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ASSESSMENT OF BTEX CONCENTRATIONS ON-BOARD IN-SERVICE PUBLIC BUSES IN JOHANNESBURG SOUTH AFRICA

School of Geography, Archaeology and Environmental Studies

University of Witwatersrand

Author: Yusuf Mansoor (445342)

Supervisors: Dr Mary Evans, Dr Raeesa Moolla and Prof. Fethi Ahmed



UNIVERSITY OF THE
WITWATERSRAND,
JOHANNESBURG

A Dissertation submitted to the Faculty of Science for the degree of Masters of Science

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Declaration

I declare that this Dissertation is my own, unaided work. It is being submitted for the Degree of Master of Science at the University of Witwatersrand, Johannesburg. It has not been submitted before for any degree or examination at any other University.

_____

Yusuf Mansoor

445342

Signed on this_____ day of _____20___in_____

ABSTRACT

Exposures to BTEX compounds in indoor environments are of great concern as these compounds have been shown to negatively influence human health. For urban dwellers, a major part of the day is spent indoors within microenvironments such as offices, schools, homes and while commuting on-board vehicles. Of the different types of microenvironments, vehicle cabins have been shown to have the highest BTEX concentrations due to the vehicle being a source of emissions itself and due to its close proximity to other sources of emissions. This study specifically considers BTEX concentrations on-board public buses as these vehicles transport large numbers of people over various distances and that commuters frequently spend a considerable amounts of time commuting on-board these vehicles daily. The aim of this study was to determine the BTEX concentrations on-board in-service public buses travelling along major routes through Johannesburg during the off-peak and peak times and to determine the factors which might affect these concentrations. The factors which were specifically taken into consideration were on-board temperature and humidity, ventilation mode, passenger number and the characteristics of the travelled routes. Two sampling campaigns were conducted; one during the off-peak and another during the peak commute times. For each campaign, buses travelling along three different routes, representing major commuter routes, were sampled. A total of 21 and 42 samples were collected on-board the buses for the off-peak and peak campaign, respectively. An active sampling approach was taken using personal air sampling pumps attached to coconut charcoal sorbent tubes. iButtons were used to collect on-board temperature and humidity and a GPS was used to collect the route data. The charcoal tubes were prepared using solvent extraction and subsequently analysed using gas chromatography (time – of – flight) mass spectrometry. In addition, field

blanks, lab and solvent blank samples were analysed as quality assurance measures during both campaigns.

The mean BTEX concentrations measured during the off-peak and peak campaigns were Benzene - 24.39 μ/m^3, Toluene - 85.88 μ/m^3, Ethylbenzene - 4.80 μ/m^3 and Xylene - 5.70 μ/m^3 and Benzene- 28.19 μ/m^3, Toluene - 9.85 μ/m^3, Ethylbenzene - 2.94 μ/m^3 and Xylene - 7.5 μ/m^3, respectively. A significant difference ($p > 0.05$) was noted between the off-peak and peak toluene concentrations, while no significant differences were observed amongst the other BEX compounds between campaigns. The analysis of the BTEX concentrations along travelled routes returned a result indicating no significant differences ($p < 0.05$) between sampled routes for both campaigns; except for the ethylbenzene measured during the off-peak campaign which showed a significant difference ($p < 0.05$) between Routes A and C. With regards to the effects of ventilation mode, passenger number and on-board temperature and humidity, no discernible effects on BTEX concentrations could be observed from the data. Furthermore, the lab and field blank samples measured varied levels of BTEX concentration, which would suggest sample contamination, which introduced a level of uncertainty in deriving actual BTEX concentrations. In general, no definitive conclusions could be drawn from this study, regarding the BTEX concentrations on-board the buses during the off-peak and peak times, effects of travelled routes, passenger number and ventilation mode, potential sources of BTEX compounds and their interaction with the on-board temperature and humidity. However, given that a study of this nature has not been published in South Africa; the current study is of value in guiding future researchers as to the potential challenges and barriers that might be faced when conducting such a study. Furthermore, this study has the potential to stimulate interest in the field of in-vehicle emission testing with regards to not

only buses and VOCs but other pollutants such as $NO_{x,}$ PM, and CO amongst a variety of vehicle types and across other microenvironments in general.

KEYWORDS: BTEX, VOC exposure, On-board in-service public buses, Vehicle cabin, Emission testing, Microenvironment air pollution, Solvent extractions, Coconut charcoal sorbent tubes, GC-TOF-MS.

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LIST OF ABBREVIATIONS

AC	Air conditioner
Amu	Atomic mass units
Asl	Above sea level
BTEX	Benzene, Toluene, Ethylbenzene and Xylenes
CNG	Compressed Natural Gas
CO	Carbon Monoxide
CO_2	Carbon Dioxide
CS_2	Carbon Disulphide
DDF	Diesel Dual Fuel
DFNG	Diesel Fuel Natural Gas
ELPI	Electrical Low Pressure Impactor
FID	Flame Ionisation Detector
GC	Gas Chromatography
GWP	Global Warming Potential
HC	Hydrocarbons
IARC	International Agency for Research on Cancer
MHC	Methane Hydrocarbons
MS	Mass Spectrometry
MSD	Mass Selective Detector
NDIR	Non-dispersive Infrared
NDUV	Non-dispersive Ultraviolet
NG	Natural Gas
NIOSH	National Institute for Occupational Safety and Health
NMHC	Non Methane Hydrocarbons
NO_x	Nitrogen Oxides

OH	Hydroxyl
OSHA	Occupational Safety and Health Administration
PAH	Polycyclic Aromatic Hydrocarbons
PM	Particulate Matter
ppb	parts per billion
ppm	parts per million
RH	Relative Humidity
SI	Spark Ignition
TOF	Time of Flight
THC	Total Hydrocarbons
VOCs	Volatile Organic Compounds
VE	Vertical Exaggeration

1. CHAPTER I

INTRODUCTION

1.1. Introduction

Exposure to harmful air pollutants in urban areas is of great concern given their negative impacts on human health and the environment. According to the World Health Organisation's annual estimate of excess deaths from selected environmental factors, 800 000 premature deaths occur globally as a result of exposure to urban air pollution (Cohen *et al.* 2005). These statistics are of concern given that urban areas are the most populated areas on earth and due to the current rapid global trends in urbanisation, especially in developing countries, estimates project that by 2030 more than two-thirds of the world's population will reside in urban areas (Duh *et al.* 2008). Furthermore, air pollutants are also detrimental to the environment in that they contribute to the formation of smog, ground level ozone and acid rain in urban areas (Wang and Hao 2012).

Anthropogenic activities resulting from the combustion of fossil fuels are the main source of air pollutant emissions in urban environments and are characterised as either being point sources, mobile sources or area sources (Duh *et al.* 2008, Wang and Hao 2012). Point sources refer to emissions from large industries or power plants and mobile sources refer to transport related emissions, while area sources refer to smaller pollution sources, for example domestic emissions (Mayer 1999, Duh *et al.* 2008). From amongst all the sources of pollution, transport related emissions have been recognised as the dominant source in urban areas.

The transport sector is amongst the largest consumer of energy and is responsible for approximately one third of the total global CO_2 emissions (Parra *et al.* 2008, Davis *et al.* 2010). Of all the modes of transport which make up this sector, road transport which includes light-duty vehicles, and heavy-duty buses and trucks contribute to nearly two thirds of the total emissions (Davis *et al.* 2010, Holmberg *et al.* 2014). Road transport, specifically heavy-duty trucks and buses are necessary in any society given that they are able to transport goods, services and people that cannot otherwise be transported by lighter forms of transport (Holmberg *et al.* 2014). These vehicles are dependent on diesel fuelled engines which are durable, efficient and cost effective, however, these engines also heavily pollute the environment (Wheatley and Sadhra 2004, Wei and Geng 2016).

1.2. Diesel Emissions

Diesel emissions are made up of a complex mixture of hundreds of different organic and inorganic compounds in solid, liquid and gaseous phases (Sydbom *et al.* 2001, Kagawa 2002). Diesel emissions are a major source of particulate matter (PM) in the environment (Ristovski *et al.* 2012). PM is composed of a carbonaceous core onto which a large variety of other compounds are adsorbed (Sydbom *et al.* 2001, Ristovski *et al.* 2012). These compounds may include metal ash, metal oxides, organic compounds and sulphates (Wheatley and Sadhra 2004, Ristovski *et al.* 2012). In addition, the gas phase components of diesel exhaust consists of carbon dioxide (CO_2), carbon monoxide (CO), nitrogen oxides (NO_x) and a variety of volatile organic compounds (VOCs) (Liaquat *et al.* 2010, Benbrahim-Tallaa *et al.* 2012). Furthermore, compounds such as nitroarenes and polycyclic aromatic hydrocarbons (PAH) can be found across gaseous and particle phases within diesel exhaust (Benbrahim-Tallaa *et al.* 2012). Diesel emissions vary depending on the different additives used by

manufactures, engine operations and maintenance and after treatment systems (Benbrahim-Tallaa *et al.* 2012). Adverse health effects from diesel emission exposure may include, but not limited to eye, throat and lung irritation, phlegm, coughing and neurophysiologic conditions (Pronk *et al.* 2009). Furthermore, diesel exhaust emissions have been classified as being carcinogenic to humans by the International Agency for Research on Cancer (Benbrahim-Tallaa *et al.* 2012).

1.2.1. Alternative Fuels

Currently, heavy duty transportation modes are predominantly dependent on conventional fuels such as diesel to operate (Holmberg *et al.* 2014). However, increasing fuel prices, diminishing oil reserves, greater environmental awareness together with stringent exhaust emission regulations, has led to the utilisation of various alternative gaseous fuels (Khan *et al.* 2015). These alternative fuels are meant to reduce society's dependence on conventional liquid fuels and are recognised as a short to medium term solutions to the reduction of automotive engine pollutant emissions (Carlucci *et al.* 2011, Khan *et al.* 2015, Lim *et al.* 2015). These alternative fuels include hydrogen, synthesis gas, liquefied petroleum gas (LPG), biogas and natural gas (Lapuerta *et al.* 2008, Geng *et al.* 2017).

Natural gas as an alternative or supplementary fuel has been shown to have many benefits as compared to conventional diesel fuels (Besch *et al.* 2015, Khan *et al.* 2015). Natural gas is cheaper and more widely available than conventional fuels (Wei and Geng 2016). In addition, natural gas is primarily made up of methane which has the lowest carbon to hydrogen ratio from amongst all fossil fuels (Wei and Geng 2016). This property of natural gas allows it produce less CO_2 when burned (Wei and Geng 2016). The properties of natural gas are

widely recognised and have been applied in various combustion engines. One such application is the use of natural gas in a compression ignition diesel engine (Geng *et al.* 2017, Hegab *et al.* 2017).

1.2.2. Diesel Dual Fuel (DDF)

For the purpose of this study, DDF will be used to refer to a compression ignition diesel engine which uses both natural gas as compressed natural gas (CNG) and diesel as fuels. A DDF engine works in much the way as a conventional four stroke compression ignition diesel engine in that the intake, compression, combustion and exhaust strokes all occur in the engines combustion chamber (Papagiannakis and Hountalas 2004). In a DDF engine, CNG is introduced into the combustion chamber with the air during the intake stroke (Papagiannakis and Hountalas 2004). This air fuel mixture is compressed during the compression stroke, as in a conventional diesel engine; however auto ignition does not occur due to the natural gas's high ignition temperature (Geng *et al.* 2017). Thereafter, towards the end of the compression stroke, a small amount of diesel is injected into the chamber which auto ignites and creates an ignition source for the surrounding gaseous mixture which propels the combustion stroke (Papagiannakis and Hountalas 2004, Wei and Geng 2016). Natural gas is mainly composed of methane which has a high octane number, and thus suitable for engines with relative high compression ratios (Papagiannakis and Hountalas 2004, Carlucci *et al.* 2011, Lounici *et al.* 2014). Furthermore, the natural gas mixes uniformly with air in the combustion chamber, resulting in increased combustion efficiency, reduced knocking and a reduction in some pollutant emissions (Lounici *et al.* 2014, Wei and Geng 2016). Additionally, conventional diesel engines can easily be converted to a DDF operating system while maintaining engine

efficiency similar to that of diesel run engines (Carlucci *et al.* 2011, Nithyanandan *et al.* 2016).

Complex relationships exist within the combustion chamber and a large number of factors within an engine, all of which influence engine exhaust emission characteristics and on-board in-cabin emissions (Taritaš *et al.* 2017, Xu *et al.* 2018). These factors may include engine load, speed, fuel types, ratios between fuels used, intake temperature, pressure and timing of fuel injections (Wei and Geng 2016, Taritaš *et al.* 2017). As mentioned, engine emission exhaust introduces a myriad of pollutants into the environment of which VOCs are one of them. Of particular relevance to this study, due to their negative impact on human health and the environment, are a group of aromatic VOCs known as BTEX (Benzene, Toluene, Ethylbenzene, Xylenes).

1.3. Benzene, Toluene, Ethylbenzene and Xylene Compounds

BTEX compounds are introduced into the environment by natural and anthropogenic sources (Hazrati *et al.* 2016). Natural sources of BTEX in the environment include emissions from volcanic eruptions, forest fires and occurs naturally in crude oil (Hazrati *et al.* 2016). Anthropogenic sources of BTEX compounds into the environment include emissions from the burning of fossil fuels, vehicles exhaust, cigarette smoke and from the activities of the petrochemical industry (Leusch and Bartkow 2010, Hazrati *et al.* 2016). Furthermore, BTEX compounds are produced and used for the production of a large variety of items including cosmetic products, resins, paints, glues, rubber products, inks, pharmaceuticals and building materials (Leusch and Bartkow 2010, Hazrati *et al.* 2016). Vehicle exhaust emissions have been identified as one of the major contributors of BTEX compounds in urban areas (Morales

Terrés *et al.* 2010) Exposure to BTEX compounds primarily occurs through inhalation (Esteve-Turrillas *et al.* 2007). These compounds, when exposed to for short and long periods of time, may have negative health impacts (Esteve-Turrillas *et al.* 2007, Chen *et al.* 2011).

1.4. Microenvironment Air Monitoring of Pollutant Emissions

The monitoring of air pollutants in microenvironments are of importance given the large amount of time spent within these environments (Kim *et al.* 2001). A microenvironment can be defined as an air space containing a unified pollutant concentration (Steinle *et al.* 2013). It has been estimated that up to 70% of time is spent indoors in modern urban areas (Kim *et al.* 2001). While cities might have fixed monitoring sites to determine ambient pollutant concentrations over large areas, studies have shown ambient pollutant concentration levels to be inconsistent with indoor microenvironment pollutant levels (Steinle *et al.* 2013, Abi-Esber 2014, Do *et al.* 2014). In many cases the microenvironment presents higher concentrations of pollutants than ambient levels (Dor *et al.* 1995, Jo and Park 1999). Exposures to air pollutants in certain microenvironments such as vehicle cabins are not only as a result of outdoor air permeating indoors; but rather these microenvironments are sources of pollution themselves (Shiohara *et al.* 2005). Studies found vehicle cabins to have greater concentrations of air pollutants than other microenvironments such as offices, homes, restaurants, pubs, libraries and department stores (Chan *et al.* 1994, Kim *et al.* 2001, Lan *et al.* 2013).

Of particular concern are the pollutant concentrations on-board public buses, as commuters spend a considerable amount of time daily within these microenvironments. Steinele *et al.* (2013) have reported that in general people spend approximately 1-1.5 hours within a transport microenvironment daily. Furthermore, the on-board bus cabin can accommodate

large numbers of people and therefore the negative effects of the exposure to harmful air pollutants within these microenvironments are more widespread. Additionally, given the dynamic nature of public buses, a number of factors are acting upon it which influences the on-board pollutant concentrations; factors which do not affect other static microenvironments such offices or homes. These factors may include travelled route, changes in surrounding land used, vehicle and fuel use, on-board temperature and humidity, varying ventilation modes and passenger number and close proximity to emission sources, to mention a few (Parra *et al.* 2008). Although ambient pollutant concentrations are measured in many cities around the world, these concentrations are not representative of the on-board in-cabin microenvironment of public transportation modes, which are amongst the most polluted microenvironments (Steinle *et al.* 2013). Furthermore, lab based emission testing is conducted during the developmental stages of vehicles; however, these tests are conducted under controlled conditions which are not representative of real-world driving conditions and on-board in-cabin conditions (Chen *et al.* 2011, Jaikumar *et al.* 2017). These conditions highlight the necessity of conducting on-board emission test especially when trying to determine potential driver and commuter risk exposure to air pollutants and to determine more accurate emission levels for mitigation efforts and policy making (Chen *et al.* 2011, Do *et al.* 2014, Jaikumar *et al.* 2017).

This study was conducted in Johannesburg, South Africa; using public buses provided for by Metrobus Pty. Ltd. Metrobus is a government owned company, which operates within the City of Johannesburg. In July 2015, Metrobus introduced its new fleet of environmentally friendly, energy efficient buses (Rea Vaya 2015). The first consignment consisted of 70 buses, 40 of which were new buses operating under diesel dual fuel (DDF) mode and an additional 30 older diesel-run buses which were converted to operate under DDF mode (Rea

Vaya 2015). The DDF operating bus uses both diesel and natural gas as fuel as compared to conventional diesel operations which utilise only diesel as a fuel. Initially the study intended to use both diesel fuelled buses and DDF buses for the on-board sampling, however, at the time of the study none of the DDF buses were operational. Therefore, only diesel fuelled buses were used in the study.

1.5. Rationale

Commuters spend a considerable amount of time on-board public buses on a daily basis. However, these buses operate on diesel fuels which produce BTEX emissions that infiltrate into the passenger cabin from the outdoors causing exposure to the occupants. In addition, passenger cabins are also affected by the infiltration of BTEX emissions from the surrounding vehicles and environment. Moreover, various factors influence the amounts and concentrations of these emissions within the cabin. Therefore, the extent to which these emissions occur on-board public buses and the factors which affect these concentrations need to be known, given that exposure to BTEX emissions have shown to negatively affect people's health as a result of both short and long-term exposure. Therefore, this study will determine the BTEX concentrations on-board in-service public buses operating in the Johannesburg area, by boarding these vehicles and conducting active BTEX sampling together with collecting information regarding the effects of peak and off-peak commutes, on-board temperature and humidity, passenger number, ventilation mode and route characteristics, to determine the influence of these factors on the measured on-board BTEX concentrations.

On-board emission testing was favoured due to the underestimation of microenvironment pollutant concentrations when compared to ambient pollutant levels or lab based vehicle emission tests. Moreover, in-service public buses were chosen as these vehicle's cabins are most representative of conditions experienced by drivers and commuters in real world traffic situations. Furthermore, public buses represent a uniform fleet consisting of a large number of vehicles. Therefore, by potentially influencing changes at a fleet level by conducting this study, more widespread benefits will result, in comparison to influencing changes at an individual level. Finally, to our knowledge, no published studies have been conducted in South Africa with regards to on-board vehicle BTEX emission tests. Thus, this study aims to fill the knowledge gap within the South African context.

1.6. Aims and Objectives

The aim of this study was to determine the concentration of BTEX compounds on-board in-service public buses given the routes travelled on during the off-peak and peak times, and to determine the factors that may affect these concentrations. The term BTEX (benzene, toluene, ethylbenzene and xylenes) concentrations used in this study refers to the concentration of the target compounds present in the air occupying a vehicle's cabin in general, and bus cabins in specific with reference to the aims and objective of the current study.

These aims are achieved through the following objectives:

1. To characterise bus routes of in-service buses in Johannesburg through mapping and profiling frequently travelled commuter journeys by boarding public buses during the off-peak and peak commute times.
2. To characterise the conditions on-board the buses during the peak and off peak times by noting the ventilation conditions, number of passengers, driving conditions and driving style to establish the effect of these factors on BTEX concentrations.
3. To measure temperature and humidity on-board the buses during the peak and off-peak times, by deploying portable loggers, and comparing these measurements with ambient levels and to determine their influence on BTEX concentrations.
4. To determine the BTEX concentrations on-board in-service buses during peak and off-peak times by conducting active air sampling on-board the buses.
5. To determine the variability of BTEX concentrations on-board buses travelling on different routes during the peak and off-peak commuter times
6. To determine the source of BTEX emissions on-board the sampled buses by analysis of the Toluene/Benzene (T/B) ratios and BTEX interspecies correlations.

1.7. Overview of Methods

For the purpose of this study, BTEX emissions were collected on-board in-service public transit buses operating on diesel fuel. Two sampling campaigns were employed, one during

November and December 2017 (off-peak samples), and the other during April and May 2018 (peak samples). For both campaigns BTEX samples were collected during the week days. Over the entire sampling period, for both campaigns, a total of 68 samples were collected which included five field blank samples. An active sampling campaign was adopted for sample collection which employed the use of personal air sampling pumps (Gil Air 3, Sensidyne, USA) and activated coconut charcoal tubes (ORBO 32, Merck, Germany). Additionally, an iButton (Hygrochron, Maxim, USA) was used to collect the on-board temperature and humidity data while a GPS (eTrax 30, Garmin, USA) was used to track the sampled routes. The sample preparation of the charcoal tubes used solvent extraction with CS_2 and was analysed using gas chromatography (time-of-flight) mass spectrometry (GS-TOF-MS) (Agilent 7098B, LECO, USA) at the University of Witwatersrand. The statistical analysis applied paired sample t-tests, independent sample t-tests, ANOVA tests and Pearson's correlations to the data set using the R software package (Core Team 2013) and Microsoft Excel 2016. The scope of this study was limited to conducting active BTEX sampling on-board twenty different in-service public Metrobuses (Mercedes-Benz 1725) on week days, travelling along six major commuter routes through the Johannesburg CBD and the surrounding areas over an eight week period during the peak and off-peak times. The defined scope of the study was deemed suitable in meeting the specific aims and objectives of the study. Furthermore, due to logistical and financial limitations, the scope of the study could not be broadened beyond this scope.

1.8. Organisation of Dissertation

Chapter 1 presents the introduction to the study. A review of the literature is presented in Chapter 2. Firstly, the relevance of BTEX compounds are discussed with regards to their physical and chemical properties and impacts on human health and the environment. Thereafter, a general summary of lab-based emission tests are presented with regards to different vehicles, engines, fuel types and pollutants. And finally, the literature related to emission tests conducted on-board vehicles are reviewed with regards to various different pollutants and the factors affecting their on-board concentrations.

Chapter 3 presents the methods and materials used in the study. This entails a detailed description of the vehicles used, the routes travelled and the sampling campaign. This section will also detail the procedure for the lab analysis, the equipment used and the analytical and statistical methods employed for analysis and interpretation of results.

Chapter 4 presents the results obtained from the study regarding the route characteristics, lab blank analysis, the BTEX concentrations on-board the peak and off-peak buses together with their associated relationships between on-board temperature and humidity, Toluene/Benzene (T/B) ratios and BTEX interspecies correlations.

Chapter 5 presents the discussion related to the observed results from the study including the effects of the sampled routes, off-peak vs peak commutes, on-board temperature and humidity, ventilation modes, passenger numbers, T/B ratios and BTEX interspecies correlations. The discussion also compares the findings in this study to international studies.

Chapter 6 presents a summary of the key finding from the study. This section includes the limitations of the study and recommendations of how the study can be improved to continue filling the gaps within the existing South African literature with regards to on-board emissions testing.

2. CHAPTER II

LITERATURE REVIEW

2.1. Introduction

This literature review firstly discusses BTEX compounds. Secondly, a summary of emission results from lab-based tests are presented. Finally, the factors influencing emissions on-board vehicles are discussed. BTEX was considered as exposure to these compounds have been linked to a number of negative health related outcomes in humans (Han and Naeher 2006). Furthermore, in an effort to reduce these and other vehicular exhaust emissions, the diesel dual fuel (DDF) system has been looked upon as a promising alternative to conventional fuel systems (Taritaš *et al.* 2017). For this reason the summary of lab-based emission tests are presented with regards to different engine operating modes. However, lab based emission tests have been shown to inaccurately represent real world driving conditions (Jaikumar *et al.* 2017). Furthermore, studies have shown that exposure to BTEX compounds and other pollutants are more pronounced in microenvironments as compared to ambient levels, in addition to vehicle cabins being amongst the most polluted microenvironments (Kim *et al.* 2001, Lan *et al.* 2013). Moreover, other than the intrusion of a vehicle's own engine emissions, a number of other factors influence on-board emission concentrations (Abi-Esber 2014). Thus, the factors influencing on-board emission are discussed.

2.2. BTEX Compounds – Characteristics, Sources and Impacts on Health

BTEX compounds are comprised of benzene, toluene, ethylbenzene and xylenes. These compounds are a group of VOCs known as aromatic hydrocarbons, and they have also been identified amongst the group of non-methane hydrocarbons (NMHC) (Lamb 2017). BTEX compounds occur naturally in the environment and occur as a result of anthropogenic activities (Hazrati *et al.* 2016). These compounds are well known to negatively influence human health as a result of both short-term and long-term exposure (Esteve-Turrillas *et al.* 2007, Chen *et al.* 2011).

2.2.1. Physical and Chemical Characteristics of BTEX

BTEX compounds are clear colourless liquids (at room temperature) with a distinctive sweet aromatic scent (ATSDR 2007a, ATSDR 2007b, WHO 2010, ATSDR 2010, ATSDR 2017). BTEX compounds range in boiling points from 80.1°C for benzene, 110.6°C for toluene, 136.2°C for ethylbenzene to 140.63°C for xylenes (Eller and Cassinelli 1994). Benzene (C_6H_6) has the lowest molecular weight amongst the BTEX species with a weight of 78.11 amu, followed by toluene (C_7H_8) 92.14 amu, and ethylbenzene (C_8H_{10}) and xylenes (C_8H_{10}) with a weight of 106.17 amu (Eller and Cassinelli 1994). Ethylbenzene and xylenes have the same empirical formula; however, they differ in their structures (Figure 2.1). Xylene has three isomers known as meta (m), ortho (o) and para (p) xylene, which are formed due to the positioning of the methyl groups on the benzene ring (Figure 2.1) (Cannella 2007). BTEX are non-polar, water soluble compounds having vapour pressures of 95.2 for benzene, toluene 28.4, ethylbenzene 9.6 and xylenes 8.06 (at 25°C mm Hg) (Eller and Cassinelli 1994, Mitra and Roy 2011, Yang *et al.* 2017). The atmospheric life span of BTEX is 9.4-12.5 days for

benzene, 1.9 days for toluene, 1.6 days for ethylbenzene and ~17.2 hours for xylenes (Monod *et al.* 2001, Tiwari *et al.* 2010). These compounds are degraded by sunlight and interact with OH in the atmosphere in the presence of NOx to produce ground level ozone, photochemical smog and organic aerosols (Hoque *et al.* 2008, Bauri *et al.* 2016).

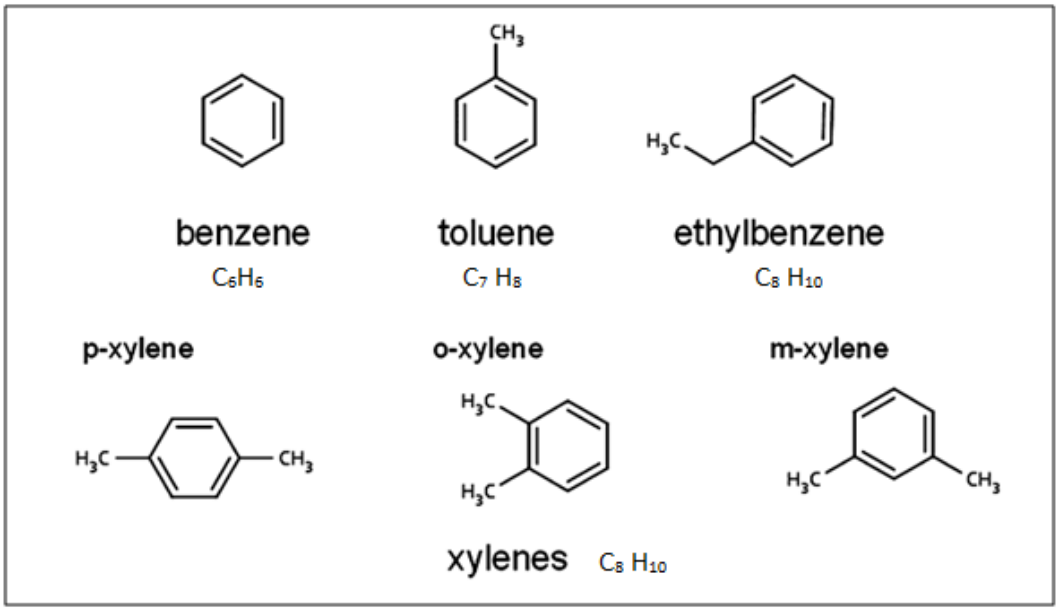

Figure 2. 1.Structure and empirical formula of BTEX compounds (after Bolden *et al.* 2015).

2.2.2. Sources of BTEX Compounds in the Environment

BTEX compounds are introduced into the environment by natural and by anthropogenic sources. Natural sources of BTEX include forest fires, volcanoes, crude oil, petroleum and coal tar (ATSDR 2007a, ATSDR 2007b, ATSDR 2010, ATSDR 2017). Anthropogenic sources of BTEX into the environment includes vehicle exhaust, fuelling stations, industrial processing, solvent usage, decomposition of waste, fuel evaporation and oil refineries (Zalel *et al.* 2008). These compounds have a wide variety of applications and are used in various industries, including petrochemical industry as an additive and solvent in fuels, and its use as a substance in the production of building materials, paints, glues, resins, varnishes, PVC,

interior decorating items, coatings, rubber, consumer products, pesticides, inks and cleaning agents, to mention a few (IARC 2000, ATSDR 2007a, ATSDR 2007b, ATSDR 2010, ATSDR 2017, Lamb 2017). Vehicular exhaust emissions have been identified as the major source of BTEX in urban environment by several researchers around the world (Lee *et al.* 2002, Khoder 2007, Tiwari *et al.* 2010, Miller *et al.* 2011, Hazrati *et al.* 2016). From amongst the BTEX componds, benzene is more closely related to automotive fuel emissions, while TEX, in addition to vehicular emission sources are also related to other industrial sources in urban environments (Singh *et al.* 2016). Sources of indoor BTEX may result from vehicular emissions infiltration into indoor spaces, cigarette smoke, and evaporative emissions from cosmetic products, cleaning agents, consumer products and building materials (ATSDR 2007a, ATSDR 2007b, Rumchev *et al.* 2007, ATSDR 2010, ATSDR 2017).

2.2.3. Health Implications Resulting from Exposure to BTEX

The most common route of exposure to BTEX compounds occurs through inhalation and these exposures have been linked to a number of negative health impacts (Rumchev *et al.* 2007, Bolden *et al.* 2015). Exposure to benzene at both an acute and chronic level might induce negative health effects. Acute exposure to benzene might lead to unconsciousness, dizziness, headaches, confusion and drowsiness (ATSDR 2007a). In addition, acute exposure might also lead to eye and skin irritation (WHO 2010). Chronic exposure to benzene has been linked to the occurrence of leukaemia and it has been classified as a known carcinogen by the US Environmental Protection Agency (Lamb 2017).

Exposure to ethylbenzene may occur in both out-door and indoor environments and has been reported to have various ill effects on the health (Bolden *et al.* 2015, Lamb 2017). Exposure to toluene may result in the occurrence of low birth weights, increased sensitivity to bronchitis, eczema and asthma amongst children, and increase the odds of cardiovascular disease (Bolden *et al.* 2015). Exposure to high concentrations of toluene may result in epileptic seizures, tremors and dementia (Lamb 2017).

Studies have shown that exposure to ethylbenzene has been linked to eye and throat irritation, an increased incidence of hearing impairment, rhinitis amongst adults and children, atopy, and an increased occurrence of wheezing and asthma diagnosis amongst children (Bolden *et al.* 2015, Lamb 2017). The IARC has classified ethylbenzene as being possibly carcinogenic to humans (IARC 2000), whereas, the US EPA's Integrated Risk Information System (IRIS) has classified ethylbenzene as not classifiable as to human carcinogenicity (Lamb 2017).

Inhalation exposure to xylene can be the result of exhaust fumes, cigarette smoke, emissions from industrial processing and as a result of coming into contact with products which contain the compound (ATSDR 2007b, Cannella 2007, Rajan and Malathi 2014). It has been reported that acute exposure to xylene may cause eye, throat and nose irritation, whereas chronic exposure may result in dizziness, reduced concentration and anxiety, together with chest pains and an increased incidence of anaemia amongst exposed groups (Langman 1994, ATSDR 2007b, Rajan and Malathi 2014, Bolden *et al.* 2015). Furthermore, xylene exposure has also been linked to diagnosed asthma amongst adults (Bolden *et al.* 2015).

2.3. Lab-based Emission Tests

During the developmental and testing phases of automobile production, a number of lab based tests are conducted on engines and vehicles to assess and optimise parameters such as performance, fuel economy and emission reduction. Commonly tested exhaust emissions measured during these lab based test include particulate matter (PM), carbon monoxide (CO), nitrogen oxides (NO_x) and hydrocarbons (HC). The following section presents emission results from a number of different emission tests conducted on various engines and fuel types, of which the comparison between diesel and alternative fuel systems such as diesel dual fuel (DDF), and natural gas/compressed natural gas (CNG) operated vehicles and engines, are the focus.

Norton *et al.* (1999) conducted chassis dynamometer lab based exhaust emission tests across multiple test cycles using diesel and DDF operated buses and trucks, to determine the emission characteristics of NO_x, CO and HC, between the two vehicle types. Their results found a reduction in NO_x emissions from the DDF buses and trucks in comparison to the buses and trucks using diesel fuel exclusively. The reduction in NO_x exhaust emissions from DDF and compressed natural gas (CNG) vehicles have been observed by several researchers (Table 2.1) (Clark *et al.* 1999, Turrio-Baldassarri *et al.* 2006, Lounici *et al.* 2014). A DDF vehicle uses both diesel and CNG as fuel, whereas certain vehicles may run on CNG exclusively, and are referred to as CNG vehicles. Clark *et al.* (1999) used a chassis dynamometer to test three diesel buses and the CNG buses. All the buses were from the same manufacturer. Their study also found a reduction in exhaust emissions from CNG buses in comparison to diesel buses (Clark *et al.* 1999). The reduction in NO_x emissions from vehicles

operating on DDF and CNG can be attributed to, amongst other factors, decrease engine ignition temperatures and increased engine speeds (Wei and Geng 2016). Clark *et al.* (1999) also found a link between driving style and emission characteristics. They found that aggressive driving, which can be characterised by sharp acceleration and rapid breaking, resulted in an increase in NO_x from CNG buses (Clark *et al.* 1999, Barkenbus 2010). In addition, Lounici *et al.* (2014) found that increased loads on a DDF engine increased NO_x emissions to a level higher than that of diesel engines.

In addition to the reduction in NOx emissions from DDF and CNG vehicles and engines, reduction in PM have also been observed (Table 2.1). Turrio-Baldassarri *et al.* (2006) conducted a study on a CNG operated engine fitted to an exhaust catalyst using an eddy current dynamometer. A dynamometer is an apparatus used for measuring power, force, torque and emissions, amongst other parameters, of an engine. Their result found a decrease in particulate matter (PM) of up to ~30 times lower using the CNG engine in comparison to a diesel engine used in a previous study (Turrio-Baldassarri *et al.* 2006). The reduction of PM emissions resulting from the use either DDF or CNG vehicles have also been observed by Norton *et al.* (1999), Clark *et al.* (1999) and Fontaras *et al.* (2012), even though different engines types and test parameters and designs were used (Table 2.1). The reduction of PM can be as a result of the replacement of diesel by CNG in the combustion chamber of the engine which causes less PM to be formed or as a result of the effective mixing of CNG with diesel in the chamber which prevents fuel rich regions to form and hence reduce PM formation (Wei and Geng 2016). Even though several researchers found a reduction in PM with DDF, Stettler *et al.* (2016) found that under high engine load, the DDF system produces up to three times more PM than diesel engines measured under the same load. This result and the results observed regarding the NO_x reduction potentials of emissions from DDF and CNG

engines would suggest that they are related to specific test design and conditions which would vary according to the tested parameters.

DDF and CNG engines and vehicles have, in general, demonstrated the potential to reduce NO_x and PM emission; however, these engine systems have also measured increases in emissions such as carbon monoxide (CO) and hydrocarbons in comparison to conventional diesel engines and vehicles (HC) (Table 2.1). Besch *et al.* (2015) conducted a dynamometer test on three DDF engines which differed in the way the natural gas (NG) was introduced into the combustion chamber of the engine and the exhaust after treatment technology. Two engines had a NG fuel injection with no exhaust catalyst, whereas with one engine the NG was drawn into the engine with the air intake phase of the engine cycle and was equipped with an exhaust catalyst. The results found an increase in CO, non-methane hydrocarbons (NMHC) and methane hydrocarbons (MHC) for both, engines with and without exhaust after treatment technologies (Besch *et al.* 2015). Similar increases in CO and HC were observed by several other researchers (Table 2.1) (Papagiannakis and Hountalas 2004, Lounici *et al.* 2014, Wang *et al.* 2016). This increase in CO and HC in DDF mode can be attributed to incomplete combustion of the fuels mixture due to lower combustion chamber temperatures, flame front quenching and in the case of HC leakage from the combustion chamber (Wei and Geng 2016). However, these negative impacts can be alleviated by increasing the amount of NG in the chamber which would make the fuel mixture more rich, resulting in increased combustion efficiency (Wei and Geng 2016). Additionally, Wang *et al.* (2016) in their study found that by precisely adjusting the diesel injection timing in a DDF engine, resulted in a decrease in HC emissions under light engine loads, as these light loads are susceptible to high HC emissions due to low internal temperatures and inefficient combustion (Wang *et al.* 2016, Wei and Geng 2016).

The above mentioned exhaust emission studies were conducted in lab based tests under controlled conditions either using engine bench tests or dynamometers running on standardised test cycles (Papagiannakis and Hountalas 2004, Jaikumar *et al.* 2017). These testing methods are not representative of real world driving condition and under estimate pollutant emissions (Jaikumar *et al.* 2017). For example, one study found that NO_x emissions were two to four times greater in traffic conditions as compared to the test cycle (Chikhi *et al.* 2014). Furthermore, large inconsistencies, as much as 10-50%, were observed between test cycle and traffic emission concentrations with regards to CO_2 emissions (Chikhi *et al.* 2014). Although, lab based emission test have value, this value is diminished when considering real world driving condition and more so when trying to determine human exposure to vehicular emissions on-board vehicles; where, in addition to the vehicles own exhaust being introduced into the passenger cabin, the on-board emissions are also influence by a number of other factors.

Table 2. 1. Summary of emission tests conducted on various engine/vehicle types operating on diesel, CNG and DDF.

Reference	Test Method	Vehicle/Engine Type	Summary of Results
Norton *et al.* 1999	Chassis Dynamometer multiple test cycles	3 Diesel trucks 4 DFNG trucks 2 DFNG buses 1 Diesel bus	Overall results showed reduction in NO_x and PM emissions, and increase in HC and CO emission in the DFNG systems across vehicles
Clark *et al.* 1999	Chassis Dynamometer CBD cycle	3 Diesel buses 3 CNG buses	Decrease in NOx, PM and CO emissions from the CNG buses. Results found links between driving styles and emission levels. Aggressive driving caused increase CO and PM emission form diesel buses, and increase in NO_x from CNG buses.
Papagiannakis and Hountalas 2004	Lab based tests	Single cylinder direct injection DFNG engine	Decreased emissions of NO_x and soot under DF operation. Increased emissions of CO and HC under DF operation compared to diesel operation.
Turrio-Baldassarri *et al.* 2006	Eddy current dynamometer	SI CNG engine equipped with three way catalyst	Results from this study were compared to results found in previous studies using a diesel engine.

			CNG engine showed a marked decrease in NO_x, PM and THC. CNG emissions were ~50, 20 and 30 times lower for PAH, formaldehyde and PM, respectively. CNG in public transport can reduce health impacts associated with harmful pollutant emission exposure.
Fontara *et al.* 2012	Real world city driving and closed track circuit	3 CNG Euro V waste trucks 1 Euro V diesel/biodiesel waste truck	The results confirm what has been found in previous studies regarding reduced NO_x and PM emissions from CNG vehicles, together with increased CO and HC emissions in comparison to diesel vehicles.
Lounici *et al.* 2014	Eddy current dynamometer	Single cylinder diesel dual fuel engine	Results show increased soot emission reduction particularly at high loads. NO_x show reduced emission over low and medium loads; but show increased emissions over high loads. At high loads NO_x emissions from DF are greater than that of diesel operations. THC and CO have greater emissions in DF than diesel modes.
Besch *et al.* 2015	Dynamometer	2 diesel engines fitted with port fuel injection of NG – no after treatment 1 diesel engine fitted with NG kit which inducts NG into air intake pipe –exhaust after treatment.	CO_2 emissions were found to decrease. CO, NMHC and MHC increased emissions in DF as compared to diesel only mode. Increased emissions of methane from all engines were related to global warming potentials. The increase in diesel replacement by methane will cause an increase in the GWPs.
Wang *et al.* 2016	Dynamometer	Turbocharged, intercooled heavy duty DFNG engine	NO_x and THC emission reduction have been linked to diesel injection timing optimisation at light loads in DFNG engine mode.
Stettler *et al.* 2016	Chassis dynamometer European transient cycle	Euro V 4x2 tractor diesel only and DDF with after treatment catalyst Euro V 6x2 tractor diesel only and DDF with after treatment catalyst	Reduced engine efficiency in DDF mode as compared to diesel. Increase in CO_{2e} in DDF Mode. PM emissions were up to 3 times higher in DDF mode compared to diesel mode at high loads.
Vávra *et al.* 2017	Engine bench test	Single cylinder diesel engine fitted with CNG port fuel injector	DF efficiency is slightly lower than diesel mode. Decrease in CO_2 in DF mode. Increase in methane emissions in DF mode compared to diesel mode.

Abbreviations: **CNG** – compressed natural gas, **CO** – carbon monoxide, **CO_2** – carbon dioxide, **DDF** – diesel dual fuel, **DF** – dual fuel, **DFNG** – dual fuel natural gas, **GWP** – global warming potential, **HC** – hydrocarbon, **MHC** – methane hydrocarbon, **NMHC** – non methane hydrocarbon, **NG** – natural gas, **NO_x** – nitrogen oxides, **PAH** – polycyclic aromatic hydrocarbons, **PM** – particulate matter, **SI** – spark ignition, **THC** – total hydrocarbons.

2.4. Factors Affecting On-board In-vehicle Emissions

A large number of factors contribute to the observed emission concentrations on-board vehicles (Batterman *et al.* 2002, El-Fadel and Abi-Esber 2009, Hsu and Huang 2009, Abi-Esber 2014). These factors include weather conditions, spatial factors related to route type and driving conditions, temporal factors related to peak vs off-peak commute times and vehicle characteristics and interior conditions which relates to the age and mileage of the vehicle and the on-board ventilation and temperature, amongst others. Table 2.2 summarises the studies used in this section with regards to the microenvironments used, compounds measured, sampling and analytical methods and study focus.

2.4.1. Weather Conditions Affecting On-board Emissions

Weather conditions which have shown to influence on-board concentration levels of pollutants includes wind speed, ambient temperature and humidity. Seasonality has also been found to influence measured on-board emission concentrations. (Kingham *et al.* 1998, Jo and Park 1999, Jo and Yu 2001, Parra *et al.* 2008, Abi-Esber 2014).

Jo and Park (1999) conducted a study to determine the on-board emissions of VOCs in four cars operating on urban and rural routes through a Korean city during summer and winter. The results found that the benzene and toluene concentrations were significantly higher on-board the cars during summer as compared with the other VOCs tested for which no significant difference was observed between seasons. The authors attributed this observation to the greater volatility of benzene and toluene, in comparison with the other VOCs

measured, which would lead to increased engine-running loss during summer through evaporation (Jo and Park 1999). A similar result was observed by Hajizadeh *et al.* (2018) in their study conducted in an urban area of Iran. Benzene measured the largest concentration in summer and the lowest in winter. Although, the BTEX concentrations measured in the study by Hajizadeh *et al.* (2018) was with regards to ambient urban air; the difference in concentrations between summer and winter will have an impact on in-vehicle concentrations as the outside air infiltrates the cabin through the ventilation and doors.

In contrast to the finding of Jo and Park (1999), Jo and Yu (2001) in their study of BTEX concentrations on-board buses and taxis in Korea found that significantly higher concentrations were observed on-board vehicles during winter for all BTEX compounds. Hoque *et al.* (2008) also observed seasonal variation in BTEX concentrations between summer and winter, in their study of VOCs in urban areas of Delhi, with higher BTEX present in the winter months. This was possibly due to a decrease in combustion efficiency within engines in cold weather (Abi-Esber 2014). In addition, due to cold start conditions, a longer period of time is required for engine catalysts to reach optimal operating temperatures to effectively reduce pollutants (O'Donoghue *et al.* 2007). As a result, during winter more pollutants are present in urban air due to the combined effects of cold start engines from many vehicles. This would influence on-board concentrations of pollutants through the infiltration of outdoor air inside the vehicle cabin (Jo and Yu 2001, Abi-Esber 2014). Furthermore, during winter, stable atmospheric conditions are experienced and atmospheric mixing is reduced in comparison to the summer, which would reduce the dispersion of the given pollutants (O'Donoghue *et al.* 2007, Hoque *et al.* 2008). In addition, due to the increased abundance of the OH radical in the atmosphere during summer, a reduction of

VOCs concentrations could be expected as these compounds are degraded by their interaction with the OH radical (Atkinson and Arey 2003, Hoque *et al.* 2008).

Parra *et al.* (2008) found a significant negative correlation in on-board BTEX and temperature. They found that as temperatures increased the measured concentration of BTEX decreased on the buses (Parra *et al.* 2008). Temperatures increased as a result of increased solar radiation, which was linked to increased photochemical degradation of BTEX compounds and hence lower observed concentrations on-board the vehicles (O'Donoghue *et al.* 2007, Parra *et al.* 2008). In contrast to the findings by Parra *et al.* (2008), Chen *et al.* (2011) observed an increase in on-board BTEX levels as temperatures increased. This observation was attributed to the release of BTEX compounds form interior trimmings and adhesives; which evaporate more easily with increased temperatures (Chen *et al.* 2011). Chen *et al.* (2011) suggested that cooling the vehicle interior will reduce the amounts of BTEX compound evaporated from interior materials (Chen *et al.* 2011). Additionally, no previous study looked at the effects of asymmetric warming on on-board in-vehicle emission concentrations. Asymmetric warming refers to the situation where the minimum ambient temperature increases faster than the maximum temperature (Su *et al.* 2015). This situation persists in many areas around the globe and is known to have varying influences within different environmental spheres (Su *et al.* 2015). Although, measuring the effects of asymmetric warming on on-board in-cabin emission concentrations is beyond the scope of the current study, it would be useful to examine in future studies, especially with regards to environmental modelling.

Kingham *et al.* (1998) and Parra *et al.* (2008) in their studies both found negative correlations between wind speed and the on-board concentrations of target compounds. Kingham *et al.* (1998) were conducting an assessment of exposure to traffic-related fumes during a journey to work in England wherein different forms of transport were used which included a train, bus, car and bicycle. Their target compounds were benzene and PM and the results showed a significant negative correlation between wind speed and both target compounds on-board the bus and car. In a similar study, Parra *et al.* (2008), while assessing the exposure of VOCs on-board public buses in Spain also found a negative significant correlation between wind speed and on-board emissions. Similarly, Gomez-Perales *et al.* (2004) also found a strong correlation between wind speed and on-board in-vehicle exposure to PM and CO in a study conducted in Mexico. These observation were linked to increased dispersion of pollutants as a result of higher wind speeds which would cause less accumulation of pollutants on-board the vehicles (Parra *et al.* 2008).

2.4.2. Spatial Factors Affecting On-board Emissions

Spatial factors that have been investigated which might influence on-board pollutant emissions include route type, road grade, surrounding infrastructure, driving conditions and traffic density (Chan *et al.* 1994, Chan and Liu 2001, Shiohara *et al.* 2005, O'Donoghue *et al.* 2007, Parra *et al.* 2008, Ongwandee and Chavalparit 2010, Wang *et al.* 2011).

Various studies have found that the route travelled by a vehicle impacts the concentration of pollutants in-cabin (Chan *et al.* 1991, Dor *et al.* 1995, Duffy and Nelson 1997, Jo and Park 1999, Parra *et al.* 2008). Chan *et al.* (1991) conducted a study to determine the VOC

concentrations on-board two passenger cars travelling on urban, rural and highway routes through North Carolina, USA. They collected VOC samples using a Summa canister and was analysed by GC-MS. In their report, the GC method is outlined, however, the MS method has not been reported. The reporting of the MS method would be useful as this analytical technique requires certain parameters to be defined, which would be of value to subsequent researchers. Nevertheless, their results found that the highest VOC concentrations were present on the vehicles when travelling through the urban route. This was followed by the highway route and the rural route, which measured the lowest VOC concentrations (Chan *et al.* 1991). Similar results were observed by Dor *et al.* (1995), Duffy and Nelson (1997), Jo and Park (1999) and Parra *et al*, (2008) all of whom measured higher VOC concentration on-board vehicles travelling through urban routes as compared to rural, residential or highway routes. The major reasons for this observation was attributed to the high vehicle congestion and reduced inter-vehicle distance experienced during urban driving, slow travelling speeds, frequent stops and idling, and the tall buildings and narrow streets, which reduce pollutant dispersion and favour accumulation.

Traffic congestion causes less distance between vehicles, which allows emissions from other vehicles to enter the bus cabin; and due to many stops, the effect of outside emission intrusion is pronounced when the vehicle's doors are opened, in the case of public transport (Parra *et al.* 2008). The effect of inter-vehicle spacing was studies by McNabola *et al.* (2009), who found that vehicles travel at a low speed and idle frequently during high traffic congestion, which allows for an increase in infiltration of emissions from the vehicles queuing in front due to the lack of pollutant dispersion through vehicle movement and the close proximity to the preceding vehicle's exhaust. They found that by increasing the inter-vehicle spacing between vehicles in congested traffic a reduction of 19-31% of VOCs and

PM can be achieved on-board the trailing vehicle (McNabola *et al.* 2009). In addition to being impacted by the surroundings vehicles emissions in slow moving traffic; this driving condition can also cause increased pollutant emissions from the boarded vehicle. Wang *et al.* (2011) conducted a study using a portable emission measurement systems (PEMS), to determine the on-road pollutant emission and fuel consumption characteristics of buses in Beijing and found that low speed driving resulted in increased emissions across all target pollutants (CO_2, CO, HC, NO_x, PM) and an increase in fuel consumption for all bus types. Similar results were obtained with respect to acceleration, where sharp acceleration caused an increase in pollutant emission and fuel consumption (Clark *et al.* 1999, Wang *et al.* 2011). The study found that buses emitted the most pollutants and consumed a greater amount of fuel when operating in low speed and high acceleration modes. However, due to traffic congestion in the city, this type of driving mode frequently occurs (Batterman *et al.* 2002, Wang *et al.* 2011). Increased driving speeds in some route would allow for increased air movement on the roads which would allow for greater pollutant dispersion and hence decreased on-board emissions (Parra *et al.* 2008).

In addition to the close proximity to other vehicles and the reduced air movement caused by slow moving traffic; the design and layout of urban areas and cities can also exacerbates the accumulation of emission pollutants and reduces dispersion. Street canyons refer to urban streets surrounded by tall buildings on both sides, where dispersion of vehicle emissions are controlled by factors such as street width and length, building height, wind direction, geometry and design of the city and traffic density, amongst others (Vardoulakis *et al.* 2003). The multifaceted dynamics of street canyons make them hotspots for emission accumulation and reduced dispersion especially during episodes of low wind speed (Vardoulakis *et al.* 2003). Therefore, the combined effects of slow vehicle movement, reduced distance between

vehicles and the effects of the street canyon can collectively contribute to increased emission pollutants on-board vehicles.

Other spatial factors which may influence on-board exposure to vehicular emissions include the road grade or elevation profile of the route. There is a scarcity of studies which take these factors into consideration when conducting on-board emission tests along given routes. However, lab based and simulated road tests do consider these parameters which are represented in the form of increased engine load (Kean *et al.* 2003). Bishop *et al.* (2001) conducted a study to determine the effect of altitude on the emissions of heavy duty diesel trucks at five different locations ranging in altitude from 104 m asl to 1695 m asl. Their study found an increase in tailpipe emissions of CO_2, CO, HC and PM with the increase in altitude and attributed this observation to the lower air-fuel ratios experienced within the engine at higher altitudes (Bishop *et al.* 2001). Although, the authors did acknowledge that in addition to the change in altitude between the locations, driving conditions and engine types also differed, and therefore the given explanation accounting for the difference in emissions with elevation was simplistic.

Other than the effect of elevation on exhaust emission, Kean *et al.* (2003) conducted a tunnel study in which uphill and downhill driving emissions were measured. This was possible as the direction of the traffic in the tunnel used for the study was changed during the day in response to the traffic needs; with some times of the day accommodating for the traffic to move in one direction (uphill) and at other times the opposite direction (downhill). Their result found that increased CO, CO_2 and NO_x was measured in tunnel during the uphill movement of traffic, as a result of fuel rich engine combustion needed to move the vehicles

uphill, and an increase in NMHC in the downhill movement of traffic, due to the lean fuel mixtures required for downhill low engine load conditions (Kean *et al.* 2003). These findings were similar to what was observed by Zhang *et al.* (2015) who found an increase in CO and NO_x emissions with the increase in road gradient. Furthermore, they found an increase in HC emissions increase with road gradient, which was in contrast to the findings of Kean *et al.* (2003). This difference can be attributed to the study design and method of data collection, vehicles used, and parameters measured. For example, Kean *et al.* (2003) used a tunnel experiment, where the emissions from a variety of vehicles were measured during a specific time, as they travelled up or down hill; whereas Zhang *et al.* (2015) used a portable emission measuring system on-board a heavy-duty vehicles to measure a real time emission profile of the vehicle, which was then applied to emission modelling software programs. Nevertheless, in general it can be expected that vehicles travelling uphill or with a heavy passenger or cargo load will burn more fuel and produce greater amounts of exhaust emissions (Frey *et al.* 2007, Yazdani Boroujeni and Frey 2014). These increased tailpipe emissions resulting from increased road way gradients could result in greater in-cabin emissions being measured, as a result of the infiltration of the vehicles own exhaust and self-pollution. The reviewed studies which looked at the effect of road grade on on-road emissions either used PEMS or tunnel tests. However, no study specifically focused on road grade and on-board in-cabin BTEX emissions.

2.4.3. Temporal Factors Affecting On-Board Emissions

Temporal factors that have been studies in a number of on-board emission tests and ambient pollutant studies include peak vs off-peak commute times and weekday vs weekend

measurements (Duffy and Nelson 1997, Chan *et al.* 2003, Parra *et al.* 2008, Ongwandee and Chavalparit 2010).

Duffy and Nelson (1997) and Parra *et al.* (2008) in their studies reported greater concentrations of VOC on-board vehicles during the peak commute times. Duffy and Nelson (1997) used a summa canister to collect VOCs on-board cars and buses travelling though Sydney during the morning peak commute. Their results found that benzene emissions were higher during peak hour traffic, for both vehicle categories, in comparison to freeway routes during non-peak hours (Duffy and Nelson 1997). Likewise, Parra *et al.* (2008) reported variations in VOCs levels on-board buses related to peak and off peak periods. They explain that during off peak periods, traffic density is lower, thus leading to increased travelling speeds which would more effectively disperse and dilute pollutant concentrations (Parra *et al.* 2008). Conversely, during the peak times, the traffic density is greater and the travelling speeds are slower in comparison to off-peak times and therefore the greater accumulations of pollutants occur in urban areas. Similar trends were observed with regard to ambient road side VOC measurements, where the peak commute times correspond to elevated measured concentrations of VOCs in comparison to the off-peak weekday times or the weekend (Hoque *et al.* 2008, Ongwandee and Chavalparit 2010).

In contrast to the above mentioned findings, Chan *et al.* (2003) conducted a study to determine the concentrations of VOC in public transports modes in China, where the authors reported no significant difference between off-peak and peak concentrations of VOCs on-board different modes of transport. The authors related this observation to the similarity of traffic densities experienced for both these commute times.

2.4.4. Vehicle Characteristics and Cabin Interior Factors Affecting On-Board Emissions

The vehicle type, cabin interior and driving conditions have all been shown to impact on-board concentrations of pollutants. Vehicle type refers to the mode, age, mileage, maintenance, interior materials, height and volume, engine, and fuel blend of a given vehicle (Kim *et al.* 2001, Som *et al.* 2007, Chen *et al.* 2011). Cabin interior refers to conditions such as the ventilation condition, load and the use of cosmetic products and cleaning agents on-board the vehicle (Duffy and Nelson 1997, Lau and Chan 2003, Mukherjee *et al.* 2003, El-Fadel and Abi-Esber 2009, Ongwandee and Chavalparit 2010, Chen *et al.* 2011, Abi-Esber 2014).

Jo and Yu (2001) conducted a study comparing on-board VOCs exposure to bus and taxi drivers. The taxi drivers were exposed to higher levels of all BTEX compounds in comparison to bus drivers (Jo and Yu 2001). This observation was consistent with the findings of Jo and Park (1999) who found that cars measured higher BTEX concentrations on-board the vehicle in comparison to buses. These observations were attributed to the difference in vehicle height, cabin volume and driving lane (Jo and Park 1999, Jo and Yu 2001). Vehicle height is important as this determines at what levels outside air will enter the cabin as with the case of cars being lower to the ground and buses higher off (Duffy and Nelson 1997). Vertical air profiles are of importance given that a change in sampling height of only a few meters can cause observed reductions in pollutant concentrations by up to 15% (Duffy and Nelson 1997). In addition to a vertical air profile, Jo and Park (1999) have proposed the existence of a horizontal pollutant profile across the breadth of a road, with the highest pollutants being present in the middle of the road and lower concentrations of

pollutants towards the curb side. This was the explanation proposed by these authors as to why car cabins measured greater VOC concentrations compared to buses; given that cars travelled in the middle lanes whereas buses travelled close to the side lanes (Jo and Park 1999). Furthermore, Jo and Yu (2001) have suggested that the larger cabin volume of a bus would allow for greater dilution of pollutants which would result in lower measured concentrations in comparison to cars which have a smaller in-cabin volume.

Kim *et al.* (2001) conducted a study measuring VOCs in a wide variety of microenvironments. These included homes, pubs, cinemas and vehicles, amongst others (Kim *et al.* 2001). From amongst all the transport related emissions, it was found that the levels of on-boards car emissions were the highest for butadiene and benzene (Kim *et al.* 2001). The authors related this occurrence to the age of the vehicles and to the smoking of the drivers in some cars during testing (Kim *et al.* 2001). They suggest that probably newer cars in the absence of smoking will result in less on-board VOCs being detected (Kim *et al.* 2001).

However, in contrast to the findings of Kim *et al.* (2001), Chen *et al.* (2011) found that older vehicles would have less BTEX concentrations than newer vehicles. They attribute this observation to the fact that older vehicles would have had more ventilation than newer vehicles from the time of being manufactured (Chen *et al.* 2011). This has been linked to the interior material being used; the newer the material the greater will be the evaporative emissions (Chen *et al.* 2011). Likewise, a similar result was observed by You *et al.* (2007) in their study of VOCs on-board cars of different ages. Their results found a large increase of VOCs on-board the new car in comparison to the older cars used and the authors conclusions were also related to the increased VOCs evaporation of the interior material of the new

vehicle in comparison to older vehicles which over time evaporated and off-gassed more VOCs. The studies which concluded that older vehicles would measure an increase in on-board VOCs did so by looking at the deteriorating engine performance of vehicles over time, in the absence of exhaust after treatment systems, which would increasingly contribute to a vehicle's self-contamination in-cabin (Kin *et al.* 2001, Som *et al.* 2007). Som *et al.* (2007) have suggested that newer modelled well maintained vehicles with advanced exhaust after-treatment technologies are more influences by the external intrusion of pollutant emissions from the surrounding vehicles, than self-pollution. The studies which concluded that newer vehicles would measure increased VOCs on-board did so from the perspective of looking at the evaporation of the interior materials.

Chen *et al.* (2011) also compared on-board emissions of buses with varied interior materials. It was found that buses with leather interior trimmings emitted more toluene and xylene than buses using plastic, wood or fabric for the interiors (Chen *et al.* 2011). This was due to the large quantities of glues used in the bus with the leather interior trimmings (Chen *et al.* 2011). Other sources of on-board toluene may be paints, cosmetic products and coatings (Ongwandee and Chavalparit 2010).

There is a paucity of studies which have looked specifically at the impact of passenger numbers on the measured BTEX concentrations on-board in-service public buses. The number of passengers can influence the amount of on-board BTEX concentrations by increasing the engine load which would in turn cause the vehicle to burn more fuel rich emissions, thereby infiltrating the interior and increasing concentrations. However, passengers could also contribute to measured BTEX concentrations by a more direct means

in terms of the usage of cosmetic products which may contain the target compounds in trace amounts.

The ventilation conditions on-board a vehicle has been shown to have great impacts on measured concentrations of pollutants. Ongwandee and Chavalparit (2010) in their study found no significant difference in on-board levels of benzene, toluene and xylenes in air conditioned (AC) buses across different routes. However, levels of toluene, ethylbenzene and xylenes were significantly different between routes on-board non-AC buses (Ongwandee and Chavalparit 2010). This difference was attributed to varying traffic densities amongst routes which caused increased infiltration of the surrounding air into the vehicle without air conditioning through the windows (Ongwandee and Chavalparit 2010).

Chen *et al.* (2011) in their study of on-board bus emission also studied the effects of air conditioning. It was found that BTEX levels were higher in air conditioned (AC) buses as compared to non-AC buses (Chen *et al.* 2011). The increase in BTEX emissions were attributed to less natural ventilation and AC pollution on-board the bus (Chen *et al.* 2011). Higher benzene levels within the bus may also result from the intrusion of the bus's own exhaust into the bus cabin when the windows are closed (Chen *et al.* 2011). These results are consistent with that of Jo and Park (1999), who found increased benzene levels in cars driving through urban routes with the windows closed and AC on. In contrast, it was found in the study by Duffy and Nelson (1997) that by leaving the vents open, benzene levels increased considerably in comparison to driving with the air conditioner on and the vents closed (Duffy and Nelson 1997).

Table 2. 2. Summary of studies used in microenvironment emission tests

Study	Microenvironment	Compounds Measured	Method	Analysis	Study Focus
Chan *et al*. 1994	Bus/Car/ Motorcycle/ Office	VOCs	Active sampling with pump and Tenax-GC tubes	GC-MS thermal desorption	Workers exposure to VOC while commuting and working in an office.
Duffy and Nelson 1997	Cars/Buses	Benzene and butadiene	Active sampling with pump and summa canister	GC-MS	Determination of on-board concentrations of target compounds between old and new vehicles with different ventilation conditions operating on different routes at peak/off peak times.
Kingham *et al*. 1998	Train/Bus/Car/ Bicycle	Benzene Particulate matter	Active sampling on thermal desorption tubes Active dust sampler	 Smokestain reflectometer	Personal exposure to traffic related fumes during a journey to work.
Jo and Park 1999	Cars/Buses	VOCs	Active sampling with pump and Tenax-TA tubes.	GC-FID thermal desorption	Determination of on-board VOC concentrations under different driving conditions.
Chan and Liu 2001	Bus/Car/Taxi	CO	Portable CO monitor	Electrochemical voltammetric sensing with direct-reading analysis	Determination of CO levels on-board vehicles travelling along different routes.
Jo and Yu 2001	Buses/Taxis	BTEX	Active sampling with pump and Tenax tubes	GC-FID thermal desorption	Personal exposure to VOCs among bus and taxi drivers during summer and winter.
Kim *et al*. 2001	Buses/Trains/ Automobiles plus a wide variety of indoor spaces	VOCs	Active sampling with pump and adsorbent tubes	GC thermal desorption	Determination of VOCs concentrations and sources in a wide range of microenvironments.
Batterman *et al*. 2002	Cars/Buses	VOCs	Active sampling with pump and adsorbent tubes	GC-MS thermal desorption	Determinations of VOCs levels on commuting routes at peak/off peak times.
Lau and Chan 2003	Tram/Buses/Cars/ Taxi/Ferry/Train	BTEX	Passive sampling with summa canister	GC-MSD	Commuter exposure to VOCs in different modes of transport
Mukherjee *et al*. 2003	Buses	Noise Heat Dust BTX	Noise meter Thermometer Sampling pump with dust filter Active	 Gravimetric analysis GC-FID	Exposure of drives and conductors to target stressors during work shifts.

			sampling with pump and activated charcoal tube	solvent extraction	
Shiohara *et al*. 2005	Car/Microbus/Bus Train	BTEX and Formaldehyde	Active sampling with pump and activated charcoal tube Sampling pump with DNPH cartridge	GC-MS solvent extraction High performance liquid chromatography	Commuter exposure to VOCs in different transport modes during morning rush hour.
O'Donoghue *et al*. 2007	Buses/Cyclists	Hydrocarbons	Active sampling with pump and Tedlar bags	GC-FID thermal desorption	Exposure to HC while commuting and exercising during morning and evening peak periods.
Som *et al*. 2007	Cars	BTEX	Active sampling with pump and activated charcoal tube	GC-FID solvent extraction	Commuter exposure to BTEX in passenger cars.
Parra *et al*. 2008	Buses	VOCs	Active sampling with pump and Tenax TA tubes	GC-MSD thermal desorption	Exposure of passengers and drivers to VOCs on-board buses travelling on different routes and peak/off peak times.
Hsu and Huang 2009	Buses	VOCs CO/CO_2 PM	Active sampling with pump and Tenax-TA tubes Q-Trak DustTrack aerosol monitor	GC-FID Thermal desorption	Determination of target compound concentrations on-board long distance buses.
Ongwandee and Chavalparit 2010	Buses/Electric sky train/ passenger boat	BTEX	Active sampling with pumps and charcoal tubes	GC-MS	Commuter exposure to VOCs on-board different modes of transport during morning and evening peak periods.
Chen *et al*. 2011	Buses	BTEX	Active sampling with activated charcoal tubes	GC-FID thermal desorption	To determine on-board concentrations of BTEX and to analyse factors influencing these concentrations.
Wang *et al*. 2011	Buses	NO_x CO/CO_2 Hydrocarbons PM	Portable emissions measurement system (PEMS)	NDUV NDIR FID ELPI	To determine on-road emissions and fuel consumption between diesel and CNG buses
Lan *et al*. 2013	Bus/Motorcycle/Taxi/ Homes/Filing station/ Outdoor vendor	BTEX	Active sampling with pumps and activated		To determine the personal exposure to benzene of selected population groups.

			charcoal tubes Passive sampling with Lanwatsu passive samplers		
Abi-Esber 2014	Cars	CO PM	CO Analyser DustTrak II		Investigation into a number of factors influencing in-cabin emissions.
Kongtip *et al*. 2015	Buses	VOCs	Passive sampling with organic vapour monitors	GC-FID solvent extraction	To determine the health risk of benzene exposure to drivers and conductors.

2.5. Toluene/Benzene (T/B) Ratios and BTEX Interspecies Correlations

T/B ratios and interspecies correlations are useful parameters used to infer whether BTEX emission sources are mobile or point source. (Hajizadeh *et al.* 2018, Miller *et al.* 2011). This is possible due to the variation in the decomposition times of toluene and benzene compounds and their dominance in different environments (Lee *et al.* 2002, Lau and Chan 2003). For example, benzene is strongly associated with motor vehicle emissions and high traffic areas whereas toluene is associated with motor vehicle emissions, paints, solvents and industry (Lee *et al.* 2002, Lau and Chan 2003, Bretón *et al.* 2017). In addition to T/B ratios, the BTEX interspecies correlations are also indicative of the source appointment of emissions; with strong correlation between species indicating a common source whereas poor correlations may indicate the influence of multiple emission sources (Miller *et al.* 2011). This relationship is proposed based on the set proportions of BTEX emissions emitted from a common source in comparison to varying emission proportions measured given the influence of varying sources (Miller *et al.* 2011).

A number of studies have used T/B ratios and BTEX correlations to infer possible sources of BTEX compounds in urban, industrial and rural areas, together with the sources of emissions on-board vehicles (Lau and Chan 2003, Khoder 2007, Tiwari *et al.* 2010, Miller *et al.* 2011, Lan *et al.* 2013, Hajizadeh *et al.* 2018). In addition, given that T/B ratios have been studied extensively, several researchers have proposed various ranges of T/B ratio values to be indicative of different emission sources. Khoder (2007) in his study of ambient VOC in areas of Cairo presented a T/B of 2.70 to be indicative of vehicular exhaust, while Hajizadeh *et al.* (2018) in their study of BTEX concentrations in Iran have suggested T/B ratios in the rage of 1.5 – 4.2 to be characteristic of traffic emissions. Tiwari *et al.* (2010) in a study conducted in Japan in the vicinity of a petrochemical industry have suggested that T/B ratios nearing one are indicative of emissions from traffic origin. Furthermore, Breton *et al.* (2017) suggested that T/B less than two can indicate a strong association of traffic emission on the BTEX concentrations in a particular area, whereas Lan *et al.* (2013) have proposed that ratios less than three are indicative of traffic emissions in studies conducted in various countries around the world.

Other than T/B ratios indicative of traffic emissions, Lan *et al.* (2013) and Tiwari *et al.* (2010) have proposed that T/B ratios greater that 4.5 are indicative of industrial locations or due to a solvent sources, while Breton *et al.* (2017) have suggested that T/B ratios greeter than two can be characteristic of industry or areas sources of emissions. Lau and Chan (2003) have reported T/B ratios up to approximate 10 in public commuter transport modes in Hong Kong and have tentatively related this high ratio to the use of solvents in train stations and the interior material of newer buses. Furthermore, Lee *et al.* (2002) have reported high T/B ratios for a number of Asian cities such as Manila, Bangkok and Hong Kong and have related these high ratios to the dominance of industrial facilities in these cities. Hsu and Hong (2009) in

their study of VOCs on-board long distance buses found BTEX ratios on-board the vehicle to be higher than those at roadsides and suggested that the in-cabin air was being influences by the interior materials, fixtures, varnishing, interior coatings and paints.

Strong interspecies correlations between BTEX compounds have been used by several researchers in studies conducted in urban environments and on-board vehicles to suggest a common emission source, whereas poor correlations amongst BTEX species have been used to infer emission sources from varying origins (Khoder 2007, Hoque *et al.* 2008, Parra *et al.* 2008, Singh *et al.* 2016). For example, Singh *et al.* (2016) in their study of different areas representing high traffic locations, industrial, commercial and residential areas; found that strong correlation between BTEX compounds existed and suggested that the common emission origin was vehicular traffic. The industrial site in their study showed weak to moderate correlations between benzene and other TEX compounds and this occurrence was attributed to emission sources of TEX other than vehicular emissions (Singh *et al.* 2016). While benzene is strongly associated with vehicular emissions, TEX is associated with vehicular emissions and industrial processing, paints, solvent use and manufacturing industries (Lee *et al.* 2002). A similar result was obtained by Hoque *et al.* (2008), where strong correlations between benzene and TEX were observed in urban areas influenced by traffic emission and poor correlations between the same species in the industrial area influenced by multiple sources of TEX compounds (Hoque *et al.* 2008). Both studies by Hogue *et al.* (2008) and Singh *et al.* (2016) were conducted in Delhi, India. In the study by Khoder (2007), strong positive correlations of BTEX compounds were found between the urban and rural sites. For the urban sites, a strong correlation was expected given that vehicular emissions are the dominant sources of BTEX in urban areas (Khoder 2007). However, in this study the rural site also exhibited strong BTEX correlation in the absence of

a dominant point source, which the author attributed to the transport of the urban air to the rural site (Khoder 2007).

The variation in the BTEX ratios and correlation values from studies conducted around the world can be attributed to factors such as varying fuel composition in different countries, varied vehicular fleet composition, the dominance of industrial facilities and the study design and sampling methods; all of which can influence on the given ratio values (Khoder 2007, Miller *et al.* 2011, Singh *et al.* 2016, Bretón *et al.* 2017, Hajizadeh *et al.* 2018). Therefore, T/B ratios are not to be considered as absolute values used to identify sources of BTEX emissions, as can be observed in the variation of values reported by several authors; and therefore, caution should be taken when making conclusions based on these ratios.

2.6. Summary

The preceding chapter presented a review of the literature regarding various aspects of the project. These aspects included the physical and chemical structure and sources of BTEX compounds in the environment, and the implications to human health from exposure to these compounds. Thereafter, the review presented the results from lab-based emissions tests conducted on a variety of heavy-duty vehicle engines fuelled on diesel and DDF/CNG. Furthermore, the factors affecting on-board in-vehicles emissions were presented with regards to the weather, special and temporal factors, and the vehicle characteristics and interiors. Finally, the BTEX ratios and correlations were presented regarding the source appointment of BTEX compounds in the environment and on-board vehicles.

The literature findings have shown BTEX compounds to be ubiquitous in a number of environments and have shown to be harmful to human health as a result of both acute and chronic exposure to the compounds. Furthermore, lab-based emission tests conducted on diesel and DDF/CNG engine fuel types have demonstrated in general a reduction in pollutant emissions of NO_x and PM (Norton *et al.* 1999, Turrio-Baldassarri *et al.* 2006) and an increase in emissions of CO and HC (Besch *et al.* 2015, Wang *et al.* 2016) from DDF and CNG engine types as compared to straight diesel fuelled engines and vehicles. However, due to the complex thermodynamic and structural relationships between different components within an engine and due to the large variety of engine test setups and study designs; differences in emission outcomes were observed amongst studies. The lab-based emission tests, although useful during the developmental stages of engine and vehicle design, lacks credence in terms of the on-road in-vehicle emissions which are subjected to conditions which are unaccounted for under lab-based tests. Therefore, the factors affecting on-board in-vehicle emission were subsequently presented.

The literature findings presented a number of factors affecting the on-road in-vehicle emissions in general and BTEX compounds in specific. These factors showed variation in the impacts observed across studies. For example, the on-board temperature was found to either cause an increase (Chen *et al.* 2011) or decrease (Parra *et al.* 2008) in on-board BTEX concentrations. Similarly, studies found enhanced concentrations of BTEX concentrations on-board in-service vehicles both in summer (Jo and Park 1999) and winter (Jo and Yu 2001) months. In terms of the spatial and temporal factors affecting on-board emissions, the majority of studies are in agreement that vehicles travelling along urban, high traffic routes measured greater BTEX concentrations than vehicles on rural, residential or highway routes (Chan *et al.* 1991, Dor *et al.* 1995, Duffy and Nelson 1997). Likewise, peak commute transit

resulted in increased measured on-board in-vehicle BTEX concentrations as compared to off-peak commute times (Duffy and Nelson 1997, Chan *et al.* 2003, Parra *et al.* 2008, Ongwandee and Chavalparit 2010). Furthermore, the effects of the studied ventilation modes on on-board BTEX concentrations in various studies have also shown contrasting results. For example, some studies reported a reduction in BTEX emission concentrations with the windows open (Chen *et al.* 2011), whereas other studies reported a reduction in concentrations with the windows closed and air conditioning on (Ongwandee and Chavalparit 2010).

Although a large number of studies have examined on-board in-vehicle BTEX concentrations, there is a paucity of studies which looked at the specific route grade and profile to determine its effect on in-cabin BTEX concentrations. Furthermore, few studies looked at the effects of passenger number on on-board emission concentrations. Passenger number is an important parameter as it accounts for increasing the engine load together with the passengers being a source of BTEX as a result of using cosmetic products. Therefore, in addition to examining other commonly examined on-board in-vehicle factors such as temperature and ventilation modes, the current study also focuses on passenger numbers and route characteristics such as the elevation profile, which have not featured prominently in previous studies. Additionally, as noted from Table 2.2 that the reviewed studies either used GC-FID or GC-MS for the sample analysis. Those studies which used GC-MS did not detail the MS procedure, which would have been useful for subsequent researchers to replicate their studies. Moreover, no previous study used a Time-of-Flight (TOF) mass spectrometer for sample analysis. Therefore, this study will used the TOF-MS and clearly define the MS methods used. Furthermore, to date there are no published records of studies of this nature

being conducted in South Africa. Therefore, this study plays and important role in filling the knowledge gap with regards to the South African context.

3. CHAPTER III

METHODS AND MATERIALS

3.1. Introduction

The aim of this study was to determine the concentrations of BTEX compounds on-board in-service buses travelling along major routes during the off-peak and peak commute times and to determine the factors which affect these measured concentrations on these buses. These aims were achieved by boarding in-service public buses and making observations regarding various aspects of the journey together with conducting air sampling which entailed the usage of portable air pumps and charcoal sampling tubes. The samples were analysed using gas chromatography mass spectrometry (GC-MS).

In this section, firstly the specifications of the buses used in this study are presented. Secondly, the routes on which the buses travelled through during the sampling campaign are described. Thirdly, an account of the sampling equipment and procedure used are detailed. Fourthly, the sample processing and analysis methods are mentioned. And finally, the selection of statistical methods for the data analysis is presented.

3.2. Vehicle Description

The vehicles used in this study were provided for by Metrobus, a state owned company which operates the largest public bus fleet in the Johannesburg area. This company was chosen for

the study as it is in possession of recently acquired DDF buses, which were the initial focus of the project – a comparison between DDF and diesel on-board emissions. However, as outlined previously due to the bus company's lack of resources and structural vulnerability, the DDF system was not operational at the time of the study. The Mercedes-Benz 1725 diesel and DDF buses were chosen for this study (Figure 3.1). These buses were chosen as they both run on the same engine type and are similar in terms of vehicle age, mileage, service history and manufacturer (Table 3.1). Twenty of these buses were used during this study, all of which represent the same vehicle fuel type (diesel). The buses travelled along various routes through the Johannesburg inner city and surrounding Northern suburbs during the morning peak (6:00 am – 8:30 am), midday off peak (10:00 am – 2: 00 pm) and evening peak (4:00 pm – 6:00 pm) periods. The vehicles on which sampling was conducted was any Mercedes-Benz 1725 diesel or DDF bus, travelling on the predetermined routes during the off-peak and peak times. The sampling method was based on the previously mentioned criteria and devised taking into consideration the project's limited resources and logistical barriers.

A



B



Figure 3. 1. Bus types used in the study. A – Mercedes-Benz 1725 DDF, B – Mercedes-Benz 1725 Diesel.

Some buses operated exclusively on diesel fuel, while other buses were converted to operate under DDF mode. In DDF mode the buses can function on diesel exclusively, in a situation where the compressed natural gas (CNG) runs out or due to a technical malfunction with the DDF system (Besch *et al.* 2015). At the time of the study none of the buses sampled were operating on the DDF mode. So, although the DDF buses were fitted with the engine system

enabling them to run on CNG, they all ran on diesel only mode. Therefore, no comparisons could be made between the diesel buses and DDF buses with regards to the fuel type being used, as initially intended. The specification of the bus type used in this study is presented in Table 3.1.The buses used in this study were in service for approximately ten years. Their mileage at the time of the study ranged between 330 000 and 370 000 km. None of the buses were fitted with air conditioning (AC) and on-board ventilation was achieved through the bus windows. Smoking on-board public buses by passengers and drivers was prohibited. Thus, no smoking occurred during commutes with passengers on-board the bus. However, bus drivers did smoke at bus stops and terminals before loading passenger or while awaiting departure.

Table 3.1. Vehicle and engine specifications of buses used in study.

Vehicle	**Specification**
Bus (public transit vehicle)	Metrobus
Length	11.5 m
Capacity	70 passengers
Weight	18500 kg
Years in service	~10
Mileage range	330 000 km – 370 000 km
Model	Mercedes-Benz O500M 1725L
Engine	OM 906 LA (6 cylinder, turbocharged, intercooled)/ Straight diesel and DDF retrofit
Engine position	Rear
Fuel type	Diesel 5ppm

3.3. Route Description

During the off-peak and peak sampling campaigns a total of six bus routes were sampled. These routes were chosen as they represent major commuter routes, through the Johannesburg CBD to the surrounding northern suburbs of Johannesburg, in which hundreds of commuters travel on daily. These routes were deemed suitable due to the frequency in

which they were travelled on by commuters and for logistical purposes given that the buses along these routes commenced and terminated at similar times from a common bus terminal. Therefore, boarding and disembarking different buses for sampling purposes was made easy. Furthermore, these routes passed through areas covering multiple land uses and were most representative of a commuter's experience. With regards to the suitability of the Johannesburg area for conducting this study; firstly, a study of this nature has not been conducted in this area before. Secondly, this area has features resembling other major international cities, such as being highly populated, experiencing high amounts of traffic and congestion and surrounded by tall buildings and narrow streets occupied by a variety of vehicle types. Moreover, it was only in Johannesburg and the surrounding areas did the Metrobus's DDF vehicles operate and given that the initial study focused on these buses, deemed the area suitable.

Routes A, B and C were sampled during the off-peak commuter times (10:00 am – 2:00 pm) between the 21st of November and 7th of December 2017 (Figure 3.2). Routes D, E and F were sampled during the morning peak commute times (6:00 am – 8:30 am) between the 16th of April and 18th of May 2018 (Figure 3.2). All of the sampled buses along their respective routes, with the exception of route E, started at the Ghandi Square bus terminal and travelled out of town to the surrounding areas. Ghandi Square is located within the heart of the Johannesburg CBD (26°12´23´´S, 28°02´26´´E) and serves as the central bus terminal for all major routes serviced by Metrobus. Buses travelling along Route E (Figure 3.2) started at the Ferndale bus depot (26°05´23´´S, 27°58´50´´E) and travels into town to Ghandi Square. While commuting along these routes observations were made regarding the on-board ventilation, number of passengers, driving conditions and driving styles, distances travelled, surrounding traffic and the land-use changes.

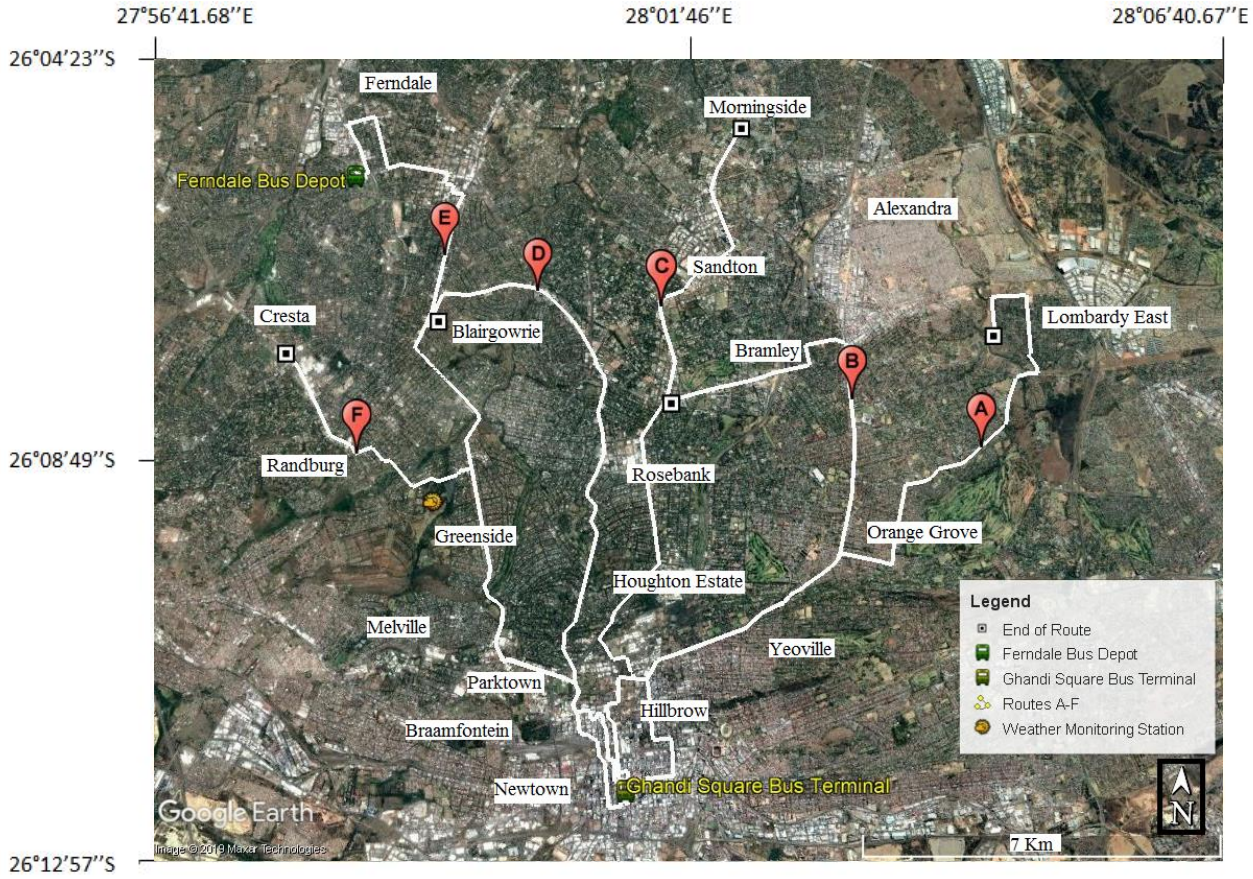

Figure 3. 2. Map of bus routes travelled upon during the off-peak (Routes A, B and C) and peak (Route D, E and F) sampling campaigns (Google Earth, 2018).

3.4. Sampling Equipment Used During Field Sampling for Off-peak and Peak Campaigns

The sampling campaign was aimed at collecting on-board BTEX emissions, temperature, relative humidity and route data which included the route profile. For the BTEX collection, an active sampling approach was adopted using personal air sampling pumps (GilAir 3, Sensidyne, USA) (Figure 3.4) and activated coconut charcoal sorbent tubes (ORBO™ - 32 small, Merck, Germany) (Figure 3.5). The sampling pump was connected to the activated coconut charcoal tube via the rubber tubing. During sampling, the pump was switched on and air was drawn from the surroundings through the sampling tube. Due to the large surface area

and micro porosity of the charcoal sorbent material, the target compounds (BTEX) are trapped in its matrix (Bansal and Goyal 2005, Ras *et al.* 2009).

There are a variety of sorbent materials available depending on the different types of compounds being sampled (Ras *et al.* 2009). Activated coconut charcoal is the most abundant and cheapest sorbent material used for the analysis of VOCs in air and has been used in many official methods by the National Institute for Occupational Safety and health (NIOSH) and the Occupational Safety and Health Administration (OSHA) (Harper 2000).

Although activated coconut charcoal has great utility in VOC sampling there are some drawbacks associated with their use (Harper 2000). For instance, activated coconut charcoal is susceptible to the negative effects of humidity in the sampling environment (Harper 2000, Kumar and Víden 2007). Humidity causes water molecules to get adsorbed by the charcoal which overtime reduces the capacity of target compounds to adsorb thereby reducing sampling and analytical efficiency (Harper 2000, Kumar and Víden 2007).

The charcoal tubes used in this study (Figure 3.5) contained two beds of 20-40 mesh activated coconut charcoal as the sorbent material. Bed A (front section) contained 100 mg and Bed B (back section) contained 50 mg of sorbent material. The sorbent beds are separated by plugs (Figure 3.5). The outer diameters of the tubes were 6 mm and the length was 75mm (Figure 3.5). Activated charcoal sorbent tubes have been used by various researchers in the field trying to determine concentrations of VOCs on-board vehicles (Shiohara *et al.* 2005, Som *et al.* 2007, Ongwandee and Chavalparit 2010, Chen *et al.* 2011, Lan *et al.* 2013).

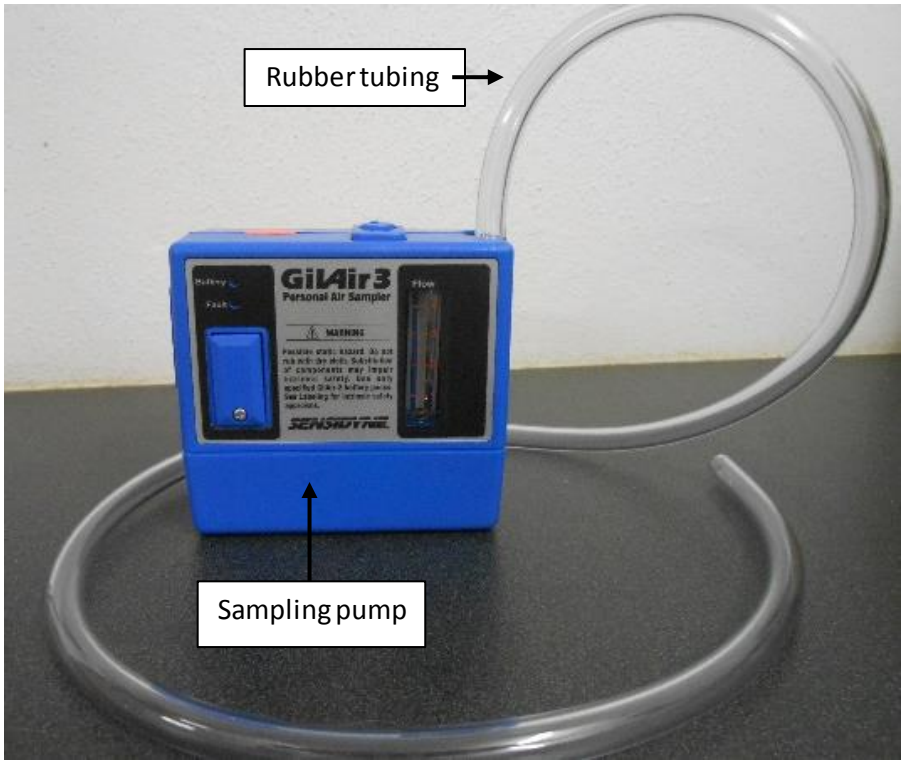

Figure 3. 3 Personal air sampling pump with connecting rubber tubing used during field sampling (GilAir 3, Sensidyne, USA).

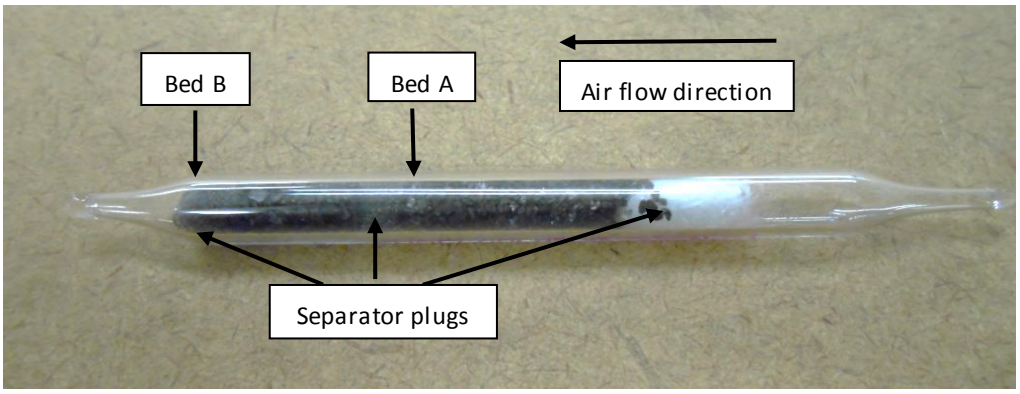

Figure 3. 4 Activated coconut charcoal glass sorbent tube (ORBO™ - 32 small, Merck, Germany).

The temperature and humidity data were collected using an iButton™ (Maxim Integrated Products Inc, USA) programmed to collect a samples on-board the vehicles. iButtons are a range of digital temperature and humidity loggers that are small (Figure 3.6), lightweight, inexpensive and versatile, and have been used in a wide range of applications (Wolaver and

Sharp 2007, Davidson *et al.* 2003). These applications include their use in the cold chain industry, medical research and environmental monitoring (Davidson *et al.* 2003, Hasselberg *et al.* 2013, Brabyn *et al.* 2014). For this study the Hygrochron iButton (DS 1932) was used (Figure 3.6). This particular iButton can measure both temperature and humidity. The temperature range of this iButton is -20 to +85°C with a temperature resolution of 0.5°C, whereas the humidity range is from 0 to 100% relative humidity (RH) with a humidity resolution of 0.04% RH. The iButton is fitted with a lithium battery and has 8192 bytes of data log memory(Davidson *et al.* 2003). The missing temperature and humidity data, resulting from either malfunctioning loggers or as a result of incorrect programming of the iButton through human error, were imputed with a multivariate imputation by chained equation (MICE) using R software (Buuren and Groothuis-Oudshoorn 2010). This imputation method has been used in previous studies to fill in gaps within meteorological data sets (Turrado *et al.* 2014, Suleiman *et al.* 2019). A GPS (eTrax 30, Garmin, USA) was used to collect the vehicles' route and elevation profile.



Figure 3. 5. Hygrochron™ iButton® (DS 1923) manufactured by Maxim Integrated Products Inc, USA.

3.5. Ambient Temperature and Relative Humidity Data

The ambient temperature and relative humidity data was obtained from the South African Weather Services' meteorological monitoring station located at the Johannesburg Botanical Gardens (26°09'21.6''S 27°59'56.4''E) (Figure 3.2). This monitoring station was the closest station to the study site and was within a 13 km radius of the furthest route (Figure 3.2). For the purpose of this study it was assumed that the ambient temperature (°C) and humidity (%RH) was uniform over the given sampling area. The data was provided as hourly measurements over a 24 hour period covering the duration of the sampling campaigns. The iButton was set to collect multiple temperature and humidity data points per hour. The iButton data was averaged over the time corresponding to the sampling duration and this was then compared to the single hourly temperature and humidity data points provided by the weather monitoring station.

3.6. Off-peak and Peak Sampling Campaigns

Sampling was conducted on-board in-service public Metrobuses operating in the Johannesburg CBD and surrounding suburbs. Two sampling campaigns were carried out i.e. the off-peak and peak sampling campaigns.

The first sampling campaign was the off-peak campaign and was considered a pilot study. This was done to determine any shortcomings in the sampling procedure, to test the equipment and to potentially refine the methods. The pilot study was conducted between the 21st of November and 7th of December 2017. During this campaign buses were boarded and sampled upon during the weekday off-peak periods (10:00 am – 2:00 pm). Due to the

availability of project volunteers during this campaign, three buses were able to be sampled on within the same or similar time range during the off-peak period. For this campaign a total of 23 samples were collected which consisted of 11 samples on-board the diesel buses, 10 samples on-board the DDF buses and two field. As mentioned previously, the DDF system was disengaged during the sampling campaign, thus all sampled buses operated on diesel only. During this campaign it was noted that very few commuters boarded the buses during off-peak hours and that those passengers who did board the buses commuted for short periods of time.

The second sampling campaign was carried out between the 16th of April and 18th of May 2018. Two peak hour (6:00am – 8:30am) buses, one diesel and one DDF, were boarded daily during the week from Monday to Friday. The buses were not equipped with air conditioning and due to the cold weather all the windows were closed during sampling. The sampling on-board the two different buses were not conducted simultaneously due to logistical challenges. These logistical challenges manifested itself in the inability to source volunteers to assist with the sampling. Therefore, one bus was boarded and sampled and after returning to the bus terminal a second bus was boarded and sampled. Both buses were sampled during the peak hours (6:00 am – 8:30 am). Given the dynamic nature of using in-service buses, it was not possible to sample the same buses every day and therefore different buses were used which operated on the same engine type (Table 3.1). The peak sampling was conducted from Monday to Friday over five weeks, and during this time 45 samples were collected; which included 21 samples on-board the diesel buses, 21 samples on-board the DDF buses and three field blanks.

3.6.1. Sampling Procedure for Off-peak and Peak Sampling Campaigns

Both sampling campaigns followed a similar method for sampling. The sampling procedure can be divided into three phases i.e. field sampling preparation, field sampling and after-field sampling.

3.6.1.1. Field sampling preparation

Before going into the field the personal sampling pumps were fully charged. Once fully charged the sampling pumps were calibrated using a primary flow calibrator (Gillian Gilibrator 2, Synsidyne, USA) (Figure 3.7). The calibration was done to ensure that the pumps were operating at the desired flow rate. Firstly, a soap solution was filled into the calibrator as per the manufactures instructions. Thereafter, refereeing to Figure 3.7 (from left to right), the sampling pump was connected to a sampling tube via the rubber tubing and tube connectors, on one end. At the other end, the sampling tube was connected to the calibrator via a tube connector and another piece of rubber tubing. The sampling pump was then switched on and the vacuum created by the pump generated soap bubbles which are drawn through the calibrator tube. The main body of the calibrator has one sensor at the bottom and one sensor at the top which measures the rate at which the bubble is travelling, in cubic centimetres per minute. The rate of the bubble is indicative of the flow rate of the sampling pump generating the vacuum. The flow rate of the sampling pumps was adjusted to the desired flow rate using the flow rate adjuster screw on the sampling pumps.

During the off-peak sampling campaign the sampling pump flow rate was set at set at 0.1 L/min and on-board sampling was conducted for 60 minutes. This allowed for 6 litres (L) of air to be collected on the sorbent sampling tube. During the peak sampling campaign, the flow rate was set at 0.2 L/min and sampling was conducted for 30 minutes, also allowing for

6 L of air to be collected, but over a shorter period. This change was made due to the shorter travel times of the buses during the peak times which did not allow for 60 minutes of sampling during the trip. Six litres of air was the preferred sampling volume as it fell within the sampling volume range of all BTEX compounds, as stated in the NIOSH manual of analytical methods (Eller and Cassinelli 1994). Pre-sampling calibration was conducted daily prior to going into the field.

Furthermore, before going into the field the iButtons were programmed once to collect temperature and humidity data every five minutes. For the off-peak campaign, no humidity data was collected due to an error with the iButtons. However, this error was resolved and during the peak sampling campaign, both temperature and humidity data was collected. And lastly, the functionality of the GPS was ensured by ensuring that the unit had sufficient battery life before field sampling.

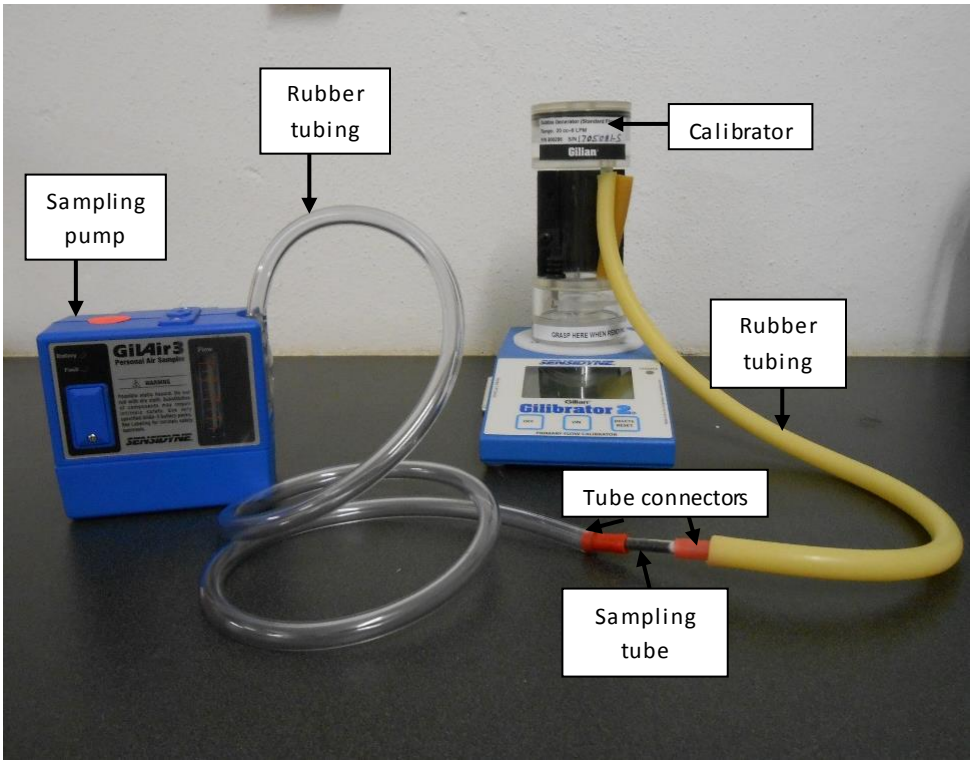

Figure 3. 6 Calibration set up for sampling pumps.

3.6.1.2. Field sampling

During field sampling, buses were boarded during the peak and off-peak times, respectively. Once boarded, the researcher took a seat towards the middle of the bus (Figure 3.8) in line with the driver. This zone was considered to be representative of the conditions experienced in the whole bus (Batterman *et al.* 2002). According to Batterman *et al.* (2002), due to the rapid mixing and air exchange rates on-board buses, any single location on-board can be representative of concentrations experienced throughout the bus. After being seated on the bus, the GPS was switched on and programmed to track the buses route.

Additionally, two iButtons were stuck onto the seat in front of the researcher. Two iButtons were used during the peak campaign as a safety precaution in the event of one iButton malfunctioning, as was the case during the off-peak sampling campaign.

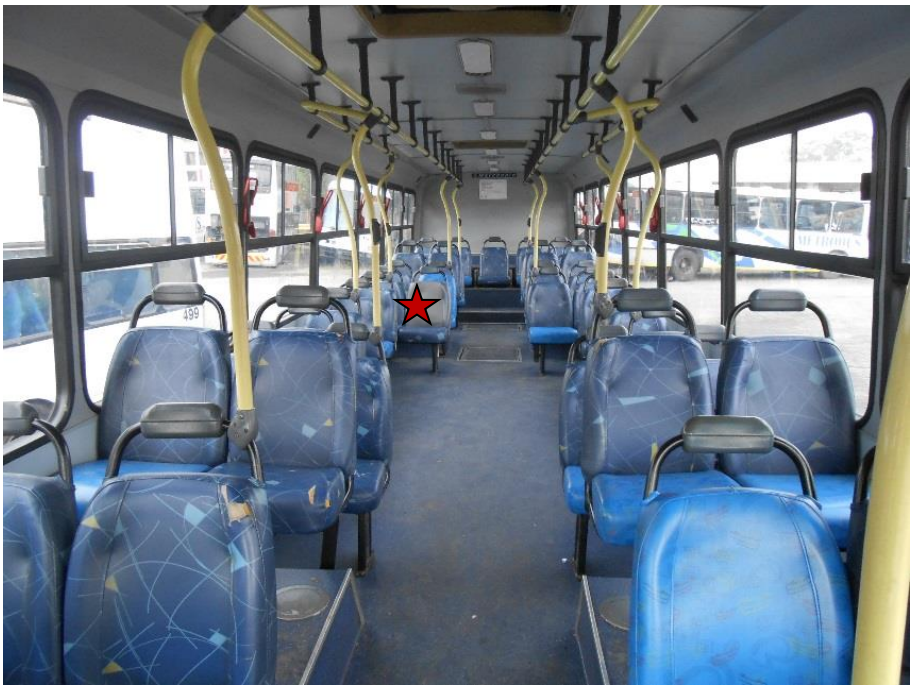

Figure 3. 7. Red star represents the sampling position on-board the bus.

Before commencing with sampling, the researcher set up the apparatus while seated on-board the bus. First the rubber tubing was connected to the personal sampling pump at one end. Thereafter, both ends of the glass sampling tube were snapped off to allow air flow through the sampler. One end of the sampler was then connected to the opening of the rubber tubing according to its prescribed orientation as indicated on the sorbent tube. The sampling set up can be seen in Figure 3.9. The sampling pump was switched on and rested on the researchers lap while the sampler was held within the breathing zone, at a height of approximately 0.8 m off the bus floor.

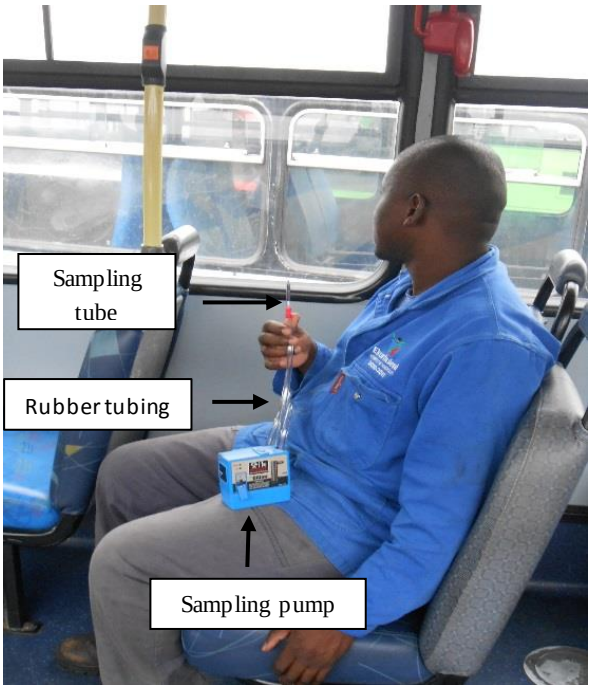

Figure 3. 8. Sampling set up on-board bus.

After the sampling duration had lapsed (60 minutes for off-peak sampling, 30 minutes for peak sampling), the sampling pump was switched off and the sampling tube was detached from the rubber tubing and both ends were sealed with plastic caps. The samples were covered in foil, placed in a zip-lock bag and stored in a cooler box out of direct sunlight as to prevent any further reactions with the BTEX compounds to occur, given that they degrade under sunlight.

3.6.1.3. After sampling

On returning from the field, the samples were stored in a fridge, to ensure sample stability and reduce reactivity, and thereafter analysed within six weeks of collection. In addition to storing the field samples, the flow rate of the sampling pumps used in the field was determined to establish the amount of drift experienced during field sampling. This was done by attaching the pump to the flow calibrator and making a note of the average of the first 10 flow readings. The flow rate of the sampling pumps measured after field sampling did not drift by more 5% of the initially set flow rate. This was possible as the pumps had automatic constant flow control which would maintain the flow rate within ±5% of the initial calibration, as stated by the manufacturer. Given this minor change in flow rate over the sampling duration, it was assumed that the effect of the flow rate drift was negligible. The post-sampling determination of the pump flow rate was not done during the off-peak campaign; but given the performance of the pumps during the peak campaign, it was assumed that negligible differences occurred over the sampling duration for this campaign as well.

3.7. Sampling Tube Analysis for BTEX Compound Concentrations

Sample analysis was conducted at the Mass Spectrometry Lab located in the Humphrey Raikes Building at the School of Chemistry, University of Witwatersrand. The analysis of the sorbent tubes was performed on a Gas Chromatographer (GC) (Agilent 7098B, USA) coupled to a TOF (Time-of-Fight) mass spectrophotometer (MS) from LECO, USA.

Gas chromatography mass spectrometry (GC-MS) is the combination of two powerful analytical techniques used for the separation of compounds from mixtures and their subsequent identification and quantification.(Stashenko and Martinez 2014). The gas

chromatographer is the instrument used to separate and detect compounds present in a given mixture based on their physical and chemical properties, through the partitioning of compounds between mobile and stationery phases in a capillary column (Skoog *et al.* 2007). There are four important components in gas chromatography which allow for the separation and detection of compounds. These are the sample injection port, carrier gas (mobile phase), column (stationary phase) and detector (Figure 3.9).

The sample injection port is where the sample mixture is introduced into the GC (Figure 3.9). The injector port is heated to a temperature appropriately hot enough to ensure immediate vaporisation of the injected sample and not too hot, where thermo-degradation of the sample may occur (Stashenko and Martinez 2014). After vaporisation of the sample mixture in the injection port, the sample is transported through the column by a carrier gas (Figutre 3.9). The carrier gas is inert and does not chemically interact with the vaporised sample being swept through the column. The most common carrier gas is helium, but gases such as hydrogen, argon and nitrogen are also used (Skoog et al. 2007). The separation of the sample occurs as the carrier gas transports the vaporised sample thought the GC column which is lined with the stationary phase and is heated in an oven (Figure 3.10) (Skoog *et al.* 2007, Stashenko and Martinez 2014). The oven temperature setting is an important parameter as it allows for mixtures of compounds with different volatilities and boiling points to elute from the column effectively (Stauffer *et al.* 2007). An ideal oven temperature programming would start off at a low temperature to allow the elution of compounds with high volatility and gradually increase in temperature to allow the elution of compounds which are less volatile (Stauffer *et al.* 2007). The separation of the sample occurs due to the differences in the way the compounds within the sample interact with the stationary phase, which would allow for

compounds to exit from the column at different times (Rahman *et al.* 2015). It is based on the difference in the delays of compounds exiting the column that the detector can identify different compounds (Rahman *et al.* 2015).

There are many different types of GC detectors available such as the flame ionisation detector (FID), thermal conductivity detector (TCD) and photo ionisation detector (PID), to mention a few (Skoog *et al.* 2007, Stashenko and Martinez 2014).However, the FID is the most widely used and most applicable to this study given that the large number of in-vehicle BTEX emission studies utilised this detection instrument. With the FID, the separated compounds leaving the column are directed into a hydrogen flame where they are burned to form ions. These ions are then passed through an area in which differential potentials are applied between two plates, which cause a current to form. This current can then be detected and used for sample identification and quantification (Skoog *et al.* 2007). This detection system is easy to use and has high sensitivity; however, a shortfall with the system is that the sample is destroyed by the burning process (Skoog *et al.* 2007,Stauffer *et al.* 2007). Furthermore, FID systems are limited when it comes to its ability to uniquely identifying compounds (Skoog *et al.* 2007, Stashenko and Martinez 2014). It is for this reason that GC systems utilise MS as a detection unit as they are more suited to the specific identification and quantification of sampled compounds. The separated compounds from the GC are transferred to the MS through the transfer line, where the molecules of the compound are detected (Figure 3.9).

Mass spectrometry (MS) is an analytical technique which ionises and fragments chemical species, and sorts these species based on their mass to charge (m/z) ratio, to quantitatively

and qualitatively identify them (Skoog *et al.* 2007, Gross 2011). Given that most of the ions have a single charge, the m/z ratio in most cases is equal to the mass number of the ion (Skoog *et al.* 2007). The mass spectrometer has an ion source, which is used to bombard the sample into ions and fragment, a mass analyser and a detector (Gross 2011). The ionisation process in MS is non-destructive as compared to the FID ionisation process, which destroys the sample. This non-destructive ionisation process of the MS, allows for the fragmentation of compounds, which can then be used as a fingerprint for sample identification due to the specificity of compound fragmentation patterns. The mass analyser separates the ions based on the m/z ratio and the detector measures the relative abundance of these ions in a sample and the fragmentation patterns of the sample. In the current study the time-of-flight (TOF) mass analyser was used (Figure 3.10). With this type of analyser, the ions are initially accelerated by an electric field pulse, before entering a one meter long field free tube, where the ions drift towards a detector with a velocity inversely proportional to the mass of the ions (Skoog *et al.* 2007,Stauffer *et al.* 2007). The mass of specific compounds can be determined by calculating the time of flight of the compound from the time it enters the drift tube to the time it hits the detector. The output of the entire process is displayed on the data processing unit, where the quantification and specific identification of compounds and molecules are presented. The current study used ChromaTOF software version 4.51.6. (LECO, USA) for the data processing

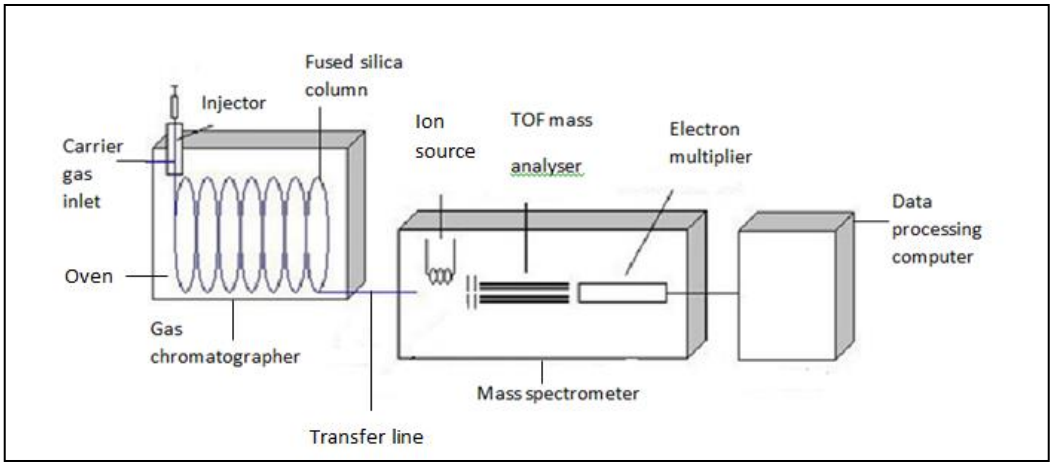

Figure 3. 9 Schematic diagram of GC-MS instrument with main components (After Skoog *et al.* 2007).

The same analysis procedure was followed for both the off-peak and peak samples. First the sample preparation and desorption steps of the charcoal sorbent tubes, prior to sample introduction into the GC-MS, will be detailed. Second, the GC method presented. Third, the MS instrumental parameter will be presented. And finally the data output and subsequent data clean-up process will be expanded upon.

3.7.1. Sample Preparation

The front, and back sections of the sorbent tube were transferred into two separate 15 mL centrifuge tubes and 2 mL (Khoder 2007) of 99% pure CS_2 (Skylabs, South Africa) was added into the tubes. Thereafter, for a more effective desorption of the BTEX from the charcoal into the solvent, the mixture was sonicated for 10 minutes in a sonicator at room temperature (Shiohara *et al.* 2005). After sonication, one micro-litre (µL) of solvent was injected into the injection port of the GC using a Gerstel Multi-Purpose Auto Sampler (Gerstel, Germany). This was done three times for each sample for triplicate measurements.

3.7.2. Gas Chromatography Method

A fused silica column (Stabilwax, Restek, USA) with the length of 28.98 m, internal diameter 250 µm and film thickness of 0.25 µm was used. The carrier gas used was Helium. The flow rate was 1.4 ml/min at constant flow while the injector temperature was 200°C (Table 3.2). The initial oven temperature of 35°C for maintained for 5 minutes and ramped at 25°C/min, to 250°C and held at this temperature for 1 minute (Table 3.2). The transfer line temperature into the MS was 250°C. The oven temperature settings were considered appropriate given that it covered the range of boiling points of all BTEX compounds being analysed. The parameters set for the GC in this study did not follow a standardised protocol but rather method development was conducted experimentally through lab trials.

3.7.3. Mass Spectrometer Instrument Parameters

An acquisition delay of 3 minutes and a mass range of between 30 to 250 m/z, was used (Table 3.2). The acquisition delay was set to allow for solvent molecules to pass through the MS without being ionised and detected (Fiehn 2016). This is to eliminate the effects of the solvent on the sample analysis. Thus, the affluent from the GC passed for three minutes through the MS before ionisation begins. The mass range between 30 – 250 m/z was used based on the mass range of BTEX compounds present in the sample. The ion source (ionisation energy) was -70 eV which was in keeping with the international standard convention for ionisation energy (Stashenko and Martinez 2014). This ionisation energy was used to experimentally determine the fragmentation patterns of compounds used in National Institute of Standards spectral library data base, which is used as a comparison to identify

compounds based on their similarity to the library search results. The library search used in this study for the identification of the BTEX compounds from the mass spectrometer was Replib and Mainlb. These library data bases are programmed into the ChromaTOF (LECO, USA) software used on the systems data processing unit.

Table 3.2. Summary of Instrument Specifications

Instruments and Parameters	**Specification**
GC-MS	GC (Agilent 7098B, USA) coupled to TOF MS (LECO, USA)
Column	Stabiwax (28.986 m)
Carrier gas	Helium
Flow rate	1.4 ml/min
Injection volume	1 µL
Injector temperature	200°C
Oven temperature	35°C ramped to 250°C at 25°C/min
Transfer line	250°C
Acquisition delay	3 minutes
Mass scan range	30 – 250 m/z
Ionization energy	-70 eV

3.7.4. Data Processing and Unit Conversions

The raw data output obtained from the GC-MS analysis can be seen in Appendix B. The front and back sections of the sorbent tubes were analysed separately and three measurements were made of each sample. Firstly, the three concentration measurements for each BTEX compounds were averaged to get one value for benzene, toluene, ethylbenzene and xylene for each samples front and back sorbent section. These concentration results were presented in part per billion. The results were then then converted to a concentration in micrograms per cubic meter ($\mu g/m^3$) by the equation provided below. This was done as these units ($\mu g/m^3$) represent the conventional reporting units within the field and that the given equation takes

into account the sampled air volume (V_a) and the extraction volume (V_{ext}); which if ignored would not present a result indicative of the sampled environment.

The equation was :

$$C_a = \frac{(C_s - C_b) \times V_{ext}}{V_a}$$

Where:

C_a = concentration of ion "x" in the sampled air with units $\mu g.m^{-3}$

C_s = concentration of ion "x" in sample solute (total of front and back sorbent tube sections), reported in ppb $\equiv \mu g.L^{-1}$

C_b = concentration of ion "x" in laboratory blank solute (total of front and back sorbent tube section), reported in ppb $\equiv \mu g.L^{-1}$

V_{ext} = extraction/leaching volume, measured in Litres (L)

V_a = volume of air sampled with units m^3

After the addition of the front and back sorbent sections, subtraction of the lab blank values and unit conversion, the final BTEX concentration results were reached. The negative values obtained from the raw data were omitted as these values were redundant in terms of any further analysis.

3.8. Quality Assurance

As part of the analytical procedure to accurately determine the BTEX concentrations from field sampling and to potentially identify sources of sample contamination, various blank samples were analysed. As mentioned previously, two and three field blank samples were

taken for both off-peak and peak sampling campaigns, respectively. In addition, three and eight CS_2 solvent blank samples were analysed during the off-peak and peak sampling campaigns, respectively. One lab blank was analysed during each campaign.

The CS_2 is the solvent used to extract the BTEX compounds from the coconut charcoal matrix during the sample preparation stages of the lab analysis. By analysing the solvent blanks it can be determined whether or not any analytes of interest (BTEX) are present in the solvent. This solvent is highly effective in recovering VOCs from activated charcoal; however, it is easily contaminated as it is able to adsorb compounds from the air, most notable benzene vapours (Czaplicka and Klejnowski 2002). Furthermore, for the analysis of lab blanks, unused charcoal sorbent tubes are opened in the lab and immediately extracted using the CS_2 solvent and analysed. For these samples no air was drawn through them. The lab blanks are used as a baseline or background value from which the field sample concentrations are subtracted from. The lab blanks could identify laboratory sources of contaminations, such as the lab air or the solvent being used. The field blanks are used to determine the introduction of BTEX compounds from sources other than the sampled air. Field blank samples were transported to the field, snapped open and immediately capped without air being pumped through them (Khoder 2007). They are transported, stored and analysed in the same manner as actual sampled tubes and could identify field or laboratory sources of sample contamination.

3.9. Statistical Analysis of Data Obtained from the Off-peak and Peak Sampling Campaigns

This study used the following statistical methods for data analysis. A paired sample t-test was used to determine statistical significance of the measured on-board temperature and humidity with that of the ambient levels measure at the corresponding times. An independent sample t-test was used to compare mean BTEX concentrations between the off-peak and peak sampling times. An ANOVA test was used to analyse the BTEX concentrations across sampling routes. And correlation tests were used to determine the relationship between BTEX concentrations and on-board temperature and humidity; and relationships amongst BTEX species.

The t-test is useful in that it can be used to compare the means of two samples and determine whether or not there is a significant difference between them (McDonald 2009). The t-value calculated from the t-test is the standardised measure of the difference in means between the two samples and is used in conjunction with the t distribution to either accept or reject the given hypothesis (Mcdonald 2009, Illowsky and Dean 2018). With the t-test, two hypothesis are being tested; the null hypothesis, which assumes that there is no difference between the means of the two samples and the alternative hypothesis which assumes that there is a difference in means between the two samples (e.g. mean ambient temperature vs mean on-board temperature or mean peak vs off-peak BTEX concentrations) (McDonald 2009). The null hypothesis is rejected if the p-value obtained from the t-test is below the significance level (Illowsky and Dean 2018). The p-value is the probability of observing a difference between samples, assuming the null hypothesis is true. The significance level is a limit set below which the null hypothesis is rejected. In this study the significance level (α) used was

0.05, which means that a p-value below this level can with 95% confidence be attributed to differences between the two samples and not as a result of random variation (McDonald 2009, Illowsky and Dean 2018).

The ANOVA test was used to test if there was a significant difference between the means of BTEX concentrations amongst sampled routes for both campaigns. The null hypothesis was that there was no difference and the alternative hypothesis was that at least two pairs of sample means were different at a significance level of 0.05. The ANOVA test similar to the t-test; however, instead of testing the difference between two sample means, the ANOVA tests the difference between three or more sample means (McDonald 2009). The ANOVA test is used to calculate the F-value, which is the ratio between the variation between sample and the variation within samples; which when used in conjunction with the f distribution can test the given hypothesis (Mcdonald 2009).

BTEX concentrations were presented as mean ± standard error (SE). The SE was included to indicate the degree of uncertainty around the mean estimate for each compound measured (Altman and Bland 2005). The SE takes into consideration the sample standard deviation (SD) and sample size (n) and is calculated using the equation; $SD \div \sqrt{n}$ (Altman and Bland 2005). The larger the sample size the smaller will be the standard error (McDonald 2009).

Furthermore, the Pearson's correlation tests were used to determine possible linear relationships between the on-board temperature, humidity and on-board BTEX concentrations. It was also used to determine the interspecies relationships of BTEX

compounds for both campaigns. The correlation coefficient (r) value obtained from the Pearson's correlation appear between -1 and 1, and signifies either no linear relationship between variables (r = 0) or perfect positive (1) or negative (-1) linear relationships (Illowsky and Dean 2018). Intermediate values can be described as having a weak, moderate or strong positive or negative relationship.

The T/B ratios were obtained by dividing the final toluene concentration (μ/m^3) with the final benzene concentration (μ/m^3) for every sample which had measured pair of these compounds for both off-peak and peak campaigns (see Appendix B).

The statistical analysis was conducted using the R software package (Core Team 2013) together with Microsoft Excel 2016.

4. CHAPTER IV

RESULTS

4.1. Introduction

The aim of this project was to determine the concentrations of BTEX compounds on-board in-service buses given the routes travelled during off-peak and peak commutes, and to determine the factors which may affect these concentrations. The following section presents the results of the study. Firstly, the route descriptions and field observations during the off-peak and peak sampling campaigns are reported, together with the on-board temperature and humidity data. Secondly, the results from the respective sampling campaigns are presented with regards to the data associated with the analytical procedures, which included blank charcoal tube, blank CS_2 and field blank concentrations, together with the actual BTEX concentrations obtained from the field sampling. Thirdly, the results from the statistical analysis of the BTEX concentration field data for both off-peak and peak campaigns are presented. And finally, the toluene and benzene ratios (T/B) are presented together with the interspecies correlations amongst the BTEX compounds and the on-board temperature and humidity.

4.2. Off-peak Route Descriptions and Field Observations

The off-peak sampling campaign was conducted in Johannesburg between the 21st November and 7th December 2017. A total of 19 trips were made on-board ten different buses along three routes (routes A, B and C). All ten buses represented the same bus engine type (Mercedes-Benz O500m 1725L) (see Figure 3.1). Routes A, B and C started at Ghandi

Square and travelled out of the Johannesburg CBD to their end points in Lombardy East, Rosebank and Morningside, respectively.

4.2.1. Route A

Route A was 17.7 km long and started in the Johannesburg CBD at Ghandi Square and traversed the CBD through Hillbrow, Parktown, Houghton Estate and Orange Grove to its end point at Lombardy East (Figure 4.1). The Johannesburg CBD and Hillbrow are heavily populated commercial and residential areas characterised by high buildings and three to four laned roads in some places and narrow single laned roads at others. The buses travelling along this route passed through a small section of the commercial area of Parktown. Thereafter, the buses travelled east-ward along a two laned road surrounded by multi-storey flats in Yeoville on one side and Houghton on the other. Due to heavy construction along this road (Louis Botha Ave) (Figure 4.1) traffic congestion occurred frequently. After travelling on Louis Botha Ave the buses travelled through Orange Grove and finally Lombardy East. These areas are residential areas with low lying building, two laned roads and freely moving traffic.

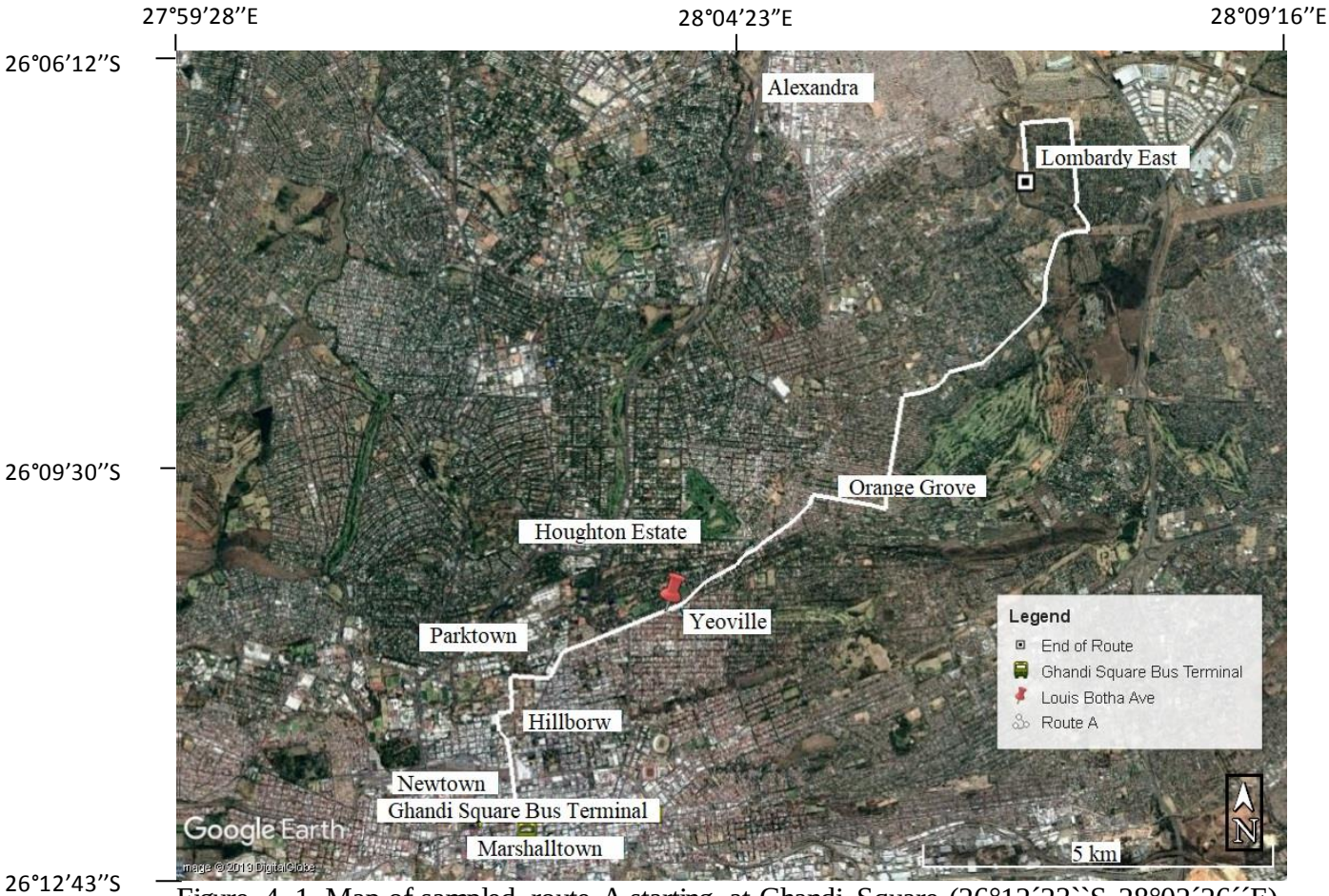

Figure 4. 1. Map of sampled route A starting at Ghandi Square (26°12´23``S 28°02´26´´E) and ending at Lombardy East (26°07’40”S 28°06’64”E).

Figure 4.2 illustrates the topographic profile for Route A which started at an elevation of 1759 m above sea level and ended at an elevation of 1546 m. The maximum elevation along the bus route occurred at approximately 2.1 km into the journey with an elevation of 1786 m whereas as the minimum elevation occurred towards the end of the bus route at approximately 17.3 km into the journey with an elevation of 1531 m (Figure 4.2). The initial 6 km of the route profile fluctuated within an elevation range of 45 m with gradual inclines and declines in the road. After approximately 6 km the elevation of the bus route gradually decrease, with minor undulations, to its end point. Overall, there is a general downhill trend in the profile from the beginning to the end with a net decrease in elevation of 255 m.

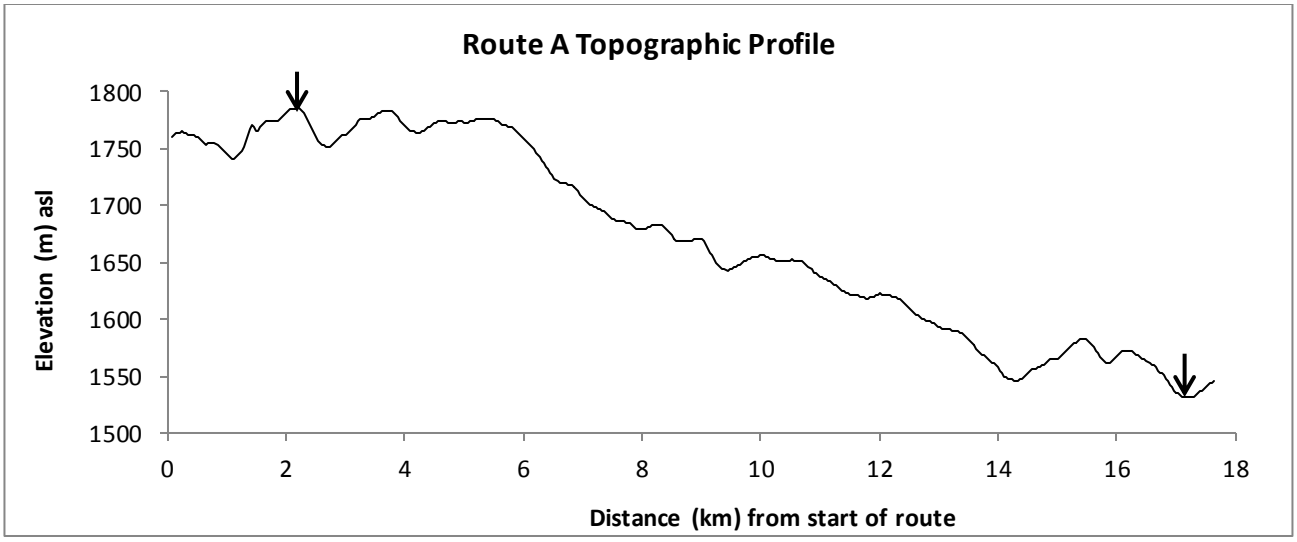

Figure 4. 2. Route A topographic profile starting at Ghandi Sqaure (0 km) and ending at Lombady East (17.7) with arrows identifying the highest and lowest elevations of the route (vertical exageration (VE) x 16).

4.2.2. Route B

Route B was 17 km long and travelled a similar course to route A. Buses travelling along Route B started at Ghandi Square and passed through Hillbrow, Houghton Estate, Orange Grove, Highlands North, Bramley and ended in Rosebank (Figure 4.3). The first leg of the route through Marshalltown and Hillbrow was characterised by highly populated commercial, residential and industrial areas surrounded by high buildings and congested 2-3 laned roads with frequently occurring traffic lights and stop streets. The next leg of the route traversed along a north easterly direction for approximately 8.5 km until reaching Bramley. This section of the route was flanked by sections of residential areas with low-lying single-story homes, flats and commercial areas lined with shops and large businesses. Finally, the bus route terminated in the commercial district of Rosebank.

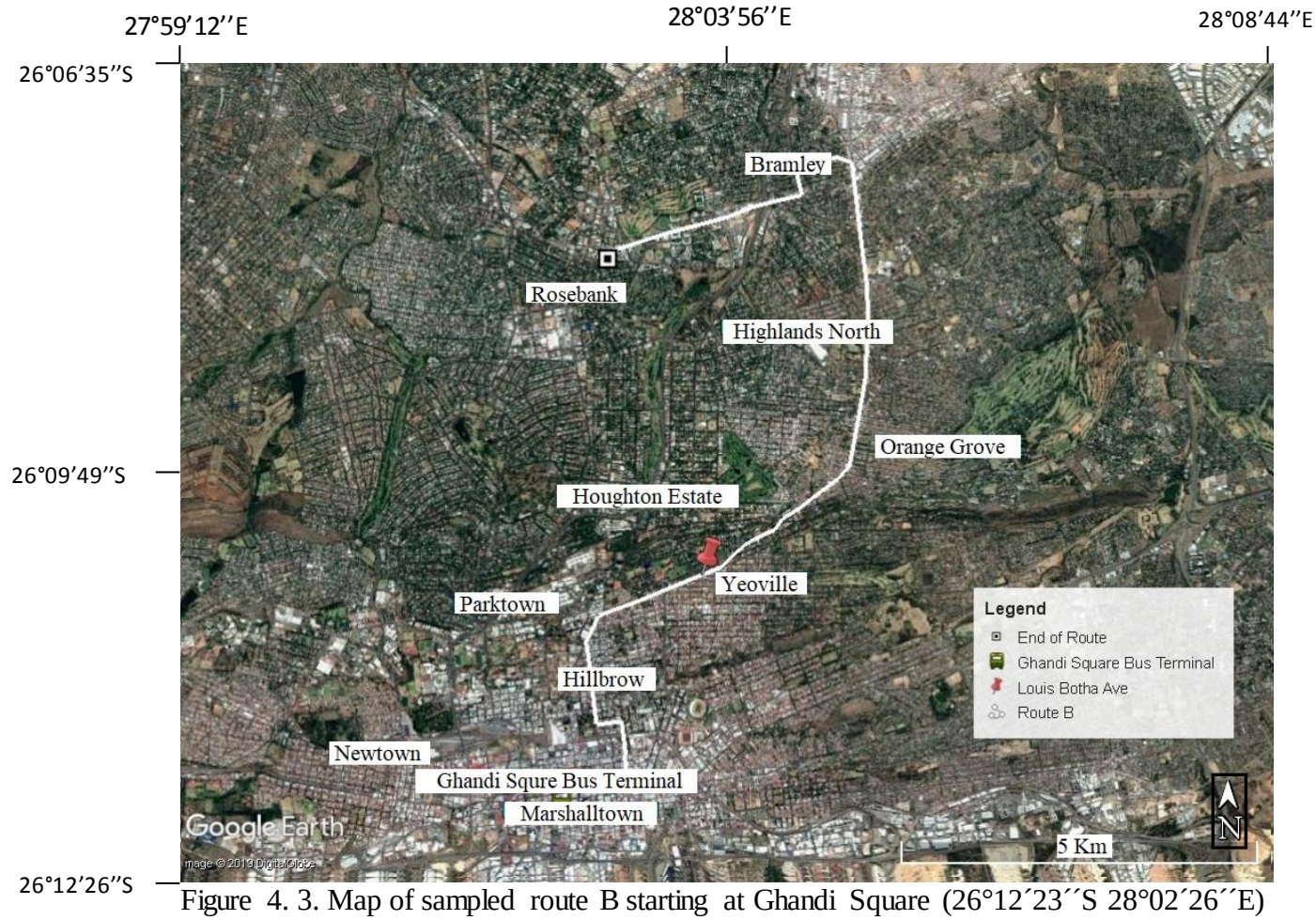

Figure 4. 3. Map of sampled route B starting at Ghandi Square (26°12´23´´S 28°02´26´´E) and ending in Rosebank (26°08’06”S 28°02’53”E).

Buses travelling along Route B started at an elevation of 1759 m above sea level and ended at an elevation of 1686 m (Figure 4.4). The maximum elevation along the route was 1798 m while the lowest point on the route was 1581 m. As with Route A, the first 6 km of the route exhibits moderately gentle inclines and declines. For example, between 2 – 3.7 km there is a rise of approximately 55 m. After 6 km of the tracked route, a general decline in elevation persists until 14.4 km, where the route begins an incline. Overall, there is a general downhill trend in the profile from the beginning to the end with a net decrease in elevation of 74 m.

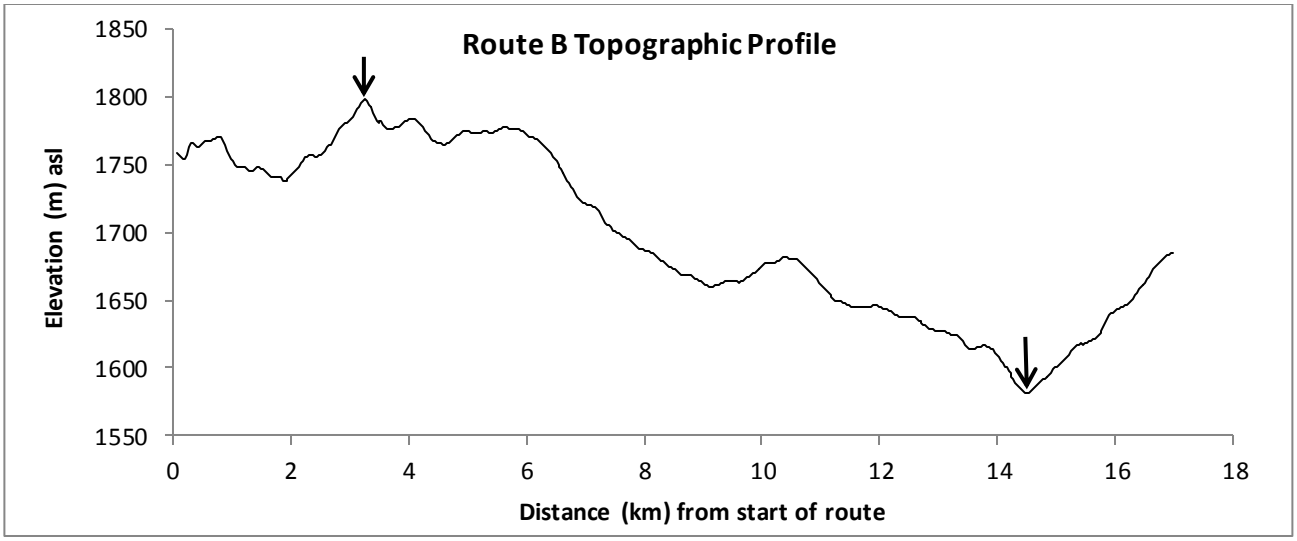

Figure 4. 4. Route B topographics profile starting at Ghandi Sqaure (0 km) and ending at Rosebank (17 km) with arrows identifying the highest and lowest elevations on the route (VE x 16).

4.2.3. Route C

Route C was 17 km long and started at Ghandi Square and ended in Morningside (Figure 4.5). This route followed the same course as Route A until Parktown where it diverged onto Oxford Road. Oxford Road predominantly passes through residential areas with the exception of Rosebank, where large buildings and shopping complexes dominate the landscape. After approximately 6.5 km, Oxford Road becomes Rivonia Road, where the areas is predominantly surrounded by commercial and business areas and traverses through the centre of Sandton, which is dominated by tall buildings, shopping complexes and a high density of people and traffic.

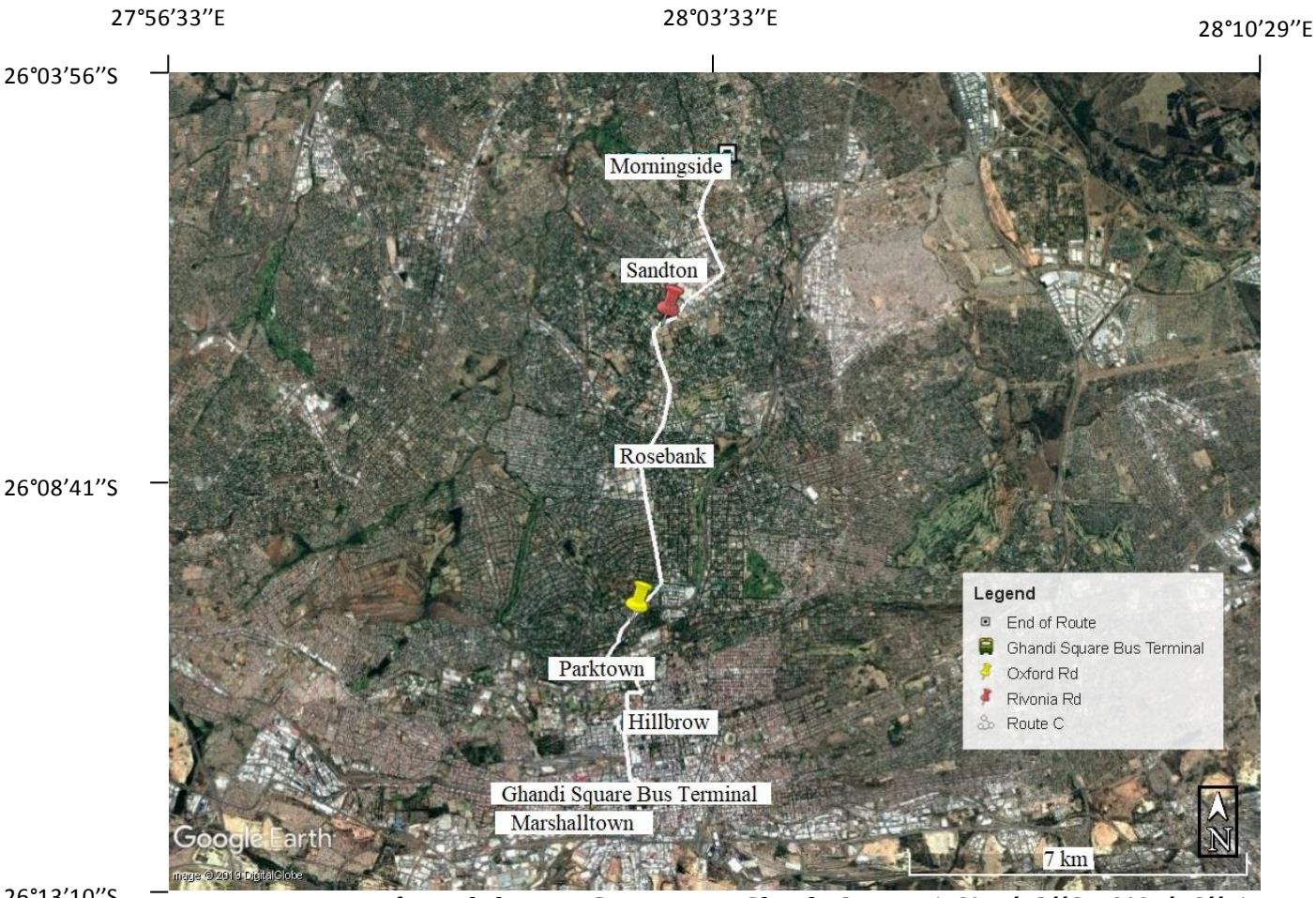

Figure 4. 5. Map of sampled route C starting at Ghandi Square (26°12´23´´S 28°02´26´´E) and ending at Morningside (26°04’56”S 28°03’41”E).

The starting point elevation of Route C is the same as Routes A and B given that they all started at Ghandi Square (Table 4.6). Route C, as with the previous routes exhibits moderate inclines and declines in the profile for the initial few kilometres, where it then begins a gradual and gentle decline in elevation up until its final point. The maximum and minimum elevations reached along the route were 1785 m and 1566 m respectively (Table 4.6). The net decrease in elevation along the route was 195 m.

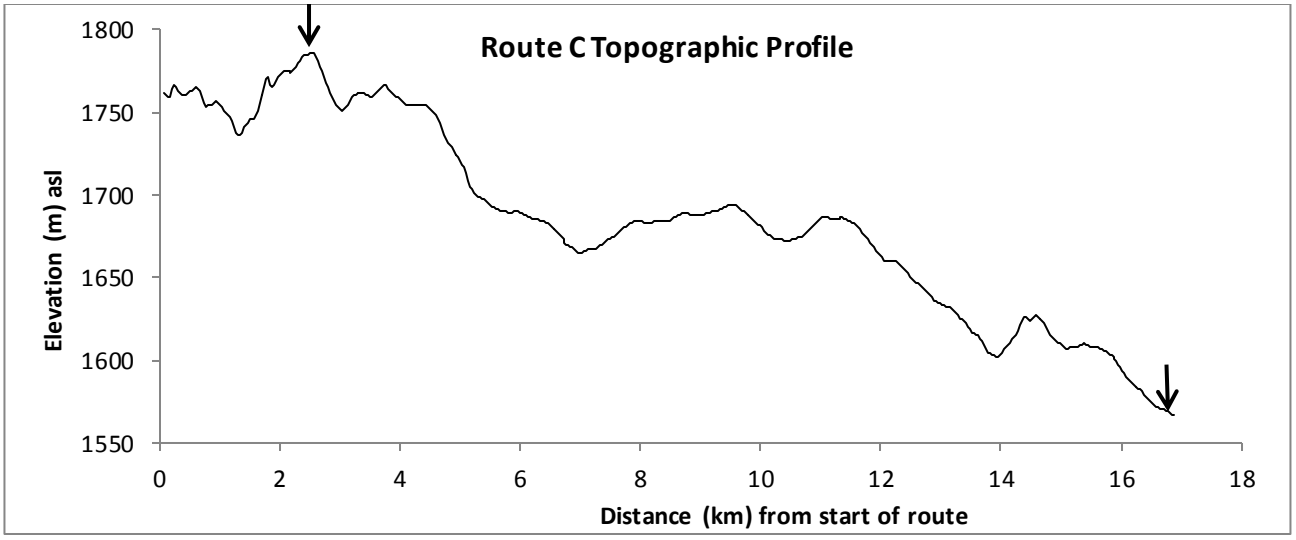

Figure 4. 6. Route C topographic profile starting at Ghandi Sqaure (0 km) and ending at Morningside (17 km) with arrows identifying the highest and lowest elevations on the route (VE x 16).

4.2.4. Field Observations During the Off-peak Sampling Campaign

For the off-peak sampling, three routes were chosen (Route A, B and C). These buses travelled along routes which all started at Ghandi Square, traversed the Johannesburg CBD and ended at their respective locations (see Figures 4.1, 4.3 and 4.5). During the initial stages of the journey through the Johannesburg CBD, the roads were highly congested with traffic along all routes, even though it was the off-peak time. The inner city is characterised as having tall buildings and narrow streets with frequently occurring traffic lights and stops. The inner city congestion was dominantly made up of passenger cars, delivery trucks and vans, commuter taxis and buses. The buses did not travel in dedicated bus lanes and due to the high traffic volume within the inner city the buses' movement was staggered with frequent and erratic sharp breaking and stopping, and instances of rapid acceleration. Aggressive driving is characterised by sharp breaking and rapid acceleration and results in poor fuel economy and increased tailpipe emissions (Clark *et al.* 1999). As the sampled buses travelled out of the city

the traffic density decreased, especially through the residential areas, which allowed for smoother and more regular driving conditions. However, certain sections of road along some route areas, for example through Rosebank and Sandton (Figure 4.5) were noted to have slow moving traffic even during the off-peak times.

The on-board ventilation was achieved through the opening and closing of the windows as none of the buses were fitted with air conditioning (AC). For this campaign all the windows were open (Table 4.1). The windows were opened or close depending on the preference and comfort of the passengers and given that this campaign was conducted during summer, the passengers resorted to opening the windows once boarded, due to the heat. It was also noted during this campaign that due to the hot weather, drivers would drive with the doors open to increase ventilation through the bus which resulted in increased air turbulence within the bus cabin.

The carrying capacity of the buses was 70 passengers and during the off-peak trips across all routes none of the buses exceeded a 30% passenger count (Table 4.1). This observation represented the maximum number of passengers on the bus at any given time during the sampling period. During this campaign, only a few people boarded the buses at Ghandi Square and subsequently along the route the bus would stop frequently to pick up and drop off passengers. These stops were not made at designated bus stops but rather randomly along the roads as required. During the sampling duration the buses doors were opened and closed in the range of approximately 18 – 30 times. However, keeping exact count of this number was difficult due to the driver keeping the doors open and driving for extended periods.

Table 4. 1. Field descriptions of samples collected during the off-peak campaign

Sample no.	Date[a]	Bus no.	Bus type[b]	Route[c]	Ventilation	% of Passengers[d]	Sampling Time
1	21/11/17	4100	DDF	B	Windows open	<30%	12:30pm - 1:30pm
2	21/11/17	4064	DDF	C	Windows open	<30%	11:30am - 12:30pm
3	22/11/17	4058	D	B	Windows open	<30%	11:30am - 12:30pm
4	22/11/17	4064	DDF	C	Windows open	<30%	11:30am - 12:30pm
5*	23/11/17	4058	D	B	Windows open	<30%	
6	23/11/17	4058	D	B	Windows open	<30%	11:30am - 12:30pm
7	23/11/17	4058	D	B	Windows open	<30%	11:30am - 12:30pm
8	23/11/17	4100	DDF	C	Windows open	<30%	12:30pm - 1:30pm
9	28/11/17	4058	D	C	Windows open	<30%	11:05am - 12:05pm
10	28/11/17	4100	DDF	B	Windows open	<30%	12:45pm - 1:45pm
11	28/11/17	4058	D	C	Windows open	<30%	11:32am - 12: 32pm
12	29/11/17	4064	DDF	C	Windows open	<30%	11:30am - 12:30pm
13	29/11/17	4033	D	B	Windows open	<30%	11:30am - 12:30pm
14	29/11/17	4100	DDF	C	Windows open	<30%	12:30pm - 1:30pm
15*	30/11/17	4036	D	B	Windows open	<30%	
16	30/11/17	4100	DDF	C	Windows open	<30%	12:30pm - 1:30pm
17	30/11/17	4036	D	B	Windows open	<30%	11:04am - 12:04pm
18	30/11/17	4078	D	A	Windows open	<30%	1:05pm - 2:05pm
19	30/11/17	4064	DDF	C	Windows open	<30%	11:30am - 12:30pm
20	6/12/17	4048	D	A	Windows open	<30%	1:10pm - 2:10pm
21	6/12/17	4037	DDF	B	Windows open	<30%	11:05am - 12:05pm
22	7/12/17	4046	D	B	Windows open	<30%	11:20am - 12:20pm
23	7/12/17	4081	D	A	Windows open	<30%	1:05pm - 2:05pm

Notes:
a – the date on which the sample was collected
b – D-Diesel, DDF-Diesel Dual Fuel
c – refer to Figures 4.1, 4.3 and 4.5
d – total carrying capacity of 70 passengers
* - field blank samples

Figure 4.7 presents the average daily temperature (°C) across all routes for the duration of the off-peak sampling campaign in comparison to the ambient temperature measured at the weather monitoring station during the corresponding sampling time intervals. In general it can be seen that the temperature on-board the bus was higher than the ambient temperatures. It is also noted that the on-board and ambient temperatures followed a similar pattern in that an increase in ambient temperatures resulted in an increased on-board temperature. Similarly, a decrease in ambient temperature caused on-board temperatures to also decrease (Figure 4.7). The analysis of the Pearson's correlation revealed a strong positive relationship between the ambient and on-board temperatures (r = 0.98). The on-board temperatures ranged between 23.7 – 31.5°C with a mean of 27.8°C, while the ambient temperatures within the same period ranged between 18.5 – 31.3°C with a mean value of 24.7°C (Table 4.2). The mean on-board temperature was found to be significantly higher than the ambient temperatures ($p<0.002$) (Table 4.3).

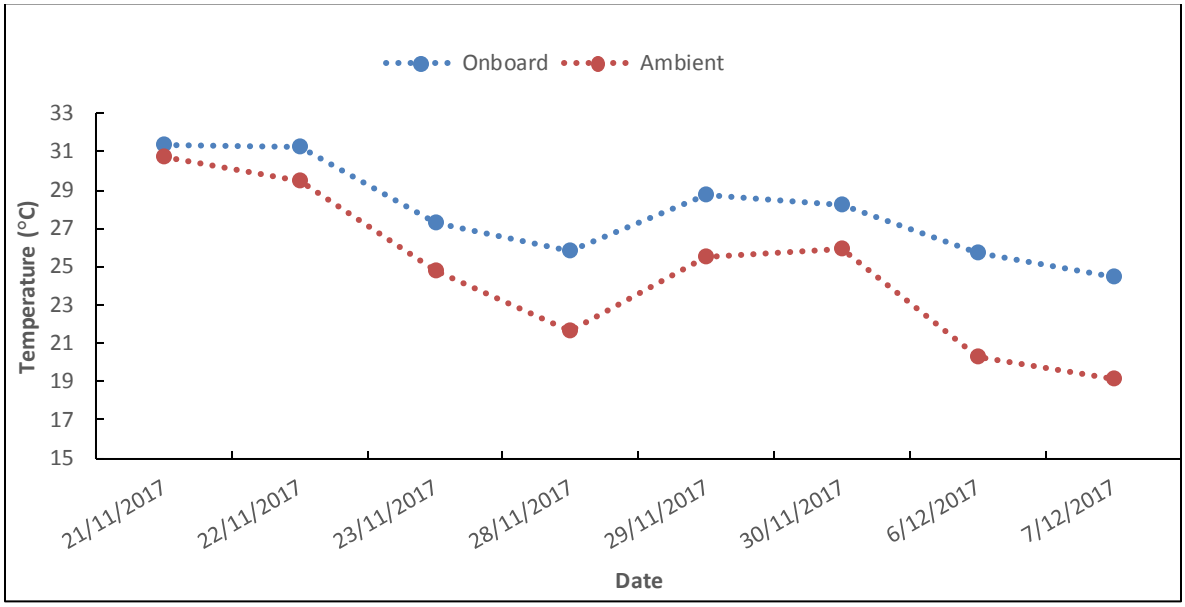

Figure 4. 7. The on-board and ambient temperatures (°C) averaged per sampling day during the off-peak sampling period. Dotted lines represent visual trend.

Table 4. 2. Data summary of on-board and ambient temperatures (°C) measured during the off-peak campaign

	Temperature (°C)	
	On-board	Ambient
Minimum	23,7	18,5
Mean	27,82	24,7
Maximum	31,52	31,3
Range	7,82	12,8
Standard Deviation	2,39	3,61

Table 4. 3. Data summary of paired sample t-test analysis of mean on-board and ambient temperatures measures during off-peak sampling

	Mean	T –Value	P – Value ($\alpha = 0.05$)	
Temperature (°C)				
On-board	27,82	3.2976	0.002	P < 0.05
Ambient	24,7			

4.3. Peak Campaign Route Descriptions and Field Observations

The peak sampling campaign was conducted in Johannesburg between the 16th April and 18th May 2018, during the peak morning commute times (6:00 am – 8:30 am) During this period, a total of 42 bus trips were taken on-board 12 different buses travelling along three routes (Route D, E and F) (Figures 4.8, 4.9 and 4.10).

4.3.1. Route D

Route D was 15.3 km long and buses travelling along this route departed from Ghandi Square and travelled in a north westerly direction and ended in Blairgowrie (Figure 4.8). The initial 3 km of the route passes through the Johannesburg CBD and Parktown. These areas are highly

populated commercial and residential areas characterised by tall buildings and congested roads with frequently occurring stop and go traffic. From Parktown, the buses moved onto Jan Smuts Avenue. Jan Smuts Avenue passes through residential, business and commercial areas (Figure 4.8). At some points along the route the road is singled laned and at other segments, 2-3 laned roads are present. Jan Smuts Avenue passes areas such as Saxonwold, which is a residential area, Rosebank, which is a commercial and business area, and Hyde Park, which has sections of residential and business areas. During the morning peak commute vehicles travelling on Jan Smuts Ave experienced slow moving traffic and heavy congestion. After traversing Jan Smuts Ave, the buses travelling along this route terminated in the residential area of Blairgowrie.

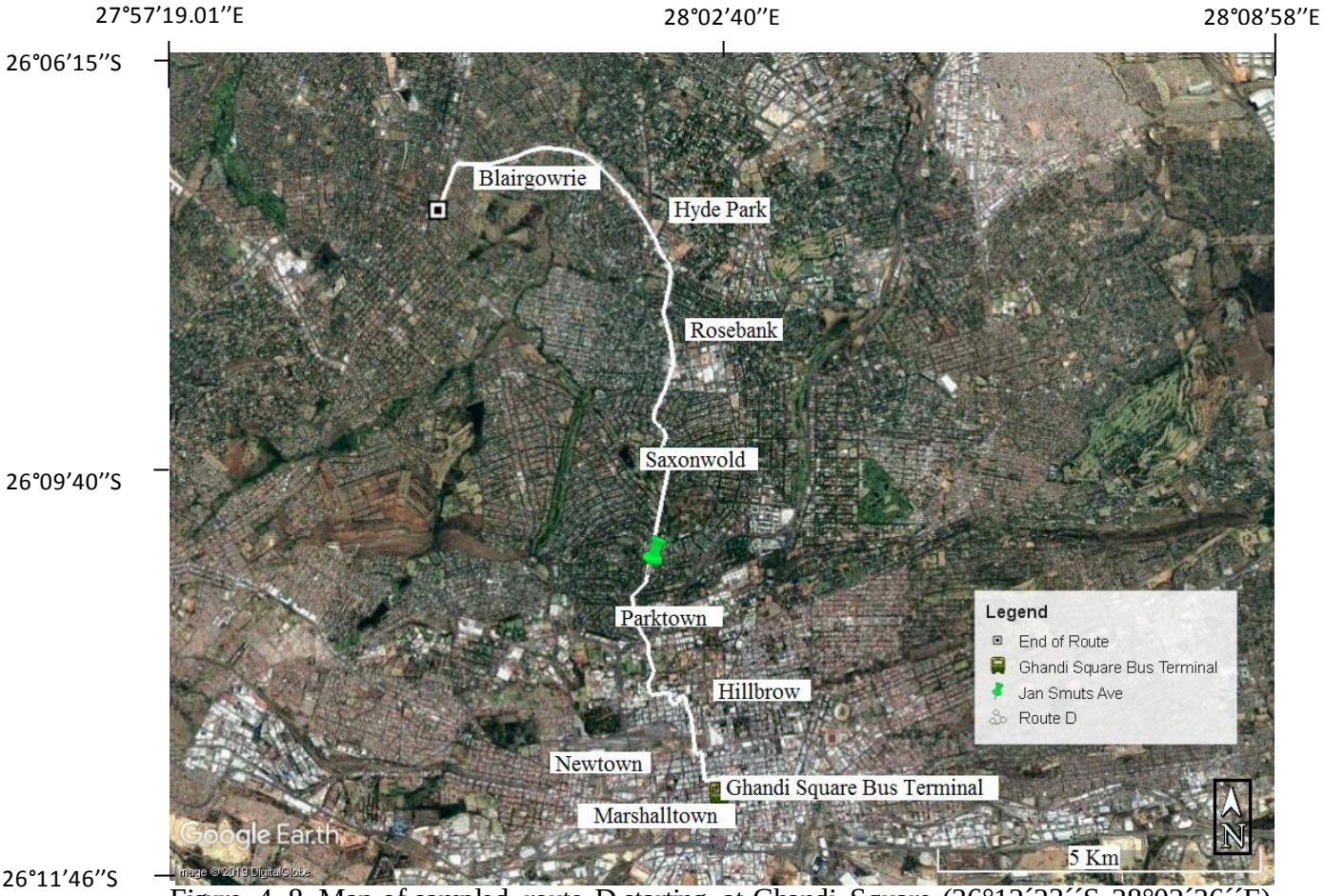

Figure 4. 8. Map of sampled route D starting at Ghandi Square (26°12´23´´S 28°02´26´´E) and ending at Blairgowrie (26°07'22"S 27°59'52"E).

Buses travelling along route D began the journey at an elevation of 1758 m above sea level, reaching its highest and lowest elevations at 1776 m and 1538 m respectively, and came to an end at an elevation of 1645 m (Figure 4.9). As with the other routes, vehicles travelling along this route experienced gradual and moderate to low inclines and declines in the route elevation. There was a decreasing trend in elevation from the beginning to the end of the route with an elevation change of 113 m.

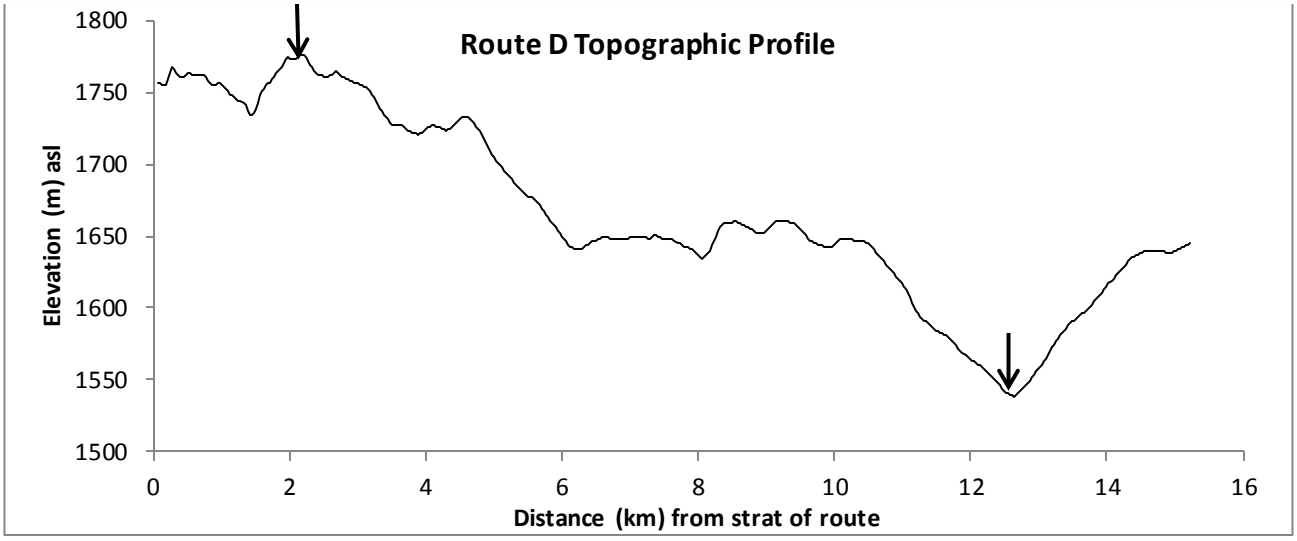

Figure 4. 9. Route D topographic profile starting at Ghandi Sqaure (0 km) and ending at Blairgowrie (15.3 km) with arrows identifying the highest and lowest elevations on the route (VE 16).

4.3.2. Route E

Route E covered a distance of 20.4 km. Buses travelling along this route started at Ferndale, trended in a south easterly direction, and ended at Ghandi Square (Figure 4.10). Initially the buses traversed the residential area of Ferndale into the business district of Randburg. This section of Randburg was dominated by high-rise office buildings and businesses and during the day, this area is a hub of activity. However, at the time the sampled buses passed through the area the roads were quiet with sparse traffic, which allowed for a quick and unhindered

transit. The route traversed Bram Fischer Drive and then Barry Hertzog Avenue, which passed through Blairgowrie, Linden, Greenside, and Melville (Figure 4.10). This route is dominantly surrounded by residential areas which are characterised by low lying residences and wider roads as compared to the inner city roads which are narrower and more congested. Finally, the buses traversed through Braamfontein and Hilbrow before coming to a stop at Ghandi Square (Figure 4.10).

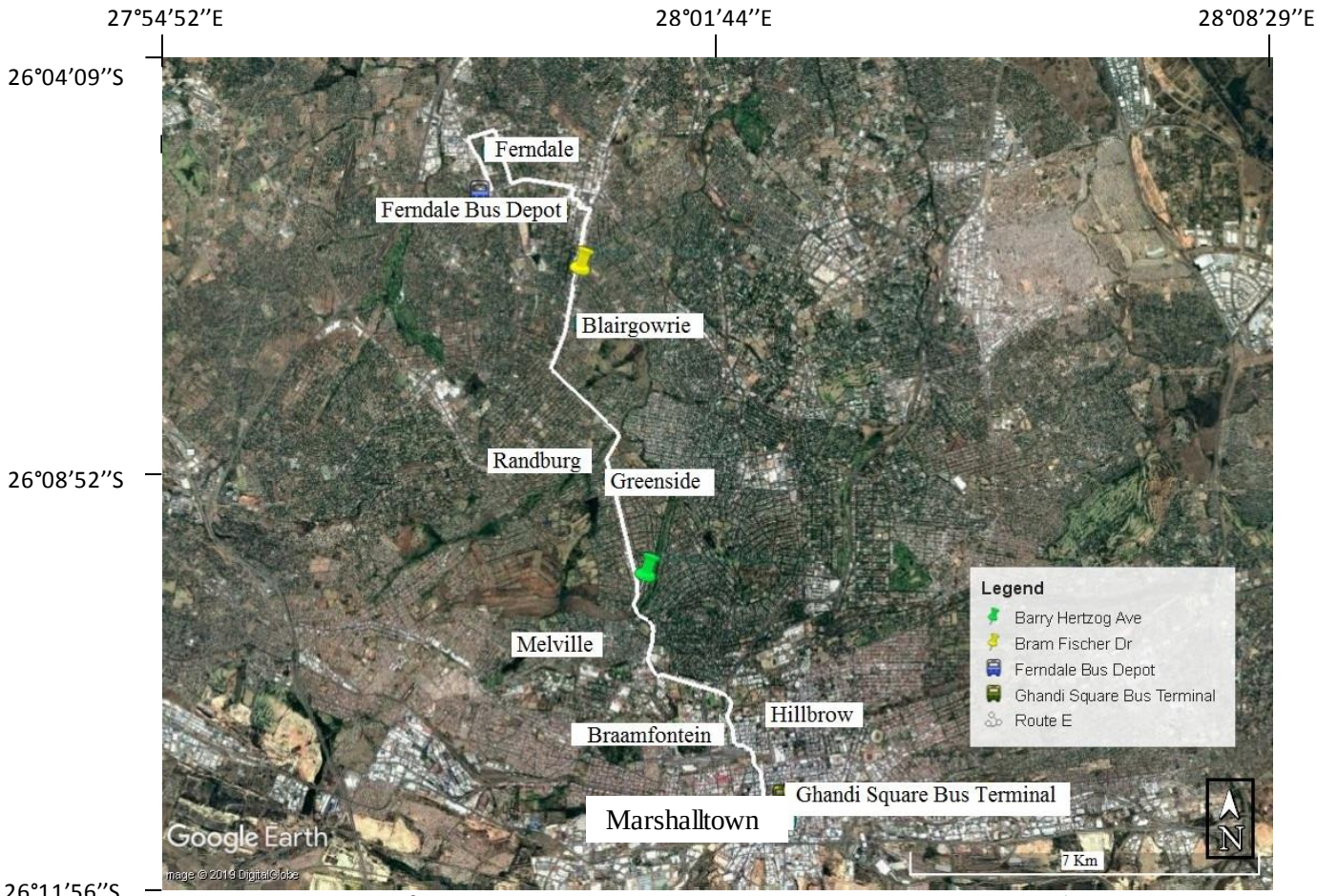

Figure 4. 10. Map of sampled route E starting at the Ferndale Bus Depot (26°05'33"S 27°58'51"E) and ending at Ghandi Square (26°12´23´´S 28°02´26´´E).

Route E has a similar topography as compared to all the other routes (A, B, C, D and F), however, instead of starting at Ghandi Square, the bus route began at Ferndale and traverses the various areas towards its end point at Ghandi Square. This is the only profile which

exhibits a net increase of 227m in elevation from the beginning at 1529 m until its ending point at 1756 m (Figure 4.11). The route has a minimum and maximum elevation of 1517 m and 1766 m respectively (Figure 4.11), and other than the route having a positive gradient, no distinct features on this route distinguish it from the other travelled routes.

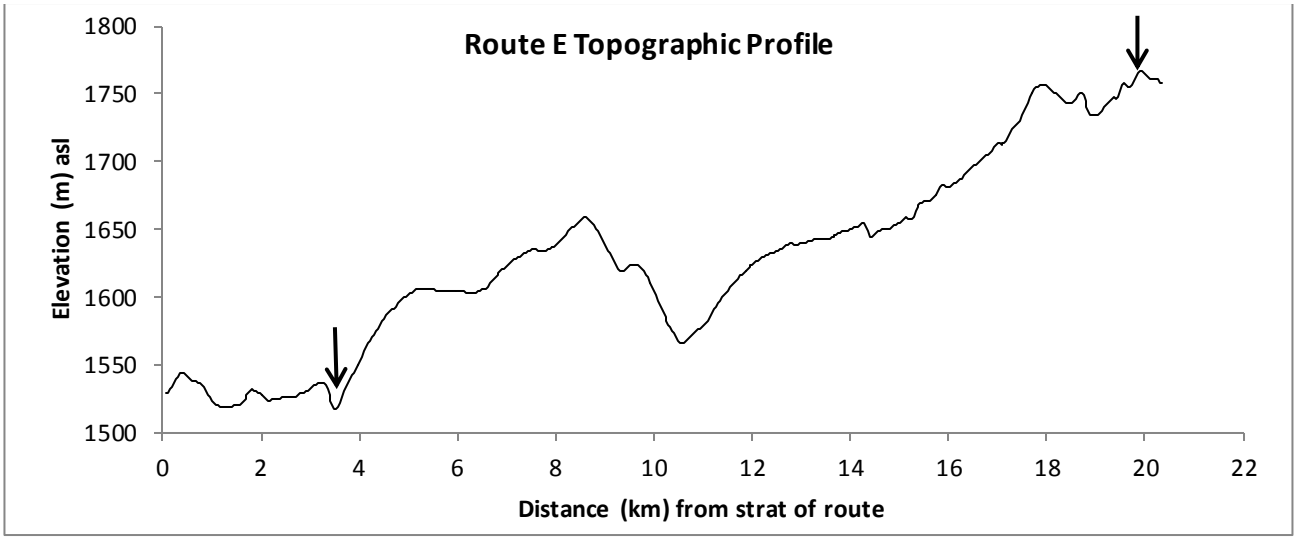

Figure 4. 11. Route E topographic profile starting at the Ferndale bus depot (0 km) and ending at Ghandi Sqaure (20.4 km) with arrows displaying the minimum and maximum elevations along the route (VE x 16).

4.3.3. Route F

Route F covers a distance of approximately 14 km. Buses travelling along this route started at Ghandi Square, travelled in a north westerly direction, and ended in Cresta (Figure 4.12). Route F covers the same section of route as route D from Ghandi Square to Greenside. After Greenside, the buses along this route track in a north westerly direction towards Cresta (Figure 2.12). This section of the route is flanked by residential, recreational and commercial areas with frequently occurring traffic lights and stops and go traffic.

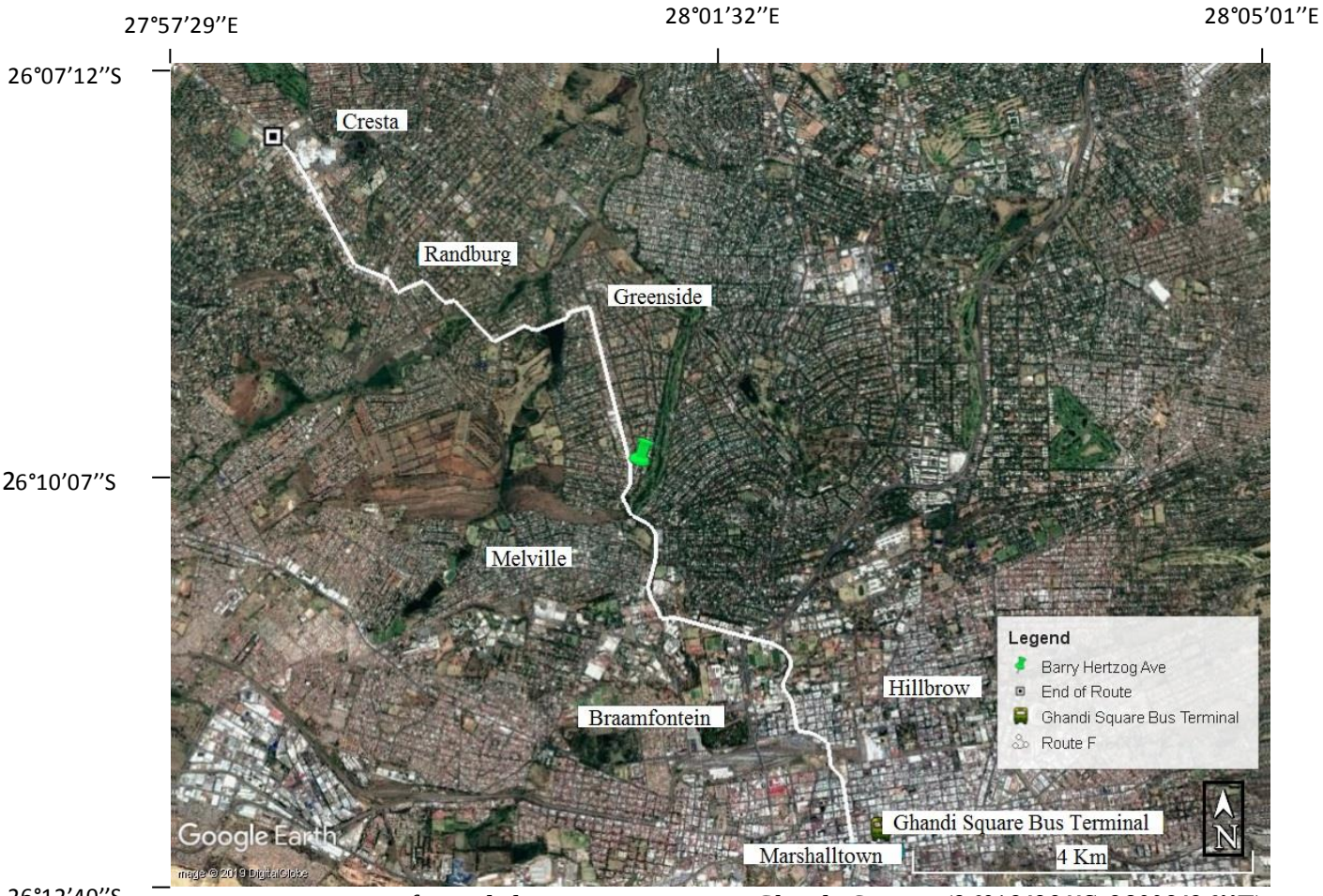

Figure 4. 12. Map of sampled route F starting at Ghandi Square (26°12´23´´S 28°02´26’’E) and ending at Cresta (26°07’43”S 27°58’11”E)

The topographic profile of Route F (Figure 4.13) did not display any features which distinguish it from the other routes sampled upon during the study, given that this route shared a common starting point with other routes used in the study and shared similar sections with routes D and E. The route started at an elevation of 1754 m, reached its maximum and minimum elevations at 1570 m and 1771m, and ended at an elevation of 1570 with a net decrease in elevation of 184 m (Figure 4.13). The route exhibited gentle inclinations and slopes throughout the profile.

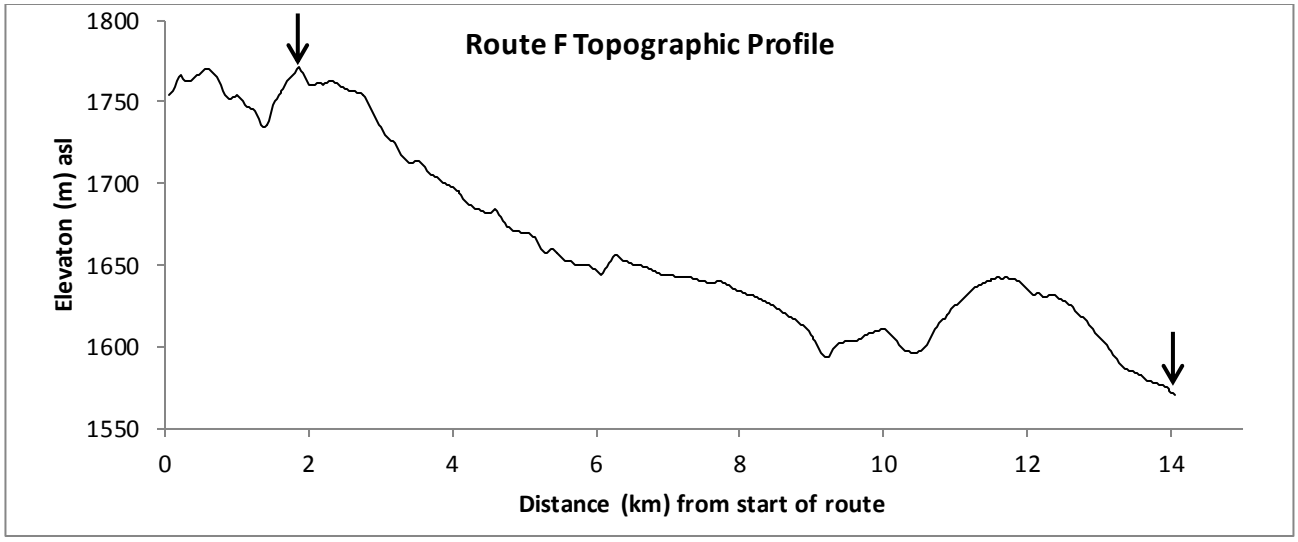

Figure 4. 13. Route F topographic profile starting at Ghandi Sqaure (0 km) and ending at Cresta (14 km) with arrows identifying the highest and loweast elevations along the route (VE x 16).

4.3.4. Field Observations During the Peak Sampling Campaign

The peak sampling campaign was carried out during the morning peak times between 6:00 am and 8:30 am. Twenty to thirty minutes before the morning departure from the bus depot, buses were turned on and allowed to idle for some time to allow the warming of the engine. During this idling period the buses windows were closed, but, the buses front doors remained open. This was not the case with the off-peak buses as these buses were already in-service since the morning commutes and thus, by the time the midday shifts started, the engines were already well-heated.

Buses travelling on Routes D and F started at Ghandi Square and moved out of the inner city to their respective destinations. These buses experienced slow moving traffic and high congestion for the majority of the trip, through the inner city and the surrounding areas. As a result, the bus was frequently staggered as it moved with frequent stopping and starting and

slower travel speeds as compared to off-peak buses. Conversely, the buses travelling along Route E from Ferndale to Ghandi Square experienced little traffic with no congestion. This situation allowed the buses to move freely without continuous stopping and starting during the trip. During this campaign some of boarded buses experienced mechanical breakdowns during the trip which resulted in no sample being collected on that day along the route.

Given that the same bus types were used for both sampling campaigns, none of the peak buses were fitted with air conditioning and all of the windows were closed for all the samples collected (Table 4.4). The number of passengers on-board the buses varied between the different routes. For example, the buses travelling from Ferndale to Ghandi square along route E (Figure 3.2) always had a passenger count of no more than 10% of the total 70 passenger capacity. However, Routes D and F had a 100% passenger count for almost all trips (Table 4.4). During the morning peak commute it was noted that the scent of cosmetic products wafted through the bus, due to a large number of people applying deodorants and perfumes. However, this scent was not noticed during off-peak sampling.

Table 4. 4. Field descriptions of samples collected during the peak campaign

Sample no.	Date[a]	Bus no.	Bus type[b]	Route[c]	Ventilation	Passenger capacity[d]	Sampling time
1	16/04/18	4034	DDF	E	Windows closed	<10%	6:17am - 6:47am
2	16/04/18	4065	D	D	Windows closed	100%	7:25am - 7:55am
3	17/04/18	4034	DDF	E	Windows closed	<10%	6:06am - 6:36am
4	18/04/18	4034	DDF	E	Windows closed	<10%	6:02am - 6:32am
5	18/04/18	4065	D	D	Windows closed	100%	7:10am - 7:40am
6	19/04/18	4034	DDF	E	Windows closed	<10%	6:10am - 6:50am
7	19/04/18	4065	D	F	Windows closed	100%	7:15am - 7:45am
8	20/04/18	4034	DDF	E	Windows closed	<10%	6:05am - 6:35am
9	20/04/18	4065	D	D	Windows closed	<15%	7:25am - 7:55am
10	23/04/18	4034	DDF	E	Windows closed	<10%	6:00am - 6:30am
11	23/04/18	4071	D	F	Windows closed	100%	8:00am - 8:30am

12	24/04/18	4034	DDF	E	Windows closed	<10%	6:10am - 6:40am
13	24/04/18	4021	D	D	Windows closed	100%	7:30am - 8:00am
14	25/04/18	4034	DDF	E	Windows closed	<10%	6:10am - 6:40am
15	25/04/18	4078	D	D	Windows closed	100%	7:30am - 8:00am
16	26/04/18	4034	DDF	E	Windows closed	<10%	6:05am - 6:35am
17	26/04/18	4078	D	D	Windows closed	100%	7:30am - 8:00am
18*	26/04/18	4078	D	D	Windows closed	100%	
19	30/04/18	4064	DDF	E	Windows closed	<10%	6:30am - 7:00am
20	30/04/18	4071	D	F	Windows closed	100%	7:55am - 8:25am
21	2/05/18	4108	DDF	E	Windows closed	100%	6:30am - 7:00am
22*	2/05/18	4108	DDF	E	Windows closed	100%	
23	3/05/18	MP4115	DDF	E	Windows closed	<50%	6:05am - 6:35am
24	3/05/18	4078	D	D	Windows closed	100%	7:30am - 8:00am
25	4/05/18	4034	DDF	E	Windows closed	<10%	6:05am - 6:35am
26	4/05/18	4021	D	D	Windows closed	100%	7:10am - 7:40am
27	7/05/18	4034	DDF	E	Windows closed	<10%	6:10am - 6:40am
28	7/05/18	4051	D	D	Windows closed	100%	7:05am - 7:35am
29	8/05/18	4034	DDF	E	Windows closed	<10%	6:10am - 6:40am
30	8/05/18	4021	D	D	Windows closed	100%	7:10am - 7:40am
31	9/05/18	4034	DDF	E	Windows closed	<10%	6:10am - 6:40am
32	9/05/18	4078	D	F	Windows closed	100%	7:30am - 8:00am
33	10/05/18	4034	DDF	E	Windows closed	<10%	6:10am - 6:40am
34	10/05/18	4021	D	D	Windows closed	100%	7:35am - 8:05am
35	11/05/18	4043	DDF	E	Windows closed	<10%	6:05am - 6:35am
36	11/05/18	4078	D	D	Windows closed	100%	7:30am - 8:00am
37*	11/05/18	4034	DDF	E	Windows closed	<10%	
38	14/05/18	4034	DDF	E	Windows closed	<10%	7:30am - 8:00am
39	14/05/18	4078	D	D	Windows closed	100%	7:30am - 8:00am
40	15/05/18	4034	DDF	E	Windows closed	<10%	6:00am - 6:40am
41	16/05/18	4034	DDF	E	Windows closed	<10%	6:10am - 6:40am
42	17/05/18	4034	D	E	Windows closed	100%	6:20am - 6:50am
43	17/05/18	4076	D	F	Windows closed	100%	7:55am - 8:25am
44	18/05/18	4075	D	E	Windows closed	100%	6:15am - 6:45am
45	18/05/18	MP4115	D	F	Windows closed	<50%	8:00am - 8:30am

Notes:
a – the date on which the sample was collected
b – D-Diesel, DDF-Diesel Dual Fuel
c – refer to Figures
d – total carrying capacity of 70 passengers
* - field blank samples

Figure 4.14 presents the average daily temperatures (°C) measured on-board the buses during the peak sampling campaign across routes in comparison to the ambient temperatures measured at the corresponding time interval at the weather monitoring station. Temperature data was collected and retrieved from the iButton for the time interval corresponding to the sampling time for each sample and averaged over the given duration. For the days on which more than one sample was collected, the two samples average temperatures were again average to represent one temperature value for the given day (see Appendix A). The ambient temperature was presented in hourly points, and retrieved according to the corresponding sampling time interval (Appendix A). It can be observed that the on-board temperature is higher than the ambient temperatures for all sampled days. The on-board and ambient temperatures fluctuate within an approximate range of 15.5°C with minimum and maximum on-board and ambient temperature of 7.65°C, 23.23°C and 5.30°C, 20.80°C respectively (Table 4.5). As observed in Figure 4.14, the on-board and ambient temperature follows a similar trend, with a Pearson's correlation ($r = 0.86$) indicating a strong positive relationship between the two variables (Table 4.7). Furthermore, the paired sample t-test returned a result indicating that there was a significant difference ($p < 0.05$) between the mean on-board and ambient temperatures (Table 4.6).

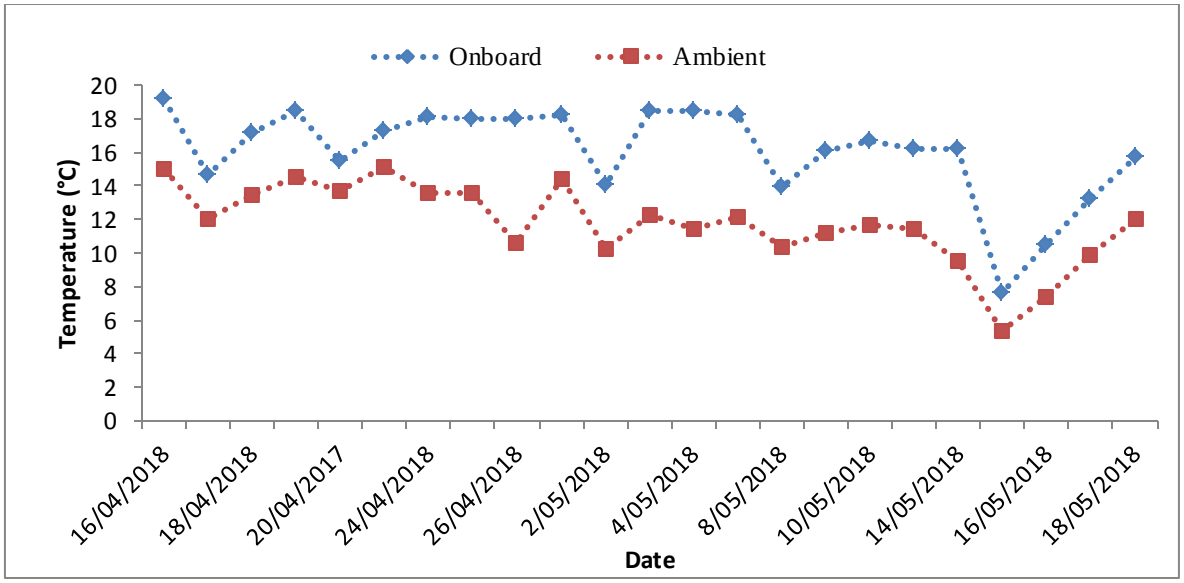

Figure 4. 14. Average daily on-board and ambient temperatures (°C) measured during the peak sampling period. Dotted lines represent visual trend.

Figure 4.15 presents the daily average humidity across routes measured during the sampling campaign in comparison to the ambient humidity measured at the corresponding time periods. The averaging of the on-board and ambient relative humidity points followed the same procedure as explained previously for the on-board and ambient temperature data (Appendix A). As can be seen in Figure 4.15, both the on-board and ambient humidity exhibit high fluctuations between sampling days throughout the sampling campaign. The minimum and maximum relative humidity was 43.53 – 85.11 % and 28 – 90 % for the on-board and ambient humidity, respectively (Table 4.5). For the majority of the days, the ambient humidity was higher than the on-board humidity except for one day (7/05/2018) where the ambient humidity dipped to a daily mean low of 34.5% and the on-board humidity spikes to an average 78.2% within the same time period. The Pearson's correlation test returned a result indicating a moderate positive relationship between the on-board and ambient humidity (r = 0.46), whereas, the paired sample t-test returned a result indicating a significant difference ($p < 0.05$) in means between the two (Table 4.6 and Table 4.7).

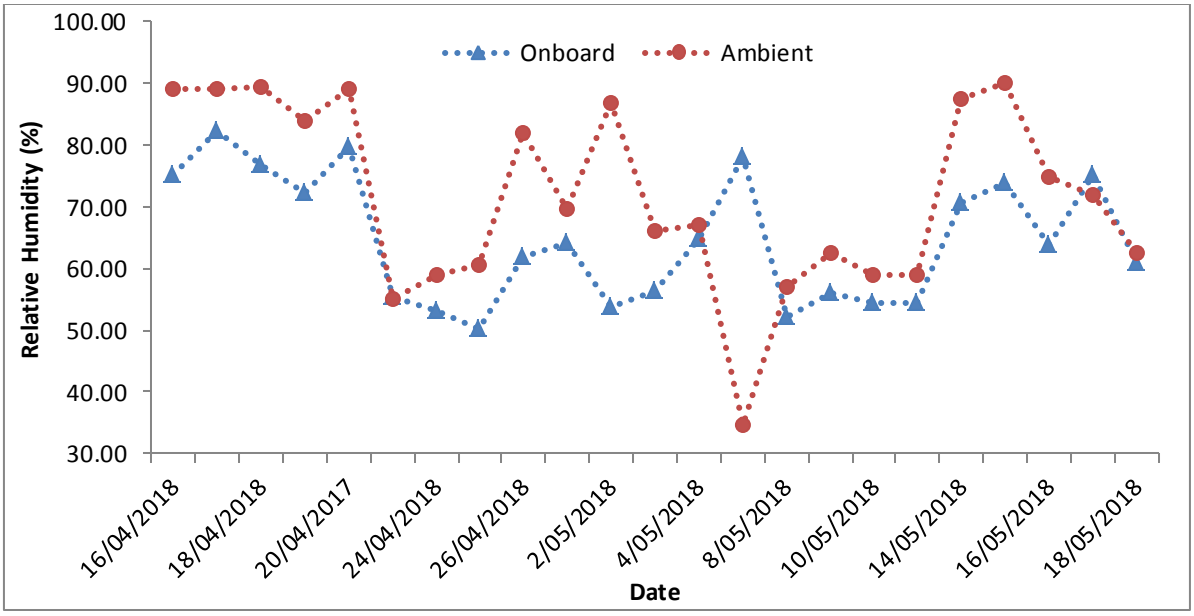

Figure 4. 15. Average daily on-board and ambient humidity (%RH) measured during the peak sampling period. Dotted line represents visual trend.

Table 4. 5. Data summary of on-board and ambient temperature (°C) and humidity (%RH) data collected during the peak sampling campaign

	Temperature (°C)	
	On-board	Ambient
Minimum	7.65	5.30
Mean ± SE	16.48 ± 0.71	12.08 ± 0.53
Maximum	23.23	20,80
Range	15.58	15.5
Standard Deviation	4.60	3.43
	Humidity (%RH)	
	On-board	Ambient
Minimum	43.53	28
Mean ± SE	64.23 ± 1.98	70.24 ± 2.67
Maximum	85.11	90
Range	41.58	62
Standard Deviation	12.65	17.33

Table 4. 6. Data summary of paired sample t-Test analysis comparing daily mean on-board temperature and humidity with ambient means during the peak sampling period.

	Mean ± SE	T –Value	P – Value ($\alpha = 0.05$)	
Temperature (°C)				
On-board	16.48 ± 0.71	4.9734	0.001	P < 0.05
Ambient	12.08 ± 0.53			
Humidity (%RH)				
On-board	64.23 ± 1.98	2.422	0.012	P < 0.05
Ambient	70.24 ± 2.67			

Figure 4.16 presents the average daily on-board temperature (°C) and humidity (%RH) measured across the sampling campaign. The on-board temperatures and humidity range between 7.65 – 23.23 (°C) and 43.53 – 85.11% respectively. For both temperature and humidity, large variability existed between sampling days as can be observed by the degree of fluctuation of both variables. The Pearson's correlation indicates a moderate negative (r = -0.33) relationship between these two variables (Table 4.7).

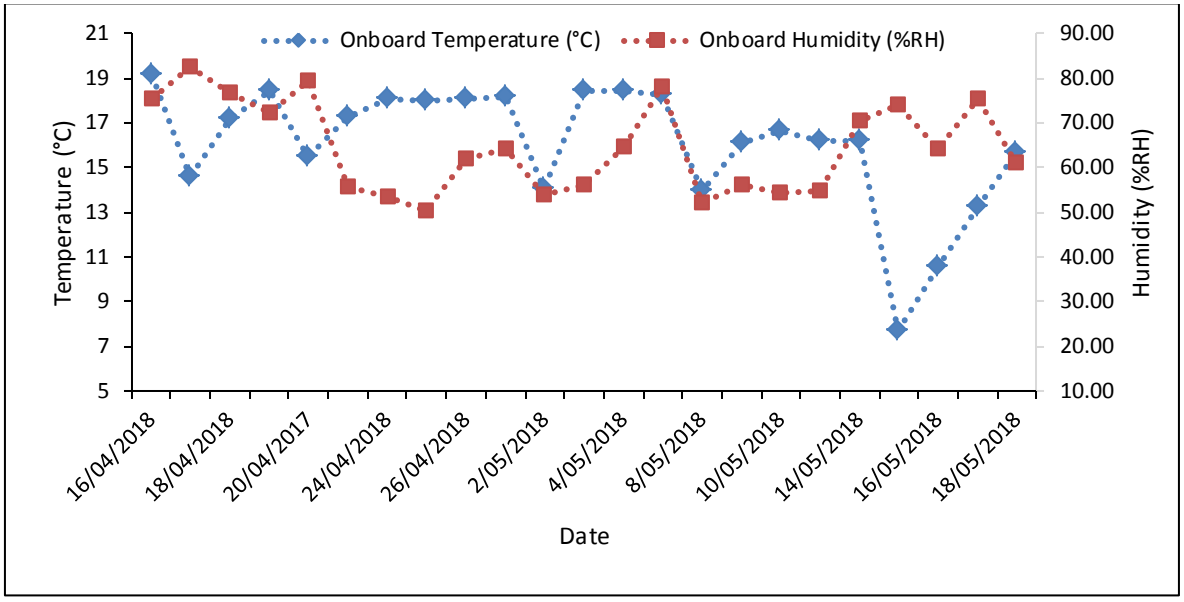

Figure 4. 16. Average daily on-board temperature (°C) and humidity (%RH) measured during the peak sampling campaign. Dotted line represents visual trend.

Table 4. 7. Peak campaign Pearson's correlation (r) between on-board and ambient temperature and humidity data.

	On-board Temperature	On-board Humidity	Ambient Temperature	Ambient Humidity
On-board Temperature	1			
On-board Humidity	-0.33*	1		
Ambient Temperature	0.86*	-0.21	1	
Ambient Humidity	-0.42*	0.46*	-0.39*	1
* – Significant at 0.05 level				

4.4. Results of BTEX Concentrations From the Off-Peak and Peak Sampling Campaigns

4.4.1. Off-Peak and Peak Sampling Campaign Lab Blank Analysis Results

As part of the analytical procedure to accurately quantify the analytes of interest from the charcoal tubes used in field sampling, various lab blank samples were analysed as a quality control measure to determine possible sources of sample contamination and to potentially optimise the analytical procedure. For both campaigns, blank carbon disulphide (CS_2) samples, lab blanks and field blanks were analysed.

During the off-peak campaign, three blank CS_2 samples were analysed, while during the peak campaign eight blank CS_2 were analysed. The results for both these campaigns are presented in Figure 4.17 and Figure 4.18, respectively. It can be observed that a large number of sample

results for BTEX concentrations appear in the negative range for both campaigns. Negative concentration values signify concentrations which are below the quantification limits of the analytical method being used and therefore cannot be reliably quantified and thus considered negligible. Although many of the BTEX concentration values appear to be negative, a small number of samples do exhibit concentrations for some analytes for both off-peak and peak samples. Examples of this can be observed in the concentration of m-xylene (10.28 ppb) measured during the off-peak analysis and unusually high presence of benzene (49.88 ppb), toluene (17.65 ppb) and xylenes (o-xylene 11.81 and m-xylene 92.62) during the peak analysis (Figure 4.18). Furthermore, some compounds were not detected at all within the CS_2, for example ethylbenzene during the peak analysis and p – xylene for both campaign analysis. The presence of BTEX compounds within the CS_2 is irregular and unexpected given the high purity (99%) of the CS_2 solvent, as indicated by the suppliers. Nevertheless, these results might suggest potential contamination of the solvent or instrument error, therefore; these results are of concern as they would introduce a degree of uncertainty in accurately determining the actual concentrations from field samples.

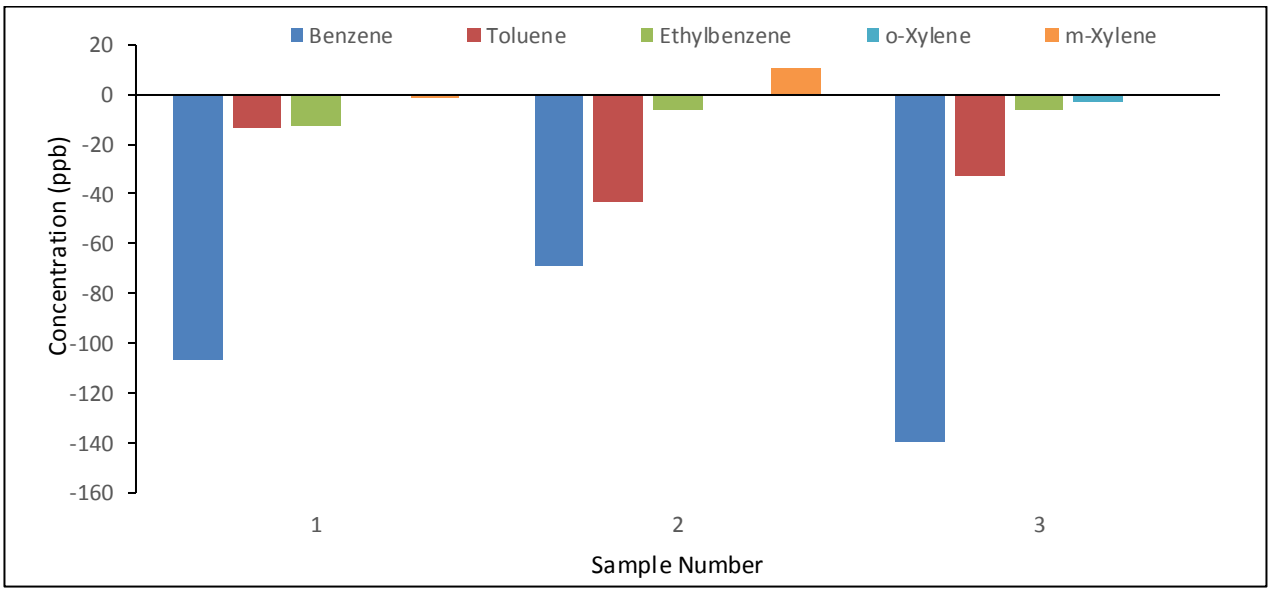

Figure 4. 17. Concentrations (ppb) of BTEX compounds detected in blank CS_2 samples analysed during the off-peak campaign lab analysis.

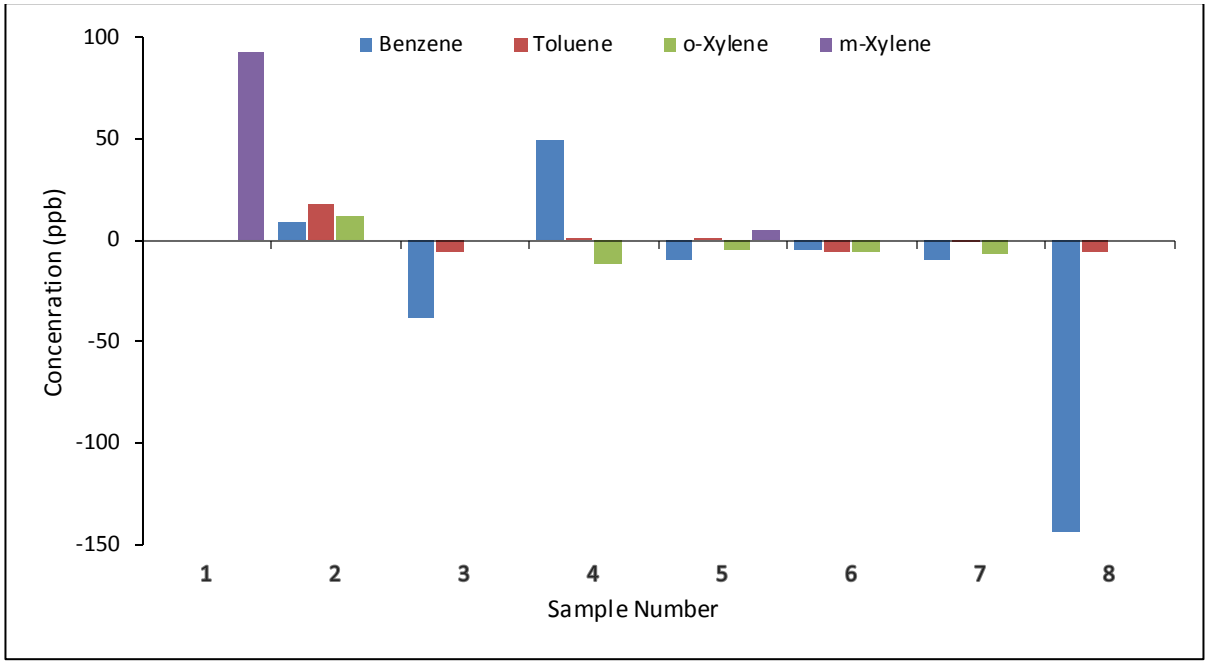

Figure 4. 18. Concentrations (ppb) of BTEX compounds detected in blank CS_2 samples analysed during the peak campaign lab analysis

In an effort to determine the potential concentration of BTEX compounds present on a charcoal tube, a blank charcoal tube was desorbed in CS_2 and thereafter analysed. A blank tube refers to a sampling tube which has not been used in field sampling and has not been exposed to sampled air. An unopened tube is snapped open in the lab and both the front and back section of the sampling tube are analysed separately. For the charcoal tube blank analysis, triplicate samples were analysed and the three data points were average to produce one value (see Appendix B). Figure 4.19 presents the average concentrations of the samples.

It can be noted from Figure 4.19 that the lab blank charcoal tubes exhibit the presence of BTEX compound concentrations for both campaigns. The off-peak lab blank measured concentrations of 244.93 ppb and 367.07 ppb for toluene on the front and back sorbent

sections, respectively. The total blank sorbent tube concentrations (front and back section) for benzene, ethylbenzene and o-xylene were 52.66 ppb, 22.81 ppb and 38.07, respectively. The peak lab blank also exhibited analyte concentrations; however, the concentrations are lower than those measured for the peak campaign. The total (front and back section) peak lab blank concentrations for benzene, toluene and o-xylene were 13.64 ppb, 21.55 ppb and 4.07 ppb, respectively. These results would indicate a potential source of contamination either within the charcoal tube itself, the lab environment in which the samples are being prepared and analysed, due to analyst error or as a result of the CS_2 which has shown potential contamination. As with the blank CS_2 samples, high blank charcoal tube values might also be a source of error and uncertainty, and loss in accuracy in determining actual field concentration values. As can be observed in Figure 4.19, the peak lab blank measured less BTEX concentrations than the off-peak lab blank. Furthermore, within the peak lab blank, m-xylene, p-xylene and ethylbenzene were not detected. Ideal lab blank values would either not detect any analyte of interest at all, measure negative concentrations or concentration close to zero.

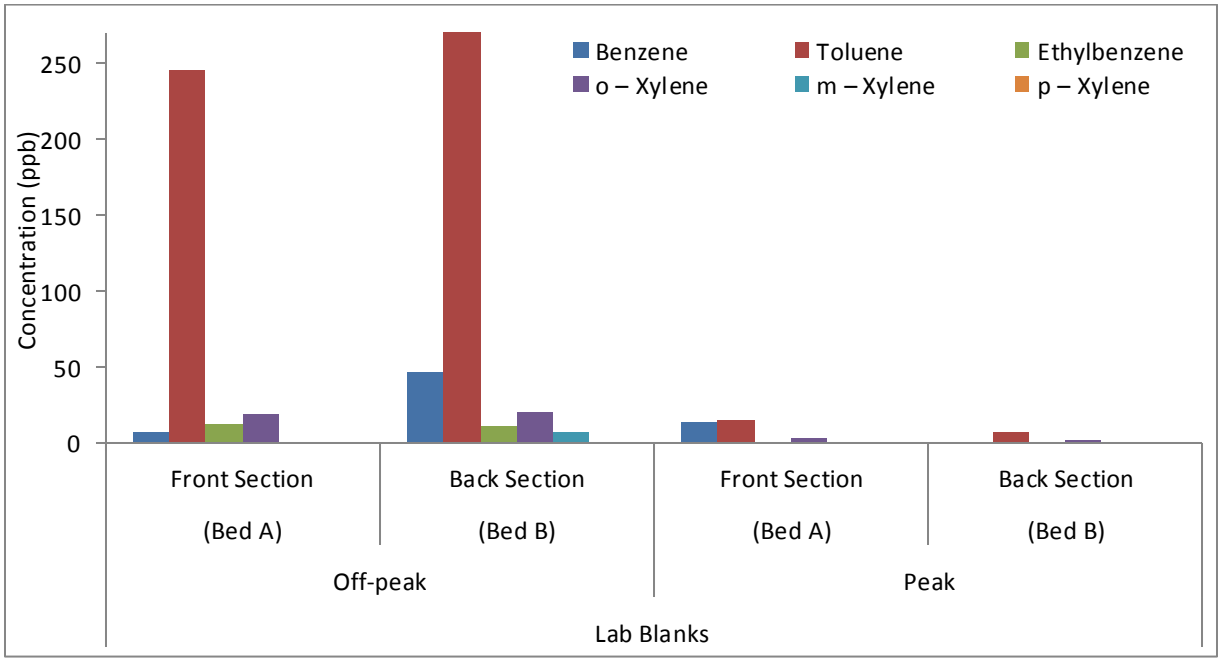

Figure 4. 19. Average concentrations (ppb) of BTEX on the front and back sections of lab blank charcoal tubes desorbed in CS_2 during off-peak and peak campaign analysis

Table 4.8 presents the average concentration of BTEX (ppb) detected on the off-peak and peak sampling campaign field blanks. Two and three field blank samples were collected during the off-peak and peak sampling campaigns respectively. It can be observed that high compound concentrations, in the range of actual field samples, are present on all field blank samples for both campaigns. There is also a high degree of variability and uncertainty between field blank samples from within the same campaign as well. For example, in the off-peak campaign, the analysis of field blank sample 1 returned a benzene value which was below detection (Table 4.7). However, the field blank sample 2 analyses returned a benzene concentration of approximately 50 ppb. This inconsistency can also be observed for the toluene concentrations during the off-peak analysis, where analysis of field blank 1 returned a concentration value below detection, whereas filed blank 2 measured a concentration of approximately 660 ppb (Table 4.7). Variability also existed within the field blank samples of the peak campaign; however, this variability was less than that of off-peak samples. The presence of analytes on field blank samples are of concern as this would potentially indicate a source of contamination either during the transportation and storage of the samples or as a result of poor samples preparation, CS_2 contamination or analyst error.

Table 4. 8. Average concentrations (ppb) of BTEX detected in off-peak and peak sampling campaign field blank samples.

	Concentration (ppb)					
	Benzene	Toluene	Ethylbenzene	o-Xylene	m-Xylene	p-Xylene
Off-peak						
Field blank 1	b.d	b.d	b.d	b.d	2.92	n.d
Field blank 2	49.71	659.54	23.29	28.14	8.82	n.d
Peak						
Field blank 1	210.24	30.57	n.d	18.33	15.31	n.d
Field blank 2	221.46	33.16	n.d	17.27	22.4	n.d
Field blank 3	47.05	6.69	n.d	6.88	9.33	n.d

Note: n.d – no detected value b.d – below detection

Blank samples (blank CS_2, blank charcoal tube and field blank samples) are meant to be used as quality control measures to ensure no contamination of BTEX compounds during the different phases of the sampling campaign, including sample transportation, field collection, storage, lab preparation and analysis and to ensure that observed field results are accurately determined. During this study, the lab analysis of the blank CS_2, lab blank charcoal tubes and field blank samples for both off-peak and peak sampling campaigns have revealed the presence of anomalously high concentrations of BTEX compounds across samples, which would indicate potential sources of sample contamination, sample preparation inadequacies or human error. It is for these reasons that issues arose while trying to deriving actual concentrations of BTEX from field samples given the great variability and uncertainty observed within blank samples. Under ideal circumstances, in such a case the sampling would be conducted again. However, due to resource and time constraints for the current study, re-sampling was not a viable option. Therefore, going forward, BTEX concentration values from field sampling are not presented and discussed as actual absolute values but rather considered as relative concentration values.

4.4.2. Off-peak (21 Nov – 7 Dec 2017) and Peak (16th Apr – 18th May 2018) Sampling Campaign Field Results of BTEX Concentrations

During the off-peak sampling campaign a total of 21 field samples were collected on-board buses travelling along three routes. From a total of 21 field samples, there was a 57% recovery of benzene values, 57% recovery of toluene values, 71% recovery of ethylbenzene values and a 52% recovery of (o + m) xylene values (Appendix B). The values not recovered

appeared in a range below detection and thus could not be reliably quantified. During this campaign no p-xylene was detected and therefore the presented xylene concentrations are composed of only the (o + m) xylene isomers.

During the peak sampling campaign a total of 42 field samples were collected, of which there was a 76% recovery of benzene concentration values, 74% recovery of toluene, 21% recovery of ethylbenzene and a 86% recovery of (o + m) xylene. The p-xylene isomer had a poor recovery rate of less than 12% and therefore excluded from the data set (Appendix B). The concentration values not recovered were either negative values or not detected at all within the samples.

Figure 4.20 presents the average BTEX concentrations (μ/m^3) measured during the off-peak and peak sampling campaigns. For each field sample three concentration (ppb) values were obtained as triplicate samples were analysed for both the front and back sorbent sections for each sample. These triplicate values were averaged to obtain one concentration (ppb) value for the front and back sorbent section for each BTEX compound. These values were then applied to the conversion equation to obtain a single final concentration (μ/m^3) for each BTEX compound. The average BTEX concentrations presented in Figure 4.20 represent the average BTEX concentration (μ/m^3) across the entire off-peak and peak sampling campaign (see Appendix B for the BTEX data progression from raw concentration (ppb) data to the final presented concentrations (μ/m^3)). For the off-peak campaign, toluene exhibited the most abundant compound concentration with a mean ± standard error (SE) value of 85.88 ± 23.6 (μ/m^3) (Table 4.9). This was followed by benzene (24.39 ± 4.5 μ/m^3), xylene (5.70 ± 1.10 μ/m^3) and ethylbenzene (4.80 ± 1.18 μ/m^3). During this campaign, toluene concentrations

also exhibited the greatest variability of data around the mean with a standard deviation of 81.74 and a range of 205.97. For the peak sampling campaign the most abundant compound concentration was benzene (28.19 ± 4.69) followed by toluene (9.85 ± 1.14), xylene (7.5 ± 0.99) and ethylbenzene (2.94 ± 0.39) (Table 4.8).

In general, the off-peak and peak BTEX concentrations appear to be very similar in terms of measured concentrations, with the exception of toluene which was substantially greater during the off-peak campaign. The results from the independent sample t-test indicated no significant difference in mean concentrations between the two campaigns with regards to benzene, ethylbenzene and xylene ($p > 0.05$). However, there was a significant difference ($p < 0.05$) observed between the off-peak and peak mean toluene concentrations (Table 4.10).

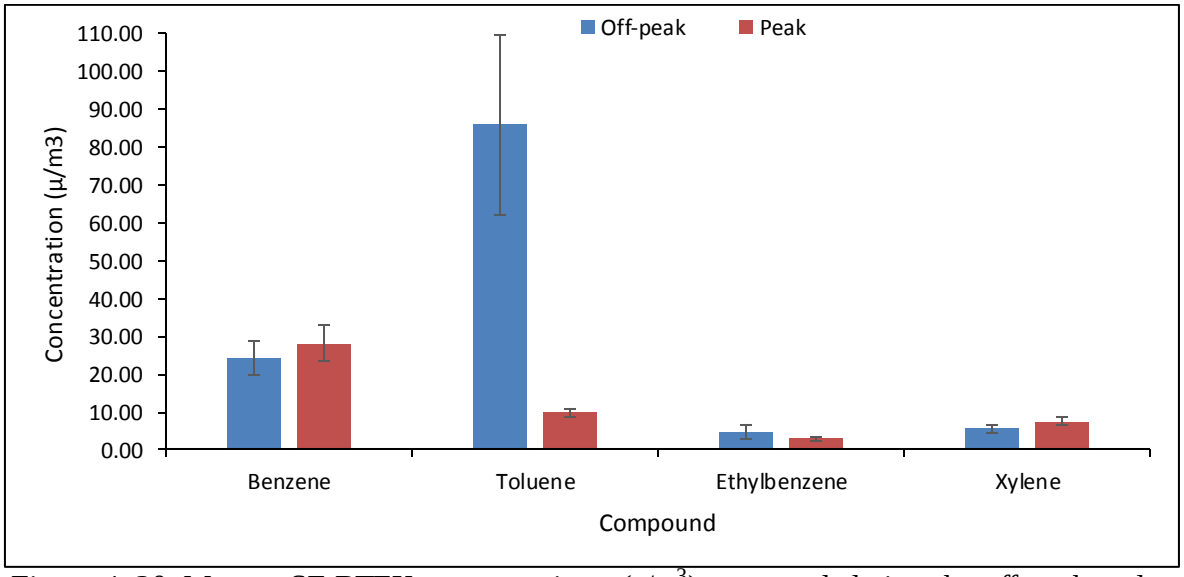

Figure 4. 20. Mean ± SE BTEX concentrations (μ/m^3) measured during the off-peak and peak sampling campaign.

Table 4. 9. Data summary of BTEX concentrations (µ/m^3) measured during the off-peak and peak sampling campaigns.

	Benzene	Toluene	Ethylbenzene	Xylene
Off-peak	**n = 12**	**n = 12**	**n = 15**	**n = 11**
Minimum	1.56	3.58	0.07	0.37
Mean ± SE	24.39 ± 4.5	85.88 ± 23.6	4.80 ± 1.18	5.70 ± 1.10
Maximum	47.98	209.37	15.01	10.54
Range	46.42	205.97	14.93	10.18
Standard Deviation	15.6	81.74	4.59	3.65
Peak	**n = 32**	**n = 31**	**n = 9**	**n = 36**
Minimum	0.74	0.92	1.34	0.32
Mean ± SE	28.19 ± 4.69	9.85 ± 1.14	2.94 ± 0.39	7.5 ± 0.99
Maximum	94.66	20.21	4.55	23.77
Range	93.92	19.29	3.21	23.45
Standard Deviation	26.53	6.35	1.17	5.98

Table 4. 10. Data summary of independent sample t-test analysis comparing mean ± SE BTEX concentrations (µ/m^3) between off-peak and peak sampling campaigns.

	Mean ± SE		T –Value	P – Value ($\alpha = 0.05$)	
	Off-peak	Peak			
Concentration (µ/m^3)					
Benzene	24.39 ± 4.5	28.19 ± 4.69	-0.46	0.64	P > 0.05
Toluene	85.88 ± 23.6	9.85 ± 1.14	3.22	0.008	P < 0.05
Ethylbenzene	4.80 ± 1.18	2.94 ± 0.39	1.16	0.27	P > 0.05
Xylene	5.70 ± 1.10	7.5 ± 0.99	-0.95	0.35	P > 0.05

4.5. Concentration of BTEX Compounds Across Bus Routes During the Off-Peak and Peak Sampling Campaign

During this study a total of six bus routes were travelled, all of which represent major commuter routes through the Johannesburg CBD to the surrounding northern suburbs. For the off-peak sampling campaign buses travelling along Routes A, B, and C were taken, whereas for the peak sampling campaign buses travelling along Routes D, E and F were taken. Table 4.11 presents the frequency distribution of bus routes used during the two campaigns. Routes

B and C, and routes E and F were sampled most frequently during the off-peak and peak sampling campaigns respectively. Given that in-service buses were used, controlling the exact number of routes sampled was difficult as on many occasions buses would be diverted from the bus terminal along different routes or experience mechanical breakdowns, which would result in a certain route not being serviced during that time period.

Table 4. 11. Frequency distribution of bus routes sampled during the off-peak and peak sampling campaigns

Route	Frequency travelled	Percentage (%) of trips
Off-peak		
A	3	14.3
B	9	42.85
C	9	42.85
Total	21	100
Peak		
D	13	30.95
E	23	54.76
F	6	14.29
Total	42	100

Figure 4.21 presents the mean distribution of BTEX compounds across the sampled routes during the off-peak campaign. Samples collected on-board Route A exhibit the highest concentrations for benzene (40.72 ± 7.26 μ/m^3), toluene (71.66 ± 39.10 μ/m^3 and ethylbenzene 11.85 ± 3.16 μ/m^3) from amongst all the off-peak routes. While the benzene and toluene concentrations on Route A are only moderately higher than the other routes, the toluene concentrations are more than twice that of Route B and C. Additionally, the toluene concentration values also exhibit the greatest variation with the sample set for all routes as can be observed by the large error margins. Even though the numeric values of the benzene and toluene concentrations on Route A exceeded that of routes B and C, the ANOVA analysis of the BTEX concentrations on different routes returned a result indicating no

significant difference ($p > 0.05$) between the routes with regards to the two compounds (benzene and toluene) (Table 4.11). However, a significant difference was observed between routes A and C with regards to the ethylbenzene concentrations (Table 4.12).

Figure 4.22 presents the mean distribution of BTEX concentrations (μ/m^3) across sampled routes during the peak sampling campaign. As can be observed, the greatest concentration of benzene and toluene was measured along routes E and D respectively. The concentrations of ethylbenzene and xylene appear very similar across all routes (Table 4.12), with Route F measuring the lowest concentrations for almost all BTEX compounds (Figure 4.22). The ANOVA analysis of BTEX concentration variance returned a result indicating no significant difference between sampled routes and measured BTEX concentrations (Table 4.12).

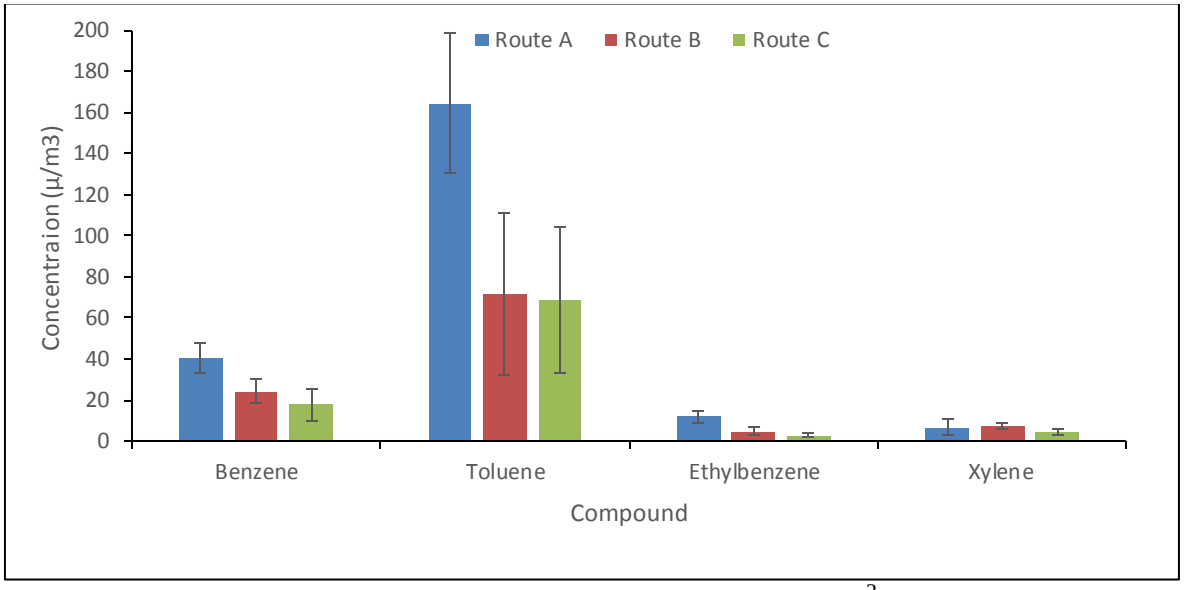

Figure 4. 21. Mean ± SE distribution of BTEX concentrations (μ/m^3) across sampled routes during the off-peak sampling campaign.

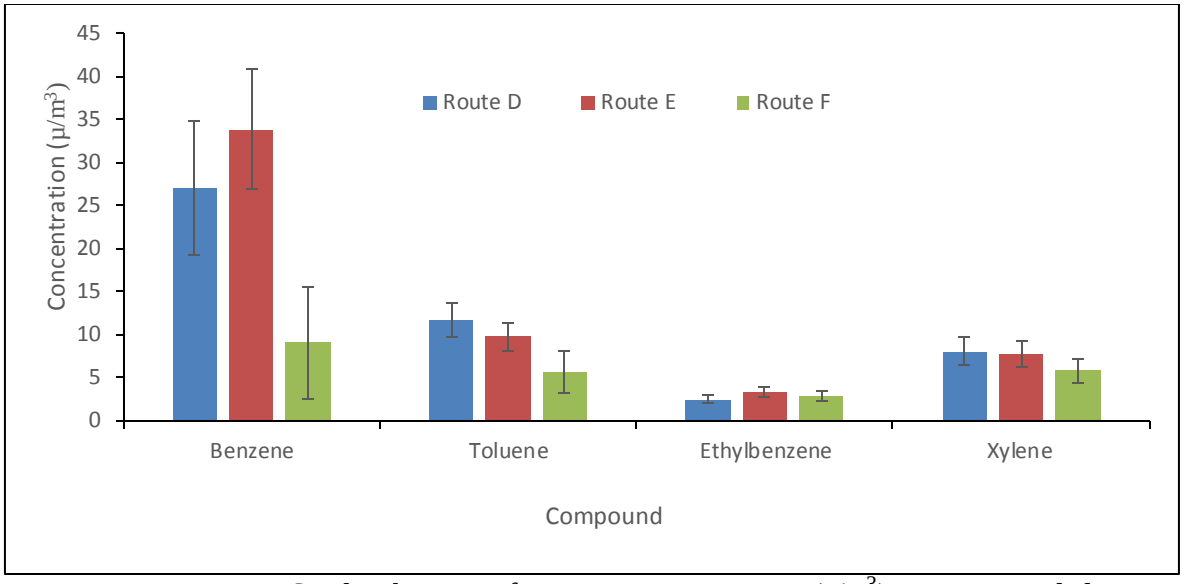

Figure 4. 22. Mean ± SE distribution of BTEX concentrations (μ/m^3) across sampled routes during the peak sampling campaign.

Table 4. 12. Data summery of ANOVA analysis of BTEX concentrations across routes during the off-peak and peak sampling campaign

	Routes	Mean ± SE (μ/m^3)	F - Value	P – Value ($\alpha = 0.05$)	
Off-peak					
Benzene	A	40.72 ± 7.26	1.74	0.23	P > 0.05
	B	24.38 ± 5.75			
	C	17.88 ±7.63			
Toluene	A	164.67 ± 32.28	1.15	0.36	P > 0.05
	B	71.66 ± 39.10			
	C	68.59 ± 35.81			
Ethylbenzene	A	11.85 ± 3.16	4.77	0.03	P < 0.05
	B	4.89 ± 1.77			
	C	2.7 ± 1.07			
Xylene	A	6.54 ± 3.99	0.60	0.57	P > 0.05
	B	7.38 ± 1.20			
	C	4.59 ± 1.59			
Peak					
Benzene	D	27.04 ± 7.73	1.46	0.25	P > 0.05
	E	33.85 ± 6.91			
	F	9.05 ± 6.52			
Toluene	D	11,74 ± 2.02	1.37	0.27	P > 0.05
	E	9,73 ± 1.57			
	F	5,6 ± 2.37			
	D	2,41 ± 0.45			

Ethylbenzene	E	3,28 ± 0.6	0.45	0.66	P > 0.05
	F	2,85 ± 0.53			
Xylene	D	8,06 ± 1.67	0.24	0.79	P > 0.05
	E	7,65 ± 1.50			
	F	5,82 ± 1.38			

4.6. Observed Variability Within Sampling Campaigns

Variability existed between the two sampling campaigns with regards to the ventilation condition, passenger numbers, on-board temperature and humidity and travelled routes. However, variability also existed between the samples collected within the same campaign. This observation was most noticeable for samples collected during the peak campaign. During this campaign, two different buses were boarded consecutively by one person which resulted in two distinct sampling times within the same peak period. The first bus was boarded between 6:00 am – 7:00 am and thereafter the second bus was boarded between 7:00 am – 8:30 am. Furthermore, the earlier boarded buses were dominantly empty for the majority of trips, whereas the later boarded buses were almost always at full capacity (Table 4.4). Additionally, the earlier boarded buses all travelled along Route E, which exhibits an uphill gradient, whereas the later buses travelled along Routes D and F which exhibited net downhill gradients (see Figures 4.9, 4.11 and 4.12).

Figure 4.23. and Figure 4.24 present the daily on-board temperature and humidity respectively, within the peak sampling campaign between the earlier (6:00 am – 7:00 am) and later (7:00 am – 8:30 am) boarded buses. It can be observed that the earlier bus's on-board temperature fluctuates within a lower range than the late buses for all sampled days. The minimum measured on-board temperature for the late buses (16.5°C) was approximately two times greater than that of the early (7.6°C) boarded bus. This was possibly due to the early

buses being boarded before sunrise during the campaign in contrast to the later buses which were boarded after sunrise, which would allow the later buses to receive more solar radiation to heat the bus. The independent t-test analysis returned a result indicating a significant difference ($p < 0.05$) between the temperature means of the early and late buses (Table 4.13).

The on-board relative humidity also shows variations between the early and late sampled buses with large daily fluctuations throughout the campaign for both time periods (Figure 4.24). For the majority of sampling days the early buses measured a higher on-board relative humidity. However, this trend did stray from the norm on certain sampling days as can be observed on 30/04/2018, where there was a dip in on-board RH of 46.88% and a corresponding rise of 81.48% for the early and late bus, respectively. The average relative humidity for both the early and late sampled buses was 68.46% and 59.11% respectively and although these mean values fell within a similar range the independent sample t-test analysis returned a result indicating a significant ($p < 0.05$) difference between the mean on-board relative humidity between these two times (Table 4.13).

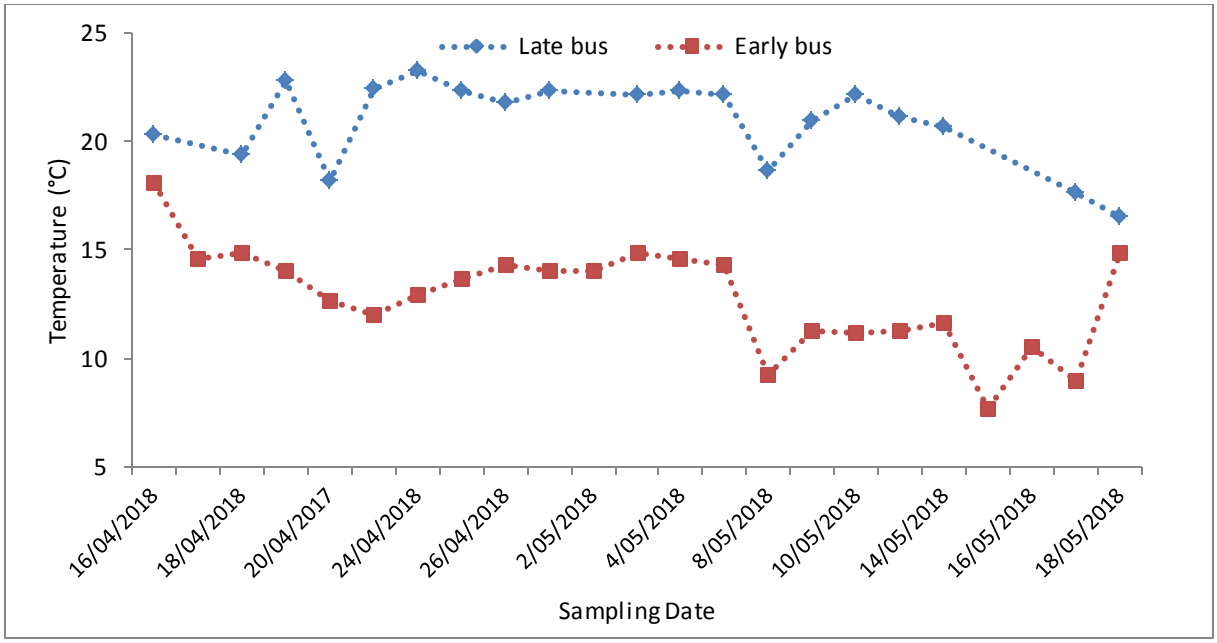

Figure 4. 23. Comparison of mean temperatures (°C) between the early and late boarded bus during the peak sampling campaign. Dotted lines represent visual trend.

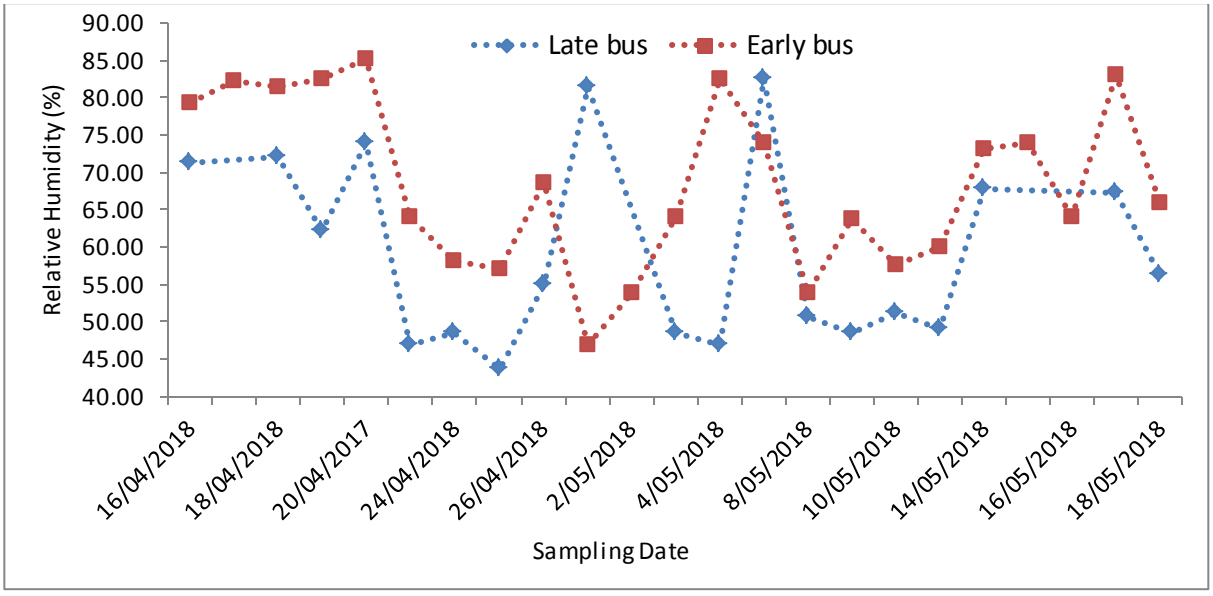

Figure 4. 24. Comparison of mean relative humidity (%) between the early and late boarded bus during the peak sampling campaign. Dotted lines represent visual trend.

Table 4. 13. Data summary of independent sample t-test analysis comparing daily mean on-board temperature (°C) and humidity (%RH) between the early and late boarded buses during the peak sampling campaign.

	Mean	T –Value	P – Value ($\alpha = 0.05$)	
Temperature (°C)				
Early	12.48	2.45	0.017	P < 0.05
Late	20.89			
Humidity (%RH)				
Early	68.46	-12.04	0.001	P < 0.05
Late	59.11			

Figure 4.25 presents a comparison of the measured BTEX concentrations between the early and late sampled buses within the peak sampling campaign. The most abundant compound measured was benzene on-board the early and late buses with concentrations of 33.85 μ/m^3 and 22.52 μ/m^3, respectively. For toluene, ethylbenzene and xylene, very little variation existed between the early and late sampled buses. Even though the early and late buses varied with regards to the on-board temperature, humidity and passenger number, the independent t-test of sampled BTEX concentrations returned a result indicating no significant ($p > 0.05$) different between the two sampling times (Table 4.14).

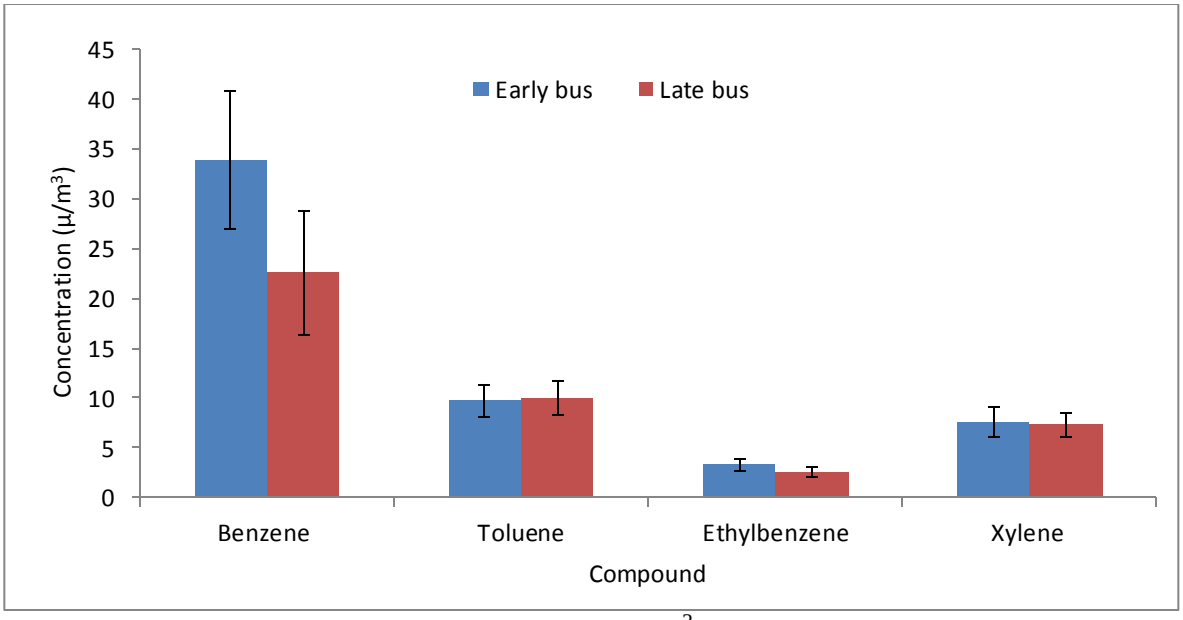

Figure 4. 25. Means ± SE BTEX concentrations (μ/m^3) on-board the early and late boarded buses during the peak sampling campaign.

Table 4. 14. Data summary of independent t-test analysis of BTEX concentrations between the early and late buses sampled during the peak campaign.

	Mean ± SE		T - Value	P – value ($\alpha = 0.05$)	
	Early bus	Late bus			
Benzene	33.85 ± 6.91	22.54 ± 6.25	1.21	0.23	P > 0.05
Toluene	9.73 ± 1.57	9.98 ± 1.73	-0.11	0.92	P > 0.05
Ethylbenzene	3.28 ± 0.6	2.52 ± 0.45	0.96	0.37	P > 0.05
Xylene	7.65 ± 1.50	7.31 ± 1.21	-3.22	0.87	P > 0.05

During the off-peak sampling campaign, no significant variation was measured between the on-board temperatures amongst samples. This was possibly so, as during this campaign the help of field volunteers was solicited which allowed for more than one sample to be collected at the same time (Table 4.1) which would reduce the variability of the on-board temperature between samples. Furthermore, unlike the passenger numbers on-board the peak sampling campaign which varied between the early and late buses, the off-peak passenger count was approximately the same for all sampled buses (Table 4.1). Given these observation, an in-depth analysis of the variability within the off-peak sampling campaign was omitted.

4.7. BTEX Correlations and Ratios for Off-Peak and Peak Sampling Campaigns

The BTEX correlations and ratios are established parameters which are used to determine the potential source of BTEX compounds in the environment (Hajizadeh *et al.* 2018). For this study, the correlations between the BTEX compounds and the on-board temperature and humidity were assessed using the Pearson's correlation test. The results for these tests are presented in Table 4.15 and table 4.16 for the off-peak and peak campaigns, respectively. The off-peak results show that benzene and toluene exhibit a strong positive significant correlation (r = 0.941), whereas ethylbenzene (r = 0.197) and xylene (r = 0.461) display a weak to moderate insignificant correlation with benzene, respectively (Table 4.15). Toluene shows a moderate to weak correlation between ethylbenzene and xylene, and ethylbenzene and xylene are poorly correlated. With regards to the on-board temperature, BTX concentrations have shown a weak to moderate negative correlation and ethylbenzene has shown a very weak positive correlation (r = 0.190). From the correlations presented, only benzene and toluene are significantly correlated (r = 0.941), whereas no significantly strong correlations were measured amongst the compounds and with regards to the on-board temperature (Table 4.15).

During the peak campaign benzene, toluene and xylene were found to have moderate to strong significant correlations (Table 4.16). Other than these correlations, no strong correlations were measured between ethylbenzene and BTX compounds. The correlation between on-board temperature and BTEX concentrations has shown that all the compounds are weakly correlated to temperature with no significance (Table 4.16). However, an unusual pattern was observed in that benzene and toluene were positively correlated and ethylbenzene

and xylene are negatively correlated. With regards to the on-board relative humidity, the BEX and toluene concentrations show weak insignificant positive and negative relationships, respectively.

The T/B ratios were assessed for both campaigns to determine the potential sources of the measured BTEX concentrations. T/B ratio below 3 have been used to identify mobile or traffic originated sources of emissions, whereas ratios above three have been identified to be indicative of point sources of emissions in industrial areas or from solvent use (Tiwari *et al.* 2010, Lan *et al.* 2013, Bretón *et al.* 2017). For the current study, only T/B ratios were considered as these compounds had the greatest recovery from the BTEX compounds for both campaigns which allowed for a larger number of sampled pairs to be analysed. These ratios were analysed across routes, the results of which are presented in Table 4.17 and summarised in Table 4.18, for both campaigns. As can be observed, not much variation in the T/B ratios existed between routes for both campaigns (Table 4.18). Overall, the off-peak sampling campaign measured higher mean T/B ratios (3.88) than the peak campaign (0.90). Furthermore, both campaigns have shown wide ranges of T/B ratios (Table 4.17). For instance the range of ratios for the off-peak and peak campaign were 0.29 – 6.41 and 0.04 – 5.69, respectively (Table 4.18). Although these ranges overlap the, the majority of peak sample ratios were below one, whereas the majority of off-peak ratios measured above 3 (Table 4.17). It should be noted however, that during this study many BTEX compounds were either below detection or not detected at all, which resulted in not all samples having the full range of T/B ratios (Appendix B).

Table 4. 15. Off-peak campaign Pearson's correlation (r) amongst BTEX species and on-board temperature

	Temperature[a]	Benzene	Toluene	Ethylbenzene	Xylene[b]
Temperature	1.000				
Benzene	-0.504	1.000			
Toluene	-0.241	0.941*	1.000		
Ethylbenzene	0.190	0.197	0.511	1.000	
Xylene	-0.252	0.461	0.203	0.107	1.000
Note: a – On-board temperature b – o-m Xylene * – Significant correlation at 0.05 level					

Table 4. 16. Peak campaign Pearson's correlation (r) between BTEX species, on-board temperature and on-board relative humidity

	Temperature[a]	Relative Humidity[b]	Benzene	Toluene	Ethylbenzene	Xylene[c]
Temperature	1.000					
Relative Humidity	-0.330	1.000				
Benzene	0.238	0.012	1.000			
Toluene	0.111	-0.058	0.585*	1.000		
Ethylbenzene	-0.329	0.350	-0.163	0.077	1.000	
Xylene	-0.183	0.002	0.806*	0.407*	-0.385	1.000
Note: a – On-board temperature b – On-board relative humidity c – o-m Xylene * – Significant correlation at 0.05 level						

Table 4. 17. T/B ratios per sample for the off-peak and peak campaigns.

Sample no.	Route	T/B Ratio
Off-peak		
2	C	6.41
3	B	0.37
10	B	1.55
12	C	0.29
16	C	4.55
17	B	5.01
18	A	4.15
19	C	3.84
20	A	3.90
21	B	5.29
Peak		
1	E	0.22
3	E	0.50
5	D	0.22
7	F	5.69
8	E	0.24
9	D	5.42
13	D	0.35
14	E	0.22
15	D	0.98
19	E	1.24
21	E	0.05
23	E	0.04
24	D	0.44
25	E	2.64
26	D	0.88
30	D	0.24
31	E	0.27
34	D	0.21
35	E	0.39
36	D	0.14
40	E	0.15
41	E	0.85
43	F	0.07
45	F	0.25

Table 4. 18. Summary of T/B ratios for off-peak and peak campaigns across routes.

Routes	T/B Ratios		
	Mean	Range	n
Off-peak			
A	4.03	3.90 – 4.15	2
B	3.06	0.37 – 5.29	4
C	3.77	0.29 – 6.41	4
Total	3.62	0.29 – 6.41	10
Peak			
D	0.99	0.14 – 5.41	9
E	0.57	0.04 – 2.64	12
F	2.00	0.07 – 5.69	3
Total	0.90	0.04 – 5.69	24

4.8. Chapter Summary

This section presented the results obtained from the study. Firstly, the route descriptions were presented for both campaigns together with and the dynamics of the on-board temperature and humidity in relation to the ambient measurements. Secondly, the results from the lab and field blank analysis were presented for both campaigns. This was followed by the BTEX concentration values from the field sampling for the off-peak and peak campaigns across the given routes. Thereafter, the results from the analysis of the peak intra-campaign BTEX concentrations were presented. And finally, the BTEX interspecies correlations were presented as well as the T/B ratios for both campaigns.

The routes sampled during the study displayed similar characteristics for both campaigns in terms of the surrounding land use and the experienced commute. This was possible as the sampled routes had shared sections and either started off or ended the journey at Ghandi Square (see Figures 4.1 – 4.11). This situation also allowed for the elevation profiles to be

similar across routes. In addition, the bus commute during the off-peak and peak times were similar in terms of the high traffic volume and congestion within the Johannesburg CBD, which did not abate during the off-peak times. The on-board temperature was significantly higher that the ambient measurements for both campaigns and the on-board relative humidity also significantly differed from the peak ambient measurements (Tables 4.3 and 4.6).

After the route descriptions, the lab blank analysis and the results from the field sampling was presented. The results from the CS_2 solvent blank analysis, lab blanks and field blanks returned results indicating levels of contamination, potentially linked to the solvent being used (Figure 4.17 – 4.19 and Table 4.8). This measured contamination was corrected for by subtracting the lab blank BTEX concentrations from the actual field sample values to obtain the final presented BTEX concentrations. For the field sampling, the measured BTEX concentrations for the off-peak and peak campaigns were, B: 24.39 ± 4.5 μ/m^3, T: 85.88 ± 23.6 μ/m^3, E: 4.80 ± 1.18 μ/m^3, X: 5.70 ± 1.10 μ/m^3 and B: 28.19 ± 4.69 μ/m^3, T: 9.85 ± 1.14 μ/m^3, E: 2.94 ± 0.39 μ/m^3, E: 2.94 ± 0.39 μ/m^3, respectively (Table 4.9). The comparison of the BTEX concentrations between the two campaigns found toluene to be significantly greater during the off-peak campaign, whereas the other BEX compounds measured no significant difference between campaigns (Table 4.10). With regards to the sampled routes, ethylbenzene was found to be significantly different between Routes A and C during the off-peak campaign; whereas no significant difference amongst routes was observed between BTX compounds and BTEX for the off-peak and peak campaigns, respectively (Table 4.12).

After presenting the field results of the BTEX concentration between the off-peak and peak campaigns across routes, the intra-campaign variability was presented. This was done with

regards to the peak campaign, which exhibited differences between the early and later boarded buses. These differences presented themselves in the form of increased temperatures on-board the late bus, significantly different relative humidity (Table 4.13) and a reduced number of passengers on the early boarded bus in comparison to the late bus (Table 4.4). The analysis of the BTEX concentrations on-board the early and late bus returned a result indicating no significant difference in concentrations between the two boarded bus times, even though the above mentioned differences were prevalent (see Tables 4.13 and 4.14).

Finally in this results section the BTEX interspecies correlations and the correlations between BTEX compounds and on-board temperature and humidity was presented. Additionally, the T/B ratios were also presented. During the off-peak campaign a significantly strong positive correlation was measured between benzene and toluene, whereas no significant correlations were observed between the other compounds. The off-peak on-board temperature had a moderately negative correlation with benzene. However, this correlation was not significant (Table 4.15). In addition to the correlations, during the off-peak campaign the T/B ratios were measured ranging between 0.29 – 6.61 (Table 4.18), indicating vehicular sources of emissions in addition to sources other than vehicular emissions. With regards to the peak campaign significantly moderate to strong correlations were observed between BTX (Table 4.16). Other than these significant correlations, no other appreciable correlations were measured between species and on-board temperature and humidity (Table 4.16). The T/B ratios for the peak campaign ranged between 0.04 – 5.69, with the majority of ratios appearing in the range below one.

5. CHAPTER V

DISCUSSION

5.1. Introduction

The following section is a discussion of the significance of the results obtained from this study. The aim of the study was to determine the BTEX concentrations on-board in-service public buses travelling along major routes during the off-peak and peak commute times, and to determine the factors which may influence these concentrations. Firstly the BTEX concentrations measured from the off-peak and peak sampling campaign along the various routes are discussed together with the observed variability between and within campaigns to determine the factors which may influence on-board BTEX concentrations. Secondly, the influence of the sampled routes and the daily variation of BTEX concentrations are explored. Thirdly, the BTEX concentrations from this study are compared to results obtained from the international literature and potential mitigation strategies will be presented regarding the reduction of on-board air pollutants in Johannesburg buses. Lastly the limitations of this study are presented together with suggestions for taking this work forward to continue filling the gaps within the South African literature.

5.2. Comparison of BTEX Concentrations Along Travelled Routes During the Off-Peak and Peak Campaign.

During this study six different sampling routes were used, each of which represent a major commuting route through the Johannesburg CBD to the surrounding northern suburbs. Three routes were sampled for each of the two campaigns (see Figures 4.1, 4.3, 4.5 and 4.8, 4.10,

4.12). The results from this study showed no significant difference in BTX concentrations and BTEX concentrations along routes during the off-peak and peak sampling campaign (Table 4.11), respectively. The only significant difference observed between routes was with respect to the ethylbenzene concentrations along routes A (11.85 μ/m^3) and C (2.7 μ/m^3), with route A measuring the greater concentrations (Table 4.11).

A number of studies measuring VOC concentrations on-board vehicles have found significant differences in concentrations between travelled routes (Chan *et al.* 1991, Dor *et al.* 1995, Duffy and Nelson 1997) however, this was not the case with all studies (Batterman *et al.* 2002, Shiohara *et al.* 2005, Parra *et al.* 2008). The studies which measured differences in VOC concentrations on-board vehicles along studied routes attributed these to the difference in traffic volumes, travelling speeds, surrounding land use (urban vs commercial vs rural) and driving styles. Furthermore, these studies were deliberately designed to include routes which varied with regards to the above mentioned parameters (Chan *et al.* 1991, Dor *et al* 1995, Duffy and Nelson 1997). Furthermore, these studies differed with regards to the vehicles used and sampling methods and analyses which would cause slight differences when comparing study results generally. In comparison, studies which measured only slightly higher or no significant difference between routes and VOC concentrations on-board various vehicles attributed their findings to similarities in routes, shared route sections, equal self-contamination amongst sampled vehicles along routes and similar driving speeds and durations (Batterman *et al.* 2002, Shiohara *et al.* 2005, Parra *et al.* 2008).

During the current study, routes for both campaigns were chosen based on the frequency on which they were travelled by commuters and that they represented major commuter route

through the Johannesburg CBD to the surrounding northern suburbs; with the exception of route E (Figure 4.10) which started out of town and travelled towards the CBD. Furthermore, buses travelling along these routes departed and arrived at the Ghandi Square bus depo at similar times which allowed for logistical convenience during the sampling campaigns. So as mentioned earlier, routes within the same campaign and between campaigns travelled on routes which experienced similar conditions in terms of traffic density, traffic congestion, surrounding high buildings and narrow streets, slow travelling speeds, heavy acceleration and breaking episodes and frequent stop-and-go driving patters. These prevailing conditions along sections of shared route through the Johannesburg CBD and surrounding suburbs could explain why no significant variation in BTX and BTEX was observed between routes for both off-peak and peak campaigns, respectively. Special consideration was not given to differences along travelled routes as was the case with the methods used in studies which found differences in on-board concentrations along chosen routes.

Furthermore, the topographic profiles for the routes were similar in terms of elevation and road grade (see Figures 4.2, 4.4, 4.6 and 4.9, 4.11, 4.13). Thus, it can be assumed that the effects of the road grade and elevation had equal impact on the on-board BTEX concentrations given that no difference was observed between routes. However, various studies have found differences in vehicle tailpipe exhaust emissions with the variation in altitude and up and downhill route grade (Bishop *et al.* 2001, Nagpure *et al.* 2011). In this study, the fluctuations in uphill and downhill transit were gradual over the travelled distance and the route elevation above sea level did not have a large variation amongst sampled routes, whereas the studies in which the effects of these factors on vehicle emissions were investigated used sections of road and areas of elevation which differed substantially from each other. For example, Nagpure *et al.* (2011) in their study to determine the effects of

altitude on light-duty vehicle emissions used areas of different elevation ranging from 225 m – 1826 m asl to test this effect. The studies which set out to determine the effects of road grade and altitude on vehicular emissions either used portable emissions measurement systems (PEMS) to test tailpipe emissions directly or computer modelling to estimate the emissions based on a number of parameters, rather than on-board in-cabin emission tests (Frey *et al.* 2007, Nagpure *et al.* 2011, Zhang *et al.* 2015). Given the results from the current study, no discernible conclusions could be drawn regarding the on-board BTEX concentrations in relation to road grade and elevation. Therefore, if the effect of route profile and elevation are to be studied, on-board in-cabin measurements should be taken on routes which exhibit steeper gradients in areas of varying elevations above sea level, or use sampling techniques that can provide real-time emission concentration results which can then be compared to the route profile data.

Now that the similarities amongst routes have been discussed and identified as the potential cause of the lack in variation between compound concentrations; a potential explanation as to why ethylbenzene, during the off-peak campaign, measured significantly higher concentration along route A as compared to route E, will be presented (Table 4.11).

During the off-peak sampling, buses travelling along routes A (Figure 4.1) and B (Figure 4.3) traversed Louis Both Ave. During this time a large section of the road was under construction with sections of road being prepared for resurfacing. Ethylbenzene is one of the constituents of asphalt, which is used in road resurfacing (Iwuoha and Udoh 2016). The increased measured ethylbenzene concentrations on route A could be as a result of the use of the road resurfacing materials. However, if this was the case, increased ethylbenzene concentrations

would also be measured on Route B, as this route also passed the construction and road resurfacing area. An explanation for this could be that, Route A was only sampled towards the end of the sampling campaign whereas Route B was being sampled on throughout the campaign (Table 4.1). Therefore, it could be possible that the actual resurfacing of the road took place at the time when route A was being sampled and given that Route B had more sampled days, the heightened concentrations of ethylbenzene could have been reduced by the averaging of values from previous trips which did not encounter resurfacing asphalt fumes. However, given the many assumptions made by this explanation, no decisive conclusions can be drawn for this account.

5.2.1. Assessment of BTEX Concentrations Between Off-Peak and Peak Sampling Campaigns

This study measured BTEX concentration on-board public buses during the off-peak (10:00 am – 2:00pm) and peak (6:00am – 8:30am) commute times. The off-peak sampling campaign was conducted between November and December 2017, and the peak sampling campaign was conducted in between April and May 2018. The results from this study comparing the on-board concentrations of BTEX between the two campaigns showed no significant difference in mean values for benzene, ethylbenzene and xylenes (Table 4.9). However, the mean toluene concentration (85.88 ± 23.6 μ/m^3) during the off-peak campaign was significantly higher, approximately eight times, than that measured during the peak campaign (9.85 ± 1.14 μ/m^3) (Figure 4.20). The lack of variation amongst the BEX compounds between campaigns could be as a result of the conditions experienced while travelling through the Johannesburg CBD as during both the off-peak and peak campaigns, buses experienced slow moving traffic, vehicle congestion, frequent stops and starts and episodes of

irregular and erratic acceleration and breaking. In addition, given that all of the routes had a common starting point or destination, the surrounding environment and topographic profiles through which the buses travelled were also similar for both campaigns (see Figures 4.1 – 4.6 and Figures 4.8 – 4.13).

Duffy and Nelson (1997) and Parra *et al.* (2008) in their studies to determine VOC concentrations on-board various vehicles found that significantly higher concentrations were measured during peak times as compared to the off-peak times. These observations were related to the traffic densities between the two times and the travelling speeds; with off-peak commutes experiencing less traffic which would allow for increased travelling speeds and distances between vehicles which resulted in greater on-road dispersion of pollutants and increased on-board ventilation through the vehicle (Parra *et al.* 2008), thus reducing measured pollutants. The off-peak and peak times are related to expected times of heavy vehicle traffic which were specifically factored into the sampling procedure for the studies conducted by Duffy and Nelson (1997) and Parra *et al.* (2008) by choosing periods which differed in terms of traffic density between the two times (Duffy and Nelson 1997, Parra *et al.* 2008). However, in the current study, traffic densities within the Johannesburg CBD did not abate even during the off-peak times, as a consequence of the prevailing conditions within the city and not as a result of study design. Therefore, variation in traffic density was not observed between sampling campaigns with regards to the inner city commute. Given that both campaigns experienced similar conditions along sections of the route could potentially account for the similarity in BEX concentrations between the campaigns. However, even though the similarities existing between the two campaigns could possibly explain why no

variations in BEX concentrations were observed; the high toluene values present during the off-peak campaign will still need to be explored.

Toluene was the only BTEX compound found to be significantly higher during the off-peak campaign as compared to the peak campaign (Table 4.9). A number of in-vehicle and ambient studies have found toluene to be the most abundant VOC from amongst the BTEX compounds in urban areas (Lee *et al.* 2002, Lau and Chan 2003, Hajizadeh *et al.* 2018). This is because toluene is emitted into urban areas not only as a result of vehicular emissions but also as a result of various industrial and manufacturing processes (ATSDR 2017). Therefore, the high toluene concentrations measured during the off-peak campaign could have been a result of the outside urban air infiltrating into the bus cabin through the open windows; a situation which would have been less pronounced during the peak campaign given that all the windows were closed.

5.3. Factors Affecting On-Board BTEX Concentrations

Variation in different on-board factors existed between the off-peak and peak buses and with regards to the peak buses within the same campaign, which could contribute to either an increase or decrease in measured on-board BTEX concentrations. These factors included the on-board temperature, ventilations mode and passenger number between the off-peak and peak campaigns (Tables 4.1 and 4.4). With regards to the peak campaign, the early boarded bus differed from the later buses in on-board temperature and humidity and passenger number (Tables 4.4 and 4.13). Additionally, even though seasonal variability between sampling campaigns was not an aim of this study; the sampling was conducted in two

different seasons. The off-peak campaign was conducted in summer (November – December 2017) and the peak campaign was conducted in autumn (April – May 2018). Variation in the above mention factors i.e. seasonality, on-board temperature and humidity, ventilation mode and passenger number, were found in other studies to have significant effects on on-board in-vehicle pollutant concentrations (Jo and Park 1999, Jo and Yu 2001, Parra *et al.* 2008, Chen *et al.* 2011).

5.3.1. Seasonal Influence of BTEX Concentrations On-Board Vehicles

Studies conducted by Jo and Park (1999) and Jo and Yu (2001) found that seasonal variability affected BTEX concentrations on-board vehicles. However, these two studies had contrasting findings. Jo and Park (1999) found significantly higher benzene and toluene concentrations on-board sampled cars during summer (B: 73.6 µ/m^3, T: 171 µ/m^3) than winter (B: 41.3 µ/m^3, T: 108 µ/m^3). The authors related this observation to the greater volatility of benzene and toluene, which would lead to increased engine running loss during summer through evaporation (Jo and Park 1999). Jo and Yu (2001) on the other hand, in their study found significantly higher concentrations of BTEX compounds in buses during winter (B: 28.5 µ/m^3, T: 84.3 µ/m^3, E: 10.3 µ/m^3, *m,p*-X: 20.6 µ/m^3, *o*-X: 8.8 µ/m^3) than summer (B: 16.3 µ/m^3, T: 44.2 µ/m^3, E: 5.5 µ/m^3, *m,p*-X: 12.1 µ/m^3, *o*-X: 4.2 µ/m^3) and attributed this observation to the reduced combustion efficiency of engines during cold start conditions. During the winter seasons, the combined effects of cold start engines of many vehicles in urban areas contribute to increased air pollutant levels and therefore could contribute to higher in-vehicle concentrations as a result of the infiltration of outdoor air inside vehicle cabins or due to increased self-pollution of the vehicles own exhaust (Jo and Yu 2001, Abi-Esber 2014). This condition was prevalent during the morning peak campaign, as the buses

were operated under cold start conditions and were allowed to idle for at least 30 minutes before departure from the bus terminal. Furthermore, during this time the ambient temperatures were also low (see Figure 4.14), which would contribute to the poor combustion characteristics of a cold start engine and thus favour an increase in on-board BTEX accumulation (You *et al.* 2007, Abi-Esber 2014). However, even though a difference in the prevailing seasonal conditions were experienced between the two campaigns for the current study, the findings do not align with those found by Jo and Park (1999) and Jo and Yu (2001) as no discernible relationships could be drawn between the given season and the concentration results.

5.3.2. Influence of On-Board Temperature and Humidity on BTEX Concentrations

During the current study, the on-board temperatures were found to be significantly higher than the measured ambient temperatures for both campaigns (Tables 4.3 and 4.6). Furthermore, the on-board temperatures had a strong positive correlated with ambient measurements (Table 4.7). In previous studies, the on-board temperatures have shown to have varying effects on BTEX concentrations. For example, Parra *et al.* (2008) observed a significant negative correlation whereas Chen *et al.* (2011) found significant positive correlations between the on-board temperature and BTEX concentrations. Parra *et al.* (2008) linked this observation to an increase in solar radiation which would cause increase photodegradation of BTEX compounds and thus reduce the measured on-board concentrations. In contrast, Chen *et al.* (2011) linked their observation to the increase in evaporation of BTEX compounds from the interior materials of the vehicle as on-board temperatures increased. Their study also concluded that older vehicles would exhibit lower BTEX concentrations as compared to newer vehicles due to the longer period of evaporation

of compounds from the interior materials over time for older vehicles (Chen *et al.* 2011). Likewise, You *et al.* (2007) in their study of VOCs on-board cars of various ages, also observed that newer cars emitted more VOCs than older cars due to the new interior materials which produced more evaporative emissions. They also found that increasing the on-board temperature caused an increase in on-board VOCs as this condition facilitated the ease of VOCs evaporation from interior trimmings and materials (You *et al.* 2007). In the current study, the sampled buses were more ten years old; therefore, it would be safe to say that the evaporative emissions of BTEX from the interior materials of the buses were negligible.

In the current study, during the off-peak campaign moderate to weak negative correlations were observed between on-board temperature and benzene (r = -0.504), toluene (r = -0.241) and xylene (r = -0.252) whereas a weak positive correlation was observed for ethylbenzene (r = 0.190) (Table 4.14). These findings, regarding the negatively correlated compounds, were similar to what was observed by Parra *et al.* (2008), (B: r = -0.378, T: r = -0.347, E: r = -0.452, *m/p*-X: r = -0.462, *o*-X: r = -0.463), in that increases in on-board temperature would result in a decreased in on-board VOC concentrations. However, in this study, unlike the correlations observed by Parra *et al.* (2008), all of the correlations were not significant (Table 4.14). Regarding the peak sampling campaign, weak insignificant correlations were observed between on-board temperature and BTEX compounds, with benzene (r = 0.238) and toluene (r = 0.111) being positively correlated and ethylbenzene (r = -0.329) and xylene (r = -0.183) being negatively correlated with on-board temperature (Table 4.15).

During the peak sampling, variability also existed between the earlier and later boarded buses with regards to on-board temperature and humidity (Table 4.12). The results from the intra-

campaign analysis showed no significant difference between BTEX concentrations on-board the early and late boarded bus even though the temperature and humidity was significantly different (Table 4.13). The on-board daily relative humidity measured during the peak campaign was found to be weakly and not significantly correlated to any of the benzene (r = 0.012), toluene (r = -0.058), ethylbenzene (r = 0.350), xylene (r = 0.002), compounds (Table 4.15). These findings are in contrast to the finding of both Parra *et al.* (2008) and Chan *et al.* (2011). Parra *et al.* (2008) found moderate to weak significant correlations between benzene (r = 0.287), ethylbenzene (r = 0.222), *m*,*p*-xylene (r = 0.413), *o*-xylene (r = 0.203) and on-board relative humidity, whereas Chan *et al.* (2011) found strongly positive significant correlations between benzene (r = 0.94), toluene (r = 0.87), ethylbenzene (r = 0.94), xylene (r = 0.94) and on-board RH. Furthermore, a similar trend was observed in ambient BTEX measurements by Parra *et al.* (2009) in their study which found moderate to strong positive correlations between BTEX concentrations and ambient RH in a city in Spain. On-board relative humidity was not measured during the off-peak campaign due to analyst error. However, it could be assumed that similar patterns of poor correlations would be observed between BTEX compounds and the off-peak on-board humidity.

The observations made in this study with regards to the on-board temperature and humidity and the related correlations with the measured on-board BTEX concentrations would suggest that these variables did not have an impact on on-board pollutant concentrations even though the on-board conditions varied between campaigns and within campaigns. These finding (Tables 4.14 and 4.15) could potentially explain why no variation was observed between the two campaigns with regards to BTEX concentrations. However, this is highly unlikely given that the finding in this study are not in agreement with what has been observed elsewhere and has shown various inconsistencies. For example, on-board correlations between BTEX

compounds and on-board temperature show weak insignificant relationships for both high (Table 4.14) and low (Table 4.15) on-board temperatures, whereas in general, a difference would be expected as observed within previous studies (You *et al.* 2007, Parra *et al.* 2008, Chan *et al.* 2011).

5.3.3. Influence of Ventilation Mode on On-Board BTEX Concentrations

The ventilation mode on-board a vehicle is an important factor influencing the levels of in-cabin pollutant concentrations (Xu *et al.* 2018). During the off-peak campaigns the buses windows were open for all samples, whereas for the peak campaign the buses windows were closed for all samples. None of the buses were fitted with air conditioning (AC) and the ventilation mode during this study was not controlled by the study design, but rather on the preference of the passengers. Ventilation mode has shown to significantly impact measured on-board pollutant concentrations in a number of studies (Duffy and Nelson 1997, Jo and Park 1999, Ongwandee and Chavalparit 2010, Chen *et al.* 2011, Abi-Esber 2014, Xu *et al.* 2018).

On-board in-cabin studies have found that using air conditioning could either reduced or increase VOC pollution within a vehicle (Xu *et al.* 2018). Duffy and Nelson (1997) and Ongwandee and Chavalparit (2010) in their studies found that using the AC reduces the measured VOC concentrations on-board the buses, as the AC prevents the polluted outdoor air from infiltrating the cabin, given that the AC operates with the windows closed and recirculates the air within the bus. On the other hand, Jo and Park (1999) and Chen *et al.* (2011) found that by engaging the AC, higher concentrations of VOCs are measured in-cabin

as a result of less natural ventilation, infiltration of the vehicles own exhaust or air pollutants originating from the AC system itself.

In the current study, while sampling on-board the off-peak buses with the windows open, more turbulent air movement was experienced through the journey as compared to the peak buses which had all the windows closed and no appreciable turbulence during the trip was experienced. These observations could influence on-board BTEX concentrations in that during the off-peak campaign a larger amount of polluted urban air enters the bus cabin through the windows; however, due to the high exchange rate between the outdoor and indoor air, this air is quickly diluted and dispersed out the vehicle resulting in lower measured pollutant concentrations (Xu *et al.* 2018). Conversely, giving that the journey thought he Johannesburg CBD was similar in terms of driving and traffic conditions for both campaigns, a greater proportion of outdoor air could infiltrate the bus cabin, and due to the slow moving traffic, congestion and reduced air movement and dispersion caused by the high buildings and narrow streets, could potentially intensify off-peak BTEX concentrations. The high buildings and relatively narrow roads present in typical city environment are referred to as street canyons and can be characterised as areas of poor natural ventilation and air dispersion favouring pollutant accumulation (Vardoulakis *et al.* 2003).

With regards to the peak campaign, the windows were closed for all samples. This could influence the on-board BTEX concentrations in a number of ways. Firstly, the peak buses idled at the bus terminal for approximately 20 -30 minutes before departure in the early mornings. During this time the front doors were open and the in-cabin windows were closed. This situation could allow for the accumulation of BTEX on-board the buses given that the

buses were stationary and that many buses idled like this at the depo at the same time, which would intensify the effect. Furthermore, during the morning commute while on route, the buses were surrounded by slow moving traffic through routes which were dominantly surrounded by other vehicles which were potentially experiencing higher engine pollutant outputs due to the morning cold start conditions (O'Donoghue *et al.* 2007, Abi-Esber 2014). Therefore, being engulfed in such an environment within a close proximity to the surrounding vehicles' tailpipe emissions, under low ventilation conditions, and due to the effects of poor pollutant dispersion of street canyons; could allow for the outdoor air to infiltrate in-cabin, through cracks and crevices within the body structure of the bus even when the windows are closed. Although this is a possibility, no major defects were observed on buses body structure to allow for this to happen. Moreover, during the morning peak commute, the distinct scent of cosmetic products was dominant in the bus cabin. Cosmetic products have been identified as a source of BTEX in indoor environments and have been reported to contribute to elevated in-vehicle VOCs concentrations (Ongwandee and Chavalparit 2010, de Gennaro *et al.* 2014, Baghani *et al.* 2018). Given that this situation prevailed in the presence of low on-board ventilation conditions, an increase in measured BTEX concentrations would be expected in comparison to the off-peak campaign; however, this was not the case in the current study.

Given the above mentioned scenarios, which might influence an increase or decrease in the on-board BTEX concentrations with varying ventilation modes, it would be expected that the two campaigns would differ with respect to measured concentrations. However, in this study no such distinctions could be made with regards to BEX concentrations in general between campaigns. In previous studies the on-board ventilation modes were controlled by study

design and therefore the findings could be attributed to specific parameters. However, in the current study, the ventilation mode was not controlled by the study design and therefore attributing specific findings to certain causes was found to be difficult.

5.3.4. Influence of Passenger Number on In-Cabin BTEX Concentrations

During the off-peak campaign all of the sampled buses had a passenger count of less than 30% of the total capacity, while during the peak campaign the early boarded bus and the late boarded bus had passenger counts of less than 5% and 100% of the total capacity, respectively. The number of passengers could influence the on-board BTEX concentrations in a number of ways. Firstly, the number of passengers on-board the bus increases the load applied on the bus's engine and therefore influences the way in which the engine's parameters operate resulting in changes in tailpipe pollutant emissions (Jayaratne *et al.* 2009, Yu *et al.* 2016) and potential changes in on-board pollutant concentrations due to self-pollution of the buses own exhaust. Secondly, the number of passengers can contribute to an increased net amount of cosmetic products, perfumes, deodorants, hair sprays and nail polishes etc. within the bus cabin, thereby increasing the BTEX concentrations. And finally, the number of passengers on-board the bus will influence the number of times the buses doors are opened and closed, which in turn influencing the amount of outdoor air entering the bus cabin.

Yu *et al.* (2016) in their study of on-road bus emissions found that emissions under varying load conditions are influences by the vehicles speed and accelerations. They found that higher HC emissions from buses operating at increased speeds across varying loads as compared to slow travel speeds, which emitted similar HC concentrations over different loads. Also, their study found that HC emissions increased across all loads as the buses acceleration increased

(Yu *et al.* 2016). This study however, was not measuring on-board emissions but rather tailpipe emissions using a PEMS. However, the findings can be of use in future on-board emission tests as the specific factors of speed and acceleration can be investigated. With regards to a study which conducted on-board BTEX measurements, Parra *et al.* (2008) found that passenger number did not correlate to BTEX concentrations on-board the sampled buses across urban routes. However, passenger number did correlate to BTEX concentrations along a residential route with low traffic densities and the authors attributed the observation to the opening of the cabin doors while loading passengers (Parra *et al.* 2008). In addition, other than the study by Parra *et al.* 2008, no other study reported the effects of passenger number on on-board, in-bus BTEX concentrations. Furthermore, the finding reported by Parra *et al.* 2008 were only inferred based on a limited number of samples and therefore if the influence of passenger number is to be tested, perhaps a simulated on-board emission study would be more suitable. During the current study, even though passenger numbers varied between the off-peak and peak campaigns and within the peak campaign no discernible conclusions could be draw regarding the influence of the passenger number on on-board BTEX concentrations. Therefore,

In general, even though differences existed between the off-peak and peak sampling campaigns and within the peak campaign with regards to seasons in which the samples were collected, on-board temperature, humidity, ventilation mode and passenger number; the results comparing the BTEX concentrations between the two campaigns and within campaigns seem to suggest that these factors have had no influence on BTEX concentration overall. Although, these vary same factors have shown to significantly influence on-board VOC concentrations in a number of previous studies.

5.4. Toluene/Benzene Ratios and BTEX Interspecies Correlations

Toluene/Benzene ratios are used as an indication of whether an emission source a mobile or point source (Hajizadeh *et al.* 2018). Likewise, the interspecies correlation between BTEX species have also been used as an indicator for pollutants origination from a common sources (Tiwari *et al.* 2010). Strong interspecies correlations indicate a common source of emissions and poor correlations between species indication multiple dominant sources of these compounds in a location (Tiwari *et al.* 2010).

In this study T/B ratios were measured for both campaigns according to the availability of T/B pairs for each sample (Appendix B). The T/B ratios observed for the off-peak campaign were in the range of 0.29 – 6.41, with the majority of the ratios appearing between 3.5 – 6.5 (n = 7) (Table 4.17 and 4.18). For the peak campaign T/B ratios appeared between 0.04 – 5.69 (Table 4.18), with the majority of ratio values appearing in a range < 1 (n=20) (Table 4.17). A total of 10 and 24 T/B ratio pairs were obtained from the off-peak and peak data sets respectively and thus the presented T/B ratios are a subset of the total campaign samples. Lan *et al.* (2013) have reported T/B ratios of < 3 to be indicative of traffic emissions in a number of worldwide studies, while Hajizadeh *et al.* (2018) have reported T/B ratios ranging from 1.5 – 4.3 to be indicative of traffic related emissions. In addition, Lan *et al.* (2013) and Tiwari *et al.* (2010) have reported T/B ratios > 4.3/4.5 to be characteristic of solvent use or industrial activities. Lee *et al.* (2002) observed in their study that T/B ratios increased as traffic volume and other urban sources increased in denser areas. The variation in T/B ratios reported by different studies indicating similar sources may be a result of the local fuel composition, industrial activities or vehicles fleet characteristics (Khoder 2007).

In the current study, during the off-peak campaign, T/B ratios were observed in the range (0.29 – 1.55) close to those indicative of traffic emissions together with higher values (3.84 – 6.41) indicating potential sources of toluene other than vehicular emissions (Table 4.17 and 4.18). Other potential sources of VOCs on-board the buses could originate from the interior materials and decorations, cleaning agents or the use of cosmetic products by the occupants (Hsu and Huang 2009, Ongwandee and Chavalparit 2010). Hsu and Hong (2009) in their study of VOCs and other pollutants on-board long distance buses in Taiwan, observed that the measured BTEX ratios were higher on-board the vehicles than from roadside measurements. The authors attributed this to the influence of the interior materials and fixtures present in these long distance buses. In addition to internal sources of VOCs, outdoor emissions also infiltrate the bus cabin, and due to the windows being open for all off-peak samples, the elevated T/B ratios could result from external industrial processing activities in the Johannesburg CBD.

For the peak sampling campaigns the majority of T/B ratios appeared < 1, ranging between 0.04 – 0.98 (Table 4.17). These measured ratios are comparable to what has been observed by Breton *et al.* (2017) in their study of ambient BTEX concentrations in two urban locations of Mexico. Their T/B ratios ranged between 0.07 – 0.27 between two sampling sites throughout the year between morning, midday and late afternoon samples. The authors (Breton *et al.* 2017) reported T/B ratios of < 2 to be indicative of vehicular emissions, whereas Tiwari *et al.* (2010) reported T/B ratios close to one being characteristics of fresh vehicular emission sources. Using the reported T/B ratio values of traffic related emission presented by Tiwari *et al.* (2010) and Breton *et al.* (2017), the measured T/B ratios during the peak sampling

campaign for the current study would suggest the dominant influence of traffic originated emissions on-board the buses. Given that the windows were closed for the all peak campaign samples, it can be suggested that the given sources of emissions during this campaign were a result of self-pollution and intrusion of the buses' own emissions. The T/B ratio differ amongst studies as a result of varying fuel compositions, vehicular fleet characteristics and the dominant industrial processing and manufacturing activities in a particular areas and therefore these ratios are used to tentatively attribute different emission sources.

Other than T/B ratios, BTEX interspecies correlations can also be used as an indication of a common pollutant source. This is possible as common emission source emit pollutants in set proportions, which would allow for significant correlations between the given pollutants to be measured. The interspecies BTEX correlation measured during the current study found benzene and toluene, during the off-peak campaign, to have a significantly strong positive correlation ($r = 0.94$); whereas for the peak campaign, BTX compounds had a moderate to strong significant correlation (B-T: $r = 0.585$, B-X: $r = 0.806$, T-X: $r = 0.407$) (see Tables 4.15 and 4.16). Other than these correlations, no other significant BTEX interspecies correlations were observed.

In the study by Parra *et al.* (2008) significant interspecies correlations of BTEX compounds were observed on-board buses travelling along different routes and between on-board BTEX species and ambient levels. The authors concluded that these correlations suggest that the BTEX compounds are from traffic related emissions and that the on-board emissions have been influenced by outdoor air. In the same study, no correlations were found between BTEX and VOCs associated with degreasing agents and cleaning materials on-board the buses

(Parra *et al.* 2008). Likewise, in the study by Lau and Chan (2003), BTEX correlations observed on-board various transport modes were similar to roadside studies, which the authors linked to a common traffic related sources of emissions on-board these vehicles. However, poor correlations were observed on-board a new air conditioned bus and an underground train, which the authors attributed to the interior materials of the buses and the use of solvents in the train tunnel (Lau and Chan 2003). Benzene and toluene are associated with vehicular emissions and given their strong correlation in the current study with regards to the off-peak sampling, could imply a common vehicular source; however, the high T/B ratios for this campaign does not support this conclusion in that the ratios appear in a range indicative of industrial sources. Furthermore, with regard to the peak campaigns, BTX compounds were significantly correlated, in addition to the T/B ratios falling within the range of vehicular traffic which would suggest a common traffic related emission source. The absence of a significant correlation between ethylbenzene and the other BTX compounds could potentially point to an additional source of this compound on-board the buses. However, the exact source would be difficult to isolate and identify without further investigation.

5.5. Comparison of BTEX Concentrations On-Board Buses from Amongst Studies

On-board in-vehicle VOC testing has been going on since the 80's up until present times in various countries around the world (Batterman *et al.* 2002), as the harmful effects of these compounds on the environment and human health have now long been recognised. The results obtained from this study with regards to the mean on-board BTEX concentrations for the off-peak and peak campaigns were 24 μ/m^3, 85 μ/m^3, 4.80 μ/m^3, 5.70 μ/m^3 and 28 μ/m^3,

9.85 μ/m^3, 2.94 μ/m^3 and 7.7 μ/m^3 , respectively. In general, the concentrations measured in this study fell within the range of other international studies.

The measured on-board benzene concentrations measured in his study compare to those measured in Australia (27.5 μ/m^3), United Kingdom (21.2 μ/m^3) and Mexico (23.6 μ/m^3) (Duffy and Nelson 1997, Kingham *et al.* 1998, Shiohara *et al.* 2005)(Table 5.1). Amongst the highest benzene concentrations appeared in a study by Kongtip *et al.* 2015, conducted in Thailand, which measured levels in exceedance of 400 μ/m$^{3.}$ The peak toluene concentrations in this study fell within a range of concentrations found in studies conducted in France (80 μ/m^3) and Taiwan (74.1 μ/m^3) (Dor *et al.* 1995, Hsu and Huang 2009). Toluene appears to be the most abundant VOC from amongst all the BTEX compounds in the majority of reviewed studies (Table 5.1) and this observation had also been made with regards to the off-peak toluene concentrations in the current study. Toluene and benzene have also shown to have a large range of concentrations amongst studies; for instance Parra *et al.* (2008) measured toluene concentrations as low as 7.1 μ/m^3, whereas Ongwandee and Chavalparit (2010) measured exceedingly high concentrations of toluene measured at 242 μ/m^3 (Table 5.1).

The peak toluene concentrations and ethylbenzene and xylene concentrations for both campaigns fell within the range of values measured in the USA by Batterman *et al.* (2002) and in Spain by Parra *et al.* (2008) (Table 5.1). A number of other factors can also influence the measured VOC concentrations on-board vehicles between different studies. These factors may include, vehicle fleet size, the composition of fuel used, engine type, emission technologies, local emission laws and regulations, road design, metrological conditions, driver behaviour, ventilation mode, dominant vehicle type, and vehicle age and maintenance

history. Therefore, given these large variations amongst studies, caution should be taken when drawing conclusions from these comparisons.

Table 5. 1. Comparison of BTEX concentrations (µg/m^3) on-board buses from international studies

Reference	**Country**	**Benzene** (µg/m^3)	**Toluene** (µg/m^3)	**Ethylbenzene** (µg/m^3)	**Xylenes** (µg/m^3)
Dor *et al*. 1995	France	11 – 13	80		
Duffy and Nelson 1997	Australia	30[a] 25[b]			
Kingham *et al*. 1998	United Kingdom	21.2			
Batterman *et al*. 2002	USA	4.1	8.9	2.1	9.1
Chan *et al*. 2003	China	11.3[a] 13.5[b]	48.9[a] 63.6[b]	8.3[a] 8.2[b]	17.6[a] 17.4[b]
Lau and Chan 2003	Hong Kong	5.6	63.2	4.9	10.7
Shiohara *et al*. 2005	Mexico	23.6	110	17.8	54.0
O'Donoghue *et al*. 2007	Ireland	7.04			
Parra *et al*. 2008	Spain	2.8	7.1	1.15	3.12
Hsu and Huang 2009	Taiwan	6.6	74.1	9.4	13.2
Ongwandee and Chavalparit 2010	Thailand	54.9[a] 39.0[b]	174[a] 242[b]	19.0[a] 15.0[b]	73.6[a] 47.8[b]
Kongtip *et al*. 2015	Thailand	415.5[a] 401.6[b]	223.8[a] 219.1[b]	16.6[a] 16.8[b]	115.3[a] 93.65[b]
Current study 2019	South Africa	24[c] 28[d]	85[c] 9.85[d]	4.80[c] 2.94[d]	5.70[c] 7.5[d]
a – Non-AC b – AC c – off-peak d – peak					

Additionally, the study design, sampling equipment and durations, analytical methods and processing can all have an influence on the outcome of the measured concentrations (Lau and Chan 2003b). For example, a number of studies used thermal desorption (Chan *et al.* 1994, Jo and Park 1999, O'Donoghue *et al.* 2007) and solvent extraction (Shiohara *et al.* 2005, Som *et al.* 2007, Kongtip *et al.* 2015) methods to analyse the sampling tubes used to collect VOCs

(see Table 2.2). These two methods vary in the way in which the samples are prepared and analysed (Król *et al.* 2010, Ramírez *et al.* 2010, Maceira *et al.* 2017), and could impact overall results. Furthermore, some studies used GC-FID (Hsu and Huang 2009, Chen *et al.* 2011, Kongtip *et al.* 2015) for detecting and analysing compounds while other studies used GC-MS (Duffy and Nelson 1997, Shiohara *et al.* 2005, Ongwandee and Chavalparit 2010). These two detection systems work on different principles and can also yield varying results. This study used the GC-TOF-MS for the analysis of charcoal tubes. There were no documented studies in the literature which used this system for the analysis of BTEX compounds on coconut charcoal tubes desorbed in CS_2, and therefore the method development stages of the analysis process posed challenges. Challenges which might have been the cause of measurement underestimation and uncertainty.

5.6. Mitigation Strategies to Reduce Air Pollutants Concentrations On-Board Public Buses in Johannesburg

Various factors influencing on-road emissions and fuel economy have been studied over the years in an effort to better understand on-road vehicular dynamics, to reduce emissions and increase fuel economy (Huang *et al.* 2018). Based on the on-board observations made during sampling; the following recommendations are made regarding potential strategies that could be used to reduce on-board pollutants in general and not only VOCs. Furthermore, the presented strategies have shown to reduce tailpipe emissions and on-board emissions in studies utilising different types of vehicles and not only buses. Therefore, these emission reduction strategies could potentially have resonance in the local context given the diversity of transport modes.

During the current study it was noted for both campaigns that; buses would idle at the bus depo before departing to the bus terminal, particularly during the morning periods. Furthermore, at the bus terminal, buses would idle while waiting for passengers to board or while awaiting departure times. Moreover, while on route, drivers would display highly irregular and erratic driving styles, which included bouts of high acceleration and sharp breaking. The aggressive driving behaviour, characterised by rapid acceleration and sharp breaking (Clark *et al.* 1999), adopted by drivers was probably a result of the prevailing traffic condition as bus transit vehicles were constantly competing with taxi drivers for right of way. This situation on many occasions might demand that bus drivers display aggressive driving behaviour. The traffic conditions on route were also highly congested and slow moving with vehicles being in very close proximity to each other as demanded by the prevailing conditions, especially through the CBD.

An immediate and low cost strategy to reduce vehicular emissions and increase fuel economy would be to encourage and support changes in driver behaviour to behaviours which are in accordance to eco-driving principles (Barkenbus 2010). Eco-driving can be characterised as being a less aggressive and more stable and regular, refined why of driving; involving gradual acceleration/deceleration, predicting traffic flows - thereby avoiding unexpected stops and starts, keeping a safe and even following distance between vehicles, driving within the speed limit and reducing excessive idling (Barkenbus 2010).

Although the cumulative benefits of eco-driving have been mainly demonstrated with regards to the reduction of CO_2 emissions (Barkenbus 2010, Huang *et al.* 2018); the individual principles have also shown to have benefits with regards to other tailpipe emissions and on-

board emissions. For example, Clark *et al.* (1999) found an increase in CO and PM, and NOx for diesel and CNG buses, respectively, under aggressive driving modes compared to non-aggressive modes tested on lab based dynamometer tests. Furthermore, by reducing the idling time and increasing distances between vehicles during driving will result in less self-contamination of exhaust fumes by the vehicle's own exhaust and will reduce infiltration of exhaust from the vehicles driving ahead (Sabin *et al.* 2005). Therefore, by encouraging eco-driving behaviours amongst driver could potentially reduce emissions pollutants on-board buses, including VOCs; however, this would still need to be further tested. Nevertheless, encouraging such behaviours would not cost anything and the potential benefits would be immediate.

Another economic solution to the reducing on-board pollutant concentrations on buses regards the ventilation conditions. None of the sampled buses were fitted with air conditioning and given the cost involved in installing air conditioning and the age of the sampled bus fleet, it would be assumed that the bus company would be reluctant to make such an investment to change ventilation systems on-board the buses. However, it was observed that the buses had ceiling vents which were not normally opened as they were considered emergency exit vents. Given that the height of these vents are higher than that of the windows; using these vents for ventilation would allow for infiltration of air from a position higher on the vertical profile to enter the bus. Duffy and Nelson (1997) have reported that the higher on the vertical profile the air intake is situated the less on-board air pollutants are measured. Therefore, the strategy of using the roof vents for on-board ventilation can be implemented immediately with no cost to the bus company. However, the effects of the new ventilation mode will need to be further tested to ensure that the ventilation produced by the ceiling vents is sufficient for the passengers comfort needs.

Studies have shown that fuels efficiency and pollutant emission reduction can be achieved by using alternative fuels systems such as DDF (Wei and Geng 2016). The usage of the DDF system in public transit buses has the potential to reduce emission pollutants both in terms of tailpipe emission reduction and on-board in-vehicles emissions (Hammond *et al.* 2007, Hegab *et al.* 2017). At the time of this study a number of in-service diesel public buses were converted to operate under DDF mode, with the intention of providing sustainable, environmentally friendly transport and to be the public. However, due to a lack of technical expertise, the DDF system could not be maintained properly and even though the system was installed on the buses, it was not being used. This is one of the concerns with regards to the implementation of such alternative fuel systems, that due to structural vulnerability within the government bus depot, the lack of expertise and resources, these systems were difficult to maintain. Furthermore, with poor maintenance these systems produce more pollutant emissions than conventional diesel buses. The structural vulnerability and lack of capacity experienced by the bus company used in this study potentially contributed to the failure experienced by the DDF system; however, an in-depth analysis of these structures is beyond the scope of this study.

Another issue with the DDF system is that it is not efficient under low load conditions, and during drive cycles which experience frequent stop-and-go traffic (Wang *et al.* 2011). Furthermore, the system performs poorly during high acceleration and heavy braking episodes (Clark *et al.* 1999, Wang *et al.* 2011). This is of concern given that these types of driving conditions are dominantly experienced during inner city bus transit. Potential solutions for such problems could be the use of dedicated bus lanes which would allow for

unhindered smother bus transit for DDF buses and diesel buses in general. Currently along sections of road within the Johannesburg inner city and surroundings areas dedicated bus lanes have been established. However, they are meant specifically for the bus rapid transit (BRT) vehicles, which are also owned by the government. As noted from journeys on-board the Metrobus, the BRT buses would move swiftly and seamlessly within the dedicated bus lanes without being hindered by the surrounding traffic. The BRT system also has dedicated traffic signals which further allows for ease of movement. In addition, studies have shown that the proximity of one vehicle to another influences the amount of on-board pollutants experienced by the vehicle travelling behind. A potential solution would be to permit the Metrobus vehicles to utilise these dedicated bus lanes, especially in congested areas, and traffic signals which would reduce the amount of stop-and-go traffic experienced currently by the transit buses and would prevent buses from trailing behind polluting tailpipe from vehicles in front of it (Duffy and Nelson 1997, McNabola *et al.* 2009). Thus, the usage of the DDF system, travelling on dedicated bus lanes, under proper engine maintenance and operational optimisation conditions; can be looked upon as a suitable mitigation strategy to reducing both tailpipe and on-board in-vehicles bus emission concentrations.

6. CHAPTER VI

CONCLUSION

6.1. Introduction

The aim of this study was to determine the BTEX concentrations on-board in-service public buses travelling along major commuter routes during the off-peak and peak times and to determine the factors which may influence these concentrations. Firstly as summary of the key findings and their significance are presented, together with the conclusions drawn from the study. Thereafter, the limitations of the study will be outlined and finally recommendations are suggested regarding furthering the study to continue filling the gaps within the South African literature.

6.2. Summary of Key Findings

The off-peak (10:00 am – 2:00 pm) sampling campaign was conducted in November - December 2017 and the peak sampling (6:00 am – 8:30 am) campaign was conducted in April - May (2018). The on-board sampling was conducted using personal sampling pump attached to coconut charcoal tubes. While boarded on the bus, the in-cabin temperature and humidity was measured, and the on-board ventilation, passenger numbers, filed observations and travelled routes were noted. The field samples were prepared using CS_2 solvent extraction and analysed using a GC-TOF-MS.

- During this study a total of six routes were used for sample collection. These routes were chosen as they represented major commuter routes through the Johannesburg CBD to the surrounding suburbs (see Figures 4.1, 4.3, 4.5 and 4.8, 4.10, 4.12). The results from the ANOVA test comparing BTEX concentrations amongst sampled routes returned a result indicating no significant differences amongst routes for BTX and BTEX during the off-peak and peak campaigns, respectively (Table 4.12). The only significant difference ($p = 0.03$) was measured in ethylbenzene between route A and route C, with route A having the higher concentration (Table 4.12).

  These observed BTEX concentrations amongst routes was attributed to the similarities existing between the sampled routes, in terms of traffic density, topographic profile, shared route sections and surrounding land use. These findings were supported by what was observed in the literature, in that studies which observed no difference in VOC concentrations along sampled route attributed their findings to the similarities in the above mentioned attributes (Batterman *et al.* 2002, Shiohara *et al.* 2005, Parra *et al.* 2008). Furthermore, the effects of an external source of ethylbenzene was suggested as an explanation as to why elevated concentrations were measured along Route A; however, no definitive conclusions could be drawn for this account.

  In conclusion, during this study no difference in on-board BTEX concentrations were observed between sampled routes, potentially due to the similarities existing amongst the sampled routes such as route profile, surrounding land use and prevailing traffic conditions, Therefore, it would be suggested that to precisely determine the effects of the sampled route on on-board emissions, the study design would need to specifically include route which differ in terms of the above mentioned characteristics.

- The results of the BTEX concentrations between the two campaigns showed no significant difference with regards to the BEX compounds (Table 4.10). However, toluene did measure a significantly higher concentration during the off-peak campaign (85.88 μ/m^3) as compared to the peak campaign (9.85 μ/m^3) (Table 4.9). These results were attributed to the similar high traffic conditions experienced during both the off-peak and peak campaigns with regards to the inner city commute which did not abate during the two periods. In addition, the high toluene concentrations were attributed to the abundance of the compound in heavy traffic urban areas and to its infiltration into the bus cabin through the open bus windows.

  To conclude, the off-peak and peak commute times were similar in terms of traffic density, and as previously mentioned the routes were similar. These findings were in keeping with what has been found in the literature regarding studies which found similar results between the peak and off-peak times. Therefore, as previously mentioned, to determine the precise effects of temporal changes on on-board in-vehicle BTEX emissions, routes on which the traffic density dramatically change between peak and off-peak times will need to be chosen.

- Various factors were at play on-board the buses between and within campaigns which could potentially contribute to an increase or decrease in the measured BTEX concentrations. These factors included the seasonal variability between campaigns, on-board temperature and humidity and passenger number (Tables 4.1 and 4.4). The result from this study could not discern any appreciable influence of these varying factors on the BTEX concentrations measured on-board the buses. This was the result of multiple

factors acting upon the on-board cabin simultaneously, which obscured the ability to isolate the effects of any single factors. Therefore, further investigation into the factors influencing on-board BTEX concentrations will be required in subsequent studies.

Although the above mentioned factors have shown to influence on-board in-vehicle emission concentrations in previous studies; no definitive links could be made from this result of this study. However, given that this study was a pilot study, greater refinement of overall study approach, including the choice of specific factors to be studied, will be required in future to understand their influence.

- The T/B ratios measured during the off-peak campaign fell within the range of ratios indicative of vehicular emissions and indicative of industrial and area sources of emissions, suggesting the influence of multiple sources of on-board emissions (Table 4.17 and 4.18). During the peak campaign, the T/B ratios appeared in a range indicative of traffic related emission sources, for the majority of samples (Table 4.17 and 4.18). These findings were in agreements with previous studies (Bretón *et al.* 2017). In addition, significant correlations existed between benzene and toluene and BTX for the off-peak and peak campaigns, respectively, suggesting a common vehicular source of these compounds on-board the buses (Tables 4.15 and 4.16). Furthermore, the overall BTEX concentrations on-board buses in the current study were comparable to those found in other international studies (Table 5.1).

In conclusion, the findings from this study were comparable to what has been found in the literature with regards to the T/B ratios, BTEX correlations and on-board in-cabin BTEX concentrations. However, difficulties were experienced in deriving actual BTEX

concentrations from field samples due to the potential contamination of the samples due to the use of solvent. Therefore, a common concluding thread throughout this research is the need to optimise the study design and sampling and analysis methods. Nevertheless, even though some shortfall were experienced, the current study was the first conducted study within the given context and will prove beneficial as a building block to further subsequent studies of this nature.

6.3. Limitations of the Study

Various limitations were recognised and acknowledged within the current study. Initially, it was intended that the current study would compare on-board in-vehicle BTEX emissions between conventional diesel buses and busses fitted with the diesel dual fuel (DDF) system. However, at the time of conducting the study, none of the fitted DDF buses were using the operating system. This was due to the bus company experiencing technical issues with the DDF system which they did not have the necessary expertise and capacity to resolve. Therefore, the study focus had to change, given that all the sampled buses operated on diesel only mode.

Furthermore, given that the sampled vehicles were in-service public buses many logistical issues arose while sampling which could not be controlled. For example, buses would experience mechanical breakdowns, not arrive on scheduled times or be rerouted at the bus station resulting in no service along a certain route for the day; which resulted in the loss of sampling days. Another logistical challenge was the sourcing of volunteers to assist with sampling. For the off-peak campaign, a group of four volunteers were assembled. However,

their availability was irregular which again resulted in the loss of sampling days during sample collection. The difficulties in sourcing volunteers during the off-peak campaign led to the decision of not utilising volunteers at all during the peak campaign which reduced the ability to collect more than two samples on any given day.

Additionally, the apparatus and lab method used to collect the samples and to prepare them for analysis proved to be limitation. For this study, active sampling was used with coconut charcoal sorbent tubes coupled with solvent extraction techniques for analysis. Although this method was found to fit the budget, the processing and analysis of the charcoal tubes proved to be extremely tedious. The sample preparation steps required the solvent CS_2 to extract the BTEX compounds from the charcoal matrix. This solvent is susceptible to VOC contamination and is toxic. Moreover, during the process of sample preparation the charcoal from the sampled tubes were briefly exposed to the lab air during the transfer of the sampling tube contents to the necessary lab beakers and vials. The CS_2 solvent and sample preparation steps may have been a source of contamination of samples as seen in the various blanks samples, which reduced the accuracy and introduced a degree of uncertainty in deriving actual values. In addition, the charcoal tubes are known to experience decreased adsorption capability in the presence of high humidity, which could results in reduced sampling and analytical efficiency (Harper 2000).

6.4. Recommendations for Future Study

Given that the charcoal tube sampling method for the collection of BTEX compound and the subsequent CS_2 extraction and lab preparation of the samples prior to analysis was identified

as limitations to the study, alternative sampling methods are recommended for future study which would mitigate these mentioned limitations. The use of sampling tubes suited for thermal desorption seems to be a suitable alternative to the use of charcoal tubes used in solvent extraction. For thermal desorption tubes, there are no sample preparations steps required, given that the sampling tubes are connected directly onto the GC MS and analysed (Woolfenden 2010a). The absence of sample preparation steps will reduce potential sources of sample contamination and would eliminate the analyst's exposure to toxic solvents such as CS_2 (Barnes 2017, Woolfenden 2010a). Moreover, thermal desorption tubes can be conditioned with inert gas and flushed out and reused for sampling, which would reduce costs of sampling in the long run (Woolfenden 2010a, 2010b). However, the use of thermal desorption tubes still require an operator to handle the sampling pumps. This can be avoided by using passive sampling methods on-board vehicles which are more convenient than active sampling in that no sampling pumps are required and it does not have to be operated by trained personal. Using passive sampling methods will alleviate the need for assistance or volunteers to man the sampling equipment and would allow for a large number of vehicles to be sampled simultaneously. The only drawback of this type of sampling method would be the cost of the samplers, which tend to be high.

Other than the sampling methods specifically, in general there is a paucity of studies in South Africa regarding on-board in-vehicle air monitoring. Therefore, future studies should continue monitoring BTEX concentrations on-board vehicles, in addition to testing other VOCs. Monitoring should also be conducted with regards to other air pollutant such as NOx, PM and CO on-board vehicles. Furthermore, the commuting patterns in South Africa are different from those experiences in other countries in that, due to the inequalities of the past, many people live far away from their work places which results in a long commute periods

spent in a number of vehicles and on road sides while waiting for transport. Therefore, daily activity surveys should be carried out to determine the accurate time periods people spend commuting and to determine the dominant modes of transport. This will assist in developing accurate commuter risk exposure matrices with regard to the local South African conditions. Additionally, the South African transport fleet is also made up of taxis and private cars, in addition to buses. Thus, on-board emissions tests should be conducted on a variety of transportation modes across different population groups. Moreover, drivers and commuters experience exposure to a suite of air pollutant at once and due to this an integrated health risk assessment should be used to determine the cumulative effects of air pollutants in the vehicle cabin microenvironment.

Furthermore, given that personal exposure monitoring is expensive to conduct and not suitable for large scale studies, models should be developed which can take into account various factors influencing on-board in-cabin pollutant concentration, to predict and approximate conditions which might be experienced by vehicle occupants. For this to happen, a more in depth analysis should be done amongst a variety of vehicles regarding specific factors which influence on-board emissions such as ventilation mode, vehicle and engine specifications, fuel types and meteorological conditions, to name a few. These models can then be used to assess the level of on-board pollutant exposure amongst different population groups travelling in different vehicle types for varying commute durations, test the effects of interventions aimed at reducing on-board pollutant exposure to vehicle occupants and to predict the effects of multiple pollutant exposures on commuters.

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APPENDIX A

RAW ON-BOARD AND AMIBIENT TEMERATURE AND HUMIDITY DATA FOR THE OFF-PEAK AND PEAK SAMPLING CAMPAIGNS

- Table A.1. On-board temperature (°C) data retrieved from the iButton during the off-peak sampling campaign (21/11/2017 – 7/12/2017).
- Table A.2. Temperature (°C) data retrieved from the weather monitoring station during the off-peak campaign (21/11/2017 – 7/12/2017).
- Table A.3. On-board temperature (°C) and humidity (%RH) data retrieved from the iButton during the peak sampling campaign (16/04/2018 – 18/05/2018).
- Table A.4. Temperature (°C) data retrieved from the weather monitoring station during the peak sampling campaign (16/04/2018 – 18/05/2018).
- Table A.5. Relative humidity (%) data retrieved from the weather monitoring station during the peak sampling camping (16/04/2018 – 18/05/20

Table A.1. On-board temperature (°C) data retrieved from the iButton during the off-peak sampling campaign (21/11/2017 – 7/12/2017).

Sample no.	Date	Temperature (°C)
1		
2	21/11/2017	29.636 30.135 30.135 30.635 30.635 31.134 31.134 31.134 31.134 31.134 31.134 31.134 31.134 31.633 31.633 31.633 32.132 32.132 32.631 32.132 32.132 32.631 32.631 32.631 32.631 32.631
3	22/11/2017	
4	22/11/2017	30.558 31.058 31.058 30.558 30.558 30.558 30.558 30.558 30.558 30.059 30.059 30.059 30.558 30.558 31.058 31.058 31.557 31.557 32.057 32.057 32.057

		32.556 32.057 32.556 32.556 32.556
5	23/11/2017	Field blank
6	23/11/2017	26.139 26.139 26.139 27.138 27.138 27.138 27.138 27.138 27.638 27.638 27.638 27.638 27.138 27.138 26.639 26.639 26.139 26.639 26.639 26.139 26.639 26.639 26.639 26.639 26.639 26.639
7	23/11/2017	25.561 26.061 26.061 27.56 27.56 27.56 27.56 28.06 28.06 28.06 28.06 28.06 27.56 27.06 26.561 26.561

		26.061 26.561 26.561 26.061 26.561 26.561 26.561 26.561 26.561 26.561
8	23/11/2017	
9	28/11/2017	23.638 23.638 24.139 24.639 24.139 24.139 24.139 24.139 24.139 23.638 23.638 23.138 23.138 23.138 23.138 23.138 23.138 23.638 23.638 23.638 23.638 23.638 24.139 23.638 24.139
10	28/11/2017	
11	28/11/2017	25.561 25.561 25.561 25.561 25.561 25.561 25.561 25.561 25.061 25.561 25.561

		25.561 25.561 25.561 25.061 25.061 25.061 25.061 25.561 25.561 25.561 25.561 25.061 25.061 25.061
12	29/11/2017	
13	29/11/2017	27.56 27.56 27.56 27.56 28.06 28.06 28.06 28.06 28.06 28.06 28.06 28.06 28.56 28.56 28.56 28.56 28.56 28.56 28.56 28.56 28.56 28.56 28.56 28.56 28.56
14	29/11/2017	25.639 26.139 27.138 28.138 28.637 29.137 28.637

		28.637 28.637 28.637 28.138 28.637 28.637 29.137 29.137 29.137 29.137 29.137 29.636 29.137 29.137 29.137 29.636 29.636 30.135 30.135
15	30/11/2017	Field blank
16	30/11/2017	26.561 26.561 28.56 29.06 29.559 29.559 29.559 29.559 29.559 29.559 29.559 29.559 29.06 29.06 29.559 29.559 29.559 29.559 29.559 30.059 30.059 30.059 30.059
17	30/11/2017	
18	30/11/2017	29.06 29.559 29.559 29.559

		29.559 29.559 30.059 30.059 30.059 30.059 30.059 30.059 30.059 30.558 30.558 31.557 31.058 31.058 30.558 30.558 30.558 30.558 30.059 30.059 30.059
19	30/11/2017	26.639 26.639 28.637 28.637 28.637 28.637 28.637 28.637 28.637 28.138 28.138 28.138 27.638 28.138 27.638 27.638 28.138 28.138 28.637 28.637 28.637 28.138 28.138 28.138 28.637
20	6/12/2017	25.64 26.14

		26.64 26.64 27.14 27.14 26.64 28.14
21	6/12/2017	24.561 26.061 24.561 23.56 24.061 23.56 24.061 24.561 27.56
22	7/12/2017	23.138 23.138 22.638 22.638 23.638 24.139 26.139
23	7/12/2017	25.139 27.138 26.639 25.639 24.139 23.638 24.139

Table A.2. Temperature (°C) data retrieved from the weather monitoring station during the off-peak campaign (21/11/2017 – 7/12/2017)

HOURLY DATA : Temperature (C) - November 2017 **JHB BOT TUINE - Climate Number:0475879 0 Lat:-26.1560 Lon:27.9990 Height:1624 m (Extracted 2018/11/15 14:30)**																							
DD	**h01**	**h02**	**h03**	**h04**	**h05**	**h06**	**h07**	**h08**	**h09**	**h10**	**h11**	**h12**	**h13**	**h14**	**h15**	**h16**	**h17**	**h18**	**h19**	**h20**	**h21**	**h22**	**h23**	**h24**
21	17.2	16.4	15.5	14.8	14.6	15.1	20.0	23.6	25.3	27.1	29.1	31.2	31.4	32.3	31.7	30.1	29.1	26.8	24.4	23.1	22.2	21.0	21.3	20.9
22	20.4	20.3	19.7	19.1	18.8	18.7	19.6	21.8	24.9	27.9	29.0	30.0	31.2	31.2	30.2	29.1	19.7	19.7	18.9	17.3	16.3	16.4	16.7	16.6
23	16.2	16.0	15.6	15.6	15.0	15.2	17.7	19.9	20.3	23.2	23.6	25.2	25.6	26.9	26.6	17.3	21.4	20.8	20.7	18.4	18.2	17.6	17.7	17.4
24	16.1	16.1	15.8	15.1	14.8	15.1	16.2	18.1	20.6	22.2	24.1	25.1	26.1	26.0	25.7	27.0	24.2	18.6	14.1	13.4	13.1	13.0	14.1	13.4
25	12.9	12.1	11.6	11.3	11.2	12.4	13.9	15.8	15.4	14.8	14.3	13.7	12.5	12.9	13.3	13.4	12.9	12.6	12.3	12.0	11.3	11.0	11.4	11.6
26	11.2	10.1	9.6	9.2	9.0	9.7	12.6	16.1	17.7	19.3	21.0	22.2	22.7	23.5	23.6	24.6	22.7	21.3	19.4	17.7	16.4	15.5	15.0	14.4
27	13.7	13.3	13.0	13.1	12.8	14.1	16.2	17.1	17.9	19.2	20.6	23.1	22.7	23.5	24.1	22.0	15.3	14.2	14.6	14.5	14.6	14.4	14.4	14.4
28	14.4	13.9	13.8	13.9	13.5	13.1	13.4	13.2	14.7	18.3	20.4	21.9	23.4	23.8	24.8	24.2	22.5	21.6	19.3	17.9	16.8	16.1	16.1	16.6
29	16.8	16.2	15.1	14.7	14.5	15.2	17.5	20.3	22.2	23.2	24.5	25.7	27.1	27.1	27.5	25.5	22.1	16.0	15.7	15.2	15.0	14.7	14.8	14.7
30	14.7	14.5	14.4	14.1	13.8	13.9	15.4	18.9	21.6	23.6	24.6	25.7	26.9	26.7	27.4	28.4	27.6	25.6	23.4	21.6	20.7	20.3	20.2	19.9
HOURLY DATA : Temperature (C) - December 2017 **JHB BOT TUINE - Climate Number:0475879 0 Lat:-26.1560 Lon:27.9990 Height:1624 m (Extracted 2018/11/15 14:30)**																							
DD	**h01**	**h02**	**h03**	**h04**	**h05**	**h06**	**h07**	**h08**	**h09**	**h10**	**h11**	**h12**	**h13**	**h14**	**h15**	**h16**	**h17**	**h18**	**h19**	**h20**	**h21**	**h22**	**h23**	**h24**
1	18.5	16.6	15.8	15.9	15.8	16.3	17.0	17.5	18.4	19.4	20.1	23.0	25.4	27.3	26.2	25.0	17.8	17.7	16.7	16.2	15.6	15.7	15.7	16.2
2	17.6	17.2	16.7	16.6	16.6	16.4	17.1	18.6	18.8	19.1	18.4	18.3	20.5	22.9	24.7	24.9	25.1	23.2	22.0	17.0	16.4	16.0	15.7	16.5
3	15.9	16.1	16.5	16.3	15.9	15.8	16.9	20.9	24.0	25.9	26.6	27.9	28.8	29.3	30.1	30.6	30.2	27.8	25.0	23.8	18.0	17.1	16.8	17.5
4	16.5	15.5	15.3	15.3	15.9	17.1	18.5	22.4	24.1	26.0	27.1	28.0	28.5	28.0	28.2	27.8	24.5	23.3	22.4	21.5	16.9	15.6	16.2	15.7
5	15.6	14.9	14.1	14.6	14.9	14.6	14.7	14.3	14.8	15.0	15.4	15.8	15.8	15.7	16.2	14.3	14.7	14.7	14.6	14.7	14.8	15.0	14.9	15.2
6	15.2	15.2	15.1	15.2	15.2	15.4	15.7	16.1	16.9	19.0	19.8	21.7	20.3	19.3	20.6	17.8	16.5	16.0	15.0	14.8	14.4	14.6	13.9	13.5
7	13.4	13.5	13.5	13.5	13.4	13.2	13.2	14.0	15.8	17.4	18.0	19.0	19.6	19.9	19.4	18.1	19.1	18.5	17.7	17.1	16.1	15.6	15.4	15.0

Table A.3. On-board temperature (°C) and humidity (%RH) data retrieved from the iButton during the peak sampling campaign (16/04/2018 – 18/05/2018).

Sample no.	Date	Temperature (°C)	Relative Humidity (%)
1	16/04/2018	20.605	69.853
		18.102	75.824
		17.601	79.064
		17.1	81.192
		17.1	81.192
		17.1	82.785
		17.1	84.887
		19.604	78.607
2	16/04/2018	20.104	72.616
		19.604	73.696
		19.604	73.143
		20.104	73.723
		20.104	71.503
		20.104	73.17
		20.605	70.415
		20.605	69.29
		20.605	68.726
		20.605	70.415
		20.605	69.853
		20.605	69.853
		20.605	68.726
3	17/04/2018	15.598	75.744
		14.595	82.12
		14.094	84.605
		14.094	84.605
		13.593	84.015
		14.094	83.07
		14.094	83.07
		14.094	83.583
		14.094	83.583
		14.595	83.664
		14.595	83.151
		15.598	82.227
		16.599	77.41
4	18/04/2018	16.098	72.437
		14.595	81.083
		14.094	83.07
		14.094	85.114
		14.094	85.621
		14.094	84.095
		14.094	82.555
		14.094	81.521
		14.094	82.039

		14.595	81.602
		14.595	81.602
		15.097	82.753
		17.1	75.787
		17.601	
5	18/04/2018	18.102	75.276
		18.102	78.542
		18.102	76.916
		19.103	75.321
		19.103	74.222
		19.604	75.893
		19.604	73.696
		20.104	71.503
		20.104	68.694
		20.104	69.259
		20.104	66.42
		20.104	66.42
		20.104	65.274
6	19/04/2018	14.595	77.937
		13.593	81.96
		13.593	84.526
		13.593	84.526
		13.593	82.991
		13.593	84.526
		13.593	83.504
		14.094	82.555
		16.098	79.023
7	19/04/2018	18.102	73.069
		19.103	73.67
		19.604	72.588
		20.104	70.944
		21.606	69.357
		22.606	64.88
		22.606	63.727
		23.107	60.275
		23.607	61.488
		26.107	52.81
		26.607	47.354
		26.607	49.203
		26.607	49.203
8	20/04/2017	14.094	74.12
		12.591	81.807
		12.591	85.895
		12.09	87.33
		12.09	87.83
		12.591	89.888

		12.591	88.898
9	20/04/2018	17.1	76.334
		17.1	75.787
		17.601	76.352
		18.102	74.175
		18.603	73.645
		19.103	72.005
		19.604	69.792
10	23/04/2018	12.591	58.801
		11.087	66.543
		10.585	65.915
		11.087	63.167
		11.087	64.298
		11.588	66.055
		13.092	64.025
		15.097	
11	23/04/2018	18.102	52.769
		18.603	54.089
		20.104	50.611
		22.106	44.568
		23.607	40.254
		24.607	42.254
		25.607	43.615
		26.607	
12	24/04/2018	18.102	43.457
		12.591	59.379
		11.588	57.495
		12.09	54.641
		12.09	59.882
		12.09	63.31
		12.09	63.877
			62.398
13	24/04/2018	19.604	48.562
		20.605	51.095
		22.106	49.999
		23.107	47.01
		23.607	47.056
		24.607	48.387
		25.607	46.632
		26.607	47.971
14	25/04/2018	18.102	
		13.593	
		12.591	
		12.591	
		12.09	
		12.591	

		12.591 15.097	
15	25/04/2018	20.104 20.605 21.606 22.106 23.607 24.107 24.107 25.607	45.339 54.865 57.641 58.222 61.603 61.677 60.531 56.775
16	26/04/2018	19.604 14.595 13.593 13.092 13.092 13.092 13.092	47.408 45.008 44.428 43.314 42.734 40.204 41.622
17	26/04/2018	19.103 19.604 20.605 22.106 22.606 23.107 23.107 24.107	49.792 64.258 70.781 72.884 73.425 74.503 75.039
18	26/04/2018		
19	30/04/2018		
20	30/04/2018		
21	2/05/2018		
22	2/05/2018		
23	3/05/2018		
24	3/05/2018		
25	4/05/2018		
26	4/05/2018		
27	7/05/2018		
28	7/05/2018		
29	8/05/2018	10.585 9.081 8.579 8.579 9.081 9.081 9.582	46.643 53.039 55.331 53.565 55.397 55.983 57.217 51.677 48.825
30	8/05/2018	16.599 17.601 18.102	56.856 54.515 51.516

		18.603	49.716
		19.103	50.367
		19.604	46.705
		20.605	44.294
31	9/05/2018	13.593	53.091
		11.087	63.734
		10.585	65.915
		10.585	65.915
		10.585	65.354
		11.087	65.984
		11.087	65.424
32	9/05/2018	17.601	51.481
		18.603	52.161
		19.604	51.627
		20.605	49.259
		22.606	46.344
		23.607	44.568
		24.107	44.616
33	10/05/2018	13.593	45.251
		11.087	54.497
		10.585	60.244
		10.585	61.39
		10.585	60.244
			60.818
			60.314
34	10/05/2018	18.603	54.582
		19.604	56.452
		21.105	54.768
		21.606	53.604
		23.107	50.699
		25.107	44.714
		25.607	43.512
35	11/05/2018	15.598	44.524
		11.087	57.424
		10.084	63.596
		10.084	65.286
		10.585	61.961
		10.585	63.664
		10.585	64.229
36	11/05/2018	17.1	50.836
		19.103	52.198
		20.104	50.444
		21.105	51.136
		22.606	48.2
		23.607	45.815
		24.107	44.616

37	11/05/2018		
38	14/05/2018	15.598	50.123
		12.591	66.759
		11.087	75.285
		10.585	78.398
		10.585	79.446
		10.585	81.008
		10.585	81.008
39	14/05/2018	16.098	60.391
		19.103	76.414
		20.605	69.853
		21.606	69.357
		22.106	65.988
		22.606	68.302
		22.606	64.304
40	15/05/2018	10.084	60.176
		8.078	72.207
		7.074	80.068
		7.074	82.653
		7.074	85.202
		7.074	87.214
		7.074	88.211
41	16/05/2018	12.09	56.401
		11.087	60.314
		10.084	63.596
		10.084	65.847
		10.084	66.406
		10.084	67.52
		10.084	67.52
42	17/05/2018	11.588	65.494
		9.081	74.486
		8.579	81.791
		8.078	84.295
		8.078	84.803
		8.579	85.871
		8.579	86.876
43	17/05/2018	16.098	66.783
		16.599	67.376
		17.1	67.398
		17.1	67.398
		18.102	68.015
		18.603	66.902
		19.604	66.96
44	18/05/2018	14.595	64.823
		14.595	65.386
		14.595	64.258

		14.595	64.258
		15.097	66.172
		15.097	67.891
		15.097	67.891
45	18/05/2018	18.102	59.322
		18.102	59.322
		15.097	62.108
		14.595	60.263
		15.598	55.601
		16.599	49.573
		17.601	47.791

Table A.4. Temperature (°C) data retrieved from the weather monitoring station during the peak sampling campaign (16/04/2018 – 18/05/2018).

HOURLY DATA : Temperature (C) - April 2018

JHB BOT TUINE - Climate Number:0475879 0 Lat:-26.1560 Lon:27.9990 Height:1624 m (Extracted 2018/11/15 14:30)

DD	h01	h02	h03	h04	h05	h06	h07	h08	h09	h10	h11	h12	h13	h14	h15	h16	h17	h18	h19	h20	h21	h22	h23	h24
16	12.9	12.8	12.7	13.8	14.4	14.7	15.2	15.6	16.0	18.3	19.2	21.1	21.8	21.7	22.6	20.9	20.2	19.1	17.7	16.9	15.9	15.2	14.3	13.8
17	14.3	13.9	13.2	12.6	12.1	11.8	12.2	13.7	15.0	16.8	17.6	19.9	20.6	22.0	21.2	20.2	20.2	18.9	18.0	17.2	16.7	15.9	15.9	15.6
18	15.1	14.0	13.0	12.8	12.2	12.1	12.8	14.1	14.9	16.9	18.6	19.6	21.4	21.8	22.0	21.2	20.0	18.9	17.2	15.9	15.0	14.3	14.2	14.0
19	13.5	13.8	13.7	13.4	13.1	12.7	12.4	16.7	20.8	22.5	23.6	24.0	23.8	24.9	22.7	19.1	18.8	18.2	15.7	14.6	14.0	13.7	13.5	14.6
20	13.8	13.2	12.8	12.5	12.1	12.0	12.4	15.1	18.1	19.6	20.9	21.4	22.3	23.1	22.8	22.7	22.5	19.9	17.9	16.4	16.1	15.2	14.5	13.9
21	13.6	14.9	14.7	14.6	13.9	13.8	14.2	14.3	15.8	18.9	20.8	21.9	22.7	23.5	23.7	23.4	22.4	19.7	17.6	15.8	14.3	12.9	12.1	11.7
22	11.5	12.6	13.2	13.2	13.1	13.1	13.2	16.6	19.3	21.3	22.5	23.7	24.7	25.3	25.6	25.0	23.7	19.8	16.5	14.7	14.7	14.4	13.5	13.0
23	12.1	11.7	10.8	10.1	9.5	9.5	9.5	16.7	20.8	22.3	23.5	24.4	25.6	26.1	26.0	25.8	25.2	20.7	17.3	15.4	14.1	13.2	12.2	11.7
24	11.3	10.8	11.0	10.5	10.0	9.9	10.3	16.8	22.2	23.9	24.8	25.8	27.5	28.2	29.0	28.4	27.0	22.0	18.8	16.6	15.0	14.5	14.4	13.6
25	12.5	11.7	11.1	10.9	10.3	10.0	10.2	17.0	21.5	23.5	25.1	25.8	26.6	27.0	26.9	25.8	24.8	21.4	17.9	16.0	14.8	14.2	13.4	13.1
26	12.7	12.7	12.1	11.7	11.0	10.8	10.6	10.7	16.4	19.9	21.2	22.5	24.4	25.6	25.8	24.7	23.6	20.5	17.3	15.8	14.7	13.9	13.3	12.6
27	12.6	12.0	11.4	11.2	11.0	10.8	10.8	16.9	21.8	24.0	24.7	25.3	25.8	26.2	26.6	26.0	25.5	20.7	18.5	16.6	15.2	14.7	13.6	13.4
28	12.6	12.3	11.8	11.3	11.1	10.8	10.4	10.2	16.4	20.1	22.5	23.0	24.2	24.8	24.9	24.2	23.2	21.7	17.6	16.5	15.6	14.9	14.4	14.1
29	13.4	12.9	12.3	12.1	11.9	11.9	12.2	15.2	20.2	21.4	22.5	23.6	24.2	23.7	23.8	23.0	21.3	19.4	17.6	16.0	14.8	13.9	13.0	13.0
30	12.5	12.2	11.6	11.0	10.7	10.6	10.9	14.1	17.9	20.5	21.6	23.1	24.6	23.4	23.8	23.5	22.1	20.2	18.2	17.2	16.9	15.8	15.2	14.7

HOURLY DATA : Temperature (C) - May 2018

JHB BOT TUINE - Climate Number:0475879 0 Lat:-26.1560 Lon:27.9990 Height:1624 m (Extracted 2018/11/15 14:30)

DD	h01	h02	h03	h04	h05	h06	h07	h08	h09	h10	h11	h12	h13	h14	h15	h16	h17	h18	h19	h20	h21	h22	h23	h24
1	14.7	14.4	13.8	13.9	13.5	12.4	11.9	12.8	16.2	18.2	20.2	20.1	20.7	22.0	22.5	21.5	21.2	18.8	16.2	16.0	16.0	14.6	14.2	14.3
2	14.5	14.2	12.2	11.0	10.5	10.2	10.2	14.6	17.3	19.7	19.5	20.9	22.1	20.7	20.8	21.8	20.7	17.9	15.7	14.6	14.7	15.2	14.4	14.0
3	13.5	13.1	12.2	11.1	10.3	9.7	10.8	13.8	15.3	17.6	18.5	19.8	22.1	22.0	21.1	18.9	18.2	16.3	14.6	13.5	12.2	12.0	11.6	10.9
4	10.4	10.2	9.7	9.3	9.1	9.3	8.9	13.9	16.8	18.9	20.4	21.4	22.3	22.8	22.7	21.0	20.4	16.5	14.0	11.5	10.4	9.5	9.0	8.7
5	8.3	8.0	7.4	6.9	6.5	5.8	6.2	12.3	17.3	20.0	21.1	22.1	22.9	23.6	23.6	22.4	21.5	16.6	13.7	11.6	10.9	11.4	11.0	9.3
6	9.3	9.0	8.9	9.0	7.7	6.6	7.9	14.5	18.0	20.1	21.8	23.3	24.6	25.1	25.5	23.6	22.8	18.2	15.0	13.3	12.5	11.2	10.2	10.7
7	11.9	13.2	13.0	11.6	10.6	8.8	9.1	15.3	19.5	20.9	22.4	23.0	23.7	24.3	24.1	22.9	21.7	17.1	14.1	11.9	11.1	10.1	9.5	9.2
8	8.5	8.4	8.3	8.1	7.3	7.3	6.9	13.8	17.9	19.3	21.2	21.3	22.2	22.9	23.2	21.8	21.0	16.9	14.3	13.2	11.9	10.9	10.5	10.1
9	9.5	9.6	10.2	9.4	8.7	8.2	8.4	14.1	19.8	21.8	23.1	23.4	24.4	24.3	24.5	23.1	22.4	18.5	15.4	13.6	12.1	11.8	11.2	10.6
10	10.2	9.8	9.8	9.5	9.1	8.5	8.3	15.1	20.5	22.4	23.6	24.2	24.6	25.5	24.9	23.1	22.1	18.6	15.6	14.2	13.3	11.9	11.4	10.7
11	10.3	10.1	9.6	9.3	8.6	8.4	8.2	14.6	17.7	19.7	20.8	22.2	23.5	23.6	23.2	21.5	20.4	16.7	14.3	12.9	12.1	11.4	10.8	10.2
12	10.0	9.4	9.2	8.9	8.4	8.0	7.8	14.4	18.1	20.1	19.7	18.8	19.6	21.3	21.9	20.4	19.3	16.5	13.8	13.5	12.1	11.2	11.3	11.5
13	10.6	10.1	9.1	8.2	7.3	6.8	6.4	12.7	16.6	17.9	19.0	20.4	21.4	21.9	22.2	20.7	19.6	15.1	12.3	10.5	9.1	8.6	7.9	8.0
14	8.3	8.0	8.2	9.6	10.3	9.5	9.4	9.7	10.0	10.3	10.3	10.8	12.0	12.4	12.7	12.7	12.8	10.9	9.8	10.6	10.5	9.2	8.1	8.0
15	8.1	7.4	6.8	6.4	5.9	5.1	5.3	9.4	11.5	11.7	12.7	14.4	16.7	16.7	17.5	16.9	17.0	14.6	11.1	10.5	9.9	9.2	8.1	7.8
16	7.3	6.9	7.5	7.6	7.7	7.4	7.4	8.4	11.6	13.3	13.9	16.0	15.4	14.7	14.6	14.0	13.1	12.0	11.5	10.8	10.0	9.7	9.4	9.5

17	9.4	9.1	9.0	8.1	7.2	6.6	6.4	10.2	13.4	16.3	17.1	17.8	18.7	19.7	19.7	18.0	17.7	14.2	11.8	10.0	9.5	8.9	8.4	9.1
18	8.7	8.2	7.8	7.9	8.0	8.7	10.1	12.9	13.9	15.7	17.4	17.7	16.9	15.7	15.9	16.3	15.9	15.5	15.1	14.7	14.4	14.0	13.5	13.0

Table A.5. Relative humidity (%) data retrieved from the weather monitoring station during the peak sampling camping (16/04/2018 – 18/05/2018).

HOURLY DATA : Humidity(%) - April 2018

JHB BOT TUINE - Climate Number:0475879 0 Lat:-26.1560 Lon:27.9990 Height:1624 m (Extracted 2018/11/15 14:30)

DD	h01	h02	h03	h04	h05	h06	h07	h08	h09	h10	h11	h12	h13	h14	h15	h16	h17	h18	h19	h20	h21	h22	h23	h24
16	88	90	90	91	90	91	90	91	88	74	68	61	50	52	43	54	57	64	70	73	78	78	82	83
17	85	85	87	86	88	88	89	91	86	76	71	60	57	47	55	53	56	62	67	73	72	77	83	82
18	82	82	86	87	87	89	90	89	85	79	68	63	54	51	50	53	57	64	72	77	81	83	85	85
19	86	88	87	88	88	87	89	79	61	47	43	45	38	40	51	76	77	82	77	84	85	87	88	88
20	88	87	87	87	89	89	90	88	71	64	61	57	54	49	45	48	47	58	67	74	81	84	85	85
21	88	89	90	90	85	89	90	86	76	64	48	36	37	35	33	33	36	49	62	68	70	72	75	76
22	73	64	56	52	48	46	48	41	32	31	26	27	27	24	23	23	24	32	44	55	50	52	56	58
23	61	64	67	70	73	72	76	55	34	28	28	23	21	20	16	19	25	33	44	54	55	60	60	63
24	64	68	68	68	69	69	70	48	29	24	22	17	19	14	16	14	20	29	34	44	49	50	50	52
25	55	59	61	63	65	66	67	54	37	34	28	27	23	24	24	25	29	39	50	55	62	62	67	67
26	69	70	73	76	79	80	81	83	64	50	46	44	38	30	25	28	31	43	54	59	61	65	68	71
27	68	70	72	75	75	76	78	59	42	30	26	25	23	22	22	23	28	39	47	55	59	60	66	64
28	66	64	66	71	72	74	76	78	63	40	38	35	32	29	28	31	33	38	55	57	62	62	64	65
29	66	69	70	73	71	73	72	69	49	46	37	34	32	32	30	34	35	42	50	56	61	64	67	68
30	73	75	77	81	83	84	85	75	54	43	39	36	33	31	32	31	34	45	51	59	62	68	70	72

HOURLY DATA : Humidity(%) - May 2018

JHB BOT TUINE - Climate Number:0475879 0 Lat:-26.1560 Lon:27.9990 Height:1624 m (Extracted 2018/11/15 14:30)

DD	h01	h02	h03	h04	h05	h06	h07	h08	h09	h10	h11	h12	h13	h14	h15	h16	h17	h18	h19	h20	h21	h22	h23	h24
1	71	73	75	74	74	77	79	75	62	57	50	47	44	41	39	40	42	52	61	53	57	61	61	61
2	60	62	70	77	81	83	87	78	61	51	51	40	33	37	33	29	33	49	56	63	61	59	62	64
3	63	62	66	70	73	76	72	60	55	47	44	36	30	29	33	42	41	54	62	65	68	70	72	73
4	77	77	79	78	79	77	78	56	42	34	29	20	13	13	17	15	19	25	31	41	46	46	49	46
5	46	47	49	50	52	52	53	35	25	16	15	12	13	11	11	13	15	22	31	40	44	39	40	50
6	46	46	47	49	56	59	51	33	27	22	23	19	18	15	15	14	19	25	37	42	47	55	58	42
7	33	32	36	38	44	50	41	28	19	18	17	15	15	14	12	12	15	25	30	34	36	41	44	45
8	49	48	46	45	52	53	61	45	35	31	30	28	26	24	24	27	29	41	50	54	59	62	63	64
9	67	66	65	68	70	71	70	55	36	28	23	19	17	17	16	17	21	29	38	45	48	50	50	53
10	53	54	54	55	57	61	63	55	30	26	24	22	22	21	22	22	24	32	42	46	49	56	57	59
11	60	58	60	62	65	67	69	49	34	30	29	29	25	22	22	22	23	34	42	49	51	55	55	58
12	58	61	61	62	64	65	66	53	35	30	29	33	29	25	24	28	30	39	50	53	57	59	60	57
13	54	59	68	72	76	82	83	64	39	29	29	23	23	15	15	14	15	25	32	41	46	51	54	53
14	52	50	52	56	64	80	89	86	86	85	88	86	80	79	67	71	69	76	85	85	75	81	85	87
15	88	87	89	88	87	87	90	84	70	72	68	61	49	30	30	31	33	47	67	62	62	64	69	69
16	71	73	70	71	70	72	75	75	66	59	56	51	53	57	59	59	63	68	73	73	75	80	80	79
17	78	80	78	81	81	86	87	76	57	45	35	31	32	27	26	32	37	46	57	63	59	61	60	56
18	54	61	74	80	83	82	74	55	51	49	50	49	51	56	54	52	54	57	58	62	63	66	70	75

APPENDIX B

RAW BTEX CONCENTRATION DATA FOR OFF-PEAK AND PEAK CAMPIGNS FIELD SAMPLING AND LAB BLANK SAMPLES

Tables B1 to B6 exhibit the progression from the raw BTEX concentration (ppb) data to the final BTEX concentrations (μ/m^3) presented in the study.

- Table B1. Triplicate BTEX concentration (ppb) data per sample from field and lab analysis during the off-peak campaign
- Table B2. Triplicate BTEX concentration (ppb) data per sample from field and lab analysis during the peak campaign
- Table B3. Average off-peak BTEX concentration (ppb) from front and back sorbent section
- Table B4. Average peak BTEX concentration (ppb) from front and back sorbent section
- Table B5. Final off-peak BTEX concentration ($\mu g/m^3$) per sample presented with T/B ratios
- Table B6. Final peak BTEX concentration ($\mu g/m^3$) per sample presented with T/B ratios
- Table B7. Blank CS_2 analysis for BTEX concentrations (ppb) during lab analysis for the off-peak sampling campaign.
- Table B8. Blank CS_2 analysis for BTEX concentrations (ppb) during lab analysis for the peak sampling campaign.

Table B1. Triplicate BTEX concentration (ppb) data per sample from field and lab analysis during the off-peak campaign

Sample no.	**Front Section**											
1.1	Peak #	Name	Similarity	R.T. (min:sec)	UniqueMass	S/N	Concentration	Conc. Units	Area	Area %	Weight	Formula
	13	Benzene	962	03:18.5	50	1412.3	38.13	ppb	4954773	26.397	78	C6H6
	35	Toluene	898	04:37.0	91	2956.6	308.14	ppb	8968784	47.782	92	C7H8
	64	o-Xylene	932	06:08.1	91	513.53	21.89	ppb	611540	3.258	106	C8H10
	71	Ethylbenzene	913	06:47.7	91	789.34	39.48	ppb	1561645	8.3197	106	C8H10
1.2	Peak #	Name	Similarity	R.T. (min:sec)	UniqueMass	S/N	Concentration	Conc. Units	Area	Area %	Weight	Formula
	12	Benzene	962	03:18.7	52	828.98	-93.31	ppb	2325191	15.088	78	C6H6
	32	Toluene	898	04:37.0	91	2595.3	320.81	ppb	9288432	60.271	92	C7H8
	57	Benzene, 1,3-dimethyl-	932	06:02.3	91	192.03	9.06	ppb	310782	2.0166	106	C8H10
	58	o-Xylene	907	06:07.9	63	53.729	11.3	ppb	367933	2.3875	106	C8H10
	63	Ethylbenzene	913	06:47.7	91	746	11.9	ppb	789369	5.1221	106	C8H10
1.3	Peak #	Name	Similarity	R.T. (min:sec)	UniqueMass	S/N	Concentration	Conc. Units	Area	Area %	Weight	Formula
	14	Benzene	962	03:18.5	78	4078.6	18.41	ppb	4560248	26.626	78	C6H6
	35	Toluene	898	04:37.0	91	3051.7	314.58	ppb	9131306	53.316	92	C7H8
	56	Benzene, 1,3-dimethyl-	932	06:02.4	91	204.23	3.92	ppb	190365	1.1115	106	C8H10
	57	o-Xylene	907	06:08.1	91	530.3	14.78	ppb	459773	2.6845	106	C8H10
	67	Ethylbenzene	913	06:47.7	91	795.6	5.69	ppb	615500	3.5938	106	C8H10
2.1	Peak #	Name	Similarity	R.T. (min:sec)	UniqueMass	S/N	Concentration	Conc. Units	Area	Area %	Weight	Formula
	15	Benzene	962	03:18.6	78	3921.3	-38.82	ppb	3415347	22.202	78	C6H6
	32	Toluene	898	04:37.2	91	2918.8	301.2	ppb	8793755	57.165	92	C7H8
	55	Benzene, 1,3-dimethyl-	932	06:02.4	91	177.32	2.56	ppb	158553	1.0307	106	C8H10
	56	o-Xylene	907	06:08.2	91	455.97	14.01	ppb	439482	2.8569	106	C8H10

	63	Ethylbenzene	913	06:47.7	91	744.75	2.81	ppb	534813	3.4766	106	C8H10
2.2	Peak #	Name	Similarity	R.T. (min:sec)	UniqueMass	S/N	Concentration	Conc. Units	Area	Area %	Weight	Formula
	13	Benzene	962	03:18.7	38	292.39	-7.78	ppb	4036297	24.456	78	C6H6
	41	Toluene	898	04:37.0	91	2775.4	313.76	ppb	9110650	55.202	92	C7H8
	67	Benzene, 1,3-dimethyl-	932	06:02.3	106	61.012	10.69	ppb	349005	2.1146	106	C8H10
	68	o-Xylene	907	06:08.1	91	462.41	8.14	ppb	284462	1.7236	106	C8H10
	76	Ethylbenzene	913	06:47.7	91	723.12	9.91	ppb	733850	4.4464	106	C8H10
2.3	Peak #	Name	Similarity	R.T. (min:sec)	UniqueMass	S/N	Concentration	Conc. Units	Area	Area %	Weight	Formula
	15	Benzene	962	03:18.8	37	278.77	-128.55	ppb	1620182	11.786	78	C6H6
	39	Toluene	898	04:37.1	91	2837.8	313.32	ppb	9099485	66.194	92	C7H8
	64	o-Xylene	932	06:08.1	91	462.02	6.99	ppb	262410	1.9089	106	C8H10
	72	Ethylbenzene	913	06:47.7	91	740.96	8.58	ppb	696347	5.0656	106	C8H10
3.1	Peak #	Name	Similarity	R.T. (min:sec)	UniqueMass	S/N	Concentration	Conc. Units	Area	Area %	Weight	Formula
	14	Benzene	962	03:19.5	78	5092.3	66.65	ppb	5525445	29.436	78	C6H6
	32	Toluene	898	04:37.7	91	3871.5	323.87	ppb	9365355	49.893	92	C7H8
	60	o-Xylene	932	06:08.3	91	534.87	19.01	ppb	543997	2.8981	106	C8H10
	68	Ethylbenzene	913	06:47.8	91	807.98	13.85	ppb	843943	4.496	106	C8H10
3.2	Peak #	Name	Similarity	R.T. (min:sec)	UniqueMass	S/N	Concentration	Conc. Units	Area	Area %	Weight	Formula
	14	Benzene	962	03:18.9	78	4858.1	57.96	ppb	5351489	30.748	78	C6H6
	31	Toluene	898	04:37.2	91	3603	315.25	ppb	9148139	52.563	92	C7H8
	56	o-Xylene	932	06:08.2	91	495.68	6.59	ppb	252954	1.4534	106	C8H10
	62	Ethylbenzene	913	06:47.8	91	789.47	3.42	ppb	551968	3.1715	106	C8H10
3.3	Peak #	Name	Similarity	R.T. (min:sec)	UniqueMass	S/N	Concentration	Conc. Units	Area	Area %	Weight	Formula
	12	Benzene	962	03:18.5	52	981.38	14.96	ppb	4491125	25.679	78	C6H6

	33	Toluene	898	04:37.0	91	3052.9	346.21	ppb	9928824	56.771	92	C7H8
	59	Benzene, 1,3-dimethyl-	932	06:02.3	91	187.27	0.98	ppb	121547	0.69498	106	C8H10
	60	o-Xylene	907	06:08.1	91	474.46	25.82	ppb	751501	4.2969	106	C8H10
	67	Ethylbenzene	913	06:47.7	91	764.34	5.72	ppb	616414	3.5245	106	C8H10
4.1	Peak #	Name	Similarity	R.T. (min:sec)	UniqueMass	S/N	Concentration	Conc. Units	Area	Area %	Weight	Formula
	13	Benzene	962	03:18.8	78	3845.3	149.84	ppb	7189686	39.971	78	C6H6
	29	Toluene	898	04:37.2	91	2685.1	265.41	ppb	7891318	43.872	92	C7H8
	55	o-Xylene	932	06:08.1	91	371.92	3.8	ppb	187523	1.0425	106	C8H10
	62	Ethylbenzene	913	06:47.7	91	562.37	19.61	ppb	1005219	5.5885	106	C8H10
4.2	Peak #	Name	Similarity	R.T. (min:sec)	UniqueMass	S/N	Concentration	Conc. Units	Area	Area %	Weight	Formula
	15	Benzene	962	03:19.4	78	3938.2	9.5	ppb	4381888	29.298	78	C6H6
	39	Toluene	898	04:37.5	91	2938.2	252.28	ppb	7560361	50.55	92	C7H8
	69	o-Xylene	932	06:08.3	91	405.56	4.58	ppb	205886	1.3766	106	C8H10
	77	Ethylbenzene	913	06:47.8	91	612.59	11.36	ppb	774409	5.1779	106	C8H10
4.3	Peak #	Name	Similarity	R.T. (min:sec)	UniqueMass	S/N	Concentration	Conc. Units	Area	Area %	Weight	Formula
	12	Benzene	962	03:19.1	78	3482.4	39.31	ppb	4978398	31.878	78	C6H6
	32	Toluene	898	04:37.3	91	2834.8	244.01	ppb	7351711	47.075	92	C7H8
	54	Benzene, 1,3-dimethyl-	932	06:02.4	91	161.86	2.43	ppb	155464	0.99548	106	C8H10
	55	o-Xylene	907	06:08.2	91	396.9	13.92	ppb	437098	2.7989	106	C8H10
	63	Ethylbenzene	913	06:47.8	91	602.79	22.68	ppb	1091368	6.9883	106	C8H10
5.1	Peak #	Name	Similarity	R.T. (min:sec)	UniqueMass	S/N	Concentration	Conc. Units	Area	Area %	Weight	Formula
	12	Benzene	962	03:18.6	52	741.01	-107.77	ppb	2035857	15.733	78	C6H6
	33	Toluene	898	04:36.9	91	2163.5	250.83	ppb	7523763	58.143	92	C7H8

	59	Benzene, 1,3-dimethyl-	932	06:02.2	91	144.43	1.72	ppb	138895	1.0734	106	C8H10
	60	o-Xylene	907	06:08.0	91	375.17	29.94	ppb	860403	6.6491	106	C8H10
	68	Ethylbenzene	913	06:47.6	91	580.7	8.89	ppb	705218	5.4498	106	C8H10
5.2	Peak #	Name	Similarity	R.T. (min:sec)	UniqueMass	S/N	Concentration	Conc. Units	Area	Area %	Weight	Formula
	11	Benzene	962	03:19.6	52	816.81	39.37	ppb	4979496	31.704	78	C6H6
	37	Toluene	898	04:37.6	91	2554.7	263.98	ppb	7855242	50.014	92	C7H8
	61	Benzene, 1,3-dimethyl-	932	06:02.6	91	158.47	1.29	ppb	128893	0.82065	106	C8H10
	62	o-Xylene	907	06:08.4	91	422.19	22.48	ppb	663206	4.2226	106	C8H10
	67	Ethylbenzene	913	06:47.9	91	628.42	3.51	ppb	554397	3.5298	106	C8H10
5.3	Peak #	Name	Similarity	R.T. (min:sec)	UniqueMass	S/N	Concentration	Conc. Units	Area	Area %	Weight	Formula
	14	Benzene	962	03:19.3	52	775.91	11.05	ppb	4412925	30.67	78	C6H6
	39	Toluene	898	04:37.4	91	2259.8	229.58	ppb	6987880	48.566	92	C7H8
	66	o-Xylene	932	06:08.2	91	383.4	14.65	ppb	441929	3.0714	106	C8H10
	73	Ethylbenzene	913	06:47.8	91	595.08	4.59	ppb	584866	4.0649	106	C8H10
6.1	Peak #	Name	Similarity	R.T. (min:sec)	UniqueMass	S/N	Concentration	Conc. Units	Area	Area %	Weight	Formula
	12	Benzene	962	03:19.0	52	786.46	-60.71	ppb	2977418	20.725	78	C6H6
	30	Toluene	898	04:37.1	91	2717.5	266.59	ppb	7921113	55.137	92	C7H8
	55	Benzene, 1,3-dimethyl-	932	06:02.4	91	160.94	4.9	ppb	213266	1.4845	106	C8H10
	56	o-Xylene	907	06:08.1	91	434.11	14.75	ppb	459181	3.1963	106	C8H10
	62	Ethylbenzene	913	06:47.7	91	628.04	19.43	ppb	1000302	6.9629	106	C8H10
6.2	Peak #	Name	Similarity	R.T. (min:sec)	UniqueMass	S/N	Concentration	Conc. Units	Area	Area %	Weight	Formula
	12	Benzene	962	03:19.4	50	1285.1	18.79	ppb	4567843	27.85	78	C6H6
	31	Toluene	898	04:37.5	91	3152.3	282.33	ppb	8318043	50.715	92	C7H8
	55	Benzene, 1,3-	932	06:02.5	91	188.81	-0.42	ppb	88615	0.54028	106	C8H10

		dimethyl-										
	56	o-Xylene	907	06:08.3	91	495.13	12.56	ppb	401121	2.4456	106	C8H10
	63	Ethylbenzene	913	06:47.8	91	722.61	29.12	ppb	1271688	7.7534	106	C8H10
6.3	Peak #	Name	Similarity	R.T. (min:sec)	UniqueMass	S/N	Concentration	Conc. Units	Area	Area %	Weight	Formula
	14	Benzene	962	03:19.5	52	843.64	23.03	ppb	4652608	30.097	78	C6H6
	37	Toluene	898	04:37.4	91	2704.6	277.26	ppb	8190292	52.982	92	C7H8
	63	Benzene, 1,3-dimethyl-	932	06:02.6	91	177.79	3.61	ppb	183099	1.1844	106	C8H10
	64	o-Xylene	907	06:08.3	91	449.69	18.14	ppb	548760	3.5499	106	C8H10
	71	Ethylbenzene	913	06:47.8	91	653.54	6.47	ppb	637301	4.1226	106	C8H10
7.1	Peak #	Name	Similarity	R.T. (min:sec)	UniqueMass	S/N	Concentration	Conc. Units	Area	Area %	Weight	Formula
	14	Benzene	962	03:19.1	50	1183.8	21.86	ppb	4629274	30.045	78	C6H6
	36	Toluene	898	04:37.3	91	2537.7	262.21	ppb	7810598	50.693	92	C7H8
	63	Benzene, 1,3-dimethyl-	932	06:02.4	91	156.41	5.94	ppb	237728	1.5429	106	C8H10
	65	o-Xylene	907	06:08.2	91	404.4	9.72	ppb	326201	2.1171	106	C8H10
	72	Ethylbenzene	913	06:47.7	91	618.9	8.28	ppb	687988	4.4653	106	C8H10
7.2	Peak #	Name	Similarity	R.T. (min:sec)	UniqueMass	S/N	Concentration	Conc. Units	Area	Area %	Weight	Formula
	13	Benzene	962	03:19.3	52	787.86	-121.81	ppb	1755021	13.45	78	C6H6
	29	Toluene	898	04:37.2	91	2613.6	272.17	ppb	8061727	61.782	92	C7H8
	54	Benzene, 1,3-dimethyl-	932	06:02.3	91	185.11	7.1	ppb	264929	2.0303	106	C8H10
	55	o-Xylene	907	06:08.1	91	475.99	10.86	ppb	356227	2.73	106	C8H10
	62	Ethylbenzene	913	06:47.7	91	729.97	12.78	ppb	813978	6.238	106	C8H10
7.3	Peak #	Name	Similarity	R.T. (min:sec)	UniqueMass	S/N	Concentration	Conc. Units	Area	Area %	Weight	Formula
	13	Benzene	962	03:19.1	78	3584.2	-11.22	ppb	3967422	25.829	78	C6H6
	32	Toluene	898	04:37.3	91	2858.3	287.42	ppb	8446280	54.988	92	C7H8

	59	Benzene, 1,3-dimethyl-	932	06:02.5	91	187.3	2.65	ppb	160742	1.0465	106	C8H10
	60	o-Xylene	907	06:08.2	106	152.18	18.15	ppb	548847	3.5732	106	C8H10
	67	Ethylbenzene	913	06:47.8	91	730.21	13.31	ppb	828947	5.3967	106	C8H10
8.1	Peak #	Name	Similarity	R.T. (min:sec)	UniqueMass	S/N	Concentration	Conc. Units	Area	Area %	Weight	Formula
	10	Benzene	962	03:19.1	78	3910.4	2.16	ppb	4235152	28.704	78	C6H6
	30	Toluene	898	04:37.5	91	2902.8	264.66	ppb	7872523	53.357	92	C7H8
	55	Benzene, 1,3-dimethyl-	932	06:02.6	91	174.17	1.4	ppb	131337	0.89016	106	C8H10
	56	o-Xylene	907	06:08.3	91	454.12	11.75	ppb	379972	2.5753	106	C8H10
	64	Ethylbenzene	913	06:47.8	91	676.2	11.87	ppb	788581	5.3447	106	C8H10
8.2	Peak #	Name	Similarity	R.T. (min:sec)	UniqueMass	S/N	Concentration	Conc. Units	Area	Area %	Weight	Formula
	12	Benzene	962	03:19.1	78	3564.9	-19.44	ppb	3803060	26.645	78	C6H6
	36	Toluene	898	04:37.4	91	2776.1	242.53	ppb	7314415	51.246	92	C7H8
	59	Benzene, 1,3-dimethyl-	932	06:02.5	91	174.17	1.54	ppb	134615	0.94313	106	C8H10
	60	o-Xylene	907	06:08.3	91	436.74	12.42	ppb	397477	2.7848	106	C8H10
	65	Ethylbenzene	913	06:47.8	91	651.15	13.88	ppb	844791	5.9187	106	C8H10
8.3	Peak #	Name	Similarity	R.T. (min:sec)	UniqueMass	S/N	Concentration	Conc. Units	Area	Area %	Weight	Formula
	14	Benzene	962	03:18.9	78	3610.8	-45.66	ppb	3278428	23.376	78	C6H6
	37	Toluene	898	04:37.3	91	2759.9	238.43	ppb	7211103	51.416	92	C7H8
	58	Benzene, 1,3-dimethyl-	932	06:02.5	91	168.93	9.86	ppb	329517	2.3495	106	C8H10
	59	o-Xylene	907	06:08.3	91	428.83	37.04	ppb	1047948	7.472	106	C8H10
	66	Ethylbenzene	913	06:47.8	91	647.27	13.18	ppb	825172	5.8836	106	C8H10
9.1	Peak #	Name	Similarity	R.T. (min:sec)	UniqueMass	S/N	Concentration	Conc. Units	Area	Area %	Weight	Formula

	10	Benzene	962	03:20.5	78	4831.4	-1.04	ppb	4171160	27.55	78	C6H6
	39	Toluene	898	04:38.2	91	3763.3	262.7	ppb	7823000	51.669	92	C7H8
	63	Benzene, 1,3-dimethyl-	932	06:02.8	91	207.09	-0.61	ppb	84192	0.55607	106	C8H10
	65	o-Xylene	907	06:08.4	91	542.87	25.97	ppb	755515	4.99	106	C8H10
	74	Ethylbenzene	913	06:47.9	91	780.2	12.75	ppb	813170	5.3708	106	C8H10
9.2	Peak #	Name	Similarity	R.T. (min:sec)	UniqueMass	S/N	Concentration	Conc. Units	Area	Area %	Weight	Formula
	14	Benzene	962	03:19.2	52	882.86	-97.67	ppb	2237827	17.793	78	C6H6
	38	Toluene	898	04:37.3	91	2520.1	235.92	ppb	7147820	56.833	92	C7H8
	63	o-Xylene	932	06:08.2	91	435.89	10.98	ppb	355837	2.8293	106	C8H10
	68	Ethylbenzene	913	06:47.8	91	647.62	5.23	ppb	602721	4.7923	106	C8H10
9.3	Peak #	Name	Similarity	R.T. (min:sec)	UniqueMass	S/N	Concentration	Conc. Units	Area	Area %	Weight	Formula
	15	Benzene	962	03:20.1	78	4845.2	-6.03	ppb	4071213	29.131	78	C6H6
	39	Toluene	898	04:38.1	91	3711.2	242.52	ppb	7314157	52.336	92	C7H8
	66	Benzene, 1,3-dimethyl-	932	06:02.7	91	203.86	1.8	ppb	140760	1.0072	106	C8H10
	67	o-Xylene	907	06:08.4	91	523.19	16.18	ppb	496803	3.5548	106	C8H10
	74	Ethylbenzene	913	06:47.9	91	763.46	2.19	ppb	517428	3.7024	106	C8H10
10.1	Peak #	Name	Similarity	R.T. (min:sec)	UniqueMass	S/N	Concentration	Conc. Units	Area	Area %	Weight	Formula
	14	Benzene	962	03:21.4	78	4827.1	79.04	ppb	5773158	29.695	78	C6H6
	39	Toluene	898	04:38.9	91	3872.1	345.4	ppb	9908261	50.964	92	C7H8
	64	Benzene, 1,3-dimethyl-	932	06:03.1	91	228.15	13.79	ppb	421568	2.1684	106	C8H10
	65	o-Xylene	907	06:08.8	91	583.66	17.79	ppb	539338	2.7741	106	C8H10
	73	Ethylbenzene	913	06:48.2	91	813.3	18.84	ppb	983693	5.0597	106	C8H10
10.2	Peak #	Name	Similarity	R.T. (min:sec)	UniqueMass	S/N	Concentration	Conc. Units	Area	Area %	Weight	Formula
	14	Benzene	962	03:19.1	76	144.05	-9	ppb	4011872	25.455	78	C6H6

	42	Toluene	898	04:37.5	91	3116.6	291.11	ppb	8539458	54.183	92	C7H8
	72	o-Xylene	932	06:08.3	91	491.81	6.15	ppb	242576	1.5391	106	C8H10
	81	Ethylbenzene	913	06:47.8	91	706.15	12.96	ppb	819110	5.1972	106	C8H10
10.3	Peak #	Name	Similarity	R.T. (min:sec)	UniqueMass	S/N	Concentration	Conc. Units	Area	Area %	Weight	Formula
	13	Benzene	962	03:19.7	52	856.23	-81.74	ppb	2556549	18.083	78	C6H6
	35	Toluene	898	04:37.6	91	2763.3	300.31	ppb	8771383	62.043	92	C7H8
	60	Benzene, 1,3-dimethyl-	932	06:02.6	91	181.81	3.97	ppb	191485	1.3544	106	C8H10
	62	o-Xylene	907	06:08.4	91	488.38	8.95	ppb	305808	2.1631	106	C8H10
	71	Ethylbenzene	913	06:47.9	91	712.38	6.85	ppb	648024	4.5837	106	C8H10
11.1	Peak #	Name	Similarity	R.T. (min:sec)	UniqueMass	S/N	Concentration	Conc. Units	Area	Area %	Weight	Formula
	13	Benzene	962	03:19.4	38	274.81	-14.32	ppb	3905494	25.896	78	C6H6
	35	Toluene	898	04:37.4	91	2562.1	263.19	ppb	7835437	51.954	92	C7H8
	59	Benzene, 1,3-dimethyl-	932	06:02.5	91	181.2	6.54	ppb	251705	1.669	106	C8H10
	60	o-Xylene	907	06:08.3	91	449.65	15.84	ppb	487856	3.2348	106	C8H10
	67	Ethylbenzene	913	06:47.8	91	610.72	6.39	ppb	635153	4.2115	106	C8H10
11.2	Peak #	Name	Similarity	R.T. (min:sec)	UniqueMass	S/N	Concentration	Conc. Units	Area	Area %	Weight	Formula
	14	Benzene	962	03:19.1	78	3193.2	-9.12	ppb	4009476	27.526	78	C6H6
	35	Toluene	898	04:37.5	91	2580.1	251.53	ppb	7541351	51.773	92	C7H8
	61	Benzene, 1,3-dimethyl-	932	06:02.6	91	176.91	3.16	ppb	172495	1.1842	106	C8H10
	62	o-Xylene	907	06:08.3	91	449.18	6.96	ppb	253411	1.7397	106	C8H10
	70	Ethylbenzene	913	06:47.9	91	626.7	6.07	ppb	626219	4.2992	106	C8H10
11.3	Peak #	Name	Similarity	R.T. (min:sec)	UniqueMass	S/N	Concentration	Conc. Units	Area	Area %	Weight	Formula
	12	Benzene	962	03:19.5	78	3749.7	6.65	ppb	4324973	28.997	78	C6H6
	34	Toluene	898	04:37.6	91	2722	253.38	ppb	7587985	50.874	92	C7H8

	58	Benzene, 1,3-dimethyl-	932	06:02.6	91	186.51	2.53	ppb	157947	1.059	106	C8H10
	59	o-Xylene	907	06:08.4	91	476.26	25.23	ppb	735834	4.9334	106	C8H10
	66	Ethylbenzene	913	06:47.9	91	649.24	9.65	ppb	726536	4.8711	106	C8H10
12.1	Peak #	Name	Similarity	R.T. (min:sec)	UniqueMass	S/N	Concentration	Conc. Units	Area	Area %	Weight	Formula
	14	Benzene	962	03:19.8	78	4143.7	-6.55	ppb	4060872	25.804	78	C6H6
	38	Toluene	898	04:37.8	91	3368.1	312.09	ppb	9068529	57.623	92	C7H8
	62	Benzene, 1,3-dimethyl-	932	06:02.6	91	223.56	7.81	ppb	281561	1.7891	106	C8H10
	64	o-Xylene	907	06:08.3	91	564.88	9.95	ppb	332345	2.1118	106	C8H10
	73	Ethylbenzene	913	06:47.8	91	698.18	7.13	ppb	655781	4.1669	106	C8H10
12.2	Peak #	Name	Similarity	R.T. (min:sec)	UniqueMass	S/N	Concentration	Conc. Units	Area	Area %	Weight	Formula
	13	Benzene	962	03:19.6	77	763.95	-95.59	ppb	2279449	16.945	78	C6H6
	36	Toluene	898	04:37.5	91	2629.7	300.36	ppb	8772562	65.212	92	C7H8
	63	Benzene, 1,3-dimethyl-	932	06:02.6	91	208.12	-0.25	ppb	92682	0.68896	106	C8H10
	64	o-Xylene	907	06:08.3	91	508.83	20.62	ppb	614059	4.5647	106	C8H10
	73	Ethylbenzene	913	06:47.9	91	654.91	5.36	ppb	606295	4.507	106	C8H10
12.3	Peak #	Name	Similarity	R.T. (min:sec)	UniqueMass	S/N	Concentration	Conc. Units	Area	Area %	Weight	Formula
	12	Benzene	962	03:19.5	51	998.12	89.3	ppb	5978442	32.911	78	C6H6
	42	Toluene	898	04:37.5	91	2843.4	313.17	ppb	9095663	50.072	92	C7H8
	69	Benzene, 1,3-dimethyl-	932	06:02.6	91	214.32	15.04	ppb	451084	2.4832	106	C8H10
	70	o-Xylene	907	06:08.3	91	540.08	24.97	ppb	729108	4.0138	106	C8H10
	79	Ethylbenzene	913	06:47.9	91	700.21	16.42	ppb	916102	5.0432	106	C8H10
13.1	Peak #	Name	Similarity	R.T. (min:sec)	UniqueMass	S/N	Concentration	Conc. Units	Area	Area %	Weight	Formula

	14	Benzene	962	03:19.2	78	2983.8	11.45	ppb	4421013	33.307	78	C6H6
	40	Toluene	898	04:37.3	91	2648.5	249.58	ppb	7492278	56.445	92	C7H8
	66	Benzene, 1,3-dimethyl-	932	06:02.5	91	156.99	2.72	ppb	162344	1.2231	106	C8H10
	67	o-Xylene	907	06:08.2	91	395.84	9	ppb	307324	2.3153	106	C8H10
	74	Ethylbenzene	913	06:47.8	91	583.49	0.69	ppb	475599	3.583	106	C8H10
13.2	Peak #	Name	Similarity	R.T. (min:sec)	UniqueMass	S/N	Concentration	Conc. Units	Area	Area %	Weight	Formula
	12	Benzene	962	03:19.3	52	709.4	-21.86	ppb	3754663	28.137	78	C6H6
	36	Toluene	898	04:37.3	91	2542.1	234.82	ppb	7120116	53.357	92	C7H8
	61	o-Xylene	932	06:08.2	91	379.08	2.09	ppb	147423	1.1048	106	C8H10
	68	Ethylbenzene	913	06:47.8	91	581.03	15.06	ppb	877852	6.5785	106	C8H10
13.3	Peak #	Name	Similarity	R.T. (min:sec)	UniqueMass	S/N	Concentration	Conc. Units	Area	Area %	Weight	Formula
	14	Benzene	962	03:19.9	78	3287.7	-65	ppb	2891598	20.69	78	C6H6
	41	Toluene	898	04:37.8	91	2928.8	288.07	ppb	8462757	60.553	92	C7H8
	66	Benzene, 1,3-dimethyl-	932	06:02.7	91	181.86	0.93	ppb	120427	0.86167	106	C8H10
	67	o-Xylene	907	06:08.4	91	457.56	9.9	ppb	331076	2.3689	106	C8H10
	75	Ethylbenzene	913	06:48.0	91	646.76	8.51	ppb	694454	4.9689	106	C8H10
14.1	Peak #	Name	Similarity	R.T. (min:sec)	UniqueMass	S/N	Concentration	Conc. Units	Area	Area %	Weight	Formula
	14	Benzene	962	03:19.7	52	775.82	-111.67	ppb	1957859	13.662	78	C6H6
	36	Toluene	898	04:37.6	91	2568.9	313.76	ppb	9110648	63.575	92	C7H8
	61	Benzene, 1,3-dimethyl-	932	06:02.6	91	215.61	7.22	ppb	267747	1.8684	106	C8H10
	62	o-Xylene	907	06:08.3	91	546.72	29.57	ppb	850523	5.935	106	C8H10
	72	Ethylbenzene	913	06:47.9	91	687.55	6.47	ppb	637498	4.4485	106	C8H10
14.2	Peak #	Name	Similarity	R.T. (min:sec)	UniqueMass	S/N	Concentration	Conc. Units	Area	Area %	Weight	Formula
	11	Benzene	962	03:19.6	62	40.046	-92.29	ppb	2345432	16.229	78	C6H6

	34	Toluene	898	04:37.4	91	2648.5	283.87	ppb	8356931	57.826	92	C7H8
	60	Benzene, 1,3-dimethyl-	932	06:02.5	91	217.71	10.41	ppb	342368	2.369	106	C8H10
	61	o-Xylene	907	06:08.2	91	540.18	28.64	ppb	826050	5.7159	106	C8H10
	68	Ethylbenzene	913	06:47.8	91	667.76	15.17	ppb	881072	6.0966	106	C8H10
14.3	Peak #	Name	Similarity	R.T. (min:sec)	UniqueMass	S/N	Concentration	Conc. Units	Area	Area %	Weight	Formula
	13	Benzene	962	03:20.4	52	877.91	-68.71	ppb	2817270	18.18	78	C6H6
	41	Toluene	898	04:38.0	91	2867.9	325.44	ppb	9405162	60.692	92	C7H8
	65	Benzene, 1,3-dimethyl-	932	06:02.8	91	239.84	7.32	ppb	270061	1.7427	106	C8H10
	66	o-Xylene	907	06:08.5	91	593.75	26.26	ppb	763171	4.9248	106	C8H10
	74	Ethylbenzene	913	06:48.0	91	755.8	11.77	ppb	785931	5.0717	106	C8H10
15.1	Peak #	Name	Similarity	R.T. (min:sec)	UniqueMass	S/N	Concentration	Conc. Units	Area	Area %	Weight	Formula
	15	Benzene	962	03:20.6	78	4678.5	82.23	ppb	5837079	20.12	78	C6H6
	47	Toluene	898	04:38.3	91	4401.4	658.44	ppb	17801771	61.361	92	C7H8
	78	Benzene, 1,3-dimethyl-	932	06:03.0	91	364.11	9.71	ppb	326132	1.1241	106	C8H10
	80	o-Xylene	907	06:08.6	91	886.56	36.98	ppb	1046274	3.6064	106	C8H10
	92	Ethylbenzene	913	06:48.1	91	1000.9	23.03	ppb	1101010	3.7951	106	C8H10
15.2	Peak #	Name	Similarity	R.T. (min:sec)	UniqueMass	S/N	Concentration	Conc. Units	Area	Area %	Weight	Formula
	14	Benzene	962	03:19.4	78	3382.1	40.21	ppb	4996332	19.185	78	C6H6
	43	Toluene	898	04:37.4	91	3471.2	575.81	ppb	15718230	60.355	92	C7H8
	71	Benzene, 1,3-dimethyl-	932	06:02.5	91	290.34	4.67	ppb	207882	0.79823	106	C8H10
	72	o-Xylene	907	06:08.2	91	731.85	38.27	ppb	1080445	4.1487	106	C8H10
	84	Ethylbenzene	913	06:47.8	91	832.73	26.96	ppb	1211211	4.6508	106	C8H10
15.3	Peak #	Name	Similarity	R.T. (min:sec)	UniqueMass	S/N	Concentration	Conc. Units	Area	Area %	Weight	Formula

	15	Benzene	962	03:21.0	78	5115.3	104.3	ppb	6278502	22.102	78	C6H6
	45	Toluene	898	04:38.5	91	5001.6	615.7	ppb	16723961	58.872	92	C7H8
	75	Benzene, 1,3-dimethyl-	932	06:02.7	91	364.68	18.89	ppb	541094	1.9048	106	C8H10
	76	o-Xylene	907	06:08.5	91	893.28	40.19	ppb	1131124	3.9818	106	C8H10
	88	Ethylbenzene	913	06:47.9	91	1003	25	ppb	1156214	4.0701	106	C8H10
16.1	Peak #	Name	Similarity	R.T. (min:sec)	UniqueMass	S/N	Concentration	Conc. Units	Area	Area %	Weight	Formula
	14	Benzene	962	03:20.3	50	1379.4	-14.34	ppb	3905070	17.463	78	C6H6
	43	Toluene	898	04:38.0	91	4113.2	510.09	ppb	14061121	62.879	92	C7H8
	73	Benzene, 1,3-dimethyl-	932	06:02.7	91	286.38	0.61	ppb	112773	0.5043	106	C8H10
	74	o-Xylene	907	06:08.4	91	738.93	23.06	ppb	678724	3.0352	106	C8H10
	86	Ethylbenzene	913	06:47.9	91	954.99	15.19	ppb	881487	3.9419	106	C8H10
16.2	Peak #	Name	Similarity	R.T. (min:sec)	UniqueMass	S/N	Concentration	Conc. Units	Area	Area %	Weight	Formula
	12	Benzene	962	03:19.8	78	4875.6	106.24	ppb	6317335	26.401	78	C6H6
	40	Toluene	898	04:37.8	91	4732.9	485.64	ppb	13444635	56.187	92	C7H8
	73	Benzene, 1,3-dimethyl-	932	06:02.6	91	299.54	7.57	ppb	276023	1.1535	106	C8H10
	74	o-Xylene	907	06:08.3	91	756.54	21.94	ppb	648977	2.7121	106	C8H10
	86	Ethylbenzene	913	06:47.8	91	973.06	20.34	ppb	1025679	4.2864	106	C8H10
16.3	Peak #	Name	Similarity	R.T. (min:sec)	UniqueMass	S/N	Concentration	Conc. Units	Area	Area %	Weight	Formula
	14	Benzene	962	03:20.1	52	1089.3	-54.46	ppb	3102343	13.97	78	C6H6
	45	Toluene	898	04:37.9	91	4136.4	596.22	ppb	16232756	73.095	92	C7H8
	75	Benzene, 1,3-dimethyl-	932	06:02.6	91	299.26	3.33	ppb	176474	0.79465	106	C8H10
	76	o-Xylene	907	06:08.4	91	737.45	16.82	ppb	513784	2.3135	106	C8H10
	87	Ethylbenzene	913	06:47.9	91	970.27	15.67	ppb	894981	4.03	106	C8H10

17.1	Peak #	Name	Similarity	R.T. (min:sec)	UniqueMass	S/N	Concentration	Conc. Units	Area	Area %	Weight	Formula
	13	Benzene	962	03:21.5	78	5188	162.57	ppb	7444390	25.577	78	C6H6
	47	Toluene	898	04:38.9	91	5581.8	645.59	ppb	17477730	60.049	92	C7H8
	76	Benzene, 1,3-dimethyl-	932	06:03.1	91	346.96	0.01	ppb	98813	0.33949	106	C8H10
	77	o-Xylene	907	06:08.8	91	874.32	27.34	ppb	791566	2.7196	106	C8H10
	89	Ethylbenzene	913	06:48.2	91	1111.7	18.12	ppb	963633	3.3108	106	C8H10
17.2	Peak #	Name	Similarity	R.T. (min:sec)	UniqueMass	S/N	Concentration	Conc. Units	Area	Area %	Weight	Formula
	14	Benzene	962	03:19.8	52	1102.7	33.91	ppb	4870364	20.306	78	C6H6
	51	Toluene	898	04:37.6	91	4259.4	587.22	ppb	16005783	66.732	92	C7H8
	83	Benzene, 1,3-dimethyl-	932	06:02.6	91	294.7	3.03	ppb	169443	0.70645	106	C8H10
	84	o-Xylene	907	06:08.3	91	747.26	18.42	ppb	556163	2.3188	106	C8H10
	96	Ethylbenzene	913	06:47.8	91	937.09	27.82	ppb	1235290	5.1502	106	C8H10
17.3	Peak #	Name	Similarity	R.T. (min:sec)	UniqueMass	S/N	Concentration	Conc. Units	Area	Area %	Weight	Formula
	15	Benzene	962	03:19.7	78	4499.8	100.53	ppb	6203201	21.955	78	C6H6
	45	Toluene	898	04:37.7	91	4489.5	652.02	ppb	17639811	62.433	92	C7H8
	76	Benzene, 1,3-dimethyl-	932	06:02.6	91	309.53	4.93	ppb	213966	0.7573	106	C8H10
	77	o-Xylene	907	06:08.3	91	761.53	25.37	ppb	739534	2.6175	106	C8H10
	87	Ethylbenzene	913	06:47.8	91	981.17	21.31	ppb	1052889	3.7265	106	C8H10
18.1	Peak #	Name	Similarity	R.T. (min:sec)	UniqueMass	S/N	Concentration	Conc. Units	Area	Area %	Weight	Formula
	16	Benzene	962	03:19.6	78	4832.9	99.97	ppb	6192001	21.253	78	C6H6
	49	Toluene	898	04:37.6	91	4889.2	685.39	ppb	18481184	63.434	92	C7H8
	81	Benzene, 1,3-dimethyl-	932	06:02.5	91	334.94	1.95	ppb	144206	0.49497	106	C8H10

	82	o-Xylene	907	06:08.2	91	834.25	41.18	ppb	1157322	3.9724	106	C8H10
	94	Ethylbenzene	913	06:47.7	91	1024.8	36.32	ppb	1473324	5.057	106	C8H10
18.2	Peak #	Name	Similarity	R.T. (min:sec)	UniqueMass	S/N	Concentration	Conc. Units	Area	Area %	Weight	Formula
	12	Benzene	962	03:19.3	78	4007.1	59.77	ppb	5387676	20.673	78	C6H6
	42	Toluene	898	04:37.3	91	4291.7	582.78	ppb	15893979	60.987	92	C7H8
	76	Benzene, 1,3-dimethyl-	932	06:02.4	91	317.33	0.3	ppb	105617	0.40526	106	C8H10
	77	o-Xylene	907	06:08.1	91	794.72	33.25	ppb	947649	3.6362	106	C8H10
	87	Ethylbenzene	913	06:47.8	91	973.28	24.24	ppb	1134882	4.3547	106	C8H10
18.3	Peak #	Name	Similarity	R.T. (min:sec)	UniqueMass	S/N	Concentration	Conc. Units	Area	Area %	Weight	Formula
	12	Benzene	962	03:19.8	78	4812.1	88.93	ppb	5971075	23.175	78	C6H6
	38	Toluene	898	04:37.6	91	4845.9	558.12	ppb	15272245	59.276	92	C7H8
	69	Benzene, 1,3-dimethyl-	932	06:02.6	91	340.52	13.12	ppb	405909	1.5754	106	C8H10
	71	o-Xylene	907	06:08.2	91	819.44	20.99	ppb	623869	2.4214	106	C8H10
	81	Ethylbenzene	913	06:47.8	91	1013.7	29.77	ppb	1289907	5.0065	106	C8H10
19.1	Peak #	Name	Similarity	R.T. (min:sec)	UniqueMass	S/N	Concentration	Conc. Units	Area	Area %	Weight	Formula
	12	Benzene	962	03:19.4	78	4619.2	36.82	ppb	4928485	20.545	78	C6H6
	39	Toluene	898	04:37.4	91	4183.6	521.95	ppb	14360128	59.862	92	C7H8
	70	Benzene, 1,3-dimethyl-	932	06:02.5	91	284.68	12.07	ppb	381422	1.59	106	C8H10
	71	o-Xylene	907	06:08.2	91	719.33	49.67	ppb	1381389	5.7585	106	C8H10
	79	Ethylbenzene	913	06:47.7	91	895.5	15.78	ppb	898195	3.7442	106	C8H10
19.2	Peak #	Name	Similarity	R.T. (min:sec)	UniqueMass	S/N	Concentration	Conc. Units	Area	Area %	Weight	Formula
	12	Benzene	962	03:19.5	78	4679.2	34.41	ppb	4880314	23.278	78	C6H6
	36	Toluene	898	04:37.5	91	4401.3	449.76	ppb	12539720	59.81	92	C7H8
	63	Benzene, 1,3-	932	06:02.5	91	268.63	7.75	ppb	280139	1.3362	106	C8H10

		dimethyl-										
	64	o-Xylene	907	06:08.2	91	695.15	19.24	ppb	577737	2.7556	106	C8H10
	74	Ethylbenzene	913	06:47.7	91	874.05	31.64	ppb	1342090	6.4013	106	C8H10
19.3	Peak #	Name	Similarity	R.T. (min:sec)	UniqueMass	S/N	Concentration	Conc. Units	Area	Area %	Weight	Formula
	14	Benzene	962	03:20.1	78	4711.4	72.66	ppb	5645604	27.012	78	C6H6
	41	Toluene	898	04:37.9	91	4718	427.15	ppb	11969700	57.271	92	C7H8
	73	Benzene, 1,3-dimethyl-	932	06:02.6	91	295.35	6.96	ppb	261523	1.2513	106	C8H10
	74	o-Xylene	907	06:08.3	91	746.11	30.33	ppb	870659	4.1658	106	C8H10
	85	Ethylbenzene	913	06:47.8	91	912.19	20.62	ppb	1033674	4.9458	106	C8H10
20.1	Peak #	Name	Similarity	R.T. (min:sec)	UniqueMass	S/N	Concentration	Conc. Units	Area	Area %	Weight	Formula
	14	Benzene	962	03:20.6	50	1641.7	126.74	ppb	6727601	28.152	78	C6H6
	46	Toluene	898	04:38.1	91	4518.6	461.53	ppb	12836626	53.716	92	C7H8
	78	Benzene, 1,3-dimethyl-	932	06:02.7	91	262.71	4.04	ppb	193184	0.80839	106	C8H10
	80	o-Xylene	907	06:08.4	91	670.79	26.94	ppb	780993	3.2681	106	C8H10
	91	Ethylbenzene	913	06:48.0	91	1080.9	19.21	ppb	994126	4.16	106	C8H10
20.2	Peak #	Name	Similarity	R.T. (min:sec)	UniqueMass	S/N	Concentration	Conc. Units	Area	Area %	Weight	Formula
	13	Benzene	962	03:20.0	52	1275	57.13	ppb	5334902	23.122	78	C6H6
	41	Toluene	898	04:37.7	91	4340.6	466.57	ppb	12963794	56.186	92	C7H8
	74	Benzene, 1,3-dimethyl-	932	06:02.6	91	265.21	2.4	ppb	154894	0.67132	106	C8H10
	76	o-Xylene	907	06:08.3	91	659.84	22.63	ppb	667181	2.8916	106	C8H10
	86	Ethylbenzene	913	06:47.8	91	1074.8	38.15	ppb	1524520	6.6074	106	C8H10
20.3	Peak #	Name	Similarity	R.T. (min:sec)	UniqueMass	S/N	Concentration	Conc. Units	Area	Area %	Weight	Formula
	13	Benzene	962	03:20.4	52	1312	14.26	ppb	4477308	20.065	78	C6H6
	42	Toluene	898	04:38.0	91	4460.8	473.37	ppb	13135079	58.864	92	C7H8

	75	Benzene, 1,3-dimethyl-	932	06:02.7	91	262.87	1.78	ppb	140295	0.62872	106	C8H10
	77	o-Xylene	907	06:08.4	91	655.04	27.95	ppb	807764	3.6199	106	C8H10
	87	Ethylbenzene	913	06:47.9	91	1088.1	37.79	ppb	1514301	6.7862	106	C8H10
21.1	Peak #	Name	Similarity	R.T. (min:sec)	UniqueMass	S/N	Concentration	Conc. Units	Area	Area %	Weight	Formula
	13	Benzene	962	03:20.2	52	1218.5	-29.48	ppb	3602212	15.769	78	C6H6
	46	Toluene	898	04:37.8	91	4247.6	526.57	ppb	14476488	63.372	92	C7H8
	77	Benzene, 1,3-dimethyl-	932	06:02.6	91	275.58	8.4	ppb	295375	1.293	106	C8H10
	78	o-Xylene	907	06:08.3	91	690.09	20.65	ppb	614939	2.692	106	C8H10
	88	Ethylbenzene	913	06:47.8	91	1077.3	37.7	ppb	1511858	6.6183	106	C8H10
21.2	Peak #	Name	Similarity	R.T. (min:sec)	UniqueMass	S/N	Concentration	Conc. Units	Area	Area %	Weight	Formula
	16	Benzene	962	03:21.2	78	4714.6	43.81	ppb	5068366	24.701	78	C6H6
	43	Toluene	898	04:36.4	111	47.222	366.77	ppb	10447168	50.916	92	C7H8
	78	Benzene, 1,3-dimethyl-	932	06:02.9	91	294.51	6.89	ppb	260018	1.2672	106	C8H10
	80	o-Xylene	907	06:08.6	91	717.2	30.53	ppb	875841	4.2685	106	C8H10
	92	Ethylbenzene	913	06:48.0	91	1110.5	26.67	ppb	1203168	5.8638	106	C8H10
21.3	Peak #	Name	Similarity	R.T. (min:sec)	UniqueMass	S/N	Concentration	Conc. Units	Area	Area %	Weight	Formula
	11	Benzene	962	03:20.7	78	4367.3	66.06	ppb	5513477	21.085	78	C6H6
	42	Toluene	898	04:38.1	91	4639.5	567.2	ppb	15500972	59.281	92	C7H8
	71	Benzene, 1,3-dimethyl-	932	06:02.7	91	281.67	3.29	ppb	175713	0.67199	106	C8H10
	72	o-Xylene	907	06:08.4	91	697.6	42.39	ppb	1189329	4.5484	106	C8H10
	83	Ethylbenzene	913	06:47.9	91	1069.5	24.22	ppb	1134498	4.3387	106	C8H10
22.1	Peak #	Name	Similarity	R.T. (min:sec)	UniqueMass	S/N	Concentration	Conc. Units	Area	Area %	Weight	Formula

	12	Benzene	962	03:19.8	78	3856.5	47.11	ppb	5134398	24.161	78	C6H6
	43	Toluene	898	04:37.6	91	3872.6	418.67	ppb	11755934	55.32	92	C7H8
	82	Benzene, 1,3-dimethyl-	932	06:02.5	91	199.13	5	ppb	215757	1.0153	106	C8H10
	83	o-Xylene	907	06:08.2	91	496.09	15.48	ppb	478253	2.2505	106	C8H10
	91	Ethylbenzene	913	06:47.7	91	819.25	27.68	ppb	1231361	5.7944	106	C8H10
22.2	Peak #	Name	Similarity	R.T. (min:sec)	UniqueMass	S/N	Concentration	Conc. Units	Area	Area %	Weight	Formula
	11	Benzene	962	03:21.1	78	4173.7	35.23	ppb	4896685	22.694	78	C6H6
	42	Toluene	898	04:38.4	91	4022.2	441.56	ppb	12333159	57.16	92	C7H8
	73	Benzene, 1,3-dimethyl-	932	06:02.8	91	195.64	8.88	ppb	306643	1.4212	106	C8H10
	74	o-Xylene	907	06:08.5	91	497.4	56.03	ppb	1549624	7.182	106	C8H10
	85	Ethylbenzene	913	06:48.0	91	830.88	5.11	ppb	599224	2.7772	106	C8H10
22.3	Peak #	Name	Similarity	R.T. (min:sec)	UniqueMass	S/N	Concentration	Conc. Units	Area	Area %	Weight	Formula
	14	Benzene	962	03:20.4	50	1362.9	5.59	ppb	4303795	22.27	78	C6H6
	46	Toluene	898	04:38.0	91	3369.1	351.75	ppb	10068477	52.1	92	C7H8
	74	Benzene, 1,3-dimethyl-	932	06:02.8	91	190.54	17.56	ppb	510002	2.6391	106	C8H10
	76	o-Xylene	907	06:08.5	91	466.85	43.72	ppb	1224286	6.3352	106	C8H10
	86	Ethylbenzene	913	06:48.0	91	810.19	23.16	ppb	1104752	5.7167	106	C8H10
23.1	Peak #	Name	Similarity	R.T. (min:sec)	UniqueMass	S/N	Concentration	Conc. Units	Area	Area %	Weight	Formula
	14	Benzene	962	03:18.4	50	1087.1	-113.08	ppb	1929615	18.782	78	C6H6
	35	Toluene	898	04:36.6	91	2252.7	194.55	ppb	6104590	59.419	92	C7H8
	59	Benzene, 1,3-dimethyl-	932	06:01.7	77	19.061	3.41	ppb	178411	1.7366	106	C8H10
	60	o-Xylene	907	06:07.7	91	362.47	8.52	ppb	294403	2.8656	106	C8H10
	68	Ethylbenzene	913	06:47.3	91	598.26	3.45	ppb	552799	5.3807	106	C8H10
23.2	Peak #	Name	Similarity	R.T.	UniqueMass	S/N	Concentration	Conc.	Area	Area %	Weight	Formula

				(min:sec)				Units				
	12	Benzene	962	03:18.0	50	1074.1	-119.92	ppb	1792681	19.118	78	C6H6
	36	Toluene	898	04:36.3	91	2227.4	172.74	ppb	5554799	59.239	92	C7H8
	59	Benzene, 1,3-dimethyl-	932	06:01.6	91	143.98	-1.37	ppb	66443	0.70858	106	C8H10
	60	o-Xylene	907	06:07.4	91	364.45	12.54	ppb	400698	4.2732	106	C8H10
	66	Ethylbenzene	913	06:47.1	91	583.59	-1.78	ppb	406323	4.3332	106	C8H10
23.3	Peak #	Name	Similarity	R.T. (min:sec)	UniqueMass	S/N	Concentration	Conc. Units	Area	Area %	Weight	Formula
	11	Benzene	962	03:17.6	77	691.72	-93.26	ppb	2326132	21.372	78	C6H6
	28	Toluene	898	04:35.8	91	2252.6	186.85	ppb	5910581	54.304	92	C7H8
	53	Benzene, 1,3-dimethyl-	932	06:01.6	106	46.545	-0.76	ppb	80652	0.741	106	C8H10
	54	o-Xylene	907	06:07.3	91	347.46	11.34	ppb	369054	3.3907	106	C8H10
	60	Ethylbenzene	913	06:47.0	91	565.99	7.27	ppb	659680	6.0609	106	C8H10
24.1	Peak #	Name	Similarity	R.T. (min:sec)	UniqueMass	S/N	Concentration	Conc. Units	Area	Area %	Weight	Formula
	11	Benzene	962	03:19.1	74	142.34	-76.33	ppb	2664753	26.546	78	C6H6
	28	Toluene	898	04:37.1	91	2130	170.39	ppb	5495409	54.745	92	C7H8
	51	Benzene, 1,3-dimethyl-	932	06:02.4	91	116.94	-1	ppb	75137	0.7485	106	C8H10
	52	o-Xylene	907	06:08.1	91	311.94	4.72	ppb	194211	1.9347	106	C8H10
	59	Ethylbenzene	913	06:47.7	91	485.42	-2.18	ppb	395313	3.9381	106	C8H10
24.2	Peak #	Name	Similarity	R.T. (min:sec)	UniqueMass	S/N	Concentration	Conc. Units	Area	Area %	Weight	Formula
	14	Benzene	962	03:19.1	52	895.35	-81.16	ppb	2568105	17.551	78	C6H6
	28	Toluene	898	04:37.2	91	2878.7	279.64	ppb	8250134	56.382	92	C7H8
	53	Benzene, 1,3-dimethyl-	932	06:02.3	91	197.64	-1.68	ppb	59136	0.40414	106	C8H10
	54	o-Xylene	907	06:08.0	91	550.29	35.7	ppb	1012453	6.9191	106	C8H10

	61	Ethylbenzene	913	06:47.6	91	789.38	12.15	ppb	796560	5.4437	106	C8H10
24.3	Peak #	Name	Similarity	R.T. (min:sec)	UniqueMass	S/N	Concentration	Conc. Units	Area	Area %	Weight	Formula
	14	Benzene	962	03:19.0	37	301.98	6.73	ppb	4326525	25.814	78	C6H6
	35	Toluene	898	04:37.3	91	3395.8	284.76	ppb	8379294	49.994	92	C7H8
	61	o-Xylene	932	06:08.2	91	577	15.03	ppb	450814	2.6897	106	C8H10
	68	Ethylbenzene	913	06:47.7	91	845.96	12.45	ppb	804937	4.8025	106	C8H10
Sample no.	**Back Section**											
1.1	Peak #	Name	Similarity	R.T. (min:sec)	UniqueMass	S/N	Concentration	Conc. Units	Area	Area %	Weight	Formula
	12	Benzene	962	03:19.1	78	3401.7	-11.94	ppb	3953101	22.894	78	C6H6
	35	Toluene	898	04:37.2	91	2998.2	326.95	ppb	9443041	54.688	92	C7H8
	56	Benzene, 1,3-dimethyl-	932	06:02.4	91	187.45	5.58	ppb	229231	1.3276	106	C8H10
	57	o-Xylene	907	06:08.1	91	484.24	7.82	ppb	276169	1.5994	106	C8H10
	67	Ethylbenzene	913	06:47.7	91	789.44	20.6	ppb	1033180	5.9836	106	C8H10
1.2	Peak #	Name	Similarity	R.T. (min:sec)	UniqueMass	S/N	Concentration	Conc. Units	Area	Area %	Weight	Formula
	13	Benzene	962	03:18.8	52	275.07	-15.38	ppb	3884144	24.89	78	C6H6
	35	Toluene	898	04:37.0	91	2788.1	303.97	ppb	8863667	56.798	92	C7H8
	59	Benzene, 1,3-dimethyl-	932	06:02.4	91	171.45	-0.01	ppb	98378	0.6304	106	C8H10
	60	o-Xylene	907	06:08.1	91	456	13.37	ppb	422687	2.7086	106	C8H10
	66	Ethylbenzene	913	06:47.7	91	748.93	-10.63	ppb	158585	1.0162	106	C8H10
1.3	Peak #	Name	Similarity	R.T. (min:sec)	UniqueMass	S/N	Concentration	Conc. Units	Area	Area %	Weight	Formula
	11	Benzene	962	03:19.4	52	932.24	-100.81	ppb	2174993	15.222	78	C6H6
	32	Toluene	898	04:37.3	91	2899.8	261.32	ppb	7788209	54.507	92	C7H8
	57	o-Xylene	932	06:08.1	91	488.21	6.22	ppb	244241	1.7094	106	C8H10
	65	Ethylbenzene	913	06:47.8	91	814.47	35.92	ppb	1462098	10.233	106	C8H10

2.1	Peak #	Name	Similarity	R.T. (min:sec)	UniqueMass	S/N	Concentration	Conc. Units	Area	Area %	Weight	Formula
	15	Benzene	962	03:19.7	78	5048.5	112.29	ppb	6438477	32.112	78	C6H6
	42	Toluene	898	04:37.8	91	3879.9	329.02	ppb	9495279	47.358	92	C7H8
	70	Benzene, 1,3-dimethyl-	932	06:02.6	91	204.62	6.4	ppb	248509	1.2394	106	C8H10
	71	o-Xylene	907	06:08.3	91	529.62	25.9	ppb	753522	3.7582	106	C8H10
	82	Ethylbenzene	913	06:47.8	91	870.07	9.53	ppb	723001	3.606	106	C8H10
2.2	Peak #	Name	Similarity	R.T. (min:sec)	UniqueMass	S/N	Concentration	Conc. Units	Area	Area %	Weight	Formula
	12	Benzene	962	03:18.9	50	1638.1	10.96	ppb	4411096	24.486	78	C6H6
	38	Toluene	898	04:37.3	91	3220.9	331.4	ppb	9555246	53.041	92	C7H8
	62	o-Xylene	932	06:08.2	91	476.64	10.17	ppb	336927	1.8703	106	C8H10
	71	Ethylbenzene	913	06:47.8	91	807.34	9.29	ppb	716453	3.9771	106	C8H10
2.3	Peak #	Name	Similarity	R.T. (min:sec)	UniqueMass	S/N	Concentration	Conc. Units	Area	Area %	Weight	Formula
	13	Benzene	962	03:19.4	78	4783.1	48.77	ppb	5167724	27.887	78	C6H6
	35	Toluene	898	04:37.6	91	3400.8	337.45	ppb	9707995	52.388	92	C7H8
	59	Benzene, 1,3-dimethyl-	932	06:02.7	91	199.61	1.64	ppb	136925	0.7389	106	C8H10
	60	o-Xylene	907	06:08.3	91	510.18	10.43	ppb	345054	1.862	106	C8H10
	69	Ethylbenzene	913	06:47.8	91	847.06	14.4	ppb	859512	4.6383	106	C8H10
3.1	Peak #	Name	Similarity	R.T. (min:sec)	UniqueMass	S/N	Concentration	Conc. Units	Area	Area %	Weight	Formula
	14	Benzene	962	03:19.7	78	5173.5	64.96	ppb	5491449	31.39	78	C6H6
	33	Toluene	898	04:37.8	91	3735.4	292.64	ppb	8578019	49.034	92	C7H8
	56	Benzene, 1,3-dimethyl-	932	06:02.6	91	181.7	4.45	ppb	202862	1.1596	106	C8H10
	57	o-Xylene	907	06:08.3	91	455.62	12.31	ppb	394762	2.2565	106	C8H10
	63	Ethylbenzene	913	06:47.8	91	808.72	6.62	ppb	641712	3.6682	106	C8H10
3.2	Peak #	Name	Similarity	R.T.	UniqueMass	S/N	Concentration	Conc.	Area	Area %	Weight	Formula

				(min:sec)				Units				
	14	Benzene	962	03:19.0	78	4575	57.48	ppb	5341906	29.773	78	C6H6
	33	Toluene	898	04:37.3	91	3297.1	304.29	ppb	8871780	49.447	92	C7H8
	57	Benzene, 1,3-dimethyl-	932	06:02.5	106	67.532	2.03	ppb	146140	0.81451	106	C8H10
	58	o-Xylene	907	06:08.2	91	455.8	14.28	ppb	446755	2.49	106	C8H10
	69	Ethylbenzene	913	06:47.8	91	828.2	9.46	ppb	721212	4.0197	106	C8H10
3.3	Peak #	Name	Similarity	R.T. (min:sec)	UniqueMass	S/N	Concentration	Conc. Units	Area	Area %	Weight	Formula
	12	Benzene	962	03:19.4	78	4819.6	-4.98	ppb	4092259	22.884	78	C6H6
	34	Toluene	898	04:37.6	91	3549.8	315.61	ppb	9157220	51.208	92	C7H8
	60	o-Xylene	932	06:08.2	91	488.82	26.05	ppb	708990	3.9647	106	C8H10
	69	Ethylbenzene	913	06:47.8	91	863.19	16.81	ppb	926934	5.1835	106	C8H10
4.1	Peak #	Name	Similarity	R.T. (min:sec)	UniqueMass	S/N	Concentration	Conc. Units	Area	Area %	Weight	Formula
	11	Benzene	962	03:19.1	52	787.52	-80.81	ppb	2575213	17.608	78	C6H6
	32	Toluene	898	04:37.2	91	2652.8	287.99	ppb	8460853	57.852	92	C7H8
	60	o-Xylene	932	06:08.2	91	403.99	12.49	ppb	391161	2.6746	106	C8H10
	70	Ethylbenzene	913	06:47.7	91	612.08	6.58	ppb	640348	4.3785	106	C8H10
4.2	Peak #	Name	Similarity	R.T. (min:sec)	UniqueMass	S/N	Concentration	Conc. Units	Area	Area %	Weight	Formula
	17	Benzene	962	03:20.4	78	3600.4	-7.74	ppb	4037165	21.907	78	C6H6
	40	Toluene	898	04:38.1	91	3360.9	349.21	ppb	10004472	54.288	92	C7H8
	67	Benzene, 1,3-dimethyl-	932	06:02.9	91	205.71	3.71	ppb	185431	1.0062	106	C8H10
	68	o-Xylene	907	06:08.6	91	503.25	24.7	ppb	721927	3.9175	106	C8H10
	78	Ethylbenzene	913	06:48.1	91	753.37	27.87	ppb	1236698	6.7108	106	C8H10
4.3	Peak #	Name	Similarity	R.T. (min:sec)	UniqueMass	S/N	Concentration	Conc. Units	Area	Area %	Weight	Formula
	14	Benzene	962	03:19.1	37	238.79	-13.2	ppb	3927830	24.295	78	C6H6

	39	Toluene	898	04:37.2	91	2804.3	288.55	ppb	8474878	52.421	92	C7H8
	65	o-Xylene	932	06:08.2	91	400.75	17.52	ppb	509192	3.1496	106	C8H10
	73	Ethylbenzene	913	06:47.7	91	612.05	12.32	ppb	801243	4.956	106	C8H10
5.1	Peak #	Name	Similarity	R.T. (min:sec)	UniqueMass	S/N	Concentration	Conc. Units	Area	Area %	Weight	Formula
	13	Benzene	962	03:19.4	50	1107.8	-8.64	ppb	4019101	30.263	78	C6H6
	33	Toluene	898	04:37.4	91	2485.3	255.23	ppb	7634592	57.488	92	C7H8
	57	o-Xylene	932	06:08.2	91	396.94	6.95	ppb	261419	1.9685	106	C8H10
	57	o-Xylene	932	06:08.2	91	396.94	7.27	ppb	261419	1.9685	106	C8H10
	66	Ethylbenzene	913	06:47.8	91	599.72	2.45	ppb	524947	3.9528	106	C8H10
5.2	Peak #	Name	Similarity	R.T. (min:sec)	UniqueMass	S/N	Concentration	Conc. Units	Area	Area %	Weight	Formula
	11	Benzene	962	03:19.0	38	296.43	-118.08	ppb	1829615	15.51	78	C6H6
	34	Toluene	898	04:37.2	91	2442.7	234.89	ppb	7121706	60.371	92	C7H8
	59	Benzene, 1,3-dimethyl-	932	06:02.4	91	147.63	7.5	ppb	274315	2.3254	106	C8H10
	61	o-Xylene	907	06:08.1	91	373.4	1.03	ppb	96673	0.8195	106	C8H10
	68	Ethylbenzene	913	06:47.7	91	579.1	13.75	ppb	841251	7.1313	106	C8H10
5.3	Peak #	Name	Similarity	R.T. (min:sec)	UniqueMass	S/N	Concentration	Conc. Units	Area	Area %	Weight	Formula
	13	Benzene	962	03:19.6	52	836.16	-71.42	ppb	2763030	18.969	78	C6H6
	36	Toluene	898	04:37.6	91	2426.2	271.98	ppb	8056977	55.314	92	C7H8
	59	Benzene, 1,3-dimethyl-	932	06:02.6	91	165.25	-0.79	ppb	79946	0.54886	106	C8H10
	60	o-Xylene	907	06:08.3	91	409.34	7.83	ppb	276431	1.8978	106	C8H10
	67	Ethylbenzene	913	06:47.9	91	625.39	13.15	ppb	824514	5.6606	106	C8H10
6.1	Peak #	Name	Similarity	R.T. (min:sec)	UniqueMass	S/N	Concentration	Conc. Units	Area	Area %	Weight	Formula
	13	Benzene	962	03:19.2	37	277.82	129	ppb	6772705	38.374	78	C6H6

	33	Toluene	898	04:37.2	91	2586.5	261.15	ppb	7784008	44.104	92	C7H8
	61	o-Xylene	932	06:08.2	91	398.64	8.2	ppb	290672	1.6469	106	C8H10
	69	Ethylbenzene	913	06:47.7	91	630.39	11.76	ppb	785610	4.4512	106	C8H10
6.2	Peak #	Name	Similarity	R.T. (min:sec)	UniqueMass	S/N	Concentration	Conc. Units	Area	Area %	Weight	Formula
	13	Benzene	962	03:19.4	52	835.39	-0.95	ppb	4172922	28.001	78	C6H6
	30	Toluene	898	04:37.4	91	2355.4	252.7	ppb	7570847	50.801	92	C7H8
	54	Benzene, 1,3-dimethyl-	932	06:02.5	91	146.48	-0.65	ppb	83347	0.55926	106	C8H10
	55	o-Xylene	907	06:08.3	91	387.75	12.97	ppb	412115	2.7653	106	C8H10
	64	Ethylbenzene	913	06:47.8	91	606.87	10.17	ppb	741083	4.9727	106	C8H10
6.3	Peak #	Name	Similarity	R.T. (min:sec)	UniqueMass	S/N	Concentration	Conc. Units	Area	Area %	Weight	Formula
	14	Benzene	962	03:19.5	52	861.95	-123.76	ppb	1715927	13.556	78	C6H6
	39	Toluene	898	04:37.5	91	2528.3	267.66	ppb	7948118	62.79	92	C7H8
	63	Benzene, 1,3-dimethyl-	932	06:02.6	91	160.73	-0.15	ppb	95097	0.75126	106	C8H10
	64	o-Xylene	907	06:08.3	91	413.54	13.87	ppb	435898	3.4436	106	C8H10
	72	Ethylbenzene	913	06:47.9	91	630.01	5.09	ppb	598642	4.7293	106	C8H10
7.1	Peak #	Name	Similarity	R.T. (min:sec)	UniqueMass	S/N	Concentration	Conc. Units	Area	Area %	Weight	Formula
	13	Benzene	962	03:19.7	52	857.12	-78.16	ppb	2628278	17.973	78	C6H6
	38	Toluene	898	04:37.6	91	2706.5	288.69	ppb	8478442	57.977	92	C7H8
	66	Benzene, 1,3-dimethyl-	932	06:02.6	91	201.36	6.25	ppb	244933	1.6749	106	C8H10
	67	o-Xylene	907	06:08.3	91	487.55	18.69	ppb	563216	3.8514	106	C8H10
	75	Ethylbenzene	913	06:47.9	91	732.69	21.48	ppb	1057570	7.2319	106	C8H10
7.2	Peak #	Name	Similarity	R.T. (min:sec)	UniqueMass	S/N	Concentration	Conc. Units	Area	Area %	Weight	Formula
	12	Benzene	962	03:19.4	78	4075.6	-21.21	ppb	3767674	26.008	78	C6H6
	33	Toluene	898	04:37.6	91	3079.2	253.93	ppb	7601923	52.475	92	C7H8

	58	Benzene, 1,3-dimethyl-	932	06:02.6	91	184.32	2.62	ppb	159857	1.1035	106	C8H10
	59	o-Xylene	907	06:08.3	91	482.19	26.86	ppb	779074	5.3778	106	C8H10
	67	Ethylbenzene	913	06:47.8	91	688.49	12.62	ppb	809518	5.588	106	C8H10
7.3	Peak #	Name	Similarity	R.T. (min:sec)	UniqueMass	S/N	Concentration	Conc. Units	Area	Area %	Weight	Formula
	10	Benzene	962	03:19.4	52	866.53	11.98	ppb	4431503	28.767	78	C6H6
	36	Toluene	898	04:37.4	91	2785.8	263.77	ppb	7850003	50.959	92	C7H8
	64	Benzene, 1,3-dimethyl-	932	06:02.4	91	178.46	-0.36	ppb	90139	0.58514	106	C8H10
	65	o-Xylene	907	06:08.3	106	147.37	15.52	ppb	479461	3.1124	106	C8H10
	71	Ethylbenzene	913	06:47.8	91	681.81	6	ppb	624264	4.0524	106	C8H10
8.1	Peak #	Name	Similarity	R.T. (min:sec)	UniqueMass	S/N	Concentration	Conc. Units	Area	Area %	Weight	Formula
	14	Benzene	962	03:19.2	52	1107.8	20.72	ppb	4606512	30.619	78	C6H6
	36	Toluene	898	04:37.5	91	2702.6	246.69	ppb	7419450	49.316	92	C7H8
	61	Benzene, 1,3-dimethyl-	932	06:02.6	91	153.44	2.52	ppb	157643	1.0478	106	C8H10
	62	o-Xylene	907	06:08.3	91	387.87	15.25	ppb	472362	3.1397	106	C8H10
	70	Ethylbenzene	913	06:47.9	91	629.95	7.63	ppb	669872	4.4525	106	C8H10
8.2	Peak #	Name	Similarity	R.T. (min:sec)	UniqueMass	S/N	Concentration	Conc. Units	Area	Area %	Weight	Formula
	13	Benzene	962	03:19.1	78	3851.8	16.09	ppb	4513736	32.053	78	C6H6
	35	Toluene	898	04:37.4	91	2806.9	243.95	ppb	7350358	52.197	92	C7H8
	61	o-Xylene	932	06:08.2	91	374.46	15.54	ppb	462635	3.2853	106	C8H10
	67	Ethylbenzene	913	06:47.8	91	644.56	5.17	ppb	600934	4.2674	106	C8H10
8.3	Peak #	Name	Similarity	R.T. (min:sec)	UniqueMass	S/N	Concentration	Conc. Units	Area	Area %	Weight	Formula
	14	Benzene	962	03:21.0	78	4561.9	-9.78	ppb	3996233	25.898	78	C6H6
	43	Toluene	898	04:38.6	91	3621.4	275.15	ppb	8136909	52.733	92	C7H8
	69	Benzene, 1,3-	932	06:02.9	91	177.15	7.07	ppb	264169	1.712	106	C8H10

		dimethyl-										
	70	o-Xylene	907	06:08.6	91	457.42	16.6	ppb	507975	3.292	106	C8H10
	78	Ethylbenzene	913	06:48.1	91	726.36	21.44	ppb	1056591	6.8474	106	C8H10
9.1	Peak #	Name	Similarity	R.T. (min:sec)	UniqueMass	S/N	Concentration	Conc. Units	Area	Area %	Weight	Formula
	15	Benzene	962	03:19.2	78	4196.3	84.85	ppb	5889372	33.103	78	C6H6
	36	Toluene	898	04:37.5	91	3117.5	255.09	ppb	7631205	42.893	92	C7H8
	65	o-Xylene	932	06:08.2	91	451.02	17.93	ppb	518650	2.9152	106	C8H10
	71	Ethylbenzene	913	06:47.8	91	727.98	31.78	ppb	1346025	7.5656	106	C8H10
9.2	Peak #	Name	Similarity	R.T. (min:sec)	UniqueMass	S/N	Concentration	Conc. Units	Area	Area %	Weight	Formula
	11	Benzene	962	03:19.1	77	889.87	29.28	ppb	4777736	31.233	78	C6H6
	34	Toluene	898	04:37.2	91	2751.8	256.53	ppb	7667364	50.122	92	C7H8
	61	Benzene, 1,3-dimethyl-	932	06:02.5	91	164.04	-0.44	ppb	88229	0.57676	106	C8H10
	62	o-Xylene	907	06:08.2	91	418.63	9.88	ppb	330354	2.1596	106	C8H10
	68	Ethylbenzene	913	06:47.8	91	684.39	11.08	ppb	766452	5.0104	106	C8H10
9.3	Peak #	Name	Similarity	R.T. (min:sec)	UniqueMass	S/N	Concentration	Conc. Units	Area	Area %	Weight	Formula
	12	Benzene	962	03:20.0	78	4594.5	4.51	ppb	4282181	28.307	78	C6H6
	34	Toluene	898	04:38.1	91	3446.5	262.42	ppb	7816028	51.667	92	C7H8
	61	Benzene, 1,3-dimethyl-	932	06:02.7	91	183.42	-0.34	ppb	90543	0.59853	106	C8H10
	62	o-Xylene	907	06:08.4	91	480.98	9.33	ppb	315911	2.0883	106	C8H10
	69	Ethylbenzene	913	06:47.9	91	763.28	6.05	ppb	625585	4.1354	106	C8H10
10.1	Peak #	Name	Similarity	R.T. (min:sec)	UniqueMass	S/N	Concentration	Conc. Units	Area	Area %	Weight	Formula
	13	Benzene	962	03:19.2	61	39.481	-11.81	ppb	3955695	23.666	78	C6H6
	35	Toluene	898	04:37.3	91	2531	337.55	ppb	9710323	58.094	92	C7H8

	60	o-Xylene	932	06:08.2	91	478.31	5.63	ppb	230403	1.3784	106	C8H10
	68	Ethylbenzene	913	06:47.8	91	637.34	11.94	ppb	790568	4.7297	106	C8H10
10.2	Peak #	Name	Similarity	R.T. (min:sec)	UniqueMass	S/N	Concentration	Conc. Units	Area	Area %	Weight	Formula
	11	Benzene	962	03:19.8	78	3945.9	-11.39	ppb	3964001	23.928	78	C6H6
	38	Toluene	898	04:37.8	91	3056.1	338.43	ppb	9732655	58.75	92	C7H8
	64	Benzene, 1,3-dimethyl-	932	06:02.8	91	211.29	-1.12	ppb	72401	0.43704	106	C8H10
	65	o-Xylene	907	06:08.4	91	550.41	8.11	ppb	283775	1.713	106	C8H10
	74	Ethylbenzene	913	06:47.9	91	700.89	2.63	ppb	529798	3.198	106	C8H10
10.3	Peak #	Name	Similarity	R.T. (min:sec)	UniqueMass	S/N	Concentration	Conc. Units	Area	Area %	Weight	Formula
	11	Benzene	962	03:19.4	50	998.02	-135.81	ppb	1474854	10.122	78	C6H6
	32	Toluene	898	04:37.4	91	2307.4	345.79	ppb	9918235	68.072	92	C7H8
	59	o-Xylene	932	06:08.2	91	478.55	14.83	ppb	446084	3.0616	106	C8H10
	59	o-Xylene	932	06:08.2	91	478.55	14.26	ppb	446084	3.0616	106	C8H10
	68	Ethylbenzene	913	06:47.8	91	627.5	6.27	ppb	631715	4.3357	106	C8H10
11.1	Peak #	Name	Similarity	R.T. (min:sec)	UniqueMass	S/N	Concentration	Conc. Units	Area	Area %	Weight	Formula
	13	Benzene	962	03:19.7	62	53.882	5.61	ppb	4304252	24.733	78	C6H6
	39	Toluene	898	04:37.9	91	3118.1	341.47	ppb	9809319	56.365	92	C7H8
	68	Benzene, 1,3-dimethyl-	932	06:02.7	91	207.65	-0.47	ppb	87424	0.50235	106	C8H10
	69	o-Xylene	907	06:08.4	91	526.93	26.17	ppb	760866	4.372	106	C8H10
	80	Ethylbenzene	913	06:48.0	91	696.35	12.41	ppb	803786	4.6186	106	C8H10
11.2	Peak #	Name	Similarity	R.T. (min:sec)	UniqueMass	S/N	Concentration	Conc. Units	Area	Area %	Weight	Formula
	13	Benzene	962	03:19.5	78	3535.9	-14.85	ppb	3894775	22.997	78	C6H6
	40	Toluene	898	04:37.6	91	2620.1	290.1	ppb	8513833	50.271	92	C7H8
	64	Benzene, 1,3-dimethyl-	932	06:02.6	91	148.45	15.18	ppb	454169	2.6817	106	C8H10

	66	o-Xylene	907	06:08.3	91	390.94	22.67	ppb	668212	3.9456	106	C8H10
	74	Ethylbenzene	913	06:47.8	91	516.43	21.8	ppb	1066720	6.2986	106	C8H10
11.3	Peak #	Name	Similarity	R.T. (min:sec)	UniqueMass	S/N	Concentration	Conc. Units	Area	Area %	Weight	Formula
	14	Benzene	962	03:19.4	79	152.49	-118.26	ppb	1825883	13.026	78	C6H6
	40	Toluene	898	04:37.4	91	2416.3	329.1	ppb	9497372	67.757	92	C7H8
	68	Benzene, 1,3-dimethyl-	932	06:02.5	91	184.08	-2.18	ppb	47396	0.33814	106	C8H10
	69	o-Xylene	907	06:08.3	91	453.07	12.42	ppb	397487	2.8358	106	C8H10
	77	Ethylbenzene	913	06:47.9	91	612.43	13.82	ppb	843310	6.0164	106	C8H10
12.1	Peak #	Name	Similarity	R.T. (min:sec)	UniqueMass	S/N	Concentration	Conc. Units	Area	Area %	Weight	Formula
	13	Benzene	962	03:19.7	50	1127.6	-43.13	ppb	3329147	20.784	78	C6H6
	38	Toluene	898	04:37.6	91	2516	319.69	ppb	9260161	57.811	92	C7H8
	65	o-Xylene	932	06:08.4	91	465.37	18.48	ppb	531623	3.3189	106	C8H10
	74	Ethylbenzene	913	06:47.9	91	636.95	14.69	ppb	867704	5.417	106	C8H10
12.2	Peak #	Name	Similarity	R.T. (min:sec)	UniqueMass	S/N	Concentration	Conc. Units	Area	Area %	Weight	Formula
	12	Benzene	962	03:19.7	50	1105.2	-23.94	ppb	3712891	22.556	78	C6H6
	40	Toluene	898	04:37.6	91	2493.6	312.86	ppb	9087850	55.209	92	C7H8
	67	o-Xylene	932	06:08.3	91	450.84	12.84	ppb	399347	2.426	106	C8H10
	74	Ethylbenzene	913	06:48.0	91	622.86	13.02	ppb	820686	4.9857	106	C8H10
12.3	Peak #	Name	Similarity	R.T. (min:sec)	UniqueMass	S/N	Concentration	Conc. Units	Area	Area %	Weight	Formula
	12	Benzene	962	03:19.7	52	760.24	-84.8	ppb	2495372	18.835	78	C6H6
	35	Toluene	898	04:37.6	91	2472.4	310.06	ppb	9017376	68.062	92	C7H8
	63	Benzene, 1,3-dimethyl-	932	06:02.6	91	183.42	7.08	ppb	264335	1.9952	106	C8H10
	64	o-Xylene	907	06:08.3	91	464.22	12.66	ppb	403992	3.0493	106	C8H10
	72	Ethylbenzene	913	06:47.9	91	636.32	4.85	ppb	592057	4.4688	106	C8H10

13.1	Peak #	Name	Similarity	R.T. (min:sec)	UniqueMass	S/N	Concentration	Conc. Units	Area	Area %	Weight	Formula
	14	Benzene	962	03:19.8	78	4005.5	-21.04	ppb	3770911	25.62	78	C6H6
	37	Toluene	898	04:37.9	91	2998.2	282.15	ppb	8313404	56.481	92	C7H8
	61	Benzene, 1,3-dimethyl-	932	06:02.7	91	161.13	3.34	ppb	176746	1.2008	106	C8H10
	62	o-Xylene	907	06:08.4	91	402.52	10.21	ppb	339043	2.3034	106	C8H10
	69	Ethylbenzene	913	06:47.9	91	647.56	7.54	ppb	667313	4.5337	106	C8H10
13.2	Peak #	Name	Similarity	R.T. (min:sec)	UniqueMass	S/N	Concentration	Conc. Units	Area	Area %	Weight	Formula
	15	Benzene	962	03:20.3	52	839.21	-163.79	ppb	915101	7.0151	78	C6H6
	41	Toluene	898	04:37.9	91	2652.6	304.37	ppb	8873763	68.025	92	C7H8
	70	Benzene, 1,3-dimethyl-	932	06:02.8	91	164.2	-0.33	ppb	90849	0.69644	106	C8H10
	71	o-Xylene	907	06:08.5	91	405.2	20.91	ppb	621712	4.766	106	C8H10
	77	Ethylbenzene	913	06:48.0	91	664.05	12.6	ppb	808962	6.2014	106	C8H10
13.3	Peak #	Name	Similarity	R.T. (min:sec)	UniqueMass	S/N	Concentration	Conc. Units	Area	Area %	Weight	Formula
	12	Benzene	962	03:18.1	37	215.49	-115.09	ppb	1889321	14.873	78	C6H6
	32	Toluene	898	04:36.4	91	2213.1	262.78	ppb	7825102	61.599	92	C7H8
	57	Benzene, 1,3-dimethyl-	932	06:02.0	91	130.17	4.38	ppb	201161	1.5835	106	C8H10
	58	o-Xylene	907	06:07.7	91	325.42	6.8	ppb	249212	1.9618	106	C8H10
	65	Ethylbenzene	913	06:47.4	91	534.53	4.17	ppb	573106	4.5115	106	C8H10
14.1	Peak #	Name	Similarity	R.T. (min:sec)	UniqueMass	S/N	Concentration	Conc. Units	Area	Area %	Weight	Formula
	15	Benzene	962	03:19.7	52	905	-49.93	ppb	3193067	19.279	78	C6H6
	35	Toluene	898	04:37.5	91	3006.4	360.71	ppb	10294513	62.156	92	C7H8
	59	Benzene, 1,3-dimethyl-	932	06:02.4	91	217.45	2.5	ppb	157196	0.94911	106	C8H10

	60	o-Xylene	907	06:08.2	91	546.61	23.31	ppb	685228	4.1373	106	C8H10
	70	Ethylbenzene	913	06:47.8	91	791.42	-1.32	ppb	419164	2.5308	106	C8H10
14.2	Peak #	Name	Similarity	R.T. (min:sec)	UniqueMass	S/N	Concentration	Conc. Units	Area	Area %	Weight	Formula
	14	Benzene	962	03:19.8	52	961.44	-78.43	ppb	2622894	14.715	78	C6H6
	36	Toluene	898	04:37.6	91	3046.8	389.59	ppb	11022632	61.838	92	C7H8
	64	Benzene, 1,3-dimethyl-	932	06:02.6	91	207.79	3.2	ppb	173562	0.9737	106	C8H10
	66	o-Xylene	907	06:08.3	91	532.76	16.73	ppb	511526	2.8697	106	C8H10
	76	Ethylbenzene	913	06:47.9	91	840.58	11.87	ppb	788601	4.4241	106	C8H10
14.3	Peak #	Name	Similarity	R.T. (min:sec)	UniqueMass	S/N	Concentration	Conc. Units	Area	Area %	Weight	Formula
	15	Benzene	962	03:20.7	52	1096.1	7.77	ppb	4347450	21.996	78	C6H6
	41	Toluene	898	04:38.3	91	3146.8	405.88	ppb	11433285	57.848	92	C7H8
	66	Benzene, 1,3-dimethyl-	932	06:03.0	91	216.66	4.74	ppb	209526	1.0601	106	C8H10
	67	o-Xylene	907	06:08.6	91	543.77	20.09	ppb	600253	3.037	106	C8H10
	77	Ethylbenzene	913	06:48.1	91	853.61	21.19	ppb	1049537	5.3103	106	C8H10
15.1	Peak #	Name	Similarity	R.T. (min:sec)	UniqueMass	S/N	Concentration	Conc. Units	Area	Area %	Weight	Formula
	11	Benzene	962	03:19.2	52	893.01	-93.5	ppb	2321319	10.413	78	C6H6
	46	Toluene	898	04:37.2	91	3504.4	581.29	ppb	15856403	71.126	92	C7H8
	74	Benzene, 1,3-dimethyl-	932	06:02.5	91	291.91	0.02	ppb	98973	0.44396	106	C8H10
	75	o-Xylene	907	06:08.2	91	727.21	26.62	ppb	772544	3.4654	106	C8H10
	86	Ethylbenzene	913	06:47.8	91	879.44	19.8	ppb	1010590	4.5332	106	C8H10
15.2	Peak #	Name	Similarity	R.T. (min:sec)	UniqueMass	S/N	Concentration	Conc. Units	Area	Area %	Weight	Formula
	12	Benzene	962	03:20.2	52	1038.4	-48.62	ppb	3219254	12.449	78	C6H6
	43	Toluene	898	04:38.0	91	3824.4	659.73	ppb	17834344	68.969	92	C7H8
	72	Benzene, 1,3-	932	06:02.8	91	302.21	10.14	ppb	336093	1.2997	106	C8H10

		dimethyl-										
	73	o-Xylene	907	06:08.5	91	745.37	29.42	ppb	846684	3.2743	106	C8H10
	85	Ethylbenzene	913	06:48.0	91	944.71	21.91	ppb	1069731	4.1369	106	C8H10
15.3	Peak #	Name	Similarity	R.T. (min:sec)	UniqueMass	S/N	Concentration	Conc. Units	Area	Area %	Weight	Formula
	13	Benzene	962	03:19.7	63	268.38	26.78	ppb	4727625	16.313	78	C6H6
	44	Toluene	898	04:37.5	91	4048	723.67	ppb	19446578	67.101	92	C7H8
	73	Benzene, 1,3-dimethyl-	932	06:02.5	91	318.65	1.31	ppb	129202	0.44582	106	C8H10
	74	o-Xylene	907	06:08.2	91	790.14	27.16	ppb	787016	2.7156	106	C8H10
	85	Ethylbenzene	913	06:47.8	91	958.49	21.58	ppb	1060539	3.6594	106	C8H10
16.1	Peak #	Name	Similarity	R.T. (min:sec)	UniqueMass	S/N	Concentration	Conc. Units	Area	Area %	Weight	Formula
	15	Benzene	962	03:19.6	78	4540	78.11	ppb	5754642	20.595	78	C6H6
	47	Toluene	898	04:37.6	91	4433.6	626.92	ppb	17006878	60.866	92	C7H8
	83	Benzene, 1,3-dimethyl-	932	06:02.6	91	318.66	19.25	ppb	549537	1.9668	106	C8H10
	84	o-Xylene	907	06:08.3	91	745.13	28.89	ppb	832573	2.9797	106	C8H10
	95	Ethylbenzene	913	06:47.8	91	967.23	14.13	ppb	851842	3.0487	106	C8H10
16.2	Peak #	Name	Similarity	R.T. (min:sec)	UniqueMass	S/N	Concentration	Conc. Units	Area	Area %	Weight	Formula
	13	Benzene	962	03:19.8	78	4712.5	62.21	ppb	5436595	19.94	78	C6H6
	48	Toluene	898	04:37.7	91	4799.9	624.22	ppb	16938906	62.128	92	C7H8
	82	Benzene, 1,3-dimethyl-	932	06:02.6	91	325.28	1.31	ppb	129358	0.47446	106	C8H10
	83	o-Xylene	907	06:08.3	91	765.76	30.43	ppb	873294	3.2031	106	C8H10
	95	Ethylbenzene	913	06:47.8	91	967.37	28.78	ppb	1262251	4.6297	106	C8H10
16.3	Peak #	Name	Similarity	R.T. (min:sec)	UniqueMass	S/N	Concentration	Conc. Units	Area	Area %	Weight	Formula
	12	Benzene	962	03:19.8	78	4305.8	69.43	ppb	5580956	19.731	78	C6H6
	49	Toluene	898	04:37.7	91	4363.2	679.83	ppb	18341147	64.845	92	C7H8

	81	Benzene, 1,3-dimethyl-	932	06:02.6	91	335.78	4	ppb	192335	0.68	106	C8H10
	82	o-Xylene	907	06:08.3	91	776.9	24.53	ppb	717353	2.5362	106	C8H10
	91	Ethylbenzene	913	06:47.9	91	983.66	30.17	ppb	1301090	4.6	106	C8H10
17.1	Peak #	Name	Similarity	R.T. (min:sec)	UniqueMass	S/N	Concentration	Conc. Units	Area	Area %	Weight	Formula
	12	Benzene	962	03:19.6	78	4950.5	46.23	ppb	5116778	19.594	78	C6H6
	42	Toluene	898	04:37.7	91	4476.3	589.58	ppb	16065391	61.519	92	C7H8
	75	Benzene, 1,3-dimethyl-	932	06:02.6	91	287.1	4.1	ppb	194656	0.7454	106	C8H10
	76	o-Xylene	907	06:08.3	91	692.84	24.69	ppb	721695	2.7636	106	C8H10
	87	Ethylbenzene	913	06:47.8	91	939.25	25.59	ppb	1172849	4.4912	106	C8H10
17.2	Peak #	Name	Similarity	R.T. (min:sec)	UniqueMass	S/N	Concentration	Conc. Units	Area	Area %	Weight	Formula
	17	Benzene	962	03:20.4	78	5167.8	94.38	ppb	6080188	24.079	78	C6H6
	50	Toluene	898	04:38.2	91	5283.1	566.91	ppb	15493868	61.359	92	C7H8
	82	Benzene, 1,3-dimethyl-	932	06:02.7	91	300.69	8.49	ppb	297579	1.1785	106	C8H10
	83	o-Xylene	907	06:08.4	91	752	23.54	ppb	691338	2.7378	106	C8H10
	93	Ethylbenzene	913	06:47.9	91	986.92	16.31	ppb	912974	3.6156	106	C8H10
17.3	Peak #	Name	Similarity	R.T. (min:sec)	UniqueMass	S/N	Concentration	Conc. Units	Area	Area %	Weight	Formula
	15	Benzene	962	03:20.4	78	4903	96.17	ppb	6115915	21.034	78	C6H6
	47	Toluene	898	04:38.2	91	5134.5	679.03	ppb	18320913	63.011	92	C7H8
	77	Benzene, 1,3-dimethyl-	932	06:02.7	91	305.05	14.47	ppb	437708	1.5054	106	C8H10
	79	o-Xylene	907	06:08.4	91	725.65	24.44	ppb	715038	2.4592	106	C8H10
	91	Ethylbenzene	913	06:47.9	91	986.05	21.78	ppb	1066076	3.6665	106	C8H10
18.1	Peak #	Name	Similarity	R.T. (min:sec)	UniqueMass	S/N	Concentration	Conc. Units	Area	Area %	Weight	Formula

	13	Benzene	962	03:21.0	78	4851	135.32	ppb	6899190	27.756	78	C6H6
	43	Toluene	898	04:38.4	91	4614.5	555.68	ppb	15210630	61.194	92	C7H8
	72	Benzene, 1,3-dimethyl-	932	06:02.8	91	225.84	26.21	ppb	712613	2.8669	106	C8H10
	73	o-Xylene	907	06:08.4	91	566.74	22.94	ppb	675482	2.7175	106	C8H10
	83	Ethylbenzene	913	06:47.9	91	785.91	8.51	ppb	694592	2.7944	106	C8H10
18.2	Peak #	Name	Similarity	R.T. (min:sec)	UniqueMass	S/N	Concentration	Conc. Units	Area	Area %	Weight	Formula
	15	Benzene	962	03:20.1	78	4990.2	111.98	ppb	6432199	23.323	78	C6H6
	46	Toluene	898	04:37.8	91	5120.9	604.02	ppb	16429456	59.573	92	C7H8
	78	Benzene, 1,3-dimethyl-	932	06:02.5	91	294.06	6.58	ppb	252771	0.91655	106	C8H10
	79	o-Xylene	907	06:08.2	91	732.04	25.44	ppb	741422	2.6884	106	C8H10
	90	Ethylbenzene	913	06:47.8	91	1029.2	29.34	ppb	1277765	4.6332	106	C8H10
18.3	Peak #	Name	Similarity	R.T. (min:sec)	UniqueMass	S/N	Concentration	Conc. Units	Area	Area %	Weight	Formula
	13	Benzene	962	03:20.3	78	5030.1	93.83	ppb	6069086	21.769	78	C6H6
	39	Toluene	898	04:38.0	91	5161.4	640.55	ppb	17350650	62.234	92	C7H8
	73	Benzene, 1,3-dimethyl-	932	06:02.7	91	305.45	2.85	ppb	165227	0.59264	106	C8H10
	74	o-Xylene	907	06:08.3	91	743.65	32.56	ppb	929638	3.3344	106	C8H10
	85	Ethylbenzene	913	06:47.8	91	1022.6	18.4	ppb	971514	3.4846	106	C8H10
19.1	Peak #	Name	Similarity	R.T. (min:sec)	UniqueMass	S/N	Concentration	Conc. Units	Area	Area %	Weight	Formula
	13	Benzene	962	03:19.9	78	4703	84.55	ppb	5883385	25.506	78	C6H6
	35	Toluene	898	04:37.7	91	4723.8	466.6	ppb	12964396	56.203	92	C7H8
	64	Benzene, 1,3-dimethyl-	932	06:02.5	91	283.84	3.44	ppb	179171	0.77674	106	C8H10
	65	o-Xylene	907	06:08.3	91	717.92	27.95	ppb	807810	3.502	106	C8H10
	75	Ethylbenzene	913	06:47.8	91	898.55	26.82	ppb	1207136	5.2331	106	C8H10
19.2	Peak #	Name	Similarity	R.T.	UniqueMass	S/N	Concentration	Conc.	Area	Area %	Weight	Formula

				(min:sec)				Units				
	15	Benzene	962	03:20.6	52	1150.3	-35.42	ppb	3483277	17.324	78	C6H6
	45	Toluene	898	04:38.1	91	4277.3	495.41	ppb	13690907	68.092	92	C7H8
	75	Benzene, 1,3-dimethyl-	932	06:02.7	91	292.04	0.05	ppb	99691	0.49582	106	C8H10
	76	o-Xylene	907	06:08.4	91	730.38	17.67	ppb	536170	2.6667	106	C8H10
	86	Ethylbenzene	913	06:47.9	91	946.11	27.54	ppb	1227390	6.1044	106	C8H10
19.3	Peak #	Name	Similarity	R.T. (min:sec)	UniqueMass	S/N	Concentration	Conc. Units	Area	Area %	Weight	Formula
	14	Benzene	962	03:19.7	78	4710.1	104.34	ppb	6279474	26.134	78	C6H6
	41	Toluene	898	04:37.5	91	4715.3	509.13	ppb	14036745	58.419	92	C7H8
	73	Benzene, 1,3-dimethyl-	932	06:02.5	91	298.05	13.03	ppb	403765	1.6804	106	C8H10
	75	o-Xylene	907	06:08.2	91	723.5	45.37	ppb	1267883	5.2767	106	C8H10
	86	Ethylbenzene	913	06:47.7	91	907.78	6.39	ppb	635184	2.6435	106	C8H10
20.1	Peak #	Name	Similarity	R.T. (min:sec)	UniqueMass	S/N	Concentration	Conc. Units	Area	Area %	Weight	Formula
	15	Benzene	962	03:20.1	52	1227.8	-18.47	ppb	3822348	17.28	78	C6H6
	44	Toluene	898	04:37.8	91	3989.7	484.56	ppb	13417221	60.655	92	C7H8
	75	Benzene, 1,3-dimethyl-	932	06:02.6	91	252.19	2.35	ppb	153650	0.69461	106	C8H10
	76	o-Xylene	907	06:08.3	91	621.3	21.75	ppb	644134	2.9119	106	C8H10
	89	Ethylbenzene	913	06:47.8	91	1019.9	26.03	ppb	1185140	5.3577	106	C8H10
20.2	Peak #	Name	Similarity	R.T. (min:sec)	UniqueMass	S/N	Concentration	Conc. Units	Area	Area %	Weight	Formula
	15	Benzene	962	03:19.4	78	4958.1	87.01	ppb	5932741	24.028	78	C6H6
	41	Toluene	898	04:37.4	91	4470.9	537.36	ppb	14748781	59.734	92	C7H8
	73	Benzene, 1,3-dimethyl-	932	06:02.5	91	261.55	-0.93	ppb	76649	0.31043	106	C8H10
	74	o-Xylene	907	06:08.2	91	662.93	16.19	ppb	497174	2.0136	106	C8H10
	84	Ethylbenzene	913	06:47.8	91	1052.3	37.06	ppb	1493912	6.0505	106	C8H10

	115	Styrene	908	07:53.7	104	913.61	613.55	ppb	1941569	7.8635	104	C8H8
20.3	Peak #	Name	Similarity	R.T. (min:sec)	UniqueMass	S/N	Concentration	Conc. Units	Area	Area %	Weight	Formula
	14	Benzene	962	03:19.8	52	1189.8	-104.64	ppb	2098386	9.0973	78	C6H6
	46	Toluene	898	04:37.6	91	4195.7	586.15	ppb	15978893	69.275	92	C7H8
	77	Benzene, 1,3-dimethyl-	932	06:02.5	91	259.45	-1.24	ppb	69400	0.30088	106	C8H10
	78	o-Xylene	907	06:08.2	91	641.11	24.65	ppb	720689	3.1245	106	C8H10
	91	Ethylbenzene	913	06:47.8	91	1038.1	45.29	ppb	1724519	7.4765	106	C8H10
21.1	Peak #	Name	Similarity	R.T. (min:sec)	UniqueMass	S/N	Concentration	Conc. Units	Area	Area %	Weight	Formula
	11	Benzene	962	03:19.7	63	287.33	33.47	ppb	4861531	21.064	78	C6H6
	42	Toluene	898	04:37.5	91	3909.4	464.43	ppb	12909803	55.935	92	C7H8
	69	o-Xylene	932	06:08.1	91	528.65	25.82	ppb	703506	3.0481	106	C8H10
	78	Ethylbenzene	913	06:47.7	91	920.5	42.13	ppb	1635836	7.0877	106	C8H10
21.2	Peak #	Name	Similarity	R.T. (min:sec)	UniqueMass	S/N	Concentration	Conc. Units	Area	Area %	Weight	Formula
	14	Benzene	962	03:20.9	78	4263.7	53.97	ppb	5271657	23.317	78	C6H6
	42	Toluene	898	04:36.4	111	43.215	457.43	ppb	12733246	56.32	92	C7H8
	77	Benzene, 1,3-dimethyl-	932	06:02.9	106	84.198	4.14	ppb	195531	0.86485	106	C8H10
	78	o-Xylene	907	06:08.5	91	563.45	14.9	ppb	463176	2.0487	106	C8H10
	87	Ethylbenzene	913	06:48.0	91	949	17.44	ppb	944545	4.1778	106	C8H10
21.3	Peak #	Name	Similarity	R.T. (min:sec)	UniqueMass	S/N	Concentration	Conc. Units	Area	Area %	Weight	Formula
	13	Benzene	962	03:21.2	52	1379.8	90.58	ppb	6004090	26.182	78	C6H6
	46	Toluene	898	04:38.5	92	2992.3	430.91	ppb	12064617	52.609	92	C7H8
	75	Benzene, 1,3-dimethyl-	932	06:03.0	91	237.25	5.41	ppb	225224	0.98212	106	C8H10
	76	o-Xylene	907	06:08.6	91	567.95	34.8	ppb	988685	4.3113	106	C8H10
	88	Ethylbenzene	913	06:48.0	91	982.85	19.14	ppb	992174	4.3265	106	C8H10

	111	Styrene	908	07:53.9	104	1055.4	938.3	ppb	2657657	11.589	104	C8H8
22.1	Peak #	Name	Similarity	R.T. (min:sec)	UniqueMass	S/N	Concentration	Conc. Units	Area	Area %	Weight	Formula
	11	Benzene	962	03:19.5	52	825.7	-127.06	ppb	1649917	13.115	78	C6H6
	28	Toluene	898	04:37.3	91	2827.2	289.76	ppb	8505388	67.61	92	C7H8
	53	Benzene, 1,3-dimethyl-	932	06:02.3	91	178.82	-1.67	ppb	59475	0.47277	106	C8H10
	54	o-Xylene	907	06:08.1	91	463.87	10.03	ppb	334352	2.6578	106	C8H10
	61	Ethylbenzene	913	06:47.6	91	758.35	9.18	ppb	713240	5.6696	106	C8H10
22.2	Peak #	Name	Similarity	R.T. (min:sec)	UniqueMass	S/N	Concentration	Conc. Units	Area	Area %	Weight	Formula
	11	Benzene	962	03:18.8	52	794.42	-39.47	ppb	3402332	25.652	78	C6H6
	32	Toluene	898	04:36.9	91	2511.5	247.39	ppb	7437014	56.072	92	C7H8
	57	o-Xylene	932	06:08.0	91	401.04	14.25	ppb	432395	3.26	106	C8H10
	63	Ethylbenzene	913	06:47.5	91	645.2	-0.61	ppb	439011	3.3099	106	C8H10
22.3	Peak #	Name	Similarity	R.T. (min:sec)	UniqueMass	S/N	Concentration	Conc. Units	Area	Area %	Weight	Formula
	11	Benzene	962	03:18.2	52	759.15	-76.53	ppb	2660805	20.477	78	C6H6
	31	Toluene	898	04:36.4	91	2435.2	265.57	ppb	7895445	60.761	92	C7H8
	59	Benzene, 1,3-dimethyl-	932	06:07.7	106	113.62	9.18	ppb	313648	2.4137	106	C8H10
	60	o-Xylene	907	06:08.2	31	30.369	9.24	ppb	313648	2.4137	106	C8H10
	66	Ethylbenzene	913	06:47.4	91	600.63	5.56	ppb	611992	4.7097	106	C8H10
23.1	Peak #	Name	Similarity	R.T. (min:sec)	UniqueMass	S/N	Concentration	Conc. Units	Area	Area %	Weight	Formula
	12	Benzene	962	03:15.3	76	124.54	-88.66	ppb	2418144	23.326	78	C6H6
	29	Toluene	898	04:35.1	91	2024.4	162.04	ppb	5284945	50.98	92	C7H8
	51	Benzene, 1,3-dimethyl-	932	06:01.1	91	110.51	3.45	ppb	179322	1.7298	106	C8H10
	52	o-Xylene	907	06:06.9	91	267.42	4.82	ppb	196888	1.8992	106	C8H10

	58	Ethylbenzene	913	06:46.8	91	489.13	11.94	ppb	790590	7.6263	106	C8H10
23.2	Peak #	Name	Similarity	R.T. (min:sec)	UniqueMass	S/N	Concentration	Conc. Units	Area	Area %	Weight	Formula
	12	Benzene	962	03:17.0	77	666.97	-166.39	ppb	863122	10.825	78	C6H6
	30	Toluene	898	04:35.5	91	1907.4	144.8	ppb	4850239	60.828	92	C7H8
	54	Benzene, 1,3-dimethyl-	932	06:01.4	91	110.68	2.55	ppb	158385	1.9863	106	C8H10
	57	o-Xylene	907	06:07.8	31	24.341	2.71	ppb	140960	1.7678	106	C8H10
	62	Ethylbenzene	913	06:46.9	91	489.43	1.11	ppb	487185	6.1099	106	C8H10
23.3	Peak #	Name	Similarity	R.T. (min:sec)	UniqueMass	S/N	Concentration	Conc. Units	Area	Area %	Weight	Formula
	9	Benzene	962	03:16.9	78	3739.9	27.15	ppb	4735091	40.011	78	C6H6
	26	Toluene	898	04:35.6	91	2198.1	155.06	ppb	5108962	43.17	92	C7H8
	51	o-Xylene	932	06:07.1	91	263.8	3.82	ppb	188077	1.5892	106	C8H10
	58	Ethylbenzene	913	06:46.9	91	484.57	-6.83	ppb	264994	2.2391	106	C8H10
24.1	Peak #	Name	Similarity	R.T. (min:sec)	UniqueMass	S/N	Concentration	Conc. Units	Area	Area %	Weight	Formula
	11	Benzene	962	03:18.9	63	245.1	-14.02	ppb	3911439	22.018	78	C6H6
	28	Toluene	898	04:37.1	91	3013.1	366.21	ppb	10433026	58.729	92	C7H8
	51	Benzene, 1,3-dimethyl-	932	06:02.3	91	199.7	0.53	ppb	110868	0.62408	106	C8H10
	52	o-Xylene	907	06:08.0	91	520.2	16.21	ppb	497624	2.8012	106	C8H10
	60	Ethylbenzene	913	06:47.7	91	823.08	13.71	ppb	840156	4.7293	106	C8H10
24.2	Peak #	Name	Similarity	R.T. (min:sec)	UniqueMass	S/N	Concentration	Conc. Units	Area	Area %	Weight	Formula
	15	Benzene	962	03:18.7	78	3792.1	1.53	ppb	4222510	23.878	78	C6H6
	36	Toluene	898	04:37.1	91	3128.6	349.51	ppb	10011934	56.616	92	C7H8
	61	o-Xylene	932	06:08.1	91	530.78	11.86	ppb	376518	2.1292	106	C8H10
	61	o-Xylene	932	06:08.1	91	530.78	11.62	ppb	376518	2.1292	106	C8H10
	69	Ethylbenzene	913	06:47.7	91	820.81	6.7	ppb	643866	3.641	106	C8H10

24.3	Peak #	Name	Similarity	R.T. (min:sec)	UniqueMass	S/N	Concentration	Conc. Units	Area	Area %	Weight	Formula
	14	Benzene	962	03:19.8	78	4266.5	90.32	ppb	5998851	28.32	78	C6H6
	37	Toluene	898	04:37.7	91	3321	385.5	ppb	10919449	51.549	92	C7H8
	65	o-Xylene	932	06:08.4	91	567.73	30.71	ppb	818239	3.8628	106	C8H10
	74	Ethylbenzene	913	06:47.9	91	884.84	11.11	ppb	767435	3.623	106	C8H10

NOTE:
Sample 24 – Lab Blank
Samples 5 and 15 – Field Blanks

Table B2, Triplicate BTEX concentration (ppb) data per sample from field and lab analysis during the peak campaign

Sample no.	**Front Section**											
1.1	Peak #	Name	Similarity	R.T. (min:sec)	UniqueMass	S/N	Concentration	Conc. Units	Area	Area %	Weight	Formula
	9	Benzene	974	03:27.8	49	142.64	-54.45	ppb	4538190	67.063	78	C6H6
	20	Toluene	925	05:38.3	91	991.62	-33.97	ppb	11753	0.17369	92	C7H8
	48	m-Xylene	952	07:11.3	91	283.18	9.81	ppb	445264	6.5799	106	C8H10
	54	o-Xylene	955	07:40.4	91	571.64	8.24	ppb	881293	13.023	106	C8H10
1.2	Peak #	Name	Similarity	R.T. (min:sec)	UniqueMass	S/N	Concentration	Conc. Units	Area	Area %	Weight	Formula
		Ethylbenzene	952					ppb			106	C8H10
	11	Benzene	974	03:33.6	78	1837.3	167.09	ppb	14057839	78.08	78	C6H6
	24	Toluene	925	05:41.6	91	1689.4	43.57	ppb	2098093	11.653	92	C7H8
	52	m-Xylene	967	07:12.1	91	443.83	10.29	ppb	448588	2.4916	106	C8H10
	61	o-Xylene	955	07:41.0	91	829.85	10.35	ppb	951220	5.2833	106	C8H10
1.3	Peak #	Name	Similarity	R.T. (min:sec)	UniqueMass	S/N	Concentration	Conc. Units	Area	Area %	Weight	Formula
		Ethylbenzene	952					ppb			106	C8H10
	10	Benzene	974	03:34.9	78	1851.2	131.71	ppb	12537576	73.765	78	C6H6
	25	Toluene	925	05:42.4	91	1622.4	28.1	ppb	1681761	9.8946	92	C7H8
	52	m-Xylene	967	07:12.3	91	436.38	25.32	ppb	889611	5.234	106	C8H10
	60	o-Xylene	955	07:41.1	91	799.97	11.77	ppb	998191	5.8728	106	C8H10
2.1	Peak #	Name	Similarity	R.T. (min:sec)	UniqueMass	S/N	Concentration	Conc. Units	Area	Area %	Weight	Formula
		Ethylbenzene	952					ppb			106	C8H10
	10	Benzene	974	03:33.1	52	473.49	46.49	ppb	8875588	78.09	78	C6H6
	20	Toluene	925	05:41.1	91	984.35	2.05	ppb	980824	8.6295	92	C7H8

	45	m-Xylene	967	07:12.1	91	334.76	13.07	ppb	529955	4.6627	106	C8H10
	52	o-Xylene	955	07:41.0	91	527.47	-4.79	ppb	449570	3.9554	106	C8H10
2.2	Peak #	Name	Similarity	R.T. (min:sec)	UniqueMass	S/N	Concentration	Conc. Units	Area	Area %	Weight	Formula
		Ethylbenzene	952					ppb			106	C8H10
		p-Xylene	967					ppb			106	C8H10
		m-Xylene	964					ppb			106	C8H10
	11	Benzene	974	03:34.8	50	590.11	-115.04	ppb	1934506	55.922	78	C6H6
	19	Toluene	925	05:42.0	91	1187.4	3.17	ppb	1011111	29.229	92	C7H8
	48	o-Xylene	955	07:41.1	91	606.63	-2.85	ppb	513670	14.849	106	C8H10
2.3	Peak #	Name	Similarity	R.T. (min:sec)	UniqueMass	S/N	Concentration	Conc. Units	Area	Area %	Weight	Formula
		Ethylbenzene	952					ppb			106	C8H10
		p-Xylene	967					ppb			106	C8H10
		m-Xylene	964					ppb			106	C8H10
	10	Benzene	974	03:34.8	78	1377.1	42.11	ppb	8687529	80.875	78	C6H6
	19	Toluene	925	05:42.1	91	1235.2	19.47	ppb	1449622	13.495	92	C7H8
	51	o-Xylene	955	07:41.1	91	589.12	-0.1	ppb	604831	5.6305	106	C8H10
3.1	Peak #	Name	Similarity	R.T. (min:sec)	UniqueMass	S/N	Concentration	Conc. Units	Area	Area %	Weight	Formula
		Ethylbenzene	952					ppb			106	C8H10
	9	Benzene	974	03:33.9	78	1628.3	59.14	ppb	9419079	72.286	78	C6H6
	25	Toluene	925	05:41.6	91	1805.5	47.53	ppb	2204701	16.92	92	C7H8
	53	m-Xylene	967	07:12.1	91	358.6	11.88	ppb	495191	3.8003	106	C8H10
	62	o-Xylene	955	07:41.0	91	650.94	-5.8	ppb	416055	3.193	106	C8H10
3.2	Peak #	Name	Similarity	R.T. (min:sec)	UniqueMass	S/N	Concentration	Conc. Units	Area	Area %	Weight	Formula
		Ethylbenzene	952					ppb			106	C8H10
		p-Xylene	967					ppb			106	C8H10
		m-Xylene	964					ppb			106	C8H10

	11	Benzene	974	03:35.1	52	626.36	61.16	ppb	9506015	78.677	78	C6H6
	22	Toluene	925	05:42.1	91	1920.2	43.81	ppb	2104533	17.418	92	C7H8
	55	o-Xylene	955	07:41.0	91	694.24	-4.12	ppb	471715	3.9042	106	C8H10
3.3	Peak #	Name	Similarity	R.T. (min:sec)	UniqueMass	S/N	Concentration	Conc. Units	Area	Area %	Weight	Formula
		Ethylbenzene	952					ppb			106	C8H10
	10	Benzene	974	03:35.6	78	1649.1	61.76	ppb	9531741	74.617	78	C6H6
	22	Toluene	925	05:42.4	91	1781.8	45.91	ppb	2161101	16.918	92	C7H8
	48	m-Xylene	967	07:12.2	91	346.47	8.96	ppb	409420	3.205	106	C8H10
	57	o-Xylene	955	07:41.0	91	687.17	-10.43	ppb	262582	2.0556	106	C8H10
4.1	Peak #	Name	Similarity	R.T. (min:sec)	UniqueMass	S/N	Concentration	Conc. Units	Area	Area %	Weight	Formula
		Ethylbenzene	952					ppb			106	C8H10
		p-Xylene	967					ppb			106	C8H10
		m-Xylene	964					ppb			106	C8H10
	13	Benzene	974	03:35.3	78	1644.4	9.25	ppb	7275483	85.762	78	C6H6
	23	Toluene	925	05:42.1	91	1349.7	4.64	ppb	1050459	12.383	92	C7H8
	51	o-Xylene	955	07:41.0	91	466.89	-13.6	ppb	157436	1.8558	106	C8H10
4.2	Peak #	Name	Similarity	R.T. (min:sec)	UniqueMass	S/N	Concentration	Conc. Units	Area	Area %	Weight	Formula
		Ethylbenzene	952					ppb			106	C8H10
		p-Xylene	967					ppb			106	C8H10
		m-Xylene	964					ppb			106	C8H10
	11	Benzene	974	03:36.2	52	670.22	11.89	ppb	7388892	84.437	78	C6H6
	24	Toluene	925	05:42.7	91	1451.1	2.59	ppb	995369	11.375	92	C7H8
	53	o-Xylene	955	07:41.0	91	523.87	-7.3	ppb	366474	4.1879	106	C8H10
4.3	Peak #	Name	Similarity	R.T. (min:sec)	UniqueMass	S/N	Concentration	Conc. Units	Area	Area %	Weight	Formula
		Ethylbenzene	952					ppb			106	C8H10
		p-Xylene	967					ppb			106	C8H10

		m-Xylene	964					ppb			106	C8H10
	11	Benzene	974	03:36.1	50	753.64	11.58	ppb	7375590	84.144	78	C6H6
	21	Toluene	925	05:42.8	91	1397	3.53	ppb	1020684	11.644	92	C7H8
	50	o-Xylene	955	07:41.0	91	503.41	-7.21	ppb	369178	4.2117	106	C8H10
5.1	Peak #	Name	Similarity	R.T. (min:sec)	UniqueMass	S/N	Concentration	Conc. Units	Area	Area %	Weight	Formula
		Ethylbenzene	952					ppb			106	C8H10
		p-Xylene	967					ppb			106	C8H10
		m-Xylene	964					ppb			106	C8H10
	11	Benzene	974	03:34.9	78	1677.9	29.93	ppb	8163868	80.873	78	C6H6
	21	Toluene	925	05:42.0	91	1436.2	11.74	ppb	1241627	12.3	92	C7H8
	52	o-Xylene	955	07:41.0	91	539.75	2.44	ppb	689128	6.8267	106	C8H10
5.2	Peak #	Name	Similarity	R.T. (min:sec)	UniqueMass	S/N	Concentration	Conc. Units	Area	Area %	Weight	Formula
		Ethylbenzene	952					ppb			106	C8H10
		p-Xylene	967					ppb			106	C8H10
		m-Xylene	964					ppb			106	C8H10
	9	Benzene	974	03:35.1	52	636.61	27.9	ppb	8076662	79.248	78	C6H6
	18	Toluene	925	05:42.1	91	1537.4	20	ppb	1463768	14.363	92	C7H8
	47	o-Xylene	955	07:41.0	91	570.18	1.3	ppb	651158	6.3892	106	C8H10
5.3	Peak #	Name	Similarity	R.T. (min:sec)	UniqueMass	S/N	Concentration	Conc. Units	Area	Area %	Weight	Formula
		Ethylbenzene	952					ppb			106	C8H10
		p-Xylene	967					ppb			106	C8H10
		m-Xylene	964					ppb			106	C8H10
	9	Benzene	974	03:34.5	52	634.25	41.22	ppb	8649201	79.624	78	C6H6
	22	Toluene	925	05:41.8	91	1509.1	22.28	ppb	1525206	14.041	92	C7H8
	50	o-Xylene	955	07:40.9	91	544.88	2.41	ppb	688174	6.3353	106	C8H10

6.1	Peak #	Name	Similarity	R.T. (min:sec)	UniqueMass	S/N	Concentration	Conc. Units	Area	Area %	Weight	Formula
		Ethylbenzene	952					ppb			106	C8H10
	9	Benzene	974	03:33.7	78	1843.1	18.58	ppb	7676494	76.864	78	C6H6
	19	Toluene	925	05:41.7	91	1344.8	8.71	ppb	1160036	11.615	92	C7H8
	38	m-Xylene	967	07:12.2	91	229.55	6.16	ppb	327400	3.2782	106	C8H10
	41	o-Xylene	955	07:41.0	91	665.71	-3.39	ppb	495836	4.9647	106	C8H10
6.2	Peak #	Name	Similarity	R.T. (min:sec)	UniqueMass	S/N	Concentration	Conc. Units	Area	Area %	Weight	Formula
		Ethylbenzene	952					ppb			106	C8H10
		p-Xylene	967					ppb			106	C8H10
		m-Xylene	964					ppb			106	C8H10
	9	Benzene	974	03:33.6	78	1647.1	21.43	ppb	7798702	83.464	78	C6H6
	19	Toluene	925	05:41.6	91	1387.5	6.33	ppb	1095989	11.73	92	C7H8
	41	o-Xylene	955	07:40.9	91	555.68	-4.8	ppb	449073	4.8061	106	C8H10
6.3	Peak #	Name	Similarity	R.T. (min:sec)	UniqueMass	S/N	Concentration	Conc. Units	Area	Area %	Weight	Formula
		Ethylbenzene	952					ppb			106	C8H10
		p-Xylene	967					ppb			106	C8H10
		m-Xylene	964					ppb			106	C8H10
	10	Benzene	974	03:35.3	27	140.13	22.14	ppb	7829230	81.921	78	C6H6
	18	Toluene	925	05:42.1	91	1400.3	8.39	ppb	1151572	12.049	92	C7H8
	43	o-Xylene	955	07:41.0	91	586.71	-0.97	ppb	576253	6.0296	106	C8H10
7.1	Peak #	Name	Similarity	R.T. (min:sec)	UniqueMass	S/N	Concentration	Conc. Units	Area	Area %	Weight	Formula
		Ethylbenzene	952					ppb			106	C8H10
		p-Xylene	967					ppb			106	C8H10
		m-Xylene	964					ppb			106	C8H10
	9	Benzene	974	03:34.6	78	1771.9	-53.77	ppb	4567235	62.14	78	C6H6
	21	Toluene	925	05:41.8	91	1589.1	46.08	ppb	2165512	29.463	92	C7H8

	50	o-Xylene	955	07:41.0	91	591.9	0.27	ppb	617123	8.3964	106	C8H10
7.2	Peak #	Name	Similarity	R.T. (min:sec)	UniqueMass	S/N	Concentration	Conc. Units	Area	Area %	Weight	Formula
		Ethylbenzene	952					ppb			106	C8H10
	9	Benzene	974	03:35.7	78	1761.3	-45.13	ppb	4938593	61.233	78	C6H6
	22	Toluene	925	05:42.1	91	1563.1	47.34	ppb	2199502	27.271	92	C7H8
	43	m-Xylene	967	07:12.1	91	237.69	1.47	ppb	189780	2.3531	106	C8H10
7.3	Peak #	Name	Similarity	R.T. (min:sec)	UniqueMass	S/N	Concentration	Conc. Units	Area	Area %	Weight	Formula
		Ethylbenzene	952					ppb			106	C8H10
		p-Xylene	967					ppb			106	C8H10
		m-Xylene	964					ppb			106	C8H10
	10	Benzene	974	03:34.6	78	1748.9	-75.57	ppb	3630747	55.98	78	C6H6
	18	Toluene	925	05:41.7	91	1520	44.44	ppb	2121389	32.708	92	C7H8
	48	o-Xylene	955	07:40.9	91	565.6	3.78	ppb	733620	11.311	106	C8H10
8.1	Peak #	Name	Similarity	R.T. (min:sec)	UniqueMass	S/N	Concentration	Conc. Units	Area	Area %	Weight	Formula
		Ethylbenzene	952					ppb			106	C8H10
	10	Benzene	974	03:35.8	52	916.32	113.3	ppb	11746249	71.67	78	C6H6
	24	Toluene	925	05:42.3	91	1651.9	37.83	ppb	1943645	11.859	92	C7H8
	61	o-Xylene	955	07:41.0	91	816.98	16.47	ppb	1154119	7.0419	106	C8H10
8.2	Peak #	Name	Similarity	R.T. (min:sec)	UniqueMass	S/N	Concentration	Conc. Units	Area	Area %	Weight	Formula
		Ethylbenzene	952					ppb			106	C8H10
	10	Benzene	974	03:34.3	78	2006.6	115.56	ppb	11843570	74.825	78	C6H6
	24	Toluene	925	05:41.7	91	1628.6	38.59	ppb	1964085	12.409	92	C7H8
	53	m-Xylene	967	07:12.1	91	420.24	15.54	ppb	602631	3.8073	106	C8H10
	61	o-Xylene	955	07:41.0	91	786.98	6.26	ppb	815524	5.1523	106	C8H10
8.3	Peak #	Name	Similarity	R.T. (min:sec)	UniqueMass	S/N	Concentration	Conc. Units	Area	Area %	Weight	Formula

		Ethylbenzene	952					ppb			106	C8H10
	14	Benzene	974	03:35.6	78	1926.2	116.79	ppb	11896518	75.235	78	C6H6
	29	Toluene	925	05:42.4	91	1694.6	32.66	ppb	1804584	11.412	92	C7H8
	57	m-Xylene	967	07:12.2	91	422.55	6.66	ppb	342021	2.163	106	C8H10
	66	o-Xylene	955	07:41.0	91	808.86	24.72	ppb	1427321	9.0266	106	C8H10
9.1	Peak #	Name	Similarity	R.T. (min:sec)	UniqueMass	S/N	Concentration	Conc. Units	Area	Area %	Weight	Formula
		Ethylbenzene	952					ppb			106	C8H10
		p-Xylene	967					ppb			106	C8H10
		m-Xylene	964					ppb			106	C8H10
	11	Benzene	974	03:34.8	52	608.27	9.22	ppb	7274015	79.487	78	C6H6
	19	Toluene	925	05:42.0	91	1272.8	14.95	ppb	1327950	14.511	92	C7H8
	48	o-Xylene	955	07:41.0	91	555.32	-1.78	ppb	549263	6.0021	106	C8H10
9.2	Peak #	Name	Similarity	R.T. (min:sec)	UniqueMass	S/N	Concentration	Conc. Units	Area	Area %	Weight	Formula
		Ethylbenzene	952					ppb			106	C8H10
		p-Xylene	967					ppb			106	C8H10
		m-Xylene	964					ppb			106	C8H10
	10	Benzene	974	03:34.2	78	1704.6	15.57	ppb	7546900	87.668	78	C6H6
	20	Toluene	925	05:41.6	91	1178.9	-2.29	ppb	864000	10.037	92	C7H8
	47	o-Xylene	955	07:40.9	91	554.11	-12.39	ppb	197611	2.2955	106	C8H10
9.3	Peak #	Name	Similarity	R.T. (min:sec)	UniqueMass	S/N	Concentration	Conc. Units	Area	Area %	Weight	Formula
		Ethylbenzene	952					ppb			106	C8H10
		p-Xylene	967					ppb			106	C8H10
		m-Xylene	964					ppb			106	C8H10
	11	Benzene	974	03:34.0	78	1678.8	16.13	ppb	7571119	82.882	78	C6H6
	18	Toluene	925	05:41.7	91	1224.6	-1.66	ppb	880991	9.6443	92	C7H8
	47	o-Xylene	955	07:40.9	91	557.9	2.25	ppb	682719	7.4738	106	C8H10

10.1	Peak #	Name	Similarity	R.T. (min:sec)	UniqueMass	S/N	Concentration	Conc. Units	Area	Area %	Weight	Formula
		Ethylbenzene	952					ppb			106	C8H10
		p-Xylene	967					ppb			106	C8H10
		m-Xylene	964					ppb			106	C8H10
	10	Benzene	974	03:35.6	50	758.29	6.68	ppb	7165109	77.369	78	C6H6
	23	Toluene	925	05:42.2	91	1598.2	28.47	ppb	1691770	18.268	92	C7H8
	58	o-Xylene	955	07:41.0	91	536.12	-6.16	ppb	404103	4.3635	106	C8H10
10.2	Peak #	Name	Similarity	R.T. (min:sec)	UniqueMass	S/N	Concentration	Conc. Units	Area	Area %	Weight	Formula
		Ethylbenzene	952					ppb			106	C8H10
		p-Xylene	967					ppb			106	C8H10
		m-Xylene	964					ppb			106	C8H10
	11	Benzene	974	03:35.3	52	625.26	10.01	ppb	7308071	77.031	78	C6H6
	22	Toluene	925	05:42.2	91	1572.9	32.31	ppb	1795035	18.921	92	C7H8
	56	o-Xylene	955	07:41.0	91	557.73	-6.76	ppb	384082	4.0484	106	C8H10
10.3	Peak #	Name	Similarity	R.T. (min:sec)	UniqueMass	S/N	Concentration	Conc. Units	Area	Area %	Weight	Formula
		m-Xylene	964					ppb			106	C8H10
	12	Benzene	974	03:35.6	78	1714.4	16.64	ppb	7593071	71.463	78	C6H6
	23	Toluene	925	05:42.1	43	97.633	32.38	ppb	1796999	16.913	92	C7H8
	45	p-Xylene	952	07:01.7	91	112.88	7.24	ppb	372006	3.5012	106	C8H10
	59	o-Xylene	955	07:41.0	91	584.09	-3.53	ppb	491113	4.6222	106	C8H10
11.1	Peak #	Name	Similarity	R.T. (min:sec)	UniqueMass	S/N	Concentration	Conc. Units	Area	Area %	Weight	Formula
		Ethylbenzene	952					ppb			106	C8H10
		p-Xylene	967					ppb			106	C8H10
		m-Xylene	964					ppb			106	C8H10
	9	Benzene	974	03:34.9	78	1650.2	-38.45	ppb	5225599	65.184	78	C6H6

	17	Toluene	925	05:41.8	91	1342.2	36.19	ppb	1899318	23.692	92	C7H8
	44	o-Xylene	955	07:41.0	91	588.25	8.56	ppb	891811	11.124	106	C8H10
11.2	Peak #	Name	Similarity	R.T. (min:sec)	UniqueMass	S/N	Concentration	Conc. Units	Area	Area %	Weight	Formula
		Ethylbenzene	952					ppb			106	C8H10
		p-Xylene	967					ppb			106	C8H10
		m-Xylene	964					ppb			106	C8H10
	9	Benzene	974	03:35.3	78	1739.5	-52.5	ppb	4621967	70.234	78	C6H6
	19	Toluene	925	05:42.1	65	216.23	25.66	ppb	1616113	24.558	92	C7H8
	48	o-Xylene	955	07:41.0	91	562.19	-8.01	ppb	342776	5.2087	106	C8H10
11.3	Peak #	Name	Similarity	R.T. (min:sec)	UniqueMass	S/N	Concentration	Conc. Units	Area	Area %	Weight	Formula
		Ethylbenzene	952					ppb			106	C8H10
		p-Xylene	967					ppb			106	C8H10
		m-Xylene	964					ppb			106	C8H10
	9	Benzene	974	03:35.4	78	1672.7	-23.49	ppb	5868456	75.412	78	C6H6
	19	Toluene	925	05:42.0	91	1295.1	15.58	ppb	1344967	17.283	92	C7H8
	45	o-Xylene	955	07:40.9	91	557.69	-1.2	ppb	568433	7.3046	106	C8H10
12.1	Peak #	Name	Similarity	R.T. (min:sec)	UniqueMass	S/N	Concentration	Conc. Units	Area	Area %	Weight	Formula
		Ethylbenzene	952					ppb			106	C8H10
		p-Xylene	967					ppb			106	C8H10
		m-Xylene	964					ppb			106	C8H10
	8	Benzene	974	03:35.4	52	669.51	-32.99	ppb	5460482	67.905	78	C6H6
	15	Toluene	925	05:42.1	91	1482.9	32.48	ppb	1799685	22.38	92	C7H8
	40	o-Xylene	955	07:41.0	73	395.17	5.22	ppb	781215	9.7149	106	C8H10
12.2	Peak #	Name	Similarity	R.T. (min:sec)	UniqueMass	S/N	Concentration	Conc. Units	Area	Area %	Weight	Formula
		Ethylbenzene	952					ppb			106	C8H10
	9	Benzene	974	03:35.4	39	239.03	-48.54	ppb	4792198	60.634	78	C6H6

	20	Toluene	925	05:42.0	91	1406.2	26.75	ppb	1645522	20.82	92	C7H8
	38	m-Xylene	967	07:12.1	91	249.13	6.23	ppb	329432	4.1682	106	C8H10
	44	o-Xylene	955	07:41.0	73	357.51	6	ppb	806917	10.21	106	C8H10
12.3	Peak #	Name	Similarity	R.T. (min:sec)	UniqueMass	S/N	Concentration	Conc. Units	Area	Area %	Weight	Formula
		Ethylbenzene	952					ppb			106	C8H10
		p-Xylene	967					ppb			106	C8H10
		m-Xylene	964					ppb			106	C8H10
	11	Benzene	974	03:34.7	52	638.77	-48.73	ppb	4784075	65.388	78	C6H6
	20	Toluene	925	05:41.7	65	238.7	34.07	ppb	1842350	25.181	92	C7H8
	42	o-Xylene	955	07:40.9	91	559.48	2.47	ppb	689996	9.4308	106	C8H10
13.1	Peak #	Name	Similarity	R.T. (min:sec)	UniqueMass	S/N	Concentration	Conc. Units	Area	Area %	Weight	Formula
		m-Xylene	964					ppb			106	C8H10
	15	Benzene	974	03:34.4	50	585.18	-12.71	ppb	6331548	73.755	78	C6H6
	22	Toluene	925	05:41.7	91	1094.7	8.17	ppb	1145591	13.345	92	C7H8
	40	p-Xylene	952	07:01.7	91	143.67	2.27	ppb	229821	2.6772	106	C8H10
	46	o-Xylene	955	07:41.0	91	505.58	1.19	ppb	647744	7.5455	106	C8H10
13.2	Peak #	Name	Similarity	R.T. (min:sec)	UniqueMass	S/N	Concentration	Conc. Units	Area	Area %	Weight	Formula
		Ethylbenzene	952					ppb			106	C8H10
		p-Xylene	967					ppb			106	C8H10
		m-Xylene	964					ppb			106	C8H10
	8	Benzene	974	03:35.0	26	135.97	-91	ppb	2967579	59.984	78	C6H6
	18	Toluene	925	05:42.3	91	1157.6	5.67	ppb	1078331	21.796	92	C7H8
	46	o-Xylene	955	07:41.2	91	505.97	8.85	ppb	901410	18.22	106	C8H10
13.3	Peak #	Name	Similarity	R.T. (min:sec)	UniqueMass	S/N	Concentration	Conc. Units	Area	Area %	Weight	Formula
		Ethylbenzene	952					ppb			106	C8H10
		p-Xylene	967					ppb			106	C8H10

		m-Xylene	964					ppb			106	C8H10
	8	Benzene	974	03:34.0	50	545.58	-143.27	ppb	721580	35.632	78	C6H6
	19	Toluene	925	05:41.7	91	1020.5	-7.82	ppb	715354	35.325	92	C7H8
	46	o-Xylene	955	07:41.0	91	472.54	-0.61	ppb	588156	29.043	106	C8H10
14.1	Peak #	Name	Similarity	R.T. (min:sec)	UniqueMass	S/N	Concentration	Conc. Units	Area	Area %	Weight	Formula
		Ethylbenzene	952					ppb			106	C8H10
	13	Benzene	974	03:34.6	78	1479.3	32.6	ppb	8278815	75.291	78	C6H6
	25	Toluene	925	05:42.0	91	1473.4	21.85	ppb	1513506	13.764	92	C7H8
	49	m-Xylene	967	07:12.2	91	404.46	6.07	ppb	324684	2.9528	106	C8H10
	56	o-Xylene	955	07:41.2	73	924.55	-1.63	ppb	554113	5.0393	106	C8H10
14.2	Peak #	Name	Similarity	R.T. (min:sec)	UniqueMass	S/N	Concentration	Conc. Units	Area	Area %	Weight	Formula
		Ethylbenzene	952					ppb			106	C8H10
	8	Benzene	974	03:34.4	78	1537.1	46.55	ppb	8878175	70.746	78	C6H6
	18	Toluene	925	05:41.8	91	1445.7	17.65	ppb	1400637	11.161	92	C7H8
	40	m-Xylene	967	07:12.1	91	386.05	16.54	ppb	631967	5.0358	106	C8H10
	45	o-Xylene	955	07:41.0	91	597.62	12.02	ppb	1006641	8.0214	106	C8H10
14.3	Peak #	Name	Similarity	R.T. (min:sec)	UniqueMass	S/N	Concentration	Conc. Units	Area	Area %	Weight	Formula
	9	Benzene	974	03:34.3	78	2322.5	113.89	ppb	11771677	72.527	78	C6H6
	27	Toluene	925	05:41.7	91	2523.5	48.01	ppb	2217374	13.662	92	C7H8
	49	Ethylbenzene	952	07:01.5	91	445.44	2.08	ppb	224486	1.3831	106	C8H10
	51	p-Xylene	967	07:07.6	91	283.82	5.93	ppb	320679	1.9757	106	C8H10
	52	m-Xylene	964	07:12.1	91	733.35	14.58	ppb	520946	3.2096	106	C8H10
	60	o-Xylene	955	07:40.9	91	987.87	17.12	ppb	1175607	7.2431	106	C8H10
15.1	Peak #	Name	Similarity	R.T. (min:sec)	UniqueMass	S/N	Concentration	Conc. Units	Area	Area %	Weight	Formula
		Ethylbenzene	952					ppb			106	C8H10

	10	Benzene	974	03:33.3	78	2066.6	77.24	ppb	10196794	71.291	78	C6H6
	25	Toluene	925	05:41.3	91	1722.8	41.04	ppb	2029926	14.192	92	C7H8
	52	m-Xylene	967	07:12.0	91	442.77	14.51	ppb	572349	4.0016	106	C8H10
	58	o-Xylene	955	07:41.0	91	799.94	9.76	ppb	931614	6.5134	106	C8H10
15.2	Peak #	Name	Similarity	R.T. (min:sec)	UniqueMass	S/N	Concentration	Conc. Units	Area	Area %	Weight	Formula
		Toluene	925					ppb			92	C7H8
	8	Benzene	974	03:28.9	63	116.29	-82.55	ppb	3330829	58.819	78	C6H6
	46	m-Xylene	952	07:11.4	91	381.7	11.03	ppb	480274	8.4811	106	C8H10
	53	o-Xylene	955	07:40.5	91	660.04	8.54	ppb	891209	15.738	106	C8H10
15.3	Peak #	Name	Similarity	R.T. (min:sec)	UniqueMass	S/N	Concentration	Conc. Units	Area	Area %	Weight	Formula
		Ethylbenzene	952					ppb			106	C8H10
	10	Benzene	974	03:34.7	78	1869.3	70.83	ppb	9921366	71.556	78	C6H6
	25	Toluene	925	05:42.0	91	1872.7	50.17	ppb	2275714	16.413	92	C7H8
	52	m-Xylene	967	07:12.3	91	500.39	15.77	ppb	609186	4.3937	106	C8H10
	61	o-Xylene	955	07:41.0	91	856.59	-4.79	ppb	449660	3.2431	106	C8H10
16.1	Peak #	Name	Similarity	R.T. (min:sec)	UniqueMass	S/N	Concentration	Conc. Units	Area	Area %	Weight	Formula
		Ethylbenzene	952					ppb			106	C8H10
	12	Benzene	974	03:36.7	52	717.73	25.2	ppb	7960842	62.522	78	C6H6
	25	Toluene	925	05:42.7	91	2222.6	58.55	ppb	2501098	19.643	92	C7H8
	52	m-Xylene	967	07:12.3	91	618.12	15.72	ppb	607692	4.7727	106	C8H10
	62	o-Xylene	955	07:41.0	91	778.32	13.5	ppb	1055449	8.2892	106	C8H10
16.2	Peak #	Name	Similarity	R.T. (min:sec)	UniqueMass	S/N	Concentration	Conc. Units	Area	Area %	Weight	Formula
		Ethylbenzene	952					ppb			106	C8H10
	11	Benzene	974	03:35.7	78	1815.4	42.73	ppb	8713853	65.197	78	C6H6
	24	Toluene	925	05:42.4	91	2221.4	60.98	ppb	2566392	19.202	92	C7H8
	52	m-Xylene	967	07:12.1	91	629.2	12.88	ppb	524421	3.9237	106	C8H10

	62	o-Xylene	955	07:40.9	91	825.93	12.92	ppb	1036315	7.7537	106	C8H10
	1	Unknown 1		03:03.7	57	115.8						
16.3	Peak #	Name	Similarity	R.T. (min:sec)	UniqueMass	S/N	Concentration	Conc. Units	Area	Area %	Weight	Formula
		Ethylbenzene	952					ppb			106	C8H10
	13	Benzene	974	03:36.4	50	833.71	56.47	ppb	9304348	66.779	78	C6H6
	25	Toluene	925	05:42.8	91	2331.5	54.42	ppb	2390079	17.154	92	C7H8
	50	m-Xylene	967	07:12.3	91	639.18	16.43	ppb	628600	4.5116	106	C8H10
	59	o-Xylene	955	07:41.0	91	854.32	11.26	ppb	981324	7.0432	106	C8H10
17.1	Peak #	Name	Similarity	R.T. (min:sec)	UniqueMass	S/N	Concentration	Conc. Units	Area	Area %	Weight	Formula
	9	Benzene	974	03:31.2	78	1704.5	-63.24	ppb	4160480	53.332	78	C6H6
	22	Toluene	925	05:39.0	91	1413.8	29.7	ppb	1724906	22.111	92	C7H8
	45	m-Xylene	952	07:10.9	91	327.47	10.71	ppb	470967	6.0372	106	C8H10
	52	o-Xylene	955	07:40.4	91	525.9	-3.18	ppb	502840	6.4457	106	C8H10
17.2	Peak #	Name	Similarity	R.T. (min:sec)	UniqueMass	S/N	Concentration	Conc. Units	Area	Area %	Weight	Formula
		Ethylbenzene	952					ppb			106	C8H10
	10	Benzene	974	03:34.8	50	587.71	-80.11	ppb	3435785	51.477	78	C6H6
	19	Toluene	925	05:41.9	91	1332.7	20.99	ppb	1490339	22.329	92	C7H8
	43	m-Xylene	967	07:12.3	91	379.23	12.65	ppb	517857	7.7588	106	C8H10
	48	o-Xylene	955	07:41.0	91	595.75	3.15	ppb	712579	10.676	106	C8H10
17.3	Peak #	Name	Similarity	R.T. (min:sec)	UniqueMass	S/N	Concentration	Conc. Units	Area	Area %	Weight	Formula
		Ethylbenzene	952					ppb			106	C8H10
		o-Xylene	955					ppb			106	C8H10
	11	Benzene	974	03:33.9	78	1492.3	-89.9	ppb	3014821	59.08	78	C6H6
	21	Toluene	925	05:41.5	91	1253	24.52	ppb	1585526	31.071	92	C7H8
	44	m-Xylene	967	07:12.1	91	341.76	3.57	ppb	251304	4.9247	106	C8H10

18.1	Peak #	Name	Similarity	R.T. (min:sec)	UniqueMass	S/N	Concentration	Conc. Units	Area	Area %	Weight	Formula
		Ethylbenzene	952					ppb			106	C8H10
		p-Xylene	967					ppb			106	C8H10
		m-Xylene	964					ppb			106	C8H10
	9	Benzene	974	03:33.2	78	1559.4	-25.44	ppb	5784613	75.429	78	C6H6
	18	Toluene	925	05:41.2	91	1539.7	16.14	ppb	1359849	17.732	92	C7H8
	47	o-Xylene	955	07:40.9	91	561.75	-2.53	ppb	524493	6.8392	106	C8H10
18.2	Peak #	Name	Similarity	R.T. (min:sec)	UniqueMass	S/N	Concentration	Conc. Units	Area	Area %	Weight	Formula
		Ethylbenzene	952					ppb			106	C8H10
		p-Xylene	967					ppb			106	C8H10
		m-Xylene	964					ppb			106	C8H10
	9	Benzene	974	03:33.9	78	1543.6	12.32	ppb	7407471	82.37	78	C6H6
	21	Toluene	925	05:41.6	91	1619.7	16.72	ppb	1375607	15.296	92	C7H8
	50	o-Xylene	955	07:41.0	91	581.48	-12.02	ppb	209877	2.3338	106	C8H10
18.3	Peak #	Name	Similarity	R.T. (min:sec)	UniqueMass	S/N	Concentration	Conc. Units	Area	Area %	Weight	Formula
		Ethylbenzene	952					ppb			106	C8H10
		p-Xylene	967					ppb			106	C8H10
		m-Xylene	964					ppb			106	C8H10
	10	Benzene	974	03:31.1	78	1704.2	-86.81	ppb	3147612	69.739	78	C6H6
	19	Toluene	925	05:40.1	91	1420.1	8.97	ppb	1166924	25.855	92	C7H8
	43	o-Xylene	955	07:40.7	91	521.66	-12.35	ppb	198885	4.4065	106	C8H10
19.1	Peak #	Name	Similarity	R.T. (min:sec)	UniqueMass	S/N	Concentration	Conc. Units	Area	Area %	Weight	Formula
		Toluene	925					ppb			92	C7H8
		Ethylbenzene	952					ppb			106	C8H10
		p-Xylene	967					ppb			106	C8H10
		m-Xylene	964					ppb			106	C8H10

	8	Benzene	974	03:28.4	52	611.43	-98.37	ppb	2650787	81.53	78	C6H6
	51	o-Xylene	955	07:40.5	91	538.28	-0.23	ppb	600516	18.47	106	C8H10
19.2	Peak #	Name	Similarity	R.T. (min:sec)	UniqueMass	S/N	Concentration	Conc. Units	Area	Area %	Weight	Formula
		Ethylbenzene	952					ppb			106	C8H10
	11	Benzene	974	03:34.0	78	1789.1	126.59	ppb	12317315	78.908	78	C6H6
	27	Toluene	925	05:41.7	91	1598.5	23.21	ppb	1550272	9.9315	92	C7H8
	53	m-Xylene	967	07:12.1	91	303.48	9.2	ppb	416555	2.6686	106	C8H10
	59	o-Xylene	955	07:41.0	91	732.96	9.08	ppb	908998	5.8233	106	C8H10
19.3	Peak #	Name	Similarity	R.T. (min:sec)	UniqueMass	S/N	Concentration	Conc. Units	Area	Area %	Weight	Formula
		Ethylbenzene	952					ppb			106	C8H10
	10	Benzene	974	03:34.7	37	200.58	133.45	ppb	12612082	78.56	78	C6H6
	24	Toluene	925	05:42.3	91	1568.2	23.88	ppb	1568256	9.7686	92	C7H8
	52	m-Xylene	967	07:12.3	91	291.86	11.62	ppb	487507	3.0367	106	C8H10
	59	o-Xylene	955	07:41.1	91	727.62	8.77	ppb	898740	5.5982	106	C8H10
20.1	Peak #	Name	Similarity	R.T. (min:sec)	UniqueMass	S/N	Concentration	Conc. Units	Area	Area %	Weight	Formula
		Ethylbenzene	952					ppb			106	C8H10
		p-Xylene	967					ppb			106	C8H10
		m-Xylene	964					ppb			106	C8H10
	11	Benzene	974	03:34.7	52	636.3	30.59	ppb	8192404	77.028	78	C6H6
	29	Toluene	925	05:41.8	91	1777.5	46.51	ppb	2177098	20.47	92	C7H8
	62	o-Xylene	955	07:41.0	91	596.14	-10.32	ppb	266138	2.5023	106	C8H10
20.2	Peak #	Name	Similarity	R.T. (min:sec)	UniqueMass	S/N	Concentration	Conc. Units	Area	Area %	Weight	Formula
		Ethylbenzene	952					ppb			106	C8H10
		p-Xylene	967					ppb			106	C8H10
		m-Xylene	964					ppb			106	C8H10
	13	Benzene	974	03:35.2	78	2017.8	37.26	ppb	8478987	78.165	78	C6H6

	26	Toluene	925	05:42.0	91	2006.1	38.94	ppb	1973477	18.193	92	C7H8
	61	o-Xylene	955	07:40.9	91	635.58	-6.43	ppb	395112	3.6424	106	C8H10
20.3	Peak #	Name	Similarity	R.T. (min:sec)	UniqueMass	S/N	Concentration	Conc. Units	Area	Area %	Weight	Formula
		Ethylbenzene	952					ppb			106	C8H10
	10	Benzene	974	03:35.1	78	1706.9	33.88	ppb	8333712	73.07	78	C6H6
	22	Toluene	925	05:42.1	91	1834.9	36.86	ppb	1917563	16.813	92	C7H8
	48	m-Xylene	967	07:12.1	91	270.91	8.3	ppb	389975	3.4193	106	C8H10
	57	o-Xylene	955	07:41.0	91	644.25	-7.07	ppb	373901	3.2784	106	C8H10
21.1	Peak #	Name	Similarity	R.T. (min:sec)	UniqueMass	S/N	Concentration	Conc. Units	Area	Area %	Weight	Formula
		Ethylbenzene	952					ppb			106	C8H10
	9	Benzene	974	03:34.8	50	589.12	-83.74	ppb	3279402	59.176	78	C6H6
	22	Toluene	925	05:42.0	91	1154.3	11.56	ppb	1236770	22.317	92	C7H8
	46	m-Xylene	967	07:12.3	91	370.64	6.62	ppb	340901	6.1515	106	C8H10
	53	o-Xylene	955	07:41.1	91	575.4	-7.98	ppb	343808	6.2039	106	C8H10
21.2	Peak #	Name	Similarity	R.T. (min:sec)	UniqueMass	S/N	Concentration	Conc. Units	Area	Area %	Weight	Formula
		Ethylbenzene	952					ppb			106	C8H10
		p-Xylene	967					ppb			106	C8H10
		m-Xylene	964					ppb			106	C8H10
	8	Benzene	974	03:33.9	78	1314.2	-106.98	ppb	2280982	59.169	78	C6H6
	18	Toluene	925	05:41.6	91	1053.4	9.83	ppb	1190310	30.877	92	C7H8
	50	o-Xylene	955	07:41.0	91	558.66	-6.78	ppb	383720	9.9538	106	C8H10
21.3	Peak #	Name	Similarity	R.T. (min:sec)	UniqueMass	S/N	Concentration	Conc. Units	Area	Area %	Weight	Formula
		Toluene	925					ppb			92	C7H8
		Ethylbenzene	952					ppb			106	C8H10
		p-Xylene	967					ppb			106	C8H10
		m-Xylene	964					ppb			106	C8H10

	9	Benzene	974	03:28.7	52	364.57	-132.35	ppb	1190971	70.301	78	C6H6
	50	o-Xylene	955	07:40.6	91	418.06	-3.17	ppb	503122	29.699	106	C8H10
22.1	Peak #	Name	Similarity	R.T. (min:sec)	UniqueMass	S/N	Concentration	Conc. Units	Area	Area %	Weight	Formula
		Ethylbenzene	952					ppb			106	C8H10
		p-Xylene	967					ppb			106	C8H10
		m-Xylene	964					ppb			106	C8H10
	12	Benzene	974	03:35.8	78	1647.4	-1.3	ppb	6822102	79.409	78	C6H6
	29	Toluene	925	05:42.4	91	1420.5	13.61	ppb	1291815	15.037	92	C7H8
	59	o-Xylene	955	07:41.0	91	524.18	-3.96	ppb	477173	5.5543	106	C8H10
22.2	Peak #	Name	Similarity	R.T. (min:sec)	UniqueMass	S/N	Concentration	Conc. Units	Area	Area %	Weight	Formula
		Ethylbenzene	952					ppb			106	C8H10
		p-Xylene	967					ppb			106	C8H10
		m-Xylene	964					ppb			106	C8H10
	11	Benzene	974	03:35.9	52	639.24	54.02	ppb	9199011	84.001	78	C6H6
	24	Toluene	925	05:42.4	91	1537.8	22.56	ppb	1532666	13.996	92	C7H8
	53	o-Xylene	955	07:41.0	91	544.55	-11.74	ppb	219340	2.0029	106	C8H10
22.3	Peak #	Name	Similarity	R.T. (min:sec)	UniqueMass	S/N	Concentration	Conc. Units	Area	Area %	Weight	Formula
		Ethylbenzene	952					ppb			106	C8H10
		p-Xylene	967					ppb			106	C8H10
		m-Xylene	964					ppb			106	C8H10
	12	Benzene	974	03:31.2	78	1716	-81.18	ppb	3389752	66.737	78	C6H6
	25	Toluene	925	05:40.1	91	1185.2	10.89	ppb	1218815	23.996	92	C7H8
	55	o-Xylene	955	07:40.6	91	392.94	-4.15	ppb	470725	9.2675	106	C8H10
23.1	Peak #	Name	Similarity	R.T. (min:sec)	UniqueMass	S/N	Concentration	Conc. Units	Area	Area %	Weight	Formula
		Ethylbenzene	952					ppb			106	C8H10

	9	Benzene	974	03:34.7	78	1729	-36.12	ppb	5325745	62.843	78	C6H6
	22	Toluene	925	05:42.0	91	1616.9	31.61	ppb	1776267	20.96	92	C7H8
	46	m-Xylene	967	07:12.1	91	284.5	13.06	ppb	529834	6.252	106	C8H10
	53	o-Xylene	955	07:41.0	91	714.23	-8.91	ppb	312956	3.6929	106	C8H10
23.2	Peak #	Name	Similarity	R.T. (min:sec)	UniqueMass	S/N	Concentration	Conc. Units	Area	Area %	Weight	Formula
		Ethylbenzene	952					ppb			106	C8H10
		p-Xylene	967					ppb			106	C8H10
		m-Xylene	964					ppb			106	C8H10
	10	Benzene	974	03:27.7	78	1319.8	-72.9	ppb	3745222	74.173	78	C6H6
	18	Toluene	925	05:38.3	91	858.6	-26.22	ppb	220176	4.3605	92	C7H8
	46	o-Xylene	955	07:40.4	91	466.37	14.36	ppb	1083924	21.467	106	C8H10
23.3	Peak #	Name	Similarity	R.T. (min:sec)	UniqueMass	S/N	Concentration	Conc. Units	Area	Area %	Weight	Formula
		Ethylbenzene	952					ppb			106	C8H10
		p-Xylene	967					ppb			106	C8H10
		m-Xylene	964					ppb			106	C8H10
	9	Benzene	974	03:33.9	79	124.89	95.44	ppb	10978956	83.974	78	C6H6
	20	Toluene	925	05:41.7	91	1528.2	18.71	ppb	1429232	10.932	92	C7H8
	53	o-Xylene	955	07:41.0	91	693.76	1.74	ppb	666046	5.0943	106	C8H10
24.1	Peak #	Name	Similarity	R.T. (min:sec)	UniqueMass	S/N	Concentration	Conc. Units	Area	Area %	Weight	Formula
		Ethylbenzene	952					ppb			106	C8H10
	8	Benzene	974	03:33.6	78	1418.7	-33.22	ppb	5450641	65.15	78	C6H6
	22	Toluene	925	05:41.5	91	1207.9	19.35	ppb	1446318	17.287	92	C7H8
	44	m-Xylene	967	07:12.1	91	321.16	12	ppb	498638	5.9601	106	C8H10
	49	o-Xylene	955	07:41.0	91	536.83	-4.11	ppb	472052	5.6423	106	C8H10
24.2	Peak #	Name	Similarity	R.T. (min:sec)	UniqueMass	S/N	Concentration	Conc. Units	Area	Area %	Weight	Formula
		Ethylbenzene	952					ppb			106	C8H10

		p-Xylene	967					ppb			106	C8H10
		m-Xylene	964					ppb			106	C8H10
	9	Benzene	974	03:34.5	52	489.69	68.79	ppb	9833868	84.819	78	C6H6
	17	Toluene	925	05:41.8	91	1125.9	12.73	ppb	1268308	10.939	92	C7H8
	46	o-Xylene	955	07:41.1	91	579.47	-3.52	ppb	491703	4.2411	106	C8H10
24.3	Peak #	Name	Similarity	R.T. (min:sec)	UniqueMass	S/N	Concentration	Conc. Units	Area	Area %	Weight	Formula
		m-Xylene	964					ppb			106	C8H10
	8	Benzene	974	03:34.2	50	574.8	-148.46	ppb	498739	18.451	78	C6H6
	16	Toluene	925	05:41.8	91	1092.7	6.15	ppb	1091268	40.371	92	C7H8
	37	p-Xylene	952	07:01.7	91	182.23	4.84	ppb	303252	11.219	106	C8H10
	47	o-Xylene	955	07:41.0	91	555.2	-3.07	ppb	506586	18.741	106	C8H10
25.1	Peak #	Name	Similarity	R.T. (min:sec)	UniqueMass	S/N	Concentration	Conc. Units	Area	Area %	Weight	Formula
		Ethylbenzene	952					ppb			106	C8H10
		p-Xylene	967					ppb			106	C8H10
		m-Xylene	964					ppb			106	C8H10
	10	Benzene	974	03:35.3	50	722.73	76.09	ppb	3608469	58.294	78	C6H6
	19	Toluene	925	05:41.9	91	1316.9	31.31	ppb	1768031	28.562	92	C7H8
	47	o-Xylene	955	07:41.1	73	1140.1	6.2	ppb	813588	13.143	106	C8H10
25.2	Peak #	Name	Similarity	R.T. (min:sec)	UniqueMass	S/N	Concentration	Conc. Units	Area	Area %	Weight	Formula
		Ethylbenzene	952					ppb			106	C8H10
	10	Benzene	974	03:35.5	78	1688.2	-48.06	ppb	4812719	56.903	78	C6H6
	19	Toluene	925	05:42.1	91	1304.1	35.58	ppb	1883041	22.264	92	C7H8
	39	m-Xylene	967	07:12.1	91	224.61	11.99	ppb	498464	5.8935	106	C8H10
	43	o-Xylene	955	07:41.0	73	1069.6	4.73	ppb	765129	9.0464	106	C8H10
25.3	Peak #	Name	Similarity	R.T. (min:sec)	UniqueMass	S/N	Concentration	Conc. Units	Area	Area %	Weight	Formula

	10	Benzene	974	03:35.8	78	1759	-60.25	ppb	4289076	54.532	78	C6H6
	21	Toluene	925	05:42.3	91	1278.4	31.84	ppb	1782448	22.663	92	C7H8
	39	Ethylbenzene	952	07:01.6	91	128.8	10.78	ppb	472960	6.0133	106	C8H10
	42	m-Xylene	967	07:12.2	91	223.98	7.84	ppb	376616	4.7884	106	C8H10
	49	o-Xylene	955	07:41.0	73	1107.4	-1.23	ppb	567468	7.2149	106	C8H10
26.1	Peak #	Name	Similarity	R.T. (min:sec)	UniqueMass	S/N	Concentration	Conc. Units	Area	Area %	Weight	Formula
		Ethylbenzene	952					ppb			106	C8H10
	10	Benzene	974	03:34.0	76	35.983	-111.17	ppb	2101098	44.552	78	C6H6
	22	Toluene	925	05:41.6	91	1406.2	16.89	ppb	1380119	29.264	92	C7H8
	47	m-Xylene	967	07:12.1	91	389.26	9.81	ppb	434469	9.2125	106	C8H10
	55	o-Xylene	955	07:41.1	91	678.42	-7.31	ppb	365918	7.759	106	C8H10
26.2	Peak #	Name	Similarity	R.T. (min:sec)	UniqueMass	S/N	Concentration	Conc. Units	Area	Area %	Weight	Formula
		Ethylbenzene	952					ppb			106	C8H10
	9	Benzene	974	03:33.0	78	1450.7	-108.96	ppb	2196073	46.865	78	C6H6
	22	Toluene	925	05:41.2	91	1151.9	18.63	ppb	1427080	30.454	92	C7H8
	48	m-Xylene	967	07:12.1	91	372.29	3.69	ppb	254929	5.4403	106	C8H10
	57	o-Xylene	955	07:41.0	91	614.91	-1.67	ppb	552945	11.8	106	C8H10
26.3	Peak #	Name	Similarity	R.T. (min:sec)	UniqueMass	S/N	Concentration	Conc. Units	Area	Area %	Weight	Formula
		m-Xylene	964					ppb			106	C8H10
	10	Benzene	974	03:33.9	78	1410	-9.79	ppb	6457307	73.749	78	C6H6
	22	Toluene	925	05:41.7	92	649.21	14.43	ppb	1314089	15.008	92	C7H8
	44	p-Xylene	952	07:01.6	91	208.16	2.64	ppb	240416	2.7458	106	C8H10
	57	o-Xylene	955	07:41.1	91	637.86	-3.16	ppb	503618	5.7518	106	C8H10
27.1	Peak #	Name	Similarity	R.T. (min:sec)	UniqueMass	S/N	Concentration	Conc. Units	Area	Area %	Weight	Formula
		Ethylbenzene	952					ppb			106	C8H10

		p-Xylene	967					ppb			106	C8H10
		m-Xylene	964					ppb			106	C8H10
	12	Benzene	974	03:34.7	78	1728	4.94	ppb	7090180	77.363	78	C6H6
	24	Toluene	925	05:41.8	91	1454.2	25.78	ppb	1619437	17.67	92	C7H8
	57	o-Xylene	955	07:40.9	73	725.52	-4.62	ppb	455218	4.967	106	C8H10
27.2	Peak #	Name	Similarity	R.T. (min:sec)	UniqueMass	S/N	Concentration	Conc. Units	Area	Area %	Weight	Formula
		Ethylbenzene	952					ppb			106	C8H10
		p-Xylene	967					ppb			106	C8H10
		m-Xylene	964					ppb			106	C8H10
	12	Benzene	974	03:33.1	78	1689	19.57	ppb	7718932	77.005	78	C6H6
	22	Toluene	925	05:41.2	91	1452.4	17.31	ppb	1391407	13.881	92	C7H8
	53	o-Xylene	955	07:40.8	73	752.28	9.21	ppb	913552	9.1137	106	C8H10
27.3	Peak #	Name	Similarity	R.T. (min:sec)	UniqueMass	S/N	Concentration	Conc. Units	Area	Area %	Weight	Formula
		Ethylbenzene	952					ppb			106	C8H10
		p-Xylene	967					ppb			106	C8H10
		m-Xylene	964					ppb			106	C8H10
	10	Benzene	974	03:32.6	52	621.01	-84.07	ppb	3265374	59.614	78	C6H6
	19	Toluene	925	05:41.0	91	1394	22.41	ppb	1528580	27.906	92	C7H8
	50	o-Xylene	955	07:40.7	73	736.41	2.27	ppb	683576	12.48	106	C8H10
28.1	Peak #	Name	Similarity	R.T. (min:sec)	UniqueMass	S/N	Concentration	Conc. Units	Area	Area %	Weight	Formula
		Ethylbenzene	952					ppb			106	C8H10
	8	Benzene	974	03:35.0	78	1484	-105.74	ppb	2334086	49.123	78	C6H6
	18	Toluene	925	05:42.1	91	1225.1	15.1	ppb	1332108	28.036	92	C7H8
	43	m-Xylene	967	07:12.3	91	339.23	3.69	ppb	254931	5.3653	106	C8H10
	50	o-Xylene	955	07:41.2	91	570.77	-0.99	ppb	575433	12.111	106	C8H10
28.2	Peak #	Name	Similarity	R.T. (min:sec)	UniqueMass	S/N	Concentration	Conc. Units	Area	Area %	Weight	Formula

		Ethylbenzene	952					ppb			106	C8H10
		p-Xylene	967					ppb			106	C8H10
		m-Xylene	964					ppb			106	C8H10
	10	Benzene	974	03:34.0	78	1398.5	-4.5	ppb	6684525	78.884	78	C6H6
	21	Toluene	925	05:41.6	91	1115.7	14.53	ppb	1316543	15.536	92	C7H8
	53	o-Xylene	955	07:41.0	91	561.6	-4.09	ppb	472828	5.5798	106	C8H10
28.3	Peak #	Name	Similarity	R.T. (min:sec)	UniqueMass	S/N	Concentration	Conc. Units	Area	Area %	Weight	Formula
		Ethylbenzene	952					ppb			106	C8H10
	8	Benzene	974	03:34.5	50	559.1	20.82	ppb	7772557	76.12	78	C6H6
	18	Toluene	925	05:41.9	91	1032.7	2.69	ppb	998006	9.7739	92	C7H8
	41	m-Xylene	967	07:12.2	91	344.72	11.19	ppb	474850	4.6504	106	C8H10
	47	o-Xylene	955	07:41.1	91	587.29	-3.55	ppb	490616	4.8048	106	C8H10
29.1	Peak #	Name	Similarity	R.T. (min:sec)	UniqueMass	S/N	Concentration	Conc. Units	Area	Area %	Weight	Formula
		Ethylbenzene	952					ppb			106	C8H10
		p-Xylene	967					ppb			106	C8H10
		m-Xylene	964					ppb			106	C8H10
	11	Benzene	974	03:36.3	52	660.33	-38.35	ppb	5230046	66.684	78	C6H6
	24	Toluene	925	05:42.4	91	1611.5	37.5	ppb	1934666	24.667	92	C7H8
	55	o-Xylene	955	07:41.0	73	744.82	2.12	ppb	678369	8.6493	106	C8H10
29.2	Peak #	Name	Similarity	R.T. (min:sec)	UniqueMass	S/N	Concentration	Conc. Units	Area	Area %	Weight	Formula
		Ethylbenzene	952					ppb			106	C8H10
		p-Xylene	967					ppb			106	C8H10
		m-Xylene	964					ppb			106	C8H10
	10	Benzene	974	03:34.7	78	1710.6	-30.27	ppb	5577050	69.209	78	C6H6
	25	Toluene	925	05:41.7	91	1582.5	38.15	ppb	1952247	24.227	92	C7H8
	56	o-Xylene	955	07:41.0	73	804.31	-2.39	ppb	528995	6.5646	106	C8H10

29.3	Peak #	Name	Similarity	R.T. (min:sec)	UniqueMass	S/N	Concentration	Conc. Units	Area	Area %	Weight	Formula
		Ethylbenzene	952					ppb			106	C8H10
	10	Benzene	974	03:35.4	78	1767.8	-40.04	ppb	5157356	58.075	78	C6H6
	22	Toluene	925	05:42.1	91	1585.9	39.61	ppb	1991362	22.424	92	C7H8
	44	m-Xylene	967	07:12.1	91	255.88	11.74	ppb	490956	5.5284	106	C8H10
	52	o-Xylene	955	07:41.0	73	811.16	4.28	ppb	749906	8.4444	106	C8H10
30.1	Peak #	Name	Similarity	R.T. (min:sec)	UniqueMass	S/N	Concentration	Conc. Units	Area	Area %	Weight	Formula
		Ethylbenzene	952					ppb			106	C8H10
		p-Xylene	967					ppb			106	C8H10
		m-Xylene	964					ppb			106	C8H10
	11	Benzene	974	03:34.7	52	494.11	-96.49	ppb	2731926	54.112	78	C6H6
	26	Toluene	925	05:42.0	91	1262.1	28.33	ppb	1687998	33.435	92	C7H8
	58	o-Xylene	955	07:41.2	91	591.15	0.62	ppb	628707	12.453	106	C8H10
30.2	Peak #	Name	Similarity	R.T. (min:sec)	UniqueMass	S/N	Concentration	Conc. Units	Area	Area %	Weight	Formula
		Ethylbenzene	952					ppb			106	C8H10
	11	Benzene	974	03:34.8	50	612.05	-9.6	ppb	6465585	74.137	78	C6H6
	20	Toluene	925	05:42.0	91	1258.9	17.74	ppb	1403061	16.088	92	C7H8
	44	m-Xylene	967	07:12.3	91	422.72	3.43	ppb	247091	2.8332	106	C8H10
	51	o-Xylene	955	07:41.2	91	633.99	-7.54	ppb	358357	4.109	106	C8H10
30.3	Peak #	Name	Similarity	R.T. (min:sec)	UniqueMass	S/N	Concentration	Conc. Units	Area	Area %	Weight	Formula
		m-Xylene	964					ppb			106	C8H10
	9	Benzene	974	03:32.7	52	502.43	-97.13	ppb	2704393	52.274	78	C6H6
	21	Toluene	925	05:41.0	91	1086.4	13.84	ppb	1298161	25.093	92	C7H8
	43	p-Xylene	952	07:01.4	91	230.21	4.51	ppb	294019	5.6832	106	C8H10
	54	o-Xylene	955	07:41.0	91	557.25	-0.77	ppb	582863	11.266	106	C8H10

31.1	Peak #	Name	Similarity	R.T. (min:sec)	UniqueMass	S/N	Concentration	Conc. Units	Area	Area %	Weight	Formula
	11	Benzene	974	03:30.4	78	1979.2	-30.96	ppb	5547547	55.355	78	C6H6
	26	Toluene	925	05:39.7	91	1782.7	34.96	ppb	1866345	18.623	92	C7H8
	52	m-Xylene	952	07:11.5	91	596.37	13.58	ppb	553138	5.5194	106	C8H10
	60	o-Xylene	955	07:40.6	91	840.4	10.27	ppb	948403	9.4635	106	C8H10
31.2	Peak #	Name	Similarity	R.T. (min:sec)	UniqueMass	S/N	Concentration	Conc. Units	Area	Area %	Weight	Formula
	9	Benzene	974	03:34.2	50	1001.2	84.45	ppb	10506769	65.185	78	C6H6
	18	Toluene	925	05:41.7	91	1986.7	49.71	ppb	2263140	14.041	92	C7H8
	40	Ethylbenzene	952	07:01.5	91	345.06	8.55	ppb	409454	2.5403	106	C8H10
	44	m-Xylene	967	07:12.1	91	677.06	21.8	ppb	786366	4.8787	106	C8H10
	52	o-Xylene	955	07:40.9	91	947.05	22.88	ppb	1366396	8.4772	106	C8H10
31.3	Peak #	Name	Similarity	R.T. (min:sec)	UniqueMass	S/N	Concentration	Conc. Units	Area	Area %	Weight	Formula
		Ethylbenzene	952					ppb			106	C8H10
	12	Benzene	974	03:34.3	78	2039.5	99.11	ppb	11136508	70.24	78	C6H6
	26	Toluene	925	05:41.8	91	2085.1	46.92	ppb	2188222	13.802	92	C7H8
	54	m-Xylene	967	07:12.1	91	666.19	16.72	ppb	637266	4.0194	106	C8H10
	63	o-Xylene	955	07:41.1	73	817.41	19.54	ppb	1255687	7.9198	106	C8H10
32.1	Peak #	Name	Similarity	R.T. (min:sec)	UniqueMass	S/N	Concentration	Conc. Units	Area	Area %	Weight	Formula
		Ethylbenzene	952					ppb			106	C8H10
	8	Benzene	974	03:35.5	78	1943.4	133.83	ppb	12628519	69.277	78	C6H6
	24	Toluene	925	05:42.1	91	1907.7	71.74	ppb	2855925	15.667	92	C7H8
	52	m-Xylene	967	07:12.2	91	701.69	16.46	ppb	629435	3.4529	106	C8H10
	62	o-Xylene	955	07:41.0	91	951.84	26.48	ppb	1485601	8.1497	106	C8H10
32.2	Peak #	Name	Similarity	R.T. (min:sec)	UniqueMass	S/N	Concentration	Conc. Units	Area	Area %	Weight	Formula
	12	Benzene	974	03:34.2	78	1997.6	179.5	ppb	14590953	71.601	78	C6H6

	26	Toluene	925	05:41.6	91	1859.1	68.49	ppb	2768454	13.585	92	C7H8
	52	Ethylbenzene	952	07:07.5	91	228.28	8.84	ppb	417625	2.0494	106	C8H10
	53	m-Xylene	964	07:12.0	91	662.11	32.4	ppb	1090211	5.3499	106	C8H10
	62	o-Xylene	955	07:40.9	91	912.79	14.64	ppb	1093379	5.3654	106	C8H10
32.3	Peak #	Name	Similarity	R.T. (min:sec)	UniqueMass	S/N	Concentration	Conc. Units	Area	Area %	Weight	Formula
		Ethylbenzene	952					ppb			106	C8H10
	9	Benzene	974	03:35.3	78	2151.2	90.62	ppb	10771649	72.248	78	C6H6
	27	Toluene	925	05:42.1	91	1626.3	31.96	ppb	1785746	11.977	92	C7H8
	56	m-Xylene	967	07:12.1	91	655.07	27.16	ppb	943482	6.3281	106	C8H10
	64	o-Xylene	955	07:40.9	91	779.62	-4.32	ppb	465000	3.1188	106	C8H10
33.1	Peak #	Name	Similarity	R.T. (min:sec)	UniqueMass	S/N	Concentration	Conc. Units	Area	Area %	Weight	Formula
		Ethylbenzene	952					ppb			106	C8H10
	10	Benzene	974	03:35.5	78	1680	16.9	ppb	7604281	70.867	78	C6H6
	19	Toluene	925	05:42.3	91	1536.8	26.08	ppb	1627429	15.167	92	C7H8
	42	m-Xylene	967	07:12.3	91	489.83	4.89	ppb	290131	2.7038	106	C8H10
	50	o-Xylene	955	07:41.1	91	751.88	9.36	ppb	918335	8.5583	106	C8H10
33.2	Peak #	Name	Similarity	R.T. (min:sec)	UniqueMass	S/N	Concentration	Conc. Units	Area	Area %	Weight	Formula
		Ethylbenzene	952					ppb			106	C8H10
		p-Xylene	967					ppb			106	C8H10
		m-Xylene	964					ppb			106	C8H10
	9	Benzene	974	03:34.7	52	557.11	21.99	ppb	7822891	78.196	78	C6H6
	22	Toluene	925	05:42.1	91	1444.7	14.3	ppb	1310379	13.098	92	C7H8
	50	o-Xylene	955	07:41.2	91	734.52	7.93	ppb	870886	8.7052	106	C8H10
33.3	Peak #	Name	Similarity	R.T. (min:sec)	UniqueMass	S/N	Concentration	Conc. Units	Area	Area %	Weight	Formula
		Ethylbenzene	952					ppb			106	C8H10
	9	Benzene	974	03:35.2	50	666.67	19.07	ppb	7697364	73.114	78	C6H6

	17	Toluene	925	05:42.4	91	1585.8	19.21	ppb	1442665	13.703	92	C7H8
	42	m-Xylene	967	07:12.4	91	487.61	3.79	ppb	257619	2.447	106	C8H10
	50	o-Xylene	955	07:41.2	91	747.98	7.98	ppb	872627	8.2887	106	C8H10
34.1	Peak #	Name	Similarity	R.T. (min:sec)	UniqueMass	S/N	Concentration	Conc. Units	Area	Area %	Weight	Formula
		Ethylbenzene	952					ppb			106	C8H10
	7	Benzene	974	03:33.9	51	488.35	-57.16	ppb	4421558	55.87	78	C6H6
	20	Toluene	925	05:41.4	91	1158.3	35.22	ppb	1873393	23.672	92	C7H8
	44	m-Xylene	967	07:12.1	91	362.29	14.2	ppb	563348	7.1183	106	C8H10
	52	o-Xylene	955	07:41.0	91	590.78	-3.5	ppb	492428	6.2222	106	C8H10
34.2	Peak #	Name	Similarity	R.T. (min:sec)	UniqueMass	S/N	Concentration	Conc. Units	Area	Area %	Weight	Formula
	8	Benzene	974	03:34.2	78	1467	-123.99	ppb	1550130	26.737	78	C6H6
	17	Toluene	925	05:41.6	91	1313.1	41.57	ppb	2044195	35.259	92	C7H8
	38	Ethylbenzene	952	07:01.8	91	207.21	13.66	ppb	555268	9.5775	106	C8H10
	42	m-Xylene	967	07:12.3	91	388.63	14.67	ppb	577010	9.9526	106	C8H10
	50	o-Xylene	955	07:41.1	91	639.39	-3.45	ppb	493987	8.5205	106	C8H10
34.3	Peak #	Name	Similarity	R.T. (min:sec)	UniqueMass	S/N	Concentration	Conc. Units	Area	Area %	Weight	Formula
		Ethylbenzene	952					ppb			106	C8H10
	8	Benzene	974	03:34.1	78	1390.3	-128.46	ppb	1358162	28.178	78	C6H6
	20	Toluene	925	05:41.6	91	1170.2	28.36	ppb	1688743	35.037	92	C7H8
	46	m-Xylene	967	07:12.1	91	357.48	13.11	ppb	531344	11.024	106	C8H10
	54	o-Xylene	955	07:41.1	91	608.28	3.08	ppb	710308	14.737	106	C8H10
35.1	Peak #	Name	Similarity	R.T. (min:sec)	UniqueMass	S/N	Concentration	Conc. Units	Area	Area %	Weight	Formula
	10	Benzene	974	03:35.4	52	875.49	102.42	ppb	11279041	72.253	78	C6H6
	26	Toluene	925	05:42.1	91	1544.8	42.12	ppb	2059084	13.19	92	C7H8
	48	Ethylbenzene	952	07:01.6	91	216.23	6.52	ppb	351329	2.2506	106	C8H10

	52	m-Xylene	967	07:12.1	91	351.63	7.52	ppb	367160	2.352	106	C8H10
	61	o-Xylene	955	07:41.0	91	767.48	17.46	ppb	1186697	7.6019	106	C8H10
35.2	Peak #	Name	Similarity	R.T. (min:sec)	UniqueMass	S/N	Concentration	Conc. Units	Area	Area %	Weight	Formula
		Ethylbenzene	952					ppb			106	C8H10
	9	Benzene	974	03:35.4	78	1932.1	137.76	ppb	12797499	76.506	78	C6H6
	25	Toluene	925	05:42.3	91	1596.7	32.83	ppb	1809039	10.815	92	C7H8
	55	m-Xylene	967	07:12.3	91	351.91	11.76	ppb	491660	2.9393	106	C8H10
	65	o-Xylene	955	07:41.0	91	777.52	15.97	ppb	1137495	6.8002	106	C8H10
35.3	Peak #	Name	Similarity	R.T. (min:sec)	UniqueMass	S/N	Concentration	Conc. Units	Area	Area %	Weight	Formula
		Ethylbenzene	952					ppb			106	C8H10
	10	Benzene	974	03:34.4	78	1934.1	95.8	ppb	10994410	74.787	78	C6H6
	24	Toluene	925	05:41.9	91	1533.1	28.64	ppb	1696378	11.539	92	C7H8
	51	m-Xylene	967	07:12.1	91	345.73	11.64	ppb	488056	3.3199	106	C8H10
	58	o-Xylene	955	07:41.0	91	755.88	12.85	ppb	1034131	7.0344	106	C8H10
36.1	Peak #	Name	Similarity	R.T. (min:sec)	UniqueMass	S/N	Concentration	Conc. Units	Area	Area %	Weight	Formula
		Ethylbenzene	952					ppb			106	C8H10
	9	Benzene	974	03:34.1	50	563.87	-0.08	ppb	6874431	66.217	78	C6H6
	19	Toluene	925	05:41.7	91	1247.4	23.67	ppb	1562580	15.051	92	C7H8
	44	m-Xylene	967	07:12.2	91	493.69	13.9	ppb	554317	5.3394	106	C8H10
	49	o-Xylene	955	07:41.1	91	686.06	6.87	ppb	836042	8.053	106	C8H10
36.2	Peak #	Name	Similarity	R.T. (min:sec)	UniqueMass	S/N	Concentration	Conc. Units	Area	Area %	Weight	Formula
		Ethylbenzene	952					ppb			106	C8H10
	10	Benzene	974	03:34.2	49	78.605	-65.6	ppb	4059153	54.871	78	C6H6
	21	Toluene	925	05:41.7	91	1234.2	26.68	ppb	1643502	22.216	92	C7H8
	48	m-Xylene	967	07:12.2	91	504.46	16.84	ppb	640656	8.6602	106	C8H10
	55	o-Xylene	955	07:41.1	91	690.93	-5.87	ppb	413726	5.5926	106	C8H10

36.3	Peak #	Name	Similarity	R.T. (min:sec)	UniqueMass	S/N	Concentration	Conc. Units	Area	Area %	Weight	Formula
		Ethylbenzene	952					ppb			106	C8H10
	11	Benzene	974	03:34.0	78	1429	119.53	ppb	1741509	32.62	78	C6H6
	22	Toluene	925	05:41.7	91	1292.1	25.89	ppb	1622330	30.388	92	C7H8
	45	m-Xylene	967	07:12.2	91	458.03	14.33	ppb	566916	10.619	106	C8H10
	52	o-Xylene	955	07:41.1	91	638.89	7.03	ppb	841106	15.755	106	C8H10
37.1	Peak #	Name	Similarity	R.T. (min:sec)	UniqueMass	S/N	Concentration	Conc. Units	Area	Area %	Weight	Formula
		Ethylbenzene	952					ppb			106	C8H10
	10	Benzene	974	03:35.1	78	1843.5	-28.31	ppb	5661446	61.475	78	C6H6
	25	Toluene	925	05:42.1	91	1429.2	32.68	ppb	1805087	19.601	92	C7H8
	48	m-Xylene	967	07:12.2	91	408.01	9.74	ppb	432489	4.6962	106	C8H10
	55	o-Xylene	955	07:40.9	73	503.02	8.14	ppb	877843	9.5321	106	C8H10
37.2	Peak #	Name	Similarity	R.T. (min:sec)	UniqueMass	S/N	Concentration	Conc. Units	Area	Area %	Weight	Formula
		Ethylbenzene	952					ppb			106	C8H10
	10	Benzene	974	03:35.5	52	651.5	60.69	ppb	9485602	73.139	78	C6H6
	24	Toluene	925	05:42.4	91	1325.3	23.78	ppb	1565501	12.071	92	C7H8
	47	m-Xylene	967	07:12.2	91	401.19	7.04	ppb	353195	2.7233	106	C8H10
	55	o-Xylene	955	07:41.0	38	20.325	18.22	ppb	1211853	9.344	106	C8H10
37.3	Peak #	Name	Similarity	R.T. (min:sec)	UniqueMass	S/N	Concentration	Conc. Units	Area	Area %	Weight	Formula
	9	Benzene	974	03:28.1	78	1418	-63.47	ppb	4150564	66.079	78	C6H6
	19	Toluene	925	05:38.6	91	937.84	-33.19	ppb	32728	0.52105	92	C7H8
	44	m-Xylene	952	07:11.2	91	277.8	11.2	ppb	485119	7.7234	106	C8H10
	50	o-Xylene	955	07:40.4	91	495.29	1.03	ppb	642525	10.229	106	C8H10
38.1	Peak #	Name	Similarity	R.T. (min:sec)	UniqueMass	S/N	Concentration	Conc. Units	Area	Area %	Weight	Formula

		Ethylbenzene	952					ppb			106	C8H10
	7	Benzene	974	03:34.5	38	99.355	-53.48	ppb	4580090	57.015	78	C6H6
	20	Toluene	925	05:41.7	91	1074.9	23.94	ppb	1569952	19.543	92	C7H8
	47	m-Xylene	967	07:12.3	91	267.16	15.93	ppb	613931	7.6425	106	C8H10
	55	o-Xylene	955	07:41.2	91	575.91	1.42	ppb	655222	8.1565	106	C8H10
38.2	Peak #	Name	Similarity	R.T. (min:sec)	UniqueMass	S/N	Concentration	Conc. Units	Area	Area %	Weight	Formula
		Ethylbenzene	952					ppb			106	C8H10
	7	Benzene	974	03:34.5	78	1481.6	-53.56	ppb	4576386	64.677	78	C6H6
	18	Toluene	925	05:41.8	91	1156.1	33.34	ppb	1822699	25.76	92	C7H8
	42	m-Xylene	967	07:12.2	91	252.27	1.09	ppb	178571	2.5237	106	C8H10
	51	o-Xylene	955	07:41.2	91	536.11	-8.71	ppb	319526	4.5158	106	C8H10
38.3	Peak #	Name	Similarity	R.T. (min:sec)	UniqueMass	S/N	Concentration	Conc. Units	Area	Area %	Weight	Formula
		Ethylbenzene	952					ppb			106	C8H10
		p-Xylene	967					ppb			106	C8H10
		m-Xylene	964					ppb			106	C8H10
	9	Benzene	974	03:33.6	78	1437.9	-72.36	ppb	3768497	60.262	78	C6H6
	20	Toluene	925	05:41.4	91	1083.7	36.44	ppb	1906089	30.48	92	C7H8
	51	o-Xylene	955	07:41.1	91	541.81	-0.88	ppb	578943	9.2579	106	C8H10
39.1	Peak #	Name	Similarity	R.T. (min:sec)	UniqueMass	S/N	Concentration	Conc. Units	Area	Area %	Weight	Formula
		Ethylbenzene	952					ppb			106	C8H10
	10	Benzene	974	03:35.0	27	75.571	45.26	ppb	8822673	77.962	78	C6H6
	20	Toluene	925	05:42.0	91	1238	8.11	ppb	1143796	10.107	92	C7H8
	45	m-Xylene	967	07:12.2	91	403.63	8.49	ppb	395521	3.495	106	C8H10
	52	o-Xylene	955	07:41.1	91	650.71	-1.48	ppb	559149	4.9409	106	C8H10
39.2	Peak #	Name	Similarity	R.T. (min:sec)	UniqueMass	S/N	Concentration	Conc. Units	Area	Area %	Weight	Formula
		Ethylbenzene	952					ppb			106	C8H10

	9	Benzene	974	03:33.7	50	563.15	-142	ppb	776030	24.897	78	C6H6
	21	Toluene	925	05:41.6	91	1226.9	8.98	ppb	1167256	37.449	92	C7H8
	46	m-Xylene	967	07:12.1	91	415.83	8.48	ppb	395377	12.685	106	C8H10
	56	o-Xylene	955	07:41.1	91	641.49	-6.8	ppb	382917	12.285	106	C8H10
39.3	Peak #	Name	Similarity	R.T. (min:sec)	UniqueMass	S/N	Concentration	Conc. Units	Area	Area %	Weight	Formula
		Ethylbenzene	952					ppb			106	C8H10
	11	Benzene	974	03:35.0	78	1731.5	41.45	ppb	8659176	78.437	78	C6H6
	24	Toluene	925	05:42.3	91	1387.7	4.21	ppb	1038860	9.4102	92	C7H8
	50	m-Xylene	967	07:12.3	91	404.03	7.94	ppb	379643	3.4389	106	C8H10
	57	o-Xylene	955	07:41.2	91	654.17	-0.78	ppb	582384	5.2754	106	C8H10
40.1	Peak #	Name	Similarity	R.T. (min:sec)	UniqueMass	S/N	Concentration	Conc. Units	Area	Area %	Weight	Formula
		Ethylbenzene	952					ppb			106	C8H10
		p-Xylene	967					ppb			106	C8H10
		m-Xylene	964					ppb			106	C8H10
	9	Benzene	974	03:33.6	78	1669.5	16.06	ppb	7568023	81.101	78	C6H6
	20	Toluene	925	05:41.6	91	1252.2	11.39	ppb	1232033	13.203	92	C7H8
	52	o-Xylene	955	07:41.0	91	619.65	-2.31	ppb	531556	5.6963	106	C8H10
40.2	Peak #	Name	Similarity	R.T. (min:sec)	UniqueMass	S/N	Concentration	Conc. Units	Area	Area %	Weight	Formula
		Ethylbenzene	952					ppb			106	C8H10
		p-Xylene	967					ppb			106	C8H10
		m-Xylene	964					ppb			106	C8H10
	9	Benzene	974	03:32.2	78	1677	-2.55	ppb	6768509	89.912	78	C6H6
	19	Toluene	925	05:41.1	91	1178.2	-27.15	ppb	195065	2.5912	92	C7H8
	50	o-Xylene	955	07:40.9	91	566.5	-1.33	ppb	564316	7.4963	106	C8H10
40.3	Peak #	Name	Similarity	R.T. (min:sec)	UniqueMass	S/N	Concentration	Conc. Units	Area	Area %	Weight	Formula
		Ethylbenzene	952					ppb			106	C8H10

		p-Xylene	967					ppb			106	C8H10
	11	Benzene	974	03:35.0	78	1650	48.98	ppb	8879270	81.601	78	C6H6
	26	Toluene	925	05:42.1	91	1306.3	7.9	ppb	1147394	10.545	92	C7H8
	50	m-Xylene	964	07:12.3	91	352.15	6.43	ppb	260441	2.3935	106	C8H10
	56	o-Xylene	955	07:41.1	91	621.92	-0.42	ppb	594264	5.4613	106	C8H10
41.1	Peak #	Name	Similarity	R.T. (min:sec)	UniqueMass	S/N	Concentration	Conc. Units	Area	Area %	Weight	Formula
		Ethylbenzene	952					ppb			106	C8H10
	9	Benzene	974	03:34.5	78	1985.4	112.71	ppb	11720999	71.823	78	C6H6
	20	Toluene	925	05:41.8	91	1806.4	38.95	ppb	1973684	12.094	92	C7H8
	50	m-Xylene	967	07:12.2	91	429.99	22.37	ppb	803041	4.9208	106	C8H10
	57	o-Xylene	955	07:41.0	91	860.71	12.38	ppb	1018475	6.2409	106	C8H10
41.2	Peak #	Name	Similarity	R.T. (min:sec)	UniqueMass	S/N	Concentration	Conc. Units	Area	Area %	Weight	Formula
		Ethylbenzene	952					ppb			106	C8H10
	13	Benzene	974	03:34.3	78	1920.5	157.3	ppb	13637182	76.612	78	C6H6
	24	Toluene	925	05:41.7	91	1711.7	35.59	ppb	1883267	10.58	92	C7H8
	51	m-Xylene	967	07:12.1	91	410.17	15.48	ppb	600724	3.3748	106	C8H10
	59	o-Xylene	955	07:41.0	91	797.64	14.19	ppb	1078443	6.0586	106	C8H10
41.3	Peak #	Name	Similarity	R.T. (min:sec)	UniqueMass	S/N	Concentration	Conc. Units	Area	Area %	Weight	Formula
		Ethylbenzene	952					ppb			106	C8H10
	9	Benzene	974	03:34.6	78	2245.2	173.34	ppb	14326152	72.76	78	C6H6
	21	Toluene	925	05:42.0	91	1771.2	22.61	ppb	1533924	7.7905	92	C7H8
	46	m-Xylene	967	07:12.1	91	372.03	36.95	ppb	1230771	6.2509	106	C8H10
	54	o-Xylene	955	07:41.0	91	747.98	22.93	ppb	1367997	6.9478	106	C8H10
42.1	Peak #	Name	Similarity	R.T. (min:sec)	UniqueMass	S/N	Concentration	Conc. Units	Area	Area %	Weight	Formula
		Ethylbenzene	952					ppb			106	C8H10

	8	Benzene	974	03:33.8	78	1752.4	-8.65	ppb	6506089	66.384	78	C6H6
	20	Toluene	925	05:41.5	91	1356.4	20.99	ppb	1490571	15.209	92	C7H8
	46	m-Xylene	967	07:12.1	91	354.17	16.04	ppb	617259	6.2981	106	C8H10
	53	o-Xylene	955	07:41.0	91	652.45	-1.17	ppb	569550	5.8113	106	C8H10
42.2	Peak #	Name	Similarity	R.T. (min:sec)	UniqueMass	S/N	Concentration	Conc. Units	Area	Area %	Weight	Formula
	10	Benzene	974	03:33.3	78	1988.1	19.32	ppb	7708164	71.524	78	C6H6
	25	Toluene	925	05:41.2	91	1749.2	28.53	ppb	1693385	15.713	92	C7H8
	48	Ethylbenzene	952	07:01.4	91	216.29	4.02	ppb	279872	2.5969	106	C8H10
	52	m-Xylene	967	07:11.9	91	313.13	3.86	ppb	259886	2.4115	106	C8H10
	59	o-Xylene	955	07:40.9	91	540.2	-0.98	ppb	575861	5.3434	106	C8H10
42.3	Peak #	Name	Similarity	R.T. (min:sec)	UniqueMass	S/N	Concentration	Conc. Units	Area	Area %	Weight	Formula
		Ethylbenzene	952					ppb			106	C8H10
		p-Xylene	967					ppb			106	C8H10
		m-Xylene	964					ppb			106	C8H10
	10	Benzene	974	03:33.9	78	1752.6	24.94	ppb	7949753	80.323	78	C6H6
	20	Toluene	925	05:41.7	91	1180.4	15.38	ppb	1339481	13.534	92	C7H8
	49	o-Xylene	955	07:41.0	91	678.07	-0.01	ppb	607990	6.143	106	C8H10
43.1	Peak #	Name	Similarity	R.T. (min:sec)	UniqueMass	S/N	Concentration	Conc. Units	Area	Area %	Weight	Formula
		p-Xylene	967					ppb			106	C8H10
		m-Xylene	964					ppb			106	C8H10
	11	Benzene	974	03:35.0	78	1452	7.15	ppb	7185195	78.206	78	C6H6
	21	Toluene	925	05:42.1	91	1215.6	15.54	ppb	1343940	14.628	92	C7H8
	56	o-Xylene	955	07:41.1	91	688.45	1.51	ppb	658428	7.1665	106	C8H10
43.2	Peak #	Name	Similarity	R.T. (min:sec)	UniqueMass	S/N	Concentration	Conc. Units	Area	Area %	Weight	Formula
	10	Benzene	974	03:34.6	78	1581.6	13.04	ppb	7438109	73.754	78	C6H6
	20	Toluene	925	05:42.0	91	1179.3	1.46	ppb	965005	9.5687	92	C7H8

	48	m-Xylene	967	07:12.3	91	401.76	12.59	ppb	515932	5.1158	106	C8H10
	57	o-Xylene	955	07:41.1	91	627.31	1.26	ppb	650035	6.4456	106	C8H10
43.3	Peak #	Name	Similarity	R.T. (min:sec)	UniqueMass	S/N	Concentration	Conc. Units	Area	Area %	Weight	Formula
		Ethylbenzene	952					ppb			106	C8H10
	10	Benzene	974	03:35.0	78	1561.6	13.37	ppb	7452462	73.79	78	C6H6
	21	Toluene	925	05:42.3	91	1262.3	9.27	ppb	1175059	11.635	92	C7H8
	49	m-Xylene	967	07:12.4	91	412.86	8.43	ppb	393862	3.8998	106	C8H10
	59	o-Xylene	955	07:41.2	91	647.07	2.3	ppb	684288	6.7754	106	C8H10
44.1	Peak #	Name	Similarity	R.T. (min:sec)	UniqueMass	S/N	Concentration	Conc. Units	Area	Area %	Weight	Formula
	11	Benzene	974	03:34.3	74	104.73	56.7	ppb	9314369	77.266	78	C6H6
	19	Toluene	925	05:41.6	91	1123.9	14.93	ppb	1327413	11.011	92	C7H8
	40	Ethylbenzene	952	07:01.5	91	140.53	1.24	ppb	200649	1.6645	106	C8H10
	45	m-Xylene	967	07:12.0	91	265.37	12.51	ppb	513511	4.2598	106	C8H10
	54	o-Xylene	955	07:40.9	91	557.35	-12.76	ppb	185497	1.5388	106	C8H10
44.2	Peak #	Name	Similarity	R.T. (min:sec)	UniqueMass	S/N	Concentration	Conc. Units	Area	Area %	Weight	Formula
		Ethylbenzene	952					ppb			106	C8H10
		p-Xylene	967					ppb			106	C8H10
		m-Xylene	964					ppb			106	C8H10
	10	Benzene	974	03:35.9	78	1527.5	48.25	ppb	8951156	84.417	78	C6H6
	21	Toluene	925	05:42.4	91	1185.4	6.82	ppb	1109129	10.46	92	C7H8
	56	o-Xylene	955	07:41.0	91	594.47	-1.96	ppb	543255	5.1233	106	C8H10
44.3	Peak #	Name	Similarity	R.T. (min:sec)	UniqueMass	S/N	Concentration	Conc. Units	Area	Area %	Weight	Formula
		Ethylbenzene	952					ppb			106	C8H10
		p-Xylene	967					ppb			106	C8H10
		m-Xylene	964					ppb			106	C8H10
	9	Benzene	974	03:35.5	37	128.67	87.67	ppb	10645053	86.415	78	C6H6

	20	Toluene	925	05:42.3	91	1155	2.21	ppb	985047	7.9965	92	C7H8
	52	o-Xylene	955	07:40.9	91	548.36	2.42	ppb	688407	5.5884	106	C8H10
45.1	Peak #	Name	Similarity	R.T. (min:sec)	UniqueMass	S/N	Concentration	Conc. Units	Area	Area %	Weight	Formula
		Ethylbenzene	952					ppb			106	C8H10
	10	Benzene	974	03:36.7	50	661.82	-29.32	ppb	5617853	67.826	78	C6H6
	22	Toluene	925	05:43.1	91	1443.6	20.73	ppb	1483527	17.911	92	C7H8
	46	m-Xylene	967	07:12.7	91	395.24	3.59	ppb	251767	3.0397	106	C8H10
	54	o-Xylene	955	07:41.4	91	727.1	2.1	ppb	677807	8.1834	106	C8H10
45.2	Peak #	Name	Similarity	R.T. (min:sec)	UniqueMass	S/N	Concentration	Conc. Units	Area	Area %	Weight	Formula
		Ethylbenzene	952					ppb			106	C8H10
		p-Xylene	967					ppb			106	C8H10
		m-Xylene	964					ppb			106	C8H10
	9	Benzene	974	03:34.3	52	536.11	-65.56	ppb	4060871	64.449	78	C6H6
	21	Toluene	925	05:41.7	91	1135.5	32.25	ppb	1793546	28.465	92	C7H8
	55	o-Xylene	955	07:41.1	91	591.29	-4.88	ppb	446521	7.0866	106	C8H10
45.3	Peak #	Name	Similarity	R.T. (min:sec)	UniqueMass	S/N	Concentration	Conc. Units	Area	Area %	Weight	Formula
		Ethylbenzene	952					ppb			106	C8H10
		p-Xylene	967					ppb			106	C8H10
		m-Xylene	964					ppb			106	C8H10
	8	Benzene	974	03:30.0	49	61.005	-124.35	ppb	1534747	39.644	78	C6H6
	18	Toluene	925	05:39.4	91	753.5	27.95	ppb	1677634	43.335	92	C7H8
	52	o-Xylene	955	07:40.7	91	475.73	1.53	ppb	658915	17.021	106	C8H10
46.1	Peak #	Name	Similarity	R.T. (min:sec)	UniqueMass	S/N	Concentration	Conc. Units	Area	Area %	Weight	Formula
	11	Benzene	974	03:35.1	78	1618.8	-12.49	ppb	6341080	62.365	78	C6H6
	24	Toluene	925	05:42.1	91	1307.5	24.13	ppb	1574907	15.489	92	C7H8

	50	p-Xylene	952	07:07.9	91	174.13	11.01	ppb	479610	4.717	106	C8H10
	51	m-Xylene	964	07:12.4	91	517.12	10.95	ppb	405058	3.9838	106	C8H10
	61	o-Xylene	955	07:41.2	91	708.43	8.43	ppb	887481	8.7284	106	C8H10
46.2	Peak #	Name	Similarity	R.T. (min:sec)	UniqueMass	S/N	Concentration	Conc. Units	Area	Area %	Weight	Formula
		Ethylbenzene	952					ppb			106	C8H10
	9	Benzene	974	03:34.3	51	526.67	-13.52	ppb	6297102	68.514	78	C6H6
	20	Toluene	925	05:42.0	91	1262.6	20.97	ppb	1489971	16.211	92	C7H8
	44	m-Xylene	967	07:12.3	91	469.05	4.04	ppb	265010	2.8834	106	C8H10
	52	o-Xylene	955	07:41.2	91	657.8	8.02	ppb	873857	9.5078	106	C8H10
46.3	Peak #	Name	Similarity	R.T. (min:sec)	UniqueMass	S/N	Concentration	Conc. Units	Area	Area %	Weight	Formula
	8	Benzene	974	03:34.7	78	1491	25.7	ppb	7982370	70.177	78	C6H6
	18	Toluene	925	05:42.1	91	1266.1	22.82	ppb	1539736	13.537	92	C7H8
	43	p-Xylene	952	07:07.7	91	159.83	9.57	ppb	438592	3.8559	106	C8H10
	44	m-Xylene	964	07:12.3	91	479.49	11.09	ppb	409394	3.5992	106	C8H10
	54	o-Xylene	955	07:41.2	91	650.95	-1.28	ppb	565982	4.9758	106	C8H10
Sample no.	**Back Section**											
1.1	Peak #	Name	Similarity	R.T. (min:sec)	UniqueMass	S/N	Concentration	Conc. Units	Area	Area %	Weight	Formula
		Ethylbenzene	952					ppb			106	C8H10
		p-Xylene	967					ppb			106	C8H10
		m-Xylene	964					ppb			106	C8H10
	10	Benzene	974	03:34.5	78	2098.2	83.23	ppb	10454144	79.413	78	C6H6
	27	Toluene	925	05:41.7	91	1589.1	40.33	ppb	2010786	15.275	92	C7H8
	62	o-Xylene	955	07:41.0	91	774.16	2.75	ppb	699295	5.3121	106	C8H10
1.2	Peak #	Name	Similarity	R.T. (min:sec)	UniqueMass	S/N	Concentration	Conc.	Area	Area %	Weight	Formula

								Units				
		Ethylbenzene	952					ppb			106	C8H10
		p-Xylene	967					ppb			106	C8H10
		m-Xylene	964					ppb			106	C8H10
	7	Benzene	974	03:32.2	78	1913.3	76.01	ppb	10144209	80.471	78	C6H6
	16	Toluene	925	05:40.8	91	1502.4	32.62	ppb	1803433	14.306	92	C7H8
	50	o-Xylene	955	07:40.7	91	692.29	1.51	ppb	658327	5.2223	106	C8H10
1.3	Peak #	Name	Similarity	R.T. (min:sec)	UniqueMass	S/N	Concentration	Conc. Units	Area	Area %	Weight	Formula
		Ethylbenzene	952					ppb			106	C8H10
	10	Benzene	974	03:34.3	78	1842.4	75.57	ppb	10125194	76.387	78	C6H6
	20	Toluene	925	05:41.8	91	1544.9	22.65	ppb	1535124	11.581	92	C7H8
	48	m-Xylene	967	07:12.1	91	318.47	10.78	ppb	462990	3.4929	106	C8H10
	56	o-Xylene	955	07:41.0	91	736.02	1.83	ppb	668818	5.0457	106	C8H10
2.1	Peak #	Name	Similarity	R.T. (min:sec)	UniqueMass	S/N	Concentration	Conc. Units	Area	Area %	Weight	Formula
		Ethylbenzene	952					ppb			106	C8H10
		p-Xylene	967					ppb			106	C8H10
		m-Xylene	964					ppb			106	C8H10
	8	Benzene	974	03:29.2	52	395.42	-134.16	ppb	1112891	57.049	78	C6H6
	19	Toluene	925	05:39.1	91	633.69	-19.96	ppb	388517	19.916	92	C7H8
	48	o-Xylene	955	07:40.7	91	379.46	-4.79	ppb	449367	23.035	106	C8H10
2.2	Peak #	Name	Similarity	R.T. (min:sec)	UniqueMass	S/N	Concentration	Conc. Units	Area	Area %	Weight	Formula
		Ethylbenzene	952					ppb			106	C8H10
		p-Xylene	967					ppb			106	C8H10
		m-Xylene	964					ppb			106	C8H10
	10	Benzene	974	03:34.0	52	481.83	-73.24	ppb	3730664	70.212	78	C6H6
	22	Toluene	925	05:41.7	91	1005.7	4.31	ppb	1041652	19.604	92	C7H8

	56	o-Xylene	955	07:41.1	91	563.31	-2.03	ppb	541120	10.184	106	C8H10
2.3	Peak #	Name	Similarity	R.T. (min:sec)	UniqueMass	S/N	Concentration	Conc. Units	Area	Area %	Weight	Formula
		Ethylbenzene	952					ppb			106	C8H10
		p-Xylene	967					ppb			106	C8H10
		m-Xylene	964					ppb			106	C8H10
	10	Benzene	974	03:34.9	52	497.53	9.87	ppb	7302046	81.067	78	C6H6
	19	Toluene	925	05:42.1	91	1067.5	8.62	ppb	1157713	12.853	92	C7H8
	54	o-Xylene	955	07:41.1	91	532.15	-1.83	ppb	547708	6.0806	106	C8H10
3.1	Peak #	Name	Similarity	R.T. (min:sec)	UniqueMass	S/N	Concentration	Conc. Units	Area	Area %	Weight	Formula
		Ethylbenzene	952					ppb			106	C8H10
		p-Xylene	967					ppb			106	C8H10
		m-Xylene	964					ppb			106	C8H10
	9	Benzene	974	03:35.7	50	736.92	-5.91	ppb	6623908	76.145	78	C6H6
	21	Toluene	925	05:42.3	91	1522.8	23.18	ppb	1549517	17.812	92	C7H8
	54	o-Xylene	955	07:41.0	91	515.5	-2.49	ppb	525679	6.0429	106	C8H10
3.2	Peak #	Name	Similarity	R.T. (min:sec)	UniqueMass	S/N	Concentration	Conc. Units	Area	Area %	Weight	Formula
		Ethylbenzene	952					ppb			106	C8H10
		p-Xylene	967					ppb			106	C8H10
		m-Xylene	964					ppb			106	C8H10
	11	Benzene	974	03:35.4	50	718.86	49.63	ppb	9010524	81.437	78	C6H6
	24	Toluene	925	05:42.3	91	1608.1	27.52	ppb	1666122	15.058	92	C7H8
	58	o-Xylene	955	07:41.0	91	550.48	-6.65	ppb	387822	3.5051	106	C8H10
3.3	Peak #	Name	Similarity	R.T. (min:sec)	UniqueMass	S/N	Concentration	Conc. Units	Area	Area %	Weight	Formula
		Ethylbenzene	952					ppb			106	C8H10
		p-Xylene	967					ppb			106	C8H10
		m-Xylene	964					ppb			106	C8H10

	14	Benzene	974	03:35.9	50	712.18	-138.92	ppb	908505	30.245	78	C6H6
	28	Toluene	925	05:42.6	91	1535.1	22.84	ppb	1540178	51.274	92	C7H8
	61	o-Xylene	955	07:41.0	91	507.46	-1.6	ppb	555111	18.48	106	C8H10
4.1	Peak #	Name	Similarity	R.T. (min:sec)	UniqueMass	S/N	Concentration	Conc. Units	Area	Area %	Weight	Formula
		Ethylbenzene	952					ppb			106	C8H10
		p-Xylene	967					ppb			106	C8H10
		m-Xylene	964					ppb			106	C8H10
	10	Benzene	974	03:35.5	52	624.64	10.43	ppb	7326206	80.161	78	C6H6
	21	Toluene	925	05:42.3	91	1283	22.67	ppb	1535678	16.803	92	C7H8
	52	o-Xylene	955	07:41.0	91	436.86	-9.98	ppb	277491	3.0362	106	C8H10
4.2	Peak #	Name	Similarity	R.T. (min:sec)	UniqueMass	S/N	Concentration	Conc. Units	Area	Area %	Weight	Formula
		Ethylbenzene	952					ppb			106	C8H10
		p-Xylene	967					ppb			106	C8H10
		m-Xylene	964					ppb			106	C8H10
	12	Benzene	974	03:36.6	52	657.86	9.34	ppb	7279113	85.993	78	C6H6
	22	Toluene	925	05:42.8	91	1382.8	3.95	ppb	1031896	12.191	92	C7H8
	52	o-Xylene	955	07:41.0	91	485.8	-13.72	ppb	153729	1.8161	106	C8H10
4.3	Peak #	Name	Similarity	R.T. (min:sec)	UniqueMass	S/N	Concentration	Conc. Units	Area	Area %	Weight	Formula
		Ethylbenzene	952					ppb			106	C8H10
		p-Xylene	967					ppb			106	C8H10
		m-Xylene	964					ppb			106	C8H10
	11	Benzene	974	03:34.7	50	687.33	13.96	ppb	7477763	82.588	78	C6H6
	20	Toluene	925	05:42.0	91	1272.2	15.08	ppb	1331316	14.704	92	C7H8
	54	o-Xylene	955	07:40.9	91	442	-10.96	ppb	245165	2.7077	106	C8H10
5.1	Peak #	Name	Similarity	R.T. (min:sec)	UniqueMass	S/N	Concentration	Conc. Units	Area	Area %	Weight	Formula

		Ethylbenzene	952					ppb			106	C8H10
		p-Xylene	967					ppb			106	C8H10
		m-Xylene	964					ppb			106	C8H10
		o-Xylene	955					ppb			106	C8H10
	11	Benzene	974	03:33.8	78	1507.9	38.59	ppb	8536040	85.607	78	C6H6
	19	Toluene	925	05:41.3	91	1225.1	18.94	ppb	1435198	14.393	92	C7H8
5.2	Peak #	Name	Similarity	R.T. (min:sec)	UniqueMass	S/N	Concentration	Conc. Units	Area	Area %	Weight	Formula
		Toluene	925					ppb			92	C7H8
		Ethylbenzene	952					ppb			106	C8H10
		p-Xylene	967					ppb			106	C8H10
		m-Xylene	964					ppb			106	C8H10
		o-Xylene	955					ppb			106	C8H10
	12	Benzene	974	03:28.3	52	381.11	-97.59	ppb	2684309	100	78	C6H6
5.3	Peak #	Name	Similarity	R.T. (min:sec)	UniqueMass	S/N	Concentration	Conc. Units	Area	Area %	Weight	Formula
		Ethylbenzene	952					ppb			106	C8H10
		p-Xylene	967					ppb			106	C8H10
		m-Xylene	964					ppb			106	C8H10
	10	Benzene	974	03:35.3	78	1676.7	40.86	ppb	8633762	85.384	78	C6H6
	24	Toluene	925	05:42.1	91	1381.1	13.75	ppb	1295785	12.815	92	C7H8
	56	o-Xylene	955	07:41.0	91	473.95	-12.86	ppb	182139	1.8013	106	C8H10
6.1	Peak #	Name	Similarity	R.T. (min:sec)	UniqueMass	S/N	Concentration	Conc. Units	Area	Area %	Weight	Formula
		Ethylbenzene	952					ppb			106	C8H10
		p-Xylene	967					ppb			106	C8H10
		m-Xylene	964					ppb			106	C8H10
	8	Benzene	974	03:28.4	74	73.753	-130.28	ppb	1279935	76.233	78	C6H6
	14	Toluene	925	05:38.7	91	785.11	-32.64	ppb	47583	2.834	92	C7H8

	39	o-Xylene	955	07:40.5	91	390.35	-7.75	ppb	351461	20.933	106	C8H10
6.2	Peak #	Name	Similarity	R.T. (min:sec)	UniqueMass	S/N	Concentration	Conc. Units	Area	Area %	Weight	Formula
		Ethylbenzene	952					ppb			106	C8H10
		p-Xylene	967					ppb			106	C8H10
		m-Xylene	964					ppb			106	C8H10
	10	Benzene	974	03:33.8	78	1552.9	24.8	ppb	7943607	80.241	78	C6H6
	22	Toluene	925	05:41.6	91	1205.9	11.61	ppb	1238086	12.506	92	C7H8
	51	o-Xylene	955	07:40.9	91	528.09	3.31	ppb	717940	7.2522	106	C8H10
6.3	Peak #	Name	Similarity	R.T. (min:sec)	UniqueMass	S/N	Concentration	Conc. Units	Area	Area %	Weight	Formula
		Ethylbenzene	952					ppb			106	C8H10
		p-Xylene	967					ppb			106	C8H10
		m-Xylene	964					ppb			106	C8H10
	10	Benzene	974	03:33.5	37	126.31	35.88	ppb	8419879	85.601	78	C6H6
	16	Toluene	925	05:41.5	91	1266	9.8	ppb	1189425	12.092	92	C7H8
	44	o-Xylene	955	07:41.0	91	496	-11.51	ppb	226856	2.3063	106	C8H10
7.1	Peak #	Name	Similarity	R.T. (min:sec)	UniqueMass	S/N	Concentration	Conc. Units	Area	Area %	Weight	Formula
		Ethylbenzene	952					ppb			106	C8H10
		p-Xylene	967					ppb			106	C8H10
		m-Xylene	964					ppb			106	C8H10
	11	Benzene	974	03:36.4	52	670.8	20.22	ppb	7746773	83.843	78	C6H6
	23	Toluene	925	05:42.5	91	1348.2	5.32	ppb	1068954	11.569	92	C7H8
	54	o-Xylene	955	07:40.9	91	457.16	-5.56	ppb	423934	4.5882	106	C8H10
7.2	Peak #	Name	Similarity	R.T. (min:sec)	UniqueMass	S/N	Concentration	Conc. Units	Area	Area %	Weight	Formula
		Ethylbenzene	952					ppb			106	C8H10
		p-Xylene	967					ppb			106	C8H10
		m-Xylene	964					ppb			106	C8H10

	11	Benzene	974	03:36.4	50	761.24	-12.38	ppb	6345955	80.611	78	C6H6
	22	Toluene	925	05:42.7	91	1420.6	5.12	ppb	1063535	13.51	92	C7H8
	52	o-Xylene	955	07:41.0	91	510.45	-4.39	ppb	462862	5.8796	106	C8H10
7.3	Peak #	Name	Similarity	R.T. (min:sec)	UniqueMass	S/N	Concentration	Conc. Units	Area	Area %	Weight	Formula
		Ethylbenzene	952					ppb			106	C8H10
		p-Xylene	967					ppb			106	C8H10
		m-Xylene	964					ppb			106	C8H10
	10	Benzene	974	03:33.6	39	171.01	17.45	ppb	7627524	86.169	78	C6H6
	20	Toluene	925	05:41.6	91	1326.5	5	ppb	1060339	11.979	92	C7H8
	49	o-Xylene	955	07:40.9	91	483.82	-13.41	ppb	163960	1.8523	106	C8H10
8.1	Peak #	Name	Similarity	R.T. (min:sec)	UniqueMass	S/N	Concentration	Conc. Units	Area	Area %	Weight	Formula
	9	Benzene	974	03:28.6	50	801.73	62.87	ppb	9579539	66.735	78	C6H6
	22	Toluene	925	05:38.7	91	1404.4	14.35	ppb	1311695	9.1378	92	C7H8
	44	m-Xylene	952	07:11.3	91	509.33	19.11	ppb	710972	4.9529	106	C8H10
	52	o-Xylene	955	07:40.5	91	721.57	21.8	ppb	1330506	9.2688	106	C8H10
8.2	Peak #	Name	Similarity	R.T. (min:sec)	UniqueMass	S/N	Concentration	Conc. Units	Area	Area %	Weight	Formula
		Ethylbenzene	952					ppb			106	C8H10
	11	Benzene	974	03:34.5	78	2101.2	58.33	ppb	9384409	65.081	78	C6H6
	24	Toluene	925	05:41.8	91	2061.8	28.19	ppb	1684167	11.68	92	C7H8
	50	m-Xylene	967	07:12.1	91	692.22	25.76	ppb	902363	6.2579	106	C8H10
	60	o-Xylene	955	07:41.0	73	1925.2	28.31	ppb	1546239	10.723	106	C8H10
8.3	Peak #	Name	Similarity	R.T. (min:sec)	UniqueMass	S/N	Concentration	Conc. Units	Area	Area %	Weight	Formula
		Ethylbenzene	952					ppb			106	C8H10
	15	Benzene	974	03:36.6	52	920.25	63.82	ppb	9620204	67.48	78	C6H6
	31	Toluene	925	05:42.8	91	1946.7	28.59	ppb	1695060	11.89	92	C7H8
	60	m-Xylene	967	07:12.3	91	698.23	14.84	ppb	581994	4.0823	106	C8H10

	69	o-Xylene	955	07:41.0	73	1807.4	35.28	ppb	1777206	12.466	106	C8H10
9.1	Peak #	Name	Similarity	R.T. (min:sec)	UniqueMass	S/N	Concentration	Conc. Units	Area	Area %	Weight	Formula
		Ethylbenzene	952					ppb			106	C8H10
		p-Xylene	967					ppb			106	C8H10
		m-Xylene	964					ppb			106	C8H10
	9	Benzene	974	03:35.4	52	648.9	-12.37	ppb	6346579	80.87	78	C6H6
	20	Toluene	925	05:42.2	91	1292.6	4.99	ppb	1060094	13.508	92	C7H8
	49	o-Xylene	955	07:41.0	91	578.25	-5.04	ppb	441248	5.6225	106	C8H10
9.2	Peak #	Name	Similarity	R.T. (min:sec)	UniqueMass	S/N	Concentration	Conc. Units	Area	Area %	Weight	Formula
		Ethylbenzene	952					ppb			106	C8H10
		p-Xylene	967					ppb			106	C8H10
		m-Xylene	964					ppb			106	C8H10
	8	Benzene	974	03:28.0	51	558.38	-98.22	ppb	2657295	77.763	78	C6H6
	17	Toluene	925	05:38.6	91	859.59	-23.15	ppb	302896	8.864	92	C7H8
	46	o-Xylene	955	07:40.4	91	408.57	-4.56	ppb	456977	13.373	106	C8H10
9.3	Peak #	Name	Similarity	R.T. (min:sec)	UniqueMass	S/N	Concentration	Conc. Units	Area	Area %	Weight	Formula
		Ethylbenzene	952					ppb			106	C8H10
		p-Xylene	967					ppb			106	C8H10
		m-Xylene	964					ppb			106	C8H10
	12	Benzene	974	03:34.7	78	1743.4	-36.14	ppb	5324807	74.579	78	C6H6
	22	Toluene	925	05:41.8	91	1210.2	8.2	ppb	1146303	16.055	92	C7H8
	51	o-Xylene	955	07:40.9	91	509.99	1.82	ppb	668676	9.3655	106	C8H10
10.1	Peak #	Name	Similarity	R.T. (min:sec)	UniqueMass	S/N	Concentration	Conc. Units	Area	Area %	Weight	Formula
		Ethylbenzene	952					ppb			106	C8H10
		p-Xylene	967					ppb			106	C8H10

		m-Xylene	964					ppb			106	C8H10
	12	Benzene	974	03:35.3	78	1752	9.92	ppb	7304323	80.999	78	C6H6
	22	Toluene	925	05:42.1	91	1532.2	23.11	ppb	1547493	17.16	92	C7H8
	55	o-Xylene	955	07:40.9	91	482.69	-13.35	ppb	166016	1.841	106	C8H10
10.2	Peak #	Name	Similarity	R.T. (min:sec)	UniqueMass	S/N	Concentration	Conc. Units	Area	Area %	Weight	Formula
		Ethylbenzene	952					ppb			106	C8H10
		p-Xylene	967					ppb			106	C8H10
		m-Xylene	964					ppb			106	C8H10
	12	Benzene	974	03:35.0	50	691.96	7.49	ppb	7199883	80.145	78	C6H6
	25	Toluene	925	05:42.1	91	1507.2	26.93	ppb	1650345	18.371	92	C7H8
	61	o-Xylene	955	07:41.0	91	531.63	-14.33	ppb	133384	1.4847	106	C8H10
10.3	Peak #	Name	Similarity	R.T. (min:sec)	UniqueMass	S/N	Concentration	Conc. Units	Area	Area %	Weight	Formula
		Ethylbenzene	952					ppb			106	C8H10
		p-Xylene	967					ppb			106	C8H10
		m-Xylene	964					ppb			106	C8H10
	10	Benzene	974	03:34.3	50	671.3	10.04	ppb	7309206	80.034	78	C6H6
	21	Toluene	925	05:41.8	91	1374	29.11	ppb	1708840	18.711	92	C7H8
	56	o-Xylene	955	07:40.9	91	479.55	-14.9	ppb	114600	1.2548	106	C8H10
11.1	Peak #	Name	Similarity	R.T. (min:sec)	UniqueMass	S/N	Concentration	Conc. Units	Area	Area %	Weight	Formula
		Ethylbenzene	952					ppb			106	C8H10
		p-Xylene	967					ppb			106	C8H10
		m-Xylene	964					ppb			106	C8H10
	8	Benzene	974	03:35.3	78	1702.4	-60.15	ppb	4293071	73.556	78	C6H6
	21	Toluene	925	05:42.0	91	1158.2	15.92	ppb	1353942	23.198	92	C7H8
	51	o-Xylene	955	07:40.9	91	504.21	-12.64	ppb	189425	3.2456	106	C8H10
11.2	Peak #	Name	Similarity	R.T. (min:sec)	UniqueMass	S/N	Concentration	Conc. Units	Area	Area %	Weight	Formula

		Ethylbenzene	952					ppb			106	C8H10
		p-Xylene	967					ppb			106	C8H10
		m-Xylene	964					ppb			106	C8H10
	9	Benzene	974	03:35.0	78	1688.3	-30.68	ppb	5559737	76.029	78	C6H6
	19	Toluene	925	05:41.7	91	1146.3	18.98	ppb	1436436	19.643	92	C7H8
	44	o-Xylene	955	07:40.9	91	484.94	-8.8	ppb	316507	4.3282	106	C8H10
11.3	Peak #	Name	Similarity	R.T. (min:sec)	UniqueMass	S/N	Concentration	Conc. Units	Area	Area %	Weight	Formula
		Ethylbenzene	952					ppb			106	C8H10
		p-Xylene	967					ppb			106	C8H10
		m-Xylene	964					ppb			106	C8H10
	11	Benzene	974	03:34.6	78	1549.9	-68.32	ppb	3942124	72.331	78	C6H6
	21	Toluene	925	05:41.7	91	1119.2	15.2	ppb	1334576	24.487	92	C7H8
	51	o-Xylene	955	07:40.9	91	473.82	-13.12	ppb	173414	3.1818	106	C8H10
12.1	Peak #	Name	Similarity	R.T. (min:sec)	UniqueMass	S/N	Concentration	Conc. Units	Area	Area %	Weight	Formula
		Ethylbenzene	952					ppb			106	C8H10
		p-Xylene	967					ppb			106	C8H10
		m-Xylene	964					ppb			106	C8H10
	9	Benzene	974	03:35.0	78	1673.5	-41.51	ppb	5094262	74.07	78	C6H6
	18	Toluene	925	05:41.7	91	1170.9	18.34	ppb	1419053	20.633	92	C7H8
	46	o-Xylene	955	07:40.9	91	501.22	-7.36	ppb	364273	5.2965	106	C8H10
12.2	Peak #	Name	Similarity	R.T. (min:sec)	UniqueMass	S/N	Concentration	Conc. Units	Area	Area %	Weight	Formula
		Ethylbenzene	952					ppb			106	C8H10
	10	Benzene	974	03:36.4	78	1713.3	-51.17	ppb	4679149	64.914	78	C6H6
	20	Toluene	925	05:42.4	91	1234.4	17.49	ppb	1396232	19.37	92	C7H8
	42	m-Xylene	967	07:12.2	91	166.47	6.03	ppb	323509	4.4881	106	C8H10
	48	o-Xylene	955	07:41.0	91	526.64	-3.7	ppb	485781	6.7393	106	C8H10

12.3	Peak #	Name	Similarity	R.T. (min:sec)	UniqueMass	S/N	Concentration	Conc. Units	Area	Area %	Weight	Formula
		Ethylbenzene	952					ppb			106	C8H10
		p-Xylene	967					ppb			106	C8H10
		m-Xylene	964					ppb			106	C8H10
	10	Benzene	974	03:34.0	78	1566.1	-54.84	ppb	4521449	67.455	78	C6H6
	17	Toluene	925	05:41.6	91	1119.8	21.16	ppb	1494930	22.303	92	C7H8
	44	o-Xylene	955	07:40.9	91	508.27	2.36	ppb	686484	10.242	106	C8H10
13.1	Peak #	Name	Similarity	R.T. (min:sec)	UniqueMass	S/N	Concentration	Conc. Units	Area	Area %	Weight	Formula
		m-Xylene	964					ppb			106	C8H10
	12	Benzene	974	03:33.3	78	1261.7	-78.06	ppb	3523842	68.343	78	C6H6
	20	Toluene	925	05:41.2	91	954.3	5.4	ppb	1071105	20.774	92	C7H8
	53	o-Xylene	955	07:41.0	91	453.8	-1.42	ppb	561132	10.883	106	C8H10
13.2	Peak #	Name	Similarity	R.T. (min:sec)	UniqueMass	S/N	Concentration	Conc. Units	Area	Area %	Weight	Formula
		Ethylbenzene	952					ppb			106	C8H10
		p-Xylene	967					ppb			106	C8H10
		m-Xylene	964					ppb			106	C8H10
	9	Benzene	974	03:34.6	78	1312.7	-109.22	ppb	2184588	60.632	78	C6H6
	19	Toluene	925	05:42.0	91	1061.3	6.64	ppb	1104321	30.65	92	C7H8
	45	o-Xylene	955	07:41.1	91	472.58	-8.88	ppb	314116	8.7181	106	C8H10
13.3	Peak #	Name	Similarity	R.T. (min:sec)	UniqueMass	S/N	Concentration	Conc. Units	Area	Area %	Weight	Formula
		Toluene	925					ppb			92	C7H8
		Ethylbenzene	952					ppb			106	C8H10
		p-Xylene	967					ppb			106	C8H10
		m-Xylene	964					ppb			106	C8H10
		o-Xylene	955					ppb			106	C8H10
	8	Benzene	974	03:28.9	50	456.98	-103.91	ppb	2412846	100	78	C6H6

14.1	Peak #	Name	Similarity	R.T. (min:sec)	UniqueMass	S/N	Concentration	Conc. Units	Area	Area %	Weight	Formula
		Ethylbenzene	952					ppb			106	C8H10
		p-Xylene	967					ppb			106	C8H10
		m-Xylene	964					ppb			106	C8H10
	10	Benzene	974	03:33.1	78	1695	-15.09	ppb	6229480	69.251	78	C6H6
	21	Toluene	925	05:41.1	91	1450.5	35.9	ppb	1891628	21.029	92	C7H8
	54	o-Xylene	955	07:40.9	91	737.95	8.03	ppb	874357	9.72	106	C8H10
14.2	Peak #	Name	Similarity	R.T. (min:sec)	UniqueMass	S/N	Concentration	Conc. Units	Area	Area %	Weight	Formula
		Ethylbenzene	952					ppb			106	C8H10
	10	Benzene	974	03:33.9	78	1960.8	83.4	ppb	10461700	73.014	78	C6H6
	21	Toluene	925	05:41.7	91	1606.5	37.84	ppb	1943761	13.566	92	C7H8
	47	m-Xylene	967	07:12.1	91	288.92	10.51	ppb	455010	3.1756	106	C8H10
	53	o-Xylene	955	07:41.0	91	748.44	12.21	ppb	1012793	7.0685	106	C8H10
14.3	Peak #	Name	Similarity	R.T. (min:sec)	UniqueMass	S/N	Concentration	Conc. Units	Area	Area %	Weight	Formula
	9	Benzene	974	03:34.1	78	1855.9	78.68	ppb	10258652	75.892	78	C6H6
	21	Toluene	925	05:41.7	91	1667.8	41.43	ppb	2040407	15.095	92	C7H8
	44	Ethylbenzene	952	07:01.6	91	181.8	2.34	ppb	232089	1.717	106	C8H10
	48	m-Xylene	967	07:12.1	91	290.62	4.57	ppb	280494	2.075	106	C8H10
	57	o-Xylene	955	07:41.0	91	743.95	-5.52	ppb	425346	3.1466	106	C8H10
15.1	Peak #	Name	Similarity	R.T. (min:sec)	UniqueMass	S/N	Concentration	Conc. Units	Area	Area %	Weight	Formula
		Ethylbenzene	952					ppb			106	C8H10
		p-Xylene	967					ppb			106	C8H10
		m-Xylene	964					ppb			106	C8H10
	9	Benzene	974	03:34.2	78	1896	135.94	ppb	12719453	82.404	78	C6H6
	20	Toluene	925	05:41.7	91	1574.7	19.93	ppb	1461845	9.4707	92	C7H8

	55	o-Xylene	955	07:41.0	91	779.64	19.49	ppb	1254118	8.1249	106	C8H10
15.2	Peak #	Name	Similarity	R.T. (min:sec)	UniqueMass	S/N	Concentration	Conc. Units	Area	Area %	Weight	Formula
		Ethylbenzene	952					ppb			106	C8H10
	14	Benzene	974	03:34.5	78	2020.5	137.84	ppb	12801044	79.349	78	C6H6
	27	Toluene	925	05:41.8	91	1536.2	16.85	ppb	1379110	8.5486	92	C7H8
	53	m-Xylene	967	07:12.1	91	259.23	9.26	ppb	418400	2.5935	106	C8H10
	61	o-Xylene	955	07:41.0	91	720.1	15.31	ppb	1115563	6.915	106	C8H10
15.3	Peak #	Name	Similarity	R.T. (min:sec)	UniqueMass	S/N	Concentration	Conc. Units	Area	Area %	Weight	Formula
		Ethylbenzene	952					ppb			106	C8H10
		p-Xylene	967					ppb			106	C8H10
		m-Xylene	964					ppb			106	C8H10
	10	Benzene	974	03:34.2	78	2005.5	133.3	ppb	12605636	83.442	78	C6H6
	22	Toluene	925	05:41.7	91	1626.7	21.99	ppb	1517480	10.045	92	C7H8
	54	o-Xylene	955	07:41.0	91	725.61	11.34	ppb	983994	6.5135	106	C8H10
16.1	Peak #	Name	Similarity	R.T. (min:sec)	UniqueMass	S/N	Concentration	Conc. Units	Area	Area %	Weight	Formula
		Ethylbenzene	952					ppb			106	C8H10
		p-Xylene	967					ppb			106	C8H10
		m-Xylene	964					ppb			106	C8H10
	12	Benzene	974	03:36.4	50	735.58	2.41	ppb	6981433	80.359	78	C6H6
	24	Toluene	925	05:42.7	91	1522.2	25.49	ppb	1611419	18.548	92	C7H8
	55	o-Xylene	955	07:41.0	91	514.28	-15.49	ppb	94974	1.0932	106	C8H10
16.2	Peak #	Name	Similarity	R.T. (min:sec)	UniqueMass	S/N	Concentration	Conc. Units	Area	Area %	Weight	Formula
		Ethylbenzene	952					ppb			106	C8H10
		p-Xylene	967					ppb			106	C8H10
		m-Xylene	964					ppb			106	C8H10
	11	Benzene	974	03:35.1	52	616.51	39.65	ppb	8581694	79.256	78	C6H6

	24	Toluene	925	05:42.1	91	1440.6	25.43	ppb	1609881	14.868	92	C7H8
	57	o-Xylene	955	07:41.0	91	512.27	0.85	ppb	636266	5.8762	106	C8H10
16.3	Peak #	Name	Similarity	R.T. (min:sec)	UniqueMass	S/N	Concentration	Conc. Units	Area	Area %	Weight	Formula
		Ethylbenzene	952					ppb			106	C8H10
		p-Xylene	967					ppb			106	C8H10
		m-Xylene	964					ppb			106	C8H10
	10	Benzene	974	03:34.3	78	1505.1	59.92	ppb	9452745	85.055	78	C6H6
	19	Toluene	925	05:41.7	91	1574	21.64	ppb	1508068	13.569	92	C7H8
	54	o-Xylene	955	07:41.0	91	540.53	-13.74	ppb	152862	1.3754	106	C8H10
17.1	Peak #	Name	Similarity	R.T. (min:sec)	UniqueMass	S/N	Concentration	Conc. Units	Area	Area %	Weight	Formula
		Ethylbenzene	952					ppb			106	C8H10
		p-Xylene	967					ppb			106	C8H10
		m-Xylene	964					ppb			106	C8H10
		o-Xylene	955					ppb			106	C8H10
	9	Benzene	974	03:30.5	38	75.077	-129.04	ppb	1333015	70.599	78	C6H6
	18	Toluene	925	05:39.7	91	749.96	-13.77	ppb	555131	29.401	92	C7H8
17.2	Peak #	Name	Similarity	R.T. (min:sec)	UniqueMass	S/N	Concentration	Conc. Units	Area	Area %	Weight	Formula
		Ethylbenzene	952					ppb			106	C8H10
		p-Xylene	967					ppb			106	C8H10
		m-Xylene	964					ppb			106	C8H10
	10	Benzene	974	03:35.2	52	492.84	-143.88	ppb	695366	32.882	78	C6H6
	22	Toluene	925	05:42.2	91	1176.8	6.71	ppb	1106214	52.31	92	C7H8
	53	o-Xylene	955	07:41.2	91	588.95	-8.91	ppb	313150	14.808	106	C8H10
17.3	Peak #	Name	Similarity	R.T. (min:sec)	UniqueMass	S/N	Concentration	Conc. Units	Area	Area %	Weight	Formula
		Ethylbenzene	952					ppb			106	C8H10
		p-Xylene	967					ppb			106	C8H10

		m-Xylene	964					ppb			106	C8H10
	9	Benzene	974	03:34.5	52	464.15	-149.9	ppb	436802	26.26	78	C6H6
	19	Toluene	925	05:42.0	91	1012.4	0.06	ppb	927240	55.744	92	C7H8
	49	o-Xylene	955	07:41.1	91	526.5	-9.32	ppb	299352	17.996	106	C8H10
18.1	Peak #	Name	Similarity	R.T. (min:sec)	UniqueMass	S/N	Concentration	Conc. Units	Area	Area %	Weight	Formula
		Ethylbenzene	952					ppb			106	C8H10
		p-Xylene	967					ppb			106	C8H10
		m-Xylene	964					ppb			106	C8H10
	11	Benzene	974	03:34.0	26	149.28	67.89	ppb	9795175	88.469	78	C6H6
	17	Toluene	925	05:41.7	91	1229.4	2.27	ppb	986844	8.9131	92	C7H8
	39	o-Xylene	955	07:41.0	91	529.4	-9.61	ppb	289830	2.6177	106	C8H10
18.2	Peak #	Name	Similarity	R.T. (min:sec)	UniqueMass	S/N	Concentration	Conc. Units	Area	Area %	Weight	Formula
		Ethylbenzene	952					ppb			106	C8H10
		p-Xylene	967					ppb			106	C8H10
		m-Xylene	964					ppb			106	C8H10
	9	Benzene	974	03:34.7	78	1684.8	56.89	ppb	9322607	84.049	78	C6H6
	14	Toluene	925	05:42.1	91	1257.6	4.64	ppb	1050594	9.4717	92	C7H8
	39	o-Xylene	955	07:41.0	91	520.81	3.33	ppb	718719	6.4797	106	C8H10
18.3	Peak #	Name	Similarity	R.T. (min:sec)	UniqueMass	S/N	Concentration	Conc. Units	Area	Area %	Weight	Formula
		Ethylbenzene	952					ppb			106	C8H10
		p-Xylene	967					ppb			106	C8H10
		m-Xylene	964					ppb			106	C8H10
	9	Benzene	974	03:34.8	78	1677.4	50.7	ppb	9056303	89.492	78	C6H6
	16	Toluene	925	05:42.0	91	1212.7	-2.88	ppb	848332	8.383	92	C7H8
	41	o-Xylene	955	07:41.0	91	498.82	-11.87	ppb	215059	2.1252	106	C8H10

19.1	Peak #	Name	Similarity	R.T. (min:sec)	UniqueMass	S/N	Concentration	Conc. Units	Area	Area %	Weight	Formula
		Ethylbenzene	952					ppb			106	C8H10
		p-Xylene	967					ppb			106	C8H10
		m-Xylene	964					ppb			106	C8H10
	9	Benzene	974	03:35.3	78	1817.1	92.41	ppb	10848675	83.081	78	C6H6
	22	Toluene	925	05:42.4	91	1699.5	33.85	ppb	1836392	14.063	92	C7H8
	57	o-Xylene	955	07:41.2	91	779.89	-7.1	ppb	372832	2.8552	106	C8H10
19.2	Peak #	Name	Similarity	R.T. (min:sec)	UniqueMass	S/N	Concentration	Conc. Units	Area	Area %	Weight	Formula
		Ethylbenzene	952					ppb			106	C8H10
		p-Xylene	967					ppb			106	C8H10
		m-Xylene	964					ppb			106	C8H10
	12	Benzene	974	03:37.2	78	1821.3	88.78	ppb	10692663	80.133	78	C6H6
	31	Toluene	925	05:43.1	91	1577.5	26.63	ppb	1642345	12.308	92	C7H8
	66	o-Xylene	955	07:41.2	91	791.75	12.09	ppb	1008715	7.5595	106	C8H10
19.3	Peak #	Name	Similarity	R.T. (min:sec)	UniqueMass	S/N	Concentration	Conc. Units	Area	Area %	Weight	Formula
		Ethylbenzene	952					ppb			106	C8H10
	9	Benzene	974	03:34.3	78	1798.5	100.38	ppb	11191057	77.306	78	C6H6
	19	Toluene	925	05:41.8	91	1567.1	25.24	ppb	1604920	11.086	92	C7H8
	46	m-Xylene	967	07:12.1	91	290.59	4.9	ppb	290249	2.005	106	C8H10
	53	o-Xylene	955	07:41.0	91	718.69	14.84	ppb	1099889	7.5978	106	C8H10
20.1	Peak #	Name	Similarity	R.T. (min:sec)	UniqueMass	S/N	Concentration	Conc. Units	Area	Area %	Weight	Formula
		Ethylbenzene	952					ppb			106	C8H10
		p-Xylene	967					ppb			106	C8H10
		m-Xylene	964					ppb			106	C8H10
	9	Benzene	974	03:35.2	78	1652.7	24.24	ppb	7919389	76.407	78	C6H6
	22	Toluene	925	05:42.1	91	1745	37.96	ppb	1947053	18.785	92	C7H8

	58	o-Xylene	955	07:41.0	91	516.02	-3.32	ppb	498239	4.8071	106	C8H10
20.2	Peak #	Name	Similarity	R.T. (min:sec)	UniqueMass	S/N	Concentration	Conc. Units	Area	Area %	Weight	Formula
		Ethylbenzene	952					ppb			106	C8H10
		p-Xylene	967					ppb			106	C8H10
		m-Xylene	964					ppb			106	C8H10
	15	Benzene	974	03:35.4	56	16.299	24.83	ppb	7944649	77.823	78	C6H6
	29	Toluene	925	05:41.8	91	1668.4	38.82	ppb	1970201	19.3	92	C7H8
	65	o-Xylene	955	07:41.0	91	553.77	-9.49	ppb	293699	2.877	106	C8H10
20.3	Peak #	Name	Similarity	R.T. (min:sec)	UniqueMass	S/N	Concentration	Conc. Units	Area	Area %	Weight	Formula
		Ethylbenzene	952					ppb			106	C8H10
		p-Xylene	967					ppb			106	C8H10
		m-Xylene	964					ppb			106	C8H10
	13	Benzene	974	03:34.9	78	1712.8	30.1	ppb	8171453	78.704	78	C6H6
	28	Toluene	925	05:42.0	91	1691.9	39.01	ppb	1975435	19.026	92	C7H8
	64	o-Xylene	955	07:40.9	91	540.66	-11.24	ppb	235684	2.27	106	C8H10
21.1	Peak #	Name	Similarity	R.T. (min:sec)	UniqueMass	S/N	Concentration	Conc. Units	Area	Area %	Weight	Formula
		Ethylbenzene	952					ppb			106	C8H10
	11	Benzene	974	03:33.6	52	503.18	-89.86	ppb	3016417	65.7	78	C6H6
	17	Toluene	925	05:41.5	91	930.84	-4.97	ppb	791843	17.247	92	C7H8
	42	m-Xylene	967	07:12.1	91	304.41	4.2	ppb	269773	5.8758	106	C8H10
	49	o-Xylene	955	07:41.0	91	550.1	-11.01	ppb	243419	5.3018	106	C8H10
21.2	Peak #	Name	Similarity	R.T. (min:sec)	UniqueMass	S/N	Concentration	Conc. Units	Area	Area %	Weight	Formula
		Ethylbenzene	952					ppb			106	C8H10
		p-Xylene	967					ppb			106	C8H10
		m-Xylene	964					ppb			106	C8H10
	11	Benzene	974	03:34.3	37	102.94	-88.39	ppb	3079951	66.225	78	C6H6

	22	Toluene	925	05:41.7	91	1003.1	-5.04	ppb	790081	16.988	92	C7H8
	55	o-Xylene	955	07:41.0	91	521.15	5.2	ppb	780696	16.787	106	C8H10
21.3	Peak #	Name	Similarity	R.T. (min:sec)	UniqueMass	S/N	Concentration	Conc. Units	Area	Area %	Weight	Formula
		Ethylbenzene	952					ppb			106	C8H10
	9	Benzene	974	03:34.3	78	1461.4	-148.97	ppb	476699	18.525	78	C6H6
	21	Toluene	925	05:41.8	91	1057.6	6.65	ppb	1104631	42.927	92	C7H8
	45	m-Xylene	967	07:12.2	91	297.23	3.19	ppb	240048	9.3284	106	C8H10
	52	o-Xylene	955	07:41.1	91	544.54	-2.91	ppb	511878	19.892	106	C8H10
22.1	Peak #	Name	Similarity	R.T. (min:sec)	UniqueMass	S/N	Concentration	Conc. Units	Area	Area %	Weight	Formula
		Ethylbenzene	952					ppb			106	C8H10
		p-Xylene	967					ppb			106	C8H10
		m-Xylene	964					ppb			106	C8H10
	12	Benzene	974	03:35.8	78	1775.2	7.14	ppb	7184767	84.253	78	C6H6
	25	Toluene	925	05:42.4	91	1403.9	6.91	ppb	1111603	13.035	92	C7H8
	52	o-Xylene	955	07:41.0	91	469.67	-11.38	ppb	231237	2.7116	106	C8H10
22.2	Peak #	Name	Similarity	R.T. (min:sec)	UniqueMass	S/N	Concentration	Conc. Units	Area	Area %	Weight	Formula
		Ethylbenzene	952					ppb			106	C8H10
		p-Xylene	967					ppb			106	C8H10
		m-Xylene	964					ppb			106	C8H10
	11	Benzene	974	03:35.8	78	1730.9	20.84	ppb	7773488	82.403	78	C6H6
	24	Toluene	925	05:42.4	91	1446.5	8.36	ppb	1150728	12.198	92	C7H8
	54	o-Xylene	955	07:41.0	91	495.08	-2.99	ppb	509240	5.3982	106	C8H10
22.3	Peak #	Name	Similarity	R.T. (min:sec)	UniqueMass	S/N	Concentration	Conc. Units	Area	Area %	Weight	Formula
		Ethylbenzene	952					ppb			106	C8H10
		p-Xylene	967					ppb			106	C8H10
		m-Xylene	964					ppb			106	C8H10

	11	Benzene	974	03:35.4	50	733.59	31.33	ppb	8224196	85.622	78	C6H6
	22	Toluene	925	05:42.1	91	1375.3	10.75	ppb	1214999	12.649	92	C7H8
	53	o-Xylene	955	07:41.0	91	476.06	-13.35	ppb	166030	1.7285	106	C8H10
23.1	Peak #	Name	Similarity	R.T. (min:sec)	UniqueMass	S/N	Concentration	Conc. Units	Area	Area %	Weight	Formula
	9	Benzene	974	03:34.2	78	1828.9	124.4	ppb	12223309	75.875	78	C6H6
	22	Toluene	925	05:41.6	91	1615.7	35.01	ppb	1867831	11.594	92	C7H8
	48	p-Xylene	952	07:07.7	91	115.5	4.95	ppb	306482	1.9024	106	C8H10
	49	m-Xylene	964	07:12.1	91	324.51	9.7	ppb	364904	2.2651	106	C8H10
	58	o-Xylene	955	07:41.0	91	773.95	13.06	ppb	1040874	6.4611	106	C8H10
23.2	Peak #	Name	Similarity	R.T. (min:sec)	UniqueMass	S/N	Concentration	Conc. Units	Area	Area %	Weight	Formula
		Ethylbenzene	952					ppb			106	C8H10
		p-Xylene	967					ppb			106	C8H10
		m-Xylene	964					ppb			106	C8H10
	8	Benzene	974	03:34.2	78	1839.2	108.94	ppb	11558971	81.126	78	C6H6
	22	Toluene	925	05:41.7	91	1671.5	29.31	ppb	1714395	12.032	92	C7H8
	54	o-Xylene	955	07:41.0	91	751.83	11.06	ppb	974877	6.8421	106	C8H10
23.3	Peak #	Name	Similarity	R.T. (min:sec)	UniqueMass	S/N	Concentration	Conc. Units	Area	Area %	Weight	Formula
	10	Benzene	974	03:34.3	78	1844.8	185.65	ppb	14855315	80.728	78	C6H6
	24	Toluene	925	05:41.8	91	1691.2	24.32	ppb	1580002	8.5862	92	C7H8
	50	p-Xylene	952	07:07.6	91	119.5	6.03	ppb	337380	1.8334	106	C8H10
	51	m-Xylene	964	07:12.1	91	329.34	8.97	ppb	341651	1.8566	106	C8H10
	58	o-Xylene	955	07:41.0	91	773.27	10.31	ppb	949901	5.162	106	C8H10
24.1	Peak #	Name	Similarity	R.T. (min:sec)	UniqueMass	S/N	Concentration	Conc. Units	Area	Area %	Weight	Formula
		Ethylbenzene	952					ppb			106	C8H10
		p-Xylene	967					ppb			106	C8H10

		m-Xylene	964					ppb			106	C8H10
	9	Benzene	974	03:34.2	78	1443.6	21.12	ppb	7785288	81.997	78	C6H6
	22	Toluene	925	05:41.7	91	1095.4	11.56	ppb	1236687	13.025	92	C7H8
	57	o-Xylene	955	07:41.0	91	532.08	-4.09	ppb	472631	4.9779	106	C8H10
	1	Unknown 1		03:02.9	57	60.358						
24.2	Peak #	Name	Similarity	R.T. (min:sec)	UniqueMass	S/N	Concentration	Conc. Units	Area	Area %	Weight	Formula
		Toluene	925					ppb			92	C7H8
	7	Benzene	974	03:29.0	52	343.63	-120.03	ppb	1720077	53.298	78	C6H6
	41	m-Xylene	952	07:11.6	91	190.52	7.74	ppb	386193	11.967	106	C8H10
	47	o-Xylene	955	07:40.7	91	390.09	-7.83	ppb	348627	10.802	106	C8H10
24.3	Peak #	Name	Similarity	R.T. (min:sec)	UniqueMass	S/N	Concentration	Conc. Units	Area	Area %	Weight	Formula
		Toluene	925					ppb			92	C7H8
		Ethylbenzene	952					ppb			106	C8H10
		p-Xylene	967					ppb			106	C8H10
		m-Xylene	964					ppb			106	C8H10
	10	Benzene	974	03:28.8	50	396.09	-153.74	ppb	271804	36.441	78	C6H6
	46	o-Xylene	955	07:40.6	91	382.3	-4.05	ppb	474063	63.559	106	C8H10
25.1	Peak #	Name	Similarity	R.T. (min:sec)	UniqueMass	S/N	Concentration	Conc. Units	Area	Area %	Weight	Formula
		Ethylbenzene	952					ppb			106	C8H10
		p-Xylene	967					ppb			106	C8H10
		m-Xylene	964					ppb			106	C8H10
	10	Benzene	974	03:35.5	78	1719.1	-39.88	ppb	5164058	73.38	78	C6H6
	23	Toluene	925	05:42.1	91	1165.3	16.76	ppb	1376576	19.561	92	C7H8
	54	o-Xylene	955	07:41.0	91	548.72	-3.36	ppb	496788	7.0592	106	C8H10
25.2	Peak #	Name	Similarity	R.T. (min:sec)	UniqueMass	S/N	Concentration	Conc. Units	Area	Area %	Weight	Formula
		Ethylbenzene	952					ppb			106	C8H10

		p-Xylene	967					ppb			106	C8H10
		m-Xylene	964					ppb			106	C8H10
	9	Benzene	974	03:35.0	78	1640.8	-59.44	ppb	4323563	67.738	78	C6H6
	23	Toluene	925	05:41.7	91	1141	14.11	ppb	1305442	20.453	92	C7H8
	53	o-Xylene	955	07:40.9	91	531.92	4.39	ppb	753751	11.809	106	C8H10
25.3	Peak #	Name	Similarity	R.T. (min:sec)	UniqueMass	S/N	Concentration	Conc. Units	Area	Area %	Weight	Formula
		Ethylbenzene	952					ppb			106	C8H10
	9	Benzene	974	03:35.1	78	1654.6	-68.08	ppb	3952312	57.845	78	C6H6
	20	Toluene	925	05:41.7	91	1187.7	18.14	ppb	1413677	20.69	92	C7H8
	44	m-Xylene	967	07:12.1	91	241.13	10.58	ppb	457022	6.6888	106	C8H10
	50	o-Xylene	955	07:40.9	91	546.69	-1.68	ppb	552570	8.0873	106	C8H10
26.1	Peak #	Name	Similarity	R.T. (min:sec)	UniqueMass	S/N	Concentration	Conc. Units	Area	Area %	Weight	Formula
		Ethylbenzene	952					ppb			106	C8H10
		p-Xylene	967					ppb			106	C8H10
		m-Xylene	964					ppb			106	C8H10
	9	Benzene	974	03:34.8	78	1391.3	-55.62	ppb	4488040	72.035	78	C6H6
	21	Toluene	925	05:42.1	91	1237.3	12.64	ppb	1265794	20.317	92	C7H8
	52	o-Xylene	955	07:41.2	91	633.54	-3.98	ppb	476509	7.6482	106	C8H10
26.2	Peak #	Name	Similarity	R.T. (min:sec)	UniqueMass	S/N	Concentration	Conc. Units	Area	Area %	Weight	Formula
		Ethylbenzene	952					ppb			106	C8H10
	11	Benzene	974	03:34.7	52	533.21	15.86	ppb	7559538	75.429	78	C6H6
	23	Toluene	925	05:42.2	91	1224.2	10.76	ppb	1215117	12.124	92	C7H8
	49	m-Xylene	967	07:12.3	91	324.57	7.68	ppb	372026	3.712	106	C8H10
	56	o-Xylene	955	07:41.2	91	618.85	-3.16	ppb	503417	5.0231	106	C8H10
26.3	Peak #	Name	Similarity	R.T. (min:sec)	UniqueMass	S/N	Concentration	Conc. Units	Area	Area %	Weight	Formula
		Ethylbenzene	952					ppb			106	C8H10

		o-Xylene	955					ppb			106	C8H10
	9	Benzene	974	03:34.3	78	1586.5	-10.48	ppb	6427456	78.09	78	C6H6
	19	Toluene	925	05:42.0	91	1197.9	8.84	ppb	1163609	14.137	92	C7H8
	44	m-Xylene	967	07:12.3	91	298.74	5.91	ppb	319898	3.8866	106	C8H10
27.1	Peak #	Name	Similarity	R.T. (min:sec)	UniqueMass	S/N	Concentration	Conc. Units	Area	Area %	Weight	Formula
		Ethylbenzene	952					ppb			106	C8H10
		p-Xylene	967					ppb			106	C8H10
		m-Xylene	964					ppb			106	C8H10
	12	Benzene	974	03:36.0	50	731.44	20.66	ppb	7765579	78.538	78	C6H6
	22	Toluene	925	05:42.4	91	1306.4	18.22	ppb	1415960	14.32	92	C7H8
	52	o-Xylene	955	07:41.0	91	428.98	2.95	ppb	706128	7.1415	106	C8H10
27.2	Peak #	Name	Similarity	R.T. (min:sec)	UniqueMass	S/N	Concentration	Conc. Units	Area	Area %	Weight	Formula
		Ethylbenzene	952					ppb			106	C8H10
		p-Xylene	967					ppb			106	C8H10
		m-Xylene	964					ppb			106	C8H10
	9	Benzene	974	03:34.9	78	1687.8	17.93	ppb	7648500	78.735	78	C6H6
	19	Toluene	925	05:42.1	91	1259.9	10.52	ppb	1208798	12.444	92	C7H8
	50	o-Xylene	955	07:41.0	91	463.95	7.51	ppb	856927	8.8214	106	C8H10
27.3	Peak #	Name	Similarity	R.T. (min:sec)	UniqueMass	S/N	Concentration	Conc. Units	Area	Area %	Weight	Formula
		Ethylbenzene	952					ppb			106	C8H10
		p-Xylene	967					ppb			106	C8H10
		m-Xylene	964					ppb			106	C8H10
	12	Benzene	974	03:35.7	52	619.64	13.73	ppb	7467875	80.715	78	C6H6
	23	Toluene	925	05:42.4	91	1276.4	12.9	ppb	1272850	13.757	92	C7H8
	54	o-Xylene	955	07:41.0	91	450.55	-2.92	ppb	511420	5.5276	106	C8H10

28.1	Peak #	Name	Similarity	R.T. (min:sec)	UniqueMass	S/N	Concentration	Conc. Units	Area	Area %	Weight	Formula
		Ethylbenzene	952					ppb			106	C8H10
		p-Xylene	967					ppb			106	C8H10
		m-Xylene	964					ppb			106	C8H10
	7	Benzene	974	03:28.8	52	335.81	-109.56	ppb	2169910	66.802	78	C6H6
	14	Toluene	925	05:38.8	91	640.43	-10.3	ppb	648493	19.964	92	C7H8
	43	o-Xylene	955	07:40.6	91	396.16	-5.38	ppb	429847	13.233	106	C8H10
28.2	Peak #	Name	Similarity	R.T. (min:sec)	UniqueMass	S/N	Concentration	Conc. Units	Area	Area %	Weight	Formula
		Ethylbenzene	952					ppb			106	C8H10
		p-Xylene	967					ppb			106	C8H10
		m-Xylene	964					ppb			106	C8H10
	9	Benzene	974	03:30.7	78	1236.2	-90.82	ppb	2975264	73.681	78	C6H6
	18	Toluene	925	05:40.0	91	795.25	-11.65	ppb	612128	15.159	92	C7H8
	52	o-Xylene	955	07:40.8	91	460.53	-4.76	ppb	450646	11.16	106	C8H10
28.3	Peak #	Name	Similarity	R.T. (min:sec)	UniqueMass	S/N	Concentration	Conc. Units	Area	Area %	Weight	Formula
		Ethylbenzene	952					ppb			106	C8H10
		p-Xylene	967					ppb			106	C8H10
		m-Xylene	964					ppb			106	C8H10
	10	Benzene	974	03:33.3	78	1357.6	86.64	ppb	10600948	88.329	78	C6H6
	24	Toluene	925	05:41.4	91	955.9	-9.31	ppb	675212	5.626	92	C7H8
	55	o-Xylene	955	07:41.0	91	492.3	3.54	ppb	725564	6.0455	106	C8H10
29.1	Peak #	Name	Similarity	R.T. (min:sec)	UniqueMass	S/N	Concentration	Conc. Units	Area	Area %	Weight	Formula
		m-Xylene	964					ppb			106	C8H10
	10	Benzene	974	03:33.6	78	2278.8	5.58	ppb	7117765	80.304	78	C6H6
	24	Toluene	925	05:40.4	91	1320.6	25.77	ppb	1619207	18.268	92	C7H8
	52	o-Xylene	955	07:40.4	91	485.54	-14.54	ppb	126591	1.4282	106	C8H10

29.2	Peak #	Name	Similarity	R.T. (min:sec)	UniqueMass	S/N	Concentration	Conc. Units	Area	Area %	Weight	Formula
		Ethylbenzene	952					ppb			106	C8H10
		p-Xylene	967					ppb			106	C8H10
		m-Xylene	964					ppb			106	C8H10
	9	Benzene	974	03:34.0	78	1700.6	-50.05	ppb	4727225	71.238	78	C6H6
	19	Toluene	925	05:41.3	91	1223.7	21.46	ppb	1503246	22.653	92	C7H8
	48	o-Xylene	955	07:40.9	91	448.33	-6.12	ppb	405390	6.1091	106	C8H10
29.3	Peak #	Name	Similarity	R.T. (min:sec)	UniqueMass	S/N	Concentration	Conc. Units	Area	Area %	Weight	Formula
		Ethylbenzene	952					ppb			106	C8H10
		p-Xylene	967					ppb			106	C8H10
		m-Xylene	964					ppb			106	C8H10
	10	Benzene	974	03:34.4	78	1641.5	-57.51	ppb	4406720	65.883	78	C6H6
	20	Toluene	925	05:41.4	91	1230.8	26.97	ppb	1651413	24.69	92	C7H8
	48	o-Xylene	955	07:40.8	91	426.66	0.67	ppb	630585	9.4276	106	C8H10
30.1	Peak #	Name	Similarity	R.T. (min:sec)	UniqueMass	S/N	Concentration	Conc. Units	Area	Area %	Weight	Formula
		Ethylbenzene	952					ppb			106	C8H10
	11	Benzene	974	03:32.7	78	1357.1	-88.51	ppb	3074471	49.513	78	C6H6
	29	Toluene	925	05:41.2	91	1107.7	2.3	ppb	987544	15.904	92	C7H8
	54	m-Xylene	967	07:12.0	91	570.44	23.84	ppb	846206	13.628	106	C8H10
	65	o-Xylene	955	07:40.9	91	664.85	-4.62	ppb	455046	7.3283	106	C8H10
30.2	Peak #	Name	Similarity	R.T. (min:sec)	UniqueMass	S/N	Concentration	Conc. Units	Area	Area %	Weight	Formula
		Ethylbenzene	952					ppb			106	C8H10
	10	Benzene	974	03:34.7	52	473.93	-91.15	ppb	2961342	49.175	78	C6H6
	28	Toluene	925	05:42.4	91	1151.4	14.65	ppb	1319756	21.916	92	C7H8
	54	m-Xylene	967	07:12.3	91	529.51	14.12	ppb	560764	9.3119	106	C8H10
	64	o-Xylene	955	07:41.1	91	627.13	0.34	ppb	619391	10.285	106	C8H10

30.3	Peak #	Name	Similarity	R.T. (min:sec)	UniqueMass	S/N	Concentration	Conc. Units	Area	Area %	Weight	Formula
	16	Benzene	974	03:36.0	78	1359.3	-144.13	ppb	684497	16.013	78	C6H6
	34	Toluene	925	05:43.1	91	1294.2	7.48	ppb	1126898	26.362	92	C7H8
	58	Ethylbenzene	952	07:01.9	91	376.21	8.96	ppb	420940	9.8471	106	C8H10
	63	m-Xylene	967	07:12.4	91	498.13	19.2	ppb	709910	16.607	106	C8H10
	72	o-Xylene	955	07:41.3	91	618.89	0.43	ppb	622611	14.565	106	C8H10
31.1	Peak #	Name	Similarity	R.T. (min:sec)	UniqueMass	S/N	Concentration	Conc. Units	Area	Area %	Weight	Formula
	9	Benzene	974	03:31.6	78	1651.2	-15.46	ppb	6213615	65.815	78	C6H6
	22	Toluene	925	05:40.4	91	1336.4	29.93	ppb	1730921	18.334	92	C7H8
	49	m-Xylene	952	07:11.7	91	291.57	6.63	ppb	354356	3.7534	106	C8H10
	59	o-Xylene	955	07:40.7	91	678.03	-5.27	ppb	433451	4.5911	106	C8H10
31.2	Peak #	Name	Similarity	R.T. (min:sec)	UniqueMass	S/N	Concentration	Conc. Units	Area	Area %	Weight	Formula
		Ethylbenzene	952					ppb			106	C8H10
	9	Benzene	974	03:35.4	50	978.02	105.83	ppb	11425217	77.513	78	C6H6
	24	Toluene	925	05:42.2	91	1669.7	24.43	ppb	1583053	10.74	92	C7H8
	50	m-Xylene	967	07:12.1	91	335.68	5.38	ppb	304414	2.0653	106	C8H10
	59	o-Xylene	955	07:40.9	91	771.98	15.53	ppb	1122691	7.6167	106	C8H10
31.3	Peak #	Name	Similarity	R.T. (min:sec)	UniqueMass	S/N	Concentration	Conc. Units	Area	Area %	Weight	Formula
		Ethylbenzene	952					ppb			106	C8H10
		p-Xylene	967					ppb			106	C8H10
		m-Xylene	964					ppb			106	C8H10
	12	Benzene	974	03:28.2	78	1729.4	144.81	ppb	13100188	98.151	78	C6H6
	25	Toluene	925	05:38.8	91	1011.1	-31.35	ppb	82205	0.61591	92	C7H8
	59	o-Xylene	955	07:40.5	91	560.97	-13.39	ppb	164562	1.233	106	C8H10
32.1	Peak #	Name	Similarity	R.T. (min:sec)	UniqueMass	S/N	Concentration	Conc.	Area	Area %	Weight	Formula

								Units				
		Ethylbenzene	952					ppb			106	C8H10
		p-Xylene	967					ppb			106	C8H10
		m-Xylene	964					ppb			106	C8H10
	8	Benzene	974	03:29.7	78	1632.2	-72.67	ppb	3755139	72.372	78	C6H6
	18	Toluene	925	05:39.3	91	1017.9	-7.97	ppb	711300	13.709	92	C7H8
	52	o-Xylene	955	07:40.5	91	503.39	3.44	ppb	722202	13.919	106	C8H10
32.2	Peak #	Name	Similarity	R.T. (min:sec)	UniqueMass	S/N	Concentration	Conc. Units	Area	Area %	Weight	Formula
		Ethylbenzene	952					ppb			106	C8H10
	10	Benzene	974	03:35.3	78	1552.2	56.29	ppb	9296840	73.43	78	C6H6
	18	Toluene	925	05:42.1	91	1266.4	12.21	ppb	1254326	9.9072	92	C7H8
	44	m-Xylene	967	07:12.1	91	303.33	24.42	ppb	863075	6.8169	106	C8H10
	54	o-Xylene	955	07:41.0	91	620.85	-6.78	ppb	383457	3.0287	106	C8H10
32.3	Peak #	Name	Similarity	R.T. (min:sec)	UniqueMass	S/N	Concentration	Conc. Units	Area	Area %	Weight	Formula
		Ethylbenzene	952					ppb			106	C8H10
		p-Xylene	967					ppb			106	C8H10
		m-Xylene	964					ppb			106	C8H10
	11	Benzene	974	03:30.5	78	1725.2	-65.21	ppb	4075801	80.548	78	C6H6
	20	Toluene	925	05:39.9	91	1045.8	-4.7	ppb	799152	15.793	92	C7H8
	53	o-Xylene	955	07:40.5	91	500.3	-12.77	ppb	185149	3.659	106	C8H10
33.1	Peak #	Name	Similarity	R.T. (min:sec)	UniqueMass	S/N	Concentration	Conc. Units	Area	Area %	Weight	Formula
		Ethylbenzene	952					ppb			106	C8H10
		p-Xylene	967					ppb			106	C8H10
		m-Xylene	964					ppb			106	C8H10
	9	Benzene	974	03:35.0	78	1550.3	-0.87	ppb	6840338	82.96	78	C6H6
	22	Toluene	925	05:42.1	91	1283.9	-0.03	ppb	924845	11.217	92	C7H8

	51	o-Xylene	955	07:41.2	91	628.5	-3.87	ppb	480142	5.8232	106	C8H10
33.2	Peak #	Name	Similarity	R.T. (min:sec)	UniqueMass	S/N	Concentration	Conc. Units	Area	Area %	Weight	Formula
		Ethylbenzene	952					ppb			106	C8H10
		p-Xylene	967					ppb			106	C8H10
		m-Xylene	964					ppb			106	C8H10
	9	Benzene	974	03:35.6	78	1624.9	-9.19	ppb	6483136	81.654	78	C6H6
	20	Toluene	925	05:42.5	91	1233	-2.43	ppb	860237	10.835	92	C7H8
	51	o-Xylene	955	07:41.2	91	569.14	-0.36	ppb	596373	7.5112	106	C8H10
33.3	Peak #	Name	Similarity	R.T. (min:sec)	UniqueMass	S/N	Concentration	Conc. Units	Area	Area %	Weight	Formula
		Ethylbenzene	952					ppb			106	C8H10
		p-Xylene	967					ppb			106	C8H10
		m-Xylene	964					ppb			106	C8H10
	9	Benzene	974	03:34.7	78	1485.2	-8.14	ppb	6528147	82.087	78	C6H6
	21	Toluene	925	05:42.3	91	1245.1	1.26	ppb	959667	12.067	92	C7H8
	50	o-Xylene	955	07:41.2	91	572.51	-4.33	ppb	464867	5.8454	106	C8H10
34.1	Peak #	Name	Similarity	R.T. (min:sec)	UniqueMass	S/N	Concentration	Conc. Units	Area	Area %	Weight	Formula
		Ethylbenzene	952					ppb			106	C8H10
		p-Xylene	967					ppb			106	C8H10
		m-Xylene	964					ppb			106	C8H10
	6	Benzene	974	03:28.9	52	408.05	-104.71	ppb	2378354	53.451	78	C6H6
	18	Toluene	925	05:38.8	91	696.03	28.87	ppb	1702612	38.265	92	C7H8
	50	o-Xylene	955	07:40.6	91	474.84	-7.23	ppb	368592	8.2838	106	C8H10
34.2	Peak #	Name	Similarity	R.T. (min:sec)	UniqueMass	S/N	Concentration	Conc. Units	Area	Area %	Weight	Formula
		Ethylbenzene	952					ppb			106	C8H10
	8	Benzene	974	03:34.4	38	98.866	-125.98	ppb	1464565	32.62	78	C6H6
	22	Toluene	925	05:41.6	91	1140.9	22.03	ppb	1518430	33.819	92	C7H8

	46	m-Xylene	967	07:12.3	91	379.33	3.98	ppb	263460	5.8679	106	C8H10
	55	o-Xylene	955	07:41.2	91	640.34	11.22	ppb	979894	21.825	106	C8H10
34.3	Peak #	Name	Similarity	R.T. (min:sec)	UniqueMass	S/N	Concentration	Conc. Units	Area	Area %	Weight	Formula
		Ethylbenzene	952					ppb			106	C8H10
	8	Benzene	974	03:34.3	78	1571.6	-123.43	ppb	1574303	34.37	78	C6H6
	19	Toluene	925	05:41.7	91	1243	35.69	ppb	1885917	41.173	92	C7H8
	46	m-Xylene	967	07:12.3	91	399.81	8.58	ppb	398228	8.694	106	C8H10
	54	o-Xylene	955	07:41.0	91	658.52	-8.58	ppb	323796	7.0691	106	C8H10
35.1	Peak #	Name	Similarity	R.T. (min:sec)	UniqueMass	S/N	Concentration	Conc. Units	Area	Area %	Weight	Formula
		Ethylbenzene	952					ppb			106	C8H10
	8	Benzene	974	03:34.6	78	2008.7	171.64	ppb	14253474	75.619	78	C6H6
	24	Toluene	925	05:41.9	91	1655.3	51.25	ppb	2304787	12.228	92	C7H8
	51	m-Xylene	967	07:12.1	91	386.37	10.53	ppb	455470	2.4164	106	C8H10
	61	o-Xylene	955	07:41.0	91	806.73	23.29	ppb	1379953	7.321	106	C8H10
35.2	Peak #	Name	Similarity	R.T. (min:sec)	UniqueMass	S/N	Concentration	Conc. Units	Area	Area %	Weight	Formula
		Ethylbenzene	952					ppb			106	C8H10
	9	Benzene	974	03:35.1	37	207.07	179.55	ppb	14593165	80.692	78	C6H6
	25	Toluene	925	05:42.1	91	1585	36.97	ppb	1920311	10.618	92	C7H8
	52	m-Xylene	967	07:12.1	91	346.13	6.61	ppb	340598	1.8833	106	C8H10
	59	o-Xylene	955	07:41.0	91	749.9	8.52	ppb	890440	4.9236	106	C8H10
35.3	Peak #	Name	Similarity	R.T. (min:sec)	UniqueMass	S/N	Concentration	Conc. Units	Area	Area %	Weight	Formula
		Toluene	925					ppb			92	C7H8
		Ethylbenzene	952					ppb			106	C8H10
		p-Xylene	967					ppb			106	C8H10
		m-Xylene	964					ppb			106	C8H10
	13	Benzene	974	03:28.7	78	1615	159.46	ppb	13730043	95.149	78	C6H6

	60	o-Xylene	955	07:40.4	91	558.78	2.77	ppb	700051	4.8513	106	C8H10
36.1	Peak #	Name	Similarity	R.T. (min:sec)	UniqueMass	S/N	Concentration	Conc. Units	Area	Area %	Weight	Formula
		Ethylbenzene	952					ppb			106	C8H10
		p-Xylene	967					ppb			106	C8H10
		m-Xylene	964					ppb			106	C8H10
	9	Benzene	974	03:33.7	39	154.59	-59.76	ppb	4309872	63.015	78	C6H6
	22	Toluene	925	05:41.4	91	1160.3	37.82	ppb	1943284	28.413	92	C7H8
	55	o-Xylene	955	07:41.0	91	605.46	-0.66	ppb	586243	8.5716	106	C8H10
	Peak #	Name	Similarity	R.T. (min:sec)	UniqueMass	S/N	Concentration	Conc. Units	Area	Area %	Weight	Formula
		Ethylbenzene	952					ppb			106	C8H10
	8	Benzene	974	03:32.6	78	1330.5	-66.53	ppb	4018983	53.678	78	C6H6
	18	Toluene	925	05:40.8	91	933.92	40	ppb	2001901	26.738	92	C7H8
	45	m-Xylene	967	07:12.1	91	319.84	7.31	ppb	361102	4.8229	106	C8H10
	53	o-Xylene	955	07:41.0	91	565.24	4.1	ppb	744110	9.9384	106	C8H10
36.3	Peak #	Name	Similarity	R.T. (min:sec)	UniqueMass	S/N	Concentration	Conc. Units	Area	Area %	Weight	Formula
		Ethylbenzene	952					ppb			106	C8H10
		p-Xylene	967					ppb			106	C8H10
		m-Xylene	964					ppb			106	C8H10
	9	Benzene	974	03:35.1	78	1426	-45.35	ppb	4929098	68.309	78	C6H6
	22	Toluene	925	05:42.2	91	1272.1	35.75	ppb	1887569	26.159	92	C7H8
	53	o-Xylene	955	07:41.2	91	658.61	-6.31	ppb	399187	5.5321	106	C8H10
37.1	Peak #	Name	Similarity	R.T. (min:sec)	UniqueMass	S/N	Concentration	Conc. Units	Area	Area %	Weight	Formula

37.2	Peak #	Name	Similarity	R.T. (min:sec)	UniqueMass	S/N	Concentration	Conc. Units	Area	Area %	Weight	Formula
37.3	Peak #	Name	Similarity	R.T. (min:sec)	UniqueMass	S/N	Concentration	Conc. Units	Area	Area %	Weight	Formula
38.1	Peak #	Name	Similarity	R.T. (min:sec)	UniqueMass	S/N	Concentration	Conc. Units	Area	Area %	Weight	Formula
		Ethylbenzene	952					ppb			106	C8H10
	7	Benzene	974	03:33.3	51	502	-34.42	ppb	5398933	66.351	78	C6H6
	18	Toluene	925	05:41.2	91	1111.4	27.31	ppb	1660647	20.409	92	C7H8
	44	m-Xylene	967	07:12.1	91	371.68	6	ppb	322504	3.9635	106	C8H10
	52	o-Xylene	955	07:41.0	91	637.2	-5.31	ppb	432338	5.3133	106	C8H10
38.2	Peak #	Name	Similarity	R.T. (min:sec)	UniqueMass	S/N	Concentration	Conc. Units	Area	Area %	Weight	Formula
		Ethylbenzene	952					ppb			106	C8H10
	7	Benzene	974	03:34.3	78	1472.5	-68.68	ppb	3926554	57.878	78	C6H6

	18	Toluene	925	05:41.7	91	1280.9	26.74	ppb	1645204	24.251	92	C7H8
	42	m-Xylene	967	07:12.3	91	376.02	5.56	ppb	309546	4.5628	106	C8H10
	49	o-Xylene	955	07:41.1	91	660.84	-0.45	ppb	593286	8.7452	106	C8H10
38.3	Peak #	Name	Similarity	R.T. (min:sec)	UniqueMass	S/N	Concentration	Conc. Units	Area	Area %	Weight	Formula
		Ethylbenzene	952					ppb			106	C8H10
	7	Benzene	974	03:33.1	78	1556.4	-53.85	ppb	4563971	55.868	78	C6H6
	21	Toluene	925	05:41.0	91	1077.2	38.1	ppb	1950720	23.879	92	C7H8
	46	m-Xylene	967	07:12.1	91	381.39	12.21	ppb	504815	6.1794	106	C8H10
	53	o-Xylene	955	07:41.0	91	651.99	1.11	ppb	644955	7.8949	106	C8H10
39.1	Peak #	Name	Similarity	R.T. (min:sec)	UniqueMass	S/N	Concentration	Conc. Units	Area	Area %	Weight	Formula
		Ethylbenzene	952					ppb			106	C8H10
		p-Xylene	967					ppb			106	C8H10
		m-Xylene	964					ppb			106	C8H10
	10	Benzene	974	03:35.0	78	1376.7	7.21	ppb	7187688	82.164	78	C6H6
	19	Toluene	925	05:42.2	91	1155.9	5.81	ppb	1082079	12.369	92	C7H8
	50	o-Xylene	955	07:41.2	91	612.77	-3.92	ppb	478263	5.4671	106	C8H10
39.2	Peak #	Name	Similarity	R.T. (min:sec)	UniqueMass	S/N	Concentration	Conc. Units	Area	Area %	Weight	Formula
		Ethylbenzene	952					ppb			106	C8H10
		p-Xylene	967					ppb			106	C8H10
		m-Xylene	964					ppb			106	C8H10
	8	Benzene	974	03:34.3	37	111.4	37.78	ppb	8501167	85.633	78	C6H6
	18	Toluene	925	05:41.9	91	1145.5	1.96	ppb	978391	9.8554	92	C7H8
	47	o-Xylene	955	07:41.2	91	574.71	-4.84	ppb	447905	4.5118	106	C8H10
39.3	Peak #	Name	Similarity	R.T. (min:sec)	UniqueMass	S/N	Concentration	Conc. Units	Area	Area %	Weight	Formula
		Ethylbenzene	952					ppb			106	C8H10
		p-Xylene	967					ppb			106	C8H10

		m-Xylene	964					ppb			106	C8H10
	12	Benzene	974	03:33.1	78	1484.3	12.39	ppb	7410314	86.121	78	C6H6
	24	Toluene	925	05:41.5	91	1114.1	-9.73	ppb	663884	7.7155	92	C7H8
	56	o-Xylene	955	07:41.0	91	521.54	-2.35	ppb	530375	6.1639	106	C8H10
40.1	Peak #	Name	Similarity	R.T. (min:sec)	UniqueMass	S/N	Concentration	Conc. Units	Area	Area %	Weight	Formula
		Ethylbenzene	952					ppb			106	C8H10
	9	Benzene	974	03:33.0	78	1458.3	-12.78	ppb	6328899	74.305	78	C6H6
	21	Toluene	925	05:41.3	91	970.76	0.01	ppb	925881	10.87	92	C7H8
	46	m-Xylene	967	07:12.1	91	290.13	7.19	ppb	357439	4.1966	106	C8H10
	51	o-Xylene	955	07:41.0	91	541.56	-1.83	ppb	547767	6.4311	106	C8H10
40.2	Peak #	Name	Similarity	R.T. (min:sec)	UniqueMass	S/N	Concentration	Conc. Units	Area	Area %	Weight	Formula
		Ethylbenzene	952					ppb			106	C8H10
		p-Xylene	967					ppb			106	C8H10
		m-Xylene	964					ppb			106	C8H10
	9	Benzene	974	03:30.7	78	1526.9	-38.54	ppb	5222001	87.643	78	C6H6
	19	Toluene	925	05:40.1	91	984.31	-22	ppb	333711	5.6008	92	C7H8
	50	o-Xylene	955	07:40.7	91	496.69	-6.21	ppb	402580	6.7566	106	C8H10
40.3	Peak #	Name	Similarity	R.T. (min:sec)	UniqueMass	S/N	Concentration	Conc. Units	Area	Area %	Weight	Formula
		Ethylbenzene	952					ppb			106	C8H10
		p-Xylene	967					ppb			106	C8H10
		m-Xylene	964					ppb			106	C8H10
	8	Benzene	974	03:34.3	78	1462.4	-111.58	ppb	2083130	56.481	78	C6H6
	17	Toluene	925	05:42.0	91	1175.4	-3.37	ppb	835105	22.643	92	C7H8
	51	o-Xylene	955	07:41.2	91	593.5	4.88	ppb	769981	20.877	106	C8H10
41.1	Peak #	Name	Similarity	R.T. (min:sec)	UniqueMass	S/N	Concentration	Conc. Units	Area	Area %	Weight	Formula

		Ethylbenzene	952					ppb			106	C8H10
	9	Benzene	974	03:35.5	52	884.27	103.74	ppb	11335749	72.079	78	C6H6
	22	Toluene	925	05:42.3	91	1655.1	35.87	ppb	1890879	12.023	92	C7H8
	48	m-Xylene	967	07:12.2	91	318.82	12.86	ppb	523982	3.3318	106	C8H10
	55	o-Xylene	955	07:41.0	91	771.13	25.47	ppb	1452254	9.2342	106	C8H10
41.2	Peak #	Name	Similarity	R.T. (min:sec)	UniqueMass	S/N	Concentration	Conc. Units	Area	Area %	Weight	Formula
		Ethylbenzene	952					ppb			106	C8H10
		p-Xylene	967					ppb			106	C8H10
		m-Xylene	964					ppb			106	C8H10
	10	Benzene	974	03:34.0	26	188.22	179.56	ppb	14593680	82.421	78	C6H6
	22	Toluene	925	05:41.6	91	1570.6	34.49	ppb	1853818	10.47	92	C7H8
	59	o-Xylene	955	07:41.0	91	752.49	19.63	ppb	1258817	7.1094	106	C8H10
41.3	Peak #	Name	Similarity	R.T. (min:sec)	UniqueMass	S/N	Concentration	Conc. Units	Area	Area %	Weight	Formula
		Ethylbenzene	952					ppb			106	C8H10
	8	Benzene	974	03:34.1	78	1843	166.17	ppb	14018180	82.722	78	C6H6
	21	Toluene	925	05:41.8	91	1610.6	27.51	ppb	1665863	9.8304	92	C7H8
	51	m-Xylene	967	07:12.1	91	285.83	9.96	ppb	438781	2.5893	106	C8H10
	59	o-Xylene	955	07:41.0	91	730.6	-6.75	ppb	384512	2.269	106	C8H10
42.1	Peak #	Name	Similarity	R.T. (min:sec)	UniqueMass	S/N	Concentration	Conc. Units	Area	Area %	Weight	Formula
		Ethylbenzene	952					ppb			106	C8H10
	8	Benzene	974	03:33.5	52	576.48	4.97	ppb	7091295	68.607	78	C6H6
	18	Toluene	925	05:41.3	91	1290.2	12.51	ppb	1262272	12.212	92	C7H8
	42	m-Xylene	967	07:12.1	91	341.32	14.1	ppb	560410	5.4218	106	C8H10
	48	o-Xylene	955	07:41.0	91	667.92	7.65	ppb	861784	8.3376	106	C8H10
42.2	Peak #	Name	Similarity	R.T. (min:sec)	UniqueMass	S/N	Concentration	Conc. Units	Area	Area %	Weight	Formula
		Ethylbenzene	952					ppb			106	C8H10

	9	Benzene	974	03:33.6	62	12.16	-9.88	ppb	6453336	68.338	78	C6H6
	21	Toluene	925	05:41.3	91	1075.1	19.48	ppb	1449847	15.353	92	C7H8
	44	m-Xylene	967	07:12.1	91	283.61	6.58	ppb	339586	3.596	106	C8H10
	51	o-Xylene	955	07:41.0	91	545.41	7.63	ppb	860950	9.117	106	C8H10
42.3	Peak #	Name	Similarity	R.T. (min:sec)	UniqueMass	S/N	Concentration	Conc. Units	Area	Area %	Weight	Formula
	9	Benzene	974	03:33.5	78	1299.6	-8.04	ppb	6532236	69.519	78	C6H6
	20	Toluene	925	05:41.4	91	975.34	1.88	ppb	976299	10.39	92	C7H8
	45	m-Xylene	967	07:12.1	91	263.32	9.64	ppb	429308	4.5689	106	C8H10
	49	o-Xylene	955	07:41.1	91	526.08	12.7	ppb	1029185	10.953	106	C8H10
43.1	Peak #	Name	Similarity	R.T. (min:sec)	UniqueMass	S/N	Concentration	Conc. Units	Area	Area %	Weight	Formula
		Ethylbenzene	952					ppb			106	C8H10
		p-Xylene	967					ppb			106	C8H10
		m-Xylene	964					ppb			106	C8H10
	8	Benzene	974	03:35.0	78	1444.9	-17.74	ppb	6115434	78.805	78	C6H6
	15	Toluene	925	05:42.1	91	1132.9	16.6	ppb	1372428	17.685	92	C7H8
	46	o-Xylene	955	07:41.2	91	572.5	-10.14	ppb	272393	3.5101	106	C8H10
43.2	Peak #	Name	Similarity	R.T. (min:sec)	UniqueMass	S/N	Concentration	Conc. Units	Area	Area %	Weight	Formula
		Ethylbenzene	952					ppb			106	C8H10
	9	Benzene	974	03:34.4	78	1429.3	-10.69	ppb	6418406	69.732	78	C6H6
	17	Toluene	925	05:41.9	91	1182.3	5.79	ppb	1081589	11.751	92	C7H8
	41	m-Xylene	967	07:12.3	91	257.64	11.38	ppb	480401	5.2193	106	C8H10
	48	o-Xylene	955	07:41.2	91	586.4	4.09	ppb	743612	8.0789	106	C8H10
43.3	Peak #	Name	Similarity	R.T. (min:sec)	UniqueMass	S/N	Concentration	Conc. Units	Area	Area %	Weight	Formula
		Ethylbenzene	952					ppb			106	C8H10
		p-Xylene	967					ppb			106	C8H10
		m-Xylene	964					ppb			106	C8H10

	9	Benzene	974	03:34.5	78	1490.2	-19.89	ppb	6023119	80.127	78	C6H6
	17	Toluene	925	05:42.1	91	1106.9	1.11	ppb	955660	12.713	92	C7H8
	47	o-Xylene	955	07:41.2	91	543.59	-2.11	ppb	538175	7.1595	106	C8H10
44.1	Peak #	Name	Similarity	R.T. (min:sec)	UniqueMass	S/N	Concentration	Conc. Units	Area	Area %	Weight	Formula
		Ethylbenzene	952					ppb			106	C8H10
	13	Benzene	974	03:35.3	27	99.612	28.32	ppb	8094827	68.655	78	C6H6
	25	Toluene	925	05:41.8	91	1315.7	21.2	ppb	1496038	12.688	92	C7H8
	49	m-Xylene	967	07:12.1	91	374.77	10.26	ppb	447696	3.797	106	C8H10
	56	o-Xylene	955	07:40.9	73	1392	21.01	ppb	1304383	11.063	106	C8H10
44.2	Peak #	Name	Similarity	R.T. (min:sec)	UniqueMass	S/N	Concentration	Conc. Units	Area	Area %	Weight	Formula
		Ethylbenzene	952					ppb			106	C8H10
	12	Benzene	974	03:35.4	78	1486.6	23.41	ppb	7883845	70.991	78	C6H6
	24	Toluene	925	05:42.2	91	1341.7	17.16	ppb	1387325	12.492	92	C7H8
	49	m-Xylene	967	07:12.1	91	358.38	6.55	ppb	338773	3.0505	106	C8H10
	57	o-Xylene	955	07:41.0	73	1440.9	16.55	ppb	1156648	10.415	106	C8H10
44.3	Peak #	Name	Similarity	R.T. (min:sec)	UniqueMass	S/N	Concentration	Conc. Units	Area	Area %	Weight	Formula
		m-Xylene	964					ppb			106	C8H10
	8	Benzene	974	03:35.8	52	665.71	53.58	ppb	9180052	81.124	78	C6H6
	22	Toluene	925	05:42.4	91	1423.7	20.43	ppb	1475325	13.037	92	C7H8
	53	o-Xylene	955	07:41.0	73	1320.5	1.58	ppb	660726	5.8388	106	C8H10
45.1	Peak #	Name	Similarity	R.T. (min:sec)	UniqueMass	S/N	Concentration	Conc. Units	Area	Area %	Weight	Formula
		Ethylbenzene	952					ppb			106	C8H10
	9	Benzene	974	03:34.5	78	1430.5	-43.46	ppb	5010380	65.906	78	C6H6

	23	Toluene	925	05:41.7	91	1082.5	22.32	ppb	1526336	20.077	92	C7H8
	50	m-Xylene	967	07:12.3	91	326.88	7.5	ppb	366591	4.8221	106	C8H10
	58	o-Xylene	955	07:41.2	91	599.79	-8.32	ppb	332442	4.3729	106	C8H10
45.2	Peak #	Name	Similarity	R.T. (min:sec)	UniqueMass	S/N	Concentration	Conc. Units	Area	Area %	Weight	Formula
		Ethylbenzene	952					ppb			106	C8H10
	8	Benzene	974	03:34.1	78	1402.8	-72.43	ppb	3765707	57.804	78	C6H6
	19	Toluene	925	05:41.6	91	1030.2	18.47	ppb	1422765	21.84	92	C7H8
	47	m-Xylene	967	07:12.2	91	327.14	8.71	ppb	402175	6.1735	106	C8H10
	53	o-Xylene	955	07:41.2	91	601.63	-2.61	ppb	521738	8.0088	106	C8H10
45.3	Peak #	Name	Similarity	R.T. (min:sec)	UniqueMass	S/N	Concentration	Conc. Units	Area	Area %	Weight	Formula
		Ethylbenzene	952					ppb			106	C8H10
	8	Benzene	974	03:34.4	78	1481.3	-74.22	ppb	3688861	53.59	78	C6H6
	20	Toluene	925	05:41.8	91	1148.7	28.74	ppb	1698937	24.682	92	C7H8
	45	m-Xylene	967	07:12.3	91	340.23	9.25	ppb	417849	6.0704	106	C8H10
	53	o-Xylene	955	07:41.0	91	625.58	1.56	ppb	659939	9.5874	106	C8H10
46.1	Peak #	Name	Similarity	R.T. (min:sec)	UniqueMass	S/N	Concentration	Conc. Units	Area	Area %	Weight	Formula
		Ethylbenzene	952					ppb			106	C8H10
	12	Benzene	974	03:39.1	52	639.42	-13.75	ppb	6287191	73.522	78	C6H6
	23	Toluene	925	05:44.0	91	1245.4	1.94	ppb	977784	11.434	92	C7H8
	49	m-Xylene	967	07:12.8	91	311.12	6.89	ppb	348698	4.0777	106	C8H10
	57	o-Xylene	955	07:41.5	91	656.14	-0.58	ppb	589049	6.8883	106	C8H10
46.2	Peak #	Name	Similarity	R.T. (min:sec)	UniqueMass	S/N	Concentration	Conc. Units	Area	Area %	Weight	Formula
		Toluene	925					ppb			92	C7H8
		Ethylbenzene	952					ppb			106	C8H10
		p-Xylene	967					ppb			106	C8H10
		m-Xylene	964					ppb			106	C8H10

		o-Xylene	955					ppb			106	C8H10
	9	Benzene	974	03:28.2	50	470.85	-98.87	ppb	2629567	100	78	C6H6
46.3	Peak #	Name	Similarity	R.T. (min:sec)	UniqueMass	S/N	Concentration	Conc. Units	Area	Area %	Weight	Formula
		Toluene	925					ppb			92	C7H8
		Ethylbenzene	952					ppb			106	C8H10
		p-Xylene	967					ppb			106	C8H10
		m-Xylene	964					ppb			106	C8H10
	8	Benzene	974	03:29.1	38	72.908	-123.06	ppb	1590102	89.85	78	C6H6
	46	o-Xylene	955	07:40.7	91	431.59	-12.94	ppb	179622	10.15	106	C8H10

NOTE:
Sample 9 – Lab Blank
Samples 19, 23 & 38 – Field Blanks

Table B3. Average off-peak BTEX concentration (ppb) from front and back sorbent sections per sample

	Average Sample Concentrations (ppb)												
	Top Section						Bottom Section						
Sample no.	Benzene	Toluene	o-Xylene	m-Xylene	Xylenes	Ethylbenzene	Benzene	Toluene	o-Xylene	m-Xylene	Xylenes	Ethylbenzene	
1	28.27	314.51	15.99	6.49	22.48	19.02		297.41	9.14	5.58	14.72	28.26	
2		309.43	9.71	6.63	16.34	7.10	57.34	332.62	15.50	4.02	19.52	11.07	
3	46.52	328.44	17.14	0.98	18.12	7.66	61.22	304.18	17.55	3.24	20.79	10.96	
4	66.22	253.90	7.43	2.43	9.86	17.88		308.58	18.24	3.71	21.95	15.59	
5	25.21	248.13	22.36	1.51	23.86	5.66		254.03	5.27	7.50	12.77	9.78	Field blank
6	20.91	275.39	15.15	4.26	19.41	18.34	129.00	260.50	11.68		11.68	9.01	
7	21.86	273.93	12.91	5.23	18.14	11.46	11.98	268.80	20.36	4.44	24.79	13.37	
8	2.16	248.54	20.40	4.27	24.67	12.98	18.41	255.26	15.80	4.80	20.59	11.41	
9		247.05	17.71	1.80	19.51	6.72	39.55	258.01	12.07		12.07	16.30	
10	79.04	312.27	10.96	8.88	19.84	12.88		340.59	9.52		9.52	6.95	
11	6.65	256.03	16.01	4.08	20.09	7.37	5.61	320.22	20.42	15.18	35.60	16.01	
12	89.30	308.54	18.51	11.43	29.94	9.64		314.20	14.66	1.14	15.80	10.85	
13	11.45	257.49	7.00	1.83	8.82	8.09		283.10	12.64	3.86	16.50	8.10	
14		307.69	28.16	7.64	35.80	11.14	7.77	385.39	20.04	8.60	28.64	16.53	
15	75.58	616.65	38.48	11.09	49.57	25.00	26.78	654.90	27.73	3.82	31.56	21.10	
16	106.24	530.65	20.61	3.84	24.44	17.07	69.92	643.66	27.95	8.19	36.14	24.36	
17	99.00	628.28	23.71	2.66	26.37	22.42	78.93	611.84	24.22	9.02	33.24	21.23	Field blank
18	82.89	608.76	31.81	5.12	36.93	30.11	113.71	600.08	26.98	11.88	38.86	18.75	
19	47.96	466.29	33.08	8.93	42.01	22.68	94.45	490.38	30.33	3.35	33.68	20.25	
20	66.04	467.16	25.84	2.74	28.58	31.72	87.01	536.02	20.86	2.35	23.21	36.13	
21	54.94	486.85	31.19	6.19	37.38	29.53	59.34	450.92	25.17	4.78	29.95	26.24	
22	29.31	403.99	38.41	13.22	51.63	18.65		267.57	11.17	9.18	20.35	7.37	
23		184.71	10.80	3.41	14.21	5.36	27.15	153.97	3.78	3.00	6.78	6.53	
24	6.73	244.93	18.48		18.48	12.30	45.93	367.07	19.59	6.09	25.68	10.51	Lab blank

Table B4. Average peak BTEX concentration (ppb) from front and back sorbent sections per sample

	Sample Concentrations (ppb)													
	Top Section							Bottom Section						
Sample no.	Benzene	Toluene	o-Xylene	m-Xylene	o-m Xylene	p-Xylene	Ethylbenzene	Benzene	Toluene	o-Xylene	m-Xylene	p-Xylene	Ethylbenzene	
1	149.40	35.84	10.12	15.14	25.26			78.27	31.87	2.03	10.78			
2	44.30	8.23		13.07	13.07			9.87	6.47					
3	60.69	45.75		10.42	10.42			49.63	24.51					
4	10.91	3.59						11.24	13.90					
5	33.02	18.01	2.05		2.05			39.73	16.35					
6	20.72	7.81		6.16	6.16			30.34	10.71	3.31				
7		45.95	2.03	1.47	3.50			18.84	5.15					
8	115.22	36.36	15.82	11.10	26.92			61.67	23.71	28.46	19.90			
9	13.64	14.95	2.25		2.25				6.60	1.82				Lab blank
10	11.11	31.05				7.24		9.15	26.38					
11		25.81	8.56		8.56				16.70					
12		31.10	4.56	6.23	10.79				19.00	2.36	6.03			
13		6.92	5.02		5.02	2.27			6.02					
14	64.35	29.17	14.57	12.40	26.97	5.93	2.08	81.04	38.39	10.12	7.54		2.34	
15	74.04	45.61	9.15	13.77	22.92			135.69	19.59	15.38	9.26			
16	41.47	57.98	12.56	15.01	27.57			33.99	24.19	0.85				
17		25.07	3.15	8.98	12.13				3.39					
18	12.32	13.94						58.49	3.46	3.33				
19	130.02	23.55	8.93	10.41	19.34			93.86	28.57	13.47	4.90			Field blank
20	33.91	40.77		8.30	8.30			26.39	38.60					
21		10.70		6.62	6.62				6.65	5.20	3.70			
22	54.02	15.69						19.77	8.67					
23	95.44	25.16	8.05	13.06	21.11			139.66	29.55	11.48	9.34	5.49		Field

														blank
24	68.79	12.74		12.00	12.00			21.12	11.56		7.74			
25	76.09	32.91	5.47	9.92	15.38		10.78		16.34	4.39	10.58			
26		16.65		6.75	6.75	2.64		15.86	10.75		6.80			
27	12.26	21.83	5.74		5.74			17.44	13.88	5.23				
28	20.82	10.77		7.44	7.44			86.64		3.54				
29		38.42	3.20	11.74	14.94			5.58	24.73	0.67				
30		19.97	0.62	3.43	4.05	4.51			8.14	0.39	19.05		8.96	
31	91.78	43.86	17.56	17.37	34.93		8.55	125.32	27.18	15.53	6.01			
32	134.65	57.40	20.56	25.34	45.90		8.84	56.29	12.21	3.44				
33	19.32	19.86	8.42	4.34	12.76				1.26					
34		35.05	3.08	13.99	17.07		13.66		28.86	11.22	6.28			
35	111.99	34.53	15.43	10.31	25.73		6.52	170.22	44.11	11.53	8.57			
36	119.53	25.41	6.95	15.84	22.79				37.86	4.10	7.31			
37	60.69	28.23	9.13	9.33	18.46									
38		31.24	1.42	8.51	9.93				30.72	1.11	7.92			Field blank
39	43.36	7.10		10.21	10.21		13.66	19.13	3.89		8.58			
40	32.52	9.65		6.43	6.43				0.01	4.88	7.19			
41	147.78	32.38	16.50	24.93	41.43			149.82	32.62	22.55	11.41			
42	22.13	21.63		9.95	9.95		4.02	4.97	11.29	9.33	10.11			
43	11.19	8.76	1.69	10.51	12.20				7.83	4.09	11.38			
44	64.21	7.99	2.42	12.51	14.93			35.10	19.60	13.05	8.41			
45		26.98	1.82	3.59	5.41				23.18	1.56	8.49			
46	25.70	22.64	8.23	8.69	16.92				1.94		6.89			

Table B5. Final off-peak BTEX concentration (µg/m^3) per sample, presented with T/B ratios

	Off-peak sample concentrations (µg.m3)						
Sample no.	Benzene	Toluene	o-Xylene	m-xylene	Xylenes	Ethylbenzene	T/B Ratio
1				1.99		8.16	
2	1.56	10.02		1.52			6.41
3	18.36	6.87					0.37
4	4.52			0.02		3.56	
5				0.97			Field blank
6	32.42					1.51	
7				1.19		0.67	
8				0.99	0.37	0.53	
9						0.07	
10	8.80	13.62		0.93			1.55
11				4.39	3.84	0.19	
12	12.22	3.58		2.16	0.52		0.29
13							
14		27.03	3.37	3.38	6.76	1.62	
15	16.57	219.85	9.38	2.94	12.32	7.76	Field blank
16	41.17	187.43	3.49	1.98	5.47	6.21	4.55
17	41.76	209.37	3.29	1.86	5.15	6.95	5.01
18	47.98	198.95	6.90	3.64	10.54	8.68	4.15
19	29.92	114.89	8.44	2.06	10.51	6.71	3.84
20	33.47	130.39	2.88		2.54	15.01	3.90
21	20.54	108.59	6.10	1.63	7.72	10.99	5.29
22		19.85	3.84	5.44	9.27	1.07	
23				0.11			

Table B6. Final peak BTEX concentration (µg/m3) per sample, presented with T/B ratios

	Peak BTEX concentrations (µg/m^3)					
Sample no.	Benzene	Toluene	Ethylbenzene	(o-m) Xylene	p Xylene	T/B ratio
1	71.34	15.39		11.33		0.22
2	13.51			3.00		
3	32.23	16.24		2.12		0.50
4	2.84					
5	19.70	4.27				0.22
6	12.47			1.80		
7	1.73	9.85				5.69
8	54.42	12.84		23.74		0.24
9	0.00	0.00		0.00		Lab blank
10	2.21	11.96			2.41	5.42
11		6.99		1.50		
12		9.52		5.04		

13				0.32	0.76	
14	43.92	15.34	1.47	13.52	1.98	0.35
15	65.36	14.55		14.50		0.22
16	20.61	20.21		8.12		0.98
17		2.30		2.69		
18	19.06					
19	210.24	30.57		11.21		Field blank
20	15.55	19.27		1.41		1.24
21				3.82		
22	20.05	0.94				0.05
23	221.46	33.16		12.62	1.83	Field blank
24	25.42	0.92		5.22	1.61	0.04
25	20.82	9.23	3.59	8.76		0.44
26	0.74	1.95		3.16	0.88	2.64
27	5.35	4.72		2.30		0.88
28	31.27			2.30		
29		13.87		3.85		
30		2.19	2.99	6.47	1.50	
31	67.82	16.50	2.85	17.47		0.24
32	59.10	16.02	2.95	15.09		0.27
33	1.89			2.90		
34		14.12	4.55	10.17		
35	89.52	19.03	2.17	13.92		0.21
36	35.30	13.91		10.04		0.39
37	47.05	6.69		4.80		0.14
38		13.47		4.96		Field blank
39	16.28		4.55	4.91		
40	6.29			4.81		
41	94.66	14.49		23.77		0.15
42	4.49	3.79	1.34	8.44		0.85
43				7.87		
44	28.56	2.01		10.77		0.07
45		9.54		3.79		
46	4.02	1.01		6.58	3.43	0.25

Note:
Sample numbers in this table correspond to those presented in main text excluding sample 9 lab blank. Thus, for example, sample 46 in this table corresponds to sample 45 presented in the main text etc.

Table B7. Blank CS_2 analysis for BTEX concentrations (ppb) during lab analysis for the off-peak sampling campaign.

Sample no.	Off-Peak CS2 lab blank concentration (ppb)											
1	Peak #	Name	Similarity	R.T. (min:sec)	UniqueMass	S/N	Concentration	Conc. Units	Area	Area %	Weight	Formula
	4	Benzene	962	03:18.5	78	2821.8	-106.5	ppb	2061329	62.565	78	C6H6
	7	Toluene	898	04:37.0	91	1027.4	-13.64	ppb	854966	25.95	92	C7H8
	12	Benzene, 1,3-dimethyl-	932	05:54.8	91	20.52	-1.66	ppb	59590	1.8087	106	C8H10
	14	Ethylbenzene	913	06:47.7	91	216.15	-13.07	ppb	90210	2.738	106	C8H10
2	Peak #	Name	Similarity	R.T. (min:sec)	UniqueMass	S/N	Concentration	Conc. Units	Area	Area %	Weight	Formula
	4	Benzene	962	03:19.8	50	817.51	-69.12	ppb	2809043	62.599	78	C6H6
	6	Toluene	898	04:37.8	91	860.69	-43.3	ppb	107140	2.3876	92	C7H8
	11	Benzene, 1,3-dimethyl-	932	05:55.1	91	24.591	10.28	ppb	339466	7.5649	106	C8H10
	13	Ethylbenzene	913	06:47.8	91	216.2	-6.64	ppb	270180	6.0209	106	C8H10
3	Peak #	Name	Similarity	R.T. (min:sec)	UniqueMass	S/N	Concentration	Conc. Units	Area	Area %	Weight	Formula
	5	Benzene	962	03:18.7	51	635.95	-139.49	ppb	1401262	52.73	78	C6H6
	14	Toluene	898	04:37.1	91	708.13	-32.68	ppb	375001	14.111	92	C7H8
	18	o-Xylene	932	06:08.1	91	23.484	-2.76	ppb	33927	1.2767	106	C8H10
	19	Ethylbenzene	913	06:47.6	91	159.87	-6.64	ppb	270225	10.169	106	C8H10

Table B7. Blank CS_2 analysis for BTEX concentrations (ppb) during lab analysis for the off-peak sampling campaign.

Sample no.	Peak CS2 lab blank concentration (ppb)										
1	Name	R.T. (min:sec)	Similarity	UniqueMass	S/N	Concentration	Conc. Units	Area	Area %	Weight	Formula
	Benzene		974				ppb			78	C6H6
	Toluene		925				ppb			92	C7H8
	o-Xylene		955				ppb			106	C8H10
	m-Xylene	07:05.2	952	106	46.942	92.62	ppb	2892542	33.333	106	C8H10
2	Name	R.T. (min:sec)	Similarity	UniqueMass	S/N	Concentration	Conc. Units	Area	Area %	Weight	Formula
	Ethylbenzene		952				ppb			106	C8H10
	p-Xylene		967				ppb			106	C8H10
	m-Xylene		964				ppb			106	C8H10
	Benzene	03:34.7	974	52	676.56	9.12	ppb	7269775	75.18	78	C6H6
	Toluene	05:42.1	925	91	1670.6	17.65	ppb	1400494	14.483	92	C7H8
	o-Xylene	07:41.2	955	91	689.89	11.81	ppb	999522	10.337	106	C8H10
3	Name	R.T. (min:sec)	Similarity	UniqueMass	S/N	Concentration	Conc. Units	Area	Area %	Weight	Formula
	Ethylbenzene		952				ppb			106	C8H10
	p-Xylene		967				ppb			106	C8H10
	m-Xylene		964				ppb			106	C8H10
	o-Xylene		955				ppb			106	C8H10
	Benzene	03:34.6	974	78	1604.9	-38.57	ppb	5220381	87.195	78	C6H6
	Toluene	05:41.6	925	91	1072	-5.91	ppb	766613	12.805	92	C7H8

4	Name	R.T. (min:sec)	Similarity	UniqueMass	S/N	Concentration	Conc. Units	Area	Area %	Weight	Formula
	Ethylbenzene		952				ppb			106	C8H10
	p-Xylene		967				ppb			106	C8H10
	m-Xylene		964				ppb			106	C8H10
	Benzene	03:34.4	974	78	1461.6	49.88	ppb	9021181	88.224	78	C6H6
	Toluene	05:41.7	925	91	1041.7	1.53	ppb	966841	9.4554	92	C7H8
	o-Xylene	07:41.0	955	91	339.61	-11.2	ppb	237241	2.3201	106	C8H10
5	Name	R.T. (min:sec)	Similarity	UniqueMass	S/N	Concentration	Conc. Units	Area	Area %	Weight	Formula
	Ethylbenzene		952				ppb			106	C8H10
	Benzene	03:35.3	974	78	1566.5	-9.66	ppb	6462816	77.464	78	C6H6
	Toluene	05:42.1	925	91	1123.6	0.09	ppb	928201	11.125	92	C7H8
	m-Xylene	07:12.2	967	91	46.09	4.82	ppb	250244	2.9994	106	C8H10
	o-Xylene	07:41.0	955	91	372.9	-4.73	ppb	451524	5.412	106	C8H10
6	Name	R.T. (min:sec)	Similarity	UniqueMass	S/N	Concentration	Conc. Units	Area	Area %	Weight	Formula
	Ethylbenzene		952				ppb			106	C8H10
	p-Xylene		967				ppb			106	C8H10
	m-Xylene		964				ppb			106	C8H10
	Benzene	03:35.0	974	52	533.17	-5.08	ppb	6659488	84.705	78	C6H6
	Toluene	05:42.1	925	91	961.04	-5.97	ppb	765075	9.7313	92	C7H8
	o-Xylene	07:41.0	955	91	352.37	-5.16	ppb	437418	5.5637	106	C8H10
7	Name	R.T. (min:sec)	Similarity	UniqueMass	S/N	Concentration	Conc. Units	Area	Area %	Weight	Formula
	Ethylbenzene		952				ppb			106	C8H10
	p-Xylene		967				ppb			106	C8H10
	m-Xylene		964				ppb			106	C8H10
	Benzene	03:35.4	974	51	601.42	-9.13	ppb	6485743	83.094	78	C6H6
	Toluene	05:42.2	925	91	1048.2	-0.29	ppb	917963	11.761	92	C7H8

	o-Xylene	07:41.0	955	91	373.13	-6.24	ppb	401562	5.1448	106	C8H10
8	Name	R.T. (min:sec)	Similarity	UniqueMass	S/N	Concentration	Conc. Units	Area	Area %	Weight	Formula
	Ethylbenzene		952				ppb			106	C8H10
	p-Xylene		967				ppb			106	C8H10
	m-Xylene		964				ppb			106	C8H10
	o-Xylene		955				ppb			106	C8H10
	Benzene	03:35.5	974	52	542.15	-144.15	ppb	683891	47.004	78	C6H6
	Toluene	05:42.4	925	91	1120.4	-5.75	ppb	771067	52.996	92	C7H8