Household survey of the impact of COVID-19 on mobility in Gauteng Province

Draft Report

4 October 2022

FOREWORD BY THE MEC FOR ROADS AND TRANSPORT IN GAUTENG PROVINCE

Our Smart Mobility 2030 vision requires a government that is agile and responsive to societal changes. The quality of government response is also critically dependent on evidence-led interventions. It is in this context that I requested the Department of Roads and Transport to critically look at the short to long term impact of COVID-19 on mobility in the province.

The survey results show that society in Gauteng Province is indeed dynamic. In the short term, the various lockdown restrictions led to major and significant declines in travel. This had a negative impact on revenues for public transport. The demand for road space was also reduced.

The survey indicates that the province is recovering to pre-pandemic levels. The structure of the travel demand remains largely the same. However, the volume of travel for some travel purposes remains relatively subdued. The decline in the use of the high capacity public transport services is concerning. Nevertheless, it is encouraging that society in the province aspires to using higher capacity services and non-motorised transport modes.

The province will continue to work with local government bodies to ensure that the results of the survey inform their responsibilities as planning authorities. Through investing in surveys such as this one, the province fulfils its constitutional mandate of ensuring that local government works as it should.

Our Smart Mobility 2030 strategy requires that the province invest in appropriate technology to enable government and society to plan and respond better to system shocks such as pandemics. A large proportion of the population remains very vulnerable to system shocks. Consequently, government needs to use the results of the survey to ensure that public transport is appropriately financed. Investment in better non-motorised transport infrastructure is absolutely necessary.

The efforts of the provincial staff and the CSIR to carry out a survey of this kind are acknowledged. I would also like to thank the many Gauteng households who welcomed us into their homes under very difficult circumstances.

EXECUTIVE SUMMARY

The COVID-19 pandemic and the associated responses by the South African government had a major impact on household travel patterns. The report presents the results of a survey in Gauteng Province to help determine the short to long-term impact of the pandemic on household mobility in the province. The survey results supplement the results of the 2019/2020 household travel survey that was completed just before the initial lockdown restrictions. The report documents the survey objectives, scope of work, methodology, survey results and detailed technical discussions. Analyses of the survey results were undertaken to confirm the statistical significance of changes in mobility patterns relative to the baseline.

The survey sampled 4 000 households spread throughout the metropolitan and district municipalities of the province. The survey resulted in a weighted total of 4 951 138 households. The data included information on: (i) households; (ii) people in households; (iii) trips taken by people in households; (iv) mode of transport used by individuals in households; and, (v) individual perceptions regarding future travel.

The table below summarises some of the key findings from the survey and their noteworthy implications. Indications are that the structure of household travel will stay mostly unchanged post-COVID-19 in the province. Cars and commuter taxis continue to be essential modes of transport. The private car remained a dominant mode of travel for all purposes both before and during COVID-19. Bus accounted for very low trips before and during COVID-19. Other modes that will be important for work, education, shopping, and medical purposes in future are the bus, commuter taxi and walking all the way.

Indications are that while the structure of trips remains largely the same, travel volumes for some trip purposes have changed. The volume of recreational trips, for example, has reduced. Other trip purposes, such as seeking health services, have experienced a marginal increase. Overall, the peak intensity has reduced and off-peak travel has marginally increased. However, the recovery trajectory may soon dwarf the subdued travel demand. This requires that planning authorities in the province should continue with the implementation of road network, public transport and integrated transport plans that they had before the COVID-19 outbreak.

Dimension	Findings	Implications
Travel Characteristics Before and During COVID-19	The private car and commuter taxi remained dominant modes of transport for all trip purposes before and during COVID-19. Higher capacity vehicles such as train, Gautrain and bus were less utilised and accounted for less than 2% of trips for each trip purpose.	Spatial planning and settlement patterns in the province are not taking advantage of high capacity public transport modes. The frequency and density of higher capacity public transport modes should be continuously reviewed to respond to changing travel patterns.
	The percentage of people who walked all the way for work increased by 1% during COVID-19 when compared to before COVID-19.	Provision of non-motorised transport infrastructure should be prioritised to improve transport service delivery in the province.
	There was no notable change in departure time and trip duration for different trip purposes before and during COVID-19.	Morning peak, off-peak and afternoon peaks in the province will likely stay as they were prior to COVID-19.
Future Travel Perspectives	A large proportion of people will continue to work full time at a workplace (71% of workers will likely continue working at a workplace).	Long-term road network plans in the province should continue. Investment in public transport, non-motorised transport and travel demand management measures should continue.
	A large proportion of people will continue with contact classes (93% of students are most likely to have contact classes).	
	A large proportion of people will continue with physical shopping (94% of people are most likely to continue with physical shopping).	
	The private car will continue to be used as a main mode of transport for all purposes in the future. Other modes that will carry substantial trips	

Dimension	Findings	Implications
	for work, education, shopping, and medical purposes in future are “bus”, “commuter taxi” and “walk all the way”.	
Answering Key Research Questions	The statistical analyses confirm that the majority of people will continue to travel to work, education, shopping and medical purposes using the same method as they used prior to COVID-19. Trips generated by travel for these purposes in future will not be significantly different from trips generated before COVID-19.	Long-term road network plans in the province should continue. Investment in public transport, non-motorised transport and travel demand management measures should continue.

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LIST OF ABBREVIATIONS

CASI	Computer Assisted Self Interview
COVID-19	Coronavirus Disease 2019
CSIR	Council for Scientific and Industrial Research
EA	Enumerator Area
GDRT	Gauteng Department of Roads and Transport
GHTS	Gauteng Household Travel Survey
HHTS	Household Travel Survey
PSU	Primary Sample Unit
SANRAL	South African National Roads Agency
SSU	Secondary Sampling Units
TAZ	Transport Analysis Zone
VDS	Vehicle Detector Station
WFH	Work from Home

DEFINITIONS

Future Travel Perspectives:	Anticipated trip patterns for the period after the COVID-19 pandemic.
Household Income:	Gross monthly income of a household (including salaries, wages, pensions, and any other income of members of the household).
Household Size:	Number of persons staying in the household at least four nights per week.
Informed Consent:	The sharing of the project details with respondent before agreeing to participate in the survey questionnaire.
Low Response Rate:	Households providing limited or little information in response to the survey questionnaire.
Non-Response:	Complete refusal by households to provide responses to the survey questionnaire.
Other Trip Purpose:	Trip purpose other than for work, education, shopping and medical. These include travel to visit family and friends, recreational places, places of worship, welfare offices and government offices.
Replacement Sample:	Selection of an alternative household in the vicinity of the originally selected household due to its unavailability or refusal to participate.

1. INTRODUCTION

Following the release of the 2019/2020 household travel survey in October 2020, the Gauteng Province Department of Roads and Transport (GDRT) deemed it necessary to commission the CSIR to carry out a supplementary survey to unravel the short to long-term impact of COVID-19 on baseline mobility in the province. The report documents the outcomes of the supplementary survey. It contains the survey objectives, scope of work, methodology, survey results and technical discussions.

2. BACKGROUND

The GDRT completed data collection for the 2019/20 household travel survey in March 2020, just before the declaration of the national state of disaster in response to the global outbreak of COVID-19. The regulations that were promulgated in line with the state of disaster included the imposition of travel restrictions, as well as the closure of schools and minimisation of non-essential travel. The loading of passengers on public transport vehicles was also restricted. A risk-based relaxation of nationwide lockdown regulations was implemented over time, from alert level five (intensive restrictions) to alert level one (minimal restrictions).

Ordinarily, each alert level affected household travel differently. Fundamentally, the travel behaviour of households in the province may be significantly altered, temporarily and permanently, thus warranting the supplementary survey.

The 2022 Quarter 1 Labour Force Survey (Statistics South Africa, 2022) reports that, by March 2022, most workers worked from their usual place of work in both Q4: 2021 and Q1: 2022, with only 6.2% of workers indicating that they worked from home, particularly in Gauteng and the Western Cape. Nonetheless, many businesses around the world are adopting flexible work arrangements. Similar arrangements are being adopted by the education sector. Such changes may impact on land-use development, trip generation, and how infrastructure and services should be planned, designed and operated.

Table 1 summarises the different alert levels implemented in South Africa from 2020 to 2022 and the corresponding time periods.

Table 1: Lockdown alert levels in South Africa

Lockdown alert levels	Start date	End date
Level 5	26 March 2020	30 April 2020
Level 4	1 May 2020	31 May 2020
Level 3	1 June 2020	17 August 2020
Level 2	18 August 2020	20 September 2020
Level 1	21 September 2020	28 December 2020
Adjusted Level 3	29 December 2020	28 February 2021
Adjusted Level 1	1 March 2021	30 May 2021
Adjusted Level 2	31 May 2021	15 June 2021
Adjusted Level 3	16 June 2021	27 June 2021
Adjusted Level 4	28 June 2021	25 July 2021
Adjusted Level 3	26 July 2021	12 September 2021
Adjusted Level 2	13 September 2021	30 September 2021
Adjusted Level 1	1 October 2021	4 April 2022
National State of Disaster Lifted	5 April 2022	–

Restrictions relating to commuter travel by public transport for each alert level as per the regulations were as follows:

- Level 5
    - People not allowed to leave their homes except under strictly controlled circumstances such as to seek medical care, buy food, medicine and other supplies or collect social grants.
    - All passenger rail services ceased to operate.
    - Special trips, such as for funerals and essential work, require a permit.
    - Transport of passengers by bus prohibited except for the purposes of ferrying passengers rendering essential services.
    - A public transport sedan limited to carrying not more than 50% of its permissible passenger carrying capacity.
    - Minibus taxis not allowed to carry more than 70% of their maximum licensed passenger seating capacity.
- Level 4
    - Bus and minibus taxi services to not carry more than 70% percent of their licensed capacity for long distance travel (200km).

- Bus and taxi services to only carry 100% of their licensed capacity for any trip not regarded as long-distance travel.

- Levels 1, 2 & 3
  - Long distance public transport permitted to operate.
  - Bus and taxi services to not carry more than 70% of their licensed capacity for long distance intra-provincial and permitted inter-provincial travel (200km).
  - Bus and taxi services allowed to carry 100% of their licensed capacity for any trip not regarded as long-distance travel.
  - E-hailing and metered taxis to remain at 50% loading capacity.
  - Shuttle, chauffer, and charter services to remain at 50% loading.
  - Gautrain allowed to operate at 70% capacity.

3. SCOPE OF WORK

The project to carry out the household survey of the impact on COVID-19 on mobility in Gauteng Province commenced in August 2021, and comprised the following key tasks:

- **Task 1 – Project inception**: Initiation of the project required the creation of a project execution plan that detailed the work breakdown structure, resources, project risks, project budget, and cash flow strategy. Following an inception meeting, the GDRT was presented with an inception report for adoption.
- **Task 2 – Selection of key variables**: A set of key variables were preselected by the project team as primary indicators. These included trip origins and destinations, travel cost, travel time, and modes of travel – all measured relative to the baseline.
- **Task 3 – Collation of secondary data**: The project team collated secondary mobility datasets for Gauteng Province to provide some indication of how the key variables have changed during different alert levels relative to the baseline. A report on altered mobility patterns was compiled from the secondary datasets.
- **Task 4 – Field instrument design:** The project team designed an appropriate survey instrument that incorporated key variables. The instrument was designed to allow respondents to indicate how the key variables have changed relative to the baseline. The deliverable from this task was a survey instrument in the form of a questionnaire.

- **Task 5 – Field survey design and methodology:** These preparations took the form of:
    - Formulation of a sampling strategy and survey plan. The project made use of the 2019/20 sample of 37 000 households and the original sampling frame to derive the sample for the supplementary survey.
    - Selection of an appropriate technology platform.
    - Coding/programming of the questionnaire and firmware system design.
- **Task 6 – Obtaining research ethics clearance:**
    - The CSIR Research Ethics Clearance procedure is required when research/projects involve surveys. The application process required presenting a detailed survey methodology, enumerator protocol, CVs of the key project team members, a project agreement/contract, an ethics declaration by each project team member, and the questionnaire.
- **Task 7 – Procurement of specialist service provider for field surveys:** Specialist field work service providers were procured to executive the survey.
- **Task 8 – Pilot survey:** To assess the survey instrument, the service provider's operating capability, and associated logistics, a pilot survey was conducted. Each region had fifty households for the pilot survey. Based on the findings of the pilot survey, necessary changes to the questionnaire were made.
- **Task 9 – Full survey:** The target sample size for the supplementary survey was 10 percent of the 2019 sample size of 37 000 households, and amounted to 4 000 households for the province. During the COVID- 19 epidemic, home visits were deemed high risk and the CSIR evaluated alternative survey approaches. The field investigation was conducted in accordance with COVID-19 safety guidelines.
- **Task 10 – Data consolidation:** Responses from the survey were instantly uploaded to the CSIR server. The quality of the data was reviewed daily, and the service provider's performance and compensation were based on data quality and the survey's proportional progress.
- **Task 11 – Data analysis:** The data were analysed and the findings presented in a narrative report with charts and tables.

- **Task 12 – Reporting:** The GDRT was provided with a draft technical report for review, followed by a final report.

3.1 Study Area

The survey was carried out in Gauteng Province and its municipal boundaries were used as the basis for defining the survey regions. The study area is shown in Figure 1.

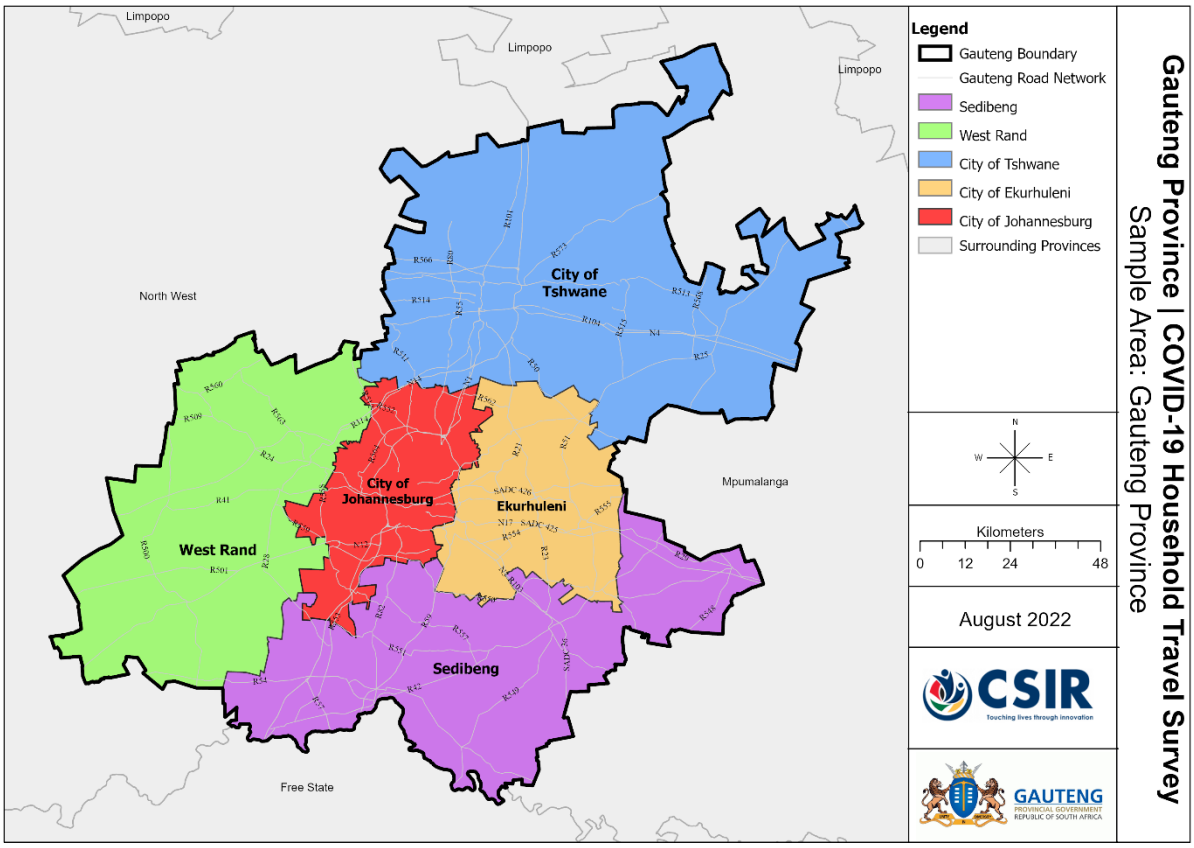

Figure 1: Study area

4. LITERATURE REVIEW

This chapter reviews published literature on the effect of the COVID-19 pandemic on travel behaviour. It is based on a synthesis of published research and empirical observations across the globe and in South Africa.

4.1 Insights from Previous Studies

Since the emergence of the global Corona Virus Pandemic in December 2019, studies have been conducted to examine the changes in mobility patterns (most notably: Abdullah, 2020;

Aloi et al., 2020; Balbontin et al., 2021; Beck and Hensher, 2020; Hensher, 2020; Nurse and Dunning, 2020; Paul, Chakraborty and Anwari, 2022). These studies focus on the impact of the pandemic on transport demand and the changes in the number of trips to workplaces, retail centres, schools, and recreational centres – demonstrating changes in mobility patterns and notable reductions in the number of trips for trip purposes due to measures such as stay at home and social distancing emanating from COVID-19 regulations. For instance, after the United States of America implemented non-medical measures to restrict the spread of the virus, Lee et al. (2020) found a decline in the average number of kilometres travelled per person. Prior to and during the pandemic, researchers have focused on changes in trip purpose, mode choice, trip frequency, distance travelled, and public transit occupancy.

Recent studies on the effects of the pandemic on travel patterns and activities have revealed a correlation between household income and the frequency of teleworking. For instance, Lui et al. (2020) found that states with higher income levels in the United States of America have a bigger proportion of individuals who work from home. Despite the removal of travel restrictions, a significant proportion of persons with high incomes have continued to work from home (WFH).

Beck and Hensher (2020) examined the impact of the pandemic on household travel behaviour during the initial phases of the Australian government's implementation of extreme travel restrictions. According to Beck and Hensher (2020), the number of persons taking workplace trips decreased significantly, and most trips were for shopping. There was a distinct shift in mode choice from public transport to private and non-motorised means of travel. According to the findings of a study conducted by Matson et al. (2022), significant shifts from traditional commutes to teleworking are occurring, as is an increase in the use of online shopping and home delivery services, an increase in the number of leisure trips by non-motorised transport, and there are significant variations across socioeconomic groups.

Notable South African mobility studies conducted during the course of the pandemic include a study by the University of Pretoria which sought to investigate the changes that are likely to happen as a result of the pandemic in South Africa (Venter et al., 2021). The study entailed a survey of 1 000 Gauteng residents to investigate the impact of the pandemic on mobility patterns. The survey was administered through an online questionnaire during the government alert level 1. Google and Apple tracking of mobility trends from January 2020 to

December 2020 were also used to compare current mobility to the pre-COVID era. It was observed that stay at home activity was higher during the pandemic than before the pandemic. Work commuting declined when compared to the pre-COVID era. Venter et al. (2021) attributed the decline in work-based trips during the pandemic to the increase in WFH and job losses. “White collar” workers falling within the categories of professionals and managers preferred to work from home. This is consistent with most of the studies that indicate a similar preference among “white collar” workers.

The outbreak of the pandemic had an impact on a variety of factors relating to travel behaviour, most notably the mode of transport that people prefer. People's concerns about getting infected with the virus led to a change in their preferred means of transport. During the pandemic, mode shift was the subject of investigation in several studies. For instance, Das et al. (2021) demonstrated that the socio-economic features of commuters, such as age, gender, and monthly income, tend to have a substantial influence on the preferences for switching modes of transport. During the pandemic, it was revealed that commuters from low-income households continued to utilise public transport, while commuters from high-income households shifted from utilising public transport to using private and non-motorised transport. A study by Loa et al. (2021) in the City of Toronto, Canada examined the effect of the pandemic on mode choice and reported a decline in public transport ridership for non-essential trips. The study further observed that most public transport users who owned a private vehicle shifted to car-based trip making. However, this was not the same for people who did not own a private car and who were observed to continue using public transport in order to fulfil their non-essential travel activities. Wang et al. (2021) reported a drop in public transport trips and an increase in public transport trips during the different periods of the pandemic.

Recent research by Transurban (2021) found that people in Brisbane, Sydney and Melbourne expect to be using public transport 21 percent less than at pre-pandemic levels, and to use private vehicles 5 percent more than pre-pandemic levels in the future. This is understood to be a direct result of a shift in preferences to avoid public transport in favour of private vehicles, even when the public health risk of active community cases has passed.

Lockdown measures have also had an impact on the frequency of trips in relation to trip purpose. Recent studies indicate that one of the trip purposes that have experienced changes

in the frequency of trips was workplace commutes. Many countries experienced a sharp decline in the frequency of trips for workplace purposes at the peak of COVID-19 lockdowns when compared with pre-COVID-19 trends. For most, work trips traditionally account for a large proportion of trips on the transport network. For, example one out of five trips are work commutes. Indications from empirical studies in most countries are that COVID-19 has significantly impacted the traditional workplace commute in terms of trip frequency. These emerging shifts emanating from the COVID-19 pandemic have the potential to change the nature of transport networks. The decline in workplace trips have related mostly to office based white collar jobs, where staff and businesses have adopted WFH measures in response to the lockdown measures. These trends are having an impact on when, where, and how people travel to their workplace. Indications are that a reduction in white-collar workforce trips drove a significant decline in public transport patronage, particularly to and from CBDs during 2020 and 2021. Even after the pandemic has ceased and lockdown restrictions have been lifted, indications are that this cohort of workers have preferred to continue WFH. The assumed implications have been a reduction in work based commuting frequency after the pandemic when compared to before the pandemic (Rafiq et al., 2022; Hensher et al., 2022). Although it is unclear whether work-from-home arrangements will continue to be commonplace, it is proving to be something that workers want moving forward.

Due to the implementation of lockdowns, restrictions on out-of-home activities, and other physical distancing requirements, many cities in the world have seen an increase in the number of people adopting new methods of shopping and in particular the use of online shopping. This has in turn impacted on the frequency of traditional shopping commutes. Jameel et al. (2022) investigated the impact of the COVID-19 restrictions on shopping trips in the urban areas of Baghdad, Iraq. The study examined changes in trip frequency, mode choice, trip distance and time of trip for shopping trips in the city. Respondents were reported to be making fewer trips to physical grocery stores.

4.2 Insights from Previous South African Household Travel Surveys

Since 2000, the GDRT has conducted three household travel surveys to better understand the mobility patterns of residents within the province. This section of the literature review attempts to provide some key findings and indicate how the previous surveys relate to the current supplementary survey.

Overall, a Household Travel Survey (HHTS) collects information on travel behaviour at a household level. The impact on travel behavioural changes since the emergence of the COVID-19 pandemic has resulted in a break in travel trends as witnessed across the globe, and South Africa is no exception. Gauteng Province now has travel survey datasets for 2000, 2014, and 2019/20 (also referred to as GHTS 2000, GHTS 2014, and GHTS 2019 respectively). The three surveys have created a reference baseline.

5.2.1. Trip-making Trends

According to the 2019/20 household travel survey, walking remains the predominant mode of travel for most households. Over 29% of trips in the peak periods take place through "walk all the way". The surveys further reported that walking time to access the first public transport service has increased from 9 minutes in 2014 to 14 minutes in 2019/20.

The GHTS 2019 survey indicated that motorised travel continues to be catered for by low-capacity modes such as private vehicles and minibus taxis. Minibus taxis account for 23% of all peak-period trips and private cars for over 22%. Higher capacity trains and buses account for about 5% of the peak-period trips. Households reported that they did not use higher capacity travel modes more because they were not available, infrequent and generally inaccessible for the trips being made.

During the pandemic the government instituted measures and regulations that relate to the operations of public transport modes which required operators to reduce their licensed passenger capacity. For example, railway services of PRASA were suspended whilst Gautrain was only allowed to carry a reduced number of passengers. Suggestions are that the pandemic and the accompanying alert levels significantly impacted the use of high-capacity modes of travel.

5.2.2. Travel Time

Analysis of travel time trends over the past 20 years indicates travel time has increased for commuters. On a typical working day travel time increased by 17% from 46 minutes in 2014 to 57 minutes in 2019/20. Overall, average travel time over the past 18 years has almost doubled. Associated with this, many more commuters choose to travel either earlier or later to avoid the peak. Travel times are particularly high for public transport trips and have deteriorated markedly for buses.

5.2.3. Cost of Transport

The proportion of household income spent on public transport has increased. Nearly 60% of households spent more than 10% of their income on public transport in 2019, up from 55% in 2014.

5.2.4. Number of Working Days

Findings of the 2019 household travel survey indicate that more people are working fewer days a week. The number of persons per household working the typical five days a week decreased from 68.7% in 2014 to 62.5% in 2019/20, in favour of fewer working days.

The emergence of the pandemic exacerbated the situation with more people making less trips to their workplaces due to the restrictions imposed. In most cases, it has been observed that businesses, especially those with white-collar employees who are permitted to work from home, have adopted the model of remote work. This could further impact the number of people traveling to work.

5.2.5. Trip Purpose

The COVID-19 pandemic has led to changes in the types of trips that travellers make and their frequency. A total of 54.2% of the estimated morning peak-period trips were reported for work and education purposes in the 2019/20 household travel survey.

5.2.6. Public Transport Trips

According to trends in the GHTS 2014 and GHTS 2019, indications are that the total number of public transport trips has shown a decline between 2014 and 2019. Train and bus trips have declined significantly compared to minibus taxi trips.

5. TRENDS IN TRAFFIC VOLUME AND FUEL SALES

The COVID-19 pandemic impacted transport and travel patterns in South Africa and around the world due to restrictions on moving implemented during different lockdown alert levels. This chapter aims to discuss the changes in traffic patterns that occurred in Gauteng Province during the different lockdown alert levels by examining data collected by SANRAL using Vehicle Detector Stations (VDS) on freeways in the province, on the one hand, and trends in retail fuel sales on the other.

The traffic data consists of traffic volumes of three classes of vehicles, namely:

- Class 1: Light vehicles and motorbikes;
- Class 2: Small goods vehicles and minibus taxis; and
- Class 3: Medium and large vehicles.

The different lockdown alert levels required residents to restrict travel and a question has emerged as to whether a "new normal" will arise that puts South Africa on a radically different path from that before the COVID-19 pandemic. The lockdown alert levels implemented in South Africa from 2020 to 2022 are summarised in Table 1. During 2020, five alert levels were implemented in South Africa from 26 March 2020 to 28 December 2020. In 2021, "adjusted" alert levels were implemented in South Africa. During adjusted alert levels, restrictions on movement of people were eased compared to the restrictions implemented during the same "non-adjusted" alert level.

5.1 Data Sources

Traffic patterns in the province were studied pre-COVID-19, during COVID-19, and post-COVID-19. In this report, "pre-COVID-19" refers to 1 March 2019–25 March 2020, "during COVID-19" refers to 26 March 2020–30 September 2021, and "post-COVID-19" refers to the period commencing on 1 October 2021.

SANRAL was approached to provide traffic data for the province for the period 2019 to 2021. The traffic data was provided in the form of MS Excel databases to facilitate analysis thereof. For each VDS station, the data provided included the station name, date, and time the data was collected, vehicle class, vehicle count and vehicle speed.

Fuel Sales Volumes were accessed from the Department of Mineral Resources and Energy's published fuel sales volumes. To obtain a representative assessment period, the analysis period used was 2013 to 2022 (Quarter 2 sales). Data for Quarter 2 of 2022 was not available.

5.2 Data Cleaning

The analysis used a traffic trends experimental design with traffic volume as the primary variable of study. During the data cleaning process, it was observed that there were stations with significant amounts of data missing. This may be attributed to VDS devices that are no

longer in operation or that are new and thus would not provide true historical traffic counts or were not operating for some time during the analysis period.

Only devices with reliable samples of data for the entire analysis period (1 March 2019 to 31 December 2021) were used. The selected stations provide a reasonable representation of the major freeways in the province as summarised in Table 2.

Table 2: Location of VDS stations

Freeway	GP VDS Station	X Co-ordinates	Y Co-ordinates
N1 North Midrand	GP_DS VDS 029 North	-25.9826	28.1258
N3	DS VDS 314 North	-26.1978	28.1337
N12	DS VDS 410 East	-26.1810	28.2100
N1 South	DS VDS 638 South	-26.2765	27.9466
R21A OR Tambo	DS VDS 813 North	-26.0741	28.2725
R24 OR Tambo	DS VDS 906 East	-26.1563	28.1629
R21B OR Tambo	DS VDS 821A South	-26.1455	28.2195
N17	DS VDS 502 West	-26.2518	28.1413
N4	DS VDS 103 East	-25.7412	28.2809

Figure 2 shows the location of the VDS stations that were used in the analysis.

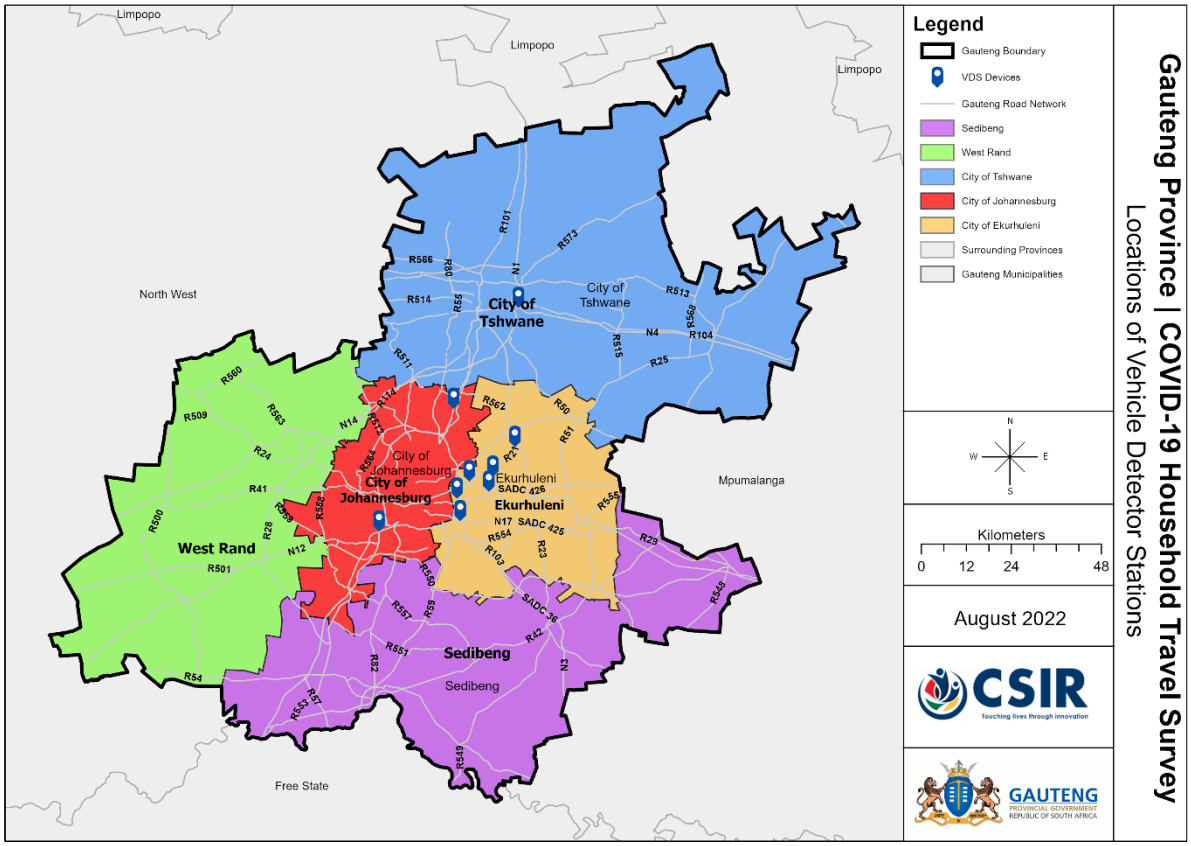

Figure 2: Location of VDS Stations

5.3 Assessment of Travel Patterns

5.3.1 Total Traffic

To understand how traffic volumes changed due to COVID-19, the total traffic pre-COVID-19 was compared to the total traffic during COVID-19 and post COVID-19. Figure 3 shows the total traffic volume along the freeways analysed. The trends in total traffic volume are similar for all the freeways analysed.

At the height of lockdown alert level 5 (26 March 2020–30 April 2020), total traffic significantly decreased (e.g. total traffic on the N3 reduced from an average 80 000 vehicles a day to an average of 21 000 vehicles a day). However, as the lockdown restrictions were eased gradually from level 5 to level 1 (May 2020–December 2020), total traffic on the freeways gradually rose again albeit below pre-COVID-19 volumes. There was a significant drop in total traffic in December due to the December holidays.

During 2021 when adjusted lockdown levels were implemented, the total traffic volumes were very similar to the volumes recorded in 2020 after the lifting of the level 5 restrictions. This suggests that the significant drop in total traffic due to the severe lockdown alert levels was relatively short-lived. It should be noted that no VDS data was available for the period from 2021/06/02 to 2021/06/22; hence, the dip shown on Figure 3 is because the month of June 2021 was not included in the analysis.

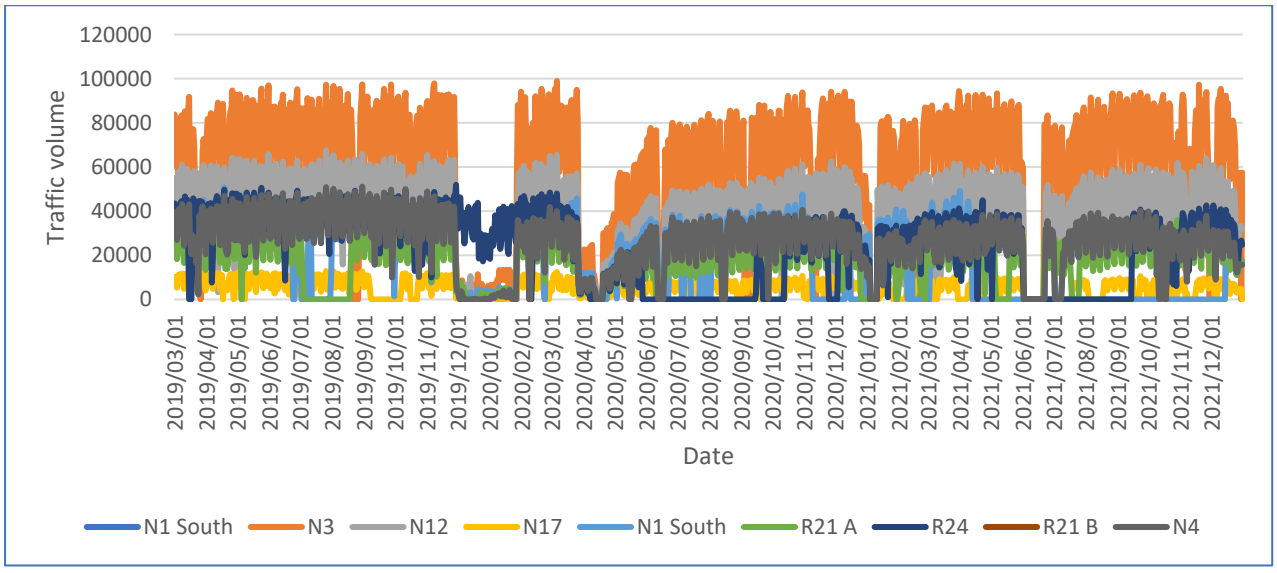

Figure 3: Total traffic volume on major freeways in Gauteng (2019–2021)

5.3.2 Different Vehicle Classes

To understand how the lockdown affected different vehicle classes, the classified traffic volume pre-COVID-19 was compared to the classified traffic volume during COVID-19 and post-COVID-19.

Figure 4 to Figure 7 show the classified traffic volume along the N1, R21, N3 and R24 freeways. The general trends in traffic volume are similar on all the freeways analysed with significant dips during December holidays and during lockdown level 5. At the height of lockdown alert level 5 from 26 March 2020 to 30 April 2020, the total traffic significantly decreased across all vehicle classes. The total traffic gradually rose again for the different vehicle classes as lockdown restrictions were eased, albeit below pre-COVID-19 volumes. When level 2 lockdown restrictions were implemented in August 2020, Class 2 and 3 recovered to normal traffic levels particularly on the N3 and R24 freeways. This suggests that transportation of goods by small, medium and large vehicles was mainly interrupted during lockdown alert level 5 to lockdown alert level 3.

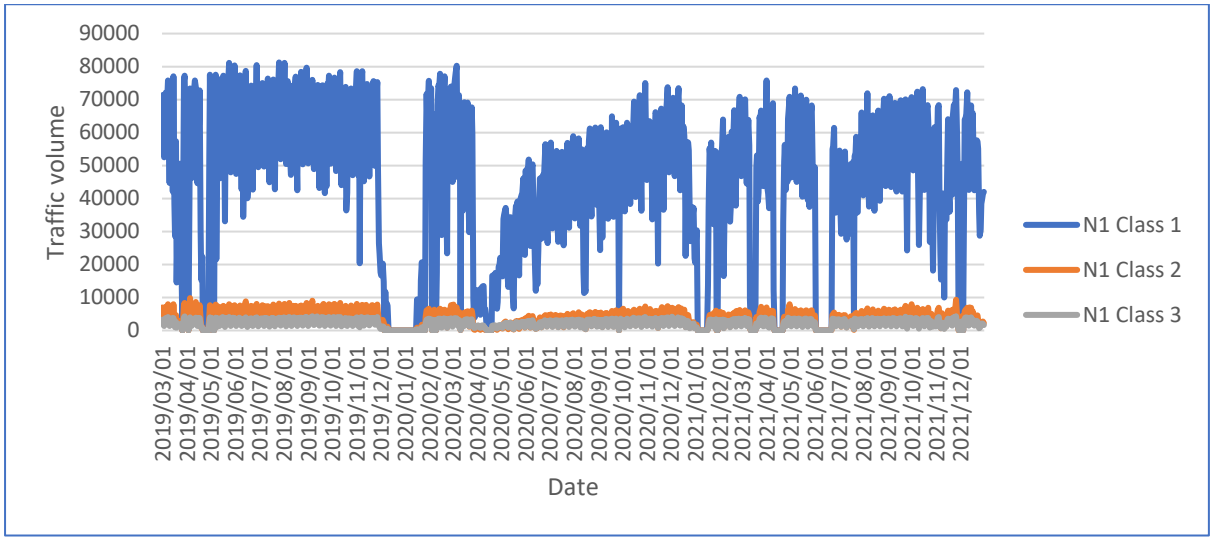

Figure 4: Classified traffic count, N1

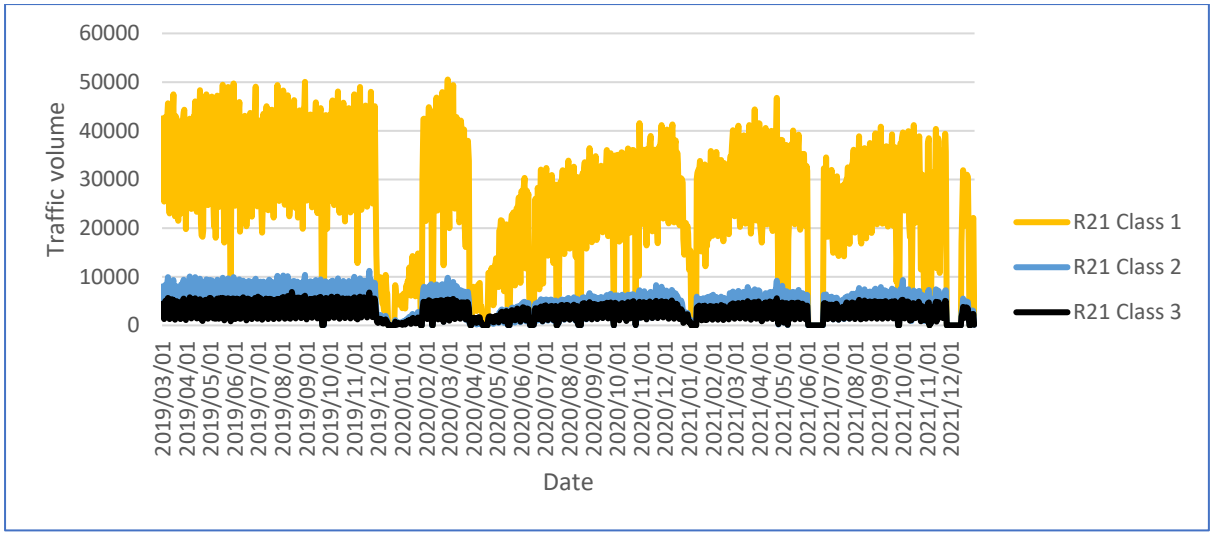

Figure 5: Classified traffic count, R21

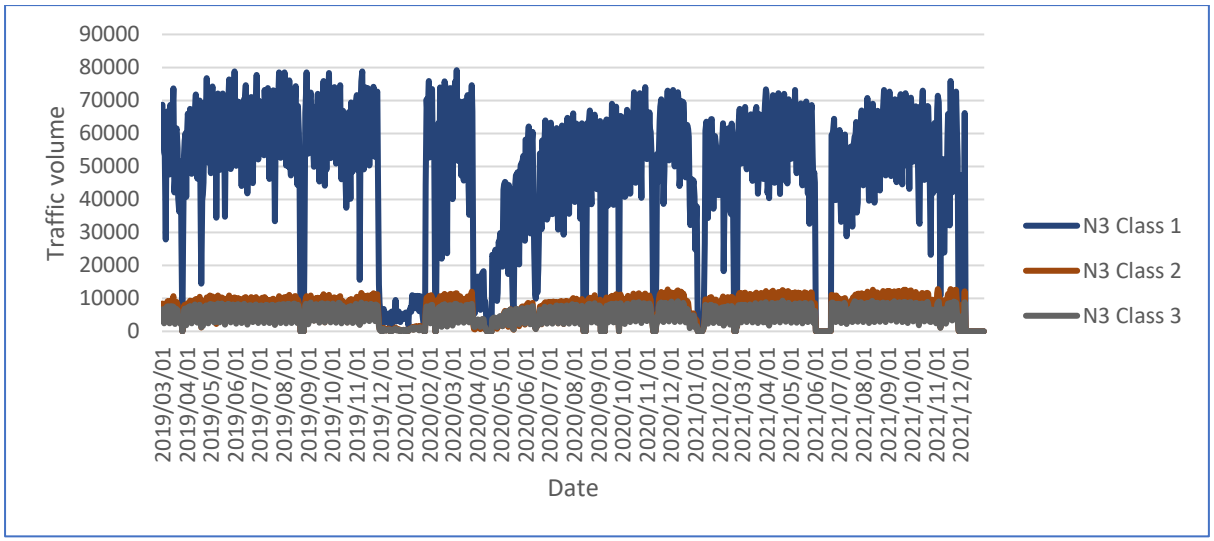

Figure 6: Classified traffic count, N3

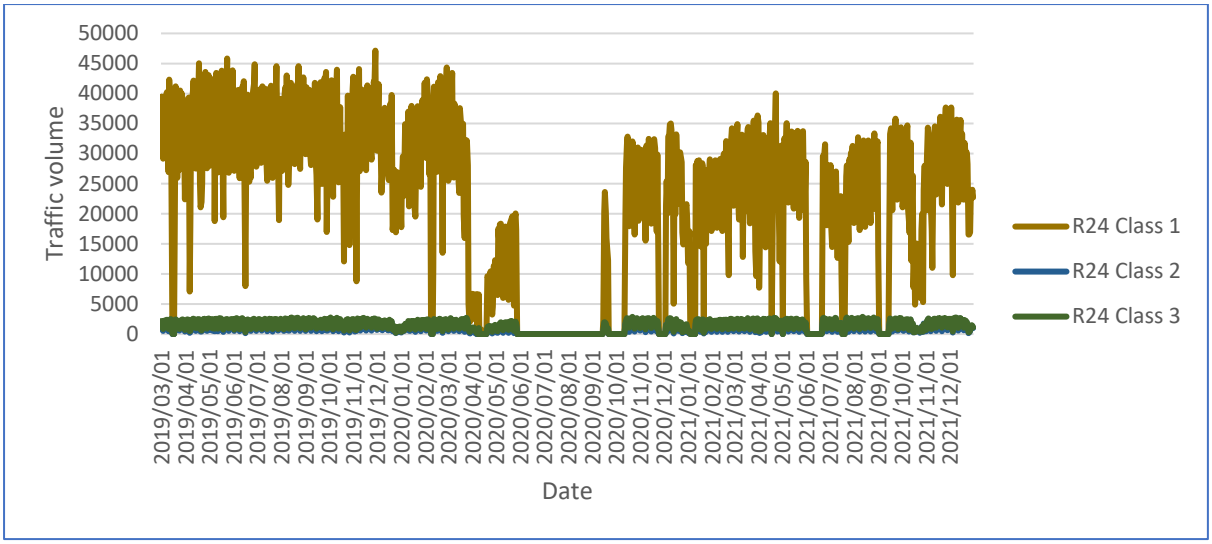

Figure 7: Classified traffic count, R24

Table 3 shows that during 2020 the total traffic volume reduced by 15% compared to 2019, after which it gradually increased by 12.3% in 2021. Between 2019 and 2021, there has been an overall reduction in total traffic of 4.4% on the four freeways.

Table 3: Traffic counts for N1, R21, N3 and R24

Vehicle class	2019	2020	2021	Percentage change (2019–2020)	Percentage change (2020–2021)	Percentage change (2019–2021)
1: Light vehicles and motorbikes	53 163 606	44 739 133	50 094 031	-15.9%	12.0%	-5.8%
2: Small goods vehicles and minibus taxis	5 759 522	5 013 733	5 861 242	-13.0%	17.0%	1.8%
3: Medium and large vehicles	4 112 095	3 912 891	4 321 007	-4.9%	10.4%	5.1%
TOTAL	**63 037 242**	**53 667 777**	**60 278 301**	**-14.9%**	**12.3%**	**-4.4%**

5.4 Assessment of Fuel Sales Volume

Figure 8 provides an overview of petrol and diesel sales over the past nine years (2013–2022) in the second quarter of the year (April to June). The petrol sales have mostly been much higher than the diesel sales at an almost constant rate from 2013 till 2019. A significant dip in both petrol and diesel sales was recorded in the second quarter of 2020. The significant dip in fuel sales can, amongst other things, be attributed to the impact of the COVID-19 pandemic and the travel restrictions that were in place during that period. Thereafter, a significant rise

leading to the second quarter of 2021 was recorded and can be attributed to the ease of travel restrictions and a return to “normal” economic activity.

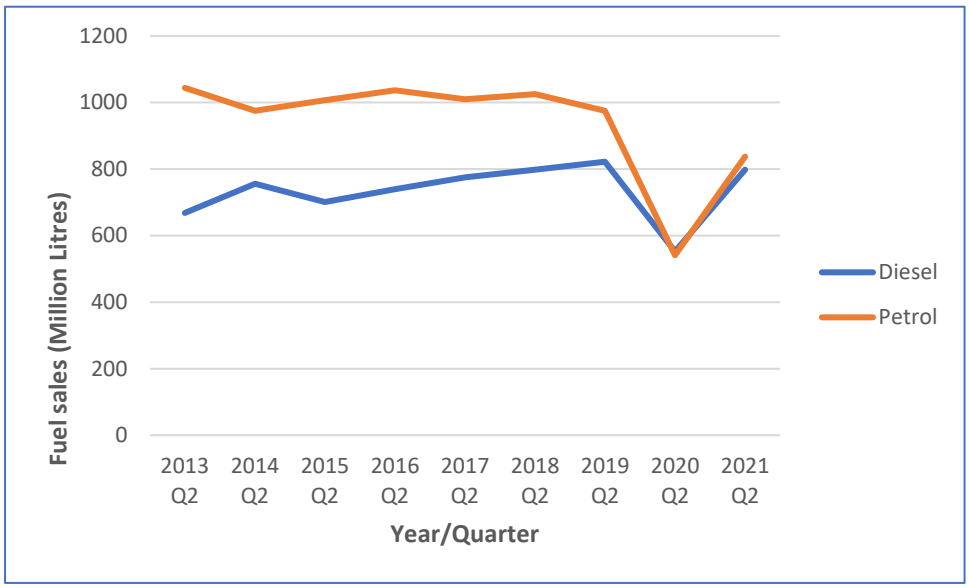

Figure 8: Gauteng fuel sales

(Source: Statutes & Practices | Department: Energy | REPUBLIC OF SOUTH AFRICA)

5.5 Conclusion

The analysis presented in this chapter shows that the COVID-19 pandemic and lockdown restrictions had a considerable impact on traffic volumes on the major freeways in Gauteng. This was particularly the case at the start of the pandemic when level 5 lockdown restrictions were in place. The recovery of the traffic volumes was gradual and depended on the government orders restricting movement in South Africa. Overall, as the lockdown restrictions were eased the traffic on the freeways gradually rose again albeit below pre-COVID-19 volumes.

However, the individual lockdown levels being repealed did not immediately lead to higher traffic volumes. Instead, traffic volumes gradually increased from the lowest point in April 2020. By October 2020, traffic volumes had stabilised on the freeways analysed. This suggests that although COVID-19 restrictions played a role in traffic reduction at the start of the pandemic, shifts in travel patterns may have been short-lived.

The trends in both diesel and petrol sales are related to the general travel patterns; hence, the travel restrictions that were in place due to the COVID-19 pandemic had a direct impact on the sales thereof. The road traffic and retail sale recovery patterns are similar.

It is, however, acknowledged that traffic patterns for low order roads were not assessed and these could have differed from those on high order roads. In addition, there are other factors that play a role in retail fuel sales that were not considered in the analysis.

6. SURVEY DESIGN AND METHODOLOGY

6.1 Introduction

To adequately answer the key questions about the potential changes in trip making choices and patterns that might have been introduced by the COVID-19 pandemic, the questionnaire was designed such that pre-COVID-19 travel information as well as travel during the pandemic was gathered from the same group of households. This was done because directly comparing the current results to the GHTS 2019 results would have been challenging given that: (1) the 2019/20 survey was designed to better understand typical weekday travel patterns so respondents provided answers based on their (exact) most recent travel details; and, (2) too much time had passed for respondents to recall their exact mobility patterns. Therefore, this survey asked for generic travel details from the past, during the pandemic, and for respondents' future travel perspectives.

The study was designed to collect data for the three relevant time periods of interest (before, during and after COVID-19), from the same sample. As a result, the within-sample analysis provides the best comparative framework for assessing the effects of the pandemic on household travel in the province.

6.2 Assessment of Survey Methods

Owing to the impact of the non-pharmaceutical interventions that had been implemented to minimise the spread of COVID-19, which necessitated reduction of extensive mobility and person-to-person contact, the team considered the associated limitations and made attempts to find alternative methods to carrying out this study. The requirements of this study involve obtaining a representative sample and administering a comprehensive questionnaire within a relatively short time limit of about 15-minutes. Because the study was conducted as a

supplementary study for the 2019/20 Household Travel Survey, considerations were made to maintain a methodology similar to that applied to the main survey for comparative purposes.

As a result, the proposed survey approach was based on a randomly selected sample of households in Gauteng. To minimise person to person contact, a sampled household was visited to obtain consent from the head of the household to complete the online survey. This process was carried out by a contracted research survey company. Engagement was minimised whilst maintaining COVID-19 safety protocols. Figure 9 provides a schematic view of the process that was followed to obtain information from respondents. The medium used to conduct the survey was Computer Assisted Self Interview (CASI).

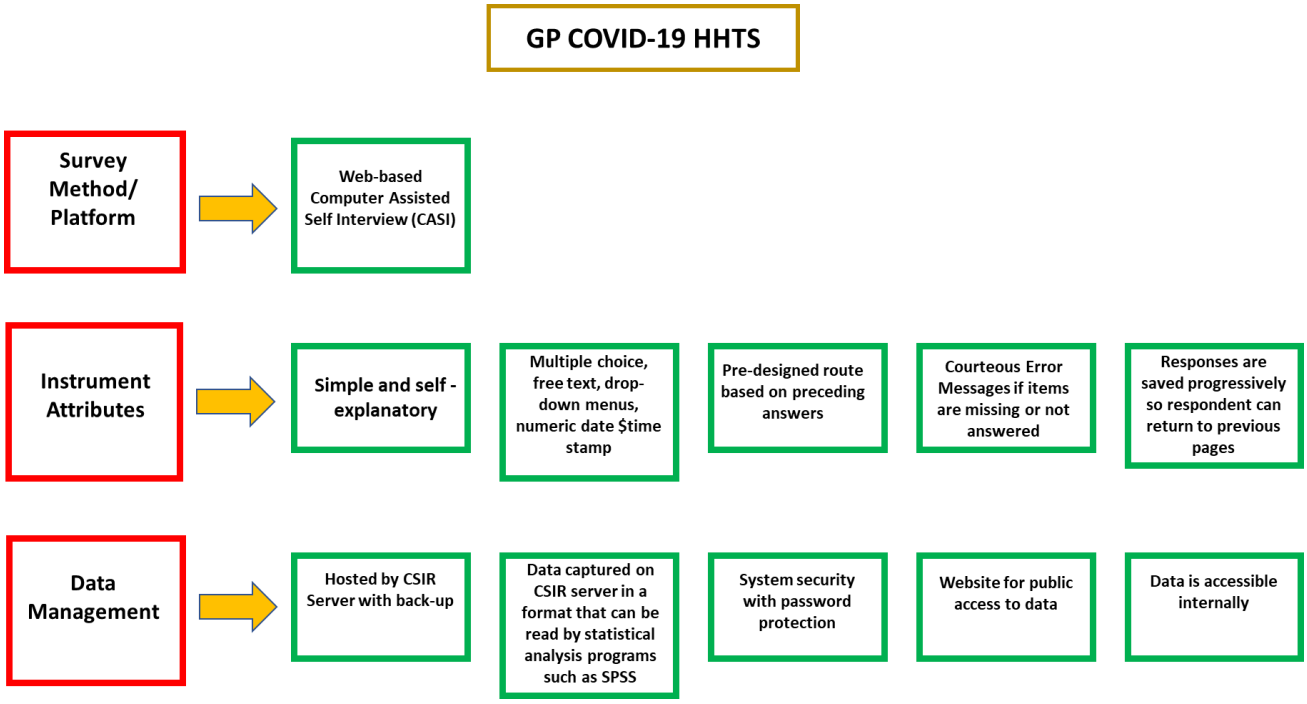

Figure 9: Survey approach

6.3 Selection of Key Variables

The problem statement addressed the following:

- Fundamentally, travel behaviour of households in the province may have been significantly altered, either temporarily or permanently. Assess travel behaviour 'Before, During & After COVID-19.
- Assess the extent to which travel behaviour changed during the lockdown period.

- Assess how travel in Gauteng Province is likely to change into the future.

The sub-problems or questions of interest were as follows:

- Which demand and supply led changes will persist?
- What proportion of WFH will continue as a new normal?
- What proportion of learners and students schooling from home will continue?
- Will public transport see a sustained reduction in patronage?
- Will the reduction in traffic congestion be sustained?
- Will traffic congestion increase due to uncertainties with public transport hygiene and crowding concerns in the context of COVID-19 infections?
- Is there an increased interest in online shopping?
- Will employers encourage options such as WFH, staggered working hours, flexible working hours, compressed work weeks, etc.?

Therefore, the design instrument was designed to address the following specific questions:

- What was the purpose of travel: Home to work? Home to School? Home to Shop? Home to other?
- What was the mode of transport used?
- What was the mode of transport before COVID-19?
- Departure and Arrival times – travel changed due to specified curfew times?
- Will the traveling public continue using public transport at lower alert levels or post-COVID-19?
- Will the traveling public change the mode of transport during COVID-19 due to the restrictions?
- Did the public transport fares increase during COVID-19?
- Did the cost of travel during COVID-19 increase or decrease or stay the same compared to before COVID-19?
- Will the public continue using online shopping platforms after COVID-19?

- Will the public continue working from home?
- Will the public continue schooling from home?
- Will the public return to the original mode of travel?
- Did the trip origin change?
- How did employment status before and during COVID-19 change?
- Did income during COVID-19 increase or decrease or stay the same compared to before COVID-19?
- Did place of work change during COVID-19?

6.4 Limitations of Secondary Data

There was missing data in the traffic data received from the National Roads Agency for national roads on the Gauteng Freeway Management System network. However, the traffic data for a reasonable sample was available and this was used to indicate traffic volumes before and during the lockdown. This data is simply a proxy for changes in traffic levels.

6.5 Information Collected

The head of the household provided information on behalf of all household members. If there was no adult head of household, then that household was replaced by another household. The primary information which was collected included travel patterns and mode of travel mode before and during the COVID-19 period. The survey also obtained travel perceptions post-COVID-19 lockdown. Some demographic information, which is necessary to align the current survey with the 2019 survey, was also collected.

Interviewing the same households that took part in the 2019/20 Household Travel Survey would have been ideal and cost–effective. However, the POPI Act's limitations on contacting former participants through their previous contact information made this impossible.

6.6 Survey Instrument

A copy of the questionnaire is included in Appendix A. Enumerators administered the questionnaire, which had a completion time requirement of 15 to 20 minutes. The survey asked about respondents' travel habits prior to and during the COVID-19 alert levels as well

as their perceptions of changes in travel habits following the COVID-19 or more relaxed alert levels such as levels 3, 2, and 1.

The questionnaire was written in English. An effort was made to simplify the phrasing, sentence structure, and selection choices. A pilot survey of 50 households per region was conducted to evaluate the questionnaire and the service providers' logistical capacity. The pilot survey was undertaken prior to the main survey and lessons learnt from the pilot survey were used to revise the survey instrument and execution. Subsequently, the questionnaire was refined as necessary. The CSIR also developed an online questionnaire and software application to use during the survey. The questionnaire was accessed by the enumerators via a smartphone/tablet.

6.7 Sample Framework

This project adopted the original probability sampling strategy from the GHTS 2019 in order to ensure alignment for the purpose of comparing travel patterns and trends before and after COVID-19. Stratification was in terms of average income and type of dwelling in a particular enumerator area (EA), including an urban and semi-urban area split within each region. Each subgroup in the total population is statistically referred to as a stratum. Furthermore, based on historic approaches to reporting and analysis units, the project maintained a Transport Analysis Zone (TAZ) level of analysis and reporting. For instance, TAZs represent an explicit stratification variable with the number of households per zone as a measure of size. EAs were considered as primary sample units (PSUs), whilst households were correspondingly considered as the secondary sampling units (SSUs). Households in all communities were included. However, institutions such as hospitals, schools and prisons, as well as industrial and recreational areas were excluded.

6.8 Sample Distribution

The supplementary survey sample of 4 000 households (approximately 10% of the 37 000 household sample used in the GHTS 2019) was used. A random probabilistic selection of households was used, with households distributed by municipal area and TAZ. Table 4 shows the population and sample distribution across municipalities in the province based on the 2016 Statistics South Africa Community Survey. The sample distribution is consistent with previous surveys in the province.

Table 4: Population and sample distribution

Municipality	Population	Total number of households	Target sample size (households) 2019/20	Target sample size (households) 2022
Ekurhuleni	3 379 104	1 299 490	8 000	1 091
Johannesburg	4 949 347	1 853 371	9 000	1 198
Sedibeng	3 275 152	330 828	8 000	363
Tshwane	957 528	1 136 877	6 000	1 075
West Rand	838 594	330 572	6 000	273
Total	**13,399,725**	**4 951 138**	**37 000**	**4 000**

Ekurhuleni

Figure 10 shows the randomly selected wards in the Ekurhuleni region where the pilot and main COVID-19 Household Travel survey were conducted. Five wards were selected for the pilot survey and six wards were selected for the main survey.

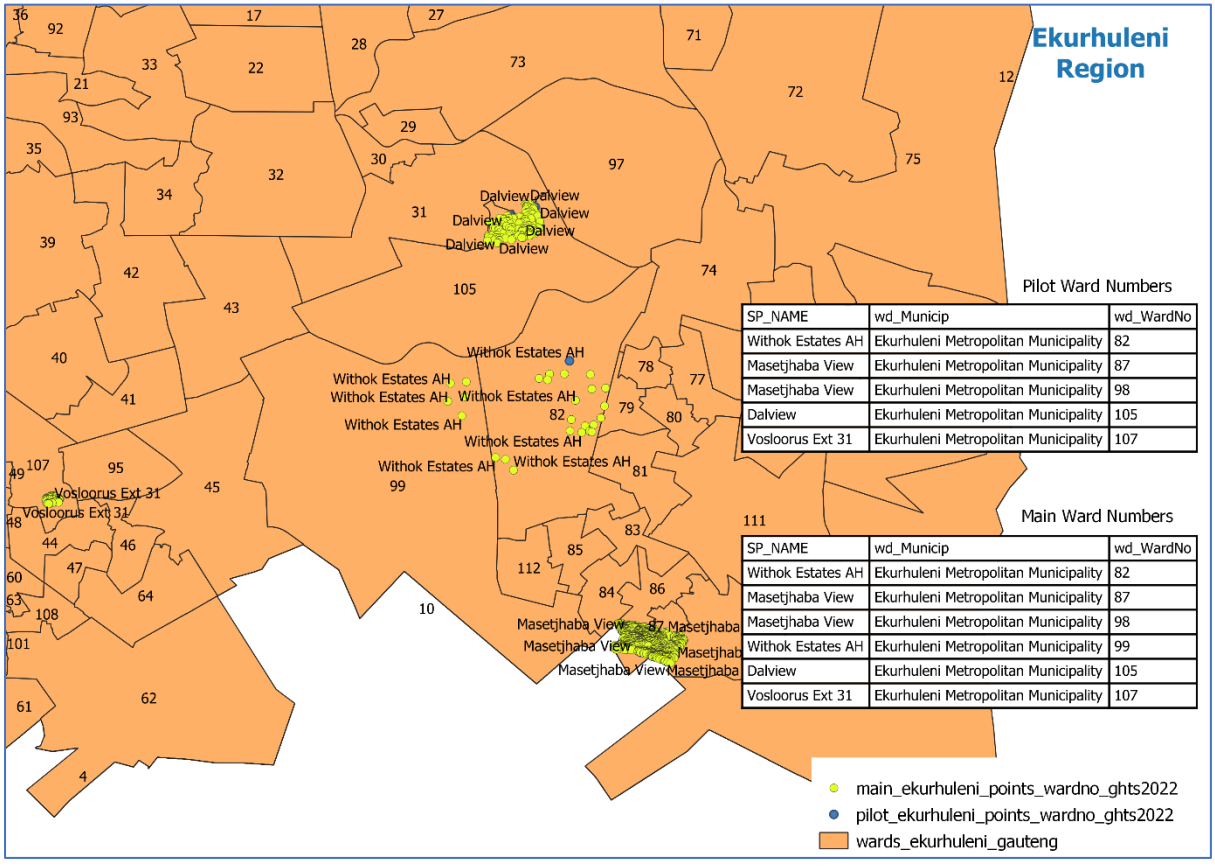

Figure 10: Ekurhuleni household distribution

Johannesburg

Figure 11 shows the randomly selected wards in the Johannesburg region where the pilot and main COVID-19 Household Travel survey were conducted. Five wards were selected for the pilot survey and eight wards were selected for the main survey.

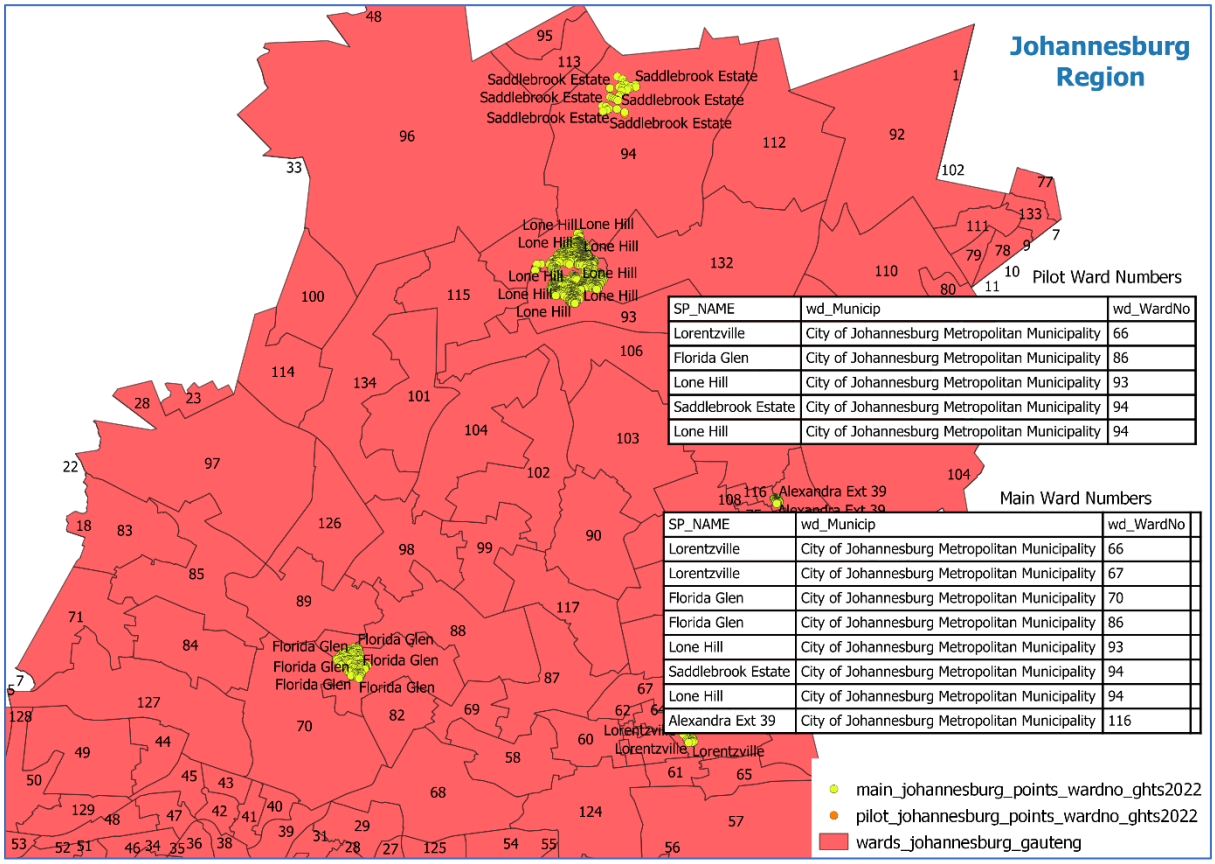

Figure 11: Johannesburg household distribution

Tshwane

Figure 12 shows the randomly selected wards in the Tshwane region where the pilot and main COVID-19 Household Travel survey were conducted. Seven wards were selected for both the pilot survey and the main survey.

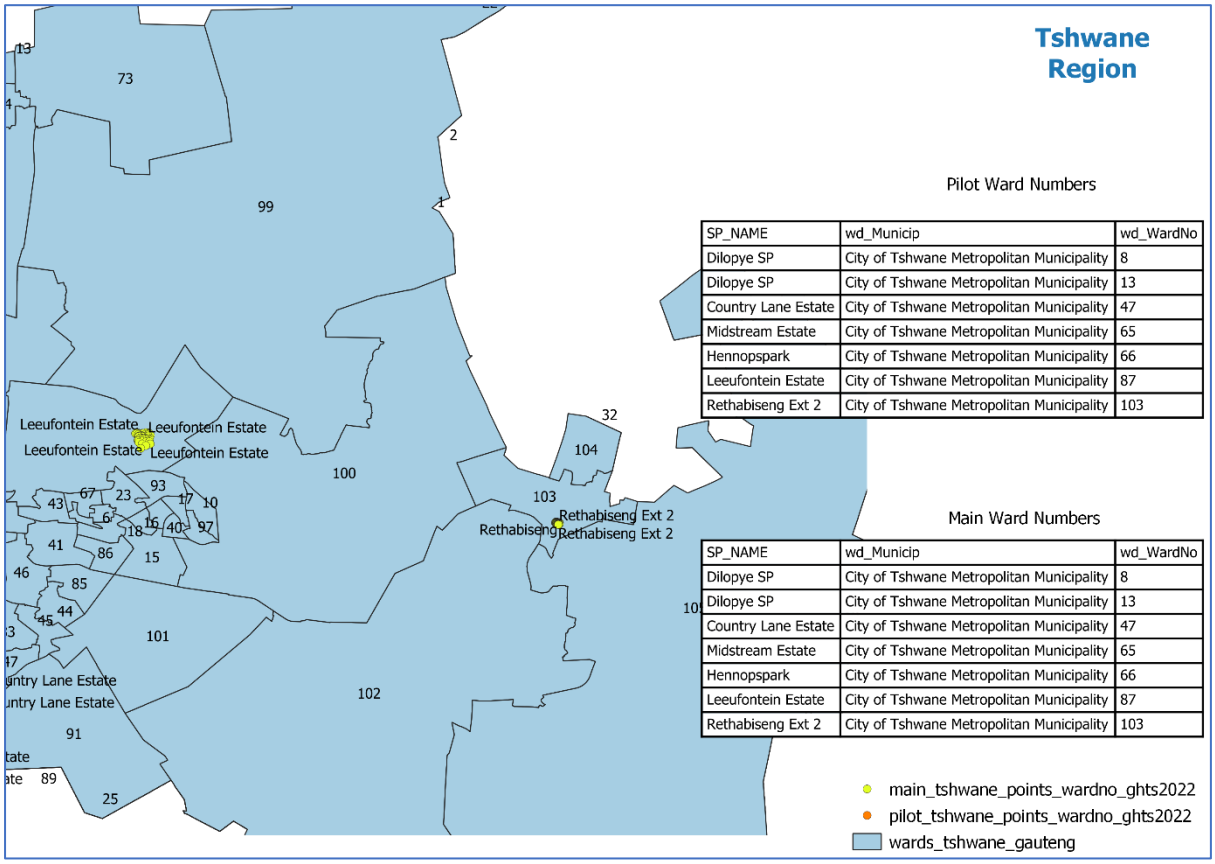

Figure 12: Tshwane household distribution

Sedibeng

Figure 13 shows the randomly selected wards in the Sedibeng region where the pilot and main COVID-19 Household Travel survey were conducted. Six wards were selected for the pilot survey and seven wards for the main survey.

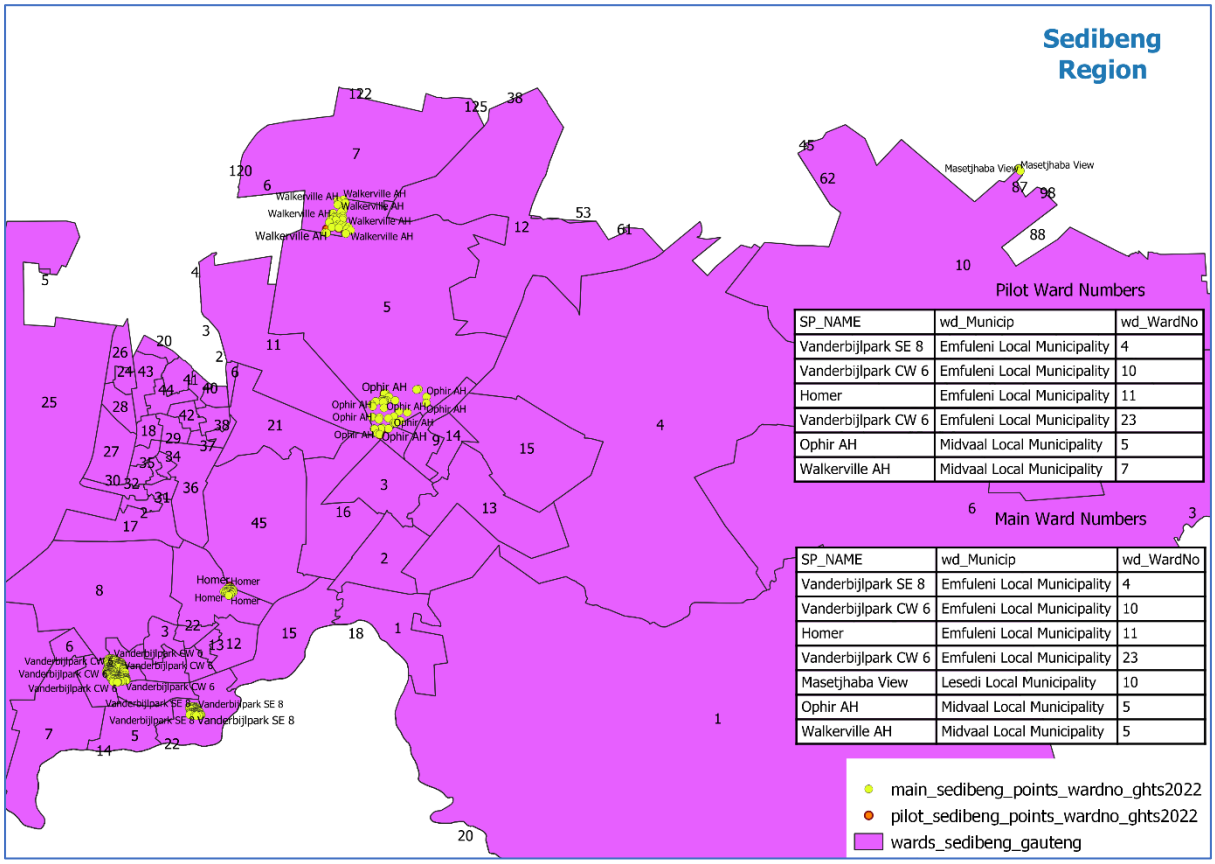

Figure 13: Sedibeng household distribution

West Rand

Figure 14 shows the randomly selected wards in the West Rand region where the pilot and main COVID-19 Household Travel survey were conducted. Six wards were selected for the pilot survey and eight wards for the main survey.

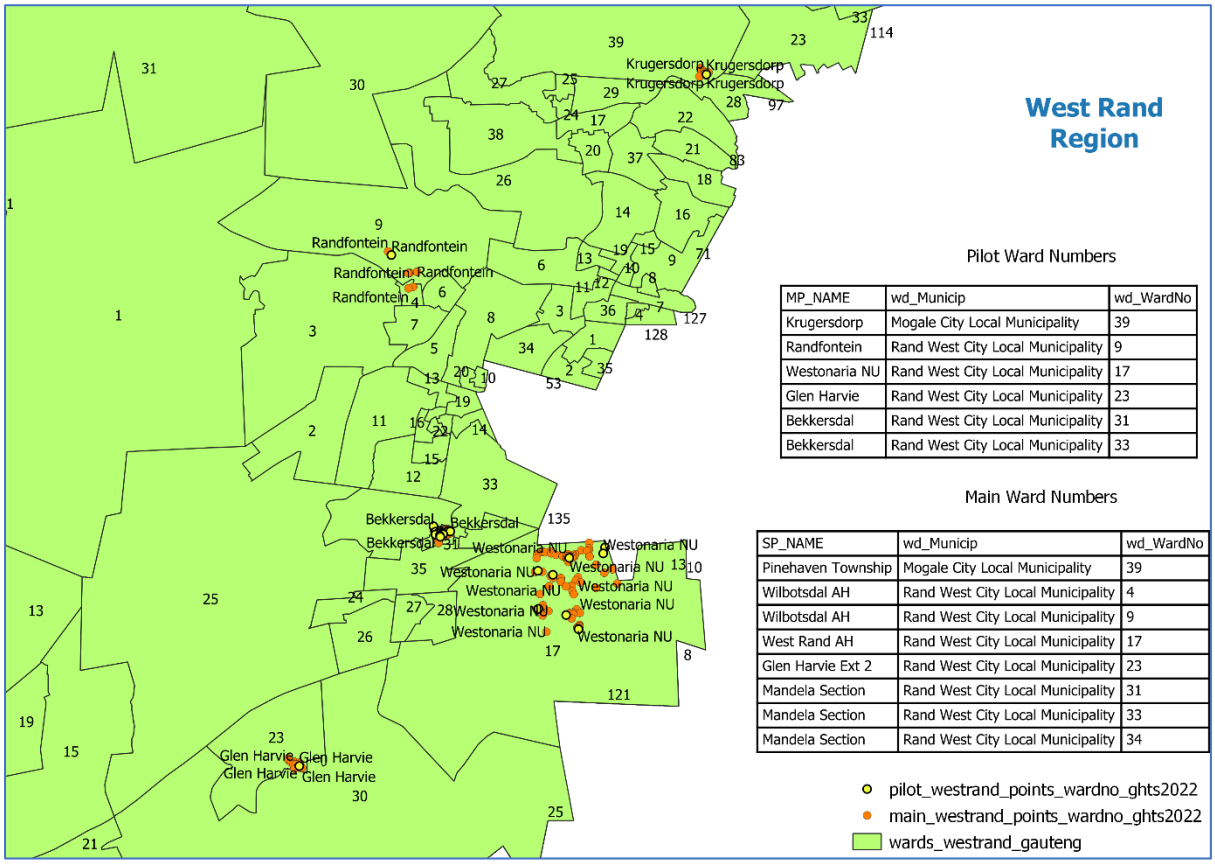

Figure 14: West Rand household distribution

6.9 Management of a Low Response Rate or Non-Response

A second, smaller sample, called a replacement sample, was selected with a similar proportional stratified sampling method to address potential low response rates or non-response households. If the originally targeted household did not qualify, then the enumerator randomly selected another household within walking distance. The following criteria were applied to substitute a household:

- A household refuses to participate
- Head of the household (adult) is not present

- Nobody is present
- The property has changed status (e.g. house rezoned to a shop)
- Child-headed households
- Restrictions of access to gated communities
- The head of the household is physically unable to engage

7. SURVEY EXECUTION

7.1 Introduction

The following section provides an overview of how the survey was carried out. It details the steps that were taken to ensure the successful execution of the survey, beginning with the conception of the supplementary survey, and continuing through the development of the questionnaire, the implementation of the pilot survey and the main survey, and the quality control measures that were taken to ensure compliance with the project methodology and scope.

7.2 Field Work Inception

In line with the project plan, an inception meeting was held with the competitively procured field work contractor teams in order to orientate them on various aspects of the surveys. The session addressed the project execution plan, including training of the enumerators, health and safety requirements, security requirements, comprehension of the questionnaire, data capturing, resource planning, scheduling, and quality management.

7.3 Logistical Planning

The contractors prepared a plan for the project's execution which included a resource schedule and programme. The contractors also arranged personal protective equipment (PPE), managed COVID-19 health and safety protocols, arranged identity tags, transport and branded bibs for the enumerators. Tablets or smartphones pre-loaded with the necessary templates were also provided to the enumerators.

7.4 Occupational Health and Safety, and Security

For safety and security reasons, enumerators operated in teams of two. Preferably, a female enumerator was paired with a male enumerator. A customised Standard Operating Procedure to manage COVID-19 related risks was developed and implemented. Enumerators were trained on health and safety with a specific emphasis on safety and security and COVID-19 Safety protocols. The contractors and every enumerator were also required to sign the statement of agreement to comply with ethical principles and the minimum safety and security requirements.

7.5 Informed Consent

Before beginning the interview, the enumerators introduced the survey to members of the household, obtained their consent to participate, and displayed their enumerator identification card. The enumerator made it clear to the participants that the participation of the household in the survey was voluntary, that all information was confidential, and that no responses would be linked to the participant's identity. The participants were able to verify the enumerators' details on the enumerator verification system provided by the CSIR. Ideally one of the following members of the household would be interviewed:

- The household head, spouse or any adult residing in the household. No person below the age of 18 was interviewed.
- The main respondent (adult) was required to provide the travel information pertaining to household members under the age of 18.

7.6 Replacement Sample (Enumerator Protocol/Manual)

According to the field work survey protocol, enumerators were expected to replace a dwelling if the original household did not qualify. The enumerator was required to randomly select another household within walking distance to replace the original targeted dwelling unit.

For households that chose not to take part in the face-to-face questionnaire interview, an alternative to complete the survey online at their own convenience was provided by a link to the survey.

7.7 Questionnaire

The digital questionnaire was designed to compel the enumerators to obtain answers to questions accurately and correctly. The survey could not be completed with missing data: all questions had to be answered before the questionnaire was submitted or uploaded to the database. The CSIR oversaw and managed the data collected during the field work using established protocols and approaches.

7.8 Recruitment and Training of Enumerators

The contractors were responsible for the recruitment and training of enumerators and other personnel such as supervisors, administrators, and project managers. The CSIR provided initial training to the service providers (Train the Trainer). The training focused mainly on the digital questionnaire, data capturing, and data quality. The service providers were required to train the enumerators in terms of:

- Safety and security requirements
- COVID-19 Protocols
- Engagement with participants
- Interviewing skills and etiquette
- Data capturing and data quality
- Daily debriefing
- Record keeping
- POPIA
- Privacy and confidentiality
- Responsibility and accountability in context of all the above.

7.9 Pilot Survey

A pilot survey was carried out in each region on the basis of 50 households per region. The aim of the pilot survey was to test the questionnaire's completeness and suitability, the logistics, and the capacity of the service providers. The questionnaire was adjusted based on the lessons learned from the pilot survey. The pilot survey was conducted from 22 to 26 February 2022 during lockdown adjusted level 1.

7.10 Main Survey

Once the lessons learnt from the pilot survey were addressed, the full survey was undertaken. Each region and the corresponding service provider were managed by a CSIR regional supervisor. The main survey was conducted from 1 March 2022 to 27 May 2022 during lockdown adjusted level 1. Table 5 shows the survey samples obtained relative to the planned sample.

Table 5: Achieved sample vs planned sample

Survey Region	Planned Sample	Achieved Sample
Ekurhuleni	1 091	949
Johannesburg	1 198	1 085
Sedibeng	363	368
Tshwane	1 075	1 222
West Rand	273	277
Total	**4 000**	**3 901**

Figure 15 shows the location of the pilot and main survey households.

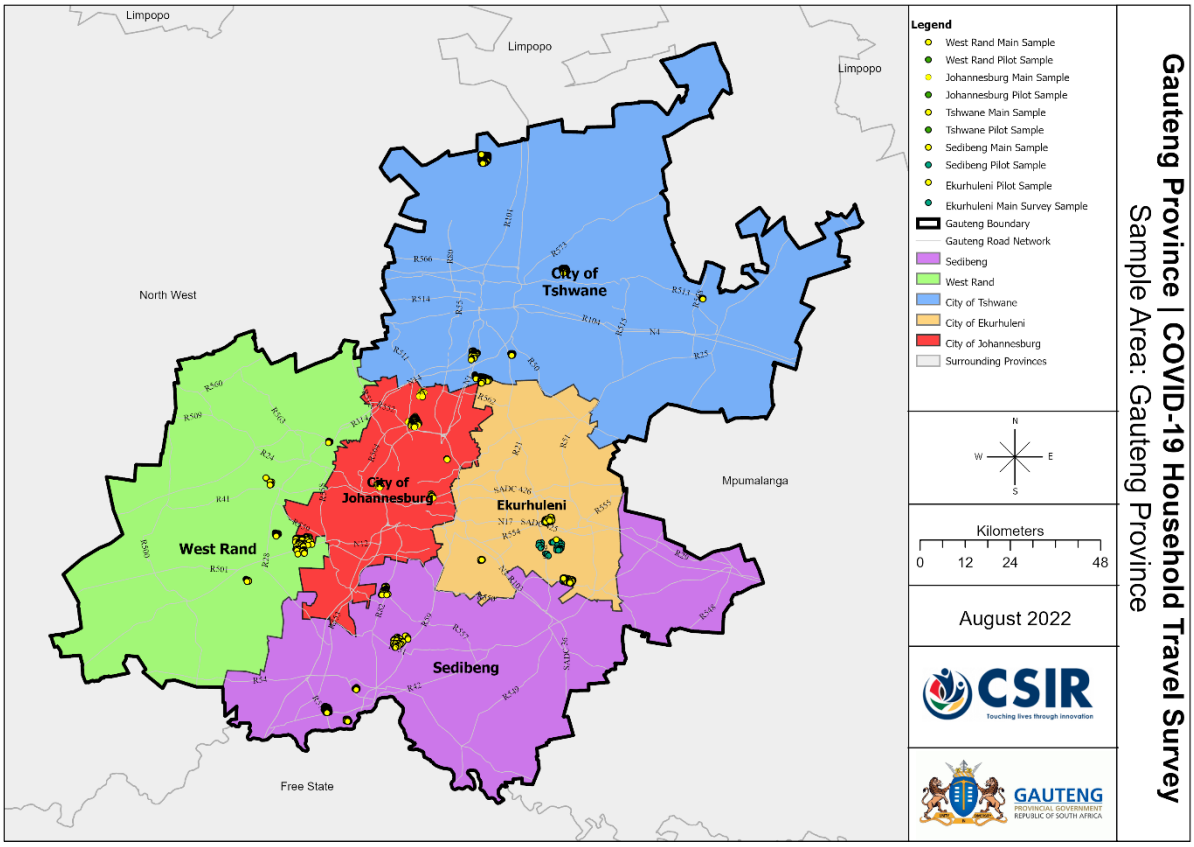

Figure 15: Location of pilot and main survey households

7.11 Data Capturing, Management and Quality Control

The data capturing was intended to be online and in real time. The service provider was not permitted to upload the responses later due to security risks. The data was uploaded almost instantaneously on the CSIR server. The CSIR team monitored the quality of the data daily and addressed queries with the respective teams.

Owing to the COVID-19 circumstances, the enumerator either carried out the interview on his/her device or assisted the participant on their own device. Different team members were assigned to supervise and monitor the enumerators and the community members/respondents.

Some team members that were responsible for the development of the survey platform monitored the data on the dashboard as it was submitted by enumerators. Once the data was received, a thorough process of pre-data cleaning was performed which included the following: enumerator photograph; time intervals between consecutive surveys per enumerator; consistency of the household member number inputs and general trends of data inputs per enumerator. The discrepancies found were insignificant and did not affect the integrity of the data. The data analysis team proceeded with the data analysis and data processing once the integrity of the collected data was confirmed.

7.12 Challenges and Lessons Learnt

Throughout the GHTS 2019 project, various challenges were experienced and documented for inclusion in the final report. At the commencement of the COVID-19 HHTS supplementary study, these challenges informed the approach of the supplementary study. However, due to the impact of COVID-19 and the period during which the supplementary study was done, new challenges were encountered and reported (see Table 6).

Table 6: Challenges and solutions

Category	Challenge	Solution
Replacement Sample	Replacement of tokens with no reasons provided	Enumerators should provide reasons for replacement tokens
Questionnaire	Fast paced interview	Enumerators to be trained to use own discretion in observing respondent's interaction

Category	Challenge	Solution
	Introductory paragraph was misleading because survey was almost occurring during “post-COVID-19” period	Wording was adjusted to describe “During COVID-19” as the 3rd wave era of COVID-19 in South Africa was occurring (with strict restrictions between June and September 2021)
	Questions too long and the introductory paragraphs lack readability	Incorporation of UPPERCASE for main keywords
	Non-compatibility of subcontractors’ devices with the survey app	Subcontractors procured compatible devices to proceed with the survey
Recruitment and Training Enumerators	Enumerators not familiar with the technical aspects of the survey	Proper interactive training of enumerators
	Enumerator protocol and introduction	Proper interactive training of enumerators
	Lack of comprehension of the term “e-hailing” by enumerators and respondents seemed to contribute to skewness of data	Add example terms, such as “uber” and “Bolt”, in questionnaire as these are more familiar
	Challenges with recruiting surveyors from the local communities	Maintain continuous contact with the ward councillors
Pilot Survey	Server issues during first week of the pilot survey	CSIR Team contacted the server service provider to resolve the issues
	Coordination with the monitoring team and subcontractors	The project managers, supervisors, and enumerators must be accessible on their mobile phones
	Some of the replacement points were a bit further apart than the chosen points in City of Tshwane	The replacement samples need to be as close as possible to allocated points otherwise it makes it difficult to judge if a point should be accepted or not
	The survey only captures coordinates once	To capture coordinates twice while the enumerator is capturing the questionnaire
	There were some points that were outside the survey area (especially with Ekurhuleni)	All devices will have to submit a "test survey" during the training in order to check if there are no GPS issues on any of them
	Some councillors not informed in advance about survey	Follow up with the MMC’s offices on informing the affected councillors prior to main survey
	Gated communities not interested in taking part in the survey due to time and security constraints	Arrangements should be put in place to allow them to do survey online and to be informed in advance (e.g. via MS teams meetings)
	Communities rejecting survey due to political and service delivery issues	Councillors should explain project to communities and emphasise that it is not related to service delivery
	Survey too slow	Some of the functions were removed, e.g. GPS function, to improve survey speed
	Non-display of token number and “successful submission” of survey	A page that indicates that the survey has been submitted is activated

Category	Challenge	Solution
Main Survey	Poor communication and logistics monitoring	CSIR field team increased to ensure proper site monitoring
	Unresponsive ward councillors	CSIR team requested direct contacts of unresponsive ward councillors and requested signed letters
	Survey too long and too many repetitive questions with little skip logic built in	In future, add 'Information same as Member X' button
	Gaining access to gated communities, flats and complexes	Obtain signed letters from councillors

8. HOUSEHOLD CHARACTERISTICS

The characteristics of the households used in the survey, for example household income, number of people per household, employment status, are discussed in this chapter. The 2016 Community Survey estimates of the household attributes were used to weigh the sample to the known household estimates.

8.1 Number of Households

Table 7 shows the total number of households in the different regions of Gauteng, their percentage distribution and the number of households sampled.

Table 7: Number of households per municipality vs sample size collected

Municipality	Number of households	Percent (%) of weighted households	Planned number of households to be interviewed	Number of households interviewed	(%) interviewed of planned	(%) interviewed of total
Ekurhuleni	1 299 490	26	1 091	949	87	24
Johannesburg	1 853 371	37	1 198	1 085	91	28
Sedibeng	330 828	7	363	368	101	9
Tshwane	1 136 877	23	1 075	1 222	114	31
West Rand	330 572	7	273	277	101	7
Gauteng	**4 951 138**	**100**	**4 000**	**3 901**	**98**	**100**

The City of Johannesburg has the highest total number of households (1 853 371) compared to the other regions; however, only 91% of the planned household response was collected. This was due to some difficulties experienced with some security estate residents and their refusal to participate in the survey. West Rand and Sedibeng regions have the lowest total number of households (~7% each of the total Gauteng household distribution). City of Tshwane had the highest survey response rate of 114% and Ekurhuleni had the lowest

response rate of 87%, which was attributed to issues of regional borders. The sample in Ekurhuleni was 13% less than planned and Tshwane was 14% over the planned sample. However, some household responses captured in Tshwane were identified as Ekurhuleni households due to an anomaly with the regional border. Figure 16 shows the weighted household distribution in the different regions of the province.

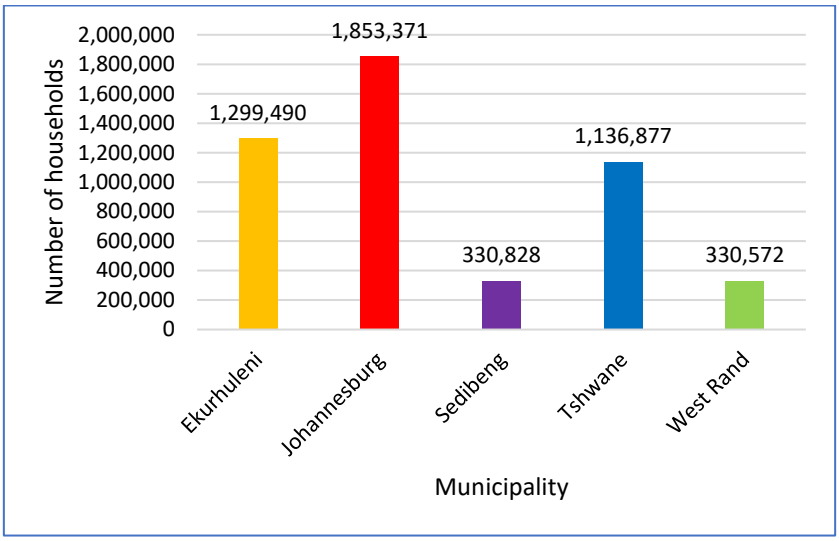

Figure 16: Weighted household distribution

8.2 Household Income

The income distribution of households in the province is aggregated to the sampled households using the weighted number of households to enable adequate representation of a provincial picture. Table 8 and Figure 17 show the income distribution of the Gauteng households. About 23% of the households refused to answer, 11.3% of the households' respondents were unsure and 4.5% of the households' responses were "no income". Accordingly, 39% of the respondents in the survey were not comfortable giving out information relating to person and household income. The low response rate could be attributable to (a) negative perceptions of disclosing sensitive information; (b) crime sensitivity; or, (c) the inaccessibility of gated communities. Close to 16% of the households were in the R30 001 or more income group.

Table 8: Household income distribution

Income group	Weighted Number of households	Households (%)
No income	223 130	4.5
R 1 – R 200	7 142	0.1
R 201 – R 500	74 557	1.5
R 501 – R 1000	140 662	2.8
R 1 001 – R 1 500	122 273	2.5
R 1 501 – R 2 500	312 979	6.3
R 2 501 – R 3 500	218 928	4.4
R 3 501 – R 4 500	212 561	4.3
R 4 501 – R 6 000	208 388	4.2
R 6 001 – R 8 000	191 706	3.9
R 8 001 – R 11 000	216 074	4.4
R 11 001 – R 16 000	239 749	4.8
R 16 001 – R 30 000	297 864	6.0
R 30 001 or more	781 038	15.8
Not Sure	558 580	11.3
Refuse to answer	1 145 511	23.1
Total	**4 951 138**	**100.0**

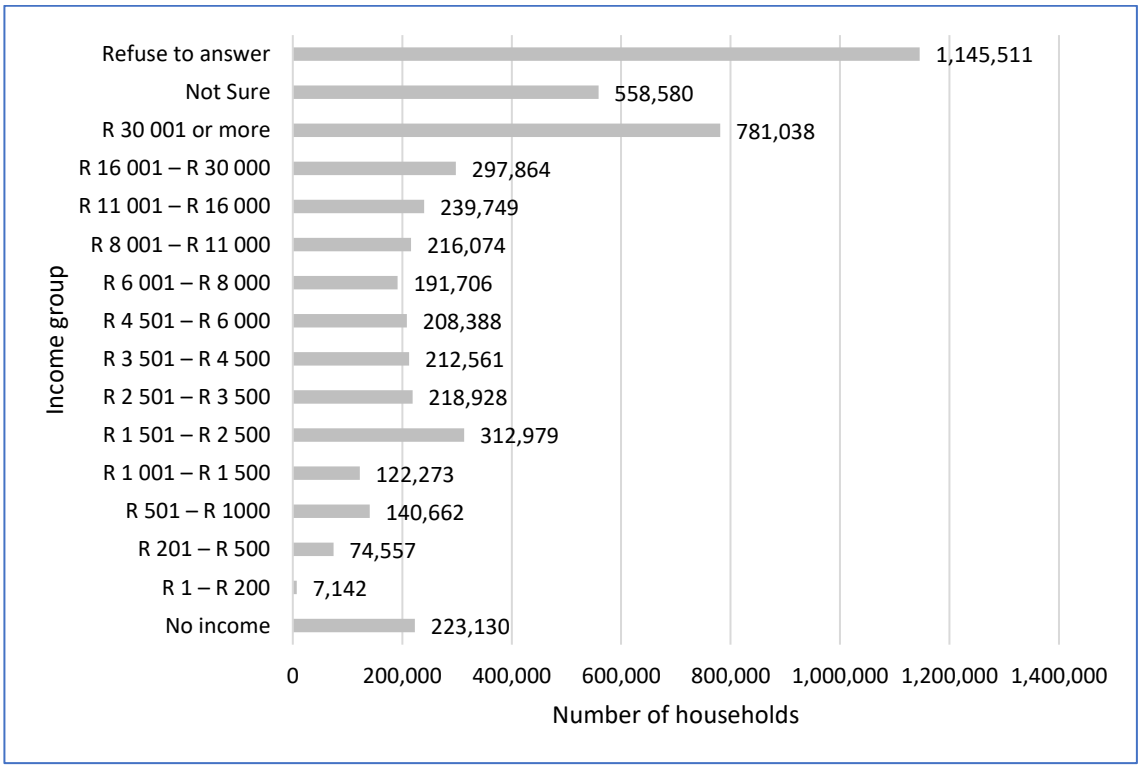

Figure 17: Household income distribution

8.3 Household Trips

Table 9 shows the number of people making trips per household. The results show that 39.5% of households had one person per household making a trip on a given day. Only 2.6% of households have 5 members making trips.

Table 9: Number of people making some trip per household on a typical day

Number of people making trips per household	Weighted Number of households	Households (%)
1	1 954 971	39.5
2	1 684 636	34.0
3	851 543	17.2
4	331 760	6.7
5	128 227	2.6
Total	**4 951 138**	**100.0**

8.4 Household Size

Table 10 illustrates the number of household sizes ranging from 1 to 6+ persons that stay in the household at least four nights per week and the corresponding percentage distribution. Gauteng Province is dominated by households with one and two household members. Households with two people staying at least four nights a week were the most prominent (33.3% of households), followed by 26.8% households with one person. The lowest percentage of 2.3% was that of households with 6+ people staying at least four nights a week. This distribution is comparable to the Community Survey 2016 distribution in a few categories.

Table 10: Household size

Number of persons in household	Weighted number of households	(%) households	Community Survey 2016 (%) households
1	1 324 415	26.8	28.2
2	1 645 879	33.3	22.2
3	1 037 194	21.0	16.9
4	501 798	10.2	14.4
5	322 807	6.5	8.7
6+	113 224	2.3	9.7
Total	**4 945 317***	**100.0%**	**100.0**

*missing observations reducing the total

8.5 Number of Employed People per Household

Table 11 shows the distribution of employed people per household. The highest percentage of 44% represents households with at least one employed person, followed by 35% of households with no employed people. The lowest percentage of 0.04% represents households where 5 people are employed.

Table 11: Employed people per household

Number of employed people per household	Weighted number of households	Households (%)
0	1 744 630	35.27
1	2 158 667	43.64
2	939 695	19.00
3	86 893	1.76
4	14 723	0.30
5	2 151	0.04
Total	**4 946 759***	**100.0**

*missing observations reducing the total

8.6 Number of Unemployed People per Household

Table 12 illustrates the distribution of unemployed people per household. The highest percentage of 37.6% represents households with no unemployed persons, followed by 35% households with one unemployed person. The lowest percentage of 0.29% represents households with 6+ unemployed persons.

Table 12: Unemployed persons per household

Number of unemployed people per household	Weighted number of households	Households (%)
0	1 861 350	37.6
1	1 731 485	35.0
2	990 975	20.0
3	253 930	5.1
4	76 301	1.5
5	16 795	0.3
6+	14 305	0.3
Total	**4 945 141***	**100.0**

*missing observations reducing the total

8.7 Number of Scholars per Household

Table 13 shows the distribution of scholars per household. About 62% of households have no scholars while 25% of households have one scholar. About 0.3% of households have more than five scholars.

Table 13: Scholars per household

Number of scholars per household	Weighted Number of households	Households (%)
0	3 067 262	62.0
1	1 223 861	24.7
2	494 202	10.0
3	129 233	2.6
4	24 244	0.5
5+	12 337	0.3
Total	**4 951 138**	**100.0**

9. POPULATION CHARACTERISTICS

The population characteristics discussed in this chapter include gender, age and education level. The 2016 Community Survey estimates of the population were used for weighing the sample.

9.1 Gender

Table 14 shows the gender split in Gauteng with 51% females and 49% males. This distribution is similar to the Community Survey 2016 distribution.

Table 14: Population distribution by gender

Gender	Weighted Population size	Population (%)	Community Survey 2016 (%) population
Female	6 831 494	51	50
Male	6 556 961	49	50
Other	11 270	0	-
Total	**13 399 725**	**100**	**100**

9.2 Age

Table 15 shows population distribution by age. The highest percentage of the population falls within the working age group with the 14–65 age group making up 71%. The 0–13 age group accounts for 20% of the population. This distribution is similar to the Community Survey 2016 distribution.

Table 15: Age distribution of population

Age	Weighted population size	Population (%)	Community Survey 2016 Age Group	Community Survey 2016 (%) population
0 - 6	958 258	7.2	0-14	24.7
7 - 13	1 654 002	12.3		
14 - 15	605 075	4.5	15-64	66.5
16 - 18	485 520	3.6		
19 - 24	900 648	6.7		
25 - 34	1 641 905	12.3		
35 - 44	2 490 892	18.6		
45 - 54	1 858 450	13.9		
55 - 65	1 559 773	11.6		
66 years and over	1 245 202	9.3	65+	8.7
Total	**13 399 725**	**100**	**Total**	**100**

9.3 Education Level

Table 16 summarises the population distribution by education level. The highest percentage of 23.1% represents the population with a degree or diploma and Grade 12, followed by 20.8% of the population that have completed high school. At an aggregate level, 54% of the population have completed at least a high school level of education. This group of people represents a substantial potential market for mobility (i.e. demand for transport services and infrastructure) as they can be expected to fall into the category of either employed or active job seekers; in this way influencing the number of work-related trips that are generated.

Table 16: Education level of population

Educational Level	Weighted population	Population (%)
No formal education	299 798	2.2
Day-care/crèche	473 316	3.5
Pre-school	175 736	1.3
Some primary school	1 686 308	12.6
Primary school complete (Grade 7 or Standard 5)	426 890	3.2
Some high school	2 382 465	17.8
High school complete (Grade 12 or Standard 10)	2 783 073	20.8
Diploma without Grade 12	388 161	2.9
Degree or Diploma with Grade 12	3 100 117	23.1
Some university/college	1 003 483	7.5
Other post-matric qualification	43 547	0.3
Post-graduate degree	244 655	1.8
Unspecified	392 175	2.9
Total	**13 399 723**	**100.0**

9.4 Employment Status

Table 17 shows the population distribution by employment status. The highest percentage of 25% represents the employed population. About 0.7% of the population is retired.

Table 17: Population distribution by employment status

Employment Status	Weighted population size	Percentage (%)
Retired	90 349	0.7
Unspecified	3 217 335	24.0
Employed	3 312 815	24.7
Not applicable	41 897	0.3
Other	4 418	0.0
Retired	1 999 754	14.9
Self-employed	1 464 437	10.9
Still studying	1 011 674	7.5
Unemployed looking for work	1 692 619	12.6
Unemployed not looking for work	564 426	4.2
Total	**13 399 725**	**100**

10. TRAVEL CHARACTERISTICS BEFORE AND DURING COVID-19

Although the survey was conducted when the COVID-19 restrictions had been relaxed (adjusted level 1) and “normal” travel for most economic activities had resumed, the questionnaire was designed to determine respondents’ travel patterns “during COVID-19”. The term “during COVID-19” was defined as the period between June 2021 and September 2021 when the third wave of "COVID-19 variant Delta" spiked in South Africa and strict COVID-19 restrictions were implemented.

In order to adequately answer the key questions raised about the potential changes in travel choices and patterns that might have been introduced by the COVID-19 pandemic, the questionnaire was designed so that pre-COVID-19 travel information as well as travel during the pandemic were gathered from the same group of households sampled for this study.

This was done because directly comparing the current results to the GHTS 2019 results would have been challenging given that: (1) the 2019 survey was designed to better understand typical weekday travel patterns, so respondents provided answers based on their (exact) most recent travel details; and, (2) too much time had passed for respondents to recall their exact mobility patterns. Therefore, this survey asked for generic travel details from before COVID-19, during COVID-19, and for respondents’ future travel perspectives. For example, respondents were asked to consider a “typical weekday before COVID-19” or a “typical weekday in the past 7 days” for a specific purpose.

Rather than directly comparing different groups of households subjected to different conditions and questioning, the study was designed to collect data for the three relevant time periods of interest (before COVID-19, during COVID-19 and after COVID-19) from the same sample. As a result, the within-sample analysis provides the best comparative framework for assessing the effects of the pandemic on household travel in the province and the results of this survey should not be directly compared with the results of another survey.

10.1 Travel to Work

10.1.1 Main Mode of Transport

Table 18 shows the number of unidirectional work trips per mode per day before COVID-19 relative to during COVID-19. The number of trips has reduced. The most predominant modes of travel for work, both before and during COVID-19, were car as driver and commuter taxi – together accounting for 89% of work trips before COVID-19 and 87% during COVID-19. Interestingly, those who walked all the way increased by 1% from before COVID-19 to 5.2% during COVID-19. Overall, however, there was no significant structural change in the main mode of transport used to travel to work before COVID-19 compared to during COVID-19. The results indicate very low work trips made using the Gautrain, even before COVID-19. The selected sample may have contributed to the results – as such the data is inconclusive with respect to travel by the Gautrain.

Table 18: Mode of transport for work

	Before COVID-19		During COVID-19	
Modes used for work	**Number of Trips***	**(%) trips**	**Number of Trips***	**(%) trips**
Bicycle	12 763	0.5	12 122	0.6
Bus (BRT)	17 028	0.6	17 270	0.9
Bus (Other)	5 520	0.2	5 175	0.3
Car, as the driver	1 742 815	62.8	1 055 288	52.8
Car, as the passenger	51 422	1.9	29 150	1.5
Commuter taxi/minibus taxi	714 857	25.7	681 574	34.1
Company transport	62 116	2.2	58 351	2.9
Gautrain bus	-	-	1 707	0.1
Lift club as a driver	2 635	0.1	6 233	0.3
Lift club as a passenger	19 182	0.7	9 188	0.5
Metered taxi	4 470	0.2	2 291	0.1
Motorcycle	13 352	0.5	10 683	0.5
Other	3 628	0.1	952	0.0
Train	2 401	0.1	2 320	0.1
Walk all the way	117 116	4.2	104 947	5.2
e-hailing service (e.g. Uber, Bolt)	6 848	0.2	2 401	0.1
Total	**2 776 153**	**100.0**	**1 999 650**	**100.0**
**One-way trips. The number of trips is based on a household weight.*				

10.1.2 Departure Times

Table 19 shows the number of trips departing for work at different time intervals before COVID-19 compared to during COVID-19. Before COVID-19, 80% of departures occurred during the 06:00–09:00 time period. During COVID-19, the percentage of travel during the 06:00–09:00 time period reduced to 74%, suggesting a marginal lowering of the peak intensity and a marginal increase in off-peak travel.

Table 19: Departure times for work.

	Before COVID-19		During COVID-19	
Departure Time for Work	**Number of Trips***	**Percentage (%)**	**Number of Trips***	**Percentage (%)**
00:00 – 05:59	482 785	17.6	413 687	20.9
06:00 – 09:00	2 178 976	79.7	1 470 505	74.2
09:01 – 23:59	73 802	2.7	98 094	4.9
Total	**2 735 564**	**100.0**	**1 982 286**	**100.0**
**One-way trips. The number of trips is based on a household weight.*				

10.1.3 Trip Duration

Table 20 and Figure 18 show trip duration before and during COVID-19 for work trips. The majority of work trips took 30–60 minutes both before and during COVID-19 (i.e., 42% in both periods). Overall, there was no significant change in the duration of work trips before COVID-19 compared to during COVID-19.

Table 20: Trip duration for work purposes

	Before COVID-19		During COVID-19	
Work trips duration	**Number of Trips***	**Percent (%)**	**Number of Trips***	**Percent (%)**
0-5 minutes	47 631	1.9	38 730	2.3
5-10 minutes	103 979	4.2	80 507	4.8
10-15 minutes	210 385	8.6	160 831	9.5
15-30 minutes	797 376	32.5	527 050	31.3
30-60 minutes	1 033 679	42.1	704 353	41.8
1-1.5 hours	226 894	9.3	150 997	9.0
1.5-2 hours	22 009	0.9	13 712	0.8
2-3 hours	6 954	0.3	5 922	0.4
More than 3 hours	4 276	0.2	3 770	0.2
Total	**2 453 183**	**100.0**	**1 685 873**	**100.0**
**One-way trips. The number of trips is based on a household weight.*				

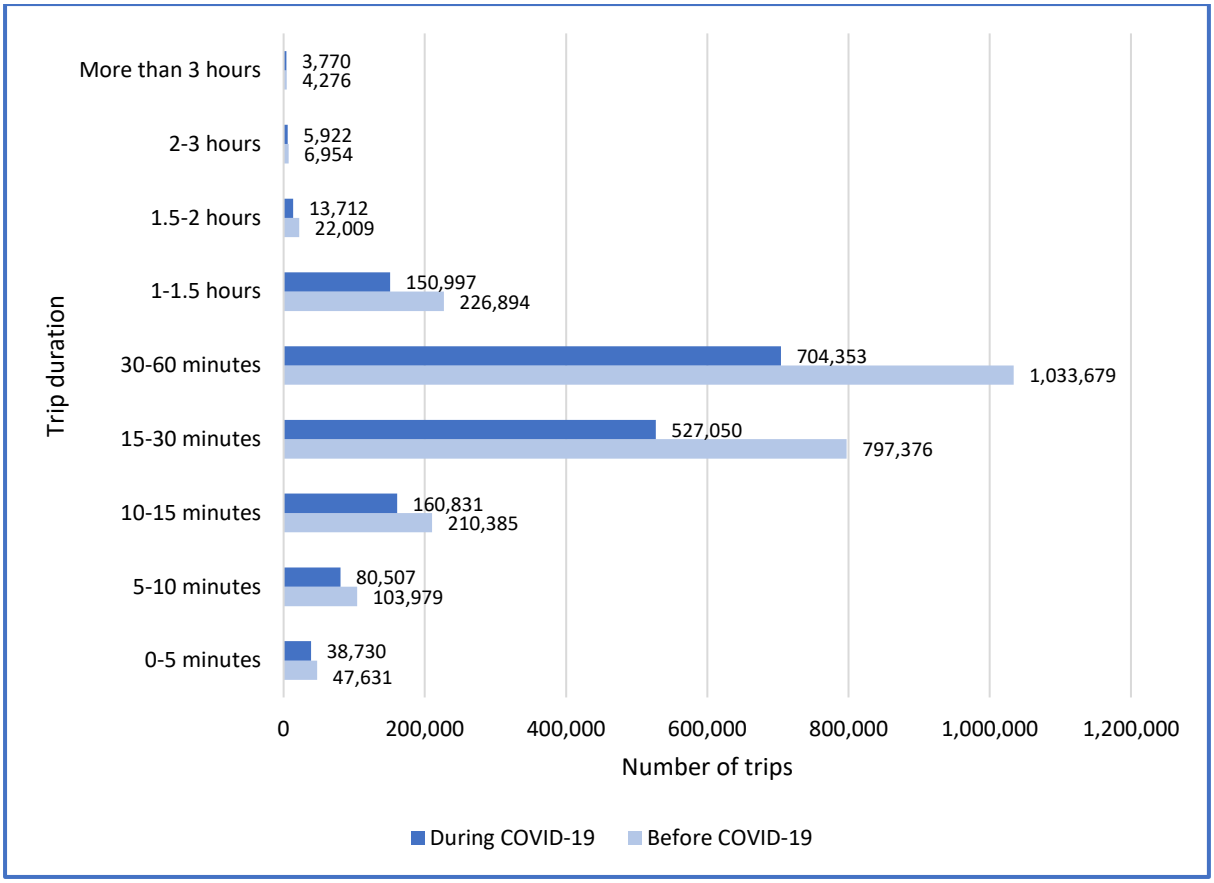

Figure 18: Trip duration for work trips

10.2 Travel to Educational Institution

10.2.1 Main Mode of Transport

Table 21 shows the number of educational trips per mode before COVID-19 relative to during COVID-19. The number of trips reduced slightly. Using car as a passenger, school bus and walking all the way remained the most predominant modes of travel for education both before and during COVID-19, accounting for 85% of education trips before COVID-19 and 87% during COVID-19. Car as the driver marginally decreased by 1.4% from 2.2% before COVID-19 to 0.8% during COVID-19. Overall, there was no significant change in the main mode of transport used to travel for education purposes before COVID-19 compared to during COVID-19. The results indicate very low education trips made using the Gautrain, even before COVID-19. The selected sample may have contributed to the results – as such the data is inconclusive with respect to travel by the Gautrain.

Table 21: Mode of transport for education

Modes used for education	Before COVID-19		During COVID-19	
	Number of Trips*	(%) trips	Number of Trips*	(%) trips
Bicycle	35 753	1.1	36 977	1.4
Bus (BRT)	35 991	1.2	26 211	1.0
Bus (Other)	3203	0.1	5 561	0.2
Car, as the driver	68 219	2.2	20 346	0.8
Car, as the passenger	771 421	24.7	617 144	23.3
Commuter taxi/minibus taxi	199 220	6.4	175 447	6.6
Gautrain	1 201	0.0	-	-
Gautrain bus	-	-	1 201	0.0
Lift club as a driver	-	-	2 401	0.1
Lift club as a passenger	63 272	2.0	49 424	1.9
Metered taxi	2 387	0.1	2 387	0.1
Motorcycle	26 680	0.9	25 224	1.0
Other	1 707	0.1	929	0.0
School bus	933 403	29.9	902 213	34.0
Train	1 201	0.0	-	-
Walk all the way	941 947	30.2	776 819	29.3
e-hailing service (e.g. Uber, Bolt)	32 822	1.1	10 247	0.4
Total	**3 118 426**	**100.0**	**2 652 531**	**100.0**
**One-way trips. The number of trips is based on a household weight.*				

10.2.2 Departure Times

Table 22 shows the number of trips for educational purposes departing at different time intervals before COVID-19 compared to during COVID-19. Before COVID-19, 97% of departures occurred during the 06:00–09:00 time period. This pattern did not change, with 96% of trips occurring during the 06:00–09:00 time period during COVID-19. The lowest percentage trips were made during the 00:00–05:59 time period both before and during COVID-19 (i.e. 0.7% and 1%, respectively). Trips during the 09:01–23:59 time period have increased by close to 2%.

Table 22: Departure times for educational purposes

Departure Time for Education Trips	Before COVID-19		During COVID-19	
	Number of Trips*	Percentage (%)	Number of Trips*	Percentage (%)
00:00 – 05:59	21 962	0.7	26 291	1.0
06:00 – 09:00	3 028 962	97.4	2 551 405	95.6

	Before COVID-19		During COVID-19	
Departure Time for Education Trips	**Number of Trips***	**Percentage (%)**	**Number of Trips***	**Percentage (%)**
09:01 – 23:59	58 323	1.9	91 154	3.4
Total	**3 109 247**	**100.0**	**2 668 850**	**100.0**
**One-way trips. The number of trips is based on a household weight.*				

10.2.3 Trip Duration

Table 24 and Figure 19 show the trip duration before and during COVID-19 for education trips. The majority of education trips took 15–30 minutes before and during COVID-19 (i.e., 36% and 37%, respectively). Overall, there was no significant change in the duration of education trips before COVID-19 compared to during COVID-19.

Table 23: Trip duration for education

	Before COVID-19		During COVID-19	
Education trips duration	**Number of Trips***	**Percent (%)**	**Number of Trips***	**Percent (%)**
0-5 minutes	142 200	5.8	126 268	6.3
5-10 minutes	466 222	18.9	378 481	18.8
10-15 minutes	631 141	25.6	484 395	24.0
15-30 minutes	888 431	36.0	736 730	36.6
30-60 minutes	313 863	12.7	272 674	13.5
1-1.5 hours	24 198	1.0	14 835	0.7
2-3 hours	2 152	0.1	1 873	0.1
Total	**2 468 207**	**100.0**	**2 015 255**	**100.0**
**One-way trips. The number of trips is based on a household weight.*				

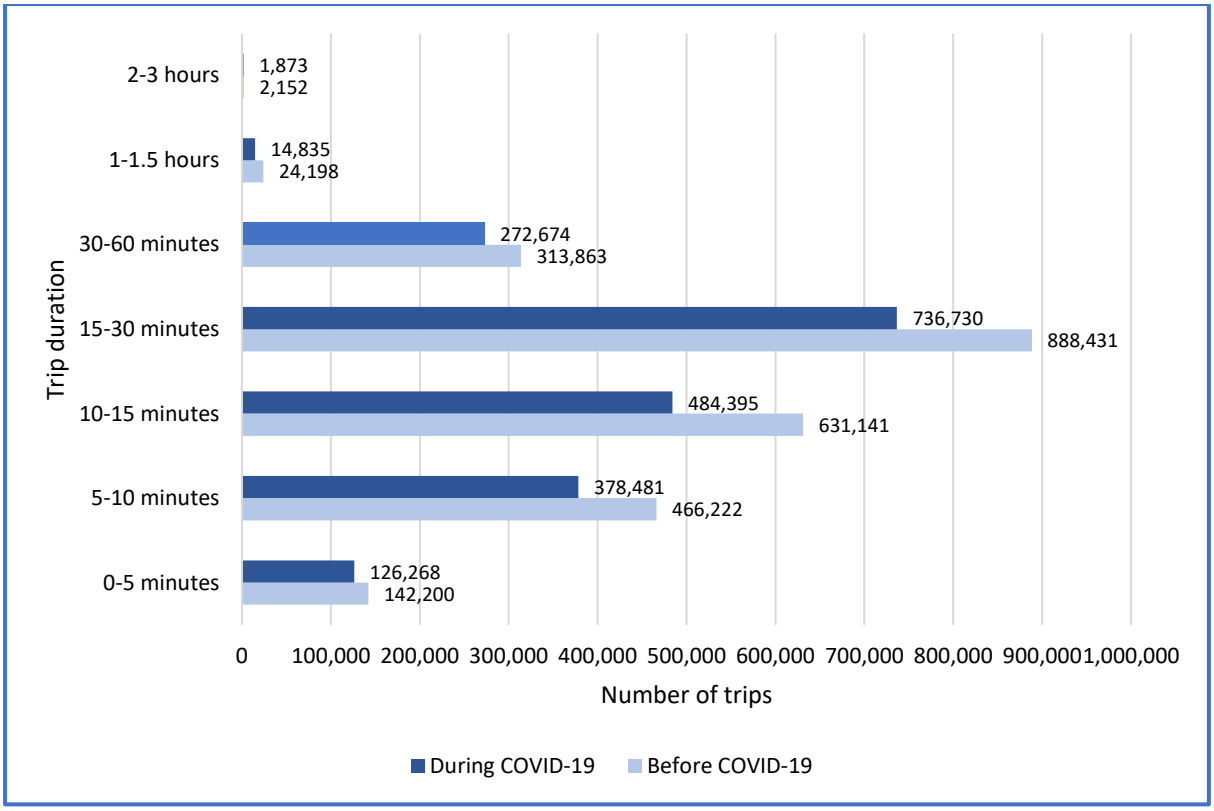

Figure 19: Trip duration for education trips

10.3 Travel for Shopping

10.3.1 Main Mode of Transport

Table 24 shows the number of shopping trips per mode type before COVID-19 compared to during COVID-19. The number of trips has remained fairly similar. The most predominant modes of travel for shopping both before and during COVID-19 were car as the driver and commuter taxi/minibus taxi – accounting for 83% of work trips both before and during COVID-19. Overall, there was no significant change in the main mode of transport used to travel for shopping before COVID-19 compared to during COVID-19. For the sample selection, the results indicate no shopping trips were made using the Gautrain, even before COVID-19. The selected sample may have contributed to the results – as such the data is inconclusive with respect to travel by the Gautrain.

Table 24: Mode of transport for shopping

	Before COVID-19		During COVID-19	
Modes used for shopping	**Number of Trips***	**Percent (%)**	**Number of Trips***	**Percent (%)**
Bicycle	15 301	0.2	19 825	0.3
Bus (BRT)	1904	0.0	5402	-
Bus (Other)	3 659	0.1	4 035	0.1
Car, as the driver	2 662 029	41.8	2 684 738	42.9
Car, as the passenger	500 608	7.9	465 509	7.4
Commuter taxi/minibus taxi	2 614 161	41.0	2 517 016	40.2
Company transport	3 072	0.0	8 183	0.1
Gautrain bus	3 690	0.1	952	0.0
Lift club as a driver	1 714	0.0	6 158	0.1
Lift club as a passenger	11 597	0.2	13 172	0.2
Metered taxi	16 851	0.3	21 758	0.3
Motorcycle	11 804	0.2	6 638	0.1
School bus	2 741	0.0	8 724	0.1
Train	2 401	0.0	-	-
Walk all the way	461 681	7.2	429 727	6.9
e-hailing service (e.g. Uber, Bolt)	58 908	0.9	64 630	1.0
Total	**6 372 120**	**100.0**	**6 256 467**	**100.0**
**One-way trips. The number of trips is based on a household weight.*				

The results in Table 24 show that every household did a shopping related trip both before and during COVID-19.

10.3.2 Departure Times

Table 25 shows the number of trips departing for shopping at different time intervals before COVID-19 compared to during COVID-19. Before COVID-19, 82% of departures occurred during the 09:01–23:59 time period. This pattern has not changed, with 81% of trips occurring during the 09:01–23:59 time period during COVID-19. The lowest percentage trips were made during the 00:00–05:59 time period both before and during COVID-19 and accounted for 3%. Trips during the 06:00–09:00 time period have increased slightly from 15% to 16%.

Table 25: Departure times for shopping

	Before COVID-19		During COVID-19	
Departure Time for Shopping Trips	**Number of Trips***	**Percentage (%)**	**Number of Trips***	**Percentage (%)**
00:00 – 05:59	132 478	2.7	127 890	2.7
06:00 – 09:00	752 867	15.4	780 869	16.3
09:01 – 23:59	3 992 652	81.9	3 876 879	81.0
Total	**4 877 998**	**100.0**	**4 785 638**	**100.0**
**One-way trips. The number of trips is based on a household weight.*				

10.3.3 Trip Duration

Table 26 and Figure 20 show the trip duration before and during COVID-19 for shopping trips. The majority of shopping trips took 5–10 minutes before COVID-19 and 15–30 minutes during COVID-19. Overall, there was no significant change in the duration of shopping trips before COVID-19 compared to during COVID-19.

Table 26: Trip duration for shopping

	Before COVID-19		During COVID-19	
Shopping trips duration	**Number of Trips***	**Percent (%)**	**Number of Trips***	**Percent (%)**
0-5 minutes	741 713	12.8	569 209	10.8
5-10 minutes	1 797 655	30.9	1 587 134	30.1
10-15 minutes	1 032 601	17.8	950 125	18.0
15-30 minutes	1 652 333	28.4	1 602 920	30.4
30-60 minutes	520 872	9.0	493 413	9.4
1-1.5 hours	42 875	0.7	32 188	0.6
1.5-2 hours	6 105	0.1	8 755	0.2
2-3 hours	16 324	0.3	18 103	0.3
More than 3 hours	5 741	0.1	6 091	0.1
Total	**5 816 219**	**100.0**	**5 267 939**	**100.0**
**One-way trips. The number of trips is based on a household weight.*				

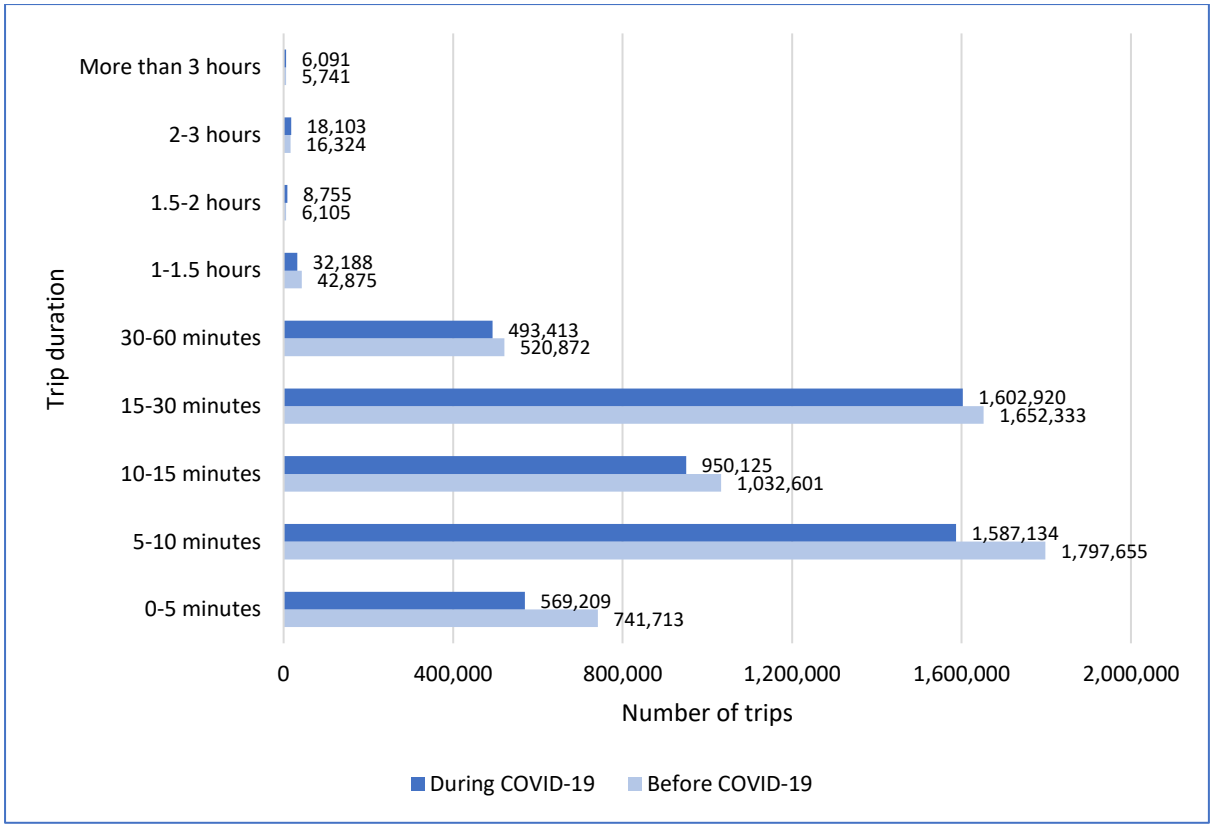

Figure 20: Trip duration for shopping

10.4 Travel for Medical Purposes

10.4.1 Main Mode of Transport

Table 27 shows the number of trips per mode type for travel for medical purposes before COVID-19 compared to during COVID-19. The number of medical trips increased slightly. The most predominant modes of travel for medical purposes both before and during COVID-19 were car, as the driver (34% before and 33% during COVID-19) and walking all the way (30% both before and during COVID-19). Overall, there was no significant change in the main mode of transport used to travel for medical purposes before COVID-19 compared to during COVID-19. The results indicate very low medical purpose trips made using the Gautrain, even before COVID-19. The selected sample may have contributed to the results – as such the data is inconclusive with respect to travel by the Gautrain.

Table 27: Mode of transport for medical trips

Modes used for medical	Before COVID-19		During COVID-19	
	Number of Trips*	Percent (%)	Number of Trips*	Percent (%)
Bicycle	1 873	0.1	4 561	0.2
Bus (BRT)	1 916	0.1	1 901	0.1
Bus (other)	1 707	0.1	0	0.0
Car, as the driver	731 901	33.5	758 207	33.1
Commuter taxi/minibus taxi	336 392	15.4	321 789	14.1
Company transport	12 683	0.6	3 353	0.1
Gautrain	1 201	0.1	-	-
Gautrain bus	1 928	0.1	-	-
Lift club as a driver	-	-	2 628	0.1
Lift club as a passenger	12 204	0.6	13 869	0.6
Metered taxi	4 797	0.2	8 584	0.4
Motorcycle	9 539	0.4	6 111	0.3
Other	-	-	2 741	0.1
School bus	-	-	4 304	0.2
Train	-	-	1 201	0.1
Walk all the way	649 359	29.7	705 267	30.8
e-hailing service (e.g. Uber, Bolt)	9 146	0.4	10 785	0.5
Total	**2 186 012**	**100.0**	**2 287 508**	**100.0**
**One-way trips. The number of trips is based on a household weight.*				

10.4.2 Departure Times

Table 28 shows the number of trips departing for medical purposes at different time intervals before COVID-19 compared to during COVID-19. Before COVID-19, 74% of departures occurred during the 06:00–09:00 time period. This pattern has not changed, with 73% of trips occurring during the 06:00–09:00 time period during COVID-19. Trips during the 09:01–23:59 time period have increased by 2%.

Table 28: Departure times for medical purposes

Departure Time for Medical Trips	Before COVID-19		During COVID-19	
	Number of Trips*	Percentage (%)	Number of Trips*	Percentage (%)
00:00 – 05:59	68 081	3.7	64 347	3.3
06:00 – 09:00	1 364 547	74.4	1 394 791	72.5

	Before COVID-19		During COVID-19	
Departure Time for Medical Trips	**Number of Trips***	**Percentage (%)**	**Number of Trips***	**Percentage (%)**
09:01 – 23:59	401 912	21.9	463 503	24.1
Total	**1 834 539**	**100.0**	**1 922 641**	**100.0**
**One-way trips. The number of trips is based on a household weight.*				

10.4.3 Trip Duration

Table 29 and Figure 21 show the trip duration before and during COVID-19 for medical purposes. The majority of medical purpose trips took 10–15 minutes before and during COVID-19 with a slight increase in the proportion of people travelling for 10–15 minutes for medical purposes (from 37% before COVID-19 to 40% during COVID-19). Overall, there was no significant change in the duration of medical purpose trips before COVID-19 compared to during COVID-19.

Table 29: Trip duration for medical purposes

	Before COVID-19		During COVID-19	
Medical trips duration	**Number of Trips***	**Percent (%)**	**Number of Trips***	**Percent (%)**
0-5 minutes	65 815	3.3	54 304	2.6
5-10 minutes	591 714	29.7	575 212	28.0
10-15 minutes	736 235	37.0	829 012	40.3
15-30 minutes	475 876	23.9	474 985	23.1
30-60 minutes	109 990	5.5	108 615	5.3
1-1.5 hours	5 692	0.3	7 296	0.4
1.5-2 hours	5 892	0.3	5 754	0.3
2-3 hours	1 201	0.1	1 201	0.1
Total	**1 992 414**	**100.0**	**2 056 377**	**100.0**
**One-way trips. The number of trips is based on a household weight.*				

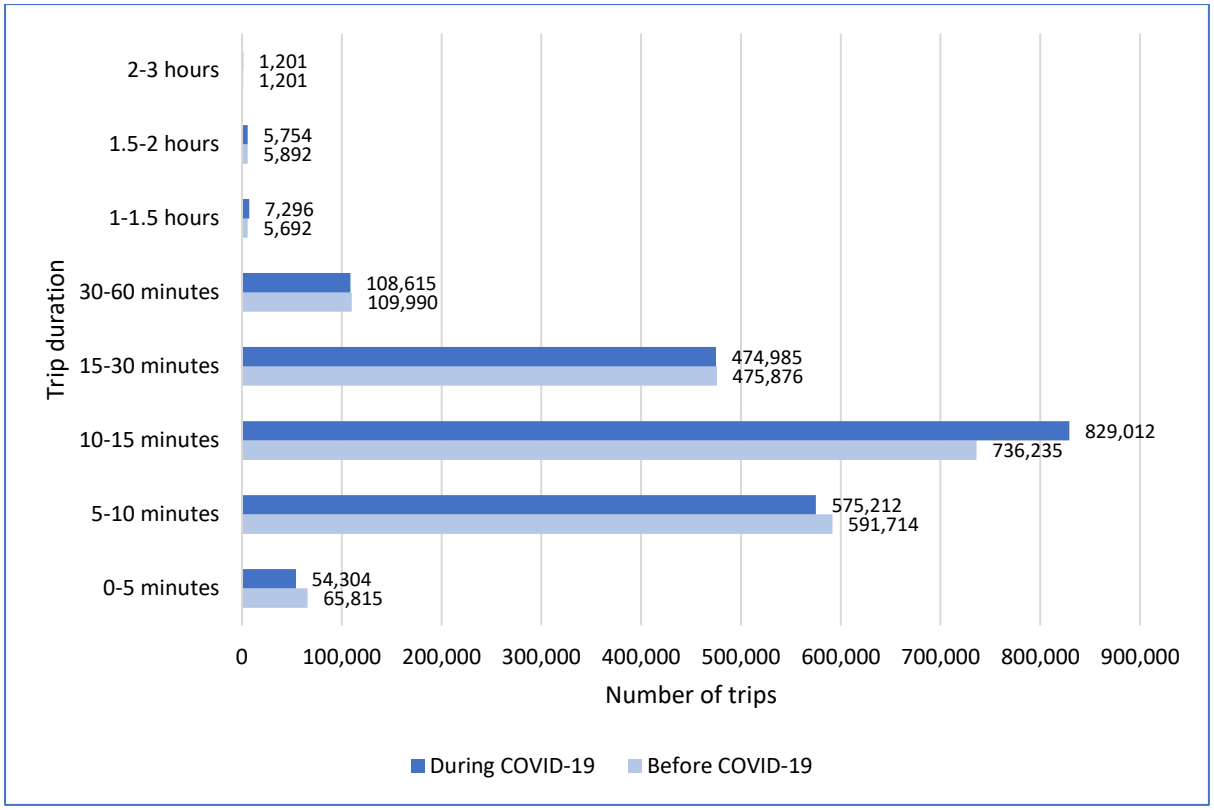

Figure 21: Trip duration for medical trips

10.5 Travel for Other Purposes

This section provides a comparison of the main mode of transport for all other purposes – that is, excluding work, education, shopping and medical purposes – before and during COVID-19. These include travel to visit family and friends, recreational places, places of worship, welfare offices and government offices.

10.5.1 Main Mode of Transport

Table 30 shows the number of trips per mode type for travel for other purposes before COVID-19 compared to during COVID-19. The number of "discretionary trips" reduced significantly. The most predominant modes of travel for other purposes both before and during COVID-19 were car as driver and walk all the way accounting for 66% of other purpose trips before COVID-19 and 68% during COVID-19. Interestingly, the use of commuter taxi decreased by 4% – from 17% before COVID-19 to 13% during COVID-19. Overall, there was no significant change in the main mode of transport used to travel for other purposes before COVID-19 compared to during COVID-19. The results indicate very few other purpose trips made using

the Gautrain, even before COVID-19. The selected sample may have contributed to the results – as such the data is inconclusive with respect to travel by the Gautrain.

Table 30: Mode of transport for other purposes

	Before COVID-19		During COVID-19	
Modes used for any other purpose	**Number of Trips***	**Percent (%)**	**Number of Trips***	**Percent (%)**
Bicycle	35 443	0.5	9 535	0.4
Bus (BRT)	46 806	0.7	14 641	0.6
Bus (Other)	-	-	2 738	0.1
Car, as the driver	2 707 605	38.8	1 088 503	43.3
Car, as the passenger	1 015 815	14.6	380 523	15.1
Commuter taxi/minibus taxi	1 182 114	16.9	323 837	12.9
Company transport	921	0.0	1 714	0.1
Gautrain	-	-	1 707	0.1
Gautrain bus	970	0.0	951	0.0
Lift club as a driver	2 635	0.0	8 203	0.3
Lift club as a passenger	18 995	0.3	3 420	0.1
Metered taxi	15 125	0.2	2 164	0.1
Motorcycle	16 970	0.2	7 202	0.3
Other	1 707	0.0		0.0
School bus	14 736	0.2	4 628	0.2
Train	4 802	0.1	3 413	0.1
Walk all the way	1 862 150	26.7	622 977	24.8
e-hailing service (e.g. Uber, Bolt)	54 512	0.8	39 772	1.6
Total	**6 981 306**	**100.0**	**2 515 926**	**100.0**
**One-way trips. The number of trips is based on a household weight.*				

11. FUTURE TRAVEL PERSPECTIVES

This chapter presents the likelihood of residents adopting different travel patterns in the future for work, educational, shopping, and medical purposes.

11.1 Likelihood to Change Working Arrangements

Respondents were asked about their likelihood to change their work arrangements to:

- Work from home full time
- Work some days at work and some days at home

- Work full-time at place of work
- Work a compressed work week (e.g. work longer hours for three or four days, and get a day off)
- Work staggered working hours (e.g. start early and end the day early); and
- Work flexible hours (work anytime, anywhere as long as the job gets done to the employer's satisfaction).

Figure 22 shows the percentage of people and their likelihood of working from home full-time in the future. About 57% indicated that they are unlikely to WFH full-time in the future while 36% are likely to do so. About 7% indicated that they were unsure whether they would continue to WFH full-time in the future.

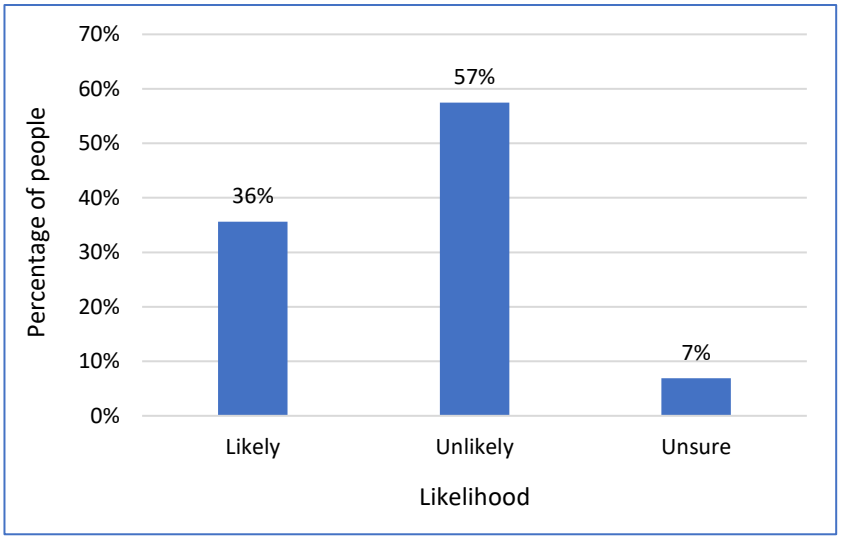

Figure 22: Likelihood to WFH full-time

Figure 23 shows the percentage of people and their likelihood of partially working from home and at the workplace in the future. About 50% indicated that they are unlikely to continue to work some days at work and some days at home in the future. About 36% indicated that they were likely to do so.

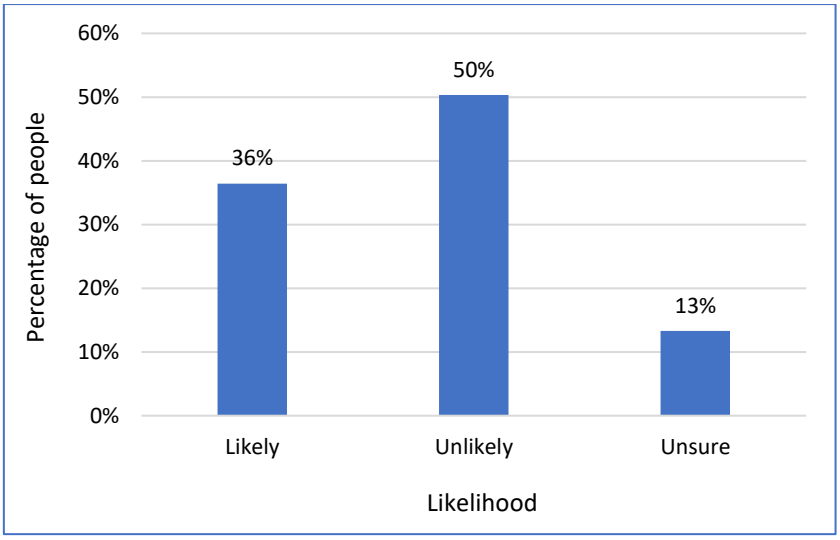

Figure 23: Likelihood to partially WFH

Figure 24 shows the percentage of people and their likelihood to work full-time at their workplace in future. About 71% are likely to work full-time at their workplace in future while 21% indicated that they were unlikely.

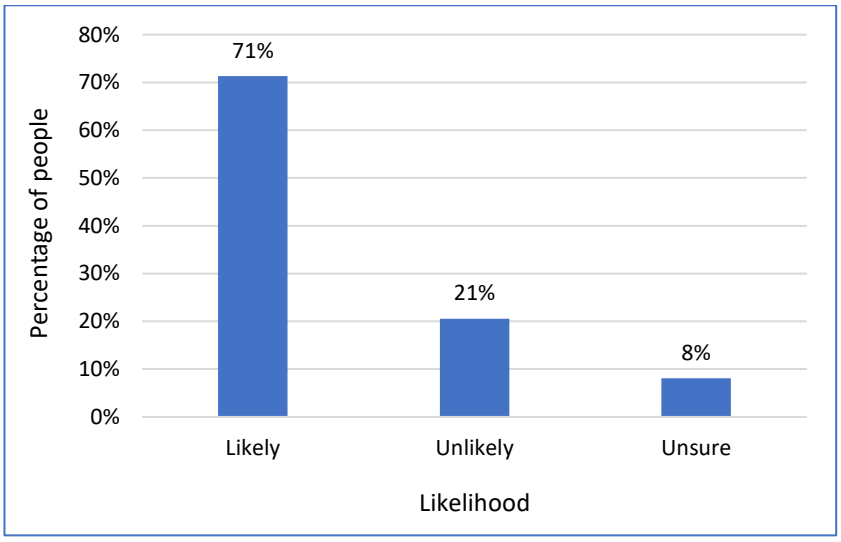

Figure 24: Likelihood to work full-time at the workplace

Figure 25 shows the percentage of people and their likelihood to work a compressed work week in future. The percentage of people that are likely to work a compressed work week and those that are unlikely to work a compressed work week in the future was equal (i.e. 44%).

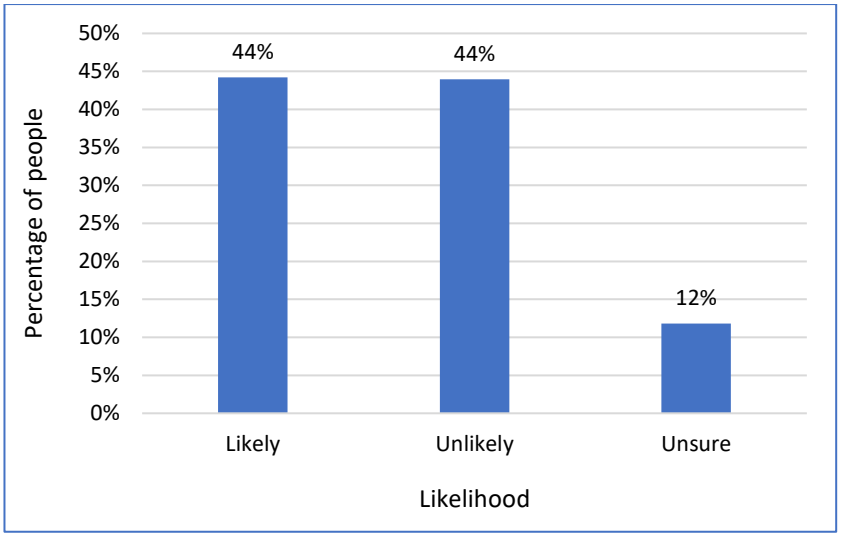

Figure 25: Likelihood to work a compressed work week

Figure 26 shows the percentage of people and their likelihood to work staggered hours in future. About 46% are likely to work staggered hours in the future while 42% are unlikely to do so.

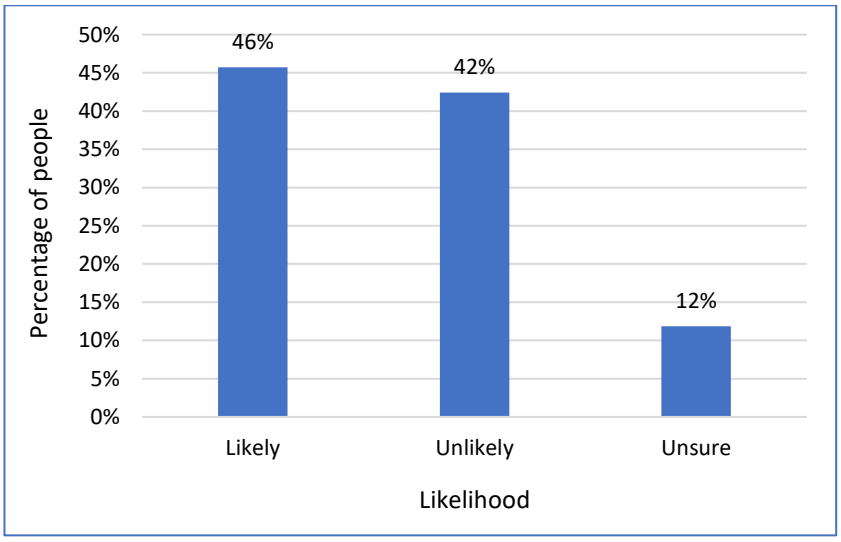

Figure 26: Likelihood to work staggered work hours

Figure 27 shows the percentage of people and their likelihood of working flexible working hours in future. About 53% are unlikely to work flexible working hours in the future while 37% indicated that they are likely to do so.

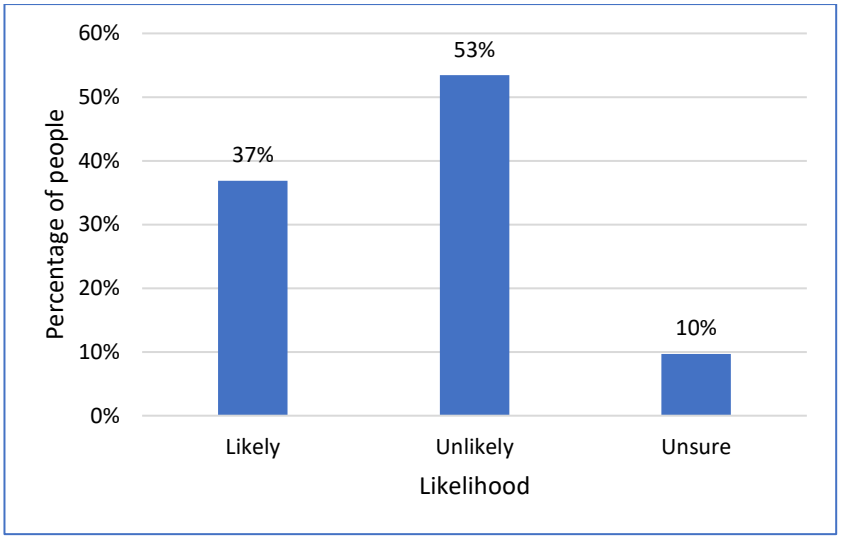

Figure 27: Likelihood to work flexible hours

Table 31 illustrates the perceptions of people towards future changes to their travel costs for work trips. About 46% of people believe that the travel cost will stay the same while 31% believe it will decrease.

Table 31: Perceptions on future travel cost for work trips

Change in cost of travel for work trips	Number of people	Percentage (%)
Decrease	1 591 018	31.0
Increase	1 162 662	22.6
Stay the same	2 383 390	46.4
Total	**5 137 070**	**100.0**

Table 32 illustrates the perceptions of people towards future changes to travel time for work trips. About 65% of people believe that their travel time for work will stay the same in the future, while 7% believe that it will increase.

Table 32: Perceptions on future work trip duration

Change in travel time for Work Trips	Number of People	Percentage (%)
Decrease	1 456 686	28.4
Increase	360 517	7.0
Stay the same	3 319 867	64.6
Total	**5 137 070**	**100.0**

11.2 Likelihood to Change Education Arrangements

Figure 28 shows the percentage of people and their likelihood to continue with contact educational classes in the future. About 93% indicated that they are likely to continue with contact classes in the future while only 4% indicated that they were unlikely to do so.

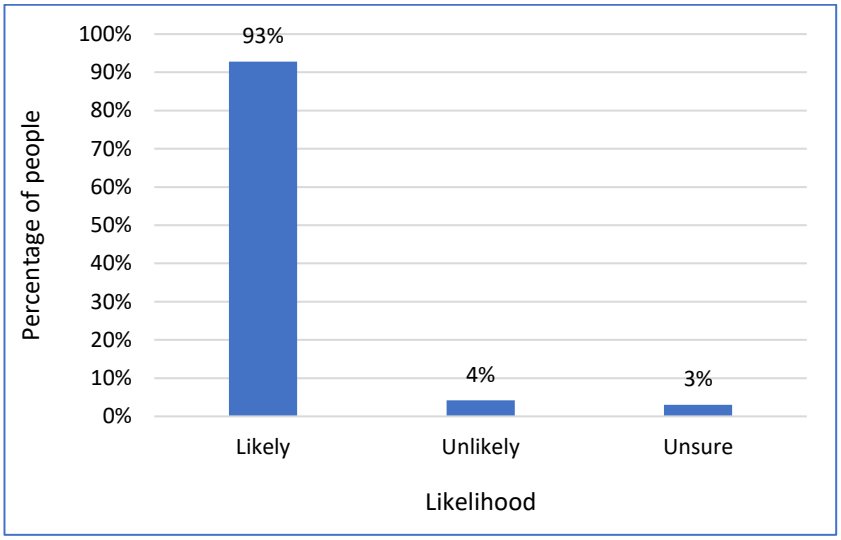

Figure 28: Likelihood to continue with contact educational classes

Figure 29 shows the percentage of people and their likelihood to continue with online educational classes in the future. About 63% indicated that they are unlikely to continue with online classes in the future while 13% are likely to continue to do so.

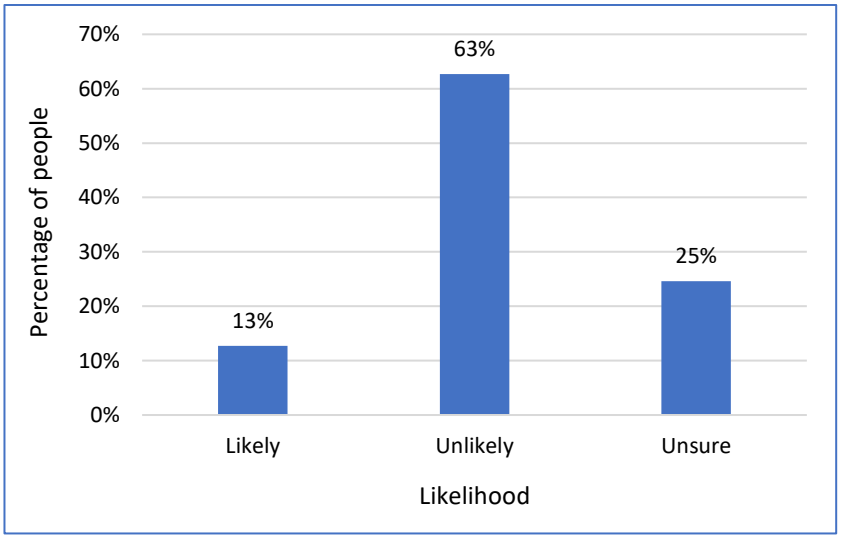

Figure 29: Likelihood to continue with online educational classes

Figure 30 shows the percentage of people and their likelihood to continue with a combination of contact and online classes in the future. About 61% indicated that they are unlikely to continue with a combination of contact and online classes in the future while 18% are likely to do so.

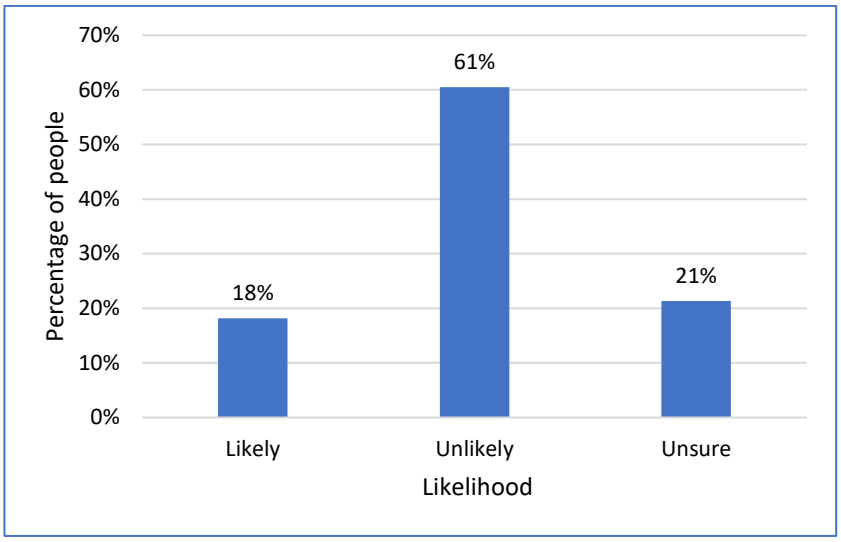

Figure 30: Likelihood to continue with a combination of contact and online

Table 33 illustrates the perceptions of people towards future changes to travel cost for educational trips. About 56% of people believe that the travel cost will stay the same while 28% believe it will decrease.

Table 33: Perceptions on future travel cost for education trips

Change in cost of travel for educational trips	Number of people	Percentage (%)
Decrease	871 630	28.3
Increase	483 769	15.7
Stay the same	1 719 831	55.9
Total	**3 075 230**	**100.0**

Table 34 illustrates the perceptions of people towards future changes to travel time for educational trips. About 73% of people believe that their travel time for education will stay the same in the future, while 21% believe that it will decrease.

Table 34: Perceptions on future educational trip duration

Change in travel time for education trips	Number of people	Percentage (%)
Decrease	652 934	21.2
Increase	193 201	6.3
Stay the same	2 229 095	72.5
Total	**3 075 230**	**100.0**

11.3 Likelihood to Change Shopping Arrangements

Figure 31 shows the percentage of people and their likelihood to continue with physical shopping in the future. About 94% indicated that they are likely to continue with physical shopping in the future while only 3% indicated that they were unlikely.

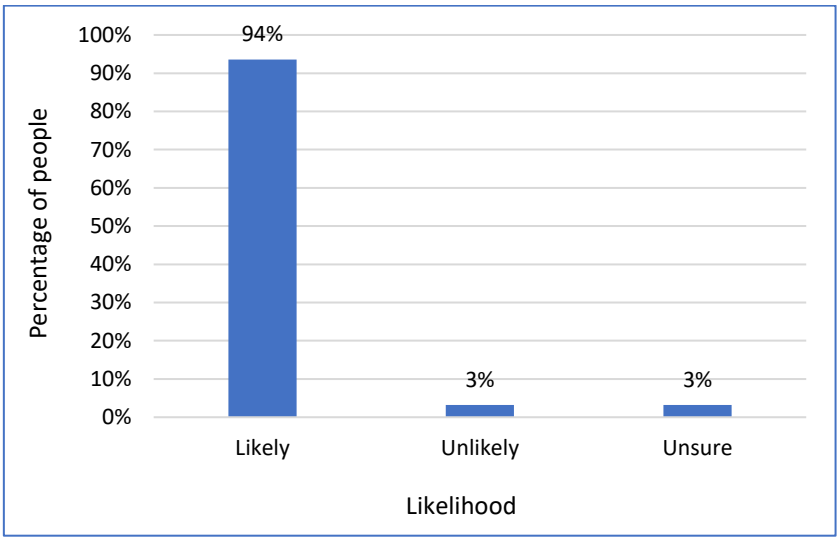

Figure 31: Likelihood to continue with physical shopping

Figure 32 shows the percentage of people and their likelihood to continue with online shopping in the future. About 61% indicated that they are unlikely to continue with online shopping in the future while 25% are likely to do so.

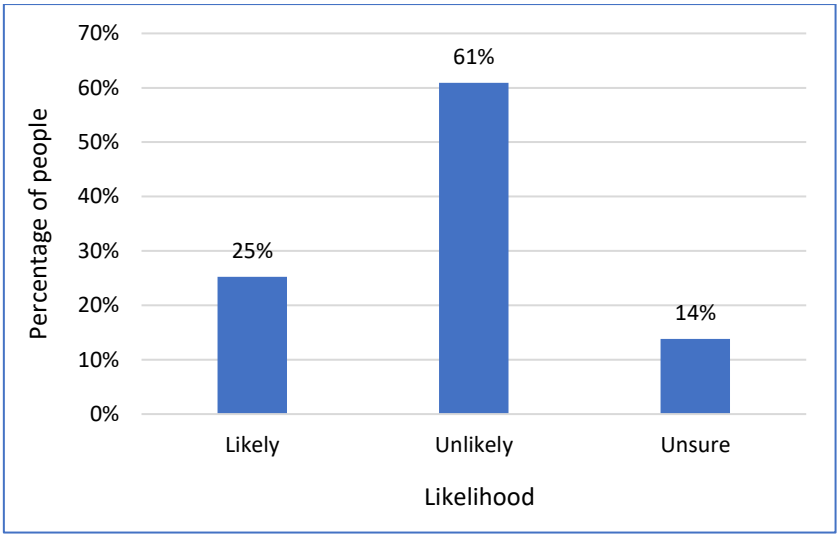

Figure 32: Likelihood to continue with online shopping

Figure 33 shows the percentage of people and their likelihood to continue with a combination of physical and online shopping in the future. About 51% indicated that they are unlikely to continue with a combination of physical and online shopping in the future while 40% are likely to do so.

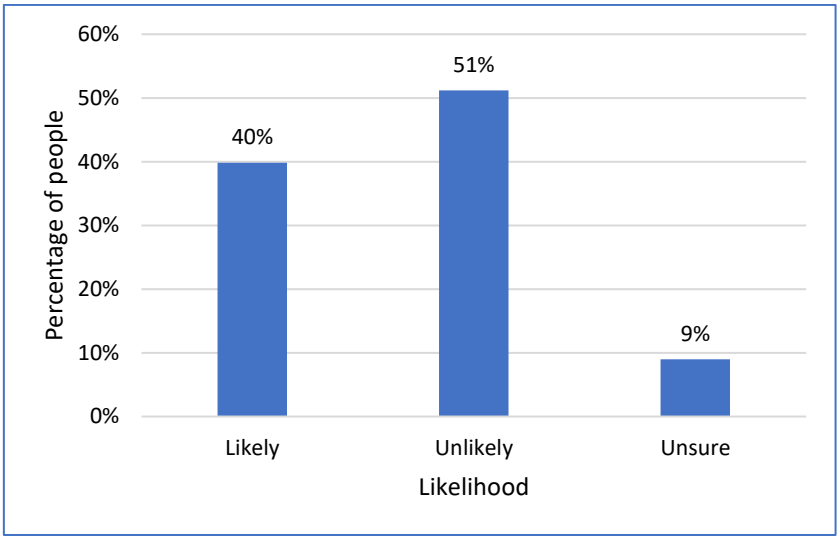

Figure 33: Likelihood of future physical and online shopping

Table 35 illustrates the perceptions of people towards future changes to travel cost for shopping trips. About 56% of people believe that the travel cost will stay the same while 26% believe it will increase.

Table 35: Perceptions on future travel cost for shopping trips

Change in cost of travel for Shopping Trips	Number of People	Percentage (%)
Decrease	1 318 403	18.2
Increase	1 849 208	25.6
Stay the same	4 065 645	56.2
Total	**7 233 256**	**100.0**

Table 36 illustrates the perceptions of people towards future changes to travel time for shopping trips. About 76% of people believe that travel time for shopping will stay the same in the future, while 18% believe that it will decrease.

Table 36: Perceptions on future shopping trip duration

Change in travel time for Shopping Trips	Number of People	Percentage (%)
Decrease	1 269 408	17.5
Increase	497 843	6.9
Stay the same	5 466 005	75.6
Total	**7 233 256**	**100.0**

11.4 Perspectives on Medical Trip Cost and Duration

Table 37 illustrates the perceptions of people towards future changes to travel cost for medical purpose trips. About 50% of people believe that the travel cost will stay the same while 37% believe it will increase.

Table 37: Perceptions on future travel cost for medical trips

Change in cost of travel for Medical Trips	Number of People	Percentage (%)
Decrease	377 786	12.7
Increase	1 114 114	37.4
Stay the same	1 489 733	50.0
Total	**2 981 633**	**100.0**

Table 38 illustrates the perceptions of people towards future changes to travel time for medical purpose trips. About 68% of people believe that travel time for medical purpose will stay the same in the future, while 20% believe that it will increase.

Table 38: Perceptions on future medical trip duration

Change in travel time for Medical Trips	Number of People	Percentage (%)
Decrease	356 869	12.0
Increase	584 546	19.6
Stay the same	2 040 219	68.4
Total	**2 981 634**	**100.0**

11.5 Perspectives on Other Purpose Trip Cost and Duration

Table 39 illustrates the perceptions of people towards future changes to travel cost for other purpose trips. About 70% of people believe that the travel cost will stay the same while 19% believe it will increase.

Table 39: Perceptions on future travel cost for other purpose trips

Change in cost of travel for Other Purpose Trips	Number of People	Percentage (%)
Decrease	355 561	10.8
Increase	631 753	19.2
Stay the same	2 298 695	70.0
Total	**3 286 009**	**100.0**

Table 40 illustrates the perceptions of people towards future changes to travel time for other purpose trips. About 86% of people believe that travel time will stay the same in the future, while 12% believe that it will decrease.

Table 40: Perceptions on future other purpose trip duration

Change in travel time for Other Purpose Trips	Number of People	Percentage (%)
Decrease	384 230	11.7
Increase	92 002	2.8
Stay the same	2 809 777	85.5
Total	**3 286 008**	**100.0**

11.6 Modes of Transport Likely to be Used Going Forward

Table 41 shows the different modes selected as potential travel modes for work in the future. More than half the trips for work (53%) are likely to be by car, as the driver. The modes that people indicated they were not likely to use at all for future work trips are bus (other) and train. Interestingly, relative to Table 18, affinity towards minibus taxi drops in the interest of bus and of walking all the way.

Table 41: Modes for future work trips

Future Mode for Work Trips	Estimated number of trips	Percentage (%)
Bicycle	11 089	0.3
BRT bus (e.g. Rea Vaya, A Re Yeng)	13 112	0.4
Bus	609 803	17.2
Bus (other)	0	0.0
Car, as the driver	1 890 839	53.3
Car, as the passenger	122 949	3.5
Commuter taxi/minibus taxi	221 170	6.2
Company transport	73 667	2.1
e-hailing service (e.g. Uber, Bolt)	44 081	1.2
Gautrain	1 201	0.0
Gautrain bus	3 690	0.1
Lift club as a driver	1 714	0.0
Lift club as a passenger	27 780	0.8
Metered taxi	20 789	0.6
Motorcycle	10 664	0.3
Other	6 733	0.2
School bus	21 222	0.6
Train	0	0.0
Walk all the way	468 533	13.2
Total	**3 549 035**	**100.0**

Table 42 shows the different modes selected as potential future travel modes for educational purposes. Approximately a quarter of the trips for education (26%) will be by car as passenger followed by commuter taxi/minibus taxi and bus (other) – at 23% and 21%, respectively. The modes people indicated they were not likely to use at all for future educational trips are train, company transport and lift club as driver. Interestingly, relative to Table 21, affinity towards

walking all the way reduces, and the increased preference is for car as passenger and minibus taxis.

Table 42: Modes for future educational trips

Future mode for school trips	Estimated number of trips	Percentage (%)
Bicycle	64 481	1.9
BRT bus (e.g. Rea Vaya, A Re Yeng)	18 732	0.5
Bus	248 419	7.1
Bus (other)	722 319	20.7
Car, as the driver	124 031	3.6
Car, as the passenger	917 592	26.3
Commuter taxi/minibus taxi	789 401	22.7
Company transport	0	0.0
e-hailing service (e.g. Uber, Bolt)	32 569	0.9
Gautrain	6 489	0.2
Gautrain bus	19 231	0.6
Lift club as a driver	0	0.0
Lift club as a passenger	67 392	1.9
Metered taxi	6 351	0.2
Motorcycle	29 689	0.9
Other	5 476	0.2
School bus	18 032	0.5
Train	0	0.0
Walk all the way	413 624	11.9
Total	**3 483 827**	**100**

Table 43 shows the different modes selected as potential travel modes for shopping in the future. About 41% of shopping trips is preferred to be by car as the driver followed by bus at 26%. Gautrain bus, lift club as a driver, and train are likely to carry low shopping trips in future.

Table 43: Modes for future shopping trips

Future Mode for Shopping Trips	Estimated number of trips	Percentage (%)
Bicycle	22 132	0.3
BRT bus (e.g. Rea Vaya, A Re Yeng)	9 512	0.1
Bus	2 140 662	26.3
Bus (other)	13 111	0.2
Car, as the driver	3 333 134	40.9
Car, as the passenger	848 063	10.4

Future Mode for Shopping Trips	Estimated number of trips	Percentage (%)
Commuter taxi/minibus taxi	472 661	5.8
Company transport	5 255	0.1
e-hailing service (e.g. Uber, Bolt)	185 857	2.3
Gautrain	3 353	0.0
Gautrain bus	1 370	0.0
Lift club as a driver	1 714	0.0
Lift club as a passenger	13 179	0.2
Metered taxi	55 846	0.7
Motorcycle	16 149	0.2
Other	9 587	0.1
School bus	2 290	0.0
Train	1 842	0.0
Walk all the way	1 004 562	12.3
Total	**8 140 279**	**100.0**

Table 44 shows the different modes selected as potential travel modes for medical purposes in the future. About 31% of the trips for medical purposes will be by walking all the way followed by car as the driver at 24%. The Gautrain, train, and BRT bus are likely to carry low medical purpose trips in future.

Table 44: Modes for future medical trips

Future Mode for Medical Trips	Estimated number of trips	Percentage (%)
Bicycle	18 643	0.2
BRT bus (e.g. Rea Vaya, A Re Yeng)	2 290	0.0
Bus	1 359 237	12.4
Bus (other)	15 657	0.1
Car, as the driver	2 580 332	23.6
Car, as the passenger	1 631 460	14.9
Commuter taxi/minibus taxi	1 734 315	15.9
Company transport	13 130	0.1
e-hailing service (e.g. Uber, Bolt)	77 977	0.7
Gautrain	0	0.0
Gautrain bus	22 236	0.2
Lift club as a driver	10 219	0.1
Lift club as a passenger	32 832	0.3
Metered taxi	42 183	0.4
Motorcycle	33 789	0.3

Future Mode for Medical Trips	Estimated number of trips	Percentage (%)
Not applicable	8 898	0.1
Other	5 990	0.1
School bus	4 004	0.0
Train	1 714	0.0
Walk all the way	3 343 336	30.6
Total	**10 938 240**	**100**

12. ANSWERING KEY RESEARCH QUESTIONS

12.1 Introduction

In this chapter, the travel patterns for work, education and shopping are compared over the three periods (i.e. before COVID-19, during COVID-19 and into the future post- COVID-19) by employing statistical analyses.

12.2 Testing hypotheses about potential shifts in travel patterns

The previous chapters have shown that there were some changes in travel patterns of Gauteng residents due to COVID-19 related restrictions on movement. The key question is whether the observed shifts are statistically significant and, accordingly, some relevant tests were performed to determine whether these shifts are statistically consistent.

The generic hypothesis under consideration in this section is as follows:

NULL hypothesis: $\mathbf{H_o}$ = As a result of the COVID-19 pandemic, there have been changes in work, education, and shopping methods, resulting in altered travel patterns.

Alternative hypothesis: $\mathbf{H_a}$ = No significant changes were brought about by COVID-19 in terms of work arrangements, education, or shopping habits. Therefore, previous travel patterns will remain going forward.

The level of significance**, alpha (α)**=0.05 or 5%. The probability of rejecting the NULL hypothesis when it is true is represented by the value of alpha.

A Chi-square test was used to evaluate the relevant hypotheses and its measures to examine the degree of association or dissimilarity between the activities undertaken in the different

time periods. The relevant measures used specifically included Phi (φ), Cramer's V (ϕ_c) and Lambda (λ).

Phi is similar to a correlation coefficient and its values range between –1 and 1, where –1 indicates a perfect negative association between variables, while zero signifies no relationship and 1 shows a perfect positive association. Phi is appropriate for use when not more than two variable categories are compared. In cases where there are more than two categories, Cramer's V becomes relevant and for two categorical variables, Phi and Cramer's V produce similar results.

Cramer's V values range between 0 and 1, where 0 corresponds to no association whereas 1 shows perfect association between variables. Since the values range between 0 and 1, they can be viewed as a percentage of the maximum possible variation between two variables that are compared.

Lambda investigates the relationship between variables by evaluating the predictive capacity of each variable on the basis of the other. It computes the amount of error that would be reduced by conducting such a prediction. Lambda ranges between 0 and 1 and reflects a percentage reduction in error when predicting one variable from another.

12.3 Work

12.3.1 Observed Work Travel Patterns

Table 45 provides a summary of work-related travel in the three periods. Considering the people who commuted to work **prior to the COVID-19 pandemic**, 64% of them indicated that they continued to commute to work during COVID-19, while 98% of those who worked from home prior to COVID-19 indicated that they continued to work from home during COVID-19. Meanwhile, only 36% of those who commuted to work prior to COVID-19 began working from home during COVID-19, and only 2% of those who worked from home prior to COVID-19 began commuting to work during COVID-19. These results generally show that most people continued to work in the same manner during COVID-19. However, a considerable shift (about 36%) to working from home can have an impact on work-related trips.

In terms of work-related travel patterns **during COVID-19 alert restrictions compared to future travel**, 91% of those who travelled to work during this period indicated that they would continue to travel to their places of employment in the future, while 70% of those who

worked from home during COVID-19 indicated that they would continue to work from home in the future. Therefore, most people are expected to continue with their current working method in the future. Further, a smaller proportion of people (30%) are expected to shift from "working from home" to "travelling to a place of work" in the future.

About 78% of individuals who commuted to work **before COVID-19** indicated that they would continue to commute, **post-pandemic**, while 87% of those who worked from home prior to COVID-19 indicated that they would continue to work from home in the future.

These results suggest that majority of people will continue to work in the same way in the future and only a relatively small percentage of people are likely to shift to a different method of work between these two periods.

Table 45: Work-related travel in the three periods

Before COVID-19	During COVID-19	Estimated number of people	Percent (%)	Row percent (%)	Column percent (%)
Travelled to a place of work	Travelled to a place of work	2 226 175	46	**64**	99
Travelled to a place of work	Worked from home	1 258 689	26	36	49
Worked from home	Travelled to a place of work	30 267	1	2	1
Worked from home	Worked from home	1 330 146	27	**98**	51
Total		**4 845 277**	**100**		
During COVID-19	**Future**	**Estimated number of people**	**Percent (%)**	**Row percent (%)**	**Column percent (%)**
Travelled to a place of work	Travelled to a place of work	2 007 486	43	**91**	73
Travelled to a place of work	Worked from home	194 668	4	9	10
Worked from home	Travelled to a place of work	749 842	16	30	27
Worked from home	Worked from home	1 755 757	37	**70**	90

Total		4 707 753	100		
Before COVID-19	**Future**	**Estimated number of people**	**Percent (%)**	**Row percent (%)**	**Column percent (%)**
Travelled to a place of work	Travelled to a place of work	2 572 499	56	**78**	94
Travelled to a place of work	Worked from home	720 549	16	22	38
Worked from home	Travelled to a place of work	171 353	4	13	6
Worked from home	Worked from home	1 169 151	25	**87**	62
Total		**4 633 552**	**100**		

12.3.2 Test of Association between Methods of Working in Different Periods

To understand whether the observed shifts in travel patterns for work are statistically significant, the following NULL hypotheses were tested:

- Work methods before and during the COVID-19 pandemic are independent or not associated.
- Work methods during the COVID-19 pandemic and in future are independent or not associated.
- Work methods before COVID-19 and in future are independent or not associated.

Table 46 shows the results obtained when these hypotheses were tested.

Table 46: Test of association for work travel

Work method/ arrangement	Chi-Square value	P-value	Phi Coefficient (ϕ)	*Lambda* (λ)
Before vs During COVID-19	1 494 869	<.0001	0.56	0.29
During COVID-19 vs Future	1 811 060	<.0001	0.62	0.55
Before COVID-19 vs Future	1 683 977	<.0001	0.60	0.45

The findings show a stronger positive relationship between work methods used during the pandemic and those that would be used after COVID-19 than the methods used between other time periods. Lambda suggests that using the pre-COVID-19 work travel methods to

predict the observed work travel methods used during the pandemic (and vice versa) would result in a 55% reduction in error, as shown in Table 46.

Before Vs During COVID-19

The NULL hypothesis tested was that *"work methods prior to and during COVID-19 pandemic are independent or not associated*". The null hypothesis is rejected at 5% (or 0.05) level of significance because the p-value (<.0001) in Table 46 is less than 5%, and we conclude that the work methods used between the two periods are associated. As a result, the number of people who switched from one work method before the pandemic to another during COVID-19 is insignificant. This implies that work-related trips prior to COVID-19 would be no different from the trips generated for work purposes during COVID-19.

During COVID-19 Vs Future

The NULL hypothesis tested was that *"work methods during the COVID-19 pandemic and in future are independent or not associated*". The findings show that the work arrangements in place during the COVID-19 restrictions are not statistically different from the work methods expected in the future. Therefore, the observed future shift in the number of people from one work method to another during COVID-19 is insignificant. Furthermore, the trips generated by work-related travel during COVID-19 would not be significantly different from future work trips.

Before COVID-19 Vs Future

The NULL hypothesis was that *"the methods of work before COVID-19 and in future are independent or not associated"*. The study results show that the number of people switching from one work method used prior to COVID-19 to another in the future is insignificant; suggesting that work-related trips prior to COVID-19 would not be significantly different from future work trips.

12.3.3 Test of Association between Methods of Working Based on Income Level

To understand whether the observed shifts in travel patterns for work were statistically significant for different income levels, the following NULL hypotheses were tested:

- Work methods before and during COVID-19 pandemic are independent or not associated for persons in low, medium, and high income households.

- Work methods During COVID-19 pandemic and in future are independent or not associated for persons in low, medium, and high income households.
- Work methods before COVID-19 and in future are independent or not associated for persons in low, medium, and high income households.

Table 47, Table 48 and Table 49 show the results obtained when these hypotheses were tested for persons from low income, medium income, and high income households respectively. The income levels are defined as follows:

- Low income: Households falling in R4 500 per month and below income category – typically from poverty line and below.
- Medium income: Households earning between R4 501 and R11 000 per month.
- High income: Households earning R11 000+, corresponding to households with at least one vehicle on average.

Table 47: Test of association for work travel (Low Income)

Work method/ arrangement	Chi-Square value	P-value	Phi Coefficient (φ)	Lambda (λ)
Before vs During COVID-19	215 269	<.0001	0.73	0.61
During COVID-19 vs Future	83 614	<.0001	0.48	0.38
Before COVID-19 vs Future	166 299	<.0001	0.67	0.57

The findings in Table 47 indicate that people living in low-income household are not expected to experience any significant changes in their work travel patterns. The low income group, however, believed that travelling to work during COVID-19 and in the future may not be similar, as seen in the drop in the level of association between the work travel methods used during the pandemic and those of the future.

Table 48: Test of association for work travel (Medium Income)

Work method/ arrangement	Chi-Square value	P-value	Phi Coefficient (φ)	Lambda (λ)
Before vs During COVID-19	209 969	<.0001	0.61	0.39
During COVID-19 vs Future	255 525	<.0001	0.69	0.58
Before COVID-19 vs Future	242 492	<.0001	0.67	0.50

The findings in Table 48 indicate that people living in medium-income households are not expected to experience any significant changes in their work travel patterns. The level of association remains stable across the time periods similar to the results obtained from a wider Gauteng Province perspective (Table 46). Work travel patterns across the three time periods remain similar in the medium income households.

Table 49: Test of association for work travel (High Income)

Work method/ arrangement	Chi-Square value	P-value	Phi Coefficient (φ)	Lambda (λ)
Before vs During COVID-19	667 957	<.0001	0.55	0.25
During COVID-19 vs Future	1 021 178	<.0001	0.68	0.62
Before COVID-19 vs Future	867 068	<.0001	0.64	0.53

Table 49 shows that work travel patterns stay the same as before for the high income households. The high income group believed that their travel patterns during COVID-19 could be more representative of their future work travel.

12.4 Education

12.4.1 Observed Education Travel Patterns

Table 50 provides a summary of education-related travel in the three periods. About 70% of school learners or students who engaged in contact classes **before COVID-19** indicated that they continued with physical classes **during the COVID-19** pandemic, while 60% of those who used the hybrid method before COVID-19 used the hybrid schooling method during COVID-19. Ninety-five percent of those who used online classes prior to COVID-19 used online classes during COVID-19. During COVID-19, a smaller percentage of learners switched from contact classes to hybrid schooling (14%) or contact classes to online classes (16%).

In terms of education-related travel patterns **during COVID-19 compared to future travel**, 96% of those who engaged in contact classes during this period indicated that they would continue with contact classes in the future, while 60% of those who used hybrid schooling during COVID-19 indicated that they would continue to use hybrid schooling in the future. Forty-five percent of those who used online classes during COVID-19 will continue using online classes in the future, while 31% of those who used online classes during COVID-19 will

shift to contact classes in the future. Therefore, most people are expected to continue with their current schooling method in the future.

Considering learners who had physical contact classes **before COVID-19**, 83% of them indicated that they will be likely to continue with physical classes **in future**, whereas 63% of those who used the hybrid methods of learning before COVID-19 will likely proceed with hybrid schooling in future. About 75% of those who used online classes before COVID-19 will still use online classes in future.

The results indicate that, generally, most learners or students will mostly continue with the method of schooling they used before the pandemic and only a relatively smaller percentage are likely to shift to a different method of schooling.

Table 50: Education-related travel in the three periods

Before COVID-19	During COVID-19	Estimated number of people	Percent	Row percent	Column percent
Physical contact classes	Physical contact classes	1 788 815	61%	**70%**	99%
Physical contact classes	Hybrid schooling	355 164	12%	14%	84%
Physical contact classes	Online classes	397 062	14%	16%	56%
Hybrid schooling	Physical contact classes	4 737	0%	5%	0%
Hybrid schooling	Hybrid schooling	62 254	2%	**60%**	15%
Hybrid schooling	Online classes	37 145	1%	36%	5%
Online classes	Physical contact classes	8 468	0%	3%	0%
Online classes	Hybrid schooling	5 480	0%	2%	1%
Online classes	Online classes	278 891	9%	**95%**	39%
Total		**2 938 016**	**100%**		
During COVID-19	**Future**	**Estimated number of people**	**Percent**	**Row percent**	**Column percent**
Physical contact classes	Physical contact classes	1 830 344	60%	**96%**	83%
Physical contact classes	Hybrid schooling	65 124	2%	3%	13%
Physical contact classes	Online classes	5 363	0%	0%	2%
Hybrid schooling	Physical contact classes	165 654	5%	39%	7%
Hybrid schooling	Hybrid schooling	254 710	8%	**60%**	52%
Hybrid schooling	Online classes	3 774	0%	1%	1%
Online classes	Physical contact classes	217 606	7%	31%	10%
Online classes	Hybrid schooling	170 446	6%	24%	35%
Online classes	Online classes	322 813	11%	**45%**	97%
Total		**3 035 834**	**100%**		
Before COVID-19	**Future**	**Estimated number of people**	**Percent**	**Row percent**	**Column percent**

Physical contact classes	Physical contact classes	2 312 874	73%	**83%**	99%
Physical contact classes	Hybrid schooling	389 703	12%	14%	76%
Physical contact classes	Online classes	93 357	3%	3%	28%
Hybrid schooling	Physical contact classes	14 992	0%	15%	1%
Hybrid schooling	Hybrid schooling	63 675	2%	**63%**	12%
Hybrid schooling	Online classes	23 155	1%	23%	7%
Online classes	Physical contact classes	13 390	0%	5%	1%
Online classes	Hybrid schooling	58 389	2%	20%	11%
Online classes	Online classes	219 715	7%	**75%**	65%
Total		**3 189 250**	**100%**		

12.4.2 Test of Association between Methods of Education in Different Periods

To understand whether the observed shifts in travel patterns for education are statistically significant, the following NULL hypotheses were tested:

- Methods of schooling used before and during COVID-19 are independent or not associated.
- Methods of schooling used during COVID-19 and those to be used in future are not related.
- Methods of education employed before COVID-19 and those that would be used in future are not associated.

Table 51 shows the results obtained when these hypotheses were tested.

Table 51: Test of association for education travel

Education method	Chi-Square value	P-value	Cramer's V	*Lambda (λ)*
Before COVID-19 vs During COVID-19	1 124 534	<.0001	0.44	0.21
During COVID-19 vs Future	2 116 514	<.0001	0.59	0.36
Before COVID-19 vs Future	1 730 785	<.0001	0.52	0.31

The measures of association in Table 51 show that the level of association between the methods of schooling used during the pandemic and those that are likely to be used in the future is stronger than the level of association between other periods.

Before Vs During COVID-19

The NULL hypothesis tested was that *"methods of schooling used before and during COVID-19 are independent or not associated".* The null hypothesis is rejected at 5% significant level

because the p-value (<.0001) in Table 51 is less than 5% and we conclude that the methods of schooling used in the two periods are associated. Consequently, the observed shift in the number of learners moving from one learning method to another, during COVID-19, for instance, is insignificant. Therefore, school trips generated before COVID-19 would not be significantly different from the school-related trips generated during COVID-19.

During COVID-19 Vs Future

The NULL hypothesis tested was that *"the methods of schooling used during COVID-19 and those to be used in future are not related".* From the results, this hypothesis is rejected, and we conclude that there is an association between the methods of schooling used between the two relevant periods. Therefore, the shift in the number of people moving from one method of learning during COVID-19 to another in future is insignificant. The education trips generated during COVID-19 would not be significantly different going forward.

Before COVID-19 Vs Future

The NULL hypothesis was that *"education methods employed before COVID-19 and those that would be used in future are not associated".* Based on the results, a similar conclusion is derived that the methods of schooling used before the pandemic are not different from the future methods and that the shift in the number of people moving from one method of schooling before COVID-19 to another in future is insignificant. Hence, the education trips yielded before COVID-19 would largely be similar going into the future.

12.5 Shopping

12.5.1 Observed Shopping Travel Patterns

Table 52 provides a summary of shopping-related travel in the three periods. Considering people who did physical shopping **before COVID-19**; 79% of them indicated that they continued to do shopping in a similar manner **during COVID-19**, while 91% of those who used online method of shopping before COVID-19, continued with online shopping during COVID-19 and 76% of those who used hybrid shopping methods before COVID-19 still used hybrid shopping method during COVID-19. Generally, most people continued with their method of shopping in the two relevant time periods. A small percentage of people shifted from shopping physically before COVID-19 to hybrid (12%) or online shopping during COVID-19 (9%).

Looking at people who went to a physical shop for their shopping requirements **during COVID-19**, approximately 90% of them indicated that they would continue to do physical shopping **in future**, whereas only 33% of those who used the online method during COVID-19 will continue to use the online method in the future. About 93% of those who used hybrid shopping during COVID-19 said that they would likely continue to use both online and physical shopping methods in the future. The majority of people continued to shop in the same way. A smaller percentage of people switched from physical shopping to hybrid in the future (9%), but a large percentage of those who used online shopping during COVID-19 would then switch to some other shopping method in the future, particularly hybrid shopping.

When examining those who did physical shopping **prior to COVID-19**, 76% indicated that they will continue to do so in the **future**, while 54% of those who used online shopping before COVID-19 will continue to use online shopping in the future. Eighty-nine percent of those who used hybrid shopping before COVID-19 will continue to use hybrid shopping in the future.

Table 52: Shopping-related travel in the three periods

Before COVID-19	During COVID-19	Estimated number of people	Percent (%)	Row percent (%)	Column percent (%)
Physical shopping	Physical shopping	5 135 258	61	**79**	98
Physical shopping	Online/internet shopping	561 609	7	9	44
Physical shopping	Both online and physical shopping	768 727	9	12	40
Online/internet shopping	Physical shopping	30 482	0	7	1
Online/internet shopping	Online/internet shopping	413 735	5	**91**	33
Online/internet shopping	Both online and physical shopping	9 669	0	2	1
Both online and physical shopping	Physical shopping	68 780	1	5	1
Both online and physical shopping	Online/internet shopping	288 457	3	19	23
Both online and physical shopping	Both online and physical shopping	1 152 796	14	**76**	60
	Total	8 429 513	100		
During COVID-19	**Future**	**Estimated number of people**	**Percent (%)**	**Row percent (%)**	**Column percent (%)**
Physical shopping	Physical shopping	4 640 156	55	**90**	94

Physical shopping	Online/internet shopping	60 666	1	1	12
Physical shopping	Both online and physical shopping	467 838	6	9	16
Online/internet shopping	Physical shopping	167 649	2	13	3
Online/internet shopping	Online/internet shopping	423 088	5	**33**	83
Online/internet shopping	Both online and physical shopping	676 906	8	53	23
Both online and physical shopping	Physical shopping	115 326	1	6	2
Both online and physical shopping	Online/internet shopping	26 762	0	1	5
Both online and physical shopping	Both online and physical shopping	1 789 193	21	**93**	61
	Total	**4 129 792**	**100**		

Before COVID-19	**Future**	**Estimated number of people**	**Percent (%)**	**Row percent (%)**	**Column percent (%)**
Physical shopping	Physical shopping	4 961 593	58	**76**	98
Physical shopping	Online/internet shopping	145 720	2	2	29
Physical shopping	Both online and physical shopping	1 429 393	17	22	49
Online/internet shopping	Physical shopping	29 267	0	6	1
Online/internet shopping	Online/internet shopping	245 126	3	**54**	49
Online/internet shopping	Both online and physical shopping	179 827	2	40	6
Both online and physical shopping	Physical shopping	57 506	1	4	1
Both online and physical shopping	Online/internet shopping	109 062	1	7	22
Both online and physical shopping	Both online and physical shopping	1 337 397	16	**89**	45
	Total	**4 181 080**	**100**		

12.5.2 Test of Association between Methods of Shopping in Different Periods

To understand whether the observed shifts in travel patterns for shopping are statistically significant, the following NULL hypotheses were tested:

- Methods of shopping used before and during COVID-19 are independent or not associated.

- Methods of schooling used during COVID-19 are unrelated to those that will be used in the future.
- Methods of shopping which were used before COVID-19 and those that are likely to be used in future are independent.

Table 53 shows the results obtained when these hypotheses were tested.

Table 53: Test of association for shopping travel

Method of shopping	Chi-Square value	P-value	Cramer's V	*Lambda (λ)*
Shopping Before COVID-19 vs Shopping during COVID	5 596 646	<.0001	0.58	0.36
Shopping during COVID-19 vs Future shopping	6 973 257	<.0001	0.65	0.58
Shopping Before COVID-19 vs Future shopping	4 821 551	<.0001	0.53	0.30

Before Vs During COVID-19

The NULL hypothesis tested was that "*methods of shopping used before and during COVID-19 are independent or not associated*". The null hypothesis is rejected at 5% significant level because the p-value (<.0001) in Table 53 is less than 5% and we conclude that they are associated. Therefore, the shift in the number of people doing shopping using a certain shopping method before COVID-19 to another shopping method during COVID-19 is insignificant. This implies that the shopping generated trips before COVID-19 would not be significantly different from the shopping-related trips generated during COVID-19.

During COVID-19 Vs Future

The NULL hypothesis tested was that "*The shopping methods used during COVID-19 are unrelated to those that will be used in the future*". The shift from one shopping method during COVID-19 to another in future is insignificant. This suggests that the trips generated for shopping purpose during COVID-19 would not be significantly different from the future shopping trips.

Before COVID-19 Vs Future

The NULL hypothesis was that "*methods of shopping which were used before COVID-19 and those that are likely to be used in future are independent*". The change from one shopping method used before COVID-19 to another shopping method in future is insignificant. This implies that the trips generated through shopping before COVID-19 would not be significantly different from the future shopping trips.

12.6 Perceptions about Future Methods for Work, Educational and Shopping

In this section, hypotheses pertaining to the respondents' perceptions about the likely change to working arrangements, methods of schooling and shopping were tested. Table 54 shows how the scoring of the perceptions is set-up, with the larger scores leaning towards the likely scenarios while the lower scores (from 3 downwards) indicating the unlikely scenarios.

Table 54: Scoring of people perceptions on the Likert scale

Perception	Very Unlikely	Unlikely	Unsure	Likely	Very likely
Score or rating	1	2	3	4	5

- H_o: The mean (average) score=3, The working population will be unlikely to return to full-time employment following the COVID-19 pandemic, traditional education methods are unlikely to continue post COVID-19 pandemic and physical shopping is unlikely to continue after the pandemic.

- H_a: The mean score >3, The workforce will most likely return to full-time employment after COVID-19, traditional education methods are most likely to continue post COVID-19 pandemic and physical shopping is most likely to continue after the COVID-19 pandemic.

Table 55 shows the results on perceptions about future methods of work, education, and shopping.

Table 55: Perceptions about future methods of work, education, and shopping

Method of activity	**DF (n-1)**	**t Value**	**P-value (2-tailed)**	**P-value (1-tailed)**	**Mean**	**95% LCL Mean**	**95% UCL Mean**
Working full-time	2 477	19.52	<.0001	<.0002	3.58	3.52	3.63

Working from home	2 404	8.11	<.0001	<.0002	3.26	3.20	3.32
Contact education	2 137	60.88	<.0001	<.0002	4.39	4.35	4.44
Physical shopping	4 881	99.19	<.0001	<.0002	4.38	4.35	4.41

Work

With respect to methods of work shown in Table 55, the NULL hypothesis that was tested was "*The working population will be unlikely to return to full-time employment following the COVID-19 pandemic*". The null hypothesis is rejected at 5% (or 0.05) level of significance because the p-value (<.0001) in Table 55 is less than 5%. We conclude that the average score (mean score) is statistically significant from 3 and is in fact larger than 3. Therefore, the working population in Gauteng province is most likely to return to full-time work. Similarly, a significant number of individuals indicated that they would be likely to continue working from home in the future. The 95% confidence limits do not stretch across the other scenarios (below the mean score of 3), thereby confirming that the results are significant.

Education

With respect to the future methods of education, the NULL hypothesis that was tested was "*Traditional education methods (contact classes) are unlikely to continue post COVID-19 pandemic*". Since the results in Table 55 show lower p-values (1-tailled) of about 0.0002 and they are less than 5%, we reject the NULL hypothesis and conclude that education is likely to be delivered using contact learning methods in the future.

Shopping

For shopping, the NULL hypothesis that was tested was "*Physical shopping is unlikely to continue after the pandemic*". The results indicate that physical shopping is likely to continue into the future.

13. CONCLUSIONS

This report has provided the findings of a supplementary household travel survey undertaken to understand the impact of COVID-19 on household travel choices and patterns in Gauteng province. Information on trends in traffic, household and population characteristics, travel characteristics before and during COVID-19, future travel perspectives, and answers to key research questions are included in the report.

Although the survey was conducted when the COVID-19 restrictions had been relaxed (adjusted level 1) and "normal" travel for most economic activities had resumed, the survey was designed to obtain respondents' travel patterns before COVID-19, during COVID-19 and into the future.

The following findings are noteworthy:

1. COVID-19 restrictions played a role in traffic reduction at the start of the pandemic. However, as the lockdown restrictions were eased the traffic on the road network gradually got close to pre-COVID-19 volumes.
2. Private car remained a dominant mode of travel for all purposes both before and during COVID-19. The low usage of the higher capacity modes (i.e. bus and train) as a main mode for work, education, shopping, and other purposes both before and during COVID-19 is concerning.
3. A significant proportion of city residents used walk all the way as the main mode of transport for education, medical and other purpose trips both before and during COVID-19.
4. The results indicate very low trips made using the Gautrain, even before COVID-19. The sample selection may have contributed to this result – as such the data is inconclusive with respect to travel by the Gautrain.
5. The majority of trips for work, education and medical purposes occurred in the 06:00–09h00 time period before and during COVID-19. The majority of trips for shopping purposes occurred in the 09:01–23:59 period both before and during COVID-19.
6. Shopping and medical trips generally took 5–15 minutes both before and during COVID-19. Educational trips took a slightly longer period (15–30 minutes) while work trips took even longer (30–60 minutes) both before and during COVID-19.

7. With respect to travel perspectives, the majority of people indicated that they are unlikely to change working, education, and shopping arrangements from what they were pre-COVID-19.
8. Indications are that the car will continue to be used as a main mode of transport for all purposes in the future. Other modes that will carry substantial trips for work, education, shopping and medical purposes in future are the bus, commuter taxi and walk all the way.
9. Work-related trips, education-related trips and shopping trips generated before COVID-19 were not significantly different from the trips generated for work, education, and shopping purposes during COVID-19.
10. The trips generated by work-related travel, education-related travel and shopping travel during COVID-19 will not be significantly different from future work, education, and shopping trips.
11. Work, education, and shopping-related trips generated before COVID-19 will not be significantly different from future work, education, and shopping trips.
12. People in the different income groups (low, medium, high) are not expected to experience any significant changes in their work travel patterns.
13. The working population in Gauteng province is most likely to return to full-time work at their usual place of work.
14. Education is likely to be delivered using contact learning methods in the future.
15. Physical shopping is likely to continue into the future.

Although the COVID-19 pandemic impacted the travel patterns of Gauteng residents, indications are that people will return to travel patterns that they used before COVID-19 for work, education, shopping, and medical purposes. This is supported by the trends in traffic volume on selected freeways in Gauteng and fuel sales in the province.

Therefore, planning authorities in the province should continue with the implementation of the road network, public transport, and integrated transport plans that they had before COVID-19.

14. RECOMMENDATIONS

Several challenges were encountered during the survey execution, as documented in section 7.12, which impacted on the quality of responses. In particular, a refusal to participate in the

survey; lack of access to gated communities, flats, and complexes; and respondents withdrawing from the survey during the course of the interview citing that the questionnaire was too long and had many repetitive questions.

A project of this nature requires an intensive awareness as it involves a large number of respondents from different backgrounds. It is recommended that in future creating awareness and engaging gated communities should be made a priority to avoid loss of time once the surveys commence. Ward Councillors should be engaged early in the project with a clear mandate on what kind of assistance is expected from them.

The use of mobile technology improved the quality, versatility, and quantity of responses. It is recommended that in future, the questionnaire should be shortened by, for example, building in skip logic and eliminating repetitive questions. An online version of the questionnaire should be created for residents who would otherwise not participate in the in-person interviews.

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16. LIST OF APPENDICES

16.1 Appendix A: Survey Questionnaire