SUSTAINABLE TRANSPORT SAFETY: COMPASS
CASE STUDY OF A COMMUNITY U-PASS IN KELOWNA, BRITISH COLUMBIA

by

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Abstract

One way to reduce the negative impacts of automobile-dependency is to encourage active transportation (AT), such as walking, biking, and transit, while reducing vehicle use. One initiative proven to reduce vehicle use is the Community U-Pass (ComPASS) concept demonstrated through Boulder, Colorado's Neighbourhood Eco (NECO) Pass program. ComPASS is a universal community transportation pass (U-Pass) that would provide unlimited access transit passes and other possible components including recreation centre passes, bike tune-ups, merchant incentives, and emergency taxi rides home. The goal of providing a ComPASS to neighbourhoods is to provide an attractive alternative to encourage decreased personal vehicle use in favour of AT modes.

This thesis explores the possibility of a ComPASS for the residents of the Glenmore neighbourhood in Kelowna, British Columbia. Two factors motivated this research: 1) an interest in sustainable communities and 2) sustainable transport safety (STS). The objectives of this research were to 1) compare Kelowna to other cities where similar ComPASS programs have been successful, 2) design a ComPASS that would compete with personal vehicle use, and 3) implement a ComPASS pilot program to test the potential of the program in Kelowna.

Results suggest that ComPASS could significantly reduce personal vehicle use at a 93.7% confidence level and increase transit use at an 85.7% confidence level. Personal vehicle use could decrease between 6% and 12% amongst ComPASS holders which would translate to a reduction in vehicle kilometres travelled (VKT) per household, resulting in several community-wide benefits. Due to the potential benefits, ComPASS is a recommended tool for the City of Kelowna to implement in efforts to achieve their sustainability goals. Consequently, a three-year permanent ComPASS trial is recommended in the Phase 2 study area, along with transit improvements. Assuming a participation rate of 59%, 19 of the 32 piloted households would participate in a permanent ComPASS program. Over the three year trial period assuming 19 participating households, there could be 6,052 kg to 12,103 kg reduced greenhouse gas (GHG) emissions, 15 to 30 reduced road injuries, 0.06 to 0.11 reduced road fatalities, and social and government savings of $20,552.26 to $41,104.51.

Preface

This research was made possible through a financial contribution from three sources: 1) the UBC Okanagan Campus Sustainable Communities Grant available for studying the Glenmore neighbourhood, 2) a grant from the Pacific Action Climate Secretariat, and 3) a Natural Sciences and Engineering Research (NSERC) Discovery Grant.

Phase 1 results (shown in Chapter Four) were published in the 2012 Canadian Society of Civil Engineers (CSCE) 9th International Transportation Specialty Conference proceedings: Morrison, E.S, Lovegrove, G.R., and Sonmor, F.D. 2012. The sustainable Glenmore ComPASS research study. *In* Proceedings of the Canadian Society for Civil Engineering, 9th International Transportation Specialty Conference, Edmonton, AB, 6-9 June 2012. Canadian Society for Civil Engineering, Montreal, QC.

Initial Phase 2 results of this research (shown in Chapter Five) were published in the 2013 Canadian Institute of Transportation Engineers (CITE) conference proceedings: Morrison, E., and Lovegrove, G. 2013 Community transportation pass pilot program in Kelowna, BC. *In* Proceedings of the Canadian Institute of Transportation Engineers, Many Faces of Transportation Conference, Calgary, AB, 7-10 April 2013. Canadian Institute of Transportation Engineers, Toronto, ON.

The Phase 1 community survey and public design workshops described in Chapter Four required UBC Behavioural Research Ethics Board (BREB) approval before data collection could commence. Phase 1 BREB approval was given for the project name "Glenmore ComPASS Research Study", with the UBC BREB certificate number H11-01532. Data collection occurred from May 2011 to September 2011 by Dr. Gordon Lovegrove, David Sonmor (summer research assistant) and Ellen Morrison. Ms. Morrison was responsible for community engagement in the Phase 1 study neighbourhood, designing the Phase 1 survey, facilitating and designing the three public design workshops, and presenting to the steering committee. She also managed the online survey and analyzed the Phase 1 survey results. Mr. Sonmor aided with community engagement, survey design, and facilitating public design workshops. Dr. Lovegrove supervised research activities, facilitated public design workshops, and managed and arranged the steering committee.

Chapter Five is based on the Phase 2 revealed preference pilot study conducted from April to September 2012 by Dr. Gordon Lovegrove and Ellen Morrison. The surveys conducted in the Phase 2 pilot study also required UBC BREB approval. Phase 2 BREB approval was given to the project under the name "Glenmore ComPASS – Phase 2 Revealed Preference Study", with the UBC BREB certificate number H12-00044. For Phase 2, Ms. Morrison was responsible for experimental design, recruiting participants, correspondence with participating merchants, designing surveys, distributing surveys, documenting

survey responses, and analyzing survey results. Dr. Lovegrove provided oversight and guidance for the study. Dr. Abbas Milani provided statistical analysis guidance for the Phase 2 survey analysis.

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Abbreviations

AIC	Akaike Information Criterion
ANCOVA	Analysis of Covariance
ANOVA	Analysis of Variance
AT	Active Transportation
BC	British Columbia
BIC	Bayesian Information Criterion
CCMTA	Canadian Council of Motor Transport Administrators
CMA	Census Metropolitan Area
CO	Colorado
CO_2e	Carbon Dioxide Equivalent
ComPASS	Community Universal Transportation Pass
CRN	Community Revenue Neutral
CSD	Census Subdivision
CSEP	Canadian Society for Exercise Physiology
DA	Dissemination Area
DM	Decision Maker
EB	Empirical Bayesian
EFM	Enterprise Feedback Management
FIPPA	Freedom of Information and Protection of Privacy Act
FTE	Full Time Equivalent
GDP	Gross Domestic Product
GEE	Generalized Estimating Equations
GHG	Greenhouse Gases
GLM	Generalized Linear Model

GLMM	Generalized Linear Mixed Model
HCM	Highway Capacity Manual
ICBC	Insurance Corporation of British Columbia
IEA	International Energy Agency
IHA	Interior Health Authority
IPCC	Intergovernmental Panel on Climate Change
KACC	Kelowna Area Cycling Coalition
KRTS	Kelowna Regional Transit System
LL	Log Likelihood
LOS	Level of Service
LSD	Least Significant Difference
MADM	Multiple Attribute Decision Making
MADW	Monthly Average Day of Week Traffic
MoTI	BC Ministry of Transportation and Infrastructure
NECO	Neighbourhood Eco
NHS	National Household Survey
OCP	Official Community Plan
PAC	Parent Advisory Committee
RDCO	Regional District of the Central Okanagan
BREB	Behavioural Research Ethics Board
RMD	Repeated Measures Design
RTD	Regional Transit District of Denver
SAW	Simple Additive Weighting
SEEDS	Social Ecological Economic Development Studies
SFU	Simon Fraser University

SOV	Single Occupancy Vehicle
STS	Sustainable Transport Safety
TAC	Transportation Association of Canada
TCQSM	Transit Capacity and Quality of Service Manual
TDM	Transportation Demand Management
TRB	Transportation Research Board
UBC	University of British Columbia
UCLA	University OF California, Los Angeles
U-Pass	Universal Transportation Pass
US	United States
VIAS	Vehicle Identification Analysis System
VKT	Vehicle Kilometres Travelled
VMT	Vehicle Miles Travelled
VTPI	Victoria Transport Policy Institute
WHO	World Health Organization
WTP	Willingness to Pay

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- Leanne Bilodeau, Director of Sustainability Operations, UBC Okanagan
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To my loving parents, grandparents, and husband.

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Chapter 1 Introduction

This thesis explores the possibility of implementing a community U-Pass (ComPASS) for the residents of the Glenmore neighbourhood in Kelowna, British Columbia (BC), Canada. A ComPASS is a universal community transportation pass (U-Pass) that can provide 1) unlimited access transit passes, 2) recreation centre passes, 3) bike tune-ups, 4) merchant incentives, and 5) emergency taxi rides home for households. Using community revenue neutral (CRN) model principles, the ComPASS is deeply discounted compared to standard fees on a per household per month basis. The goal of providing a ComPASS to neighbourhoods is to provide attractive active transportation (AT) alternatives to encourage residents to decrease personal vehicle use in favour of AT modes (e.g. biking, walking, and transit). A successful ComPASS design would effectively compete with, and help reduce, vehicle use.

There are two main motivators for research on a ComPASS. First is the overall concept of sustainability and its importance in creating a community that effectively balances the environment, economy, society, and culture. Second is the impact that reduced personal vehicle use (a result of a successful ComPASS design) can have on sustainable transport safety (STS). In other communities (e.g. Boulder, Colorado), community transportation passes like ComPASS have demonstrated the ability to reduce vehicle use. Therefore, it was hypothesized that one possible solution to the problem of sustainability and STS in Kelowna, BC could be addressed by designing and testing a ComPASS in the neighbourhood of Glenmore.

To explore the possibility of a ComPASS in Kelowna, this research involved two parts including the Phase 1 Stated Preference Survey followed by the Phase 2 Revealed Preferences Pilot Study. Phase 1 (May 2011 to October 2011) involved conducting a literature review and consulting a multi-disciplinary steering committee for overall project direction. Based on background research and input from the steering committee, a 750-household study area in the Glenmore neighbourhood was selected to gauge existing transportation attitudes, beliefs, behaviours and potential support for and design of a ComPASS program. Data was analyzed to determine any existing trends and level of support for a ComPASS in their neighbourhood. Phase 2 (April 2012 to September 2012) involved using the data acquired from Phase 1 to design a pilot study. Households from a smaller Phase 2 study area (which included a total of 55 households) were recruited to take part in control and participating groups. The participating group was provided a ComPASS for three months while the control group was asked to continue behaving normally. Both groups were surveyed before, during, and after the three-month pilot study to monitor any changes in transportation attitudes, beliefs, and behaviours. Simultaneously, traffic count data was collected. Based on findings, recommendations were made regarding potential ComPASS design and implementation in the City of Kelowna.

The focus of Chapter One is to review the motivation and objectives for the Glenmore ComPASS Study. Section 1.1 of this chapter outlines the motivation for exploring transportation solutions in Kelowna, BC. Section 1.2 discusses the reasoning for reviewing ComPASS as a potential solution to improve sustainability and STS in Kelowna communities. Section 1.3 outlines the objectives of this research, while Section 1.4 describes the structure of this thesis.

1.1 Motivation

1.1.1 Sustainability

Historic barriers have precluded the development of sustainable communities in North America. After World War II, vehicle manufacturing became increasingly more efficient, which reduced the price of vehicles and allowed more families to purchase them (Giles-Corti and King 2009). With more personal vehicles, people were able to abandon public transportation and other AT modes which allowed them to live farther away from employment centres, schools, and other attractions. This contributed to the sprawl and suburbanization of North America; a shift from traditional urban densities and demographic patterns. This, in turn, encouraged more highways and isolated neighbourhoods. At the time, this land use seemed to offer a lifestyle where people could reside on larger and more affordable lots only a few miles away from the big city. However, this suburbanization created an auto-dependent culture in North America and consequently, an imbalance between the four pillars of sustainability (environment, economics, society, and culture).

The concept of sustainability has evolved since the popular use of the concept began in the 1980s when the Brundtland Commission of the United Nations referred to sustainability as when "development meets the needs of the present without compromising the ability of future generations to meet their own needs" (Brundtland 1987). Today, the University of British Columbia (UBC) Continuing Studies Centre for Sustainability created their own definition, which defines sustainability as "economic and social progress that protects and improves our life-supporting ecosystems, generates positive social and cultural outcomes, and enhances economic prosperity" (UBC 2014).

The question of sustainability is becoming a focus within many governments and organizations who are working to change behaviours and beliefs in efforts to maintain sustainability. The City of Kelowna's Official Community Plan (OCP) (2011) states that a sustainable city "can feed itself from the surrounding countryside, power itself with renewable sources of energy, ensure all residents can find housing, offer a diversity of employment opportunities, and provide the cultural and recreational opportunities desired by residents". To achieve a sustainable community, Kelowna's OCP (2011) identifies developing a balanced transportation network as one of the main goals, involving the implementation of streets that will accommodate all transportation modes with particular focus on pedestrians, cyclists and transit. This goal

of Kelowna's OCP (2011) helps to address the four pillars of sustainability, and also aligns with the motivation for ComPASS. The following subsections outline the four pillars of sustainability in more detail.

1.1.1.1 Environment

According to the Intergovernmental Panel on Climate Change (IPCC), human-caused greenhouse gas (GHG) emissions, such as carbon dioxide (CO_2), methane (CH_4), and nitrous oxide (N_2O), along with other human-related activities, are "extremely likely" to be the main cause for climate change (IPCC 2014). Examples of observed environmental changes associated with climate change include (IPCC 2014):

- Between 1880 and 2012, the global temperature (land and ocean surface) has been increasing;
- Acidity of the ocean has increased by 26% due to increased CO_2 levels;
- Glaciers across the world have continued to shrink; and,
- Between 1901 and 2010, the sea level has been rising.

Events such as those listed above can result in negative effects on the planet, such as (IPCC 2014):

- Changing hydrological systems;
- Changes in temperature (areas that have higher/lower extremes) and precipitation (areas with more and areas with less);
- Increased natural events such as heat waves, floods, cyclones, and wildfires; and,
- Resulting effects on ecosystems and various species.

These changes are negatively affecting the natural environment which is resulting in risks for extinction of plant and animal species, reduction in air/water quality, reduced food security, and increased stress on human-made infrastructure (from flooding, storms, rising sea levels, etc.) (IPCC 2014). Overall, these impacts will affect the survivability of all species, including humans, on the planet.

To help reduce the impacts of climate change, GHG emissions must be reduced substantially, particularly by limiting cumulative CO_2 emissions (IPCC 2014), as CO_2 makes up about three quarters of all GHG emissions (IPCC 2014; IEA 2014). According to the International Energy Agency (IEA), the transportation sector was the second highest contributor (23%) to the world's CO_2 emissions in 2012; second after electricity and heat (42%) (IEA 2014). Within the world's transportation sector, road transport contributed 75% of all CO_2 in 2012 (IEA 2014). In comparison with global contributions, 32% of Canada's CO_2 emissions in 2012 were from the transportation sector, of which 84% were from road transport (IEA 2014), demonstrating that road transportation is a main contributor to GHGs in Canada. In

BC, 38% of GHGs in 2012, measured in CO_2e (carbon dioxide equivalent), were from the transport sector (Province of BC 2012). Within the transportation sector, 63% was attributed to road transportation (Province of BC 2012), also demonstrating that road transportation is a main contributor to GHGs in BC. In Kelowna, road transportation accounted for 65% of total emissions, compared to 25% from buildings and 7% from solid waste (City of Kelowna 2012).

In efforts to mitigate climate change impacts, the Province of BC developed a target to reduce GHG emissions by 33% from 2007 levels by the year 2020, and by 80% from 2007 to 2050 (Province of BC 2007). The City of Kelowna also committed to their target by signing the Provincial Climate Action Charter along with other local governments in BC (City of Kelowna 2012). Due to road transportation's high contribution to Kelowna's GHG emissions, reducing vehicle use should be a primary focus for achieving GHG emission reduction goals.

1.1.1.2 Economics

The effects of climate change on the environment would affect the global economy by impacting available resources, production, and services (Michaud 2012). Several resulting impacts of climate change (e.g. poor air, water, and soil quality, changes in weather patterns, and extreme weather events) could negatively impact the economy with costs associated with mitigating these negative impacts (e.g. increased healthcare costs, making up for loss of air/water/soil quality, loss of crops, damages to infrastructure and natural resources). Alternatively, economic benefits could include producing technology to mitigate these concerns and increased construction to repair damages and build new infrastructure (Michaud 2012). However, the economic disadvantages far outweigh the potential advantages.

The ability to substitute manufactured capital for natural capital is the concept of weak sustainability (Ayres et al. 1998). In weak sustainability, humans essentially act as "portfolio managers" of the Earth (Ayres et al. 1998), where they keep score of the increases and decreases of manufactured and natural capital as they are substituted for each other. However, destroying natural capital by substituting manufactured capital will eventually limit the viability of our planet. The strong sustainability viewpoint does not see manufactured and natural capital as perfectly substitutable, and recognizes that in order for an economy to prosper, natural resources are necessary as inputs (Ayres et al. 1998). Once these natural resources are depleted, then there is nothing for the economy to feed and grow on. Considering natural capital as non-substitutable would ensure that natural capital is preserved in efforts to keep the economy strong for future generations.

A 2007 report by Nicholas Stern indicated that "there is still time to avoid the worst impacts of climate change, if we take strong action now" (Stern 2007). The report also indicates that if action is not taken to

mitigate climate change, 5% of the global Gross Domestic Product (GDP) could be lost each year, with maximum estimates at a 20% loss per year or more. A more recent study conducted in 2012 by DARA (an independent non-profit organization based in Madrid, Spain) and the Climate Vulnerability Forum (a partnership of leaders of climate change vulnerable countries) found that in 2010, climate change and the carbon intensive economy resulted in a loss of 1.7% of the global GDP. Of these losses, developing countries lost the most, at an average of 7% of their GDP in 2010. With effects of climate change and expected increases in carbon intensive economies, economic impacts will increase.

1.1.1.3 Social

Social sustainability pertains to quality of life, a measure of how comfortably and happily community members are functioning within society through factors such as justice, equity, and health. One major contributor to comfort and happiness is health. In 2010, about five million deaths occurred worldwide as a result of climate change and the carbon-based economy (deaths linked to air pollution, cancer, hunger, diseases, etc.), and is expected to rise to six million deaths per year by 2030 (DARA and Climate Vulnerability Forum 2012). In 2012, about 56 million people died globally (WHO 2015a), meaning about 1 in 12 deaths worldwide are related to climate change and carbon-based energy.

One way to help improve public health is to increase AT while decreasing personal vehicle use. Many avoidable health risks are directly and indirectly associated with automobile use, including injuries due to crashes, respiratory ailments due to emissions, and obesity due to lack of exercise (Litman 2010). The Canadian Society for Exercise Physiology (CSEP) recommends adults aged 18-64 receive 150 minutes of moderate to vigorous exercise per week, and youth aged 5-17 should receive 60 minutes of moderate to vigorous exercise per day (CSEP 2011). Much of these physical activity recommendations could be achieved simply by walking, cycling, or taking transit (walking/to and from bus stops) instead of driving for daily commutes to work or school. In fact, AT use is significantly associated with improved cardiovascular health and reduced body weights (Wen et al. 2013). There is an estimated 6% increased likelihood of obesity for every additional hour spent in a car per day, and an estimated 4.8% reduced likelihood of obesity for each additional kilometre walked per day (Frank et al. 2004). Bassett et al. (2011) found that in countries where AT is common (in Europe, North America, and Australia) there were lower obesity rates, while alternatively, countries with less AT usage had higher rates of obesity. Obesity is linked to various serious health risks such as cardiovascular diseases, diabetes, musculoskeletal disorders, and some cancers (WHO 2015b). Therefore, public health can be improved by reducing time in vehicles while increasing walking (Frank et al. 2004) and other AT modes.

1.1.1.4 Culture

In sustainability, culture is separate from the social element to emphasize a difference between quality of life and different ways of thinking, natures of existence and ways of understanding the world (Gonzales, 2000). However, the meaning of culture is often misunderstood. Jon Hawkes (2001) defines culture in two ways:

1. "the social production and transmission of identities, meanings, knowledge, beliefs, values, aspirations, memories, purposes, attitudes, and understanding"; and,
2. "the 'way of life' of a particular set of humans: customs, faiths and conventions; codes of manners, dress, cuisine, language, arts, science, technology, religion and rituals; norms and regulations of behaviour, traditions and institutions".

Essentially, culture is the foundation of community (Hawkes 2001) and "defines us as inhabitants of a specific place" (Momer 2011).

The culture of a community impacts the policies that a community's government adopts (Momer 2011), which in turn influences how a community is shaped. Therefore, shifting a community's culture to place more value on sustainability will encourage governments to implement initiatives that better balance culture, society, economics, and the environment. For example, if a community values the principles of sustainability (e.g. improved health, improved air quality, etc.), a government may reflect this value by implementing policies that place less emphasis on accommodating the personal vehicle (e.g. through increasing and enhancing existing road infrastructure), while instead placing more emphasis on creating more bike lanes, safe walking paths, and improving their transit system. However, without a community's desire for these types of initiatives, a government is less likely to implement them. Therefore, inspiring cultural change to value sustainable initiatives is essential to change how governments shape communities.

One way to inspire cultural change is to encourage more AT usage. Results from a survey conducted in 2013 and 2014 in Metro Vancouver revealed that cyclists and walkers are 17% more likely to report a strong sense of community belonging compared to those who commute by car (UBC et al. 2015). In reference to auto-dependent cultures, Untermann and Vernez Moudon (1989) stated:

"a deeper issue than the functional problems caused by road widening and traffic buildup is the loss of sense of community in many districts. Sense of community traditionally evolves through easy foot access-people meet and talk on foot, which helps them develop contacts, friendships, trust, and commitment to their community. When everyone is in cars there can be no social contact between neighbors, and social contact is essential to developing commitment to neighbourhood."

Overall, increased AT usage creates opportunities for residents to experience, identify with, and create connections with a community, and people are willing to protect these connections (Momer 2011). Once people are willing to protect their communities, residents will become advocates for sustainable solutions, further encouraging sustainable communities.

1.1.2 Sustainable Transport Safety (STS)

Poor sustainable transport safety (STS) leads to unacceptably high frequency and severity of collisions that increase the probability of injury or death. In 2010, road injuries were the eighth leading cause of death globally and the fifth leading cause of death in high-income North America (Lozano et al. 2012). Based on 2010 estimates, the World Health Organization (WHO) estimates about 1.24 million road deaths and 20 to 50 million road injuries occur globally each year (WHO 2013). In 2011, road injuries were the leading cause of death for youth aged 15 to 29 (WHO 2013). In Canada, 32% of injury deaths between 2000 and 2004 were due to motor vehicle collisions (Ramage-Morin 2008). Seventy percent (70%) of all accidental deaths between 2000 and 2004 were due to road collisions for the age group from 15 to 24 years old (Ramage-Morin 2008).

In addition to loss of life, injuries, and decreases in productive years in life, there is an immense economic burden associated with road crashes. In 2004, injuries in Canada cost $19.8 billion, 19% of which was from transportation related injuries (SMARTRISK 2009). These cost estimates include direct (e.g. health care costs) and indirect (e.g. reduced productivity) costs (SMARTRISK 2009). Globally, the costs due to road collisions and injuries amount to $518 billion USD per year (Peden et al. 2004).

Although the frequency and severity of collisions and associated economic burdens and human costs remain unacceptably high, efforts to date have helped somewhat. In 2013, there were 1,923 fatalities across Canada as a result of motor vehicle collisions, a slight decrease of 7.2% from 2012 (Transport Canada 2015). In 2013, reported fatalities, serious injuries, and total injury counts were the lowest since the early 1970s in Canada (Transport Canada 2015). These improvements in road safety in Canada could be attributed to the efforts of various initiatives such as the following (Road Safety Canada Consulting 2011):

1. Canadian Year of Road Safety 2011 (a year dedicated to raising awareness of road safety in Canada, planned by the Canadian Global Road Safety Committee in partnership with the Canadian Council of Motor Transport Administrators, federal, provincial, territorial governments, the Public Health Agency of Canada, and other organizations);
2. Canada's Road Safety Strategy 2015, produced by the Canadian Council of Motor Transport Administrators (CCMTA) with the long term goal to make Canada's roads the safest in the world (CCMTA 2011); and,

3. The United Nation's (UN) Decade of Action for Road Safety (2011 – 2020), a resolution passed in 2010 to globally stabilize and reduce traffic related fatalities.

To address the goals of initiatives listed above, improved road safety can be accomplished through engineering, education, and enforcement. This thesis focuses on the engineering element of transportation safety. Transportation engineering can either be reactive or proactive. Reactive engineering involves designing safety features in "reaction" to complaints, injuries, or deaths in a particular location. Proactive transportation engineering involves identifying and mitigating a potentially unsafe circumstance before it becomes a serious safety problem. By being proactive, transportation engineers can address road safety before problems occur to improve the quality of life in a community.

1.2 ComPASS as a Solution

ComPASS is meant to be a proactive strategy to alleviate both the current transportation safety and community sustainability issues in the Okanagan Valley. About 96% of collisions involve driver-related factors, while 26% involve the road environment and 7% are related to vehicle components (Sayed et al. 1995), suggesting that reducing the number of drivers on the road can help reduce road collisions. With ComPASS, drivers are encouraged to instead use lower energy transportation modes, such as walking, cycling, and transit, to reduce the number of vehicles and the amount of driving in communities. Across North America, there are many examples of ComPASS related programs, known by several different names, including: community transportation pass, universal transportation pass (U-Pass), all access transportation pass, unlimited access transportation pass, ECO Pass, or Neighbourhood ECO Pass. Specifics for each program may differ in their structure and specific components, but they all provide one major component in common: unlimited transit access at a deeply discounted price, ranging from 40 to 90 percent off of the regular price (Nuworsoo 2005). This "deep discount" does not necessarily come from government or transit agencies, but rather from neighbours subsidizing fellow neighbours or students subsidizing fellow students. This principle is a part of the community revenue neutral (CRN) model, which is described in more in depth in Chapter Two (Section 2.2).

Deep discounted U-Passes tend to have a high rate of success by significantly reducing vehicle use and encouraging more transit use (Nuworsoo 2005). For example, 31 universities across the United States (US) with a U-Pass were surveyed and after the first year of U-Pass operation, transit ridership increased by 70 to 200 percent (Nuworsoo 2005). However, a U-Pass program alone is not the only way to reduce personal vehicle use; other engineering, education, and enforcement strategies are necessary. Encouraging AT as a viable option requires an integrated approach, including policies and mandates that enable AT programs and initiatives, improved AT infrastructure, improved AT connectivity, and continuous AT promotional and educational programs. With a properly integrated ComPASS design, transit becomes

more convenient and can successfully compete with vehicle use as an effective Transportation Demand Management (TDM) strategy.

This thesis researches the potential for a ComPASS within the City of Kelowna in BC. Through reduced personal vehicle use and the associated environmental, economic, social, and cultural benefits, a successful ComPASS program could help the City of Kelowna achieve its sustainability goals.

1.3 Research Objectives

The motivation for researching a ComPASS in Kelowna, BC is largely due to the community sustainability and STS benefits that can result from a successful program. If successful, its resultant reduction in personal vehicle use in Kelowna would result in significant social, economic, and environmental benefits to the community that align well with Kelowna's stated sustainability and climate change goals. The three objectives for this research were as follows:

1. Conduct a comprehensive review of Kelowna and ComPASS to assess the Kelowna community and how it compares to other communities where community U-passes have been successful, most notably Boulder, Colorado's Neighbourhood ECO (NECO) Pass.
2. Use the findings of this review to design a ComPASS that could compete with and reduce vehicle use, including a stated preference survey of Kelowna's Glenmore community regarding their transportation beliefs, attitudes, habits, and specific desires for a ComPASS program.
3. Test this ComPASS design via a Kelowna pilot program, including revealed preference surveys and traffic counts, with specific focus on the Glenmore neighbourhood.

1.4 Thesis Structure

This thesis is divided into six chapters. The first chapter introduces the topic, background, research objectives, and the thesis structure. The second chapter contains literature reviews on successful and failed ComPASS type programs, the ComPASS economic model, multiple attribute decision making (MADM) tools, transit quality of service measures, pilot program design, and methods for analyzing survey data. Chapter Three reviews the demographics and transportation conditions in Kelowna, BC, with a focus on the Glenmore community. Kelowna's demographics were also compared to Boulder, Colorado, the home of the successful Neighbourhood ECO (NECO) Pass program. Chapter Four is dedicated to the Phase 1 Stated Preferences Survey, and is divided into two main sections: 1) Phase 1 methodology and 2) Phase 1 results and discussion. Chapter Five is dedicated to the Phase 2 Revealed Preferences Pilot Study and is also divided into two main sections: 1) Phase 2 methodology and 2) Phase 2 results and discussion. Finally, the sixth chapter sums the conclusions and recommendations drawn from the research, along with areas for future research considerations.

Chapter 2 Literature Review

The literature review chapter provides a foundation for understanding the theory, practices, lessons learned, and methodology used to design and implement community transportation passes. Section 2.1 explores successful and failed examples of ComPASS programs that have been implemented in North America to determine lessons learned that could be applied in Kelowna, BC. Section 2.2 reviews ComPASS economic model based on the Community Revenue Neutral (CRN) model. Section 2.3 reviews multiple attribute decision making (MADM) tools with a specific focus on the simple additive weighting (SAW) method. Section 2.4 reviews measures of transit levels of service (LOS) for headway, service coverage, and hours of service. Section 2.5 analyzes the best practices for implementing pilot programs, including sample sizes and pilot program duration. Finally, Section 2.7 summarizes the findings from the literature review.

To complete the background research, several databases and keywords were used to find information. Table 2.1 displays a list of the databases and keywords used in the literature review.

Table 2.1 Databases and keywords used for conducting the literature review

Database	Keywords	Topic
General UBC Library Search	Pedestrian, transit, accessibility, U-Pass, community transit pass, active transportation, walking, biking, cycling, discounted transit pass.	To determine what constitutes accessible transit for pedestrians.
General UBC Library Search	Discounted transit pass, group pass, revenue neutral, U-Pass, economic model.	To research economic models.
General UBC Library Search	Multiple attribute decision making, simple additive weighting, multi criteria decision making.	To research multiple attribute decision making tools.
General UBC Library Search	Level of service, transit, headway, coverage, service hours.	To research transit levels of service measures.
Transportation Research Information Services (TRIS)	Transit pass pilot program, length, duration, transit or bus, duration or length, pilot or trial.	Phase 2 Pilot Program Design.
PubMed	Pilot sample size calculations, Pilot study sample size.	To determine required sample size for a transportation pass pilot study.
Transportation Research Information Services (TRIS)	All-access, unlimited access, universal, transit pass, transportation pass, community transit pass, Boulder Colorado, road safety, sustainable communities, Community based social marketing, survey design, survey questions.	Phase 1 Survey and to research survey best practices.
General UBC Library Search	Generalized linear mixed models, general linear models, random effects, post-hoc analyses, IBM SPSS.	To research statistical tools and software.

2.1 Lessons Learned from Relevant ComPASS Programs in North America

The following section explores existing representative programs in North America; some successful and others unsuccessful. The successful programs include: 1) UBC's (both the Vancouver campus [2003 to present] and Okanagan campus [2008 to present]) U-Pass; 2) Boulder, Colorado's NECO Pass (1993 to present); and 3) the UBC 2004 ComPASS Demonstration Study in Vancouver. One unsuccessful program reviewed is SFU's UniverCity Community Transit pass in Burnaby (2006 to 2011).

2.1.1 Successes

2.1.1.1 UBC U-Pass

In September of 2003, UBC Vancouver implemented its student U-Pass program as part of a larger TDM strategy. This initiative evolved out of UBC's Official Community Plan (OCP) goals to increase transit ridership by 20%, and to decrease automobile use by 20% relative to 1997 levels (UBC TREK Program 2004, www.trek.ubc.ca). The U-Pass program was funded via student fees based on a community revenue neutral (CRN) model approved through a 70% majority student referendum. At UBC, the requirements for a referendum to pass is that 8% of eligible voters vote yes and win the majority of votes (AMS 2014).

To support the introduction of the UBC student U-Pass, a number of other program components were implemented, including:

- UBC U-Pass Infrastructure Improvements
    - Bike racks on buses;
    - Bike lanes;
    - End-of-trip facility improvements for cyclists;
    - Improved transit service to and from campus; and,
    - Restructured UBC course start times to smooth out peak morning transit use and to reduce conflict with the GVRD morning peak use.
- UBC U-Pass Bundled User Privileges
    - Unlimited access to TransLink Bus, SkyTrain, and SeaBus services in all zones;
    - Discounted West Coast Express fares;
    - Discounts at participating merchants through the ValU-Pass program;
    - Ride-matching services;
    - Emergency Ride Home Program; and,
    - Community Shuttles at UBC.

Measurements of transportation use have been taken since 1997 and used as a base for comparing future measurements (UBC TREK 2004). Between 1997 and 2003 there was a 30% increase in bus service to and from the UBC campus.

In the fall of 2002, one year before the introduction of the UBC student U-Pass program, 19% of all trips to and from campus were made via public transit (UBC 2013a). In the fall of 2003, the year that U-Pass was introduced, transit use doubled, and the portion of transit trips to and from campus increased to 39% (UBC 2013a). With the introduction of the U-Pass in 2003, public transit became the preferred mode of travel. As of 2003, the program was saving an estimated 16,000 tonnes of GHG emissions per year (UBC 2009). UBC Vancouver was also able to eliminate 3,000 parking stalls since 1997 (UBC 2013a).

In 2010, public transit made up 49% of the total mode split, with single occupancy vehicle (SOV) use down to 34%. Table 2.2 below shows the full time equivalent (FTE) student enrolment, transit trips per day, and private vehicle trips per day for the years 1997, 2002, 2003, and 2010.

Table 2.2 UBC U-Pass weekday person trips - 1997 versus 2010 (UBC TREK Program 2012)

	Number of People				Change from 1997 to 2010	
	Fall 1997	**Fall 2002**	**Fall 2003**	**Fall 2010**	**# Person Change**	**% Change**
FTE Student Enrolment per year	29,343	33,377	34,006	47,225	17,882	61%
Transit Trips per day	19,000	29,700	45,400	63,300	44,300	233%
Private Vehicle Trips per day	82,100	79,000	68,000	62,800	-18,500	-24%

The immediate increases in public transit use in 2003 (the year the U-Pass was implemented) suggests a direct correlation with the implementation of a U-Pass program. The continued increase from 2003 to 2010 suggests that this was not a temporary spike in popularity, but a growing trend. Moreover, this change was achieved despite an increase in FTE student enrolment (UBC 2013b).

In January 2013, a referendum asked students if they would like to renew the U-Pass program to year 2016 despite a cost increase to $35 per month in 2013, $36.25 per month in 2014 and $38 per month in 2015 (AMS 2013a). 22,405 students voted in the referendum (AMS 2013b) out of 49,896 total enrolled students (UBC 2013b), equivalent to 44.9% of the student population. Ninety-six percent (96%) of them voted in favour of continuing the program (AMS 2013b), an indicator of the popularity of the program.

The success and popularity of the student U-Pass program on the Vancouver campus was a deciding factor when a U-Pass program was considered for UBC's Okanagan campus in Kelowna. In March 2006, the UBC TREK Program conducted an online survey as part of the UBC SEEDS (Social Ecological

Economic Development Studies) Project to determine the feasibility of a U-Pass program at the Okanagan campus. Respondents identified seven key factors to running a successful U-Pass initiative in Kelowna (Ross 2006):

1. End of trip facilities: should be easily accessible and house all necessary facilities for alternate modes of travel including but not limited to washrooms with showers and adequate bike racks.
2. Merchant Discounts: 67% of students responded that they would find a U-Pass program more desirable if it offered merchant discounts.
3. Emergency rides home: to address fears of being stranded in the case of an emergency.
4. Recreational partnerships: offering discounted rates to a local recreation center to improve fitness and health of participants.
5. Combination of U-Pass and campus parking permits: combining the U-Pass with a parking pass would help promote carpooling for students who live in areas with inadequate transit service.
6. Infrastructure improvements: improved and increased bus stops.
7. Transit service improvements: increased service to and from campus. An increase in bus frequency and the addition of express routes to and from the UBCO campus have since been implemented.

In response to these requested improvements, the City of Kelowna and BC Transit improved transit service through additional routes and increased headway. A referendum was held at the Okanagan campus in November 2006 regarding the implementation of a UBC Okanagan U-Pass program. Thirty-four percent (34%) of the student body voted, of which 53% voted in favour of implementing the U-Pass (UBC 2010). When it launched at UBC Okanagan in 2007, transit usage went up by 50% in the first year (Pavlich 2010), likely a result of combined TDM strategies (e.g. U-Pass, increased parking fees, improved transit service). In Kelowna, the U-Pass employs a decal that can be mounted on a student card which must be flashed to a bus driver to gain local transit access. A new decal colour is offered each year to ensure that each student has paid for that year. In 2014, UBC Okanagan students paid $54 per semester for the U-Pass.

Both UBC Vancouver and UBC Okanagan student U-Pass programs have demonstrated positive effects of increased transit usage. Moreover, a U-Pass program supported by infrastructure improvements and bundled privileges helps to sustain the U-Pass program and realized reduced auto use as an effective long term TDM program. Although the U-Pass has been successful for student communities (which tend to be lower income, lower car ownership, and of a different culture), some adjustments would be required to apply the U-Pass concept to neighbourhoods in the general population. Boulder's Neighbourhood ECO (NECO) Pass and the 2004 ComPASS pilot in Vancouver demonstrate successful programs applied to communities rather than just student populations.

2.1.1.2 Neighbourhood Eco Pass (Boulder, Colorado)

Another successful community U-Pass program that has been in place for over 20 years and that caters to residents is the Boulder Neighbourhood ECO (NECO) Pass, one of the most successful and well known community transportation pass programs in North America. Located 25 miles northwest of Denver, Colorado, Boulder covers an area of 63.9 square kilometres and has a population of about 97,385 (US Census Bureau 2015a). Boulder acts as a sub-regional centre to Denver, and is home of the University of Colorado Boulder campus, the National Center for Atmospheric Research, and other business industries, such as the high tech industry and federal laboratories (Winfree 2002).

Boulder is a progressive city, having won countless awards for its sustainability initiatives, such as their cycling, pedestrian, and transit programs and infrastructure. The City of Boulder strongly values preserving its natural setting, and therefore has many sustainable land use and transportation initiatives set in place. In particular, Boulder has a dedicated 0.6% local city sales tax which is the primary revenue source for transportation initiatives (City of Boulder 2013).

2.1.2 Similarities with Kelowna

Like Boulder, Kelowna acts as major hub within the Okanagan, and is a centre for retail, commercial, and industrial industries, and is a centre for post-secondary education (City of Kelowna 2004). Furthermore, Boulder and Kelowna share similar climate, terrain, layout, socio-demographics, and civic sustainability goals.

Boulder is located at the foot of the Rocky Mountain range, while Kelowna is located in the Okanagan Valley between the Monashee Mountain Range to the West and the Coastal and Cascade Mountains to the East. Both locations are dry with average annual precipitation of 383 mm in Boulder, CO (The Weather Network 2015a), and 409 mm in Kelowna, BC (The Weather Network 2015b). The mean temperature for each month is also similar between the two cities, shown in Figure 2.1 below.

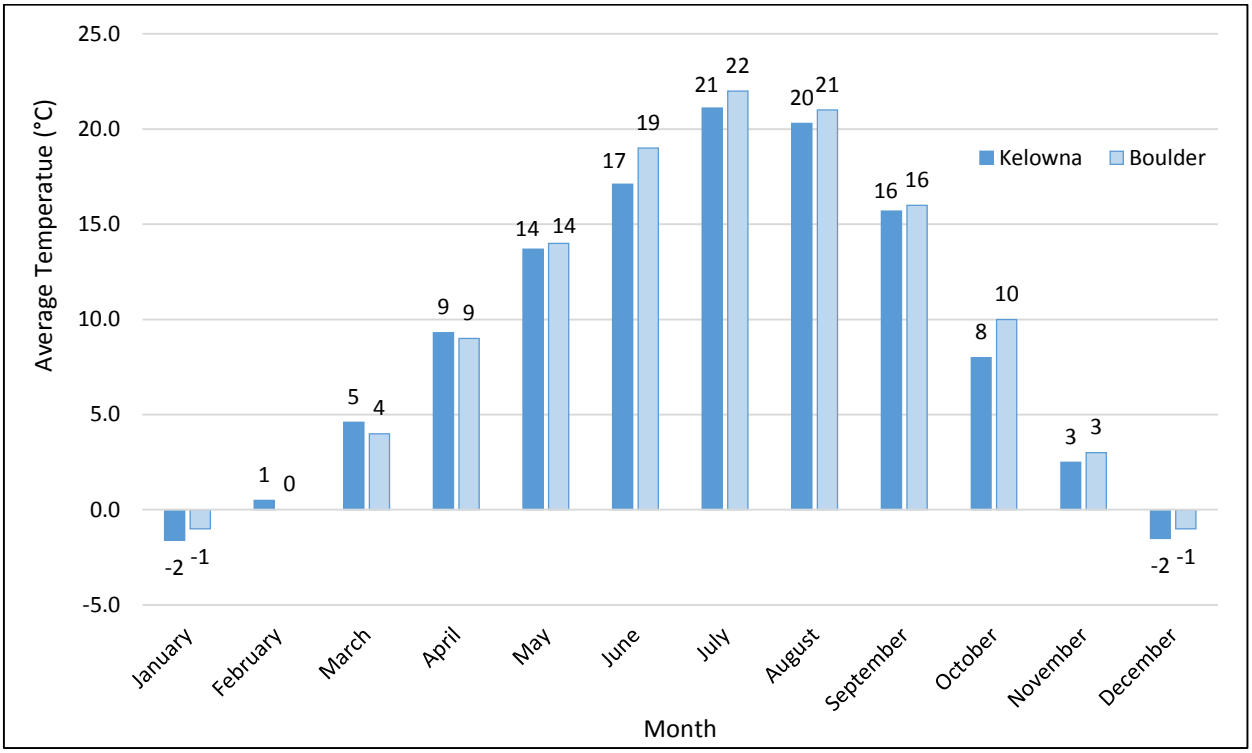

Figure 2.1 Average temperature in Boulder and Kelowna (The Weather Network 2015a; 2015b)

Furthermore, both cities have a population close to 100,000 people and a median household income of about $60,000 +/- $5,000 per year. Table 2.3 below outlines the general similarities and differences between Kelowna and Boulder.

Table 2.3 Similarities and differences between Boulder, CO and Kelowna, BC

Characteristic	Boulder, Colorado (US Census Bureau 2015a; 2015b)	Kelowna, BC (Statistics Canada 2012a)
Population	97,385	117,312
Historic Annual Growth Rates	0.3% / year (2000 to 2010)	1.9% / year (2006 to 2011)
Median Household Income	$56,312	$57,948 (Statistics Canada 2013)
Average Total precipitation per year	383 mm (The Weather Network 2015a)	409 mm (The Weather Network 2015b)
Median Age	29 years	43 years
Population Aged 65+	8.9 %	19.1 %
Area (km^2)	63.9 km^2	211.8 km^2
Average Population Density	1,524 people/km^2	554 people/km^2

Despite these similarities, Kelowna and Boulder do have some differences, such as median age and population density. Kelowna is an older community with a median age of 43 years (Statistics Canada 2012a), while Boulder's median age is 29 years (US Census Bureau 2015a). Those aged 65 years and older make up 19.1% of Kelowna's population (Statistics Canada 2012a), while they make up only 8.9% of Boulder's population (US Census Bureau 2015a). Furthermore, Boulder has a higher population density of about 1,524 people per square kilometre (US Census Bureau 2015a; 2015b), while Kelowna's average population density is 554 people per square kilometre (Statistics Canada 2012a). Therefore, a simple cookie cutter approach for a community transportation pass would not be wise; hence, the need for a "made in Kelowna" ComPASS. For a more in-depth review of Kelowna's demographics, refer to Chapter Three.

2.1.2.1.1 What is the Neighbourhood Eco Pass?

There are three main types of U-Passes available in Boulder: 1) the regular Eco Pass for employers and employees, 2) an RTD (Regional Transit District of Denver) College Pass for college and university students, and 3) a Neighbourhood Eco (NECO) Pass for residents (Boulder County 2014). The NECO pass includes annual RTD transit passes that can be used for all RTD light rail routes and local, express, and regional bus services (City of Boulder 2012). The NECO Pass also includes the option to pick up an "Eco Pass Extra" sticker at no additional cost. This sticker can be placed on users' cards to obtain merchant discounts at participating businesses. There are over 50 merchants involved with the program who all provide the discounts without payment from RTD (City of Boulder 2014a).

2.1.2.1.2 History of Boulder's Pass Programs

In 1993, the first NECO Pass pilot program was implemented (City of Boulder 2006a). By 1997, RTD implemented a permanent NECO Pass throughout the RTD district (City of Boulder 2006a). In combination with the implementation of the pass programs, the City of Boulder began making large changes to their transit system. Boulder received funding from the Intermodal Surface Transportation Efficiency Act (Winfree 2002), which allowed them to ask the community what they would like to see in a transit service and deliver their requests. In the early 1990s, the community responded that they wanted more frequent service and a more fun and lively atmosphere (Winfree 2002). Taking community input, Boulder implemented the Hop bus which services three main hubs in Boulder. The Hop was a huge success; daily ridership on the route increased eightfold within 4 months from the first day of implementation (Winfree 2002). After the Hop, came the Skip, which more than doubled its monthly ridership by the second year of implementation (Winfree 2002). Subsequently, the Jump, Leap, Bound, Stampede, and Dash routes were implemented (Winfree 2002). These huge ridership improvements were a result of effective marketing and schedule-free bus service running at 10 minute headways (Winfree

2002). Today, Boulder has about 4.9% of their residents regularly taking transit, while 10.1% of commuters regularly uses transit solely for their work commute (National Research Center 2013).

As of 2011, there were 42 neighbourhoods involved with the NECO Pass Program. Of these 42 neighbourhoods, there were 6,520 households eligible to receive NECO Passes, with 11,010 decals distributed (Hagelin 2011a). Each distributed decal represents one person who is eligible to use their NECO Pass card. Not everyone in a NECO Pass community will pick up a NECO Pass decal as not everyone who is eligible contributes to the neighbourhood fund. In 2015, the participating NECO Pass neighbourhood sizes ranged from 27 households to 531 households (City of Boulder 2015). On average, 55% of households in a NECO Pass neighbourhood participate and contribute to the program (Hagelin 2011b). The lowest participation rate is about 20%, with a high of 100% participation in some neighbourhoods (Hagelin 2011b). Some new condominiums include a NECO Pass as part of their monthly fees (Hagelin 2011b).

2.1.2.1.3 How the NECO Pass Works

There are three main requirements for a neighbourhood to be eligible to participate in the NECO Pass program (City of Boulder 2012), as follows:

1. The neighbourhood must a) be within RTD boundaries and b) be represented by either a registered neighbourhood association or a city/county government entity.
2. The neighbourhood requires a resident volunteer (called a neighbourhood coordinator) to represent the community to canvass their neighbourhood and to collect funding from the community. Enough money must be raised from the neighbourhood to meet the full RTD 12 month contract payment.
3. The neighbourhood must meet a minimum annual contract payment as decided by RTD. To determine the required contract amount, RTD conducts a survey to determine how much money RTD is currently making from the neighbourhood's transit use. In 2012, the minimum annual contract payment was $7,497 for the neighbourhood. If the actual usage currently generates less revenue than the minimum required contract payment, then the community will still be asked to pay the minimum contract payment of $7,497.

To determine the NECO Pass Program payment required in a Boulder community, consider an example neighbourhood with 150 residents which make up 50 households (3 residents per household). If 2% of residents (3 residents) in that community purchase a yearly regional transit pass from RTD for $1,936 per year, then RTD would typically receive $5,808 per year (3 x $1,936) from that neighbourhood. This is less than the minimum required payment of $7,497 for a year, so to be eligible for the NECO Pass Program the neighbourhood would need to raise at least $7,497 instead of $5,808 for the year. Although

in this case RTD would receive more funding after the NECO Pass Program is implemented, this minimum contract payment ensures that RTD can administer and sustain the program for the neighbourhood. Assuming 100% of households participate, then the $7,497 would be spread over all 50 households in the neighbourhood, meaning a unit price of $12.50 per household per month.

Alternatively, if 10% of residents (15 residents) in the same example community of 50 households purchase a yearly regional transit pass from RTD, then RTD would typically receive $29,040 per year (15 x $1,936) from that neighbourhood. Since this revenue of $29,040 is greater than the minimum required payment of $7,497 for a year, the neighbourhood must raise $29,040 for the year to be eligible for the NECO Pass Program. This ensures that RTD would make at least the same amount of money after the program as before the program. Assuming 100% of households participate, then the $29,040 would be spread over all 50 households, meaning a unit price of $48.40 per household per month. Figure 2.2 below shows a sample calculation demonstrating this concept.

Suppose 10% of a neighbourhood with 50 homes (assume 150 residents) take transit. The local transit system's revenue from that neighbourhood each year is:

$$(10\%)(150)\left(\$1{,}936 \text{ per} \frac{\text{pass}}{\text{year}}\right) = \$29{,}040 \text{ revenue/year/neighbourhood}$$

Since $29,040 per year is more than the minimum required contract payment of $7,497 per year, the neighbourhood will need to pay at least $29,040 per year.

The cost per household in the neighbourhood:

$$\frac{\$29{,}040/\text{year}}{50 \text{ households}} * \left(\frac{1 \text{ year}}{12 \text{ months}}\right) = \$48.40 \text{ per household per month at 100\% participation}$$

$$\frac{\$29{,}040/\text{year}}{25 \text{ households}} * \left(\frac{1 \text{ year}}{12 \text{ months}}\right) = \$96.80 \text{ per household per month at 50\% participation}$$

Figure 2.2 NECO Pass household price sample calculation

Merchant discounts through the Eco Pass Extra component are donated, so costs for this addition is not included in the NECO Pass price. GO Boulder relies heavily on volunteer neighbourhood coordinators to organize neighbourhoods and encourage them to participate in the NECO Pass Program. Originally, the City of Boulder had a full time employee to manage and organize neighbourhoods but budget cuts reduced this position to part time, from August to January (Hagelin 2011b). As a result, the City must now rely on neighbourhood coordinators for the success of the program. To support neighbourhood coordinators, the City of Boulder's website provides ample instruction and advice on how to get a NECO Pass Program started (https://bouldercolorado.gov/goboulder/neco-pass-program-resources).

2.1.2.1.4 Price of the NECO Pass

To determine the average cost per household, RTD conducts a survey for the applying NECO Pass within the defined neighbourhood boundary. The neighbourhood coordinator distributes the survey. The results of the survey, which quantifies existing transit usage in the neighbourhood, indicates to RTD how much the NECO Pass should cost on average per household for the particular neighbourhood.

The price of the NECO Pass varies greatly from household to household or neighbourhood to neighbourhood, as described in the previous sample calculation (Figure 2.2). The neighbourhood generally decides the payment method – whether it is accomplished by age (whether a student, adult, or senior), usage (whether a regional commuter, local commuter, infrequent user, or frequent user), a combination of both, or a blanket cost per household (every household must contribute). The method of payment is up to the neighbourhood or neighbourhood association, as long as they raise enough money to meet the contract requirement set out by RTD. Therefore, one household could contribute $80 ($6.70 per household per month) for the year knowing that they will not make much use of the pass, while another household could contribute $500 ($41.70 per household per month) if they know they will use the pass frequently. Boulder staff reported that some households simply make a payment to benefit the community as a whole, even if they will not use a NECO Pass. Alternatively, some households do not contribute at all. Overall, as long as the community meets the minimum contract requirement, the neighbourhood will be able to participate in the NECO Pass program. Once a neighbourhood is approved, those who wish can obtain a NECO Pass Card with their name and photo, and must pick up a decal to place on the back of their card. The decal indicates that they belong to an approved neighbourhood that has paid the contract amount.

It is not just the community members paying for the NECO Pass, however. The City of Boulder subsidizes 50% of the contract price for the neighbourhood's first year (City of Boulder 2014b). After the first year, the City of Boulder will contribute 30% to 35% per year (City of Boulder 2014b). These subsidies, which come from a 0.6% local city sales tax dedicated to the Boulder Transportation Division, reduce NECO Pass payments required by residents (City of Boulder 2013).

2.1.2.1.5 How the NECO Pass has Affected Boulder

Since 1990, a transportation survey has been conducted in Boulder every 2 to 3 years to understand how transportation habits are changing. In their most recent survey in 2012, there were 1,075 responses from a survey mailed out to 7,000 randomly selected households (with 376 returned as undelivered), resulting in a 16.2% response rate. Each survey year had a sample size of 1,000 or more, resulting in a margin of error of +/- 1.3% per year. The survey requested that households fill out a travel diary for a randomly assigned day in September 2012.

Survey results suggest that transportation mode splits of all trips have generally shifted away from automobile use, carpooling, and, toward walking, cycling, and transit use. Figure 2.3 displays how transportation shifts have changed from 1990 to 2012, showing how behaviours changed over a 22 year period likely as a result of the Eco Pass programs and other transportation initiatives in Boulder.

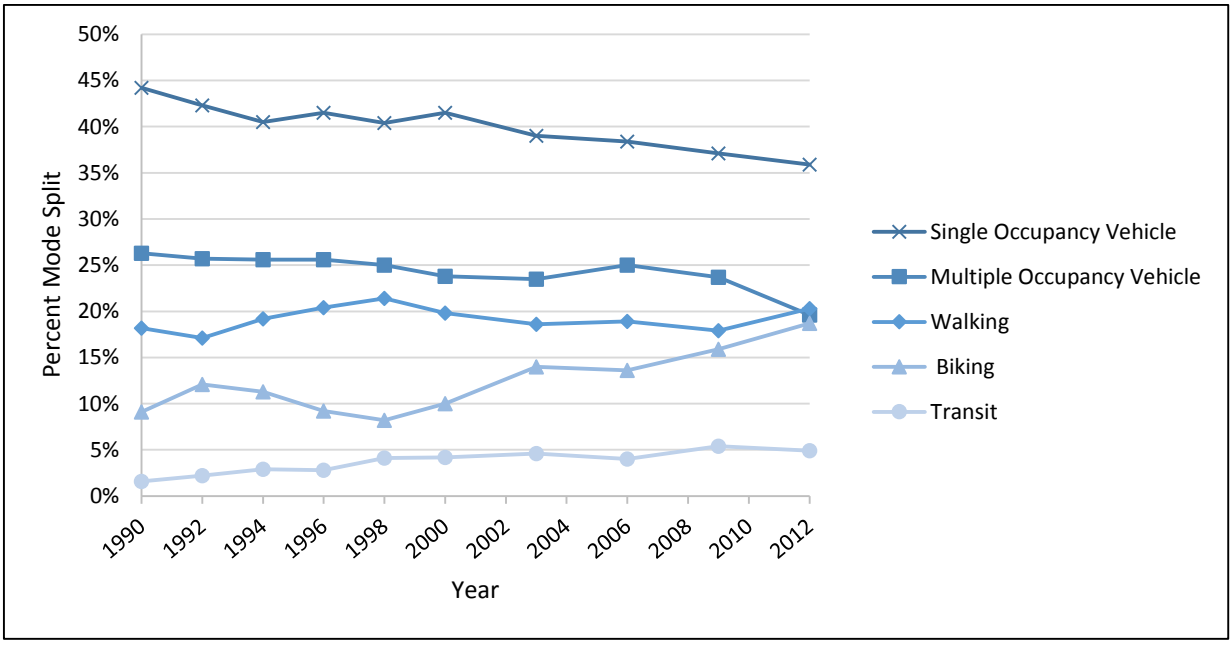

Figure 2.3 1990 to 2012 percent change in transportation mode (National Research Center 2013)

Table 2.4 below displays the percent changes from the program start in 1990 to the latest available data in 2012 for all transportation trip purposes (e.g. work, errands, tourism, etc.).

Table 2.4 Change in travel mode in Boulder, CO - 1990 to 2012 (National Research Center 2013)

Transportation Modes	1990 Mode Shares (Pop. 83,312)		2012 Mode Shares (Pop. 101,771)		Change from 1990 to 2012 (Pop. Increase: 22%)	
	Percentage	No. of People	Percentage	No. of People	Percent Change of Population	Change # of People
Vehicle (Driver)	44.2%	36,824	35.9%	36,536	-0.8%	-288
Carpool/Vanpool	26.3%	21,911	19.6%	19,947	-9.0%	-1,964
Transit	1.6%	1,333	4.9%	4,987	+274.1%	+3,654
School Bus	0.6%	500	0.6	610	22.0%	+110
Bicycle	9.1%	7,581	18.7%	19,031	+151.0%	+11,450
Foot	18.2%	15,163	20.3%	20,660	+36.3%	+5,497

*Grey highlighted rows signify mode shift percentages statistically significantly different between 1990 and 2012.

The change in the number of people who use each mode clearly shows that despite a 22% population increase, and despite a potentially higher number of registered vehicles in the area, the number of drivers decreased by 1% in terms of population, and from a 44% to 36% mode share. Moreover, the number of residents taking transit tripled, from a 1.6% to 4.9% mode share.

These significant shifts away from automobile use towards more sustainable transportation options have been attributed to the City of Boulder's innovative and forward thinking Eco Pass (Business, College, and Neighbourhood) programs in combination with significant transit service and infrastructure improvements and managed parking in the downtown area. Moreover, the increase in cycling is likely due to a combination of major improvements to cycling infrastructure, such as bicycling lanes, and a multi-use path system with 75 underpasses (City of Boulder 2014c), designated bicycle routes, accommodation of bikes on buses (option to bring bikes onboard or to store in luggage compartments) and at bus stops, and community programs.

These shifts from automobile use towards more sustainable transportation options also greatly reduce the amount of GHG emissions in Boulder. Each year, Eco Pass holders travel 4,252 VKT less by reducing vehicle use than non-Eco Pass holders per year (City of Boulder 2006b); a reduction of 41%. As annual VKTs reduce, so do the CO_2 emissions. The average NECO Pass cardholder creates 1.2 metric tons of CO_2 less than a non-Eco Pass holder per year (City of Boulder 2006b).

2.1.2.1.6 Future Considerations for Boulder's NECO Pass

GO Boulder will also be implementing a smart card to be used for NECO Passes. The smart card will be able to track actual usage for each NECO Pass holder (Hagelin 2011b). With this information, RTD will be able to price NECO Passes to ensure community revenue neutrality. Another future consideration for the NECO Pass program is to add additional privileges such as bike sharing, and car sharing to further enhance its attractiveness to more neighbours (Hagelin 2011b).

2.1.2.2 ComPASS Pilot (UBC Vancouver, BC)

Due to the popularity of the student U-Pass program at UBC and the Boulder NECO Pass program, UBC researchers became interested in instituting a similar pass for residents in Vancouver. As a result, a Vancouver ComPASS study was performed, where a demonstration study, surveys, and a pilot study were conducted. A comprehensive research report and ComPASS video was produced by the UBC TREK Program. The UBC ComPASS Demonstration Study was funded in part with a $100,000 research grant from the Federation of Canadian Municipalities (FCM) Green Municipal Enabling Fund, and $50,000 from TransLink, the regional transportation authority.

2.1.2.2.1 Phase 1: Demonstration Study – Transit Passes

The demonstration study monitored the transportation habits of 140 participant families (214 residents) who were given transit passes for two months through multiple surveys. If all participant family household members were UBC students, existing transit users, did not have a driver's license, or were planning to move that calendar year, then that household was excluded from the study. This was done to prevent the skewing of data as existing transit users and U-Pass holders would likely use transit more often without the aid of a ComPASS (UBC TREK Program 2004). Surveys were completed before, during, immediately after, and 6 months after the demonstration study ended. A control group also consisting of 140 families (229 residents) were surveyed parallel to the 140 participant families.

Figure 2.4 shows the percentage of respondents in the control and participating groups that reported using transit in the past week for the post, mid, end, and pre-trial surveys

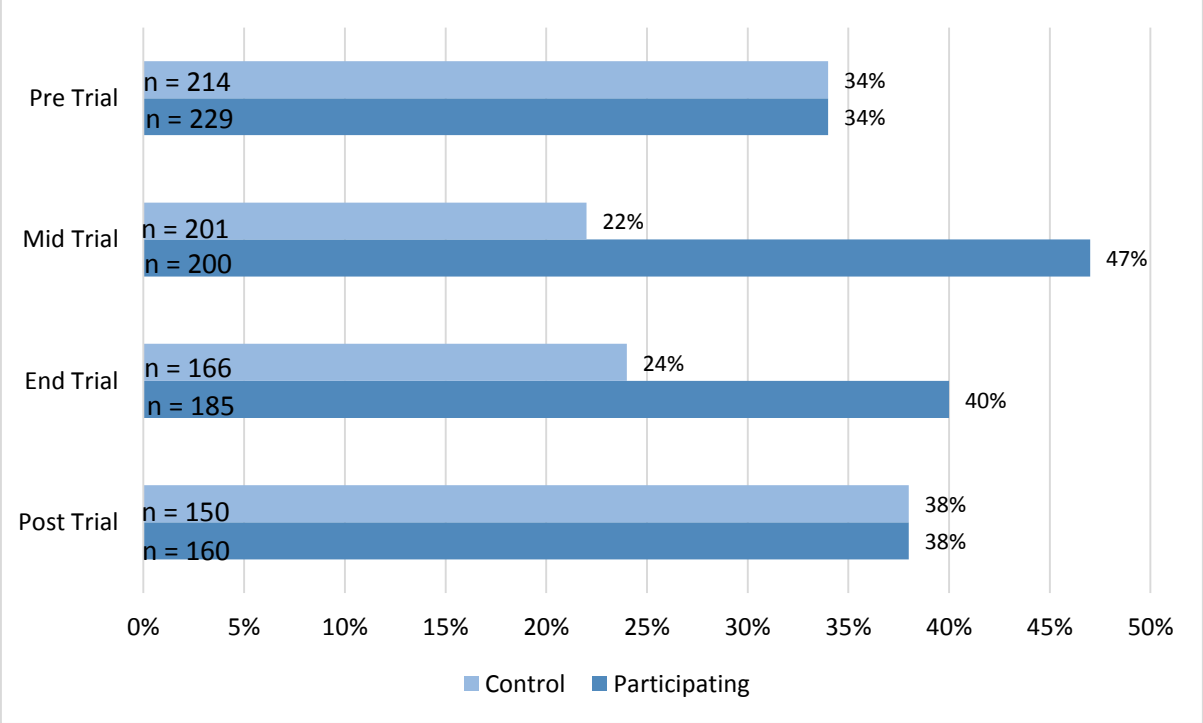

Figure 2.4 ComPASS demonstration study transit use in the past week (UBC TREK Program 2004)

In the pre-trial (before participating residents were provided transit passes), the participating and control households reported the same transit usage. By the end trial (before the transit passes expired), 40% of participating family members reported using transit in the past week, while only 24% of control family members reported using transit, showing that participating residents were 67% more likely to use transit than control residents. By the post-trial (6 months after the trial finished), transit use was again the same

between control and participating households, demonstrating that a long term intervention like ComPASS is required to increase transit use (UBC TREK Program 2004).

2.1.2.2.2 Phase 2: Greater Vancouver Regional District (GVRD) Survey

A telephone survey of 1,000 participants within the greater Vancouver region revealed that about two thirds of respondents demonstrated an interest in participating in a local ComPASS program (UBC TREK Program 2004). Results of the survey suggest that a ComPASS neighbourhood should be carefully selected based on four main factors, including (UBC TREK Program 2004):

1. A younger than average population;
2. A lower income neighbourhood;
3. Good transit service with fast and frequent trips; and,
4. Lower than average automobile ownership.

The respondents suggested a ComPASS price of under $30 dollars per month per household was needed to ensure the participation of more residents in the program (UBC TREK Program 2004).

2.1.2.2.3 Phase 3: Pilot Study - ComPASS

From the initial two phases, a third phase included a more comprehensive ComPASS design. Fourteen households were chosen for the three month pilot study under the stipulation that they must own at least one vehicle (UBC TREK Program 2004). The pilot program included the following additional privileges (UBC TREK Program 2004):

- Transit pass;
- Emergency taxi ride home service;
- Car sharing membership;
- Local school bus service;
- Local shopping shuttle bus service;
- Carpool ride matching service;
- Bike safety training;
- Bike trailer/handcart loaner system;
- Family pass to the local recreation centre; and,
- Local merchant discounts.

Upon completion of the pilot study, all of the above privileges were rated high among the participants, except for the bike safety training, the shuttle service, and the ride matching service (UBC TREK

Program 2004). Additional discounts and improved transit information were among the suggestions put forward by participants to improve the ComPASS program upon completion of the pilot study (UBC TREK Program 2004). As a result of the pilot study, three variables were identified to promote the success of a future ComPASS program, as follows (UBC TREK Program 2004):

1. Clearly identify the benefits of being a ComPASS member: this included stating the benefits of using alternative modes of transportation as well as stating the discounts versus full prices and other benefits included as privileges.
2. Help people to use the ComPASS: this included guidance on how one can make use of the privileges granted by ComPASS as well as encouraging members to make use of public transit.
3. Add value to ComPASS: it was clear from pilot program participants that a ComPASS system would need to include additional privileges and not be limited to just a transit pass.

Overall, the yearlong UBC study results indicated that the Vancouver ComPASS had the potential to be successful and positively influence communities and the environment (UBC TREK Program 2004). Overall, the Vancouver ComPASS was estimated to reduce CO_2 emissions by 4 kg per household each day (UBC TREK Program 2004).

2.1.3 Failures

The only unsuccessful U-Pass program reviewed, the SFU/TransLink UniverCity Community Transit Pass in Burnaby, BC, is described below.

2.1.3.1 UniverCity Community Transit Pass (Burnaby, BC)

Selecting parts of the UBC TREK Program's ComPASS Demonstration Study (2004) results, a community transit pass program was launched in 2006 at UniverCity, a residential development neighbouring Simon Fraser University (SFU) in Burnaby, BC. UniverCity currently houses about 3,000 residents, but will accommodate 10,000 residents once development is fully complete (UniverCity 2015a). UniverCity was built upon principles of sustainability and employs mixed-use housing, transit oriented planning, green building requirements, and sustainable transportation options (UniverCity 2015a) which included their Community Transit Pass.

2.1.3.1.1 What is the UniverCity Community Transit Pass?

UniverCity's Community Transit Pass was a three zone transit pass option available to all residents of the UniverCity community, but differs from Boulder's NECO Pass (and recommendations of the UBC ComPASS study) in three ways:

1. The pass was applied to individuals rather than households;
2. The neighbourhood did not necessarily need to raise money to meet a minimum contract requirement for the local transit company; and,
3. The pass was largely subsidized by a bank (VanCity), the developer (SFU Community Trust), and the transit service provider (TransLink) (Roseland 2013).

In particular, this unsustainable funding model was a distinct departure from all previous U-Pass programs and led to its eventual demise.

There were additional privileges indirectly associated with the pass available to UniverCity residents, including (UniverCity 2015b):

- Community card came at no additional cost and gave residents of UniverCity free or discounted access to various amenities at SFU. Such amenities included access to the SFU library collections, discounted access to SFU's athletic and recreational facilities and programs, discounted access to SFU events (such as theatre productions and sporting events), and summer camps for UniverCity children.
- Car sharing was available through membership in the Modo Car Co-op (www.modo.coop) at an additional fee according to P. Hui (personal communication, 2011a) for UniverCity residents.

Although these amenities were not necessarily combined into a single transportation pass, they complemented each other to essentially create a sustainable transportation pass package.

In 2008, VanCity Financial Services dropped out of the program, no longer contributing funds to the Community Transit pass (UniverCity 2011). Consequently, the subsidies were left to the SFU Community Trust and TransLink, who shortly thereafter cancelled the program in December 2011 (UniverCity 2011).

The Community Transit Pass was priced at $29.67 per participating resident per month (UniverCity 2010), or about $90 per month per 3 person household, plus a $50 first time application fee for each pass (TransLink 2005). Participants saved 80% of the price of a standard three zone transit pass from TransLink by purchasing the Community Transit Pass, according to P. Hui (personal communication, 2011b).

Although only 25% of UniverCity residents were enrolled in the Community Transit Pass program (SFU Community Trust 2011), almost 40% of all UniverCity residents used transit, whether enrolled in the program or not, which was three times the regional average (SFU Community Trust 2011). Surveys over time were not conducted in the UniverCity community regarding transportation trends, therefore, it was

difficult to accurately determine how sustainable transportation options were affected by the Community Transit Pass program.

On June 22, 2011, TransLink distributed a letter to UniverCity residents stating that they could no longer subsidize the program and would be ending the program on December 31, 2011 (TransLink 2011).

2.1.3.1.2 Lessons Learned from the UniverCity Community Transit Pass

Given 25% participation, while it lasted, the UniverCity Community Transit Pass program was likely effective in encouraging more transit use. However, two program flaws led to its demise: 1) lack of monitoring; and 2) an unsustainable funding model.

Changes in attitudes, beliefs, and behaviours were not thoroughly monitored over time. Had these changes been measured, it is possible that decision makers would have more readily observed the benefits of the program. Consequently the program may not have been discontinued.

A second flaw with the program was the funding model. Up to 80% of the Community Transit Pass funding was built on subsidies from TransLink, the SFU Community Trust, and the corporate partner, VanCity. With only a few supporters each funding a large sum of money towards the program, there was a high risk of failure of the program. If only one of the three supporters ceased to contribute funding, the entire program was jeopardized. When VanCity discontinued their funding, a heavier financial burden was placed upon TransLink and the SFU Community Trust, which could not be sustained. Moreover, the price was too high at $30 per person per month in addition to a $50 registration fee. The pricing model would have been more successful if it was based on the community revenue neutral (CRN) model, if it was priced per household per month, and if it reflected actual transit usage. The Community Transit Pass program would likely have continued for much longer if it had been based on the more sustainable CRN model, with residents paying the full cost of transit usage and subsidizing fellow residents.

2.2 Community Revenue Neutral Model

Most successful ComPASS type programs have been sustained due to the application of the community revenue neutral (CRN) economic model. The CRN model ensures that a community transportation pass program produces at least as much revenue generated before the introduction of the program, including transit passes, recreation services, etc.

For example, consider a neighbourhood of 150 residents living in 50 households. Assume that 5 residents (about 3% of the neighbourhood) regularly buy $60 transit passes per month. This means that the local transit authority generates $300 per month from that neighbourhood as a whole. With the implementation of a community transportation pass, the CRN model spreads that $300 over all 50 households, to give

each household member a transit pass for $6.00 per household per month based on 100% participation. If participation rates decrease, for example to 50%, then the price per household per month would double to $12 per household per month. Figure 2.5 below shows a sample calculation of the CRN model.

Pre ComPASS Neighbourhood Revenue:
The local transit system revenue from 5 people who buy bus passes living in a neighbourhood with 50 households:
5 x $60 per pass = $300 revenue/month

Using CRN Model:
The revenue is dispersed over all households in the same neighbourhood:
$300 / 50 households = $6 per household/month at 100% participation (all 50 households)
$300 / 25 households = $12 per household/month at 50% participation (25 households)

Figure 2.5 CRN economic model sample calculation

Overall, using the CRN model, the local transit authority would still generate the same revenue as before the pass program, but with an expected increase in ridership on otherwise underutilized buses thus improving transit cost effectiveness. This means that the program essentially becomes self-sustaining with little cost to the organization running the program (e.g. municipality).

The CRN model can also be applied to the additional benefits in a community transportation pass package, such as recreation centre passes, therefore giving each household multiple privileges at a discounted price. Following are the three main CRN model principles:

1. Revenue - transit authority and other service providers do not lose existing (pre ComPASS) revenue;
2. Price - participants collectively pay the price such that the total paid equals existing revenue; and,
3. Community - existing revenue amount is based on that which is currently paid by users within a geographic boundary containing participants, with adjustments as needed for program administration and overhead cost.

2.3 Multiple Attribute Decision Making

Multiple Attribute Decision Making (MADM) involves making decisions between various alternatives characterized by several attributes (Hwang and Yoon 1981). An example of MADM could involve the selection of a used vehicle within several possible options based on various criteria (e.g. fuel efficiency, kilometres, and price). In this example, MADM involves balancing these attributes to ensure fuel efficiency is maximized, kilometres on the odometer are minimized, and the price is minimized.

Regardless of the problem or methodology used, there are several common MADM components, described in Table 2.5.

Table 2.5 Multiple attribute decision making (MADM) components (Yoon and Hwang 1995)

Common MADM Components	Description
Alternatives	The alternatives are essentially the number of choices or options the decision maker (DM) is comparing in the MADM process. Using the used vehicle selection example, the alternatives would be the various vehicles the DM is choosing between. For this example, there are i alternatives, where A_i represents the i^{th} alternative.
Multiple Attributes	Each alternative has multiple attributes, or criteria, of interest to the DM. Using the used vehicle selection example, the attributes for each alternative would be fuel efficiency, kilometres, and price. For this example, there are j attributes, where X_j represents the j^{th} attribute.
Incommensurable Units	Incommensurable units refers to the units of measurement for each considered attribute. For example, fuel efficiency may be measured in litres per 100 kilometres and price would be measured in dollars.
Attribute Weights	The attribute weights describes the relative importance of each attribute. Weights can be selected by the DM based on experience or by using various methodologies to find a suitable attribute weight.
Decision Matrix	An MADM problem can be expressed as a decision matrix where columns represent alternatives (A_i), and rows represent attributes (X_j). Within the decision matrix, x_{ij} represents the value for the j^{th} attribute of the i^{th} alternative.

One of the most common MADM methods is the Simple Additive Weighting (SAW) method, which is described further in the next section.

2.3.1 Simple Additive Weighting (SAW) Method

The Simple Additive Weighting (SAW) Method, one of the most common MADM methods, can be described using the following equation (Yoon and Hwang 1995):

$$V(A_i) = V_i = \sum_{j=1}^{n} w_j v_j(x_{ij}), \quad i = 1, \ldots, m$$

Where $V(A_i)$ is the value function of alternative A_i, w_j is a weight function of attribute X_j, $v_j(.)$ is a value function of attribute X_j, and x_{ij} represents the value for j^{th} attribute of the i^{th} alternative (Yoon and Hwang 1995).

To enable the comparison of different attributes with different units (e.g. fuel efficiency, number of kilometres, and price), the attributes should first be normalized. There are various ways to normalize attributes, one of which is linear normalization. Linear normalization is described with the following equation (Yoon and Hwang 1995):

$$r_{ij} = \frac{x_{ij}}{x_j^*}, \qquad i = 1, \ldots, m; j = 1, \ldots, n$$

Where r_{ij} is the normalized value of x_{ij}, and x_j^* is the maximum value of the j^{th} attribute (Yoon and Hwang 1995). Once the attributes are normalized, the SAW method equation adjusts to the following equation (Yoon and Hwang 1995):

$$V(A_i) = V_i = \sum_{j=1}^{n} w_j r_{ij}, \qquad i = 1, \ldots, m$$

Once the value functions for all alternatives are found, they are ranked in order from highest to lowest (highest being the more favourable alternative and lowest being the least favourable alternative). Based on the ranks, the DM can select one or more optimum alternatives.

2.4 Transit Quality of Service

If a municipality tends to have low transit usage, there is often a belief that this is because there is no demand for transit. However, in reality, transit demand could be much higher than actual transit ridership due to poor level of service (LOS) (Vuchic 2005). LOS can be presented in different forms, but for this research it is presented in six letter grades from A (best service) to F (worst service). These LOS grades represent transit service from transit riders' perspectives (TRB 1999).

The Transportation Research Board's (TRB) 2010 Highway Capacity Manual (HCM) is a fundamental reference document for transportation engineers and planners. The HCM (2010) lists TRB's Transit Capacity and Quality of Service Manual (TCQSM), Second Edition, (2003) as the transit counterpart document to HCM (2010). The TCQSM lists several different measures of transit performance, which can be grouped into 1) service availability, and 2) comfort and convenience. Table 2.6 below lists several measures categorized into these two measures of transit performance.

Table 2.6 Measures of transit performance (TRB 2003)

Service Availability	Comfort and Convenience
• Service Coverage • Scheduling • Capacity • Information	• Passenger Loads • Reliability • Travel Time • Safety and Security • Cost • Appearance and Comfort

The TCQSM (2003) also outlines LOS ratings for various transit performance measures, including: 1) headway, 2) hours of service, and 3) service coverage.

Headway is defined as the interval between two successive transit vehicles pass a fixed point (e.g. transit stop) on a transit route in the same direction (Vuchic 2005). Transit riders prefer shorter headways, as this generally means shorter wait times and more flexibility. In contrast, maintaining shorter headways is expensive for transit operators, so a compromise must be balanced.

Table 2.7 below outlines different LOS for different headway intervals ranging from LOS A (less than 10 minute headway) to LOS F (greater than one hour headway).

Table 2.7 Service headway level of service (LOS) (TRB 2003)

LOS	Headway (minutes)	Comments
A	<10	Passengers don't need schedules
B	10-14	Frequent service, passengers consult schedules
C	15-20	Maximum desirable time to wait if bus/train missed
D	21-30	Service unattractive to choice riders
E	31-60	Service available during hour
F	>60	Service unattractive to all riders

Service span measures the number of hours in a day a particular route operates. This time is measured by subtracting the first departure time from the last departure time and adding one hour. The additional one hour accounts for the additional service time that the last bus departure operates. If a service span has more than an hour interval between departure times, then that time is not counted as service span. Instead, there would be at least two service spans added together.

It is possible to measure service span by either trip or route. Measuring by trip would mean measuring service hours from a particular origin to a destination, and not the particular bus route number. Several bus routes could operate along similar routes, therefore potentially increasing the service span and as a result increasing the LOS. Table 2.8 shows the hours per day intervals for each LOS.

Table 2.8 Hours of service level of service (LOS) (TRB 2003)

LOS	Hours per Day	Comments
A	19-24	Night or owl service provided
B	17-18	Late evening service provided
C	14-16	Early evening service provided
D	12-13	Daytime service provided
E	4-11	Peak hour serviced/limited midday service
F	0-3	Very limited or no service

To receive a LOS A, the transit route must operate for 19 hours or more. In contrast, LOS F means a service span of three hours or less. To measure the hours of service, the first departure time is subtracted from the last departure time when service is offered at least hourly. One hour is then added to the calculated time to account for the last hour of provided service (TRB 2003). When service is offered

infrequently (> 60 minute headways) then one hour was considered as the service span for a departure time (e.g. departures at 7:45 am and 11:45 am = 2 hours of service). Several service spans can be added together for a single route in a single day.

Another measure of quality is service coverage. Service coverage can be expressed in different units, particularly: 1) route kilometres per square kilometre, and 2) percentage of the system area covered by transit (TRB 2003). This measure particularly examines how much an area serves potential transit riders. In particular, 75 – 80% of pedestrians are willing to walk 400 m or less (5 minute walk at 5 km/h) to access transit (TRB 2003). This means that areas within about 400 m or less are within accessible service coverage. Accessible cycling distances are typically between 3.5 and 7 km (casual cyclists) and between 7 to 10 km (experienced cyclists) (TRB 2003). Assuming cyclists prefer a five minute bike trip to access a transit stop (at 20 to 25 km/h), this means cyclists would be willing to travel about 1.6 to 2 km (TRB 2003). Considering cyclist trips in coverage greatly increases potential transit service coverage, however provisions to integrate bikes with transit (e.g. bike racks at bus stops and on buses) should be implemented for this to work. Table 2.9 below shows the LOS for different coverage percentages.

Table 2.9 Service coverage level of service (LOS) (TRB 2003)

LOS	% Transit-Supportive Area Covered
A	90.0 - 100
B	80.0 – 89.9
C	70.0 – 79.9
D	60.0 – 69.9
E	50.0 – 59.9
F	< 50

To receive a LOS A, transit coverage must be 90 to 100%. Service coverage must be less than 50% for the route to receive LOS F.

2.5 Pilot Program Design

Piloting a program provides an opportunity to refine the program design before it is permanently implemented (McKenzie-Mohr 2011; Lancaster et al. 2004). There must be at least two groups involved: the study group and the control group. The study group would include those who take part in the treatment while the participants within the control group are not exposed to the design treatment. The two groups provide a comparison to accommodate for uncontrollable circumstances that may influence transportation behaviours such as increases in gasoline prices, road closures, or seasonal changes. To ensure statistical validity and reduced bias, participants must be randomly selected for each group (McKenzie-Mohr 2011).

Before the pilot can begin, a benchmark must be established to measure current attitudes, behaviours, and beliefs regarding transportation (McKenzie-Mohr 2011). This could be accomplished through a variation of methods, including traffic counts, ridership counts, and surveys. Establishing a benchmark allows the researcher to compare effects of the pilot program with measures from before the pilot began. Sample size calculations must also take place before recruitment begins to ensure the study is statistically valid and to direct efforts in a manner that will gather sufficient interest from potential participants (Lancaster et al. 2004). Another important factor to consider when designing a pilot program is that the components must not be so expensive that it would be unaffordable to implement on the larger scale (McKenzie-Mohr 2011). This ensures that a potential permanent program does not fail through the inability to provide popular components among pilot participants when more realistic options could have been tested.

2.5.1 Pilot Program Durations

Several transportation pass-related pilot programs were reviewed to determine the optimum pilot program duration. One week, one month, and greater durations were reviewed to assess effectiveness.

2.5.1.1 Weekly Pilot Programs

Abou-Zeid et al. (2012) conducted a pilot program focussing on the happiness of travellers based on travel mode. The pilot program was implemented in Switzerland where 30 private auto drivers were required to use public transportation for their commute 2-3 times in a one week study. No control group was included. Reasons for choosing one week as the study duration were not given. Surveys were conducted before, immediately after, and several months after the study to measure traveller satisfaction, and perceptions on commuting by personal versus public transportation. Also taken into consideration were the characteristics of specific commutes (amount of traffic congestion, length, etc.), and traveller demographics. Through the analysis, researchers discovered that traveller satisfaction was correlated with the transportation mode used. In general, participants' satisfaction with their vehicle showed a hedonic treadmill, meaning that they preferred their vehicle during the treatment period more than before or after the treatment. None of the participants fully converted to public transportation users after the study. Researchers suggested that to improve satisfaction with transit, features such as driver friendliness, timeliness, and cleanliness could be improved. However, it was also important to consider whether one week might have been too short to influence transportation behaviours.

2.5.1.2 One-Month Pilot Programs

Several pilot programs studying transportation behaviours involved giving participants a one month free transit pass. Fujii and Kitamura (2003) wanted to determine the effects of giving drivers a free one month public transportation pass. Forty-three students from Kyoto University were gathered as study

participants and were randomly assigned to the study group (23 participants) or the control group (20 participants). A survey was conducted before, immediately after, and again one month after the study to assess changes in attitudes, habits, and behaviours. The study group and the control group were not informed of each other so as not to induce unnatural behaviours. Results of the study showed that immediately after and one month after the study, attitudes towards using the bus were more positive among the study group than before the study started. Frequency of bus use also increased 20% after the study ended, but the habitual use of the transit system still did not change significantly. However, it was found that personal vehicle use habits significantly decreased immediately after the intervention, and increased a small amount one month after the pilot program. In contrast, there were no significant changes of auto use habits within the control group. Bus habits increased within the control group, which remains unexplained. This could mean that one month was insufficient for measuring the effects of a free transit pass on transportation behaviour.

Another study was conducted between 2002 and 2003, where drivers in Copenhagen were given a free one month transit travel card (Thogerson 2009). Attitudes, beliefs, and behaviours were measured before the project began, immediately after, and again 6 months after completion. The final sample included 597 participants, 224 who served as the control group, and 373 received the free one month transit travel card. Those who had received a free one month transit travel card increased their use of public transit immediately after and 6 months after the study was completed, and used transit two times more than the control group. Ultimately, this study suggests that the free one month travel card could significantly change driver behaviour. The results of this study may have been more reliable than those of Fujii and Katamura (2003) as there was a higher number of participants, which increased statistical validity.

Both of these one month pilot studies concluded that behaviours shifted in favour of public transit relative to the personal vehicle. Although these programs showed favourable results for behaviour change, they did not explain why they chose their specific durations.

2.5.1.3 Greater than One-Month Pilot Programs

The 2004 UBC Vancouver study employed a two month ComPASS pilot program between September and October in 2003 (UBC TREK Program 2004). Households were recruited through advertising in local housing publications and by mounting posters in the community. This method of recruitment may have increased bias of the results as households interested in transit (and other offered components) would have been more likely to contact researchers. Fourteen households were recruited to participate in the pilot program. Before the pilot began, a meeting was held to inform the 14 households on the program, to give instructions, and to answer any questions or concerns. Households were given information packages with basic instructions on how to use various pilot program components (bus pass, emergency taxi rides

home, school bus, bike safety training courses, aquatic centre, etc.) (UBC TREK Program 2004). A control group was not selected for the pilot study.

As the 2004 Vancouver ComPASS Demonstration Study is the framework for the Glenmore ComPASS in Kelowna and closest in terms of culture and geographic location, it was essential to consider their pilot program design. UBC researchers chose 14 households for a length of two months. It could be argued that 14 households was not statistically valid and two months may not have been long enough, but these numbers were constrained by the level of community interest, budget, and/or time constraints. Even though the two month pilot program proved to be a success, the issue of pilot program duration must be delved into further to understand the rationale for this choice. Consequently, several additional studies of lengths greater than one month were examined to determine the optimal pilot program duration.

Zhou and Schweitzer (2011) conducted research on a social experiment called "Dump the Pump" that took place at the University of California's Los Angeles (UCLA) Campus in 2008. The study took place for three months, and during this time participants received a free bus pass if they gave up their parking permits. After three months, the participants could choose to continue using their transit pass for a 50% discount or could go back to purchasing a parking pass. 384 drivers participated, and of these participants, 47% permanently discontinued their parking passes in favour of AT. Once again, the researchers did not provide justification for selecting a three month duration. However, in another report reflecting on the same pilot program, the authors acknowledged that the selection of program duration is an issue for pilot program design (Gould and Zhou 2010). They suggested that further research be completed to determine if the optimal time for such an experiment should be a week, month, or more (Gould and Zhou 2010).

Another earlier pilot program for the UCLA campus called the BruinGO was conducted for eight months between October 2000 and June 2001 (Brown et al. 2003). The pilot included giving complimentary transit passes for students and faculty who used a particular transit line, called the Blue Bus. There were 62,700 eligible transit riders, which cost UCLA $640,000 for the program. A survey was conducted before the BruinGO pilot program began and again after six months of operation (Brown et al. 2003). Results showed that the pilot influenced an increase of employee and student transit ridership by 123%, and a reduction in personal vehicle use by 8%. This suggests that the eight month pilot program was successful in promoting transit use. Although it may appear that eight months may have more of an effect on transit ridership compared to shorter studies, the studies may not be entirely comparable. Different methods were used and different conditions were present, which would influence each program differently. Such differences include participant demographics, location, and transit services available.

A one year pilot program was implemented in Victoria, BC and primarily focused on seniors (Stepaniuk et al. 2008). The goal of the pilot was to determine what would influence seniors to use public transportation more often. The 41 participants in the study were divided into three main groups:

1. Those who received a free bus pass along with transit use training;
2. Those who only received transit use training without a free bus pass; and,
3. Those who were left as a control group.

Each group was surveyed prior to the study, and again three, six, and 12 months after the study commenced. It was found that the two groups that had transit use training were equally likely to use transit even though one group received a free transit pass. This pilot again demonstrated that providing a free transit pass (and in this case combined with education) has the potential to influence transportation behaviours in favour of public transportation. However, once again there was no discussion in the research as to why the duration of one year was selected.

2.5.2 Pilot Program Sample Size

A successful study relies on an appropriate sample size; sample sizes that are too small could detect results that are not meaningful, while overly large sample sizes can needlessly waste available time and budget (Guo et al. 2013).

Repeated measures designs (RMDs) complicate the process of sample size selection (Guo et al. 2013). The correlation between subjects in RMDs must be accounted for; some software packages are available to accomplish this but can oversimplify assumptions, giving researchers false confidence in sample sizes, while other software packages may be more accurate, but require sufficient programming skills (Guo et al. 2013).

To complete an accurate sample size calculation, six main inputs must be known, including (Guo et al. 2013):

1. Primary hypothesis being tested;
2. Type I error rate (α);
3. Predictor variables;
4. Smallest important difference in means;
5. Variances of the response variables; and,
6. Correlations among repeated measures.

Table 2.10 outlines the description of each of these sample size calculation inputs.

Table 2.10 Required inputs for sample size calculation (Guo et al. 2013)

Source	Explanation
Primary Hypothesis	Hypothesis testing, also known as significance testing, is a technique of statistical inference. Hypothesis testing allows the researcher to compare the difference between datasets. Where μ_1 is the mean of one sample, and μ_2 is the mean of another sample, the null hypothesis is known as H_0: $\mu_1 = \mu_2$, while the two-sided alternative hypothesis is known as H_1: $\mu_1 \neq \mu_2$. The null hypothesis tests whether the mean from the first dataset is statistically the same as the mean of the second dataset. The two-sided alternative hypothesis tests whether the means between the datasets are not the same. The desired hypothesis to test must be specified to calculate the required sample size.
Type I Error Rate (α)	Type I error, also known as the significance level, is signified by the variable alpha (α), and represents the error that the primary hypothesis is rejected when it should be accepted (Montgomery 2009). Generally, researchers strive to maintain their alpha at the 5% level (Noordzij et al. 2011), meaning that there is a 5% probability that we reject the hypothesis when it is actually true. In addition to 5%, the most commonly used type I errors used are 10% and 1% (Noymer 2008).
Predictor Variables	Predictor variables are the intervention tested on the study subjects, whether control or type of treatment (Guo et al. 2013).
Smallest Scientifically Important Difference	The critical difference in means is the difference in samples that researchers wish to detect, denoted by ($\mu_1 - \mu_2$) (Montgomery 2009; Noordzij et al. 2011).
Variance of Repeated Measurements	The variance of the repeated measures can be estimated using the following three methods (Guo et al. 2013): 1) Estimated from data from previous studies; 2) Estimated with data from a pilot study; or, 3) Educated speculation based on experience. The residual variance must be selected, which is the variance not explained by the predictors (Guo et al. 2013).
Correlations among Repeated Measurements	Correlations among repeated measurements would also be estimated using previous data from studies and pilot studies, or based on speculation and experience. Residual correlation must be selected, which is the correlation among the residuals for the repeated measures (Guo et al. 2013).

Overall, without prior knowledge on data nor educated speculation based on experience, a formal sample size calculation for RMDs is not feasible. In cases without prior knowledge of similar data, main constraints to sample size becomes budget and time constraints.

2.6 Analyzing Survey Data

2.6.1 Selecting a Statistical Analysis Tool

Selecting which statistical analysis tool to use largely depends on characteristics of the data collected. For example, whether data is 1) continuous or non-continuous, 2) normally or non-normally distributed, 3) independent or dependent, and 4) whether there are fixed or random effects. These four characteristics are explored further in subsections below.

2.6.1.1 Continuous and Non-Continuous Data

The statistical tool selected to analyze data largely depends on the type of data that is collected. In particular, whether data is continuous or not continuous will strongly guide which statistical analysis tool to apply. Examples of continuous data could include height, weight, or temperature. Examples of non-continuous, or discrete, data could include counts (e.g. number of transit trips made in the past week), ordinal (e.g. rating transit satisfaction on a 5-point scale), or binary (e.g. "yes" or "no" answers).
Normally and Non-normally Distributed Data

Linear models, also known as general linear models are classically used for regression analysis, analysis of variance (ANOVA) and analysis of covariance (ANCOVA) (Madsen and Thyregod 2011). For nonlinear models with non-normally distributed discrete dependent variables, the generalized linear model (GLM) is appropriate. Both are described further in subsections below.

2.6.1.1.1 General Linear Models

The standard equation for general linear models follows (Norušis 2012):

$$Y = X'\beta + \epsilon$$

Where Y is the dependent variable, X'β is the linear combination of predictor variables (X values) and unknown coefficients (β values), and ϵ is the error, assumed to be normally distributed with zero mean and constant variance.

Applying general linear models require that datasets meet certain assumptions, including (Norušis 2012):

- Independent observations;
- Linear relationship between the dependent variable and the independent variables; and,
- Normally distributed errors with constant variance.

If the dependent variable fits the above criteria, but is not normally distributed, transforming the dependent variable is a common attempt to obtain normally distributed data (Madsen and Thyregod 2011). To accomplish this, a function would be applied to the dependant variable (Madsen and Thyregod 2011), where the applied function is some type of transformation (e.g. log, gamma, etc.). Data transformations can be an effective way to handle non-normal responses, but can pose several issues, including 1) researchers may not be interested in finding significant differences in transformed data, 2) transformations could produce unreliable values from the dependent variable (e.g. if the data is not continuous), and 3) there is no assurance data transformations will induce normality (Montgomery 2009). Furthermore, if data is discrete (e.g. counts, ordinal, categorical, etc.), then performing a transformation

and applying a statistical tool with basic assumptions of continuous data and normality still may not be appropriate (Montgomery 2009). In these cases, which is often the case in real-world circumstances, data does not meet the assumptions required for general linear models. One solution is to use generalized linear models (GLM) as they have fewer constraints on dependent variable characteristics.

2.6.1.1.2 Generalized Linear Models (GLM)

Developed by Nelder and Wedderburn (1972), generalized linear models (GLM) are essentially linear regression models including a random component (error term), a function of the design factors (x values), and unknown parameters (betas) (Montgomery 2009). GLMs are an extension of general linear models and have fewer assumption requirements (Norušis 2012), therefore in cases when data violates assumptions for linearity, then GLMs could be applicable. For GLM, the mean of the dependent variable is related to the linear combination of the predictor variables, but there is a link function that connects them, as follows (Norušis 2012):

$$g(\mu) = X'\beta$$

Where μ is the expected value of Y and X'β is the systematic component. Common link functions and associated distributions are shown in Table 2.11.

Table 2.11 Common link functions (Norušis 2012)

Link Name	Link Function	Distribution
Identity	μ	All
Log	ln(μ)	All (including Poisson and Negative Binomial)
Logit	ln(μ/(1- μ))	Binomial

The resulting GLM, after the link function is applied to the standard general linear model equation, is as follows (Norušis 2012):

$$E(Y) = g^{-1}(X'\beta)$$

Similarly, there are still assumptions that must be satisfied before proceeding, including (Norušis 2012):

- Independent observations; and,
- Observations must be from an exponential probability distribution.

Exponential probability distributions are characterized by two parameters: 1) the mean, and 2) a scale parameter for dispersion (Norušis 2012). Exponential probability distributions include the normal, inverse normal, gamma, Poisson, binomial, and multinomial distributions (the negative binomial distribution is

not always in the exponential family, but can still be analyzed using GLM) (Norušis 2012). Table 2.12 shows the different possible distributions depending on the dependent variable collected.

Table 2.12 Distributions for different dependent variable types (Madsen and Thyregod 2011)

Data Type	Data Example	Distribution
Continuous	$y_1 = 1.3, y_2 = -5.1, y_3 = 10.7, \dots, y_n = -0.2$	Normal (Gaussian)
Continuous positive	$y_1 = 2.2, y_2 = 1.4, y_3 = 9.5, \dots, y_n = 6.2$	Log-normal
Count	$y_1 = 8, y_2 = 0, y_3 = 22, \dots, y_n = 14$	Poisson
Binary	$y_1 = 1, y_2 = 0, y_3 = 0, \dots, y_n = 1$	Binomial
Nominal	"Unsatisfied", "Neutral", "Satisfied"	Multinomial
Count	$y_1 = 8, y_2 = 0, y_3 = 22, \dots, y_n = 14$	Negative Binomial

GLMs are appropriate when data is discrete and non-normal, but is not appropriate when data is dependent, as is the case for repeated measures designs (RMDs). There are two main extensions of GLM to account for correlation among subjects in RMDs using GLM, called 1) Generalized Estimating Equations (GEE), and 2) Generalized Linear Mixed Models (GLMM) (Fitzmaurice et al. 2011).

2.6.1.2 Dependent and Independent Data

Repeated measures designs (RMD) involve measuring the same subject (e.g. households or individuals) on more than one occasion, to determine if particular interventions (e.g. providing transit passes) may impact the dependent variables (e.g. transit use, car use, etc.). In the case of RMDs, responses are not independent of each other as responses from the same subject will be correlated with each other (Heck et al. 2012). Examples of RMDs could include (Kraska 2010):

- Changes in behaviours before and after an intervention;
- Results of different exercise regimes over time; and,
- Different reaction times under different conditions.

An advantage to RMDs is that subjects can be used as their own control, which can reduce costs for the experimental design (Kraska 2010). Disadvantages of RMDs can be the carryover effects, where subjects can become complacent with survey responses; one remediation to this is to provide enough time between measurements (Kraska 2010).

Each subject has their own personalities, own past experiences, beliefs, and inherent make-up that could make their responses over time correlated with each other. However one subject would likely be very different from other subjects who have different personalities, past experiences, beliefs and make-ups. To account for this correlation and increased variability, particular statistical models are required for RMDs (Norušis 2012), which could include fixed effects and/or random effects (Kraska 2010).

2.6.1.3 Fixed and Random Effects

Whether there are random and/or fixed effects present in a statistical analysis also guides which statistical tool to utilize; whether they are fixed effects models or mixed effects models (mixed effects models consider both fixed and random effects). A simple way to describe the difference between fixed and random effects is that fixed effects are purposely selected by the investigator while random effects are not specifically selected by the investigator (Bennington and Thayne 1994). For example, fixed effects may include predetermined treatment factors such as drugs, drug dosages, temperature, or diet. In contrast, random effects could include subjects (e.g. individuals or households) of which the investigator selected from a larger population (Bennington and Thayne 1994). In general, there are three main criteria used to determine if effects are random or fixed, as outlined in Table 2.13.

Table 2.13 Criteria to determine if effects are fixed or random (Eisenhart 1947)

Criteria	Fixed	Random
Subjects	Selected because they are of particular interest.	Selected randomly.
Analysis Results	Conclusions confined to the subjects actually studied.	Conclusions will be applied to a larger population.
Repeatability	If the experiment was repeated, the same subjects would be selected again.	If the experiment was repeated, new subjects would be selected from a larger population.

In the context of GLM, there are two repeated measures analysis tools which could be used depending on whether fixed effects or both fixed and random effects are present. Generalized Estimating Equations (GEE) assumes only fixed effects are present, while Generalized Linear Mixed Models (GLMM) account for both fixed and random effects.

2.6.1.4 Selecting a Statistical Analysis Tool Summary

To focus the statistical analysis literature review on the most relevant tool for this research, Table 2.14 shows the data characteristics of the dependent variables from the Phase 2 ComPASS statistical analysis.

Table 2.14 ComPASS statistical analysis data characteristics

Data Characteristics	ComPASS Data Characteristics
Continuous or Non-Continuous	Non-Continuous
Normal or Non-Normal	Non-Normal
Dependent or Independent	Dependent
Fixed and/or Random Effects	Fixed and Random

Based on the Phase 2 ComPASS dependent variable characteristics, the GLMM statistical tool, an extension of GLM, was appropriate for statistical analysis of the data. As a result, GLMM is discussed more in depth in the following section.

2.6.2 Generalized Linear Mixed Models (GLMM)

Generalized Linear Mixed Models (GLMM), also known as multilevel or hierarchal linear models, elaborate on dependencies in GLMs by incorporating normally distributed 'random effects' terms that account for observed correlations (Norušis 2012). The GLMM estimates the population mean of each parameter and an associated sampling error term (Smithson and Merkle 2014). The estimated mean parameter is a fixed effect while the error term is a random effect. The GLMM can be expressed as follows (Norušis 2012):

$$E(Y|\gamma) = g^{-1}(X'\beta + Z\gamma)$$

Where Y is the dependent variable, X'β is the linear combination of predictor variables and unknown parameters, Z is the design matrix for the vector of random effects, and γ represents the random effects.

2.6.3 Fitting Models

The likelihood is known as the probability of the observed results, given the parameter estimates (Norušis 2012). Often, the log-likelihood (LL) is used to measure how well estimated models fit the data (Norušis 2012). For linear models, R^2 is often used as a value to determine how well a model fits the data; similarly, for nonlinear models (e.g. GLM), LL is used to determine how well the model fits the data.

To assess goodness of fit in nonlinear models, the Akaike's information criterion (AIC) and the Bayesian information criterion (BIC) are common (Norušis 2012). For both AIC and BIC, a lower calculated value corresponds to models with a better fit (Norušis 2012).

2.6.3.1 Akaike's Information Criteria (AIC)

The equation for calculating AIC follows:

$$AIC = -2LL + 2p$$

Where LL is the log-likelihood and p is the number of parameters in the model (including the intercept) (Norušis 2012).

The corrected AIC (AICC) corrects for small sample sizes and is calculated using the following equation (Norušis 2012):

$$AICC = AIC + \frac{2p(p+1)}{N-p-1}$$

Where N is the sample size and p is the number of estimated parameters (Norušis 2012). The AICC value should be used when possible to be conservative; for large sample sizes AIC and AICC will be similar because as the sample size increases, AICC becomes closer to AIC (Norušis 2012).

2.6.3.2 Bayesian Information Criteria (BIC)

The equation for calculating BIC follows:

$$BIC = -2LL + \ln(N)\, p$$

Again, N is the sample size and p is the number of estimated parameters. BIC is typically higher than the AIC for the same analysis (Norušis 2012).

2.6.4 Post Hoc Statistical Analyses

If the GLMM data analysis results show that there are significant differences between fixed effects, further investigation is required to determine more specifically where these significant differences are. One way to accomplish this is to conduct pairwise comparisons. There are numerous pairwise comparison methods, but one common procedure is the Fisher Least Significant Difference (LSD) Method.

The Fisher LSD method tests the hypothesis H_O: $\mu_1 = \mu_2$, and uses the t statistic, as follows (Montgomery 2009):

$$t_O = \left(\bar{y}_i. - \bar{y}_j.\right) / \sqrt{MS_E\left(\frac{1}{n_i} + \frac{1}{n_j}\right)}$$

Where $\bar{y}_i.$ is the average of the observations under the i^{th} treatment, $\bar{y}_j.$ is the average of the number of observations under the j^{th} treatment, n_i is the number of observations under treatment i, n_j is the number of observations under treatment j, and MS_E is the mean square of the error.

Once the t statistic is found, the LSD is calculated as follows (Montgomery 2009):

$$LSD = t_{\frac{\alpha}{2}, N-a} \sqrt{MS_E\left(\frac{1}{n_i} + \frac{1}{n_j}\right)}$$

Where alpha is the level of significance, N is the total number of observations, a is the total number of data sets to compare, and N-a represents the degrees of freedom. The value for $t_{\alpha/2, N-a}$ can be looked up in a t distribution table (Montgomery 2009).

If the average of dataset i subtracted from the average of dataset j is greater than the calculated LSD value, then H_O is rejected, and the two means are considered significantly different (Montgomery 2009). In contrast, if the average difference is less than or equal to the LSD value, then H_O is accepted, and the two means are considered to be statistically the same.

The LSD method is generally effective for detecting differences in means once a significant difference at a confidence level of 95% is already found at the initial analysis stage (e.g. GLMM, ANOVA, etc.) (Montgomery 2009).

2.7 Literature Review Summary

In the first section of the literature review (Section 2.1) lessons were learned from relevant successful and unsuccessful U-Pass programs in North America. Whether ultimately successful or unsuccessful, each program resulted in increased transit use and decreased auto use. Through lessons learned from previous programs, it is apparent that the critical success factors for a successful resident U-Pass program include the following: 1) a CRN model that promotes economic sustainability rather than depending on corporate subsidies, 2) more benefits bundled than just a transit pass broadens value to the pass and increases participation, and 3) an educational component to teach users how to use ComPASS components.

In Section 2.2, the CRN model (the economic model for the U-Pass) was reviewed to demonstrate how a ComPASS can be priced at a deeply discounted rate without a loss in revenue to participating merchants (e.g. transit authority, recreation centre, etc.). Subsequently in Section 2.3, MADM concepts were reviewed with a specific focus on the SAW method, one of the most commonly used MADM tools.

Section 2.4 outlined measures of transit quality, with particular focus on headways, service span, and service coverage levels of service, based on TRB guidelines. These measures of quality will be used in Chapter Three to determine the quality of transit service provided in the ComPASS research study area.

Next, Section 2.5 reviewed pilot program design, including general practices, optimal pilot study length and sample size. It was found that there is little literature available regarding recommended pilot study durations. Literature that was consulted generally did not describe why researchers selected a particular pilot study duration, so this is an area requiring further research and development. Sample sizes are also complicated to select when there is limited previous knowledge on the dataset and especially when a pilot study is formatted as an RMD.

Finally, Section 2.6 reviewed analysis of survey data, including the process for selecting a statistical analysis tool. Findings were that the GLMM is the appropriate tool for analyzing RMD data for the Phase 2 ComPASS pilot study.

Chapter 3 ComPASS Research Study Area Assessment

The study area for this research is within Kelowna, a city located in the south central region of BC, Canada. Kelowna is situated in the Okanagan Valley between the Monashee Mountain Range to the West and the Coastal and Cascade Mountains to the East, with a semi-arid climate (City of Kelowna 2015a). Kelowna is known as a tourist destination within Canada for its ski slopes in the winter and warm weather activities in the summer.

This chapter reviews demographics and transportation conditions within Kelowna, the location of the ComPASS research study. Section 3.1, 3.2, and 3.3 reviews Kelowna's demographics, transportation network, and transportation safety issues, respectively. Within Kelowna, there were two main study areas for this research: the Phase 1 study area (bound by High Road to the north, Glenmore Drive to the east, Clifton Road to the west, and Clement Avenue to the south), and the Phase 2 study area, which was subset within the Phase 1 boundary (along Pinehurst Crescent, Lambert Avenue, Van Street, and Brent Place). Section 3.4 describes the characteristics of the Phase 1 study area as a whole, which also encompasses the Phase 2 study area. Finally, Section 3.5 summarizes the findings of Chapter Three.

3.1 Kelowna Demographics

Table 3.1 outlines Kelowna's community characteristics including population, population growth, median age, and percent aged 65 and up from the 2011 Census (Statistics Canada 2012a) as well as the median individual income and median family income from the 2011 National Household Survey (NHS) (Statistics Canada 2013). The table includes the same data for BC and Canada for comparison.

Table 3.1 Demographics of Kelowna, BC, and Canada (Statistics Canada 2012a; 2013).

	Kelowna	BC	Canada
Population	117,312	4,400,057	33,476,688
Population Growth (2006 to 2011)	9.6%	7.0%	5.9%
Median Household Income	$57,948	$60,333	$61,072
Median Individual Income	$29,832	$28,765	$29,878
Median Age	43.0 years	41.9 years	40.6 years
Population Aged 65+	19.1 %	15.7%	14.8%
Land Area (km^2)	211.8	922,509.3	8,965,121.4
Population Density (residents/km^2)	553.8	4.8	3.7

Kelowna is a relatively fast growing community as it has grown faster than BC and Canada during the same time period (2006 to 2011). And while Kelowna has a lower median household income than BC and Canada, it has a median individual income on par with BC and Canada's. Part of this may be due to the fact that Kelowna is an older community than BC and Canada, with a higher median age and a higher

percentage of residents aged 65 years and older. Not surprisingly, Kelowna has a higher population density than the provincial and federal densities, which encompass vast rural and uninhabited areas; Kelowna's density would not fare as well compared to densities of other urban areas (e.g. Vancouver, which has an urban density of over 5,000 residents per km^2).

In 2015, the City of Kelowna surveyed a sample of 301 randomly selected Kelowna residents (aged 18 or older) to obtain an understanding of citizens' attitudes, satisfaction levels, and priorities with regard to living in the city (City of Kelowna 2015b). Residents were asked (on an unprompted basis) what they believed was the most important issue in the City of Kelowna. Thirty-eight percent (38%) of residents identified transportation as the most important issue facing their community. Transportation was mentioned more than twice as many times than any other issue as the most important issue facing Kelowna. Other main issues facing Kelowna were cited as social (16%), growth/development (13%), economy (12%), and parks/recreation/culture (12%) (City of Kelowna 2015b). Specific transportation issues cited by survey respondents included (City of Kelowna 2015b):

- Traffic Congestion (13%);
- Condition of roads/streets/highways (9%);
- General transportation mentions (9%);
- Parking (3%);
- Bicycle paths/lanes (3%); and,
- Public transportation (2%).

All of these topics are directly or indirectly related to the need to increase AT use in Kelowna. Increased AT would mean fewer drivers and fewer vehicles on the road therefore reducing traffic congestion and demand for parking, while also reducing negative impacts on road/street/highway conditions (fewer vehicles on road infrastructure means less wear and maintenance requirements). Those who mentioned bicycle paths/lanes and public transportation demonstrate the demand for these facilities and the need to improve them for increased AT use.

3.2 Kelowna's Transportation Network

Results from the 2011 NHS indicate that about 4% of commuters in Kelowna (population of 117,312) use public transit as their main mode of transportation, compared to 13% for the rest of BC (population of 4,400,057), and 12% for all of Canada (population of 33,476,688) (Statistics Canada 2013). For walking and cycling, Kelowna is on the same level as the province with about 10% of the labour force but differs from the country at 7% (Statistics Canada 2013). 79% of Kelowna commuters drive their vehicle to and from work, compared to 71% for BC and 74% for Canada (Statistics Canada 2013).

The Transportation Association of Canada's (TAC) 2010 Urban Transportation Indicators Survey outlines transportation related survey results from 31 out of 33 Census Metropolitan Areas (CMAs) in Canada in 2006. CMAs are comprised of one or more contiguous municipalities with a total population of at least 100,000 with at least 50,000 of the population located in the core of the CMA (Statistics Canada 2013). Table 3.2 outlines the CMAs surveyed for the 2010 Urban Transportation Indicators Survey (TAC 2010).

Table 3.2 CMAs contacted in TAC's 2010 Urban Transportation Indicators Survey (TAC 2010)

CMA Group	CMA Population	CMAs	Number of CMAs in Group
Group A	More than 2,000,000	Toronto Montreal Vancouver	3
Group B	500,000 to 2,000,000	Calgary Ottawa-Gatineau Edmonton Quebec Winnipeg Hamilton	6
Group C	190,000 to 500,000	Kitchener London St. Catharines – Niagara Victoria Oshawa Halifax Windsor Saskatoon Regina	9
Group D	Less than 190,000	Barrie St. John's Abbotsford Kelowna Trois-Rivieres Guelph Kingston Greater Sudbury Brantford Saguenay Moncton Saint John	13

Of the 31 surveyed CMAs, Kelowna had the highest light duty car ownership at 0.85 per capita and had 42 heavy duty vehicles owned per 1,000 capita, which was the second highest (TAC 2010). Kelowna also had 23 daily vehicle kilometres travelled (VKT) per capita, which was the third highest of all CMAs surveyed. VKTs are a measure used to characterize the number of kilometres travelled by vehicles in a specific location (e.g. CMA) during a specific time frame (e.g. daily). VKTs are a way to characterize how much driving occurs in a community. The high degree of auto dependency in Kelowna could be a combination of the low density (compared to a Canadian average density of 730 residents per square

kilometre for municipalities with a population ranging from 90,000 to 150,000 (Statistics Canada 2011)) and the high sprawl of Kelowna.

The transit authority servicing the City of Kelowna is the Kelowna Regional Transit System (KRTS), which also serves Peachland, the District of West Kelowna, the Westbank First Nation, the Regional District of the Central Okanagan (RDCO), and the District of Lake Country. Figure 3.1 shows the current transit routes in the City of Kelowna.

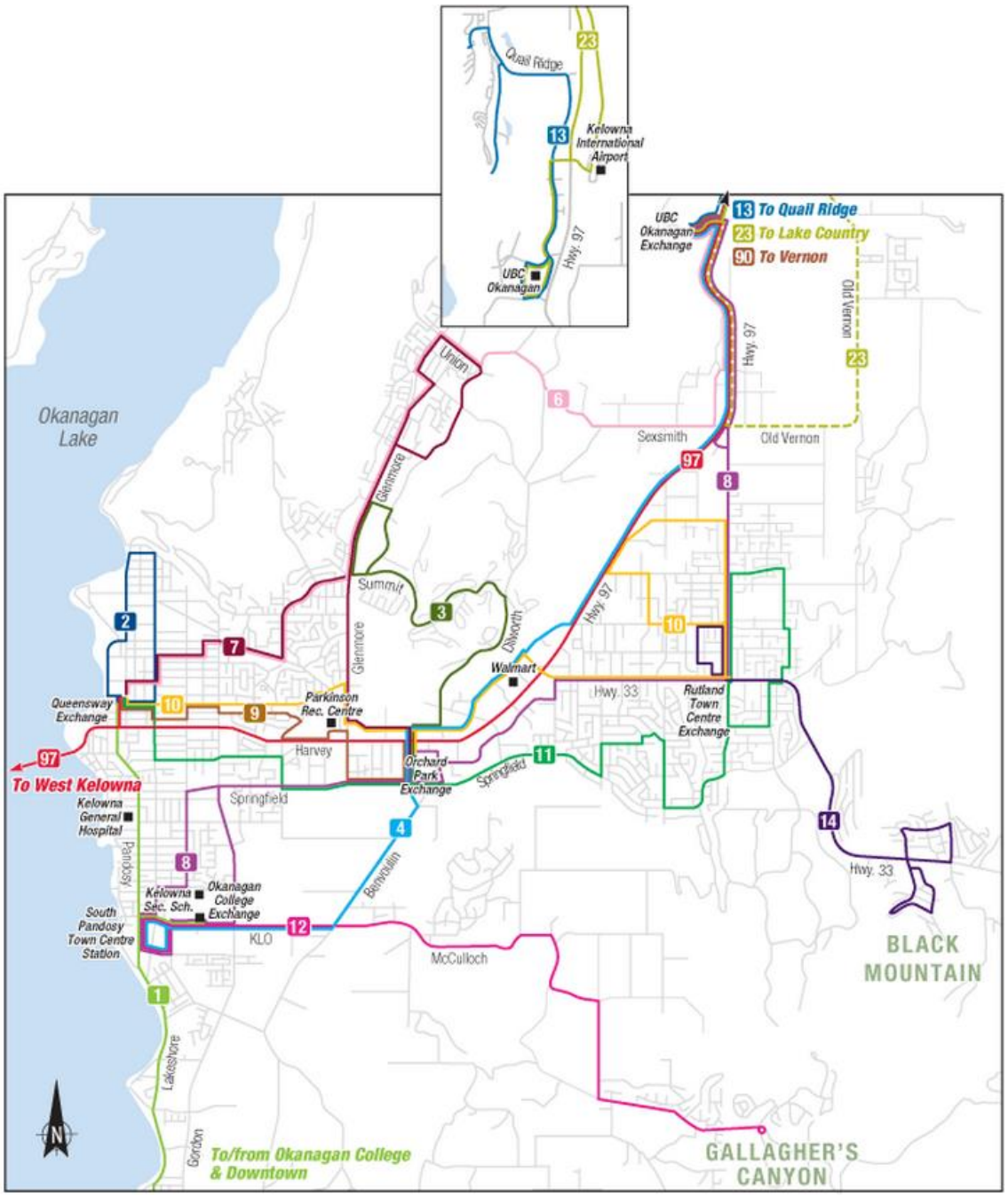

Figure 3.1 KRTS transit network in Kelowna (BC Transit 2014)

Funding for KRTS is shared through several governmental organizations on the municipal, regional, and provincial levels, including the City of Kelowna, District of Lake Country, Regional District of the Central Okanagan (RDCO), and BC Transit. The last fiscal year, funding for KRTS came from the following sources (BC Transit 2013):

- 46.7% from the Province;
- 25.0% from transit fares;
- 27.1% from property taxes; and,
- 1.2% from bus advertising.

The KRTS utilizes 98 buses on 25 routes and operates for 175,000 hours each year (smartTRIPS 2013), averaging to about 19 hours per day per route. There are roughly 130 transit route kilometres within Kelowna (BC Transit 2013). In general, BC Transit conducts data analysis and planning, while municipalities make their own decisions regarding transit fares, routes, and service levels.

Existing transit pass programs in Kelowna include (BC Transit 2014):

- BC Bus Pass Program;
- ProPASS; and,
- U-Pass.

The BC Bus Pass Program is a reduced cost transit pass (not including Handy Dart) available for low income seniors and those receiving disability assistance from the Province of BC (Province of BC 2014). The BC Bus Pass program costs participants $45 per year (Province of BC 2014). The ProPASS is a discounted pass system for organizations; if three or more people from that organization purchase monthly bus passes in Kelowna, they receive a discount (BC Transit 2014). As of summer 2011, there were 17 people enrolled in the ProPASS program in Kelowna, 9 from Kelowna City Hall (K. Bergen, personal communication, 2011). Finally, the U-Pass is a mandatory discounted transit pass providing all UBC's Okanagan Campus students with unlimited transit access on KRTS routes (BC Transit 2014). The UBC U-Pass is described more in depth in Section 2.1.1.1.

The Central Okanagan Region has over 425 km of bike lanes and pathways (RDCO 2012). According to the RDCO Regional Active Transportation Master Plan (2012), the RDCO plans to expand their AT system by incorporating the following:

- 88 kilometres of fully separated cycling/pedestrian facilities;

- 50 kilometres of marked on-street bike lanes; and,
- 24 km of shared travel lanes.

These additions will greatly expand the AT network in the RDCO area and Kelowna. In 2006, Kelowna reported having about 0.65 on-street bikeway kilometres per roadway lane kilometre, which was the third highest of all cities surveyed across Canada (TAC 2010). Despite this, bike lanes are not well maintained during winter months therefore reducing the year-round utility of these facilities. Kelowna also had the most Full-Time Equivalent (FTE) staff dedicated to AT projects of all cities surveyed, at 2.4 FTEs per 100,000 capita (TAC 2010).

3.3 Transportation Safety in Kelowna

Traffic congestion has been identified as a main issue for residents in Kelowna (City of Kelowna 2015b). In fact, the average speed in the worst congested area in Kelowna is only about 28 km/h during the day (HDR Decision Economics 2009) despite 6 lanes and 60 kilometres per hour speed limits. These excessive traffic delays amount to large costs incurred due to personal time wasted, additional vehicle wear, lost business revenue, and increased industry costs, at an estimated $342.5 million for 2007 in the Central and North Okanagan regions (HDR Decision Economics 2009). If no mitigation strategies are implemented, this cost is expected to increase by 75% to $600.6 million for 2030 (HDR Decision Economics 2009). In addition to negative economic impacts, this high congestion leads to high collision rates.

Figure 3.2 shows the number of total collisions, injured victims, and pedestrian collisions per 1,000 capita reported in Kelowna and BC in 2013, assuming 2013 population estimates for Kelowna extrapolated from the 2011 census population using the annual growth rate between the 2006 and 2011 censuses (Statistics Canada 2012a). The number of collisions in 2013 was gathered from the Insurance Corporation of BC's (ICBC) road safety reports for various regions in BC (ICBC 2013).

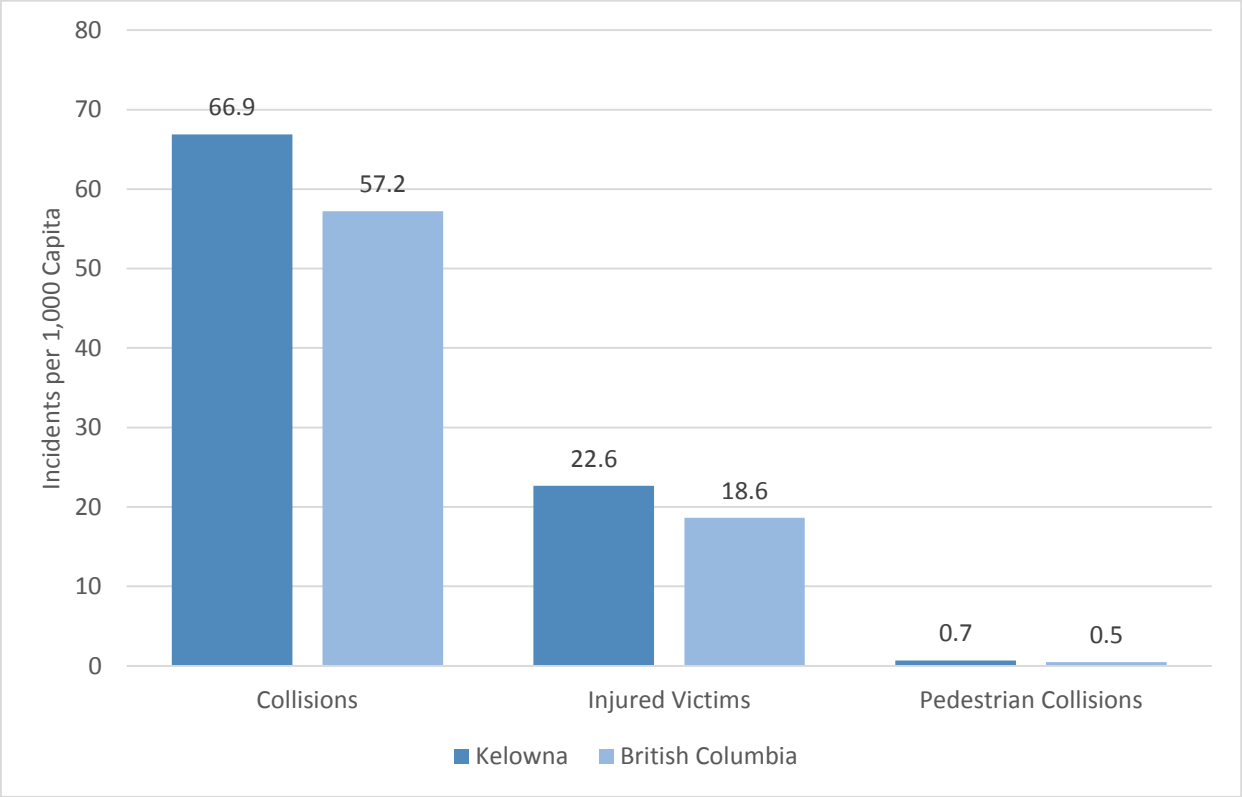

Figure 3.2 2013 Collisions per 1,000 capita in BC and Kelowna (ICBC 2013; Statistics Canada 2012a)

Compared to BC as a whole, Kelowna had per 1,000 capita:

- 17% more collisions;
- 21% more injured victims; and,
- 38% more pedestrian collisions.

Moreover, the Transportation Association of Canada's (TAC) 2010 Urban Transportation Indicators Survey revealed several additional concerns that need to be addressed about transportation safety in Kelowna, including:

- 55 pedestrian injuries per 100,000 capita in 2006 (fourth highest of CMAs surveyed in Canada);
- 66 cyclist injuries per 100,000 capita in 2006 (highest of CMAs surveyed in Canada);
- 2.75 fatalities per 1 million VKT (third highest of CMAs surveyed in Canada); and,
- 0.75 injuries per 1,000 VKT (second highest of CMAs surveyed in Canada).

This failing collision history suggests that transportation safety in Kelowna is behind the rest of the province and Canada, and that Kelowna needs to find ways to reduce collisions. Overall, Kelowna is in need of sustainable and effective solutions to improve transportation safety in the Okanagan region.

3.4 ComPASS Study Area: Glenmore (Kelowna, BC)

To implement a successful ComPASS, it was important to understand characteristics of the neighbourhood in which it could be implemented. There were two main study areas for this research: the Phase 1 study area (bound by High Road to the north, Glenmore Drive to the east, Clifton Road to the west, and Clement Avenue to the south shown in Figure 3.3), and the Phase 2 study area, which was subset within the Phase 1 boundary (along Pinehurst Crescent, Lambert Avenue, Van Street, and Brent Place shown in Figure 3.4). This section describes the characteristics of the Phase 1 study area as a whole, which also encompasses the Phase 2 study area.

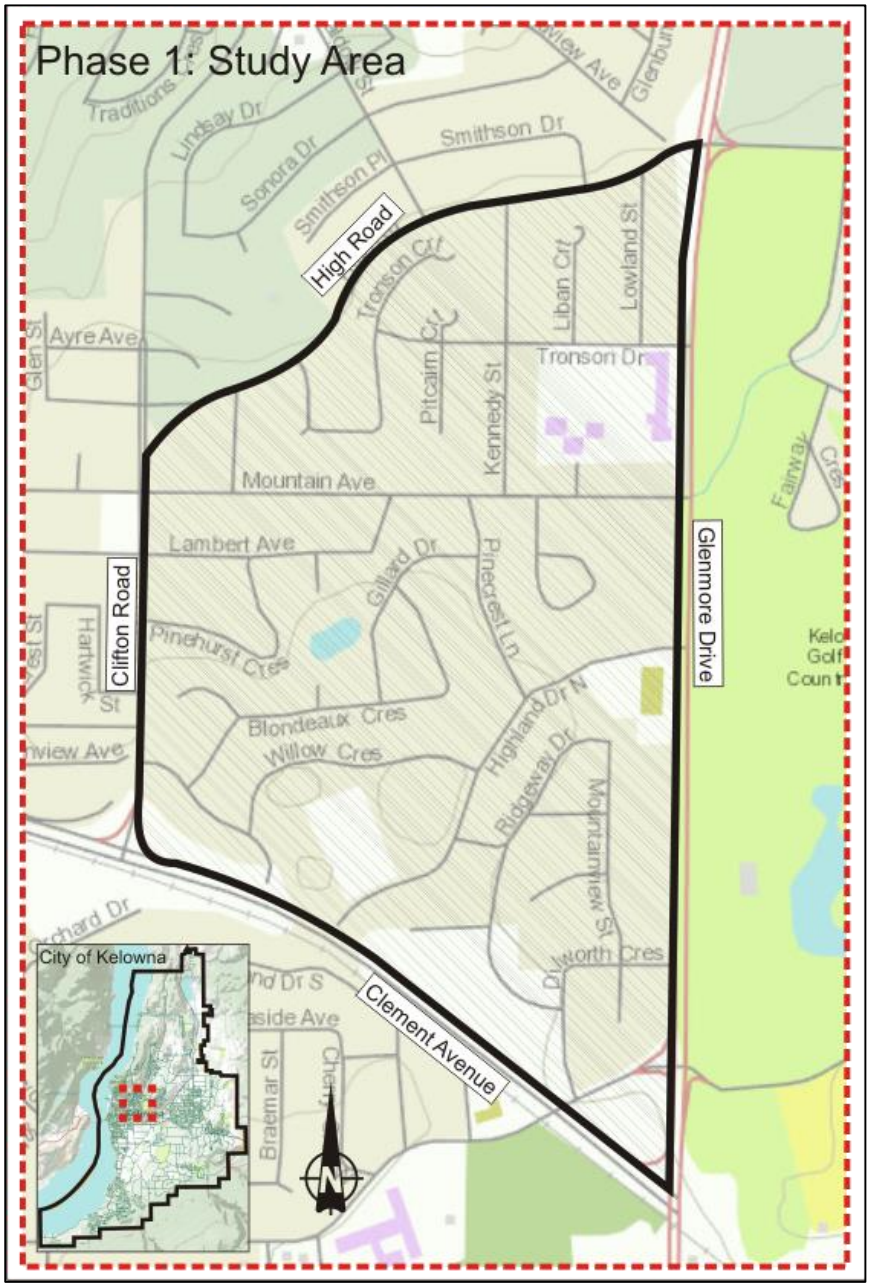

Figure 3.3 Phase 1 study area

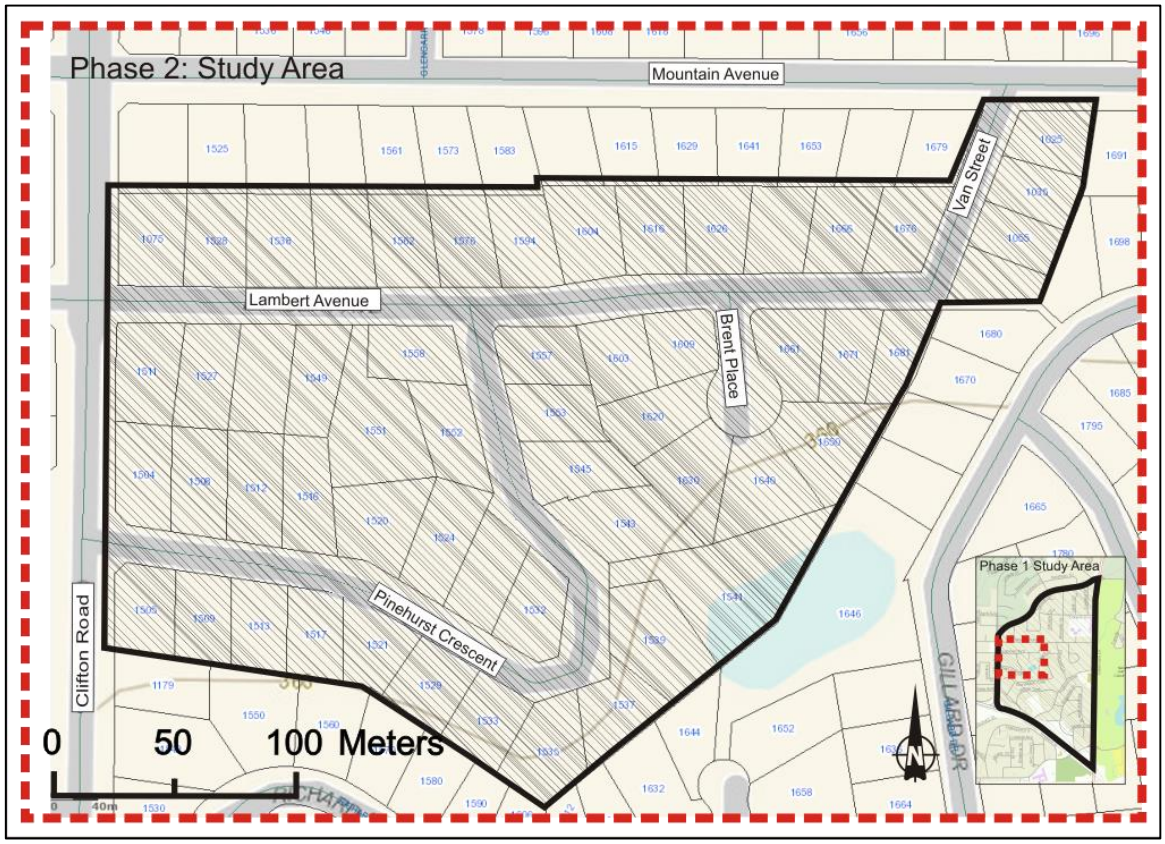

Figure 3.4 Phase 2 study area

The Phase 1 study area was selected through: 1) constraints of funding requirements and 2) input from the ComPASS Steering Committee. The demographics and transit service within this boundary were analyzed. Ideally the study boundary characteristics should fit the four criteria for a successful community transportation program previously discussed, including (UBC TREK Program 2004):

1. A younger than average population;
2. A lower income neighbourhood;
3. Good transit service with fast and frequent trips; and,
4. Lower than average automobile ownership.

3.4.1 Phase 1 Study Area Demographics

2011 Census (Statistics Canada 2012b) and 2011 NHS (Statistics Canada 2013) data was analyzed to determine the demographics of the Glenmore community within the Phase 1 study boundary. There were six different dissemination areas (DA) within the Phase 1 boundary. DAs are small geographic areas composed of about 400 to 700 people within larger census subdivisions (CSD) (Statistics Canada 2013). CSDs contain census and NHS data at the municipal level, and are typically broken down into many DAs (Statistics Canada 2013). Three of the six DAs within the Phase 1 study boundary were only partially

within the boundary. Ratios of the DA area (square metres) located within the Phase 1 study boundary to the total DA area (square metres) were found using a dissemination block shapefile (Lesack 2012) in ArcGIS (ESRI 2014). These ratios were applied to census and NHS data within each DA to estimate demographics within the Phase 1 study area. Table 3.3 shows the DA codes and the corresponding DA area ratio within the Phase 1 study boundary.

Table 3.3 Phase 1 study area dissemination areas

Dissemination Area (DA) Number	Portion of Dissemination Area in Phase 1 Study Boundary
59350039	1.00
59350040	1.00
59350041	1.00
59350042	0.37
59350075	0.02
59350209	0.15

Based on available 2011 census and NHS data, the study area included:

- 750 households (Statistics Canada 2013);
- 1917 people (Statistics Canada 2013); and,
- 0.88 square kilometres (Lesack 2012).

This equates to a population density of 2,167 people per square kilometre and about 2.6 residents per household within the Phase 1 study boundary. The majority of the Phase 1 study area is zoned as urban residential (single or two family), with pockets of urban residential (multi-family), commercial, parks, and educational/institutional zones (City of Kelowna 2014).

Figure 3.5 to Figure 3.12 display the demographic composition of the Phase 1 study area compared to Kelowna as a whole.

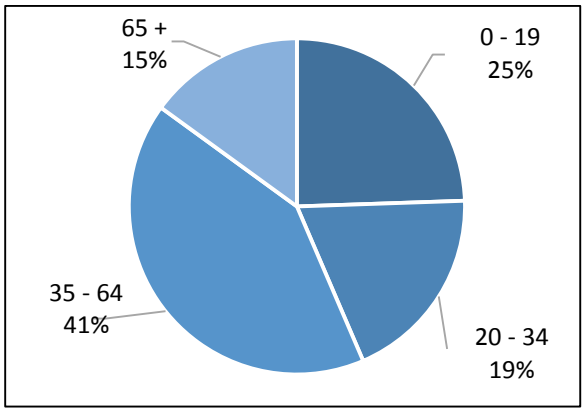

Figure 3.5 Phase 1 area age distribution (Statistics Canada 2012b)

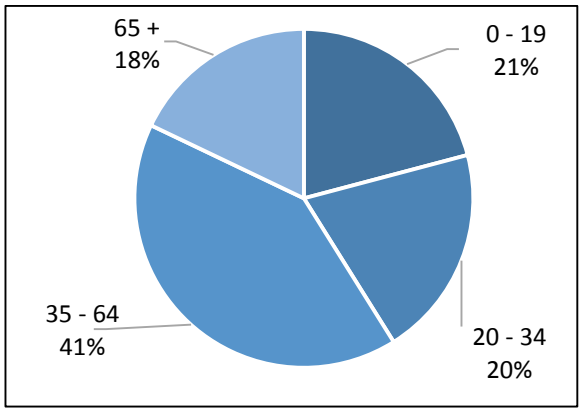

Figure 3.6 Kelowna age distribution (Statistics Canada 2012b)

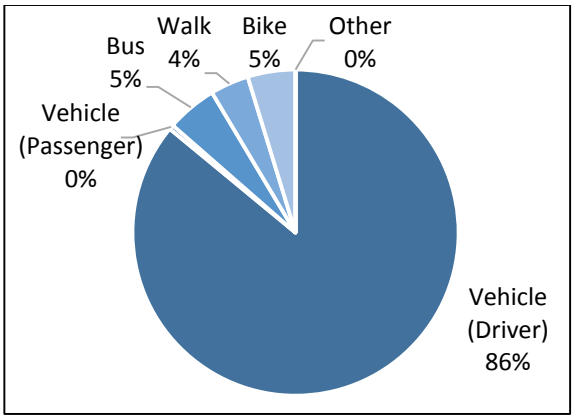

Figure 3.7 Phase 1 area transportation mode split to work (Statistics Canada 2013)

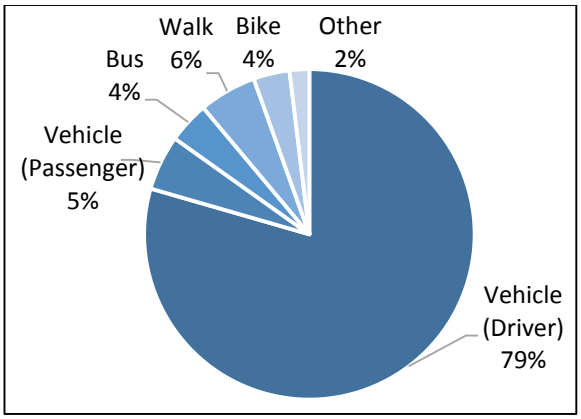

Figure 3.8 Kelowna transportation mode split to work (Statistics Canada 2013)

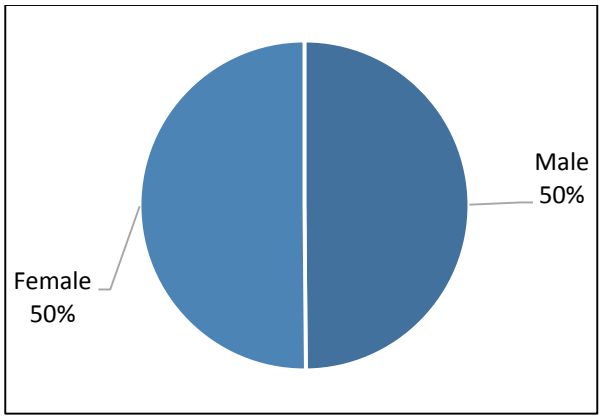

Figure 3.9 Phase 1 area males and females (Statistics Canada 2012b)

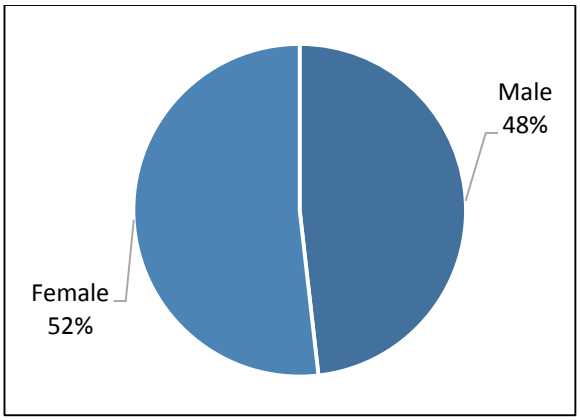

Figure 3.10 Males and females in Kelowna (Statistics Canada 2012b)

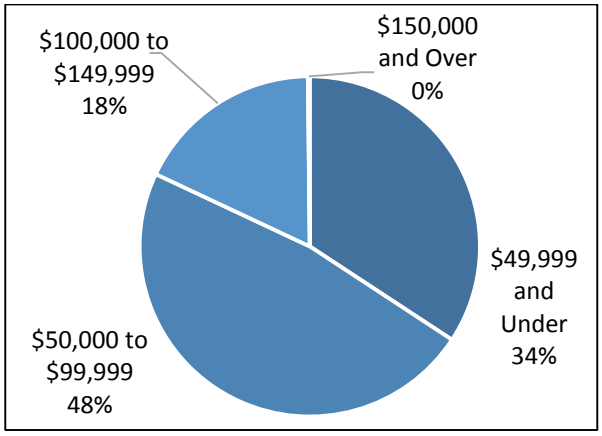

Figure 3.11 Phase 1 area household income (Statistics Canada 2013)

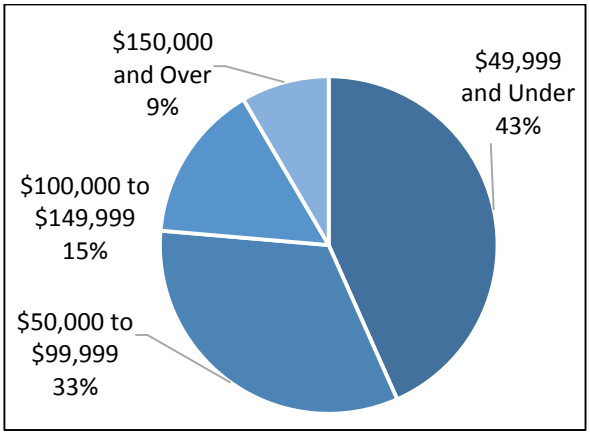

Figure 3.12 Individual income in Kelowna (Statistics Canada 2013)

As shown in Figure 3.5 and Figure 3.6, the Phase 1 study area population is slightly younger than Kelowna as a whole as there are more residents aged 19 and younger and fewer residents aged 65 and over. Figure 3.7 and Figure 3.8 demonstrate that there are more residents that drive, bike, and take the bus to/from work in the Phase 1 study area compared to Kelowna as a whole. Alternatively, there are fewer Phase 1 study area residents that walk and travel as a vehicle passenger to and from work. Figure 3.9 and

Figure 3.10 show that the Phase 1 study area and Kelowna as a whole have similar male and female proportions. As demonstrated in Figure 3.11 and Figure 3.12, the Phase 1 study area has fewer households with an income $49,999 and under, but no households with an income of $150,000 or over. There are similar proportions of households that make $100,000 to $149,999 per year in the Phase 1 study area and Kelowna as a whole. Overall, the Phase 1 study area is neither a low income nor a high income neighbourhood compared to Kelowna; the majority of households in the Phase 1 study area have mid-range household incomes.

Overall, the analysis of the Phase 1 study boundary demographics reveal that, compared to the rest of Kelowna, there is:

1. A younger than average neighbourhood age,
2. Moderate income levels, and
3. Higher than average automobile usage.

3.4.2 Public Transit in Glenmore

There are three bus routes that travel through Glenmore – Route 3, 6, and 7 shown in Figure 3.13.

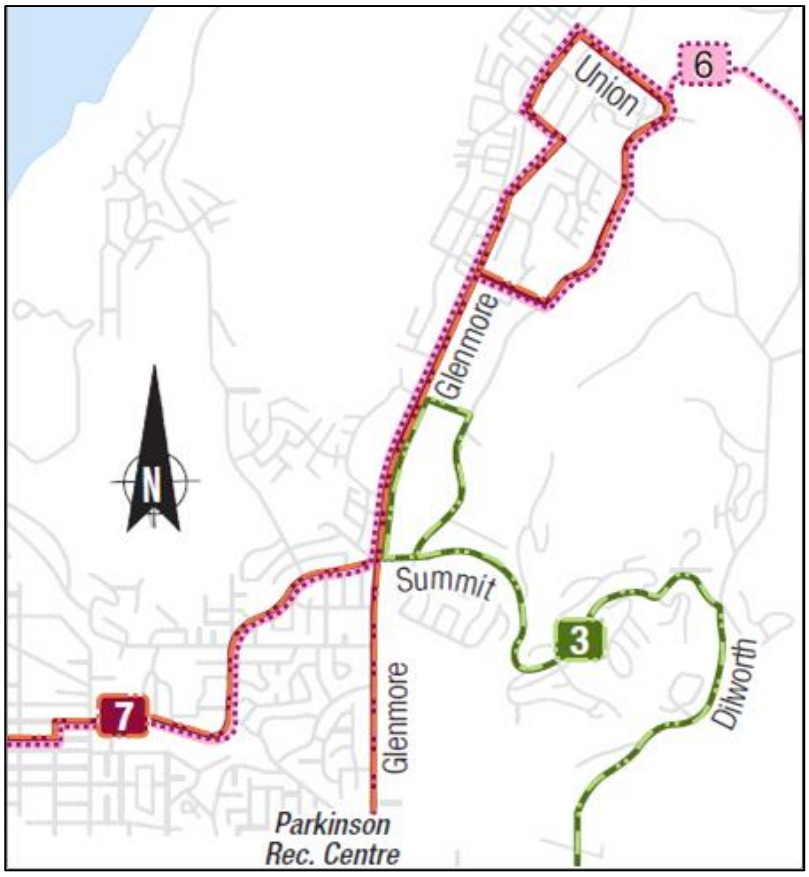

Figure 3.13 Routes 3, 6, and 7 servicing the Glenmore community

To gauge the quality of transit service to the Glenmore community, subsections below outline measures of transit levels of service (LOS) for headways, service hours, and coverage for routes servicing the Phase 1 study area.

3.4.2.1 Glenmore Transit Headways

Table 3.4, Table 3.5, and Table 3.6 below outline the transit headways for Route 3, Route 6, and Route 7, respectively. In the two rightmost columns of each table are the peak hour LOS and off-peak hour LOS according to TCQSM (2003) thresholds. Note that Route 6 is seasonal and only operates from September to April.

Table 3.4 Glenmore Route 3 transit service headway (BC Transit 2014)

	Headway (minutes)		Level of Service (LOS)	
Day of Week	Peak	Off-Peak	Peak	Off-Peak
Weekday	30	> 60	D	F
Saturday	> 60	> 60	F	F
Sunday	> 60	> 60	F	F

Table 3.5 Glenmore Route 6 transit service headway (BC Transit 2014)

	Headway (minutes)		Level of Service (LOS)	
Day of Week	Peak	Off-Peak	Peak	Off-Peak
Weekday	31 – 60	N/A	E	F
Saturday	N/A	N/A	F	F
Sunday	N/A	N/A	F	F

Table 3.6 Glenmore Route 7 transit service headway (BC Transit 2014)

	Headway (minutes)		Level of Service (LOS)	
Day of Week	Peak	Off-Peak	Peak	Off-Peak
Weekday	15 - 22	30	C/D	D
Saturday	21 - 30	60	D	E
Sunday	31 - 60	> 60	E	F

Route 7 has the highest headway of the three routes, servicing the Glenmore area at 15 - 22 minutes during peak hours and 30 minutes during off peak hours. Route 3 has lower headways, especially during the weekends, but this is mainly attributed to the service continuing as Route 7 for the remainder of the route. Route 6 has a frequency of between 31 – 60 minutes during peak hours, but there is no service at all during the off-peak hours and weekends, warranting LOS F for headway.

3.4.2.2 Glenmore Transit Service Hours

Glenmore receives varying levels of service hours depending on the route, time of the day and day of the week. Table 3.7, Table 3.8, and Table 3.9 below show the total service hours for Route 3, 6, and 7, respectively. The rightmost column of each table indicates the LOS for service hours according to the TCQSM (2003) thresholds.

Table 3.7 Glenmore Route 3 hours of operation (BC Transit 2014)

Day of Week	Start Time	End Time	Total Service Hours	LOS
Weekday	6:50 am 3:20 pm 7:44 pm 9:47 pm 11:05 pm	8:50 am 6:05 pm N/A N/A N/A	9 h 45 m	E
Saturday	8:40 am 10:39 am 1:35 pm 5:40 pm 7:42 pm 9:47 pm 11:52 pm	N/A N/A N/A N/A N/A N/A N/A	7 h 0 m	E
Sunday	8:03 am 10:15 am 12:18 pm 1:41pm 4:41 pm 7:53 pm 10:00 pm	N/A N/A N/A N/A N/A N/A N/A	7 h 0 m	E

Table 3.8 Glenmore Route 6 hours of operation (BC Transit 2014)

Day of Week	Start Time	End Time	Total Service Hours	LOS
Weekday	6:20 am 7:41 pm	7:05 am 8:41 pm	4 h 0 m	E
Saturday	N/A	N/A	N/A	F
Sunday	N/A	N/A	N/A	F

Table 3.9 Glenmore Route 7 hours of operation (BC Transit 2014)

Day of Week	Start Time	End Time	Total Service Hours	LOS
Weekday	6:45 am	10:31 am	16 h 46 m	C
Saturday	7:50 am	12:25 am	17 h 35 m	B
Sunday	7:39 am	10:25 am	15 h 46 m	C

Overall, Route 7 has the most service hours followed by Route 3, and finally Route 6. Route 6 is intended to service students at UBC's Okanagan Campus to/from the Glenmore neighbourhood during peak morning and afternoon hours only, resulting in only 4 hours of service on weekdays and therefore LOS E. Since it is an express route specifically for the university, it also does not operate on weekends, hence the LOS F for Saturday and Sunday. Moreover, the route stops operating entirely during summer months (May to August) and therefore receives LOS F for four months of the year. Route 3 also has fewer service hours, meaning it receives LOS E on weekdays and LOS F on weekends. Route 7 operates at LOS C on weekdays and Sundays, but LOS B on Saturdays as it operates later until 12:25 am.

3.4.2.3 Glenmore Transit Coverage

High LOS for transit coverage occurs when transit access is within 400 m walking distance, which would translate to about a five minute walk to bus stops (TRB 2003). The entire area within the study boundary is within 500 m distance to a transit route, which suggests it has a higher LOS for transit coverage (A or B) according to thresholds presented by the TCQSM (2003).

3.4.3 Biking and Walking

There are several bike lane and sidewalk kilometres in the Glenmore Phase 1 study area. To view the bike lanes within the study area, see Figure 3.14 below.

Figure 3.14 Bike lanes within the study area (City of Kelowna 2009)

Bike lanes exist on both sides of the street on roads bordering the study area. Mountain Road also allows cycling, but does not have defined bike lanes at this time. Furthermore, Clement has bike lanes separated from the roadway, which would allow safer and easier travel to main hubs like downtown.

Sidewalk infrastructure also exists throughout the study area. However, there are several main streets in the study area that do not have sidewalks on both sides of the street, which can be a barrier for pedestrians. Mountain Road, the main street travelling directly east/west through the study area, has sidewalks on both sides of the street east of Van Street. However, west of Van Street, sidewalks currently exist only on the north side. Furthermore, High Road currently has sidewalks on the north side of the

street only. Clifton also has discontinuous sidewalks on the east side of the street, which can be a barrier for residents wishing to catch the bus northbound on Clifton, but construction is underway to address this. On Glenmore Road there are continuous sidewalks on the west side of the road but sidewalks are discontinuous on the east side. There are discontinuous sidewalks on the north side of Clement Avenue, but there is a continuous multi-use pathway that accommodates both pedestrians and cyclists on the south side.

3.4.4 Study Area Businesses

There are several businesses located within the study area, including a convenience store, hair studios, flower shop, restaurants, day care centres, and adventure outfits. Furthermore, Glenmore Elementary School and Grace Baptist Church are also located within the Phase 1 study area.

3.5 ComPASS Study Area Summary

Overall, an assessment of the Kelowna community revealed that there is a strong need for more sustainable transport safety (STS) solutions due to the high level of community concern for transportation in the city and the poor level of road safety compared to the rest of BC and Canada. This enforces the need for STS solutions such as a ComPASS that could potentially reduce personal vehicle use in Kelowna and provide attractive transportation alternatives.

The assessment of the Phase 1 study area revealed that compared to Kelowna as a whole, the Phase 1 study area had:

1. Younger than average neighbourhood age;
2. Higher than average income levels;
3. Higher than average automobile usage; and,
4. Mediocre transit service (not the worst in Kelowna but not the best).

Results from the 2004 ComPASS study (UBC TREK Program 2004) suggests that a ComPASS neighbourhood should be selected based on four criteria. These four criteria and how the Phase 1 study area compares are shown in Table 3.10.

Table 3.10 Recommended ComPASS neighbourhood demographics

Recommended ComPASS Neighbourhood Demographics	Phase 1 Study Area Demographics
Younger than average population.	✓
Lower income neighbourhood.	X (moderate income levels)
Good transit service with fast and frequent trips.	X (moderate transit LOS available)
Lower than average automobile ownership.	X (higher than average automobile usage suggesting higher than average automobile ownership)

Based on these criteria, the Glenmore study neighbourhood would appear to be a non-ideal candidate to test a Community U-Pass (ComPASS) because of it's higher than average income neighbourhood, mediocre transit service, and higher than average vehicle use. However, while it may not be the ideal neighborhood from a strictly demographic profiling perspective, it was selected based on two other mitigating factors, including: 1) available research funding required the study focus on the Glenmore neighbourhood and 2) its resident association had been one of the most active in the city, suggesting adequate study participation rates would be relatively easy to achieve.

Chapter 4 Phase 1 Study and Results: Stated Preference via Survey

This chapter is dedicated to the Phase 1 portion of the ComPASS study, and is broken down into two main parts. The first part, Section 4.1, outlines the Phase 1 methodology. Data regarding transportation beliefs, behaviours, and attitudes was collected through a resident survey and three public design workshops, with the study area bound by High Road to the north, Clement Road to the south, Glenmore Road to the east, and Clifton Road to the west. The second part, Section 4.2, presents and discusses the results from the Phase 1 pilot study. Overall, the purpose of the Phase 1 study was to achieve the second objective of the thesis: conduct a stated preference survey of Kelowna's Glenmore community regarding their transportation beliefs, attitudes, habits, and specific desires for a ComPASS program. Results from Phase 1 informed the direction for Phase 2, including which pilot study location to select and which components should be included in the piloted ComPASS package.

4.1 Phase 1 Methodology

Phase 1 of the research was accomplished by acquiring data through a steering committee, a stated preference resident survey, and three public design workshops in six months between May 2011 and October 2011. The Phase 1 objectives were to:

1. Engage and inform the Glenmore community on effective, proven sustainable transportation alternatives using an integrated, system-based design philosophy and an inclusive community-driven public process.
2. Conduct an online stated preference survey to gauge resident support for the above Glenmore ComPASS design.
3. Based on findings from objectives 1 and 2, design a recommended "made in Glenmore" ComPASS to compete with, and significantly reduce, vehicle use for the Phase 2 pilot study.

Section 4.1.1 outlines the data collection process for Phase 1, while Section 4.1.2 reviews the survey data analysis process.

4.1.1 Data Collection

In Phase 1, data regarding transportation beliefs, behaviours, and attitudes were collected through steering committee meetings, three public design workshops, and an online community survey.

4.1.1.1 Steering Committee Meetings

Throughout Phase 1, the research team consulted a Steering Committee monthly for ideas and opinions regarding the ComPASS, the community survey, and workshop design. Members of the steering

committee came from various backgrounds, including the Interior Health Authority (IHA), Glenmore Elementary Parent Advisory Committee (PAC), Fresh Outlook Foundation, City of Kelowna, Glenmore Valley Community Association, School District No. 23, Glenmore Elementary School, and local businesses. The steering committee were extremely helpful for providing input regarding the operation of Phase 1 of the project.

4.1.1.2 Public Design Workshops

Three public design workshops were held in the Glenmore community throughout the summer of 2011. To supplement data gathered through the surveys, all residents of Glenmore were invited to the workshops to provide their opinions regarding design and pricing of a ComPASS. Residents were invited to attend through newspaper articles, radio interviews, neighbourhood association distributions, and through door-to-door canvassing. The workshops also provided education for Glenmore residents on sustainable transportation choices. These workshops were also used as a means to introduce residents to the community survey. Appendix A shows an outline for the public design workshops.

4.1.1.3 Community Survey

The Glenmore ComPASS stated preference survey had two goals:

1. To determine the most appealing ComPASS design to Glenmore residents. As different communities are composed of different demographics with differing lifestyles, the survey sought data regarding the specific ComPASS needs and desires of the Glenmore community.
2. To record the community's current travel habits and their current opinions on public transit. Information regarding current travel habits was essential to the research as it gave a standard pre-pass benchmark that could be compared to future surveys. This would allow the research team to measure behaviour and belief change over time and the potential effect of the pass on automobile use.

Prior to distribution of the survey, an application from the UBC Behavioural Research Ethics Board (BREB) was fully completed and approved. The survey was distributed as both an online version and a hardcopy version. Appendix B shows the Phase 1 survey questions, while Appendix C shows the number of responses for each survey question. Due to the length and intensity of the survey, prize incentives were included to motivate more residents to participate. Consequently, the research team asked many businesses in Glenmore and downtown Kelowna to provide donations to include in a prize draw for survey participants.

The software used for the online survey was the Enterprise Feedback Management (EFM) Survey Tool. The EFM survey tool was free for UBC students and faculty. It allowed many features such as conditional branching, matrix style questions, results filtering, and real-time results. Information could be viewed graphically on the EFM website or downloaded in Excel (Microsoft Office 2013) format for further interpretation. All data acquired through EFM was securely stored and backed up in Canada and complied with the BC Freedom of Information and Protection of Privacy Act (FIPPA) (Cundy 2011).

Invitations to take the survey were distributed by the research team, who sought to engage residents at community events and meetings, radio and newspaper interviews, through flyers, door-to-door campaigns, and the research website. Attendees of community meetings were also given the link to the online survey or extra hardcopies of the survey to distribute to their neighbours in Glenmore. By utilizing multiple media surveys and advertising methods and offering prizes, the research team was able to appeal to more residents and to increase the number of survey responses.

Although there were attempts to reduce selection bias by appealing to various demographics, bias was still present in survey responses which is a limitation of the Phase 1 research. One likely form of bias was that residents in favour of sustainable initiatives and AT were more likely to respond to a survey regarding AT. In contrast, those who had no particular opinion or feeling towards the topic were less likely to respond. Efforts to reduce bias through weighting survey responses are discussed further in Section 4.1.3.

To facilitate analysis of the data and minimize multiple unique answers, the survey relied more on multiple choice questions and less on open ended questions. This ensured that the answers given by participants were not subject to interpretation. It was important not only to have clear and concise questions, but also well-defined multiple choice answers so respondents were completely aware of what they were answering. The survey was pre-tested through the steering committee to ensure questions were simple to understand and the presentation of the survey was adequate. One open ended question was included near the end of the survey where residents could fill in any opinions, needs, or issues that the researchers may have overlooked when designing the survey. By including this question, the research team was be able to retain the quantized data for simpler analysis, while also allowing participants the ability to submit any other comments they felt were also important.

4.1.1.3.1 Glenmore ComPASS Design

Numerous possible ComPASS components were identified prior to the stated preference resident survey for consideration to be included in a potential ComPASS package. Table 4.1 below outlines each possible ComPASS component.

Table 4.1 Potential Glenmore ComPASS components

Possible Component	Description
Transit Pass	Unlimited access to transit within the limits of the Kelowna Regional Transit System (KRTS).
Parkinson Recreation Centre Pool Pass	Access to the pool at the Parkinson Recreation Centre, the local recreation centre in Glenmore.
Parkinson Recreation Centre Facility Pass	Access to the gym facility at the Parkinson Recreation Centre, the local recreation centre in Glenmore.
Bicycle Training Classes	Bicycle training to improve cycling safety to encourage more cycling as a mode of transport.
Bike Tune-ups	Bike tune-ups at a local bicycle shop to ensure bikes are road safe.
Bus Mounted Bike Racks	More bike racks on buses to decrease possibility of passing up riders with bikes if existing bus-mounted bike racks are full.
Ground Mounted Bike Racks at Bus Stops	Bike racks at bus stops give transit riders with bikes the option to leave their bike at the bus stop if the bus mounted bike racks are full.
Bicycle Winery Tours	A recreational means to encourage more bicycle transport among participants in a fun and relaxed atmosphere.
Pedicab Art Gallery Tours	A low energy means for transport or recreation within downtown rather than the traditional taxi.
Bike Sharing	Bike rack stations would be dispersed at different hubs in Kelowna for bike sharing members to pick up and drop off bikes at their convenience. Only members would have access to these bikes. The program could be run by a formal company (e.g. BIXI) or run by the community.
Emergency Taxi Rides Home	To ensure that participants that used a lower energy transportation mode have a quick way to get home in the event of an emergency.
Community Shuttle (community purchased)	A transit bus that would serve the Glenmore community and could potentially travel to high demand locations or feed into other existing transit routes.
Merchant Incentives	Merchant discounts or discounts that pass holders would receive as a perk to being a ComPASS participant.
CanCarts	A manoeuvrable cargo cart which promotes easier movement of goods using lower energy transportation modes. The CanCart can be led by hand through shopping aisles, on the sidewalk, and can be taken onto the bus. The CanCart can also be led by a bicycle with a simple attachment procedure. Various CanCarts can be shared throughout a neighbourhood and signed out in advance of use, similarly to bike and car sharing.
Car Sharing	The sharing of communal cars that would be situated in ideal locations for easy pick up and drop off. ComPASS members could have access to this service through Kelowna's OGO Car Share Co-op.
Ski Shuttle	Discounted access to a shuttle that would transport community members to the local ski hill (Big White) to decrease private auto use to this location.

Each component in the above table was presented in the Phase 1 stated preference survey to gauge which components the public preferred in a ComPASS package.

4.1.1.4 Level of Community Engagement

The Glenmore ComPASS research team was able to gauge the overall level of community engagement by tracking the number of residents involved in the various community events, including: the City of Kelowna Summer 2011 Park and Play events, Glenmore Community Potluck, Glenmore Valley Community Association Annual General Meeting, the three Glenmore ComPASS public design workshops, those who completed the online survey, door-to-door visits, steering committee meetings, and feedback from media interviews. Over 1000 residents were engaged throughout the process of Phase 1. Table 4.2 below displays a summary of the results of each community engagement strategy used throughout the research study.

Table 4.2 Glenmore ComPASS public engagement summary

Event	Number Engaged
Door to door	650
City of Kelowna Park and Play Events	30
Glenmore Valley Community Association General Meeting	35
Glenmore Community Potluck	23
Public Design Workshops	32
Steering Committee	15
Media Interviews*	300
Total	1085 +

*Based on 1:100 assumed ratio of feedback to listeners used in the radio industry.

4.1.2 Survey Data Analysis

To analyze Phase 1 survey responses, online survey data was exported to Excel (2013) format. Once responses were in Excel (2013), pivot tables were used to summarize survey data. Pivot tables are a powerful tool in Excel that allows for various filtering, summarizations (e.g. summation, average, percent total, etc.), and cross-referencing of datasets between rows and columns.

After reviewing data it was found that survey sample demographic averages were slightly skewed when compared to the population data obtained from the 2011 NHS (Statistics Canada 2013). In attempts to limit bias, survey responses were weighted against the NHS data in four categories: 1) home location, 2) employment status, 3) work location, and 4) transportation mode to and from work.

The home postal code of respondents was requested in the survey to determine whether or not survey households were located within the Phase 1 study boundary. Postal codes were used to filter out respondents from outside of the study boundary. For respondents within the Phase 1 study area, Figure

4.1 displays the survey respondents' employment status while Figure 4.2 displays the 2011 NHS employment status in the Phase 1 study area. In addition, Figure 4.3 displays respondents' workplace location (whether they work from home or typically travel to and from work), while Figure 4.4 displays the 2011 NHS work place location for the Phase 1 study area. Furthermore, Figure 4.5 shows the survey respondents' transportation mode split to and from work, while Figure 4.6 shows the 2011 NHS transportation mode split within the Phase 1 study area.

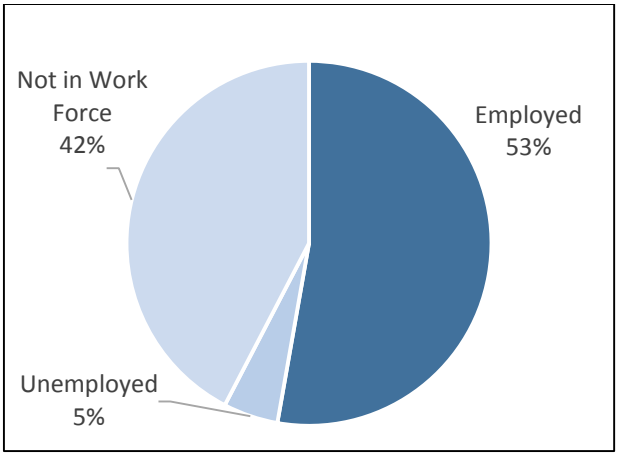

Figure 4.1 Phase 1 survey employment status

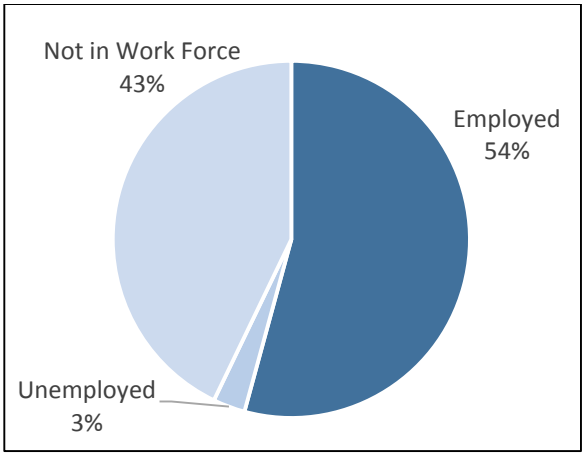

Figure 4.2 2011 NHS Phase 1 study area employment status (Statistics Canada 2013)

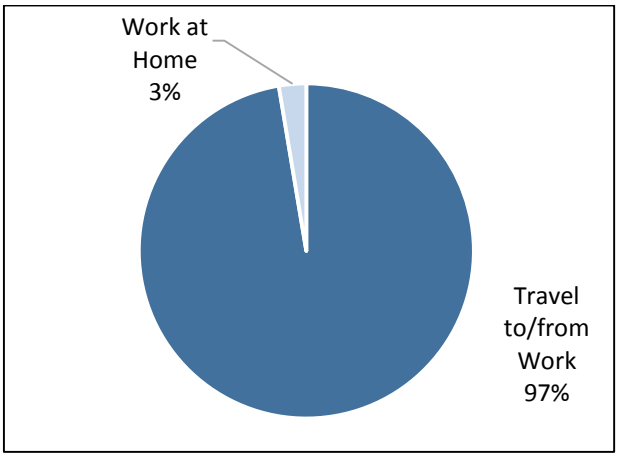

Figure 4.3 Phase 1 survey work place location

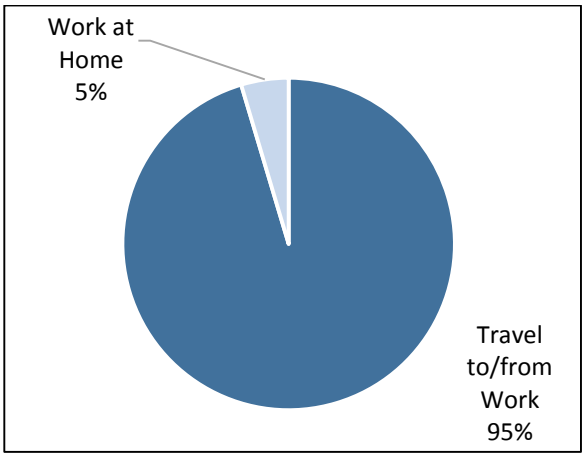

Figure 4.4 2011 NHS Phase 1 study area work place location (Statistics Canada 2013)

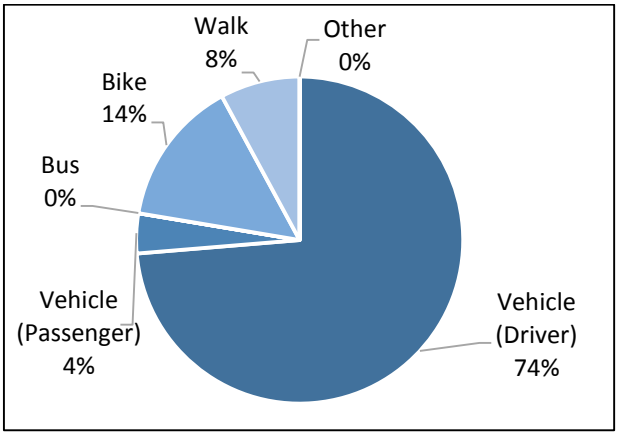

Figure 4.5 Phase 1 survey transportation mode to and from work only

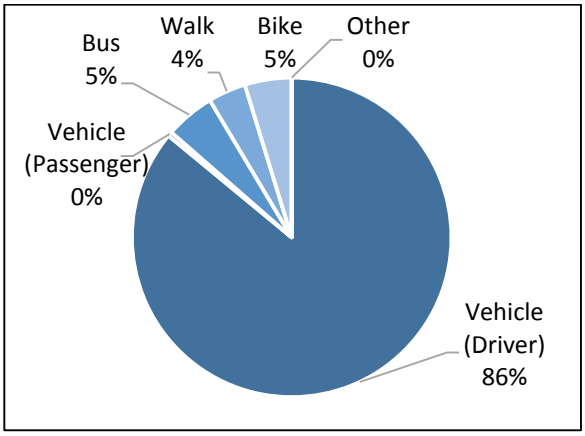

Figure 4.6 2011 NHS Phase 1 study area transportation mode split to work (Statistics Canada 2013)

When compared with 2011 NHS data, survey respondents had similar percentages of employment status (employed, unemployed, and not in the work force) and workplace location (home or travels to/from work). However, there was a greater difference between 2011 NHS data and survey data for the transportation mode split to work. According to results, survey respondents were under represented by those who travel to work in a vehicle as a driver and those who take transit, and over represented by walkers, cyclists and those who travel in a vehicle as a passenger. The difference between transportation mode to and from work between survey respondents and the 2011 NHS Phase 1 study area population was anticipated. Residents who support AT and therefore less likely to drive to/from work would likely be more interested in answering a survey related to AT. To help reduce the survey respondents' bias, weights were applied to each household respondent by comparing survey response data to 2011 NHS data. Figure 4.7 below shows how weights were calculated.

Step 1 - Household Location Multiplier:
If households were not within the study boundary they were removed from the analysis.

Step 2 - Employment Status

Employment Status	Survey Responses	NHS 2011	NHS/Survey Ratio
Employed	52.8%	54.2%	See Step 3
Unemployed	4.9%	2.9%	0.60
Not in Work Force	42.4%	42.9%	1.01

Step 3 - Employed Residents Work Location:

a. Percent from Survey and NHS 2011

Work Location	Survey Responses	NHS 2011
Work from Home	2.6%	4.6%
Travel to/from Work	97.4%	95.4%

b. Percent of those Employed

Percent Employed:	52.8%	54.2%	
Work Location	Survey Responses	NHS 2011	NHS/Survey Ratio
Work from Home	1.4%	2.5%	1.80
Travel to/from Work	51.4%	51.7%	See Step 4

Step 4 - Transportation Mode of the Employed Residents that Travel/to from Work:

a. Percent from Survey and NHS 2011

Transportation Mode for Work	Survey Responses	NHS 2011
Driver	73.7%	86.0%
Carpool	3.9%	0.5%
Bus	0.0%	5.0%
Bike	14.5%	4.7%
Walk	7.9%	3.8%
Other	0%	0%

Percent of those Employed & Travel to/from Work

Percent Employed & Travel to/from Work	51.4%	51.7%	
Transportation Mode for Work	Survey Responses	NHS 2011	NHS/Survey Ratio
Driver	37.9%	44.2%	1.17
Carpool	2.0%	0.2%	0.11
Bus	0.0%	2.6%	N/A
Bike	7.4%	2.4%	0.33
Walk	4.1%	2.0%	0.48
Other	0%	0%	N/A

Figure 4.7 Phase 1 survey response weighting

Figure 4.8 shows a graphical representation of the process of calculating household weightings.

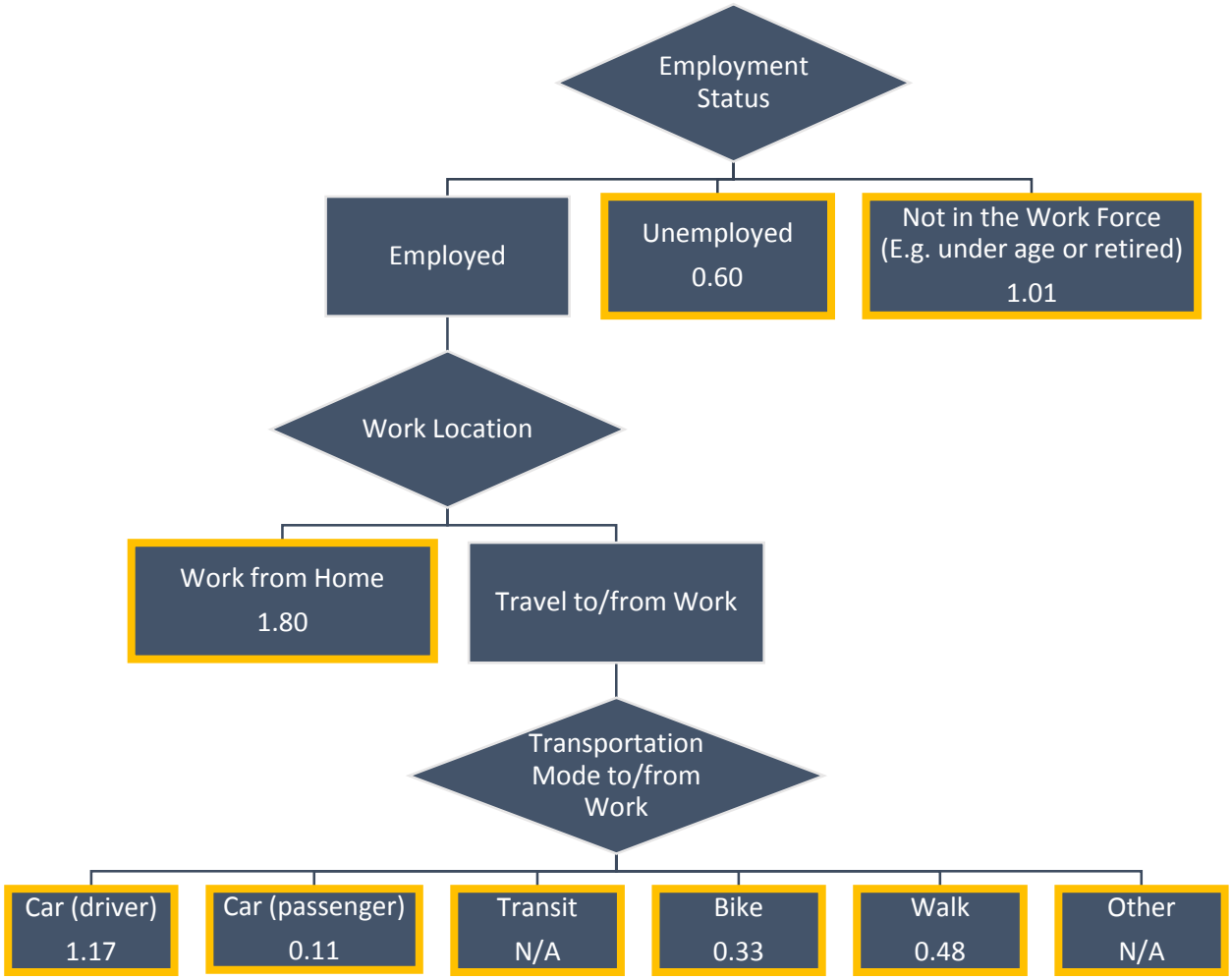

Figure 4.8 Phase 1 survey data weighting

Since survey respondents responded on behalf of their entire household, weights for each household member were averaged to find an overall weighting for each household. Figure 4.9 shows a sample calculation for finding the weight of a single surveyed household.

Household Sample Weighting:

Employment Status	Work Location	Transportation Mode to Work	Weight	Number of Household Members	Household Weighting
Employed	Travel to/from Work	Vehicle (Driver)	1.17	1	1.17
		Vehicle (Passenger	0.11	0	0
		Transit	N/A	0	0
		Bike	0.33	1	0.33
		Walk	0.48	0	0
	Work at Home		1.80	0	0
Unemployed	N/A		0.60	0	0
Not in Work Force	N/A		1.01	2	2.02
				Average:	**0.88**

Figure 4.9 Phase 1 survey household weighting sample calculation

Once weights per household were calculated, the weights were applied to survey responses related to ComPASS design questions.

4.2 Phase 1 Results and Discussion

Section 4.2.1 describes the data collected in Phase 1, Section 4.2.2 reviews results from the three public design workshops. Section 4.2.3 outlines the stated preference resident survey results, and Section 4.2.4 summarizes the Phase 1 results.

4.2.1 Data Description

The survey included 32 questions with an optional travel diary section at the end. The travel diary was optional so as not to deter some potential respondents from participating in the main 32-question survey. A total of 99 responses were received, with 49 responses from households within the Phase 1 study area. Forty-nine responses out of 650 households (the number of households invited to participate in the Phase 1 study area via door-to-door community engagement) translates to a 7.5% response rate (49 ÷ 650 = 7.5%). The sample size of a survey of this nature is calculated using the following equation (Rodriguez del Aguila and Gonzalez-Ramirez 2014):

$$n = \frac{t_\alpha^2 pqN}{(N-1)e^2 + t_\alpha^2 pq}$$

Where: n is the sample size, N is the total population from which the sample size was selected, p is the expected percentage of the response variable, q is 1 – p, e is the accepted margin of error, t_α is the value of the normal curve associated with the selected confidence level (e.g. for a confidence level of 99% t_α is

2.57, for a confidence level of 95% t_α is 1.96, and for a confidence level of 90% t_α is 1.64) (Rodriguez del Aguila and Gonzalez-Ramirez 2014).

To determine the worst case, an expected percentage of the response variable (p) is typically taken as 50%, meaning q is also 50% (1 – 0.5 = 0.5) (Rodriguez del Aguila and Gonzalez-Ramirez 2014). For example, this means for a yes/no question in a survey, 50% are assumed to say yes and 50% are assumed to say no. As p increases or decreases from 50%, the margin of error decreases, meaning there is more confidence in the result. Therefore, with no previous knowledge of the data being collected, using 50% is the most conservative approach to find the required sample size (Rodriguez del Aguila and Gonzalez-Ramirez 2014). Figure 4.10 shows a sample calculation for finding the desired Phase 1 survey sample size.

Assumptions:
N = 750
e = 10%
Confidence level = 90% (t_α is 1.64)
p = 0.5
q = 0.5

$$n = \frac{t_\alpha^2 pqN}{(N-1)e^2 + t_\alpha^2 pq}$$

$$n = \frac{1.64^2 * 0.5 * 0.5 * 750}{([750-1] * 0.10^2) + (1.64^2 * 0.5 * 0.5)}$$

$$= 62.16 \cong 63\ samples$$

Figure 4.10 Phase 1 desired sample size

The acquired 49 responses is lower than the desired sample size, however; this was all that could be achieved after extensive community engagement in the Phase 1 study area. Figure 4.11 shows the sample calculation to find the actual margin of error for the sample size of 49.

Given:
N = 750
n = 49
Confidence level = 90% (therefore t_α is 1.64)
p = 0.5
q = 0.5

$$e = \sqrt{\frac{t_\alpha^2 pq(N-n)}{n(N-1)}}$$
$$= \sqrt{\frac{1.64^2 * 0.5 * 0.5 * (750-49)}{49 * (750-1)}}$$
$$= 11.4\%$$

Figure 4.11 Phase 1 margin of error

Overall, the receipt of 49 responses meant that the Phase 1 study area sample size met a 90% confidence level with a confidence interval of 11.4%. In other words, if survey results show that 50% of respondents would support a ComPASS program in their neighbourhood, there would be 90% likelihood that between 38.6% and 61.4% (e.g. 50% +/- 11.4%) of the target population (e.g. 750 households in the Phase 1 study area) would support a ComPASS program in their neighbourhood. However, the margin of error decreases as the percent response deviates from 50%. For example, if instead 80% of respondents would support a ComPASS program in their neighbourhood, there would be margin of error of 9.1%, meaning there would be a 90% likelihood that between 70.1% and 89.1% (e.g. 80% +/- 9.1%) of the target population would support a ComPASS program in their neighbourhood. However, when results are closer to 50%, the small sample size results in a higher confidence interval, which is a limitation to the Phase 1 research.

Data was also collected from the three public design workshops. Of the 650 households notified door to door of the workshops, 32 residents attended. It was found that the responses from the online survey generally matched the remarks from the public design workshops.

Figure 4.12 displays a map with general survey response households mapped out based on postal codes. The size of the points are weighted based on the number of responses from each postal code (e.g. the larger the point, the more responses from that postal code).

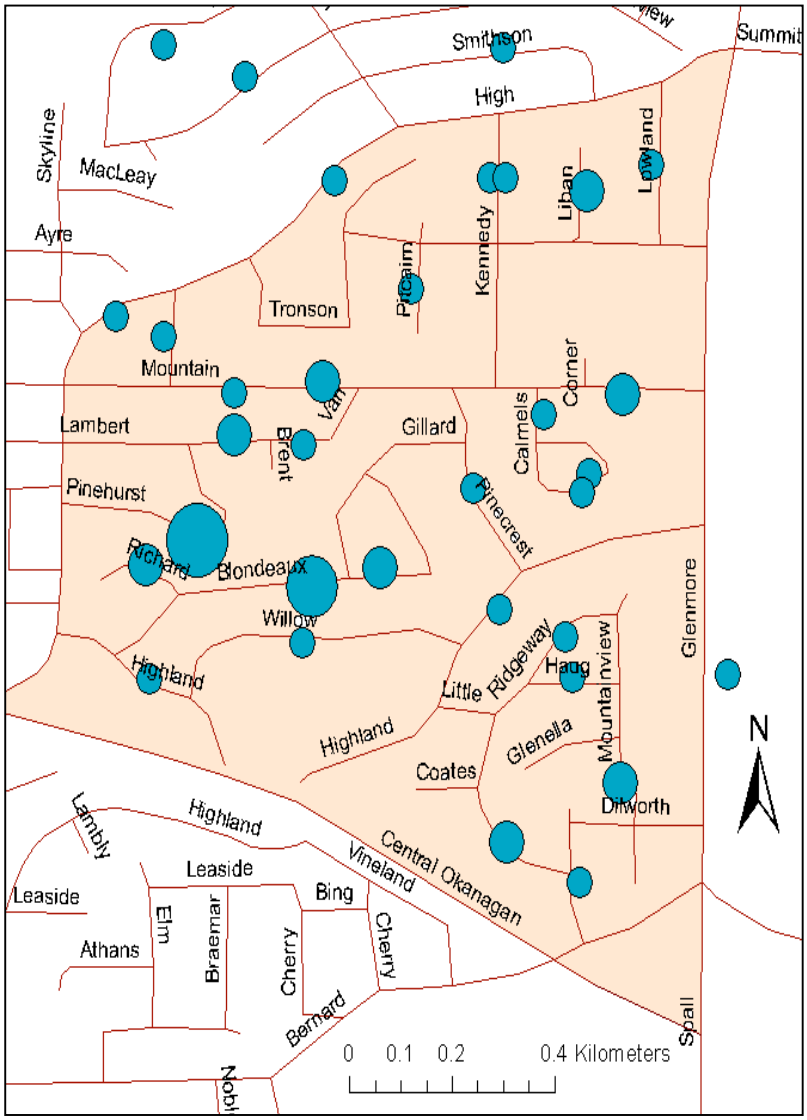

Figure 4.12 General locations of survey respondents based on postal code

4.2.2 Public Design Workshop Results

Although there was less than ideal attendance for the public design workshops, the research team still received significant input. Furthermore, the public design workshops gave the research team an opportunity to educate residents further on the barriers, benefits, and incentives associated with using sustainable transportation as well as details of the Glenmore ComPASS.

The most popular ComPASS design components discussed at workshops included (in addition to a bus pass):

- Improved transit service (increased headway, later service hours, more bus stops, improved coverage);

- Recreation centre pass;
- Emergency taxi rides home;
- Bike tune-ups or repairs;
- Glenmore community shuttle; and,
- Merchant discounts or incentives.

Residents were willing to pay from $10 per month per household to over $100 per month per household for a ComPASS, depending on what was included. The general consensus between residents was that for the Glenmore ComPASS to be attractive and successful, it was essential that 1) it be more than a bus pass, and 2) the transit service to the study area be improved.

4.2.3 Community Survey Results

Phase 1 community survey results, including transportation behaviours and beliefs, preferred ComPASS design, and ComPASS pricing, are discussed in subsections below.

4.2.3.1 Transportation Behaviours

Transportation mode trip distance for various trip types (work, shopping, recreation, and school) were analyzed. The frequencies of cycling and transit use were also analyzed.

The community survey asked residents which transportation mode they predominantly used for work, school, shopping, and recreation, as summarized in Figure 4.13.

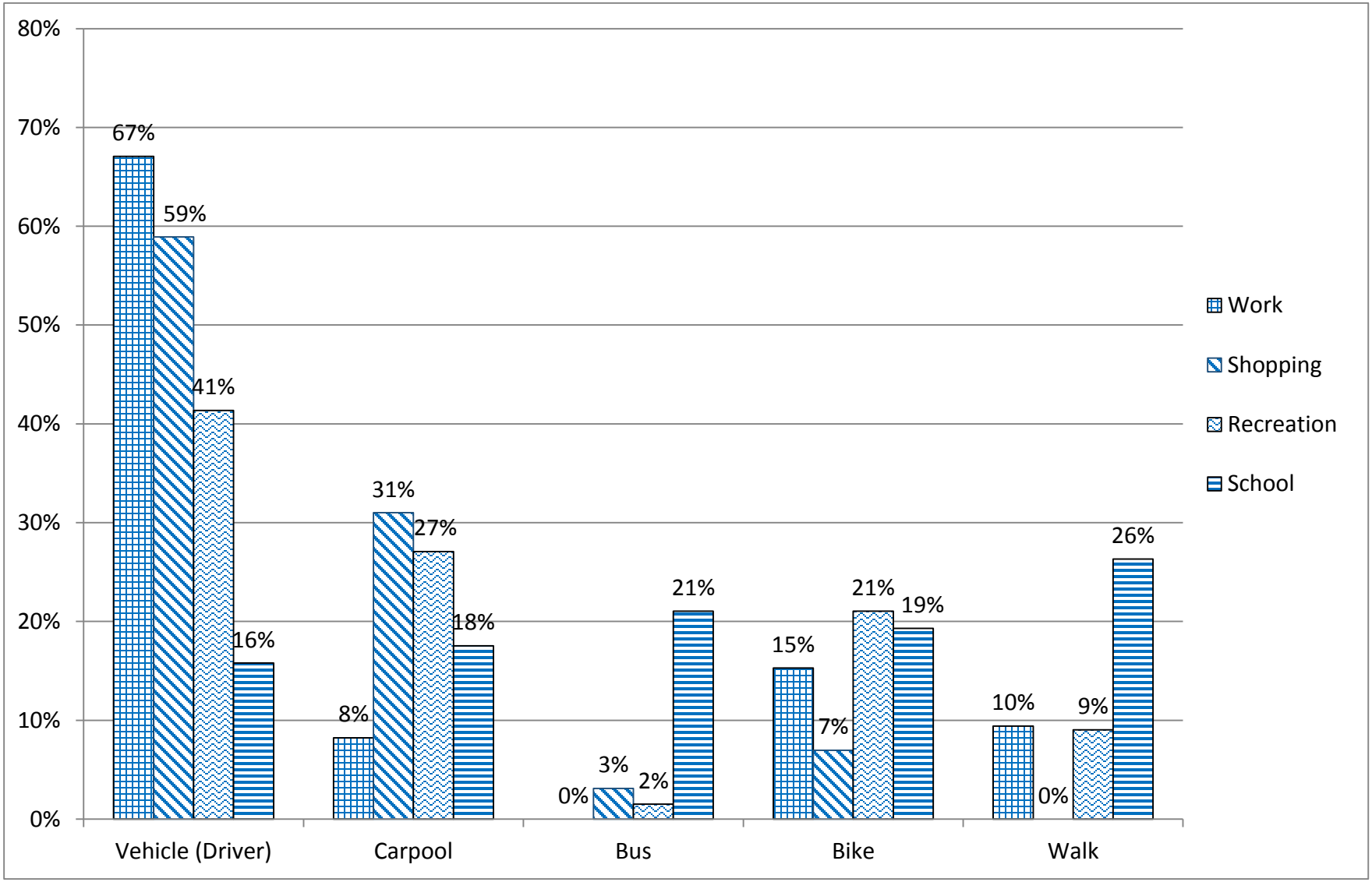

Figure 4.13 Transportation mode splits for different trip purposes (Phase 1)

Work, shopping, and recreational trips are mostly dominated by vehicle trips as the driver. In contrast, transportation modes to and from school are more equally shared. This is likely because the majority of students are below the legal driving age and typically live closer to their schools. Moreover, it is apparent that students are the main bus users within the study boundary.

Figure 4.14 shows the travel distance distribution of survey respondents' commutes to work and school. One third of residents' trip distances were below 3 km, which is the ideal trip distance for cycling in terms of travel time, speed, and energy efficiency (Feng and Lovegrove 2012).

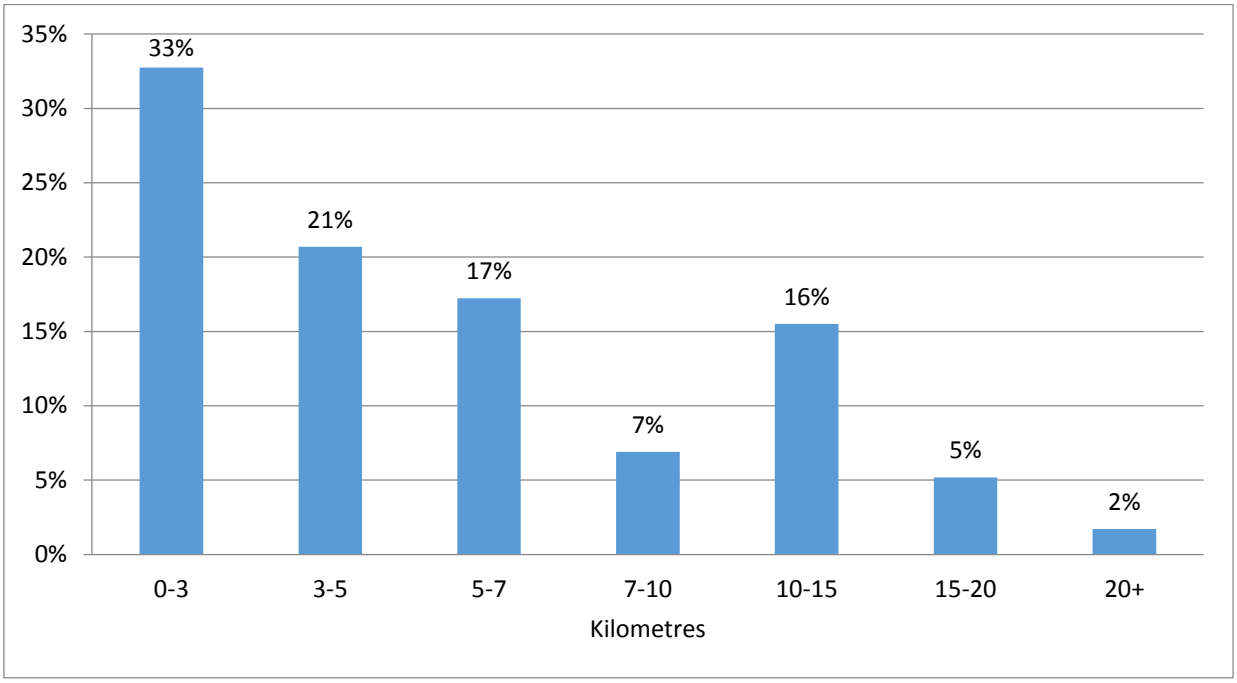

Figure 4.14 Travel distance for work and school trips (Phase 1)

In addition, residents were asked how often each member of their household uses the bus in Kelowna. 62% of respondents never use the bus, and only 3% use the system daily.

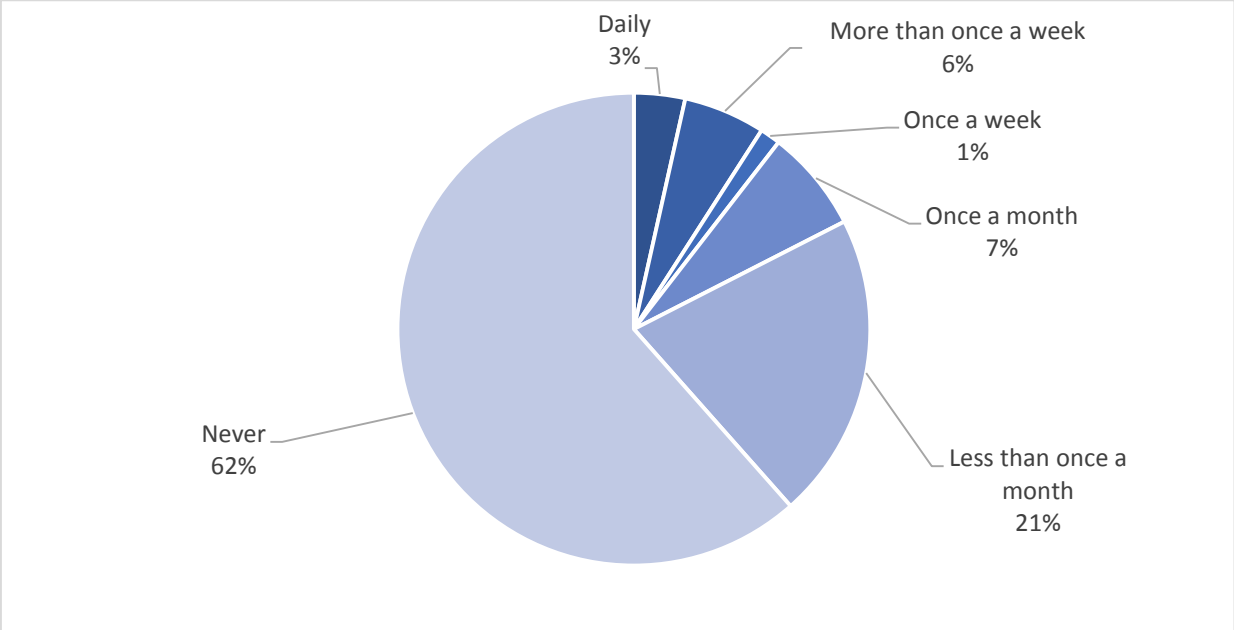

Figure 4.15 Frequency of bus use in the study area (Phase 1)

Residents were also asked to answer how often members of their household cycle to work, shopping, recreation, and school which and results are displayed in Figure 4.16, Figure 4.17, Figure 4.18, and Figure 4.19, respectively.

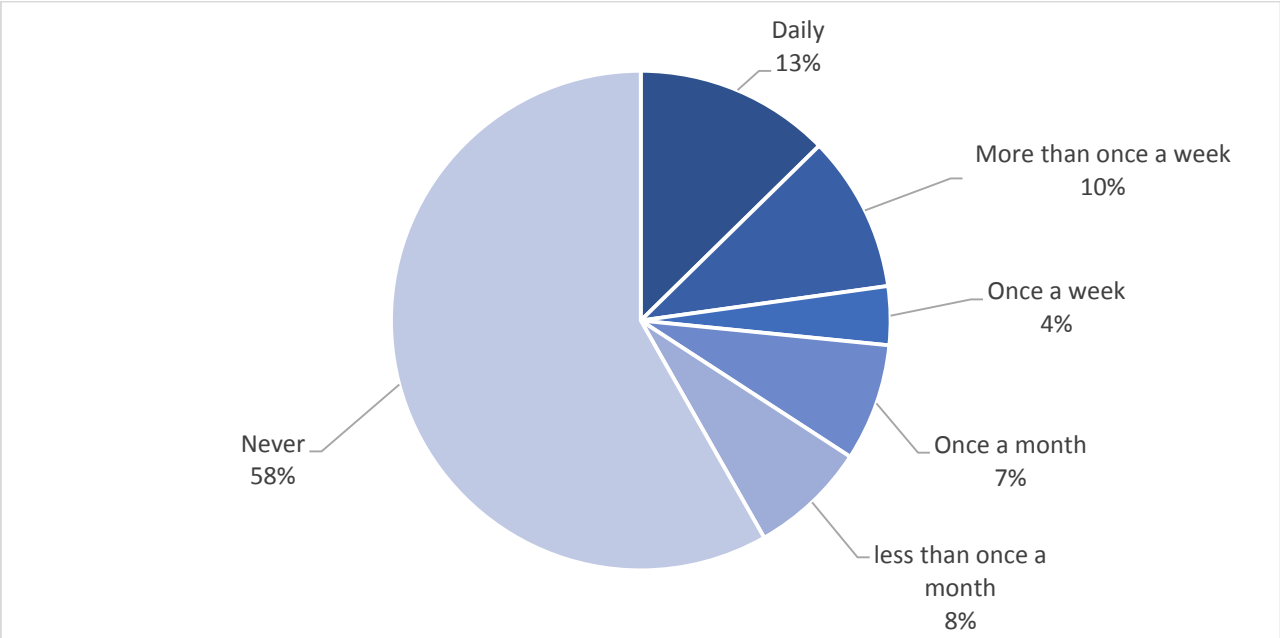

Figure 4.16 Frequency of bike use for work commutes only (Phase 1)

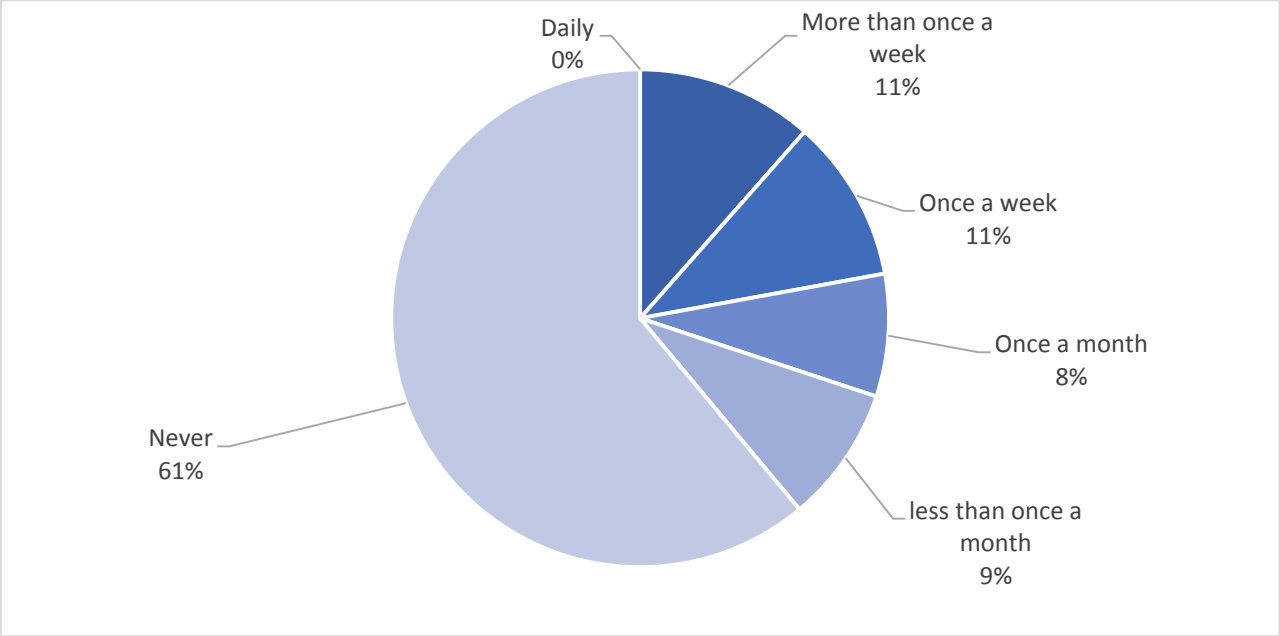

Figure 4.17 Frequency of bike trips for shopping related trips only (Phase 1)

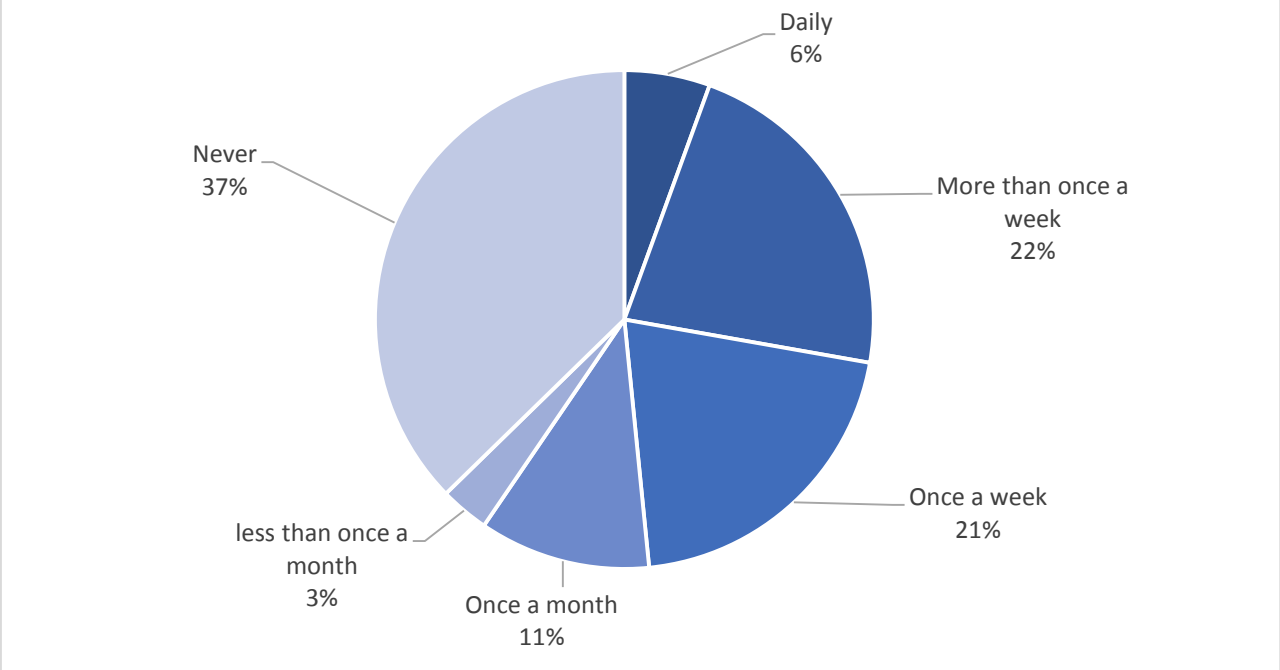

Figure 4.18 Frequency of bike trips for recreation trips only (Phase 1)

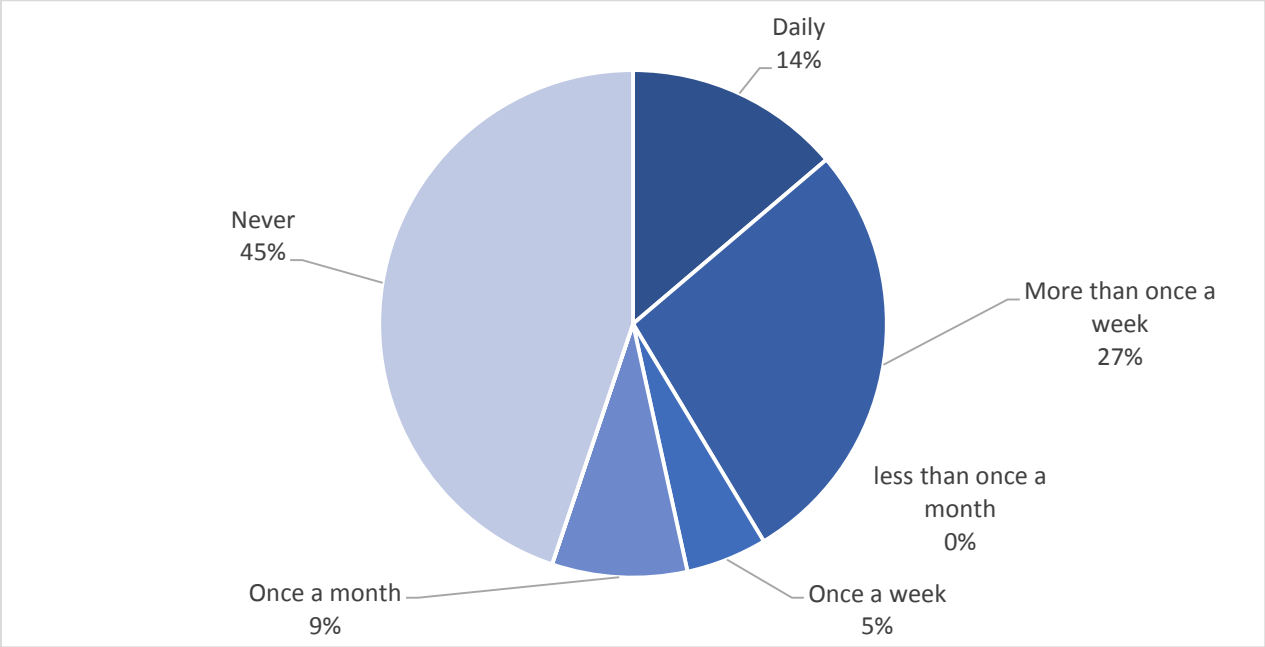

Figure 4.19 Frequency of bike use for trips to and from school only (Phase 1)

The majority of residents never ride their bikes for work and shopping. Biking is most popular for school and recreation with fewer residents indicating they never use their bikes for those purposes.

4.2.3.2 Current Transportation Beliefs

Several questions in the survey asked residents about their current beliefs regarding transportation in Kelowna and their community. Understanding current beliefs would allow researchers to gauge how and if future changes to the transportation system changed beliefs and behaviours. Therefore, several questions regarding opinions on transit, cycling, and pedestrian infrastructure were asked in the survey.

According to Figure 4.20, 47% of residents moved to Glenmore to be in close proximity to amenities. Despite this fact and the short average trip distances from the study area, the majority of residents still strongly rely on their personal vehicles to travel. Therefore, it is important to determine why this is the case.

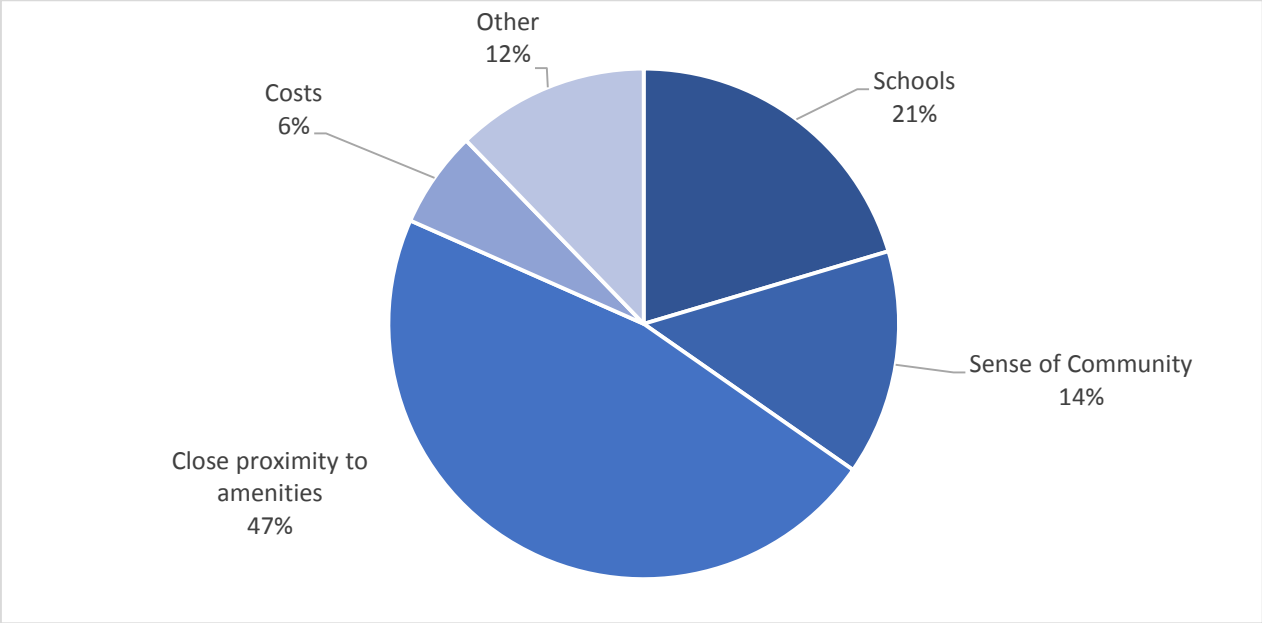

Figure 4.20 Reasons why residents moved to the Glenmore community (Phase 1)

Several survey questions asked respondents about their current beliefs regarding bike use and what might encourage more cycling and walking in the community. Residents were asked to respond to statements with "strongly agree", "agree", "neutral", "disagree", or "strongly disagree". Figure 4.21 shows whether households agreed they would be more likely to ride a bike to businesses if those businesses were more cyclist friendly.

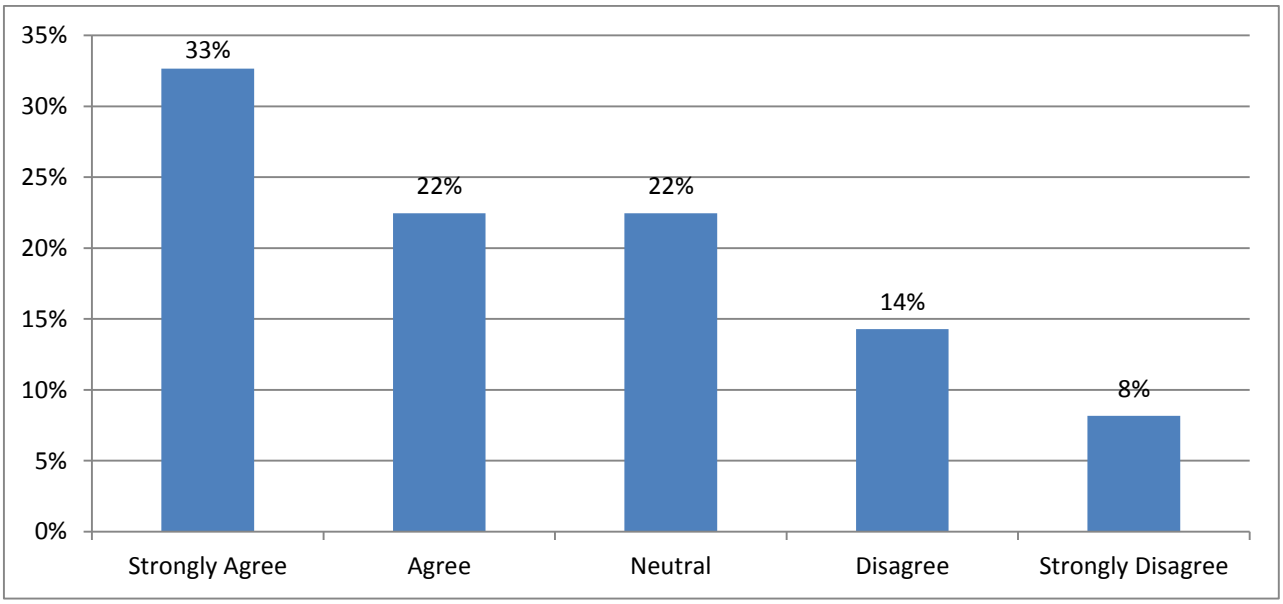

Figure 4.21 If businesses were more cyclist friendly (e.g. more bike racks, bike lanes, etc.), my household would be more likely to cycle to these businesses (Phase 1)

Results indicated that 55% agreed or strongly agreed, while only 22% said they disagreed or strongly disagreed.

Figure 4.22 shows whether households agreed they would be more likely to walk to businesses if they were more pedestrian friendly (e.g. accessible for pedestrians, adequate pedestrian infrastructure, safer parking lots).

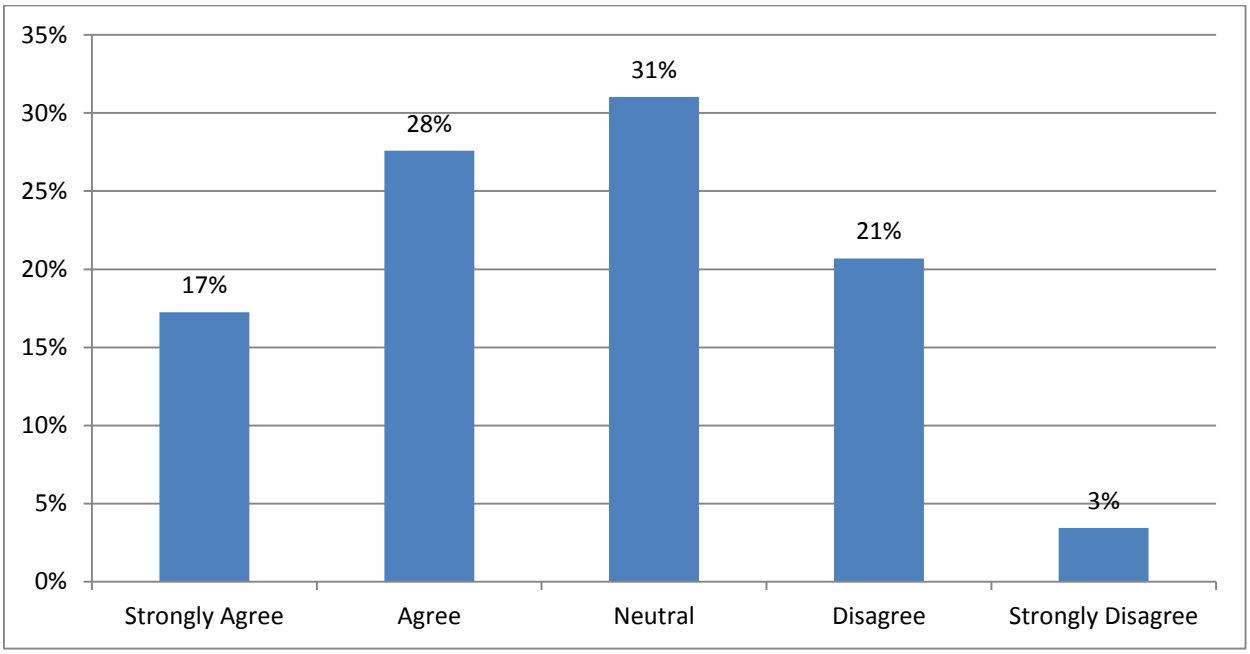

Figure 4.22 If businesses were more pedestrian friendly, my household would be more likely to walk to these businesses (Phase 1)

Results show that 45% said they agreed or strongly agreed, while 24% disagreed or strongly disagreed. Results shown in both Figure 4.21 and Figure 4.22 suggest that businesses also play a role for encouraging residents to take AT by accommodating AT modes.

Residents were also asked if they would consider riding the bus. Results are shown in shown in Figure 4.23.

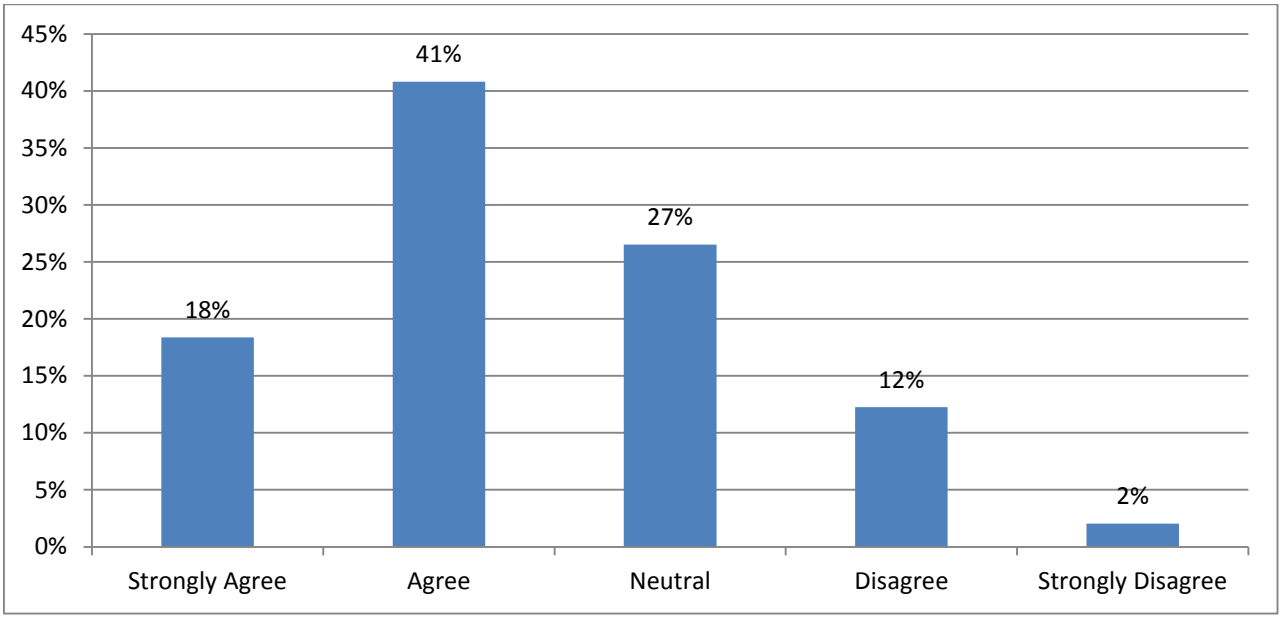

Figure 4.23 I would consider riding the bus (Phase 1)

Results demonstrate that 59% agreed or strongly agreed, while only 14% stated that they disagreed or strongly disagreed. This shows that the majority of residents would be willing to use transit in Kelowna. Since the majority of residents are willing to use the bus yet few actually do, it is important to determine what barriers are deterring them.

Figure 4.24 shows responses to whether households agree with the statement that their household rides the bus because it is the most affordable option.

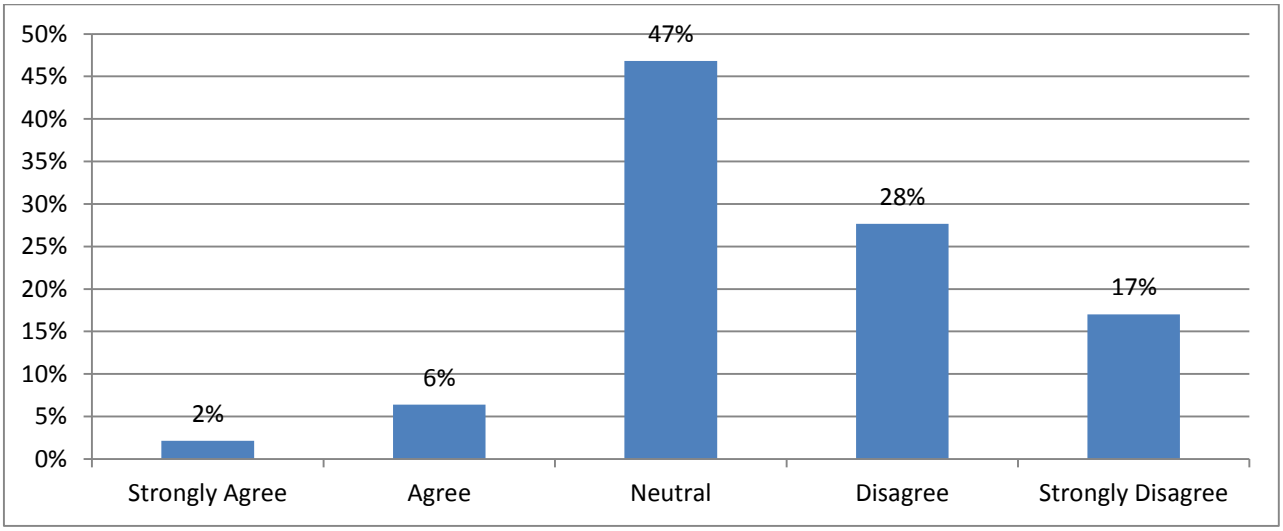

Figure 4.24 My household rides the bus because it is the most affordable option (Phase 1)

According to results, only 8% agree and strongly agree with the statement, while 45% disagree and strongly disagree. Therefore, results suggest that few residents ride the bus because it is their most affordable option.

Probing further, residents were asked if they would be willing to ride the bus if there were improvements to the service. Results to this question are shown in Figure 4.25.

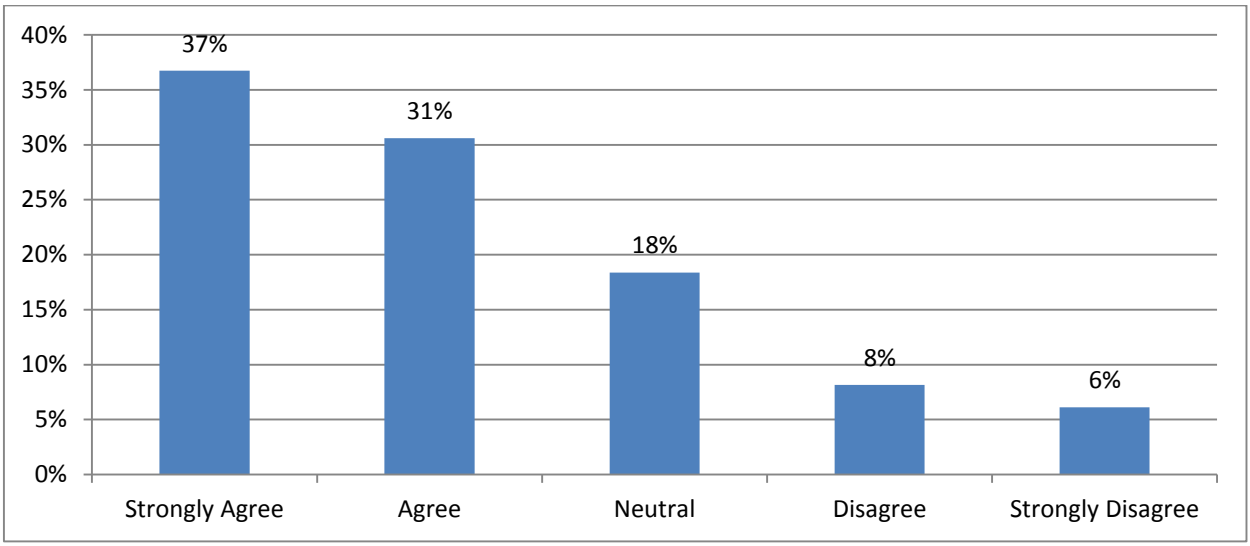

Figure 4.25 Would you ride the bus if there were improvements to the service? (Phase 1)

Results show there is a strong skew towards "strongly agree". Overall, 68% of households agree or strongly agree that they would ride the bus with service improvements. This demonstrates that transit service improvements are necessary to increase ridership.

Figure 4.26 shows how residents rate traffic congestion in Kelowna on a scale of 1 (good, e.g. not that bad at all) to 5 (bad, e.g. too congested).

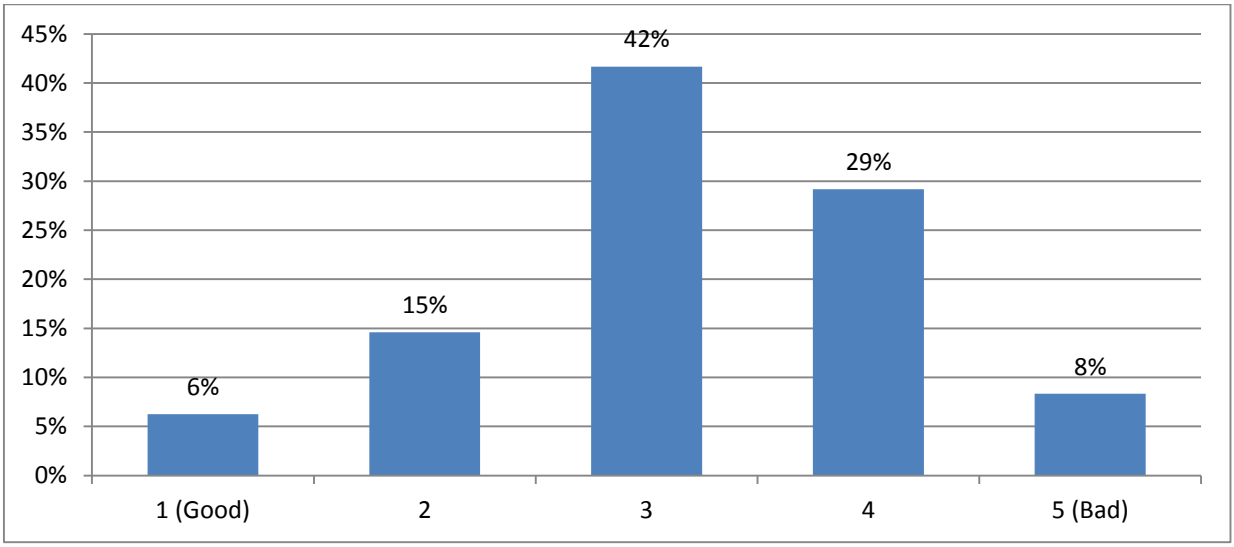

Figure 4.26 Rate traffic congestion in Kelowna on a scale of 1(good) to 5 (bad)? (Phase 1)

The above figure shows that 37% of residents believing congestion is bad (rank 4 and 5), while 21% believe it is not that bad at all (rank 1 and 2). However, 42% are neutral on the subject, suggesting that many Glenmore residents do not feel strongly about traffic congestion in Kelowna. Although the 2015 Citizen Survey suggests that traffic congestion is one of the main concerns for Kelowna residents (City of Kelowna 2015b), Glenmore residents may feel differently since they are located in a central area close to amenities.

Figure 4.27 shows how residents rate transit service in Kelowna on a scale of 1 (good) to 5 (bad).

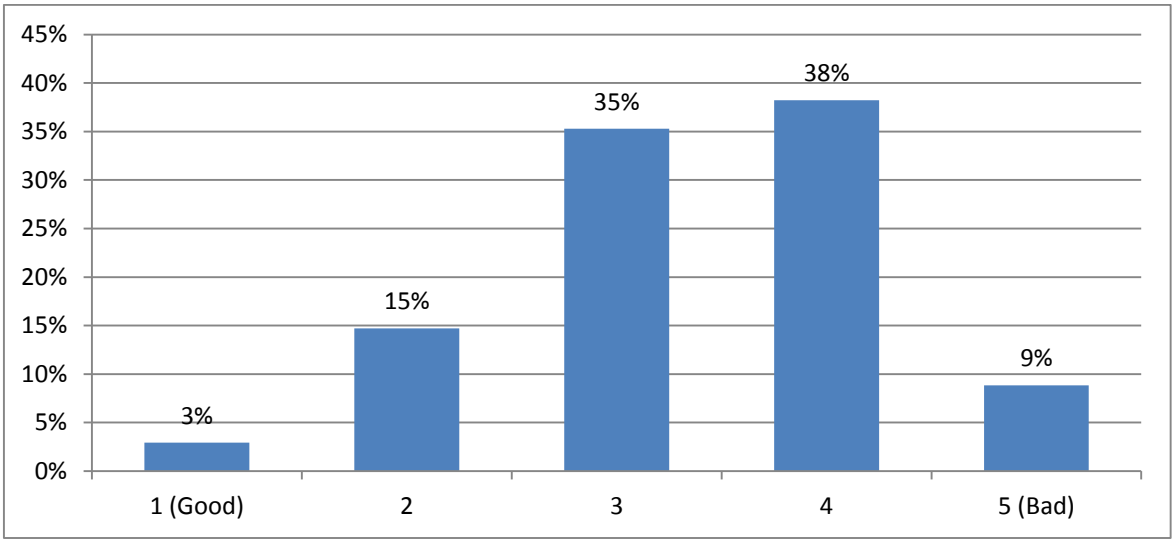

Figure 4.27 Rate transit service in Kelowna on a scale of 1 (good) to 5 (bad)? (Phase 1)

The results are generally skewed towards bad service, with 47% rating it as below average, and only 18% rating it as above average. However, many residents within the study area do not use transit, and may be misinformed, leading to 35% rating transit service as neutral. With further transit improvements and education, it is possible to shift these ratings more favourably.

Table 4.3 displays survey respondents' ranking of possible transportation improvements that would influence their households to leave their vehicles at home one extra day per week.

Table 4.3 Influences for households to reduce car use by one day per week (Phase 1)

Rank	Possible Improvement
1	Shorter wait times for the bus
2	Better bike routes
3	Cheaper public transit
4	More bus stops
5	Higher gas prices
6	Nothing

The most influential improvement was shorter wait times for the bus, followed by better bike routes, and cheaper public transit. Ranked last was "Nothing". This promising result suggests that residents would be willing to leave their vehicle at home if there were improvements in their current transportation choices.

Table 4.4 displays respondents' ranked results for the main reasons why households take the bus.

Table 4.4 Why households ride the bus (Phase 1)

Rank	Reason your household rides the bus
1	Our only choice
2	It is good for the environment
3	Our cheapest option
4	It is easy

Ranked first is that it is the household's only choice. Ranked second is that it is good for the environment, which displays that residents are conscious of the need to reduce their carbon footprint and take alternative transportation modes. Ranked last was "it is easy", which demonstrates that the current transit service is inconvenient for residents, which also reinforces the results shown in Table 4.3.

Finally, Table 4.5 shows results of survey respondents ranking what would most influence them to use public transit more often.

Table 4.5 What influences households to use public transit more often (Phase 1)

Rank	Possible Transit Improvements
1	Shorter wait times between buses
2	Closer bus stops
3	Extended service hours
4	Lower costs
5	Better weekend service
6	Better evening service
7	More bus stop shelters
8	Friendlier drivers
9	Better lighting at bus stops

Ranked first was shorter wait times between buses (which is again consistent with results in Table 4.3), followed by closer bus stops, and extended service hours. These points also suggest that residents require better service with shorter bus headways, better coverage, and more service hours.

4.2.3.3 Preferred ComPASS Design

One question in the Phase 1 community survey asked participants to indicate if they would use various potential Glenmore ComPASS components (see Table 4.1 for the list of possible components). Of all possible Glenmore ComPASS components listed in the survey question, Table 4.6 displays the six most popular components in order of highest popularity. Responses were weighted to reduce potential bias.

Table 4.6 The six most popular Glenmore ComPASS components (Phase 1) - weighted

Rank	Component	Percent Who Would Use it
1	Glenmore Community Shuttle	82%
2	Local Merchant Discounts	81%
3	Parkinson Recreation Centre Pass	71%
4	Bike Tune-ups	59%
5	H2O Centre Pool Pass	59%
6	Emergency Taxi Rides Home	53%

4.2.3.4 Preferred ComPASS Price

Survey respondents were asked questions regarding two forms of pricing: 1) the price they would be willing to pay for each ComPASS component individually and 2) the overall price they would be willing to pay for a Glenmore ComPASS comprised of these preferred bundled privileges.

Question 26 of the Glenmore ComPASS survey asked respondents about the price they would pay for each ComPASS component individually. Table 4.7 summarizes the weighted average preferred price for the five most popular ComPASS components. The H2O Centre Pool Pass component was removed since

the Parkinson Recreation Centre Pass, which was ranked higher, already provided a recreation centre/pool pass component.

Table 4.7 ComPASS price preferences (Phase 1) - weighted

Rank	Components (excluding unlimited transit pass)	Weighted Price Willing to Pay per Month	Estimated Cost per Household per Month
1	Glenmore Community Shuttle	$3.22	$10
2	Local Merchant Discounts	$3.69	< $1
3	Parkinson Recreation Centre Pass	$5.46	$3
4	Bike Tune-ups	$4.19	$3
5	Emergency Taxi Rides Home	$2.15	< $1

The preferred price for the top five components sums to $18.71 per household per month. Another survey question asked participants to state the total amount they would be willing to pay for a Glenmore ComPASS package comprised of an unlimited bus pass bundled with preferred privileges. Table 4.8 summarizes the weighted responses.

Table 4.8 ComPASS price preferences (Phase 1) - weighted

Price (per month per household)	Percent Voted for ComPASS Price
$15 or less	24.5%
$25	35.0%
$35	10.1%
$45	20.7%
$55 or more	4.4%

This equates to a weighted average of a willingness to pay (WTP) of $30.10 per household per month to hold a Glenmore ComPASS. This result suggests that the CRN model would work to fuel the Glenmore ComPASS, as the WTP overall price for a Glenmore ComPASS package ($30.10) is higher than the sum of the preferred prices for individual components ($18.71).

4.2.3.5 ComPASS Support

In question 28 of the survey, participants were also asked to indicate whether they would use a Glenmore ComPASS if given the opportunity. 48% of residents indicated they would use a Glenmore ComPASS, while 46% said they were not sure and 7% said no. If respondents responded with a “No” or “Not sure” in question 28, they were asked in question 29 if they would still be willing to support a ComPASS. In this case, support is defined as those who might not be willing to use or pay for the program, but would support a ComPASS initiative in their neighbourhood. Of the “No” or “Not Sure” responses, 55% said yes, 45% said not sure and 0% said no. This provides an encouraging indication of the sense of

community that Glenmore residents hold. Even though nearly half were unsure if they would use it, a great many did still support it because it would be good for their community.

The responses to questions 28 and 29 suggest strong support for a Glenmore ComPASS program, with 77% stating they would use or support a ComPASS, as shown in Figure 4.28 below.

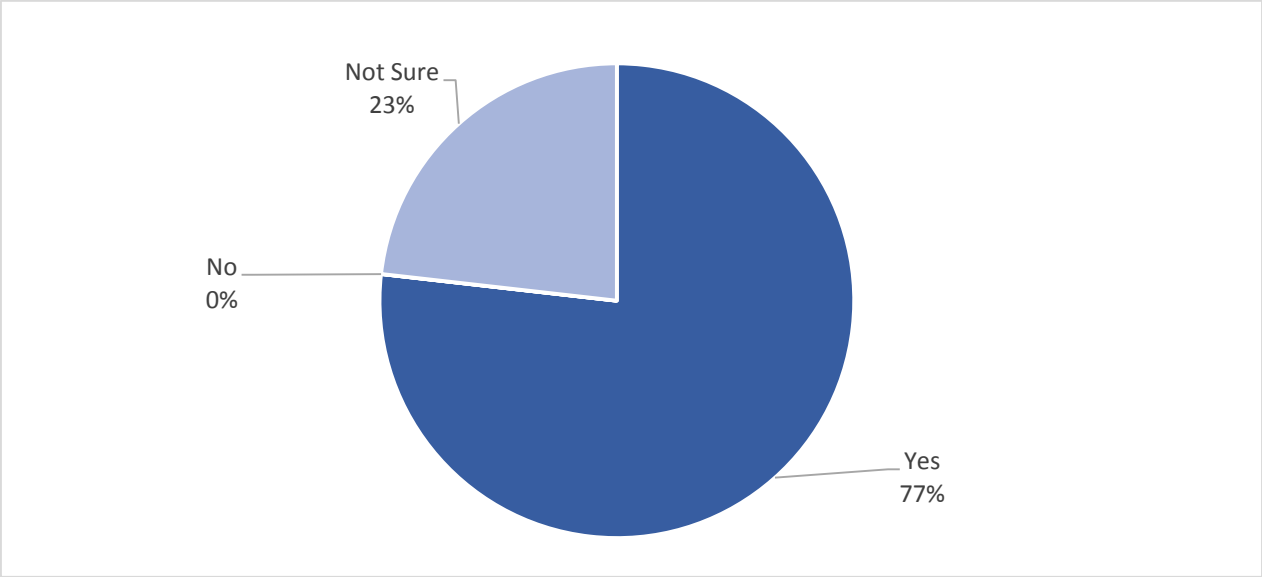

Figure 4.28 Who would use or support a ComPASS program (Phase 1) – weighted

For 77% in support of the ComPASS program, the margin of error decreases to 9.5%, as shown in the sample calculation provided in Figure 4.29.

Given:
N = 750
n = 49
Confidence level = 90% (therefore t_α is 1.64)
p = 0.77
q = 0.23

$$e = \sqrt{\frac{t_\alpha^2 pq(N-n)}{n(N-1)}}$$
$$= \sqrt{\frac{1.64^2 * 0.77 * 0.23 * (750-49)}{49 * (750-1)}}$$
$$= 9.5\%$$

Figure 4.29 ComPASS support margin of error

This means that using a 90% confidence level there is a level of support for ComPASS ranging from 67.5% to 86.5% in the Phase 1 study area.

4.2.4 Phase 1 Results and Discussion Summary

All presented Phase 1 results are within a 90% confidence level within a maximum confidence interval of 11.4%. Therefore all results presented are within a plus or minus 11.4% range. Typically a higher confidence level (95%), and lower confidence intervals are preferred. However, the 49 household responses were the maximum obtained from the Phase 1 study area, and still met reasonable statistical confidence level significance tests.

One other limitation that must be appreciated is that surveys relying on self-selection techniques often incur bias, as was reflected in the difference in survey response demographics and personal vehicle use compared to 2011 NHS data. In efforts to reduce this bias, survey responses related to ComPASS design were weighted as described in Section 4.1.2, and, the following conclusions were made regarding transportation behaviours in in Phase 1 study area:

- Highly auto dependent for work, shopping, and recreation trips;
- The majority of the population never uses public transit;
- The majority of the population never uses their bike for work or shopping trips; and,
- Bike use trip purpose is more likely for recreation and school trips than for work trips.

Although the population rarely uses their bike for work, survey respondents reported that about 33% of work and school trips are under three kilometres, which is within a reasonable distance for travelling by bike according to most other AT research. Therefore, travel distance does not appear, on average, to be a large barrier for roughly one third of trips in the Phase 1 area.

A summary of transportation beliefs within the study area include:

- Residents value being located close to amenities;
- Residents generally believe that businesses play a role in encouraging and accommodating cycling and walking by providing pedestrian and cyclist friendly environments;
- Residents are aware of the impact vehicles have on the environment and desire to reduce their emissions given a safe and convenient opportunity; and,
- Residents are generally willing to reduce vehicle use given improvements to alternative transportation infrastructure (transit, cycling, and pedestrian).

Overall, general consensus suggests that there must be AT improvements, with specific focus on an improved transit service, in the study area before residents will use these services.

Furthermore, Phase 1 respondents rated the following ComPASS components highest: 1) community shuttle, 2) local merchant discounts, 3) Parkinson Recreation Centre pass, 4) bike tune-ups, 5) H2O Centre pool pass, and 6) emergency taxi rides home. Residents also responded that they were willing to pay a weighted average of $30.10 per household per month for a ComPASS package.

Moreover, there is a high level of support (77% +/- 9.5%) for a ComPASS program in the Phase 1 study area. This suggests that a ComPASS may have the required level of support needed to be initiated in the Glenmore neighbourhood.

Chapter 5 Phase 2 Study and Results: Revealed Preferences via Pilot Study

This chapter is dedicated to the Phase 2 portion of the ComPASS study, and is broken down into two main parts. The first part, Section 5.1, outlines the Phase 2 methodology, including experimental design, survey data acquisition procedures, survey data analysis, and traffic count data collection and analysis. The second part, Section 5.2, outlines and discusses the results from the Phase 2 pilot study.

In Phase 2, residents were canvased in a smaller area within the larger Phase 1 study area, along Van Street, Pinehurst Crescent, Lambert Avenue, and Brent Place in Glenmore. Eighteen households were recruited to participate in the treatment group (received a ComPASS package), while 14 households were recruited to participate in the control group (did not receive a ComPASS package). To determine whether the ComPASS had an effect on transportation behaviours, data was collected through three means: 1) pre, mid and post surveys, 2) pre, mid and post travel diaries, and 3) pre, mid and post traffic data counts. This data was analyzed and compared to determine where there may have been differences as a result of the ComPASS intervention. Overall, the Phase 2 pilot study was designed to achieve the third objective of the thesis: test the ComPASS design through a Glenmore pilot program via revealed preference surveys and traffic counts. The main objectives of Phase 2 was to determine how the ComPASS may or may not have affected transportation attitudes and behaviours.

5.1 Phase 2 Methodology

Phase 2 pilot study methodology involved three main steps including: 1) design the experiment, 2) acquire data, and 3) analyze the acquired data,

5.1.1 Experimental Design

To design the Phase 2 pilot study, it was necessary to determine the optimum 1) study location, 2) study duration, 3) sample size, and 4) ComPASS package components.

5.1.1.1 Study Boundary

A smaller location within the larger phase 1 study boundary was preferred for the Phase 2 pilot study since community engagement had already been invested in the area. To determine the optimal Phase 2 study location, the Phase 1 study area was divided into several cells, as shown in Figure 5.1 below. The points shown in the figure demonstrate survey response locations.

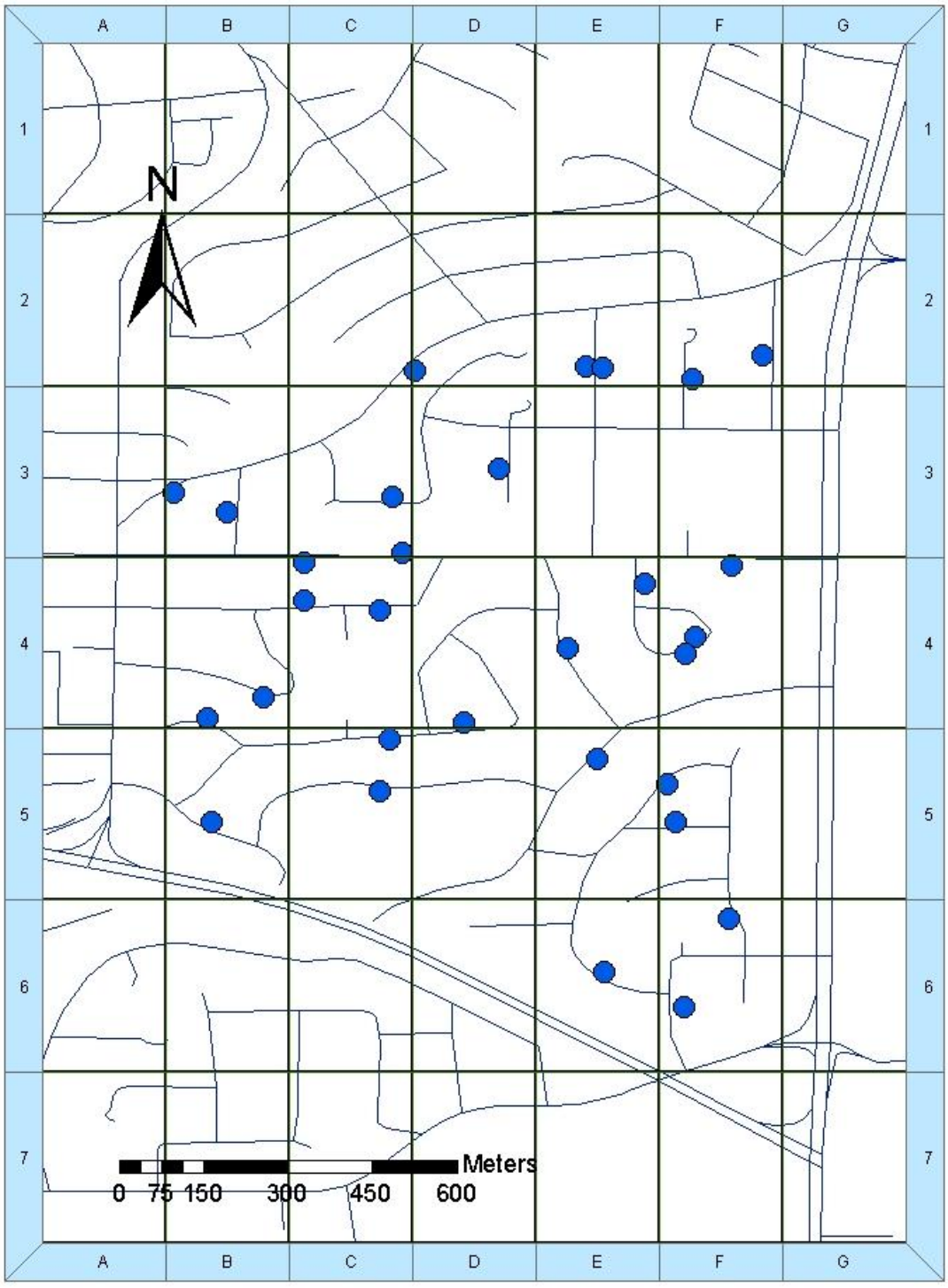

Figure 5.1 Phase 1 study area divided into cells A1 to G7

Each cell was given a code number, A1 to G7, depending on which row number and column letter the cell belonged. To determine the optimal pilot study location within the mapped cells, two criteria were considered for each cell, including: 1) number of Phase 1 survey responses, and 2) distance to transit

stops. These criteria were compared between cells using a Multiple Attribute Decision Making (MADM) tool called the Simple Additive Weighting (SAW) method. For more details on the SAW method, see Section 2.3.1.

Before applying the SAW method, the relative importance of each criterion was assigned using the 9-point intensity scale (Saaty 1980) to determine the weighting for each criterion. Table 5.1 displays the 9-point intensity scale.

Table 5.1 The 9-point intensity scale (Saaty 1980)

Description	Assignment
Equally Important	1
Moderately More Important	3
Strongly More Important	5
Very Strongly More Important	7
Extremely More Important	9
Intermediate values between adjacent assignments to present compromise between priorities	0, 2, 4, 6, 8

Table 5.2 shows the pilot study location selection criteria, the relevance of each criterion, and the assigned 9-point intensity scale score.

Table 5.2 Pilot study location selection criteria

Criteria	Relevance	9-Point Intensity Score
Number of Phase 1 Survey Responses	The number of survey responses received in Phase 1 was a way to measure each cell's willingness to participate in community initiatives. If residents were willing to answer the community survey in Phase 1, there were higher chances they would also participate in a pilot study in Phase 2, whether they supported the ComPASS initiative or not. Finding a pilot study location where participants could be recruited was essential for the Phase 2 pilot study.	3 Moderately More Important
Distance to Transit Stops	Transit use was an intrinsic part of the ComPASS, therefore, accessible transit was important for the pilot study neighbourhood. The distance to a transit stop from each cell was measured using ArcGIS 9.3 software (ESRI 2014).	1 Equally Important

To find the weights for each criterion, the 9-point intensity score assigned for a criterion was divided by the sum of scores for all criteria (e.g. the weight for distance to transit stops = (1) / (1 + 3) = 0.25). Table 5.3 below shows the criteria for each cell along with associated weightings.

Table 5.3 List of criteria for each cell

	Criteria	
Objective	**Maximize**	**Minimize**
9-Point Intensity Score	**3**	**1**
Weighting	**0.75**	**0.25**
Cell	**Number of Survey Responses**	**Distance to Transit Stop (m)**
B3	2	255
B4	9	320
B5	1	420
C3	4	400
C4	4	510
C5	5	590
D2	1	250
D3	1	500
D4	2	580
D5	0	690
E2	2	175
E3	0	400
E4	2	500
E5	1	510
E6	2	360
F2	3	535
F3	0	375
F4	5	360
F5	2	400
F6	3	250

Table 5.4 shows the resulting rank of each cell after applying the SAW method

Table 5.4 Ranking of each cell

Cell	Rank
B4	1
F4	2
C5	3
C3	4
F6	5
C4	6
E2	7
B3	8
F2	9
F5	10
D2	11
E4	12

D4	13
E6	14
B5	15
D3	16
E5	17
F3	18
E3	19
D5	20

Based on the SAW method results, the area bounded by cells B4 and C4 (Pinehurst Crescent, Lambert Avenue, and Van Street) was selected as the optimal pilot study location for Phase 2. Cell B4 was ranked first and cell C4 was ranked sixth of all possible cells. These two cells were selected for the pilot study since they were 1) ranked high, 2) located adjacent to each other, and 3) on continuous streets in a defined neighbourhood. The neighbourhood within cells B4 and C4 contains 55 households. The selected Phase 2 study area is shown in Figure 3.4 in Chapter Three.

5.1.1.2 Study Duration

Literature review findings were inconclusive as to what pilot study duration was optimal. Overall, a longer duration was desired, but time and budget constraints allowed for a duration of three months for the Phase 2 pilot study.

5.1.1.3 Study Sample Size

The available research time and budget were the main factors governing the sample size for the phase 2 pilot study, as enough background information required to calculate an accurate sample size was not available. Therefore, to encourage as high a sample size as possible, the research team attempted to contact all 55 households in the phase 2 study boundary, but the sample size ultimately depended on households' willingness to participate. Overall, while sample size was a limiting factor to the research, the acquired data via the phase 2 pilot study could provide information for future experimental designs of a similar nature.

5.1.1.4 Pilot ComPASS Components

Data from the Phase 1 survey was used to determine the most desirable design for a "made in Kelowna" ComPASS package. The Phase 1 survey revealed the percent of people who would use several different possible ComPASS components (see Table 4.6 in Chapter Four).

Based on the ranked list, the top four components chosen to be included in the ComPASS pilot study (in addition to an unlimited transit pass) included: 1) local merchant discounts, 2) Parkinson Recreation Centre pass, 3) bike tune-ups, and 4) emergency taxi rides home.

Two high-ranked components were not included in the ComPASS pilot study package, including 1) Glenmore community shuttle and 2) H2O Adventure + Fitness Centre pool pass. The Glenmore community shuttle could not be provided as part of the pilot study due to budget limits. However, this component's rank demonstrated the community's desire for improved transit service. The desire for a community shuttle also suggests that if the ComPASS program was permanently implemented, a portion of the ComPASS program cost should be allotted to improving existing transit services and to potentially increase transit education among residents.

The H2O Adventure + Fitness Centre component was not included in the ComPASS package as a similar component (Parkinson Recreation Centre) was ranked higher. In addition to the redundancy of including two recreation centre pass components in the pilot ComPASS package, the 11 kilometre distance between the H2O Adventure + Fitness Centre location and the Phase 2 pilot study location did not support the goals of the ComPASS. In contrast, the Parkinson Recreation Centre is within two kilometres from the pilot study location, and therefore more accessible and attractive for AT modes.

5.1.2 Data Acquisition

Subsections below describe how survey and traffic count data was acquired.

5.1.2.1 Survey Data Acquisition

Prior to any contact with residents in Phase 2, an application from the UBC Behavioural Research Ethics Board (BREB) was submitted and approved. To recruit participants for the pilot study, the research team engaged community members within the Phase 2 study boundary (along Van Street, Lambert Avenue, and Pinehurst Crescent) by knocking on doors and speaking to residents in person. Posters were also placed on streetlight poles in the neighbourhood to spread the word of the program. To recruit as many households as possible, the research team knocked on all 55 doors within the Phase 2 study boundary. However; after several attempts, seven households were unreachable. Sixteen households were not willing to participate, while the remaining 32 households agreed to participate. Table 5.6 shows the recruitment results within the Phase 2 study boundary.

Table 5.5 Phase 2 study area recruitment results

Participation	Number of Households
Willing to participate in the pilot study	32
Unwilling to participate in the pilot study	16
Not reachable	7

Since 32 households were recruited for the study, this meant there was a 58% participation rate (32 / 55 = 58%), which is similar to the expected NECO Pass 55% participation rate in Boulder, Colorado. Although a higher participation rate would have been desirable, households' willingness to participate was the main constraint for the sample size.

When communication with households was successful, the central idea of ComPASS and ComPASS components were explained and they were asked if they would be interested in participating in the pilot program. If households agreed to participate, they were asked if they would prefer to be in the control or participating group, and the meaning of each group was described. In this sense, there was a degree of bias in survey results as households were able to choose which group they were in. As a result, inferences of the Phase 2 research could not be applied beyond the group studied. However, this pilot study represents realistic circumstances where a ComPASS program depends on willing participation.

Of the recruited 32 households, there were 18 participating households (64 individuals) who were given a ComPASS for three months from May 1 to July 31, 2012 and 14 control households (41 individuals) who were not given a ComPASS and asked to continue normally in the same timeframe.

Recruited participating and control households were surveyed before, during, and after the pilot study. Each survey included about 30 questions. Appendix D, E, F, G and H shows the survey questions for the pre, mid, and post surveys in Phase 2 for the participating and control households. A travel diary was also distributed at the same time as the surveys, which is shown in Appendix I. Data acquisition began in mid-April 2012. A household representative was asked to fill out survey questions for all household members and to answer questions for the household as a whole.

The first survey was distributed on April 19, 2012, before the pilot study began, with a request for the travel diary to be filled out for trips made on Wednesday, April 18, 2012. The first survey was meant to serve as a benchmark for transportation beliefs, behaviours, and attitudes. The second survey was distributed on June 21, 2012, the mid-point of the pilot study (when the ComPASS was in effect), with a request for the travel diary to be filled out for trips made on Wednesday, June 20, 2012. This second survey was meant to determine how transportations beliefs, behaviours, and attitudes may have changed due to the influence of the ComPASS. The final survey was distributed on September 21, about 1.5 months after the pilot study concluded, with a request for the travel diary to be filled out for trips made on

Thursday, September 20, 2012. The final survey was conducted 1.5 months after the pilot concluded due to available time and budget. The intent of the third survey was to determine if attitudes, beliefs, and behaviours reverted to those that were measured in the first survey, or if the ComPASS had a lasting effect.

Paper surveys and trip diaries were distributed rather than online surveys to allow residents to make comments on the side, and to ensure that residents did not have technical difficulties. Specific times for pickup were outlined in the distributed surveys to ensure there was enough time for completion and for the distributor to collect and input data.

Although surveys were filled out by hand on hardcopies, there were still issues for residents. In circumstances where households did not fill in a response, the household or individual was not included in the analyses of those particular questions. In some cases, residents reported erratic or unreasonable responses. In these cases, attempts to contact the household were made to determine the validity of the responses.

In other cases, there were several "Not Applicable" responses to questions such as: "how much would you reduce car trips as the driver if you owned a ComPASS?" In this example, many of these "Not Applicable" responses were because those without valid driver's licenses were simply unable to reduce car trips as drivers. Therefore the "Not Applicable" responses were not be included in the analysis for those instances. For further details, Appendix J shows the number of "Not Applicable" and non-responses for the survey questions discussed in Section 5.2 (Phase 2 Results and Discussion) in the Phase 2 pre, mid, and post surveys. Appendix J also shows the number of "Not Applicable" and non-response households for the travel diaries. Reasons for no travel diary response were either because households were out of town or they did not fill in their travel diaries with enough information.

5.1.2.2 Traffic Count Data Acquisition

Three one week-long pneumatic tube traffic counts were conducted at the three entrance and exit points of the pilot study neighbourhood: 1) Van Street and Mountain Avenue, 2) Lambert Avenue and Clifton Road, and 3) Pinehurst Crescent and Clifton Road. These three locations were selected as they were the entrance and exit points of the pilot study neighbourhood and could capture inbound/outbound neighbourhood trips. The specific count location relied on locations of street lights or poles to secure and lock the count equipment in place. The traffic counts were conducted during the same time as surveys were distributed. Figure 5.2 below shows the three traffic count locations in the Phase 2 study area.

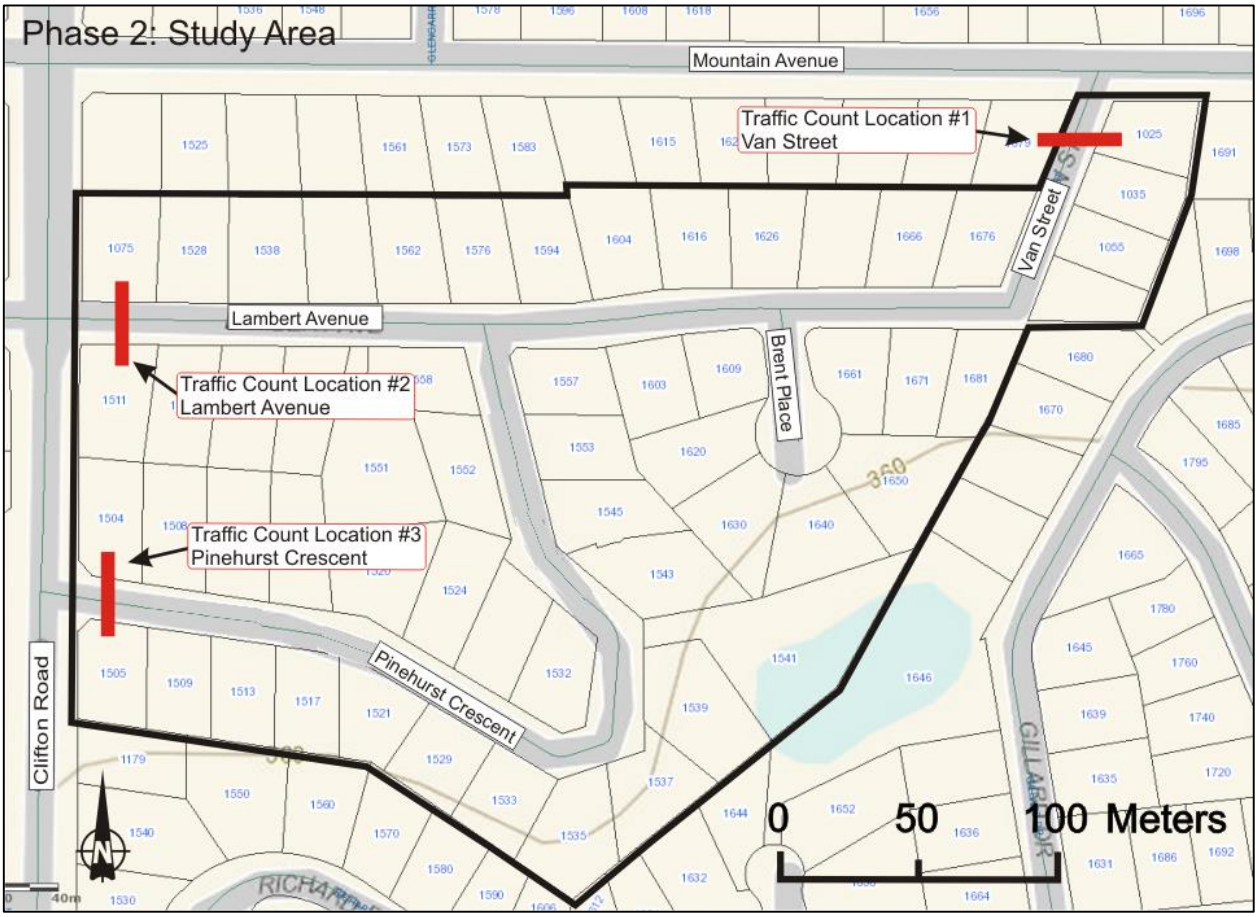

Figure 5.2 Phase 2 traffic count locations

The first traffic count was conducted from April 16 to April 22, 2012, the second was conducted from June 18 to June 24, 2012 and July 9 to July 15, 2012, while the final traffic count was from September 19 to September 25, 2012. Counts were completed using both UBC and City of Kelowna traffic count equipment. Data sent from the City of Kelowna was in Excel format, so Excel was used to view that data. However, UBC equipment required VIAS (Vehicle Identification Analysis System) software (TimeMark 2013) to view data, so this software was used to analyze results downloaded from UBC counting equipment.

5.1.3 Data Analysis

Survey and traffic count data were analyzed as described in subsections below.

5.1.3.1 Survey Data Analysis

For more sophisticated statistical analyses, IBM® SPSS® Version 22 (2013a) software was utilized. The pilot study employed a repeated measures design (RMD) involving surveying the same household three

times, as follows: before (survey 1 in April), during (survey 2 in June), and after (survey 3 in September). Using RMD terminology, the group (control or participating) is a between-subjects factor and surveys (1, 2, and 3) are one within-subjects factor. Both group and survey are fixed factors, while households are a random factor (i.e. households were not specifically selected for the study while the group and survey were specifically selected). Comparing the control with the participating group between the pre, mid, and post surveys determined if the data was statistically the same or statistically different between the two groups and between surveys. The purpose of monitoring control households was to show what trends may have occurred for the participating households if they did not have the ComPASS treatment applied. Comparing data within either the participating or control groups between all three surveys determined if there was a statistically significant behavioural change between surveys and groups, possibly as a result of the ComPASS.

To complete the statistical analysis using IBM ® SPSS ® Version 22 (2013a), the generalized linear mixed model (GLMM) tool was applied. The software was used to analyze the following survey questions:

1. How many car trips as the driver trips did each member of your household make in the past week?
2. How many car trips as the passenger trips did each member of your household make in the past week?
3. How many transit trips did each member of your household make in the past week?
4. How many cycling trips did each member of your household make in the past week?
5. How many walking trips did each member of your household make in the past week?

Since the number of trips made in the past week is count data, the Poisson or negative binomial probability distributions were applied to the data to generate ANOVA tables which, for each fixed effect, displayed the F statistic, the numerator and denominator degrees of freedom (both used to calculate the F statistic), and the associated p-value (used to determine the significance level of the fixed effect). Prior to assessing the ANOVA tables, the goodness-of-fit of the model was tested via the Corrected Akaike Information Criterion (AIC) and the Bayesian Information Criterion (BIC). The lower the AIC and BIC results, the better the model; if the AIC and BIC results for Poisson were lower than the AIC and BIC results for the negative binomial distribution, then the Poisson distribution was applied. In contrast, the negative binomial distribution was applied when the associated AIC and BIC results were lower. Furthermore, the Satterthwaite approximation was applied to the GLMM analysis since it is "useful if sample size is smaller; or data are unbalanced" (IBM 2013a). Modelling under this assumption ensured

results were more conservative in case sample sizes were too small. IBM ® SPSS ® Version 22 (2013a) codes used for each of these five analyses are shown in Appendix K.

To normalize the data, the total number of trips made in the past week for a particular transportation mode was offset by the total number of trips each household made in the past week. Since either the Poisson or negative binomial models were applied to the count data, the natural log of the total was used as the offset (IBM 2013b). Applying an offset ensured that reported trips for a transportation mode was not over- or under-represented in case households tended to over- or under-report their trips.

To assess statistical differences in trips in the past week the GLMM analysis results, the resulting p-values found between the main effects (group, survey, and interaction between group and survey) were examined. If the p-value was less than 0.05 using a 95% confidence level, then the difference between datasets were concluded to be statistically different. If the p-value was less than 0.10 but greater than 0.05, then the difference between datasets were concluded to be borderline statistically different.

If the GLMM analysis showed that there were significant or borderline significant differences between datasets, then a Fisher LSD pairwise comparison was performed using IBM® SPSS® Version 22 (2013a) software. This pairwise comparison meant that more detailed comparisons could be found between datasets.

5.1.3.2 Travel Diaries

Travel diaries were used to determine average household vehicle kilometres travelled (VKT) by personal vehicle. VKTs were used to determine the potential greenhouse gas (GHG) emission reductions, road safety improvements, and municipal economic savings if ComPASS holders reduced their trips (and therefore VKTs) by personal vehicle.

To determine VKT per trip in the travel diaries, the origin and destination of each trip made by personal vehicle (as the driver) were inputted into Google Maps (2015). The distance in kilometres were reported by Google Maps, and then recorded in Excel (Microsoft Office 2013). Each trip from a particular household was identified by the household identification code ranging from P1 to P18 for participating households and C1 to C14 for control households. To summarize the number of trips per household and the VKT for each trip, the pivot table tool was used in Excel.

5.1.3.3 Traffic Count Data Analysis

Throughout the three traffic counts during the pre, mid, and post surveys, there were various equipment malfunctions. Table 5.6 shows the percent data collected at each traffic count location.

Table 5.6 Traffic count malfunction locations

	Traffic Count Location #1 Van Street & Mountain Avenue	Traffic Count Location #2 Lambert Avenue & Clifton Road	Traffic Count Location #3 Pinehurst Crescent & Clifton Road
Pre	100%	100%	0%*
Mid	100%	100%**	100**
Post	100%	100%	71%***

*UBC traffic count equipment malfunctioned for the entire week-long count.
**City of Kelowna traffic count equipment malfunctioned for the entire week-long count at these locations. The City of Kelowna recollected data at all three count locations in July without any equipment malfunctions.
***UBC traffic count equipment partly malfunctioned, and only captured half-day count data on the Monday and Wednesday, and no data on the Tuesday of the week-long count. Effectively, five of seven days were collected.

Where equipment malfunctions occurred, data could be reasonably extrapolated based on successfully collected data. This extrapolation is a standard traffic engineering practise, and was deemed reasonable since traffic volumes typically follow a seasonal trend (e.g. traffic patterns in July tend to be different than traffic patterns in December, etc.) and daily trend (e.g. traffic patterns on Mondays tend to be different than traffic patterns on Tuesdays, etc.). Subsections below discuss how data was estimated for days with missing data for each pre, mid, and post traffic count.

5.1.3.3.1 First Traffic Count (April)

Since an entire traffic hose count at Traffic Count Location #3 (Pinehurst Crescent & Clifton Road) malfunctioned, traffic volumes at this location were estimated based on other successfully acquired data. There were no malfunctions at Traffic Count Location #1 (Van Street and Mountain Avenue) for either April, June, or September, so ratios between traffic count volumes from Traffic Count Location #1 were applied to Traffic Count Location #3. To accomplish this, the ratio between the April (first traffic count) and September (third traffic count) traffic volumes (both when ComPASS was not in effect) were calculated for Traffic Count Location #1. Assuming traffic patterns were similar for both locations during the same timeframe, these ratios were applied to available September data at Traffic Count Location #3 to estimate likely April traffic count data.

5.1.3.3.2 Second Traffic Count (June)

While ComPASS was in effect, traffic count data was collected from the three traffic count locations in June, but equipment at two of the three locations malfunctioned (Traffic Count Location #2 and #3). There were no malfunctions at Traffic Count Location #1, therefore June traffic data was available for this location. Data was collected at all three locations again in July (while ComPASS was still in effect). To estimate June data for Traffic Count Location #2 and #3, ratios between June and July count data at

the successful Traffic Count Location #1 were calculated and applied to July data at Traffic Count Location #2 and #3 to find likely June traffic volumes.

5.1.3.3.3 Third Traffic Count (September)

During the third traffic count, only half-day data was collected on Monday and Wednesday, and no data was collected on Tuesday at Traffic Count Location #3. To estimate volumes for the missing days, percent proportions of traffic volumes occurring on each day of the week (e.g. Monday, Tuesday, Wednesday, etc.) were calculated using September traffic volume data at Traffic Count Location #1 and #2. The percentages calculated for each day of the week for Traffic Count Location #1 and #2 were averaged. The average daily proportion of traffic in September was assumed for Traffic Count Location #3. Daily traffic proportions are shown in Table 5.8.

Table 5.7 Daily traffic volume proportions for the third traffic count (September)

	Mon.	Tues.	Wed.	Thurs.	Fri.	Sat.	Sun.
Traffic Count Location #1	14%	18%	16%	12%	14%	17%	10%
Traffic Count Location #2	11%	14%	13%	14%	15%	21%	11%
Average (Assumed for Traffic Count Location #3)	12.5%	16.0%	14.5%	13.1%	14.6%	18.8%	10.6%

Using the average daily proportion of traffic volumes, the total week-long traffic count volume was estimated by multiplying the available daily traffic count volumes at Traffic Count Location #3 by the assumed percent proportion for each day. After the total week-long traffic volume was averaged from the four successful count days, the average total volume was multiplied by the estimated percentage for Monday, Tuesday, and Wednesday. Table 5.8 shows the process for finding the estimated September Monday, Tuesday, and Wednesday traffic count volumes at Traffic Count Location #3.

Table 5.8 Third traffic count data estimation for traffic count location #3

	Mon.	Tues.	Wed.	Thurs.	Fri.	Sat.	Sun.
Estimated daily proportion of traffic	12.5%	16.0%	14.5%	13.1%	14.6%	18.8%	10.6%
Traffic Volume	165*	211*	192*	183	183	251	139
Estimated Total Traffic Volume for the Week	--	--	--	1,392 (= 183 / 13.1%)	1,256 (= 183 / 14.6%)	1,336 (= 251 / 18.8%)	1,313 (= 139 / 10.6%)
Average:				**1,324**			
**Estimated based on 1) the calculated average weeklong traffic volume and 2) estimated daily proportion of traffic (e.g. Monday traffic volume = 1,324 x 12.5% = 165).*							

Using the estimated average of 1,324 vehicles per week during the weeklong September count at Traffic Count Location #3, the estimated Monday, Tuesday, and Wednesday traffic count volumes were 165, 211, and 192 vehicles, respectively.

5.1.3.3.4 Summary

In summary, extrapolation of missing data for the pre, mid, and post traffic counts were accomplished as follows:

- Collected September and April data (both when ComPASS was not in effect) was used to estimate missing April data;
- Collected June and July traffic count data was used to estimate missing June data; and,
- Collected September traffic count data was used to estimate missing September data.

5.2 Phase 2 Results and Discussion

Subsections below outline the results and discussion found from the Phase 2 revealed preferences pilot study, in several main subjects, including:

- Pilot study household characteristics (Section 5.2.1);
- Survey weather (Section 5.2.2);
- Transportation attitudes and beliefs (Section 5.2.3);
- Transportation behaviours (Section 5.2.4);
- Attitudes and beliefs regarding the ComPASS program (Section 5.2.5); and,
- Recommended ComPASS design (Section 5.2.6).

Finally, Section 5.2.7 summarizes the Phase 2 results and discussion.

5.2.1 Pilot Study Household Characteristics

Surveys asked both control and participating households questions regarding general household characteristics, including information such as household income, household members' age groups, employment status, and number of vehicles owned.

Table 5.9 summarizes the number of residents, vehicles, and bikes per household.

Table 5.9 Phase 2 study area household characteristics

Characteristic	Control	Participating	Average
Residents per Household	2.9	3.4	3.3
Vehicles per Household	2.2	2.6	2.4
Bikes per Household	2.6	4.2	3.5

On average, there were 3.3 residents per household (2.9 residents per household for the control group and 3.4 residents per household for the participating group). There were also about 2.4 vehicles per household on average (2.2 for control households and 2.6 for participating households), and 3.5 bikes per household on average (2.6 bikes for control households and 4.2 for participating households). There are typically more vehicles and bikes in participating households compared to control households, which is expected since there are typically more residents in participating households than control households.

Figure 5.3 below displays the percent of residents in each age group for the control group, participating group, and all households combined.

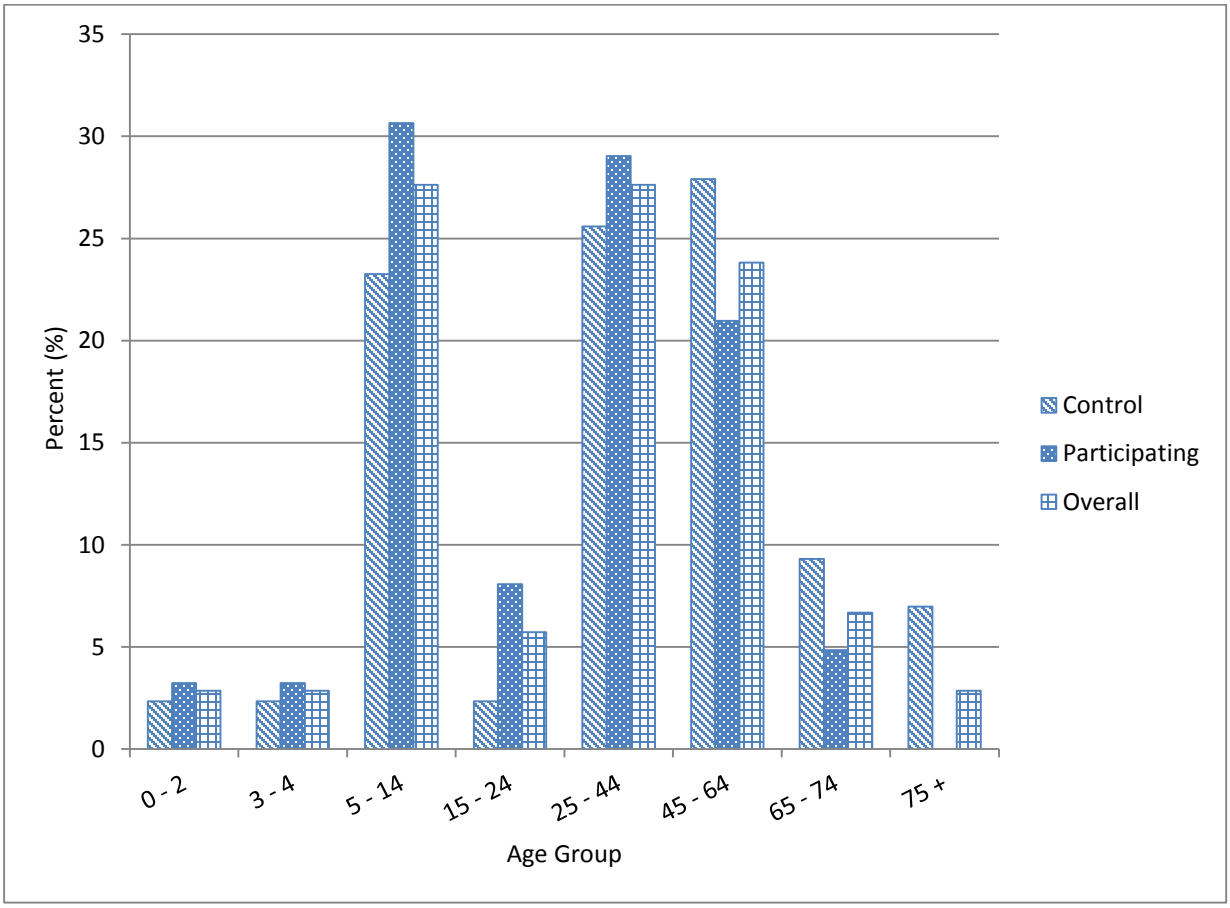

Figure 5.3 Age groups within survey households

The participating households tended to have a slightly younger population, with more residents in the 0 to 44 age group, while residents in the control group tended to have more residents in the 45+ age group. This means that there were more young families in the participating group and more seniors in the control group. This helps to explain why the participating households tended to have more residents per household than the control households.

Figure 5.4 below shows the percent of residents in each employment group for the control group, participating group, and for all households.

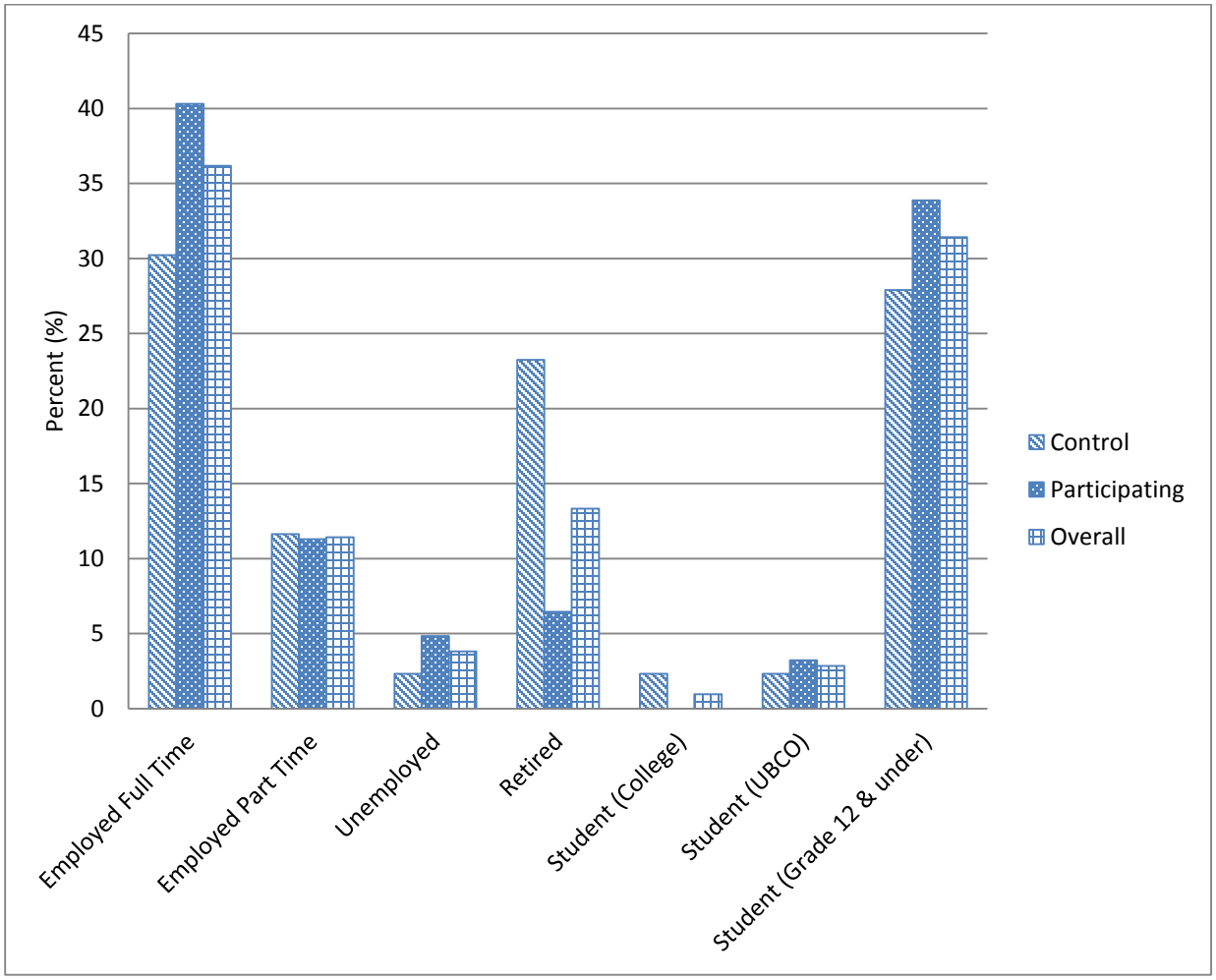

Figure 5.4 Employment status within survey households

According to the graph, the participating group had more students (UBC and grade 12 & under) and full time employees, while the control group has more retired residents. These characteristics were expected since the participating households tended to be younger than the control households. Overall, control households have more retired, senior residents while the participating households have more students and full time employed residents.

Figure 5.5 below shows the household income distribution for the control group, participating group and for all households combined.

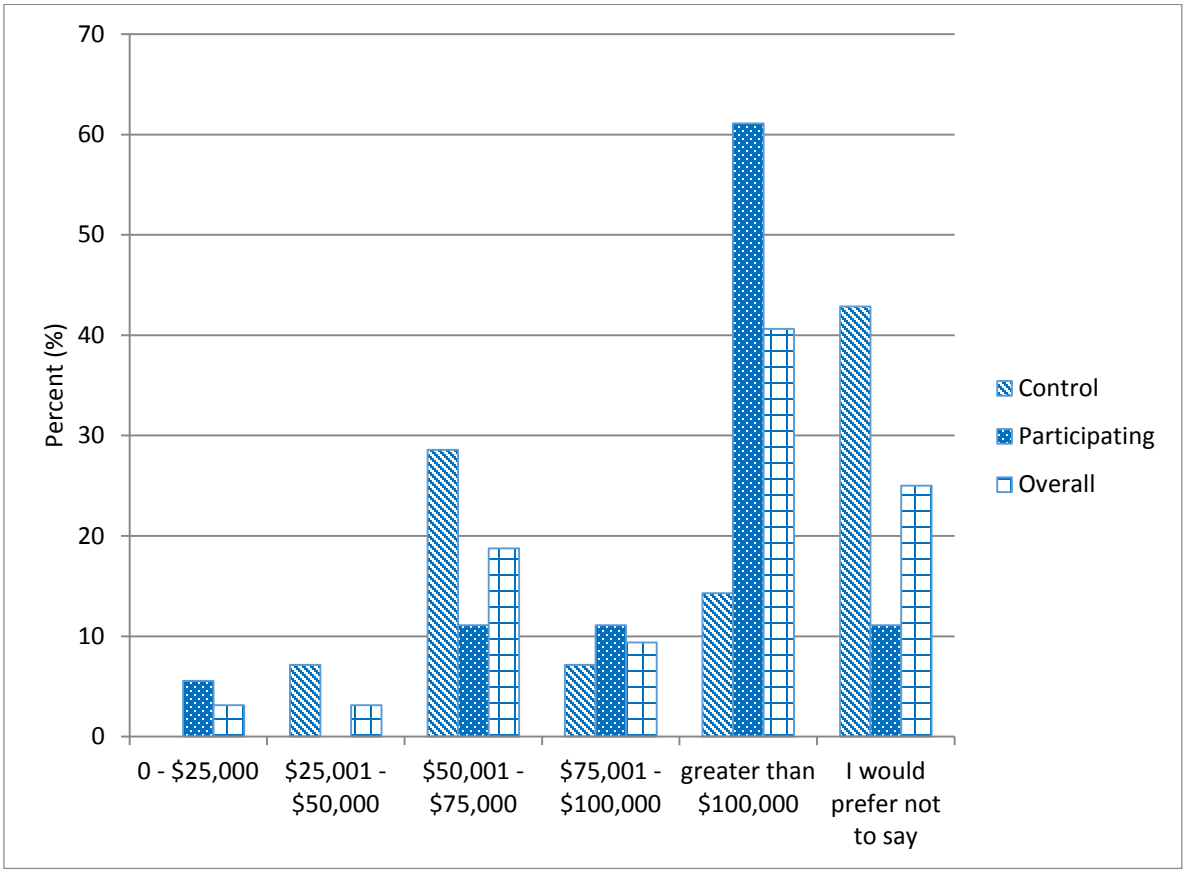

Figure 5.5 Household income for survey households

Due to the sensitive nature of the question, not every household responded with their household income. Out of those who responded, the majority of participating households had incomes over $100,000 per year. Control households tended to have a lower household income, which could be because they have more retirees and fewer household members employed full time. Although this information is informative about the general characteristics of the pilot study neighbourhood, since not every household responded, these results should be used with caution.

The demographics of the control group and the participating group differ to some extent. In general, the participating group has a lower average age, more full time employed residents, more students (UBC and grade 12 & under), more bikes and vehicles per household, and a higher household income. The preference in which group households chose (whether control or participating) may have been a result of these differences in household characteristics. While control and participating groups should typically not be significantly different, in this research, these differences demonstrate realistic attitudes towards AT

among different demographics, and what type of residents would participate in a ComPASS program and which ones would not. Moreover, since these differences are known, they will aid in understanding and analyzing data acquired throughout the pilot study.

5.2.2 Survey Weather

To better understand how weather may have affected transportation behaviours during survey timing, Figure 5.6, Figure 5.7, and Figure 5.8 show the maximum, average, and minimum temperature (degrees Celsius) for the weeks leading up to each survey distribution date in April, June, and September, respectively.

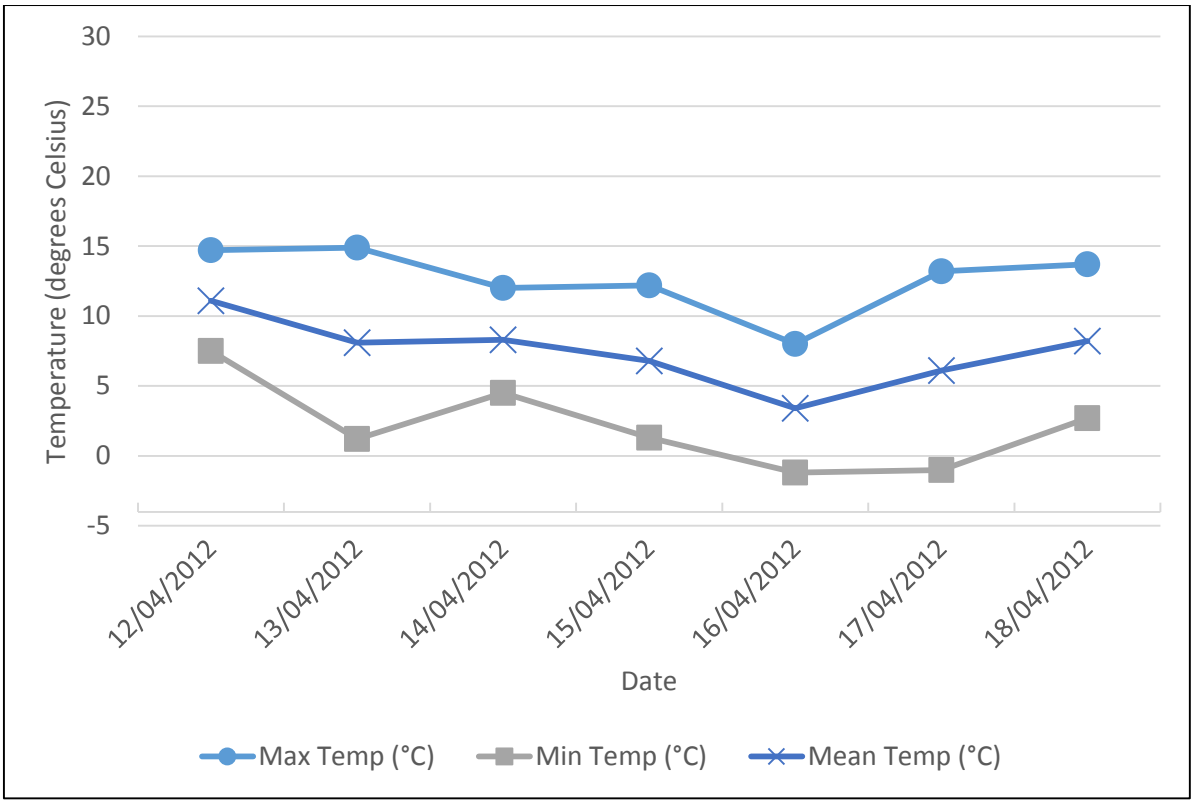

Figure 5.6 Weather for survey 1 – April 12 to 18, 2012 (The Weather Network 2015c)

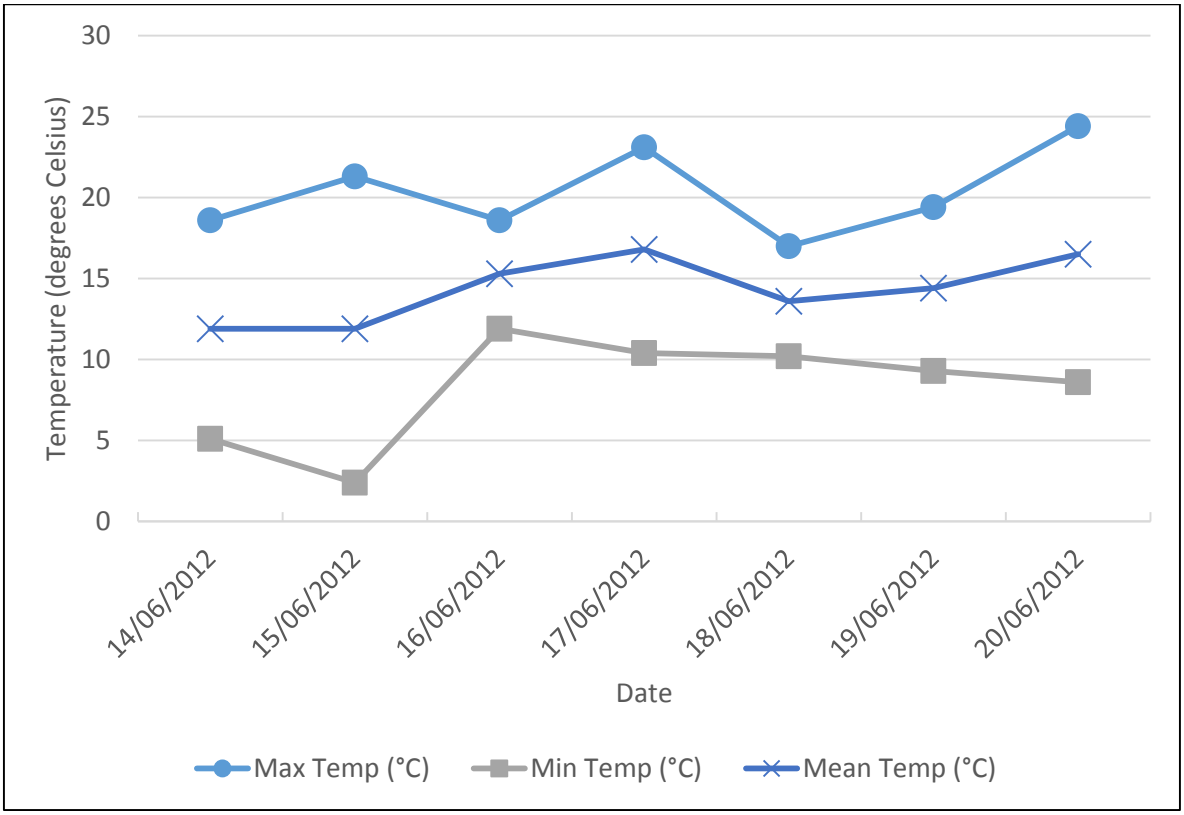

Figure 5.7 Weather for survey 2 – June 14 to 20, 2012 (The Weather Network 2015c)

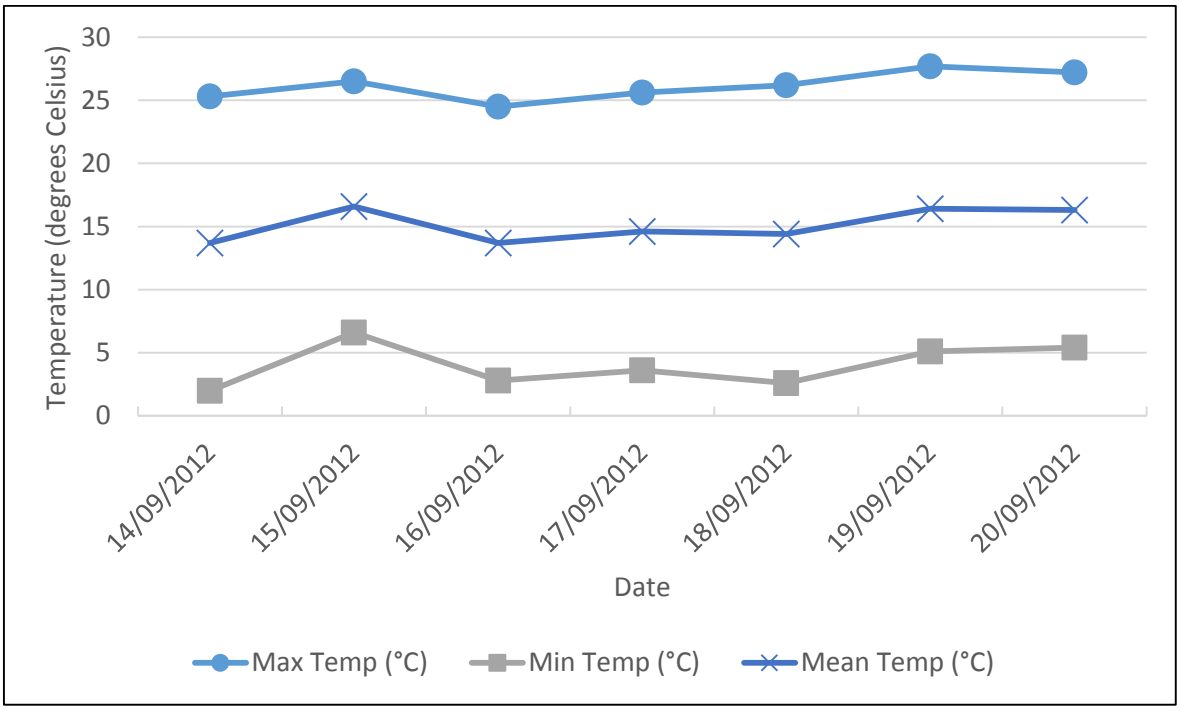

Figure 5.8 Weather for survey 3 – September 14 to 20, 2012 (The Weather Network 2015c)

As expected, the average temperature in April, which hovered between 3 and 11 degrees Celsius, was the lowest of the three survey time periods. Temperatures even dipped below zero in some instances leading up to the survey in April. The average temperature for both June and September hovered around 15 degrees Celsius for the week leading up to the survey.

Figure 5.9 below shows the total precipitation for each day of the week (in millimetres) leading up to surveys 1, 2, and 3 in April, June, and September.

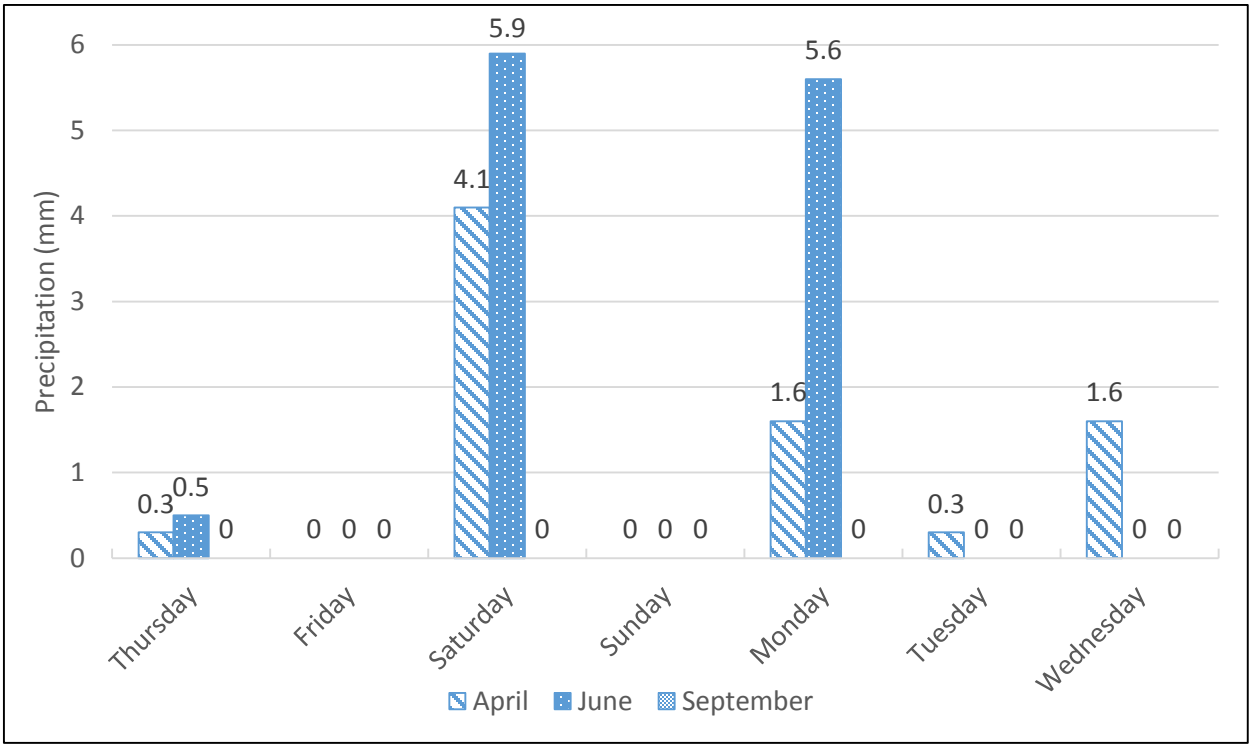

Figure 5.9 Precipitation for survey 1, 2, and 3 (The Weather Network 2015c)

There were five days of rain in April, three days of rain in June and no rainy days in September for the weeks leading up to survey distribution. The rainy days in April and June may have caused differences in transportation behaviours, especially compared to September where the temperature and limited precipitation were more favourable for AT activities.

5.2.3 Transportation Attitudes and Beliefs

In each of the three surveys, residents were asked several questions related to their attitudes and beliefs towards transportation in Kelowna, including:

- What would be the primary reason for your household to use transit?

- What is your satisfaction level with walking, biking, and transit services and facilities in Kelowna?
- Do you believe the nearest bus stop is within walking distance for your household?
- What are some positives and negatives with transit your household experienced throughout the pilot study?
- What are some barriers to using AT modes your household experienced throughout the pilot study?

Responses to these questions are discussed in subsections below.

5.2.3.1 Primary Reason for Using Transit

Figure 5.10 below represents the responses for the primary reasons participating households would use transit.

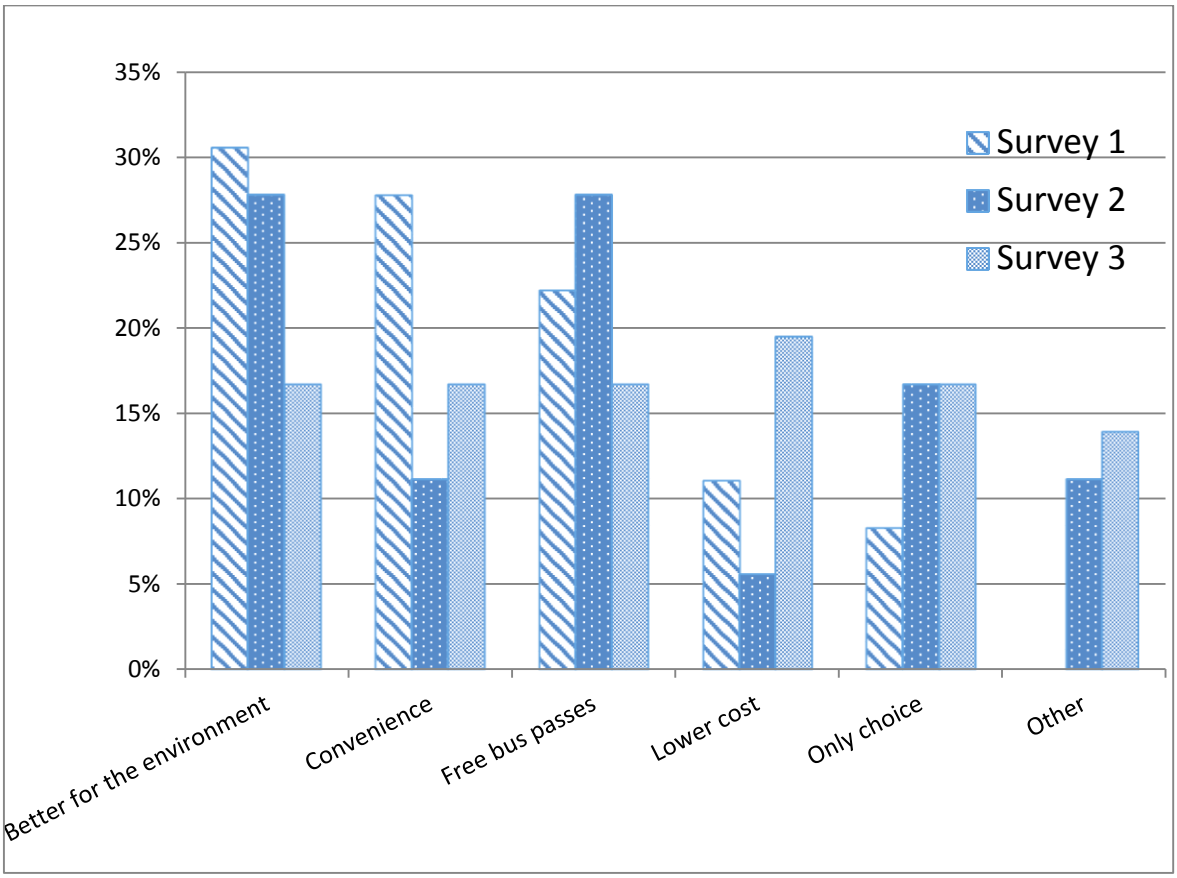

Figure 5.10 Why participating households would use transit

As demonstrated in Figure 5.10, in survey 1 (pre-pilot) the primary reasons for participating households to use transit were to be environmentally conscious, for convenience, or if they had free bus passes. There

were no responses for the "other" category. In survey 2 (mid-pilot), after the participating households were given their ComPASS packages, the responses for "convenience" decreased, while the "free bus passes" response increased. This change between survey 1 and survey 2 suggests that once residents had their bus passes in the ComPASS package, they changed their priorities. It appears as though they felt that free bus passes were a motivator for becoming the primary reason for their household taking transit.

By survey 3 (post-pilot), "better for the environment", "convenience", "free bus passes" and "only choice" were tied for second for the participating households. "Lower cost" was the primary reason why participating households would use transit, while "other" was third highest reason. In a sense, the responses equalized and became nearly equally distributed between all six responses. However, for surveys 1 and 2, lower cost was not a large priority. After the pilot study ended, participating households chose "lower cost" as the top reason for taking transit, which may indicate that residents would use transit more often if passes were discounted. In surveys 2 and 3, the "other" option became more predominant. The "other" reasons included : 1) when biking is unsafe (when there is snow) 2) when the weather is poor and biking is unattractive 3) for going to school, 4) when inebriated and there is a lack of downtown parking, and 5) if they owned a ComPASS. These "other" statements show how the transit pass component of the ComPASS could be beneficial to many of the participating households. Overall, "better for the environment" and "convenience" decreased from survey 1 to survey 3, while "lower cost", "only choice", and "other" increased. This could represent that the transit level of service (LOS) proved to be inconvenient for participants and they consequently shifted their priorities. This could also demonstrate the importance of residents becoming more educated on how the Kelowna transit system works, and UBCO researchers understanding more on how transit is perceived by residents.

Figure 5.11 below represents the responses for the primary reasons control households would use transit.

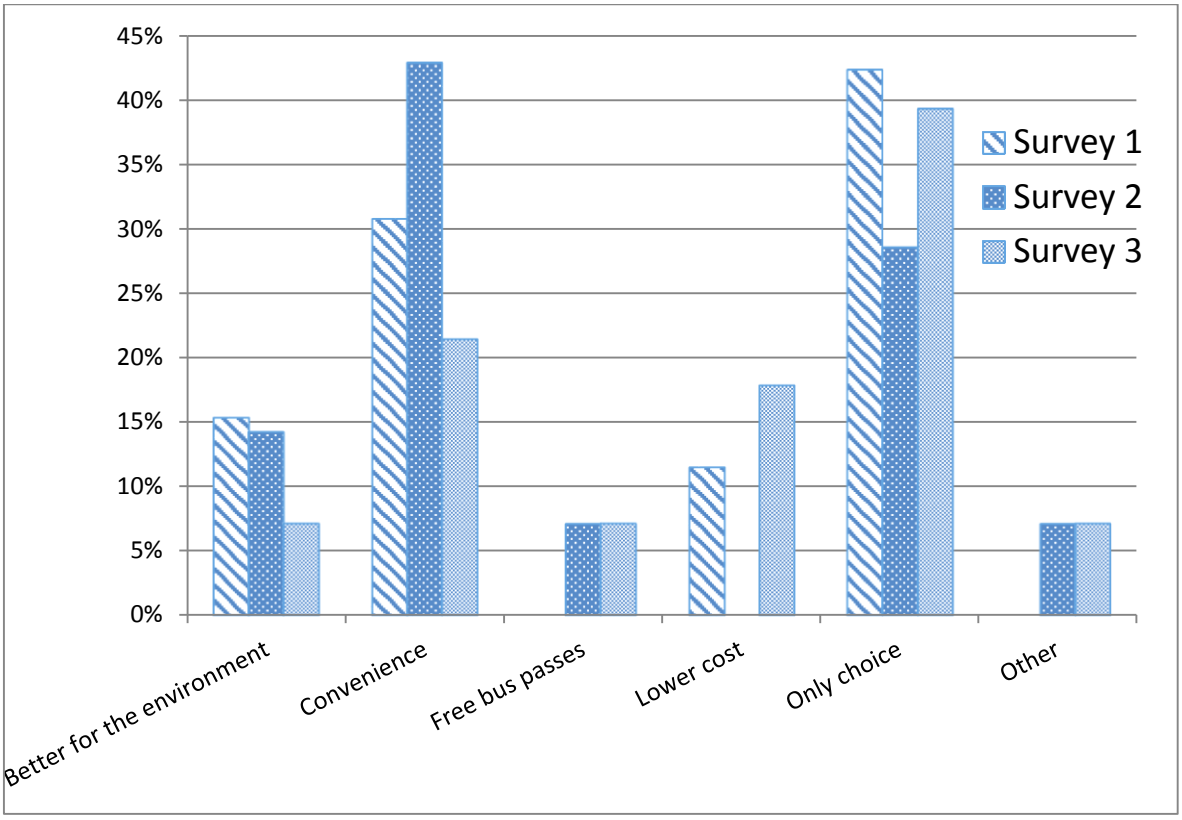

Figure 5.11 Why control households would use transit

Results suggest there is a different mindset between the participating and control households. Control households' responses on why they would use transit were dominated by "convenience" and "only choice" in all three surveys. The high response rate of the "only choice" answer demonstrates that the control group may not be as willing to change their behaviours as the participating households. This may also be because the average age of the control households was higher than the participating households, which could signify that the older residents (seniors for example) depend more on the convenience of their personal vehicle for transport. The "other" responses included: 1) once young children are old enough and 2) for going to school.

5.2.3.2 Satisfaction with Active Transportation Facilities and Services in Kelowna

Both control and participating households were asked to rank their satisfaction level with walking, biking, and transit facilities and services in Kelowna between 1 and 10, where 1 was very unsatisfied and 10 was very satisfied.

5.2.3.2.1 Satisfaction with Walking Facilities in Kelowna

Figure 5.12 displays the average control and participating household satisfaction rank (where 1 is very unsatisfied and 10 is very satisfied) with walking facilities and services in Kelowna.

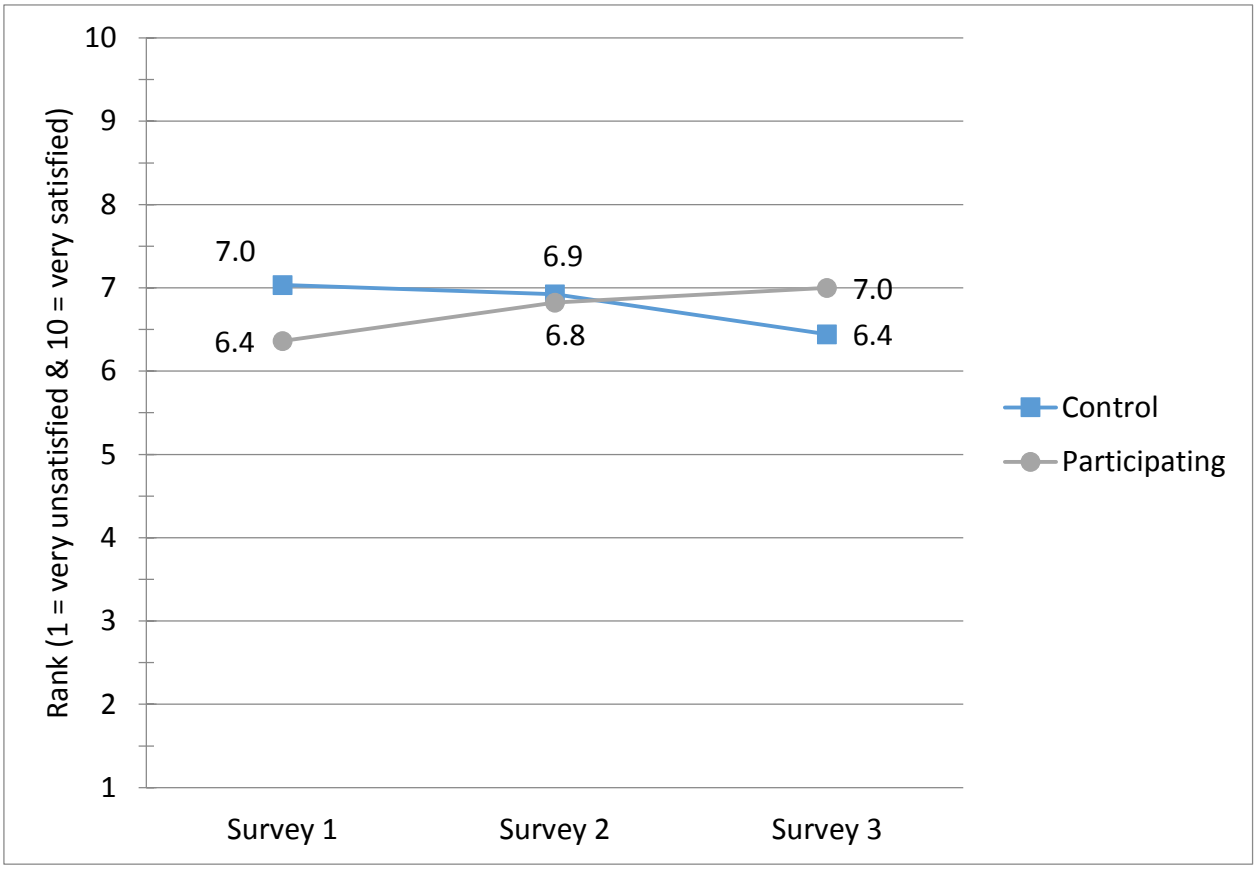

Figure 5.12: Household satisfaction with walking facilities and services in Kelowna

From survey 1 to 3, control households' satisfaction with walking facilities and services generally decreased while participating households' satisfaction generally increased. Overall, these are minimal changes and may have just been a result of outside factors (e.g. changes in weather and seasonal activities).

5.2.3.2.2 Satisfaction with Cycling Facilities in Kelowna

Figure 5.13 displays the average household satisfaction rank (where 1 is very unsatisfied and 10 is very satisfied) with biking facilities and services in Kelowna

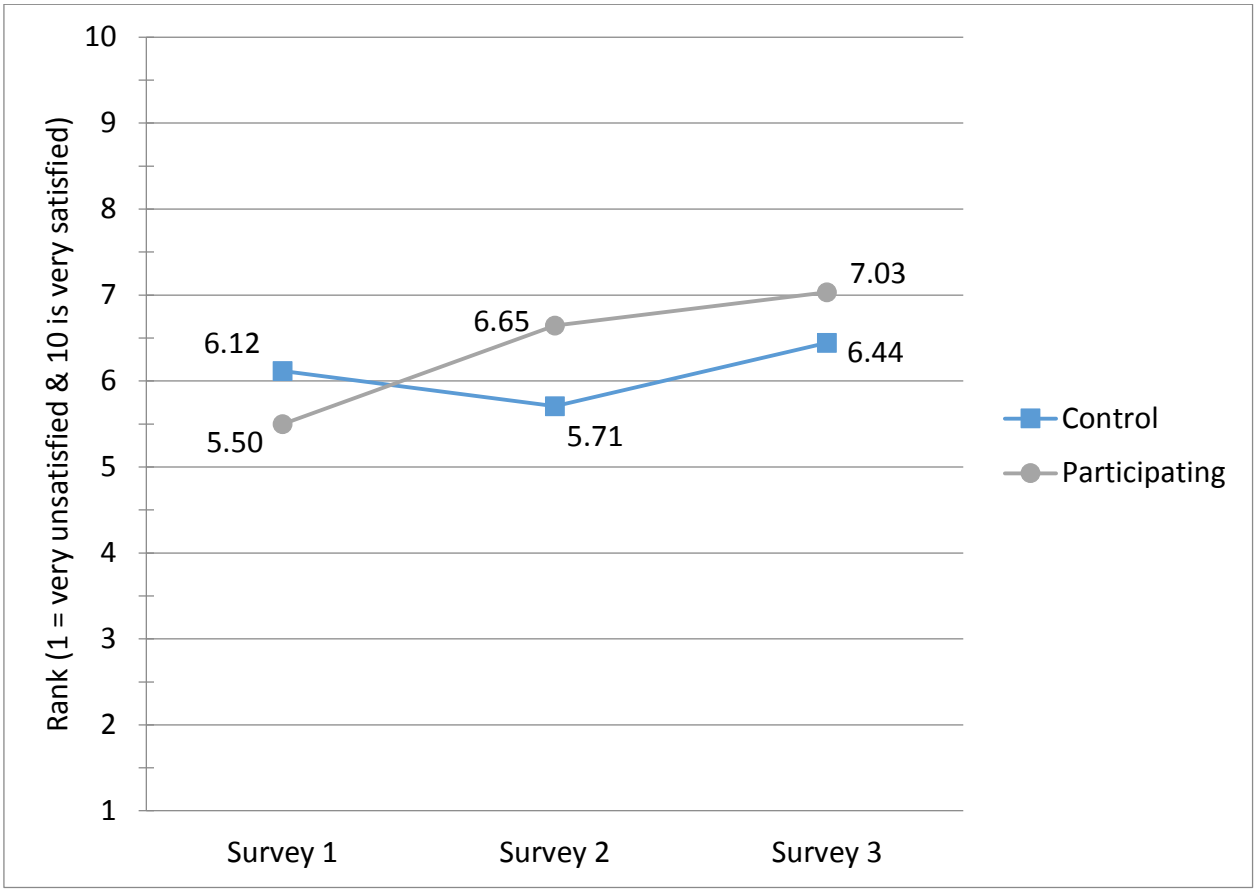

Figure 5.13 Households' satisfaction with biking facilities and services in Kelowna

From survey 1 to 2, control households' satisfaction with biking facilities decreased, but increased again by survey 3. In contrast, participating households' satisfaction generally increased from survey 1 to 3. Again, these are minimal changes, and may have just been a result of outside factors (e.g. changes in weather and seasonal activities).

5.2.3.2.3 Satisfaction with Transit Facilities in Kelowna

Figure 5.14 displays the average household satisfaction (where 1 is very unsatisfied and 10 is very satisfied) with transit services and facilities in Kelowna.

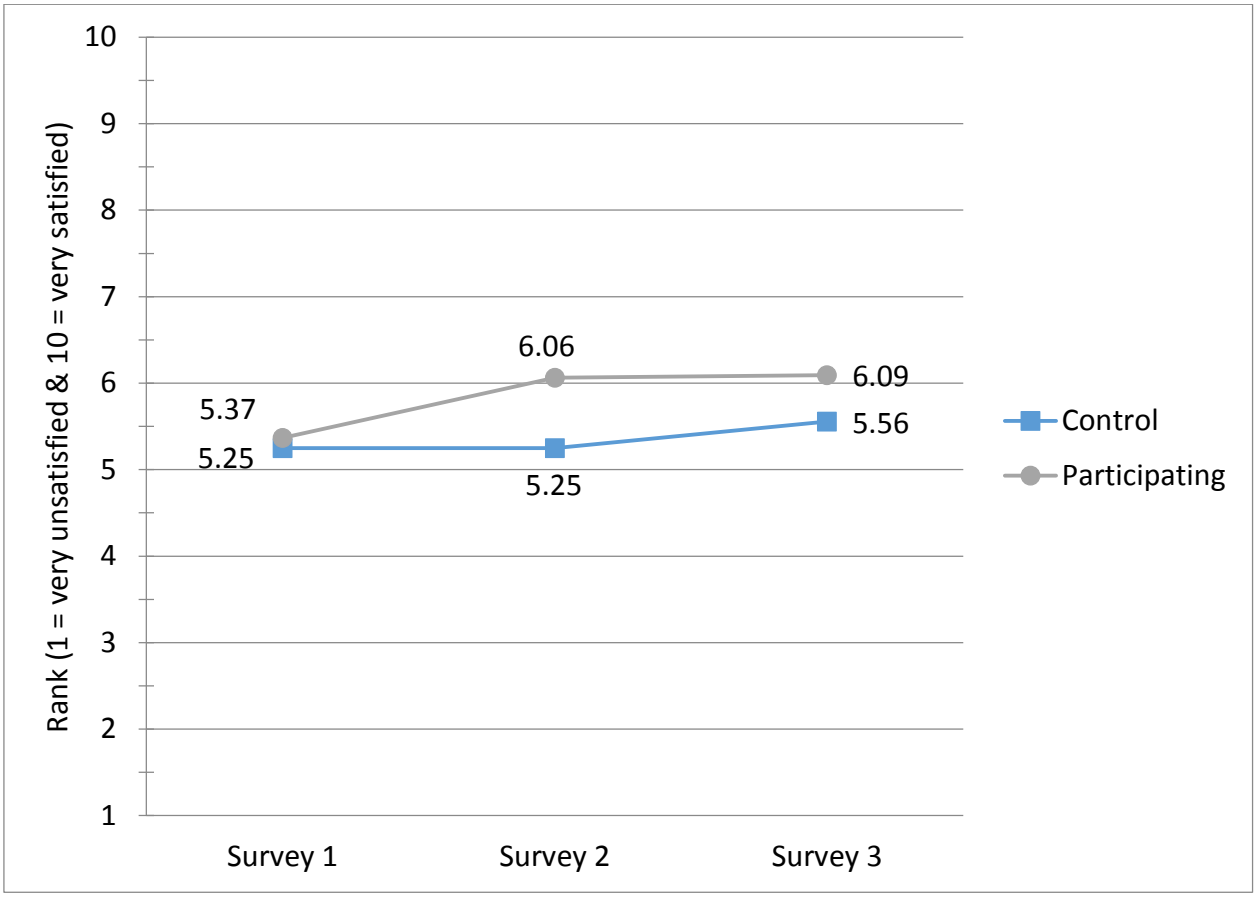

Figure 5.14: Households' satisfaction with transit facilities and services in Kelowna

From survey 1 to 3, control households' satisfaction with transit facilities and services slightly increased. In contrast, satisfaction for participating households increased from survey 1 to 2, but decreased slightly by survey 3. This increase could be a result of more transit use as a result of ComPASS, and residents therefore becoming more educated on the Kelowna transit system.

5.2.3.3 Transit Accessibility

All households in the phase 2 study area believed that the nearest bus stop was within walking distance from their residence. This suggests that the distance for walking to and from bus stops is not a barrier for using transit in the phase 2 study area.

5.2.3.4 Positive and Negative Experiences with Transit

In survey 3, both the control and participating households were asked to list any positives or negatives with using transit in Kelowna that their household encountered during the ComPASS pilot study. Table 5.10 below outlines the positive and negative responses given by the control households.

Table 5.10 Control households' positive and negative experiences with transit

Positive	Negative
• Very easy access, quick, reliable, and convenient. • The length of the bus trip from UBC to the Glenmore area is very positive when the express bus (the number 6) is running in the morning	• Length of the bus trip from UBC to Glenmore is negative when the express is not running (i.e. during summer months) and one needs to go to Orchard Park first to transfer to the number 7. • I looked into getting to school and back using transit. It is six times longer for me to bus than it is to drive (Glenmore to Okanagan College). • Kelowna does not seem to be "into" the transit system. The bus is infrequent, big, and empty. They should be more frequent and smaller – then I would use it. • Not good enough for us to use. Would use it if we had to. • Scheduling is inconsistent or buses don't show up at all. Transfers to other buses to get to our final destination can take 1.5 hours. • Uncooperative bus drivers. Often buses are not on time and then connections cannot be made. First bus from Glenmore area to downtown is late. • We just never use it.

Out of all responses given, there were only two positive comments; that the system has "easy access, quick, reliable, and convenient" service, and a good express route to the UBC campus. Generally, control households appeared to have had experience with the service but have found it to be too inconvenient for their requirements. This reinforces the fact that the system must be improved before it will be used.

Table 5.11 shows the responses from participating households about positive and negative experiences they have had with transit throughout the ComPASS pilot study.

Table 5.11 Participating households' positive and negative experiences with transit

Positive	Negative
• We all believe in transit and are happy to use transit when it works. We're all good cyclists though and until the interval between buses is down to 10 – 15 minutes, it will always be more convenient (and less expensive) to bike. • The times were sometimes difficult to coordinate but we were very satisfied with our experiences. • Enjoyed the freedom of coming and going without the time limit of a transfer. • Drivers were mostly friendly and helpful.	• Used transit more than when I didn't have the transit passes. It was 14 minutes early one time so I had to sprint to catch it to make a meeting. The maps are not that detailed. • For us it is not convenient as we are often taking sports equipment. • There are time constrictions in terms of getting to appointments or lessons that may take half an hour, but two hours (in total) to get to by transit. • Buses to school (Dr. Knox Elementary) is on time, while buses to Kelowna Secondary School via Orchard Park mall are too full. Therefore, a person must go via Queensway to avoid overcrowding. • The Glenmore bus (the number 7) did not always arrive on schedule so using the bus if time was important was not very good. • Not enough arrival/departure times to make it convenient. • Great service except transfer times are often too long. • Lack of shade at our nearest bus stop! • Long waits – either the bus came early or very late. • It would be nice in the summertime if there were shelters at bus stops to keep out of the heat, especially when the bus comes late. • A better map (even if it was only online) showing all stops on each route would be nice. • Need more buses coming in shorter time spans (every 10 to 15 minutes). Need a more direct route and/or faster turnover to the Westside. We took over an hour to get there. Would not let the kids ride alone as there are scary people – drug dealers and users. • Not enough buses. Overcrowded at times. • Not enough transit service especially on main routes.

Of 18 comments made by the participating households, 14 were negative and only 4 were positive. Participating households generally believed that headways between buses are too long, buses are often not on time, transfer times are too long, there should be more bus shelters, and more detailed route maps are needed.

Although the number of negative comments outweighed the positive comments, some responses conflicted with each other. For example: 1) some residents felt that bus drivers were unfriendly while others believed them to be friendly, 2) some residents thought that buses often run empty, while others thought buses were overcrowded, and 3) other residents have had positive experiences with transit convenience, while others have not. These differing opinions are subjective, but likely different due to the different LOS available for different destinations at different hours. However, participating households were overall unimpressed with the service, which demonstrates that changes need to be made before residents will consider transit as a viable alternative. This also shows that even residents that are informed and educated about transit find the service is generally poor.

5.2.3.5 Barriers to Using Active Transportation

In surveys 2 and 3, participating households were asked if they experienced any barriers to using components of the ComPASS. Table 5.12 outlines the barriers participating households said they experienced that prevented them from using ComPASS components throughout the pilot study.

Table 5.12 Barriers to using ComPASS components for participating households

Survey 2 ComPASS Component Use Barriers	Survey 3 ComPASS Component Use Barriers
• Would like an outline of the bus schedule. • Transit was not convenient as buses were often late, came too infrequently, no express route to UBCO in the summer, or taking transit took too much time. • Bus schedule changes that residents were not aware of. • Had to carry heavy loads so driving was more feasible. • Time and convenience of the personal vehicle. • Cycling safety. • Poor Weather. • Family obligations. • Bike was in too poor of condition to use the Kelowna Cycle tune-up. • Lifestyle (busy schedules, etc.). • Illness.	• Age and lifestyle are not compatible with bus passes, biking, etc. • The bus schedule is slower than cycling. • Buses are inconvenient and take too long, sometimes buses are cancelled with no warning, too few buses. • Getting our bikes to the bike shop was difficult. • Family emergencies. • Would use the bus more in the winter. • Many cards to coordinate. • Would only use the bus if we could not bike or drive. • Young children.

The main barriers participating households experienced were mostly associated with inconvenient transit service. Other main barriers include lifestyle, illnesses, and family obligations.

Since control households did not receive a ComPASS package during the pilot study, they were asked what barriers they experienced to using AT, rather than components of the ComPASS. Table 5.13 displays the responses the control households gave for why they did not use AT in survey 2 and survey 3.

Table 5.13 Barriers to active transportation (AT) for control households

Survey 2 AT Barriers	Survey 3 AT Barriers
• Transporting elderly family members. • Mobility difficulties and health issues. • Poor weather reduced biking and walking. • Unsafe cycling paths and sidewalks. • Late schedule means walking late at night. • Transit takes too long. • Too busy.	• Nearby activities were moved to locations farther away. • Health issues. • Need safer walkways and bike routes. • During the summer vacation preferred to drive to places. • Time restrictions.

As control households comprised of more seniors and retired residents than the participating households, the barriers focussed more on perception of safety, health, or mobility issues. This could also suggest that where there are higher percentages of seniors, there should be a higher standard for AT connectivity and safety measures.

Between both the control and participating households, the main barrier to using AT was inconvenient transit service. Again, this reinforces the importance of convenient transit service to encourage more transit ridership. This suggests that without improvements to the current level of service, programming attempts to encourage transit use alone may have limited success.

5.2.4 Transportation Behaviours

Several questions were posed to both control and participating households in all three surveys to gauge their transportation habits and how the transportation behaviours of the participating households may have changed as a result of the ComPASS pilot program. Such questions included:

- How far and how long are your work, shopping, recreation, and school related trips?
- How many trips did each member of your household make in the past week (car trips as the driver, car trips as the passenger, transit, biking, and walking)?

In addition to these questions, pre, mid, and post traffic count data was analyzed to validate survey responses.

5.2.4.1 Average Trip Distance and Time

Both control and participating households were asked how far and how long it usually takes them to get to work, shopping, recreation, and school. Table 5.14 displays the average trip distances and time for work, shopping, recreation, and school in kilometres and minutes, respectively.

Table 5.14 Average trip distance and time for work, shopping, recreation, and school trips

Treatment Group	Trip Purpose	Distance (kilometres)	Time (minutes)	Average Speed (kilometres per hour)
Control Households	Work	7.7	12.5	36.9
	Shopping	5.3	10.5	30.9
	Recreation	5.6	20.9	16.0
	School	4.8	10.3	25.1
Participating Households	Work	14.3	20.3	42.3
	Shopping	7.9	15.7	30.4
	Recreation	12.1	34.6	21.0
	School	4.8	10.3	25.1

School trips are generally made closest to home, with an average distance of less than five kilometres. Therefore, trips to and from school on average are the most efficient for walking or cycling. Shopping trips are also fairly close to home; about five to eight kilometres on average, which could also be efficient for some cycling trips. However, shopping trips often require carrying heavier loads, so residents often choose to take their personal vehicles. Work trips tend to be the longest trips made by household members, with an average of just under eight kilometres for control households and about 14 kilometres for participating households. Recreational trip distances vary greatly as many households reported they went to other cities for most of their recreational trips, while other households said their recreation was walking, cycling, or running in their neighbourhood.

In general, the distances for all trip purposes differed between the control and participating groups. In particular, work and recreation trips were about double the distance among participating households compared to control households. School and shopping trip distances remained fairly similar among the two groups. The average speeds (average distance divided by average time) were fairly similar for trip purposes for the control and participating groups. Recreational and school trips tended to be the slowest trips, suggesting that residents tend to take more AT (slower) modes for these trip purposes. In contrast, shopping and work trips had faster average speeds, suggesting more personal vehicles are used for these trip purposes.

To determine the average kilometres travelled specifically for car trips as the driver, the travel diaries were used. Table 5.15 shows the average car trips as the driver distance for the control and participating groups according to the pre, mid, and post travel diaries.

Table 5.15 Travel diary average trip distance for car trips as the driver

Treatment Group	Average Trip Distance (km)		
	Pre	Mid	Post
Control	4.3	6.0	6.2
Participating	10.3	7.0	9.3

Again, car trips as the driver distances tended to be longer for the participating households than the control households. It is unknown why the trip length changed over time, but this could have been changes in household's reporting habits in the travel diaries. The pre survey was considered the most accurate for typical average car trips as the driver distances, as there was no ComPASS in effect at this time.

5.2.4.2 Transportation Trips in the Past Week

To determine if the ComPASS had an effect on transportation behaviours, each household representative was asked to record the number of one-way trips each household member made in the preceding week in survey 1, 2, and 3 (pre, mid, and post). This was asked for car trips as the driver, car trips as the passenger, transit, biking, and walking trips. Data was analyzed on a per household basis.

5.2.4.2.1 Transportation Mode Split

Table 5.16 shows the transportation mode split for the control and participating groups in the pre, mid, and post surveys. The percent mode splits reflect the number of trips household members made in the week leading up to each survey.

Table 5.16 Transportation mode split

Group	Survey	Car Trips as Driver	Car Trips as Passenger	Transit Trips	Cycling Trips	Walking Trips
Control	**Pre**	49%	22%	4%	4%	22%
	Mid	53%	20%	1%	5%	21%
	Post	44%	21%	3%	4%	28%
Participating	**Pre**	41%	23%	4%	11%	20%
	Mid	36%	22%	6%	14%	22%
	Post	42%	22%	4%	12%	19%

Table 5.17 shows the percent change in transportation mode split between the pre, mid, and post surveys.

Table 5.17 Transportation mode split percent change between surveys

Group	Survey Change	Car Trips as Driver	Car Trips as Passenger	Transit Trips	Cycling Trips	Walking Trips
Control	**Pre to Mid**	+8%	-9%	-75%	+25%	-5%
	Mid to Post	-17%	+5%	+200%	-20%	+33%
	Pre to Post	-10%	-5%	-25%	0%	+27%
Participating	**Pre to Mid**	-12%	-4%	+50%	+27%	+10%
	Mid to Post	+17%	0%	-33%	-14%	-14%
	Pre to Post	+2%	-4%	0%	+9%	-5%

Overall, the control group generally represents normal transportation behaviours that may have occurred for participating households between the pre, mid, and post surveys. The participating group shows how transportation behaviours change with the ComPASS treatment in effect in the midpoint survey.

Assuming the control households represent normal transportation behaviour changes without a ComPASS, car trips as the driver would normally have increased by about 8% between the pre and mid surveys. This increase in driving could have been a result of the increased precipitation (despite warmer temperatures) in June compared to April. Another reason could be the typical seasonal increase in traffic in Kelowna during the summer. However, despite the control household's increase in personal vehicle use in the mid survey, the participating groups *decreased* their car trips as drivers by 12%. Furthermore, the control group's transit trips for the control group *decreased* by 75% between the pre and mid surveys, while the participating group's transit trips *increased* by 50%. This suggests that under normal circumstances, the participating households would have increased car trips as the driver and decreased transit use, but instead participating households decreased car trips as the driver and increased transit use. The next section describes whether differences in mode splits between groups (control and participating) and surveys (pre, mid, and post) were statistically significant.

5.2.4.2.2 Transportation Behaviours Statistical Analysis

Statistical analyses using Generalized Linear Mixed Models (GLMM) were completed in IBM® SPSS® Version 22 (2013a) software to determine if there were significant differences for the main effects (group, survey, and interaction between group and survey). Subsections below outline the results for the GLMM statistical analysis for 1) car trips as the driver, 2) car trips as the passenger, 3) transit trips, 4) cycling trips, and 5) walking trips made in the week preceding each survey.

5.2.4.2.2.1 Car Trips as the Driver per Week

Table 5.18 below shows the GLMM model summary completed for the car trips as the driver reported in the preceding week using SPSS software.

Table 5.18 Car trips as the driver model summary

Target		Car Trips as the Driver
Probability Distribution		Negative Binomial
Link Function		Log
Information Criterion	Akaike Corrected	101.012
	Bayesian	105.873
Information criteria are based on the -2 log likelihood (96.874) and are used to compare models. Models with smaller information criterion values fit better.		

Table 5.19 below shows the fixed effects model results for car trips as the driver within surveys (survey 1, 2, and 3), groups (control and participating), and the interaction between the surveys and groups (survey*group).

Table 5.19 Car trips as the driver fixed effects model results

Source	F[a]	df1[b]	df2[c]	p-value
Corrected Model	1.744	5	67	.137
Survey	.561	2	60	.574
Group	1.571	1	31	.219
Survey * Group	3.007	2	60	.057

Rows highlighted in grey show the most significant results.

a. F = F distribution test statistic.

b. df1 = numerator degrees of freedom (used to calculate F).

c. df2 = denominator degrees of freedom for F (used to calculate F). Represents the degrees of freedom calculated by SPSS software using the Satterthwaite approximation (instead of the standard residual method). The Satterthwaite approximation is useful if the sample size is smaller or if data are unbalanced.

The p-value for the "corrected model" source listed in Table 5.19 above is the result of testing the hypothesis that all parameters except for the intercept are zero (IBM 2013c). Other results show there is a borderline statistically significant interaction effect present between the surveys (pre, mid, and post) and the group (control and participating) within a 94.3% confidence level (very close to the preferred 95% confidence level). No significant difference was found between the survey and group fixed effects.

The car trips as driver data was explored further to determine specific differences in the interaction effect. Figure 5.15 displays a graphical representation of the control and participating car trips as driver means for each survey.

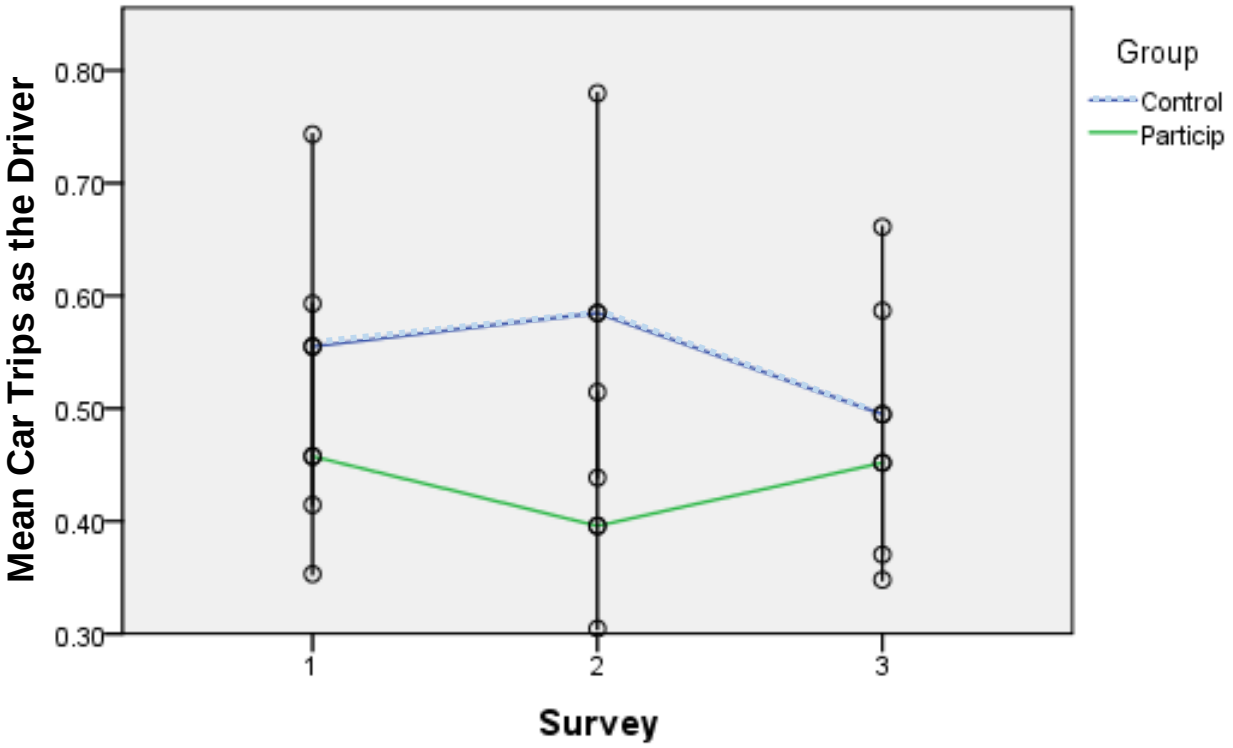

Figure 5.15 Car trips as the driver estimated means graph

As shown in the figure above, the lines for the control and participating groups do not run parallel with each other, supporting the result that the interaction effect is significant.

To determine where the significant differences lie within the interaction term, least significant difference (LSD) pairwise comparisons were completed on the data. Table 5.20 shows the results of this LSD pairwise comparison by group.

Table 5.20 Car trips as the driver pairwise comparison results for interaction by group

Survey	Group Pairwise Contrasts	Contrast Estimate[a]	Std. Error[b]	t[c]	df[d]	p-value
1	Control - Participating	.097	.099	.979	41	.333
	Participating - Control	-.097	.099	-.979	41	.333
2	Control - Participating	.189	.098	1.930	41	.061
	Participating - Control	-.189	.098	-1.930	41	.061
3	Control - Participating	.043	.092	.468	41	.642
	Participating - Control	-.043	.092	-.468	41	.642

Rows highlighted in grey show most significant results.

a. Difference in means between group (e.g. for survey 1, $\mu_{control} - \mu_{participating} = 0.097$)

b. Standard error = standard error of the difference between the two means being compared.

c. t = t distribution test statistic.

d. df = degrees of freedom of the error.

As shown in the table above, the results are the same for each survey when comparing control versus participating, and participating versus control. The overall results do not show statistically significant results within 95% confidence, but reveals that the difference between the control and participating groups in the second survey are the most significant at a confidence level of 93.9%, compared to the first survey at a confidence level of 66.7%, and the third survey at a confidence level of 35.8%. By viewing the interaction graph in Figure 5.15 and the contrast estimates in Table 5.20, in the second survey the participating group's car trips as the driver were lower than the control group's car trips as the driver.

The pairwise comparison results confirmed that the ComPASS (which was in effect for participating households in survey 2) may have resulted in decreased car trips for participating households. Furthermore, when ComPASS was not in effect (during survey 1 and survey 3), there was essentially no significant difference in car trips as the driver between the control and participating groups. These results suggest that the three month ComPASS intervention affected car trips as the driver during the intervention, but did not have lasting effects on participating households' vehicle use. Therefore, a permanent ComPASS program may be necessary to decrease vehicle use rather than the use of short term interventions.

Another pairwise comparison was completed to determine if there were significant differences between surveys (pre, mid, and post) within the groups (control and participating). Table 5.21 shows the results of the LSD pairwise comparison by survey.

Table 5.21 Car Trips as the driver pairwise comparison results for interaction by survey

Group	Survey Pairwise Contrasts	Contrast Estimate	Std. Error	t	df	p-value
Control	1 - 2	-.030	.053	-.563	60	.576
	1 - 3	.060	.050	1.212	64	.230
	2 - 1	.030	.053	.563	60	.576
	2 - 3	.090	.051	1.758	66	.083
	3 - 1	-.060	.050	-1.212	64	.230
	3 - 2	-.090	.051	-1.758	66	.083
Participating	1 - 2	.062	.036	1.718	64	.091
	1 - 3	.006	.038	.154	60	.878
	2 - 1	-.062	.036	-1.718	64	.091
	2 - 3	-.056	.036	-1.564	64	.123
	3 - 1	-.006	.038	-.154	60	.878
	3 - 2	.056	.036	1.564	64	.123

Rows highlighted in grey show most significant results.

As shown in the table above, there are again repeated comparisons, as results are the same when comparing survey 1 with survey 2, and survey 2 with survey 1, and so on. Similarly to the pairwise

comparison results of interaction between groups, the overall results do not show statistically significant differences within a 95% confidence level.

However, results show that there are borderline significant differences within the control group between survey 2 and survey 3 at a 91.7% confidence level. In this comparison, car trips as the driver are higher in survey 2 than survey 3 for the control group. The reason for this difference is unknown, and is likely due to outside factors (e.g. the weather, household characteristics, etc.).

Within the participating group, there is a borderline significant difference between survey 1 and survey 2 at a 90.9% confidence level, where the car trips as the driver were higher in survey 1 than survey 2. This decrease in car trips as the driver could be a result of the ComPASS intervention in survey 2. The control group actually increased their car trips as the driver from survey 1 to survey 2 (although not significantly), while conversely, the participating group reduced their car trips the driver. Therefore, the reduced car trips as the driver in survey 2 suggests that the ComPASS may have contributed to reduced vehicle use for participating households.

Furthermore, it is worth noting that for participating households, the car trips as the driver in survey 2 was lower than survey 3 at an 87.7% confidence level. Although not within the borderline statistically significant threshold, this high confidence level suggests that after the ComPASS intervention was removed, participating households reverted back to behaviours similarly to the benchmark (survey 1). This suggests a permanent ComPASS program may be required to impact behaviours rather than a short intervention.

5.2.4.2.2.2 Car Trips as the Passenger per Week

Table 5.22 below shows the GLMM model summary completed for the car trips as the passenger reported in the past week, using SPSS software.

Table 5.22 Car trips as the passenger model summary

Target		Car Trips as the Passenger
Probability Distribution		Poisson
Link Function		Log
Information Criterion	Akaike Corrected	173.198
	Bayesian	178.060
Information criteria are based on the -2 log likelihood (169.060) and are used to compare models. Models with smaller information criterion values fit better.		

Table 5.23 below shows the resulting fixed effects model results for the car trips as the passenger within surveys (survey 1, 2, and 3), groups (control and participating), and the interaction between the surveys and groups.

Table 5.23 Car trips as the passenger fixed effects model results

Source	F	df1	df2	p-value
Corrected Model	.157	5	66	.977
Survey	.241	2	60	.786
Group	.212	1	36	.648
Survey * Group	.037	2	60	.964

Rows highlighted in grey show significant results.

Overall, there were no significant differences found for the fixed effects for car trips as the passenger during the pilot study. Therefore, the ComPASS intervention likely had no effect on car trips as the passenger among participating households.

5.2.4.2.2.3 Transit Trips per Week

Table 5.24 below shows the GLMM model summary completed for the transit trips reported in the past week, using SPSS software.

Table 5.24 Transit trips model summary

Target		Transit
Probability Distribution		Negative Binomial
Link Function		Log
Information Criterion	Akaike Corrected	391.814
	Bayesian	396.675
Information criteria are based on the -2 log likelihood (387.676) and are used to compare models. Models with smaller information criterion values fit better.		

Table 5.25 below shows the resulting fixed effects model results for transit use within surveys (survey 1, 2, and 3), groups (control and participating), and the interaction between the surveys and groups.

Table 5.25 Transit trips fixed effects model results

Source	F	df1	df2	p-value
Corrected Model	1.877	5	58	.112
Survey	.521	2	60	.597
Group	.349	1	30	.559
Survey * Group	4.414	2	60	.016

Rows highlighted in grey show significant results.

Based on results displayed in Table 5.25 above, there is a statistically significant interaction effect present between the survey (pre, mid, and post) and the group (control and participating) within a 95% confidence level. No significant difference was found between the pre, mid, and post surveys, and no significant difference was found between the control and participating group.

To determine where the differences are in the interactions, the data was explored further. Figure 5.16 displays a graphical representation of the control and participating transit trip means for each survey.

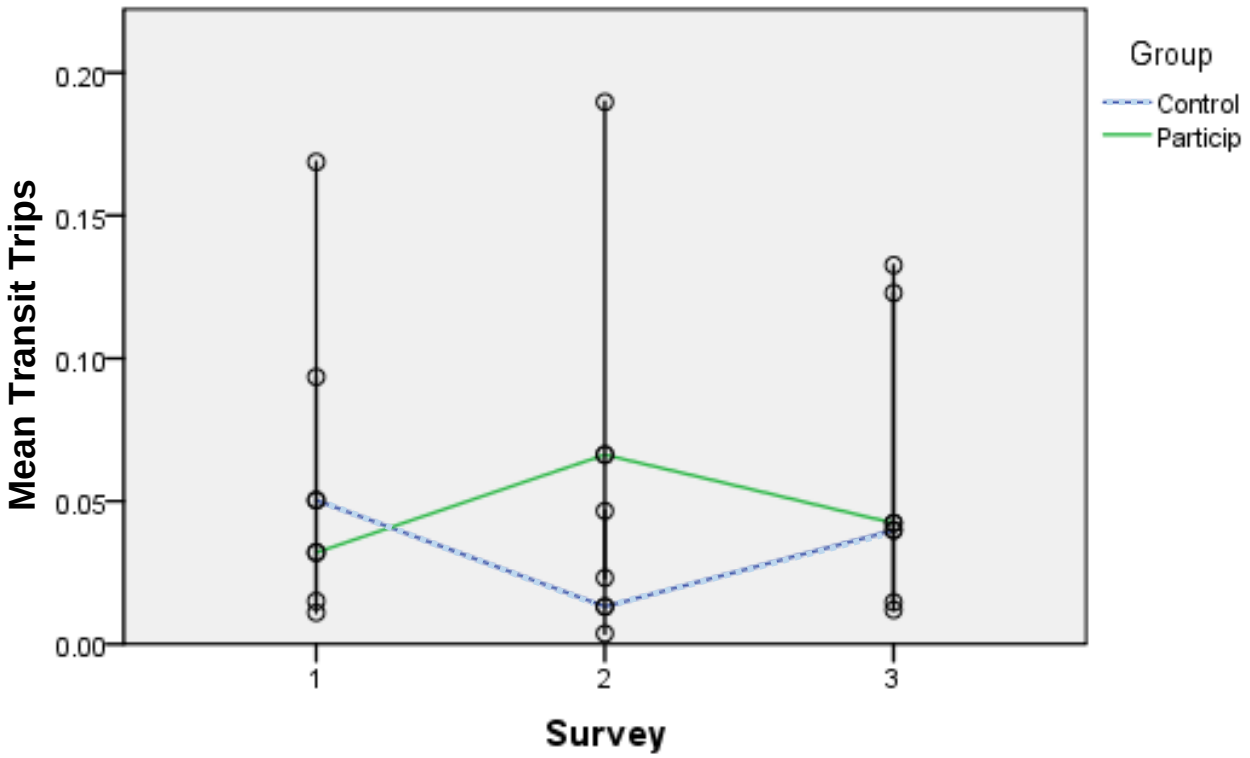

Figure 5.16 Transit trips estimated means graph

As shown in the figure above, the lines for the control and participating groups do not run parallel with each other, supporting the result that the interaction effect is significant.

To determine where the significant differences lie within the interaction term, least significant difference (LSD) pairwise comparisons were completed on the data. Table 5.26 shows the results of this LSD pairwise comparison by group.

Table 5.26 Transit trips pairwise comparison results for interaction by group

Survey	Group Pairwise Contrasts	Contrast Estimate	Std. Error	t	df	p-value
1	Control - Participating	.018	.035	.526	52	.601
	Participating - Control	-.018	.035	-.526	52	.601
2	Control - Participating	-.053	.036	-1.489	52	.143
	Participating - Control	.053	.036	1.489	52	.143
3	Control - Participating	-.003	.033	-.077	52	.939
	Participating - Control	.003	.033	.077	52	.939

Rows highlighted in grey show most significant results.

As shown in the table above, the results are the same for each survey, when comparing control versus participating, and participating versus control. The overall results do not show statistically significant results, but reveals that the difference between the control and participating groups in the second survey are the most significant at a confidence level of 85.7%, compared to the first survey at a confidence level of 39.9%, and the third survey at a confidence level of 6.1%. By viewing the interaction graph in Figure 5.16 and the contrast estimates in Table 5.26, the control group's transit use was lower than the participating group's transit use in the second survey. The pairwise comparison results suggest that the ComPASS, which was in effect in survey 2, may have resulted in increased transit use for participating households. Furthermore, when ComPASS was not in effect (during survey 1 and survey 3), there was essentially no difference in transit use between the control and participating groups. These results suggest that the three month ComPASS intervention affected transit use during the intervention, but did not have lasting effects on participating households' transit use. Therefore, a permanent ComPASS program may be necessary to increase transit use rather than the use of short term interventions. Moreover, the weak transit use difference (at 85.7% confidence) in survey 2 may further attest to the relatively low level of satisfaction reported by the pilot study participants, such that transit improvements would also be needed for a permanent ComPASS program to be successful.

Another pairwise comparison was completed to determine if there were significant differences between surveys (pre, mid, and post) within the groups (control and participating). Table 5.27 shows the results of the LSD pairwise comparison by survey.

Table 5.27 Transit trips pairwise comparison results for interaction by survey

Group	Survey Pairwise Contrasts	Contrast Estimate	Std. Error	t	df	p-value
Control	1 - 2	.037	.026	1.422	78	.159
	1 - 3	.011	.025	.424	66	.673
	2 - 1	-.037	.026	-1.422	78	.159
	2 - 3	-.027	.020	-1.336	85	.185
	3 - 1	-.011	.025	-.424	66	.673
	3 - 2	.027	.020	1.336	85	.185
Participating	1 - 2	-.034	.028	-1.224	89	.224
	1 - 3	-.010	.018	-.565	68	.574
	2 - 1	.034	.028	1.224	89	.224
	2 - 3	.024	.028	.862	77	.391
	3 - 1	.010	.018	.565	68	.574
	3 - 2	-.024	.028	-.862	77	.391

As shown in the table above, there are again repeated comparisons, as results are the same when comparing survey 1 with survey 2, and survey 2 with survey 1, and so on. Overall, results do not show statistically significant differences within a 95% confidence level. However, results show that the most significant differences are for the control group between survey 1 and survey 2, and between survey 2 and survey 3. By viewing the interaction graph in Figure 5.16 and the contrast estimates in Table 5.27, the control group's transit use is lowest in survey 2 compared to survey 1 and survey 3. This means that during survey 2, the control group reduced their transit use compared to survey 1 at a confidence level of 84.1%, and compared to survey 3 at a confidence level of 81.5%. Therefore, under normal circumstances, the control group reduced their transit use during survey 2. Although the participating group's transit use remained fairly consistent between survey 1, 2, and 3 (although there was an insignificant increase in transit use in survey 2), under normal circumstances without the ComPASS intervention, the participating group's transit use may have decreased similarly to the control group's transit use. Therefore, results suggest that despite a decrease in transit use under normal circumstances for the control group, the participating group's transit use remained statistically the same between survey 1, 2, and 3. This could further support the notion that ComPASS affected transit use among participating households.

5.2.4.2.2.4 Cycling Trips per Week

Table 5.28 below shows the GLMM model summary completed for the cycling trips reported in the past week, using SPSS software.

Table 5.28 Cycling trips model summary

Target		Cycling
Probability Distribution		Negative Binomial
Link Function		Log
Information Criterion	Akaike Corrected	299.987
	Bayesian	304.849
Information criteria are based on the -2 log likelihood (295.849) and are used to compare models. Models with smaller information criterion values fit better.		

Table 5.29 below shows the resulting fixed effects model results for cycling use within surveys (survey 1, 2, and 3), groups (control and participating), and the interaction between the surveys and groups.

Table 5.29 Cycling trips fixed effects model results

Source	F	df1	df2	p-value
Corrected Model	1.936	5	61	.101
Survey	.886	2	60	.418
Group	6.816	1	30	.014
Survey * Group	.835	2	60	.439

Rows highlighted in grey show significant results.

Based on results displayed in Table 5.29 above, there is a statistically significant effect for groups (control and participating) at a 98.6% confidence level. No significant difference was found between the pre, mid, and post surveys, and no significant difference was found for the interaction between the surveys and groups.

To determine where the differences are in the groups, the data was explored further. Figure 5.17 shows the graphical representation of the estimated cycling use means between surveys and groups.

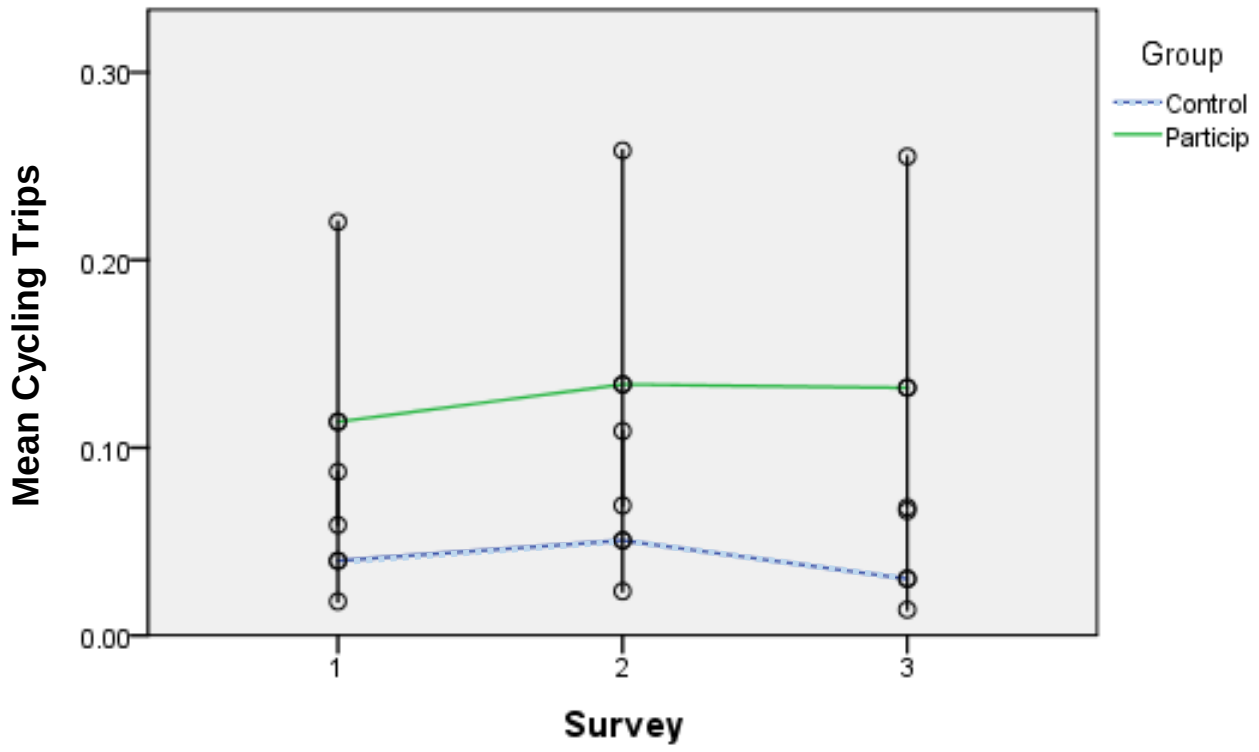

Figure 5.17 Cycling trips estimated means graph

As shown in the figure above, the lines for the control and participating groups run fairly parallel with each other, further supporting the result that there is no significant interaction effect. Furthermore, in each survey it is clear that the participating group cycles more than the control group.

Overall, the participating group cycles more than the control group at a 98.6% confidence level. This difference could be a result of the inherent demographical differences between the two groups (e.g. the participating group is younger than the control group). In both groups there was an increase in cycling use, which could be a result of warmer weather in survey 2 (mid-June) compared to survey 1 (late April). Cycling again decreased for both groups in survey 3 (late September) compared to survey 2 (mid-June), again likely related to the weather. Overall, results suggest the ComPASS intervention likely had no impact on cycling use throughout the pilot study.

5.2.4.2.2.5 Walking Trips per Week

Table 5.30 below shows the GLMM model summary completed for the walking trips reported in the preceding week, using SPSS software.

Table 5.30 Walking trips model summary

Target		Walking
Probability Distribution		Poisson
Link Function		Log
Information Criterion	Akaike Corrected	193.883
	Bayesian	198.745
Information criteria are based on the -2 log likelihood (189.745) and are used to compare models. Models with smaller information criterion values fit better.		

Table 5.31 below shows the resulting fixed effects model results for walking trips within surveys (survey 1, 2, and 3), groups (control and participating), and the interaction between the surveys and groups.

Table 5.31 Walking trips fixed effects model results

Source	F	df1	df2	p-value
Corrected Model	1.090	5	60	.375
Survey	.573	2	60	.567
Group	.001	1	35	.982
Survey * Group	2.175	2	60	.122

Rows highlighted in grey show significant results.

Overall, there were no significant differences found for the fixed effects for walking trips during the pilot study. Therefore, the ComPASS intervention likely had no effect on walking trips among participating households.

5.2.4.2.2.6 Transportation Trips in the Past Week Summary

After conducting several statistical comparisons between the three surveys and the control and participating groups, the main findings of the trips per week per household analyses were:

- Participating households' car trips as the driver were significantly less frequent than control households in survey 2 (when ComPASS was in effect) at a 93.9% confidence level.
- Participating households reduced their car trips as the driver at a 90.9% confidence level between survey 1 and survey 2. Participating households then increased their car trips as the driver between survey 2 and survey 3 at an 87.7% confidence level.
- Participating households' transit trips were significantly more frequent than control households' transit trips in survey 2 (when ComPASS was in effect) at an 85.7% confidence level.
- As a group, participating households cycled significantly more than the control households in all surveys at a 98.6% confidence level.
- There were no significant differences found for: 1) car trips as the passenger, nor for 2) walking trips datasets.

Based on the results of these statistical analyses, it would appear that the ComPASS package pilot:

- Played a role in reducing car trips as the driver;
- Contributed to increased transit trips; and,
- Likely did not impact cycling, walking, nor car trips as the passenger.

Furthermore, results revealed that a permanent ComPASS program would be necessary to impact car trips as the driver and transit trips since the short term intervention did not have lasting effects on behaviours.

Overall, the ComPASS pilot study reached the objective to reduce car trips as the driver and possibly increased transit trips, which would help support sustainable communities. Although the piloted ComPASS package impacted car trips as the driver and transit trips, other initiatives (e.g. improved infrastructure, and/or neighborhood designs) may be required to further reduce driving and increase other transportation modes (e.g. carpooling programs, improved cycling and walking infrastructure, etc.).

5.2.4.3 Traffic Counts

Pre, mid, and post traffic count data was collected during the same timeframes as the surveys. Table 5.32 below shows the results for the three traffic counts for each day of the week, and the total week-long count volume.

Table 5.32 Pilot study neighbourhood two-way traffic count data

	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday	Sunday	Total
Pre (April)	475	639	860	694	365	343	246	3,623
Mid (June)	603	616	675	634	655	525	378	4,088
Post (Sept.)	477	610	554	510	546	718	403	3,818

The displayed traffic count data shows that there was an increase in volumes from April to June, and a decrease in volumes from June to September, which is consistent with Kelowna traffic seasonal fluctuations, which increase in summer months. BC Ministry of Transportation and Infrastructure (MoTI) monthly average day of week (MADW) traffic volume data from the William R. Bennett Bridge (site P-25-1NS-NY) was obtained from the MoTI's online Traffic Data Program (BC MoTI 2012) to find 2012 seasonal ratios to convert April and September traffic volumes to equivalent June data for better comparison. Table 5.33 shows the calculated MoTI MADW factors to convert collected traffic count data (Table 5.32) to equivalent June traffic volumes.

Table 5.33 Monthly average day of week (MADW) factors to June equivalent data

	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday	Sunday
Pre (April)	1.07	1.04	1.06	1.07	1.13	1.06	1.12
Mid (June)	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Post (Sept.)	1.06	0.99	1.03	1.03	1.02	0.99	0.99

These factors were applied to traffic volumes presented in Table 5.32. Table 5.34 shows the resulting equivalent June traffic volume data.

Table 5.34 Pilot study neighbourhood two-way equivalent June traffic count data

	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday	Sunday	Total
Pre (April)	475	639	860	694	365	343	246	3,882
Mid (June)	603	616	675	634	655	525	378	4,088
Post (Sept.)	477	610	554	510	546	718	403	3,873

Even though April and September data was converted to equivalent June data for better comparison, traffic volumes increased in June compared to April and September. However, April and September data (when ComPASS was not in effect) were very similar. It is unknown why traffic volumes increased when ComPASS was in effect, but this could have been a result of outside factors (e.g. increased cut-through tourist traffic due to the summer traffic increase in Kelowna), and/or un-recorded local traffic data due to the previously mentioned equipment malfunctions. The most influential factor to consider that likely contributed to this increase is that only 18 of the 55 households in the neighbourhood had the ComPASS during the midpoint traffic count. Therefore, it is possible that the traffic count was higher in June due to the increase in the 14 control (and possibly the other 23 non-participating) households' personal vehicle trips.

5.2.4.4 ComPASS Reduced Personal Vehicle Use Benefits

Assuming ComPASS holders could reduce their car trips as the driver, the reduced vehicle kilometres travelled (VKT) would result in benefits such as reduced GHG emissions, improved road safety, and economic savings. The average car trip distance as the driver for Phase 2 participating households found in the first travel diary (before the ComPASS intervention) was 10.3 km. The average number of trips per day made by participating households according to the reported number of trips for participating households in survey 1 (the benchmark before the effects of ComPASS), was 33.0 trips per household per week (or 4.7 trips per household per day). With a 12% reduction in car trips as the driver through ComPASS (see Section 5.2.4.2.1), the average number of trips per household per week could drop to 29.0

(or 4.1 trips per household per day). This would equate to a reduction of 5.8 VKT per household per day. Under a conservative estimate, assuming a 6% reduction in car trips as the driver through ComPASS (half of the 12% assumption), there could be an average of 31.0 trips per household per week (or 4.4 trips per household per day). This conservatively equates to a reduction of 2.9 VKT per household per day.

5.2.4.4.1 ComPASS Greenhouse Gas Emission Reductions

This reduction in VKT also translates to a reduction in greenhouse gas (GHG) emissions. Table 5.39 shows the potential reduction in CO_2 equivalent (CO_2e) kilograms produced by participating households as a result of ComPASS.

Table 5.35 Reduced CO_2 equivalent (CO_2e) emissions due to reduced driving

	Baseline	ComPASS (-12% driver trips)	ComPASS (-6% driver trips)
Average trip distance for participating households in survey 1	10.3 km	10.3 km	10.3 km
Average daily trips per participating household in survey 1 (car trips per driver)	x 4.7	x 4.1	x 4.4
Daily vehicle kilometres travelled (VKT) per household	48.6 km	42.7 km	45.6 km
Greenhouse gas emissions per VKT (kilograms of CO_2e)	x 0.3 kg/km	x 0.3 kg/km	x 0.3 kg/km
Daily emissions per household	14.5 kg	12.8 kg	13.7 kg
Reduction due to ComPASS (per household):			
• Daily greenhouse gas emission reduction (kg of CO_2e)		1.7 kg	0.9 kg
• Annual greenhouse gas emission reduction (kg of CO_2e)		637.0 kg	318.5 kg

Assuming there is a factor of 0.3 kg of CO_2e emitted per VKT (Province of BC 2010), then a ComPASS holder could reduce their CO_2e emissions by 1.7 kg per household per day. This equates to a reduction in GHG emissions of 637.0 kg of CO_2e per ComPASS household per year. Under conservative estimates (6% reduction in car trips as the driver), then there could be a reduction in 318.5 kg of CO_2e per ComPASS household per year.

5.2.4.4.2 ComPASS Collision Reductions

The Transportation Association of Canada's (TAC) 2010 Urban Transportation Indicators Survey revealed that there were about 2.75 road fatalities per 1 million VKT (third highest of CMAs surveyed in Canada), and 0.75 road injuries per 1,000 VKT (second highest of CMAs surveyed in Canada) in Kelowna in 2006. Based on these fatality and injury rates per VKT, Table 5.36 shows the estimated reduction in fatalities and injuries resulting from potential reduced car trips as the driver as a result of ComPASS (12% reduction and conservative 6% reduction).

Table 5.36 Reduced road injuries and fatalities due to reduced driving

	Baseline	ComPASS (-12% driver trips)	ComPASS (-6% driver trips)
Average trip distance for participating households in survey 1	10.3 km	10.3 km	10.3 km
Average yearly trips per participating household in survey 1 (car trips per driver)	x 1,716	x 1,510	x 1,613
Yearly vehicle kilometres travelled (VKT) per household	17,676 km	15,554 km	16,614 km
Injuries per 1,000 VKT	x 0.75	x 0.75	x 0.75
Fatalities per 1 million VKT	x 2.75	x 2.75	x 2.75
Average number of injuries per household per year	13.3	11.7	12.5
Average number of fatalities per household per year	0.049	0.043	0.046
Reduction due to ComPASS (per household):			
• Annual average reduced injuries per household per year		1.6	0.8
• Annual average reduced fatalities per household per year		0.006	0.003

Overall, there could be an average reduction of 1.6 injuries per year and 0.006 fatalities per year based on a single household's reduced VKTs (assuming a 12% reduction in trips). Assuming a conservative estimate of 6% reduced trips, the resulting reduced VKTs could mean 0.8 fewer injuries and 0.003 fewer fatalities per ComPASS household per year on average.

5.2.4.4.3 ComPASS Economic Savings

A reduction in VKT and GHG emissions along with improved road safety results in many community-wide economic benefits. Litman (2015) of the Victoria Transport Policy Institute (VTPI) estimated the cost savings per reduced vehicle mile travelled (VMT) from reduced vehicle use. Table 5.37 shows the economic savings anticipated for each reduced VKT (converted from VMT) according to Litman (2015). The table also shows whether each type of savings benefits the user (U), society (S), or government (G).

Table 5.37 Economic savings for each reduced vehicle kilometre traveled (VKT) (Litman 2015)

	Urban Peak	Urban Off-Peak	Rural	Overall Average	Benefits	Comments
Vehicle Cost Savings	$0.16	$0.14	$0.12	$0.14	U	Consumer savings from reduced vehicle ownership and use.
Avoided Chauffeuring Driver's Time	$0.43	$0.37	$0.31	$0.36	U	Reduced chauffeuring responsibilities due to improved travel options.
Congestion Reduction	$0.12	$0.03	$0.01	$0.04	S, U	Reduced traffic congestion from automobile travel on congested roadways.
Reduced Barrier Effect	$0.01	$0.01	$0.01	$0.01	S	Improved active travel conditions due to reduced traffic speeds and volumes.
Roadway Cost Savings	$0.03	$0.03	$0.02	$0.03	G	Reduced roadway construction, maintenance and operating costs.
Parking Cost Savings	$0.37	$0.25	$0.12	$0.22	G, S	Reduced parking problems and facility cost savings.
Energy Conservation	$0.02	$0.02	$0.02	$0.02	S, U	Economic and environmental benefits from reduced energy consumption.
Pollution Reductions	$0.06	$0.03	$0.01	$0.03	S	Economic and environmental benefits from reduced air, noise, and water pollution.

G = Government, S = Society, U = User

Assuming Kelowna would fit in the "Overall Average" category, the total potential savings (for users, society, and the government) per reduced VKT is $0.84. However, to demonstrate potential municipal savings (rather than personal economic savings for users), the user categories were removed (vehicle cost savings and avoided chauffeuring driver's time). When considering only social and government savings, the updated savings is $0.34 per reduced VKT. Table 5.38 shows the estimated cost savings resulting from potential reduced car trips as the driver as a result of ComPASS (12% reduction and conservative 6% reduction).

Table 5.38 Economic savings due to reduced driving

	Baseline	ComPASS (-12% driver trips)	ComPASS (-6% driver trips)
Yearly vehicle kilometres travelled (VKT) per household.	17,676 km	15,554 km	16,614 km
Reduced VKT per household.	-	2,121 km	1,060 km
Cost savings per reduced VKT ($ per VKT).		$0.34	$0.34
Cost savings per household per year.		$721.13	$360.57

There could be economic savings of $721.13 (assuming a 12% reduction in vehicle trips) to $360.57 (assuming a 6% reduction in vehicle trips) per ComPASS household per year.

5.2.5 Attitudes and Beliefs Regarding the ComPASS Program

Control and participating households were asked several questions focussing on their perceived opinions and attitudes towards the ComPASS program throughout the pilot study.

5.2.5.1 ComPASS Program Participation Influences

Both control and participating households were asked to rank seven reasons in order of the strongest (1) to weakest (7) reason their household would participate in a possible future ComPASS program. The options were either 1) better bike routes, 2) higher gas prices, 3) price of ComPASS, 4) improved transit service, 5) increased traffic congestion, 6) nothing, or 7) other. Figure 5.18 displays the average ranking that participating households gave for each option between the pre, mid, and post pilot surveys (survey 1, 2, and 3, respectively).

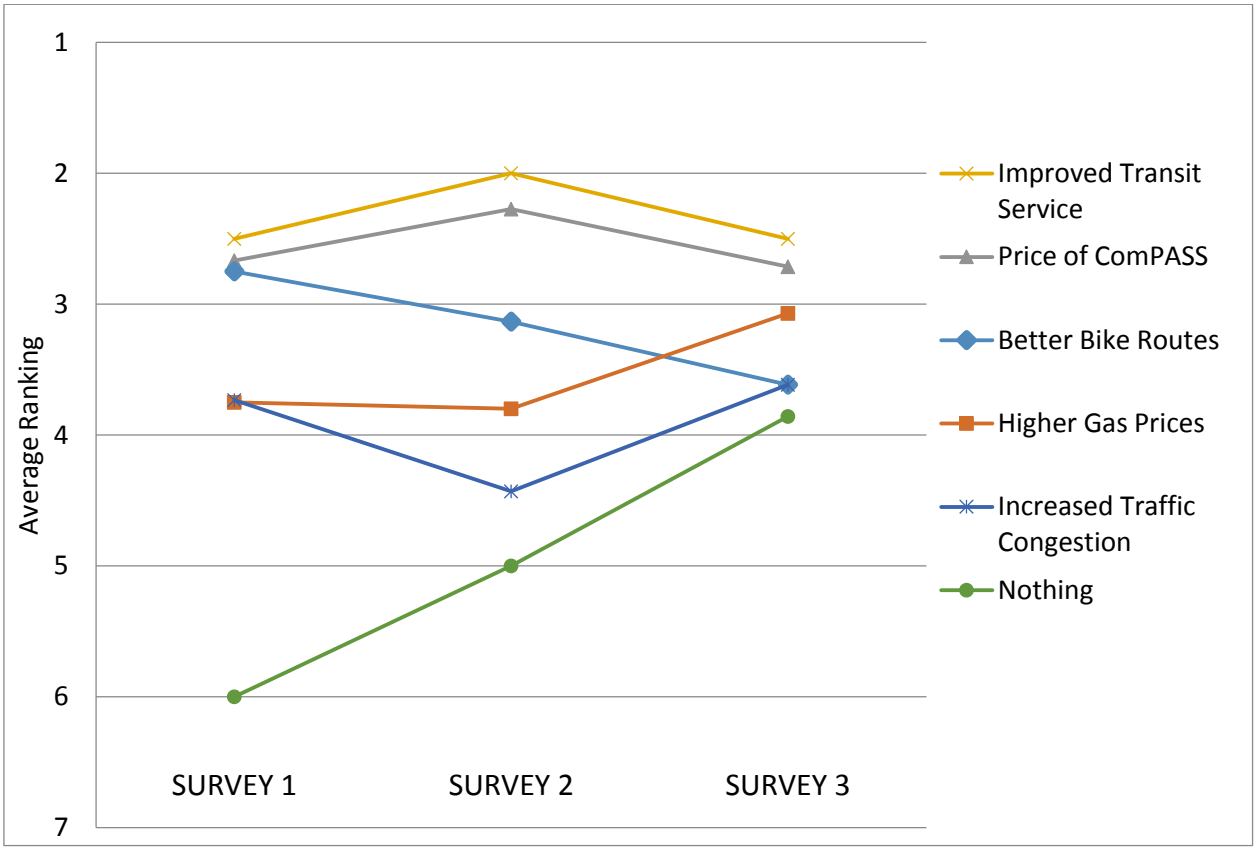

Figure 5.18 Influences to participate in the ComPASS program (participating households)

In all three surveys, improved transit service was the highest ranked option, while nothing was ranked the lowest. In all three surveys, the second highest ranked option was the price of ComPASS. During the pilot study, participating households increased their average ranking for improved transit service as an influencer to participate in the ComPASS program (in survey 2). This suggests that participating households may have become more aware of the service in their area due to more use of the system, and began to understand that the level of service must improve before they would use a ComPASS. The fact that the price of ComPASS was ranked the second highest priority in all three surveys also shows that in general, residents would like to participate in the program, but participation may strongly depend on the price of the program. However, a lower price could be a trade-off for poor service and vice versa. "Nothing" was ranked last in all three cases, suggesting that residents are willing to participate in general, given there are changes in transportation characteristics in Kelowna (improved bike routes, transit service, or higher gas prices and increased traffic congestion). In surveys 1 and 2, better bike routes was ranked as third. However, this decreased to about fifth highest (tied with increased traffic congestion) by the third survey. This may have been a result of residents experiencing the ComPASS, and finding that better bike routes would not have a strong impact on their participation in the program. The higher gas prices option remained fairly constant between surveys, remaining either as the fourth or third most

influential reason to participate in a ComPASS program. In the third survey, higher gas prices and price of ComPASS were ranked third and second, respectively, suggesting that cost plays a large role in potential participation in a ComPASS program. Overall, although participants had experienced more AT throughout the pilot study, they discovered that it would take more incentive to use AT modes, and to therefore participate in the ComPASS program. This reinforces the concept that price could strongly affect participation rates.

Figure 5.19 shows the average ranking that control households gave for each option between the pre, mid, and post pilot surveys (survey 1, 2, and 3, respectively).

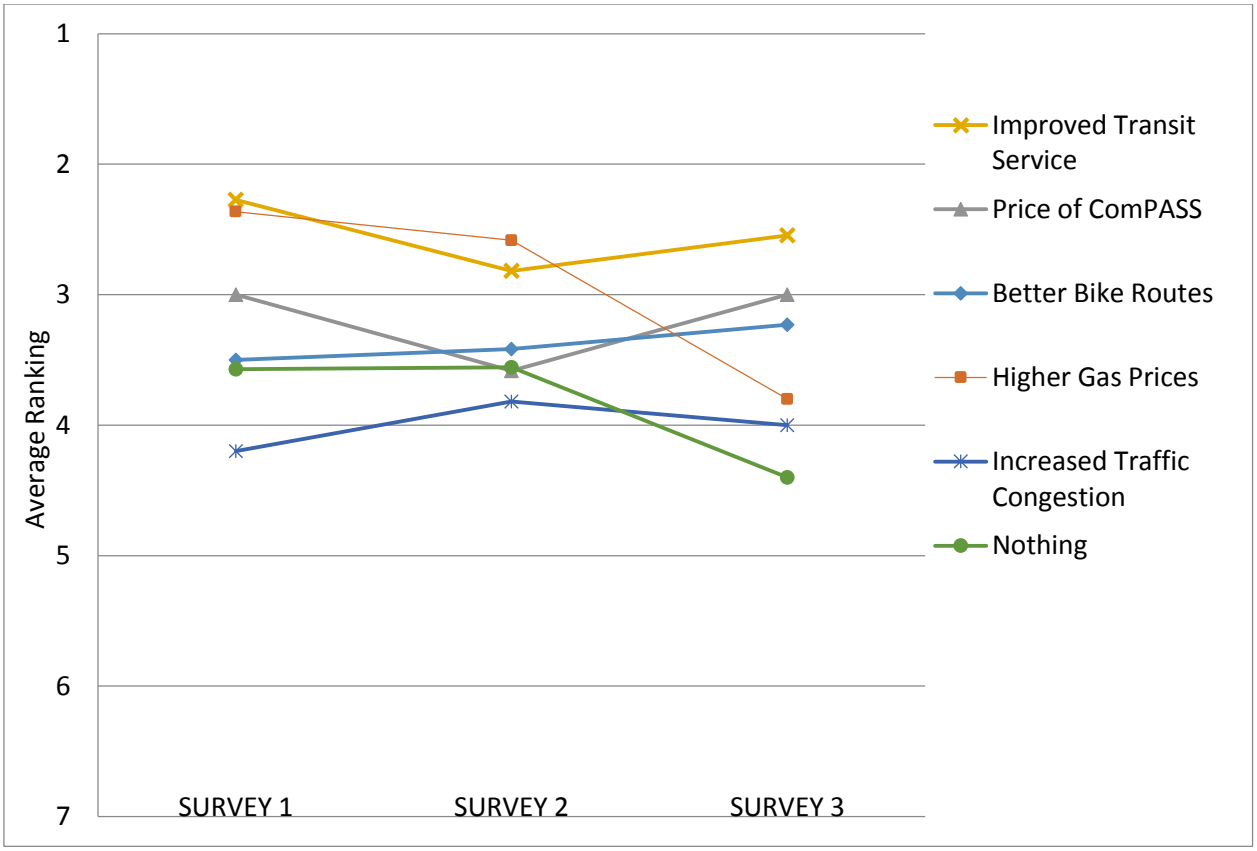

Figure 5.19 Influences to participate in the ComPASS program (control households)

Comparing Figure 5.18 and Figure 5.19 suggests that the control group and participating group have some different and some similar priorities for which aspects could influence them to participate in a ComPASS program. In surveys 1 and 2, the control households ranked higher gas prices as second and then first, respectively. This may show that the control group may be less environmentally conscious than the participating group. However, improved transit service was ranked first in surveys 1 and 3, and one of the top options in survey 2. This shows that improved transit service is the strongest influencer for both control and participating groups, and would be necessary for the success of a future program. By the end

of the pilot study, control households ranked the price of ComPASS as the second strongest influence for participating in a ComPASS program. By survey 3 (after the completion of the pilot program), improved transit service, price of ComPASS, and better bike routes were ranked as the first, second, and third highest influences, respectively. In contrast, higher gas prices, increased traffic congestion, and nothing were ranked as the lowest influences. These attitudes may have changed since residents may have become more aware of the ComPASS program and its goals throughout the pilot study.

Overall these results suggest that improved transit service and the price of ComPASS play a major role in influencing residents to participate in a potential future program in their neighbourhood. Improved bike routes are also important, but some residents may not be aware of the existing routes and service levels available.

5.2.5.2 Participating Households' Perceived Success of a Future ComPASS Program

In all three surveys, participating households were asked whether they believed a ComPASS would be successful in the Glenmore area. Figure 5.20 displays the responses for participating households in surveys 1, 2, and 3.

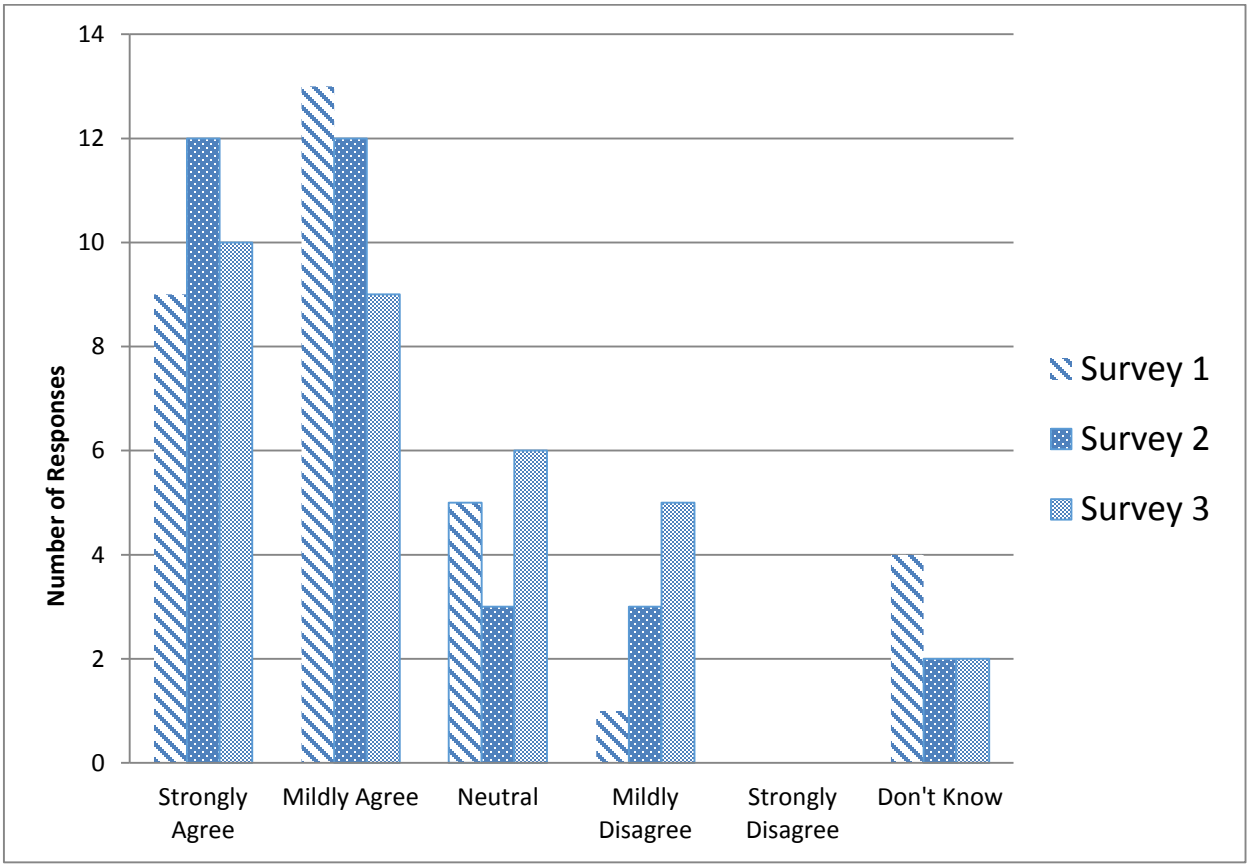

Figure 5.20 Would ComPASS be successful in the Glenmore area? (participating households)

In general, responses in surveys 1, 2, and 3 show that residents agree with the statement that they believe the ComPASS would be successful in Glenmore. From survey 1 to survey 3, optimism for the program tended to decrease, which could have been a result of residents realizing that they would not use some components as regularly as previously thought. However, households generally believed that the ComPASS would be successful in Glenmore. This shows promise and that there is potential for success in the Glenmore area.

5.2.5.3 How Behaviours are Believed to Change if Households Owned a ComPASS

Both control and participating households were asked several questions regarding how they believe their walking, biking, and transit use would change as a result of the ComPASS program. Questions discussed in this section include:

- Would your household walk more if you owned a ComPASS?
- Would your household bike more if you owned a ComPASS?
- Would your household take transit more if you owned a ComPASS?
- How many less car trips as the driver and car trips as the passenger would your household take if you owned a ComPASS?
- How many more walking, biking, and transit trips would your household take if you owned a ComPASS?
- Respond with “Strongly Agree”, “Agree”, “Neutral”, “Disagree”, “Strongly Disagree”, or “Don’t Know” to the statement: My household uses transit more after the pilot study compared to before the pilot study.

Figure 5.21 displays households’ responses to whether they believed their household would walk more if they owned a ComPASS.

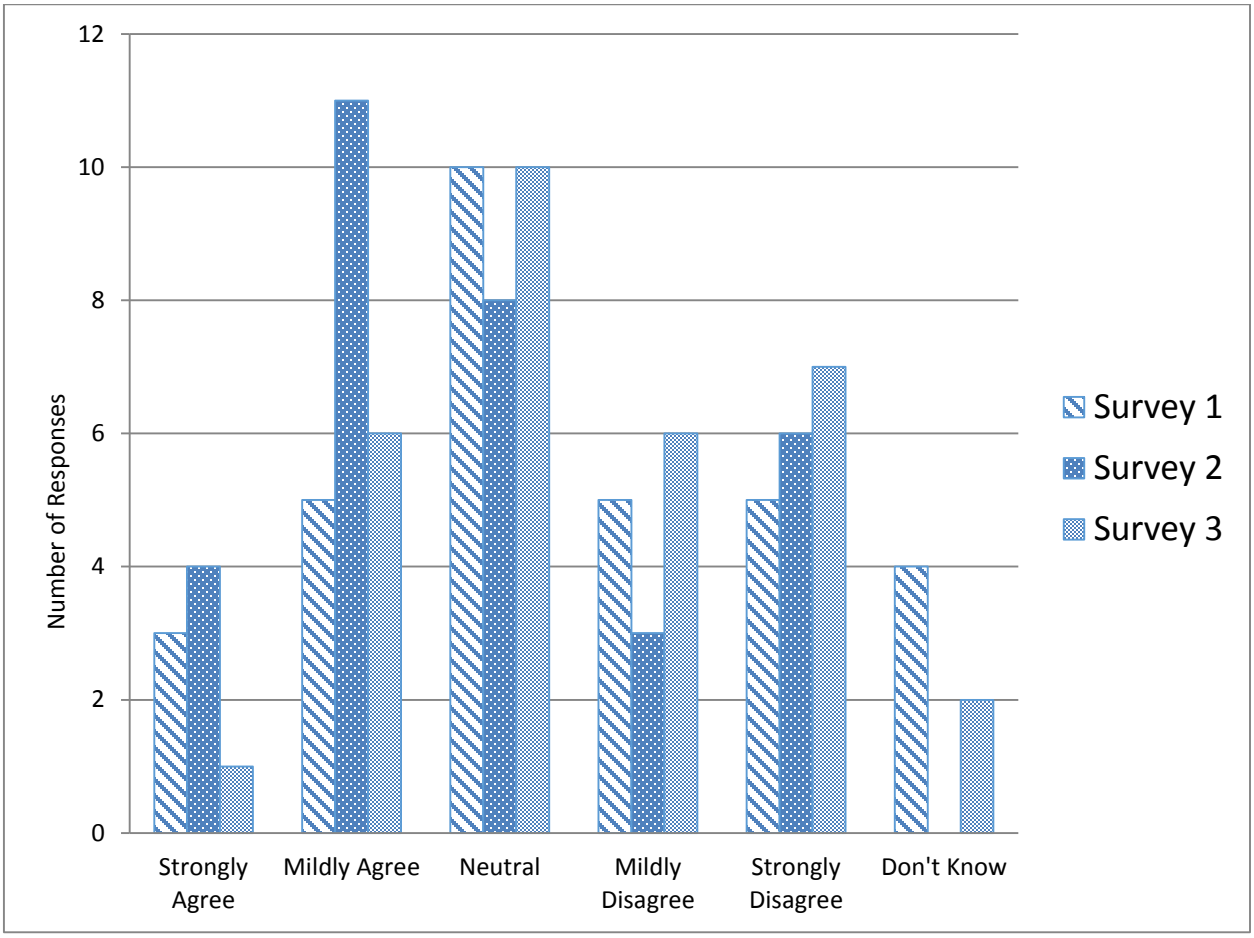

Figure 5.21 Would your household walk more if you owned a ComPASS? (all households)

Results suggest that in survey 1, households were mostly neutral about the statement, but by survey 2, more residents mildly agreed that they would walk more if they owned a ComPASS. In survey 3, however, responses generally reverted back to responses given in survey 1, where most residents were neutral. This change could be because as more residents were able to contemplate the ComPASS program throughout the pilot study period, they were able to give a more informed response to the question.

Figure 5.22 displays households' responses to whether households believed they would bike more if they owned a ComPASS.

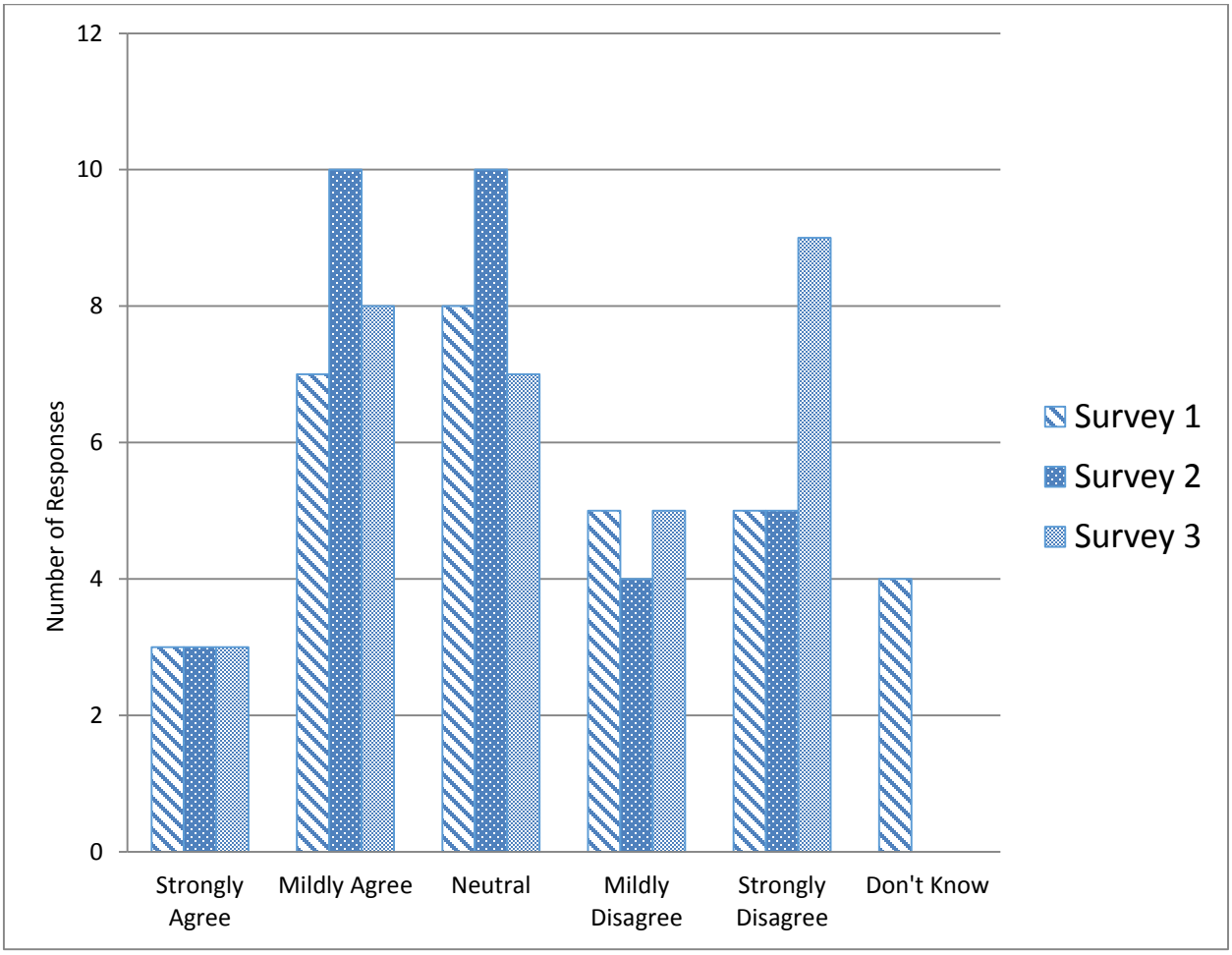

Figure 5.22 Would your household bike more if you owned a ComPASS? (all households)

In survey 1, households were generally equally distributed between agreeing and disagreeing with the statement. By survey 2, residents were more inclined to mildly agree or be neutral on the statement. By survey 3, the majority of residents said that they strongly disagree that their households would bike more if they owned a ComPASS. Again, this change in opinion through surveys could be a result of more understanding throughout the pilot program what the ComPASS program entails. By survey 3, households may have experienced that the ComPASS would not strongly influence their cycling patterns.

Figure 5.23 displays households' responses to whether they would take transit more if they owned a ComPASS.

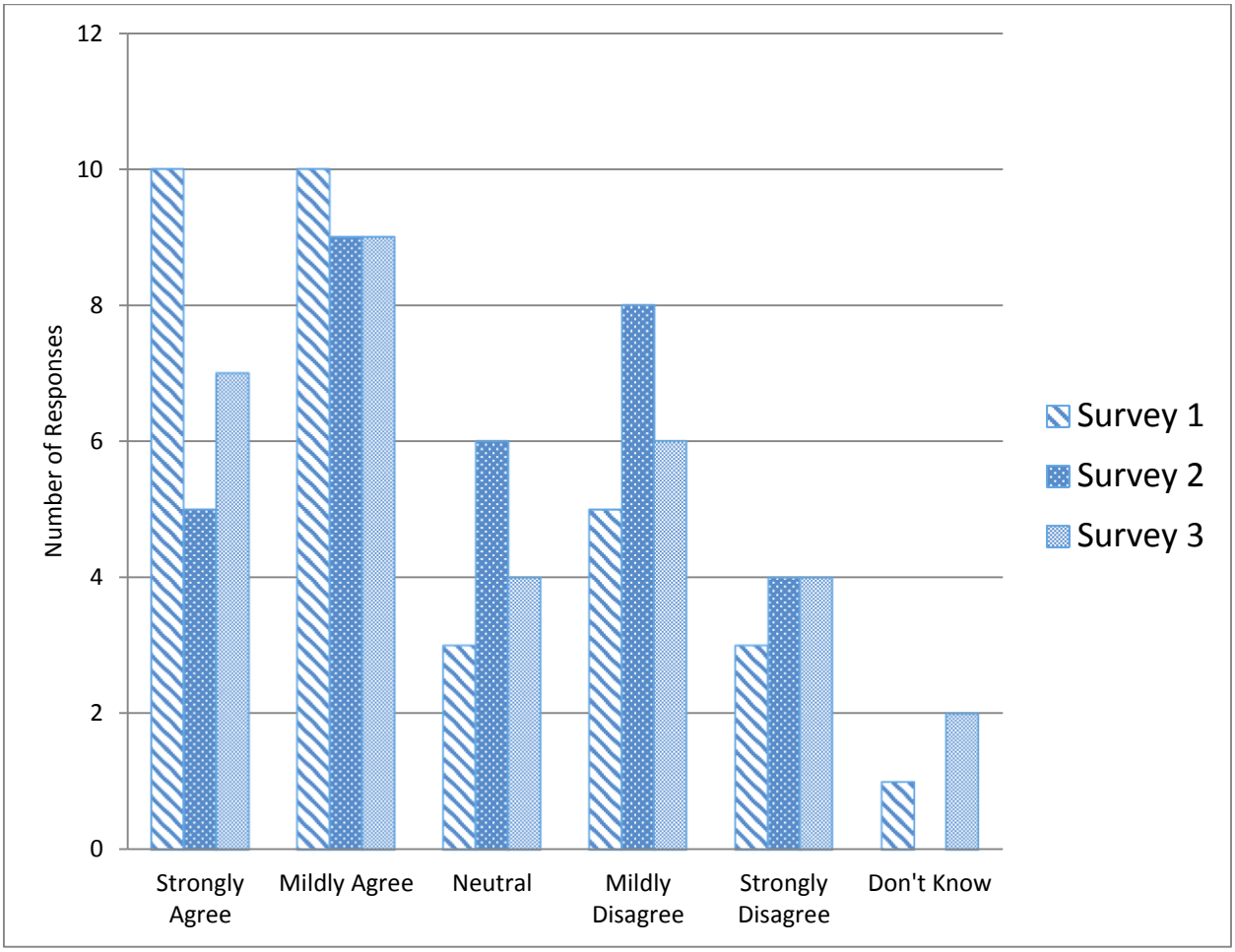

Figure 5.23 Would your household take transit more if you owned a ComPASS? (all households)

Overall, it appears as though residents would use transit more if they owned a ComPASS. In survey 1, residents were more likely to agree that they would take transit more. However, in survey 2, this changed and more residents changed their responses to disagree with the statement. By survey 3, more residents were agreeing with the statement, but not as strongly as in survey 1. The reduced agreement between survey 1 and survey 2 could have been a result of experiencing transit service as a result of the pilot program, and realizing that it was too inconvenient for household needs.

In survey 3, all 32 households were also asked whether they believed their household used transit more after the pilot study completed compared to before the pilot study started. The results of this question are displayed in Figure 5.24.

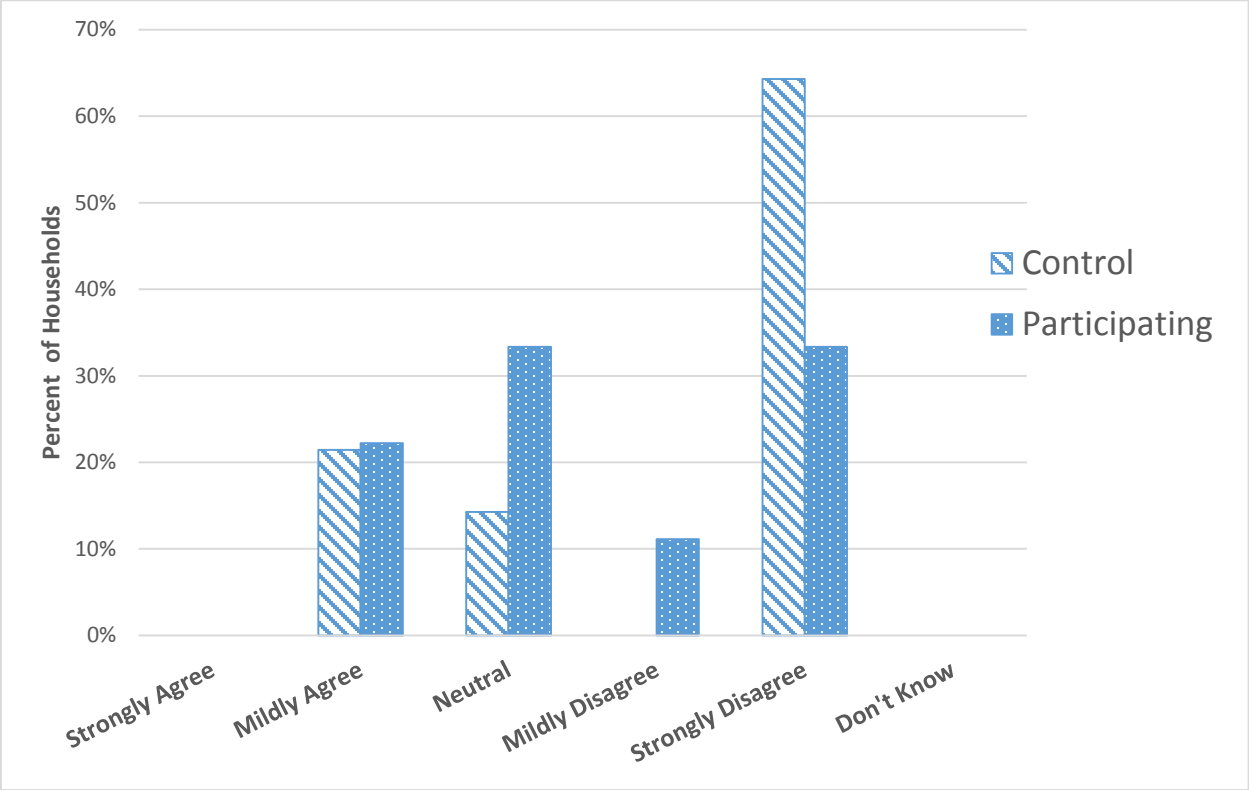

Figure 5.24 My household uses transit more after the pilot study compared to before the pilot study

Overall, results suggest the majority of control households strongly disagree with this statement. Many of the participating households also strongly disagreed and were neutral with the statement. About the same number of control and participating households mildly agreed with the statement, which shows that there was no real difference between the two groups. This suggests that without significant transit improvements, the discontinued pilot ComPASS would not have lasting effects on transit use. Therefore, an ongoing ComPASS program would need to influence residents to use transit more often.

5.2.5.4 How ComPASS Affected Households' Perceived Overall Health

To determine if the ComPASS had any effect on health, both control and participating households were asked if they agreed that the overall physical health of their household improved after the pilot study compared to before the pilot study started. Results of this question are shown in Figure 5.25.

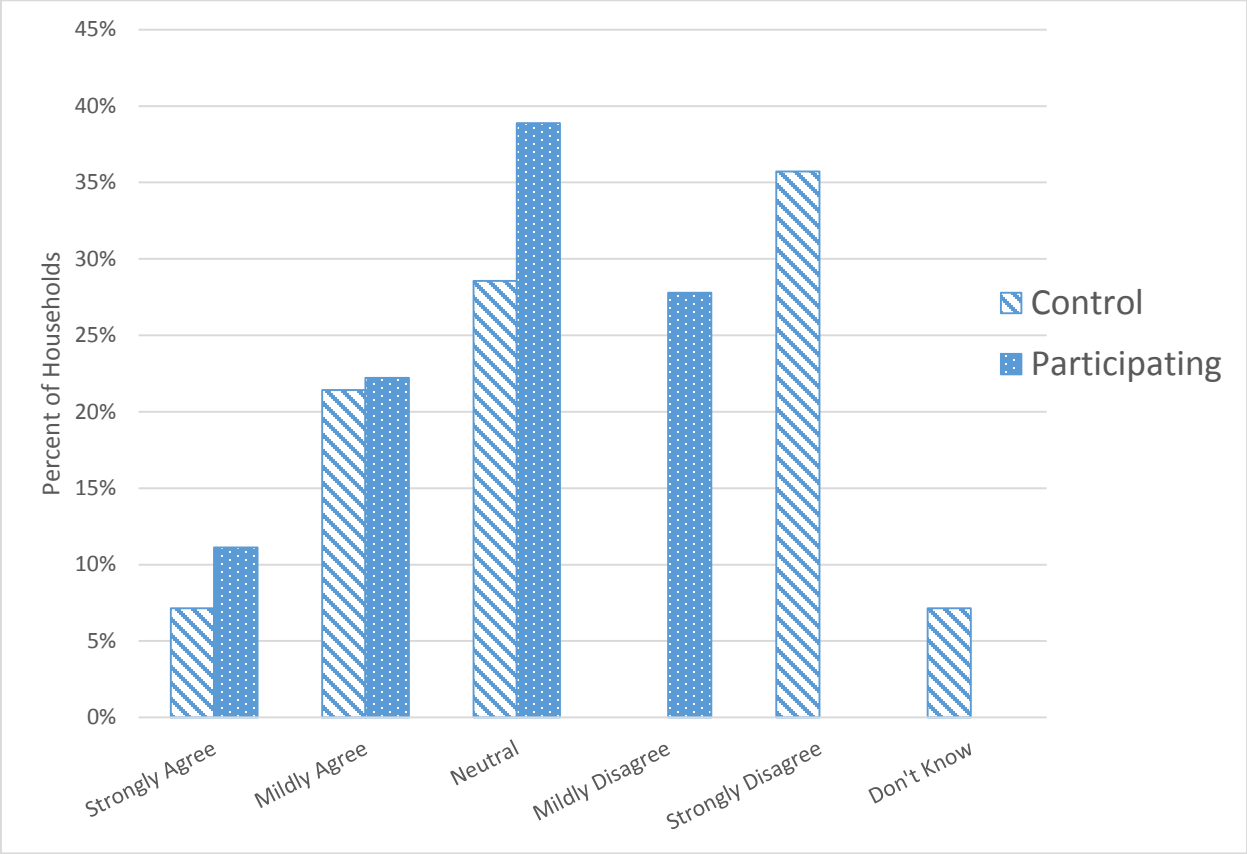

Figure 5.25 Whether ComPASS affected overall household physical health

Overall, just over 35% of control households and 28% of participating households disagreed with the statement. In contrast, 28% of control households and 33% percent of participating households agreed. The remainder were neutral. Overall, participating households tended to agree with the statement more than the control households, however, the results are inconclusive whether these responses were particularly as a result of the ComPASS program, as there could be multiple outside factors. Therefore, detailed health impacts due to the ComPASS program is a recommended point for future research.

5.2.5.5 New, Fun, and Interesting Experiences through the ComPASS Program

Participating households were asked to describe any new, fun, and interesting experiences they encountered as a result of the ComPASS program. Some responses included:

- Taking the bus to go swimming was fun – my children loved riding the bus;
- Enjoyed family dinner at de Bakker's Kitchen – we would go again;
- Enjoyed being able to move about the city and explore, transferring as needed. Met new people and great bus drivers;
- Enjoyed trying de Bakker's Kitchen;

- Enjoyed having exposure to UBC Okanagan transportation studies and deliberations, meeting Ellen Morrison, making me more aware of infrastructure needs and utilization. Probably would not have gone to de Bakker's Kitchen without the incentive and got acquainted with business operators;
- Kids got to ride the bus a few times on the way home which they really enjoyed;
- Seeing more of the neighbourhood, getting outside walking, taking the bus just to enjoy the company rather than be worried about driving;
- Taking the bus when we usually would drive – felt like an adventure;
- The kids especially liked the recreation centre pass. We all loved de Bakker's Kitchen;
- We love eating at de Bakker's Kitchen;
- We rode the bus to the library and our kids loved it. They want to do it on a regular basis. We loved the gift cards and used them all; and
- Went on nice bike rides and took the bus farther than ever before.

These comments suggest that participating households' children particularly enjoyed taking the bus. This shows potential for creating life-long transit users by creating a positive image of the system at a young age. The ComPASS also provided a means for more communication and socialization between families and among community members. This supports the notion that the ComPASS can help to build a stronger sense of community – through partnering with local business owners, creating meaningful discourse on transportation issues in the community, encouraging residents to meet new people and bus drivers while taking transit, and by being outside and interacting with neighbours and other AT users. The de Bakker's Kitchen merchant incentive was also favourably perceived by residents, which strongly suggests this, or a similar, component should be included in a future ComPASS program if possible.

5.2.6 Recommended ComPASS Design

To design a permanent ComPASS program in the City of Kelowna, several main areas were analyzed, including:

- Resident participation levels;
- ComPASS components;
- ComPASS package pricing;
- Implementation strategy; and,
- Households' comments and suggestions.

These five main areas were assessed to create an overall design of a possible future permanent ComPASS program in the Glenmore neighbourhood in Kelowna.

5.2.6.1 Resident Participation Levels

In all three surveys, both the control and participating households were asked if they would use a ComPASS if a permanent program was offered in their neighbourhood. Figure 5.26 shows whether households strongly agreed, mildly agreed, mildly disagreed, strongly disagreed, were neutral, or didn't know.

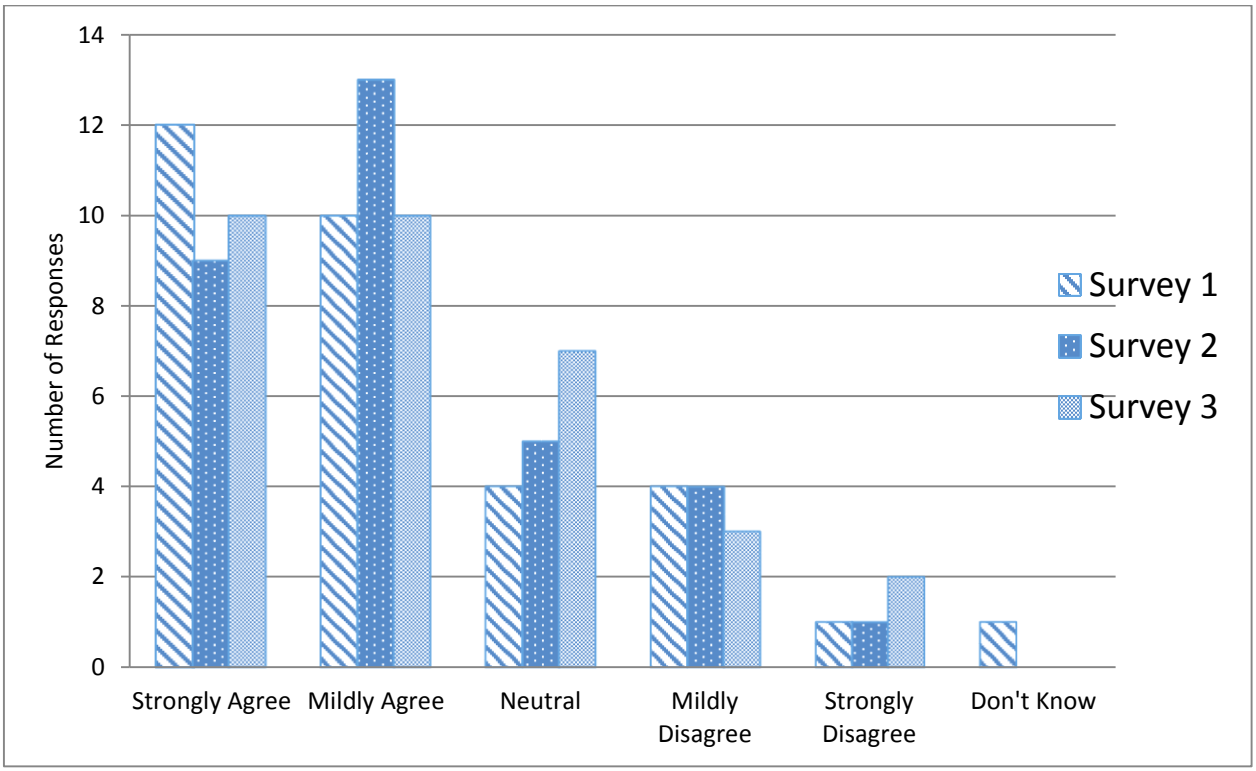

Figure 5.26 My household would use a ComPASS if a program was offered (all households)

Overall, most households said they would use a ComPASS. This suggests that the program could be well used in the pilot study neighbourhood if ComPASS was implemented permanently.

Households were also asked if they would be willing to support a ComPASS program financially if a program was implemented permanently in their neighbourhood. Figure 5.27 displays the results of this question.

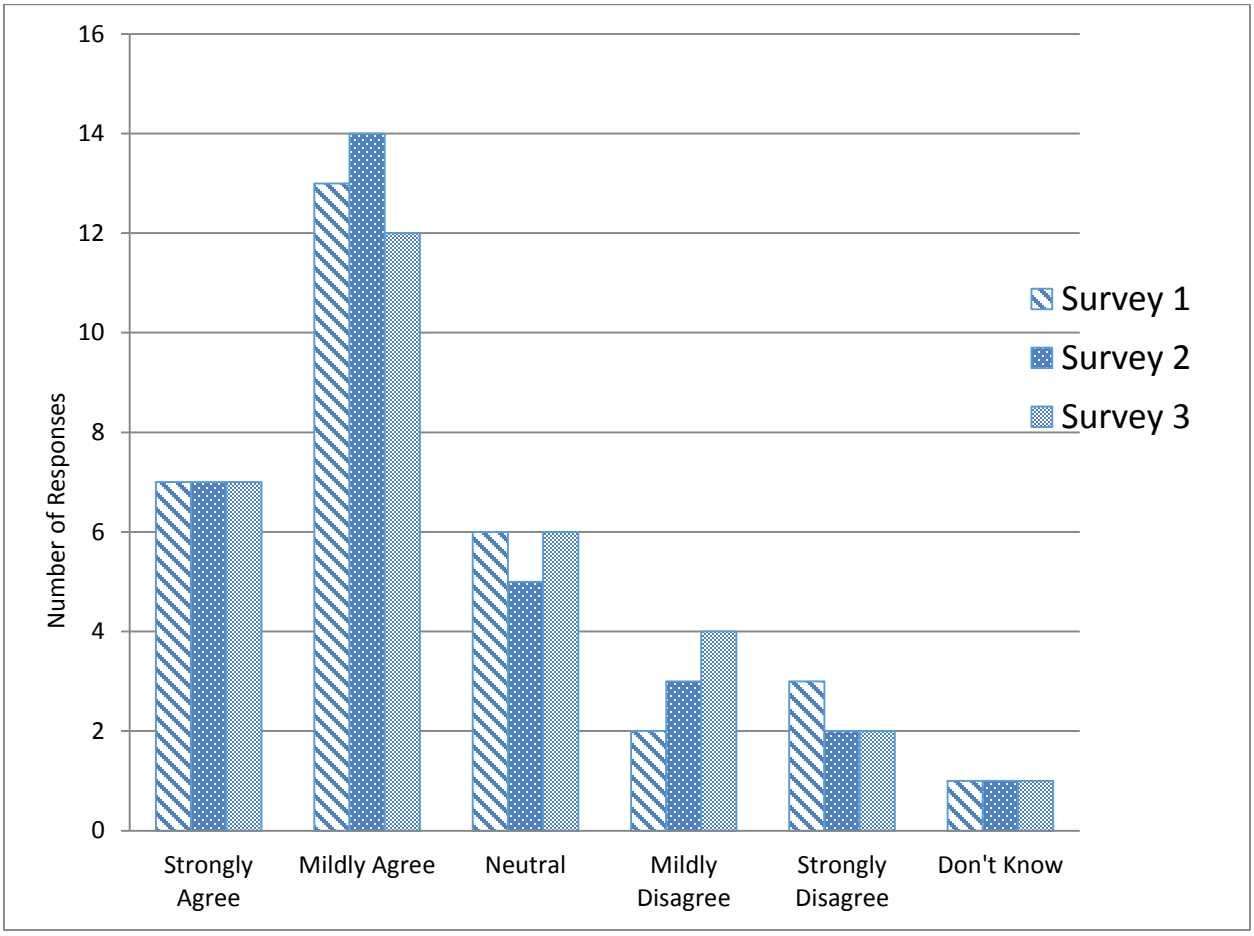

Figure 5.27 My household would support a ComPASS program financially (all households)

Most households said they would contribute financially. This suggests that the program could be financially viable in the pilot study neighbourhood if ComPASS was implemented permanently.

In survey 3, households were also asked whether their household would participate in a permanent ComPASS program if one was implemented in their neighbourhood. The results of the control and participating groups combined showed that 50% of all households said they would participate, while 44% said they would not. The remaining 6% said they would maybe participate. If residents responded "No" to whether they would participate in a future permanent ComPASS program, they were asked to explain why. Table 5.39 shows the reasons control group households said they would not participate in a future ComPASS program, categorized into three areas: transit service, price, and existing behaviours.

Table 5.39 Reasons control households would not participate in a ComPASS program

Transit Service	Price	Existing Behaviours
• We work nights and walking to a bus from my job would not be that safe. • Because the way transit operates is inefficient on the customers' time and is therefore not a viable alternative to using a car. • We have young kids and not in the season of life right now to take the bus. • I don't like waiting for the bus and I'm not sure of the routes.	• Depends on the price. Would have to be cheap enough. Overall, it is closer to a "No" than a "Maybe". It would also depend on how convenient and what gym or pool is included. At the Capital News Centre it is $20 per month for seniors and retirees for the gym and track between 9am and 3pm. • It would depend on the cost. I already have a gym membership so not interested in the Parkinson Recreation Centre.	• Not interested. • We wouldn't use the recreation centre, we do not cycle, and due to mobility issues, need to take a vehicle door to door. • We have established our transportation methods over the years, actively working in alternate modes already, mainly walking or biking. We think it is a good program but we always have done this naturally without the ComPASS.

Four of eight control households in the control group who said they would not participate in a permanent ComPASS program believed that transit was too inconvenient for their needs. For two households, it strongly depended on the price of the ComPASS. Three households were simply not interested due to their current lifestyle requirements. Table 5.40 below outlines the reasons why the five households from the participating group said they would not participate in a permanent ComPASS program if one was implemented in their neighbourhood.

Table 5.40 Reasons participating households would not participate in a ComPASS program

Transit Service	Existing Behaviours
• For us it isn't convenient as we are often taking sports equipment and there are too many time restrictions to using transit. • If transit was more convenient our household would take it – but we could walk to downtown or Glenmore faster than taking transit. Improved bike paths to all areas would encourage all to ride their bikes more. • Not convenient.	• Our own means of transportation (walk, bike, motorbike, or car) are more convenient to us at this time. • We work out of town and my main concern is a tight time schedule so I use my car. As well I'm not aware of transportation to my workplace so therefore I drive to and from work. It's all about time and my parking is covered in my work contract. • We see no need to require a "pass" for biking or walking. Parkinson Recreation Centre is not our gym. We prefer to be self-sufficient. We don't use transit very much because it takes the same amount of time just to ride bikes around.

The main theme behind two of five participating households' reasoning for not participating in a permanent Glenmore ComPASS program is the inconvenience of taking transit in their neighbourhood. Two other participants even felt that walking or biking was more efficient than taking transit. This reinforces the fact that transit service in Glenmore needs to improve to not only ensure the success of

ComPASS, but to simply increase transit ridership in Kelowna. Furthermore, unlike the control households' responses, the participating households did not indicate that price was a barrier to participation. It is apparent that the main barrier to using transit in Glenmore (at least according to residents in the phase 2 pilot study) is not that residents do not want to use the service, but the fact that it is too inconvenient. This suggests that more than just a bus pass is required to change behaviours – components including deep discounts and other privileges combined with improved service and infrastructure are also needed.

5.2.6.2 ComPASS Components

To understand the potential of the piloted ComPASS components, their usage and resident satisfaction with each were explored. The analysis of these components helped to better gauge which components should be included in a potential future permanent ComPASS program.

5.2.6.2.1 Parkinson Recreation Centre Passes

To determine if the Parkinson Recreation Centre pool and gym use should be included in a future ComPASS package, satisfaction and usage were monitored for both facilities.

5.2.6.2.1.1 Parkinson Recreation Centre Usage

Table 5.41 below shows the number of times the control and participating households used the Parkinson Recreation Centre gym pass in the week leading up to the pre, mid, and post surveys.

Table 5.41 Parkinson Recreation Centre gym pass usage

Survey	Control Households	Participating Households	All Households
Pre	8	4	12
Mid	7	8	15
Post	3	0	3

Use of the Parkinson Recreation Centre gym was very low, especially for participating households considering they were provided complementary access to the facility during the mid-survey.

Table 5.42 below shows the number of times the control and participating households used the Parkinson Recreation Centre pool facility in the week leading up to the pre, mid, and post surveys.

Table 5.42 Parkinson Recreation Centre pool pass usage

Survey	Control Households	Participating Households	All Households
Pre	3	38	41
Mid	7	27	34
Post	7	6	13

There was higher usage of the Parkinson Recreation Centre pool pass component compared to the gym component at the same facility. Providing the pass to the participating households during the midpoint survey did not seem to encourage increased use, which could have been a result of improved weather and activities occurring during summer months. Although ComPASS did not increase usage, the Parkinson Recreation Centre pool pass was relatively well used and could help make a ComPASS package more attractive for potential participants.

5.2.6.2.1.2 Parkinson Recreation Centre Satisfaction

Participating households were asked to rank their satisfaction with the Parkinson Recreation Centre pool and gym facilities in both survey 2 and survey 3, while control households were asked in survey 3 only. Table 5.43 below shows the combined average satisfaction ranking the control and participating households gave the Parkinson Recreation Centre gym and pool facilities.

Table 5.43 Satisfaction rankings for the Parkinson Recreation Centre gym and pool pass

Facility	Control Households	Participating Households
Gym	7.0	7.1
Pool	7.1	8.2

Overall, the rankings are high (1 = very unsatisfied while 10 = very satisfied), which shows there is fairly high satisfaction with both facilities. The pool was given a higher satisfaction rank, and was also used more throughout the pilot study than the gym by both the control and participating households. The 1) high satisfaction with the Parkinson Recreation Centre pool component and 2) no increase in pool use resulting from the ComPASS means there could be low additional costs incurred on the Parkinson Recreation Centre (through minimal increased capacity and associated maintenance requirements) if it was included in a future ComPASS program. Consequently, it is recommended that a Parkinson Recreation Centre pool pass is offered in a future ComPASS program in the pilot study neighbourhood.

5.2.6.2.2 Bike Tune-ups

In survey 1, residents in both the control and participating households stated that they give their bikes 52 tune-ups combined per year in total. This averages to about 1.6 tune-ups per household per year. However, during the 3 month pilot study, 54 bike tune-ups were completed. This demonstrates that

residents may have under reported the number of tune-ups they give their bikes per year or that most of bike tune-ups occur during the spring and summer.

Table 5.44 below shows the percent of control and participating households that went to Kelowna Cycle since the last survey.

Table 5.44 The percent of households that went to Kelowna Cycle (all households)

		YES	NO
Survey 2 (Been to Kelowna Cycle since May 1)	**Control**	14.3%	85.7%
	Participating	22.2%	77.8%
Survey 3 (Been to Kelowna Cycle since the last survey)	**Control**	7.1%	92.9%
	Participating	16.7%	83.3%

The reason a higher percentage of participating households had gone to Kelowna Cycle than the control households was likely due to the Kelowna Cycle incentive included as part of the ComPASS package. Two control households went to Kelowna cycle since the pilot study started and four participating households went to Kelowna cycle since the pilot study started.

In total, over 70 free Kelowna Cycle bike tune-ups were distributed to participating households (one for each reported bike). Even though participating households were given free Kelowna Cycle bike tune-ups, only 14 tune-ups were used by participating households during the pilot study. Therefore, only 20% of the free bike tune-ups were actually used. Of the 18 participating households, the 14 used Kelowna Cycle bike tune-ups were used by 4 households, which means that 22% of the total number of participating households actually used some of their tune-ups. Only one household used the offered 10% discount at Kelowna Cycle during the pilot study. Table 5.45 shows the number of bike tune-ups that were completed either at Kelowna Cycle, by households themselves (personally), or by other bike shops by survey 2 and survey 3.

Table 5.45 Bike tune-ups conducted throughout the pilot study (participating households)

Survey 2			**Survey 3**		
Number Completed at Bike Shop (Not Kelowna Cycle)	**Number Completed Personally**	**Number Completed at Kelowna Cycle**	**Number Completed at Bike Shop (Not Kelowna Cycle)**	**Number Completed Personally**	**Number Completed at Kelowna Cycle**
3	15	11	3	9	3

Overall, 55.6% of all bike tune-ups were completed personally by participating households, 13.6% were completed by a bike shop other than Kelowna Cycle, and 31.8% were completed at Kelowna Cycle. This

shows that even though these households were given the opportunity to use their free bike tune-up component from Kelowna Cycle, many tune-ups were still done personally since the start of the pilot study. Also, six bike tune-ups were done at other bike shops despite the availability of free tune-ups from Kelowna Cycle.

In survey 2, the average participating household satisfaction ranking (where 1 is very unsatisfied and 10 is very satisfied) with Kelowna cycle was 8.3. In survey 3 this average satisfaction ranking increased to 8.9. This signifies that the overall contentment with the Kelowna Cycle component was satisfactory. In contrast, control households ranked Kelowna Cycle as 8.0 in survey 3. Overall, Kelowna Cycle was highly ranked and participating households were generally satisfied with bike tune-ups at Kelowna Cycle. Therefore, it is recommended that bike tune-ups from a bike shop, such as Kelowna Cycle, should be included in a future ComPASS program as a result of the high satisfaction and the reasonable use rate.

5.2.6.2.3 Merchant Discounts (Glenmore Marketplace IGA and de Bakker's Kitchen)

Local merchant incentives (in this case merchant gift certificates and coupons) proved to be an excellent addition to the ComPASS. Nearly all participating households used all gift certificates from de Bakker's Kitchen and the Glenmore Marketplace IGA, and ranked their satisfaction with these components very high.

5.2.6.2.3.1 de Bakker's Kitchen Merchant Incentive Use

According to the final survey results, 50% of control households went to de Bakker's Kitchen since the pilot study started even though they were not provided with an incentive, while 72% of participating households did. Overall, 64% of the entire worth distributed in de Bakker's Kitchen coupons and gift certificates were actually used.

The average satisfaction (where 1 is very unsatisfied and 10 is very satisfied) with de Bakker's Kitchen amongst participating households was 9.9 in survey 2 and 8.6 in survey 3, which gave an overall ranking of 9.1. Furthermore, 82% of participating households said that having the de Bakker's merchant incentive encouraged their household to use AT as since it was located within walking distance. In survey 3, control households provided an overall ranking of 7.8 for de Bakker's Kitchen. The overall satisfaction with de Bakker's Kitchen was good even for the control households who were not provided with a de Bakker's Kitchen incentive during the pilot study.

The high level of satisfaction and usage of the de Bakker's Kitchen incentive demonstrated the popularity of the restaurant and potential for inclusion in a future ComPASS package. Unfortunately, the de Bakker's Kitchen restaurant is now closed, so other similar merchants (e.g. restaurants, coffee shops, etc.)

located within walking distance would likely be popular and should be included in a potential future ComPASS package.

5.2.6.2.3.2 Glenmore Marketplace IGA Merchant Incentive Use

93% of control households went to IGA since the pilot began compared to 83% of participating households who used their IGA gift certificates. More participating households may have gone to IGA, but did not remember to use their gift certificates. By the end of the pilot study, 83% of participating households had used some portion of their Glenmore Marketplace IGA coupon, while only 72% of households used the entire $65 amount. Overall, 80% of the entire amount of IGA gift certificates distributed was actually used throughout the pilot study.

In survey 2, participating households ranked their satisfaction with IGA as 8, and ranked their satisfaction as 9.4 in survey 3. This gave an overall ranking of 8.9 for participating households. In survey 3, control households ranked IGA as 7.9, which is lower than participating households. The overall sense was that residents in the pilot study area were generally satisfied with the Glenmore Marketplace IGA merchant. Therefore, a similar component, along with other possible merchant incentives located close to the pilot study neighbourhood.

5.2.6.2.4 Emergency Taxi Ride Home Use

Throughout the pilot study, no emergency taxi rides home were used. Consequently, residents were not able to rank their satisfaction with the service. However, since this component provides a sense of security and peace of mind as found in the literature review (UBC TREK Program 2004), it is recommended that it is included in a future permanent ComPASS program.

5.2.6.2.5 ComPASS Component Usage Beliefs

Households were asked the following questions in the third ComPASS survey:

- Estimate how often household members would use ComPASS components if they were included in a future permanent ComPASS program?
- Would ComPASS components encourage your household to use AT (bike, walk, or take transit)?
- Would ComPASS components encourage your household to participate in a ComPASS program?

The results of these survey responses are discussed in subsections below.

5.2.6.2.5.1 Estimated ComPASS Component Usage

In survey 3, both participating and control residents were asked to estimate how often they thought each household member would use ComPASS components if they were included in future permanent ComPASS program. The average number of times used per control and participating household was calculated for each component, and the results are presented in Table 5.46. The average between all households (both control and participating groups) is also presented in Table 5.46. Each component is presented in either the number of times per week or per year depending on what was reasonable for each component.

Table 5.46 Estimated future ComPASS component usage (all households)

	Average Use per Control Household	Average Use per Participating Household	Total Average Use
Emergency Taxi Rides Home (per year)	1.2	1.4	1.3
Bike Tune-ups (per year)	2.1	2.3	2.2
Merchant Discounts (per week)	2.8	1.8	2.3
Pool Facility (per week)	2.6	4.6	3.8
Gym Pass (per week)	3.2	3.2	3.2
Transit Pass (per week)	2.9	5.1	4.1

Overall, it is apparent that households believe they would use each component to some extent if they were provided in a permanent ComPASS program. Understandably, the number of emergency taxi rides believed to be used is the lowest, as this is a component that is unpredictable and hopefully not often required. It is estimated that the transit pass would be used the most at over four times per week per household, followed by a pool facility pass at just under four times per week per household. Merchant discounts or incentives would also be used frequently at 2.3 times per week per household. Bike tune-ups would also be used substantially at about 2 bike tune-ups per household per year.

5.2.6.2.5.2 ComPASS Components that Encourage Active Transportation Modes

In survey 3, participating households were also asked whether piloted ComPASS components would encourage more AT (walking, biking, or transit use). This would mean, for example:

- Would having the gift certificate and coupon for de Bakker's Kitchen create an incentive for household members to walk or bike to or from the restaurant?
- Would having the Parkinson Recreation Centre pass mean that households took more biking or walking trips to its location?

- Would having the Glenmore Marketplace IGA gift certificate mean that households walked, biked, or took transit to its location?
- Would having the emergency taxi ride home component provide a peace of mind that encouraged household members to use AT knowing that they would have a quick way home if there was an emergency?

Table 5.47 shows the percent of participating households that responded yes, no, not applicable (N/A) or maybe for whether each ComPASS pilot study component would encourage their household to use more AT.

Table 5.47 ComPASS components that would encourage less vehicle use (participating households)

	de Bakker's Kitchen	Glenmore Marketplace IGA	Kelowna Cycle	Parkinson Recreation Centre	Emergency Taxi Rides Home
YES	82.4%	17.7%	11.8%	52.9%	23.5%
NO	11.8%	76.5%	64.7%	47.1%	35.3%
MAYBE	0.0%	0.0%	0.0%	0.0%	5.9%
N/A	5.9%	5.9%	23.5%	0.0%	35.3%

The Parkinson Recreation Centre component would encourage a higher percent of ComPASS households to use AT modes (52.9%). Based on the high reported usage of the pool facility combined with encouragement to use more AT modes, the Parkinson Recreation Centre pool component would be beneficial to include in a future permanent ComPASS program. Emergency taxi rides home did not encourage a high percent of AT use, but is an important component to provide peace of mind to ComPASS holders.

The de Bakker's Kitchen merchant incentive included in the pilot study would encourage over 82% of participating households to use AT to and from the location, which shows that including merchants in the same vicinity as de Bakker's Kitchen (at Glenmore Road and Mountain Avenue) in a permanent program strongly aligns with the values and goals of the ComPASS program. The Glenmore Marketplace IGA was accessible by transit from the pilot study neighbourhood but the component had limited influence on AT use. This is likely because 1) the Glenmore Marketplace IGA was located farther from the pilot study neighbourhood, and 2) many residents would prefer to transport groceries using personal vehicles. This could mean that specifically including a grocery store merchant incentive in a ComPASS program may not align with the values and goals of the ComPASS program. Therefore, including a grocery store merchant incentive as a core component of a future permanent ComPASS package in Glenmore is not essential, but would be welcomed if a grocery store merchant was willing to provide a discount to ComPASS users. Overall, for the specific pilot study location tested, there should be a focus on including

merchant incentives from the Glenmore Road and Mountain Avenue commercial area, which is accessible by walking and biking.

According to results, including Kelowna Cycle bike tune-ups in a ComPASS package would encourage the lowest percent of households to use AT modes, at 11.8%. Although there is lower encouragement to use AT, bike tune-ups help to support cycling safety in the community. Furthermore, satisfaction rates and usage for the bike tune-up component were reasonable. Therefore, the bike tune-up component would be beneficial to a ComPASS package, along with arranging bike tune-up workshops with the Kelowna Area Cycling Coalition (KACC) to encourage ComPASS users ensure their bikes are safe for use.

5.2.6.2.5.3 ComPASS Components that Encourage Participation

In survey 3 participating households were also asked whether each ComPASS component would encourage them to participate in a permanent Glenmore ComPASS program. Control households were not asked this question since participating households had experience with the components as part of the ComPASS pilot. Table 5.48 shows the percent of participating households who would be encouraged to participate in a permanent ComPASS program in their neighbourhood by each component. A total of 17 households responded to this question.

Table 5.48 Components that would encourage participating households to participate in ComPASS

Response	de Bakker's Kitchen	Glenmore Marketplace IGA	Kelowna Cycle	Parkinson Recreation Centre	Emergency Taxi Rides Home
YES	76.5%	76.5%	76.5%	88.2%	35.3%
NO	17.7%	23.5%	23.5%	11.8%	47.1%
MAYBE	5.9%	0.0%	0.00%	0.00%	17.7%

The Parkinson Recreation Centre, Kelowna Cycle, Glenmore Marketplace IGA, and de Bakker's Kitchen components would encourage the majority of participating households to participate in a future permanent ComPASS. In contrast, responses were fairly divided on whether the emergency taxi ride home component would encourage their household to participate.

5.2.6.2.6 Recommended ComPASS Components

Based on the analysis of piloted ComPASS component usage, satisfaction, believed future usage, potential to encourage AT, and potential to encourage ComPASS participation, the components in a potential future ComPASS program should include (in addition to the foundational transit pass component):

- Merchant incentives (with a focus on including merchants located near the old de Bakker's Kitchen location at Glenmore Road and Mountain Avenue along with other willing merchants throughout Kelowna);
- Bike tune-ups (a bike shop such as Kelowna Cycle should be included, as well as free bike tune-up sessions taught by local cycling groups),
- Pool facility pass (Parkinson Recreation Centre would be ideal due to close proximity to the neighbourhood); and,
- Emergency taxi rides home (a local taxi company should be recruited to participate to include a discount for program organizers when residents are reimbursed for their taxi rides).

5.2.6.3 ComPASS Package Pricing

The pricing for the ComPASS was broken down into six areas including 1) transit passes, 2) Parkinson Recreation Centre passes, 3) bike tune-ups, 4) merchant incentives, 5) emergency taxi rides home, and 6) administration. These six areas are described in subsections below.

5.2.6.3.1 Transit Passes

The total transit revenue from the 32 households surveyed was $2,002 per year based on the number of each transit pass type they said they purchased in a typical year. This equated to $62.07 per household per year (= $2,002 / 32 households), which is $5.21 per household per month (= $62.07 / 12 months) based on the community revenue neutral (CRN) model for 100% participation. Figure 5.28 displays how the unit price per household per month for transit passes would change as participation rates decrease within the surveyed households and if the transit authority requires an increase in revenue (0%, 25%, 50%, 75%, and 100% increases) for improvements to the existing transit service.

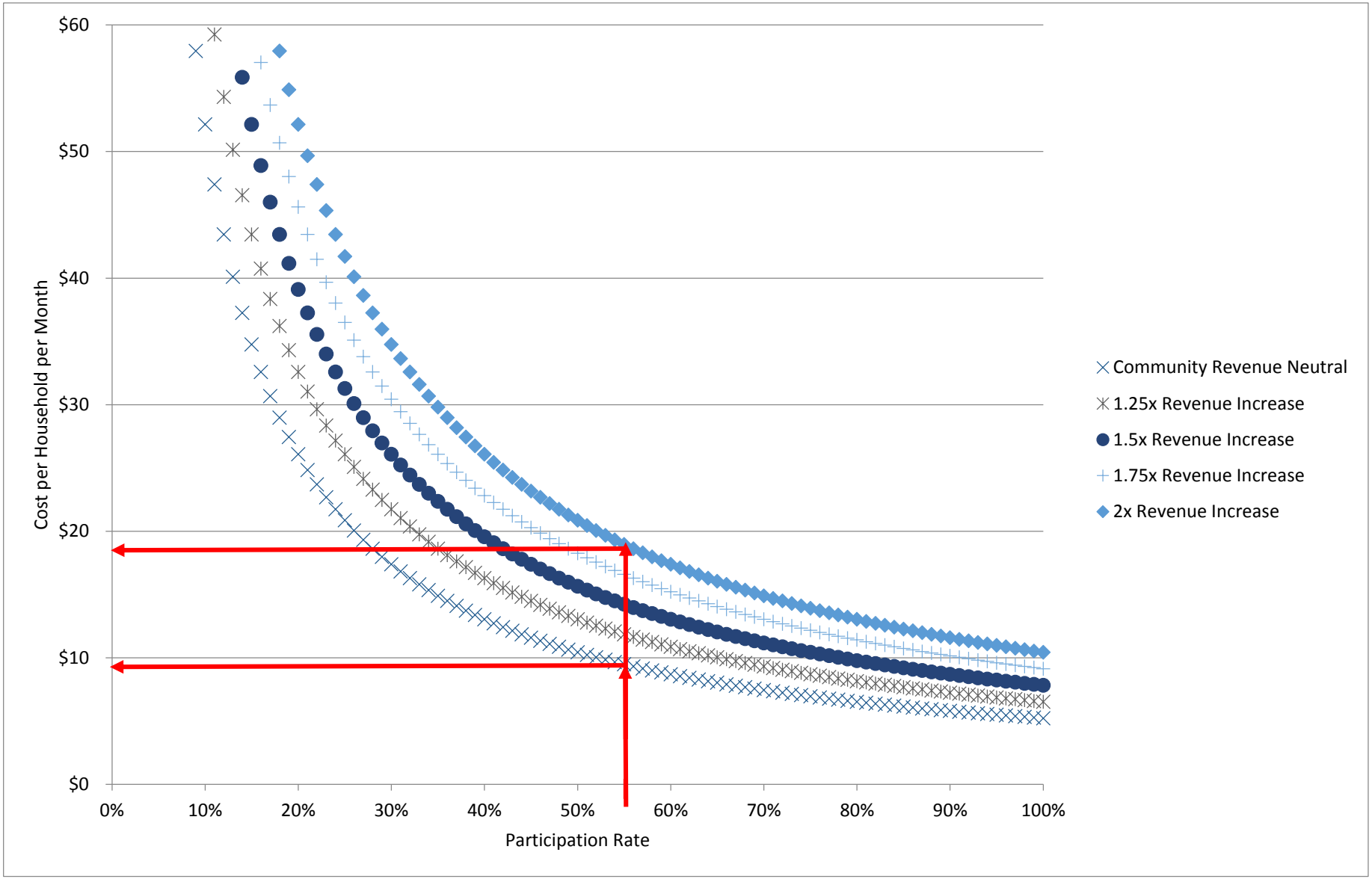

Figure 5.28 Potential costs for transit passes per household per month

Since the average participation rate for Boulder, Colorado's NECO pass is about 55% (Hagelin 2011b), and a similar participation rate occurred within the pilot study neighbourhood, a 55% ComPASS participation rate was assumed for the Glenmore community. In the worst case scenario, pricing for a 25% participation rate was also considered. Table 5.49 summarizes the transit pass costs per household per month assuming 100%, 55%, and 25% participation rates with different potential transit authority revenue increases (shown in Figure 5.28).

Table 5.49 Cost per household per month for transit passes

Participation Rate	Number of Households	Community Revenue Neutral	1.25x Revenue Increase	1.5x Revenue Increase	1.75x Revenue Increase	2x Revenue Increase
100%	32	$5.21	$6.52	$7.82	$9.13	$10.43
55%	18	$9.48	$11.85	$14.22	$16.59	$18.96
25%	8	$20.86	$26.07	$31.29	$36.50	$41.72

Assuming the CRN model (0% revenue increase), the cost per household per month with a 55% participation rate would be $9.48. Since residents in the pilot study area would generally like to see an improvement to transit service, there could potentially be a 50% increase in the transit price in efforts to improve transit service in the neighbourhood. Therefore, it could cost $14.22 per household per month for transit passes and improvements to transit service in their neighbourhood. The pricing could be increased even further depending on the transit authority's funding requirements to improve transit service for routes serving the ComPASS neighbourhood. Assuming a conservative participation rate of 25%, the cost per household per month increases considerably to $20.86 under the CRN model (0% revenue increase). With a 50% increase in transit services, the cost per household per month would be $31.29. However, due to Boulder, CO's NECO Pass average participation rates, it is assumed that a 55% participation rate could be achieved in the Phase 2 study area.

5.2.6.3.2 Parkinson Recreation Centre Passes

In survey 1, residents were asked to report the number of times their household typically goes to the Parkinson Recreation Centre in a typical week. This data was later separated between trips to the Parkinson Recreation Centre pool and the Parkinson Recreation Centre gym facility. Based on the reported times per week, the 32 pilot study households collectively spend about $408.26 per month at the Parkinson Recreation Centre pool facility, and about $151.03 at the gym facility. As discussed earlier, since residents rarely use the Parkinson Recreation Centre gym facility, a future ComPASS package would include a Parkinson Recreation Centre pool pass only. Figure 5.29 displays how the unit price per household per month for the Parkinson Recreation Centre pool would change as participation rates

decrease and if the Parkinson Recreation Centre requires an increase in revenue (0%, 25%, 50%, 75%, and 100% increases) for potential increased usage and maintenance.

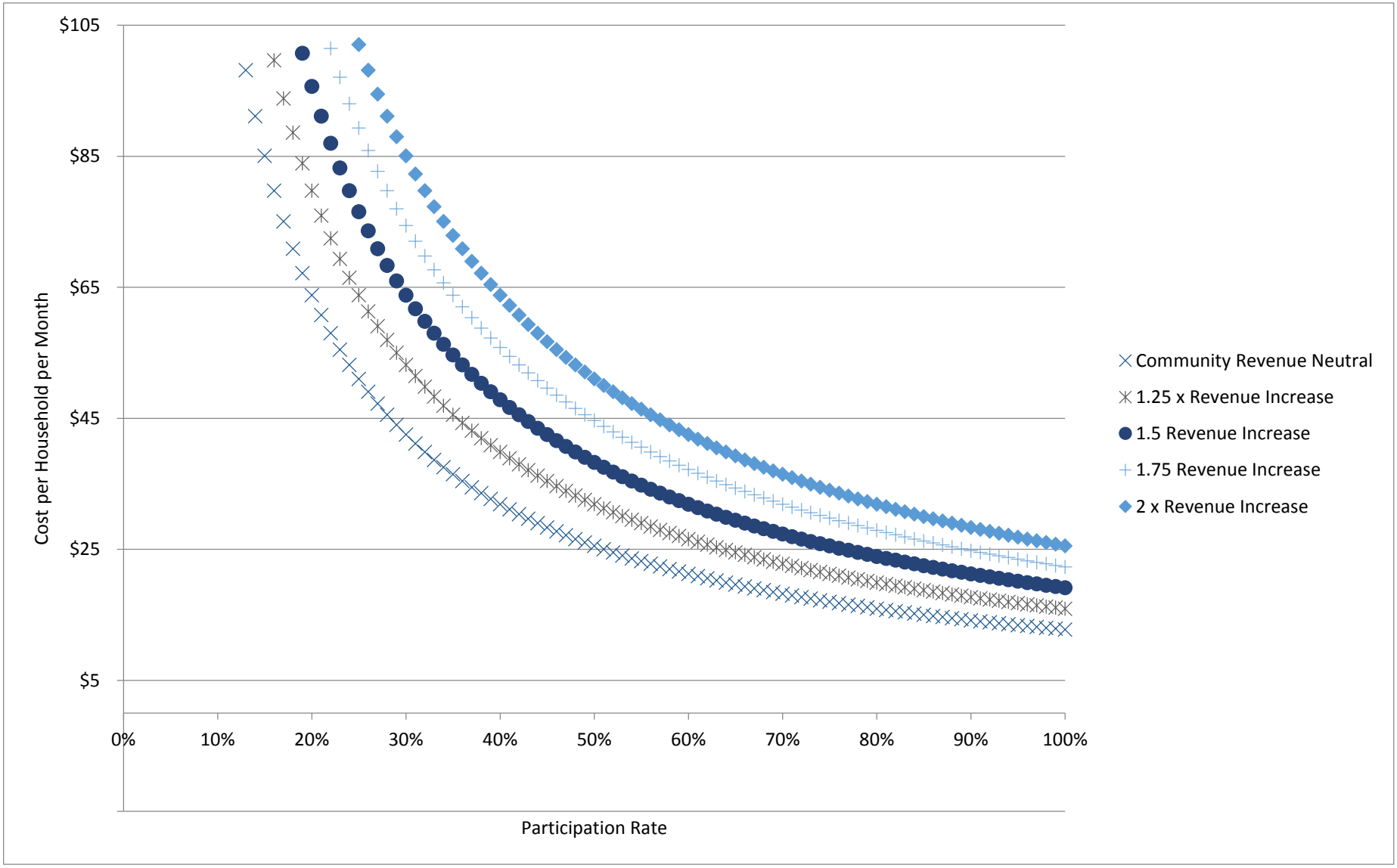

Figure 5.29 Potential monthly costs for Parkinson Recreation Centre pool passes per household

Table 5.50 displays the different prices per household per month for Parkinson Recreation Centre pool passes for 100%, 55%, and 25% participation rates for different revenue increases.

Table 5.50 Cost per household per month for Parkinson Recreation Centre pool passes

Participation Rate	Number of Households	Community Revenue Neutral	1.25x Revenue Increase	1.5x Revenue Increase	1.75x Revenue Increase	2x Revenue Increase
100%	32	$12.76	$15.95	$19.14	$22.33	$25.52
55%	18	$23.20	$29.00	$34.79	$40.59	$46.39
25%	8	$51.03	$63.79	$76.55	$89.31	$102.07

5.2.6.3.3 Bike Tune-ups

Based on survey results, only about 20% of bike tune-ups offered for participating households were actually used and households stated they wanted about 3 bike tune-ups per household on average. Assuming 20% would actually be used, this means there would be an average of 0.6 bike tune-ups per household per year (= 3 x 20%). At a unit price of $60 per bike tune-up at Kelowna Cycle, about $36 in bike tune-ups would be spent per household per year (= $60 x 0.6), equating to $3 per household per month (= $36 / 12 months) regardless of participation rates. In combination with this offer, free or by donation, basic bike tune-up workshops could be scheduled through the Kelowna Area Cycling Coalition (KACC) to teach residents how to tune up their own bikes.

5.2.6.3.4 Merchant Incentives

As was noted in survey results, local merchants in the neighbourhood would be canvassed to determine if they would be willing to contribute a discount for ComPASS users. This could be accomplished without additional costs added to the ComPASS package price. Merchant discounts would be a benefit to businesses as it could potentially increase overall profits.

Furthermore, this component would be a great benefit for ComPASS users whether or not they use the other components. For example, if a 10% discount to a local grocery store was given to ComPASS users, there would be substantial savings from the average grocery bill. If a household spent $300 in a month on groceries, about $30 could be saved per month. This amount alone could contribute to the household's monthly price of a ComPASS. This would also be a positive for households who do not wish to change their transportation behaviours, but could find a benefit from participating in the program.

It is recommended that existing merchants located near the old de Bakker's Kitchen location (Glenmore Road and Mountain Avenue) be included in a future ComPASS program as de Bakker's Kitchen encouraged AT use, likely due to the close proximity to the pilot study neighbourhood. The Glenmore Marketplace IGA was also a positive addition, but it did not encourage AT to the same degree as the de Bakker's Kitchen incentive. Therefore, a different grocery store, perhaps located within walking or biking distance to the neighbourhood would be ideal. Furthermore, some residents indicated that IGA can be more expensive than other grocery stores. Even so, the IGA incentive would still be useful as a loyalty reward. In survey 1, residents were asked which merchant they used the most. The merchants used the most included:

- Costco
- Save on Foods
- Safeway
- Mediterranean Market
- Superstore
- London Drugs
- Nature's Fair
- Home Hardware
- Nesters
- Quality Greens
- Home Depot
- Choices Market
- Wal-Mart
- Rona

Merchants like Costco, Superstore, Wal-Mart, Home Depot, Rona, and Home Hardware usually require a personal vehicle for transporting purchased goods since heavier or bulk items are typically purchased from these locations. Other locally owed merchants, such as Nature's Fair, Nesters', Quality Greens, Choices Market, and the Mediterranean Market would be more suitable for the goals of ComPASS. Ultimately, however, which merchants are included depend on merchants' willingness to participate.

5.2.6.3.5 Emergency Taxi Rides Home

According to survey 3 results, households said they would use the emergency taxi ride home component on average 1.3 times per year. Assuming each ride would cost $25, the average cost per household per month would be $2.71 (= 1.3 trips per year x $25 per ride / 12 months).

For this component, those who require an emergency taxi ride home would pay for the ride, then keep the receipt to submit to the ComPASS program coordinator or managing entity. The ComPASS program would then reimburse the ComPASS user for the taxi ride. Situations that would constitute an emergency would be outlined and given to ComPASS users to ensure they understand the policies and reasoning behind the component.

5.2.6.3.6 ComPASS Administration

The ProPASS is an existing discounted pass program run by the Kelowna Regional Transit System (KRTS) for businesses; if three or more people from a business purchase monthly bus passes in Kelowna, they can receive a discount through the ProPASS program (BC Transit 2014). As of summer 2011, there were 17 people enrolled in the ProPASS program in Kelowna (K. Bergen, personal communication,

2011). The City of Kelowna was consulted regarding the number of full time equivalent (FTE) employees required for their current ProPASS program. The value given was estimated at 0.05 FTEs (M. Kittmer, personal communication, 2011). Assuming an FTE would make $50,000 in a year, this would mean that about $2,500 per year is spent on the administration of the ProPASS program. This means that about $150 per year in administration is already spent per ProPASS participant per year (assuming 17 participants per year). This funding is already in place could potentially be redirected to a ComPASS program which could have volunteers complete a portion of the work.

5.2.6.3.7 Overall ComPASS Pricing

Table 5.51 shows the summary of estimated prices for each ComPASS component as well as the total prices for a ComPASS package based on 100%, 55%, and 25% participation rates.

Table 5.51 Estimated CRN prices for each ComPASS component per household per month

	Price per Household per Month		
	100% Participation	**55% Participation**	**25% Participation**
Transit Passes (50% Revenue Increase)	$7.82	$14.22	$31.29
Parkinson Recreation Centre Pool Pass	$12.76	$23.20	$51.03
Bike Tune-ups	$3.00	$3.00	$3.00
Emergency Taxi Rides Home	$2.71	$2.71	$2.71
Merchant Incentives	$0.00	$0.00	$0.00
ComPASS Total ($/household/month)	$26.29	$43.13	$88.03

In ideal conditions based on 100% participation, a ComPASS in the study neighbourhood should be priced at about $30 per household per month (rounded for increased contingency). With a more realistic participation rate of 55%, the ComPASS price should be $45 per household per month (again rounded for increased contingency). Under a more conservative estimate of 25% participation, a ComPASS should be $90 per household per month (rounded for increased contingency). However, 55% is the anticipated participation rate due to typical participation rates reported in Boulder, Colorado.

During merchant canvassing before the pilot study began, the Parkinson Recreation Centre agreed to participate in the pilot study, but said they would never participate in a future ComPASS program based on the CRN model. Researchers still wanted to test the Parkinson Recreation Centre in the pilot study since it was local and cost effective. If the Parkinson Recreation Centre will not participate in a future ComPASS program, the recreation centre component would need to be removed entirely, reducing the price per household per month to $13.59 based on 100% participation (rounded to $15 per household per month), $19.93 based on 55% participation (rounded to $22.50 per household per month), and $56.74 based on 25% participation (rounded to $60 per household per month). However, not including a recreation centre pool pass in the ComPASS package could deter some households from participating. In

contrast, the reduced cost from removing the pool pass component could also encourage other households to participate. Overall, the pool pass component was well received by participating households, so including it in a future ComPASS program would be beneficial if possible.

5.2.6.4 Resident Willingness to Pay (WTP)

In each survey, residents were asked how much they would be willing to pay for a ComPASS. The willingness to pay (WTP) given in the third survey was considered to be the most valuable since households had time to consider the program, learn more about it, and give a more informed decision. In this survey, households were also asked two other related questions, including:

- Is your household willing to contribute to the ComPASS program financially? (respond with either: “strongly agree”, “mildly agree”, “neutral”, “mildly disagree”, “neutral”, “strongly disagree” or “do not know”).
- Would your household be willing to participate in a ComPASS program if a permanent program was offered in your neighbourhood? (respond with yes, no, or maybe).

If a resident said they: 1) strongly agree, mildly agree, or were neutral on whether they would contribute to a ComPASS program financially, 2) gave a WTP larger than $0, and 3) would or would maybe participate in the program, then the household was assumed to be willing to contribute financially. The WTP for each household was found based on these three criteria, as shown in Table 5.52.

Table 5.52 Willingness to pay for a ComPASS program

	My Household would Support the ComPASS Program Financially	Households that would Participate in a Future Permanent ComPASS Program.	Willingness to Pay
Control Households	Strongly Agree	NO	$50
		YES	$30
	Mildly Agree	NO	$50
		NO	Not Participating
		YES	$30
		YES	$75
		YES	$30
	Neutral	NO	Not Participating
		NO	Not Participating
		YES	$187.50
	Mildly Disagree	NO	Not Participating
		NO	Not Participating
		NO	Not Participating
	Strongly Disagree	NO	Not Participating
Participating Households	Strongly Agree	YES	$40
		YES	$68
		YES	$75
		YES	$20
		YES	$100
		MAYBE	$60
	Mildly Agree	NO	Not Participating
		YES	$75
		YES	$70
		YES	$100
		YES	$75
		YES	$15
	Neutral	MAYBE	Not Participating
		NO	Not Participating
		YES	$30
	Mildly Disagree	NO	Not Participating
	Strongly Disagree	NO	Not Participating
	Don't Know	NO	Not Participating
		Average:	**$62.13**

Overall, using these criteria, 19 households (59%) of both control and participating groups would be willing to contribute financially to a ComPASS program. Using Table 5.52 data, summary statistics were calculated on WTP, as shown in Table 5.53 below.

Table 5.53 Characteristics of willingness to pay (WTP) per household per month data

Maximum	$187.50
75th percentile	$75.00
50th percentile	$60.00
25th percentile	$30.00
Total monthly contribution	$1,180.50
Average monthly contribution	$62.13

The average WTP is $62.13 per household per month, which is about 1.5 times the estimated actual price of $45/month per household based on 55% participation. The estimated price of the ComPASS ($45/month per household) is at the 36th percentile WTP threshold, meaning that 36% of households would not be willing to pay more than $45/month. Under the conservative estimate of a 25% participation rate, the average WTP of $62.13 is less than the estimated price of the ComPASS ($90 per household per month). In this scenario, the estimated price of the ComPASS ($90/month per household) is at the 86.7 percentile WTP threshold, meaning that 86.7% of households would not be willing to pay more than $90/month. This demonstrates that higher participation rates are necessary to achieve financial sustainability for the ComPASS financial model.

The assumed 55% participation rate prices are slightly conservative (with 4% to spare) since 59% of the 32 household study group suggested they were willing to contribute financially. The total amount required for a ComPASS program based on 59% participation is $855 ($45 per household per month x 19 households).

Since the actual estimated cost for all 19 households ($855) is less than the total willingness to pay of all 19 households ($1,180), then all 19 households could hold a ComPASS for the amount they are willing to pay. Therefore, a ComPASS program could be financially feasible in the pilot study neighbourhood.

5.2.6.5 ComPASS Implementation Strategy

There are two implementation process models that were presented through the literature reviews, including:

1. UBCO Student U-Pass Model: institute a mandatory tax so everyone has access to a ComPASS; or,
2. Boulder NECO Pass Model: institute a neighbourhood volunteer to collect cheques from the neighbourhood amounting to the minimum contract amount for a year, and only those who contribute will have access to a ComPASS.

Table 5.54 below displays the positives and negatives for the two possible payment options.

Table 5.54 The positives and negatives associated with ComPASS implementation strategies

	Positives	Negatives
Student U-Pass Model (add ComPASS fees to property taxes for whole neighbourhood)	• Cost will be lower for each household; • Less work for neighbourhood coordinators; and, • More program stability.	• There would be costs for City administration; and, • There would be increased complexity for those households that rent.
Boulder NECO Pass Model (only those who want to participate contribute money to the program.)	• Those who will not use the pass will not have to contribute; • Anyone can contribute if they want, even if they do not use the pass; • A household can choose how much they want to contribute as long as the whole neighbourhood raises a minimum amount to cover costs for the ComPASS components; and, • Simpler for City administration.	• More work for neighbourhood coordinators (gathering cheques & participants); • The cost may be higher for each household since there would be fewer contributors; and, • If enough money is not raised, the program may not go forward.

Both control and participating households were asked in survey 3 whether they would prefer to pay for ComPASS through their property taxes or whether they wanted only those who participate to pay for the program. Households were allowed to say "Yes" to both if they liked both ideas. Overall, 15 households said "Yes" to property taxes, while 24 said "Yes" to only those who participate should pay. Based on these results, it is recommended that the ComPASS should be operated in a method like Boulder, Colorado's NECO Pass, where neighbourhood coordinators canvass their neighbourhood and raise funds for their transportation pass. This method may require more work for the neighbourhood coordinators, but this may also ensure the program is self-sustaining as the future of the program would not solely rely on City resources.

Out of all 105 individuals in the pilot study, one resident said they would be willing to be a volunteer to help coordinate the implementation of the program in their neighbourhood. Two other residents in the pilot study said they might be willing to be a volunteer for the program. This number of potential resident volunteers may be sufficient for ensuring that a ComPASS program be initiated in the pilot study neighbourhood.

In addition, the City or a separate organization would need to play a large role in the program's communication, marketing, administration, revenue collection, ComPASS cards and technology, and program monitoring. Without the City's support, especially as they are the transit leaders in Kelowna, the program would not be feasible.

5.2.6.6 Households' Comments and Suggestions

In survey 2 and 3, residents were asked to write down any suggestions they may have had for an improved ComPASS program. Following are an overview of the responses given:

- New bus routes on Mountain Avenue;
- Secure bike facilities downtown;
- Possibly households could pick and choose components based on their usage and budget;
- Hold a transit scavenger hunt adventure for Glenmore, like other programs held in Kamloops aimed at getting residents familiar with the transit system;
- Mechanism to take suggestions for places where transit, biking, or pedestrian facilities could be improved;
- Link the ComPASS program into larger commuter programs like walk/bike/bus to work week;
- Transit should have better access to get to areas (e.g. direct to the H2O Centre);
- Ensure that Google Transit is more accurate – it is not always representative of schedules;
- Include access to classes in the recreation centre pass;
- Include other recreation centres (like the H2O Centre, YMCA, etc.);
- Include the HandyDART in a future ComPASS program;
- Create more walking paths; and,
- Integrate a car /truck sharing program perhaps with a charging station for an electric option.

It would be beneficial to keep these points in mind for a future permanent program even if they cannot be implemented at once. In addition, in all three surveys, residents were also asked if they had any other comments regarding the ComPASS Program. Appendix L shows a list of the comments. Many households expressed their contentment that new initiatives for AT were being explored in their community. In contrast, other households said they were not interested in a ComPASS program. Some households also expressed that the price of the program would strongly influence their participation in the program.

5.2.7 Phase 2 Results and Discussion Summary

Although limitations to the research exist, the following conclusions from the Phase 2 study appear reasonable based on collected data and statistical analyses:

- ComPASS has the potential to reduce private vehicle use and increase transit use among participating households. When ComPASS was in effect, participating households' car trips as the driver were significantly lower than the control households at a 93.7% confidence level, and transit trips were significantly higher than control households at an 85.7% confidence level.

Between the pre and mid surveys, control households' car trips as the driver increased and transit trips decreased, while participating households' car trips as the driver decreased and transit trips increased. It is likely that under normal circumstances without the ComPASS intervention, participating households' trip characteristics would have followed the same trends as the control households. Therefore, it is reasonable to suggest that ComPASS results in decreased personal vehicle and increased transit use.

- Control household car trips as the driver increased while the ComPASS was in effect. During the same time, participating groups decreased their car trips as drivers by 12%. Furthermore, while there was a decrease in control households' transit trips while the ComPASS was in effect, participating households increased their transit use by 50%.
- Although results suggest ComPASS reduced personal vehicle use and increased transit use, this was without improvements to the transit service and with poor weather conditions (increased precipitation) during the second survey. With improved transit service, the effects of ComPASS could be shown higher confidence levels.
- Although ComPASS supports other forms of AT (e.g. walking and cycling) through components such as including merchants accessible by AT, providing bike tune-ups, and emergency taxi rides home, the ComPASS did not prove to have an influence on walking and cycling usage.
- Assuming 12% fewer car trips as the driver, ComPASS households could reduce their VKTs by 2,121 km per household per year. Assuming a more conservative estimate of 6% reduced car trips as the driver, ComPASS holders could reduce their VKTs by 1,060 km per household per year.
- Table 5.55 summarizes the potential CO_2 equivalent (CO_2e) emission reductions, road injury and fatality reductions, and economic savings resulting from ComPASS through reduced VKT. Results are outlined in annual savings per household and three year savings if a ComPASS were implemented in the Phase 2 pilot study (assuming 59% of the 32 piloted households (19 households) would participate in a permanent ComPASS program).

Table 5.55 Reduced driving benefits as a result of ComPASS

		ComPASS (-12% driver trips)	**ComPASS (-6% driver trips)**
Annual Savings per Household	Reduced CO_2 equivalent (CO_2e) emissions	637 kg	319 kg
	Reduced road injuries per household	1.6	0.8
	Reduced road fatalities per household	0.006	0.003
	Economic savings	$721.13	$360.57
3-year Permanent ComPASS Program Savings	Reduced CO_2 equivalent (CO_2e) emissions	12,103 kg	6,052 kg
	Reduced road injuries per household	30	15
	Reduced road fatalities per household	0.11	0.06
	Economic savings	$41,104.51	$20,552.26

As demonstrated in Table 5.55, the benefits of reduced VKT through a ComPASS could help Kelowna become a more sustainable community, and would align with Kelowna's goals.

In relation to attitudes and beliefs regarding ComPASS, the following conclusions were made:

- Survey results suggest that to encourage households to participate in a ComPASS program, improved transit service and price of ComPASS are strong influencers.
- Households believed that ComPASS would be successful in Glenmore, showing promise for a future program in the Glenmore area.
- Households tend to disagree that ComPASS would increase their walking or cycling, but they believe it would increase their transit use.
- Results were inconclusive whether the ComPASS may have increased participating households' overall health, but this would be a point for future research.
- When participating households were asked to describe any new, fun, and interesting experiences they encountered as a result of the ComPASS program, the majority of responses were related to children particularly enjoying taking the bus, and how ComPASS helped to increase opportunities for families and community members to interact, suggesting that the ComPASS helped to build a sense of community and social cohesion within the pilot study neighbourhood.

In regards to the recommended ComPASS design, the following conclusions were made:

- 50% of all households surveyed suggested they would participate in a permanent ComPASS program, while 44% said they would not and 6% said they would maybe participate. This closely aligns with Boulder, Colorado's NECO Pass average participation rate of 55% (Hagelin 2011b), suggesting that the estimated participation rates would be on par with Boulder's successful NECO Pass.
- Based on the analysis of piloted ComPASS component usage, satisfaction, believed future usage, potential to encourage AT, and potential to encourage ComPASS participation, a future ComPASS program should include (in addition to unlimited transit passes): 1) merchant incentives, 2) bike tune-ups, 3) pool facility pass, and 4) emergency taxi rides home.
- In ideal conditions based on 100% participation, a ComPASS in the study neighbourhood should be priced at about $30 per household per month, but with a more realistic participation rate of 55%, the ComPASS price should be $45 per household per month. This pricing, based on the CRN model would help ensure that the operational cost of compass would become self-sustaining (residents subsidizing residents) with limited costs to the City of Kelowna.
- 59% of households suggested they would contribute to the program financially. Findings suggest that the majority of willing households (64%) would pay up to the recommended $45 per

household per month. The remaining 36% are not willing to pay as much as $45 per household per month, but the combined WTP of willing households would exceed the minimum required payment for the program. This means all households willing to contribute financially (assuming they would pay their specified WTP amount) could participate in the ComPASS program.

- Based on these results, if ComPASS is implemented, it is recommended that the ComPASS should be operated in a method like Boulder, Colorado's NECO Pass, where neighbourhood coordinators canvass their neighbourhood and raise funds for their transportation pass. This method may require more work for the neighbourhood coordinators, but this may also ensure the program is self-sustaining as the future of the program would not solely rely on City resources. However, greenhouse gas (GHG) reductions, road safety benefits, and economic savings would help to offset any administrative costs.

Overall, based on the resulting benefits of a ComPASS and the level of support available from Phase 2 pilot study households, a ComPASS would appear to be an effective tool for the City of Kelowna to implement in efforts to reach their sustainability goals. With this in mind, a three year trial implementation is recommended for the Phase 2 study area, along with transit improvements, with potential for growth to other neighbourhoods in Kelowna.

5.2.7.1 Limitations

Important limitations to the Phase 2 research study to note include:

- Control and participating households were not selected in a fully random process as households were given the opportunity to choose whether they were in the control or participating group. This means that the two different groups were likely biased in their pre, mid, and post survey responses (e.g. households more likely to use transit and be in favour of AT would be more likely to join the participating group to enjoy the ComPASS components for three months). Although this bias would have been present in survey responses, this self-selection demonstrates realistic conditions for households opting to participate in a ComPASS, should one be implemented in the future. For example, in realistic conditions, households would have the opportunity to choose whether or not they participate in the program – those that would participate would likely have different values and demographics than those that choose not to participate. Therefore, even though households were not placed in control or participating households using a random process, the results demonstrate how ComPASS users attitudes, beliefs, and behaviours change compared to non-ComPASS users.
- The pilot study occurred in the summer, which may have impacted results due to a change in seasonal activities (e.g. school was out of session between the end of June and early September,

and households are more likely to go on summer vacation). To view the factors required to bring April and September traffic data to equivalent June data, please see Table 5.33. This table demonstrates how traffic volumes vary by month and day of the week at the William R. Bennett Bridge (site P-25-1NS-NY) in Kelowna, BC. As the seasonal factors demonstrate, traffic volumes must be increased in April and September to convert data to equivalent June data, showing that June traffic volumes are typically higher than April and September data.

- The traffic count data collected experienced several equipment malfunctions. Although, missing data was estimated based on accepted methodology and seasonal / daily traffic pattern ratios, it is possible that errors were introduced in count data.
- Varying weather (temperature and precipitation) between surveys may have also affected transportation behaviours in the pre, mid, and post survey.
- The GLMM statistical analysis procedure was not possible for ordinal and nominal data using IBM® SPSS® Version 22 (2013a) according to error messages which indicated: “repeated measures analysis is not supported for the multinomial probability distribution”. The multinomial distribution is necessary for analyzing nominal and ordinal data. Therefore, ordinal and nominal data was not assessed statistically in the Phase 2 data analysis.

Chapter 6 Conclusions, Contributions, and Future Research

To achieve a sustainable community, Kelowna's OCP (2011) identifies developing a balanced transportation network as a main goal, which involves implementing streets that will accommodate all transportation modes with a particular focus on pedestrians, cyclists and transit. This goal aligns with the motivations for ComPASS, and helps to address the four pillars of a sustainable community. The two motivations for ComPASS include: 1) helping to create and/or retrofit a community such that it can effectively support the environment, economy, society, and culture in a balanced manner and, 2) helping to sustainably reduce the immense social and economic burdens associated with injuries due to road collisions. In response to these motivators, this ComPASS research study achieved its three objectives:

1. Kelowna, BC's demographics, transportation network, and transportation safety conditions were reviewed in Chapter Three (with focus placed on the Phase 1 Glenmore ComPASS study area). Kelowna was compared against successful community U-Passes including Boulder, CO's NECO pass, and ComPASS community recommendations found in the 2004 ComPASS Pilot study in Vancouver, BC.
2. Using information found from other successful community transportation pass programs in North America, the Phase 1 Glenmore community was surveyed to determine existing transportation attitudes, beliefs, and behaviours, and to determine specific desires for a ComPASS program in Glenmore.
3. Based on findings from the literature review and the Phase 1 stated preference survey, a Phase 2 pilot study was designed and applied to a smaller study area within the larger Phase 1 study area. Traffic counts and surveys were conducted before, during, and after a three-month ComPASS pilot study to determine how a permanent ComPASS program might affect transportation attitudes, beliefs, and behaviours, and to determine optimum inputs for a potential future permanent ComPASS program in Glenmore.

Ultimately, ComPASS results suggest that ComPASS can contribute to reduced personal vehicle use and increased transit use. As discussed in Chapter One, reduced vehicle use results in many community-wide environmental, economic, social, and cultural benefits. By reducing personal vehicle use and promoting AT modes, the benefits of ComPASS could be immense, as demonstrated in Table 6.1.

Table 6.1 Sustainable Benefits of ComPASS

Sustainability	Benefits
Environment	• Reduced demand for vehicles and associated energy and material required to manufacture them. • Decreased GHG emissions by 319 to 637 kg of CO_2 equivalent (CO_2e) per ComPASS household per year.
Economics	• Less amount of time spent driving reduces the probability of collisions and the economic burden associated with them (e.g. healthcare costs, loss of life, collision clean-up, etc.). • Reduced economic stress on healthcare resulting from increased physical activity. • Reduced wear and tear on roadways leading to reduced resources spent on maintenance, rehabilitation, or replacement of road infrastructure. • With less VKT per household, households spend less on vehicle costs, including purchasing, maintenance, and fuel. • Through reduced VKT, the City of Kelowna could see economic benefits of $360.57 to $721.13 per ComPASS household per year through reduced congestion, improved active travel conditions, decreased roadway costs, decreased parking requirements, energy conservation, and pollution reductions.
Society	• Encourages more AT usage which enables more physical activity and healthier lifestyles leading to a higher quality of life. • The local benefits of ComPASS create more opportunities for fostering social connections (more people out of their houses and out of their cars). • Through reduced VKT, road injuries could decrease by 0.8 to 1.6 injuries per ComPASS household per year. • Through reduced VKT, road fatalities could decrease by 0.003 to 0.006 fatalities per ComPASS household per year. • Through improved road safety, there would be increased productivity and quality of life. • Those without driver's licenses are provided an affordable means to travel without relying on family or friends to transport them.
Culture	• Creates opportunities for more AT usage which encourages residents to experience their community and develop social cohesion. • The resulting increased sense of community creates stronger ties to neighbourhoods and environments that residents are more willing to defend by supporting sustainable initiatives.

Overall, there is potential for a successful ComPASS program in Kelowna, BC, with particular potential in the Phase 2 study area. With the benefits resulting from reduced VKT, a ComPASS program could help improve sustainable transportation choices in Kelowna. It is recommended that a three-year permanent ComPASS trial is implemented, together with transit improvements, in the Phase 2 study area where community engagement has already been invested. This three-year trial could also include further data collection and monitoring to determine if ComPASS benefits could be applied to other Kelowna neighbourhoods. Assuming 59% of the 32 piloted households (19 households) would participate in a permanent ComPASS program, Table 6.2 outlines the potential greenhouse gas (GHG) emission reductions, reduced road injuries and fatalities, and economic savings over a three year period. Two estimates have been shown, assuming a 12% reduction (optimistic), and a 6% reduction (conservative) in car trips as the driver.

Table 6.2 Three year permanent ComPASS program benefits

		ComPASS (-12% driver trips)	ComPASS (-6% driver trips)
3-year Permanent ComPASS Program Savings	Reduced CO_2 equivalent (CO_2e) emissions	12,103 kg	6,052 kg
	Reduced road injuries per household	30	15
	Reduced road fatalities per household	0.11	0.06
	Economic savings	$41,104.51	$20,552.26

These benefits combined would help the City of Kelowna become a more sustainable community and to reach its OCP and GHG emission reduction targets. Furthermore, these economic savings could help offset any costs to the City of Kelowna associated with administering a ComPASS program.

6.1 Contributions

This research has contributed to knowledge within this field, especially as a potential tool to use within the Okanagan to decrease personal vehicle use. The main contributions of this research include:

- The design of a resident supported ComPASS program for the City of Kelowna that would have the ability to: 1) reduce vehicle kilometres travelled (VKT), 2) reduce GHG emissions, and 3) increase transit use. This would have significant implications if ComPASS was successfully implemented city-wide in Kelowna as reductions in vehicle trips will reduce traffic congestion and collisions, improve air quality, improve the health and safety of residents and increase a sense of community. Resident survey results suggest that these benefits would combine to create an overall improved quality of life for participating residents.
- A potential transportation demand management (TDM) strategy for the City of Kelowna. ComPASS showed that it may have increased transit use despite reductions to transit service and the popularity of cycling and walking in the summer, not to mention in a neighbourhood with a higher income with low density. With improved transit service in the neighbourhood, there is potential for even greater shifts from personal vehicle use to transit use. A ComPASS type program would prove to be successful as a TDM strategy and could be effective if applied to neighbourhoods throughout Kelowna.
- The CRN model could be successful in Kelowna. Businesses were willing to participate and contribute to the pilot program, which reflects the potential for businesses to participate in a permanent ComPASS program. Furthermore, the willingness to pay was higher than the estimated actual costs based on the CRN model, which suggests that the CRN model could be achieved.
- Broaden community sustainability for potential application of ComPASS in communities across the Okanagan, BC, and Canada. Many cities in Canada, including Kelowna, may be similar to

Boulder, Colorado. This pilot study proved that a program like Boulder's NECO Pass could be successful in a midsized Canadian city as well. If cities across Canada were to adopt a program like the ComPASS or the NECO Pass, there would be several sustainable community improvements.

6.2 Future Research

There are also many areas for future research to build upon the analysis already completed. Such areas of future research include:

- The possibility of other components (such as car sharing [Okanagan Car Share Co-Op, www.ogocarshare.ca] or a CanCart program [TREK 2004]) to be added to a ComPASS package. These components could increase the price of a ComPASS package, but may add additional benefit for residents. If there was a car sharing program in the neighbourhood, this may give residents even more reason to reduce their vehicle ownership. This possible component was suggested by several residents, so there may be some level of support for the program in the neighbourhood already. A CanCart program would give residents a convenient opportunity to carry heavier goods for walking, biking, or taking transit. This component may further increase AT trips, especially to grocery stores or for other shopping trips.
- Conduct traffic counts again to verify the traffic volumes gathered in this study. Future traffic counts should also include license plate surveys to estimate the volume of cut-through traffic, visitors, and utility vehicles. With this verification, the traffic count data gathered pre, mid, and post pilot might provide further information on how travel behaviours changed throughout the pilot study.
- Attempt to reassess the number of trips in the past week data using alternative statistical methods, including the empirical Bayesian (EB) approach, which is often used to assess collisions before and after safety treatments are applied on road segments (Persaud et al 2010).
- IBM® SPSS® Version 22 (2013a) software was not capable of assessing nominal and ordinal data (e.g. transit satisfaction levels and main influences for using transit) using generalized linear mixed models (GLMM). A potential point for future research could be to use alternative statistical tools that may be capable of assessing nominal and ordinal data to determine if there were significant differences between groups (control and participating) and surveys (pre, mid, and post).
- Create a toolbox for municipalities to assess interested neighbourhoods for the implementation of a ComPASS program. Such a toolbox could include steps to develop the program for a new neighbourhood, include outlines of surveys, survey question design, analysis steps for current usage of ComPASS components, measures of success, price point analysis, and implementation

steps. For pricing of the ComPASS, spreadsheet templates could also be provided where specific pricing values could be inputted to determine the price points of each component using the community revenue neutral (CRN) model.

- Neighbourhoods other than Glenmore could be analyzed for the feasibility of a ComPASS program. Specifically, a ComPASS program in Rutland (another community in Kelowna) may show even more success than a Glenmore ComPASS. Rutland has more favourable characteristics that could make for a successful ComPASS program, including a lower average household income and higher levels of transit service (more routes and shorter headway). Furthermore, the Rutland Residents Association already expressed interest in the program during the Phase 1 public engagement process.
- More analysis could also be conducted on pilot study best practices for the successful design of pilot studies of a similar nature. This could include the development of a tool that could be applied to determine the number of participants required and the required study duration. There could also be more detailed analysis on how the season, weather, or month affects transportation mode choice. This could include comparing cloudiness, precipitation, temperature, and daylight hours with transportation mode split and pilot study results.

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Appendices

Appendix A Public Design Workshop Outline

Introduction	• Described the goals and objectives of the Glenmore community transportation pass • Described the goals and objectives of the workshop • Described the consent forms and received signed forms from participants • Attendees split into groups of 6 to 8
Sustainable Transportation Self Education Discussion	• Each group had a facilitator from either the Glenmore community transportation pass • Research team or the Steering Committee • Discussed benefits, barriers, and incentives for using sustainable transportation choices such as walking, biking, and public transit. • Each participant received a worksheet for them to write individual or group ideas (participants were asked to keep sheets)
Break	• Allowed a 10 minute break • During this time, handed out surveys and asked attendees to review them and ask us if they had any questions
Tell the story of Boulder, Colorado	• Described Boulder's Neighbourhood ECO Pass to attendees and how it benefited their community • Afterwards, attendees go back to their designated groups
Glenmore Community Transportation Pass Design & Pricing Discussion	• Each participant received a worksheet for them to write individual or group ideas (sheets were collected as data at the end) • Asked questions about what they would like to see in their preferred Glenmore community transportation pass • Asked how much they would pay for their preferred community transportation pass packages • Group ideas written on easel paper to be used as data
Group Presentations	• Each group was asked to present their group ideas to the entire audience
Conclusion	• Audience was thanked for attending and closing remarks were stated.
Open Microphone Session	• Attendees were given the opportunity to speak their personal opinions related to the study to the audience.

Appendix B Phase 1 Community Survey

Part A: Mobility:
In this section we will ask questions regarding your current transportation habits and access to public transit.

1. How many vehicles of each type does your household currently own or lease?
Car _____
Truck _____
SUV _____
Motor bike _____
Recreational Vehicle _____
Other _____
There are no vehicles in our household [ ]

2. How many useable and/or fixable bicycles are there in your household?
a) 0
b) 1
c) 2
d) 3
e) Other: _____

2. How many bus passes in total are usually purchased by members of your household over one year? (e.g.: if one person buys a Monthly Bus Pass each month, 1 x 12 = 12 per year)
a) Monthly Bus Pass _____
b) U-PASS _____
c) College Semester Pass _____
d) BC Bus Pass _____
e) Fire/Police Pass _____
f) ProPASS _____

3. Please choose the main reason you decided to live in the Glenmore community.
Costs
a) Sense of community
b) Close proximity to amenities
c) Schools
d) Parks & Recreation
e) Other _____

Part B: Basic Transportation:
In this section we will ask questions regarding your current transportation use.

4. For parts a, b, and c of this question, please mark the appropriate box for each member of your household. For example, if there are 5 members in your household that drive to work, there should a 5 written beside "Drive" in the "To Work?" column.

a) Which method of transportation does each member of your household use most to travel to work, shopping, recreation, and school?

	Work?	Shopping?	Recreation?	School?
Vehicle (Driver)				
Vehicle (Passenger)				
Bus				
Bike				
Walk				
Not Applicable				

b) Approximately how long is your travel time for each member of your household for work, shopping, recreation, and/or school?

	To work?	To shopping?	For recreation?	To school?
0-10 minutes				
10- 20 minutes				
20-30 minutes				
30-45 minutes				
45-60 minutes				
Greater than 60 minutes				
Not Applicable				

c) Approximately how often does each member in your household use public transit in Kelowna?

Daily	
More than once a week	
Once a week	
Once a month	
Less than once a month	
Never	

5. In what hour do members of your household typically commute to and from work or school? Please write the number of people in the box corresponding to the appropriate time interval.

		From home to work or school		From work to home or school
a)		Midnight to 1am		Midnight to 1am
b)		1am to 2am		1am to 2am
c)		2am to 3am		2am to 3am
d)		3am to 4am		3am to 4am
e)		4am to 5am		4am to 5am
f)		5am to 6am		5am to 6am
g)		6am to 7am		6am to 7am
h)		7am to 8am		7am to 8am
i)		8am to 9am		8am to 9am
j)		9am to 10am		9am to 10am
k)		10am to 11am		10am to 11am
l)		11am to 12pm		11am to 12pm
m)		12pm to 1pm		12pm to 1pm
n)		1pm to 2pm		1pm to 2pm
o)		2pm to 3pm		2pm to 3pm
p)		3pm to 4pm		3pm to 4pm
q)		4pm to 5pm		4pm to 5pm
r)		5pm to 6pm		5pm to 6pm
s)		6pm to 7pm		6pm to 7pm
t)		7pm to 8pm		7pm to 8pm
u)		8pm to 9pm		8pm to 9pm
v)		9pm to 10pm		9pm to 10pm
w)		10pm to 11pm		10pm to 11pm
x)		11pm to Midnight		11pm to Midnight
y)		Not Applicable		Not Applicable

Part C: Perception:

In this section we will ask questions regarding your current perceptions of transportation in Kelowna.

6. How would you rate traffic congestion in Kelowna on a scale of 1 to 5 where 1 is not congested at all (no delays), and 5 is extremely congested (long delays)?

a) 1
b) 2
c) 3
d) 4
e) 5

7. How would you rate the public transit system in Kelowna with respect to the quality of service on a scale of 1 to 5 where 1 is very good and where 5 is very poor?

a) 1
b) 2
c) 3
d) 4
e) 5
f) I have no experience with Kelowna's transit system

8. What would influence your household to get out of a car for 1 extra day a week? Rank the reasons below in order of strongest (= 1) to weakest (= 7) influence.

a) Cheaper public transit [ ]
b) More convenient transit service [ ]
c) Better bike routes [ ]
d) Higher gas prices [ ]
e) I already ride the bus at all times [ ]
f) Nothing [ ]
g) Other: _____ [ ]

9. Rank the reasons below in order of strongest (= 1) to weakest (= 6) influence. My household rides the bus because it is:

a) Our cheapest option [ ]
b) Our only choice [ ]
c) It is good for the environment [ ]
d) It is easy [ ]
e) I don't ride the bus [ ]
f) Other _____ [ ]

10. For the following statements in parts a, b, c, and d, please mark the appropriate box corresponding to your opinion. (Note: this will be in a matrix format).

a) I would consider riding the bus.
Strongly agree [ ]
Mildly agree [ ]
Neutral [ ]
Mildly disagree [ ]
Strongly disagree [ ]
Do not understand the question [ ]

b) I ride the bus because it is my most affordable option.
Strongly agree [ ]
Mildly agree [ ]
Neutral [ ]
Mildly disagree [ ]
Strongly disagree [ ]
I do not ride the bus [ ]
Do not understand the question [ ]

c) I would ride the bus if there were improvements to the service.
Strongly agree [ ]
Mildly agree [ ]
Neutral [ ]
Mildly disagree [ ]
Strongly disagree [ ]
I already ride the bus [ ]
Do not understand the question [ ]

d) If businesses were more pedestrian friendly, my household would be more likely to walk to these businesses.

Strongly agree	[ ]
Mildly agree	[ ]
Neutral	[ ]
Mildly disagree	[ ]
Strongly disagree	[ ]
Do not understand the question	[ ]

11. Rank which of these transit improvements would most influence you to use public transit more often (1 being most convincing, 8 being least convincing)?

1) Closer bus stops	[ ]
2) Lower costs	[ ]
3) Friendlier drivers	[ ]
4) Extended service hours	[ ]
5) Better weekend service	[ ]
6) Better evening service	[ ]
7) Better lighting at bus stops	[ ]
8) More bus stop shelters	[ ]
9) Shorter wait times between buses	[ ]
10) Other: _____	[ ]

Part D: ComPASS Design:

In this section we ask you what services or amenities you would be interested in if the ComPASS were implemented. Please keep in mind that the most successful ComPASS programs are NOT subsidized by the city, transit, or businesses. Typically, each household pays for ComPASS via one monthly cost, only after the community holds a referendum. For a typical household, this might range from $15/month for a basic pass to over $45/month for a deluxe pass. This financial model is known as 'revenue neutral', because it maintains existing revenue levels to transit, city, and local businesses by spreading costs across all households in the neighbourhood. For example, a Glenmore ComPASS would be paid for by Glenmore households.

Parkinson Recreation Center Privileges:

12. In total, how often do you and members of your household visit the Parkinson Recreation Centre in a typical month?

a) Daily
b) More than once a week
c) Once a week
d) Once a month
e) Less than once a month
f) Never

13. What mode of transportation do you and members of your household most often use to travel to and from the Parkinson Recreation Centre?

a) Walk
b) Bicycle
c) Public transit (bus)
d) Car (single occupant)
e) Carpool (2 or more occupants)
f) Other: _____
g) I do not go to the Parkinson Recreation Centre

Bicycle Habits (if your household does not own or have access to a bike, please skip over to the next section titled "Big White Privileges")

14. How often do you and members of your household ride a bike? Please mark the appropriate box for each member of your household. For example, if there are 5 members in your household who daily ride a bike to work, there should be a 5 written beside "Daily" in the "To Work?" column.

	To work?	To shopping?	For recreation?	To school?
Daily				
More than once a week				
Once a week				
Once a month				
Less than once a month				
Never				

15. How often do you give your bike a tune-up?

a) Annually
b) Seasonally (once or twice a year)
c) Every 2 years
d) Every 5 years
e) Never
f) Other: _____

16. For the following statements please mark the appropriate box corresponding to your opinion.

a) If there were more **ground** mounted bike racks available throughout Kelowna my household would ride a bike more often.

Strongly agree [ ]
Mildly agree [ ]
Neutral [ ]
Mildly disagree [ ]
Strongly disagree [ ]
Do not understand the question [ ]

b) If there were more **bus** mounted bike racks available my household would ride a bike more often.

Strongly agree	[ ]
Mildly agree	[ ]
Neutral	[ ]
Mildly disagree	[ ]
Strongly disagree	[ ]
Do not understand the question	[ ]

c) If businesses in Kelowna were more cyclist friendly (for example, installing more bike racks), my household would ride a bike more often to these businesses.

Strongly agree	[ ]
Mildly agree	[ ]
Neutral	[ ]
Mildly disagree	[ ]
Strongly disagree	[ ]
Do not understand the question	[ ]

Ski Hill Privileges:

17. How often do you or members of your household go to a ski hill near Kelowna in the winter and in the summer (eg: Big White, Silverstar, etc)? Please mark the appropriate box for each member of your household. For example, if there are 5 members in your household who go to Big White daily in the winter, there should be a 5 written beside "Daily" in the "In the Winter" column.

	In the Winter	In the Summer
Daily		
More than once a week		
Once a week		
Once a month		
Less than once a month		
Never		

18. What mode of travel do you and your household most frequently use to travel to the ski hill?

a) Drive alone
b) Carpool
c) Bus
d) Other: _____
e) I do not go to the ski hill.

Car Sharing Privileges:

Car sharing is a program where several households share the use of vehicles for non-commuting trips to avoid the full cost of owning a vehicle or a second vehicle. This might include access to a fleet of vehicles (small truck, minivan, sedan) parked in your neighbourhood for shared use by Glenmore residents (ie. ComPASS holders). These vehicles could be booked online for personal use at a reasonable cost (for example, 40 cents/km, $3/hr). For more info please visit www.modo.coop.

19. In order to be eligible for car sharing, one must have a clean driving record for a minimum of the past 3 years. How many drivers in your household have a safe driving record, that is, no claims in the past 3 years of driving?

a) 1
b) 2
c) 3
d) 4
e) 5
f) Other _____

20. Did you have any previous knowledge of car sharing prior to this survey?

a) YES
b) NO

21. For parts a and b of this question, please mark the appropriate box corresponding to your opinion.

a) If my household had access to a fleet of community owned vehicles that could be booked online my household would use them.

Strongly agree	[ ]
Mildly agree	[ ]
Neutral	[ ]
Mildly disagree	[ ]
Strongly disagree	[ ]
I do not understand the question	[ ]

b) If my household had access to a fleet of community owned vehicles that could be booked online, my household would be willing to own 1 less vehicle.

Strongly agree	[ ]
Mildly agree	[ ]
Neutral	[ ]
Mildly disagree	[ ]
Strongly disagree	[ ]
Do not understand the question	[ ]
I do not own a car	[ ]

<u>Community Shuttle Privileges:</u>

22. It is possible that the community of Glenmore could have access to an exclusive community shuttle bus. This bus would not be intended to replace public transit, but could be available to complement existing transit with special VIP services for ComPASS holders. Examples may be for the shuttle bus to service public events, dinners out, pub crawls, Prospera Place events, the Farmers' Market, rides to school, and holiday shopping. These are all times when driving a vehicle may not be desirable and when parking is limited. If the Glenmore ComPASS design was to include an exclusive community shuttle, which of the following destinations listed would appeal to your household? Please mark all boxes that apply.

	Would use	Would not use
Farmers' market		
Holiday Shopping		
Public Events (Canada day, Mardis Gras, etc.)		
Prospera Place		

Late night downtown shuttle		
Rides to school		

23. Are there any other areas or places you would like to see a Glenmore community shuttle service? Please write in point form.

General ComPASS Design Aspects

24. Please indicate yes, maybe, or no for each of the following possible ComPASS components to tell us which possible ComPASS privileges your household would make use of.

	Yes	Maybe	No
a) Parkinson Recreation Centre	[ ]	[ ]	[ ]
b) Capital News Centre	[ ]	[ ]	[ ]
c) H2O Centre	[ ]	[ ]	[ ]
d) Bike safety training	[ ]	[ ]	[ ]
e) Winery bicycle tours	[ ]	[ ]	[ ]
f) Local merchant discounts	[ ]	[ ]	[ ]
g) Emergency taxi rides home*	[ ]	[ ]	[ ]
h) Bike tune-ups**	[ ]	[ ]	[ ]
i) Glenmore community shuttle	[ ]	[ ]	[ ]
j) More bike rack capacity on buses	[ ]	[ ]	[ ]
k) More bike racks at bus stops	[ ]	[ ]	[ ]
l) More bike racks in commercial areas	[ ]	[ ]	[ ]
m) Glenmore car sharing program	[ ]	[ ]	[ ]
n) Bike sharing program***	[ ]	[ ]	[ ]
o) CanCarts****	[ ]	[ ]	[ ]
p) Big White shuttle	[ ]	[ ]	[ ]
q) I do not understand the question [ ]			

Figure 2: CanCart

*Emergency taxi rides home addresses the risk of not taking your car to every destination. If you use transit and encounter an emergency, as a ComPASS holder, you could receive a free taxi ride to your home.

**A bike tune-up is when you bring your bike into a bicycle store and have adjustments made. Adjustments could include adjusting shifters, brakes, hubs, the headset, minor wheel tune, inflate tires, installation of cable and housing, and lubing the chain.

***Bike sharing is very similar to car sharing, which was described earlier in this survey. For more information, please visit www.bixisystem.com.

****A CanCart is a manoeuvrable bicycle cargo cart which promotes easier movement of goods using low energy transportation modes. The CanCart can be led by hand through shopping aisles, on the sidewalk, and can be taken onto the bus. The CanCart can also be led by a bicycle with a simple attachment procedure. Various CanCarts can be shared throughout a neighbourhood and signed out in advance of use, similar to bike and car sharing. Please see Figure 2 for a picture of a CanCart.

25. Please estimate how often your household might use the following ComPASS privileges. Circle the number for each component.

		Times Per Week					
a)	Parkinson Rec Centre Pool Pass	0	1	2	3	4	5
b)	Capital News Centre (CNC)	0	1	2	3	4	5
c)	H2O Centre Pool Facilities	0	1	2	3	4	5
d)	Local merchant discounts	0	1	2	3	4	5
e)	Bike racks on buses	0	1	2	3	4	5
f)	Bike racks at bus stops	0	1	2	3	4	5
g)	Bike racks in commercial areas	0	1	2	3	4	5
h)	Glenmore community shuttle	0	1	2	3	4	5
		Times Per Month					
i)	Car sharing	0	1	2	3	4	5
j)	Bike sharing	0	1	2	3	4	5
k)	CanCarts	0	1	2	3	4	5
l)	Ski hill shuttle	0	1	2	3	4	5
		Times Per Year					
m)	Bicycle safety training	0	1	2	3	4	5
n)	Emergency taxi rides home	0	1	2	3	4	5
o)	Bike tune-ups	0	1	2	3	4	5
p)	Winery bicycle tours	0	1	2	3	4	5

q) I do not understand the question [ ]

26. While the transit pass component of ComPASS would likely cost less than $10 per month per household based on the successful programs in Boulder, Colorado (total cost per household to give everyone unlimited transit access), other components would likely add to its monthly cost. To help us decide which components should be included in the final ComPASS design, we need to know what monthly value per household you would place on these additional privileges. Your choices do not necessarily reflect the final cost of the ComPASS, but allow us to understand how you value each component. Please circle the value you choose for each component.

a)	Parkinson Rec Centre pass	$8	$6	$4	$2	$0	Unsure
b)	Capital News Centre pass	$8	$6	$4	$2	$0	Unsure
c)	H2O Centre pass	$8	$6	$4	$2	$0	Unsure
d)	Bicycle training	$2	$1.5	$1	$0.5	$0	Unsure
e)	Bicycle winery tours	$6	$4	$2	$1	$0	Unsure
f)	Merchant discounts	$4	$3	$2	$1	$0	Unsure
g)	Emergency taxi rides home	$1	$0.75	$0.5	$0.25	$0	Unsure
h)	Bike tune-ups	$4	$3	$2	$1	$0	Unsure
i)	More bike rack capacity on buses	$1	$0.75	$0.5	$0.25	$0	Unsure
j)	More bike racks at bus stops	$1	$0.75	$0.5	$0.25	$0	Unsure
k)	More bike racks in commercial areas	$1	$0.75	$0.5	$0.25	$0	Unsure
l)	Glenmore community shuttle	$16	$12	$8	$4	$0	Unsure
m)	Car sharing	$2	$1.5	$1	$0.5	$0	Unsure

n)	Bike sharing	$4	$3	$2	$1	$0	Unsure
o)	CanCarts	$4	$3	$2	$1	$0	Unsure
p)	Big White shuttle service	$4	$3	$2	$1	$0	Unsure

q) I do not understand the question [ ]

27. What is the most you would be willing to pay for a ComPASS (i.e. total $ monthly cost for your household)? (we will alternate the order of this list to preclude selection bias/fatigue)

a) $15 or less
b) $25
c) $35
d) $45
e) $55 or more
f) Other:_____

28. Would you use a ComPASS if given the opportunity?

a) YES
b) MAYBE
c) NO

29. If you would not use a ComPASS, would you support it?

a) YES
b) MAYBE
c) NO

Part E: Statistical Data

In this section of the survey we will be looking for general information about your household that will be used to confirm and supplement general census data on the Glenmore area.

30. Please indicate the number of people in your household who fit under the following categories:

	Employed	Unemployed	Retired	Student
How many seniors (65+)	[ ]	[ ]	[ ]	[ ]
How many adults (34-65)	[ ]	[ ]	[ ]	[ ]
How many young adults (19-33)	[ ]	[ ]	[ ]	[ ]
How many youth (5-18)	[ ]	[ ]	[ ]	[ ]
How many children (younger than 5)	[ ]	[ ]	[ ]	[ ]

31. What is your current annual household income (the sum total of all working adults)?

a) 0-$25,000
b) $25,001-$50,000
c) $50,001-$75,000
d) $75,001-$100,000
e) greater than $100,000
f) I would prefer not to say

32. What is your home postal code? Your work/school postal code? Please include postal codes for all working adult members of the household. * If self employed please use home postal code in the work section as well.

Home _____ Work/School _____

33. Do you have any general questions or comments regarding this survey, ComPASS, or transportation needs in Kelowna?

Part F: Travel Diary (Optional)

In order to become eligible for the phase 2 pilot program we will need to know your name, address, and contact information, as well as your daily travel patterns. As with the previous 5 sections, all of this information will remain strictly confidential.

Your name:

Your address:

Your e-mail or phone contact:

In this section we will be acquiring more specific details of your individual travel patterns on a typical weekday. Please fill out a diary summarizing all trips that you made on a recent weekday (see attached travel diary "**A**"), and all trips that you typically make on an average weekday in September (see attached travel diary "**B**"). Please note that a trip means any (e.g. walk, bike, bus, auto trip) made in one-direction from an origin to a destination (e.g. from home to work = 1 trip). A round trip would be counted as two trips.

Travel Diary A
Your most recent weekday:

Trip Number	Purpose	Origin	Departure Time	Primary Mode of Travel	Arrival Time	Cost (eg. Parking)
Sample	To work	Home	8:00 am	Car	8:30 am	$5
Trip 1						
Trip 2						
Trip 3						
Trip 4						
Trip 5						

Travel Diary B
Average weekday in September:

Trip Number	Purpose	Origin	Departure Time	Primary Mode of Travel	Arrival Time	Cost (eg. Parking)
Sample	To work	Home	8:00 am	Car	8:30 am	$5
Trip 1						
Trip 2						
Trip 3						
Trip 4						
Trip 5						

Appendix C Phase 1 Number of Survey Responses

Questions	Number of Responses
Age Distribution	49
Transportation mode used most for recreational trips	49
Transportation mode used most for shopping trips	49
Transportation mode used most for school trips	39
Transportation mode used most for work trips	48
Trip distance to/from work or school	49
Trip duration to/from work or school	49
How often do members of the household use the bus?	49
How often do members of the household cycle for work trips only?	47
How often do members of the household cycle for recreation trips only?	45
How often do members of the household cycle for shopping trips only?	45
How often do members of the household cycle for school only?	42
Why did your household move to the Glenmore neighborhood?	49
Is your household more likely to bike to more cyclist friendly businesses?	49
Is your household more likely to walk to more pedestrian friendly businesses?	48
I would consider riding the bus	49
My household rides the bus because it is the most affordable option.	47
Would your household ride the bus if there were improvements to the service?	49
What would influence your household to use public transit more?	46
Would you use any of the listed possible ComPASS components?	49
What price would your household be willing to pay for each ComPASS component? (per household per month)	45
What overall price would your household be willing to pay for a ComPASS package? (per household per month)	48
Would your household use a ComPASS if given the opportunity?	49
If your answer was no or not sure to the question above, would you support a ComPASS program?	24
Rate traffic congestion in Kelowna	48
Rate transit service in Kelowna	48
Influences to reduce car use for one day a week	49
Why does your household ride the bus?	47

Appendix D Phase 2 Survey 1 (Control & Participating)

*Please have the survey and travel diary completed by latest **Monday, April 23, 2012**. Ellen Morrison will be around to pick up surveys on **Saturday (April 21) between 11am & 1pm**, and again on **Monday (April 23) between 11am & 1pm and between 7pm & 8pm**. If you know you will be away, please leave the completed survey in your mail box visible for Ellen to find it. If you would like to arrange for an alternate pick-up time or day, please contact Ellen.*

Part 1: Household Profile

Household Contact Person:
Name:_____ Address:_____

1. For your reference, these are the people you listed in your household in Survey 1:

Person 1: _____

Person 2: _____
***Please keep this consistent with the rest of the survey.*

Part 2: Travel Behaviours

2. Please estimate the number of one-way TRANSIT trips each person in the household took in the past 7 days (5 round trips = 10 trips).

	Person 1	Person 2	Person 3	Person 4	Person 5	Person 6
Transit trips/week						

3. Please estimate the number of one-way CYCLING trips each person in the household took in the past 7 days (5 round trips = 10 trips).

	Person 1	Person 2	Person 3	Person 4	Person 5	Person 6
Cycling trips/week						

4. Please estimate the number of one-way WALKING trips each person in the household took in the past 7 days (5 round trips = 10 trips).

	Person 1	Person 2	Person 3	Person 4	Person 5	Person 6
Walking trips/week						

5. Please estimate the number of one-way CAR TRIPS AS THE DRIVER each person in the household took in the past 7 days (5 round trips = 10 trips).

	Person 1	Person 2	Person 3	Person 4	Person 5	Person 6
Car (driver) trips/wk						

6. Please estimate the number of one-way CAR TRIPS AS A PASSENGER each person in the household took in the past 7 days (5 round trips = 10 trips).

	Person 1	Person 2	Person 3	Person 4	Person 5	Person 6
Car (passenger) trips/week						

7. Since May 1, Which method of transportation do members of your household use most to travel to work, shopping, recreation, and school? *Choose between the following options:* *car (d) for car as the driver, car (p) for car as a passenger, transit, bike, walk, or N/A for Not Applicable.*

	Person 1	Person 2	Person 3	Person 4	Person 5	Person 6
Work						
Shopping						
Recreation						
School						

8. Approximately how far and how long does each member of your household travel for work, shopping, recreation, and/or school? (write N/A when Not Applicable)

a) Distance (kilometres)

	Person 1	Person 2	Person 3	Person 4	Person 5	Person 6
Work						
Shopping						
Recreation						
School						

b) Time (minutes)

	Person 1	Person 2	Person 3	Person 4	Person 5	Person 6
Work						
Shopping						
Recreation						
School						

9. How many bike tune-ups has your household used since May 1, 2012? _____

10. How many of these bike tune-ups were from the Kelowna Cycle gift certificates? _____

Part 4: Transportation Attitudes & Beliefs

11. What would be the primary reason for your household using transit?

a. Only choice
b. Lower cost
c. Convenience
d. Better for the environment
e. Free bus passes
f. Other (please specify)_____

12. Do you believe the nearest bus stop is within walking distance for your household (Y/N)?

13. I believe ComPASS would be successful in the Glenmore area.

Strongly agree [ ]
Mildly agree [ ]
Neutral [ ]
Mildly disagree [ ]
Strongly disagree [ ]
Don't Know [ ]

14. My household would use a ComPASS if a permanent program was offered in our neighbourhood.

Strongly agree [ ]
Mildly agree [ ]
Neutral [ ]
Mildly disagree [ ]
Strongly disagree [ ]
Don't Know [ ]

15. My household would take TRANSIT more if we owned a ComPASS.

Strongly agree [ ]
Mildly agree [ ]
Neutral [ ]
Mildly disagree [ ]
Strongly disagree [ ]
Don't Know [ ]

16. My household would BIKE more if we owned a ComPASS.

Strongly agree [ ]
Mildly agree [ ]
Neutral [ ]
Mildly disagree [ ]
Strongly disagree [ ]
I do not ride the bus [ ]
Don't Know [ ]

17. My household would WALK more if we owned a ComPASS.

Strongly agree [ ]
Mildly agree [ ]
Neutral [ ]
Mildly disagree [ ]
Strongly disagree [ ]
I do not ride the bus [ ]
Don't Know [ ]

18. If ComPASS were to be implemented permanently in our neighbourhood, my household would support it financially.

Strongly agree [ ]
Mildly agree [ ]
Neutral [ ]
Mildly disagree [ ]
Strongly disagree [ ]
Don't Know [ ]

19. How much do you believe ComPASS is worth and how much would you pay? (total monthly cost for your entire household)?

	Worth ($/month/household)	Willing to Pay ($/month/household)
$/month/household		

Adult bus pass = $60/month, adult Parkinson Rec Center Pass = $49.42/month, bike tune-up=$60

20. What would influence your household to participate in the ComPASS program? Rank the reasons below in order of strongest (= 1) to weakest (= 7) influence by connecting lines between the options and the potential ranks.

Options	Rank
a. Better bike routes	1
b. Higher gas prices	2
c. Price of ComPASS	3
d. Improve transit service	4
e. Increased traffic congestion	5
f. Nothing	6
g. Other: _____	7

21. Please list any other comments you may have regarding the ComPASS program.

Thank you for filling out Survey 1!

Appendix E Phase 2 Survey 2 (Control Group)

Part 1: Household Profile

Household Contact Person:
Name:_____ Address:_____

For your reference, these are the people you listed in your household in Survey 1:

Person 1: _____

Person 2: _____

**Please keep this consistent with the rest of the survey.*

Part 2: Travel Behaviours

1. **Please estimate the number of one-way TRANSIT trips each person in the household took in the past 7 days (5 round trips = 10 trips).**

	Person 1	Person 2	Person 3	Person 4	Person 5	Person 6
Transit trips/week						

2. **Please estimate the number of one-way CYCLING trips each person in the household took in the past 7 days (5 round trips = 10 trips).**

	Person 1	Person 2	Person 3	Person 4	Person 5	Person 6
Cycling trips/week						

3. **Please estimate the number of one-way WALKING trips each person in the household took in the past 7 days (5 round trips = 10 trips).**

	Person 1	Person 2	Person 3	Person 4	Person 5	Person 6
Walking trips/week						

4. **Please estimate the number of one-way CAR TRIPS AS THE DRIVER each person in the household took in the past 7 days (5 round trips = 10 trips).**

	Person 1	Person 2	Person 3	Person 4	Person 5	Person 6
Car (driver) trips/week						

5. **Please estimate the number of one-way CAR TRIPS AS A PASSENGER each person in the household took in the past 7 days (5 round trips = 10 trips).**

	Person 1	Person 2	Person 3	Person 4	Person 5	Person 6
Car (passenger) trips/wk						

6. **Since May 1, which method of transportation did members of your household use most to travel to work, shopping, recreation, and school? *Choose between the following options: "car (d)" for car as the driver, "car (p)" for car as a passenger, "transit", "bike", "walk", or "N/A" for Not Applicable.***

	Person 1	Person 2	Person 3	Person 4	Person 5	Person 6
Work						
Shopping						
Recreation						
School						

7. **Please estimate the last time members of your household took transit, biked, or walked (for pleasure or for travel) in Kelowna. Please estimate a date (mm/dd/yyyy).**

	Person 1	Person 2	Person 3	Person 4	Person 5	Person 6
Transit						
Biked						
Walked						

8. **Has your household had any bike tune-ups since May 1, 2012? (Y / N)**
   a) **How many bike tune-ups were done by household members/friends? _____**
   b) **How many bike tune-ups were done by a bike shop/store? _____**

Part 3: Local Merchants

9. **How many times did members in your household use the Parkinson Recreation Centre gym facility and pool facility in the past 7 days?**

	Person 1	Person 2	Person 3	Person 4	Person 5	Person 6
Gym Facility						
Pool Facility						

10. **Has your household been to de Bakker's Kitchen restaurant since May 1? (Y / N)**

11. **Has your household been to the Glenmore Marketplace IGA since May 1? (Y / N)**

12. **Has your household shopped at Kelowna Cycle since May 1? (Y / N)**

13. **Have members in your household taken a taxi ride for an emergency since May 1? (Y/N)**

Part 4: Transportation Attitudes & Beliefs

For your reference, ComPASS is a community transportation pass for residents. It would give all household members transit passes, recreation center passes, merchant discounts, bike tune-ups, and emergency taxi rides home for a discounted price. The objective of a ComPASS program is to provide a transportation pass that can compete with and reduce personal vehicle use in favour of transit, biking, and walking.

14. I believe ComPASS would be successful in the Glenmore area.

Strongly agree	[ ]
Mildly agree	[ ]
Neutral	[ ]
Mildly disagree	[ ]
Strongly disagree	[ ]
Don't Know	[ ]

15. My household would use a ComPASS if a permanent program was offered in our neighbourhood.

Strongly agree	[ ]
Mildly agree	[ ]
Neutral	[ ]
Mildly disagree	[ ]
Strongly disagree	[ ]
Don't Know	[ ]

16. If ComPASS were to be implemented permanently in our neighbourhood, my household would support it financially.

Strongly agree	[ ]
Mildly agree	[ ]
Neutral	[ ]
Mildly disagree	[ ]
Strongly disagree	[ ]
Don't Know	[ ]

17. My household would take TRANSIT more if we owned a ComPASS.

Strongly agree	[ ]
Mildly agree	[ ]
Neutral	[ ]
Mildly disagree	[ ]
Strongly disagree	[ ]
Don't Know	[ ]

18. My household would BIKE more if we owned a ComPASS.

Strongly agree	[ ]
Mildly agree	[ ]
Neutral	[ ]
Mildly disagree	[ ]
Strongly disagree	[ ]
Don't Know	[ ]

19. My household would WALK more if we owned a ComPASS.

Strongly agree	[ ]
Mildly agree	[ ]
Neutral	[ ]
Mildly disagree	[ ]
Strongly disagree	[ ]
Don't Know	[ ]

20. How much do you believe ComPASS is worth and how much would you pay? (total monthly cost for your entire household)?

	Worth ($/month/household)	Willing to Pay ($/month/household)
$/month/household		

Adult bus pass = $60/month, adult Parkinson Rec Center Pass = $49.42/month, bike tune-up=$60

21. What would influence your household to participate in the ComPASS program? Rank the reasons below in order of strongest (= 1) to weakest (= 7) influence by connecting lines between the options and the potential ranks.

Options	Rank
a. Better bike routes	1
b. Higher gas prices	2
c. Price of ComPASS	3
d. Improved transit service	4
e. Increased traffic congestion	5
f. Nothing	6
g. Other: _____	7

22. What would be the primary reason for your household using transit? (Choose the best answer for your household).

a. Only choice
b. Lower cost
c. Convenience
d. Better for the environment
e. Free bus passes
f. Other (please specify)_____

23. From 1 to 10, where 1 is very unsatisfied and 10 is very satisfied, how would your household rate the following facilities/services in Kelowna?

	Transit Facilities & Service	Bike Facilities & Services	Pedestrian Facilities & Services
Rate			

24. Do you believe the nearest bus stop is within walking distance for your household (Y / N)?

Part 5: General Program Evaluation

25. Since May 1, please list any barriers your household has faced that may have prevented household members from using active transport (transit, biking, walking, etc).

26. List any suggestions you have for an improved ComPASS pilot program (eg. more information, more guidance, etc)

27. Please list any other comments you may have regarding the ComPASS program.

28. We would like to have a promotional event to check in, share stories, and get the word out about ComPASS in your neighbourhood. Please tick all dates/times that would work for your household to attend:

	Monday	Tuesday	Wednesday	Thursday	Friday
	July 9	July 10	July 11	July 12	July 13
Afternoon					
Evening					

None of these days/times work for my household [ ]

Thank you for filling out Survey 2!

Appendix F Phase 2 Survey 2 (Participating Group)

Part 1: Household Profile

Household Contact Person:
Name:_____ Address:_____

For your reference, these are the people you listed in your household in Survey 1:

Person 1: _____

Person 2: _____

***Please keep this consistent with the rest of the survey.*

Part 2: Travel Behaviours

1. Please estimate the number of one-way TRANSIT trips each person in the household took in the past 7 days (5 round trips = 10 trips).

	Person 1	Person 2	Person 3	Person 4	Person 5	Person 6
Transit trips/week						

1. Please estimate the number of one-way CYCLING trips each person in the household took in the past 7 days (5 round trips = 10 trips).

	Person 1	Person 2	Person 3	Person 4	Person 5	Person 6
Cycling trips/week						

2. Please estimate the number of one-way WALKING trips each person in the household took in the past 7 days (5 round trips = 10 trips).

	Person 1	Person 2	Person 3	Person 4	Person 5	Person 6
Walking trips/week						

3. Please estimate the number of one-way CAR TRIPS AS THE DRIVER each person in the household took in the past 7 days (5 round trips = 10 trips).

	Person 1	Person 2	Person 3	Person 4	Person 5	Person 6
Car (driver) trips/week						

4. Please estimate the number of one-way CAR TRIPS AS A PASSENGER each person in the household took in the past 7 days (5 round trips = 10 trips).

	Person 1	Person 2	Person 3	Person 4	Person 5	Person 6
Car (passenger) trips/wk						

5. **Since May 1, which method of transportation did members of your household use most to travel to work, shopping, recreation, and school? *Choose between the following options: "car (d)" for car as the driver, "car (p)" for car as a passenger, "transit", "bike", "walk", or "N/A" for Not Applicable.***

	Person 1	Person 2	Person 3	Person 4	Person 5	Person 6
Work						
Shopping						
Recreation						
School						

6. **Please estimate the last time members of your household took transit, biked, or walked (for pleasure or for travel) in Kelowna. Please estimate a date (mm/dd/yyyy).**

	Person 1	Person 2	Person 3	Person 4	Person 5	Person 6
Transit						
Biked						
Walked						

7. **Has your household had any bike tune-ups since May 1, 2012? (Y / N)**
   a) **How many bike tune-ups were done by household members/friends? _____**
   b) **How many bike tune-ups were done by a bike shop/store? _____**

Part 3: ComPASS Component Use

8. **How many times did members in your household use the Parkinson Recreation Centre gym facility and pool facility in the past 7 days?**

	Person 1	Person 2	Person 3	Person 4	Person 5	Person 6
Gym Facility						
Pool Facility						

9. **Have you used the de Bakker's Free Pizza Coupon? (Y / N)**

10. **How much has your household spent so far from the merchant gift certificates?**

	De Bakker's $20 Gift Certificate	Marketplace IGA $65 Gift Certificate
Amount Spent ($)		

11. **How many bike tune-ups from Kelowna Cycle has your household used? _____**

12. **Did your household use the 10% discount at Kelowna Cycle on in-store clothing, parts & accessories? (Y / N)**

13. **How many ComPASS Emergency Taxi Rides Home from Checkmate Cabs has your household used? _____**

Part 4: ComPASS Component Evaluation

14. How would members in your household rate Kelowna's transit service on a scale of 1 to 10, where 1 is very unsatisfied and 10 is very satisfied. If a member has not used transit, you may indicate N/A.

	Person 1	Person 2	Person 3	Person 4	Person 5	Person 6
Rate						

15. How would members in your household rate the Parkinson Recreation Center gym facility and pool facility on a scale of 1 to 10, where 1 is very unsatisfied and 10 is very satisfied. If a member has not used this service, you may indicate N/A.

	Person 1	Person 2	Person 3	Person 4	Person 5	Person 6
Gym Facility						
Pool Facility						

16. How would your household rate the local merchant gift certificate ComPASS component (de Bakker's and IGA) from 1 to 10, where 1 is very unsatisfied and 10 is very satisfied. If a member has not used this service, you may indicate N/A.

	Person 1	Person 2	Person 3	Person 4	Person 5	Person 6
De Bakker's						
IGA						

17. How would members in your household rate the bike tune-up service at Kelowna Cycle from 1 to 10, where 1 is very unsatisfied and 10 is very satisfied? If a member has not used this service, you may indicate N/A.

	Person 1	Person 2	Person 3	Person 4	Person 5	Person 6
Rate						

18. How would members in your household rate the emergency taxi ride service from Checkmate Cabs from 1 to 10, where 1 is very unsatisfied and 10 is very satisfied? If a member has not used this service, you may indicate N/A.

	Person 1	Person 2	Person 3	Person 4	Person 5	Person 6
Rate						

Part 5: Transportation Attitudes & Beliefs

19. From 1 to 10, where 1 is very unsatisfied and 10 is very satisfied, how would your household rate the following facilities/services in Kelowna?

	Transit Facilities & Service	Bike Facilities & Services	Pedestrian Facilities & Services
Rate			

20. What would be the primary reason for your household using transit? (Choose the best answer for your household).

a. Only choice
b. Lower cost
c. Convenience
d. Better for the environment
e. Free bus passes
f. Other (please specify)_____

21. I believe ComPASS would be successful in the Glenmore area.

Strongly agree	[ ]
Mildly agree	[ ]
Neutral	[ ]
Mildly disagree	[ ]
Strongly disagree	[ ]
Don't Know	[ ]

22. My household would use a ComPASS if a permanent program was offered in our neighbourhood.

Strongly agree	[ ]
Mildly agree	[ ]
Neutral	[ ]
Mildly disagree	[ ]
Strongly disagree	[ ]
Don't Know	[ ]

23. If ComPASS were to be implemented permanently in our neighbourhood, my household would support it financially.

Strongly agree	[ ]
Mildly agree	[ ]
Neutral	[ ]
Mildly disagree	[ ]
Strongly disagree	[ ]
Don't Know	[ ]

24. My household would take TRANSIT more if we owned a ComPASS.

Strongly agree	[ ]
Mildly agree	[ ]
Neutral	[ ]
Mildly disagree	[ ]
Strongly disagree	[ ]
Don't Know	[ ]

25. My household would BIKE more if we owned a ComPASS.

Strongly agree	[ ]
Mildly agree	[ ]
Neutral	[ ]
Mildly disagree	[ ]
Strongly disagree	[ ]
Don't Know	[ ]

26. My household would WALK more if we owned a ComPASS.

Strongly agree	[ ]
Mildly agree	[ ]
Neutral	[ ]
Mildly disagree	[ ]
Strongly disagree	[ ]
Don't Know	[ ]

27. Do you believe the nearest bus stop is within walking distance for your household (Y / N)?

28. How much do you believe ComPASS is worth and how much would you pay? (total monthly cost for your entire household)?

	Worth ($/month/household)	Willing to Pay ($/month/household)
$/month/household		

**Adult bus pass = $60/month, adult Parkinson Rec Center Pass = $49.42/month, bike tune-up = $60

29. What would influence your household to participate in the ComPASS program? Rank the reasons below in order of strongest (= 1) to weakest (= 7) influence by connecting lines between the options and the potential ranks.

Options	Rank
a. Better bike routes	1
b. Higher gas prices	2
c. Price of ComPASS	3
d. Improved transit service	4
e. Increased traffic congestion	5
f. Nothing	6
g. Other: _____	7

Part 6: General Program Evaluation

30. My household found that the initial information sheet that came with the ComPASS package was helpful.

Strongly agree	[ ]
Mildly agree	[ ]
Neutral	[ ]
Mildly disagree	[ ]
Strongly disagree	[ ]
Don't Know	[ ]

Suggest information sheet improvements:

31. My household would like to receive more information regarding the following (mark all that apply):

Biking	[ ]
Walking	[ ]
Kelowna Transit	[ ]
Parkinson Recreation Center	[ ]
Emergency Taxi Rides Home	[ ]
Kelowna Cycle Bike Tune-ups	[ ]
Merchant Gift Certificates	[ ]
Other : _____	[ ]

32. **In this pilot study, have you experienced any barriers to using components of the ComPASS? If so, please elaborate.**

33. **List any suggestions you have for an improved ComPASS program (eg. more/less ComPASS components, more information, more guidance, etc)**

34. **Please list any other comments you may have regarding the ComPASS program.**

Thank you for filling out Survey 2!

Appendix G Phase 2 Survey 3 (Control Group)

*Please have the survey and travel diary completed by **Wednesday, September 26, 2012**. Ellen Morrison will be around to pick up surveys between **11am - 1pm** and **7pm – 8pm** on **Monday, Tuesday, and Wednesday (Sept 24, 25, & 26)**. If you know you will be away, please leave the completed survey in your mail box or under your door mat visible for Ellen to find it. If you would like to arrange for an alternate pick-up time or day, please contact Ellen.*

Part 1: Household Profile

Household Contact Person:
Name:_____ Address:_____

For your reference, these are the people you listed in your household in Survey 1:

Person 1: _____

Person 2: _____

***Please keep this consistent with the rest of the survey.*

Part 2: Travel Behaviours

1. Please estimate the number of one-way TRANSIT trips each person in the household took in the past 7 days (5 round trips = 10 trips).

	Person 1	Person 2	Person 3	Person 4	Person 5	Person 6
Transit trips/week						

2. Please estimate the number of one-way CYCLING trips each person in the household took in the past 7 days (5 round trips = 10 trips).

	Person 1	Person 2	Person 3	Person 4	Person 5	Person 6
Cycling trips/week						

3. Please estimate the number of one-way WALKING trips each person in the household took in the past 7 days (5 round trips = 10 trips).

	Person 1	Person 2	Person 3	Person 4	Person 5	Person 6
Walking trips/week						

4. Please estimate the number of one-way CAR TRIPS AS THE DRIVER each person in the household took in the past 7 days (5 round trips = 10 trips).

	Person 1	Person 2	Person 3	Person 4	Person 5	Person 6
Car (driver) trips/wk						

5. Please estimate the number of one-way CAR TRIPS AS A PASSENGER each person in the household took in the past 7 days (5 round trips = 10 trips).

	Person 1	Person 2	Person 3	Person 4	Person 5	Person 6
Car (passenger) trips/wk						

6. **Since August 1, which method of transportation did members of your household use most to travel to work, shopping, recreation, and school? *Choose between the following options: "car (d)" for car as the driver, "car (p)" for car as a passenger, "transit", "bike", "walk", or "N/A" for Not Applicable.***

	Person 1	Person 2	Person 3	Person 4	Person 5	Person 6
Work						
Shopping						
Recreation						
School						

7. **Please estimate the last time members of your household took transit, biked, or walked (for pleasure or for travel) in Kelowna. Please estimate a date (mm/dd/yyyy).**

	Person 1	Person 2	Person 3	Person 4	Person 5	Person 6
Transit						
Biked						
Walked						

8. **Has your household had any bike tune-ups since the last survey? (Y / N)**
   a) **How many of these bike tune-ups were done by household members/friends? _____**
   b) **How many bike tune-ups were done by a bike shop/store? _____**

Part 3: Local Merchants

9. **How many times did members in your household use the Parkinson Recreation Centre gym facility and pool facility in the past 7 days?**

	Person 1	Person 2	Person 3	Person 4	Person 5	Person 6
Gym Facility						
Pool Facility						

10. **Has your household been to de Bakker's Kitchen restaurant since the last survey*? (Y/N)**
*The last survey was taken around June 25, 2012.

11. **Has your household been to the Glenmore Marketplace IGA since the last survey? (Y/N)**

12. **Has your household shopped at Kelowna Cycle since the last survey? (Y / N)**

13. **Have household members taken an emergency taxi ride since the last survey? (Y / N)**

14. **How would members in your household rate the Parkinson Recreation Center gym facility and pool facility on a scale of 1 to 10, where 1 is very unsatisfied and 10 is very satisfied. If a member has not used these services before, you may indicate N/A.**

	Person 1	Person 2	Person 3	Person 4	Person 5	Person 6
Gym Facility						
Pool Facility						

15. How would your household rate the following local merchants (de Bakker's and IGA) from 1 to 10, where 1 is very unsatisfied and 10 is very satisfied. If a member has not used these merchants before, you may indicate N/A.

	Person 1	Person 2	Person 3	Person 4	Person 5	Person 6
De Bakker's						
IGA						

16. How would members in your household rate the bike tune-up service at Kelowna Cycle from 1 to 10, where 1 is very unsatisfied and 10 is very satisfied? If a member has not used this service before, you may indicate N/A.

	Person 1	Person 2	Person 3	Person 4	Person 5	Person 6
Rate						

Part 4: Transportation Attitudes and Beliefs

17. How would members in your household rate Kelowna's transit service on a scale of 1 to 10, where 1 is very unsatisfied and 10 is very satisfied. If a member has not used transit, you may indicate N/A.

	Person 1	Person 2	Person 3	Person 4	Person 5	Person 6
Rate						

18. Please list any positives or negatives of using transit in Kelowna that your household may have encountered.

19. Do you believe the nearest bus stop is within walking distance for your household (Y / N)?

20. How would your household rate the following facilities/services in Kelowna, from 1 to 10, where 1 is very unsatisfied and 10 is very satisfied?

	Transit Facilities/Service	Bike Facilities/Services	Pedestrian Facilities/ Services
Rate			

21. What would be the primary reason for your household using transit? (Choose the best answer for your household).

a. Only choice
b. Lower cost
c. Convenience
d. Better for the environment
e. Free bus passes
f. Other (please specify)_____

Part 5: ComPASS Attutudes & Beliefs

For your reference, ComPASS is a community transportation pass for residents. It would give all household members transit passes, recreation center passes, merchant discounts, bike tune-ups, and emergency taxi rides home for a discounted price. The objective of a ComPASS program is to provide a transportation pass that can compete with and reduce personal vehicle use in favour of transit, biking, and walking.

22. I believe ComPASS would be successful in the Glenmore area.

Strongly agree	[ ]
Mildly agree	[ ]
Neutral	[ ]
Mildly disagree	[ ]
Strongly disagree	[ ]
Don't Know	[ ]

23. My household would use a ComPASS if a permanent program was offered in our neighbourhood.

Strongly agree	[ ]
Mildly agree	[ ]
Neutral	[ ]
Mildly disagree	[ ]
Strongly disagree	[ ]
Don't Know	[ ]

24. If ComPASS were to be implemented permanently in our neighbourhood, my household would support it financially.

Strongly agree	[ ]
Mildly agree	[ ]
Neutral	[ ]
Mildly disagree	[ ]
Strongly disagree	[ ]
Don't Know	[ ]

25. My household would take TRANSIT more if we owned a ComPASS.

Strongly agree	[ ]
Mildly agree	[ ]
Neutral	[ ]
Mildly disagree	[ ]
Strongly disagree	[ ]
Don't Know	[ ]

26. My household would BIKE more if we owned a ComPASS.

Strongly agree	[ ]
Mildly agree	[ ]
Neutral	[ ]
Mildly disagree	[ ]
Strongly disagree	[ ]
Don't Know	[ ]

27. My household would WALK more if we owned a ComPASS.

Strongly agree	[ ]
Mildly agree	[ ]
Neutral	[ ]
Mildly disagree	[ ]
Strongly disagree	[ ]
Don't Know	[ ]

28. My household uses transit more after the ComPASS pilot study completed (after August 1) compared to before the ComPASS pilot study started (before May 1).

Strongly agree [ ]
Mildly agree [ ]
Neutral [ ]
Mildly disagree [ ]
Strongly disagree [ ]
Don't Know [ ]

29. The overall physical health of my household has improved since the ComPASS pilot study started (after May 1) compared to before the ComPASS pilot study started (before May 1).

Strongly agree [ ]
Mildly agree [ ]
Neutral [ ]
Mildly disagree [ ]
Strongly disagree [ ]
Don't Know [ ]

30. How much do you believe ComPASS is worth and how much would you pay? (total monthly cost for your entire household)?

	Worth ($/month/household)	Willing to Pay ($/month/household)
$/month/household		

Adult bus pass = $60/month, adult Parkinson Rec Center Pass = $49.42/month, bike tune-up=$60

31. What would influence your household to participate in the ComPASS program? Rank the reasons below in order of strongest (= 1) to weakest (= 7) influence by connecting lines between the options and the potential ranks.

Options	Rank
a. Better bike routes	1
b. Higher gas prices	2
c. Price of ComPASS	3
d. Improved transit service	4
e. Increased traffic congestion	5
f. Nothing	6
g. Other: _____	7

32. Would your household participate in a permanent ComPASS program if one was implemented in your neighbourhood? (Y / N)

33. If the answer was NO to the previous question, please describe any reasons why your household would not participate in a permanent ComPASS program.

Part 6: Future Program Potential

34. Please estimate how many FEWER car trips in a typical WEEK each member of your household would make as the passenger or as the driver if a permanent ComPASS program was implemented in your neighbourhood. (1 round trip = 2 trips).

	Person 1	Person 2	Person 3	Person 4	Person 5	Person 6
# Fewer Car (d) Trips/wk						
# Fewer Car (p) Trips/wk						

35. Please estimate how many MORE trips in a typical WEEK each member of your household would make using the following transportation modes if a permanent ComPASS program was implemented in your neighbourhood. (1 round trip = 2 trips).

	Person 1	Person 2	Person 3	Person 4	Person 5	Person 6
# More Transit Trips/Week						
# More Biking Trips/Week						
# More Walking Trips/Wk						

36. Please estimate how often members of your household would use the following components if a permanent ComPASS program was implemented in your neighbourhood (see the definition of ComPASS under "Part 4"). For each household member please write the number of times per week, month, or year (e.g. "X/week", "X/month, "X/year").

	Person 1	Person 2	Person 3	Person 4	Person 5	Person 6
Gym Pass						
Pool Pass						
Local Merchant Discounts						
Bike Tune-up Service						
Emergency Taxi Rides Home						

37. Would any members of your household be interested in becoming a neighbourhood coordinator to help start up a ComPASS program in your neighbourhood? (Mark an "X" for all that may be interested).**

	Person 1	Person 2	Person 3	Person 4	Person 5	Person 6
Possible Volunteer						

**Volunteers who recruit participants in their neighbourhood and gather cheques from participants to raise the required money for a ComPASS program.

38. If a ComPASS program was implemented permanently in your neighbourhood, how would your household prefer to pay? (This is for research purposes – this does not mean a particular method will necessarily happen!)

a. Credit Card
b. Through property taxes
c. Cheque
d. Other (please specify): _____

39. If a ComPASS program was implemented permanently in your neighbourhood, which payment plans would your household be open to using?

	Positives	Negatives	YES	NO
Add ComPASS fees to property taxes for whole neighbourhood.	- Cost will be lower for each household - Less work for neighbourhood coordinators - More program stability	- Some households would pay even if they do not use the ComPASS.		
Only those who want to participate contribute money to the program.	- Those who will not use the pass will not have to contribute. - Anyone can contribute if they want, even if they do not use the pass - A household can choose how much they want to contribute as long as the whole neighbourhood raises a minimum amount to cover costs for the ComPASS components.	- More work for neighbourhood coordinators (gathering cheques & participants) - The cost may be higher for each household since there would be fewer contributors. - If enough money is not raised, the program may not go forward.		

40. If the two payment plans mentioned in the previous question do not appeal to you, do you have an alternative suggestion? If so, please describe below.

<u>Part 7: General Program Evaluation</u>

41. Since the last survey, please list any barriers your household has faced that may have prevented household members from using active transport (transit, biking, walking, etc).

42. List any suggestions you have for an improved ComPASS pilot program (eg. more information, more guidance, etc)

43. Please list any other comments or suggestions you may have regarding the ComPASS program.

Thank you for filling out Survey 3!

Appendix H Phase 2 Survey 3 (Participating Group)

*Please have the survey and travel diary completed by **Wednesday, September 26, 2012**. Ellen Morrison will be around to pick up surveys between **11am - 1pm** and **7pm – 8pm** on **Monday, Tuesday, and Wednesday (Sept 24, 25, & 26)**. If you know you will be away, please leave the completed survey in your mail box or under your door mat visible for Ellen to find it. If you would like to arrange for an alternate pick-up time or day, please contact Ellen.*

Part 1: Household Profile

Household Contact Person:
Name:_____ Address:_____

For your reference, these are the people you listed in your household in Survey 1:

Person 1: _____

Person 2: _____

***Please keep this consistent with the rest of the survey.*

Part 2: Travel Behaviours

1. Please estimate the number of one-way TRANSIT trips each person in the household took in the past 7 days (5 round trips = 10 trips).

	Person 1	Person 2	Person 3	Person 4	Person 5	Person 6
Transit trips/week						

2. Please estimate the number of one-way CYCLING trips each person in the household took in the past 7 days (5 round trips = 10 trips).

	Person 1	Person 2	Person 3	Person 4	Person 5	Person 6
Cycling trips/week						

3. Please estimate the number of one-way WALKING trips each person in the household took in the past 7 days (5 round trips = 10 trips).

	Person 1	Person 2	Person 3	Person 4	Person 5	Person 6
Walking trips/week						

4. Please estimate the number of one-way CAR TRIPS AS THE DRIVER each person in the household took in the past 7 days (5 round trips = 10 trips).

	Person 1	Person 2	Person 3	Person 4	Person 5	Person 6
Car (driver) trips/wk						

5. Please estimate the number of one-way CAR TRIPS AS A PASSENGER each person in the household took in the past 7 days (5 round trips = 10 trips).

	Person 1	Person 2	Person 3	Person 4	Person 5	Person 6
Car (passenger)trips/wk						

6. **Since August 1, which method of transportation did members of your household use most to travel to work, shopping, recreation, and school? *Choose between the following options: "car (d)" for car as the driver, "car (p)" for car as a passenger, "transit", "bike", "walk", or "N/A" for Not Applicable.***

	Person 1	Person 2	Person 3	Person 4	Person 5	Person 6
Work						
Shopping						
Recreation						
School						

7. **Please estimate the last time members of your household took transit, biked, or walked (for pleasure or for travel) in Kelowna. Please estimate a date (mm/dd/yyyy).**

	Person 1	Person 2	Person 3	Person 4	Person 5	Person 6
Transit						
Biked						
Walked						

8. **Has your household had any bike tune-ups since the last survey? (Y / N)**
   a) **How many of these bike tune-ups were done by household members/friends? _____**
   b) **How many bike tune-ups were done by a bike shop/store? _____**

Part 3: Merchant & Facility Use

9. **How many times did members in your household use the Parkinson Recreation Centre gym facility and pool facility in the past 7 days?**

	Person 1	Person 2	Person 3	Person 4	Person 5	Person 6
Gym Facility						
Pool Facility						

10. **Have you used the de Bakker's Free Pizza Coupon? (Y / N)**

11. **How much has your household spent so far from the merchant gift certificates?**

	De Bakker's $20 Gift Certificate	Marketplace IGA $65 Gift Certificate
Amount Spent ($)		

12. **In total, how many bike tune-ups from Kelowna Cycle has your household used? _____**

13. **Did your household use the 10% discount at Kelowna Cycle on in-store clothing, parts & accessories? (Y / N)**

14. **How many ComPASS Emergency Taxi Rides Home from Checkmate Cabs has your household used? _____**

Part 4: ComPASS Component Evaluation

15. How would members in your household rate the Parkinson Recreation Center gym facility and pool facility on a scale of 1 to 10, where 1 is very unsatisfied and 10 is very satisfied. If a member has not used this service, you may indicate N/A.

	Person 1	Person 2	Person 3	Person 4	Person 5	Person 6
Gym Facility						
Pool Facility						

16. How would your household rate the local merchant gift certificate ComPASS component (de Bakker's and IGA) from 1 to 10, where 1 is very unsatisfied and 10 is very satisfied. If a member has not used this service, you may indicate N/A.

	Person 1	Person 2	Person 3	Person 4	Person 5	Person 6
De Bakker's						
IGA						

17. How would members in your household rate the bike tune-up service at Kelowna Cycle from 1 to 10, where 1 is very unsatisfied and 10 is very satisfied? If a member has not used this service, you may indicate N/A.

	Person 1	Person 2	Person 3	Person 4	Person 5	Person 6
Rate						

18. How would members in your household rate the emergency taxi ride home service from Checkmate Cabs from 1 to 10, where 1 is very unsatisfied and 10 is very satisfied? If a member has not used this service, you may indicate N/A.

	Person 1	Person 2	Person 3	Person 4	Person 5	Person 6
Rate						

Part 5: Transportation Attitudes & Beliefs

19. How would your household rate the following facilities/services in Kelowna, from 1 to 10, where 1 is very unsatisfied and 10 is very satisfied?

	Transit Facilities & Service	Bike Facilities & Services	Pedestrian Facilities & Services
Rate			

20. What would be the primary reason for your household using transit? (Choose the best answer for your household).

a. Only choice
b. Lower cost
c. Convenience
d. Better for the environment
e. Free bus passes
f. Other (please specify)_____

21. Do you believe the nearest bus stop is within walking distance for your household (Y / N)?

22. How would members in your household rate <u>Kelowna's transit service</u> on a scale of 1 to 10, where 1 is very unsatisfied and 10 is very satisfied. If a member has not used transit, you may indicate N/A.

	Person 1	Person 2	Person 3	Person 4	Person 5	Person 6
Rate						

23. Please list any positives or negatives of using transit in Kelowna that your household encountered during the ComPASS pilot study.

<u>Part 6: ComPASS Attitudes & Beliefs</u>

24. I believe ComPASS would be successful in the Glenmore area.

Strongly agree [ ]
Mildly agree [ ]
Neutral [ ]
Mildly disagree [ ]
Strongly disagree [ ]
Don't Know [ ]

25. My household would use a ComPASS if a permanent program was offered in our neighbourhood.

Strongly agree [ ]
Mildly agree [ ]
Neutral [ ]
Mildly disagree [ ]
Strongly disagree [ ]
Don't Know [ ]

26. If ComPASS were to be implemented permanently in our neighbourhood, my household would support it financially.

Strongly agree [ ]
Mildly agree [ ]
Neutral [ ]
Mildly disagree [ ]
Strongly disagree [ ]
Don't Know [ ]

27. My household would take TRANSIT more if we owned a ComPASS.

Strongly agree [ ]
Mildly agree [ ]
Neutral [ ]
Mildly disagree [ ]
Strongly disagree [ ]
Don't Know [ ]

28. My household would BIKE more if we owned a ComPASS.

Strongly agree [ ]
Mildly agree [ ]
Neutral [ ]
Mildly disagree [ ]
Strongly disagree [ ]
Don't Know [ ]

29. My household would WALK more if we owned a ComPASS.

Strongly agree	[ ]
Mildly agree	[ ]
Neutral	[ ]
Mildly disagree	[ ]
Strongly disagree	[ ]
Don't Know	[ ]

30. My household uses transit more after the ComPASS pilot study completed (after August 1) compared to before the ComPASS pilot study started (before May 1).

Strongly agree	[ ]
Mildly agree	[ ]
Neutral	[ ]
Mildly disagree	[ ]
Strongly disagree	[ ]
Don't Know	[ ]

31. The overall physical health of my household has improved since the ComPASS pilot study started (after May 1) compared to before the ComPASS pilot study started (before May 1).

Strongly agree	[ ]
Mildly agree	[ ]
Neutral	[ ]
Mildly disagree	[ ]
Strongly disagree	[ ]
Don't Know	[ ]

32. After having experienced the ComPASS program for 3 months, would your household participate in a permanent ComPASS program in the future? (Y / N)

33. If the answer was NO to the previous question, please describe any reasons why your household would not participate.

34. How much do you believe ComPASS is worth and how much would you pay? (total monthly cost for your entire household)?

	Worth ($/month/household)	Willing to Pay ($/month/household)
$/month/household		

**Adult bus pass = $60/month, adult Parkinson Rec Center Pass = $49.42/month, bike tune-up = $60

35. What would influence your household to participate in the ComPASS program? Rank the reasons below in order of strongest (= 1) to weakest (= 7) influence by connecting lines between the options and the potential ranks.

Options	Rank
a. Better bike routes	1
b. Higher gas prices	2
c. Price of ComPASS	3
d. Improved transit service	4
e. Increased traffic congestion	5
f. Nothing	6
g. Other: _____	7

Part 7: Future Program Potential

36. Please estimate how many FEWER car trips in a typical WEEK each member of your household would make as the passenger or as the driver if a permanent ComPASS program was implemented in your neighbourhood. (1 round trip = 2 trips).

	Person 1	Person 2	Person 3	Person 4	Person 5	Person 6
# Fewer Car (Driver) Trips/wk						
# Fewer Car (Passenger) Trips/wk						

37. Please estimate how many MORE trips in a typical WEEK each member of your household would make using the following transportation modes if a permanent ComPASS program was implemented in your neighbourhood. (1 round trip = 2 trips)

	Person 1	Person 2	Person 3	Person 4	Person 5	Person 6
# More Transit Trips/Week						
# More Biking Trips/Week						
# More Walking Trips/Week						

38. Please estimate how often members of your household would use the following components if a permanent ComPASS program was implemented in your neighbourhood. For each household member please write the number of times per week, month, or year (e.g. "X/week", "X/month, "X/year").

	Person 1	Person 2	Person 3	Person 4	Person 5	Person 6
Gym Pass						
Pool Pass						
Local Merchant Discounts						
Bike Tune-up Service						
Emergency Taxi Rides Home						

39. Would any members of your household be interested in becoming a neighbourhood coordinator* to help start up a ComPASS program in your neighbourhood? (Mark an "X" for all that may be interested).

	Person 1	Person 2	Person 3	Person 4	Person 5	Person 6
Possible Volunteer						

*Volunteers who recruit participants in their neighbourhood and gather cheques from participants to raise the required money for a ComPASS program.

40. If a ComPASS program was implemented permanently in your neighbourhood, how would your household prefer to pay? (This is for research purposes – this does not mean a particular method will necessarily happen!)

a. Credit Card
b. Through property taxes
c. Cheque
d. Other (please specify):_____

41. If a ComPASS program was implemented permanently in your neighbourhood, which payment plans would your household be open to using?

	Positives	Negatives	YES	NO
Add ComPASS fees to property taxes for whole neighbourhood.	- Cost will be lower for each household - Less work for neighbourhood coordinators - More program stability	- Some households would pay even if they do not use the ComPASS.		
Only those who want to participate contribute money to the program.	- Those who will not use the pass will not have to contribute. - Anyone can contribute if they want, even if they do not use the pass - A household can choose how much they want to contribute as long as the whole neighbourhood raises a minimum amount to cover costs for the ComPASS components.	- More work for neighbourhood coordinators (gathering cheques & participants) - The cost may be higher for each household since there would be fewer contributors. - If enough money is not raised, the program may not go forward.		

42. If the two payment plans mentioned in the previous question do not appeal to you, do you have an alternative suggestion? If so, please describe below.

<u>Part 8: General Program Evaluation</u>

43. In this pilot study, have you experienced any barriers to using components of the ComPASS? If so, please elaborate.

44. Please outline any new/interesting/fun experiences members of your household encountered by using the ComPASS during the pilot study.

45. List any suggestions you have for an improved ComPASS program (eg. more/less ComPASS components, more information, more guidance, etc)

46. Please list any other comments you may have regarding the ComPASS program.

Thank you for filing out Survey 3!

Appendix I Phase 2 Trip Diary

Household Contact Name: _____ _____

Household Address:_____ _____

Please fill out a travel diary summarizing all trips that you and your household made on **<insert date>**. A trip means any travel (e.g. walk, bike, bus, car (driver), or car (passenger)) made in 1 direction (e.g. from home to work = 1 trip). A round trip would be counted as 2 trips.

Trip Number	Household Member Name	Purpose (if shopping use merchant name)	Origin (Main Intersection or Major Hub)	Destination (Main Intersection or Major Hub	Departure Time	Primary Mode of Travel	Arrival Time	Costs (eg. Parking/gas/ etc)
Sample	*Ellen*	*To work*	*Hwy 97/ McCurdy Rd.*	*Hwy 97/ Spall Rd.*	*8:00 am*	*Car (driver)*	*8:20 am*	*$5*
Trip 1								
Trip 2								
Trip 3								
Trip 4								
Trip 5								
Trip 6								
Trip 7								
Trip 8								
Trip 9								
Trip 10								
Trip 11								
Trip 12								
Trip 13								
Trip 14								

If you have any questions regarding the content of the survey, method of delivery, or a specific surveyor, please feel welcome to contact Dr. Gord Lovegrove, Assistant Professor of Engineering at UBC Okanagan.

Appendix J Phase 2 Number of Unknown and Not Applicable Responses

Question	Per Person or Per Household	Unknown (No Response)						"Not Applicable" Responses					
		Survey 1 (Pre)		Survey 2 (Mid)		Survey 3 (Post)		Survey 1 (Pre)		Survey 2 (Mid)		Survey 3 (Post)	
		C	P	C	P	C	P	C	P	C	P	C	P
Age Group	Individual	0	0	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Employment Status	Individual	0	0	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Number of vehicles	Household	0	0	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Number of Bikes	Household	0	1	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Household Income	Household	1	0	N/A	N/A	N/A	N/A	5	2	N/A	N/A	N/A	N/A
Distance to Work	Individual	2	2	N/A	N/A	N/A	N/A	21	32	N/A	N/A	N/A	N/A
Distance to Shopping	Individual	7	7	N/A	N/A	N/A	N/A	13	9	N/A	N/A	N/A	N/A
Distance to Recreation	Individual	9	5	N/A	N/A	N/A	N/A	2	9	N/A	N/A	N/A	N/A
Distance to School	Individual	0	0	N/A	N/A	N/A	N/A	25	36	N/A	N/A	N/A	N/A
Time to Work	Individual	1	2	N/A	N/A	N/A	N/A	21	32	N/A	N/A	N/A	N/A
Time to Shopping	Individual	2	7	N/A	N/A	N/A	N/A	9	13	N/A	N/A	N/A	N/A
Time to Recreation	Individual	7	7	N/A	N/A	N/A	N/A	6	6	N/A	N/A	N/A	N/A
Time to School	Individual	0	0	N/A	N/A	N/A	N/A	25	36	N/A	N/A	N/A	N/A
Number of Transit Passes Purchased per Year	Individual	0	0	N/A	N/A	N/A	N/A	0	0	N/A	N/A	N/A	N/A
Primary Reason for Using Transit	Household	1	0	0	0	0	0	0	0	0	0	0	0
Number of Times Took a Car Trip as the Driver in the Past Week	Individual	1	0	0	0	0	0	12	25	12	25	12	25
Number of Times Took Car Trips as The Passenger in the Past Week	Individual	1	2	0	0	0	6	0	0	0	0	0	0
Number of Times Took Transit in the Past Week	Individual	0	0	0	0	0	0	0	0	0	0	0	0
Number of Times Biked in the Past Week	Individual	0	0	0	0	0	0	0	0	0	0	0	0
Number of Times Walked in the Past Week	Individual	0	6	0	0	0	0	0	0	0	0	0	0

Question	Per Person or Per Household	Unknown (No Response)						"Not Applicable" Responses					
		Survey 1 (Pre)		Survey 2 (Mid)		Survey 3 (Post)		Survey 1 (Pre)		Survey 2 (Mid)		Survey 3 (Post)	
		C	P	C	P	C	P	C	P	C	P	C	P
Household Satisfaction with Transit	Household	0	0	0	0	1	0	4	3	2	3	4	2
Household Satisfaction with Biking	Household	0	0	1	0	1	1	1	0	1	1	4	2
Household Satisfaction with Walking	Household	0	0	1	0	0	0	0	0	0	1	1	1
Do you believe your household is within walking distance to a bus stop?	Household	1	2	2	1	0	1	0	0	0	0	0	0
Positives and negatives with using transit?	Household	N/A	N/A	N/A	N/A	6	4	N/A	N/A	N/A	N/A	0	1
Has your household experienced any barriers to active transportation since the last survey?	Household	N/A	N/A	4	N/A	7	N/A	N/A	N/A	0	N/A	0	N/A
Has your household experienced any barriers to using ComPASS components since the last survey?	Household	N/A	N/A	N/A	2	N/A	6	N/A	N/A	N/A	2	N/A	1
What would influence your household to participate in ComPASS?	Household	0	0	0	0	0	1	0	0	0	0	0	0
I believe ComPASS would be successful in the Glenmore community	Household	0	0	0	0	0	0	0	0	0	0	0	0
Would your household walk more if you owned a ComPASS?	Household	1	0	0	0	0	0	0	0	0	0	0	0
Would your household bike more if you owned a ComPASS?	Household	2	0	0	0	0	0	0	0	0	0	0	0
Would your household use transit more if you owned a ComPASS?	Household	0	0	0	0	0	0	0	0	0	0	0	0
How much would you reduce car trips as the driver if you owned a ComPASS?	Individual	N/A	N/A	N/A	N/A	0	0	N/A	N/A	N/A	N/A	12	25
How much would you reduce car trips as the passenger if you owned a ComPASS?	Individual	N/A	N/A	N/A	N/A	4	11	N/A	N/A	N/A	N/A	0	0

Question	Per Person or Per Household	Unknown (No Response)						"Not Applicable" Responses					
		Survey 1 (Pre)		Survey 2 (Mid)		Survey 3 (Post)		Survey 1 (Pre)		Survey 2 (Mid)		Survey 3 (Post)	
		C	P	C	P	C	P	C	P	C	P	C	P
How much would you increase transit trips if you owned a ComPASS?	Individual	N/A	N/A	N/A	N/A	5	9	N/A	N/A	N/A	N/A	0	0
How much would you increase cycling trips if you owned a ComPASS?	Individual	N/A	N/A	N/A	N/A	3	9	N/A	N/A	N/A	N/A	0	0
How much would you increase walking trips if you owned a ComPASS?	Individual	N/A	N/A	N/A	N/A	1	9	N/A	N/A	N/A	N/A	0	0
My household uses transit more after the pilot study compared to before the pilot study	Household	N/A	N/A	N/A	N/A	0	0	N/A	N/A	N/A	N/A	0	0
My household's health has changed after the pilot study compared to before the pilot study	Household	N/A	N/A	N/A	N/A	0	0	N/A	N/A	N/A	N/A	0	0
Please outline any new/interesting/fun experiences members of your household encountered by using the ComPASS during the pilot study.	Household	N/A	N/A	N/A	N/A	N/A	3	N/A	N/A	N/A	N/A	N/A	3
My household would use a ComPASS if a program was offered in our neighborhood.	Household	0	0	0	0	0	0	0	0	0	0	0	0
If ComPASS were to be implemented permanently in our neighborhood, my household would support it financially.	Household	0	0	0	0	0	0	0	0	0	0	0	0
After having experienced the ComPASS program for 3 months, would your household participate in a permanent ComPASS program in the future?	Household	0	N/A	0	N/A	0	N/A	0	N/A	0	N/A	0	N/A
If the answer was NO to the previous question, please describe any reasons why your household would not	Household	N/A	0	N/A	0	N/A	0	N/A	0	N/A	0	N/A	0

Question	Per Person or Per Household	Unknown (No Response)						"Not Applicable" Responses					
		Survey 1 (Pre)		Survey 2 (Mid)		Survey 3 (Post)		Survey 1 (Pre)		Survey 2 (Mid)		Survey 3 (Post)	
		C	P	C	P	C	P	C	P	C	P	C	P
participate in a permanent ComPASS program.													
How many times did members in your household use the Parkinson Recreation Centre gym facility in the past 7 days?	Individual	0	0	0	0	0	0	0	0	0	3	0	0
How many times did members in your household use the Parkinson Recreation Centre pool facility in the past 7 days?	Individual	0	0	0	0	0	0	0	0	0	0	0	0
How would members in your household rate the Parkinson Recreation Centre gym facility?	Individual	N/A	N/A	N/A	0	4	0	N/A	N/A	N/A	48	26	38
How would members in your household rate the Parkinson Recreation Centre pool facility?	Individual	N/A	N/A	N/A	0	4	0	N/A	N/A	N/A	31	13	20
How often do members in your household get bike tune-ups in a year?	Individual	4	0	N/A	N/A	N/A	N/A	2	2	N/A	N/A	N/A	N/A
Have members of your household been to Kelowna Cycle since the last survey?	Household	N/A	N/A	0	0	0	0	N/A	N/A	0	0	0	0
In total, how many bike tune-ups from Kelowna Cycle has your household used?	Household	N/A	N/A	0	0	0	0	N/A	N/A	0	0	0	0
Did your household use the 10% discount at Kelowna Cycle on in-store clothing, parts and accessories?	Household	N/A	N/A	0	0	0	0	N/A	N/A	0	0	0	0
Has your household had any bike tune-ups since the last survey?	Household	N/A	N/A	1	0	1	1	N/A	N/A	0	0	0	0
How many of these bike tune-ups were done by household members/friends?	Household	N/A	N/A	1	0	1	2	N/A	N/A	0	0	0	0

Question	Per Person or Per Household	Unknown (No Response)						"Not Applicable" Responses					
		Survey 1 (Pre)		Survey 2 (Mid)		Survey 3 (Post)		Survey 1 (Pre)		Survey 2 (Mid)		Survey 3 (Post)	
		C	P	C	P	C	P	C	P	C	P	C	P
How many of these were done by a bike shop/store?	Household	N/A	N/A	1	0	1	1	N/A	N/A	0	0	0	0
How would members in your household rate the bike tune-up service at Kelowna Cycle?	Individual	N/A	N/A	N/A	0	0	0	N/A	N/A	N/A	52	37	50
Has your household been to de Bakker's Kitchen restaurant since the last survey?	Household	N/A	N/A	N/A	0	0	0	N/A	N/A	N/A	0	0	0
How would members of your household rate de Bakker's Kitchen?	Individual	N/A	N/A	N/A	0	4	0	N/A	N/A	N/A	30	15	18
Has your household been to the Glenmore Marketplace IGA since the last survey?	Household	N/A	N/A	N/A	0	0	0	N/A	N/A	N/A	0	0	0
How would members of your household rate the Glenmore Marketplace IGA?	Individual	N/A	N/A	N/A	0	0	0	N/A	N/A	N/A	32	13	33
Has your household used the Emergency Taxi Rides Home Service since the last survey?	Household	N/A	N/A	N/A	0	N/A	0	N/A	N/A	N/A	0	N/A	0
How would members of your household rate the Emergency Taxi Rides Home Service?	Individual	N/A	N/A	N/A	0	N/A	0	N/A	N/A	N/A	64	N/A	64
Please estimate how often members of your household would use a gym pass if included in a permanent ComPASS program in your neighborhood.	Individual	N/A	N/A	N/A	N/A	0	6	N/A	N/A	N/A	N/A	4	6
Please estimate how often members of your household would use a pool pass if included in a permanent ComPASS program in your neighborhood.	Individual	N/A	N/A	N/A	N/A	0	0	N/A	N/A	N/A	N/A	4	5

Question	Per Person or Per Household	Unknown (No Response)						"Not Applicable" Responses					
		Survey 1 (Pre)		Survey 2 (Mid)		Survey 3 (Post)		Survey 1 (Pre)		Survey 2 (Mid)		Survey 3 (Post)	
		C	P	C	P	C	P	C	P	C	P	C	P
Please estimate how often members of your household would use a gym pass if included in a permanent ComPASS program in your neighborhood.	Individual	N/A	N/A	N/A	N/A	4	6	N/A	N/A	N/A	N/A	0	6
Please estimate how often members of your household would use local merchant discounts if included in a permanent ComPASS program in your neighborhood.	Individual	N/A	N/A	N/A	N/A	8	6	N/A	N/A	N/A	N/A	1	3
Please estimate how often members of your household would use a bike tune-up service if included in a permanent ComPASS program in your neighborhood.	Individual	N/A	N/A	N/A	N/A	1	4	N/A	N/A	N/A	N/A	0	2
Please estimate how often embers of your household would use emergency taxi rides home if included in a permanent ComPASS program in your neighborhood.	Individual	N/A	N/A	N/A	N/A	11	6	N/A	N/A	N/A	N/A	3	4
Would de Bakker's merchant discounts encourage your household to use more active transportation?	Household	N/A	N/A	N/A	N/A	N/A	0	N/A	N/A	N/A	N/A	N/A	1
Would Glenmore Marketplace IGA merchant discounts encourage your household to use more active transportation?	Household	N/A	N/A	N/A	N/A	N/A	0	N/A	N/A	N/A	N/A	N/A	1
Would Kelowna Cycle merchant discounts encourage your household to use more active transportation?	Household	N/A	N/A	N/A	N/A	N/A	0	N/A	N/A	N/A	N/A	N/A	4

Question	Per Person or Per Household	Unknown (No Response)						"Not Applicable" Responses					
		Survey 1 (Pre)		Survey 2 (Mid)		Survey 3 (Post)		Survey 1 (Pre)		Survey 2 (Mid)		Survey 3 (Post)	
		C	P	C	P	C	P	C	P	C	P	C	P
Would Parkinson Recreation Centre merchant discounts encourage your household to use more active transportation?	Household	N/A	N/A	N/A	N/A	N/A	0	N/A	N/A	N/A	N/A	N/A	0
Would Emergency Taxi Rides Home encourage your household to use more active transportation?	Household	N/A	N/A	N/A	N/A	N/A	0	N/A	N/A	N/A	N/A	N/A	6
Would de Bakker's merchant discounts encourage your household to participate in a ComPASS program?	Household	N/A	N/A	N/A	N/A	N/A	0	N/A	N/A	N/A	N/A	N/A	0
Would Glenmore Marketplace IGA merchant discounts encourage your household to participate in a ComPASS program?	Household	N/A	N/A	N/A	N/A	N/A	0	N/A	N/A	N/A	N/A	N/A	0
Would Kelowna Cycle merchant discounts encourage your household to participate in a ComPASS program?	Household	N/A	N/A	N/A	N/A	N/A	0	N/A	N/A	N/A	N/A	N/A	0
Would Parkinson Recreation Centre merchant discounts encourage your household to participate in a ComPASS program?	Household	N/A	N/A	N/A	N/A	N/A	0	N/A	N/A	N/A	N/A	N/A	0
Would Emergency Taxi Rides Home encourage your household to participate in a ComPASS program?	Household	N/A	N/A	N/A	N/A	N/A	1	N/A	N/A	N/A	N/A	N/A	0
How much would you pay for a ComPASS?	Household	5	4	4	4	2	1	0	0	0	0	0	0
How much do you think a ComPASS is worth?	Household	5	6	3	4	2	2	0	0	0	0	0	0

Question	Per Person or Per Household	Unknown (No Response)						"Not Applicable" Responses					
		Survey 1 (Pre)		Survey 2 (Mid)		Survey 3 (Post)		Survey 1 (Pre)		Survey 2 (Mid)		Survey 3 (Post)	
		C	P	C	P	C	P	C	P	C	P	C	P
Would any members of your households be interested in becoming a neighborhood coordinator to help start up a ComPASS program in your neighborhood?	Individual	N/A	N/A	N/A	N/A	0	4	N/A	N/A	N/A	N/A	0	0
If a ComPASS program was implemented permanently in your neighborhood, how would your household prefer to pay?	Household	N/A	N/A	N/A	N/A	0	0	N/A	N/A	N/A	N/A	0	0
If a ComPASS program was implemented permanently in your neighborhood, Would your household be willing to add ComPASS fees to property taxes for the whole neighborhood?	Household	N/A	N/A	N/A	N/A	1	1	-N/A	N/A	N/A	N/A	0	0
If a ComPASS program was implemented permanently in your neighborhood, Would your household be willing to have only those who participate contribute financially to the ComPASS program?	Household	N/A	N/A	N/A	N/A	1	2	N/A	N/A	N/A	N/A	0	0
List any suggestions you may have for an improved ComPASS pilot program?	Household	N/A	N/A	N/A	N/A	0	1	N/A	N/A	N/A	N/A	0	1
Travel Diaries	Household	1	0	0	0	2	2	1	1	1	2	3	0

C = Control Households
P = Participating Households.

Appendix K IBM ® SPSS ® Version 22 Software Inputs

Car Trips as the Driver in the Past Week

```
*Generalized Linear Mixed Models.
GENLINMIXED
  /DATA_STRUCTURE SUBJECTS=Household REPEATED_MEASURES=Survey
COVARIANCE_TYPE=COMPOUND_SYMMETRY
  /FIELDS TARGET=CarDriver TRIALS=NONE OFFSET=FIELD(Ln_Total)
  /TARGET_OPTIONS DISTRIBUTION=NEGATIVE_BINOMIAL LINK=LOG
  /FIXED  EFFECTS=Survey Group Survey*Group USE_INTERCEPT=TRUE
  /BUILD_OPTIONS TARGET_CATEGORY_ORDER=ASCENDING
INPUTS_CATEGORY_ORDER=ASCENDING MAX_ITERATIONS=100 CONFIDENCE_LEVEL=95
DF_METHOD=SATTERTHWAITE COVB=MODEL PCONVERGE=0.000001(ABSOLUTE) SCORING=0
SINGULAR=0.000000000001
  /EMMEANS_OPTIONS SCALE=ORIGINAL PADJUST=LSD.
```

Car Trips as the Passenger in the Past Week

```
*Generalized Linear Mixed Models.
GENLINMIXED
  /DATA_STRUCTURE SUBJECTS=Household REPEATED_MEASURES=Survey
COVARIANCE_TYPE=COMPOUND_SYMMETRY
  /FIELDS TARGET=CarPassenger TRIALS=NONE OFFSET=FIELD(Ln_Total)
  /TARGET_OPTIONS DISTRIBUTION=POISSON LINK=LOG
  /FIXED  EFFECTS=Survey Group Survey*Group USE_INTERCEPT=TRUE
  /BUILD_OPTIONS TARGET_CATEGORY_ORDER=ASCENDING
INPUTS_CATEGORY_ORDER=ASCENDING MAX_ITERATIONS=100 CONFIDENCE_LEVEL=95
DF_METHOD=SATTERTHWAITE COVB=MODEL PCONVERGE=0.000001(ABSOLUTE) SCORING=0
SINGULAR=0.000000000001
  /EMMEANS_OPTIONS SCALE=ORIGINAL PADJUST=LSD.
```

Transit Trips in the Past Week

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*Generalized Linear Mixed Models.
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COVARIANCE_TYPE=COMPOUND_SYMMETRY
  /FIELDS TARGET=Transit TRIALS=NONE OFFSET=FIELD(Ln_Total)
  /TARGET_OPTIONS DISTRIBUTION=NEGATIVE_BINOMIAL LINK=LOG
  /FIXED  EFFECTS=Survey Group Survey*Group USE_INTERCEPT=TRUE
  /BUILD_OPTIONS TARGET_CATEGORY_ORDER=ASCENDING
INPUTS_CATEGORY_ORDER=ASCENDING MAX_ITERATIONS=100 CONFIDENCE_LEVEL=95
DF_METHOD=SATTERTHWAITE COVB=MODEL PCONVERGE=0.000001(ABSOLUTE) SCORING=0
SINGULAR=0.000000000001
  /EMMEANS_OPTIONS SCALE=ORIGINAL PADJUST=LSD.
```

Cycling Trips in the Past Week

```
*Generalized Linear Mixed Models.
GENLINMIXED
  /DATA_STRUCTURE SUBJECTS=Household REPEATED_MEASURES=Survey
COVARIANCE_TYPE=COMPOUND_SYMMETRY
  /FIELDS TARGET=Cycling TRIALS=NONE OFFSET=FIELD(Ln_Total)
  /TARGET_OPTIONS DISTRIBUTION=NEGATIVE_BINOMIAL LINK=LOG
  /FIXED  EFFECTS=Survey Group Survey*Group USE_INTERCEPT=TRUE
  /BUILD_OPTIONS TARGET_CATEGORY_ORDER=ASCENDING
INPUTS_CATEGORY_ORDER=ASCENDING MAX_ITERATIONS=100 CONFIDENCE_LEVEL=95
DF_METHOD=SATTERTHWAITE COVB=MODEL PCONVERGE=0.000001(ABSOLUTE) SCORING=0
SINGULAR=0.000000000001
  /EMMEANS_OPTIONS SCALE=ORIGINAL PADJUST=LSD.
```

Walking Trips in the Past Week

```
*Generalized Linear Mixed Models.
GENLINMIXED
  /DATA_STRUCTURE SUBJECTS=Household REPEATED_MEASURES=Survey
COVARIANCE_TYPE=COMPOUND_SYMMETRY
  /FIELDS TARGET=Walking TRIALS=NONE OFFSET=FIELD(Ln_Total)
  /TARGET_OPTIONS DISTRIBUTION=POISSON LINK=LOG
  /FIXED  EFFECTS=Survey Group Survey*Group USE_INTERCEPT=TRUE
  /BUILD_OPTIONS TARGET_CATEGORY_ORDER=ASCENDING
INPUTS_CATEGORY_ORDER=ASCENDING MAX_ITERATIONS=100 CONFIDENCE_LEVEL=95
DF_METHOD=SATTERTHWAITE COVB=MODEL PCONVERGE=0.000001(ABSOLUTE) SCORING=0
SINGULAR=0.000000000001
  /EMMEANS_OPTIONS SCALE=ORIGINAL PADJUST=LSD.
```

Appendix L Phase 2 General Comments from Residents

General comments from control households in survey 1:

- For the young and elderly, ComPASS would encourage more people to enjoy the city through using transit. However, since Kelowna is so spread out, this makes it difficult for all to use transit regularly.
- If buses were more frequent and smaller (not double-deckers), I would use transit. I don't want to wait 30 minutes for the bus and would prefer to wait a maximum of 10 minutes. Also would like to see improved bus routes. I do bike in better weather.
- It is a great idea and I can see it working for many people. Unfortunately for us at this time, with elderly family members, using our vehicles to take them to appointments, shopping, etc. seems to be the only efficient solution.
- Our family has grown, and we have always encouraged biking/walking as a family. We would not change many of our habits, as we have adjusted our recreational travel habits. The ComPASS program offers existing programs already in operation, if they are already in operation what will induce more individuals to utilize these methods if they already are not utilizing them? What about implementing new ideas?
- The bus service isn't timely enough, and it is too long to wait for a bus.
- This program will only be successful if time to take transit is reasonably comparable to the time required to drive to a location. At the moment, transit is so inefficient that most working people are unwilling to take it.
- ComPASS would be useful for seniors who are no longer able to drive and might encourage more use of Parkinson Recreation Centre.

General comments from participating households in survey 1:

- Difficult getting kids to school and sports. Upgrades to Parkinson Rec Center or new gym at UBCO for Kelowna residents.
- I don't feel I need government program to get me to use transit. Need more frequent buses and better bike lanes (not like the one on Clement)
- I like the idea, but I already try not to use the car much, so my main motive would be better transit schedules and routes. My partner would use a recreation center pass and I prefer to be outdoors.
- I strongly support this. I need an up to date schedule to use it and due to the nature of my work. I'm not sure it will be applicable for my work however would like to try for some trips. With fewer residents in my household, the value would be less than for a whole family, whoever I would support it financially just to support it even if I wasn't able to use it very much.

- I'm delighted with the idea and hope that it is successful!
- I'm excited to see the outcome of this study and appreciate the efforts to better our community.
- I'm not very familiar with it. It would help if it was explained on the survey. I'm sure it was mentioned at the time I agreed to do the survey but was very busy and in a hurry, so I'm a bit vague on the details. As my children get older they can be more independent and not rely solely on us for rides.
- Our trips for recreation after school are tight and depend on one parent to transport our children. Spring and summer travel could depend on walking and biking, as well as transit. Winter months are more challenging for this age of child (12 and 14). As the children get older, I think the ComPASS program is more appealing as it frees the parent from nervously driving to activities that are relatively close. H20 activities remain a challenge as do all Mission and Rutland activities and require better planning.
- Please bring the program in soon
- Rails for trails to UBCO is very important for Kelowna.
- Some household members work in construction on various sites so they would ever use a bus pass for work but for recreation. My office might be moving office out of home and if new site is on bus route then she would take the bus more often. But currently Jordan would use it the most. We would like Parkinson rec Centre monthly passes but unable to afford them so this ComPASS would work well for us. Thanks for all your hard work.
- We think this is a great idea, but it will all come down to the price per family per month.

General comments from control households in survey 2:

- Better bus service at rush hour might encourage more use for people going to work.
- Good idea. Will work for some people but will have to be in place for a number of years as people in Kelowna are used to driving everywhere. Cost of gas won't make a difference for this household to use or not use the ComPASS.
- I don't know if ComPASS would be financially beneficial to us. I get discounted Parkinson Rec pass because of my disability. When I need to purchase art supplies or work at schools, I need my van for ALL my stuff - 2 carts full. And then for recreational, I can ride my bike to pool/downtown, etc. I usually grocery shop a few times and like to stock up, again - need a vehicle unless I'm only buying a couple of things.
- May not be practical for most people until bus routes and services improved.
- Thank you for considering this project. It's very good for all of us.

General comments from participating households in survey 2:

- A great program! With small children convenience is very important. If program/services aren't convenient we won't access them. We have a bus stop close by and would use it more frequently if there were more convenient times for getting to and from work (children are in daycare at work - UBCO). Our children also aren't at an age where they can take advantage of a family pass to the rec centre etc... Safety is also a concern for biking. Our children are learning to ride their bikes, so if there aren't safe bike routes to our destination we cannot bike.
- I did enjoy the bus I just feel that riding my bike would be faster. I don't believe Kelowna will take the bus if its not readily available and convenient. It was a bit of a hassle.
- I thank you for taking the initiative and appreciate all the support from the community to those included.
- I think its great, fully support it and really hope that it is fully implemented for my neighbourhood. I would like to get out of my car more! I do not need the PRC pass to be included although I feel I would use it if it was a permanent program and I was paying for it.
- Looks like you are doing an excellent job, however out present lifestyle doesn't include the ComPASS program.
- Randy and Cory both work in construction and I, Christina, work from home. But I hope to use it more (transit) when my office moves downtown.
- learned that if an adult in our house has a monthly bus pass, all the kids are free. The gift cards were greatly appreciated.
- We live centrally to where we go. We walk and cycle a lot. The bus passes are influencing our thinking, even though we have not yet used them often. More frequent bus schedule would help.
- We would use the ComPASS program. It has also inspired our family to use the rec centre more.
- We would use transit and/or bike more if we were less involved in other areas, for example hockey, where the games are on the Westside or Rutland and involve carrying a large equipment bag. Also, soccer is in many varied locations from Westside to Lake Country. One son is often at Kung fu while the other is at hockey. Also, if we are out doing errands it is not very efficient to take transit when the stops aren't near the destination and there are several places to get to on the way to/from an activity.

General comments from control households in survey 3:

- Green is the way to go plus improving bike and walking routes to help the residents become more active & healthy. The beginning of the railway walkway and to downtown is a great start but we need more "safe" routes particularly for bikers.
- If cheap and convenient enough, would buy into the program.

- Replace the school bus system in populated Kelowna and service by Kelowna transit. This provides incentive for households to pay for it by taxes. Takes advantage of economics of scale by providing stable consulate funding and ridership.

General comments from participating households in survey 3:

- Difficulties with transit. Enjoyed the recreation centre pass and coupons for dinner.
- Great job. Looking forward to rolling out this program Kelowna wide.
- I hope it happens. I want to support it but it would be helpful if I did not have to pay a family rate when I am just 1 in the household. However, if family rate is $20 or less that is fine.
- and vote on. I think that all the cards have to be out there. If it has an extra $150 - $100 per month for residents then it can't work. Or at least not for use. * Note: our son just moved back in with us so we have a household of 5 or more.
- I think costs are a lot to do with these factors. I think that it has to be presented to all households and vote on. I think that all the cards have to be out there. If it has an extra $150 - $100 per month for residents then it can't work. Or at least not for use. * Note: our son just moved back in with us so we have a household of 5 or more.
- I would like to see a pilot study done with transit to see if a regular route could have 5 - 10 minute interval buses. Perhaps from Glenmore to downtown?
- In terms of transportation I would think utilization would rise if it (ComPASS) would beat individual transportation by a lot in terms of convenience and cost and even then it would be hard to win people over. Leather seats, 16 speakers, your choice of radio station (of the private car) make the bus seem like a poor alternative.
- It's a good idea. In a few years we would use the service more often.
- My entire family fully supports this program. We hope that it goes through because we will use it often.
- Our patterns have not been changed by this program. We are compelled by our school aged children to take them to activities that are not easily arranged to use transit. Both adults work so we are stuck in a rut of sorts that the layout of Kelowna does not permit ease of transit use.
- We haven't been very good participants in the program - mostly because of illness and age related problems.
- We need a pedestrian overpass at High/|Clement (or an underpass). We are not interested in government walking/cycling plan other than infrastructure support such as bike paths, walking trials, etc. that everyone can use and benefit from.