AN EXAMINATION OF THE FEASIBILITY OF AUTOMATED LICENSE PLATE RECOGNITION TECHNOLOGY FOR PARKING LOT DEPLOYMENT

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Abstract

In order to assess the feasibility of ALPR technology in Canada, a pilot project using the technology was conducted in Surrey, British Columbia, Canada in 2006. As part of this larger pilot project, one unmarked police vehicle equipped with ALPR technology was deployed to a number of major parking lots in Surrey. The purpose of this current study was to examine the data from this one car to analyze the quantity, quality, and location of 'hits' to determine whether it was a viable and useful strategy to deploy ALPR-enabled police vehicles to parking lots. Given the proportion of 'hits' in parking lots, it is recommended that ALPR not be deployed to parking lots alone. While there may be a benefit to deploying ALPR-enabled vehicles to parking lots between 3 p.m. and 7 p.m., it would appear that the technology might be more useful along high traffic corridors.

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Dedication

I dedicate this paper in memory of my father for encouraging me to be all that I can be and for his vision.

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Introduction

Auto theft is a serious problem throughout the Lower Mainland of British Columbia. In 2003, in British Columbia, approximately 40,000 cars and trucks were stolen; 30,000 of which were stolen from the Greater Vancouver Region (IMPACT, 2005). In Surrey, B.C. alone which has been described as the auto theft capital of the world (McLaren, 2004), there were 6,338 auto thefts in 2005 (IMPACT, 2005). While the increase in Surrey was only 1%, over the same time period, the Greater Vancouver Region saw a 10% reduction in auto and truck thefts (IMPACT, 2005). Needless to say both police agencies and ICBC have been anxious to find approaches which will help reduce this problem (Miller Interview, 2006).

Two of the main explanations offered for the large number of auto thefts are the relationship between drug use and car theft and the role that cars play in the commission of other crimes, such as break and enter and other property crimes. In fact, there is some indication to support a direct connection between these two explanations. Specifically, drug addicts, especially those using methamphetamine, frequently steal cars and trucks in order to facilitate the commission of other crimes or to obtain money or goods for the purpose of acquiring more drugs (IMPACT, 2005). In the Fraser Valley, in particular, pick-up trucks are apparently very popular with car thieves because they are effective for driving through road blocks and transporting stolen goods (Miller Interview, 2006).

One of the innovative approaches introduced in British Columbia to combat the problem of auto theft is the BAIT Car program. The BAIT car program places cars with hidden video cameras, GPS technology, and kill switches in car theft ‘hot spots’ both as a deterrent and as a way to catch and convict car thieves. While this program has met with some success, many communities in the Lower Mainland are victims of repeat BAIT car thieves (Miller Interview, 2006). For example, in Abbotsford, a car thief was recently caught stealing their third BAIT car (Miller Interview, 2006). Clearly, the BAIT car program alone will not resolve the auto theft problem. Other innovative initiatives are also required if British Columbia is to significantly reduce the number of cars stolen in the province.

One such innovative technology is Automated License Plate Recognition (ALPR). While the way in which this technology works will be discussed in greater detail below, ALPR technology photographs up to 3,600 license plates per hour (Pughe, 2006) of moving or stationary vehicles without human intervention and compares the photographed license plate to a number of police and insurance company databases to determine whether the car is uninsured or stolen, or whether the owner of the vehicle is an unlicensed or a prohibited driver. Theoretically, this technology should assist police in uncovering stolen vehicles, thus contributing to the recovery of stolen vehicles and the apprehension of car thieves. In addition to its potential benefits with respect to stolen vehicles, due to its ability to search license plates against police and insurance company databases, this new technology may also be a useful mobile apprehension tool to locate uninsured or unlicensed vehicles and prohibited drivers.

The general purpose of this major paper is to analyze the feasibility of ALPR in Surrey, British Columbia, specifically its deployment in parking lots. While this technology was tested with five unmarked RCMP police cruisers in Surrey, this study focuses on the data collected from one of the unmarked cars which patrolled major parking lots in Surrey. Given this, the specific issues to be considered in this major paper are: (1) the effectiveness of this technology; (2) how ALPR can be most efficiently deployed; and (3) its viability as a crime prevention strategy.

The potential benefits of ALPR seem clear. For example, if the technology operates as intended, it would allow a mobile police cruiser to examine hundreds of license plates without requiring officers to enter the license plate information into the computer. Furthermore, it would eliminate the distraction to officers of having to manually enter license plates while driving, and many license plates could be examined virtually simultaneously, rather than an officer making a decision about which plates to enter and missing other vehicles while entering the selected one. However, in being so efficient, ALPR should also result in an enormous increase in the number of 'hits' officers receive during a typical shift. Increasing the number of stolen or uninsured vehicles or the number of unlicensed or prohibited drivers that police identify will have a significant impact on police workloads and the ability to respond to other traffic related incidents. Given this, the success of ALPR as a general traffic tool may require the police to rethink deployment strategies, the number of traffic officers on the road per shift, and, perhaps most importantly, implement a method of prioritizing the response to 'hits'.

As mentioned above, this current study will examine the feasibility and utility of deploying ALPR in parking lots. The potential value of targeting parking lots in Surrey is that these locations may be used as a place to abandon stolen vehicles. Deploying ALPR in parking lots may also be a time efficient way to discover uninsured vehicles and/or unlicensed or prohibited drivers.

This major paper is organized into four chapters. Chapter One examines the research literature on automatic license plate recognition systems, with a particular focus on the British experience. Chapter Two outlines the methodology of this current study and Chapter Three discusses the results of this project. Finally, Chapter Four provides a range of recommendations about the utility of ALPR as a crime reduction and crime prevention tool in parking lots.

Chapter One: Review of the Research Literature

The use of ALPR technology is new in North America. However, this technology has been used for several years in the United Kingdom. In the United Kingdom, this technology is referred to as Automated Number Plate Recognition (ANPR). As the technologies are fundamentally the same and have been used in the same manner in both the United Kingdom and Surrey, the terms ANPR and ALPR will be used interchangeably.[1] While there is a very limited research literature on this technology currently published, this chapter will examine the history of Automated License Plate Recognition technology and the effects of this technology specifically on police resources. Further there is limited research on this specific technology, this chapter will also examine the use of static cameras by police in public places as a crime prevention strategy.

The British Experience with ANPR

Similar to ALPR, ANPR uses pattern recognition software to read a vehicle's registration mark (PA Consulting Group, 2003). ANPR has been used by police in the United Kingdom for over a decade, initially to enforce traffic offences (Pughe, 2006). More recently, however, ANPR has been expanded into a mainstream policing tool as part of a national intelligence gathering network that can track nearly all vehicles in Britain. This growing network is able to capture five million vehicle plates a day (Pughe, 2006). According to Pughe, the developing network "has ten times the capacity and uses

[1] The term ALPR refers specifically to the Canadian context.

around 3,000 cameras comprising roadside cameras on posts and gantries (not speed cameras as has been reported elsewhere), cameras in police vehicles, local authority CCTV cameras, and even cameras on petrol forecourts" (2006: 36).

In 2001, each police force in the United Kingdom was equipped with vans containing ANPR cameras and computers with the ability to store the ANPR information in real time (Pughe, 2006). ANPR was tested from 2002 to 2003 with nine police forces, and again from 2003 to 2004 with 23 police forces. The main conclusion from these baseline experiments was that ANPR substantially increased arrests (Pughe, 2006). Before reviewing the details of these studies, it is important to understand the basic design of the ANPR system in the United Kingdom.

The hub of the system is located in Hendon, London and is called the National ANPR Data Center (NADC). The centre was installed alongside the Police National Computer (PNC) (Pughe, 2006). The effectiveness of the system derives from the fact that all number plate data and current lists of suspect vehicles are housed by the NADC (Pughe, 2006). When a number plate is read by a camera in a police vehicle, four pieces of data are generated: (1) a text file detailing the car registration number, time and date of the scan, and the GPS location of the camera site; (2) a JPEG image of the plate; (3) a video image of the plate; and (4) a video of the vehicle occupants (Pughe, 2006).

The ANPR data warehouse has the capacity to store 35 million plates per day (Pughe, 2006). Logistically, the 43 police forces of England and Wales each have their own ANPR servers which connect all ANPR cameras to the NADC (Pughe, 2006). When a picture is taken of a number plate by an ANPR camera, officers in the vehicle which took the photo receive information on whether the vehicle is stolen, has been involved in a crime, or is under surveillance. This entire process takes approximately four seconds (Pughe, 2006). During the four seconds, the number plate is examined by the computer system to determine whether there is a match in the Police National Computer system or in any of the other intelligence databases that ANPR is connected to, such as Revenue and Customs or the DVLA and Motor Insurance databases (Pughe, 2006). Having ANPR networked to a range of other data systems allows officers to identify vehicles that are not registered, taxed, insured, or are without valid insurance. Perhaps most important, the research on ANPR concluded that the system correctly read number plates 95% of the time (Pughe, 2006).

The expansion of ANPR in the United Kingdom was due, in part, to a decline in the system's IT costs and improvements to the technology in the past few years (PA Consulting Group, 2003). Initially, in the United Kingdom, a six month pilot project took place in which nine police forces were selected to be part of ANPR-enabled intercept teams (PA Consulting Group, 2003). Entitled Laser 1, during this pilot phase, ANPR-enabled police officers spent more than three quarters of their time (79 per cent) in the field on intercept duties or traveling to and from intercept duties (PA Consulting Group, 2003). On average, police officers spent a slight majority of their time (57 per cent) away from the police station (PA Consulting Group, 2001; PA Consulting Group, 2003). Furthermore, ANPR intercept teams were more visible than typical police officers while out in the field carrying out their duties, which may have the additional effect of contributing to an increase in the public's feelings of safety and satisfaction with the police and lower levels of fear of crime (PA Consulting Group, 2003).

In evaluating the conclusion that ANPR technology increased officer productivity, it is important to remember that there were clear differences between the duties of ANPR enabled intercept teams and the duties of typical police officers (PA Consulting Group, 2003). For example, ANPR teams did not have to spend nearly as much time as other officers waiting for 'hits'. Instead, due to ANPR, these officers were able to spend considerably more time investigating vehicle 'hits' (PA Consulting Group, 2003). In fact, according to PA Consulting Group (2003), it could be expected that a typical constable using ANPR would make, on average, 100 arrests per year; ten times the national average for a constable.

In addition to a significant increase in the number of arrests one could expect by using ANPR, the evaluation of Laser 1 concluded that, on average, a constable operating as part of an ANPR-enabled intercept team, could also expect annually to: recover 11 stolen vehicles valuing 68,000 pounds in total; recover stolen goods on three occasions with a total value of approximately 23,000 pounds; seize drugs on seven occasions valuing approximately 3,300 pounds in total; seize two offensive weapons or firearms; and recover stolen property on five occasions (PA Consulting Group, 2003). It is also interesting to note that the six months in which the pilot project was undertaken had extremely poor weather and light conditions. Given this, the researchers concluded that the averages presented above would likely be even higher if the project was piloted for a full year (PA Consulting Group, 2003).

In addition to the increased proportion of time officers spent investigating and dealing with untoward vehicles, and the increase in the number of arrests that ANPR-enabled officers made compared to other officers, there were a number of other benefits associated with the use of the technology. One of the important benefits of ANPR was that it could provide the Home Office with a more accurate description of the total number of vehicles on the road which were in violation of some traffic or insurance regulation, associated with some other criminal offence, or were owned or operated by an individual of interest to the police. During Laser 1, one out of every 200 cars photographed by ANPR technology was stopped by the intercept teams for some reason (PA Consulting Group, 2003). In other words, for each hour in the field, each ANPR-enabled officer stopped one vehicle. Moreover, in slightly less than two thirds of the cases in which an officer stopped a vehicle (61 per cent), the officer took some action as a result of the stop (PA Consulting Group, 2003). This result is likely due, in part, because one of the important benefits of ANPR is that it allows police to stop vehicles on the basis of prior intelligence.

It is important to keep in mind that ANPR is likely most effective when used in conjunction with other police strategies and techniques. For example, ANPR should not be considered a replacement for police experience and observation when on patrol. Indeed, with experience, police officers develop a sense of which vehicles or drivers should be investigated. This important skill was found to enhance the effectiveness of ANPR as, during Laser 1, officer observation generated nearly one quarter (22 per cent) of all vehicle stops (PA Consulting Group, 2003).

Perhaps the biggest challenge posed by ANPR during the pilot phase was with respect to the question of adequate resourcing. With a standard complement of officers on patrol during a typical shift, the police were only able to adequately respond to approximately 13% of all ‘hits’ during Laser 1 (PA Consulting Group, 2003). Given this, it would appear that current staffing levels for ANPR-enabled intercept teams would have to be increased considerably in order to capitalize on the full benefits of ANPR technology.

Based on the initial evaluation of Laser 1, it was concluded that ANPR significantly increased arrests rates when compared to conventional policing strategies. Still, no additional funding was available to further test the ability of ANPR-enabled intercept teams. However, conditional approval was given by the Home Office for a cost recovery program for ANPR-enabled intercept teams. This enabled police to use ANPR to target vehicle documentation offences and crime in general. This next phase in the use of ANPR was entitled Laser 2 and took place from June, 2003 to June, 2004 involving 23 police forces from England and Wales operating dedicated intercept officers (PA Consulting Group, 2004).

The total number of vehicles stopped in the twelve months during Laser 2 was 180,543 which resulted in 13,499 people being arrested (PA Consulting Group, 2004). Figure 1 demonstrates the nature of the arrests made during Laser 1. As one of the main purposes of the ANPR technology was to assist the police in finding disqualified, uninsured, or prohibited drivers, it is important to note that one quarter of all arrests during Laser 2 were for these types of driving offences. Moreover, it is clear that ANPR-enabled intercept teams also discovered other forms of criminality by stopping cars flagged by the system. For example, of all people arrested as a result of an ANPR induced stop, slightly less than one fifth (16.8 per cent) were for theft or burglary, while an additional one fifth were for either drug offences (8.2 per cent) or theft from a vehicle or theft of a vehicle (10.3 per cent) (see Figure 1).

Figure 1: Types of Arrests

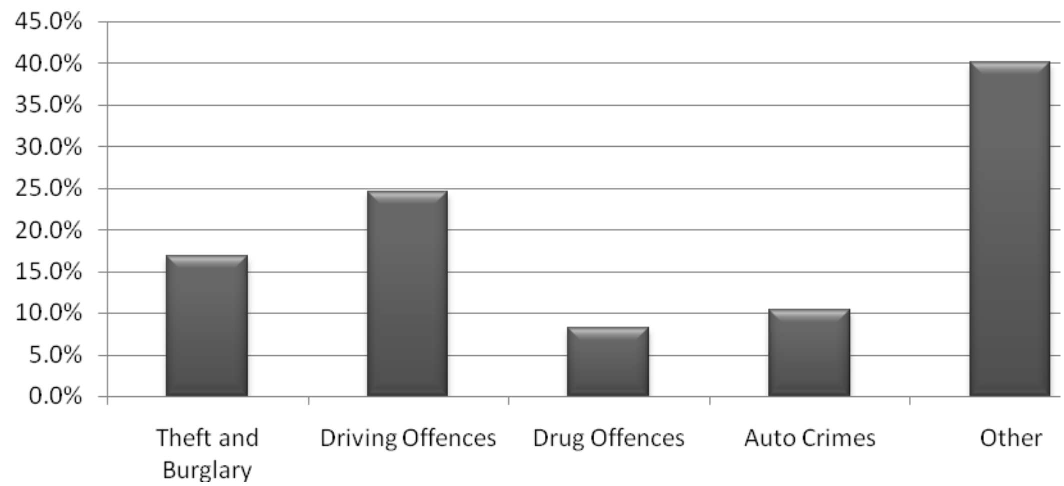

Chart adapted from PA Consulting Group (2004)

The value of ANPR should not be measured exclusively in terms of the number of arrests made as a result of ANPR-induced stops. Many stops resulted in the police taking other actions in addition to making arrests, such as recovering or seizing property. For example, during Laser 2, the police recovered 1,152 stolen vehicles with a total value of 7.5 million pounds. In other words, 0.6% of all ANPR 'hits' resulted in the discovery and recovery of stolen vehicles. In addition to stolen vehicles, police seized 266 offensive weapons and firearms, drugs with a value of over 380,000 pounds from 740 vehicles, and 640,000 pounds worth of stolen goods from 430 vehicles.

ANPR-enabled intercept teams also issued a large number of fixed penalties. Specifically, 12.6% of stops resulted in the police issuing a ticket for failing to display a valid Vehicle Excise Duty (VED). In 3.5% of cases, police issued a ticket for no insurance and, in 11.2% of cases, officers issued tickets for a variety of other offences, such as not wearing a seat belt or using a cellular phone while driving (PA Consulting Group, 2004). The evaluation of Laser 2 concluded that a typical ANPR-enabled intercept team officer would "contribute around 31 offences per annum towards the Government's Offences Brought to Justice Target" (PA Consulting Group, 2004: 6). This is over three times the expected rate for a non-ANPR-enabled officer.

One of the more important results of Laser 2 was that it demonstrated that the benefits of ANPR could be sustained over a long period of time and over a larger cross section of forces in different jurisdictions (PA Consulting Group, 2004). More specifically, the analysis of the data suggested that the use of ANPR enabled intercept teams represented an innovative approach focusing on "targeting vehicle documentation enforcement to engage with and disrupt criminals delivered through an intelligence-led piece of technology (an ANPR reader)" (PA Consulting Group, 2004: 7).

Another significant recommendation derived from Laser 2 was that intelligence needs to be more effectively shared locally and nationally (PA Consulting Group, 2004). In effect, all vehicle intelligence needed to be housed in a national data warehouse so that it could be accessed, in real time, by national ANPR users. The data warehouse would also house ANPR reads and 'hits' as a further source of vehicle intelligence which would benefit other criminal investigations, such as those involving major crimes, organized crime, or terrorism (PA Consulting Group, 2004).

To increase the productivity of ANPR-enabled teams, it was also recommended that, where appropriate, teams be relocated with the help of basic command and road policing units to make the best use of police time and resources (PA Consulting Group, 2004). One of the concerns during both the Laser 1 and Laser 2 were that ANPR teams needed to travel to their target locations, thus reducing the amount of time per shift that the teams were operating in their designated locations. Moreover, to ensure that performance is properly monitored and that best practices and intelligence are appropriately shared strategically and operationally, support systems must be in place (PA Consulting Group, 2004).

Overall, the results from Laser 1 and Laser 2 indicated that ANPR was beneficial to the police as it allowed officers to respond to more crimes through intelligence-led policing compared to conventional methods of policing. However, as mentioned above, an important question related to the implementation of this technology is how to respond to the increased workload generated by ANPR. The authors of the United Kingdom study indicated that there was not an ideal number of officers for an intercept team. However, it was recommended that teams be expanded. In considering the implementation of this technology in Canada, adequately resourcing intercept teams and planning for the increased workload would be required. This is, however, a particular concern in Canada given the current nation-wide shortage of police officers (Malm et al., 2004). Although, the use of ANPR would likely be beneficial for police in Canada in much the same way as it continues to be effective in the United Kingdom, the success of this program is, in part, dependent on ensuring the proper level of staffing resources.

The Potential Benefits of ALPR in the Canadian Context

Due to an increase in workloads, the potential for expanding the number of officers on the roads, and/or an increase in the number of stops that police make on a typical shift, one of the potential benefits associated with the implementation of ALPR in Canada is that the police will become more present and more visibly active in the community. In addition to the deterrent effect that an actual or perceived increase in police presence might have on crime, the public may feel safer if they see and believe that their police are solving more crime. Related to this is the fact that ALPR allows the police to be more proactive as opposed to reactive. As demonstrated in the United Kingdom pilot projects, the ALPR technology assists officers in finding those, for example, with criminal records, outstanding warrants, driving prohibitions, and stolen vehicles. Importantly, ALPR can assist the police in finding these people before they commit additional offences. To better achieve this objective, in the United Kingdom, ANPR is linked to CCTVs, which will be discussed below.[2]

Another significant benefit found with the ANPR projects in the United Kingdom was that the volume of 'hits' was such that there was not a lot of time spent by the police waiting for a 'hit'. In other words, ANPR contributed to a more efficient use of police patrol and shift time, thus maximizing resources. Still, a constant flow of 'hits' is likely dependent on where the technology is deployed and the data systems that the technology is connected to. Nonetheless, the rate of 'hits' experienced in the United Kingdom projects suggests that the technology will assist the police in identifying criminals at a much higher rate than other currently employed strategies.

As alluded to above, the operational success of the technology is dependent, in large part, on the link between the cameras in the police vehicles and the databases that are searched after a license plate is photographed. To maximize this benefit, a national data warehouse, similar to the one mentioned in the United Kingdom study, should be developed to house all the relevant data. The more information that is stored in this warehouse, with contributions from a wide range of databases, the more effective the police will be at identifying criminals. While the arguments for and against the development of a national data warehouse are beyond the scope of this paper, it is recognized that existing privacy legislation, security issues, and the lack of established information sharing protocols between government and the private sector could impede

[2] CCTV refers to Closed Circuit Television. As will be discussed in greater detail below, the use of CCTVs is especially beneficial in proactive policing when there is good communication between CCTV operators and the police.

the formation of a national data warehouse. Notwithstanding this significant obstacle, the development of a national data warehouse is necessary when seriously considering the implementation of ALPR in multiple jurisdictions across Canada. Based on the United Kingdom experience, and the Canadian experience with respect to other policing issues, local and national information sharing is paramount for the successful implementation of ALPR in Canada.

Before discussing the effects of ALPR on police resources, it is useful to examine the United Kingdom's police experience with a similar technology, namely closed circuit television.

CCTV and Policing

> The deployment of video surveillance cameras has become an innovation in a broad range of policing activities: the usage of surveillance images as evidence in court; documentation of interrogation procedures; covert surveillance in criminal investigations; monitoring of traffic flows for both management and control purposes; temporary and mobile surveillance of crowds at demonstrations and mass events to deter and detect public order offences; and last but not least the permanent operation of open street CCTV for combating street crime. CCTV is seen as a useful instrument for investigative assistance, evidence gathering, ensuring police procedures, efficient deployment of the scarce resource police, and finally proactive crime prevention (Hempel and Topfer, 2004: 51).

The potential of CCTV has been recognized by the British Police who use it in response to the public's demand for more officers on the street and to assist the police in their core functions of crime control and fighting crime. According to Jay:

> Nevertheless, whilst public space CCTV systems continue to offer the police opportunities to improve their crime-fighting effectiveness, to increase their efficiency by means of the appropriate deployment of personnel in response to incidents caught 'live' on camera, to provide the public with a substitute of sorts for officers on the beat, and to save the police time and effort by inducing admissions of guilt on the part of those caught on camera, the enthusiasm of the police service for CCTV is unlikely to diminish (1998: 321).

Police around the world are also using CCTV as part of a larger crime prevention strategy. In the United States, a large majority of law enforcement agencies (approximately 80 per cent) utilize CCTV (Nichols, 2001; Norris, McCahill, & Wood, 2004). Many police forces in the United States have equipped mobile units with CCTV in order to effectively monitor arrest and detention procedures. CCTVs in the United States are also used to monitor courtrooms and government buildings. Furthermore, CCTV has also been used by American police agencies to monitor high crime areas, public streets, parks, and public housing schemes (Nichols, 2001; Norris, McCahill, & Wood, 2004).

In China, surveillance infrastructure has been implemented on a large scale (Norris, McCahill, & Wood, 2004). Surveillance in China was implemented as part of the Golden Shield Project and the purpose of it was to advocate:

> …the adoption of advanced information and communication technology to strengthen central police control, responsiveness, and crime combating capacity, so as to improve the efficiency and effectiveness of police work. China's security apparatus announced an ambitious new plan; to build a nationwide digital surveillance network linking national, regional, and local security agencies with a panoptic web of surveillance. Beijing envisions the Golden Shield as a database-driven remote surveillance system offering immediate access to records on every citizen in China, while linking to vast networks of cameras designed to increase police efficiency (Walton, 2001: 8).

The Middle East is also employing CCTV to protect commercial establishments and guard against the threat of terrorism (Norris, McCahill, & Wood, 2004). Police in Tehran, for example, have CCTV in each local police station that receives images from cameras throughout their jurisdiction (Norris, McCahill, & Wood, 2004). The network in Tehran is so extensive that there is a central control room, similar to the national data warehouse in the United Kingdom, which receives information from the entire network and traffic control systems (Norris, McCahill, & Wood, 2004). In Russia, countries throughout Eastern Europe, India, and Pakistan, CCTV is also used to prevent crime and to monitor the behavior of police officers (Norris, McCahill, & Wood, 2004). More specifically, in

India and Pakistan, CCTV is expanding into the transportation sector to prevent theft and terrorism (Norris, McCahill, & Norris, 2004).

As CCTV becomes a more routine part of policing, researchers have examined police attitudes towards the technology. In general, the majority of officers viewed CCTV as an asset, assisting them to be more efficient and effective (Levesley and Martin, 2005). According to Levesley and Martin (2005), police officers felt that CCTV was a useful tool in dealing with a range of criminal behaviour, such as public order offences, theft, and assault, as the technology could help identify offenders and witnesses, support or challenge alibis, resolve contradictory accounts of similar events, and provide evidence in court. In addition to monitoring events and suspicious behavior in real time, CCTV has also been used to more effectively deploy officers, allow the police to respond to a situation before events escalate into more serious incidents, and provide guidance for officers on the scene (Levesley and Martin, 2005).

Levesley and Martin contended that, in addition to the positive role of CCTV during court proceedings, such as saving time and money by inducing offenders to plead guilty, the police have used CCTV to make investigations more cost effective. However, as with ANPR, the use of CCTV has also been associated with increased police workloads. This is mainly because CCTV draws incidents to the attention of the police that might otherwise have gone unnoticed. In addition, CCTV requires that police spend time searching through and retrieving video footage; all of which increase the demands on police resources.

There are several lessons that can be learned from the research on CCTV that could be applied to ALPR deployment in Canada. As mentioned in the ANPR research, the effectiveness of CCTV tends to be linked to good communication between police officers and CCTV operators (Levesley and Martin, 2005). A recurring theme in Levesley and Martin's (2005) research was the necessity to recruit well-trained CCTV operators or a commitment to spend the extra money necessary to develop highly skilled

CCTV operators. An alternative to well-trained CCTV operators might be to have a police presence in the control room to ensure effective deployment (Levesley and Martin, 2005). Good communication and a police presence in the control room ensured that operators were also more likely to be sensitive to the demands made on police time and resources which allowed the operators to filter demands for service accordingly. This recommendation is extremely important because the training of CCTV operators in the United Kingdom was, in most cases, determined to be inadequate (Hempel and Topfer, 2004). While the method of deploying ALPR is different than the use of CCTV, the lesson remains fundamentally the same. For ALPR to be most effective, officers who use the technology in their vehicles must be trained sufficiently as must those who are responsible for maintaining and updating the computer systems that ALPR depends on for its information.

In terms of using CCTV as an effective deployment tool, police reported a very high level of satisfaction (Levesley and Martin, 2005). In many cases, CCTV allowed the police to deploy officers before a complaint was received by the public. CCTV also allowed the police to monitor situations in real time ensuring, therefore, that the appropriate number of officers was deployed to an incident (Levesley and Martin, 2005). Again, these lessons are important in terms of the tactical deployment of ALPR. Specifically, over time, ALPR should assist the police in better defining 'hot spots' or those locations or areas that are most likely to result in the highest number of quality 'hits'. Maximizing the quantity and quality of stops will inevitably result in the police being more efficient and effective. Moreover, by making stops based on intelligence, the police will be better prepared for what they might face during the stop, thus allowing them to send an appropriate number of officers to support the stop and being more tactical in their decisions about which cars to stop.

There are some problems with CCTV which might also be a concern with ALPR. For example, in order to store all of the video obtained by CCTV, data images are compressed. However, compression reduces the quality of images making it difficult for officers to use the photos in investigations or as evidence in judicial proceedings (Hempel and Topfer, 2004). This similar problem might be associated with ALPR. It is important to ensure that the quality of photos obtained by the cameras in the cars and the process of saving the images in a database are such that the images are useful for a myriad of police and judicial purposes.

Based on the increased number of 'hits' generated by the ANPR pilot projects and the research on CCTV which found that CCTV increased the potential for deploying officers to low or no priority incidents (Levesley and Martin, 2005), it is important for police managers to develop a system to prioritize what type of 'hits' officers should respond to when deploying ALPR. This is extremely important because the highest single negative response about the use of CCTV was related to officer frustration with the increase in incidents being brought to their attention (Levesley and Martin, 2005). Similarly, as mentioned above, the research on Laser 1 concluded that the police were only able to respond to 13% of all 'hits'. This significant increase in the number of 'hits' requires that the ALPR-enabled officers have a clear understanding of how they are to respond to the increased number of 'hits' they receive on a typical shift.

In the United Kingdom, there is a large amount of vehicle documentation crime (PA Consulting Group, 2003). These crimes include not having a valid vehicle excise duty, no registered keeper information, not having a valid Ministry of Transport (MOT) test certificate, and driving while uninsured (PA Consulting Group, 2003). In the past, British police did not spend a significant proportion of their resources dealing with these crimes because they were not viewed as high priority (PA Consulting Group, 2003). However, with the publication of research demonstrating a link between vehicle crime and more general types of crime, the attitude of the police has shifted (PA Consulting Group, 2003). A Home Office study entitled *Illegal Parking in Disabled Bays: A Means of Offender Targeting* concluded that, of those people parking illegally in disabled parking bays, nearly one quarter (21 per cent) were of immediate police interest, one third (33 per cent) had a previous criminal record, nearly one half (49 per cent) of vehicles had a history of traffic violations, slightly less than one fifth (18 per cent) of vehicles were known or suspected of being used in other criminal activities, and approximately one in ten vehicles (11 per cent) were in breach of some other traffic law, such as not having a valid Vehicle Excise Duty (VED) (Chenery, Henshaw, & Pease, 1999; PA Consulting Group, 2003). In all cases, these findings were higher than for the average United Kingdom vehicle or driver (PA Consulting Group, 2003).

Another study by the Home Office examined whether those engaged in anti-social behavior on the roads were likely to engage in other types of criminal activity (Rose, 2000; PA consulting Group, 2003). This study focused on driving while under the influence of alcohol, driving while disqualified, and dangerous driving (Rose, 2000; PA Consulting Group, 2003). The findings suggested that disqualified drivers shared a similar profile with mainstream criminal offenders (Rose, 2000; PA Consulting Group, 2003). Specifically, more than three quarters of disqualified drivers (79 per cent) had a criminal record prior to disqualification. Nearly the same proportion (72 per cent) of mainstream offenders were disqualified drivers. Moreover, both disqualified drivers and mainstream offenders were equally likely to be convicted again within a one year time frame (37 per cent) (PA Consulting Group, 2003).

Another reason why vehicle documentation crime had not been a priority for British police was that their traffic sections faced significant resource constraints due to other policing priorities (PA Consulting Group, 2003). In support of this conclusion, the PA Consulting Group (2003) stated that, in spite of the fact that over a four year time frame (1997-2001) traffic volumes and incidents increased on British Highways, the number of traffic police officers declined by 12%. Clearly, a reduction of officers or an insufficient number of officers would have a direct effect on the number of incidents that traffic police can respond to, their response times, and the quality of service they can provide. With respect to ALPR, one implication of having too few officers is that the traffic divisions within detachments are likely to be stretched to their maximum capabilities trying to keep up with the increased number of incidents brought to the attention of the police as a result of the technology. As the British experience demonstrated, ANPR is extremely useful in assisting police to identify ‘hits’, however, the combination of inadequately resourced traffic divisions and the increased number of ‘hits’ requires the development of a priority scheme to respond to ‘hits’.

As mentioned above, police in Canada are also facing a shortage of general duty officers and, more specifically, traffic officers. In part, this shortage is the result of the aging police demographic which has produced a retirement bubble (Van Nieuwenhuizen Interview, 2006). To replace the large number of officers retiring, the police must aggressively recruit new members. However, at the beginning of 2000, the RCMP put a financial freeze on recruiting new members (Van Nieuwenhuizen Interview, 2006). The result of this policy is that it has been difficult for the RCMP to recruit a sufficient number of police officers to fill current staffing need. While not all police jurisdictions in Canada currently have a shortfall in members, making full use of the benefits derived from ALPR will likely require a significant increase in the number of officers, especially in the traffic divisions. It is, however, important to keep in mind that even with a commitment to increase the number of officers, there will likely still be important workload issues to consider as a result of the implementation of ALPR.

Although the research into ANPR and CCTV suggests that both technologies contribute significantly to the effectiveness and efficiency of police work, they also contribute to police workload. As police resources in Canada are scarce, it is likely that police may simply be unable to deal with the sheer volume of crimes and criminals that ALPR will help them identify. In addition to developing a priority scheme to deal with ‘hits’, it may also be feasible to outfit community policing volunteer vehicles, such as Citizens on Patrol, with ALPR technology. For example, volunteers could be tasked with using ALPR to search for stolen or abandoned vehicles. Once volunteers get a 'hit', they could contact the police with the location of the stolen car so that the police could determine how best to respond. Still, this potentially time saving measure would have to be balanced against the cost of purchasing and installing the technology, training volunteers on the technology, and all other ALPR-related expenses.

As outlined above, if ALPR were to be implemented in Canada, there are a number of important issues that must be considered and addressed, namely staffing, intelligence, deployment, and cost. In terms of staffing, it may be necessary to hire additional civilian staff to help police cope with the number of 'hits' that ALPR will likely generate. In the United Kingdom pilot projects, civilian staff were part of ANPR-enabled intercept units which assisted in reducing the workload on officers. In Canada, well trained civilians could be involved in the control room/dispatch helping to deploy police officers, could use ALPR-enabled vehicles to assist in looking for stolen or abandoned vehicles, could be used to search for 'hits' in more static locations, such as parking lots, and could undertake a range of secretarial functions associated with the use of ALPR.

In addition to staffing, developing, implementing, and maintaining intelligence networks is critical for the success of the ALPR program. As mentioned throughout this paper, a national data warehouse, similar to the United Kingdom's, is necessary if ALPR is to be most effective. Moreover, the greater the number of different databases that the police have access to, the more effective they will be at preventing, deterring, and responding to crime and criminals. The creation of this type of intelligence network will undoubtedly be time consuming and expensive as a wide range of government agencies and stakeholders would have to be involved in its development and operation. Nonetheless, the benefits of this undertaking will be the more efficient operation of ALPR in the long and short-term.

Deployment is another important issue that needs to be considered. One crucial question is whether it is better to deploy ALPR-enabled intercept teams from one central location or have several support sites capable of deploying teams. It is also important to consider whether there are ‘hot spots’ or corridors within a jurisdiction where it might be better to concentrate ALPR resources, or whether police should simply drive their usual patrol routes.

For obvious reasons, cost is also an extremely important consideration prior to the full implementation of ALPR. While it is beyond the scope of this paper to delve fully into the issue of cost, it is necessary to consider the cost of the technology, in terms of purchase, installation, maintenance, data warehousing, staffing, and training. It is also necessary to consider these costs against the costs associated with a reduction in crime, the recovery of vehicles and goods, and public perception. In some ways, the lessons learned in the United Kingdom’s pilot projects can be instructive. British Columbia appears to be taking a measured approach to ALPR as it is piloting the technology in a variety of jurisdictions for at least one year prior to making a final decision about its full deployment.

One further issue that should be mentioned is the challenge that ALPR technology poses to privacy or civil liberties. This issue is not dealt with in a rigorous manner in the ANPR literature, however, privacy and civil liberty concerns have been discussed in the context of CCTV. In Canada, concerns have been raised about the use of CCTVs in public spaces. The Privacy Commissioner of Canada has legally challenged the use of CCTVs stating that “continuous, non-selective monitoring is a violation of the Privacy Act and that the sophistication of the technology makes them particular privacy-invasive requiring a higher standard of justification than other forms of intelligence gathering” (Deisman, 2003: 18). Furthermore, in terms of the Canadian Charter of Rights and Freedoms, “it is claimed that indiscriminate video surveillance in the absence of cause, even without continuous recording, breaches the fundamental privacy rights of all

Canadians" (Deisman, 2003: 18) as set out in the Charter, the United Nations Universal Declaration of Human rights, and the International Covenant on Civil and Political Rights. According to Pughe (2006), the capacity of the state to engage in universal surveillance tests the limits of the principle of innocent until proven guilty. Moreover, part of the trust that society places with the police is based on the belief that police target those individuals where there exists some evidence of criminal activity, rather than tracking and passively investigating everybody while they are engaged in their normal business. Furthermore, Deisman described the Privacy Commissioner's stance as:

> …Canadians retain the right of being lost in the crowd, of going about their business without being systematically monitored by anyone, let alone the police. Further that there is a reasonable expectation of, and entitlement to, a degree of privacy, even in a public place. And, finally, that the use of video surveillance by the RCMP infringes on the exercise of freedom of association, prevents the exercise of mobility rights, deprives Canadians of their liberty and security of person, and constitutes unreasonable search and seizure (2003:18).

It should be noted that the basis of the Privacy Commissioner's legal argument stemmed from the fact that research has not confirmed the benefits of CCTV (Deisman, 2003). The Privacy Commissioner asserted that CCTV does not actually reduce crime, but merely displaces it to other areas, nor does it reduce violent crime (Deisman, 2003). In conclusion, the general view of the Commissioner was that CCTV would have a negative effect on policing by reducing the number of police officers on the street and placing an additional strain on limited police resources (Deisman, 2003).

However, from the perspective of the police and the government, technologies, such as ALPR, provide the police with the ability to take advantage of the enormous power of modern computing, storage, and networking to more effectively and proactively carry out their primary responsibilities of preventing crime and protecting society. Given this, it is necessary to consider all of the potential benefits of ALPR against the possibility that this technology could undermine civil liberties (Pughe, 2006).

Due to the fact that the use of CCTVs in Canada currently constitutes an infringement of privacy and civil liberties, the use of ALPR might be similarly classified. However, according to Deisman, even "if it is determined that the use of CCTV systems by the State in public spaces is not, as a matter of principle, unconstitutional or illegal objectionable, there is still a formidable set of issues associated with the governance and regulation of CCTV systems so that their use does not run afoul of the law or the Charter" (2003: 19). It would appear, therefore, that research is required to better understand how the use of ALPR can be effectively deployed in a way that does not compromise the benefits of the technology, but is also used in accordance with privacy and civil liberties legislation.

In order to assess the feasibility of ALPR in Canada, a pilot project using the technology was conducted in Surrey, British Columbia, Canada in 2006. As part of this larger pilot project, one unmarked police vehicle equipped with ALPR technology was deployed to a number of major parking lots in Surrey. The purpose of this current study is to examine the data from this one car to analyse the quantity, quality, and location of 'hits' to determine whether it was a viable and useful strategy to deploy ALPR-enabled police vehicles to parking lots.

Chapter Two: Project Methodology

The ALPR technology used in the Surrey pilot project was based on the same technology used in the United Kingdom. The ALPR camera system and computer system are separate entities. Every morning, before the car was deployed, ‘hot lists’ of vehicles were obtained from the Canadian Police Information Centre (CPIC) and the Motor Vehicle Branch. The ‘hot list’ from the Motor Vehicle branch consisted of three pieces of data: (1) Unlicensed drivers; (2) uninsured/unlicensed vehicles; and (3) prohibited drivers. The ‘hot list’ from CPIC contained information exclusively on stolen vehicles. These lists were loaded into the police vehicle’s onboard computer. In effect, the ‘hot lists’ were uploaded into the car’s computer system every twenty four hours. In other words, the ALPR technology was not “live”. The ‘hot lists’ which were downloaded to the onboard computer were not updated throughout the day. The implications of this process will be discussed in Chapter Four.

The vehicle’s ALPR camera was equipped with infrared illuminators that helped the camera locate a vehicle’s license plate. The infrared illuminators were attracted to license plates because the plates are reflective. In every instance, the camera took a picture of the entire vehicle, but isolated the license plate. The system was programmed with the specifications of British Columbia license plates and searched the vehicle for its location. Once the license plate was located, the computer compared the characters of the license plate against the downloaded ‘hot lists’ in the onboard computer. If the computer found a match, an alarm in the police vehicle sounded. The computer screen in the police vehicle showed the photo of the entire target car, a photo of the license plate, and the license plate that was read by the computer. This last piece of information was critical as it allowed the officer to determine whether the computer accurately read the license plate. In addition to this information, the monitor informed the officer as to the nature of the 'hit'. All of this information was presented to the officer within seconds of the camera taking the original photograph.

In order for the ALPR-enabled police car to be effective for parking lot deployment, the cameras were set at a ninety degree angle. The police car, using only one camera, would drive down each row of parked cars and read each license plate. The car would then turn around and go down the same row photographing all of the cars on the other side. In order to allow the police vehicle to go down each row only once and photograph all of the cars on both sides, a second camera would have to be installed in the car and the ALPR system would have to be reconfigured somewhat. As mentioned in the previous section, the costs of the doing this would have to be weighed against the time saved by only driving down each parking lot row once as opposed to twice.

It is important to keep in mind that this test of the ALPR technology was limited to the aforementioned four categories of 'hits'. The category of stolen vehicles was selected in order to determine whether ALPR technology would be a more effective way of locating stolen vehicles compared to some of the other local programs already in place, such as those by Citizens on Patrol. The other 'hit list' categories were selected because there were no other police programs in place for finding wanted persons in British Columbia. Still, there were many other categories of offenses that were not included in the 'hot lists' primarily because CPIC Ottawa wanted the Integrated Municipal Provincial Auto Crime Team (IMPACT), the team responsible for the pilot project, to make a case for the viability of the technology before releasing additional 'hot lists'.[3]

All of the patrolled parking lots were selected in consultation with the Surrey RCMP. A sample of parking lots in high and low crime areas were selected in order to determine whether there were specific parking lots in Surrey that were more appropriate

[3] An evaluation of ALPR using four unmarked cars patrolling specific traffic corridors in Surrey was undertaken around the same time as the parking lot study. However, the results of this evaluation have not yet been published and, therefore, are not included in this major paper.

for ALPR. In total, 31 parking lots were selected for inclusion in the pilot study. In addition to the consultations with the Surrey RCMP, the list of parking lots was also mapped in conjunction with the Surrey Crime Prevention Society. The Surrey Crime Prevention Society has a mobile patrol team that assists the RCMP specifically with auto crime. Once all of the parking lots were selected, the author of this report rode along with the mobile patrol team for five days to develop a route to all the parking lots which would be most efficient. As a result of these ride-alongs, a circuit was developed which mapped out the shortest routes between parking lots in order to minimize the amount of time the ALPR-enabled police car was in a designated parking lot (for a complete list of the parking lots, please see Appendix A).

Another purpose of the ride-along was to determine how long it would take the ALPR-enabled car to photograph every car in the entire parking lot. It was not feasible, during the mapping phase of the project, to drive up and down every row of each parking lot in all 31 parking lots. With the help of Surrey Crime Prevention Society, for some parking lots, the research team estimated as accurately as possible how long it would take the ALPR-enabled car to drive through the entire parking lot. In terms of this estimate, consideration was given to the typical number of vehicles that would be parked in the lot on any given day.

Once this was completed, a complete route was created that would occupy the ALPR-enabled vehicle for a ten hour shift for seven consecutive days. Based on resourcing issues, time constraints, and a consideration of the parking patterns of vehicles in these parking lots, it was decided that the ALPR-enabled vehicle would operate from 1400 hours to 2400 hours for seven consecutive days. In order to ensure that the ALPR-enabled vehicle was in each lot at different times of the day, the car would start the circuit at a different point along the route each day and would complete the entire circuit as many times as possible during each ten hour shift. Finally, parking lots in four districts of

Surrey were included in the circuit.[4] In all four districts, major parking lots were selected, such as the parking lots of large shopping centers, strip malls along major traffic corridors, bars, motels and SkyTrain Stations.

The larger pilot project testing the ALPR technology consisted of two phases. The first phase was to understand how to best deploy the technology by collecting baseline data, while the second phase consisted of testing the technology live to determine what impact this technology had on police resources. This current study analyses exclusively the data from the parking lot ALPR-enabled vehicle during the first phase of this project. During this phase, volunteer students from the University-College of the Fraser Valley rode along in the ALPR-enabled vehicle and recorded specific information on each ‘hit’. This method was necessary as the RCMP had not yet developed an efficient way to get the data out of their central data warehouse at the end of each shift for analysis. Moreover, having a student compare the photo of the license plate against the characters read by the computer for each ‘hit’ allowed the researchers to determine the technology’s level of accuracy in reading plates.

Whenever there was a ‘hit’, the coder would record the date, time, and location of the ‘hit’, the nature of the ‘hit’, and whether or not the ALPR camera accurately recorded the license plate of the target vehicle (see Appendix B for the data collection form). At the end of each shift, all of the coding forms were entered into an SPSS database for analysis.

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[4] The four districts of Surrey are: Whalley, Guildford, Newton, and South Surrey.

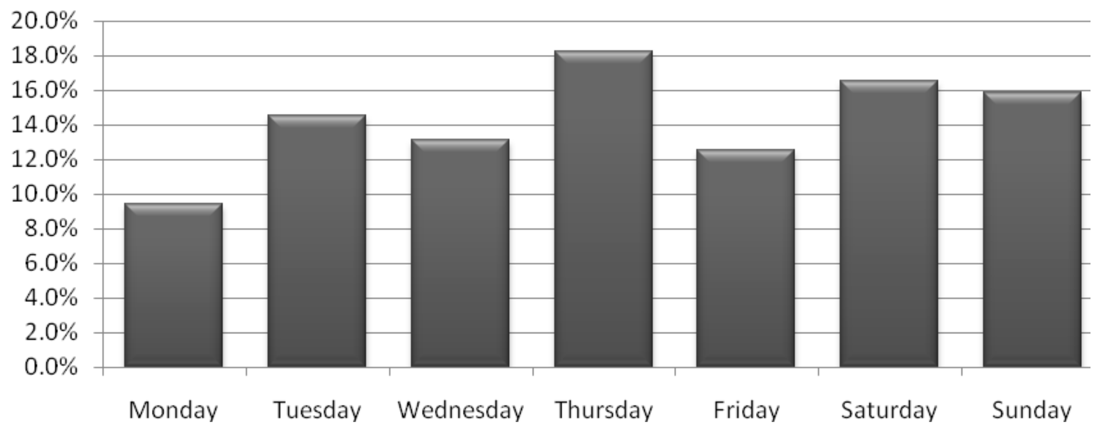
Chapter Three: Research Results

As discussed in the methodology chapter, the ALPR-enabled vehicle was deployed for seven consecutive days for ten hours from 2 pm to midnight during the first week of November, 2006. A total of 21,876 license plates in the 31 parking lots were read. A very small proportion of all photos taken resulted in a 'hit' (1.6 per cent). Still, there is a hit for every sixty two photos taken and given the number of 'hits' (n = 352) and the total number of minutes that the ALPR-enabled car was operational (5,060 minutes), on average, the car had a 'hit' every 4.3 minutes or 4 hits per hour. In terms of the ability of the ALPR camera to correctly read license plates, the computer was accurate in almost all cases (97.7 per cent). Moreover, in 10% of the 'hit' vehicles, the registered owner of a vehicle had a criminal history.[5]

As indicated in Figure 2, 'hits' were, for the most part, evenly distributed throughout the week. It is interesting to note that, although one might anticipate that the volume of vehicles would be much higher on the weekend, this did not result in a substantial increase in the number of 'hits' on the weekend. Moreover, the day with the highest proportion of hits was Thursday (18.2 per cent) followed by Saturday (16.5 per cent) and Sunday (15.9 per cent).

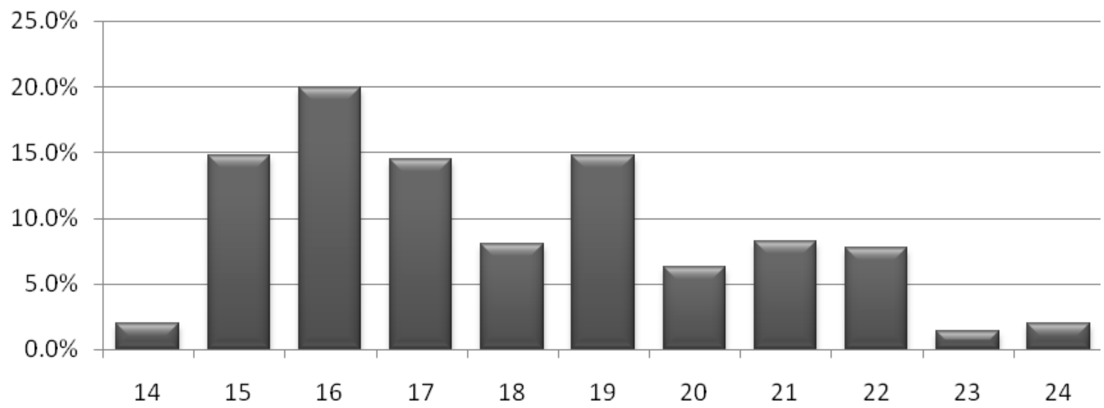
[5] No further analysis was done on the criminal histories of drivers because of the inability to collect consistent data from CPIC (Canadian Police Information Center).

Figure 2: Distribution of 'Hits' by Day of the Week



In terms of the time of day in which 'hits' occurred, nearly three quarters (72 per cent) of all 'hits' occurred between 3 and 7 pm. (see Figure 3). However, unlike the day of the week, there was less of an even distribution with respect to time. The assumption that the greatest proportion of 'hits' would occur late at night was not evident as only 3.4% of 'hits' occurred between 11 pm and midnight. In fact, the hours with the greatest proportion of 'hits' were 4 pm (19.9 per cent), 3 pm (14.8 per cent), and 7 pm (14.8 per cent). Not surprisingly, 4 pm and 5 pm accounted for slightly more than one third (34.4 per cent) of all 'hits'. It would appear that these results were a function of car volume in that there were more cars in major parking lots during the hours that shopping mall stores were open.

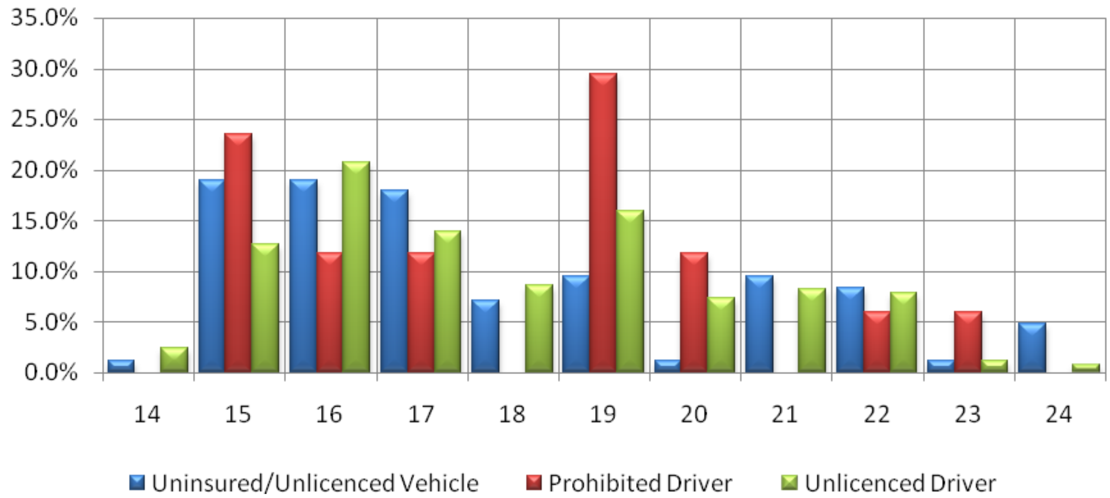
Figure 3: Distribution of 'Hits' by Time of Day



An analysis of the nature of 'hits' revealed that slightly more than two thirds of all 'hits' (69.8 per cent) were for unlicensed drivers. An additional one quarter (23.9 per cent) of all 'hits' were for unlicensed vehicles, while a very small proportion (4.8 per cent) were for prohibited drivers. The ALPR-enabled car located very few stolen vehicles (1.4 per cent). In fact, there were only four 'hits' for a stolen vehicle. There are several possible explanations for this finding, which will be discussed in the next chapter, however, it is important to note that this finding may suggest that ALPR, especially when deployed to parking lots, may not be the most efficient use of the technology.

Figure 4 presents the results of an analysis on the relationship between the nature of 'hit' and the time of day that the 'hit' occurred. Due to the low number of stolen vehicles, this type of 'hit' was not included in the analysis. For the most part, uninsured or unlicensed vehicles were most likely to be found between 3 pm and 5 pm (55.9 per cent). It is possible that this occurred because drivers thought that they were less likely to be caught if they were on the roads during high traffic density times. Another explanation might be that this was simply the peak periods at shopping centers and drivers may have thought that they were less likely to be discovered in busy parking lots. The effectiveness of ALPR is that these kinds of drivers will be detected even if they back their vehicles into parking spots in an attempt to make it harder for police to see their insurance decals.

Figure 4: Distribution of the Nature of 'Hit' by Time of Day



Prohibited drivers were somewhat unevenly distributed throughout the time period. On the other hand, there were several time periods (2 pm, 6 pm, 9 pm, and midnight) in which no prohibited drivers were detected. However, there appeared to be two time periods (3 pm and 7 pm) which accounted for the majority (52.9 per cent) of prohibited driver 'hits'. Unlicensed drivers were somewhat evenly distributed throughout the time periods. The two most frequent time periods were 4 pm (20.8 per cent) and 7 pm (15.9 per cent). Likely similar to uninsured or unlicensed vehicles, prohibited and unlicensed drivers might have selected to drive at these times because these are both peak traffic times and the parking lots were likely to be more full. Without ALPR technology, both of these factors could contribute to a driver feeling confident that their chances of being discovered were very low.

As mentioned in the methodology chapter, a total of 31 parking lots were selected to be part of the routing for the ALPR-enabled vehicle. However, five parking lots accounted for nearly half of all 'hits' (47.7 per cent). These five parking lots were:

Guildford Town Centre (12.8 per cent); Strawberry Hill Lot (12.4 per cent); Central City Lot (9.4 per cent); Surrey Central SkyTrain Station (6.7 per cent); and Scott Road SkyTrain Station (6.4 per cent). Table 1 presents an analysis of the nature of 'hits' in these five locations.[6]

Table 1: Parking Lots by the Nature of Hits

Parking Lots	**Uninsured/Unlicensed Vehicles (n = 84)**	**Prohibited Drivers (n = 17)**	**Unlicensed Drivers (n = 245)**
Guildford Town Centre	16.4%	21.4%	11.3%
Strawberry Hill Lot	16.4%	7.1%	11.7%
Central City Lot	6.0%	7.1%	6.1%
Surrey Central SkyTrain Station	9.0%	14.3%	9.4%
Scott Road SkyTrain Station	6.0%	7.1%	6.6%

It is interesting to note that although Guildford Town Centre accounted for 12.8% of all 'hits', it contributed slightly more than one fifth (21.4 per cent) of all 'hits' for prohibited drivers. It is also slightly overrepresented in its proportion of uninsured or unlicensed vehicles (16.4 per cent).

Perhaps more importantly, approximately one third (32.8 per cent) of all 'hits' for an uninsured or unlicensed vehicle occurred at Guildford Town Centre and Strawberry Hill parking lots. Again, this may be a result of owners believing that their chances of being discovered was less if they park in large, busy parking lots.

Slightly more than one third of prohibited drivers (35.7 per cent) were discovered at Guildford Town Center (21.4%) and Surrey Central SkyTrain Station (14.3%) parking lots. It was initially believed that a high proportion of prohibited drivers would be discovered at SkyTrain station parking lots as drivers may consider it less risky to drive to the SkyTrain and take this form of transportation than drive all the way to their destination. While this might account for those 'hits' at the Surrey Central SkyTrain

[6] Due to the way data was collected, it was not possible to determine a hit rate or proportion of hits by the number of photographs taken in each parking lot.

Station, only 7.1% of all prohibited driver ‘hits’ occurred at the Scott Road SkyTrain Station parking lot (see Table 1). Moreover, this does not account for the fact that slightly more than one fifth of all prohibited driver ‘hits’ occurred at Guildford Town Centre parking lot. Still, Guildford Town Center is a large shopping mall with an enormous parking lot. In considering these findings, however, it is important to keep in mind that only 17 prohibited drivers in total were discovered.

The large majority of ‘hits’ (69.8 per cent) were associated with unlicensed drivers. A similar proportion of unlicensed drivers were discovered at Strawberry Hill (11.7 per cent), Guildford Town Center (11.3%), and Surrey Central SkyTrain Station (9.4 per cent) parking lots, accounting for approximately one third (32.4 per cent) of all ‘hits’ for unlicensed drivers. Although only a small proportion of ‘hits’ uncovered an individual with a criminal history (10 per cent), it is possible that the full pilot project will demonstrate similar results to the United Kingdom studies where there was an association between driving offences and criminality. If so, the fact that 1.1% of all photos taken of cars in parking lots results in a ‘hit’ for an unlicensed driver may have a significant impact on policing and crime reduction.

Chapter Four: Conclusions and Recommendations

The results presented in Chapter Three have a number of important implications for the use of ALPR in Canada. This chapter will discuss both the implications and recommendations associated with the use of ALPR-enabled cars in parking lots and more general recommendations for the deployment of ALPR as part of a crime reduction strategy for British Columbia.

In terms of the data on ALPR in parking lots, the proportion of ‘hits’ was low. However, it would appear that, regardless of the type of ‘hit’ one was interested in, based on the ‘hot lists’, the best time to deploy ALPR-enabled cars to parking lots is in the afternoons and evenings between 3 pm and 7 pm. Given this, it would likely be more efficient to deploy the ALPR-enabled parking lot vehicle along major traffic corridors during the remainder of the shift.

Given that of the approximately 22,000 photos taken only four vehicles were found to be stolen, ALPR does not appear to enhance the police’s ability to locate stolen vehicles. There are, however, several potential reasons for the low number of stolen vehicles discovered by ALPR. First, the overall number of stolen vehicles in Surrey compared to the total number of cars in Surrey is extremely small. Furthermore, for these vehicles to be discovered by the technology, the cars have to be parked in one of the 31 identified parking lots in Surrey. In addition, because the ‘hot list’ data is uploaded into the ALPR-enabled vehicle only once in the morning and not updated during the shift, the stolen vehicle information is at least 24 hours old. Finally, in order for ALPR to locate a stolen vehicle there has to be a meeting in time and space between the ALPR-enabled police vehicle and the stolen car. As there was only one ALPR-enabled vehicle examining cars exclusively in parking lots, and the car was constantly moving from parking lot to parking lot, and the stolen vehicle had to be in the parking lot at the time the ALPR-enabled vehicle was also in the lot, it is extremely unlikely that this meeting would ever take place. Given that all of these factors contribute to making it extremely difficult to locate a stolen vehicle, even if we accept the theory that parking lots make good locations to abandon stolen vehicles, it is not surprising that there were so few stolen vehicles located. Instead, stationary cameras at the major entries and exits for parking lots, or along major traffic corridor intersections, may be a more feasible approach to discovering stolen or abandoned vehicles.

Given the proportion of 'hits' in parking lots, it is recommended that ALPR not be deployed to parking lots alone. While there may be a benefit to deploying ALPR-enabled vehicles to parking lots between 3 pm and 7 pm, especially if they are being operated by community policing volunteers, to reduce the strain on police resources, it would appear that the technology might be best deployed along high traffic corridors.

In effect, the results of this limited pilot project indicated that ALPR was an useful mobile apprehension tool. If it is to be deployed as piloted, the best way to deploy ALPR technology may be to make it available to police officers who enforce traffic violations and to use it only in a select few parking lots. ALPR technology will undoubtedly increase the number of drivers the police identify with criminal records and who are not supposed to be driving. One of the major benefits of ALPR technology is that traffic members can find these drivers while they are out on patrol during the course of their regular duties. Even if police decide to drive through a parking lot to investigate the cars parked there, ALPR-enabled officers will save a considerable amount of time simply because they will not have to manually enter each license plate or only enter a sample of plates. In a manner of speaking, with the use of ALPR, the criminals come to the police.

Based solely on the success of this limited research in identifying prohibited and unlicensed drivers, it would appear that ALPR could be effectively expanded to discover all types of wanted persons. It would appear that ALPR, as it is currently deployed in

British Columbia, would be even more effective if CPIC Ottawa released more 'hot lists' which would allow the police a greater opportunity to catch even more criminals. However, the ability to catch more criminals will not just increase police workload, but will likely have far reaching effects throughout the criminal justice system. The increased number of criminals detected by police with ALPR will have to be processed through the criminal justice system which will effect the courts and corrections. The current back-log issues in the courts will increase with a sudden increase in volume. Similarly, an increase in the number of those convicted will increase the burden on the Correctional Service of Canada. However, considering the potential deterrent effect of ALPR, it is possible, that this increase will be a short-term problem. Over time, ALPR should not result in just an increase in criminals coming to the attention of the police, but a decrease in the overall number of 'hits'. In other words, rather than just a tool for enforcement, ALPR has the capacity to be a significant prevention tool. The prevention of prohibited or unlicensed drivers on the road may prove to be the main beneficial outcome of implementing this technology.

The use of ALPR technology will undoubtedly increase police workload. There is not, unfortunately, one best way to respond to the workload issue. One obvious way to address this concern is to increase police traffic sections. In most cases, police traffic sections are not fully staffed or resourced (Malm et al., 2005). Nonetheless, police agencies will have to determine whether enforcing traffic violations is a priority. However, for any police agency to make effective use of ALPR technology, it is necessary to have enough members to deal with the increased number of 'hits' the technology generates. Similar to the United Kingdom experience with ANPR, it may be necessary to hire civilians to be part of ALPR teams. Based on the United Kingdom experience, ALPR will likely result in increased arrests, paperwork, and officer time spent in court. Given this, there is likely a value in considering some of the lessons learned from the United Kingdom pilot projects. In terms of the staffing issue, one of the key findings from the United Kingdom test of ANPR technology was:

> The average staffing per force for ANPR-enabled intercept teams was one Inspector/Sergeant, seven Constables, and half an administrative assistant. This equates to 290,000 pounds per force per annum. On average, staff spent about half their time on intercept duties, 25% of their time traveling to and from ANPR sites or rest periods, and the remainder of their time dealing with administration/prisoner handling (PA Consulting Group, 2003: 16).

As mentioned in Chapter One, in the United Kingdom study, there were no specific recommendations in terms of the ideal number of officers for intercept teams. However, there was the clear suggestion that the teams be increased. In terms of ALPR implementation in Canada, police organizations may need to experiment with several staffing models to determine the most appropriate number of members per ALPR team. While policing priorities will play a role in determining whether or not, or the degree to which, ALPR will be deployed, based on this current study of ALPR, it seems clear that police traffic sections should be encouraged to use this technology. Based on the fact that ALPR technology has the ability to read 3,600 plates per hour, even in cases where the ALPR-enabled vehicle is traveling at speeds of up to 100 miles per hour[7] (Pughe, 2006), this technology would be extremely useful for municipal traffic sections and highway patrol, in part, because criminals are mobile and do not restrict their criminality to a single police jurisdiction. As such, ALPR appears to be an excellent way to catch wanted criminals who cross jurisdictional boundaries, especially if law enforcement agencies communicate with each other and share information.

As discussed throughout this paper, based on the rapid rate at which 'hits' are discovered, it would appear that it is necessary for each police agency to create a prioritization scheme for responding to 'hits' when implementing ALPR. In designing a priority scheme, a number of different issues must be considered, such as specific police

[7] In practice, due to the speed at which the ALPR enabled car can drive in a parking lot, the number of photos per hour in this study is 259.4 per hour.

priorities, how to operationally deal with ALPR ‘hits’, how to maximize the response time to ‘hits’, and which ‘hits’ to respond to. Clearly, police priorities will determine which ALPR ‘hits’ police will respond to and the order in which police will respond to these ‘hits’. For example, if auto crime is a particular priority in a given jurisdiction, the use of ALPR would likely be less of a priority as the technology does not appear to be particularly well suited to discovering stolen and abandoned vehicles. However, an additional priority may be enforcing traffic violations. In this case, ALPR technology can be extremely beneficial, specifically in terms of assisting the police in finding uninsured or unlicensed vehicles, prohibited drivers, and unlicensed drivers.

Another important benefit of developing a priority scheme in line with general police priorities is that it will assist police agencies in determining how to respond to the sheer number of ‘hits’ generated through the use of ALPR. In other words, while in this pilot study, a large proportion of ‘hits’ were for an unlicensed drivers, the ratio of ‘hit’ types may vary from jurisdiction to jurisdiction, and is also likely different along major traffic corridors compared to parking lots. In high volume areas, where the nature of ‘hits’ are more evenly distributed, police will have to decide whether they give priority to unlicensed drivers over prohibited drivers, for example, or whether ‘hits’ for unlicensed vehicles will be responded to before unlicensed drivers. Therefore, it is recommended that the technology always be piloted in order to determine general baseline information about the quantity and quality of ‘hits’ prior to full deployment. In addition to this information providing managers with a better idea of where ALPR is likely to be most effective, the baseline data would provide analysts with the information necessary to make informed decisions about the implementation of a priority scheme for responding to ‘hits’.

Police agencies may also find that volunteer groups, such as Citizens on Patrol, may be helpful in making ALPR more effective and reducing some of the workload issues associated with the technology. Volunteer groups could assist the police by filtering ALPR ‘hits’ and could have access to the technology and communicate with police when they discover a particular type of ‘hit’ based on the prioritization scheme.

As with the introduction of any new piece of technology, police agencies seriously considering implementing ALPR technology should invest the necessary time and resources to properly pilot the technology. If the pilot phase concludes that there were benefits to implementing ALPR, the introduction of the technology to the field should occur slowly, in phases, to avoid overwhelming the organization. It is recommended that, at first, only a few vehicles be equipped with the technology and only a few officers undergo training to use the technology. After a period of time, the results of this initial phase should be thoroughly analyzed to determine the most effective and efficient manner to expand the use of ALPR. In terms of specific steps to take, both the United Kingdom’s and Surrey’s pilot and implementation strategies serve as excellent models.

For the most part, ALPR would appear to be an excellent tool for police agencies in terms of apprehending offenders. However, in order for ALPR to function most effectively, it is necessary for the onboard computer to have a live link to police databases. Rather than downloading ‘hot lists’ into the onboard computer at the beginning of the shift in the morning and continuing to compare photographed cars to data that is, at least, 24 hours old, it would be better to have a live connection so that as computer systems are updated with new information, that information is available immediately to the officer in the ALPR-enabled vehicle. In addition, expanding the information sources or the number of ‘hot lists’ available to ALPR-enabled officers would also result in a greater number of quality ‘hits’.

It is also important to keep in mind that ALPR does not eliminate the need for a well-trained, observant police officer. Not only does the technology require trained police officers or volunteers to operate the vehicle and decide how to respond to ‘hits’, but, as the United Kingdom pilot projects concluded, the system works best in combination with an experienced officer using their powers of observation, discretion, and decision-making.

Overall, based on the current study of ALPR deployment in parking lots, and the research being conducted on the technology in the larger Surrey pilot phases and the United Kingdom studies, ALPR is a viable technology that is an excellent additional resource for law enforcement agencies. It would be interesting to conduct a similar study with a larger sample of parking lots and ALPR-enabled vehicles 24 hours a day, seven days a week, in multiple jurisdictions.

It appears that regardless of police priorities, ALPR increases the effectiveness and efficiency of traffic and patrol officers. However, this must be balanced against the costs of purchasing, installing, and maintaining the system, training officers and staff to operate the technology, increased workloads, creating an information sharing and storing system, and addressing privacy and civil liberty concerns.

As mentioned above, ALPR technology could also serve as a deterrent for potential criminals. Even if the technology was phased in over time to prevent overwhelming an organization, it is important to create the public image that the technology is widespread, similar to the strategy employed with the bait car program. Municipalities and agencies, such as ICBC, may also be interested in the technology if it demonstrates that it can, for example, help law enforcement agencies enforce traffic violation offences, catch criminals, and reduce crime more effectively and efficiently than conventional policing methods. Still, ALPR must be considered within the larger context of police resourcing and strategic thinking. While this technology does appear to have a role to play in the prevention and apprehension of offenders, it should not be used as a replacement for other police strategies. Given the realities of limited police resourcing, the funds that would be allocated to ALPR would likely come at the expense of some other police program or strategy. As such, ALPR should be considered a useful tool for the police, but should be evaluated more fully to understand how it can best be used in combination with other police programs.

As more law enforcement agencies implement ALPR technology, it will be interesting to conduct a series of research projects examining the measurable benefits derived from the technology against the costs and workload issues generated by ALPR. It is interesting that it appears that many of the technological obstacles associated with the technology have been overcome. It remains to be seen whether, in the Canadian context, ALPR can overcome the political and organizational challenges to its full deployment.

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Appendix A: List of Parking Lots

Whalley Area Parking Lots

-Scott Rd. Sky Train Station- 124th & 110th (20-30 min) (10 min →

-Scott Towne Plaza- Back onto Scott Rd., left at 96th & Scott, and turn right into this lot. (5 min)(5 min →

-Cedar Hill's Plaza- Back onto 96th, right on 128th, and left into this plaza. (10 min) (10 min →

-Days Inn-Right on 96th, left onto KG HWY, right into this lot, turn to right parking lot, then right again to Days Inn Lot. (20 min) (no travel time to next lot)

-KG HWY Sky Train Station- Drive straight back from the Days Inn Parking lot to Sky Train lot. (5 min) (5 min →

-Central City Mall- Right onto KG HWY, left into this mall parking lot. (40 min) (no travel time to next lot)

-Surrey Central Sky Train Station & North Surrey Rec Center- Turn right onto Old Yale Rd., right on 134 A St., right on 102, and turn into this lot. (5 min)

-Park & Ride Lots and Rec Center Lots- Right on 102, right into these lots. (5 min) (5 min →

-Canada Safeway- left onto 102 ave, left on 135 St., right into this lot. (10 min) (10 min →

-North Gate Shopping Center- Exit onto 135 Right to 104 and on 104 and continue to Northgate (Dell).(10 min) (10 min

-Canadian Tire and Price Smart- right on East Whalley Ring Rd., through 104 and right into this lot. (10 min) (10 min →

Guildford Area Parking Lots

-Guildford Mall (North Parking Lot) - Left on E. Whalley Ring , R on 104, left on 150th, right into Guildford Mall. (15 min) (no travel time to next location)

-Guildford Rec Center- Go straight back to this parking lot from the Guildford Mall North Parking Lot. (5 min) (5 min →

-Guildford Mall (Enter by Sears)- Right on Lincoln Drive, right on 152, right on 105, left into this lot. (10 min) (5 min→

-Guildford Mall (By Old Navy) - Right on 152, right into Guildford Town Center by Old Navy. (30 min) (35 min →

South Surrey Area Parking Lots

-South Pointe Mall- Right on 152 to this mall. (10 min) (10 min→

-Semiahmoo Mall- Right on 152, right onto 17th (at the lights) and into the mall parking lot. (30 min) (10 min→

-South Surrey Park & Ride- Right on KG HWY, right into this lot. (10 min) (30 min →

Newton Area Parking Lots

-Strawberry Hill Mall (122nd & 72nd) - Right on 72nd, and right into this lot. (35 min) (10 min →

-Walmart- Scott Rd turn right on 88th (Nordell), turn left into this lot. (10 min) (10 min →

-Costco- Left onto 88, to KG HWY right , and right into Costco. (15 min) (5 min →

-Kings Cross (superstore mall) - Exit the same way and right onto KG HWY to 74th, and turn into this lot. (10 min) (5 min →

Evening Routes

-Dolphin Pub (7115 138 St.) & Hollywood 3 Cinemas (7125 138 St.)- Exit in front of Office Depot left onto 74 Ave, Right on 138 St, through 72 ave and turn right into Safeway mall. (10 min) (10 min →

-Cineplex Odeon (Strawberry Hills-12161 72 Ave.)-Left on 138 at the lights, left on 72nd, right at 122 or 123 into Strawberry Hill Mall- 12161 72nd)(30 min) (15 min →

-The Dell- KG HWY & 107th- Right on Scott Rd to 96 Ave right to KGH left to this mall (entrance at approx 106 ave & KGH) (10 min) (10 min →

-The Mirage (15330 102A Ave) – Exit the Dell by East Whalley ring road right to 104 Ave, left to 152 St, right to 102 and turn left. Mirage is on the right at 154.
(5 min) (5 min →

-Empire Theatre - Left on 102, straight across 152 into Guildford Town Center to access Empire theatres. (10 min)

Appendix B: ALPR Coding Form

Date	Time (24 hrs)	Location	Direction of Target	Direction of PC	Nature of Hit	Read License Plate	Actual License Plate

Appendix C: Locations of Top Five Parking Lots


STRAWBERRY HILLS MALL
75A Ave
75A Ave
76th Ave
121A St
122nd St
75A Ave
74A Ave
Scottsdale Exchange
unnamed lane
74th Ave
120th St
unnamed lane
122nd St
72nd Ave
120th St


CENTRAL CITY MALL
104th Ave
134 A St
103 A Ave
103rd Ave
135th St
102nd Ave Loop
102nd Ave Loop
102 A Ave
102nd Ave
102nd Ave
King George Hwy
King George Hwy
102nd Ave
mall access
100th Ave
100th Ave


SURREY CENTRAL
SKYTRAIN STATION
103 A Ave
134 A St
134 A St
103 rd Ave
102nd Ave Loop
102nd Ave Loop
102 A Ave
102nd Ave
102nd Ave
102nd Ave
mall access


SCOTT ROAD
SKYTRAIN STATION
112th Ave
112th Ave Offramp
Scott Rd Offramp
Scott Rd Offramp
Scott Rd
Scott Road Station
Scott Rd Onramp
turning lane
turning lane
110th Ave
126 th St
125 th St
109 th Ave