RIDESHARE ISSUES AND IMPLICATIONS FOR CURB MANAGEMENT.

by

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Presented to the Faculty of the Graduate School of
The University of Texas at Arlington in Partial Fulfillment
of the Requirements
for the Degrees of

MASTER OF LANDSCAPE ARCHITECTURE
And
MASTER OF CITY AND REGIONAL PLANNING

The University of Texas at Arlington
December 2019

Arlington, Texas

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ACKNOWLEDGEMENTS

I want to express my sincere gratitude to my committee chairs Dr. Joowon Im, and Dr. Jianling Li for their continued support, guidance, and patience throughout the production of this thesis. I would also like to thank my committee members, Dr. Amy Archambeau, and Dr. Ardeshir Anjomani for their time and willingness to provide encouragement and constructive feedback as committee members.

To all my professors at the College of Architecture, Planning, and Public Affairs (CAPPA), you have challenged me, and I have grown as a result.

December 3rd, 2019

DEDICATION

I dedicate this thesis to my wife Aleisha Utterback. I could not have done this without your love and support.

December 3rd, 2019

ABSTRACT

RIDESHARE AT THE UNIVERSITY OF TEXAS AT ARLINGTON:

ISSUES AND IMPLICATIONS FOR CURB MANAGEMENT.

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The University of Texas at Arlington, 2019

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As autonomous vehicles continue to prove themselves on our roads today, a look at the considerations of implementation will be necessary. The potential for rethinking our infrastructure requirements, as a result of this new technology, could be a significant benefit to everyday life in terms of safety, congestion, and travel behavior. We must also consider the potential impact on the environment, which is often overlooked. If automobile infrastructure such as roads and parking lots are reduced in urban areas, how will this rediscovered urban space be used? How will planners, designers, and policymakers adapt our infrastructure needs when less pressure is put on parking, and more pressure is felt at the curb, sidewalk, and doorstep?

Autonomous and rideshare technologies will replace the need for a commuter to visit a parking lot only to leave a car behind. Autonomous vehicles will park themselves, and point-to-point ride share enables riders to be dropped off much closer to their desired destinations. The literature indicates that we are beginning to see the need for an alternative type of infrastructure to support this desire. Currently, rideshare pickups and drop-offs are causing issues in congestion and safety, as this transaction typically occurs in areas not yet designed for passenger exchange.

However, drivers are left with limited alternatives as riders demand to be dropped off in places that are most convenient for them. Therefore, drivers are likely to take the risk and/or break the law in order to accommodate a rider's desire. These issues may continue to increase as millennials choose to give up their cars, and Mobility as a Service (MaaS) gains popularity.

Research methods adopted for this study were quantitative and qualitative in nature. Observational studies provided data on the current interface between people and automobiles at various types of arrival and departure points. This led to an understanding and recommendations on alterations to associated transportation infrastructure, with an emphasis on exploring efficiency, and safety in drop-off and pickup of passengers.

Recommendations from this research look to aid decision-makers at UTA and beyond in transitioning from the current infrastructure centered around the parked car, to a new infrastructure. Lessons learned from the data collected in observation and survey data provided insight into where and how rideshare occurred, as well as insight into considerations of safety, traffic, preference, comfort, and use of current and the potential of future alterations to accommodate a new type of rideshare infrastructure.

The findings of this study can also be applied to scenarios outside of UTA as those entities look to accommodate rideshare exchange infrastructure solutions of their own. Whether cars park themselves or drivers drop riders off at the curb, the need for riders to visit parking will likely decrease, and the need to accommodate rideshare pick-up and drop-offs will only increase. The sooner that policy and decision-makers assess these needs and make proactive and transitional changes, the better. A look toward the curb and away from the parking lot could not only save space and money, it could do so in a way that makes our lives safer, more convenient, and in a more environmentally responsible way.

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CHAPTER 1: INTRODUCTION

1.1 Introduction

In the last decade, rideshare has experienced dramatic growth in popularity, and billions of dollars have been invested in order to promote this technology (Conway, Salon, & King, 2018). As a result, more and more people are being dropped off in front of their destinations than ever before (Rogers, 2018). This means that fewer people are using parking as they are not leaving a car behind. This has been brought on by point to point rideshare technologies such as Uber, Lyft, Via, and other Transportation Network Companies (TNCs). This change can be felt all over the campus of The University of Texas at Arlington (UTA), as cars double park to exchange their passengers. This is an activity that will only increase in frequency as these services are more utilized, and the prices associated with them decrease with efficiencies such as autonomy, electrification, and rideshare pooling of passengers (Compostella, Fulton, De Kleine, Kim, & Wallington, 2019). This could mean enormous change in the way that we interact with our destinations as Dr. Katherine Kortum explains in an article in The Institute of Transportation Engineers that "Transportation network companies (TNCs) are the most disruptive innovation to face the transportation industry in a generation (Kortum, 2015, p. 10)."

Speaking to the benefits of rideshare, Uber co-founder Travis Kalanick writes in the Wall Street Journal "A city that embraces shared modes of transportation will be a city where people spend less time stuck in traffic or looking for a parking space, a city where people will spend less of their income on cars and commutes, a city that lives and breathes more easily (Kalanick, 2016, par. 11)." McKinsey Quarterly furthers these potential benefits of rideshare and publishes research that reports 83% of U.S. rideshare users do so out of convenience, not price, over the traditional taxi (Hensley, Padhi, & Salazar, 2017). However, rideshare may not be dependent only on convenience, but personal economic factors could be an additional key to success. Autonomy could raise the initial cost of a vehicle of approximately $75,000 per year, with a vehicle life of only 4 years, the savings would amount to over $300,000. When these savings are passed on to consumers, rideshare travel could increase sharply (Hensley et al., 2017)

The role of autonomy in lowering the price of these services is determined by several aspects of the technology. In this research, autonomy is considered an efficiency aspect to rideshare. The obvious comes in savings when the driver is replaced, and companies save on labor costs as a seat is freed for an additional passenger (Ostrovsky & Schwarz, 2018). Autonomous cars will also lessen the liability of TNC's as they prove themselves as safer and more reliable than human-driven cars. As fleets of vehicles are normalized, they will become cheaper to buy, maintain, and operate. These cars will also likely be electric and will look to charge themselves when it is convenient for the rider rather than the driver. However, this thesis does not look to make the argument of the viability of Autonomous Vehicles and other technologies that will impact the current automobile infrastructure. The consensus is no longer on *if* Autonomous Vehicles (AV) will occur; it is a matter of *when*. That when is now, as fully autonomous cars are being driven and continually tested on our streets today. Waymo, formerly Google's Self-Driving Car Project, is the first company to offer autonomous rides without the need for a human driver. Waymo has driven autonomously over 5 million miles on public roads ("Safety Report," 2018). Many have predicted that 10 million self-driving cars will be fully road ready by 2020.

Milo, VIA, Marble, Drive AI, Uber, and Lyft are all in operation. Consequently, it is imperative that this thesis addresses the issues that will help anticipate the needs associated with accommodating these new technologies and their adoption, as well as the impact on parking and the curb as it changes transportation infrastructure at UTA and beyond. There will be no discussion of AV big rigs or flying taxis, as this is not likely to directly impact the curb on the UTA campus. The success and further adoption of rideshare and AV will contribute to rideshare exchanges placing more pressure on the curb as riders are dropped off and picked up closer to their destinations without the need to visit a parking space and leave a car behind. The real question is how will the tech be employed, managed, and fit into our lives and current infrastructure?

The specific study area of Nedderman Drive and Greek Row within the campus of UTA was determined to be a manageable scale that could be accurately and efficiently observed within a limited boundary. Many instances of rideshare activity occurred here with varying infrastructure such as curbspace, crosswalks, metered spaces, parking, and a fire lane turn around that are similar to infrastructure that is found beyond the campus of UTA and holds the potential for implementation elsewhere. The study area also includes the College of Architecture, Planning, and Public Affairs (CAPPA) where this researcher attended graduate school in pursuit of a dual master in landscape architecture, and city and regional planning. This allowed for frequent casual observation of where rideshare was happening, as well as the times of high demand for rideshare exchange activity.

The overall campus of UTA was selected in the hopes that further research would be conducted as access to potential research funding, and willingness to participate is expected to be higher than areas outside of a university campus setting. UTA has also proven a commitment to alternative transportation choices and sustainability as early adopters of innovative mobility programs. This is displayed with UTA's participation in the car-sharing program Zipcar and bike-share program Zagster. Also notable is the Mav Mover shuttle service and its associated real-time app, as users track shuttle locations at shopping destinations around Arlington and Grand Prairie. Gallup poll information points to higher usage of rideshare by young adults, with higher incomes, who are living in urban areas (Inc, 2018). This information indicates as millennials begin to take the reins, their preferences for transportation could continue to promote rideshare moving forward. With a large percentage of millennials at UTA aged 18-29 ("How Diverse is The University of Texas at Arlington?," 2013) at 65.3% of UTA's student population, higher expected incomes of college graduates, as well as UTA's location at the center of the DFW Metroplex, this further supported UTA as a logical choice for this research of rideshare activity. Additionally, UTA has always been considered a commuter campus. However, with the increase in the availability of student housing on and around campus, there are more students who are less dependent upon private car ownership. This often leaves those without cars to choose rideshare and delivery services to meet their transportation needs. This forward-thinking could also facilitate the early development of rideshare infrastructure and management at UTA, as well as provide examples of best practices to other entities, agencies, and municipalities wishing to address their own accommodation of rideshare services.

There are several technologies that are converging, as we find ourselves at the intersection of electrified vehicles, deep learning, autonomous vehicles, drones, 5G wireless, and rideshare. These combined elements will usher in a transportation revolution. This revolution will require a new type of infrastructure. When cars do not need to park, the space allocated for parking will decrease. As rides are shared, the number of cars will also decrease and relieve pressure on roads and other infrastructure, currently dedicated to the privately owned and driven automobile. This reduction in infrastructure will liberate space for other uses. A more profound question to be answered in further research is, what do planners and landscape architects do with this newly rediscovered space?

State governments are also preparing for autonomous cars. In an article published by The Council of State Governments in August of 2016, “Seven states and the District of Columbia have enacted autonomous vehicle legislation. Another state has an executive order on the books.” (“State Laws on Autonomous Vehicles,” 2016, p. 1). as policymakers take steps necessary for ensuring these cars perform in a safe manner on public roads. It is also essential for landscape architects and planners to consider how this new technology will impact their profession as they make way for this transportation revolution.

The implications of increased use of rideshare at UTA could be a paradigm shifter in the way we think about our campus space. Liberating that space could mean tremendous savings to future development and allow UTA to allocate that space for better uses in classrooms, student housing, commercial space, and more. To do this, however, will require a replacement of that infrastructure in a more efficient manner where rideshare and alternative modes of transportation are emphasized over the parking lot.

1.2 Problem Statement

As rideshare continues to grow in popularity, pressure on parking will likely decrease, and the demand for rideshare exchanges at the curb will increase. Again, this will mean that fewer cars will visit parking lots as riders are exchanged closer to their destinations and most likely at the curb. This change in the way we use auto infrastructure needs to be addressed by planners and designers now before the technology leaves us looking for solutions to a problem after the problem has already occurred. This is not only a matter of potential traffic flow but of safety and economic concerns, as well.

1.3 Research Purpose

The purpose of this research is to understand better how people are using the existing vehicle infrastructure to exchange riders and then make recommendations to alter or enhance that infrastructure to accommodate safe and efficient rideshare management practices. These recommendations will likely come in incremental phases as the popularity of rideshare and potential move away from private vehicle ownership when autonomy is fully realized.

As indicated by insiders of the technology, the implementation of autonomous vehicles is likely to move very fast. More research needs to be conducted to help designers and decision-makers plan for the short and long-term futures as they anticipate the effect on the curb. For example, a parking garage constructed today may never realize a full life if autonomous cars begin to reduce infrastructure needs within the next twenty years (Brown, 2016). Parking garages with sloped floors are virtually useless as other forms of architecture. Issues such as this and others need to be identified and explored to help mitigate waste and unnecessary development.

To understand how riders and drivers are using current infrastructure to accommodate rideshare exchanges, observational studies will be compared to survey responses to understand what is actually happening vs. what users say they will do. As an addition to the observational studies of passengers, this researcher will be observing adjacent uses, pedestrian flow, proximities to amenities, and other factors that will lend to the recommendations of better infrastructure and place associated with rideshare exchanges in the future.

The objectives of this paper are to bring awareness and suggest recommendations to the current problems associated with rideshare exchanges. For this purpose, this paper looks to inspire designers and policymakers to be proactive by anticipating the pressure placed upon the curb. This will be done through passive observation to help determine the places where riders wish to be dropped off and picked up. This will not only help solve the current problems with rideshare here at UTA but hopefully, it will add to the conversation of making room for the design and planning of rideshare infrastructure of our future cities.

1.4 Research Questions

In anticipation of impacts upon urban design it will be necessary to examine current, and future literature as mobility evolves. To help spur conversation, several questions will need to be addressed. The questions to be explored as part of this research paper are stated below:

> How will rideshare and autonomous technologies change the way in which we interface with our destinations?
>
> What infrastructure will need to change to accommodate rideshare and autonomous vehicles?

1.5 Definitions of Terms

- Autonomous: A fully autonomous car, or vehicle, is one that can run—and drive—without any human intervention at all. This would mean a vehicle without controls or steering wheels. But some groups, like SAE, define different levels of autonomy, from zero to five, where Level One, for example, would include adaptive cruise control, and a Level Five would give all controls to the driving system in all conditions ("Levels of Driving Automation," 2019).
- TNC A Transportation Network Company (TNC), sometimes known as a Mobility Service Provider (MSP) or ride-hailing service, is a company that matches passengers with drivers via websites and mobile apps. TNCs are examples of the sharing economy and shared mobility.

- Rideshare is a service where individuals use smartphone-based applications to request a ride. This research refers to rideshare as any vehicle picking up or dropping off passengers without the need for the passenger to park the vehicle. This research excludes vehicles designed to transport more than 10 people.
- Queueing Lane an isle or lane designed to allow cars to line up as they either drop-off or pick up passengers. This example can most easily be seen at elementary schools where parents leave and retrieve their kids.
- 5G: Fifth-generation mobile technology that is much faster than today's wireless. This technology looks to connect autonomous and semi-autonomous cars to allow them to communicate with each other and other devices, making our roads safer and more efficient.
- Electrification: Is the conversion from fossil fuel vehicles to battery-powered vehicles and a provision for the associated infrastructure primarily in charging stations.

1.6 Research Methods

The methods for research conducted will be mixed methods, quantitative and qualitative in nature. Data will be gathered from passive observations and surveys. Quantitative data collected will include survey questions. This will aid in the design and recommendation process as user preferences, satisfaction, and use of rideshare will be determined. Qualitative analysis will be collected as observational map data is gathered on where these exchanges happen and the paths that respondents indicate that they would take to get from the car to destination or departure point to car. This will help identify where rideshare infrastructure is most needed and what amenities this infrastructure will need to include.

1.7 Significance

The significance of this research is to bring attention to the need for rideshare infrastructure now. This is not a simple matter of traffic congestion, but of safety, policy, and potential loss of revenue that can be answered by the thoughtful redesign of infrastructure. This research does not look to solve all of these problems but promotes others to build upon these findings to make room for rideshare. By being proactive landscape architects and planners can determine how these exchanges are managed rather than allowing the exchanges to happen ad hoc and then attempt to design and regulate around them as a correction or alleviation to a problem. “Ridesharing is a cost-effective, sustainable and effective alternative transportation mode that is beneficial to the environment, the economy and society (Y. Zhang & Zhang, 2018, p. 1).” Proactive design and policy by landscape architects and planners can help to seize all the benefits that rideshare has to offer urban design.

1.8 Limitations

There are several limitations to this research. First of all, there is a limited amount of research uncovered that specifically addresses the issues of rideshare and the need for new infrastructure. Additionally, an observational study does not allow for an in-depth understanding of identifying rideshare exchange locations. The selection of the site where a passenger is picked-up or dropped-off is often negotiation by the driver and rider seconds before the exchange. There is also the limitation of time over the course of a single semester. This limits the insight into varying conditions, including weather, as riders and drivers are likely to act differently during inclement and seasonal weather in regards to rideshare exchanges, and this is beyond the scope of this study.

1.9 Summary

Rideshare continues to grow in popularity, and with its use, fewer people will be utilizing parking as a part of their commute. This could mean an enormous change in the way that we interact with our destinations and the infrastructure needed to get us where we are going. As transportation preferences change with new generations of travelers, a proactive policy and design approach will be needed to form a more sustainable transportation system. This could mean great benefits to the economy, efficiency, and the environment. It cannot be understated the importance that landscape architects and planners have to offer in their roles to usher in change.

CHAPTER TWO: LITERATURE REVIEW

2.1 Introduction

There is much interest in the literature on how rideshare and AV technologies will change our world. These technologies have the potential to make our lives safer, more efficient, reduce stress, and have a positive impact on the environment with the reduction in the use of fossil fuels and the potential reduction of space associated with parking. This study looks specifically at the infrastructure of the passenger exchange and how the experience can be made safer and better for passenger, driver, and others who share space where these rideshare exchanges are occurring. This will require a new type of interface as rideshare cars today are seen double-parked curbside to allow passengers to get in or out, where traffic congestion and safety issues are created for the sole benefit of the passenger in this exchange.

Today, rideshare and AV technologies are developing at a rapid pace. Much faster than most had anticipated or currently realize. There are several factors that will determine the rate of implementation beyond the technological aspects. First, legislation surrounding the safety and implementation of autonomous technology looks to slow the wheels as liability placement is negotiated. Second, a tipping point of use enables an economy of scale, specifically when it comes to rideshare. Third, and likely the most critical aspect is public perception and political will in the adoption of these technologies as they are applied and made practical. These potential speed governors will ultimately determine the rate of the coming transportation revolution. “One of the key challenges in creating a carpooling platform is getting to a critical mass where on-demand carpooling is reliable enough to be practical. With transportation services powered by self-driving cars, this issue is resolved automatically (Ostrovsky & Schwarz, 2018, p. 6).”

This review of the literature is organized by the questions posed by this research. Each question is then broken down into sections that help answer the research question more in-depth. By organizing the literature review in this manner, a better comprehension of the problem and its possible solutions begin to emerge. This also allows the reader to identify key issues before moving into the methodology, analysis, and recommendations sections of this research.

2.2 Effects of Autonomous Technologies

The following has been perceived as the effects of rideshare and autonomous technologies on the way in which we interface with our destinations:

2.2.1 Autonomous and Rideshare

Autonomous cars are vehicles that can assist or completely take the responsibility of driving from its rider(s). The Society of Automotive Engineers (SAE) defines six levels of driving automation, these range on a scale from zero to five where zero is no autonomation and five is full automation in all conditions (“Levels of Driving Automation,” 2019). Without the need for a driver coupled with the business models of current ride-share programs, such as Uber and Lyft, cars are expected not to park and wait for a single passenger to travel to their next destination. These fully automated rideshare cars would look to maximize their efficiency and take multiple riders to destinations along a common route. This has the potential to reduce the overall number of cars as riders could see autonomous ride-share programs as a form of mass transit and part of Mobility as a Service (MaaS) and give up their privately owned vehicles.

When it comes to models of AV technologies, Dr. Millard-Ball (2018) shares with the reader two schools of thought when it comes to the adoption of autonomous technologies in his article titled ‘Pedestrians, Autonomous Vehicles, and Cities (Millard-Ball, 2018).’ The first school of thought is on the emphasis of the autonomous vehicle and its potential to stimulate additional travel as a rider is able to engage in other activities. This new availability of free time could make travel less of an issue and add to urban sprawl (Millard-Ball, 2018). The second school of thought is that automation can reduce travel as people release car ownership, and cars reduce cruising as drivers look for parking.

Tesla Motors released the first privately owned cars that could drive themselves on the highway with a software update in October of 2015 (Sütfeld, Gast, König, & Pipa, 2017). This introduction of autonomous technology could allow for an entirely new way of seeing our cars. Today our vehicles sit in a parking space the majority of the time and wait for a driver to go to the next destination. This is a wholly uneconomical and inefficient use of an asset (Neil, 2015). Autonomous vehicles will be able to go places without the need to wait for a driver. This will correct those inefficiencies that rideshare is currently looking forward to, but not yet able to enjoy. However, AV and rideshare is now a reality as Waymo, which began as the Google Self Driving Car Project in 2009, has announced that self-driving ride-hailing service is now available in Phoenix, AZ ("Waymo," 2019).

Even though AV is getting most of the attention for its potential to change our world, AV tech only replaces the driver. Rideshare provides the technology that allows Transportation Network Companies (TNC's) to fill the seats of an otherwise underutilized vehicle, making transportation more efficient and economical as rideshare companies begin to pool riders and offer discounts for sharing their trip with other riders. AV technology does the same, but only by replacing the labor of the driver and the single-seat that they occupy. However, both of these technologies allow for commuters to be dropped off and picked-up closer to their destinations without the need to visit a parking space. This has created the problem with infrastructure lacking in support of curbside service and is thus the focus of this thesis.

More than all of the other technologies combined, rideshare has the most potential to reduce Vehicle Miles Traveled (VMT) and overall numbers of vehicles on the road. Where autonomous tech is talked about as the big new thing, rideshare has the potential to take the most vehicles off the road, whereas autonomous technologies only remove the driver. However, for rideshare to be effective, it will be necessary for the public to alter their transportation paradigm to Mobility as a Service (MaaS) and give up their privately owned cars. It is easy for one to imagine that they will be driving a vehicle that is mostly or even completely autonomous, but it seems much more difficult for Americans to wrap their heads around not owing, but sharing vehicles (Neil, 2015).

Uber alone now conducts 14 million rides per day globally, in 63 Countries with over 10 billion trips completed worldwide since Uber began providing service ("Company Information | Uber Newsroom United Kingdom," 2019). That is a tremendous amount of passenger exchanges, with most rides not having adequate or safe places to exchange their passengers. These numbers will rise as we move into full vehicle autonomy Engineering Professor Kara M. Kockelman of the University of Texas at Austin suggests that research results indicated that 70 to 87 percent of light-duty vehicles would be fully self-driving by 2045 (Fagnant & Kockelman, 2014). However, this may be adopted more quickly as public policies and individuals embrace this new technology in the way and rate that they did with smartphones (Kockelman, 2016). Professor Kockelman also suggests that simulations show that AV tech could replace 5 to 10 privately owned vehicles (Fagnant & Kockelman, 2014). The benefits of this could promote dynamic ride-sharing which helps riders save money, time, congestion, and emissions (Kockelman, 2016).

2.2.2 Safety

Rideshare, coupled with autonomy, has the potential to make our roads a safer place. However, recent Gallup Poll information indicates that human-driven rideshare actually contributes to traffic incidents.

According to a 2018 Gallup Poll (Inc, 2018);

- 2-3% of auto accidents in any given area can be linked to ridesharing or ride-hailing.
- Fatal auto accidents across the U.S. increased by 7.2% from 2014 to 2015.
- Fatal auto accidents increased by 5.6% from 2015 to 2016.
- Ridesharing services have been attributed to a 2-3% increase in auto accident fatalities, accounting for around 1,100 deaths.
- Ridesharing has been linked to an increase in vehicles on the road, and therefore, congestion. Rideshare drivers spend about 40 to 60% of their time searching for passengers, which is called deadheading.
- Auto accident fatality rates had decreased to the lowest rate since 1949 before ridesharing became popular in the U.S. (Inc, 2018).

Correcting these safety issues is expected to be realized with autonomy. However, this safety from autonomous cars could come at a price in which careful consideration from landscape architects and planners should help direct. In an article written by Dr. Millard-Ball (2018), he uses the scenario of a pedestrian and a driven car at the intersection of road and crosswalk. Both assume risks and the driver has a legal responsibility to yield to pedestrians. However, when AV technology is widespread the risks to pedestrians will lessen as AV cars will always yield to pedestrians regardless of circumstances (Millard-Ball, 2018). The implications of this could be detrimental for traffic as pedestrians and cyclists look to exploit AV's safety features. This may increase the instances that a cyclist will run a stop sign or a pedestrian will step into the road, and the more that this happens the more cautiously an AV will behave (Millard-Ball, 2018). The author (Millard-Ball, 2018) suggests that design concerns be employed when faced with pedestrian impunity, saying that, "Physical barriers in the form of fences between the sidewalk and roadway are erected to corral pedestrian traffic along busy streets, marking a return to the mid-20th century street designs that emphasize segregation of road users. Enforcement action against jaywalkers and similar violators is stepped up, and legislation specifies that an autonomous vehicle manufacturer is not liable for any collision where a pedestrian was unlawfully present in the roadway (Millard-Ball, 2018, p. 10)."

Human drivers are a little less strict on the rules as a passenger's desires, and the potential for a gratuity and a high feedback rating encourages a compromise to safety and the law. Without a place for rideshare to exchange passengers, this behavior will likely continue and even get worse. Rogers (2018) addresses this in his recommendation for SUM Zones as passengers desire to be exchanged as close to their arrivals and departures as possible. This article makes a case for SUM zones as traffic flows are disrupted by passenger and parcel deliveries without a place to park. This forces rideshare and delivery drivers to illegally double park in order to conduct their business. The author continues that this is not just a congestion problem, but a safety problem as drivers, passengers, cyclists, and unrelated pedestrians attempt to negotiate the obstacle of the vehicle parked in traffic (Rogers, 2018). In San Francisco, TNCs conduct more than 170,000 pickups every weekday and account for about 20 percent of traffic – but account for 65 percent of traffic violations (Rogers, 2018).

2.2.3 Environmental

In an article in the Journal of the American Planning Association the author asks the question with the title 'Are cities Prepared for Autonomous Vehicles?' and explains that AV's could reduce parking as vehicles park themselves and reduce car trips with shared travel (Freemark, Hudson, & Zhao, 2019). A reduction in parking would be a tremendous boon for today's urban cores as a space that was previously dedicated to storing cars could be rediscovered for other uses (Freemark et al., 2019). This could leave space for urban infill, densification, environmental services, as well as recreation. It is not difficult to imagine that the local Home Depot would display a working garden or a park instead of an underutilized parking lot. It is incredible to think of the potential impact that removing the impervious surface of parking and returning it to a natural state could have on environmental services like stormwater management.

Autonomy is not guaranteed to solve all of our transportation problems as it could also lead to negative externalities; as people are freed from driving, riders could engage in leisure time, and this reduced cost associated with transportation and could lead to an increase in urban sprawl (Millard-Ball, 2018). Autonomous cars that are not shared would not require a parking space close to their destination; they could enable denser development and infill on former parking lots as they relocate (W. Zhang, Guhathakurta, Fang, & Zhang, 2015), this would free space as referred to by Freemark (2019) but would increase Vehicle Miles Traveled (VMT) as those zero capacity cars drive themselves to a remote locations.

2.2.4 Millennials

Helping to understand who is likely to take rideshare and why is answered by Dr. Noreen McDonald (2015) in her article titled ‘Are Millennials Really the “Go-Nowhere” Generation?’ Dr. McDonald explains several reasons why Millennials will turn their backs on the privately owned vehicle for shared mobility (McDonald, 2015). She presents some demographic facts about how Millennials may be the ones to usher in this new form of transportation (McDonald, 2015), stating the Millennials have a lot of influence as they are now the largest population group in the United States. The preferences of millennials could help to transform our cities and how we get around as they are resisting the need to obtain a driver license and have an affinity for urban living served by multiple modes of travel (McDonald, 2015). Appealing to these desires could help shape the new way that we think about personal transportation and in turn, the design of our cities. Dr. McDonald also warns that these preferences could change as Millennials move to different stages of life such as getting married, having children, and becoming employed and that their travel needs will increase as they age, but will do so later than previous generations (McDonald, 2015). Dr. McDonald also states opportunities for planners to encourage sustainable travel with this generation. If these opportunities are not seized early, she warns of a sharp rise in travel as they move through those different stages of life (McDonald, 2015). A 2018 Gallup Poll on rideshare usage identifies similar trends with Millennials. The information presented states that almost one in three Americans use these services, but usage rates are exceptionally high in young adults aged 18 to 29 at 45% (Inc, 2018). Knowing that Millennials carry the potential for change, planners and landscape architects should look to speak to this group with policies and designs that appeal to Millennials in the attempt to make sustainable change in transportation.

2.2.5 Shift to Multi-Modal Transportation

A change in thinking on how we see transportation and a shift away from the privately-owned vehicle is beginning to take hold. Evidence supports that people begin to travel more by foot and bike after utilizing car-sharing programs as well as decreased car ownership (McDonald, 2015). This is not only good for the environment, but potentially could be right for traffic congestion, health, and personal economics. When individuals replace individual car ownership with a fleet of shared vehicles with the added efficiencies of autonomy, the cost of travel will fall as a consequence (Millard-Ball, 2018).

2.2.6 The Underserved

Mobility to the underserved populations of the young, disabled, and elderly are beginning to change as they look to niche services provided by TNC's that are beginning to develop. These services cater to needs of security and/or a little extra help, such as carrying in groceries or ensuring that they have arrived at the right place. Millard-Ball (2018) contributes to the conversation on the underserved by stating that people with disabilities and the young could be released from the dependence upon others for their transportation needs.

2.3 Infrastructure Needs to Accommodate Rideshare and Autonomous Technologies

In order to accommodate rideshare and autonomous technologies, the existing literature has anticipated the following changes in infrastructure:

2.3.1 Traditional Parking

The article 'Will autonomous vehicles really lead to the demise of the parking garage?' written for the International Parking Institute (IPI) asks the reader to doubt claims of Uber CEO Travis Kalanick that parking garages will be obsolete by the year 2025 (Curtis, 2016). The article also reminds us of how the paperless office was hinted at in 1964 and predicted by 1975, and still, we are decades away from realizing that prediction (Curtis, 2016). Additionally, the article boldly answers its own question "Will the driverless car eliminate the need for parking garages?" Answering, "probably not and definitely not anytime soon (Curtis, 2016, par. 2)." The author of this article is Thomas E. Curtis, CAPP (Certified Administrator of Public Parking) and is a division manager for Platinum Parking in Houston, Texas (Curtis, 2016). Surely, as a matter of job security, the author does not promote autonomous or rideshare technologies. His job is to advocate for more parking, not less. A quick peek at his Twitter feed further displays his doubt for the viability of the technology and disdain for the autonomous car.

Mr. Curtis continues the article by listing the obstacles of the driverless car. These listed impediments include technology, cost, infrastructure, regulation, liability, other vehicles, and people (Curtis, 2016). His related statements are addressed as follows:

Technology – The author addresses the challenges faced by technology developers. These include weather conditions of heavy rain or snow as well as issues of cybersecurity. These are valid concerns and ones that are taken seriously by AV tech developers. What Mr. Curtis does not account for is that AV's will be more slowly adopted in areas where frequent heavy rains or snow occur. This is evident in the testing and current implementation of proving this tech in places like California, Arizona, Florida, and Mr. Curtis' own home state of Texas.

Cost – Mr. Curtis says that cost will be a factor well into the future. He does acknowledge that price will come down as most technologies do with time. There is nothing to disagree with here. The technology will be expensive and rightfully so. AV's will need to be held to a higher standard in reliability, durability, and safety. The fact that AV cars may be priced out of the range of the average current car owner may actually have positive implications on the aspects of our transportation future. Driven cars today sit 95% of the time (Neil, 2015). This may leave car ownership to companies who can afford the technology like Uber and Lyft to provide Mobility as a Service (Maas) in true rideshare fashion.

Liability – As autonomous cars prove themselves safer and more reliable than human drivers, they will become less of a liability as opposed to the human-driven car. The reason why parking costs is that it also is a liability as costs are associated with its operation, maintenance, and occupation of land. Newly discovered land in unused parking will simply shift away from that use as that newly rediscovered space is liberated.

Other Vehicles – Mr. Curtis claims that all 250 million cars and trucks on the road today aren't going away anytime soon (Curtis, 2016). He claims that it would take 20 years to replace the entire fleet of vehicles on the road today. This assumes that all cars will be replaced in all geographic areas at the same time. Inevitably, as AV becomes more utilized in areas like Arlington, Texas, other areas that face specific geographic and weather conditions will be buying driven cars from places like Arlington as they make room for AV and rideshare tech.

People – Many of us own cars because we like cars. It is a large part of our culture as Americans. It is true that Americans love their cars. However, millennials are falling out of love with individual car ownership (McDonald, 2015). The author believes the real driver behind pushing these new technologies is a matter of personal economics as well as convenience and safety. When Mobility as a Service (MaaS) can fulfill all the transportation needs of an individual, at a fraction of the cost of owning your own car, people will need to choose between owning a car or and buying the latest iPhone.

Mr. Curtis does acknowledge that "sometime in the distant future, there may be fewer cars (Curtis, 2016, par. 22)." However, his bet is on a world where we still own our own vehicles that park in his garages in remote locations far from the center of the city. Again, this will be a matter of economics as the wealthy may retain their own private vehicles as a luxury item, but the rest of us abandon the practice as it will not be worth the economic realities. He continues by stating that driverless cars will most likely be evolution, not a revolution as he asks young professionals and other stakeholders in parking to consider the design and operation of the future garage now (Curtis, 2016). This is a smart and proactive stance on the potential of future parking and one that this research encourages as planners and landscape architects steer this transportation paradigm shift.

It is understood that Mr. Curtis would be, and hope for everyone else to be, skeptical and even resistant to AV and rideshare technology as that goes directly against his livelihood. As AV and rideshare technologies progress, parking management will need to transform alongside the new technologies. Thus, parking management will have a significant role to play in the future with far fewer spaces. Think of parking that is leaner and meaner in a more dynamic system. Parking that is automatically monitored much in the way the toll roads where allocated spaces are metered in minutes or even seconds and charged based on use and time of day (Rogers, 2018). They may even act as hubs for charging, maintenance, or storage during non-peak travel times.

2.3.2 Designated Space for Rideshare

CNN tech article titled “Cities Warm Up to Designated Uber, Lyft Pick-up Spots” begins with the statement and subtitle that “Some of the hottest real estate in cities right now is curb space (McFarland, 2017, par. 1).” The underrated curb is becoming a hot commodity. For areas in need of a drop-off space, the doorstep directly in front of that space will be preferred by passengers. There is a real need to redesign the way in which our streets work to accommodate the demand for drop-off and pick-up as well as package delivery. The way in which these cities are addressing the issue is by replacing traditional parking spaces with pickup and drop-off areas specially designated for use by TNC companies like Uber and Lyft (Sadon, 2018). This is an attempt to embrace rideshare programs and help find a place for them within our infrastructure.

Greg Rogers a Senior Policy Analysis and Assistant Editor for Eno Transportation weekly agrees with Millard-Ball in his article titled ‘Ahead of the Curb: The Case for Shared Use Mobility (SUM) Zones (Rogers, 2018), by explaining that the curb and the purpose that it serves is beginning to change. Today, unlike a century ago, there is a need not just to accommodate parking, deliveries, taxi stands, and bus stops, but a need to accommodate the booming rideshare and eCommerce services. These services are relatively new and demand a new type of curb (Rogers, 2018). He continues by explaining, “Shared Use Mobility Zones (SUM Zones), [are] a flexible curb management tool that can help cities reduce congestion, meet their mobility goals, adapt to emerging technologies, and even increase their revenue (Rogers, 2018, par. 9).” The case made by this article for SUM Zones is definitely a step in the right direction. Allocating space for rideshare, AV, and delivery will surely prove to be an essential part of our parking infrastructure in the future. However, this initial assessment and consideration of the placement of spaces need more consideration. A one size fits all application will not work as not all streets are the same as the ones explored in the article. Moreover, most people will want to be dropped off as close as possible to their destination rather than walking from a zone halfway down the block. The flexible spaces over time to allow for the delivery of people and parcel is a smart idea. Smart meters that read license plates and charge by the minute could be employed to manage transactions without the driver ever leaving the car. This is much the same as the technology used on toll roads or visitor parking in the UTA parking garage on Nedderman Drive. These spaces could be flexible as SUM zones recommend, but they should generate revenue to help recuperate detraction from other parking revenue sources. A geofenced zone as explained by McFarland (2017), would help with revenue, but still ignores issues of safety.

The article continues with a list of cities that are employing test programs, including Washington, D.C., San Francisco and Fort Lauderdale, FL. These cities are looking for solutions that help them to maximize efficiencies at the curb and make way for a new, safer way to accommodate rideshare without compromising safety (McFarland, 2017). San Francisco’s plans would designate drop-off zones in a popular commercial corridor and work with the San

Francisco Bicycle Coalition to help relieve double-parking issues due to ride-share popularity (McFarland, 2017). In Fort Lauderdale, drop-off hotspots are identified along with entertainment areas and will study the issue over a six-month pilot program where 18 parking spaces are converted into designated pickup and drop-off zones across three areas (McFarland, 2017). These zones would be active during high traffic times on nights and weekends (McFarland, 2017). The program would allow for an initial grace period to educate and warm in drivers to the new program, but then drivers would be fined for not using the zones. (McFarland, 2017) With high turnover and intermittent employability of drivers, there should be some method for standardizing signage or incorporation into the rideshare applications themselves. This will surely need to be done in preparation for fully autonomous rideshare as they would likely not take the risk that a human driver does in a programmed bent toward safety and in strict adherence to the law (Millard-Ball, 2018). In fact, drivers often state that finding safe places to drop-off and pick-up passengers is the most challenging part of the job (McFarland, 2017). The article continues by quoting Harry Campbell, who is the editor of TheRideShareGuy.com, a blog for drivers "When you get into the heart of the city, passengers often want to be dropped off or picked up in illegal and sometimes dangerous places (McFarland, 2017, par. 16)."

Gerry Tierney of Perking+Will, who is the director of the mobility research lab, believes that "most cities will have reserved pick-up and drop-off spots in dense downtown areas in the next few years (McFarland, 2017, par. 6)." Tierney continues by stating that "The Wild West of pick you up anywhere and drop you off anywhere is over," and that "It's total common sense that we designate these areas." (McFarland, 2017, par. 7) "This is sort of like a beta test for autonomous vehicles, when people will summon cars on demand," Tierney said. "You have to first make sure the ridesharing works effectively with transit, bus, bike lanes and everyone using the street (McFarland, 2017, par. 22).” If one looks around they will see these spots have begun to show up in the DFW area, most commonly as an amenity to mixed-use developments in densely populated areas in entertainment and retail hotspots, however still very rare and elementary in function.

Dr. Millard-Ball (2018, p. 6) states in his article ‘Pedestrians, Autonomous Vehicles, and Cities writes that “Autonomous vehicles could provide the most dramatic transformation in urban transportation systems, and the largest upheaval for transportation planning practice, since the arrival of the motor car more than a century ago.” He continues by stating that “parking provision, street design, and transit and paratransit service networks are likely to be revolutionized (Millard-Ball, 2018, p. 6).”

When these vehicles do not find a place to park, they often find themselves circling the block, which contributes to congestion and greenhouse gas emissions or subject to tickets for double parking (Rogers, 2018). As cities look to mitigate traffic safety hazards SUM Zones may help by designating some on-street parking as such during peak drop-off and pickup times. (Rogers, 2018) These SUM Zone spaces could be flexible by uses during the times that they are in most demand. This would leave space for passenger, parcel, and privately-owned vehicles within the same parking spaces when in demand throughout the day (Rogers, 2018).

2.3.3 5G Wireless

Connecting our cars to each other seems to be a very complicated far off endeavor. However, with the advancement in 5G wireless technologies and Dedicated Short-Range Communications (DSRC) devices, likely be required on new passenger vehicles by 2020 (Kockelman, 2016), connectivity will develop much faster than expected. Retrofitting existing cars will be relatively easy. However, it will require the driver to react to alerts by the system on vehicles without technologies like emergency braking (Kockelman, 2016). These vehicles will share information such as position, speed, and direction as well as realize improvements to traffic signal timing, and road conditions (Kockelman, 2016). Vehicles that are connected will share information such as speed, position, and direction. This will enable them to avoid collisions, improve traffic and get alerts about upcoming conditions (Kockelman, 2016) Connective technology employed on cars will also find its way into cell phones, backpacks, and bikes to keep pedestrians safe (Kockelman, 2016).

2.3.4 Electrification

Rideshare has the potential to usher in the electrification of our transportation system (Bauer, Phadke, Greenblatt, & Rajagopal, 2019). With increased efficiencies in battery life and range, electric cars will be more attractive for rideshare companies. Cars will also be able to charge themselves to the convenience of the rider as range, or battery life will not be a consideration of the user.

2.3.5 Politics and Legislation

There is much difficulty in planning and predicting future travel demands and impacts of these technologies and their adoption into our lives. This seems to allow policymakers to push the issue to the back burner with a wait and see attitude. (Millard-Ball, 2018) However, planning for new infrastructure is not wasted. Any well thought out changes to accommodate these technologies today can facilitate the autonomous and rideshare technology of tomorrow. Today, rideshare vehicles are often seen double-parked or circling the block looking for, or waiting on, their passengers (Rogers, 2018). There is no designated place at the curb for these vehicles, and with increased demand for rideshare and eCommerce deliveries, the problems will only get worse. Therefore, it is critical that city planners, designers, and policymakers think about how autonomous vehicles, rideshare, and enhanced wireless technologies will change the way in which we interface with our destination as we receive goods and services now and in the future.

The relationship between rideshare services and cities has not always been perfect, but rideshare has found a permanent place in our transportation systems. There are incentives for both government and TNC's to solve the problems associated with rideshare. Andrew Salsberg Uber's head of transportation policy and research states, "There's a lot of benefits to getting this right --- not just for the people who use our service, but for overall transportation on the streets (McFarland, 2017, par. 9)." Planning for this uncertain future can be addressed by improving demand models and the adoption of how Millennials could influence transportation (McDonald, 2015). It will be government policies that will be depended upon to help shape the form of that new mobility (McDonald, 2015). Given the intimate relationship with the urban form, AVs, and mobility, it should be considered a failure of municipalities not to plan for this new form of transportation. (Freemark et al., 2019). With less pressure on parking and a cities involvement in the management of parking, cities will need to begin to manage pick-up and dropoff sites for rideshare (Henao & Marshall, 2019). This is an opportunity for cities to implement comprehensive strategies for more sustainable transportation systems by encouraging limited vehicle ownership and the demands of rideshare (Y. Zhang & Zhang, 2018).

Arlington, Texas has long been touted as the largest American city without mass transportation. This is a title that the city looked to change with the single bus route from the Metro Arlington Xpress (MAX) in 2012. However, this service stopped in December of 2017 with the introduction of micro-transit offered by a company called Via. Via offers on-demand minibus rides with much of the flexibility offered by Uber and Lyft but with a pooling aspect as riders share the ride. This lack of investment in an Arlington bus system allowed the city to explore options like micro-transit without destroying or competing with any existing mass transit. This seems to be a logical reason why Via has been supported by the city and is now a success indicated by its continued growth in Via's coverage. This new relationship and acceptance of rideshare and micro transit give Arlington the unique opportunity to be a model for the future of rideshare.

2.3.6 Economics

2.3.6.1 Government

One major issue is that cities depend on parking revenues (McFarland, 2017). As cities look to replace revenue once collected at the parking garage or meter, will TNC's be required to pay for the use of specialized parking (McFarland, 2017)? Senior Analyst at the Eno Center for Transportation acknowledges this reliance on parking revenues and suggests a nominal fee for drop-offs and pickups in a geofenced area (Rogers, 2018). When a rideshare vehicle enters the geofenced area, the TNC will be charged and then pass this cost along to riders. This would help cover the cost of lost revenue from parking not utilized due to the adoption of rideshare. Moreover, AV's may save the United States' economy roughly $430 billion per year. (Kockelman, 2016).

2.3.6.2 Personal

The potential for AV to help mitigate parking costs and improve fuel economy, as well as other social benefits, is estimated to be roughly $3,000 to $5,000 per year, per vehicle (Kockelman, 2016). As part of this research and interest in rideshare, This author has committed to rideshare in lieu of buying a vehicle. The cost of services to get to and from work average $450.00 per month. This is an approximate savings of nearly $4,000 per year.

CHAPTER THREE: METHODOLOGY

3.1 Introduction

It is the author's personal experience with over 2,000 rideshare exchanges that the location where a rideshare passenger is picked up or dropped off is often an unspoken negotiation of circumstance between driver and rider. On pickup, the exchange site is usually determined by whoever arrives first. If a passenger is waiting outside and signals the driver upon their arrival, the decision is mostly made by the rider as the driver stops where the passenger is located. Conversely, when a driver arrives first, and a passenger is not identified, the driver looks for a place where the exchange is likely to occur or keeps moving in search of their passenger or for a place to conveniently wait until the passenger is identified. At the terminus of a trip, the rider is usually the one who picks the point of drop-off as the driver again looks for direction from the passenger. It is logical to assume that a rider's desire would be to be dropped off as close to their destination's point of entry as possible as a matter of convenience. This is done without much respect for traffic law or congestion as the responsibility and consequences of not obeying traffic laws or traffic etiquette is left to the driver. This leads to a compromise where the driver who wishes to obtain a tip, and/or a good rating, bends to the wishes of the rider.

To better understand how people are using the existing vehicle infrastructure to exchange riders, this researcher will gather quantitative data in the form of survey questionnaires and passive observation of rideshare passenger exchanges. The data collected by the survey will help to gain a better understanding of where rideshare exchanges are likely to occur and rider preferences. Passive observations will look to reveal where rideshare exchanges are occurring now without designated rideshare infrastructure. This will also allow for the observation of any traffic or safety issues that are caused as a result.

3.2 Observational Study

Passive observation was appropriate for use in this study as it allowed for the collection of data in natural settings as they unfolded over time (Kempf-Leonard, 2005). Observational studies were initially selected from three differing typologies on the UTA campus. These typologies were office, residential, and commercial, which looked to yield information on varying land use types for this research. On initial observations, these typologies yielded varying levels of rideshare exchange activity. The residential typology located west of the new parking garage on Nedderman Drive at UTA's student housing 'West Hall' produced moderate, but promising activity. This location allowed for the observation of the front of the building that interfaced with the associated parking lot and a fire lane turn around that ran along the east side of the building before turning to the west to connect with Nedderman Drive. The area selected for the commercial typology was identified at College Park on Spaniolo Drive, where several restaurants are located. This area was observed for several hours over multiple occasions where only a few rideshare exchanges occurred, and none of those passengers entered the selected retail area but instead to the residential area across the street. It is worth noting that the restaurants on Spaniolo Drive have struggled to stay in business and there were several vacancies at the time observations were attempted. The office typology located between CAPPA and the MAC displayed a large number of rideshare exchanges not only on Nedderman drive but also to the south at the fire lane turn around at the end of Greek Row, as illustrated in Figure 1 and pictured in Figures 2, and 3. From the initial observations, it was necessary to change the areas of study, as the commercial area would provide little if any data and the residential typology was very similar to the infrastructure at the Greek Row with its fire lane turn around. This change allowed for a more comprehensive look of rideshare activity in a concentrated area with different types of associated infrastructure. An observation point was established at the southwest corner of Nedderman Drive and Greek Row on the UTA campus. This allowed for a viewing of both study areas simultaneously and provided for an efficient and non-intrusive way of gathering observational data. This area was familiar to the researcher as it has been casually observed throughout his graduate studies as an area of high demand for rideshare. Also from these informal observational studies it was learned what times of day were most active and would yield most occurrences of rideshare exchange activity.

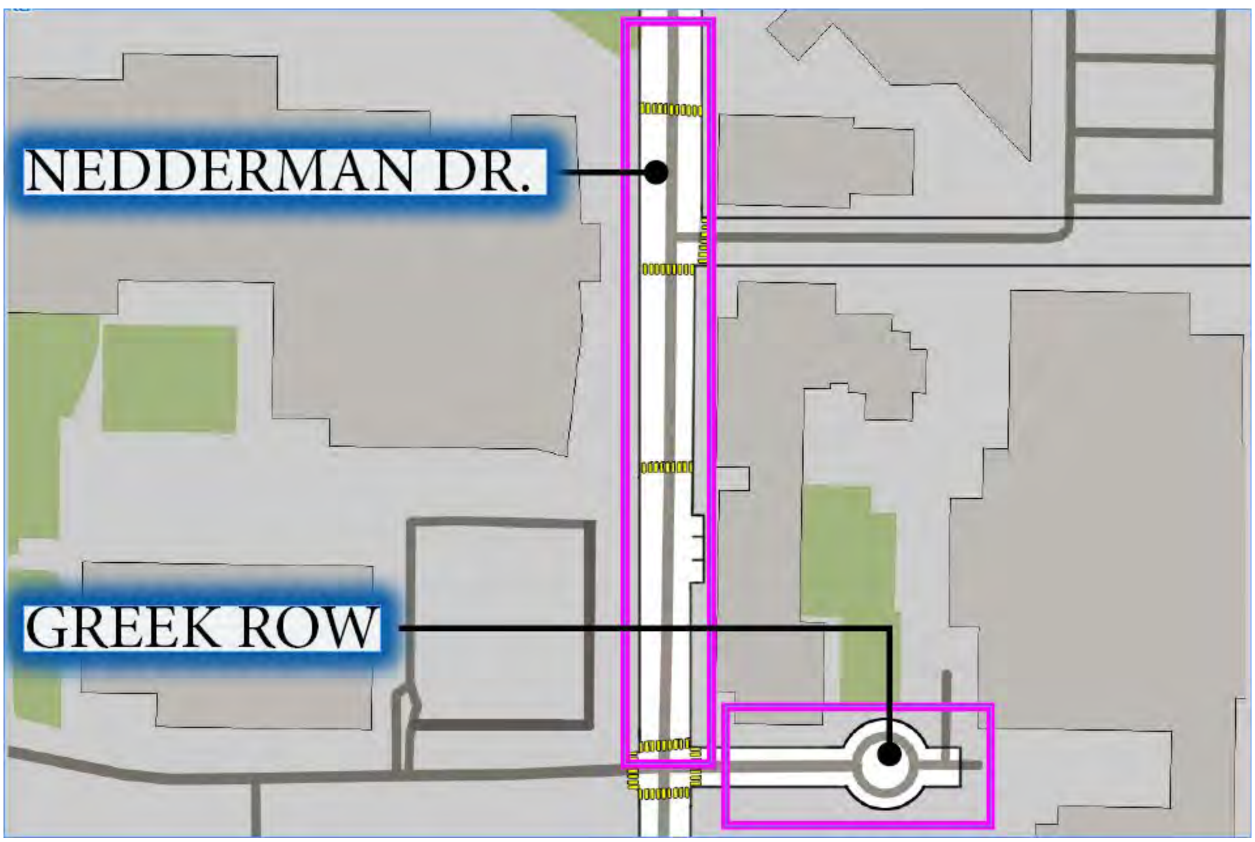

Figure 1 Observational Study Areas of Interest

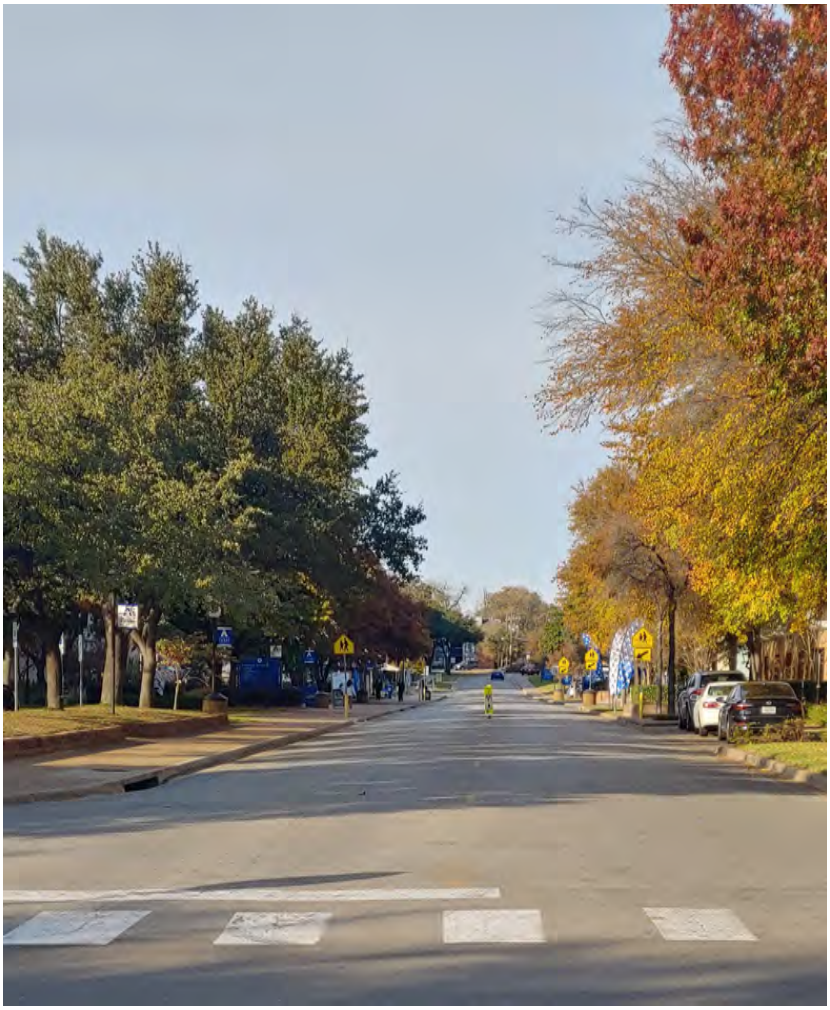

Figure 2 Nedderman Drive

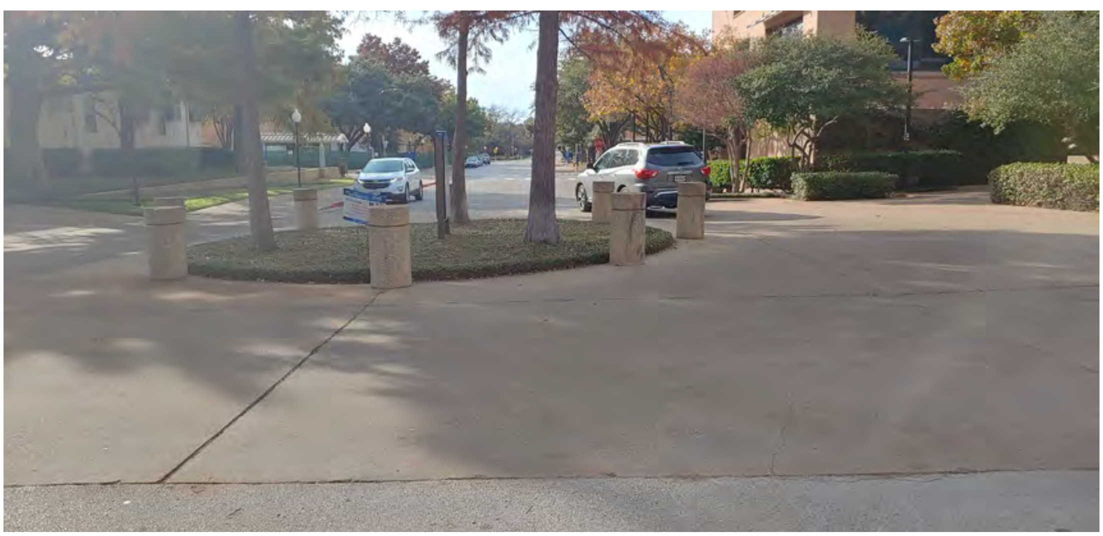

Figure 3 Greek Row fire lane

With two new areas for the observational study selected the collection of data could begin. Recorded observational data collection was conducted the week of November 3rd, 2019. Individuals and vehicles moving through this space were observed for rideshare exchanges and activities that could potentially lead to a better understanding of safety, traffic, convenience, and other considerations of rideshare activities. Several data points were collected on each rideshare exchange, which included the type of exchange, the direction of vehicle travel, the direction of pedestrian travel, time, duration over 1 minute, and weather a crosswalk was needed and or used with examples of each type in Figure 4 and complete observation log in Appendix A.

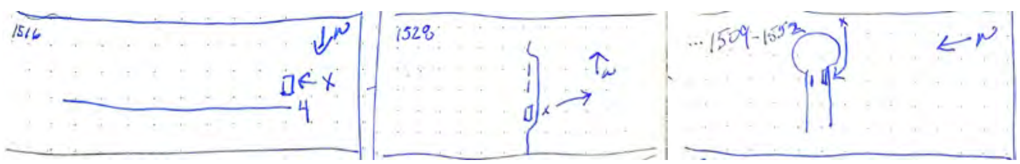

Figure 4 Observational Data Collection Sample Examples

Observations occurred from the northwest corner of Nedderman Drive and Greek Row, allowing data to be collected from both streets simultaneously. It was essential to capture different times of day where rideshare exchange drop-offs were observed in the morning and pickups were observed in the afternoon (Table 1). Exploratory observations in preparation for the collection of data revealed the highest frequency of rideshare exchange activity weekdays from 08:00 to 09:30 and 15:00 to 16:30. It was observed as expected that the majority of drop-offs happened in the morning, and the majority of pickups happened in the afternoon, both on Nedderman Drive (Table 2) and Greek Row (Table 3).

Date	**Day**	**Time Start**	**Time Stop**	**Number of Exchanges**
11/04/2019	Monday	08:03	09:39	34
11/05/2019	Tuesday	08:03	09:37	46
11/07/2019	Thursday	15:06	16:34	31
11/08/2019	Friday	15:09	16:30	21
Total				**132**

Table 1 All Observational Data Collected

Date	Day	Pickup	Drop-off	Number of Exchanges
11/04/2019	Monday	3	15	18
11/05/2019	Tuesday	0	19	19
11/07/2019	Thursday	10	2	12
11/08/2019	Friday	6	3	9
Total				**58**

Table 2 Nedderman Drive Observational Data

Date	Day	Pickup	Drop-off	Number of Exchanges
11/04/2019	Monday	0	16	16
11/05/2019	Tuesday	0	27	27
11/07/2019	Thursday	15	4	19
11/08/2019	Friday	11	1	12
Total				**74**

Table 3 Greek Road Observational Data

Observations yielded 132 rideshare exchange data points of 87 rideshare drop-offs and 45 rideshare pickups. Observational data allowed for insights about what was happening with rideshare exchanges, within the current infrastructure. Seeing how these exchanges were happening was instrumental to a deeper understanding for further recommendations and potential for rideshare exchange sites.

The purpose of these observational sessions was to get an understanding of what is occurring in the absence of dedicated rideshare exchange sites. These passive observations identified not only where these exchanges are taking place, but they also provided information on the impacts on traffic, safety, and behavior. This method was particularly useful for this research as it allowed for insight into how rideshare actually functioned within the existing infrastructure. This information also allowed for the documentation of challenges and opportunities that were observed leading to recommendations of future considerations in design and planning.

3.3 Survey

Surveys were collected from twelve pedestrians within the study area. The survey was divided into two parts where the first part included 7 survey questions about the use and preferences for rideshare, and the second part included twelve scenarios where respondents indicated how they would negotiate the infrastructure from point to point in either arrival or departure within the study area. The first part simply looked to qualify respondents as users of rideshare and asked questions of general preference. When respondents indicated that they did not use rideshare the survey would be stopped and excluded from the survey data. In the second part of the survey, respondents were asked how they would reach the vehicle or destination on pick-up or drop-off, by drawing as prompted on three different scenarios groups, with indications made on four maps for each group. This was an attempt to gather the preferences for the locations of rideshare exchanges and the proximity to building entries, use of crosswalks, and pedestrian routes to and from exchanges. These methods were appropriate for this study as only the diversity of behavior was sought from members within the selected population (Jansen, 2010). From the 144 points of data collected in the scenario responses clear and consistent behavioral within the selected population was achieved (Jansen, 2010).

Surveys were collected on the two Saturdays November 09th from 15:15 to 16:47 on Greek Row and the 16th from 15:37pm to 16:30pm on Nedderman Dr. As part one of the survey, the seven questions listed below were asked:

1. How often do you use rideshare?
2. Which Rideshare Service do you use?
3. What do you use rideshare for?
4. Why do you use rideshare?

5. Do you see any problems with rideshare pick-up or drop-offs?
6. On a scale from 1 to 10 (one being very dissatisfied and 10 being very satisfied), how would you rate rideshare pick-ups or drop-offs at UTA in regards to the following?
7. What is most important to you when being picked up or dropped off by rideshare?

3.3.1 Survey Scenario's

Scenario's from three differing situational conditions were asked as respondents indicated pathways on a map. The three scenario conditions were presented as "Pick-up Scenario," "Drop-off Scenario," and "Alternate Drop-off Scenario." This was an attempt to gather the preferences for the locations of rideshare exchanges and the proximity to building entries, use of crosswalks, and pedestrian routes to and from exchanges.

3.3.1.1 Pick-up Scenario

This scenario looked to understand where respondents wanted to be picked up by rideshare, as well as where they expected the driver to wait, what building exits they would use, and how they would get from inside the building to the desired exchange site by presenting the following scenario question:

> You are in the building here (blue O), the exits are here (red arrows), where do you request to be picked up (draw a red rectangle)? See Figure 5.

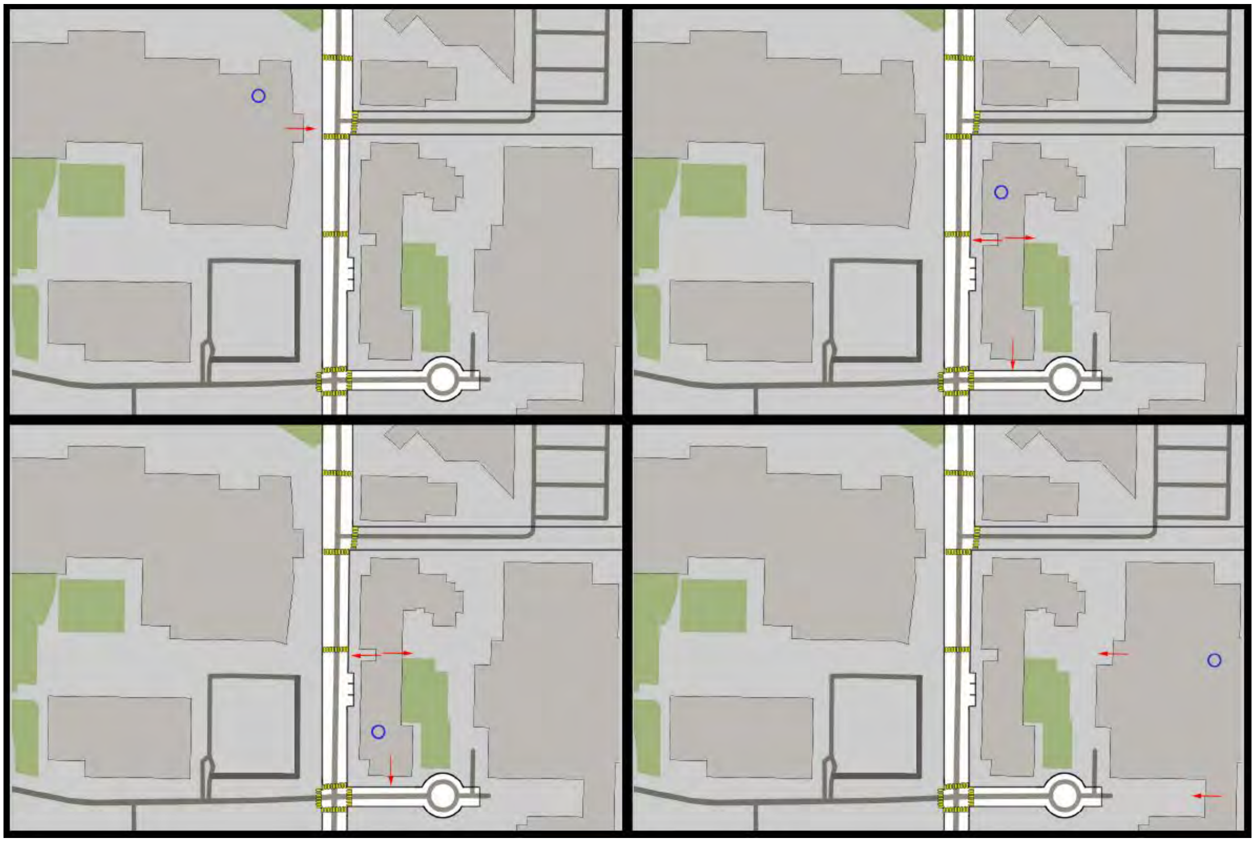

Figure 5 Survey Instrument Pick-up Scenario

3.3.1.2 Drop-off Scenario

This scenario looked to understand where respondents wanted to be dropped off by rideshare, what building entrances they would use, and how they would get from the exchange site to their destination. The key difference in this scenario was when passengers were dropped off on the side of the street opposite from their destination, respondents would need to address the crossing of the street and potential use of the crosswalk. This was presented to respondents in the following scenario question:

> Your destination is here (blue O), your driver approaches from here (black arrow), entries are here (red arrows) where do you ask the driver to stop and let you out (draw red rectangle)? What is the path you take to walk to the entry (draw a red line)? See Figure 6.

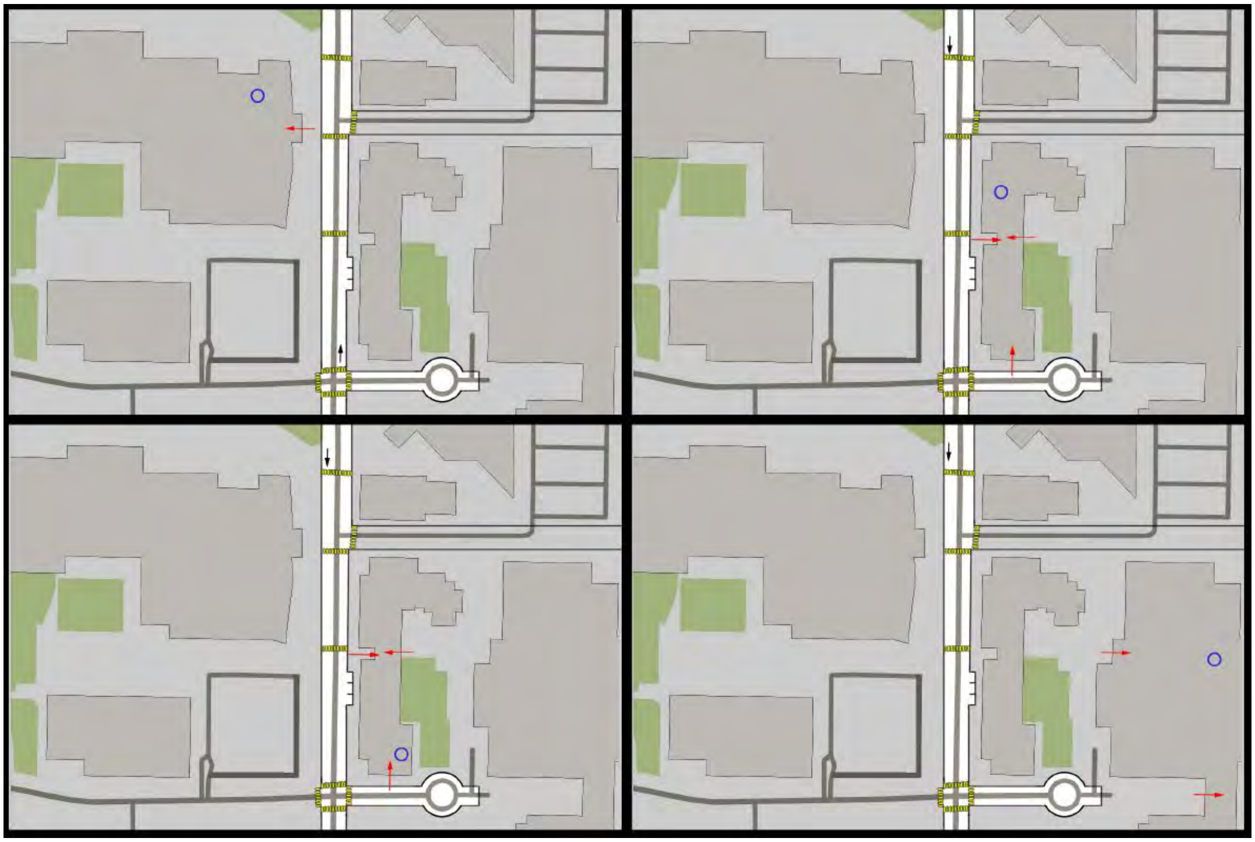

Figure 6 Survey Instrument Drop-off Scenario

3.3.1.3 Alternate Drop-off Scenario

This scenario presented an alternative drop-off location not selected by the rider. This scenario looked to understand the same preferences on building entrances used and how they riders would get to their destinations with the key difference in this scenario took the choice of the closest exchange point away from a rider. The purpose for this was to see how the respondents would indicate the use of crosswalks when removed more than one car length or more away from the crosswalk. This was presented to respondents in the following scenario question:

> Your destination is here (blue O), entries are here (red arrows), but traffic is preventing your driver from getting you exactly where you want to be dropped

off. Your driver stops here (black arrow) and you get out of the car, what is the path you take to walk to the entry (draw a red line)? See Figure 7.

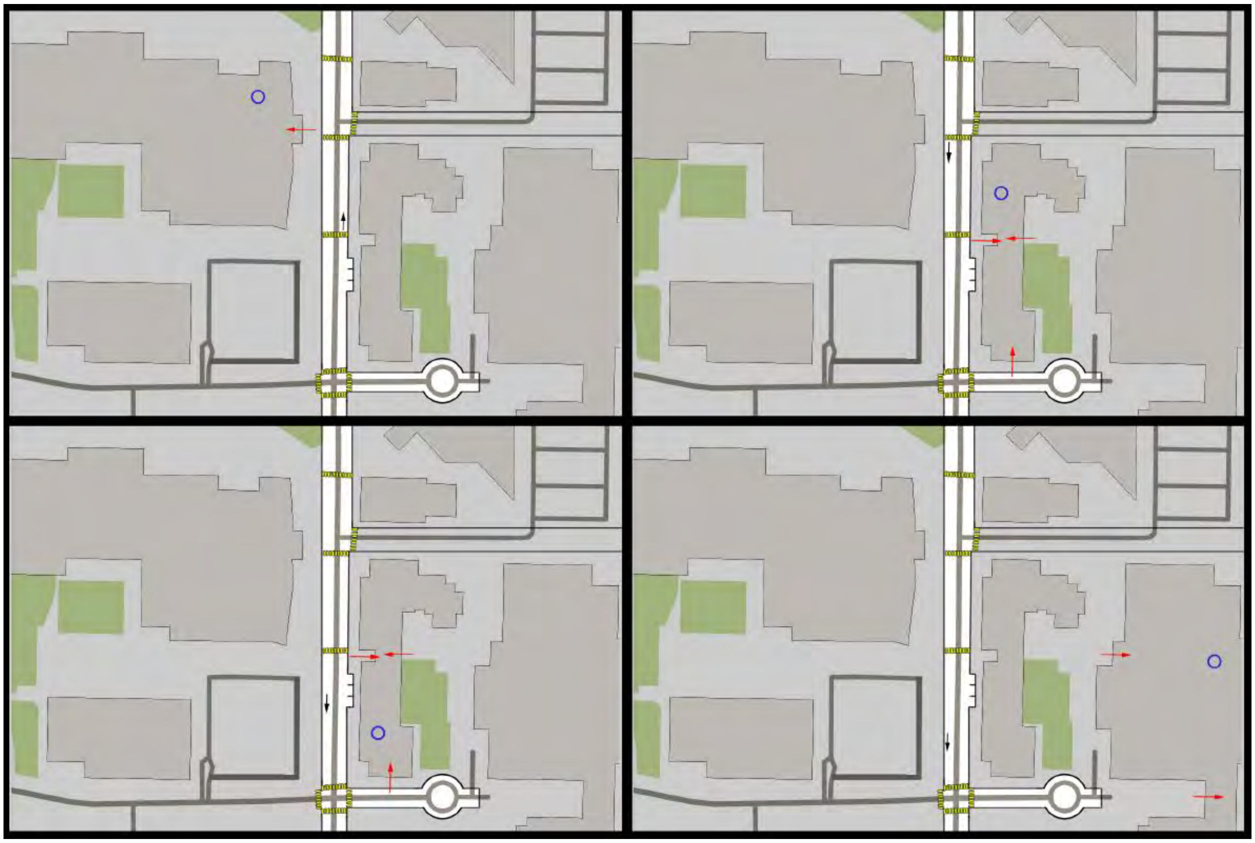

Figure 7 Survey Instrument Alt Drop-off Scenario

CHAPTER FOUR: ANALYSIS AND FINDINGS

4.1 Introduction

All data collected was done in the attempt to record what was actually happening in observation and in interpreting what was indicated by survey respondents. This allowed for proper analysis and comparison of what was observed on the street, juxtaposed against the data that was collected with surveys. The author began the study by identifying potential bias (Kempf-Leonard, 2005) and hopes to find a place for and the need for rideshare exchange sites within the study location. The author conducted research when alert and for durations that would not lead to boredom, as well as limiting exposure as not to change the behavior of rideshare exchanges.

It is important to note that there were 144 data points of survey scenario data to compare with the 132 points of observational data; however, the survey information was collected from only twelve participants answering twelve scenarios and seven questions about rideshare exchange preferences. Although the combined data did yield significant contributions to a greater understanding of rideshare exchanges.

4.2 Observational Data

4.2.1 Nedderman Drive

Nedderman Drive presented observational opportunities between CAPPA and the MAC that included four crosswalks, and three on-street metered parking spaces along the 750’ of observable curb space from the corner of Greek Row and Nedderman Drive to the north as represented in Figure 8. Of the 132 rideshare exchanges that were observed, 58 were on Nedderman Drive, and most of these exchanges occurred at or near crosswalks.

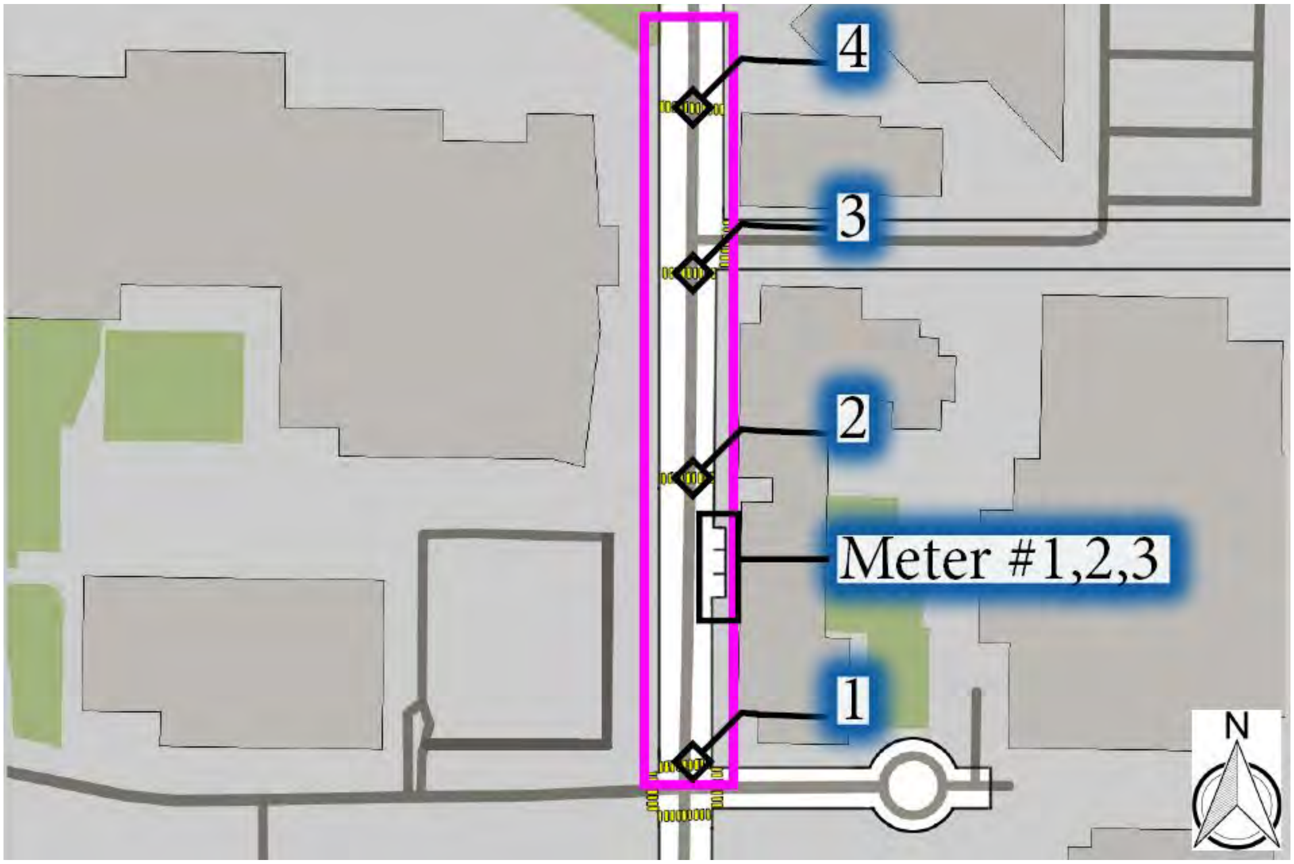

Figure 8 Nedderman Drive Observational Study Locations

4.2.1.1 Crosswalks

Of the 58 observed rideshare exchanges on Nedderman Drive, 26% of those exchanges required the use of one of the four crosswalks in Figure 9. The need to use a crosswalk meant that the

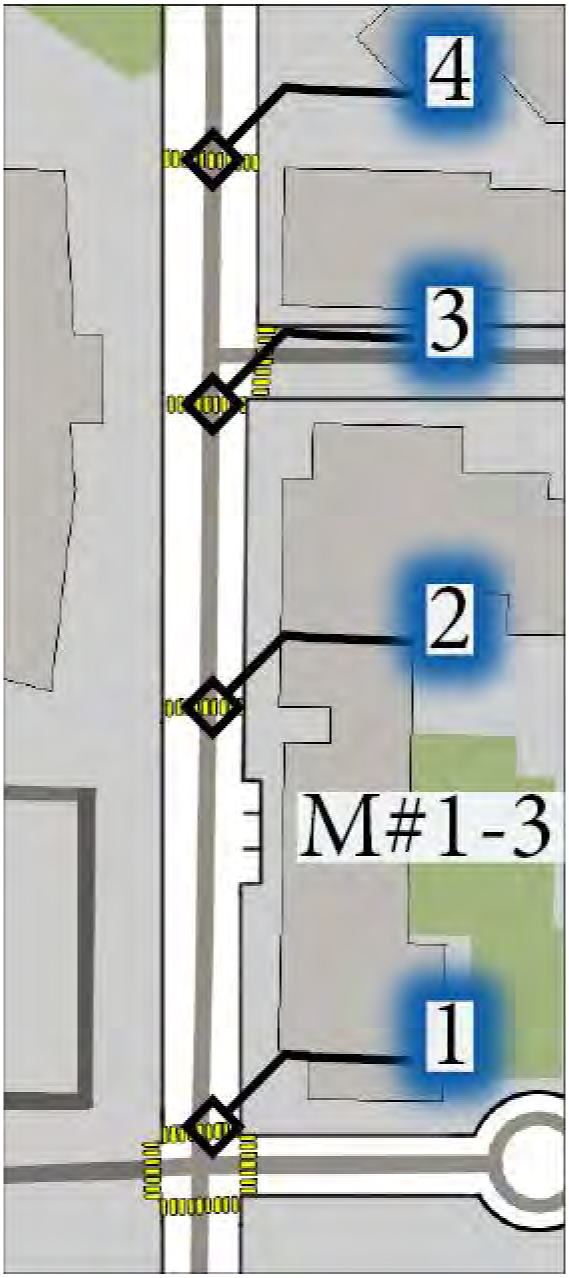

Figure 9 Nedderman Drive Crosswalk Locations

vehicle delivering its passenger was oriented so that the passenger was exchanged on the opposite side of the street from their desired destination. From the 15 rideshare exchanges that required passengers to cross the street, only six actually used the crosswalk, as where the other nine riders chose to cross the street outside of any crosswalk area. This adds to safety considerations where the need for these crossings could have been avoided altogether had the vehicles approached in the proper orientation by leaving the passenger on the side of the street where their destination was located. Of those nine who did not use the crosswalk, six were one space or more away from a crosswalk. Of those six passengers, all of them should have used a crosswalk, but none of them actually did so. Of the 15 rideshare exchanges observed, 11 passengers or 73% were exchanged before the crosswalk, and four passengers were exchanged after. Of all 34 rideshare exchanges occurring immediately before crosswalks, there were four remaining that occurred after a crosswalk. Exchanges that happened after the crosswalk were less than half as likely to use the crosswalk than those that occurred before. There were only 11 rideshare exchanges on Nedderman Drive, where a crosswalk was not considered a factor. The area one space just before or after a crosswalk is where 92 percent of rideshare exchanges occur. See Table 4.

Crosswalk Number	Crosswalk used	Distance from crosswalk	Exchanged before or after crosswalk	Exchange type
1	NO	2 Spaces	Before	Drop-off
1	NO	3 Spaces	Before	Drop-off
3	NO	3 Spaces	Before	Drop-off
3	NO	2 Spaces	After	Pick-up
1	NO	2 Spaces	After	Pick-up
1	NO	3 Spaces	After	Drop-off
4	NO	At Crosswalk	Before	Drop-off
3	NO	At Crosswalk	Before	Drop-off
2	NO	At Crosswalk*	Before	Pick-up
3	YES	At Crosswalk	Before	Drop-off

3	YES	At Crosswalk	Before	Drop-off
2	YES	At Crosswalk	Before	Drop-off
3	YES	At Crosswalk	After	Drop-off
3	YES	At Crosswalk	Before	Drop-off
3	YES	At Crosswalk	Before	Pickup

Table 4 Nedderman Drive Observed Data

The relationship between observed rideshare exchanges and crosswalks could be that these crosswalks are closest to the destinations and entrances through which passengers wish to pass. A second reason that may contribute to the stopping at crosswalks is the ease in communication between drivers and riders in referencing them as drop-off points, rather than spontaneous instructions from a passenger of ‘here’ or ‘near that sign.’ A third reason that crosswalks may be selected as exchange points is that when pedestrian traffic is high, crosswalks are often necessary stopping points. Here, the rider takes the opportunity to get out as the vehicle is already stopped. It is likely that any of these considerations make crosswalks a natural place for rideshare exchanges to happen. Whatever the reason, crosswalks should be considered when recommending where rideshare exchange locations should be established.

Even though crosswalks were observed as places where exchanges naturally took place, this does not mean that the practice is always safe. While observing exchanges on Nedderman Drive, on the morning of November 4th, a van was seen parked at the curb before the crosswalk that aligns with the door of the MAC, as seen in Figure 10. This was a service van that stayed in that spot for approximately 15 minutes (represented by the blue rectangle). While the van was there, traffic seemed to operate relatively regular as vehicles simply went around the van, stopping at the crosswalk, and then continuing on their way. However, when one vehicle was going around the van (represented by the pink rectangle), it stopped at the crosswalk and a passenger got out. This angered another driver behind the rideshare exchange that was occurring and that vehicle decided to go into the opposing lane and go around both vehicles (represented by the red rectangle and arrow). What the angered driver did not realize is that the van and

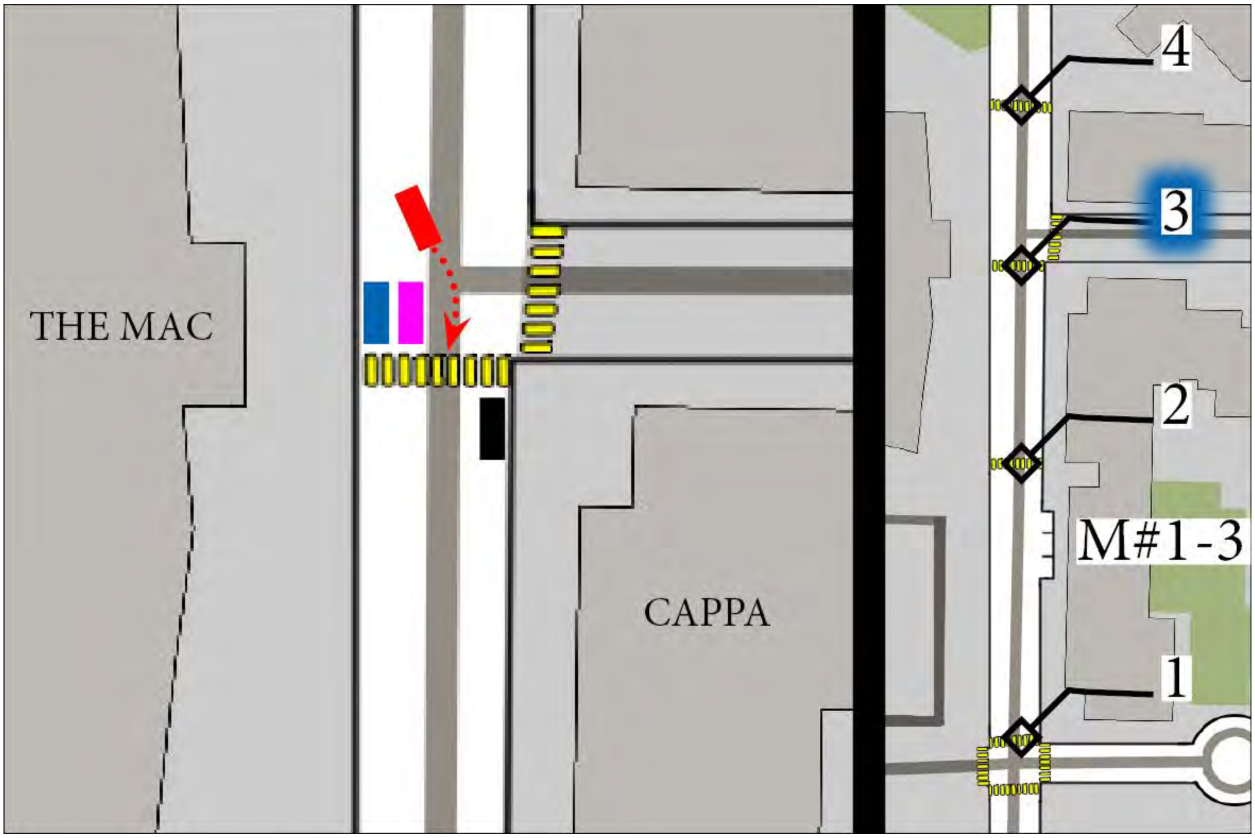

Figure 10 Observed Safety Concern

rideshare exchange were blocking the view of pedestrians in the crosswalk. The angered driver saw the pedestrians just in time, but this could have ended in a pedestrian/vehicle accident caused in part by a rideshare exchange. With this observation consideration for exchange, safety will need to be examined when recommending rideshare exchanges.

4.2.1.2 Crosswalk 1

Crosswalk 1 is located at the corner of Nedderman Drive and Greek Row, as displayed in Figure 9 and pictured in Figures 11 and 12. Rideshare exchanges at this location required pedestrians to use the crosswalk four out of five times; however, the crosswalk was never used during a rideshare exchange. One rideshare exchange happened just before the crosswalk on a drop-off and all others were one or more car lengths away from the crosswalk (Table 5). Stopping away from the crosswalk was seen as an attempt to keep a safe distance from the intersection as there was no obvious entrance for the passenger to enter or exit to or from directly.

Figure 11 Intersection of Crosswalk 1 facing east.

Figure 12 Crosswalk 1 facing east.

Crosswalk Needed	Crosswalk Used	Stop Location	Vehicle Direction	Passenger Direction	Exchange Type
Yes	No	2 Spaces Before	South	East	Drop-off
Yes	No	3 Spaces Before	South	East	Drop-off
Yes	No	2 Spaces After	South	West	Pick-up
Yes	No	3 Spaces After	North	West	Drop-off
No		Before	North	East	Drop-off

Table 5 Crosswalk 1 Data

4.2.1.3 Crosswalk 2

Crosswalk 2 is the crosswalk closest to the entry of the College of Architecture, Planning, and Public Affairs (CAPPA), where 21 exchanges were observed as pictured in Figures 13 and 14. Here the crosswalk was only needed twice and was used only once. All but one of the 21 exchanges happened before the crosswalk. There were 7 pickups and 14 drop-offs observed. 7 of the 21 exchanges did not involve CAPPA as pedestrians made their way to the MAC on the opposite side of the street, as displayed in Table 6.

Figure 13 Crosswalk 2 Entrance to CAPPA facing east.

Figure 14 Crosswalk 2 facing West

Crosswalk Needed	Crosswalk Used	Stop Location	Vehicle Direction	Passenger Direction	Exchange Type
No		Before	North	East	Drop-off
No		Before	North	East	Drop-off
No		Before	North	East	Drop-off
No		Before	North	East	Drop-off
No		Before	North	East	Drop-off
No		Before	North	East	Drop-off
No		Before	North	East	Drop-off
No		Before	South	West	Drop-off
No		Before	North	East	Drop-off
No		Before	North	East	Drop-off
No		Before	North	East	Drop-off
Yes	Yes	Before	South	East	Drop-off
No		Before	South	West	Drop-off
No		Before	North	East	Drop-off
No		Before	North	West	Pick-up
No		Before	South	East	Pick-up
No		Middle of Street	South	East	Pick-up
No		2 Spaces Before	South	Southeast	Pick-up
No		Before	North	West	Pick-up
Yes	No	Before	South	Northwest	Pick-up
No		Before	North	West	Pick-up

Table 6 - Crosswalk 2 Data

4.2.1.4 Crosswalk 3

Crosswalk 3 leads directly into the MAC on the west side of Nedderman Drive (Figure 15). The crosswalk was needed 8 times but was only used 5 of those times. Seventeen exchanges happened before the crosswalk, and 4 occurred after (Table 7). Eight of the 21 exchanges did not involve the MAC as pedestrians made their way to CAPPA on the opposite side of the street as pictured in Figure 16.

Figure 15 Crosswalk 3 Entrance to MAC facing west.

Figure 16 Crosswalk 3 facing east

Crosswalk Needed	Crosswalk Used	Stop Location	Vehicle Direction	Passenger Direction	Exchange Type
No		Before	South	West	Drop-off
No		Before	South	East	Pick-up
No		Before	South	West	Drop-off
No		Before	South	West	Drop-off
Yes	No	Before	North	West	Drop-off
Yes	No	After	North	East	Pick-up
No		Before	South	West	Drop-off
No		After	South	West	Drop-off
Yes	Yes	Before	South	East	Drop-off
No		Before	South	South	Drop-off
Yes	Yes	Before	South	East	Drop-off
No		Before	South	West	Drop-off
No		Before	South	East	Pick-up
Yes	Yes	After	North	West	Drop-off
No		After	North	West	Pick-up
Yes	No	Before	North	West	Drop-off
No		Before	South	West	Drop-off
Yes	Yes	Before	South	East	Drop-off
No		Before	North	West	Pick-up
No		Before	North	West	Pick-up
Yes	Yes	Before	North	East	Pick-up

Table 7 Crosswalk 3 Data

4.2.1.5 Crosswalk 4

Crosswalk 4 was the farthest from where observations were recorded at the intersection of Nedderman Drive and Greek Row. Here there were only 4 recorded exchanges. All vehicles traveled south, and there were 2 pickups and 2 drop-offs (Table 8). There are no entrances closely associated with this crosswalk (Figures 17 and 18) as with the conditions of Crosswalk 1.

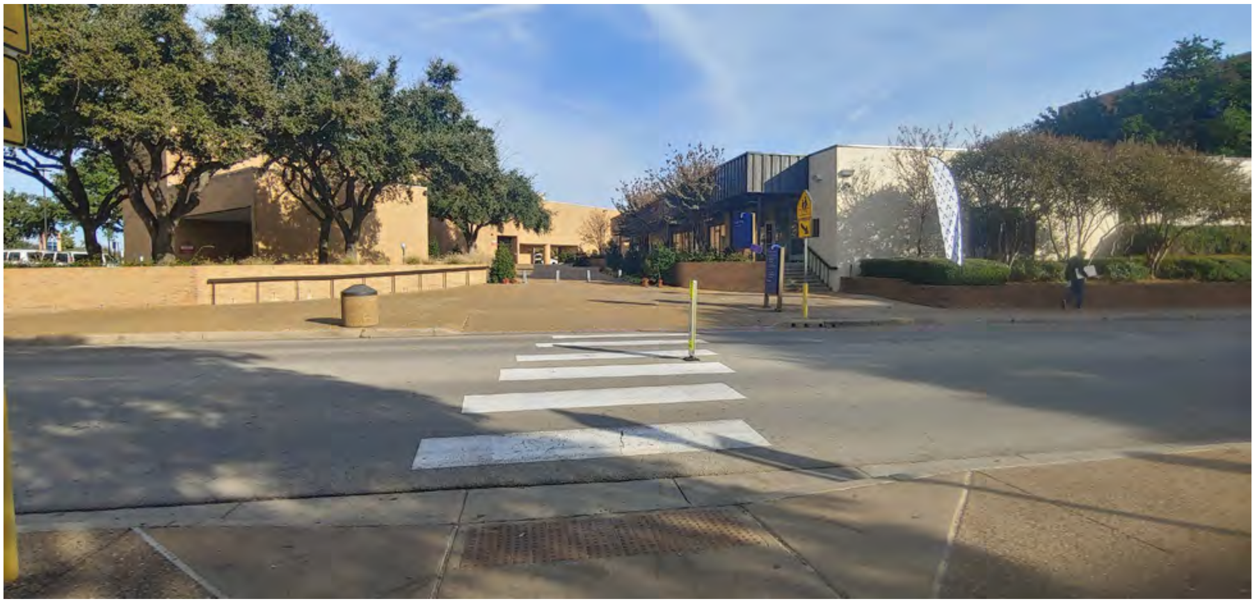

Figure 17 Crosswalk 4 facing east

Figure 18 Crosswalk 4 facing west

Crosswalk Needed	**Crosswalk Used**	**Stop Location**	**Vehicle Direction**	**Passenger Direction**	**Exchange Type**
No		Before	South	Southwest	Drop-off
Yes	No	Before	South	East	Drop-off
No		After	South	East	Pick-up
No		After	South	East	Pick-up

Table 8 Crosswalk 4 Data

4.2.1.6 Metered/Parallel Spaces

There are three metered spaces that sit just south of the west entrance to CAPPA and the crosswalk that is associated with that entrance (Figures 19 and 20). It was anticipated that these three spaces would be used for rideshare exchanges as this seemed to be a natural and safe exchange point for those visiting CAPPA, as seen in Figure 21. This would closely resemble the recommendations of SUM zones (Rogers, 2017) mentioned in the literature review of this research paper, as the use could be alternated from parking to rideshare exchange on demand.

Figure 19 Metered Spaces at Cappa facing east

Figure 20 Metered spaces at Cappa facing southeast.

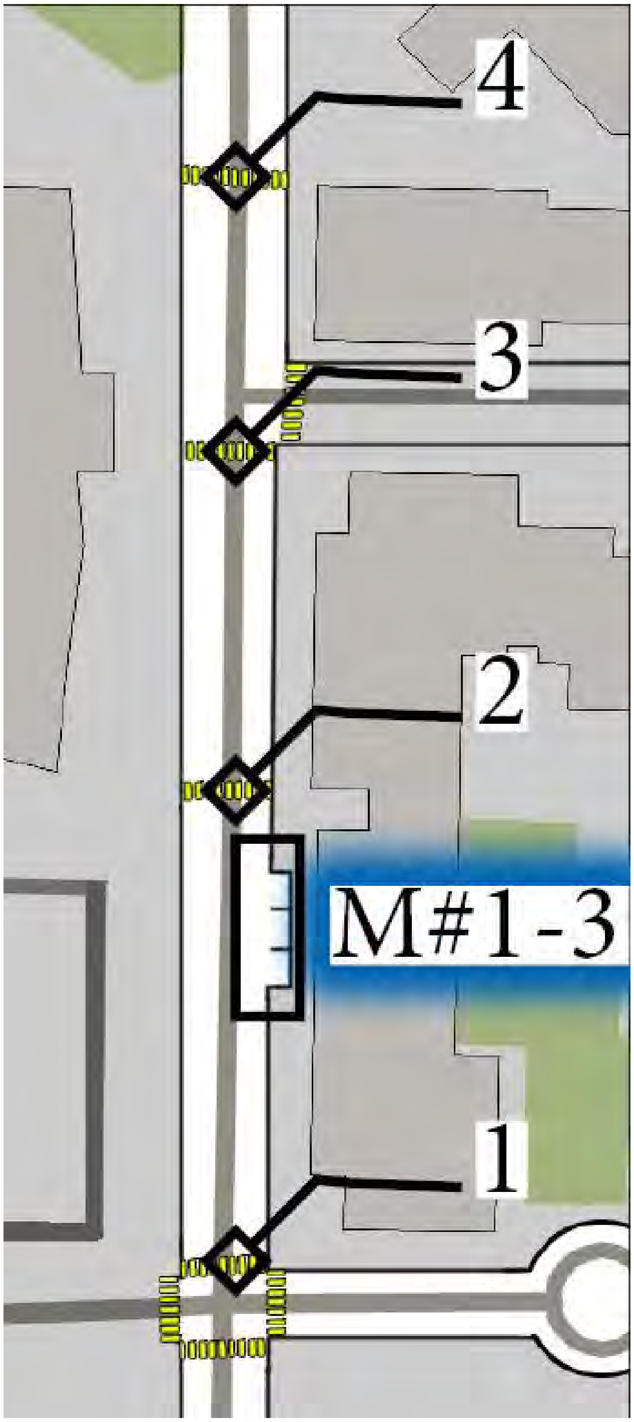

Figure 21 Location of Metered Spaces

Of the 58 exchanges that occurred on Nedderman Dr., seven of these exchanges happened in the metered/parallel parking spaces. The majority of the time, at least one of these spaces stayed empty and allowed for an exchange to happen. Seventeen percent of the time, when space was available, the exchange happened in the street next to the space. The seven times that exchanges happened near this site, five happened inside one of the spaces, and two occurred in the street directly next to these metered spaces. On one of those occasions, all three spaces were occupied with parked cars preventing an exchange, and on the other, a passenger was exchanged in the street next to open space (Table 9). This exchange caused a backup of three cars as the passenger unloaded some items.

Space number	Space available	Space Used	Vehicle direction	Exchange type
3	Yes	Yes	North	Drop-off
2	No	No	North	Drop-off
1	Yes	No	North	Drop-off
1	Yes	Yes	North	Drop-off
2	Yes	Yes	South*	Pick-up
1	Yes	Yes	North	Pick-up
3	Yes	Yes	North	Drop-off

Table 9 Metered Space Data **Car made U-turn to enter space*

Observations revealed that these spaces were being used, and they did give a safe space for exchanges to occur; however, it was difficult for vehicles to get in and out and required considerably more time for exchanges. Exchanges outside of the spaces were quick, especially on drop-offs where a passenger could get out of a vehicle almost unnoticed. Design considerations will require not only safety measures but places where longer exchanges can happen as with loading or unloading of items along with the passenger.

4.2.2 Greek Row Fire Lane

This area is located at the end of Greek Row just south of CAPPA and extends to the east from Nedderman Drive. The fire lane bisects the south end of CAPPA and the Smart Hospital Figure 22. The Fine Arts building and Music Hall at the corners of the terminus incorporates a plaza between the two before rising in a stairway that allows pedestrians to cross over the top of

South Cooper Street to the east with the use of a pedestrian bridge. This bridge connects the east and west sides of the UTA campus and is heavily traveled by pedestrians.

At the Greek Row fire lane turn around, there were 74 exchanges comprised of 26 pickups and 48 drop-offs (Table 10). This area functioned very well as an exchange for rideshare and almost seemed to be designed for this function. There were no observed disruptions to traffic flow or safety as the majority of vehicles that entered this space were exchanging passengers, and those that did not exchange passengers simple entered, turned around, and then exited the area. Drivers were very attentive to pedestrian activity and slowed down upon entering. Pedestrians moving through the space were easily seen and moved around the space rather than attempting to mix with traffic. As with crosswalks on Nedderman Dr., the vast majority of vehicles exchanged passengers as close as possible to the rider’s intended point of arrival or departure. This area also provided places for vehicles to park at the top (east) of the turn around allowing cars to wait for passengers or in accommodation of loading and unloading items. There were three spots within this area where these exchanges happened, as identified in Figure 23.

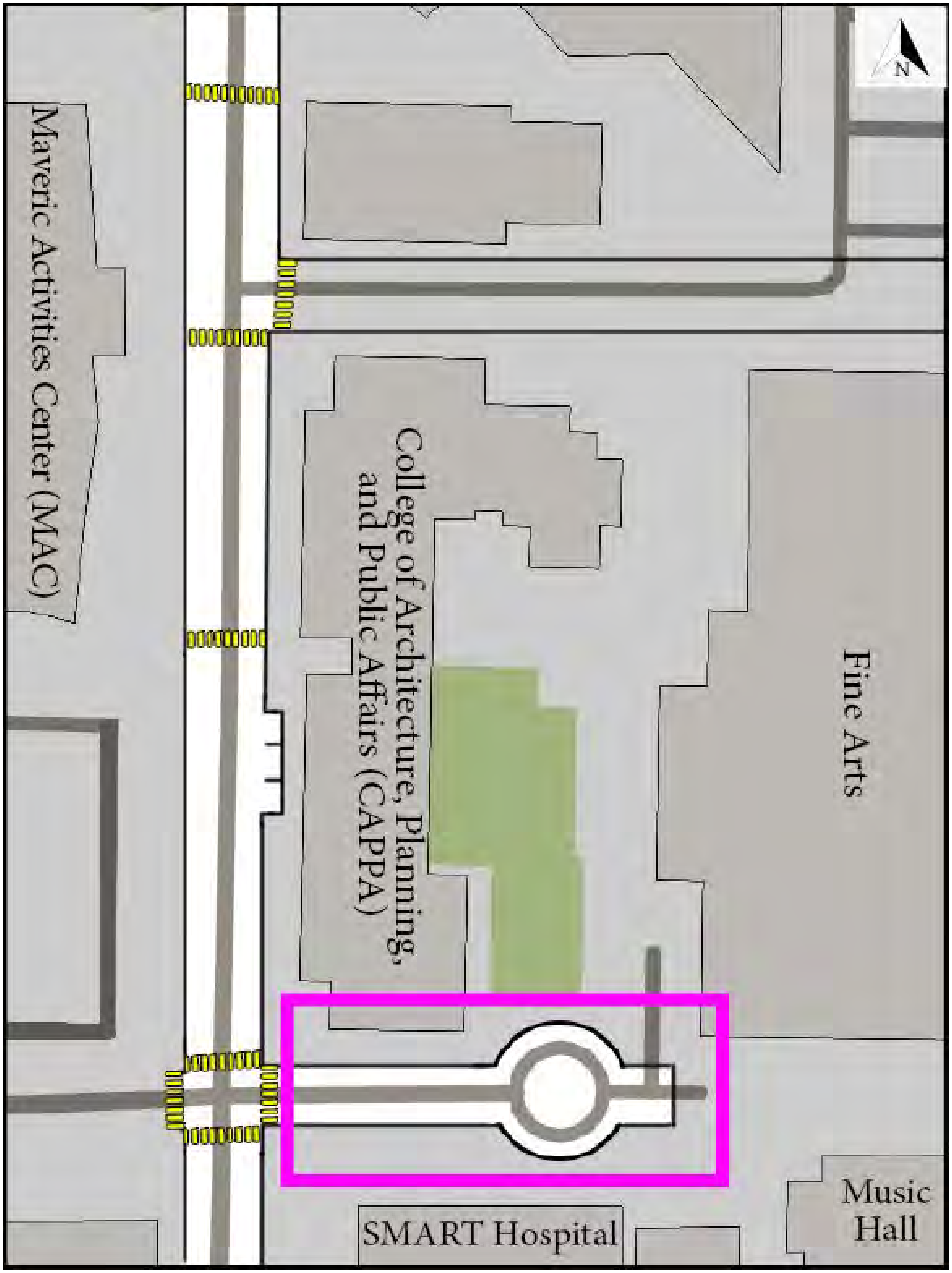

Figure 22 Greek row Fire Lane Context Map

Stop number	Exchange type	Passenger direction
1	Drop-off	East
1	Drop-off	East
1	Drop-off	East
1	Drop-off	East
1	Drop-off	East
1	Drop-off	East
1	Drop-off	East
1	Drop-off	East
1	Drop-off	East
1	Drop-off	East
1	Drop-off	East
1	Drop-off	East
1	Drop-off	East
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1	Drop-off	East
1	Drop-off	East
1	Drop-off	East
1	Drop-off	East
1	Drop-off	East
1	Drop-off	East
1	Drop-off	East
1	Pick-up	West
1	Pick-up	West
1	Pick-up	West
1	Pick-up	North
1	Drop-off	East
1	Pick-up	North
1	Drop-off	East

1	Pick-up	West
1	Pick-up	West
1	Pick-up	North
1	Pick-up	West
1	Drop-off	East
1	Pick-up	Southeast
1	Drop-off	East
1	Pick-up	West
1	Pick-up	West
1	Pick-up	West
1	Pick-up	West
1	Pick-up	West
1	Pick-up	West
1	Drop-off	West

Table 10 Greek Row Data

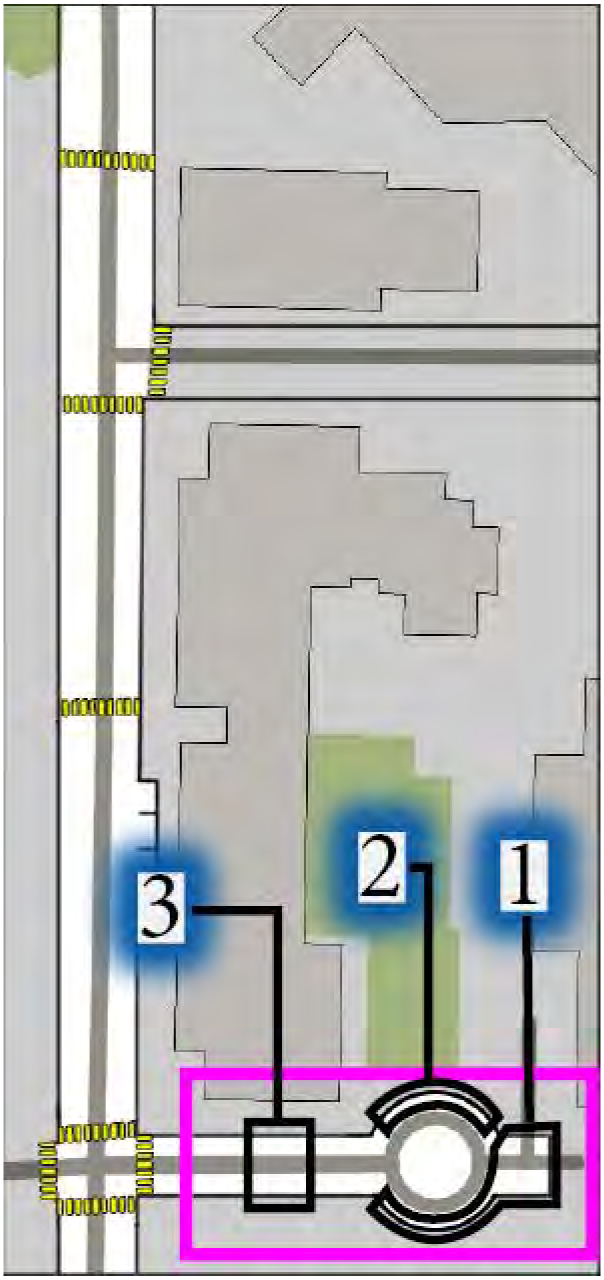

Figure 23 Greek Row Stop Locations

4.2.2.1 Stop 1

The first and most common passenger exchange location was this stop that included the top of the fire lane and area south, as seen in Figure 23. This area was selected as the majority of rideshare activity at this location moved toward or originated from the east. Of all the observed exchanges, both on Nedderman Dr. and Greek Row 43% would happen at Stop 1 and 93% of those riders were either coming from or going toward locations to the east. There was a total of 57 exchanges observed at this spot. Forty of those exchanges were drop-offs and 17 pickups as displayed in Table 11. This location also had space for cars to park when waiting for pickups. There were three rideshare exchanges at this location that were observed waiting more than 7 minutes for their riders at 7, 43, and 51 minutes as displayed in a complete data table in Appendix B. This location provides an excellent example of how rideshare exchanges could look in the future. There are places to park and wait for passengers and lots of amenities like seating, and shade as displayed in Figures 24, 25, and 26.

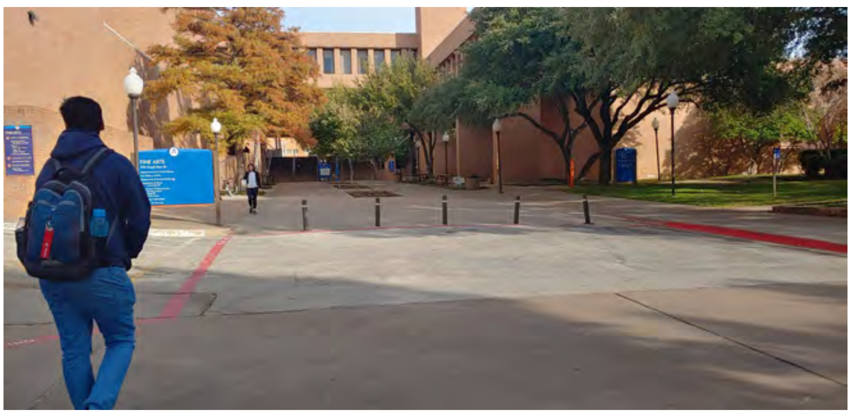

Figure 24 Greek Row Stop 1 facing east

Figure 25 Greek Row Stop 1 facing west

Figure 26 Greek Row Stop 1 facing north

Stop number	Exchange type	Passenger direction
1	Drop-off	East
1	Drop-off	East
1	Drop-off	East
1	Drop-off	East
1	Drop-off	East
1	Drop-off	East
1	Drop-off	East
1	Drop-off	East
1	Drop-off	East
1	Drop-off	East
1	Drop-off	East
1	Drop-off	East
1	Drop-off	East
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1	Drop-off	East
1	Drop-off	East
1	Drop-off	East
1	Drop-off	East
1	Drop-off	East
1	Pick-up	West
1	Pick-up	West
1	Pick-up	West
1	Pick-up	North
1	Drop-off	East
1	Pick-up	North
1	Drop-off	East
1	Pick-up	West
1	Pick-up	West
1	Pick-up	North
1	Pick-up	West
1	Drop-off	East
1	Pick-up	Southeast
1	Drop-off	East
1	Pick-up	West
1	Pick-up	West
1	Pick-up	West
1	Pick-up	West
1	Pick-up	West
1	Pick-up	West
1	Drop-off	West

Table 11 Greek Row Stop 1 Data

4.2.2.2 Stop 2

This location was in the north part of the circle (Figure 23), where five passengers were dropped off, and three passengers were picked up for a total of eight exchanges. Exchanges at this location (Figure 27) interfaced with the CAPPA courtyard as passengers quickly emerged from or into that space (Table 12). From the observation spot at the corner of Nedderman and Greek Row, it was often difficult to see how or if passengers were even exchanged. When there was a question, the data was removed from the dataset.

Figure 27 Greek Row Stop 2 facing north

Stop number	Exchange type	Passenger direction
2	Drop-off	North
2	Drop-off	North
2	Drop-off	North
2	Drop-off	North
2	Drop-off	East
2	Pick-up	South
2	Pick-up	South
2	Pick-up	Southwest

Table 12 Greek Row Stop 2 Data

4.2.2.3 Stop 3

Nine passengers were seen using this location as three were dropped off, and six were picked up. These passengers were exchanged curbside outside the fire lane circle directly in front of the door of CAPPA on the south (Figure 23). The covered space outside of the entry, as well as the building, provided protection from the elements (Figure 28). Exchanges observed here were very efficient as drivers and passengers quickly found each other. Three of these exchanges happened on the south side of the lane, which riders crossed the fire lane to get to their rides (Table 13). In these three exchanges, there was no issue of safety; however, if the riders had waited for the driver to make the turnaround before entering the vehicle, they could have been picked up without crossing into the fire lane.

Figure 28 Greek Row Stop 3 facing north

Stop number	Exchange type	Passenger direction
3	Drop-off	North
3	Drop-off	North
3*	Pick-up	West
3	Pick-up	South
3	Drop-off	South
3	Pick-up	South
3*	Pick-up	South
3*	Pick-up	West
3	Pick-up	South

Table 13 Greek Row Stop 3 Data
**Opposite side of the street*

4.2.3 Observation Data General Findings

The observations of the Greek Row Fire Lane helped gain a better understanding of how rideshare exchange activities performed. From these observations, the following findings will help to establish guidelines to be considered in the recommendation of dedicated rideshare exchange sites:

- Passengers want to be exchanged as close as possible to points of arrival/destination.
- Designated space for rideshare exchanges would help to alleviate traffic congestion.
- Designated space for rideshare exchanges would help make streets safer for drivers, riders, pedestrians, and others sharing the road.
- The orientation of the rideshare exchange approach is essential in limiting pedestrian/car interactions in consideration of traffic and safety.
- Rideshare exchanges usually happen very quickly, but space should be allocated for more extended exchanges to accommodate the loading and unloading of items.
- New rideshare infrastructure should look to replace parking revenue with the use of metered charge or geofence for vehicles conducting rideshare exchanges within a specified zone.

4.2.3.1 Crosswalk Observation Findings

- The orientation of rideshare exchanges is essential in limiting the necessity for the use of a crosswalk, which adds to safety by limiting pedestrian/car interactions.
- The area one space just before or after a crosswalk is where 92 percent of rideshare exchanges were observed when crosswalks are present.
- When rideshare exchanges happen 1 or more car lengths from a crosswalk, riders do not use the crosswalk.
- Exchanges that happen before a crosswalk are twice as likely to use that crosswalk than those exchanges that happen after.
- Proximity to crosswalks should be considered in the design of rideshare exchange sites.
- Rideshare exchanges at crosswalks happen quickly, usually before the car is able to breach the crosswalk due to use by pedestrians.

4.2.3.2 Metered/Parallel Observation Findings

- The use of a parallel parking space slows the rideshare exchange time as drivers negotiate parking.
- Exchanges made within a space are much safer than a double park and allows for loading and unloading.
- Parking spaces provide a place for rideshare cars to park and wait for passengers.
- Even when space is available in parallel parking, it is not used 17% of the time.
- Parking spaces encourage the proper orientation of rideshare exchanges.

4.2.3.3 Fire Lane Turn-Arounds Observation Findings

- Fire Lane Turn-Arounds discourage through traffic as there is no place for drivers to go other than turning around.
- Fire Lane Turn-Arounds provide an injection from the street that can provide service to multiple destinations.
- Fire Lane Turn-Arounds could reduce infrastructure associated with full service through streets.
- There is no need for crosswalks as riders always have the opportunity to get out on the right side of the street as the rideshare vehicle turns-around and returns to the desired stop.
- Fire Lane Turn-Arounds can accommodate lengthy duration exchanges without disruption to traffic.
- Vehicles entering fire lane turnarounds are very aware of pedestrians making for a safer place.
- Fire Lane Turn-Arounds interface nicely with a variety of uses, including building frontage and entrances, plazas and courtyards, sidewalks, parking.
- Fire lane turn arounds can provide access to more buildings while using less space.

4.2.4 Summary of Observation Findings

The primary understanding and lesson learned in this research are that every situation is different. In the literature, there were recommendations of SUM zones and methods utilizing geofencing to accommodate rideshare; however, there were none found that would seem to suit the conditions of the areas observed at UTA. Understanding and careful observation is the key to sound recommendations and, as with most design, and there is no one-size-fits-all solution. The aforementioned observational findings should be considered when recommending designated stops for rideshare exchanges, and are applied as recommendations in the next chapter.

4.3 Survey Data

Survey data was collected from pedestrians near the intersection of Nedderman Dr. and Greek Row. Seven questions were asked, and twelve scenarios prompted respondents to indicate paths or locations on a diagrammatic map. These questions are displayed in Figures 29 – 35, and scenarios are addressed in the methodology section as displayed in Figures 5, 6 and 7.

4.3.1 Survey Questions

From the survey questions, all participants claim to use rideshare at least once per month (Figure 29). Not surprisingly, Uber and Lyft ranked highest (Figure 30). Respondents indicated that shopping and a night out were the biggest reasons for taking rideshare at 92% and 83%, respectively, with only 25% indicating that they used the services for commuting to work or school (Figure 31). Interestingly, there were 50% indicating that they used rideshare because they simply did not own or have access to a car (Figure 32). Generally, respondents are happy with rideshare as 58% indicated that they saw no problems with rideshare or did not produce a response (Figure 33). Of those that indicated problems associated with the rideshare pickup location, finding their car was indicated most. High marks were given to all four considerations of convenience, availability, safety, and traffic from highest to lowest (Figure 34). When answered, the two most equally important considerations were safety and the driver being in the right place (Figure 35).

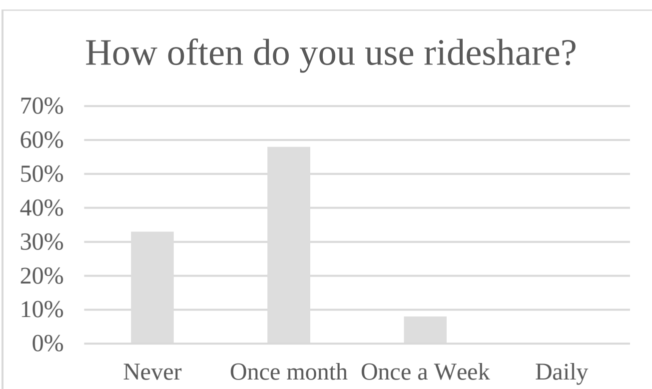

Figure 29 Survey Question 1

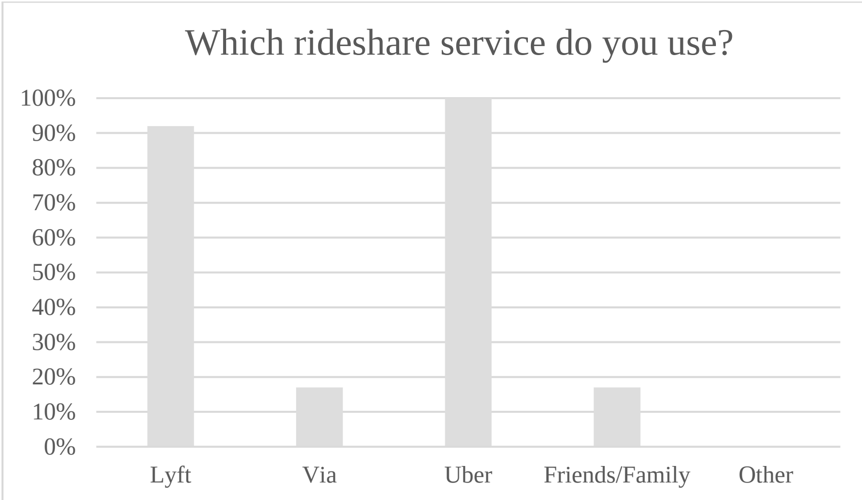

Figure 30 Survey Question 2

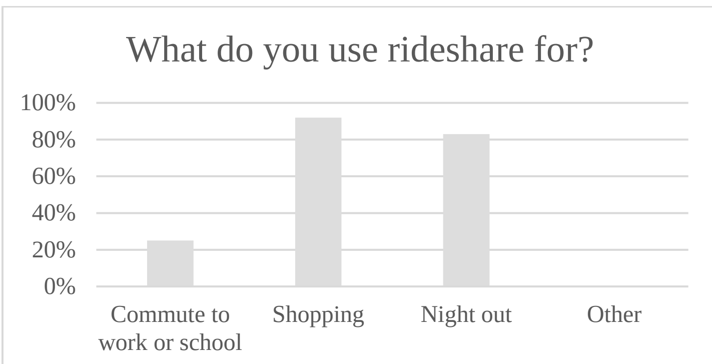

Figure 31 Survey Question 3

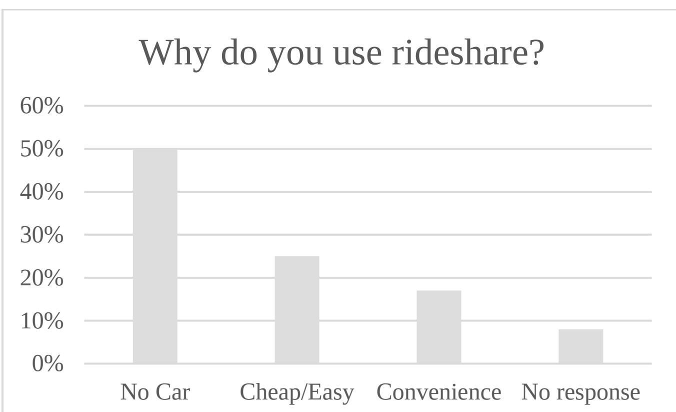

Figure 32 Survey Question 4

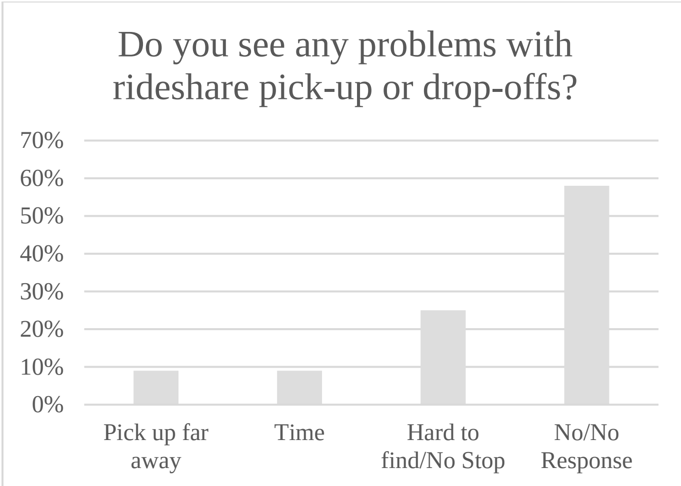

Figure 33 Survey Question 5

Figure 34 Survey Question 6 **average mean score*

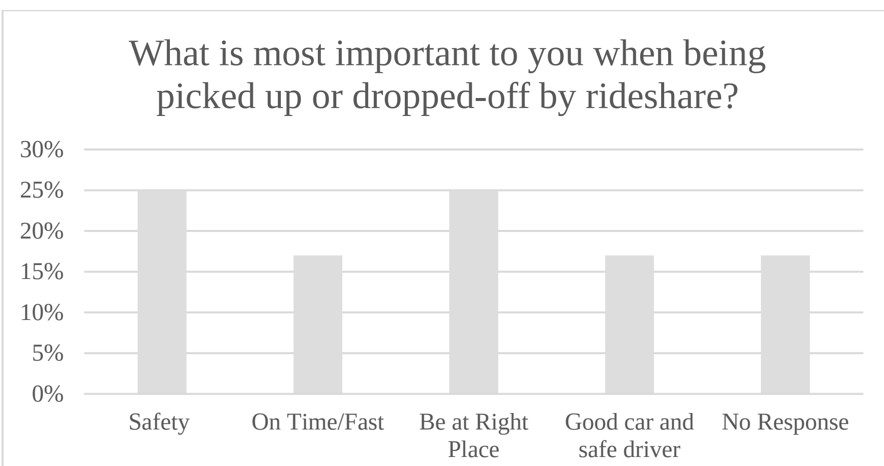

Figure 35 Survey Question 7

4.4 Data Synthesis

There were several challenges and issues with synthesizing the data. After conducting both survey and observational studies, certain limitations were identified in the usefulness of the survey data compared to the observational studies. If the study was to be conducted again, more attention would be paid to the possible connections between the two data sets in their design, or to simply remove the survey data altogether, as it yielded little information for comparative purposes. There were, however, several aspects of each data set that reinforced one another. The similarities were that all participants, without fail, indicated on survey scenarios that they would want to be picked up and/or dropped off as close as possible to their destinations. However, a departure in the way in which respondents indicated they would make their way on foot was slightly different as everyone's response to scenarios used the crosswalk. This may be attributed to the fact that the cost in the effort of writing with a marker on a survey is less than actually taking the extra steps. This may also be attributed to observation without knowledge of being observed as opposed to participating in a survey conducted in front of another person.

CHAPTER FIVE: CONCLUSION AND RECOMMENDATIONS

5.1 Introduction

The intent of this study was to understand how rideshare fits into the current infrastructure of The University of Texas at Arlington. When considering how rideshare will change the way in which we interface with our destinations, rideshare continues to transform our world. The observation and survey data helped to gain a better understanding of how people are using rideshare technology today. The understanding presented in the collected data is simply a starting point to add to the conversation, as planners and landscape architects move forward in making space for rideshare on our campus and in our cities. However, much more research needs to be done as this thesis looks only to identify a problem and hopes to inspire others to think further of a new future where people begin to see and utilize Mobility as a Service (MaaS).

Through observational studies and survey data collected, there were several things that guided the recommendations and considerations of rideshare in the future. When recommending a place for rideshare exchanges, it is essential to remember the lessons learned from this study. The driving questions asked for this research organized the literature review as well as providing for a common thread and an element of continuity. The author will again restate these questions as the conclusion begins:

> How will rideshare and autonomous technologies change the way in which we interface with our destinations?
>
> What infrastructure will need to change to accommodate rideshare and autonomous vehicles?

An ongoing conversation that addresses these two questions should be promoted by landscape architects and planners intersectionally within their own industries, and through interdisciplinary thinking with other disciplines and the public at large. A continual reassessment of where we are and where we would like to go should be expressed in comprehensive master plans, site design standards, land use, transportation planning, and environmental services, as rideshare and autonomous technologies continue to develop and change our world. The way in which we interact with our destinations will change as we make the transition from leaving our cars at the parking lot, to them leaving us at the curb. This could save time, money, and the environment as the efficiencies of autonomy and rideshare are passed on to the consumer. This could also be the beginning of the end of privately-owned vehicles, as people begin to see Mobility as a Service (MaaS). However, this future could take an alternate path as the cost of transportation in time and money is lessened, it could increase Vehicle Miles Traveled (VMT), urban sprawl, and traffic congestion, thereby becoming negative externalities of our new transportation future. This and other unintended consequences should be anticipated and guided by planners and landscape architects in the attempt for a better and more sustainable transportation system.

Today, we do not have the proper infrastructure to accommodate even the modest amount of rideshare exchanges that are being seen at the curb. The existing infrastructure of concrete, politics, and public opinion will need to be transformed to pave the way for a future of less parking and more parks. A wait-and-see attitude could leave our cities to be redesigned in an ad hoc manner. Responsibility rests on the planner and landscape architect to preempt these infrastructure strains, as we negotiate this road that has not yet been traveled. Through the research findings, the author was able to make sound recommendations to the area studied. These recommendations are broken down into the three distinct categories where rideshare exchanges were observed. These categories are crosswalks, metered/parallel parking spaces, and fire lane turn arounds. These findings and recommendations support only what was discovered within the scope of this study, and does not advocate for a one size fits all application. However, the methods applied and consideration of findings should assist in developing recommendations of rideshare infrastructure at other sites, not only at UTA, but beyond.

5.2 Recommendations

It is essential to keep in mind that the changes we make to our infrastructure must consider future needs. We will need to adapt our current infrastructure in a way that will not require retrofitting again in 5, 10, or 20 years. If possible, they must grow alongside these new technologies. Therefore, the element of scalability is crucial to the design thinking, and as a means to plan for reclaiming space as the virtual obsolescence of parking is realized. Further observational studies in different settings can help to establish guidelines for uses beyond the UTA campus. From these research findings, recommendations will be made for the three categories that include crosswalks, parallel parking spaces, and fire lane turn arounds. Recommendations of this research may contradict with current transportation planning but are recommended from the rideshare perspective. Always refer to governing regulations and standards before implementing a place for rideshare exchanges.

5.2.1 General Guidelines

When making recommendations on rideshare exchange locations, to be applied to the observed study area on Nedderman Drive and Greek Row at UTA, general guidelines were established. These guidelines are based on the findings in Chapter 4 to help develop the recommendations for accommodating rideshare exchanges. These guidelines should be considered on all types of rideshare exchange stops as they have broad implications. Specific guidelines for crosswalks and fire lane turn arounds are presented in the subsequent sections, under their respective headings. Further research should be done to understand the exact dimensions, placement, signage, markings, acceptance, and policy of the recommended rideshare exchange stops but is beyond the scope of this study. However, these guidelines may be used by landscape architects, planners, and others in the attempt to accommodate rideshare in their own areas of study as a starting point in making space for exchanges.

In recommending rideshare exchange locations, it is essential to remember that one size does not fit all sites or applications. Site-specific observational studies should be conducted. These guidelines apply to all categories observed within this study and are presented below:

- Locate rideshare exchange points as close as possible to building entries.
- Place rideshare exchanges where they will have minimal impact on traffic.
- Consider safety for drivers, riders, pedestrians, and others sharing the road.
- Promote the proper orientation of rideshare approaches.
- Provide places where riders can load and unload cargo.
- Consider the replacement of revenue lost in parking with geofence or spaces with scanning meters that charge by the minute, therefore, encouraging quick exchanges.

5.2.2 Crosswalks on Nedderman

On Nedderman Drive, crosswalks were observed and identified as natural stopping points for rideshare exchanges. However, crosswalks are not always safe, and pedestrian/vehicle interaction should be lessened when possible. The observational study revealed when riders are dropped off on the opposite side of the street from their destination, the use of the crosswalk is often ignored and even more so when the exchange takes place either after or several spaces away from a crosswalk. Proper approach and planning ahead can prevent the need for passengers to use crosswalks as riders get out on the right side of the street. This practice should be encouraged with drivers, passengers, and companies providing rideshare services.

Rideshare exchanges should continue to be associated with existing crosswalks as they are the safest option, and their close relationship promotes the use of the crosswalk but must be done correctly. This relationship also provides a natural stopping point where the time associated with rideshare exchange does not add to traffic congestion as vehicles wait for pedestrians to clear the crosswalk. By providing spaces narrower than a full parking space, exchanges just before crosswalks will act as traffic calming devices. This will help to slow traffic, encourage the use of crosswalks, and alleviate traffic congestion as observed with double parking.

5.2.2.1 Crosswalk Guidelines

In recommending locations for rideshare exchanges, findings in the observational study were considered as well as additional design considerations for overcoming issues of safety, traffic flow, policy, education, and economics. These guidelines apply specifically to exchanges at crosswalks and are presented below:

- Place the exchange stop for rideshare less than one space away from the crosswalk to promote the use of the crosswalk by riders.
- Place the exchange stop before the crosswalk and not after.
- Place exchange stops at building entries and pedestrian gateways.
- Exchange stops should be longer and shallower than a traditional parking space to promote a quick stop.
- Allow exchange stops to act as traffic calming devices such as chicanes.
- Provide signage that explains the purpose of the rideshare stop to all who are impacted by its use.
- Provide markings on the pavement to delineate the space from the rest of the road.
- Enforce current laws on double parking.

5.2.2.2 Crosswalk Recommendations

The recommend alterations to place rideshare exchange at crosswalks are displayed in Figures 36 and 37. These spaces, when placed less than one space before the crosswalk, promote the use of that crosswalk when needed. By encouraging those participating in rideshare to approach in the correct orientation, the need for the use of a crosswalk by passengers could be greatly reduced. These spaces are more shallow and longer than a traditional parking space and are intended to allow for an easy in and out of cars making exchanges. This also acts as a traffic calming device, making the crosswalk safer for everyone.

Figure 36 Plan View Crosswalk Recommendation

Figure 37 Crosswalk Recommendation Axonometric View

Proper signage instructing passengers and drivers as to the proper use of rideshare exchange will aid in understanding and acceptance of these exchange sites, as seen in Figure 38. The painted spaces will help other drivers identify this as a special-use area, as they become familiar with the practice. Low walls will prevent a pedestrian from accidentally crossing into the rideshare exchange stop and these walls will constrain the space between the car and the wall making the best option for riders to exit the space and use the associated crosswalk (Figure 38). More research should be conducted to determine what signage should be displayed and how paving should be marked and is only mentioned here, as the exact specifications are beyond the scope of this research.

Figure 38 Crosswalk Signage

Users will be allowed to load and unload without disruption to traffic, but still encourage quick exchanges as scanning meters charge users by the minute for occupying the space. This will help to replace revenue lost from traditional parking, especially when double parking is discouraged by enforcement of the law.

5.2.3 Parallel Parking on Nedderman

On Nedderman Drive, the three parallel parking spots looked to be an excellent place for rideshare exchanges. These spaces were used in this manner, but entry into the space required more time parking than a quick stop at the curb to exchange a passenger. Therefore, these spaces were used by people who loaded/unloaded cargo or waited extended periods of time for passengers. The recommendations for the use of crosswalks with lengthened and shallow spaces are a hybrid of the crosswalk, and parallel parking spaces observed combine the strengths of both. Parallel exchange spaces could continue to accommodate extended waiting as well as loading and unloading and even electric vehicle charging. These spaces could also accommodate accessible parking for handicapped riders and those with special needs.

5.2.4 Fire lane on Greek Row

The fire lane turn-around on Greek row was observed as a hotspot for rideshare activity and functioned very well for that purpose. This space serviced an extensive area as passengers were seen interacting with CAPPA, the SMART Hospital, Music Hall, the Fine Arts Building, and crossing the pedestrian bridge to the other side of campus. This infrastructure limits through-traffic that is not conducting rideshare, as there is no little need for a car to visit other than for the purposes of rideshare. Regulations differ from city to city on the use of fire lanes by vehicles other than emergency services. Whether or not fire lanes should be used in this way is not the subject of this research or part of its scope. What is essential is understanding that this type of infrastructure could serve as a model for providing space for rideshare. There is also the potential to provide for a fire lane to accommodate emergency vehicles with a lane for rideshare offset to the outside that provides a new space for rideshare without disrupting emergency access (Figure 39).

As places for rideshare develop, these spaces should be designed for people. For rideshare stations to exist and be successful, people will need to find the settings useful, comfortable, safe, functional, and even beautiful. These places should be able to facilitate a variety of vehicles as the delivery of passenger and parcel are accommodated, as well as access and space for service vehicles. As we make the transition from gas to electric vehicles, these spaces may not only be an optimal place to wait for a passenger, but also space to charge electric vehicles.

5.2.4.1 Fire Lane Turn Around Guidelines

These guidelines apply specifically to Fire Lane Turn Around within this study and are presented below:

- Fire Lane Turn-Arounds should discourage through traffic.
- Fire Lane Turn-Arounds should provide access to as many pedestrian entrances as possible.
- Fire Lane Turn-Arounds should look to replace traditional infrastructure by providing access without the need for a through street connection.
- Crosswalks should not be a part of fire lane turn around as exchanges should only occur on the right side of the street.
- Fire Lane Turn-Arounds should provide parking for extended wait times and opportunities for electric vehicle charging.
- Fire Lane Turn-Arounds should interface with a variety of uses, including building entrances, plazas, courtyards, sidewalks, and vehicle waiting.
- Fire Lane Turn-Arounds should provide a sense of place as they are the first and last opportunity to make a good impression.

5.2.2.2 Fire Lane Turn Around Recommendations

Through the observational studies, it was realized that this area was already used for rideshare exchanges and functioned efficiently and safely as such. Very little traffic enters this space for purposes other than rideshare exchanges. Pedestrian and car interaction is removed, as the rider has the opportunity to take the loop or wait for the car to arrive on the side of the turnaround where they are waiting, as displayed in Figure 39.

Figure 39 Fire Lane Recommendation Plan View

By expanding the area to preserve the dedicated space for emergency use, rideshare has a place for quick exchanges without impeding emergency vehicles, even when demand for rideshare is exceptionally high. People waiting for rideshare have a place be without encroaching on pedestrian flow. This designated exchange space allows for rideshare vehicles to load and unload as well as a place to wait for passengers. These spaces can also be serviced by electric charging stations. Riders are provided with shaded seating to wait comfortably for the service of their choice, or to be picked up by friends or family, as represented in Figure 40.

Figure 40 Fire Lane Recommendation Axonometric View

The use of the fire lane turn arounds could relieve pressure on roadways and accommodate for rideshare and delivery services, as well. This efficient use of auto infrastructure could lead to freeing more space for alternative uses as through streets are traded for fire lane turnarounds that access more buildings by using less space.

5.3 Potential Impact on Land Use

The section in which the study area sits is from UTA Boulevard to the north, just past Greek Row on the south, Cooper to the east, and extends to the west side of the Maverick Activities Center and displayed in Figure 41.

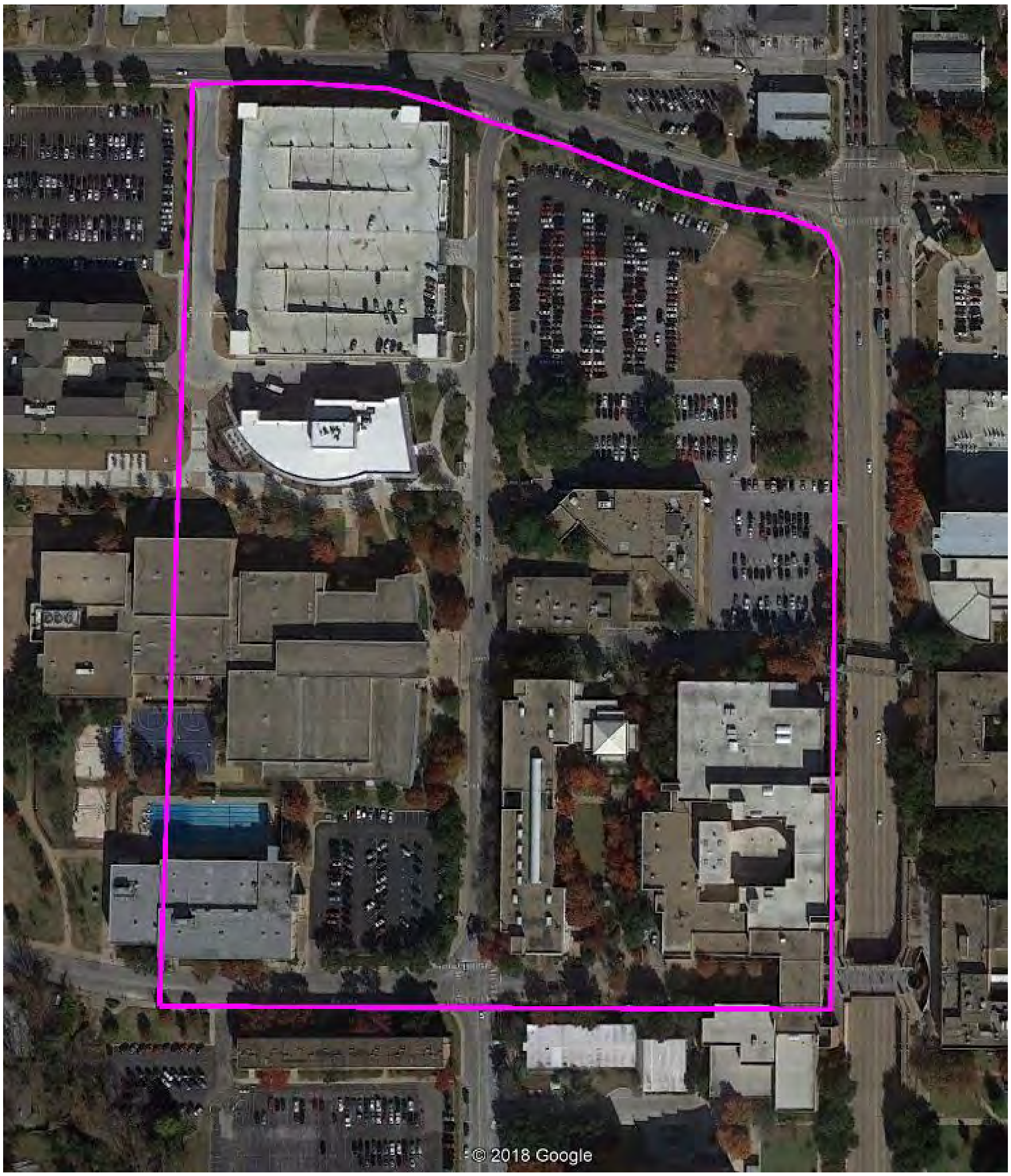

Figure 41 Expanded Study Area for Land Use Implications

This area is currently comprised of 29.33 acres, which currently includes of 10.3 acres of parking and road represented in black in Figure 42, 7.47 acres of building footprint represented in blue, and 11.56 acres of pedestrian accessible and greenspace represented in green.

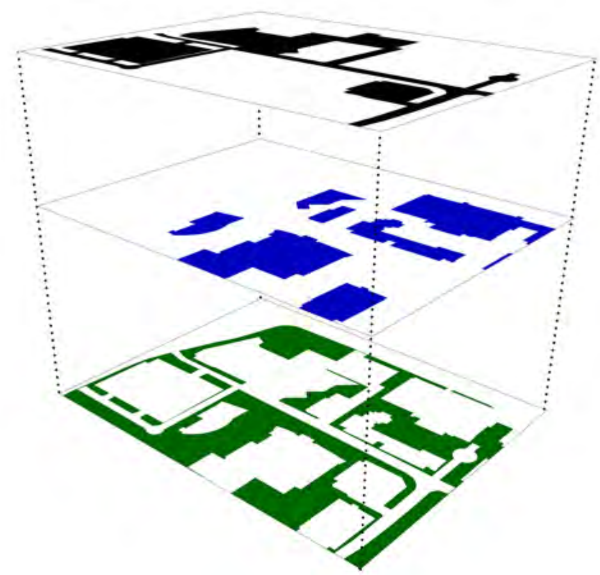

Figure 42 Exploded Land Use (Existing Conditions)

By implementing rideshare, infrastructure a new definition of this space can be realized on campus without the need for parking. In the new scenario represented in Figure 43, the 29.33 acres could be traded for a reduction of 67.96% of roads (black) at 3.29 acres, 72.23% increase in space for buildings (blue) at 12.87 acres, and a 13.97% increase in pedestrian and greenspace (green) at 13.18 acres.

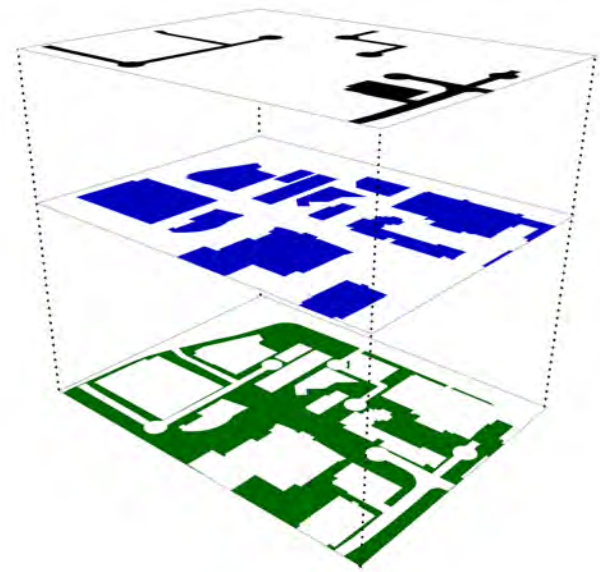

Figure 43 Exploded Land Use (Potential Conditions)

These calculations were determined by taking the image of the *expanded study area for land use implications* represented in Figure 42, to the raster graphics editor of Adobe PhotoShop and utilizing the Histogram feature to calculate the number of pixels represented, to the number of acres calculated in Google Earth. This researcher was then able to determine how many pixels per acre allowing for comparative analysis. Existing condition typologies were reflected in layers in PhotoShop and those totals were calculated in pixels per acres individually for roads, building footprints, and greenspace both in existing and proposed conditions (Figures 42, and 43).

As the need for parking diminishes, and new buildings are desired, lanes that inject in the same manner as the Greek Row fire lane can be placed north of the NanoTech Lab. Eventually, Nedderman Drive, from Greek Row to the entrance of the MAC, could be eliminated, and this space could be reclaimed as a pedestrian plaza. Parking that exists to the north, east, and southeast can be developed, and rideshare services can be accommodated in the same way as Greek Row. This infrastructure can be implemented in this manner as parking is reclaimed around UTA. This also translates well to development in our cities as there are many similarities in the way this infrastructure relates to what is currently in place. The application of these rideshare exchanges at crosswalks would be relatively easy to integrate into existing infrastructure. The example of the fire lane at the end of Greek Row has the potential to be applied in that way with relatively few additions and modifications.

5.4 Relevance to the Professions

5.4.1 Landscape Architecture

The relevance of rideshare exchange sites to the profession of landscape architecture and the development of rideshare and autonomous technologies exist in the design of the exchange sites themselves, as well as the potential for rediscovered space. Design considerations for rideshare exchange sites should be implemented as a part of normal master planning process and taught in Site Design classes in landscape architecture programs.

If the reduction of parking outpaces the need for new development, many of these spaces could serve as parks, open space, or environmental services such as stormwater management or even migratory stations for insects, birds, or other wildlife. Real estate development will only happen when there is a demand leaving much of this newly rediscovered space empty. As a result, landscape architecture is sure to see a boon to the development of space as unused parking will likely not sit idle in anticipation for development as the eventual removal of the impervious paving could reduce the Albedo and Urban Heat Island Effect.

5.4.2 City and Regional Planning

Planners will find relevance in the transition beyond parking as they look for ways to reallocate this rediscovered space and turn what was once used for parking into the highest and best use of that valuable resource. As stated before, planners need to act now to enact policy and set the pace of transition. A wait-and-see attitude on when and how technology develops is not planning; it is merely waiting and seeing. Municipalities must look to be proactive to help manage and develop this change. Small steps can be taken now through education and inclusion of this thinking in meetings, public outreach, and comprehensive master plans. Incorporation into comprehensive master plans needs to happen sooner rather than later. Ways in which to transition income once gained from parking need be explored as politics tied to economic considerations will likely give the most resistance.

5.5 Future Research

The need for future research is high. The research conducted as part of this thesis is merely a beginning step to spur conversation and inspire others to take the research further. Proving the concept of rideshare exchanges as well as an exploration of the policies, regulations, and politics will all need to be explored. How much space can be rediscovered? As parking is present in almost all built environments, is there a network of use or services that can benefit from this proximity and relatively even distribution of consistent physical condition? Could this be an opportunity for food security and sustainable communities in the practice of urban farming? There seems to be an endless list of questions to be answered by landscape architects and planners in pursuit of more sustainable stewardship of people, place, and planet.

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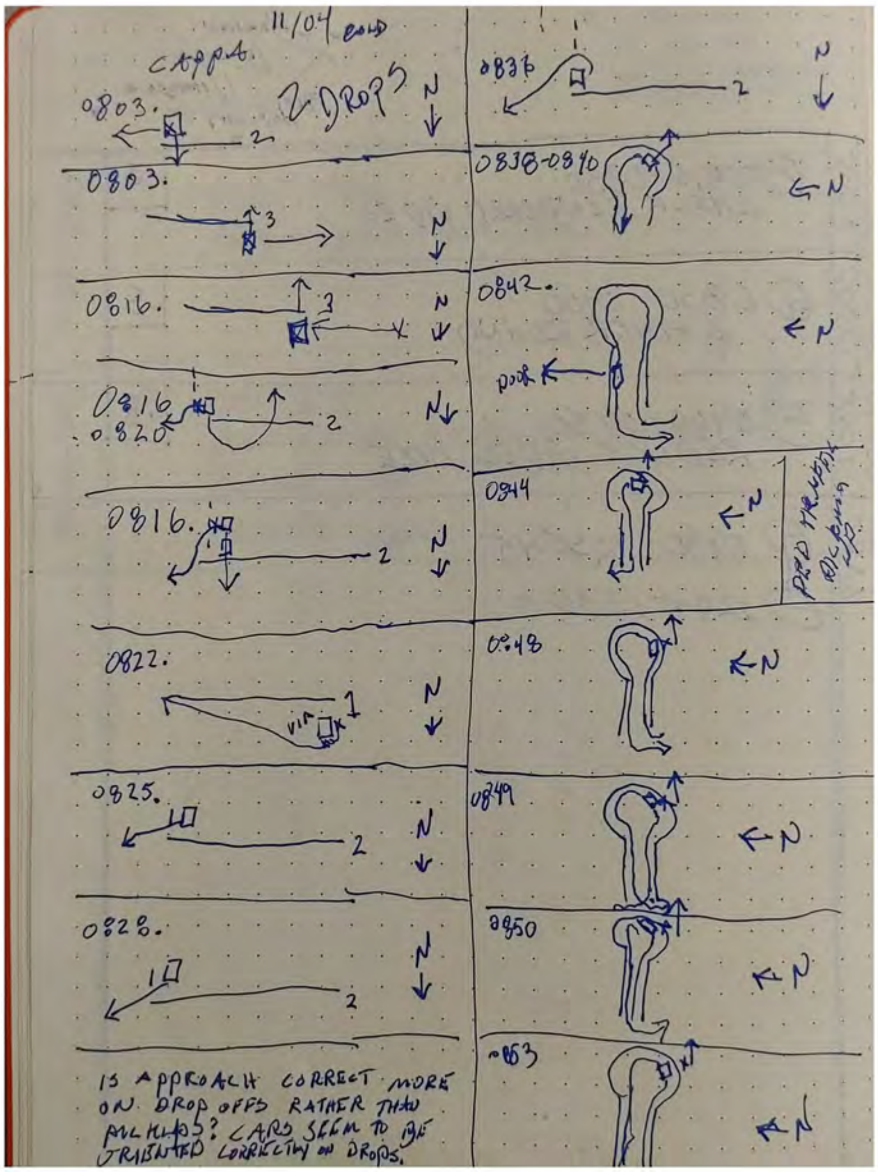
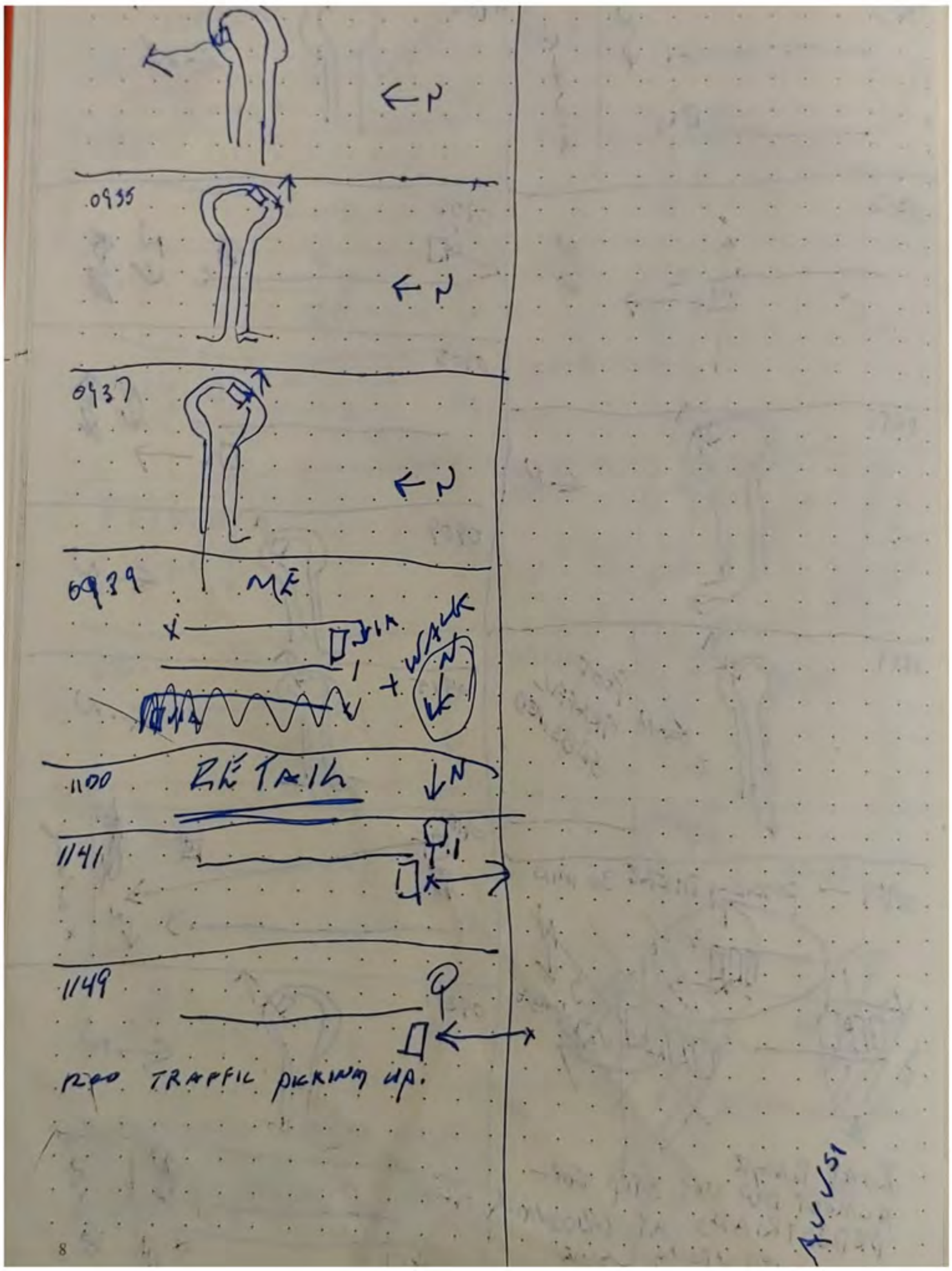
Appendices

Appendix A (Complete Observational Study Log and notes)

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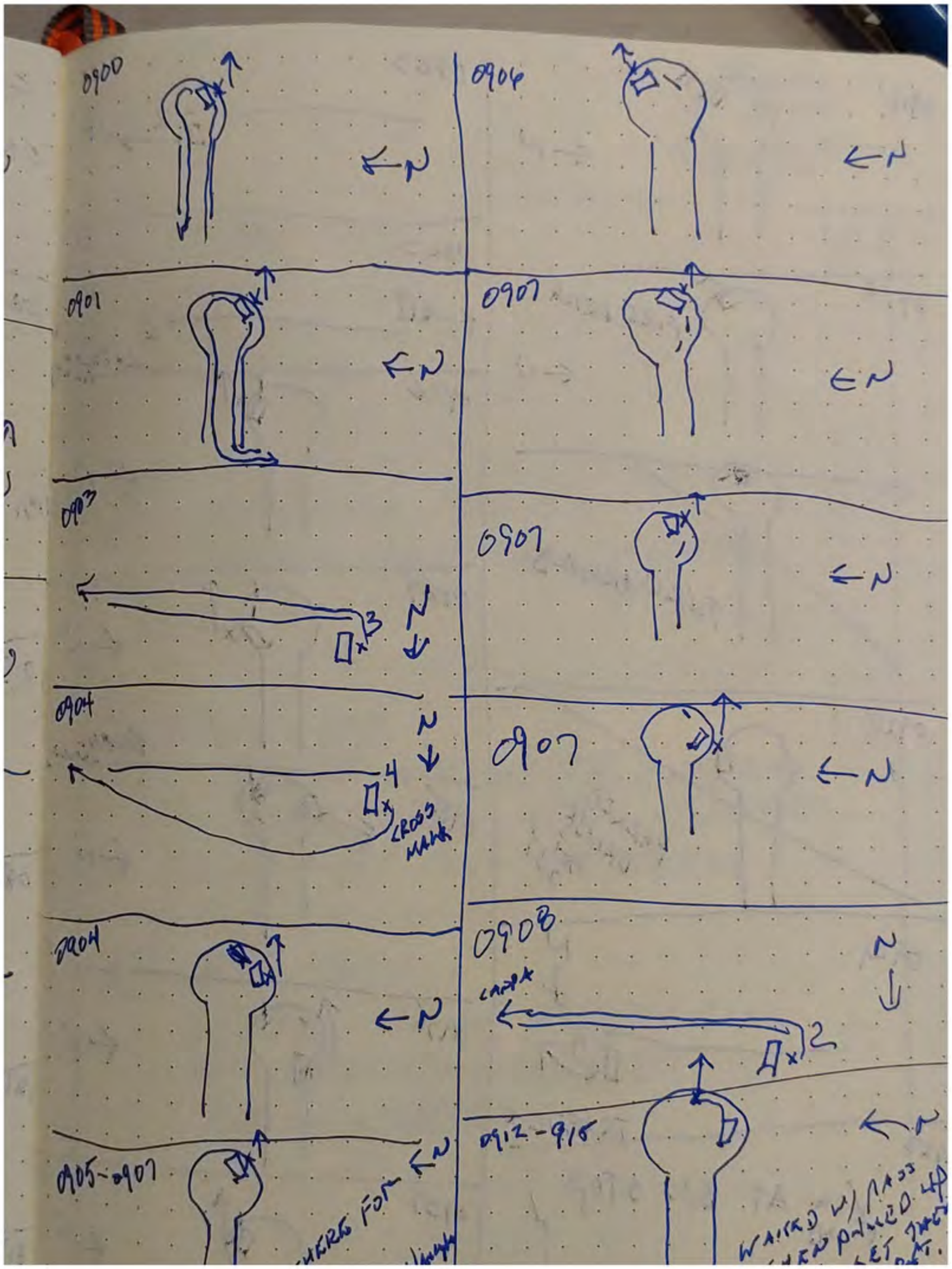
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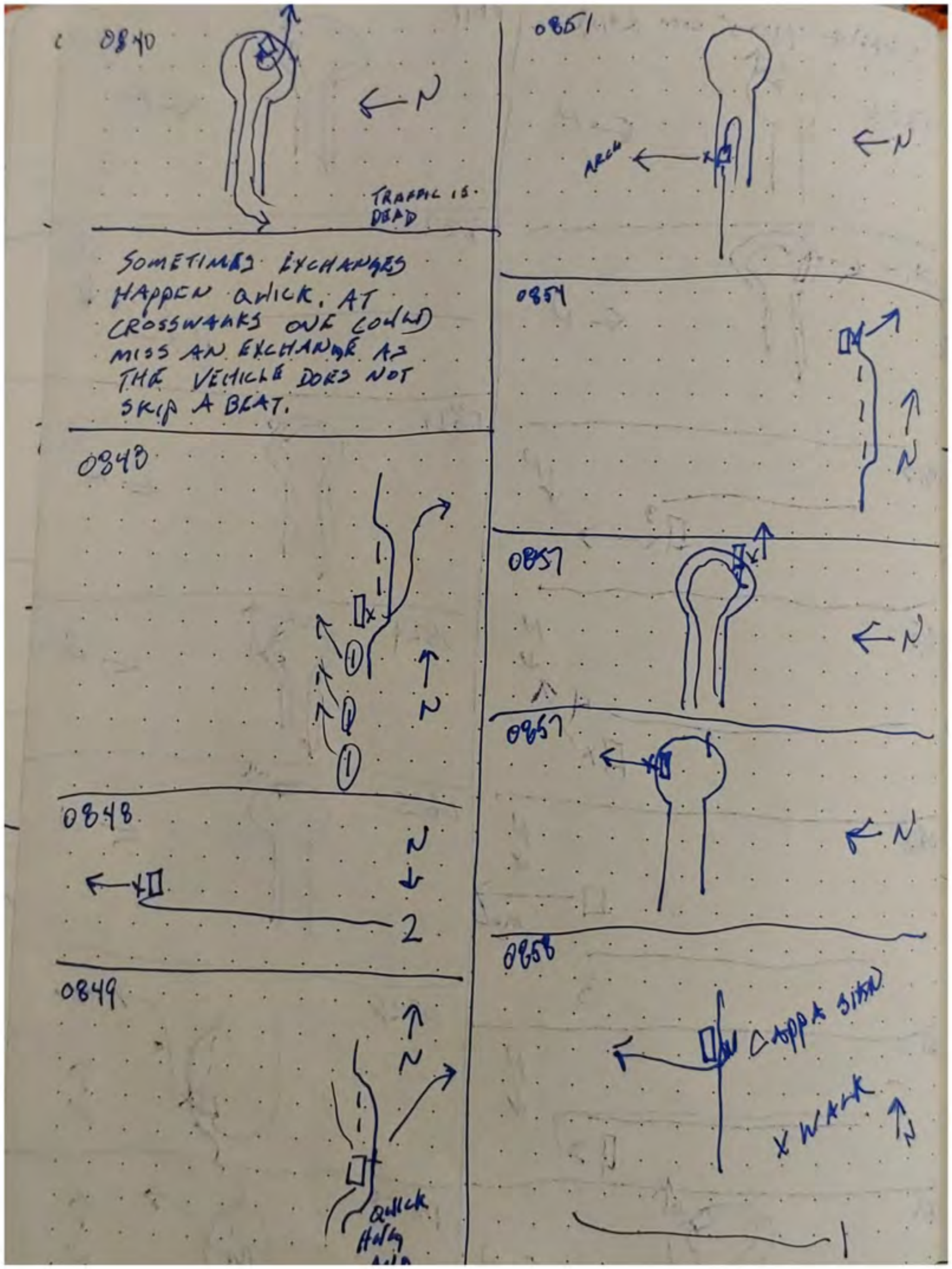
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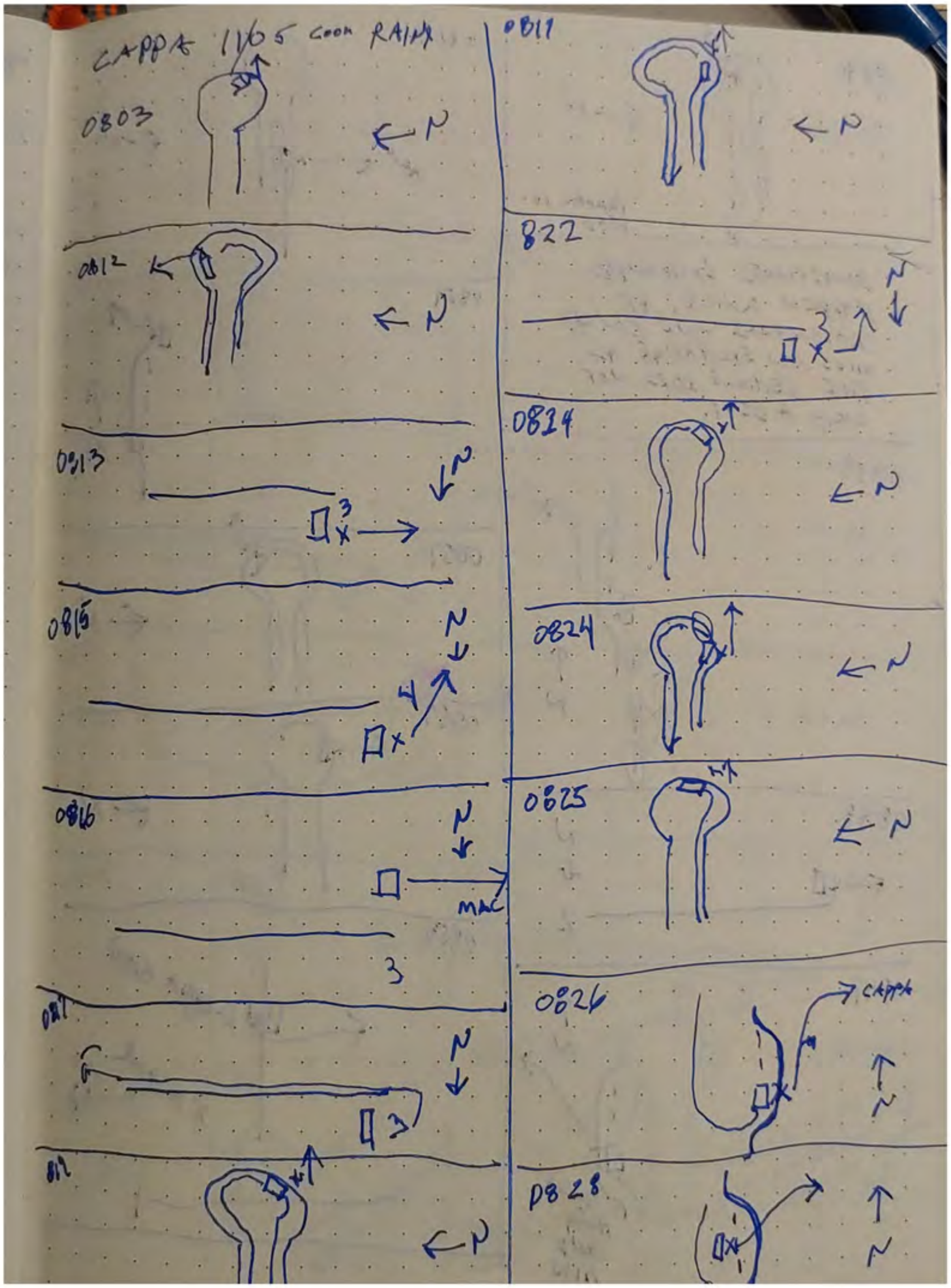
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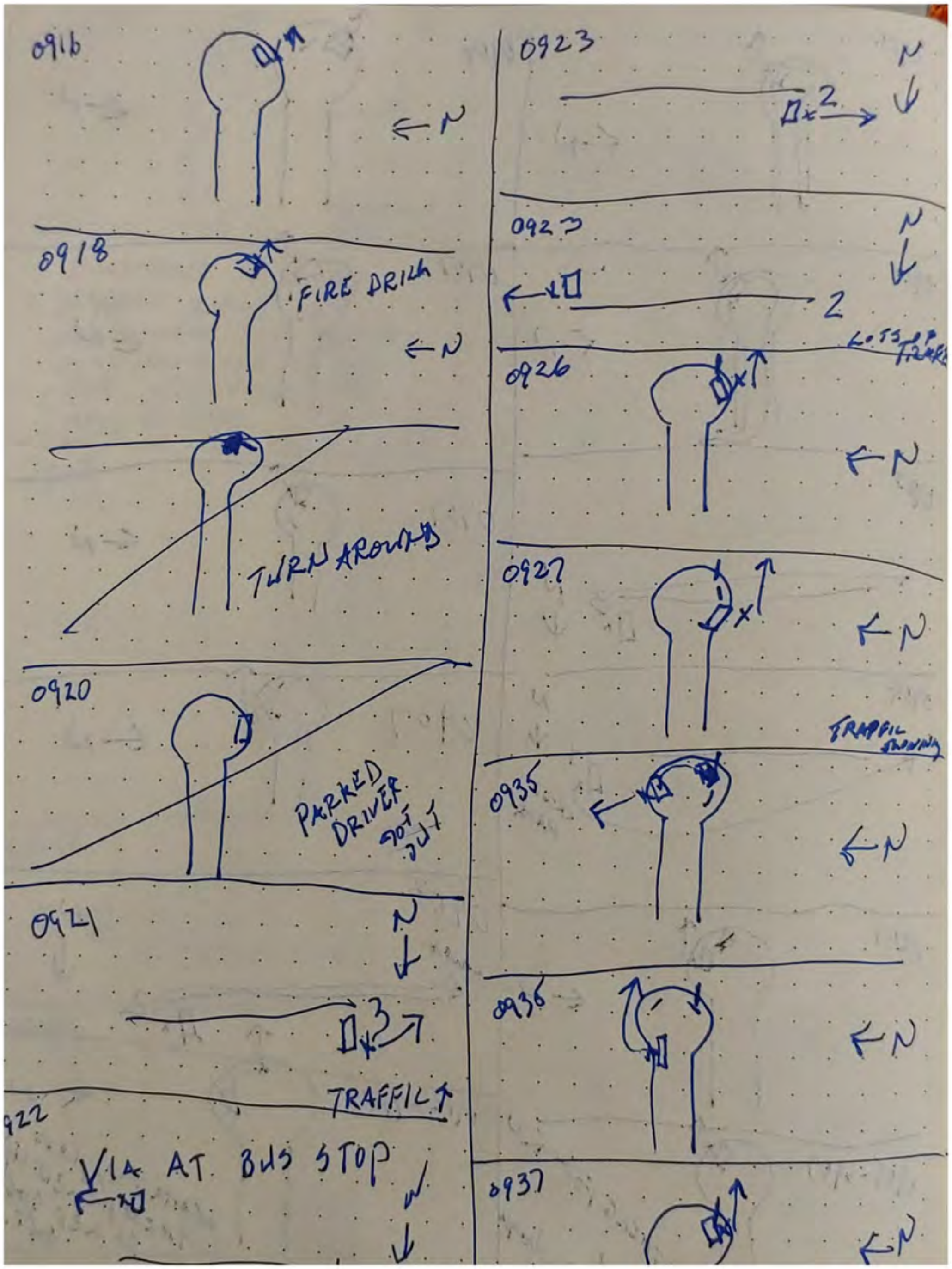
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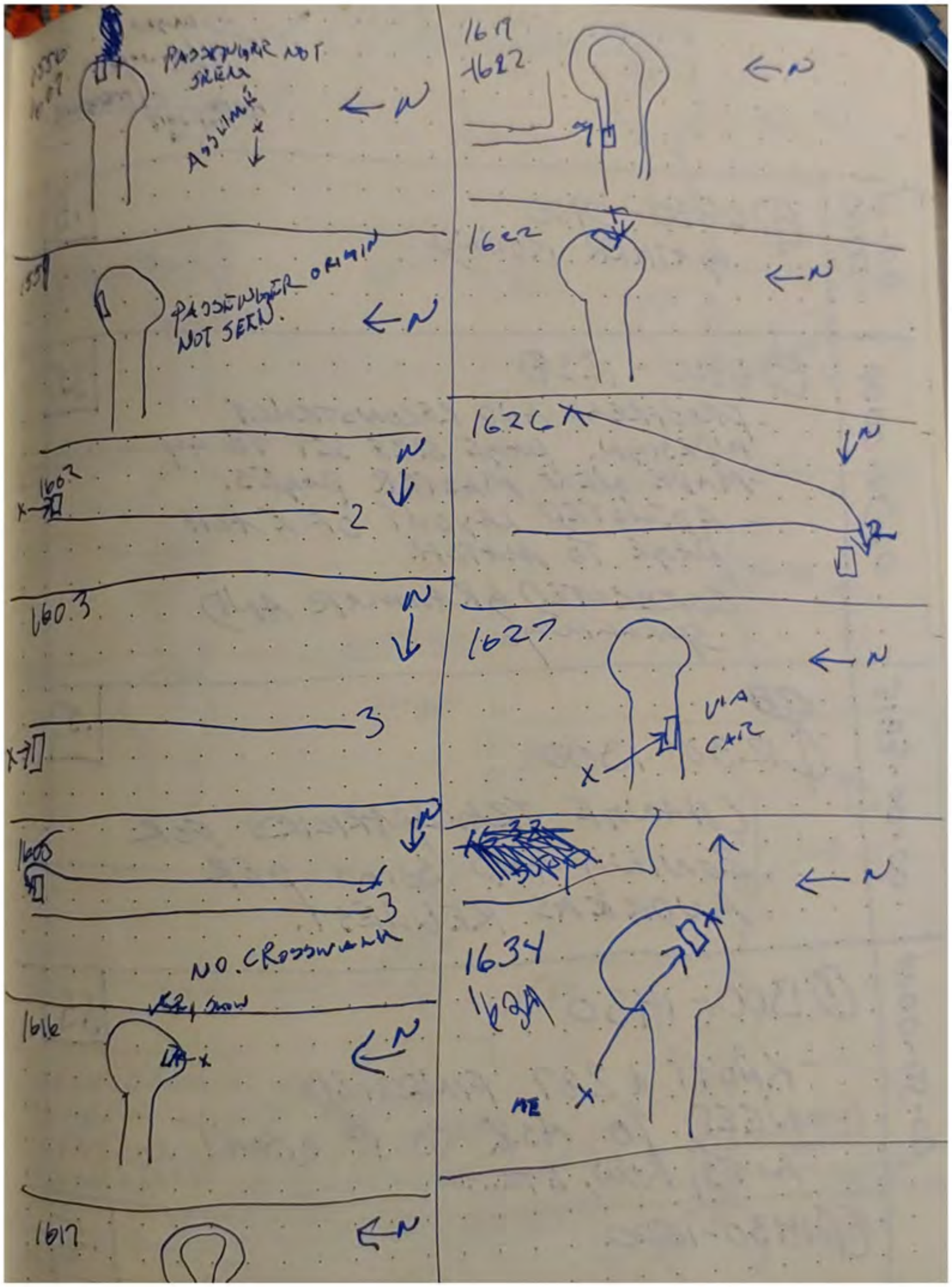
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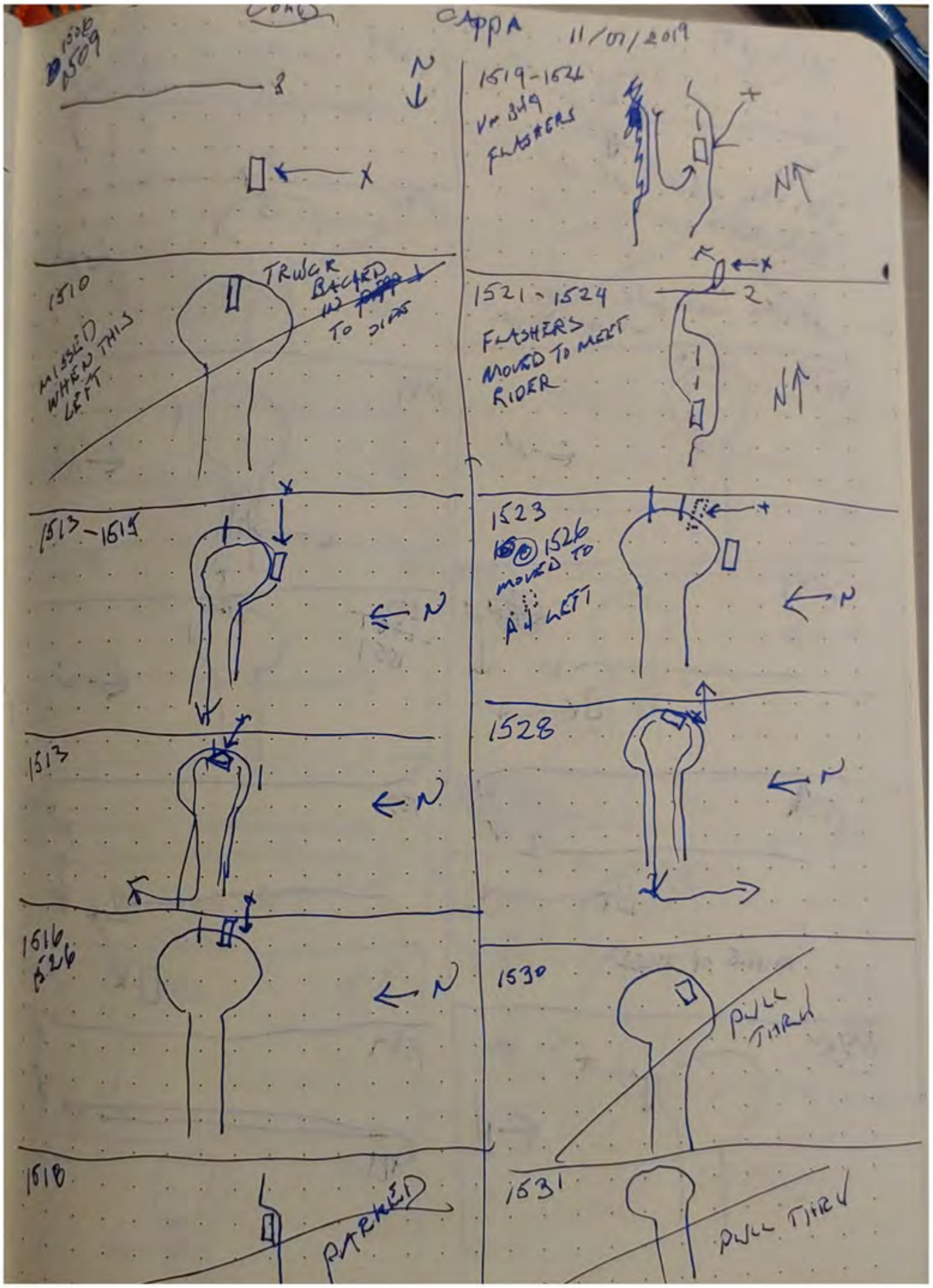
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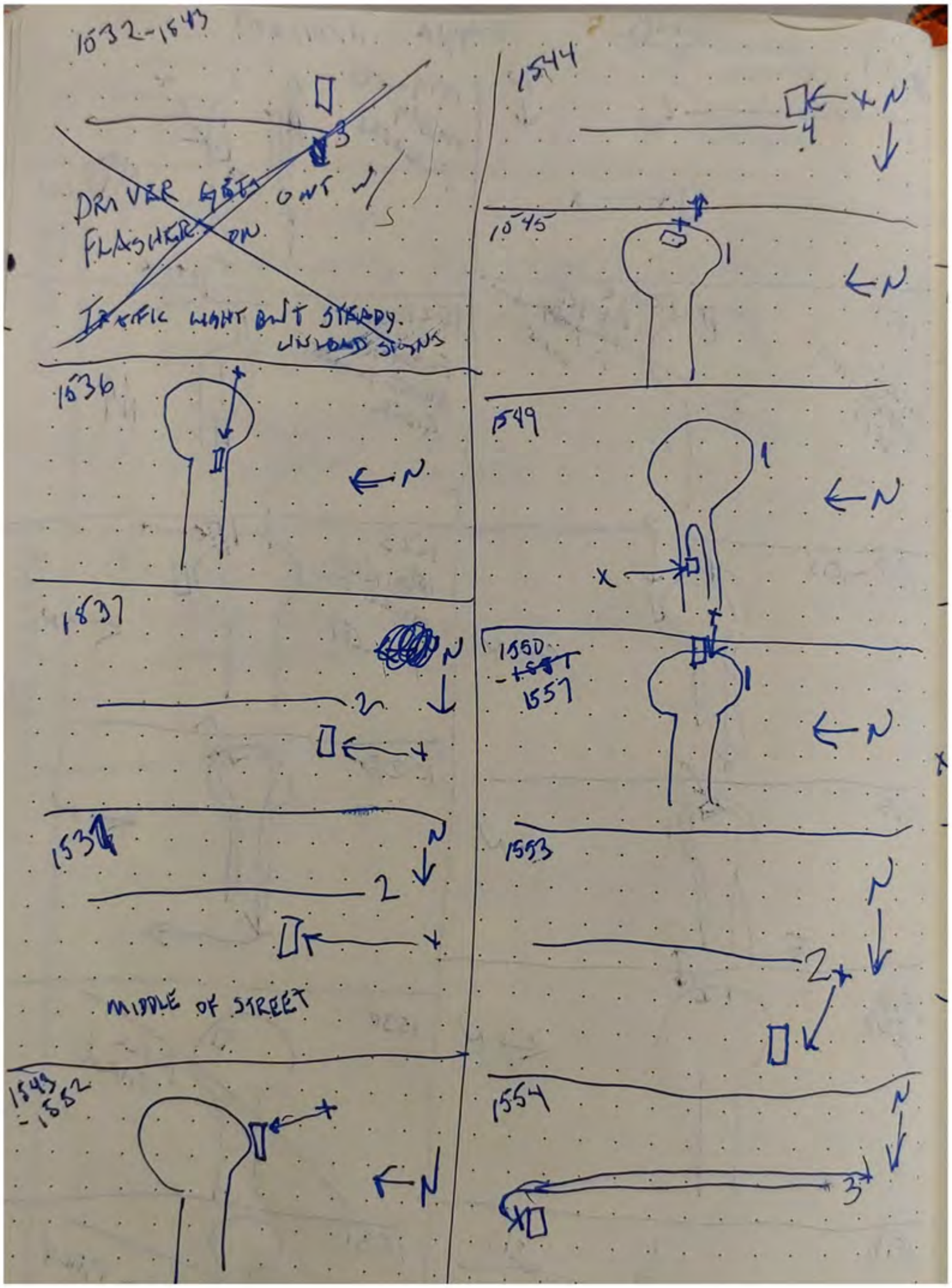
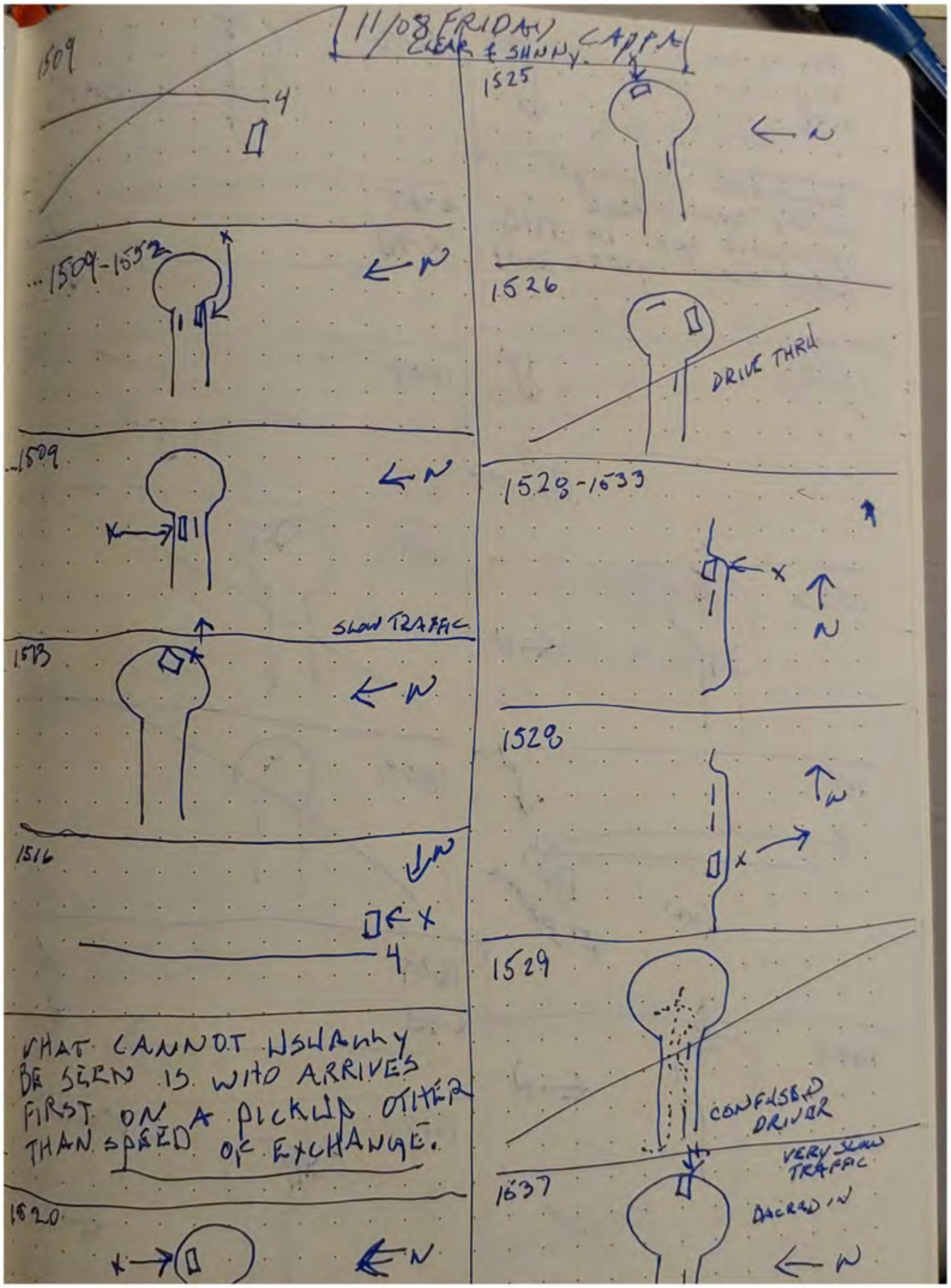
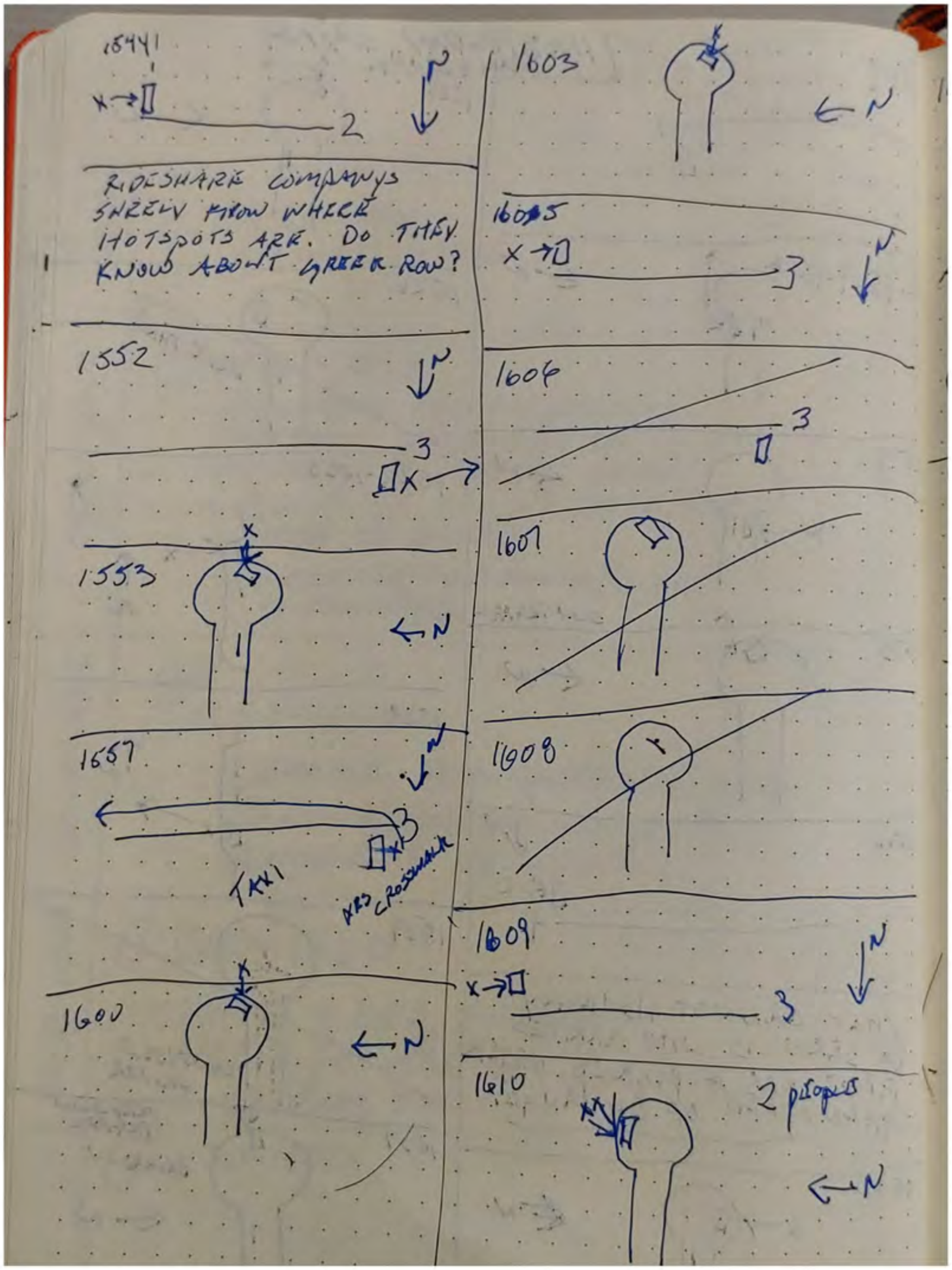
1531
PULL THRU

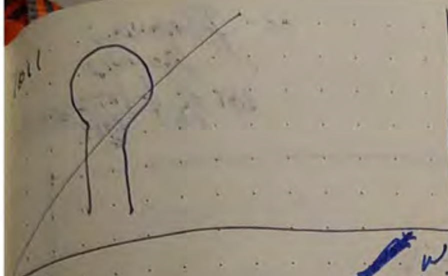


1532-1543
DRIVER GETS OUT w/ FLASHERS ON
TRAFFIC LIGHT BUT STEADY.
UNLOAD SIGNS
1536
1537
MIDDLE OF STREET
1543
-1552
1544
1545
1549
1550
1557
1553
1554
N

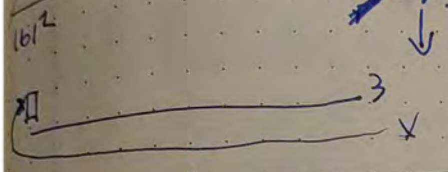

11/08 FRIDAY
CLEAR & SUNNY
1509
1509-1552
1509
SLOW TRAFFIC
1513
1516
WHAT CANNOT USUALLY BE SEEN IS WHO ARRIVES FIRST ON A PICKUP OTHER THAN SPEED OF EXCHANGE.
1520
1525
1526
DRIVE THRU
1528-1533
1528
1529
CONFUSED DRIVER
VERY SLOW TRAFFIC
1537
BACKED IN


1544
RIDESHARE COMPANYS SURELY KNOW WHERE HOTSPOTS ARE. DO THEY KNOW ABOUT GREEK ROW?
1552
1553
1557
TAXI
1600
1603
1605
1606
1607
1608
1609
1610
2 people

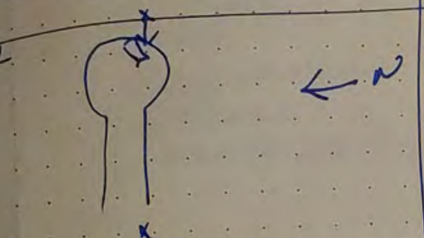
1611



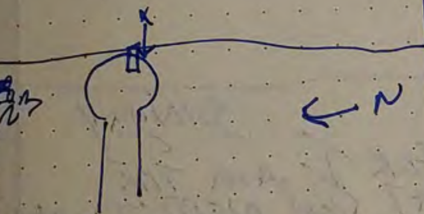
1612



1612



1623



HOW OFTEN IS ORIENTATION OF VEHICLE CORRECT FOR EXCHANGE (NOT CROSSING STREET BY PASSENGER?)

1630 STOP.

IN RIDESHARE EXCHANGES THE PASSENGER CALLS THE SHOTS. GIVE PASSENGER REASON TO BE OR GO TO

WAITING AREA FOR PU WOULD SPEED THINGS UP.

WILL WE ONE DAY BE REQ TO PROVIDE SPACE FOR TNC SAME AS FD?

EXCHANGE NOT LIKE A PARKING SPACE. PARALELL INTO A RIDESHARE DROP WOULD NOT BE USED AS MUCH.

Appendix B (Complete Observation Data Table)

							Crosswalk				Metered		Fire Lane	
Date	Time START	TIME STOP	Pick-up	Drop-off	V Direction	P Direction	Crosswalk #	X NEEDED	X USED	Before or After	METERED SP #	AVAIL Y OR N	IN OR OUT	Fire Lane Sp#
11/4/2019	803			X	N	E	2	N		B				
11/4/2019	803			X	N	E	2	N		B				
11/4/2019	803			X	S	W	3	N		B				
11/4/2019	816		X		S	E	3	N		B				
11/4/2019	816	820		X	N	E	2	N		B				
11/4/2019	816			X	N	E	2	N		B				
11/4/2019	822			X	S	E	1	Y	N	B				
11/4/2019	825			X	N	E	2	N		B				
11/4/2019	828			X	N	E	2	N		B				
11/4/2019	836			X	N	E	2	N		B				
11/4/2019	838	840		X	NA	E	2							1
11/4/2019	842			X	NA	N								3
11/4/2019	844			X	NA	E								1
11/4/2019	848			X	NA	E								1C
11/4/2019	849			X	NA	E								1B
11/4/2019	850			X	NA	E								1
11/4/2019	853			X	NA	E								1B
11/4/2019	853			X	S	E	1	Y	N	B				
11/4/2019	856			X	S	W	2	N		B				
11/4/2019	857			X	NA	E								1
11/4/2019	859			X	NA	E								1
11/4/2019	901			X	S	W	3	N		B				
11/4/2019	906			X	NA	E								1B
11/4/2019	906			X	N	E	2	N		B				
11/4/2019	908			X	S	W	3	N		B				
11/4/2019	909			X	NA	E								1
11/4/2019	915			X	NA	E								1
11/4/2019	918			X	N	W	3	Y	N	B				
11/4/2019	921			X	NA	E								1
11/4/2019	925		X		N	E	3	Y	N	A				
11/4/2019	934			X	NA	N								2
11/4/2019	935			X	NA	E								1
11/4/2019	937			X	NA	E								1
11/4/2019	939		X		S	W	1	Y	N	A				
11/5/2019	803			x	NA	E								1
11/5/2019	812			x	NA	N								2
11/5/2019	813			X	S	W	3	N		B				
11/5/2019	815			X	S	SW	4	N		B				
11/5/2019	816			X	S	W	3	N		A				
11/5/2019	817			X	S	E	3	Y	Y	B				
11/5/2019	819			X	NA	E								1
11/5/2019	819			X	NA	E								1
11/5/2019	822			X	S	S	3	N		B				
11/5/2019	824			X	NA	E								1
11/5/2019	824			X	NA	E								1C
11/5/2019	825			X	NA	E								1
11/5/2019	826			X	N	E					3	Y	IN	

11/5/2019	828			X	N	E					2	N	OUT	
11/5/2019	840			X	NA	E								1
11/5/2019	848			X	N	E					1	Y	OUT	
11/5/2019	848			X	N	E	2	N		B				
11/5/2019	849			X	N	E					1	y	IN	
11/5/2019	851			x	NA	N								3
11/5/2019	854			x	N	E	2	N		B				
11/5/2019	857			X	NA	E								1
11/5/2019	857			X	NA	N								2
11/5/2019	858			X	N	W	1	Y	N	A				
11/5/2019	900			X	NA	E								1
11/5/2019	901			X	NA	E								1
11/5/2019	903			X	S	E	3	Y	Y	B				
11/5/2019	904			X	S	E	4	Y	N	B				
11/5/2019	904			X	NA	E								1
11/5/2019	905	907		X	NA	E								1
11/5/2019	906			X	NA	E								1
11/5/2019	907			X	NA	E								1
11/5/2019	907			X	NA	E								1
11/5/2019	907			X	NA	E								1
11/5/2019	908			X	S	E	2	Y	Y	B				
11/5/2019	912	915		X	NA	E								1
11/5/2019	916			X	NA	E								1
11/5/2019	918			X	NA	E								1
11/5/2019	921			X	S	W	3	N	N	B				
11/5/2019	922			X	N	E	1	N	N	B				
11/5/2019	923			X	S	W	2	N		B				
11/5/2019	923			X	N	E	2	N		B				
11/5/2019	926			X	NA	E								1C
11/5/2019	927			X	NA	E								1C
11/5/2019	935			X	NA	N								2
11/5/2019	935			X	NA	E								2
11/5/2019	937			X	NA	E								1B
11/7/2019	1506	1509	X		S	E	3	N		B				
11/7/2019	1513	1515	X		NA	W								1C
11/7/2019	1513		X		NA	W								1
11/7/2019	1516	1526	X		NA	W								1
11/7/2019	1519	1526	X		S	W					2	Y	IN	
11/7/2019	1521	1524	X		N	W	2	N		A				
11/7/2019	1523	1526	X		NA	N								1BP
11/7/2019	1528			X	NA	E								1
11/7/2019	1536		X		NA	W								0
11/7/2019	1537		X		S	E	2	N		B				
11/7/2019	1537		X		S	E	2	N		B				
11/7/2019	1543	1552	X		NA	N								1CP
11/7/2019	1544		X		S	E	4	N		A				
11/7/2019	1545			X	NA	E								1
11/7/2019	1549		X		NA	S								3
11/7/2019	1550	1557	X		NA	W								1P
11/7/2019	1553		X		S	SE	2	N		B				
11/7/2019	1554			X	N	W	3	Y	Y	A				
11/7/2019	1556	1607	X		NA	W								1P
11/7/2019	1559		X		NA	S								2
11/7/2019	1602		X		N	W	2	N		B				
11/7/2019	1603		X		N	W	3	N		A				
11/7/2019	1605			X	N	W	3	Y	N	B				
11/7/2019	1616		X		NA	N								1C

11/7/2019	1671			X	NA	S								3
11/7/2019	1619	1622	X		NA	S								3
11/7/2019	1622		X		NA	W								1
11/7/2019	1626		X		S	NW	2	Y	N	B				
11/7/2019	1627		X		NA	S								0
11/7/2019	1634			X	NA	E								1
11/7/2019	1634		X		NA	SE								1B
11/8/2019	1509	1552	X		NA	W								3
11/8/2019	1509		X		NA	S								3
11/8/2019	1513			X	NA	E								1
11/8/2019	1516		X		S	E	4	N		A				
11/8/2019	1520		X		NA	S								2
11/8/2019	1525		X		NA	W								1
11/8/2019	1528	1533	X		N	W					1	Y	IN	
11/8/2019	1528			X	N	E					3	Y	IN	
11/8/2019	1537		X		NA	W								1P
11/8/2019	1544		X		N	W	2	N		B				
11/8/2019	1552			X	S	W	3	N		B				
11/8/2019	1553		X		NA	W								1
11/8/2019	1557			X	S	E	3	Y	Y	B				
11/8/2019	1600		X		NA	W								1
11/8/2019	1603		X		NA	W								1
11/8/2019	1605		X		N	W	3	N		B				
11/8/2019	1609		X		N	W	3	N		B				
11/8/2019	1610		X		NA	SW								2
11/8/2019	1612		X		N	E	3	Y	Y	B				
11/8/2019	1612		X		NA	W								1
11/8/2019	1623		X		NA	W								1