

## **2023 TRIP DIARY SURVEY**

## **TECHNICAL REPORT**

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#### **EXECUTIVE SUMMARY**

TransLink commissioned Ipsos to conduct the 2023 Regional Trip Diary Survey. TransLink has been undertaking household travel surveys periodically since 1985. The information collected from the study allows transportation authorities to gain in-depth understanding of travel behaviour patterns across all modes of transportation for households and individuals in the study area. The study was last conducted in 2017 and was also administered by Ipsos.

The two main objectives of the survey were to:

- Collect high-quality, reliable, and valid household travel data for current and future regional transportation and land-use planning purposes including the regional transportation model; and,
- Provide a statistically reliable basis for a comparative assessment of the changes in travel behaviour and patterns in Metro Vancouver, impacts of infrastructure investments, land use trends, and policies.

The study area included the Greater Vancouver Regional District (also known as Metro Vancouver) and the Fraser Valley Regional District.

The 2023 Trip Diary Survey consisted of four major phases:

- Study Design
- Recruitment & Data Collection
- Data Processing & Verification
- Final Reporting & Documentation

To be successful, a survey of this size required careful design and testing prior to its launch, spanning a period of eight months from January to August 2023 before launching the main data collection period in September.

Key recruitment and data collection dates for this survey were:

Task	Dates
Study Design and Preparation	January to May 2023
Pilot Testing	May to August 2023
Trip Diary Dates	September 11 <sup>th</sup> to December 8 <sup>th</sup> , 2023

#### Phase 1: Study Design

The Study Design phase included the initial planning and design, integration of the CATI, online survey





and mobile app platforms, development and approval of all study material including online and mobile app instruments and communications, internal and pilot testing, and training of telephone recruiters.

Some refinements to the survey instruments and processes were made based on the results of two pilot studies with a total of 242 completed households prior to the main launch in September.

As in 2017, the 2023 Trip Diary Survey consisted of two data collection stages: recruitment and diary stage. The recruitment approach used an address-based sampling method with a pre-notification letter mailed to randomly, pre-selected households. The letter outlined the purpose and importance of the study, requested their participation, listed the incentives and provided a direct link and QR code to the online survey. Letters were mailed on a staggered flight schedule throughout the three-month field window.

All households were asked to register to participate by going to the online survey or scanning the QR code provided in the pre-notification letter. Those without a computer or smartphone were able to call the helpdesk line and register over the phone. Additionally, households with available phone numbers received a recruitment call if they had not registered to complete the survey within approximately one week of receiving the letter. The registration section of the survey prompted households to provide basic demographic information, select a diary method, and be assigned a weekday trip diary date.

As in previous years, maintaining the methodology with previous surveys was important to maintain consistency when analyzing trends over time. However, several modifications were made to the methodology and survey instruments based on improvements in digital and mobile capabilities since 2017, and changes to travel behaviour as a result of the COVID-19 pandemic.

In 2017, the mobile app option had only been offered to a sub-set of the sample population as it was the first time using this approach for the region's trip diary. Considering the substantial progress in smartphone technology over the last few years and in an effort to improve the accuracy of collected trip data, the decision was made to offer the mobile app option to anyone aged 16+ with a smartphone.

As such, the diary stage was completed using either the online survey or the mobile app. All household members, regardless of age, were asked to record their travel behaviour for the assigned trip diary day, including information about trip start, end locations and times, purpose, and mode of transportation.

To ensure consistency with the 2017 study, the sampling area was segmented into the same 58 regions, although boundaries between some regions shifted slightly.

The 2023 base target sample size was set at 1.25% of the region's household population, which was determined according to the 2021 Census household population counts. Overall, the base target sample size was set at 14,508 households. In addition, an oversample of 600 households across various regions in the City of Surrey was requested. Thus, the total number of households targeted for this survey was 15,108.

A stratified sampling strategy was used to reduce the need for post-data collection weighting. Specifically, each region was given a target completion rate proportionate to its population size. For example, if a region accounts for 10% of the total survey sample area, then it was assigned a target completion rate of 10% of the total base target sample.





According to Statistics Canada, 52% of Canadian households reported using a cellphone exclusively (unlisted households) in 2021, up from 36% in 2017<sup>1</sup>. To address the increase in unlisted households and to take into consideration the higher non-response rate expected from unlisted households, the sample was initially comprised of 30% unlisted households and 70% listed households for the first 236,000 letters. However, new in 2023 was the ability to match unlisted household addresses with a phone number using the Data Axel database. While not all unlisted addresses could be matched to a phone number, it greatly enhanced the ability to reach unlisted households.

A dedicated email address and toll-free helpline in both English and Chinese (Mandarin or Cantonese) was set up to field participants' queries and help survey participants complete the study. Households that completed the survey were offered a gift card or charity donation and a ballot entry to the draw prize for their participation. To increase participation through the mobile app, individuals who completed the survey via the mobile app were offered an additional gift card or donation, and an additional entry to the draw prize.

#### Phase 2: Recruitment and Data Collection

In total, 686,497 households received a pre-notification letter. Of these, 34,784 (5.1%) registered and 15,426 completed the survey, representing an overall completion rate of 2.2%. An additional 566 completes were achieved through supplemental cellphone dialing (560 completes) and an open recruitment link for the City of Surrey (6 completes) for a total of 15,992 households. The chart below depicts the completion rate overall and by each flight of pre-notification letters:

Flight Group	Pre-notification Letters Sent On	# of Letters Sent	# of Completed Households	Completion Rate (%)
Group 1	September 7, 2023	39,334	1,203	3.1%
Group 2	September 14, 2023	39,334	1,190	3.0%
Group 3	September 21, 2023	39,329	1,078	2.7%
Group 4	October 6, 2023	58,509	1,520	2.6%
Group 5	October 18, 2023	48,154	1,396	2.9%
Group 6	October 26, 2023	62,548	1,399	2.2%
Group 7	November 6, 2023	100,043	1,999	2.0%
Group 8	November 10, 2023	24,195	612	2.5%
Group 9	November 15, 2023	100,004	2,145	2.1%
Group 10	November 20, 2023	164,237	2,754	1.7%
Group 11	November 27, 2023	10,810	130	1.2%
		686,497	15,426	2.2%

#### EXHIBIT 1 Overall Completion Rate Among Mailout Sample

<sup>1</sup> Statistics Canada, https://www.statcan.gc.ca/o1/en/plus/5289-landline-use-decreases-amid-growing-cellphone-ownership





As with previous surveys in the region and elsewhere, a lower response rate was observed for younger households. To ensure the age distribution of the final sample was closer to the general population, all sampling requests to Canada Post included a skew towards households with a higher likelihood of younger demographics. Additionally, the help desk outreach and telephone recruitment prioritized households with members under the age of 55. Furthermore, as in 2017, the mailout recruitment was supplemented with a cellphone sample boost to increase the participation of younger households in the survey.

During the survey design phase, it was anticipated that response rates would be lower than in previous years and results from the pilot studies corroborated this expectation. As such, several changes were made prior to the main launch to bolster response rates. This included increasing the value of the household incentive and adding an additional incentive for mobile app participants, reducing the number of required diary dates from three to one for mobile app participants, streamlining the online survey and email reminders, adding more frequent and customized push notifications for the mobile app, modifying the diary date algorithm to reduce the window between the registration and diary phases, and reorienting the helpdesk to focus more on outreach to help participants complete the survey.

Further actions were taken during the main survey to help boost response rates and ensure overall and regional targets were met. Most importantly, the decision was made to mail out an additional 300,000 letters – increasing the mailout outgo from 354,000 to 654,000 (excluding additional letters required for the City of Surrey oversample). Additionally, SMS text reminders were sent directly to secondary household members who were signed up to use the mobile app and had opted in to receive text messages, additional email reminders were implemented with links that allowed respondents to change their diary date or survey mode themselves, and the survey deadline was extended from November 30 to December 8.

#### Phase 3: Data Processing and Verification

After data was collected from completed households, it was put through a rigorous cleaning process. The framework for the data cleaning process was established using pilot data and insights from the 2017 survey, and included:

- Preliminary data verification (lpsos helpdesk staff)
- Geocoding (automatic geocoding and manual geocoding reviews by Ipsos and McElhanney)
- Initial Data Cleaning (Ipsos data processing)
- Advanced review and flagging (McElhanney and Ipsos)
- Final review and cleaning (TransLink)





Once all the data cleaning and data exclusion was completed, a total of 15,879 surveys were retained from the original 15,992 received.

A detailed account of trip diary surveys and exclusions is shown in the following table:

	Number	Percentage of Total Returned Diary Surveys
Total Diary Surveys Returned	15,992	-
Total Diary Surveys Flagged After Initial Cleaning	15,879	99.3%
Total Diary Surveys Excluded	113	0.7%
Total Retained Households	15,879	-
Total Retained Persons	35,252	-
Total Retained Trips	96,193	-

#### Phase 4: Final Reporting and Documentation

This methodology report details the processes followed to implement the survey.





#### **DEFINITION OF TERMS**

- *API*: refers to an Application Programming Interface.
- CATI: Computer Assisted Telephone Interviewing.
- Loop Trip: A recreational trip taken without a destination (e.g., walking the dog, going for a run or a bike ride)
- *Mixed mode households:* refers to households who completed the diary portion of the survey using a mix of online and mobile app platforms.
- *Mobile app households:* refers to households who completed the diary portion of the survey using the mobile app platform only
- *Mobile app survey/interface*: refers to Mobile Market Monitor's X-ING app. The app is integrated with GPS tracking, Google Map API and the online survey program logic (e.g., follow-up questions based on the relevant trip information)..
- Online households: refers to households who completed the diary portion of the survey using the online platform only.
- Online survey/interface: refers to Ipsos's online survey platform. The program is integrated with Google Map API and skip logics.
- Oversampled sub-regions: refers to the four City of Surrey regions that were sampled at a higher rate than the region-wide sample size of 1.25%.
- *Sub-regions*: refers to the 58 smaller geographic areas into which the municipalities within the survey sample area were broken down to for sampling and expansion purposes.
- *Registration section*: refers to the first part of the survey, in which participants selected a diary date, survey method, and recorded their person and household information.
- *Sample or dataset*: refers to the aggregation of all data collected for this survey into one central electronic file.
- *Regions*: refers to the 7 larger geographic areas into which the 58 sampling areas were combined.
- *Survey sample area*: refers to the geographic region included in the 2023 Trip Diary Survey, specifically all of Metro Vancouver and the Fraser Valley Regional District, extending from Lions Bay to Hope.
- *Trip diary date*: refers to the date assigned to each participating household on which they recorded all of their trips.
- *Trip diary section*: refers to the second part of the survey, in which participants recorded all of their trips.







## **SURVEY OVERVIEW**



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#### **Background and Introduction**

Regional trip diary surveys have been conducted periodically (typically every 5 years) in the Greater Vancouver region since 1985. Previous trip diary surveys occurred in 1992, 1994, 1999, 2004, 2008, 2011 and 2017, with the latter two executed by Ipsos. While there has been continual improvement in methodology with each survey, a key design consideration has always been the backward compatibility of the results for the purpose of analyzing long-term trends.

The information collected from the study allows transportation authorities to gain in-depth understanding of travel behaviour patterns, across all modes of transportations, for households and individuals in the study area.

The 2023 trip diary survey will have the same two main objectives:

- Collect high-quality, reliable, and valid household travel data for current and future regional transportation and land-use planning purposes including the regional transportation model; and
- Provide a statistically reliable basis for a comparative assessment of the changes in travel behaviour and patterns in Metro Vancouver, impacts of infrastructure investments, land use trends, and policies.

The purpose of this technical report is to provide a detailed and robust accounting of all aspects of this study. The importance of detailing all decisions, processes and methodologies followed ensures that:

- users of the resulting data understand the parameters and limitations of the information collected;
- when the study is repeated in the future, comparability can be maintained in design and implementation; and,
- any learnings can benefit the design and execution of future studies of the same or similar nature.

#### **General Approach**

The 2023 Trip Diary Survey consisted of four major phases:

- Study Design
- Recruiting & Data Collection
- Data Processing and Verification
- Final Reporting & Documentation





#### Phase 1 – Study Design

The Study Design phase focused on the initial planning and design of the entire study, as well as the training of support and recruitment staff, and the development and approval of all study materials. Trip diary tools, systems and processes were developed and tested for accuracy and effectiveness. The results of two pilot studies with a total of 242 households (166 from Pilot 1 and 76 from Pilot 2) were reviewed and refinements were made to the survey instrument and internal processes to ensure that the survey was carried out on schedule with confidence and precision.

#### Phase 2 – Recruitment and Data Collection

The Recruitment and Data Collection phase involved a multi-step approach to surveying households. Randomly-selected households were sent a pre-notification letter which explained the nature of the study and requested their participation. The letter included a link and QR code to the online survey, as well as a unique household ID number and password. All households were invited to go directly online to register themselves for the survey. Households with listed landlines that had not registered online within about a week's time of receiving the pre-notification letter were contacted by phone and asked to participate in the study. All household members were given the option to participate in the study using the mobile app if the household member had a smartphone and was at least 16 years of age.

To ensure a high response rate with good quality responses, a dedicated email address at Ipsos and TransLink and a toll-free helpline were set up to field participants' queries in both English and Chinese (Mandarin and Cantonese). As a token of thanks for their participation, all households that completed the survey were given the option to select a \$20 gift card of their choice (Amazon, Starbucks, Indigo or President's Choice) or to donate the gift card value to either the BC Children's Hospital, David Suzuki Foundation, or United Way. Each household also received an entry into a prize draw. Additional incentives were provided to individuals who completed the survey using the mobile app – an additional \$10 gift card or charity donation and an additional ballot entry to the prize draw.

#### Phase 3 – Data Processing and Verification

Data quality checks were agreed to prior to the start of data collection to ensure the most critical and common data quality checks were built into the logic of the program and subsequent quality checks were conducted upon survey completion. Collected data were then put through a rigorous cleaning process by Ipsos, McElhanney and TransLink.

#### Phase 4 – Final Reporting and Documentation

This methodology report details the processes followed to implement the survey.



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# PHASE 1: STUDY DESIGN





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#### 2. METHODOLOGY

#### 2.1 Survey Design

The 2023 study was designed to maintain continuity with the 2017 survey where possible while still making improvements to online and mobile usage and capabilities and accommodating changes to travel behaviour and patterns as a result of the pandemic. As with previous surveys, the current study was designed to collect information on travel behaviour using randomly selected households in the survey area during weekdays (Monday to Friday) over a 24-hour period (from 4:00 am of the assigned date to 4:00 am of the next day). Recipients of the pre-notification letter were informed about the transportation study and were asked to participate to help TransLink and regional partners to better understand travel behaviour in order to help manage congestion and get more people to where they want to go.

While consistency in data collection methods was an important consideration to maintain comparability of the data to previous trip diary surveys conducted in the region, some modifications were made to the survey design in 2023. Specifically:

- All household members were now required to provide their trip information, regardless of age. However, no demographic information aside from age was collected for those under the age of 5. As such, preschool or daycare address was also added as a question to be prepopulated as a frequent place for the trip section of the survey.
- A series of equity, diversion and inclusion (EDI) questions were also added to the survey, including ethnicity and disability status. Updates were also made to iconography and wording to remove any gender-related bias throughout the survey.
- In light of expected changes to travel behaviour as a result of increased work-from-home and hybrid work situations since 2017, those who were employed were asked which days of the week, if any, they travelled to a work site.
- The definition of a trip was expanded to include recreational loop trips in 2023. For example, walking the dog around the neighbourhood, or going for a run or bike ride without a destination, where the start and end location of the trip may be the same.
- The series of questions about the number of insured household vehicles was reduced to just vehicle type and fuel type.
- Additional modes of transportation were added to the trip section to reflect increased usage of alternate modes of transportation such as electric bicycles, other electric-powered devices, or human-powered devices.
- Minor changes were also made to the borders between regions for geocoding purposes.
- A question about the highest level of education for each household member over the age of 18 was also added.





Additionally, in 2017 the study was primarily offered online with a mobile app component added. As that was the first time utilizing a mobile app for the region's trip diary survey, only a subset of the population (15% of the final sample) were invited to complete the diary survey using the mobile app to minimize any potential issues that might arise. For the 2023 study, the decision was made to remove any limits on app participation as data collected via mobile app is generally considered to be higher quality than self-reported online responses due to less reliance on respondent's memory and more precise location and travel time data captured through GPS enabled technologies. Improvements to mobile technologies and increased usage of smartphones among Canadians<sup>2</sup> also factored into the decision to maximize mobile app participation this year.

The data collection process consisted of two main phases: a recruitment phase and a diary phase.

A key objective of the **recruitment phase** was to ensure that the study has a representative sample of households by reaching out to those with *and* without listed landline phone numbers (including those who rely solely on cell phones). All randomly selected households received the letter, which requested their participation, outlined the purpose and importance of the survey, listed the incentives available for completing the survey, and provided contact information for Ipsos' help desk as well as a direct link and QR code to the online survey.

This first part of the survey collected basic personal and household information (e.g., employment status, driver's license status, whether a person travels to a work site), whereas the second section (**diary phase**) recorded trips for the assigned travel diary date for all household members. This included information about each trip's start and end locations and times, purpose, and mode of transportation.

Registered households were reminded by email (and SMS text if they opted in) several times to encourage participation. The email included a direct link to their survey, and eventually links were also added which allowed households to switch their diary date or survey method (online vs. the mobile app).

The quality control procedures that were followed throughout the diary phase can be found in Section 9: Quality Control and the processes for fielding respondent inquiries can be found in Section 10: Respondent Inquiries.

Included in the Appendix are copies of the key documents used during the recruitment and data collection phase. These include the telephone recruitment questionnaire, online survey and mobile app survey.

#### 2.1.1 Listed vs. Unlisted Sample

According to Statistics Canada, 52% of Canadian households reported using a cellphone exclusively (unlisted households) in 2021, up from 36% in 2017<sup>3</sup>. Based on experience, the response rate from unlisted households was anticipated to be lower than that of listed households. However, new in 2023

<sup>&</sup>lt;sup>3</sup> Statistics Canada, https://www.statcan.gc.ca/o1/en/plus/5289-landline-use-decreases-amid-growing-cellphone-ownership



<sup>&</sup>lt;sup>2</sup> Statistics Canada, https://www.statcan.gc.ca/o1/en/plus/3582-so-long-landline-hello-smartphone



was the ability to match unlisted households to a phone number using the Data Axel database (formerly known as Info Canada).

In total, Ipsos was able to append phone numbers to 29% of the unlisted sample, though exact match rates varied between mailout flights. While not all unlisted addresses could be matched to a phone number, it greatly enhanced the ability to contact hard-to-reach populations, including younger age cohorts, and target the right households with telephone recruitment. Using Canada Post postal code targeting, Ipsos was also able to target certain areas based on probabilities of household members belonging to a particular age cohort.

Unlisted (cellphone and unlisted landlines) were appended to the sample by a data merge by address to telephone numbers provided by Data Axel. Listed telephone numbers were provided by Canada Post with the sample. Telephone recruiting began approximately one week after the pre-notification letters were mailed out, and was conducted for all households with phone numbers who had not yet registered online prior to the beginning of recruitment calls.

The sample for the first 236,000 letters was comprised of 30% <u>listed</u> households (referred to as personalized mail as the letters were addressed to the current resident's name) and 70% <u>unlisted</u> households (referred to as non-personalized mail). Once it became clear that there was not a significant difference in completion rates between listed and unlisted households (due, in part, to the new ability to append phone numbers to assist telephone recruitment for unlisted households), the decision was made to use 100% unlisted sample for the remaining outgo to capitalize on the cost efficiencies of using this type of sample.

#### 2.1.2 Multilingual Surveying

The Metro Vancouver and Fraser Valley regions contain a large population of residents whose first language is not English. To ensure that at least some of these residents were represented in the sample and to facilitate their participation, the pre-notification letter included a description of the study in Mandarin and encouraged participation. Additionally, a dedicated Chinese helpline was set up to offer support in Mandarin and Cantonese.





#### 2.2 Survey Sample and Sampling Plan

#### 2.2.1 Study Area

The sampling area of interest covers the Greater Vancouver Regional District (also known as Metro Vancouver) and Fraser Valley Regional District. To ensure consistency with the 2017 study, the sampling area was segmented into the same 58 regions. The following exhibit depicts the sampling regions:



#### EXHIBIT 2.2.1 Map of Target Areas

#### 2.2.2. Sampling Plan

The 2023 base target sample size was set at 1.25% of the region's households and was determined according to the 2021 Census occupied dwelling counts.

A proportionate sampling strategy was used to reduce the need for post-data collection weighting. That is, each region was given a target completion rate proportionate to its population size. For example, if a region accounts for 10% of the total survey sample area, then it was assigned a target completion rate of





10% of the total base target sample. However, a minimum target of 30 surveys was set for smaller areas. Oversampling was implemented for specific regions within the City of Surrey as requested by the municipality.

Please see Exhibit 2.2.2 below, for a detailed description of the sampling plan by region.

Sample Area ID	Sample Area	Municipality	Base Target	Oversample	Total Target
11.1	West Vancouver	West Vancouver	238		238
11.2	Lion's Bay / Electoral Area A	Lion's Bay	30		30
11.3	Bowen Island	Bowen Island	30		30
12	North Vancouver District	North Vancouver District	423		423
13.1	Lonsdale RCC	North Vancouver City	197		197
13.2	North Vancouver City (ex. RCC)	North Vancouver City	147		147
21	CBD - West End 1	Vancouver	447		447
22	CBD - False Creek 2	Vancouver	430		430
29	UEL	Vancouver	94		94
33	Vancouver Broadway 3	Vancouver	440		440
34	Vancouver South 4	Vancouver	483		483
35	Vancouver Kerrisdale 5	Vancouver	295		295
36	Vancouver Kitsilano 6	Vancouver	414		414
37	Vancouver SE 7	Vancouver	449		449
38	Vancouver East 8	Vancouver	607		607
39	Vancouver Strathcona / Grandview 9	Vancouver	258		258
41	Burnaby North	Burnaby	329		329
42.1	Metrotown RCC	Burnaby	202		202
42.2	Burnaby Metrotown (ex. RCC)	Burnaby	189		189
43	Burnaby South Central	Burnaby	320		320
44	Burnaby NE	Burnaby	225		225
47.1	New Westminster RCC	New Westminster	107		107
47.2	New Westminster (ex. RCC)	New Westminster	344		344
51.1	Port Moody	Port Moody	164		164
51.2	Belcarra	Belcarra	30		30
51.3	Anmore	Anmore	30		30
52.1	Coquitlam Centre	Coquitlam	121		121
52.2	Coquitlam North (ex. RCC)	Coquitlam	205		205
53.1	Burquitlam	Coquitlam	137		137

#### **EXHIBIT 2.2.2 Targets by Region**







Sample Area ID	Sample Area	Municipality	Base Target	Oversample	Total Target
53.2	Coquitlam South (ex. Burquitlam)	Coquitlam	237		237
55	Port Coquitlam	Port Coquitlam	286		286
56	Pitt Meadows	Pitt Meadows	93		93
57.1	Maple Ridge RCC	Maple Ridge	81		81
57.2	Maple Ridge (ex. RCC)	Maple Ridge	333		333
61	Richmond East	Richmond	162		162
62.1	Richmond RCC	Richmond	414		414
62.2	Richmond West (ex. RCC)	Richmond	361		361
63	<b>Richmond South - Steveston</b>	Richmond	76		76
67	Tsawwassen First Nation	Tsawwassen First Nation	30		30
68	Delta - Ladner / Tsawwassen	Delta	238		238
69	Delta North	Delta	238		238
71.1	Surrey Metro Centre	Surrey	197		197
71.2	Surrey Centre (ex. RCC)	Surrey	289		289
72	Surrey Fleetwood	Surrey	375	200	575
73	Surrey Newton	Surrey	278		278
74	Surr Panorama	Surrey	348	100	448
75	Surrey Cloverdale	Surrey	387	200	587
77	Surrey South	Surrey	448	100	548
79	White Rock	White Rock	134		134
81	Langley City	Langley City	157		157
82	Langley Township - South	Langley Township	234		234
83	Langley Township - North	Langley Township	356		356
92	FVRD Abbotsford West	FVRD	421		421
93	FVRD Abbotsford East / Electoral Area G	FVRD	246		246
94	FVRD Chilliwack / Electoral Area E H	FVRD	447		447
95	FVRD Cultus Lake / Hope / Electoral Areas B D	FVRD	51		51
96	FVRD Mission	FVRD	176		176
97	FVRD Kent / Harrison / Electoral Area C F G	FVRD	30		30
	Total		14.508	600	15,108





#### 2.3 Survey Participation

Achieving a high completion rate was essential to meet overall, regional, and age sampling targets and to obtain a representative sample of residents' travel behaviour. Hence, the survey was designed to encourage pre-selected households to participate. The measures taken in this regard included:

- Sending a pre-notification letter to all pre-selected households. The objective of the letter was to introduce the survey and highlight its purpose and importance for the recipient households and their communities in both English and Mandarin. The letter also listed the incentives offered for completion.
- **Offering incentives.** A combination of a guaranteed incentive (a gift card) and entry in a draw for several larger monetary prizes was offered to all households who successfully completed the survey. The option to donate the gift card value to one of three charities was also provided to encourage participation among those who may not be interested in a gift card. Detailed information about the incentive structure can be found in Section 2.4.
- **TransLink communications efforts** leading up to and throughout the field window, as well as the web page set up on the TransLink website to encourage participation and verify the survey's legitimacy.
- Removing the restriction (15%) on mobile app participation from the 2017 study. Anyone with a smartphone aged 16 and above was able to participate using the app, with the intention to help encourage participation among younger cohorts and to improve data quality.
- Setting up a dedicated helpdesk and toll-free helpline to help participants register or complete the survey over the phone and troubleshoot mobile app or survey issues. The help desk was staffed for extended business hours during weekdays as well as reduced hours on Saturday (See Section 10: Respondent Inquiries for more information on the helpdesk).
- Assuring confidentiality and anonymity. Households were assured that their data was being collected in strict accordance with BC's Freedom of Information and Protection of Privacy Act (FOIPPA) and that their information would only be used for transportation research and planning purposes. They were provided with a unique household ID and password-protected survey link to ensure that their information was secure.
- Contacting households with listed landlines and appending phone numbers to unlisted sample via telephone to solicit their participation in the survey.
- Sending acknowledgement and reminder emails and SMS texts to households who registered for the online survey and opted in to being contacted by SMS.
- Directing households who wished to verify the validity of the survey to a dedicated page • on TransLink's website, which posted information about the survey.
- Setting up an FAQ website to answer frequently asked questions.



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- Setting up video instructions to provide information on what is considered a trip for the online survey, embedded in the online survey and in the FAQ page.
- Short how-to video instructions to answer frequently asked questions related to using the mobile app.





#### **2.4 Survey Instruments**

#### 2.4.1 Pre-Notification Letter

A pre-notification letter was sent to all selected households, allowing us to reach a cross-section of households including unlisted households, single-person households, renters, low-income households, seniors, and students. The letter outlined the purpose, importance and requirements of the survey and provided a direct link and QR code to the online survey. The QR code made enrolment more convenient and alleviated the need to type in the survey URL. The letter also encouraged Chinese-speaking households to take part in the study. Information about the study and the Chinese toll-free helpline was included in simplified Mandarin at the bottom of the letter.

To lend greater creditability to the study and maximize the rate of opening the letters, the prenotification letters were sent in a plain manila (Kraft) envelope similar to what other official government documents use (See Appendix A.3 for an example of the envelopes). Additionally, and similar to 2017, the CEO of TransLink signed the letter to give it more validity and weight.

The pre-notification letters were mailed on a staggered flight schedule every one to two weeks to allow for targeting adjustments to accommodate high and low responding regions or age groups. The algorithm to assign a trip diary date was based on the day and time of household registration. Changes made to the diary date algorithm after Pilot 1 reinforced the need for a staggered flight schedule to ensure a reasonable distribution of trip diary dates across the field window.

Exhibit 2.4.1 outlines the flight schedule and corresponding telephone recruitment schedule.

Flight Group	Pre-notification Letters Sent On	# of Letters Sent	Telephone Recruitment Began
Group 1	September 7, 2023	39,334	September 14, 2023
Group 2	September 14, 2023	39,334	September 21, 2023
Group 3	September 21, 2023	39,329	September 28, 2023
Group 4	October 6, 2023	58,509	October 11, 2023
Group 5	October 18, 2023	48,154	October 23, 2023
Group 6	October 26, 2023	62,548	November 2, 2023
Group 7	November 6, 2023	100,043	November 15, 2023
Group 8	November 10, 2023	24,195	November 17, 2023
Group 9	November 15, 2023	100,004	November 22, 2023
Group 10	November 20, 2023	164,237	November 24, 2023
Group 11	November 27, 2023	10,810	-
		686,497	

#### EXHIBIT 2.4.1 Flight and CATI Recruitment Schedule





#### 2.4.2 Telephone Recruitment

Telephone recruiting was conducted from Ipsos' computer assisted telephone interviewing (CATI) facility. The telephone recruitment took place June 5<sup>th</sup> to June 20<sup>th</sup> for Pilot 1, July 21<sup>st</sup> to August 4<sup>th</sup> for Pilot 2 and September 14 to December 4<sup>th</sup>, 2023 for the main survey. Recruitment calls were not made on statutory holidays and weekend calling was restricted from 10:00 am to 6:00 pm PST.

To encourage survey participation, households with phone numbers were contacted by phone approximately one week after each flight was mailed if they had not yet registered online. Three attempts, on different days and at different times, were made to each household. Towards the end of the field window, telephone recruiters also began to leave a voicemail message to encourage households to register for the survey online.

Additionally, as in 2017, the mailout recruitment was supplemented with a cellphone sample boost to try to increase the participation of younger households in the survey. Younger age cohorts are overrepresented among cellphone samples. As such, cold call recruitment through cellphone sample greatly assisted to achieve a representative age distribution. The same telephone recruitment script was used but with a modified introduction to provide background information on the purpose of the study and to screen out any households who may not be eligible to participate (e.g., if they reside outside the study area).

The telephone recruitment survey was tested with actual household respondents during both pilot studies. At that time, improvements were made to the script, where appropriate, mostly to improve wording. After Pilot 1 the decision was made to combine the registration and household sections of the online survey to streamline the registration process. As such, telephone recruiters went from covering just the registration section in Pilot 1 to also going through the entire household registration section in Pilot 2. Recruitment calls for the main survey were 17 minutes on average, and 20 minutes on average for the cellphone sample boost, for an overall total average of 19 minutes. A copy of the telephone recruitment screener questionnaire can be found in Appendix B.

Improvements were made to the programming this year, allowing for seamless integration between the CATI system and the online survey platform. This allowed telephone recruiters to move directly to the same online survey that respondents access so that all data was housed in the same system. Registration confirmation emails could therefore be sent in real time for households who were recruited over the phone.

For quality control, the following criteria were followed during the telephone recruitment process:

- Prior to the telephone recruiting, all telephone recruiters were provided with a briefing covering a discussion of objectives, a review of the survey questionnaire, and a read-through of the script.
- Recruiters were monitored by the telephone supervisors throughout every shift, and feedback or coaching was provided as needed throughout the field window.
- As the CATI system took recruiters directly to the online survey platform, logic checks and





immediate error messages prompted interviewers to seek clarification before moving on in the survey.

• The telephone recruitment completion rate was constantly monitored to ensure participation rates were representative of the sample areas.

#### 2.4.3 Email Reminders

Several automated email reminders were sent to each household who agreed to participate in the survey. These included:

- Acknowledgement email sent immediately after registration, whether online or over the phone. Households were reminded of their assigned trip diary date (see Appendix F.1).
- **Mobile App Acknowledgement email** sent only to <u>mobile app household members</u> who were registered by the main household contact whose email address was different from the primary contact email, providing a link to download the mobile app and instructions for how to participate (see Appendix F.2).
- Household Completion Reminder email sent only to <u>main household contacts</u> who had provided their email address but not yet completed the rest of the household section of the survey (see Appendix F.3).
- **Reminder email** sent by 6:00 pm (PST) the day before the assigned diary day (see Appendix F.4).
- **Mobile App Initialization Reminder email** sent only to <u>mobile app household members</u> to remind them to download and initialize the mobile app the night before the assigned diary day (see Appendix F.5).
- **Post Diary Reminder email** sent only to main household contacts that had not yet completed the survey at 7:00 pm (PST) the day after the assigned diary date (see Appendix F.6).
- Second Chance email sent only to households that had not yet completed the survey (either online or using the mobile app) 72 hours after their assigned trip diary day. Households were given the option to keep their original trip diary date if they had tracked their household's travel on that day but had not yet entered the information into the online system form, or had not yet fully verified all trip segments on the mobile app, or to choose a new diary date or switch their diary mode (see Appendix F.7 for online and F.8 for mixed mode and app version).
- Thank you and Follow-up email sent to all households at 12:00 pm (PST) the day after the assigned diary day to either thank them for their participation or remind them to select their gift card or charity of choice (see Appendix F.9).







The following exhibit details the flow of the email notifications for the different household types:



#### EXHIBIT 2.4.3 Email Notification Flow Chart for Online Only Households

#### EXHIBIT 2.4.3(1) Email Notification Flow Chart For Mixed and Mobile App Only Households



To manage email bounce-backs, households whose acknowledgement emails were undeliverable were contacted by telephone to confirm their correct email addresses. They were then re-entered into the system to be emailed again.

#### 2.4.4 SMS Reminders

The 2023 survey introduced the option for survey participants to receive SMS text reminders. During the





household registration process, the household lead could choose to provide the cellphone number of household members aged 16 and above who would be participating in the survey using the mobile app. A confirmation SMS text with a link to download the mobile app was sent directly after the registration process was complete. Language was included to indicate that clicking on the download link would be considered as consent to be contacted by Ipsos for purposes related to the survey. Those who did not click on the download link were not re-contacted by SMS text. Standard opt-out language was also included at the bottom of every SMS text to allow recipients to opt out or ask for help.

The SMS text reminders included the messages below (see Appendix G for more detailed information):

- Acknowledgement text sent shortly after registration, whether online or over the phone. Households were reminded of their assigned trip diary date and were provided with a link to download the mobile app if participating using that survey method.
- **Reminder text** sent to the <u>main household contact</u> at 5:00 pm (PST) the day before the assigned diary day.
- Mobile App Reminder text sent only to mobile app household members at 5:00 pm (PST) the day before the assigned diary date to remind them to have the app initialized before the assigned diary day begins.
- Thank You text sent only to the <u>main household contact</u> at 8:00 pm (PST) the day after the assigned diary date to thank them for participating or remind them to select their gift card or charity of choice.

#### 2.4.5 Online Survey

The online survey directed respondents through the survey with sidebar instructions and explanations, examples, and drop-down menus. If a respondent skipped a question or for some questions provided an answer that appeared to be inconsistent or inaccurate, they were prompted to review and correct their answers. For example, for each one-way trip, the arrival time was checked against the departure time to ensure that they were chronological.

The online survey was structured as follows:

- Landing page / Login screen participants were asked to enter their unique household ID and password. The landing page also included a privacy statement, contact information for TransLink's Privacy Officer, and support information, including Ipsos' toll-free helpline and email address and a link to the FAQ page.
- **Personal Information screens** personal demographic information was collected for each member of the household, including name or nickname, age, gender, education, ethnicity, and disability status.
- **Registration screens** participants were able to self-register online and pick one of the suggested trip diary dates and survey methods (online or the mobile app).





- Household Information screens respondents provided more information about their household, including but not limited to dwelling type, household income, employment status, number and type of household vehicles, transit usage, and work, school or preschool/daycare addresses. In 2023, a series of questions were also asked of those who were employed to confirm which days of the week, if any, were spent at a work site outside of the home.
- **Trip Data screens** trip information was collected for all one-way trips made by each household member on the specified trip diary date. Video instruction, provided by TransLink, explaining what constitutes a trip was provided.

A copy of the online survey can be found in Appendix C.1 (technical version) and Appendix C.2 (simplified version), and exhibits showing some of the embedded logic checks, pull-down menus and prompts included in the online survey platform can be found in Appendix H.

In 2023, improvements were made to the user interface to make it mobile friendly, allowing respondents to fill out the survey using a smartphone. As part of this revamp, the trip section of the survey was restructured to be able to fit on a phone screen. Unnecessary text was removed or replaced with an Information icon that could be clicked on for a pop-up with more information. Follow-up questions relating to a trip's purpose, departure and arrival time, mode of transportation, and parking or passenger-related information were accessible through icons which, when clicked on, opened a pop-up window. Follow-up question icons only became active after a respondent entered a trip destination and confirmed the address.

The online survey was programmed to create an efficient and intuitive process for respondents while ensuring high quality, consistent and accurate data. Specifically:

- Using the Google Map interface, the map auto populated a list of possible locations based on what is typed in the search box. This enabled respondents to enter trip information quickly and accurately, thus minimizing the entry of incorrect information.
- Automatically geocoded locations upon entry of information. Geocoding is the process of assigning the X-Y coordinates for every start and end points of a trip. This was done in real-time by integrating the online platform with Google Map API.

Respondents were provided with several ways to record their location information, specifically:

- By choosing from a customized list of personal locations collected during the household section of the survey such as their home, work, school and preschool or daycare addresses.
- By entering a common landmark.
- By entering two cross streets.
- By entering the exact address.





To ensure the location was recorded as precise as possible, those who entered a cross street or generic location were prompted to drag the pin to the location closest to their actual location.

The online survey included a number of logic checks to ensure consistency between answers to different questions. In cases where an inconsistency was detected, the respondent was prompted to review and modify their answer. In some cases, the respondent could choose to not modify their answer by clicking "continue" a second time. This option to skip some logic checks was included to minimize respondent frustration and increase survey completion rates while still encouraging the provision of accurate and logical answers. If illogical information was entered, it was flagged during data cleaning.

Exhibit 2.4.5 outlines the logic checks programmed into the online survey.





#### EXHIBIT 2.4.5 Summary of Logic Checks and Type

Logic Checks	Туре
Respondents were directed to the registration page if they had not yet selected a trip diary date.	Mandatory
Respondents were prompted to review their information if the first trip origin was not "home".	Optional
Respondents were prompted to review their information if their last trip destination was not "home".	Optional
Respondents were prompted to confirm they went "nowhere, no other locations until 4am the next morning" before submitting their trip diary.	Mandatory
The time of arrival for a trip could not be earlier than the time of departure.	Mandatory
The time of departure for a trip could not be earlier than the time of arrival for the previous trip.	Mandatory
Verification of the duration of a trip when trip lasted more than two hours.	Optional
Household members without a valid driver's license could not state that they drove themselves for any trip.	Mandatory
Respondents were prompted to review their information if they were going to another household member's workplace and the trip purpose was "to work".	Optional
Respondents were prompted to review their information if they were going to another household member's school and the trip purpose was "to go to school".	Optional
Household members could not indicate they were both "retired" or "unemployed" and "working full-time", "working part-time" or "self- employed" at the same time.	Mandatory
Respondents were prompted to review their information if they selected "Auto – Driver" and the consecutive trip was using a different vehicle or mode of transportation, unless the initial trip ended at home.	Optional





Logic Checks	Туре
Respondents were prompted to review their information if an address was not geocodable.	Mandatory
Respondents were prompted to review their information if an address was generic (e.g., Vancouver).	Mandatory
The number of household members selected as passengers in an auto trip could not exceed the total number of people in the car.	Mandatory
Mode and speed checks prompted respondents to review and correct their information if speeds surpassed the following thresholds:	Mandatory
Mode and distance checks prompted respondents to review and correct their information if it surpassed the following thresholds:	Mandatory
Respondents were prompted to review their information if the trip was not a recreational loop trip and the trip duration lasted longer than: • Walk > 1.5 hours • Bike > 2.5 hours • Auto > 3 hours	Optional
If none of the household members in the vehicle during a trip have a driver's license, the total number of people in the car must be greater than the number of household members selected.	Mandatory
If the origin and destination of a trip are both out of the survey region, respondents were prompted to only enter the next location visited within the survey region.	Mandatory
<ul> <li>Respondents were prompted for any key missing information:</li> <li>Age of each household member</li> <li>Gender and other demographic information for those aged 5+</li> <li>Home address</li> </ul>	Mandatory





Logic Checks	Туре
<ul> <li>Work/school/preschool/daycare address</li> <li>Household size</li> <li>Smartphone ownership</li> <li>Driver's license ownership</li> <li>Employment/school status</li> <li>Number of insured vehicles in household</li> <li>Trip origin/destination</li> <li>Trip purpose</li> <li>Trip start/end time</li> <li>Trip mode(s)</li> </ul>	







#### 2.4.6 Mobile App: X-ING

The mobile app, X-ING, used for this study was created by Mobile Market Monitor (MMM). The X-ING app has been developed based on Future Mobility Sensing (FMS) software first developed by MIT researchers and has been successfully deployed in large-scale trip diary studies globally. The platform leverages mobile sensing and machine learning technologies to deliver high-quality behavioural data. The software places a particular focus on multi-modal trips in terms of capturing access to and egress from transit through their inference engine and displaying such trips in a visually understandable way. The X-ING app collects raw data such as GPS, accelerometer, WiFi, motion and fitness, and other sensors and signals. X-ING is downloadable from the app stores and supports the current and at least two previous iOS and Android OS versions.

To ensure that the survey data stayed within Canada, MMM used a Canadian-based Amazon Web Services (AWS) cloud-hosted server. Various measures were put in place to ensure the security of the data, including strict access control to the servers and database based on user account and role, encryption of all data in transit as well as in storage, and regular backup of the database.

To ensure a smooth experience for the survey participants, the household and individual information entered by the survey participants through Ipsos' online survey were transferred to MMM automatically via an API. MMM would then return individual registration links to each household member> Once a mobile app participant signed up for the X-ING app with that link, their pre-survey information (e.g., vehicle information, home, work or school address) was already transferred to the account.

APIs were also set up to send mobile app participants' completion status to Ipsos every two hours, and the trip diary details for completed app participants daily.

After consulting with TransLink, a few customizations were made to the X-ING app to customize to the study and to improve user experience:

• Updated the project logo on the app landing page.



- Removed irrelevant onboarding screens.
- Added language to the login screen to mitigate confusion during the account creation process.
- Auto-populated the origin and destination stations or stops for transit trips.
- Added video segments with instructions for frequently asked questions.
- Created and customized push notifications to remind app users to verify the trips on their diary date.





Consistent with online participants, respondents who chose to use the mobile app were asked to complete the survey for one full weekday (from 4:00 am on their diary day to 4:00 am the following day). Respondents were asked to download and initiate the mobile app by 12:00 am on their diary day to ensure it was collecting data and to familiarize themselves with the app before the diary day started.

To be considered complete using the mobile app, respondents were required to manually verify each trip information segment that was passively collected through the app and were prompted to answer additional follow-up questions similar to the online survey.





#### 2.4.7 Diary Date Algorithm

The results from Pilot 1 demonstrated there was increased attrition associated with the time lapsed between a household's registration date and their assigned diary date. As such, changes were made to the diary date algorithm to shorten the window between registration and the diary day and prevent attrition due to decreased engagement.

For Pilot 2 and the main survey, the following rules were applied when assigning diary days:

	Registration Time of Day (Day 0)	
Offered Diary Dates	Before 12pm	12pm onwards
Option 1	+1 day	+2 days
Option 2	+2 days	+3 days
Option 3	+4 days	+4 days

#### **EXHIBIT 2.4.7 Diary Date Assignment**

Weekends, statutory holidays (October 2 – Truth and Reconciliation Day, October 9 – Thanksgiving, November 13 – Remembrance Day) and special days (school districts Professional Development days – October 20, and Halloween – October 31) were excluded from the diary date algorithm.

#### 2.4.8 Geocoding

Geocoding is the process of assigning the latitude and longitude to the locations. As collecting accurate and precise origin/destination points is key to the success of the study, it was extremely important to ensure that the geocoding interface used in the survey instrument was accurate and up-to-date.

#### **Online Survey**

The online survey platform was integrated with Google Map API and most locations were geocoded automatically by the program in real-time as they were entered. Locations that were within the study area but not a full address, intersection, premise, landmark, park or airport were identified as generic locations. Follow-up prompts were built in to probe for more specific/precise locations when a general location (e.g., Vancouver) was entered.

#### Mobile App

The mobile app utilized the advanced location platform features of smartphones to automatically detect and capture travel data, including detailed GPS trace data. To minimize its impact to the phone battery, the app limits its background run time while recording GPS trace data and made extensive use of the smartphones' geofence capabilities, which typically utilized the smartphone's WiFi and cell-modem radios to detect significant movement, to determine when GPS trace data logging should be resumed. Respondents were encouraged to keep WiFi enabled while using the app as part of the onboarding process.






Locations that were not captured by the smartphone's location sensor or when participant forgot to carry the phone while travelling could also be directly entered to the app. Similar to the online survey, the mobile app was also integrated with Google Map API to facilitate logging locations. To ensure that the online data and mobile app data were synced in real-time, an API was set-up allowing the two platforms to connect and communicate.





#### 2.4.9 Incentive Structure

To encourage participation, incentives were only provided if all household members completed their assigned diary day. All completed households received an incentive and a ballot entry to the prize draw, with additional incentives for individual app participants.

Details of the incentive structure for each household or participant type are outlined below:

#### Online Households:

- A \$20 gift card from one of Amazon, Starbucks, Indigo or President's Choice, or the option to donate the gift card value to one of BC Children's Hospital, the David Suzuki Foundation, or United Way
- One ballot entry in a draw to win one of the following:
  - One \$2000 Visa gift card;
  - One of 2 \$1000 Visa gift cards;
  - One of 5 \$500 Visa gift cards;
  - One of 10 \$250 Visa gift cards; or,
  - One of 22 \$100 Visa gift cards.
- An additional ballot entry if the household registered by the early bird deadline mentioned in their pre-notification letter.

<u>Mobile App</u>: In addition to the incentives mentioned above, the following individual incentives were offered to each household member who participated using the mobile app:

- A \$10 gift card from one of Amazon, Starbucks, Indigo or President's Choice, or the option to donate the gift card value to one of BC Children's Hospital, the David Suzuki Foundation, or United Way, and
- One additional ballot entry to the draw prize.

In total, 13,782 households (representing 86% of completed households) selected a gift card while 1,961 households (12% of completes) chose to donate to charity.

The following exhibit explains the qualifying criteria for incentives:







## **EXHIBIT 2.4.9 Qualifying Criteria for Incentives**



#### How many gift cards and prize draw entries do I get?

	Household (Per hou	l Incentive usehold)	App In (Per ind completin mobile ap	centive dividual og 1 day of op survey)	TOTAL IN	CENTIVES
# of mobile app users		•	Î	•	Ĥ	•
Zero	\$20	1 entry	-	-	\$20	1 entry
Ŷ	\$20	1 entry	\$10	1 entry	\$30	2 entries
ŶŶ	\$20	1 entry	\$20	2 entries	\$40	3 entries
ព្រំស្ត្រំ	\$20	1 entry	\$30	3 entries	\$50	4 entries
ពុំទំពុំទំ	\$20	1 entry	\$40	4 entries	\$60	5 entries
<b>ŶŶŶŶŶ</b>	\$20	1 entry	\$50	5 entries	\$70	6 entries





## 3. SUMMARY OF PILOT RESULTS

## 3.1 Status of Pilot Study Returns

#### Pilot 1 Results

To test response rate and ensure all of the survey instruments and processes were functioning correctly and effectively, all instruments were pre-tested internally at TransLink and then piloted by inviting a small sample of randomly-selected households to participate. A total of 6,000 households were invited to participate in Pilot 1 and a total of 166 households completed the diary for all household members.

Pilot 1 took place between May 24<sup>th</sup> and June 21<sup>st</sup>, 2023. The pre-notification letter was sent to all randomly pre-selected households on May 24<sup>th</sup>, 2023 and the telephone recruitment took place between June 6<sup>th</sup> to 16<sup>th</sup>, 2023. Of the 6,000 pre-notification letters mailed out, 314 registered for the survey and 166 households completed both the household section and trip section of the survey by June 21<sup>st</sup>, 2023.

The exhibit below shows the overall response and completion rates by the two recruiting methodologies (those who self-registered online and those who were recruited by Ipsos over the phone):





The 6,000 pre-notification letters were split into two mailout types (personalized mail for listed households and non-personalized mail for unlisted households) to gauge potential differences in response rates.

The exhibit below shows the response rate by the two different mailout types.





## EXHIBIT 3.1(1) Pilot 1 Response Rate – Mailout Type

# of Households	Total Sample	# Recruited/ Self-Registered	# Completed the Diary	Completion Rate (%)
Personalized Mail	3,000	187	106	3.5%
Non-Personalized Mail	3,000	127	60	2.0%
Total	6,000	314	166	2.7%

Respondents were provided with two options to fill out the trip diary part of the survey – either online or via the mobile app. Not all household members needed to use the same survey method – households where some selected the online method and others selected the mobile app were referred to as mixed mode households.

The exhibit below shows the response rate by the three different household survey modes. Completion rates were significantly higher among online only households compared with mobile app only or mixed mode households.

# of Households	Total Sample	# Recruited/ Self-Registered	# Completed the Diary	Completion Rate (%)
Online Only	6,000	216	148	2.5%
App Only		57	11	0.2%
Mixed Mode		41	7	0.1%
Total	6,000	314	166	2.7%

## EXHIBIT 3.1(2) Pilot 1 Response Rate – Survey Mode

With regards to SMS text reminders, of the 314 registered households, 65 (21%) opted-in to SMS reminders.

#### Incentives Tested in Pilot 1

Two incentive structures were tested during the first pilot to determine the incentive amount that would yield the highest response rate: \$10 per household plus an additional \$10 per mobile app participant vs. \$20 per household and no additional incentive for mobile app participation. Based on the pilot results, it was determined that a \$20 incentive was the most effective for overall household recruitment.

#### EXHIBIT 3.1(3) Pilot 1 Response Rate – Incentive Amount

# of Households	Total	# Recruited/	# Completed	Completion
	Sample	Self-Registered	the Diary	Rate (%)
\$10 per household + \$10 per app participant	3,000	147	68	2.3%





\$20 per household + no additional app incentive	3,000	167	98	3.3%
Total	6,000	314	166	2.7%

Results from Pilot 1 demonstrated a lower completion rate than expected for mobile app participants. As a result, the decision was made to test the impact of reducing the number of diary dates required for mobile app participants from 3 days to 1 day on response rates. Explanatory text and elements of the survey instrument interface were also adjusted to remove potential barriers for participants. Once these changes had been internally tested, a second pilot was launched in July 2023.

#### Pilot 2 Results

The pre-notification letter for the second pilot was sent to randomly selected households on July 19<sup>th</sup>, 2023. Telephone recruitment took place between July 21<sup>st</sup> and August 4<sup>th</sup>. A total of 3,000 prenotification letters were sent, of which 167 registered for the survey and 73 households completed both the household and trip sections of the survey by August 9<sup>th</sup>, 2023.

The exhibit below shows the overall response and completion rates:



## EXHIBIT 3.1(4) Response Rate – Pilot 2

There was also interest in understanding the efficacy of telephone recruitment among households who had not received a pre-notification letter. As such, 500 records of listed households that had not been used for the second pilot were cold-called by telephone recruiters and asked to participate. Of these, 11 registered and 3 completed both the household and trip sections of the survey. Including these households, Pilot 2 had a total of 76 completed households.

As a result of low completion rates among app participants during Pilot 1, the second pilot tested the impact of reducing the requirements for app participation from 3 full days of data collection to 1 full





day. Higher registration and completion rates were observed among the test cell offered 1 day of data collection using the mobile app.

The exhibit below illustrates the difference in app participation between the 3 day and 1 day requirement for data collection.

# of App / Mixed Mode Households	Total Sample	# Recruited/ Self-Registered	# Completed the Diary	Completion Rate (%)
3 days using the mobile app	1,500	27	5	19%
1 day using the mobile app	1,500	39	12	31%
Total	3,000	66	17	26%

## EXHIBIT 3.1(5) Pilot 2 App/Mixed Mode Response Rate – 3 Day vs. 1 Day Test Cells

## **Comparison of Pilot Results**

During the project scoping and survey design phases, it was anticipated that recruitment levels in 2023 would be lower compared to 2017 and 2011. Actual response rates during both pilot studies came in lower than anticipated, driven largely by lower registration rates, suggesting that fostering engagement to get registrations would be a key challenge for the main survey. This resulted in overall completion rates between 2% to 3% (based on the total completed households out of the total sample).

The exhibit below shows the final pilot response rates compared with projected rates.

## EXHIBIT 3.1(6) Comparison of Pilot Response Rates

	Pilot Response Rates			
	Pilot 1	Pilot 2		
Total Sample	6,000	3,000		
Registration Rate (among <b>total sample</b> )	4%	6%		
Completion Rate (among <b>those recruited</b> )	53%	44%		
Overall Response Rate (completed among total sample)	2.7%	2.4%		

As a result of the findings from both pilots, improvements were made to the survey instruments to help with ease of participation for households, and to streamline internal processes for added efficiencies.





## 4. SUMMARY OF MAJOR DECISIONS

During the study design and development phase, several revisions and improvements were made to the survey instruments and methodological approach. Some of these revisions were made as a result of the two pilot studies and some were made as part of the fine-tuning process as the survey was being prepared for full launch. A summary of the major revisions made are listed below in Exhibit 4.1.

Туре	Issues	Revisions Made
Household and Mobile App Incentives	During the pilot phase, two incentive structures were tested to determine the amount that yields the highest response rate. It was determined that a \$20 household incentive and an additional incentive for mobile app users was the most effective.	Survey logic and pre-notification letters were revised to offer \$20 for households and an additional \$10 incentive to each mobile app respondent.
Mobile Friendly Survey	Significant improvements have been made to mobile friendly online interfaces since 2017, and user expectations have also risen.	Significant efforts were made to ensure that all survey pages would display properly on all mobile devices, requiring restructuring the layout of the trip section.
Language and Logic Checks	Elements of the online survey were perceived to be cumbersome or text heavy, potentially resulting in respondent fatigue.	Extra verbiage was removed from the survey and email communications. Additional information was removed from main screens and made accessible through icons or pop-ups. Questions deemed not essential for future research and modelling were removed, or program logic was implemented so certain questions were asked only if a threshold had been triggered. For example, removing the requirement to provide public transit stations or bus numbers for the online survey, auto populating "to go
		home" as a trip purpose if the destination was home, and only asking parking-related questions if the respondent had been at a destination for at least 30 minutes.
Low Registration Rates	By the end of the first month of the main survey launch, it became clear that the generally low registration rates in the pilot surveys were not an anomaly due to the time of the year, and the original number of target completes would not be reached with the existing sample.	TransLink made the decision to mail out an additional 300,000 letters across the survey area.

## **EXHIBIT 4.1 Study Issues & Revisions**







Number of Required Diary Dates for App Participants	After the first pilot, one of the barriers for mobile app response rates was the requirement to collect 3 full days of trip information.	Lowering the required number of days from 3 to 1 for app participants was tested during the second pilot and was implemented for all mobile app participants for the main survey.
Registration and Household Sections of the Survey	Another obstacle to higher response rates identified during the first pilot was the structure of the survey that separated the registration section (basic household information, and diary mode and date selection) from the household section. The opt-in link for mobile app participants was not sent until the household section was also completed.	The registration and household sections of the survey were combined, so a household was not considered registered until they had reached the end of both sections.
Initialization Process for Mobile App	The first pilot also demonstrated attrition throughout the mobile app initialization process as app participants needed to first click on an opt-in link, allowing lpsos to contact them for the study. They then needed to click on a download link for the mobile app that appeared in a new window. The number of steps required, in addition to issues arising from clicking on the link on a device other than a smartphone led to higher drop off rates.	The mobile app confirmation, opt-in and download link were combined into one email. Language was added to the email to indicate that clicking on the download link would be considered opting-in. Instructions were also provided for participants to only click on the download app using their smartphone.
Unlisted Sample	By the second flight, no significant differences in response rates were detected between listed and unlisted sample.	The decision was made to send out 100% unlisted households for the remaining letters as it was more cost efficient.
Households without Access to Computers or Smartphones	Throughout the pilot and main launch, the help desk received queries from households who had received a letter and wished to participate but did not have access to a computer or smartphone.	Help desk support staff helped register these households over the phone and would schedule a call-back following the diary date to collect their trip information. In total, 124 households registered through the help desk and 71 (59%) completed the diary.
Help Desk Outreach	From the pilot studies, it was apparent that mobile app and mixed mode households generally required more support or reminders to complete the diary for the entire household.	Processes were established for the help desk staff to follow-up with incomplete app only or mixed mode households to remind them to complete and provide technical support as needed. In contrast to the 2017 study, outreach was a significant part of the help desk role, rather than solely fielding inbound calls and emails.









## PHASE 2: RECRUITMENT AND DATA COLLECTION





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## 5. RECRUITMENT AND DATA COLLECTION

This section details the outcomes of the Recruitment and Data Collection phase of the 2023 Trip Diary Survey. The Recruitment and Data Collection phase involved recruiting survey participants, collecting completed surveys, handling respondent inquiries, and monitoring data collection and response rates to ensure all quotas were on target and to address any issues that arose with respondents.

The recruiting of households began with a pre-notification letter, which invited recipients to self-register online using a link or QR code, and was followed by telephone recruitment calls if telephone numbers were available. The details of these processes, as well as survey completion rates by key variables, are outlined in Section 7: Recruitment Processes and Section 8: Final Response Rates.

The following table summarizes the key dates for recruitment and data collection:

Task	Key Dates
Pre-notification letters sent	Sept 7 to Nov 27, 2023
Online Registration Open	Sept 7 to Dec 7, 2023
Telephone Recruitment	Sept 14 to Dec 4, 2023
Cell Sample Recruitment	Oct 11 to Dec 4, 2023
Trip Diary Dates	Sept 11 to Dec 8, 2023

## **EXHIBIT 5.1 Summary of Key Recruitment and Data Collection Dates**





## 6. RECRUITMENT PROCESS

## **6.1 Overview of Recruitment Process**

The recruitment of survey participants used an address-based sampling methodology which allowed for a representative sample frame based on 2021 Census dwelling counts for the survey area. A flow chart of the recruitment and data collection process is outlined below.



#### **EXHIBIT 6.1 Flow Chart of Data Collection Process**







## **6.2 Pre-Notification Letter**

A total of 686,497 pre-notification letters were mailed to a regionally stratified sample of households in the Metro Vancouver and Fraser Valley region. Two versions of the letter were designed – personalized mail for households with listed landlines (sent to 72,363 households), and non-personalized mail for those without listed landlines (sent to 614,134 households).

The content of both letters was identical with the exception of the current resident's name being included in the personalized version for listed households. The letter explained the nature of the study, requested their participation, and included a link and QR code to the online survey and a unique household ID and password. All households were invited to go directly to the online link to register themselves for the survey. As the household ID was embedded in each QR code, those who scanned the QR code on their phone only needed to enter their password to login.

The letters were mailed on a staggered flight schedule throughout the field window to ensure an equal distribution of completed households across the three-month survey period, and to ensure the letter was top-of-mind when follow up recruitment phone calls were made. The first batch of letters was mailed on September 7, 2023, and the eleventh and final batch was mailed on November 27, 2023. Based on learnings from the 2017 study, letters were mailed in a plain manila (Kraft) envelope similar to what other official government documents use in order to bring greater credibility to the study and maximize the rate of opening the letter. An early bird deadline for registration was also included in each mailout flight to encourage early participation. Households who registered by the early bird deadline were eligible for an additional ballot entry for the prize draw.

Appendix A provides examples of the pre-notification letter sent to listed and unlisted households.

Households with phone numbers associated were contacted by telephone approximately one week after the letters were mailed to further encourage participation. Telephone recruitment began on September 14 and continued until December 4, 2023. Recruitment was not conducted on October 2 due to recognition of Truth and Reconciliation Day, October 8 and 9 due to Thanksgiving, and November 11 due to Remembrance Day.

Early into the field window, it was noted that participation was skewing towards 65+ participants. To correct for this and build a more balanced age distribution telephone recruiters began to screen for those households that had at least one person under the age of 55 in early October. If there was no one under the age of 55, the recruitment call was ended without registering the household, though the household could still register themselves online if interested.







## **6.3 Supplemental Recruitment Methods**

#### **Cell Phone Sample**

While telephone recruitment could effectively be conducted among listed households, it was important to balance telephone recruitment with cellphone-only households recruitment as it is more likely to be associated with younger households.

As such, from October 11 to 15, a soft launch of cell phone dialling was conducted to gauge the response rate and efficacy of cell phone recruitment. As the soft launch was successful, the decision was made to supplement the main survey phone recruitment with cell phone dialing as much as possible.

The introduction of the telephone recruitment script was modified to provide background about the purpose of the study, confirm that household location was within the study boundaries, and to confirm whether the household had already participated. If the household was eligible and interested in participating, a household ID and password was generated in real-time and the telephone recruiter was able to complete the registration section during the same call.

In total, 1,595 households were recruited via cold call recruitment from the cell phone sample, and 560 households completed both the registration and diary sections of the survey.

#### City of Surrey Open Link

The City of Surrey requested an oversample in four sub-regions within the municipality. However, response rates in a number of these regions were significantly lower than in the rest of the survey area and it became apparent that meeting the desired oversample targets would be problematic. As such, a multi-pronged approach was taken to boost response rates in Surrey, including:

- Mailing a pre-notification letter to all available Canada Post records to the sub- regions of concern;
- Prioritizing City of Surrey households for telephone recruitment, as well as adding additional dialling attempts and leaving voicemails; and,
- Prioritizing City of Surrey households for help desk outreach and support to incomplete households.

Additionally, on November 8, Ipsos set up an open recruitment webpage where those interested could provide basic household information, including their home address and contact information, and submit a request to participate in the trip diary. The City of Surrey then shared the link through its online newsletter and social media channels to encourage participation among households in the region.

The Ipsos project manager would then review the provided information to confirm:

• That the household was located within the priority oversample regions. It was important to limit the extent of introducing non-random sample into the survey and as such, only those located in the oversample regions with low response rates were eligible to opt-in to the survey without having received a pre-notification letter.





• Whether the household had received a pre-notification letter and/or already participated in the study. If the household had received a pre-notification letter but not yet registered or completed, they were provided with their original household ID and password and encouraged to participate that way. If the household had already completed the survey, they were thanked for their interest but not eligible to participate for a second time.

In total, 74 households submitted a request to participate in the study. Of these, 53 were eligible and were provided with login information. 12 households registered and 6 completed.





## 7. ACTIONS TAKEN TO IMPROVE RESPONSE RATE DURING MAIN SURVEY

As overall response rate , response rate by age and region became problematic during the main launch, several additional actions were taken throughout the main field window to bolster response rates:

- **Targeted Recruit**: For all mailouts during the main launch, all sample requests to Canada Post included a skew towards households with a higher propensity for younger age cohorts. Additionally, from October 3 onwards, telephone recruiters screened for households with someone under the age of 55 and only continued to register those who met this criterion.
- **Targeted Outreach**: As mentioned above, the help desk support staff pivoted to focus more on outreach and follow-ups to incomplete households. This process was further fine-tuned during the main launch to focus on regions with lower response rates, or household types that were underrepresented (e.g., younger households, larger household sizes, etc.)
- Extended Field Window: The last possible diary date was extended from November 30 to December 8, allowing for additional telephone recruitment and second-chance diary dates for those who had registered but missed their original diary day.
- **SMS Texts**: During the pilots, SMS texts were only sent to main household contacts who had opted in for text reminders during the registration phase. However, as secondary household members using the app generally showed a lower response rate, SMS texts were introduced as an option for them as well, with language around consent added into the survey and introductory SMS text to ensure compliance with privacy regulations.
- **Post-Diary Date Email Reminders**: An additional email reminder was sent to incomplete households 24 hours and 72 hours after their diary date had passed.
- **Cell Phone Sample**: The main mail-based recruitment method was supplemented with a cell phone sample boost to households that had not received a pre-notification letter.
- **Modified Email Content:** Confirmation and reminder emails were updated to include links that allowed households to change their diary date or survey mode themselves without needing to contact the help desk.





## 8. FINAL RESPONSE RATES

In total, 686,497 households were sent a pre-notification letter. Of those, 15,426 (2.2%) completed the survey. Additionally, 1,595 households who did not receive a pre-notification letter were recruited by way of supplemental cell phone dialing, and of those, 560 completed the survey. An additional 6 completed the survey after registering through the open recruitment link created for residents of Surrey.

Exhibit 8.1 details the outcomes of the various recruiting methods.

Recruitment Method	# of Letters Sent / Households Contacted	# Recruited/ Self-Registered	# Completed the Diary	Completion Rate (%)	Overall Response Rate (%)
Online (Self- Registration)	642,862	32,618	14,493	44%	2.3%
Telephone	43,635	2,167	933	43%	2.1%
Cell Sample	7,338	1,595	560	35%	7.6%
Open Link (Surrey)	-	12	6	50%	-
Total		36,392	15,992	44%	

## EXHIBIT 8.1 Response Rate by Recruitment Method

Exhibit 8.1(1) details the completion rate by sample type. Those who were recruited via cell phone sample were less committed.

## EXHIBIT 8.1(1) Response Rate By Sample Type

Sample Type	# of Letters Sent / Households Contacted	# Recruited/ Self- Registered	# Completed the Diary	Completion Rate (%)	Overall Response Rate (%)
Total Mailout	686,497	34,785	15,426	44%	2.2%
Listed	72,089	5,206	2,383	46%	3.3%
Unlisted	614,408	29,579	13,043	44%	2.2%
Cellphone	7,338	1,595	560	35%	7.6%
Open Link (Surrey)	-	12	6	50%	-
Total		36,392	15,992	44%	





Best efforts were made to obtain 100% of the overall regional target and between 90% and 110% of the target sample for each sub-region. Exhibit 8.1(2) details the sample targets (with and without oversampling) and survey participation by the 58 sample areas. The last column of the table shows the success rate of meeting at least 90% of the target for each sub-region.

Sample Area ID	Sample Area	Base Target	Over sample	Total Target	Completed Surveys	% Total Target Met	Reached 90 - 110% of Target
11.1	West Vancouver	238		238	215	90%	$\checkmark$
11.2	Lion's Bay / Electoral Area A	30		30	1	3%	×
11.3	Bowen Island	30		30	6	20%	×
12	North Vancouver District	423		423	433	102%	$\checkmark$
13.1	Lonsdale RCC	197		197	235	119%	$\checkmark$
13.2	North Vancouver City (ex. RCC)	147		147	153	104%	$\checkmark$
21	CBD - West End 1	447		447	462	103%	$\checkmark$
22	CBD - False Creek 2	430		430	435	101%	$\checkmark$
29	UEL	94		94	96	102%	$\checkmark$
33	Vancouver Broadway 3	440		440	534	121%	$\checkmark$
34	Vancouver South 4	483		483	596	123%	$\checkmark$
35	Vancouver Kerrisdale 5	295		295	333	113%	$\checkmark$
36	Vancouver Kitsilano 6	414		414	458	111%	$\checkmark$
37	Vancouver SE 7	449		449	509	113%	$\checkmark$
38	Vancouver East 8	607		607	724	119%	$\checkmark$
39	Vancouver Strathcona / Grandview 9	258		258	272	105%	$\checkmark$
41	Burnaby North	329		329	445	135%	$\checkmark$
42.1	Metrotown RCC	202		202	244	121%	$\checkmark$
42.2	Burnaby Metrotown (ex. RCC)	189		189	204	108%	$\checkmark$
43	Burnaby South Central	320		320	371	116%	$\checkmark$
44	Burnaby NE	225		225	257	114%	$\checkmark$
47.1	New Westminster RCC	107		107	134	125%	$\checkmark$
47.2	New Westminster (ex. RCC)	344		344	405	118%	$\checkmark$
51.1	Port Moody	164		164	213	130%	$\checkmark$
51.2	Belcarra	30		30	12	40%	×
51.3	Anmore	30		30	3	10%	×
52.1	Coquitlam Centre	121		121	146	121%	$\checkmark$
52.2	Coquitlam North (ex. RCC)	205		205	216	105%	$\checkmark$

## EXHIBIT 8.1(2) Targets and Completed Households by Sub-Region







Sample Area ID	Sample Area	Base Target	Over sample	Total Target	Completed Surveys	% Total Target Met	Reached 90 - 110% of Target
53.1	Burquitlam	137		137	204	149%	$\checkmark$
53.2	Coquitlam South (ex. Burquitlam)	237		237	285	120%	$\checkmark$
55	Port Coquitlam	286		286	311	109%	$\checkmark$
56	Pitt Meadows	93		93	89	96%	$\checkmark$
57.1	Maple Ridge RCC	81		81	88	109%	$\checkmark$
57.2	Maple Ridge (ex. RCC)	333		333	350	105%	$\checkmark$
61	Richmond East	162		162	184	114%	$\checkmark$
62.1	Richmond RCC	414		414	425	103%	$\checkmark$
62.2	Richmond West (ex. RCC)	361		361	369	102%	$\checkmark$
63	Richmond South - Steveston	76		76	111	146%	$\checkmark$
67	Tsawwassen First Nation	30		30	22	73%	×
68	Delta - Ladner / Tsawwassen	238		238	248	104%	$\checkmark$
69	Delta North	238		238	225	95%	$\checkmark$
71.1	Surrey Metro Centre	197		197	338	172%	$\checkmark$
71.2	Surrey Centre (ex. RCC)	289		289	242	84%	×
72	Surrey Fleetwood	375	200	575	491	85%	×
73	Surrey Newton	278		278	193	69%	×
74	Surr Panorama	348	100	448	295	66%	×
75	Surrey Cloverdale	387	200	587	634	108%	$\checkmark$
77	Surrey South	448	100	548	632	115%	$\checkmark$
79	White Rock	134		134	119	89%	×
81	Langley City	157		157	185	118%	$\checkmark$
82	Langley Township - South	234		234	197	84%	×
83	Langley Township - North	356		356	415	117%	$\checkmark$
92	FVRD Abbotsford West	421		421	396	94%	$\checkmark$
93	FVRD Abbotsford East / Electoral Area G	246		246	223	91%	$\checkmark$
94	FVRD Chilliwack / Electoral Area E H	447		447	412	92%	$\checkmark$
95	FVRD Cultus Lake / Hope / Electoral Areas B D	51		51	22	43%	$\checkmark$
96	FVRD Mission	176		176	167	95%	$\checkmark$
97	FVRD Kent / Harrison / Electoral Area C F G	30		30	8	27%	×
	Total	14,508	600	15,108	15,992	106%	





Exhibit 8.1(3) details the completion rate by survey methodology. Completion rates were higher among online only households – nearly double that of mobile app or mixed mode households.

Household type	# Recruited/ Self-Registered	# Completed the Diary	Completion Rate (%)
Online only households	15,909	9,472	60%
Mobile app only households	13,519	4,153	31%
Mixed households	6,964	2,367	34%
Total	36,392	15,992	44%

## EXHIBIT 8.1(3) Completion Rate by Survey Methodology

Exhibit 8.1(4) below details the outcomes across each mailout group, excluding response rates from the cellphone sample and Surrey open link.

## EXHIBIT 8.1(4) Completion Rate by Mailout Group (Flight)

Mailout Group	# of Letters Mailed Out	# Recruited/ Self-Registered	# Completed the Diary	Completion Rate (%)	Overall Completion Rate (%)
Group 1 (Mailed Sept 7)	39,334	2,619	1,203	46%	3.1%
Group 2 (Mailed Sept 14)	39,334	2,618	1,190	45%	3.0%
Group 3 (Mailed Sept 21)	39,329	2,381	1,078	45%	2.7%
Group 4 (Mailed Oct 6)	58,509	3,397	1,520	45%	2.6%
Group 5 (Mailed Oct 18)	48,154	3,175	1,396	44%	2.9%
Group 6 (Mailed Oct 26)	62,548	3,558	1,399	39%	2.2%
Group 7 (Mailed Nov 6)	100,043	5,014	1,999	40%	2.0%
Group 8 (Mailed Nov 10)	24,195	1,335	612	46%	2.5%
Group 9 (Mailed Nov 15)	100,004	4,681	2,145	46%	2.1%
Group 10 (Mailed Nov 20)	164,237	5,763	2,754	48%	1.7%
Group 11 (Mailed Nov 27)	10,810	244	130	53%	1.2%
Total	686,497	34,785	15,426	44%	2.2%





As mentioned previously, during the first month of the main launch, a significant skew towards households with at least one person over the age 65 was observed among completed households. As such, a number of actions were taken to ensure the age distribution for the final sample generally aligned with the actual population in the survey area, as well as within each of the 7 larger regions. These actions included:

- Increasing the proportion of the Canada Post sample requests skewed towards households with a higher propensity of having someone under the age of 55;
- Supplementing the mailout sample with additional cellphone sample which typically skews towards younger age cohorts;
- Screening households for someone under the age of 55 during telephone recruitment and terminating the call if not; and,
- Prioritizing households with people under the age of 55 for help desk outreach.

Exhibit 8.1(5) compares the final age distribution of the survey sample with the overall population.

	TOTAL		North Shore		Vancouv	er / UBC	Burnaby / New West	
	Sample	Census	Sample	Census	Sample	Census	Sample	Census
0 to 19	18%	20%	16%	21%	14%	15%	15%	17%
20 to 24	4%	6%	3%	5%	4%	7%	5%	8%
25 to 34	17%	15%	12%	11%	21%	20%	23%	18%
35 to 54	29%	28%	26%	28%	30%	29%	30%	28%
55 to 64	13%	13%	15%	15%	13%	13%	12%	13%
65+	20%	17%	28%	21%	19%	17%	16%	17%

EXHIBIT 8.1(5) Age Distribution Of Survey Sample (At Person Level)

	Northeast Sector		Maple Ridge/ Pitt Meadows		Southwest Sector		Southeast Sector	
	Sample	Census	Sample	Census	Sample	Census	Sample	Census
0 to 19	20%	21%	22%	23%	18%	19%	21%	23%
20 to 24	3%	6%	4%	5%	4%	6%	4%	7%
25 to 34	17%	13%	13%	12%	14%	13%	14%	13%
35 to 54	31%	29%	29%	28%	28%	26%	28%	27%
55 to 64	11%	15%	15%	15%	13%	15%	13%	13%
65+	18%	16%	18%	16%	22%	21%	21%	17%





The tables below compare response rates for the last three Metro Vancouver Regional Trip Diary surveys conducted by Ipsos in 2023, 2017 and 2011.

	# Letters Mailed Out			# Completed the Diary			Overall Completion Rate (%)		
	2011	2017	2023	2011	2017	2023	2011	2017	2023
Total	124,553	491,888	686,497	22,848	28,225	15,426	18.3%	5.7%	2.2%
% of Universe	12.5%	46.0%	59.6%	-	-	-	-	-	-
Universe (Total # of Households in Region)	992,725	1,068,913	1,151,501	-	-	-	-	-	-
Mailout Type									
Listed	91,617	274,756	72,089	17,727	14,829	2,383	19.3%	5.4%	3.3%
Unlisted	32,936	217,132	614,408	5,121	13,026	13,043	15.5%	6.0%	2.1%

## EXHIBIT 8.1(6) Historical Comparison of Overall Completion Rates

## EXHIBIT 8.1(7) Historical Comparison of Registration and Completion Rates

	# Recruited/ Self-Registered		#	# Completed the Diary			Completion Rate (%)		
	2011	2017	2023	2011	2017	2023	2011	2017	2023
Total	31,978	65,709	36,392	22,848	28,225	15,992	71%	43%	44%
Recruitment Method									
Online	21,017	49,272	32,618	16,085	22,469	14,493	77%	46%	44%
Telephone	10,406	16,437	2,167	6,451	5,756	933	62%	35%	43%
Cell Sample	-	962	1,595	-	370	560	-	38%	35%
Helpline	555	-	-	312	-	-	56%	-	-
Open Link	-	-	12	-	-	6	-	-	50%
Mailout Type									
Listed	25,104	34,259	5,206	17,727	14,829	2,383	71%	43%	46%
Unlisted	6,874	30,488	29,578	5,121	13,026	13,042	74%	43%	44%
Survey Method									
Online only	29,466	50,151	15,909	21,754	23343	9,472	74%	47%	60%
Mobile app only	-	7,028	13,519	-	2905	4,153	-	41%	31%
Mixed mode	-	8,530	6,964	-	1977	2,367	-	23%	34%
Paper	2,512	-	-	1,094	-	-	44%	-	-





## 9. QUALITY CONTROL

This section provides a description of the quality control measures in place at various points in the study.

#### **Telephone Recruitment**

Prior to telephone recruitment, the Ipsos CATI project manager gave all recruiters a complete briefing during which the objectives of the research were discussed, the survey was reviewed, and a read-through of the script was conducted. Telephone recruiters were monitored by the Ipsos project manager throughout every shift, and feedback or additional training was provided as needed.

#### **Online and App Survey Data**

Household and trip data from completed households was reviewed on a daily basis and those with missing or contradicting information were contacted for clarification. More detailed information on the process for following up with these households is provided in Section 11.1: Overview of the Data Processing and Verification Process.

Early into the main survey field window it became apparent that some households participated on a day where all household members were out of region for the entire diary day. To mitigate this, Ipsos added a pop-up message to the diary date selection pages of the online survey cautioning that all members of the household must be within the survey region for at least part of the diary date, otherwise the household should pick another diary date. Completed households who were out of the region for the entire diary day were contacted and if reached, were asked to re-do their diary on a date when they would be within the survey area.

#### **Monitoring Response Rates**

New in 2023 was the use of a custom-designed dashboard that would allow Ipsos and TransLink to monitor the quality of data collected, as well as response rates across a variety of household and demographic variables. The dashboard was a secure online portal that was updated in real time, allowing the project team to check recruitment and completion rates by variables such as region, age, household size, mailout group, or sample type at any time, providing important feedback for recruitment decision-making.







## **10. RESPONDENT INQUIRIES**

Respondent inquiries were handled by Ipsos' help desk support staff. Respondents were provided with a toll-free helpline and a helpdesk email address, which were staffed from September 8 to December 22, 2023. The hours of operation were Monday to Friday from 9:00am to 6:30pm PST for both the English and Chinese lines, as well as Saturday from 10:00am to 2:00pm PST for the English line.

In total, the help desk received 4,555 inbound emails and 3,117 inbound phone calls from September 8 through December 22, 2023.

The nature of the calls and emails received can be categorized into six main groups:

- 1. Respondents who required technical assistance (62% of inbound queries).
- 2. Respondents requesting clarification about the survey questions (3% of queries).
- 3. Respondents with transit service ideas and/or complaints for TransLink.
- 4. Respondents who required assistance in Mandarin or Cantonese.
- 5. Respondents requesting to switch their survey mode from mobile to online or vice versa (15% of queries).
- 6. Respondents who missed their diary date requesting a new date (6% of queries).
- 7. Respondents with questions regarding the status of their gift card(s) (5% of queries).





# PHASE 3: DATA PROCESSING AND VERIFICATION







## 11. DATA PROCESSING AND VERIFICATION

This section outlines the outcomes of the Data Processing and Verification phase of the 2023 Trip Diary Survey. Included are details on the data cleaning, geocoding, and, to provide a sense of scope and rigour, the counts of returned and retained surveys.

## 11.1 Overview of the Data Processing and Verification Process

All data was examined for inconsistencies or inaccuracies and any such issues were reviewed and, if necessary, corrected. Prior to the cleaning process, a total of 15,992 surveys had been received.

Exhibit 11.1 depicts the general data processing and verification process following the data collection phase of the study.









## 11.2 Initial Data Cleaning and Review (Performed by Ipsos and McElhanney)

As the completed diaries were received, responses were reviewed daily to ensure accuracy and completeness. Ipsos' initial data cleaning involved household-level checks and corrections (e.g., adjusting AM/PM times, verifying trip purpose against location type, verifying trip modes against trip distance). As in 2017, logic checks were built into the data processing program allowing for easy prioritization of the most critical cases ahead of the more minor ones.

## Step 1: Ipsos Help Desk

Where required, help desk staff flagged cases for callbacks to clarify answers or fill in missing data. Follow-up calls and emails were made within four days of the survey completion to ensure the information was still relatively fresh in the respondent's memory. A maximum of three calling attempts were made. If contact was made with a respondent, the correct or missing information was logged, and the survey data was corrected before being incorporated into the batch data cleaning. If a respondent could not be reached, the survey data was submitted for batch cleaning as is.

#### Step 2: Ipsos Data Processing (DP)

Ipsos' internal data processing team conducted a bi-weekly batch cleaning of the household survey data (e.g., cleaning out extraneous responses resulting from inconsistent responses, renumbering trips if any had been deleted) prior to it being shared with McElhanney for a more extensive data logic review. Personally identifiable information such as names or nicknames and phone numbers or email addresses were removed at this stage.

#### Step 3: McElhanney Data Logic Review

McElhanney conducted a data logic review, which was a key step in the data cleaning process. Household, person and trip records were reviewed to confirm their validity and reasonableness. Working with TransLink staff, flags and data checks for the 2023 survey were developed based on insights from the 2023 pilot data and the 2017 survey. This review helped identify recurring data issues, such as missing trip modes, purposes or times, and the underlying causes. It was also used to identify illogical cases, such as unrealistically high travel speeds given the mode or incorrect mode entries, which helped the development of automated data cleaning scripts.

#### Step 4: Ipsos Review and Cleaning of Flagged Cases

After McElhanney flagged illogical or missing cases, the data was returned to Ipsos for a second round of cleaning. Ipsos reviewed the flags and cleaned the data where possible.

#### Step 5: McElhanney Second Data Logic Review

The data was then returned to McElhanney to re-run the data cleaning scripts and append flags to the outstanding cases remaining after the previous rounds of cleaning. These flags served as the final data cleaning statistics for each batch of data prior to being sent to TransLink for further review.

#### **Step 6: Ipsos Final Review**

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After McElhanney's second review, the data was returned to Ipsos and they conducted a final review of the data to ensure all personally identifiable information had been removed. Ipsos then sent it to TransLink along with a summary of the data logic flags.

## 11.2.1 Summary of Flags and Error-Checking

As described in the previous section, all data received by McElhanney was examined for inconsistencies or inaccuracies, referred to as "flags" at the trip level, and "checks" at the respondent and household level. The flags and checks were reviewed and sent back to Ipsos for further post-processing and cleaning.

The checks completed at the household and respondent level were used primarily to validate the general reasonableness of high-level demographic and trip-making statistics and verify overall data consistency within batches. Exhibit 11.2 below summarizes the data checks completed at the household and respondent level.

Type of Information	Commentary
Number of households who made zero trips	Statistics helped identify if a high proportion of
Number of respondents who made zero trips	respondents in the batch did not make any trips.
Number of respondents who made zero trips because they worked from home	Statistics useful for insights into post-pandemic travel behaviour.
Specific respondents that identified as "unemployed" but made a work trip	Logic check to flag illogical cases where unemployed people made work-related trips.
Specific respondents who did not have a drivers license and made an auto driver trip	Logic check to flag illogical cases where a person without a driver's license indicated they drove.
Percentage of respondents who completed the survey by web	Statistics used for post-processing insight on the
Percentage of respondents who completed the survey by app	result from different survey modes.
Average Household Size	
Average Trips per Person	Statistics used to compare differences between batches and validate with previous trip diary
Average Trips per Household	Survey Statistics.

## EXHIBIT 11.2 Respondent and Household-Level Data Checks







Records were flagged at both the waypoint and trip level if they breached logic checks, were missing key information, or exhibited structural data inconsistencies, such as missing a trip in the trip sequence. Waypoints are the endpoints of a trip (the origin and destination). Each waypoint has an associated 'arrival time' and 'departure time', except for the first waypoint (no arrival time) and the last waypoint (no departure time) in a daily trip sequence. A pair of consecutive waypoints combine to make a trip record, with the first waypoint being the origin of the trip and the second waypoint the destination.

Exhibit 11.2(1) summarizes the data flags and cleaning that was performed for each batch. For specific examples on the flagging methodology please refer to Appendix K.

Type of Information	Flag Description	Action Taken
Trip Sequencing	The trip sequence was flagged as having a missing trip if there was a missing trip in a person's trip record sequence.	Ipsos reviewed the trip sequencing with their DP team to ensure trips were correctly sequenced, and re- sequenced where needed.
Trip Information	Respondents did not provide key trip information. Trips were flagged if they did not specific a mode of travel, a trip purpose, and/or the trip time.	Logs of the outcome of callback attempts were reviewed to check whether contact had been made, and to ensure any corrections had been accurately entered.
Trip Time Conflicts	Trip records were flagged if destination arrival time was earlier than departure time.	Ipsos verified trip information and made corrections where possible.
Trips Outside the Trip Diary Regions	Trips were geocoded using the latitude and longitude of the waypoints. The waypoints were checked to see if they were located within the trip diary region as defined by a shapefile boundary. Trips were flagged if they were identified as outside the regions.	Trips were reviewed to see if records should be kept or excluded from the final dataset.

## EXHIBIT 11.2(1) Trip-Level Data Flags and Cleaning







Trip Duration	The trip duration was compared against pre-set thresholds by travel mode to identify records with exceptionally long trip times. The threshold assumptions are provided in Appendix J.	Ipsos verified trip information.
Trip Speed	After geocoding, average speeds were calculated using the distances extracted from Google Maps API between start and end points of a trip, and the recorded trip time. These speeds were compared against pre-set thresholds to validate for logic. The threshold assumptions are provided in Appendix J.	Ipsos verified trip information, specifically if the correct mode was identified and recorded.
Merge Trip Candidates	<ul> <li>The 'merge trip' flag refers to cases where two or more trips should be examined and potentially merged into one trip record. Typical merge trip cases are provided in Appendix K. A trip is identified as a candidate for merging with a previous or subsequent trip if two of the following three conditions are met: <ol> <li>Consecutive trips that have the same trip purpose.</li> <li>Trips with a short activity duration.</li> <li>Trips with a short trip duration.</li> </ol> </li> <li>The cut-offs for short activity and trip durations by trip purpose are provided in Appendix J.</li> </ul>	Delivered to TransLink. 'Merge' trip candidates will be examined in more detail by TransLink.

## 11.3 Advanced Data Processing (Performed by TransLink)

In addition to the data checks and cleaning performed by Ipsos, TransLink staff carried out data cleaning routines to address low-quality data samples and performed data weighting and expansion to ensure representative travel behaviors at the regional level.





## **Data Review and Cleaning**

TransLink's data review and cleaning were primarily focused on flagging low-quality data, performing algorithmic and manual corrections, and coding final data fields to be consistent across multiple survey years.

Travel surveys are lengthy and require multiple touchpoints with the survey instrument until completion. As a result, low-quality data is often a concern and can skew survey results. TransLink used several criteria to flag common survey issues before performing data cleaning:

- **Missing attributes**: households, persons, and trips with missing information that were not resolved by Ipsos were flagged for review.
- **Trip continuity**: a trip must depart after the conclusion of a previous trip, and the start and end locations must match. Any trips with trip continuity issues were flagged.
- **Trip not meeting speed, distance, and duration cutoffs**: trips that did not meet defined outlier cutoffs were further reviewed by TransLink staff. The cutoff criteria for each trip were evaluated against Google API directions. See EXHIBIT 11.3(1) for cutoff criteria used.
- **Multiple consecutive trips**: consecutive trips with identical purposes often indicate GPS geofencing and tracking issues and are flagged for review.
- **External location spatial coding**: trips with origin or destination locations that fall outside of the study area are flagged for external trip processing.
- **Respondent comments suggesting potential mistakes**: trips with respondent comments often include complex survey issues involving a combination of trip times, locations, modes, and purposes. Respondent comments with these issues were flagged for review.

Mode	Distance (km)	Duration (minutes)	Min. Speed (km/m)	Max. Speed (km/m)
Auto Driver	NA	180	1	120
Auto Passenger	NA	180	1	120
Transit	NA	120	1	80
Walk	5	90	NA	15
Bike	50	150	NA	40
Other	NA	NA	1	100

## EXHIBIT 11.3(1) Trip-Level Outlier Record Flagging Critieria

Flagged trips were then sorted into different data cleaning treatments. TransLink used a combination of algorithmic data cleaning and manual data cleaning depending on the complexity of the issues identified for each flagged trip. Trips that had been flagged with a single issue were addressed through one of the following data cleaning algorithms:

• Large language model (LLM) free-text processing: For records with *missing attributes* coded as "Other" in the completed surveys, a free-text box was included to provide the respondent an opportunity to manually enter a category. Based on TransLink's review, a vast majority of these





attributes in trip modes, trip purposes, person ethnicities, person occupations can be coded into one of the existing categories. TransLink ran data processing to verify and recategorize the missing data coded as Others using an open source LLM by META, Llama3. To ensure data privacy, we hosted the LLM in a secured and private server within TransLink's premises, so no data is sent to any third-party vendors. TransLink verified the performance of the LLM categorization against labeled data from multiple human responses and found that the LLM performed at near-human-level at this data cleaning task.

- **Trip time parsing:** any trips with trip end time earlier than the trip start time of the next trip indicate a *trip continuity* problem. This is typically due to inconsistent trip times coding, particularly related to AM vs PM coding that were found in some of the online survey responses. TransLink used an alternative time parsing pattern to resolve this issue.
- Merging short trips: *Trips not meeting speed, distance, and duration cutoffs,* and trips with *multiple consecutive trips* were processed using a trip merging algorithm with criteria defined for trip distance and activity duration by trip purposes see EXHIBIT 11.3(2). These affected trips are often very short with low trip distance and activity duration.
- **External trip processing**: trips with one end outside of the data collection region were trimmed and then assigned one of 12 external exit points. Trip attributes were updated to reflect the adjustments made to the external locations.

For more complex data issues with multiple flags and with *respondent comments suggesting potential mistakes*, manual reviews and data processing were performed by TransLink staff. A total of 199 household- level, 9 person- level, and 481 trip-level records were modified with manual data processing.





Purpose Code	Purpose Text	Trip Distance Cutoff (km)	Trip Activity Duration <sup>4</sup> Cutoff (minutes)
1	To Work	0.4	10
2	During work/business trip	0.05	2
3	To drop-off/pick-up someone	0.1	1
4	To school/study	0.4	10
5	Shopping	0.1	1
6	Dining/restaurant	0.1	1
7	Recreation/social/entertainment	0.1	1
8	Personal Business	0.1	5
9	To volunteer	0.4	5
10	To go home	0.1	5
11	Other: please specify	0.05	1
12	Recreational loop trip without a destination <sup>5</sup>	0.05	5
13	Waiting for transit/transfer stop <sup>6</sup>	0.1	1

## EXHIBIT 11.3(2) Trip-Level merging criteria

#### **Data Weighting and Expansion**

As with any random sample survey, the Trip Diary data had to be weighted (adjusting the data to ensure the distribution of demographic attributes in the sample match those of the general population) and expanded (inflating the sample so that the data matches the size of the entire population).

To conduct the weighting, TransLink used external data sources (also referred to as *control data*) such as 2023 land use data from Metro Vancouver (MV), Census 2021 data and the Labour Force Survey (LFS) from 2022 to 2024 to correct sampling biases on several dimensions related to respondent's demographic attributes. Please see EXHIBIT 11.3(3) for a full list of variables included for data weighting and expansion. The data expansion is performed first using the total households and total samples by "sub seed" geography. The initial weights provided for data expansion are then entered into data

<sup>&</sup>lt;sup>6</sup> Transit transfer and stop purpose is a trip purpose specifically identified by Smartphone App method, since these trips represent an intermediate stop and does not represent the destination of interest, these trips are merged in the final dataset.



<sup>&</sup>lt;sup>4</sup> Activity duration is the difference in time between the end time of one trip and the start time of the next trip. A low activity duration trip combined with short trip distance indicate that the trip may not be associated with a real activity or purpose, and could be the result of GPS tracking errors.

<sup>&</sup>lt;sup>5</sup> Recreational loop trips have distinct travel behaviors since they do not have a specific destination. Loop trips are filtered into a separate trips table for loop trips in the final dataset.



weighting where a variety of survey biases are minimized based on population-level statistics.

## EXHIBIT 11.3(3) Attributes for Data Weighting and Expansion

Attribute Names	Attribute Values	Geography	Source Data
Total Number of Households	All Households	Traffic Analysis Zone <sup>7</sup> , Sub Seed <sup>8</sup> , and Trip Diary Sub Area	MV Land Use
Household Sizes	1, 2, 3, 4+	Sub Seed	MV Land Use
Households Income	0 to 50k, 50k to 100k, 100k to 150k	Sub Seed	MV Land Use and 2021 Census
Household Dwelling Type	Single-detached home, Non-single-detached home	Sub Seed	MV Land Use and 2021 Census
Population	All persons	Traffic Analysis Zone, Sub Seed, and Trip Diary Sub Area	MV Land Use
Population by Age	0 to 4, 5 to 12, 13 to 17, 18 to 24, 25 to 34, 35 to 54, 55 to 64, 65 plus	Sub Seed	MV Land Use
Population by Gender	Male, Female	Sub Seed	MV Land Use and 2021 Census
Population by Employment Status	Full Time, Part Time, non-Worker	Sub Seed	MV Land Use and 2021 Census
Workers by Usual Place of Work and Usual Mode of Commute	WFH Commute by Auto Commute by Transit Commute by Active	Regional (MVRD and FVRD)	MV Land Use and 2023 LFS
Number of transit trips	Total transit trips	Regional (MVRD only)	TransLink Compass Ridership with APC corrections

<sup>&</sup>lt;sup>8</sup> Sub Seed Geography is a 44-zone geography based on the 58-zone Trip Diary Sub Area sampling geography. The Sub Seed Geography combined a number of smaller sub areas with limited sample sizes to ensure all attributes specified can be used for data weighting.



<sup>&</sup>lt;sup>7</sup> Traffic analysis zone (TAZ) is a 1709-zone geography with 500-1000 households per zone. Due to the lower sampling rate in Trip Diary, multiple geographies are often used in combination with TAZ to ensure weighting does not over weigh lower geographies while ensuring the targets are meant with reasonable accuracy at higher geographies.



## **Underreporting Adjustments**

In addition to data expansion and weighting at the household- and person-level, TransLink performed underreporting adjustments at the person- and trip-level. While smartphone surveys can passively track all the trips a respondent performed throughout the entire day, web surveys typically have an increased survey burden due to the need to manually enter trip information after the diary day, resulting in underreporting of trips.

At the person-level, TransLink found statistically significant differences in daily travel patterns due to survey methods (online website versus smartphone apps). To estimate the degree of this difference, person records were categorized into having one of four daily travel patterns:

- <u>Home</u> pattern: no trips were performed during the survey day
- <u>Nonmandatory only pattern</u>: only trips that are not work or school-related have been performed
- <u>Mandatory only pattern</u>: only trips that are work or school-related have been performed
- <u>Mandatory plus nonmandatory</u> pattern: both trips related to work or school, and trips related to non work or school purposes have been performed.

TransLink estimated a multinomial logit (MNL) model with daily travel pattern as the response variable. The survey method, along with several demographic variables such as worker commuting frequency, employment status, student status, household size, car ownership, and age, are included as predictor variables. The demographic variables were used to control for the impact of different person- and household-level characteristics on a person's daily travel pattern. Using the MNL model, TransLink found the following corrections are needed for daily travel patterns:

- reduction of 7.3% of web persons with home pattern
- reduction of 0.5% of web persons with mandatory only pattern
- increase of 4.7% of web persons with nonmandatory only pattern
- increase of 3.1% of web persons with both mandatory and nonmandatory pattern

In addition to underreporting correction at the daily person level, TransLink also conducted an underreporting adjustment at the trip level. Even after reducing the number of web surveys with underreporting, we found additional bias in the reporting of trip purposes and trip modes. To quantify the degree of bias by purpose and modes, we segmented the trips into 6 categories: 1) home-based auto, 2) home-based transit, 3) home-based active, 4) non-home-based auto, 5) non-home-based transit, 6) non-home-based active. We estimated a Negative Binomial Generalized Linear Model (NB-GLM) with trip rate as the response variable. The survey method, along with several demographic variables such as household composition, household income, gender, age, transit pass ownership, employment status, commuting frequency, student status, and vehicle ownership were used to control for the impact of demographic factors. The variable for the survey method for all segments, except for home-based auto, was found to be significant. The trip rate adjustment factors derived from our NB-GLM are as follows:

- Home-based transit 0.88
- Home-based active 0.98
- Non-home-based auto 1.49
- Non-home-based transit 1.28
- Non-home-based active 1.31

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## 11.4 Mobile App Data Processing

Several steps were taken to integrate Ipsos' online platform with MMM's database by converting the survey data and mobile app data into a workable format.

## 11.4.1 Pre-Processing

The X-ING app passively collected raw sensor data from app participants' phones, including GPS, Wi-Fi, accelerometer, and motion activity data. This raw data was sent to MMM's backend system where a machine learning algorithm processed the raw data together with contextual information such as General Transit Feed Specific (GTFS) data to infer stop times, locations, activities, as well as trip modes (e.g., bus, SkyTrain, Canada Line, car).

## False Stops and Noise Stops

To minimize the app user's verification burden, data logic was built into the backend to identify both false stops and noise stops. Noise stops are cases where the respondent was not travelling, but some activity, movement or jump in the GPS data triggered the app to capture travel. To reduce these phantom trips, the MMM backend made use of other sensor data collected, such as accelerometer, WIFI and motion data, to check if the user was really travelling.

Short false stops, where the participant was still travelling but some activity triggered the app to create a stop (e.g., stopped at a traffic light) were removed based on stop durations and the travel modes recorded before and after the stop. The trip traces before and after the short stop were also examined. If they overlapped with each other, the stop might be a valid short pickup or drop-off stop. Otherwise, it was likely a false stop that should be removed.

## Identifying Transit Trips

Public transit trips were identified based on mapping with the region's transit network data from GTFS data files. If a bus, SeaBus, SkyTrain, Canada Line or West Coast Express trip was identified, the bus number or start/end train station names were pre-filled into the trip diary.

#### **11.4.2** App User Verification of Trip Diary Day

The X-ING user interface was designed to make the verification process simple and intuitive for mobile app participants. Based on the participant's demographic information collected in the online registration survey, logic was built into the app to guide users through potential follow-up questions for each trip.

If a stop was missing during a trip, the participant was able to specify the location of the missing stop and the system automatically inferred the start and end times of the stop based on the participant's raw GPS data. This not only simplified the process for users but also improved accuracy of the data by limiting the number of manual edits. Similarly, if a data gap was present (e.g., a period of time where the app did not collect any data), the app provided shortcuts to the most likely options for filling the gap and guided the participants through the steps to fill it in.






# 11.4.3 Post-Processing (After App User Verification)

The output data from MMM was customized to match the data format and structure required by Ipsos to easily integrate the two systems. As a full trip diary day is from 4am to 4am, MMM's system was adjusted to check the app participant's completion status based on this timeframe and only sent the trip diary information to Ipsos for fully verified 24-hour periods (4am to 4am). Although the users still view their dairy in the app based on calendar days, the reminder to verify the trip diary is sent in the morning of the day after the diary date, so that the user will get a chance to capture and verify the early morning trips, if any. Also, MMM adjusted its data processing algorithm to only consider a day as fully verified based on the 4am cut-off time, so that Ipsos could follow up with the participant if there were any trips between midnight and 4am that still needed verification.

### Trip Chaining

The data in MMM's database is stored as intervals, and each interval corresponds to either a stop (activity) or a trip segment. However, the data in the Ipsos database is a list of locations (which also include the trips leading to each location). As such, MMM needed to perform trip chaining to organize the trip segments into trips (or multi-mode trips) prior to sending the data back to Ipsos' platform.

# Reorganization of the Data

Additionally, prior to sending the mobile app data back to Ipsos, MMM's database was reorganized to follow the format required by Ipsos. This involved breaking up the continuous data into days and sending each day's data separately based on its verification status.

### Data Mapping

The data stored on MMM's database also needed to be in line with code values used by Ipsos. This included answer codes for variables such as trip purpose, trip mode, parking information, transit stations, and reasons for not travelling. For some of these values, the question was asked slightly differently between the X-ING app and the online survey, and the codes needed to be derived based on answers to multiple questions as well as household or individual characteristics. For example, all bus modes in the X-ING app are grouped under one mode (Bus), and there is a follow up question to capture the detailed mode such as public bus, school bus, etc. Before sending the data back to Ipsos, the answers to these two questions are combined and mapped to Ipsos' mode values.





### **12. FINAL STATUS OF COMPLETED SURVEYS**

# 12.1 Final Status of Survey Returns

After data processing, data cleaning, and data review, 113 completed surveys with low data quality were identified, manually reviewed, and removed. These surveys contained numerous coding errors, internal data inconsistencies, and missing values. The final percentage of households retained after data cleaning is approximately 99.3%; see Exhibit 12.1(1) for a breakdown of the final survey returns by household survey types.

Household type	Total number of households completed	Total number of households, retained after data cleaning	Percentage of households, retained after data cleaning	Total number of persons retained	Total number of trips retained
Online only households	9,472	9,453	99.8%	21,721	51,426
Mobile app only households	4,153	4,097	98.7%	6,205	21,546
Mixed households	2,367	2,329	98.4%	7,326	23,221
Total	15,992	15,879	99.3%	35,252	96,193

# EXHIBIT 12.1(1) Survey Returns after Data Processing







# 13. CONSIDERATIONS FOR FUTURE RESEARCH







# **13.1** Considerations for Future Research

Based on the challenges, issues and successes encountered throughout the 2023 survey, a number of learnings have been identified that may prove useful for the design and implementation of similar trip diary studies in the future. These learnings are described in detail below.

### Awareness Building is Key

As seen in Exhibit 8.1(6), overall response rates have continuously trended downstairs over the last few trip diary surveys. Fewer landlines and increased cellphone-only households, an increase in spam callers and phishing emails as well as invitations to participate in survey research, and increased disengagement with surveys all contribute to lower levels of participation. Even greater downward shifts in response rates to surveys have been observed since the COVID-19 pandemic.

While nonetheless a helpful recruitment tactic, incentives alone are not enough to trigger significant interest in participating. Anecdotally, even among those who completed the trip diary, a number of households mentioned they were not interested in collecting their household or app incentive but were participating out of a sense of civic duty. In this regard, providing an option to donate to charity likely attracted some households who would not otherwise be swayed to participate.

Additionally, alternative or supplemental recruitment and reminder methods will prove important for future trip diaries. For example, supplemental cell phone dialing or postcard reminders sent to households who have already received a letter.

### **Additional Language Supports**

Incorporating other languages such as Punjabi or Hindi into the survey design could prove beneficial for future trip diary surveys, especially in some of the low response rate regions.

In 2017, a helpdesk phone line was offered in Chinese to provide support in Cantonese or Mandarin as the survey instrument was in English only. In 2011, paper surveys were mailed out in English, Chinese and Punjabi, and the vast majority of returned surveys were in English. However, the population of non-English speakers has likely grown since 2011. For example, in the City of Surrey, the proportion of residents who identify Punjabi as their mother tongue has increased 2 percentage points (nearly 35,000 people) between 2011 and 2021.

This year, four respondents contacted the help desk to ask for support in a South Asian language or questioned why it was not provided. However, the proportion who might have been interested in participating could be higher as those not confident speaking in English likely would not phone the support desk.

As such, certain regions and populations may prove challenging to reach in future research without further language accommodations. For example, including other languages on the pre-notification letter and in targeted communications, or offering help desk support in other languages. Acknowledging those with other first languages and encouraging their participation could help incite a higher level of engagement among these groups.

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# APPENDIX

Survey Instruments:

- A. Pre-Notification Letters and Envelopes
- B. Telephone Recruitment Questionnaire
- C. Online Survey
- D. Mobile App Survey
- E. FAQ Page
- F. Email Reminders
- G. SMS Reminders
- H. Online Survey Screenshots
- I. X-ING App Screenshots

### Data Cleaning:

- J. Data Cleaning Assumptions
- K. Data Cleaning Examples

