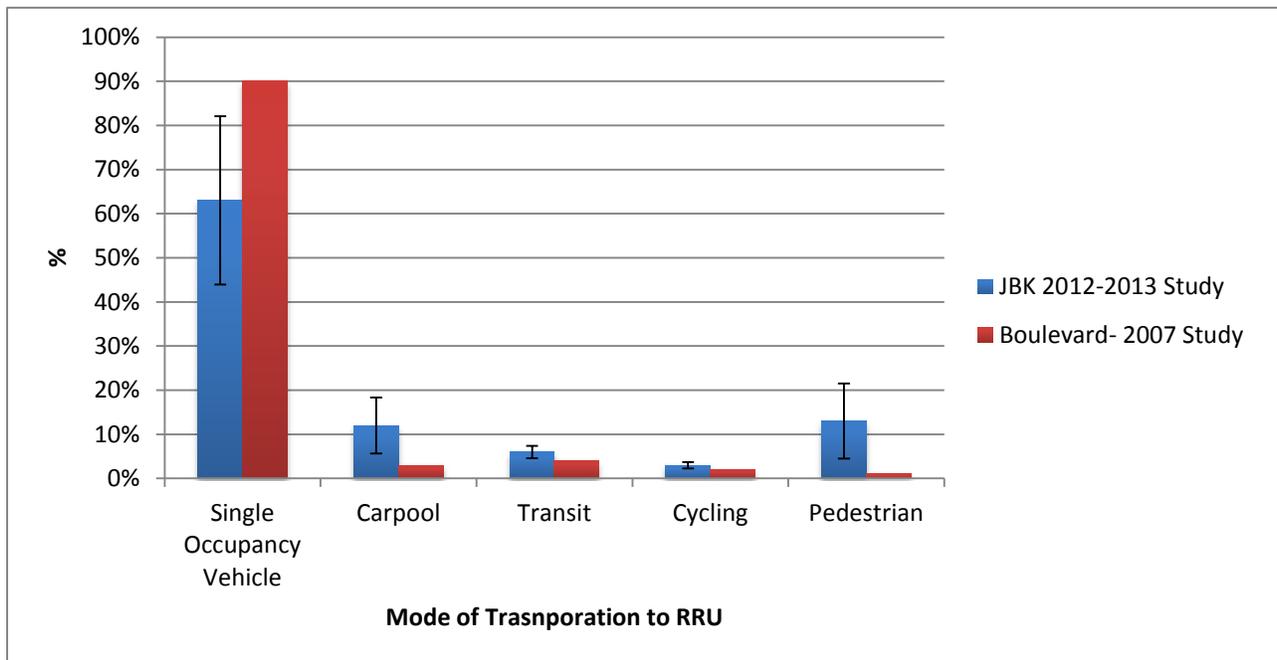


Figure 10 – Comparison of JBK Environmental Professionals quantitative assessment data (2013) vs. Boulevard Transportation Group TDM (2007).

10.3. Comparison of Qualitative Survey and Quantitative Assessment

Table 13 and Figure 11 illustrate the comparison of the quantitative assessment and qualitative survey data compiled by JBK Environmental Professionals. The biggest difference can be seen in the pedestrian data with a standard deviation of 0.062%. This difference can likely be attributed to limitations in the amount of trails covered by the sampling team and in making the discrepancy between students using the trails for commuting to school or local residents using them for pleasure.

Table 13 – Comparison of the qualitative and quantitative data.			
Mode of Transportation	RRU 2013 JBK Environmental Quantitative Assessment	RRU 2013 JBK Environmental Qualitative Survey	% Standard deviation (+/-)
Single Occupancy Vehicle	63%	63.85%	0.006010408
Carpool	12%	16.44%	0.031395541
Transit	6%	7.04%	0.007353911
Cycling	3%	8.45%	0.03853732
Pedestrian	13%	4.23%	0.062013265

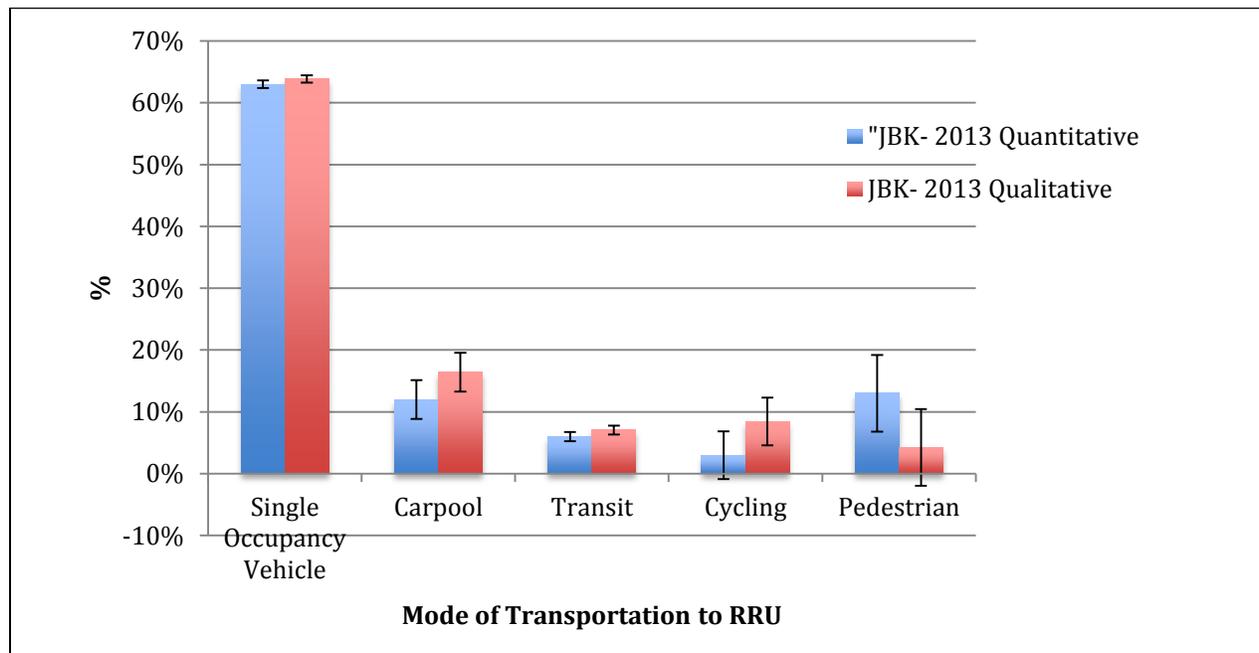


Figure 11 – Quantitative assessment vs. qualitative survey data of modal split determined by JBK Environmental Professionals (2013).

11. Conclusions

This study has outlined a baseline for the current modal split at the university and it is now important for RRU executives and/or affiliates to establish a realistic and obtainable benchmark to strive for in future studies. This benchmark should be based upon future initiatives that the university implements, such as a raise in the parking pass price. RRU should also look at updating the Sustainability Plan, as it is approaching five years since the completion of the current plan; this will make it easier for future TDM studies to determine what priorities are currently important to RRU executives when making final recommendations.

11.1. Recommendations

This section includes recommendations accumulated from the *LimeSurvey* and the literature review of best management practices from other Canadian Colleges and Universities. It also makes feasible recommendations that can be attempted at the RRU campus to shift the transportation away from SOV.

Establishing a realistic modal split benchmark is essential for RRU if they aim to reduce the overall use of not just SOV but vehicles altogether. The benchmark should be realistic, based on the modal split acquired from this study. Furthermore, it should be aimed at reducing the use of SOV through implementation of future initiatives. For example, if RRU opens up a bike share/rental program the benchmark should reflect the actual number of participants estimated to participate in the new bike program and therefore reflect this number of individuals as a reduction in the use of SOV in future studies.

Increasing the parking pass price is an essential element if RRU is serious about reducing the number of vehicles coming to and from campus. RRU has the cheapest parking pass of any school studied. In RRU's 2008 Sustainability report, raising the price of the parking pass was noted as having a high priority (Royal Roads University, 2008); however, the price has not been changed since 2010 with the implementation of the harmonized sales tax (HST). It is recommended that the price of the parking pass at least stay consistent with inflation. If this is a route that the school chooses to go they will need to develop a partnership with the City of Colwood to ensure people parking across the road at the Galloping Goose Regional Trail parking

lot are getting charged for daily parking. One suggestion could be to install a pay parking meter and limit parking in that lot to a three hour maximum. Another suggestion could be to have a municipal officer be at the location during peak times to ensure that only users of the trail are parking there; at least at the beginning of the price increase or until commuters become accustomed to the change.

Another area of interest for reducing the amount of traffic and congestion on campus is to structure class/work schedules in such a way that students and professors each have heavy scheduled days so that most of their courses can be completed within a couple of days of the week. However, this may be difficult at RRU as most of the programs offered are condensed; therefore, this type of scheduling may not be possible. Another aspect would be to include telecommuting.

Offering people incentives to carpool is another great way to reduce the number of cars coming onto campus. This type of system could be modeled after the Thompson Rivers carpool system, in which the price of a parking pass is cut in half for people that carpool. Moreover, participants in the carpool program are offered prime parking spots at the campus (Thompson Rivers University, 2013). However, it may be hard to lower the cost of the already extremely low parking pass.

Providing incentives and eliminating barriers for new students to live closer to RRU would help to reduce SOV. RRU currently has a website for off campus housing (available at: <http://royalroads.och101.com/>); however, this database includes postings from all of Victoria. Adding a search option for students to select potential residences within given radius options would help to encourage students to live closer. Additionally, better advertising and marketing for alternative modes of transportation, such as rideshare programs and public transportation schedules, could help to encourage students to live where they could make better transportation choices.

Patti Walsh is the manager of the recreation centre at Royal Roads and is currently looking into setting up a bike share/rental program at the University. Currently, Coastal Cycles, which is

located at 1610 Island Highway, Victoria, BC, is one of the only services that offer bike rentals; they require a minimum three-week commitment at \$75 a week from RRU staff and students and \$80 on a week to week basis. Walsh believes that RRU could offer its staff and students a better alternative to Coastal Cycles and is certain that there is enough space and infrastructure at the gym to house and maintain this kind of operation. Walsh is currently working on a business plan to propose to RRU executives. She would also like to see improvements to, as well as maintenance of, the campus trails, including improving trail signs. Walsh also stated that in the past campus trails were marked with color-coded signs that followed a large map posted in front of the recreation centre. The map marks out several trails on the campus, including the distance of each trail and elevation differences throughout the trails. However, posts throughout the trails have not been maintained and are in dire need of repair. Marking trails could sway more people to come to the campus via biking or walking. Furthermore, better signage will help to improve campus safety, as people may feel more comfortable knowing where they are in the large and dense forest located on campus (P. Walsh, personal communication, May 7, 2013). Using Geographic Information System (GIS) technology so that the length of each trail, level of difficulty (pertaining to topography), as well as approximate time to the destination, is recommended.

Nancy Wilkin, the Director of the Office of Sustainability at RRU, says that the original trail map and trail markings were funded by the Naval Academy that occupied the RRU campus prior to 1995. Therefore, there has been no discussion between departments in regards to funding and maintenance of the trail posts (N. Wilkin, personal communication, May 27, 2013).



Figure 12 – Map of trails located in front of the recreation center; indicates distances and elevations of campus trails. The post (right) is an example of signage that could be placed throughout the campus trails with color coding to show people what trail they are following. Photo by B. Cassidy, 2013.

JBK Environmental Professionals participated in a campus safety audit hosted by the RRU Safety Committee and Toronto-based Metrac. During this audit one of the major concerns indicated by members of the Safety Committee was the lack of signage on the trails. Members of the Safety Committee mentioned that there may be funding available in their budget to address this issue directly. It is recommended that the Office of Sustainability explore partnerships with the Safety Committee to improve trail signage and help to ease the financial burden of their maintenance.

Some recommendations regarding the qualitative survey include only allowing two digits for questions referring to the participants commuting distance. One participant indicated their commute was 4200km, for instance, which is highly unlikely and therefore has been considered an outlier in the data set. Many survey participants also had specific comments, such as “frequency and convenience of bus services” and “RRU affordable bike rental/share program”, which should therefore be added to the list that could influence behavioural changes in future surveys. Another participant mentioned that they would like the qualitative survey to include more options for how frequently people commute to work, as the only options for days were 0-1, 2-4 and 5 or more; perhaps it could be shown on a daily basis to better reflect actual commuting data.

Additional ideas/recommendations that RRU could explore further include:

- Make recommendations based on the population growth expectancy (visionary);
- Build plans/initiatives in accordance with the RRU Master Plan (sustainability website - plans and policies);
- Much like TRU, RRU should aim recommendations based on becoming a village to promote a community feel on campus (sense of place);
- Look into costs for a plug in electric bicycle station;
- Map out where the RRU population lives in the CRD and incentivise people to live closer to campus;
- Map out peak hours and days for campus traffic, congestion and population;

- Look into busing schedules and advocate for means of increasing bus routes to and from campus; and
- Up-grading Moodle to include bike share and carpool information.

11.2. Sources of Error & Barriers

This section outlines any barriers and errors that have been identified throughout the course of this study. Error is inherent with any survey or study and could be based on human bias or errors in the survey itself. Any potential errors from the qualitative survey and the quantitative assessment were assessed prior to completion of this report. Therefore, the following statements in this section are all accountable and potential errors.

One barrier that was identified early in the project was that computer services did not allow a team email account that all members of JBK Environmental Professionals could have access to. This was a barrier for communication as it would have shared the responsibility of communication with all members and made the study more transparent for the sponsors, who could have had access throughout.

One of the hardest barriers noticed while conducting the quantitative assessment is that it was impossible to monitor all of the trails on campus; therefore, the quantitative data can be skewed to reflect fewer pedestrians. Moreover, as many of the trails are open to the public, determining those using the trails for recreation (e.g. walking, hiking, running, biking) rather than transportation to school posed a slight challenge. It is also possible that some people may have been counted more than once, especially if they were observed at different sampling locations. An example of this would be a pedestrian counted as they enter the main entrance and then who follows the trails for leisure and is counted again as they pass the second sampling location.

There may be some discrepancies for the amount of pedestrians and those who used public transportation to get to campus. The Western Exchange, which is located at the corner of Ocean Boulevard and Sooke Road, is the closest stop to RRU for the #50 bus coming from downtown Victoria. Many people that get off the bus at the exchange will walk the rest of the way to campus. This increases the percentage of pedestrians observed and decreases the

percent of public transportation observed. The percentage of pedestrians may have also been increased by Individuals that park their vehicle at the Galloping Goose Regional Trail; they would have been counted as pedestrians as they walk across the street to campus.

Another potentially large source of error was the varying times at which the residencies were on campus. The residencies could have skewed our calculated peak travel times, as well as contributing to more traffic (pedestrian and other) on campus overall during the sampling weeks.

In regards to the qualitative portion of this study, although it is unlikely, there is a chance that some of the survey emails could have ended up in a spam folder. In this case, students and faculty would not have gotten the link to the survey and would have been unable to participate. Furthermore, it is also possible that students may have disregarded the email from student services when they saw it was for a survey, or due to the high workload some students may not have felt they had the time to fill out the survey. The qualitative survey may also be over-represented with staff or students that are proud of their transportation choices, which would be an error in this aspect of the study. This is precisely why the data collected in this portion of the study is not considered to be essential data in the sense of the modal split. However, it does give an idea of why people make the transportation choices they make and can also be used for an indirect comparison with the modal split obtained from the quantitative portion of the study.

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