THE EFFECTIVENESS OF PSYCHOLOGICAL TRAFFIC CALMING: A COMPARATIVE CASE STUDY OF TWO NEIGHBORHOODS IN ALACHUA COUNTY, FLORIDA

By

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To my parents, Lawrence and Emily Lisska

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LIST OF ABBREVIATIONS

ASCE	American Society of Civil Engineers
FDOT	Florida Department of Transportation
ft	feet (unit of measure)
ITE	Institute of Transportation Engineers
mph	miles per hour (unit of measure)
NAHB	National Association of Home Builders
NHTSA	National Highway Traffic Safety Administration
RoSPA	Royal Society for the Prevention of Accidents
TRL	Transport Research Laboratory
ULI	Urban Land Institute

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The effectiveness of traditional traffic calming methods, usually involving horizontal and vertical deflections to slow automobiles, is thoroughly documented and well-proven. In recent decades, however, certain problems have surfaced with the traditional physical methods, such as deflection noise levels, driver discomfort, potential vehicle damage, and general unpopularity. Many authorities in Europe and Asia have begun to favor an expanded portfolio of psychological techniques, calming schemes that compel drivers to slow down rather than forcing them to. These psychological methods have been slow to catch on in the United States, and American examples are mostly limited to older, urban neighborhoods and the semi-public street networks of privately developed communities. Subsequently, studies of effectiveness are rare.

My study examined the effectiveness of the psychological calming schemes in two different Alachua County, Florida, neighborhoods. The first, Haile Village Center, is a new urbanist development representing a meticulously designed, privately developed community. The second, a portion of College Park, is an older neighborhood a quarter

mile north of the University of Florida. Research was conducted by administering a questionnaire to residents of both neighborhoods, performing a field survey to confirm the presence of psychological traffic calming, and recording speeds along four street segments, two from each neighborhood.

Results indicated that the residents of both neighborhoods perceived their streets to be safe for pedestrians. Speeds on three out of four street segments were comparable to physical traffic calming design standards, best practice design speeds for residential streets, and the preferred speed of neighborhood residents (as determined by the questionnaire). The fourth segment was subject to a large amount of cut-through traffic and was only safe by the conventional 30 mph standard for residential streets.

Overall, both the master-designed scheme of Haile Village Center and the informal scheme of College Park were effective at calming traffic and creating safe streets for pedestrians.

CHAPTER 1
INTRODUCTION

The Need for Safe, Livable Streets

As we continue to embrace the automobile as the primary mode of transportation on streets in the United States, the safety and overall experience of the pedestrian is often relegated. In describing the effect of this era of automobile priority, writer Tom McNichol (2004) comments, “Wide roads [slice] through residential areas, dividing neighborhoods, discouraging pedestrian activity, and destroying the human scale of the urban environment. To improve safety and general living conditions, municipalities all across the country have implemented transportation policies and programs that aim to slow automobile movement or divert traffic to other streets. This practice, called traffic calming, originated in Europe in the 1960s and was imported to the United States in the 1970s to treat residential streets where excess vehicle speed or traffic volume was considered inappropriate.

Traffic calming methods used to slow traffic are mostly physical and force drivers to slow down through vertical or horizontal deflection. The common speed hump is a classic example of a vertical deflection; to travel over the hump with minimal discomfort and without inflicting damage to the undercarriage of a low-riding vehicle, a driver must reduce his or her speed. Horizontal deflection methods are typically installed on straight roadways that might otherwise encourage driver acceleration. The chicane, an area of raised curb that extends into the roadway and forms a tight curve, forces drivers to slow while deflecting inward toward the narrower portion of the street.

In the early 1980s, livable streets expert Donald Appleyard examined traffic calming and noted the distinction between physical and psychological control methods.

By his definition, psychological traffic calming consisted chiefly of signs and required driver obedience and enforcement to succeed; more flexibility was afforded to the driver and emergency services, but pedestrians could not be certain of effective control (Appleyard, 1981, p. 295). Physical controls were deemed to have a more definite control over drivers' movements but were also noted as a source of driver hostility (Appleyard, 1981, p. 295). In recent decades, however, additional problems have surfaced with the physical methods of traffic calming, and many authorities in Europe and Asia have begun to favor an expanded portfolio of psychological techniques. Meanwhile, policy in the United States has been slow to catch up, and domestic examples of these new methods primarily exist within the street networks of private developments.

The psychological traffic calming movement contends that non-physical means can produce a comparable degree of control that is more acceptable to both pedestrians and motorists (Kennedy, 2005). However, few studies based in the United States have confirmed if psychological traffic calming schemes actually produce slower traffic or make neighborhood residents feel that their streets are safe.

Research Question and Study Objectives

My study attempted to evaluate the effectiveness of psychological traffic calming methods within two distinct neighborhoods in Alachua County, Florida. The first neighborhood is Haile Village Center, a new urbanist community within the larger Haile Plantation master-planned community. The second is a section of the College Park Neighborhood in Gainesville, nearby to the University of Florida. In determining the effectiveness of psychological traffic calming in these neighborhoods, the following questions were addressed:

- Do neighborhood residents feel safe among calming schemes that are more psychological than physical?
- Does driving behavior change when drivers enter the psychologically calmed neighborhoods?
- Do psychological calming schemes slow traffic to levels similar to that of physical calming?
- Do psychological calming schemes keep traffic at speeds comparable to residential street design best practices?
- Do psychological calming schemes slow traffic to levels acceptable to neighborhood residents?
- Does successful psychological calming require intensive design and infrastructure, or can it also be successful in locations with few formal design elements?

The specific approach to answering these questions involved a perceptual survey of neighborhood residents, a field survey of calming elements, and observations of traffic speeds. If results show that psychological calming is effective, my study may help create a jumping-off point for psychological traffic calming research in the United States.

CHAPTER 2
LITERATURE REVIEW

To understand the development and theory of psychological traffic calming methods, the evolution of street design and the conditions that necessitated, and continue to necessitate, conventional traffic calming methods must be understood as well. In this context, the development and philosophy of psychological traffic calming can be examined.

The Urban Street as a Public Place

The traditional role of the street in society is multi-faceted. In addition to supporting movement and providing access, it is a place for social interaction, commerce, recreation, enjoyment, and events. Just as any park or plaza, the street is an important part of the public realm.

Urban designers that promote the idea of the street as an important public space contrast public utilization in the past with that of the present. Lennard and Lennard (1995) note that, historically, “The social, economic, and religious life of cities happened in its squares and streets, in the places adjacent to the cathedral or important civic buildings, and on streets where people lived, and where shops and workshops were located” (p. 83). However, they lament that the contemporary prominence of the automobile has made streets useless for social and civic functions, instead becoming receptacles for car movement and storage (Lennard & Lennard, 1995, p. 83).

Contemporary street designs may still designate a portion of the right-of-way as “activity space,” often between the sidewalk and vehicle lanes or abutting the building façades, but “vehicle space” still consumes the majority of the cross-section. This vehicle space adds up. In Berkeley and Los Angeles, CA, street and highway right-of-ways comprise 26% of city land area (Southworth & Ben-Joseph, 2003, p. 5). Furthermore, residential streets in the United States, which are often underutilized as public space, are also underutilized by the automobiles they have been designed to support. These residential streets carry only 15% of total vehicle miles traveled, despite comprising 80% of national road miles (Southworth & Ben-Joseph, 2003).

Due to the street's current status as underutilized space, Hoyle (1995) implores us to, "recognize streets as a place [for living] rather than a channel created only for the benefit of car and driver (p. 16). As the character of a street's public realm degrades to support additional automobile movement, the public's perception of the street as a place for people degrades as well.

The Outdoor Room

When conceptualizing the design and character of streets and other public space, urban design theorists often compare the space to a room of a house, effectively, an "outdoor room." Engwicht (1999) argues that the balance of movement needs and the provision of the outdoor living room were built into the design of streets in older cities. He goes on to identify the elements that make up the outdoor room as floors, walls, doors and windows, entryways, ceilings, nooks and crannies, and furniture. Floors and furniture (and in some cases entryways, ceilings, and nooks and crannies) correlate to infrastructural elements commonly contained within the street right-of-way.

The floor is the surfacing and landscaping of the street. For pedestrians, bicyclists, and even motorists, the floor can provide a varied sensual experience (Lennard & Lennard, 1995; Engwicht, 1999). Additionally, the floor can afford a sense of place or information about the history of the street (Lennard & Lennard, 1995, p. 73). Lennard and Lennard (1995) go so far as to suggest that the design and quality of a street's pavement can even have a dialogue with users, communicating the “degree of consideration” a city has given to its inhabitants (p. 73). They discuss the consideration to pavement design and detail found in Western Europe:

> In Baden-Baden, Germany, the floor is laid in a pretty scallop design of pink and white stones. In Dusseldorf, light and dark grey granite stones are highlighted by green moss that grows in the cracks. In Karlsruhe, geometric designs in natural stone are inlaid in the reconstructed stone paving. In the historic city of Strasbourg, France one finds echoes of the city’s past in natural stone mosaic designs set in the pedestrian street paving. (Lennard & Lennard, 1995, p. 73)

Potentially, the street floor is just as much a palette for expression or a carpet for activities as it is a utility of movement.

Street furniture is a collective term used to refer to publicly used street fixtures: seating, mailboxes, street lights, drinking fountains, art installations, and so on. The dynamic functionality of this street furniture is comparable to that of house furniture. Engwicht (1999) identifies the immediate function (seating to sit on), aesthetic function (providing character or telling a story), social function (seating for people watching, provoking conversation, or allowing reflection), and a movement or direction function (placement of furniture directs and channels pedestrian flows) (p. 105).

Old versus New

Camillo Sitte (1843 – 1903) was one of the first urban design theorists to comment on the value of historic street construction and layout. To Sitte, the informal street designs and layouts of the Middle Ages were superior to more formalized, geometrical arrangements. Specifically, the informal nature of these streets was “more in tune with human aspirations” (Southworth & Ben-Joseph, 2003, p. 51). Raymond Unwin (1863 – 1940), known for his contributions to the Garden City movement, agreed with this sentiment. He wrote:

> There can be no doubt that much of the interest of the old irregular streets and towns lies in the sense of their free, spontaneous growth, their gradual extension under changing influences, much of which must be lacking in the case of a town built to order and according to a prearranged plan. (as cited in Southworth & Ben-Joseph, 2003, p. 51)

Others vehemently opposed traditional and organic street design as impedance to modern society and progress. Architect and designer Le Corbusier (1887 – 1965) was one of the most vocal opponents. To him, straight lines represented the most efficient movement of traffic, while curves and organic configurations were "ruinous, difficult and dangerous" (as cited in Southworth & Ben-Joseph, 2003, p. 79). Like Sitte and Unwin, he read into street design as a reflection of human nature and aspirations. Accordingly, he believed, "The winding road is the result of happy-go-lucky heedlessness, of looseness, lack of concentration and animality. The straight is a reaction, an action, a positive deed, the result of self-mastery. It is sane and noble" (as cited in Southworth & Ben-Joseph, 2003, pp. 79 – 80). The natural attraction of pedestrians to curves and unfolding streetscapes was belittled. To Le Corbusier, curves were only appropriate for "countrified" paths and gardens, only useful for strolls and recreation (Southworth & Ben-Joseph, 2003, pp. 80).

While Le Corbusier's ideas were famously derided when he showcased them in his "Radiant City" plan for central Paris, some of his philosophy survives in modern traffic engineering and road and highway planning practices (Southworth & Ben-Joseph, 2003). Highways are grade-separated from other streets and are designed for limited access to maximize automobile mobility. In the United States, suburban streets have a distinct hierarchy to satisfy automobile movement as the expense of pedestrian and non-motorized access. The right-of-way of a major arterial road can exceed 170 feet in some instances, a daunting task for the crossing pedestrian.

Pedestrians at Risk

In the United States, street design has evolved to accommodate the needs of automobiles, often at the expense of pedestrian needs. According to the National Highway Traffic Safety Administration (NHTSA), traffic crashes caused 59,000 pedestrian injuries and 4,092 pedestrian deaths in 2009 (2010, p. 1). Though both the total number of traffic-related fatalities and pedestrian traffic fatalities have decreased since 2005, pedestrian fatalities have consistently represented 11% to 12% of the total (NHTSA, 2010). Florida may be more dangerous for pedestrians than other states. While the 2009 national average for pedestrian fatalities per 100,000 population was 1.33, the rate for Florida was almost double at 2.51, the highest rate of any state in the nation (NHTSA, 2010). Furthermore, a study by the Florida Department of Transportation (2003) noted that Florida's pedestrian fatality rate is consistently above the national average and often the highest among the states.

Upon looking into the demographics of pedestrian crashes, it becomes clear that children age 15 and under and adults age 65 and up, two groups that may be more likely to walk places, are particularly at risk. In 2009, The 15 and younger age group represented 25% of all pedestrians injured in traffic crashes; meanwhile, the 65 and up group represented 19% of all pedestrian fatalities and 8% of all pedestrian injuries (NHTSA, 2010).

High pedestrian injury and fatality rates have frequently been related to high vehicle speeds (Tolley, 1997, p. 48). A study by the United Kingdom Department of Transportation found that the probability of death for a pedestrian hit by a motor vehicle decrease significantly with speed: 85% at 40 mph, 45% at 30 mph, and only 15% at 20 mph (1987). This relationship is summarized in Figure 2-1. Findings from a more recent study suggest that the risk of fatality increases very gradually up to 30 mph but then increases between 3.5 and 5.5 times from 30 mph to 40 mph (Richards, 2010). The minimum required stopping distance for a motor vehicle also increase significantly with vehicle speed. As seen in Figure 2-2, driver response time and the time it takes to come to a complete stop after first applying the brake results in a total stopping distance of 40 feet at 20 mph, but rises to three times that amount (120 ft) at 40 mph (NHTSA, 2006).

Children may be more susceptible than the average adult on streets with high speed. One study notes that the neural mechanisms that detect the looming of a moving object, such as a speeding automobile, are not fully developed until adulthood (Wann, Poulter, & Purcell, 2011). Based on a perceptual experiment with participants ages 6 through 11, the study suggests that children may not perceive that a vehicles is approaching if it is traveling in excess of 20 mph (Wann, Poulter, & Purcell, 2011). A child may be naturally less equipped than an adult to make judgments about crossing the street during fast moving traffic.

Traffic Calming Origins and Principles

In the early 1970s, the need for safer streets for pedestrians led American transportation engineers to conceive street treatments that would reduce speeds and traffic volumes in residential neighborhoods and areas of high pedestrian activity (Federal Highway Administration [FHWA] & Institute of Transportation Engineers [ITE], 1999). Since then, traffic calming has evolved to include other purposes. The Florida Department of Transportation (FDOT) assigns four main goals to traffic calming (1999):

- Improve safety for people, especially children, by controlling conflict points, reducing vehicle speeds and vehicle volumes;
- Improve the physical environment by lowering vehicle generated noise, pollution, and disruption;

- Create a green and inviting streetscape;
- Increase security by bringing back a higher number of pedestrians.

As mentioned in Chapter 1, many traditional, physical calming measures have been designed to induce horizontal and vertical deflections in passing vehicles, forcing slow-down (Kennedy, 2005). However, multiple problems have been associated with physical traffic calming techniques, among them (a) increased vehicle emissions due to abrupt acceleration and deceleration; (b) noise pollution from vehicles crossing vertical deflections; (c) vehicle damage and occupant discomfort incurred from crossing deflections at inappropriate speeds; (d) construction costs; (e) unwanted visual intrusion from required signing; (f) unpopularity with motorists and residents (Kennedy, 2005). A common assumption is that, while speed humps are unpopular with cut through drivers, they are embraced by residents living nearby. On the other hand, one study found that many residents also object to speed bumps due to noise, color, visual clutter from required signage, and/or increased emissions (Du, Ivan, Gardner, & Aultman-Hall, 2002). The same study noted that residents preferred traffic calming devices that also improved the aesthetics of their living environment (Du, Ivan, Gardner, & Aultman-Hall, 2002). Traffic calming experts such as Hoyle (1995) have implored American society to recognize streets as places for living rather than a channels created only for the benefit of car and driver . However, many physical traffic calming measures only address vehicle speeds and do little else to build community and sense of place.

Psychological Traffic Calming

In the wake of the issues with traditional, physical approaches, a new generation of traffic calming policy has arisen that seeks to avoid horizontal and vertical deflections. Some refer to this new wave of utilizing driver uncertainty as dynamic traffic calming

(Hayward & McGlynn, 1993). Major organizations in the United Kingdom such as the Royal Society for the Prevention of Accidents (RoSPA) and the Transport Research Laboratory (TRL) refer to the measures as psychological traffic calming (Kennedy, 2005). These two organizations outlined the following principles of psychological traffic intervention (Kennedy, 2005, p. 4):

- More complex environments tend to be associated with slower driving speeds, the likely mechanisms being increases in cognitive load and perceived risk;
- Natural traffic calming such as a hump back bridge or a winding road can be very effective in reducing speeds, as well as being more acceptable to drivers. Carefully designed schemes, using the properties of natural traffic calming, have the potential to achieve a similar effect;
- Emphasizing changes of environment e.g. highway / village boundary can increase awareness and/or reduce speed;
- Enclosing a distant view and/or breaking up linearity can reduce speeds;
- Creating uncertainty can reduce speeds;
- Combinations of measures tend to be more effective than individual ones, but can be visually intrusive and may be costly;
- Roadside activity (e.g. parked vehicles, the presence of pedestrians, or a cycle lane) can reduce speeds.

At first, some of these principles, especially those regarding perceived risk and uncertainty, may seem counterintuitive. However, it will be shown that many schemes based on these ideas have succeeded in maintaining pedestrian safety.

Five basic elements of design were established around RoSPA and TRL’s psychological calming principles: (a) context, such as road type and environmental character; (b) scale, regarding road width and building height; (c) proportion, like the enclosure formed by the juxtaposition of road width and building height; (d) roadside activity, via pedestrians, cyclists, and parked vehicles; (e) road surface, including color and texture (Kennedy, 2005).

Many of these design elements have been implemented and evaluated in a psychological scheme in Latton, England, a small village bisected by a rural highway. Major treatment components included (a) stone gateways at entry points with village name and speed limit posted; (b) planter build-outs to form parking bays on alternate sides of the roadway; (c) removal of the center-line marking; (d) enhancements around the main village junction with paved build-outs and crossings; (e) a new bus bay; (f) buffed surfacing near the bus stops and main junction, areas considered likely pedestrian crossings; (g) lighting columns lowered to a more human scale (Kennedy, 2005).

Studies of the new scheme revealed positive results. For example, two-way average speeds within the village center fell from 38 to 31 miles per hour (mph), and 85th percentile speeds decreased by 8-10 mph to 37-38 mph (Kennedy, 2005). Surveys of Latton residents showed that over three-quarters of respondents supported the implemented measures, half felt that it was safer to cross the road than before, and three-quarters enjoyed the overall appearance of the scheme (Kennedy, 2005).

The Woonerf Concept

Though the distinction of psychological traffic calming and its advocacy over physical methods are fairly recent, many of the principles and concepts are not completely new. The Dutch “woonerf” (plural: woonerven), literally “residential yard,” pioneered the idea of mixing pedestrian and vehicle movement in order to slow down motorists as early as 1969. Physically, the woonerf consists of integrating sidewalk and roadway into a single surface by removing the curb (Ben-Joseph, 1995). Because the scheme allows and encourages children to play in the streets, traffic on a woonerf is intended to proceed at about 9 to 12 mph (Appleyard, 1981).

The first two woonerven were implemented in the Dutch city of Delft. In addition to the iconic zero-clearance curb, other psychological aspects bearing multiple uses were explored. For example, it was reasoned that a pillar near a residence's front door discouraged vehicles from coming too close and also held community functions, marking a specific house or providing a bicycle rest, for instance (Appleyard, 1981, p. 307). Public and administrative reception was overwhelmingly positive, and by 1978, the Delft road network featured 25 woonerven (Appleyard, 1981, p. 309). Beyond the Netherlands, Woonerf policies have been established in Germany (1976), England (1977), Sweden (1977), Denmark (1977), France (1979), Japan (1979), Israel (1981), and Switzerland (1982) (Ben-Joseph, 1995).

Policies are slightly different from country to country based on local traffic climate. For instance, conditions in Japan differ from those in Europe in that neighborhood streets may be narrower and mixed traffic flows tend to be heavier (Tolley, 1997, p. 391). Consequently, Japan has instituted a variation of the woonerf called the "community street." Whereas the woonerf attempts to reclaim the street as a public living space, the community street aims to give pedestrians crossing priority in zones with vulnerable users or high concentrations of shoppers (Tolley, 1997, p. 392). These streets tend to be popular and well accepted by Japanese residents. In fact, 90% of those surveyed believed community streets were intended more for pedestrian than auto use, 66% felt the scheme encouraged social interactions with neighbors, and 67% considered the street a safe place for children to play (Ben-Joseph, 1995). The first community street, constructed in Osaka in 1980, utilized low clearance curbs and dedicated only three meters of the total ten meter street width to one-way motorized traffic (Tolley, 1997, p. 392). Area-wide coverage projects of community streets, named "Road-Pia," have also been implemented.

Shared Space and "Naked Streets"

In the 1980s, Hans Monderman, a Dutch traffic engineer, proposed that the woonerf concept be taken one step further. Monderman advocated the removal of road signs and traditional uniform traffic control devices, asserting that they are an admission of failure on the part of the road designer (McNichol, 2004). By removing signing, motorists are afforded less authority and more uncertainty regarding street travel. Perceived risk and forced eye-contact with pedestrians result in slower and more alert drivers. This scheme has been referred to as a shared space or "naked road" (McNichol, 2004).

In the Dutch town of Oosterwolde a standard signal controlled intersection was converted into a shared space, allowing pedestrians to use the area like a public square. Despite a daily traffic flow of 5,000 vehicles, no serious accident occurred in the five years after redesign (McNichol, 2004).

The removal of control devices has also been explored in the United Kingdom via the removal of center-lines. A study of a Wiltshire street found that center-line removal yielded 35% less accidents (McNichols, 2004).

Appleyard confirms much of Monderman's convictions on traffic control signing. Further, he believes informal signs placed by neighborhood residents draw more attention and regard from the driver than official ones (Appleyard, 1981, p. 297). He references one sign found on a residential Berkeley, California, street that read, "This barrier makes our neighborhood safer and more pleasant. Please Respect It" (1981, p. 297). Moreover, according to some authorities, speed limit signs typically have no effect on segment traffic volume and minimal effect on traffic speed, since motorists generally drive at a speed perceived to be safe and reasonable under environmental conditions (Florida Department of Transportation [FDOT], 1999). Ideally, a speed limit, as Monderman contends, should be self-enforcing through strategic design.

State of Practice of Psychological Traffic Calming in the United States

Though numerous policies have been successful around the world, psychological traffic calming schemes are scarce in the United States. Of 10 municipalities in the United States that were early adopters of traffic calming programs, none have fully assumed the European model that stresses shared space (Ewing & Brown, 2009). Much of this may be due to the differing character of US cities compared to the European towns that have successfully implemented psychological traffic calming. In many of the European examples, city streets had been constructed before the advent of the automobile and had naturally been designed and maintained for lower transportation speeds. Furthermore, policy approaches differ in scale. While guidelines in Germany, Holland, and Denmark support area-wide coverage and implementation on all street classifications, plans in the United States typically focus on a single corridor, usually lower than arterial and collector in the network hierarchy (Ewing & Brown, 2009).

American practitioners and researchers also continue to largely ignore non-physical traffic calming methods. Ewing and Brown (2009) note that "the ITE definition emphasizes the use of physical measures to slow or divert traffic. The definition excludes nonengineering measures that may improve street appearance, assuage residents' concerns about traffic, or in some cases even affect traffic volumes and speeds” (p. 2). Furthermore, Ewing and Brown(2009) assert that “psycho-perception measures such as restriping to visually narrow lanes, without physical changes, won’t fool many drivers. We know that from before-and-after studies” (p. 40). However, the authors do not reference any before-or-after studies to prove this claim.

Davis Festival Street in Portland, Oregon is one of the few examples of a shared space scheme on a public, urban road in the United States. The design, located in Portland’s Chinatown neighborhood, removed the center-line marking and grade-separation between street and sidewalk, installed a unique texture of concrete squares, and placed large, palm tree planters flanking both entry points (Baker, 2006). As with many of the woonerven and European shared spaces, short stone posts were the only physical barrier implemented to segregate pedestrian and automobile. By effect, priority over the space was granted to pedestrians.

Despite few public attempts, psychological calming activity is not completely inert in America. Ben-Joseph (1995) notes that private developments, where local governments possess no legal responsibility for the street system, are prime venues for domestic experimentation with new traffic calming measures. Some developers and community planners have taken heed. In 2005, the United States-based Congress for the New Urbanism lauded the shared space concept as the most important recent innovation in European street design (Baker, 2006). New urbanist communities, which by principle encourage livable and pedestrian-oriented street networks, are therefore a natural stage for testing. However, few available studies document the effectiveness of measures within these communities.

Specifically, measures have been implemented into or achieved by multiple semi-private new urbanist and neo-traditional developments in America, independent of guidance by municipal policies. One example is Baldwin Park, a 1,100-acre master-planned community on the site of the former Naval Training Center in Orlando, Florida. Baldwin Park has a dense network of streets that provides a great amount of connectivity both within the development and to the surrounding City of Orlando street network. To lessen the impact of speeders and cut-through traffic, residential streets in Baldwin Park have a width between 20 and 22 feet wide (Ewing & Brown, 2009, p. 209). At this width, two-way traffic has to yield if passing even a single parked car (Ewing & Brown, 2009, p. 209). Seaside, Florida, one of the original new urbanist developments, has a calming scheme that mimics the shared space. The streets in Seaside have no raised sidewalks or curbs, so pedestrians and cars share the same paved surface (Southworth & Ben-Joseph, 1997, p. 137). The narrowness of the paved surface, small building setbacks, and short block length further control the automobile speed (Southworth & Ben-Joseph, 1997, p. 137). Because the design of Seaside's residential streets would not meet local street regulations, the developer classified them as parking areas, providing more flexible regulations for building setbacks, lane width, and curb radii (Southworth & Ben-Joseph, 1997, p. 138).

Sometimes, older urban neighborhoods that predate the rise of auto-oriented street standards exhibit psychological traffic calming features as well. Elmwood, a neighborhood of Berkeley, California, is an example of a pedestrian friendly neighborhood with no formal design elements. Unlike Baldwin Park and Seaside, Elmwood grew gradually with the individual construction of homes by various builders on a lot-by-lot basis (Ewing & Brown, 2009, p. 103). Because of this piecemeal growth, architectural styles and building setbacks vary greatly. The streets of the neighborhood are characterized by sidewalks with planting strips, relatively narrow travel ways, and a tree canopy that has had decades to mature (Ewing & Brown, 2009, p. 103).

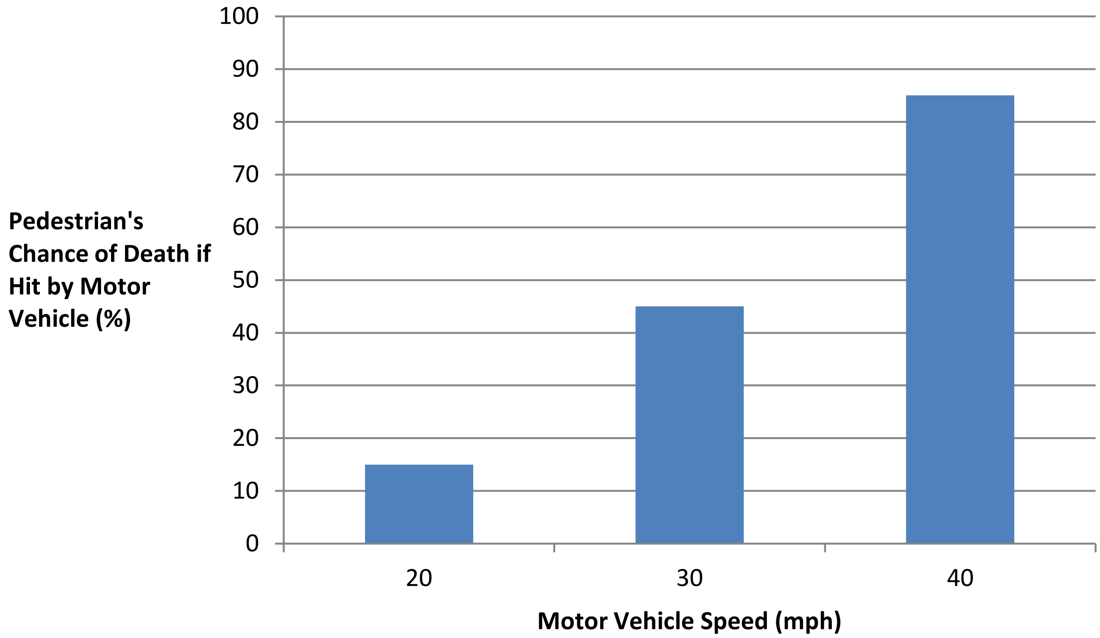


Figure 2-1. Pedestrian fatality probability if hit by motor vehicle, by speed of motor vehicle. (Data source: United Kingdom Department of Transportation, 1987)

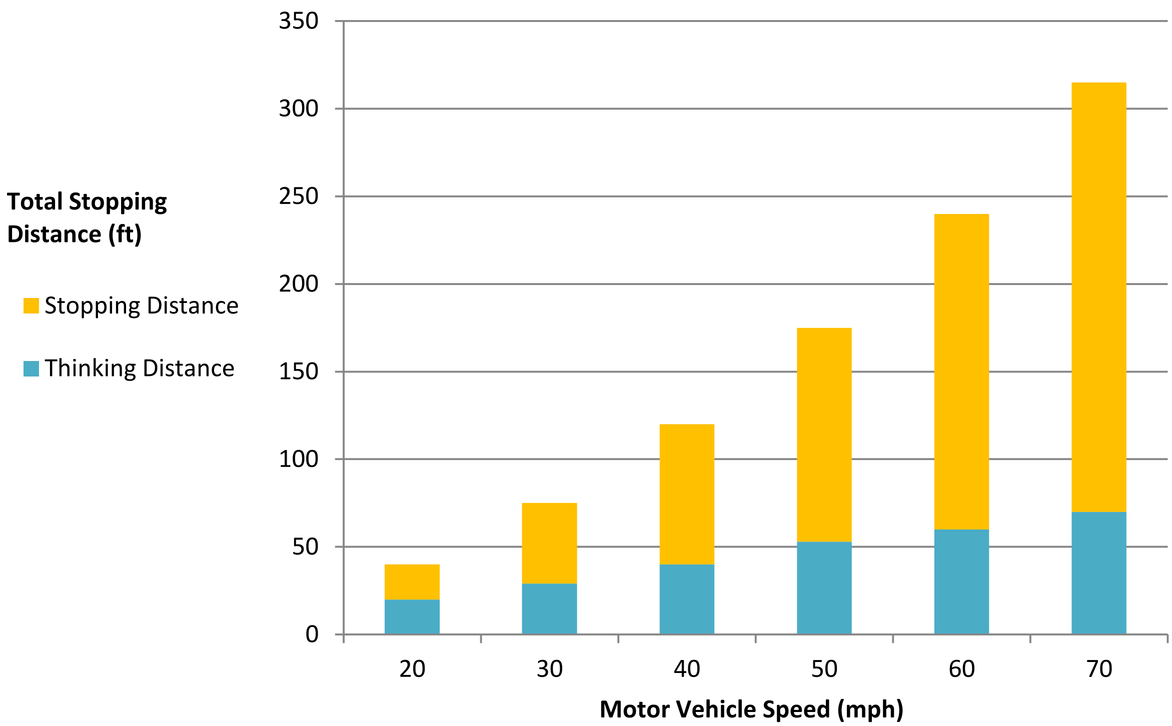


Figure 2-2. Minimum stopping distance by speed of motor vehicle. (Data source: NHTSA, 2006)

CHAPTER 3
METHODOLOGY

Research Question

This study examined the success of psychological traffic calming in two neighborhoods in Alachua County, Florida. The first neighborhood, Haile Village Center, is a privately developed and owned new urbanist community designed to accommodate pedestrian activity. The second neighborhood is a portion of Gainesville's College Park neighborhood, an older community in close proximity to the University of Florida. While these two neighborhoods both have street grids with short blocks, interconnected streets, and numerous psychological calming elements, they are fundamentally different in many ways, including roadway design, land use, and population demographics.

Study Areas

Introduction to Haile Village Center

Haile Village Center, seen in Figure 3-1, is a new urbanist community located west of Interstate 75 in Alachua County, Florida, approximately six miles from the central campus of the University of Florida. The Village Center is fully contained within Haile Plantation, a 1,073 acre planned unit development (PUD) begun in 1979 (Osemene, 1984, p. 40). The traditional neighborhood component of Haile Plantation originated in 1992 when an amendment to the PUD zoning master plan allowed the consolidation of 280,000 sq. ft. of proposed commercial space into a separate town center (Ben-Bassat, 1996, p. 51). Haile Village Center architect Robert Kramer designed the community around main objectives not dissimilar from those of traffic calming. Kramer primarily sought to, "build a community in which people could work, shop, worship, attend school, enjoy outdoor recreation and leisure-time activities within a short walking distance from their home" (2001).

Introduction to the College Park Neighborhood

The study area within the College Park Neighborhood, seen in Figure 3-2, is located about one mile northwest of downtown Gainesville and a quarter mile north of the University of Florida. Platted as the Colson and Blanding Subdivision, the street grid has somewhat shorter block length than surrounding College Park development. Though mostly residential, some commercial uses line NW 13th Street on the east side of the study area.

Approach

Conceptual Framework

In general, street safety and livability can be seen as the result of two independent variables: street speed (i.e. technical and statistical safety) and public perception (i.e. how safe observers feel). Volume of motor-vehicle traffic is also a major factor in determining street safety, but under the assumption that volumes would be relatively low in both neighborhoods, it was not a focus of the study structure. A casual arrow diagram of the conceptual model can be seen in Figure 3-3. To distinguish the fundamental differences between psychological and physical traffic calming, both have been included in the model.

Depending on the specific situation, control over the variables surrounding the psychological traffic calming intervention can change. For example, during the design phase of a new community and its street network, variables like street scale, street proportion, and neighborhood context can all be modified as desired to fit a calming scheme. After construction, however, the flexibility of these variables can be significantly constrained, especially by cost.

Methodology Design and Assessment Process

This was a cross-sectional, prospective, and non-experimental study; observations and responses were acquired for the current conditions of Haile Village Center and College Park. The methodology was three-pronged, including a qualitative, a quantitative, and a both qualitative and quantitative research task.

The qualitative task involved the creation of a street safety/livability perception questionnaire and administering the questionnaire to the residents of both neighborhoods. Too often, the element of public perception is overlooked in the assessment of pedestrian safety. Hine (1996) criticizes the transportation engineering and planning fields for being “concerned with, and overwhelming focused on, the use of quantitative methodologies reflecting a greater concern with technological advances, i.e. the performance of traffic control and management devices rather than a concern with the human perspective” (p. 180). Sisiopiku and Akin (2003) agree on the importance of user perceptions in the evaluation of street safety, in that “[p]edestrians themselves are the most appropriate group to identify treatments that create a safe and/or desirable environment for them and options that increase their likelihood to properly use pedestrian designated facilities” (p. 251). By this view of pedestrian safety assessment, qualitative user perception data became a major part of my study. Generally, the questionnaire sought to understand perceptions of safety, street travel experiences, study area demographics, and general concerns from neighborhood residents, the people that use the study area street networks on a daily basis. Data from this task were used to determine if driver behavior matched what would be expected for a psychological calming scheme, if residents felt safe from traffic on their streets, and if there were any major differences between the study areas.

The qualitative-quantitative task involved a field survey of the street design and urban form elements that, according to psychological calming theory, can impact safety. Building morphology/massing, street cross-sectional measurements, street width to building height ratios, neighborhood context, and tree canopy coverage were the key measures. This task was performed to confirm the presence of psychological traffic calming and to identify which segments would be observed in the final task.

For the quantitative task, traffic and pedestrian data were obtained through non-participant observations. This task measured the speed, volume, and street-side activity variables which directly relate the safety level of a traffic calming scheme.

Questionnaire

Two questionnaires were used in this research, one for each of the two Alachua County neighborhood study areas. The full texts of these questionnaires can be seen in Appendix A. The questionnaires asked the same basic questions in the same order and format, but the descriptions and language in each were tailored to the specific study area. The questionnaire was divided by topic into five sections: (1) experiences as a driver, (2) experiences as a pedestrian, (3) safety perceptions, (4) additional feedback, and (5) general information. The 24 questions are a mix of multiple choice and free-response. This format is similar to pedestrian safety questionnaires previously administered by Sisiopiku and Akin (2003) and by Qionghui (2002). Additionally, an informed consent document approved by the University of Florida Internal Review Board was provided as the cover letter of the questionnaire.

Two sets of potential participants were selected – one from each of the two study areas. The study area boundaries used for selection can be seen in the Figure 3-4 and 3-5. Since both study areas were relatively small, the questionnaire was administered comprehensively to all households rather than extracting a random sample.

According to geographic information system (GIS) data, the Haile Village Center study area contains 372 property parcels of various uses. Of these 372 properties, 161 are condominiums, 96 are single family housing, and 23 are mixed-use properties (may have a residential component). Publically available data from the Alachua County Property Appraiser and a supplemental field survey identified 239 valid residential addresses out of the original 280 residential parcels. One questionnaire package (a questionnaire, an informed consent cover letter, a prepaid return envelope, and, potentially, a letter of encouragement) was sent to each of the 239 valid residential addresses.

GIS data showed that the College Park study area contains 54 property parcels of various uses. Of these 54 properties, 18 are multi-family housing of less than 10 units, and 26 are single family housing. Again, publically available data from the Alachua County Property Appraiser and a supplemental field survey identified the valid residential addresses within these 44 properties, a total of 83 addresses. The questionnaire package was sent to each of the 83 valid addresses. Numbers from both participant selection processes are summarized in Table 3-1.

Each potential participant was mailed a questionnaire, an informed consent form cover letter, and return envelope with prepaid postage. The informed consent cover letter invited the potential participant to fill out the questionnaire; return the completed questionnaire using the prepaid envelope; keep the informed consent cover letter for his or her records; and contact me by email or phone for questions about my research or inquiries about my results. Participation was limited to people at least 18 years of age. The questionnaire was administered only once to each potential participant and responses were reviewed and recorded as they are returned.

Field survey

In each neighborhood, the field survey was performed to make general observations about neighborhood characteristics, confirm the presence of psychological traffic calming, and to identify street segments appropriate for the quantitative safety analysis. The survey was augmented by GIS data from the questionnaire portion of the methodology. Two street segments were chosen in each of the two study areas to allow for intra-neighborhood safety comparisons.

In Haile Village Center, two village street segments of comparable design and character, seen in Figure 3-4, were evaluated side-by-side. The first street segment, SW 91 Terrace (between SW 48 Place and SW 49 Place), was perceived by the Haile Village Center Home Owners Association as possessing high vehicle speeds and, by consequence, unsafe pedestrian conditions. The second street segment, SW 91 Drive (between SW 48 Place and SW 49 Place), is parallel and directly adjacent to SW 91 Terrace in the village grid pattern. Since the entire lengths of both streets extend between village access points to the north and south, the segments were judged to support similar movement roles.

In the College Park study area, NW 15th Street and NW 13th Terrace, seen in Figure 3-4 were evaluated. These two segments are parallel to one another between

NW 5th Avenue and NW 7th Avenue. Both are subject to cut-through and overflow traffic from nearby arterials such as University Avenue, NW 13th Street, and NW 8th Avenue.

Psychological traffic calming design elements were detected through first-hand observations and recordings. Inventory activities focused on the factors of context, scale, proportion, roadside activity, and road surface previously outlined by the Royal Society for the Prevention of Accidents (RoSPA) and the Transport Research Laboratory (TRL) (Kennedy, 2005). Street horizontal dimensions were taken using measuring tape. Conversely, vertical measurements were estimated with consideration to typical design values and perceived reference points. Approximate segment lengths were gathered via geographical information system.

Spot speed studies

To get quantitative measurements of the effects of psychological traffic calming in the two neighborhoods, speed and volume data were recorded from first-hand observations. These studies were carried out, and later processed, in accordance to directions by Roess, Prassas, and McShane (2004) on how to record and analyze spot speeds, the speeds of vehicles passing a point on a roadway. Specifically, speeds must be measured under conditions of free vehicle flow to make sure any observed speeds are not impeded by the factors resulting from the build-up of traffic (Roess, Prassas, & McShane, 2004, p. 204). Furthermore, the study conductor must be concealed from the view of motorists while recording speeds. If a motorist becomes aware of the speed recording activity, he or she may slow down under the assumption of a law enforcement operation, and the measurements will no longer reflect the true speed conditions of the site (Roess, Prassas, & McShane, 2004, p. 207).

Vehicle speeds were measured by a hand-held radar meter. The device, a Bushnell Velocity Speed Gun, is able to measure automobile speeds between six and 200 mph from as far as 1500 ft. To ensure accurate readings, the path of the emitted radar from the device must coincide with the path of the automobile as closely as possible. Error increases as the angle of the reading diverges from the vehicle path. By attempting to approximate a straight-on path of measurement, readings have an accuracy of ±1 mph.

As mentioned, four road segments selected for speed measurement: SW 91 Terrace and SW 91 Street in Haile Villages Center, and NW 15th Street and NW 13th Terrace in College Park. Measurements of these road segments were taken over the course of two weeks in late August and early September, during the start of the University of Florida Fall 2011 semester. Recording during this time period ensured that traffic would along the segments would reflect conditions at peak travel demand. The Traffic Calming Program of the City of Gainesville Public Works Department maintains the same practice of only measuring traffic speeds while university classes are in session (P. Mann, personal communication, March 25, 2010). Each segment received two observation periods, one for the morning travel demand peak between 8:30 AM and 10:30 AM and one for the afternoon peak between 4:30 PM and 6:30 PM.

SW 91 Drive was observed on Wednesday, August 31, 2011, and SW 91 Terrace was observed on Friday, September 2, 2011. For both locations, I recorded data from an unmarked car parked in an on-street parking stalls so that drivers would not notice the speed readings being taken. Aside from vehicles entering or leaving one of the segment parking stalls, all motorized vehicles traveling northbound or southbound along either segment were recorded. The recording strategy for the Haile Village Center segments is summarized in Figure 3-6.

NW 15th Street was observed on Tuesday, August 23, 2011, and NW 13th Terrace was observed on Friday, September 2, 2011. For both locations, I recorded data from an unmarked car parked about five feet parallel to the road right-of-way. Because both segments had additional intersections between the northern terminus at NW 7th Avenue and southern terminus at NW 5th Avenue, only vehicles that traveled at least half the segment were recorded. Vehicles traveling less than half the segment did not have enough distance to gather significant speed and were judged to not be representative of typical driving behavior. My recording strategy for the College Park study area segments is summarized in Figure 3-7.

As traffic speeds were being recorded pedestrian and bicycle counts were also taken. For Haile Village Center, segment parking occupancy was monitored on each curb, and an average for the two hour period was recorded.

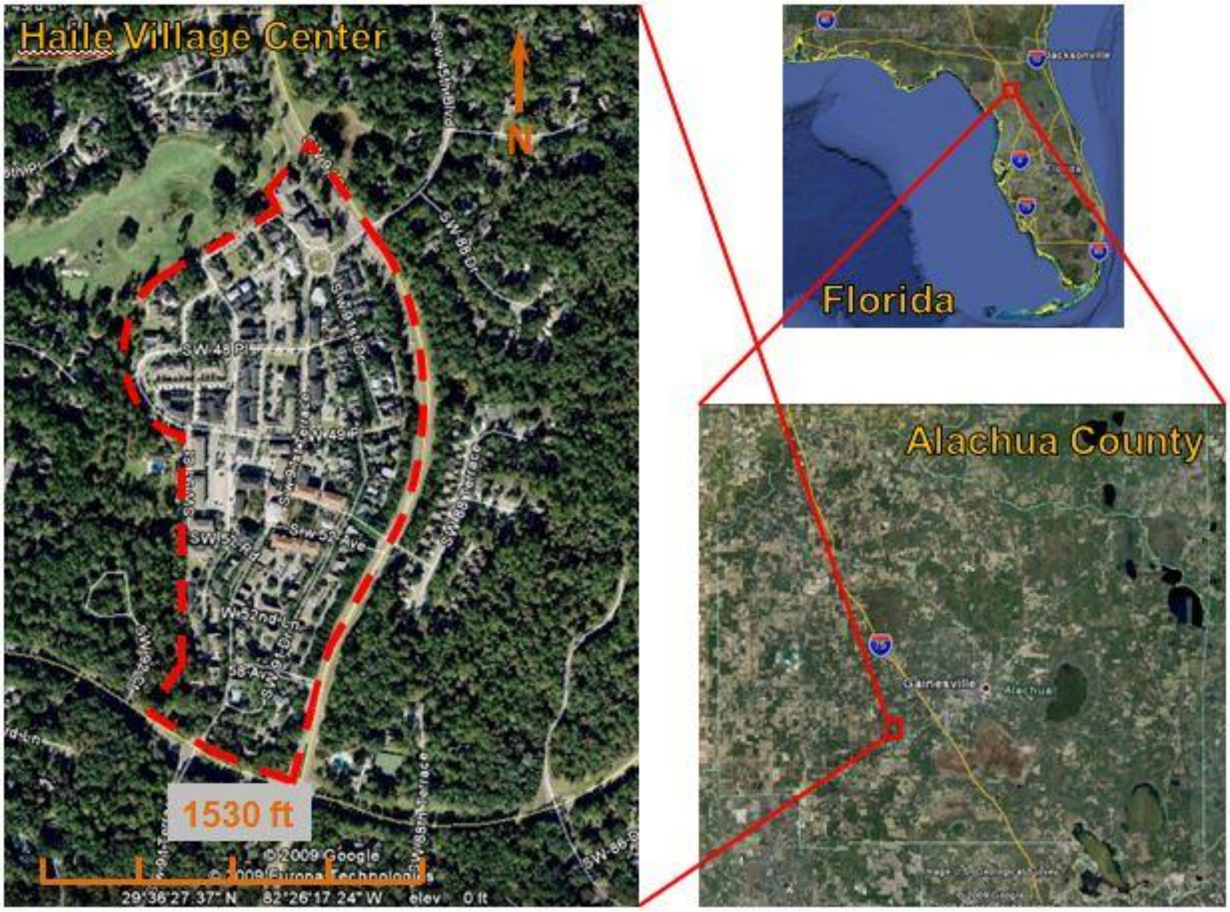


Figure 3-1. Haile Village Center location.

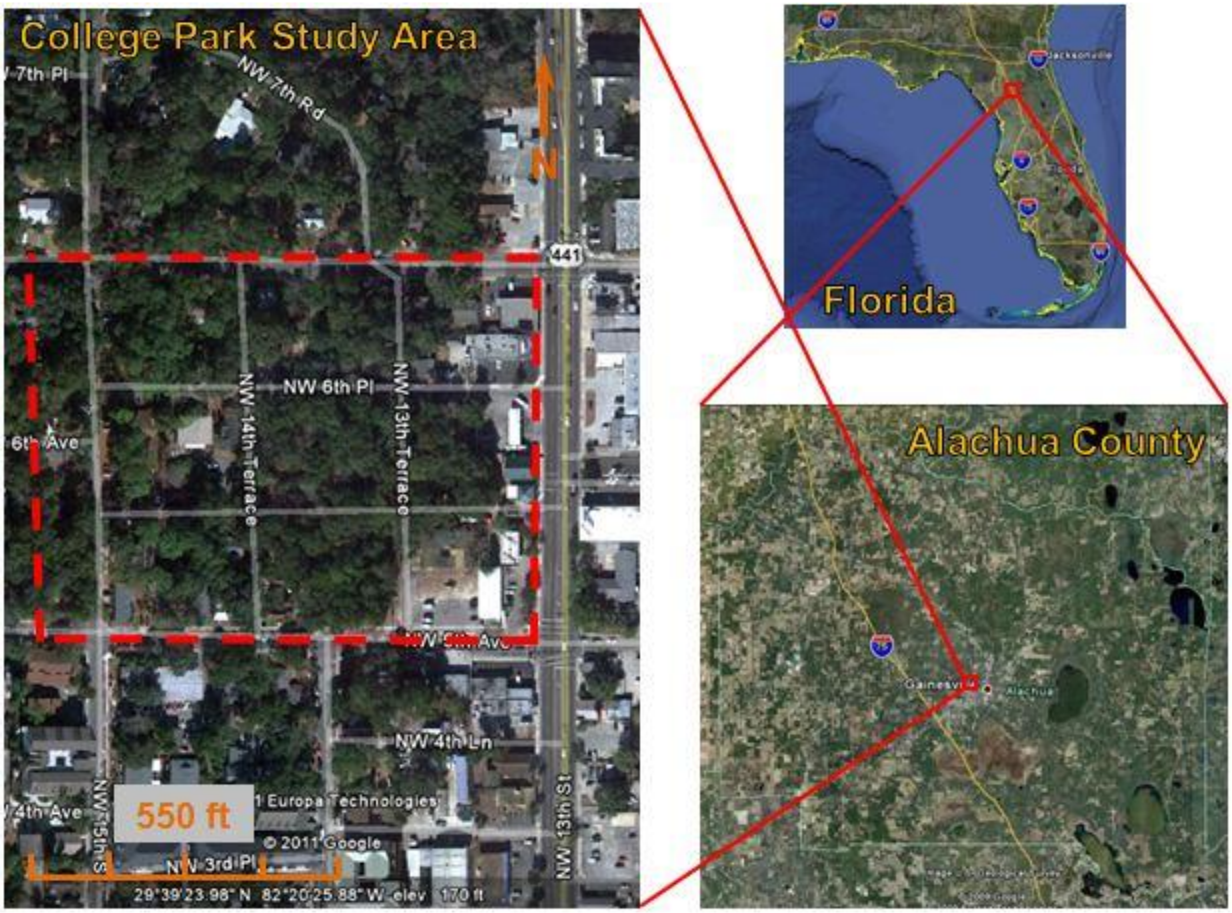


Figure 3-2. College Park study area location.

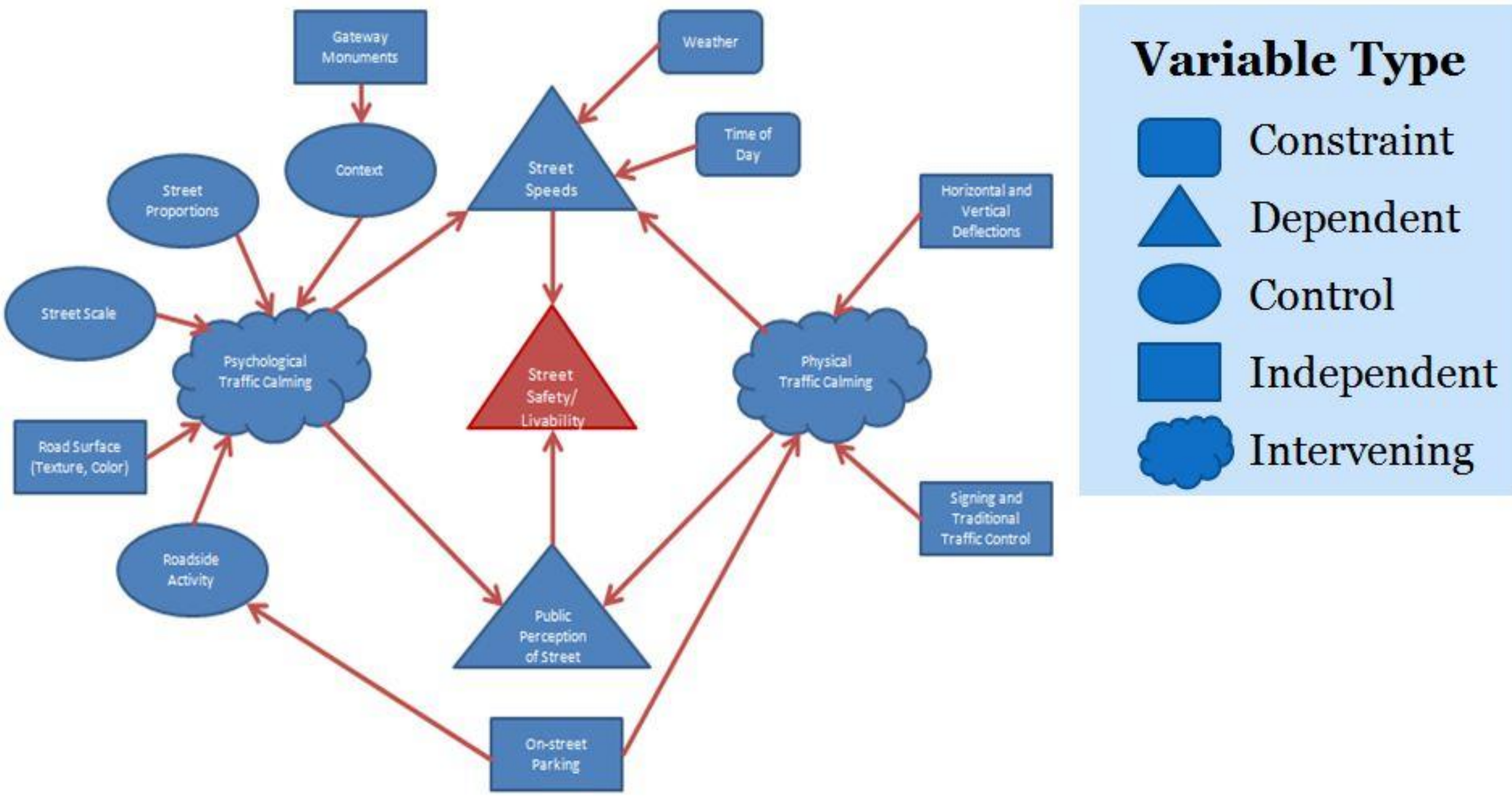


Figure 3-3. Casual arrow diagram of conceptual model.

Figure 3-4. Haile Village Center study segments. Selected study segments on SW 91 Terrace and SW 91 Drive are seen as orange arrows. Village access points at the northern and southern termini of the streets are shown in red.

Figure 3-5. College Park study segments. Selected study segments on NW 15th Street and NW 13th Terrace are seen as orange arrows. Commonly used access points to and from NW 13th Street, NW 8th Avenue, and W University Avenue are shown in red.

Figure 3-6. Haile Village Center speed study strategy. Selected study segments on SW 91 Terrace and SW 91 Drive are shown within the yellow boxes. The locations from which I recorded speeds are shown as gold stars. The blue dotted lines show the northbound movements of vehicles that were recorded, while the red dotted lines show the southbound movements of vehicles that were recorded.

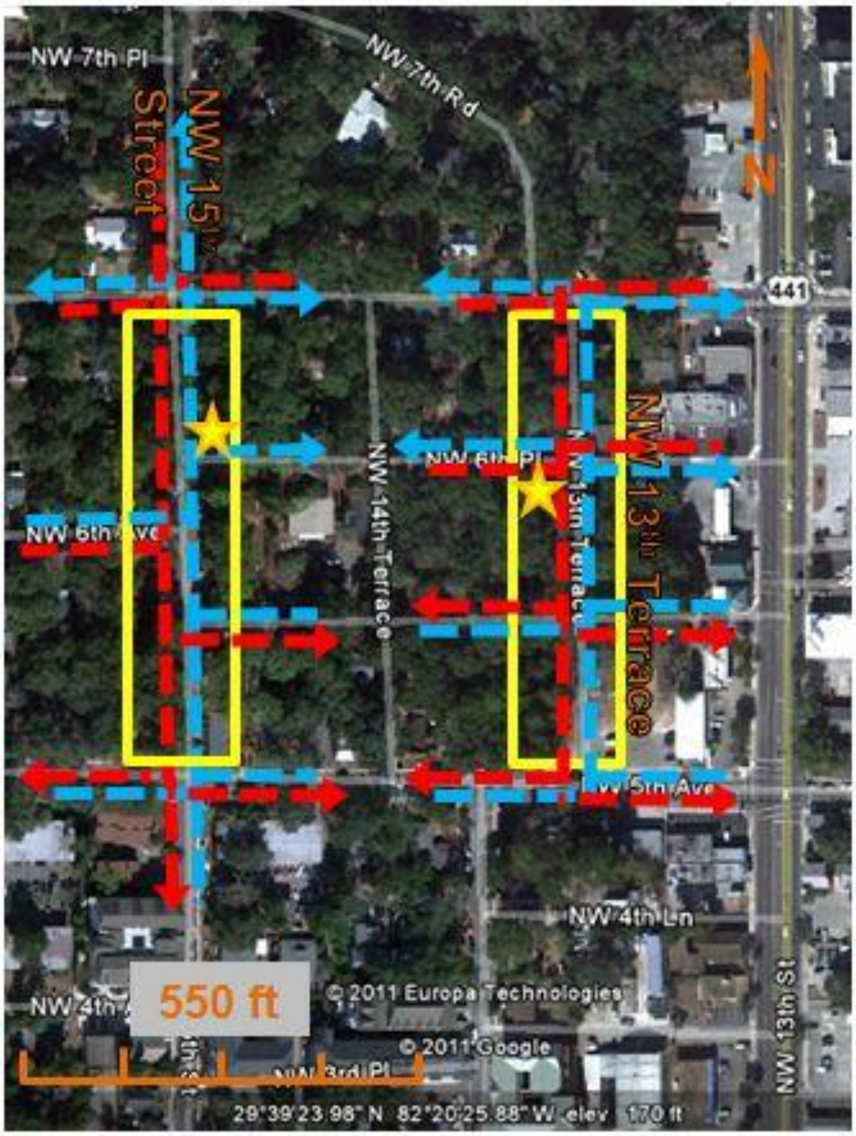


Figure 3-7. College Park speed study strategy. Selected study segments on NW 15th Street and NW 13th Terrace are shown within the yellow boxes. The locations from which I recorded speeds are shown as gold stars. The blue dotted lines show the northbound movements of vehicles that were recorded, while the red dotted lines show the southbound movements of vehicles that were recorded.

CHAPTER 4
RESULTS

Results from the questionnaire, field study, and spot speed study portions of the methodology are compiled and detailed in this chapter. First, responses to various sections of the questionnaire are summarized. Next, field study results characterize the design and traffic environment of the two study neighborhoods and the study street segments. Finally, findings from the spot speed studies of the street segments are described.

Questionnaire Results

Of the 239 questionnaires sent to Haile Village Center, 50 were returned for being undeliverable or addressed to a vacant residence. From the 187 delivered successfully, 80 were ultimately returned, a 42.3% response rate. Of the 83 questionnaires sent to College Park, 13 were returned for being undeliverable or addressed to a vacant residence. The response rate was far lower for this neighborhood. From the 70 delivered successfully, 20 were ultimately returned, a 28.6% response. These results are summarized in Table 4-1.

Not all questions were answered by all respondents, so for some questions, the number of responses is lower than the total number of respondents.

Demographics

Over 60% of Haile Village Center respondents were female, whereas College Park response was evenly divided between male and female. The age of respondents differed greatly between the two neighborhoods. Slightly less than half in Haile Village Center were 45 years old or above, while 85% were 25 years old or below in College Park. This age disparity was expected given College Park's proximity to the University of Florida and its reputation as a student-oriented neighborhood. Education also varied in terms of bachelor and graduate degrees. Haile Village Center had 42% of respondents with graduate degrees and 30% with bachelor degrees, compared to College Park with 30% graduate degrees and 20% bachelor degrees. However, the percentage of respondents in each neighborhood with an associate's degree or higher was similar: 88% in Haile Village Center and 85% in College park. Demographics are summarized in Figures 4-1, 4-2, and 4-3.

Travel and Modal Tendencies

Questionnaire results showed that 100% of Haile Village Center respondents had access to a car. For College Park, only one of the 20 total respondents did not have access to a car. Despite similar car ownership, regular usage was only 26.3% in College Park compared to 85% in Haile Village Center. At the same time, 55% of College Park respondents regularly walk to destinations, compared to 38.8% in Haile Village Center, a community designed to support walking and pedestrianism. It is likely that a large number of College Park residents also regularly bike to destinations, but this was not inquired in the questionnaire. For both study areas, no respondent claimed to never walk to destinations. Results are summarized in Figures 4-4 and 4-5.

Travel Behavior and Collision Reports

In Haile Village Center, 82.5% reported that their driving behavior changes as they enter the neighborhood's street network. A larger number, 96.3%, claimed to slow down upon entry. This discrepancy of percentages suggests that some respondents did not consider slowing down to be a change in driving behavior. Also, 73.6% claimed to communicate in a non-verbal manner with other road users, much in the spirit of the woonerf and shared space.

For the College Park study area, only 50% alleged to change driving behavior upon entry. The same discrepancy of percentages occurred with the two follow-up questions: 77.8% claimed to slow down and 55.6% claimed to communicate non-verbally. Respondent travel behavior is summarized in Figures 4-6 and 4-7.

No respondent in either Haile Village Center or College park claimed to have been involved in an automobile-pedestrian collision as a driver or pedestrian. However, 16.3% in Haile and 10.5% in College Park reported a close call with a pedestrian as a driver. Meanwhile, 10% in Haile and 30% in College Park reported a close call with a car as a pedestrian. Collision reports are summarized in Figures 4-8 and 4-9.

Safety Perceptions

For the series of questions regarding safety perceptions, respondents were asked to indicate whether they strongly agreed; agreed; neither agreed nor disagreed; disagreed; or strongly disagreed with certain statements. Results from this part of the questionnaire indicated the following:

- Ninety percent of Haile Village Center respondents either agreed or strongly agreed that they feel safe crossing neighborhood streets at all intersections - 88.8% felt the same way about crossing anywhere along the street. In College Park, the percentages were 80 and 70, respectively

- In Haile Village Center, at least 50% of respondents either disagreed or strongly disagreed to the each of the statements claiming that drivers, pedestrian, and bicyclists do not pay enough attention. In College Park, 15% disagreed for drivers, 35% for pedestrians, and 30% for bicyclists.

- About a third of respondents agreed or strongly agreed that drivers go too fast in Haile Village Center. The same faction represented 55% of respondents in College Park.

- Few people in either neighborhood felt that the streets are safe enough to play on during daytime hours. Only a quarter either agreed or strongly agreed in College Park, while the same number for Haile Village Center was 21.5%.

- Both neighborhoods felt their streets are generally safe for pedestrians - 92.4% in Haile Village Center and 65% in College Park either agreed or strongly agreed with the statement.
- Ninety-five percent in Haile Village Center either agreed or strongly agreed that streets need sidewalks to create a safe pedestrian environment, and 68.4% felt the same way about the statement that pedestrian safety is a matter of infrastructure design.
- Interestingly, though respondents in College Park generally felt that their curbless, shared streets are safe for pedestrians, 90% either agreed or strongly agreed that sidewalks are important to create a safe street environment for pedestrians.

The above results and additional safety perception responses can be seen in Figures 4-10 and 4-11.

After the section on safety perceptions, the questionnaire asked the respondents to provide a reasonable speed limit for their neighborhood's streets. If a range of speeds was given instead of a single number, the median speed in the range was recorded as the response. Results from this question were then averaged. For Haile Village Center, answers varied from a high of 35 mph to a low of 5 mph. The average was 17.8 mph with a standard deviation of 5.6 mph. For College Park, answers varied from a high of 30 mph to a low of 15 mph. The average was 21.8 mph with a standard deviation of 4.78 mph.

Field Survey Results

Haile Village Center

Before specific traffic calming elements were inventoried, some general characteristics of Haile Village Center were examined. According to GIS data, the study area is 40.63 acres. Dividing the total number of residential units from the questionnaire (239) by this acreage yielded a neighborhood density of 5.88 units per acre.

Next, transportation patterns were observed. On a road network map, a cordon was placed around the boundary of the village. On the perimeter of this cordon, there are only four access points, three connecting to SW 91 Street and one to SW 46 Boulevard. Both of these roads could be classified as connectors since they support Haile Plantation resident traffic to and from major and minor arterials. From this arrangement, it can be assumed that the Haile Village Center street network carries no external to external automobile trips. A substantial portion of village trips, however, are completely internal. A 1996 study determined that, of the 10.5 trips per day generated by single-family households, 23% were internally captured (Kramer, 2001). Consequentially, the remainder of the trips was classified as internal to external and vice-versa. These observations are summarized in Figure 4-12.

Many of the psychological traffic calming design aspects of Haile Village Center were found to originate from property ownership circumstances. The street network of the village is owned privately by the developer, giving the village home owners association powers over maintenance, security, and physical changes (Ben-Bassat, 1996, p. 88). Because of this governance, traffic controls and regulations are greatly different than those in neighborhoods of comparable density. For example, there is no posted or enforced speed limit. Additionally, parking has no formal regulation, though parallel parking bays are located on most street segments. Coverage of signage, striping, and other control devices is minimal throughout the village. The only discernable instances are stop signs at intersections, no-turn signs to indicate one-way streets, and parallel parking gage-length markings. In essence, Haile Village Center is the archetypal experimental American venue described by Ben-Joseph (1995).

The results of the segment design element field survey can be seen in Figures 4-13 and 4-14 in addition to Figure B-1 in Appendix B. The SW 91 Terrace segment is approximately 330 ft in length, and intersections at each end are controlled by stop signs. Abutting property consist of one vacant lot and five buildings, all mixed-use with offices at street level and residences above. When traveling down the street by automobile in either direction, visual linearity is experienced due to long building frontages. From the southbound approach, the driver's view is partially interrupted by building facades on the subsequent, gently curving segment.

The SW 91 Drive segment is approximately 375 ft in length, and only the southern intersection has stop sign control. Two alleyway access points are midblock on the eastern curb. Property lining the segment consists of one 16 single-family homes and one garage structure (without direct street access). Due to the numerous small building frontages, visual linearity when traveling by automobile is mostly dispersed. The southbound view is fully enclosed by a 90 degree bend and three homes placed perpendicular to the study segment.

Cross-section views of both segments reveal nearly identical street geometry. Street widths are 21 ft, abutted on each side by 8 ft parking bays. Building setbacks are 11 to 12 ft, with a 5.5 to 6 ft landscape planter buffering pedestrian sidewalks. Properties fronting both segments have similar building heights, creating comparable proportions with regard to street enclosure. One noticeable difference exists with the trees lining either segment. While landscape buffer trees on SW 91 Terrace are approximately 25 to 30 ft tall, those lining SW 91 Drive are older and taller, rising approximately 40 to 45 ft and creating a much more substantial canopy over the travelway.

College Park Study Area

The College Park study area is 13.04 acres according to GIS data. Dividing the total number of residential units from the questionnaire (83) by this acreage yielded a neighborhood density of 6.36 units per acre.

Placing a cordon around the boundary of the College Park study area reveals nine access points on the perimeter. Two of these points connect to NW 13th Street, a major north-south arterial. One connects to NW 6th Avenue, a residential local street. The remaining six connect to NW 7th Avenue and NW 5th Avenue, local streets that carry some east-west through traffic. NW 15th Street, one of the study segments, runs straight through the neighborhood and, continuing north to NW 8th Avenue, a minor east-west arterial, and south to W University Avenue, a major east-west arterial. This street pattern suggests a fair amount of external to external trips, or cut-through traffic, in the College Park study area. NW 15th Street likely bears the most external to external trips, but the other neighborhood streets no doubt experience cut-through traffic as well. Internal to external trips and external to internal trips are generated by neighborhood residents, their visitors, and patrons of the businesses bordering NW 13th Street within the neighborhood. Internal to internal trips may occur when neighborhood residents patronize those same businesses. These observations are summarized in Figure 4-15.

While the College Park study area is gridded like the surrounding network of streets, the layout and design of streets is different. Blocks in the study area is about two-thirds the length of a typical Gainesville block. With the exception of NW 15th Street where it meets NW 5th Avenue and NW 7th Avenue, the street pavement is not striped or marked. Additionally the streets have no curb or gutter and are narrower than surrounding streets. Without a curb soil, plants, and other debris encroach on the street right of way. As much as two feet of travelway pavement on either side may be covered at any given location along the roadway. Stop signs are the only traffic control in the neighborhood, placed on the east-west streets where they intersect the north-south streets. There is no posted speed limit, but since the roads are publicly owned and residential in nature, a speed limit of 30 mph applies. Street parking is not allowed, but sometimes vehicles infringe on the right of way when parked on adjacent properties.

The results of the segment design element field survey can be seen in Figures 4-16 and 4-17 in addition to Figure B-2 in Appendix B. The NW 15th Street segment is approximately 600 ft in length. The intersection with NW 7th Avenue at the north end of the segment is a traffic circle and is controlled by a yield sign. The intersection with NW 5th Avenue at the south end of the segment is a four-way stop. The segment has the right of way with all other east-west cross streets. Abutting property consists of six one-story single family homes, three one story multi-family complexes, and one two-story boarding house. The view of the driver is linear and mostly unobstructed traveling in both directions, though the traffic circle likely becomes a visual focal point for approaching northbound drivers. There are no sidewalks on the segment between NW 5th Avenue and NW 7th Avenue, so the surface is shared by motorists, bicyclists, and pedestrians, though some pedestrians chose to walk on the frontages of adjacent properties.

The NW 13th Terrace segment is approximately 620 ft in length. The intersections with NW 5th Avenue and NW 7th are controlled by stop signs, but the segment has the right of way with all other east-west cross streets. Abutting property consists of four one-story single family homes, three one-story duplexes, a pair of adjoined two-story townhouses, a two-story auxiliary apartment, a one-story quadplex, and a vacant lot used for private permit parking. The view of the driver is fairly linear at the midpoint of the segment but becomes fully enclosed as northbound and southbound drivers approach the termini at NW 7th Avenue and NW 5th Avenue, respectively. As with NW 15th Terrace, there are no sidewalks on the segment between NW 5th Avenue and NW 7th Avenue, so the surface is shared by motorists, bicyclists, and pedestrians, though some pedestrians chose to walk on the frontages of adjacent properties.

Cross-section views of both segments reveal similar but slightly different street geometry. The roadway is 20 ft wide along NW 15th Street, and building setbacks are between 25 and 45 ft. The roadway only 16 ft wide along NW 13^{h} Terrace, and building setbacks are between 20 and 35 ft. Building heights on both segments are 18 to 20 ft for one story buildings and around 30 ft for two story buildings. On both segments, the proportions of building height to street width, combined with the large setbacks, create very little enclosure. Trees along the street segments are not formal streetscape elements like those in Haile Village Center, and their placement is organic. They form a high canopy approximately 80 to 120 ft above the street. The canopy is almost fully enclosed all along NW 13th Terrace. The trees are more spread out in the building setbacks on NW 15th Street, so there is a large gap in the canopy coverage for the middle third of the segment. Since the height of the limbs is fairly high on both segments, the College Park trees do not really create a tunnel effect to the same degree as the street trees in Haile Village Center.

Spot Speed Study Results

Combining AM and PM records, the spot speed tests yielded 149 entries on SW 91 Terrace, 59 entries on SW 91 Drive, 250 entries on NW 15th Street, and 87 entries on NW 13th Terrace. For each of the AM, PM, and combined data sets the mean speed, median speed, and standard deviation were determined for each segment.

Next, the speed records were processed to determine the 85th percentile and 15th percentile speeds. Roess, Prassas, and McShane recommend identifying these two values since they can be used to describe the high and low speeds of most reasonable drivers (2004, p. 213). The upper and lower 15% of the speed distribution are generally thought of as too extreme to accurately describe existing conditions (Roess, Prassas, & McShane, 2004, pp. 213-214). Additionally, many roads are designed by the desired 85th percentile speed, so it is one of the most important measures in understanding driving behavior.

To find the 85th and 15th percentile speeds, records were grouped into 2 mph ranges. A frequency percentage for each group was calculated against the overall number of records. Then, a cumulative frequency percentage was computed for the speed groups, working in ascending order from the lowest to highest group value. From these calculations, frequency and cumulative frequency distribution scatter graphs were generated for each segment. The graphs with fitted smooth curves can be seen in Figure C-1 through Figure C-12 in Appendix C, and the frequency distribution tables they were derived from can be seen in Table C-1 through Table C-12. Values for 15th percentile, 85th percentile, and mean (50th percentile) speed were interpolated from the cumulative frequency graphs. A summary of all major speed test statistics, pedestrian and bicycle counts, and parking observation results is shown in Table 4-2.

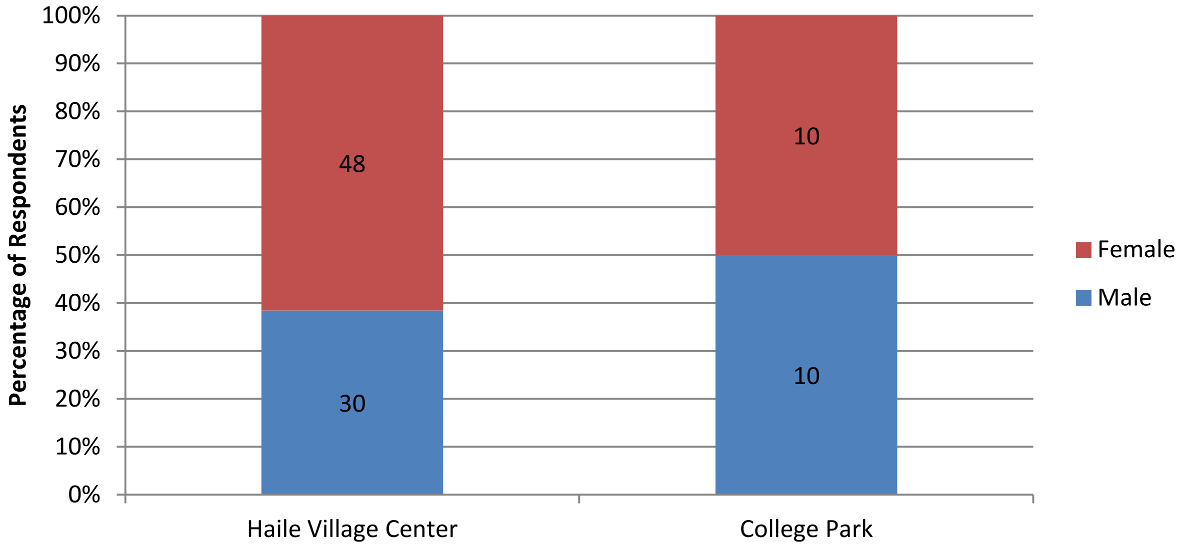


Figure 4-1. Questionnaire: gender of respondents. The number of respondents to give each answer appears on the columns.

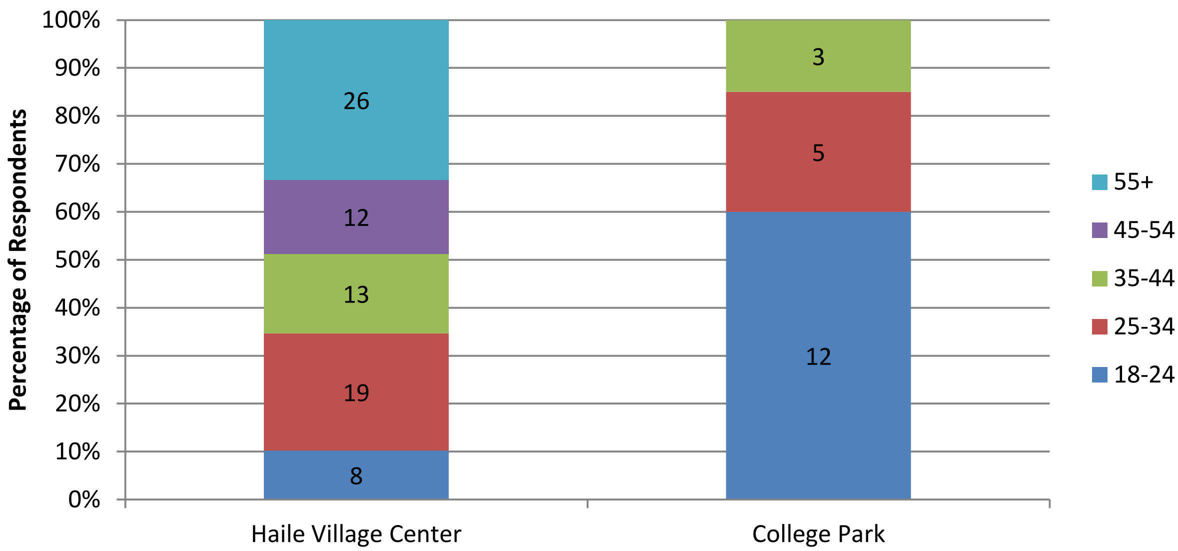


Figure 4-2. Questionnaire: age of respondents. The number of respondents to give each answer appears on the columns.

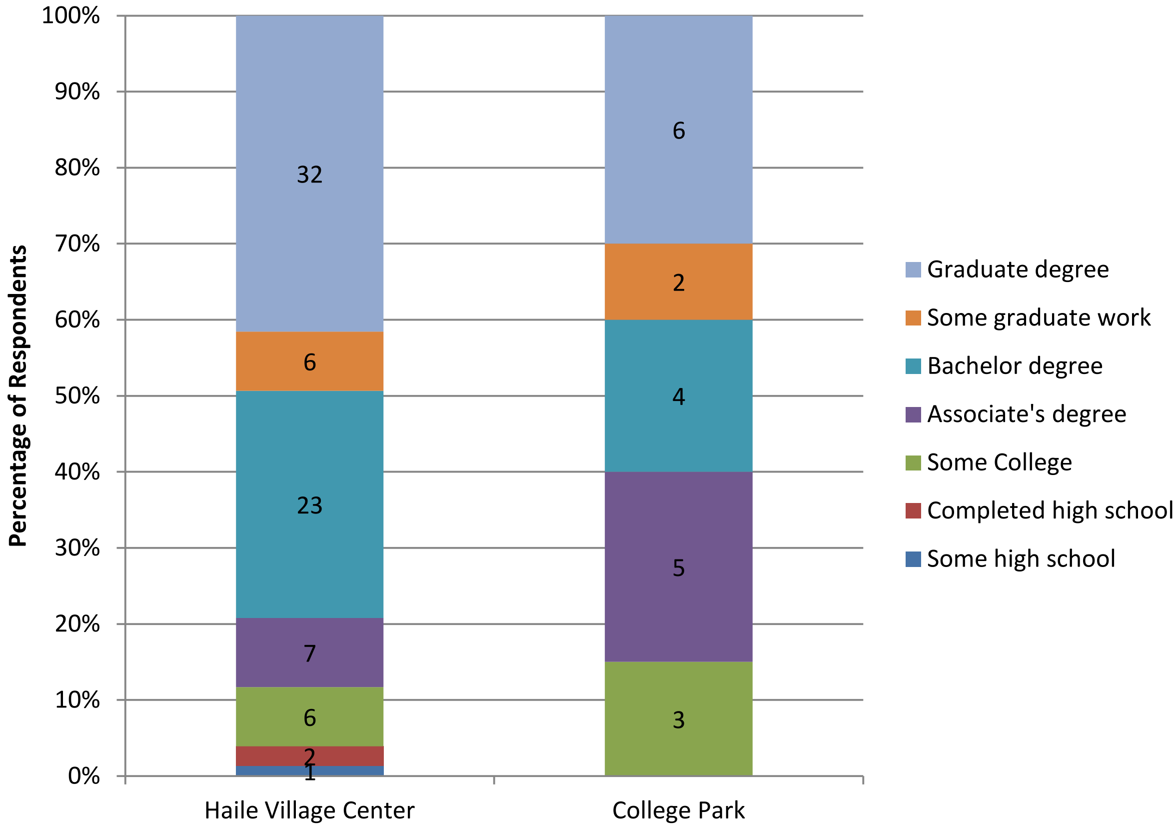


Figure 4-3. Questionnaire: education of respondents. The respondent was asked to select the highest level of education he or she had completed. The number of respondents to give each answer appears on the columns.

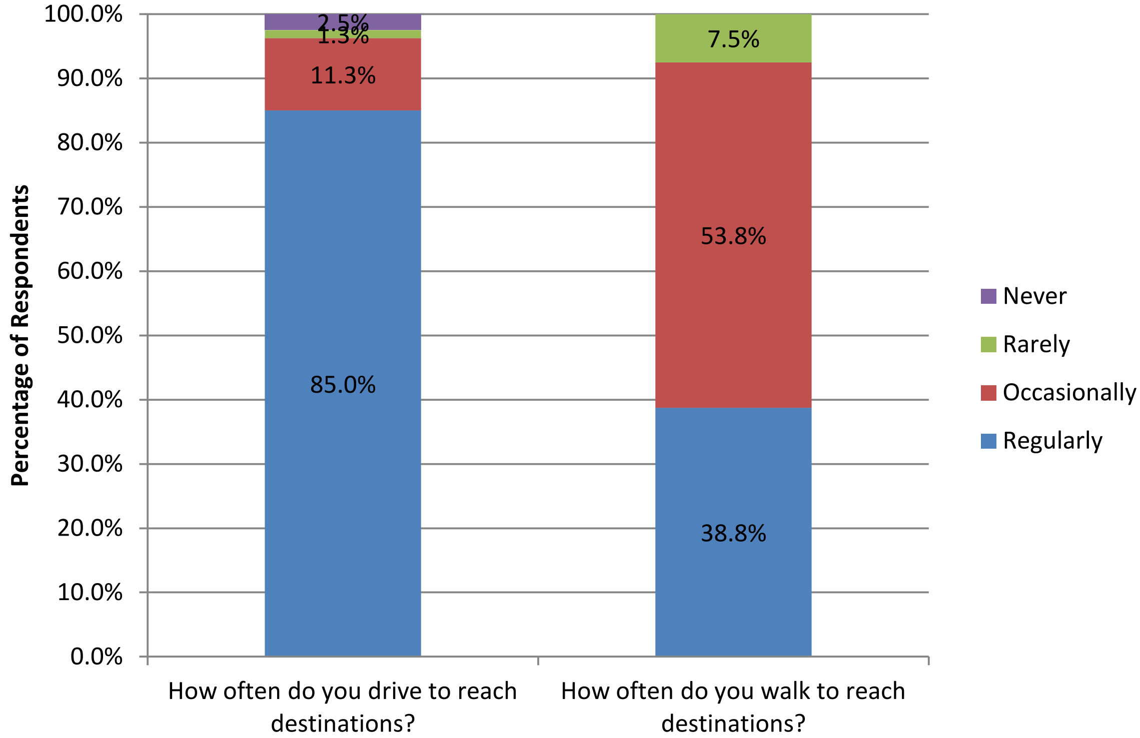


Figure 4-4. Questionnaire: Haile Village Center modal tendencies.

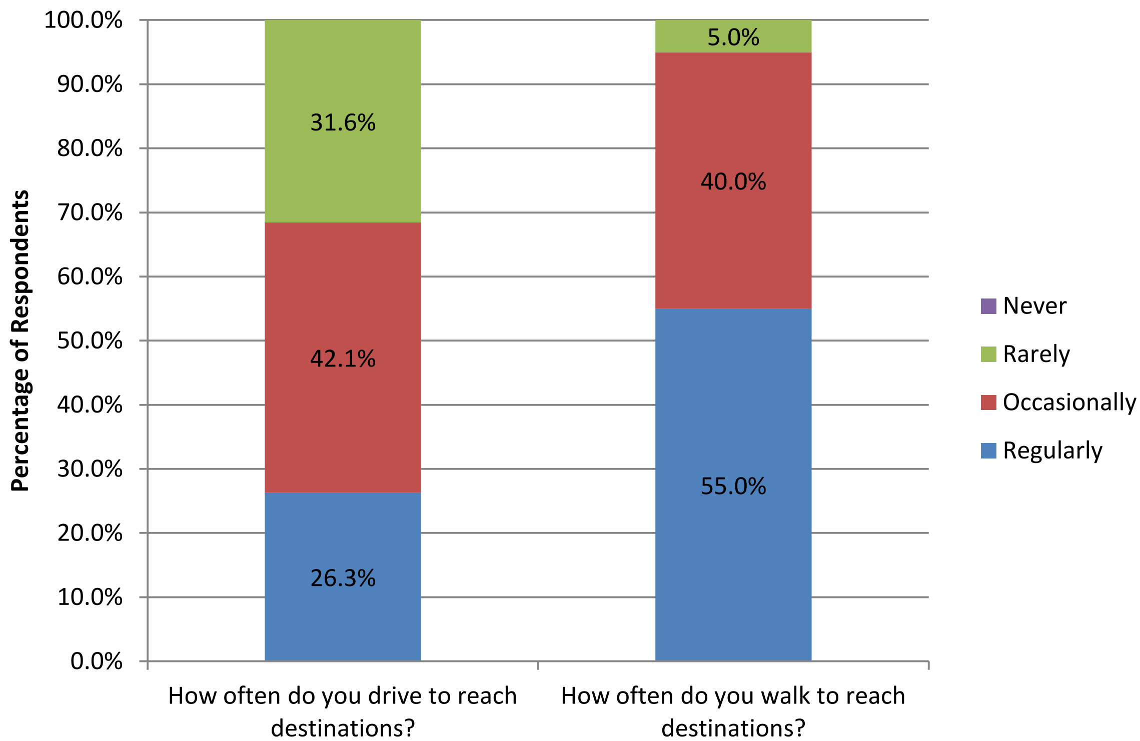


Figure 4-5. Questionnaire: College Park modal tendencies.

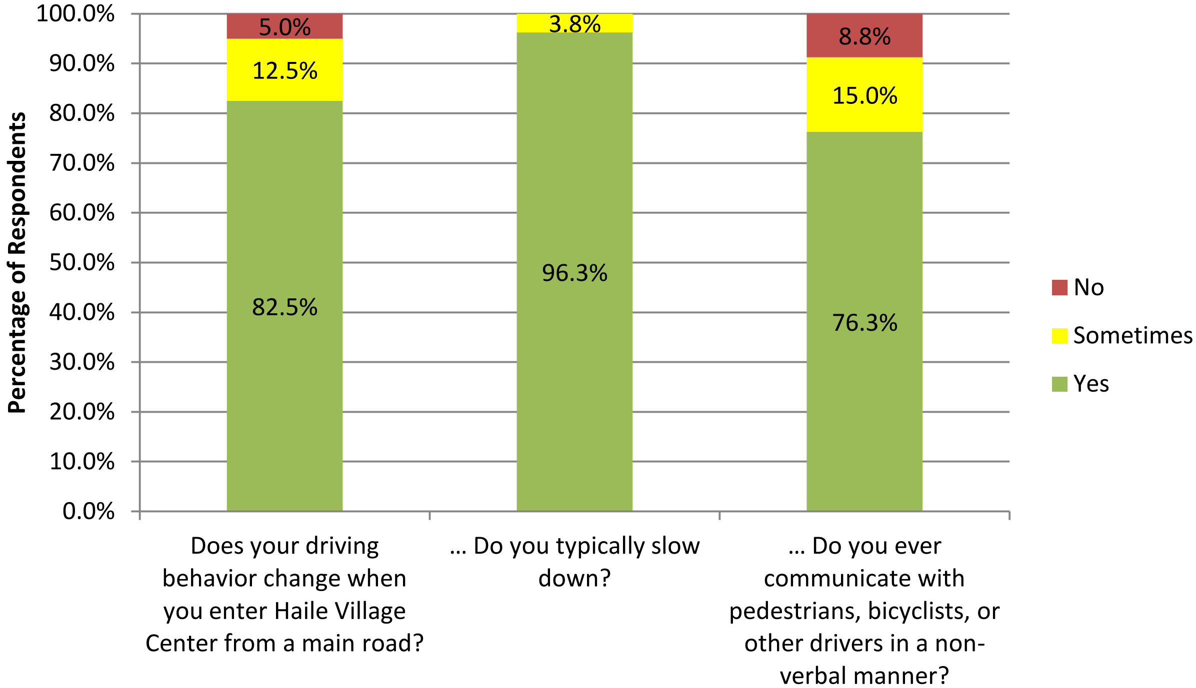


Figure 4-6. Questionnaire: Haile Village Center driver behavior.

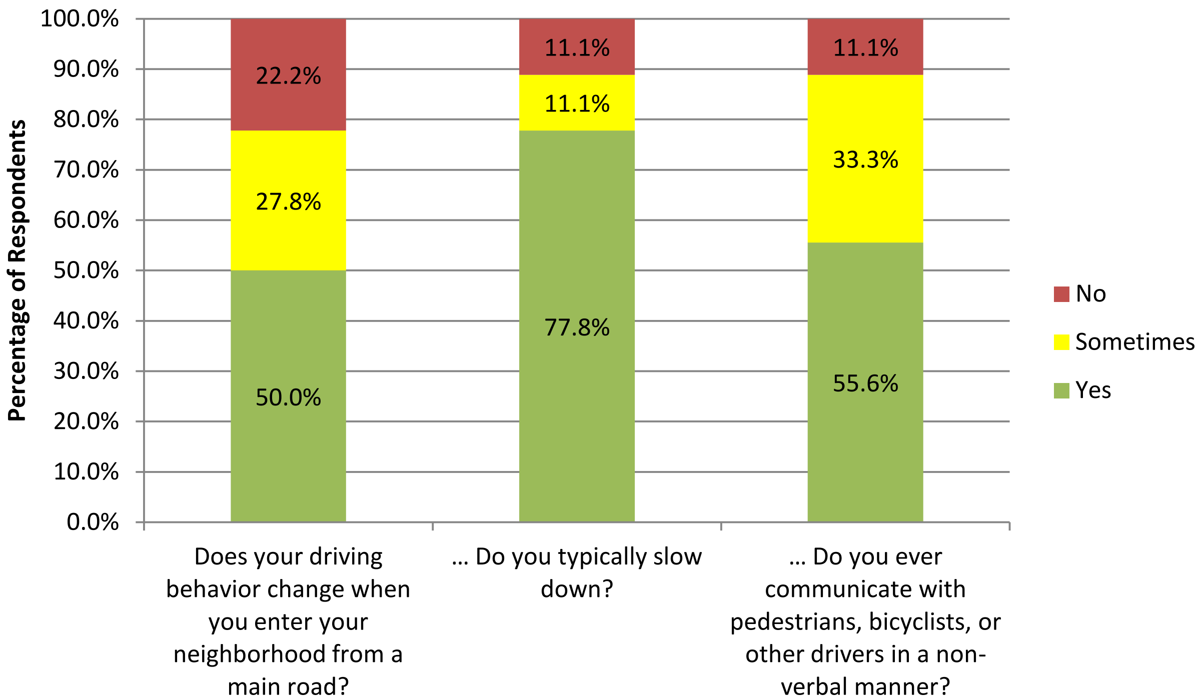


Figure 4-7. Questionnaire: College Park driver behavior.

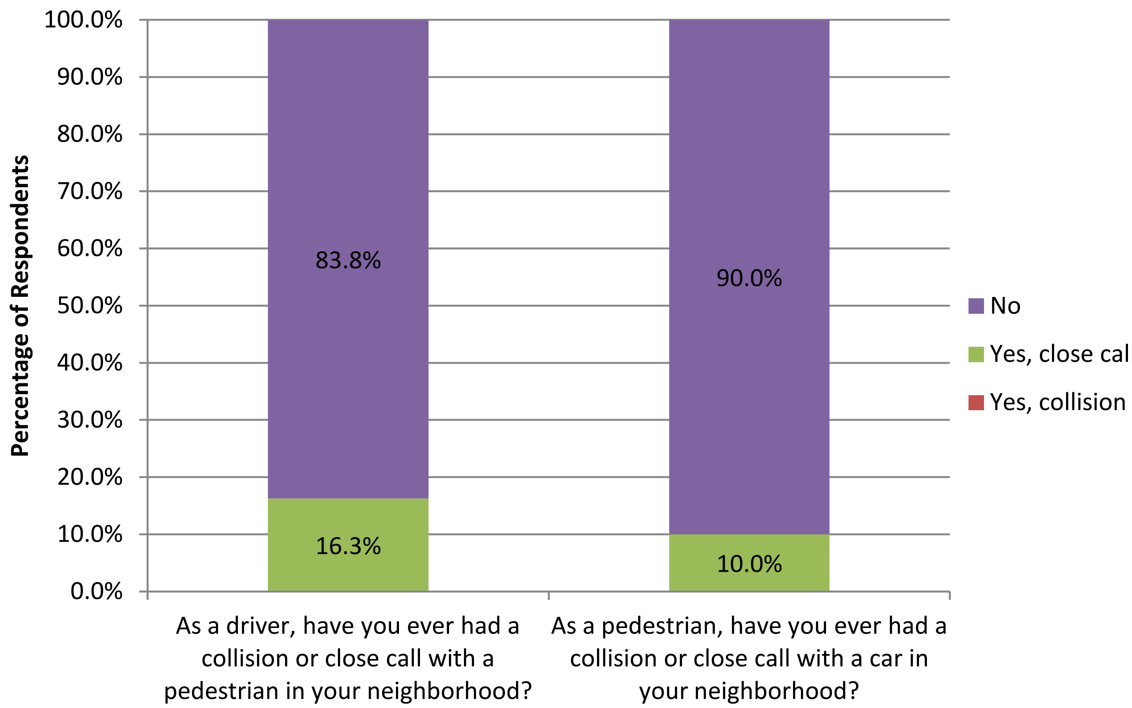


Figure 4-8. Questionnaire: Haile Village Center collisions.

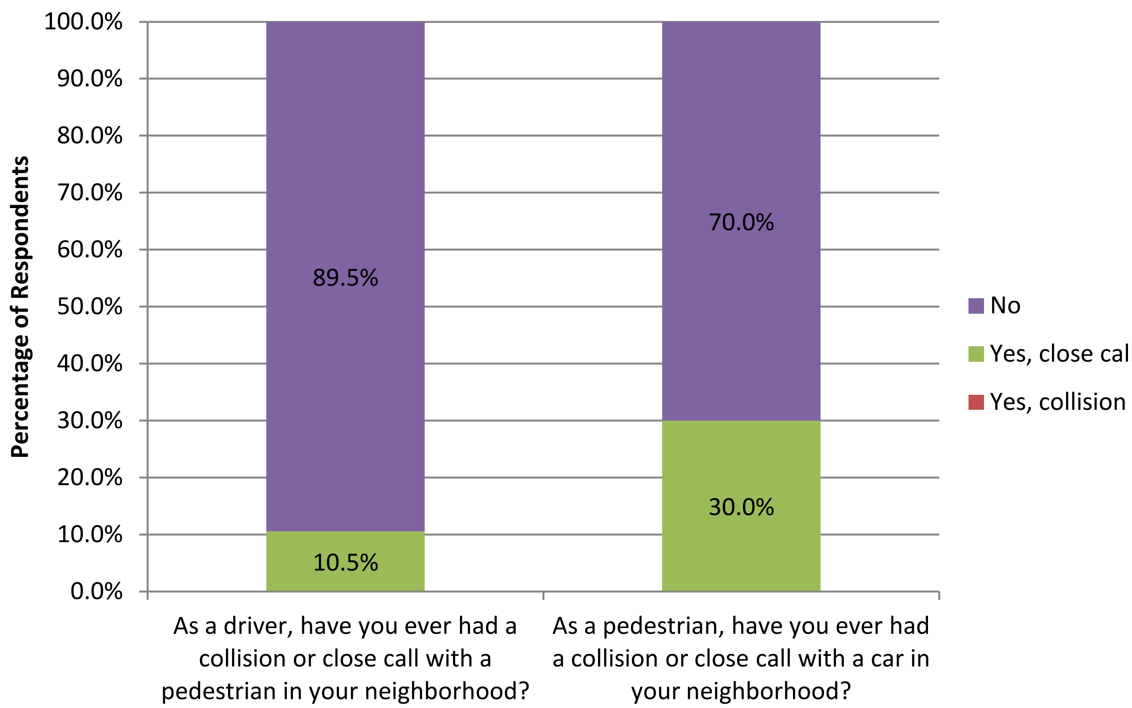


Figure 4-9. Questionnaire: Haile Village Center collisions.

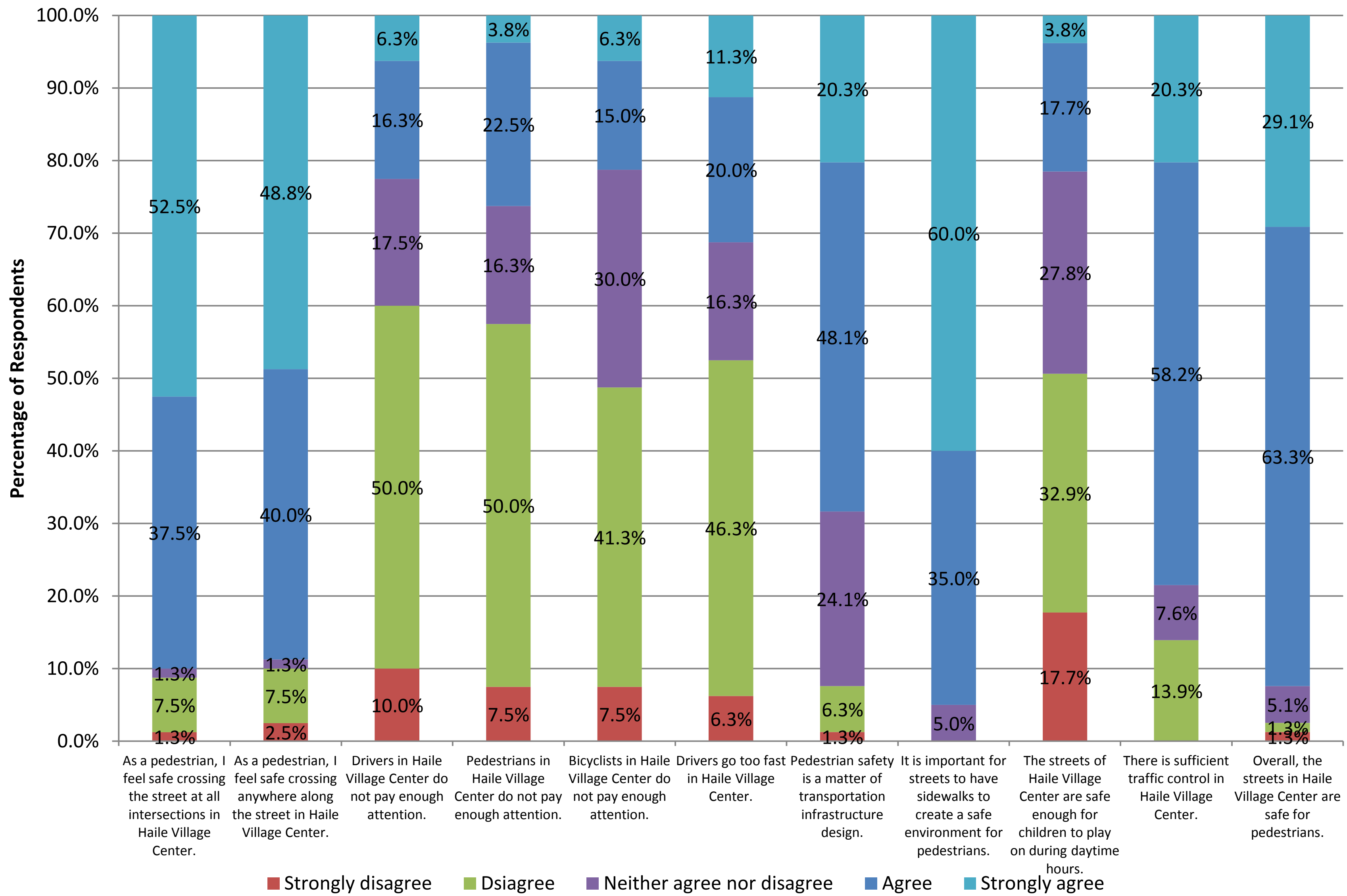


Figure 4-10. Questionnaire: Haile Village Center safety perceptions.

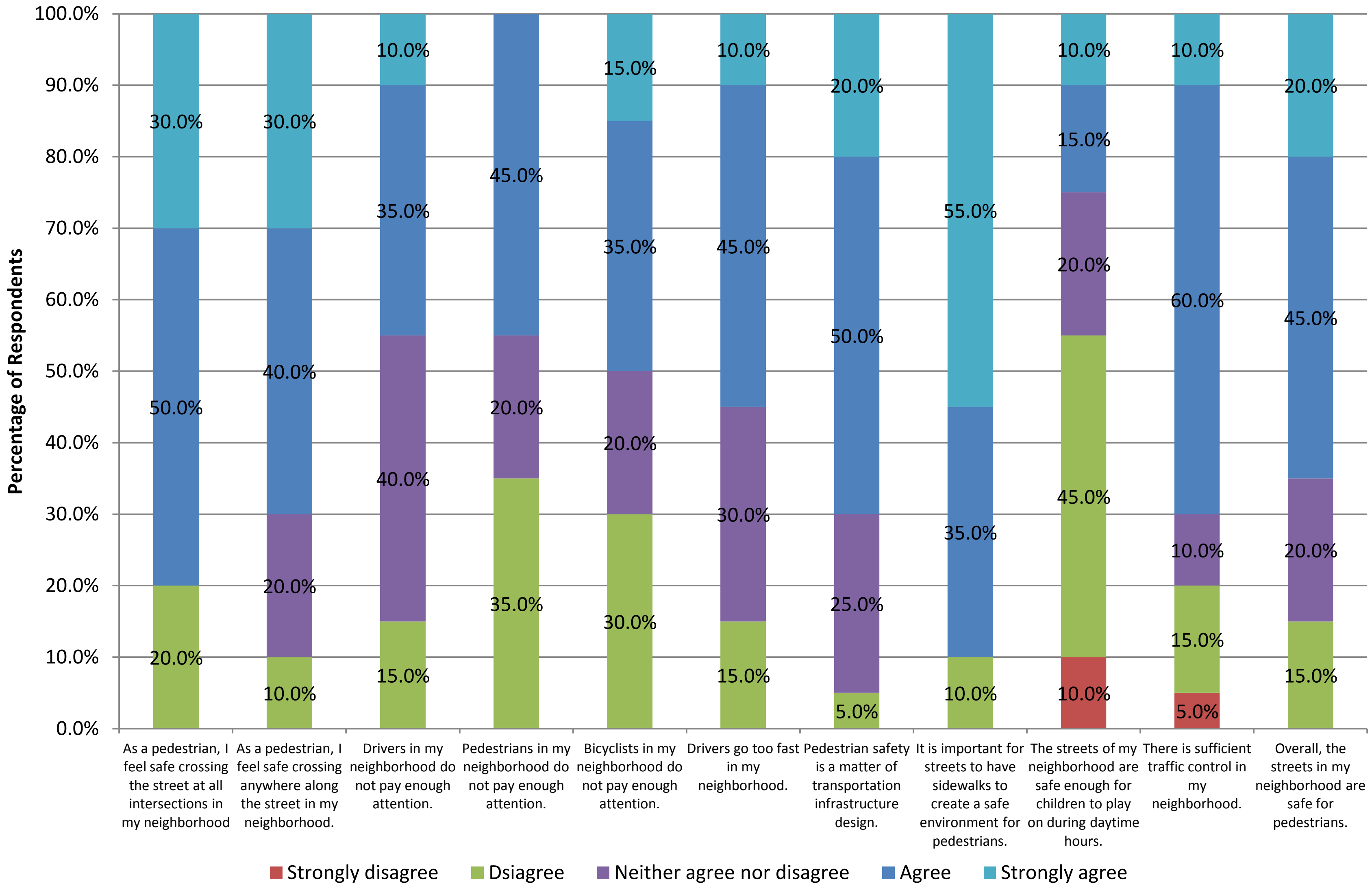


Figure 4-11. Questionnaire: College Park safety perceptions.

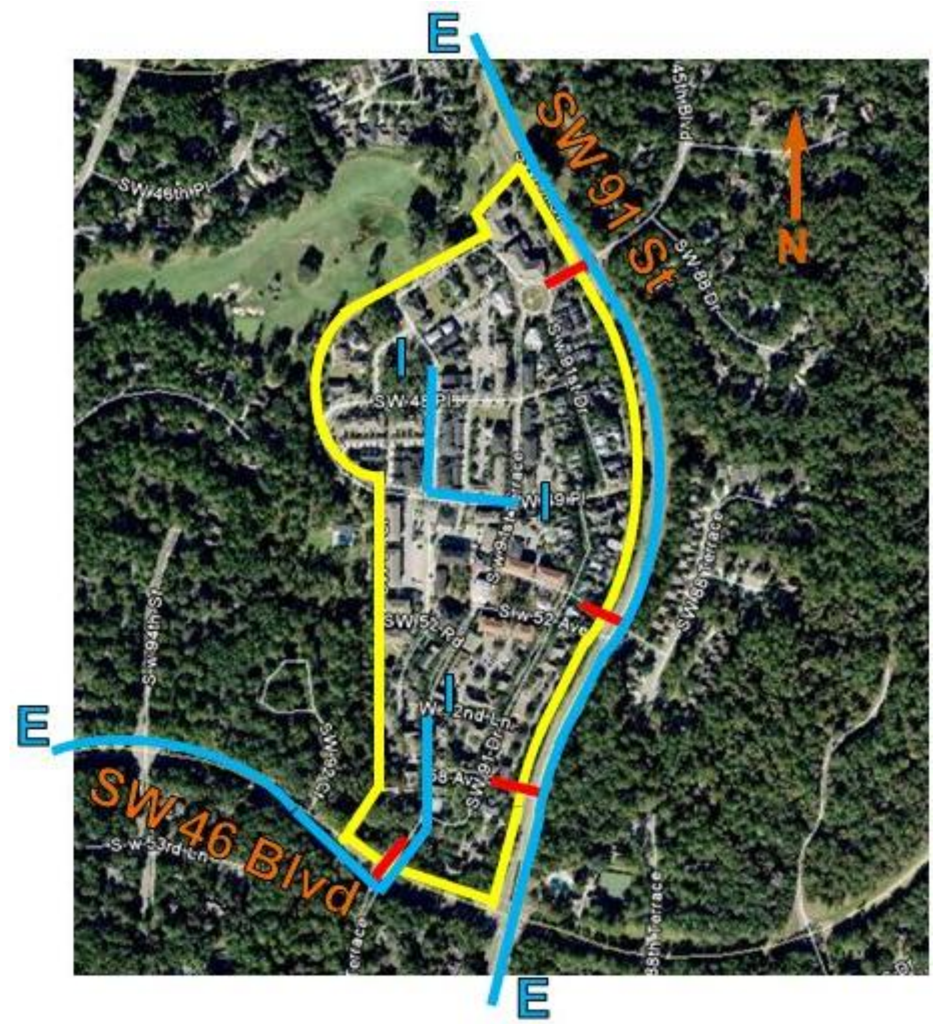


Figure 4-12. Haile Village Center travel patterns. The network cordon is seen in yellow. Cordon access points are marked in red."I" denotes an internal origin or destination of a trip and "E" an external origin or destination.

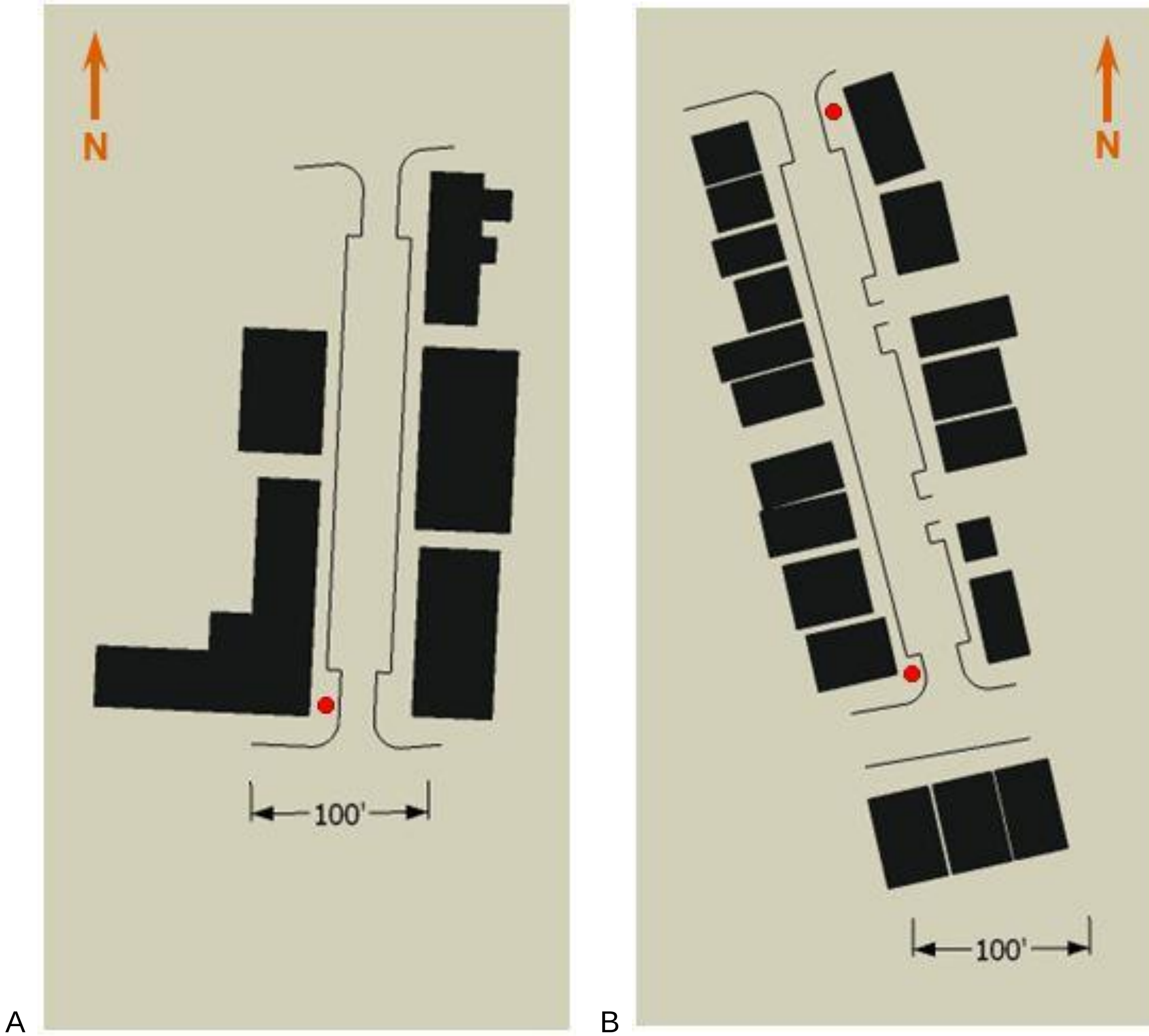


Figure 4-13. Plan view of Haile Village Center street alignments and building footprints. Red dots indicate stop sign traffic control installations. A) SW 91 Terrace. B) SW 91 Drive.

A

B

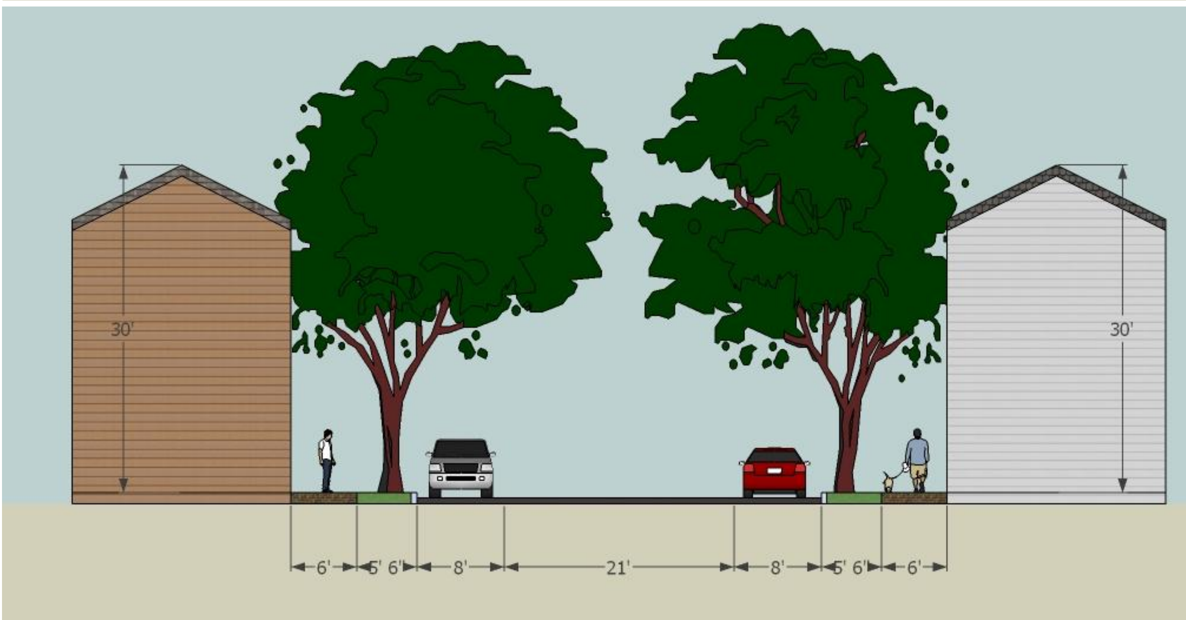
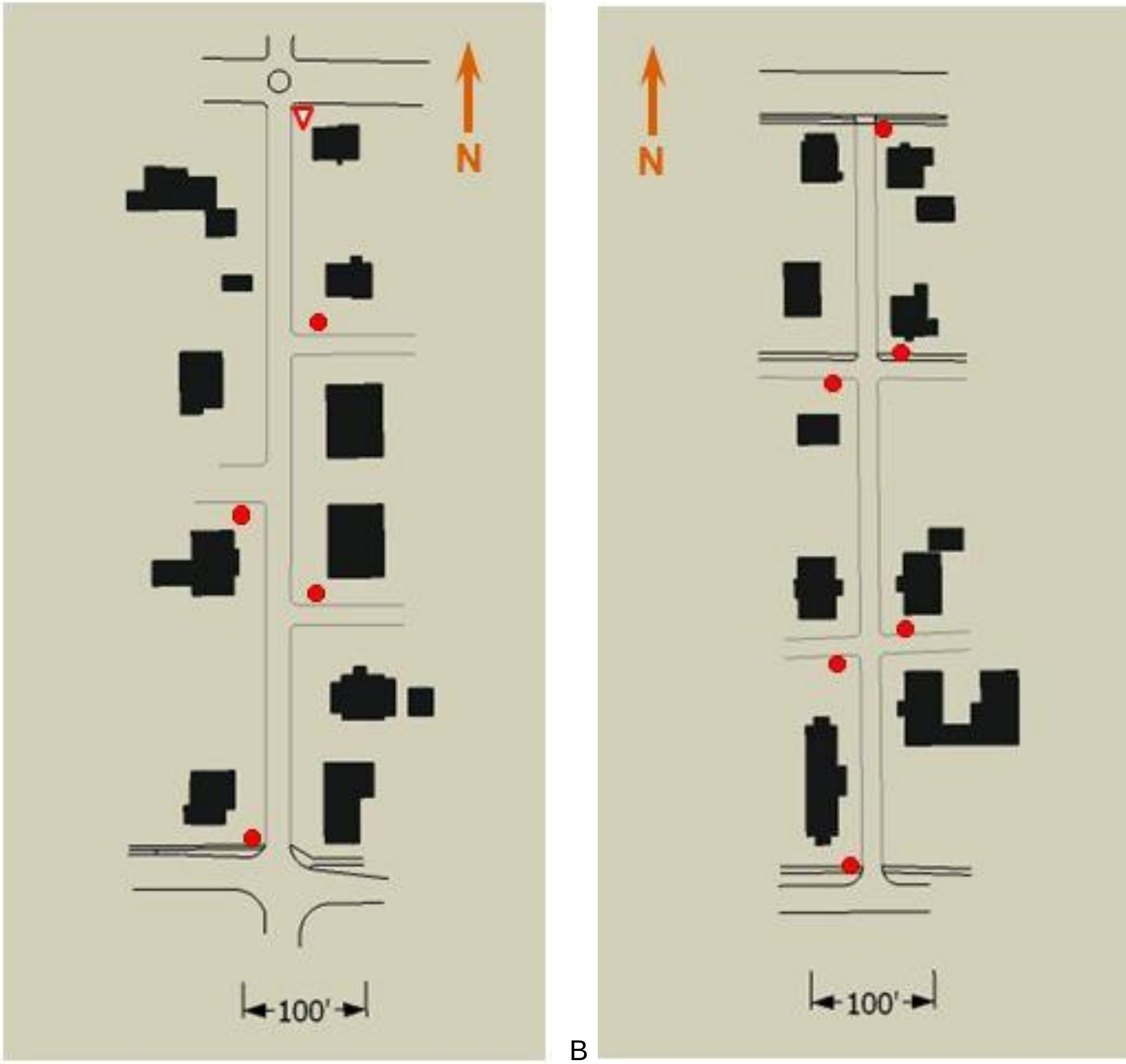


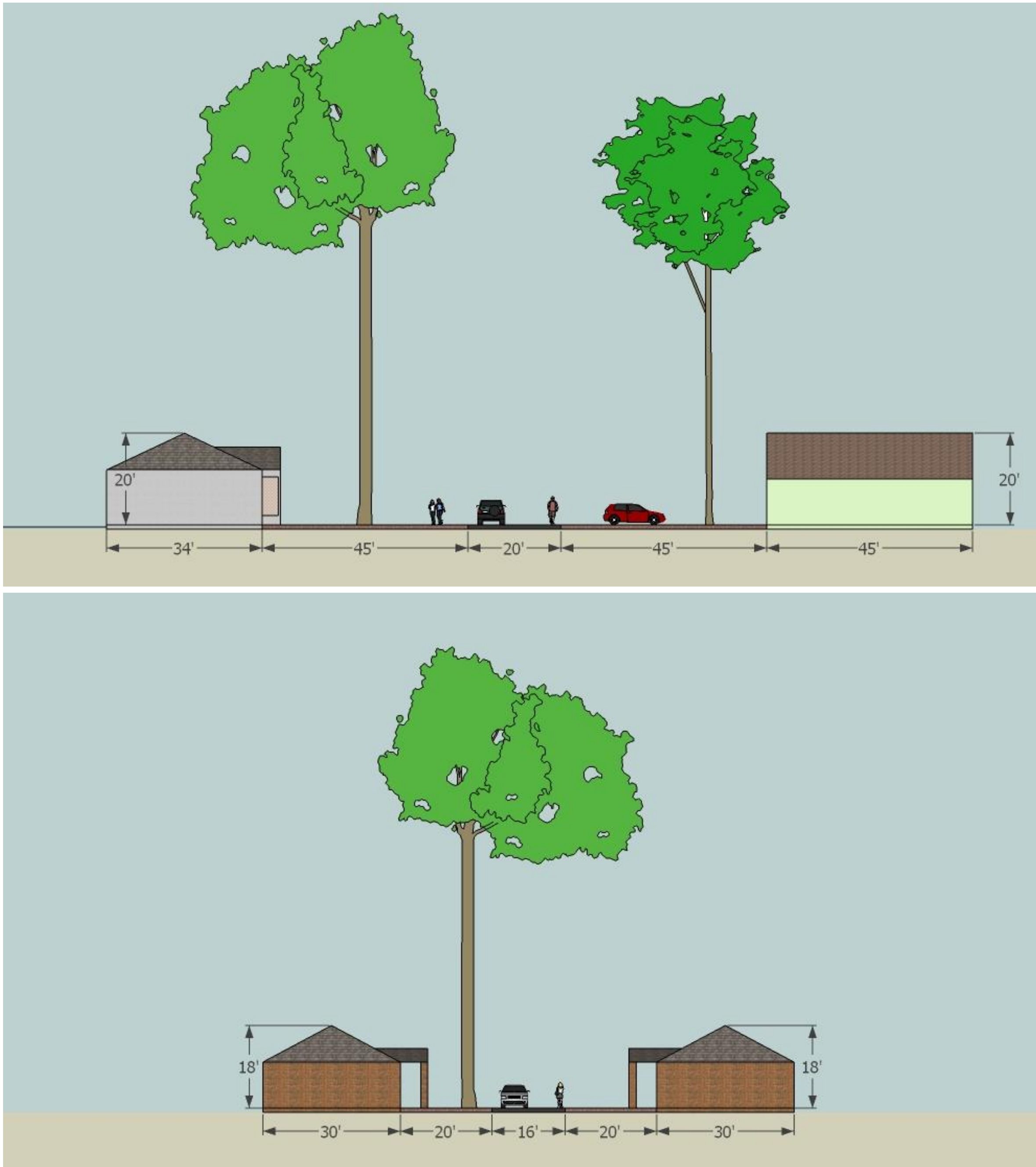
Figure 4-14. Section profile of Haile Village Center street geometry. A) SW 91 Terrace. B) SW 91 Drive.

Figure 4-15. College Park Study Area travel patterns. The network cordon is seen in yellow. Cordon access points are marked in red."I" denotes an internal origin or destination of a trip and "E" an external origin or destination.



A B

Figure 4-16. Plan view of College Park street alignments and building footprints. Red dots indicate stop sign traffic control installations. Red-rimmed triangles with white background show yield sign locations. Where the street outlines are light grey in color, the roadway has no curb and sits at-grade with surrounding properties. A) NW 15th Street. B) NW 13th Terrace.



A
B

Figure 4-17. Section profile of College Park street geometry. A) NW 15th Street. B) NW 13th Terrace.

Table 4-1. Questionnaire send out and response rates

Measure	Haile Village Center	College Park
Original send out (gross send out)	239	83
Vacant or undeliverable	50	13
Successfully delivered (net send out)	187	70
Completed and returned	80	20
Gross response rate	33.5%	24.1%
Net response rate	42.3%	28.6%

Table 4-2. Summary of spot speed study results

Measure	Haile Village Center						College Park Study Area					
	SW 91 Terrace			SW 91 Drive			NW 15th Street			NW 13th Terrace		
	AM	PM	TOT	AM	PM	TOT	AM	PM	TOT	AM	PM	TOT
Vehicle Count	61	88	149	26	33	59	71	179	250	26	61	87
Parking Occupancy	60%	40%	50%	30%	40%	35%	-	-	-	-	-	-
Pedestrian Count	18	15	33	14	12	26	29	49	78	14	9	23
Bicycle Count	9	3	12	2	3	5	37	56	93	6	14	20
Mean Speed (mph)	17.5	18.7	18.2	17.1	17.4	17.3	24.9	24.3	24.5	18.0	18.4	18.3
Median Speed (mph)	18.0	18.0	18.0	16.0	17.0	17.0	25.0	24.0	24.0	17.0	18.0	18.0
Standard Deviation (mph)	3.4	3.3	3.4	3.2	3.3	3.3	3.9	4.0	4.0	3.8	3.5	3.6
15th Percentile Speed (mph)	13.0	15.2	14.4	13.0	13.6	13.3	20.8	19.8	20.3	14.0	14.4	14.0
85th Percentile Speed (mph)	20.0	20.8	20.4	20.4	20.0	20.2	28.2	28.4	28.3	22.0	22.8	22.4

CHAPTER 5
DISCUSSION

The following chapter uses the results from the questionnaire, field survey, and spot speed studies to determine the effectiveness of psychological traffic calming within the study areas. The evaluation of effectiveness was broken down into the following questions:

- Do neighborhood residents feel safe among calming schemes that are more psychological than physical?
- Does driving behavior change when drivers enter the psychologically calmed neighborhoods?
- Do psychological calming schemes slow traffic to levels similar to that of physical calming?
- Do psychological calming schemes keep traffic at speeds comparable to residential street design best practices?
- Do psychological calming schemes slow traffic to levels acceptable to neighborhood residents?
- Does successful psychological calming require intensive design and infrastructure, or can it also be successful in locations with few formal design elements?

Deficiencies in effectiveness are addressed, and recommendations for improving these deficiencies are proposed. Finally, limitations identified within the methodology and results are discussed.

Perception of Safety

Pertinent respondent statistics are summarized in Table 5-1. A great majority from both neighborhoods felt safe crossing anywhere along the street as well as at all intersections. However, neither neighborhood felt their streets were safe enough for children to play on. In this case, the actual safety level of streets may not have been the most important factor to respondents when answering. Instead, many may have simply felt that streets should not be used as public space or that children should not be exposed to any risk beyond the perceived minimum.

A major difference between the study areas was seen in the perceptions of road user behavior. Compared to College Park, residents in Haile Village Center tended to be more confident in the attentiveness of motorists, pedestrians, and bicyclists and more comfortable with the speed of drivers on their streets. Many of the free responses received for College Park mentioned that stop signs on the east-west streets were often not obeyed by road users, so a lot of the general distrust of other road users may stem from this phenomenon. Additionally, external to external vehicle trips, or cut-through traffic, may be a factor.

On the whole though, the questionnaire results made it clear that neighborhood residents of both Haile Village Center and the College Park study area felt their psychologically calmed streets were safe for pedestrians, with 92.4% and 65%, respectively, either agreeing or strongly agreeing.

Driver Behavior

In Haile Village Center, a large majority of respondents claimed to change driving behavior when entering the neighborhood. Similarly, they largely claimed to slow down and communicate with other road users non-verbally. This is consistent with the theory that a psychologically calmed area will create slower, more attentive drivers.

In College Park, the fact that only 55.6% of respondents reported communicating non-verbally with pedestrians, bicyclists, and other motorists upon entering the neighborhood street network was surprising. The design of most street segments in this neighborhood, including the two selected for deeper study, requires that users share a single, narrow travelway, and Woonerf and shared space case studies typically indicated that streets such as these encourage pedestrian-driver communication by design. One survey respondent expressed dissatisfaction with the behavior of College Park drivers:

> Drivers on these streets … are often openly hostile to pedestrian and cyclists; the danger, then, is not only a matter of infrastructure, but also cultural attitude (i.e., the absolute power of the individual owner automobile over all other forms of transportation). I LIKE my narrow, sidewalk-free streets. The problem is the recklessness, obliviousness, and hostility of drivers.

Another respondent reported far better behavior and etiquette on the part of College Park drivers: “While biking, I have only been cut off by a driver running a stop sign once and they clearly realized their mistake immediately and acted apologetic. I actually like the lack of sidewalks on most of the streets and enjoy walking in the middle when I can.”

By comparison, Haile Village Center, which separates pedestrian and motorized traffic, reported a non-verbal communication percentage of 73.6. Perhaps other design and contextual factors, such as proximity to the high speed and volume NW 13th Street, contributed to this unexpected behavioral tendency in College Park.

Speeds Compared to Physical Traffic Calming

The statistics from the spot speed studies matched up fairly well with the speed goals of physical traffic calming mechanisms. A 90 foot radius chicane aims for traffic speeds of 20 to 25 mph, and a standard speed hump has a design speed of 15 to 20 mph (Ewing, 1996). Of the segment mean and 85th percentile speeds, only the 85th percentile speed of NW 15th Street was above the speed range of the 90 foot chicane. Additionally, neither the mean nor 85th percentile speed for NW 15th Street fell within the design speed of a speed hump. The 85th percentile speeds of all the other segments were slightly above the range of the speed hump. At the same time all the mean speeds of those segments fell comfortably into speed hump range.

Overall, NW 15th Street in College Park was the only segment to not perform on comparable levels with physical calming measures.

Speeds Compared to Design Best Practices and Livable Street Standards

Previously, local roads in the United States had been held to a minimum design speed of 30 mph (Ewing, 1996, p. 66). In the City of Gainesville, some residential streets are signed for speeds below this value, but 30 mph is the default limit for unsigned streets.. In recent years, many have advocated lower speeds for various types of local streets. Nelessen (1994) recommends a limit of 25 mph for streets in newly constructed small communities (p.190). Street standard researchers Southworth and Ben-Joseph (1997) suggest that speed on residential streets be below 20 mph (p. 145). Meanwhile, slow speed areas with pedestrian concerns in the Netherlands usually aim for a 30 kilometer per hour, or about 19 mph, design speed (Tolley, 1997, p. 272). A joint publication of the Urban Land Institute (ULI), National Association of Home Builders (NAHB), American Society of Civil Engineers (ASCE), and Institute of Transportation Engineers (ITE) recommends 20 mph for local streets on level terrain but allows 30 mph for residential collectors on level terrain, reasoning that the collector has greater movement needs (2001, p. 20).

As mentioned in Chapter 2, the difference in pedestrian safety between 30 mph and 20 mph is staggering. Whereas a pedestrian has an 85% chance of surviving a traffic collision at 20 mph, the survival rate drops to 55% at 30 mph (United Kingdom Department of Transportation, 1987). Considering 16.3% of drivers and 10% of pedestrians in Haile Village Center and 10.5% of drivers and 30% of pedestrians in

College Park claimed to have had close calls in neighborhood traffic, keeping speeds at 20 mph or lower would be a good precaution. However, Appleyard (1981) advises that a speed limit of 15 mph may even be too much if children are known to utilize the street as a play zone (p. 296). Table 5-2 displays the discussed best practice speeds, along with all the observed segment mean and 85th percentile speeds, in order from highest to lowest value.

By these policies and standards, the observed mean and median speeds for both street segments in Haile Village Center were relatively low. Further, the 85th percentile speeds measured at or below the 20 mph design standard.

The NW 15th Street 85th percentile speed in College Park did not compare favorably to any of the standards except the 30 mph speed limit typically seen for residential streets in the United States and the ULI design speed for residential collectors. On the other hand, the results for NW 13th Terrace closely matched the performance of the Haile Village Center segments.

It should be noted that neither the 85th percentile speed nor the mean speed for any of the segments reached the 15 mph or lower recommended by Appleyard for streets with children at play. This result gives a degree of legitimacy to the prevailing sentiment that the streets are not safe enough for children to play on in either neighborhood.

Speeds Compared to Desired Levels of Residents

A comparison of segment speed results and the average desired neighborhood speed calculated from questionnaire results can be seen in Table 5-3. None of the 85th percentile speeds satisfy the desired speeds. All segments aside from NW 15th Street had mean speeds below the desired levels, however.

Given these and previous results, should the NW 15th Street segment be considered unsafe for pedestrians and the psychological scheme deemed unsuccessful? The answer depends on how NW 15th Street is prioritized. Clearly, not all streets should be designed primarily for the movement of automobiles, as once suggested by Le Corbusier and a generation of traffic engineers. Likewise, not all streets should be woonerven or shared spaces. There are many street design typologies in between with various levels of automobile or pedestrian priority. As a purely local, residential street, NW 15th Street exceeds physical calming, best practice, and desired speed standards. As a residential collector that gives a greater amount of priority to the expedited movement of motor vehicles, it is acceptable. Since NW 15th Street connects W University Avenue with NW 8th Avenue, two major east-west movement corridors, the residential collector classification may be more appropriate. However, in the residential collector scenario, more design elements would ultimately be needed to protect a more vulnerable population of bicyclists and pedestrians.

Through the comparisons to physical calming and best practices, the other three segments looked as though they were successfully calming traffic through psychological means. Nevertheless, the 85th percentile speeds for these segments were all slightly above the residents' desired speeds. Overall, the 85th percentile speeds cannot increase much more without creating a negative impact on the neighborhoods' perceptions of street safety.

Formal versus Informal Psychological Schemes

NW 13th Terrace is a very different street from SW 91 Terrace and SW 91 Drive in terms of design. NW 13th Terrace has no curb, no pedestrian realm, no street enclosure from buildings, and wide setbacks. The Haile Village Center streets, on the other hand, utilize all five elements of psychological calming in their design: (a) context, (b) scale, (c) proportion, (d) roadside activity, and (e) road surface. At the same time, all three streets had very similar observed speed profiles.

In actuality, NW 13th Terrace uses at least four of these elements, only informally. The entire College Park study area benefits from the residential, student-oriented context. By some measures, this context could be considered more urban than that of Haile Village Center. As mentioned in the results of the field survey, the College Park study area has a higher residential unit density, 6.36 units per acre, than Haile Village Center, 5.88 units per acre. Despite having decidedly less “urban” design characteristics – long front and side building setback, few sidewalks, and no curbs – College Park has a potentially greater residential presence.

The residential context of College Park both generates and supports a large amount of roadside activity. For about every 4 motor vehicles on NW 13th Terrace, there was one bicyclist and one pedestrian. On NW 15th Street there was one bicyclist and one pedestrian about every 3 motor vehicles. Since these bicyclists and pedestrians shared the road surface with motor vehicles, drivers usually slowed down to accommodate them.

The need to accommodate pedestrians and bicyclists is compounded by the scale of the road and the condition of the road surface. Not only are the roads narrow by design, but, during observation, they were typically covered by 1.5 to 2 ft of soil and other debris on either side of the pavement. While the actual width of NW 13th Terrace is 16 ft, the effective width was 12 to 13 ft – only wide enough for one car at a time to proceed. Drivers likely realized this and reduced speed in anticipation of any on-coming traffic.

Before it can be determined if the informal scheme is effective like the formal scheme, the case of NW 15th Street must be touched upon. The College Park study area is smaller and has twice as many access points compared to Haile Village Center. Each of Haile Village Center's four access points has a gateway monument and other visual cues that may lead some drivers to slow as they enter the neighborhood. Additionally, the density of residences and businesses, combined with new-urbanist design elements, contrasts dramatically with the adjacent neighborhoods, filled predominantly with detached single-family dwellings. Haile Village Center is an enclave of urban character. On the other hand, the transition into the College Park study area is not quite as defined as Haile Village Center at street level. While street design in surrounding neighborhoods is more formalized, housing stock and lot setbacks are similar. Because of this degree of homogeneity, the trigger to change driving behavior may not be as strong, especially for cut-through traffic on NW 15th Street.

Though volume analysis was not included in the methodology, the high volume of traffic on NW 15th Street should be noted. The study segment carried 100 more motor-vehicles over the four hour AM and PM observation periods than the second most traveled segment in Haile. Per hour during the peak periods, NW 15th Street carried 62.5 motor-vehicles. Two streets eastward, NW 13th Terrace carried only 21.8 motor-vehicles per hour. In Haile Village Center, SW 91 Terrace and SW 91 Drive carried 37.3 and 14.8 motor-vehicles per hour, respectively.

What if the traffic volume doubled due to new developments and/or changing travel patterns? A set of shared space guidelines by the United Kingdom Department for Transport (2011) suggests that, above 100 motor vehicles per house, pedestrians perceive the roadway as a place to cross rather than a place to co-occupy with motor vehicles (p, 13). Doubling the NW 15th Street traffic volume would create a peak period flow of 125 motor vehicles per hour, potentially creating a conflict between pedestrians and automobiles for use of the roadway surface. The other three street segments would remain below the 100 motor vehicle per hour threshold. Volumes are summarized in Table 5-4. Overall, high traffic volumes and the cut-through mentality of drivers likely prevent the NW 15th Street segment from calming traffic as effectively as NW 13th Terrace.

Despite its informal design, the College Park neighborhood calms traffic through mechanisms similar to the intensively designed Haile Village Center. Furthermore, the effectiveness of the informal calming scheme was also comparable to the formal calming scheme. However, NW 15th Street has a few issues that merit a formal design treatment. The following section discusses recommendations for its improvement and the development of a psychologically calmed street design typology.

Recommendations

The process of determining a psychological calming treatment for NW 15th Street begins with the identification of safety deficiencies. According to the preceding analysis, NW 15th Street has mean and 85th percentile vehicle speeds that are higher than the design speeds of physical traffic calming, most livable streets guidelines, and the desired speed from the questionnaire. Additionally, the peak period traffic volume may be too high to allow a shared space scheme to properly function. The questionnaire results also suggest that drivers in College park do not change their driving behavior or slow down upon entering the neighborhood to the degree of Haile Village Center respondents. Non-verbal communication with bicyclists and pedestrians is also less common in College Park than in Haile Village Center.

After understanding the deficiencies, the designer must decide which elements will be changed and to what extent. Of the five elements of psychological traffic calming, road surface and street scale are the most easily altered assuming control of the right-of-way. Context and roadside activity cannot be directly changed by calming treatments. However, they might be indirectly changed as part of a short or long term result. Proportion cannot be modified if the designer has no control over building heights and setbacks of surrounding properties, which is assumed for this process.

In maintaining and improving the shared space scheme, NW 15th Street only needs small alterations to road surface and street scale. On each side of the street, one foot of roadway and 2.5 ft of right-of-way should be paved with bricks or some material similar in color and texture. These pavers should be at-grade with the asphalt roadway. This design intervention clearly defines a pedestrian realm within the pavers but continues to allow both vehicle and pedestrian to share the road surface. This curb-less design feature is similar to the woonerven in Delft and the shared space in Oosterwolde, Netherlands (Appleyard, 1981; McNichol, 2004). Additionally, the ability to park on properties along the street would not be affected. Without a curb, residents and visitors would be able access any driveway or parking area. Similarly, the residential streets of Seaside, Florida, use a curb-less, shared space design to maintain automobile access at the side of the street (Southworth & Ben-Joseph, 1997).

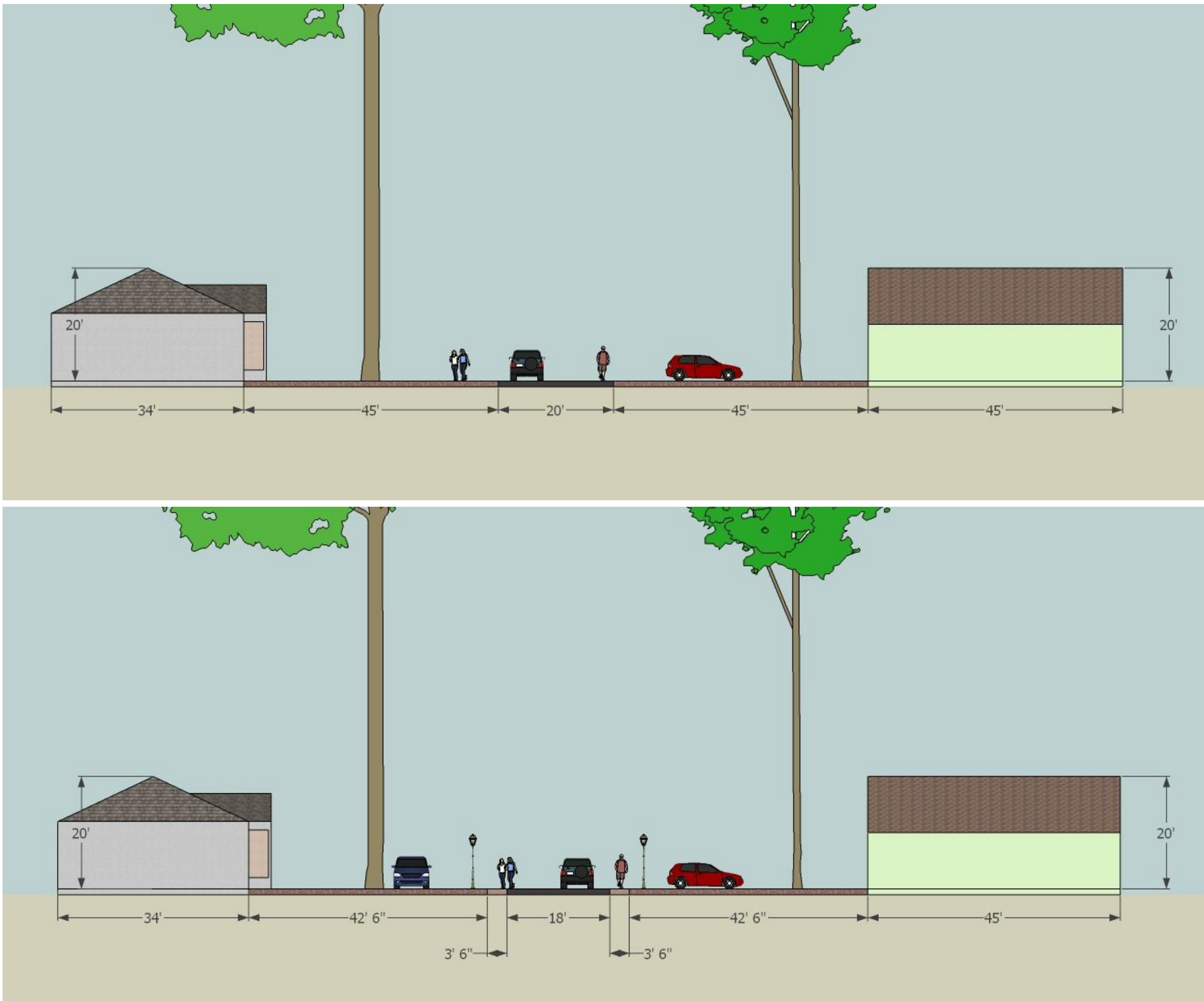
Buffed surfacing in a color contrasting the asphalt should be installed at all the intersections leading into the NW 15th Street study segment. This treatment would define cross-walk areas for pedestrians and compel drivers to slow down by signaling a change in environment. Additionally, pedestrian-scale lighting poles, placed a few feet beyond the edge of the pavers on both sides of the street, would strengthen the pedestrian realm. Slowing drivers via buffed surfaces and improving the definition of the pedestrian scale through human-scale lighting were elements of the Latton, England psychological traffic calming scheme (Kennedy, 2005).

The spirit of the preceding research might suggest that the treatment process of NW 15th Street should include the removal of the traffic circle at the intersection with NW 7th Avenue, making the calming scheme fully psychological. However, since the traffic circle is a major traffic control feature for the NW 7th Avenue corridor, judgment should be reserved until that corridor has been analyzed in a similar manner to NW 15th Street.

Depictions of the design recommendations can be seen in Figure 5-1 and 5-2. Figure 5-1 shows the pedestrian realm pavers and human-scale lighting poles in before and after section profile views. Figure 5-2 shows pavers, intersection buffed surfacing, and lighting pole spacing in a plan view.

Limitations

The questionnaire response rate for the College Park study area was 28.6%, 14% lower than the rate for Haile Village Center. To a certain extent, this low response rate was expected. The questionnaire was administered between early July and early August, outside the main academic year for the University of Florida. Since many of the residents of College Park are college students, some were probably not in residence at the time the questionnaire packages were mailed. A larger response would have yielded a more accurate representation of the College Park study area, but the 20 that did respond provided valuable feedback and insight.



A

B

Figure 5-1. Section profile views of NW 15th Street before and after treatment. A) Before treatment. B) After treatment, with pedestrian realm pavers and human-scale lighting poles.

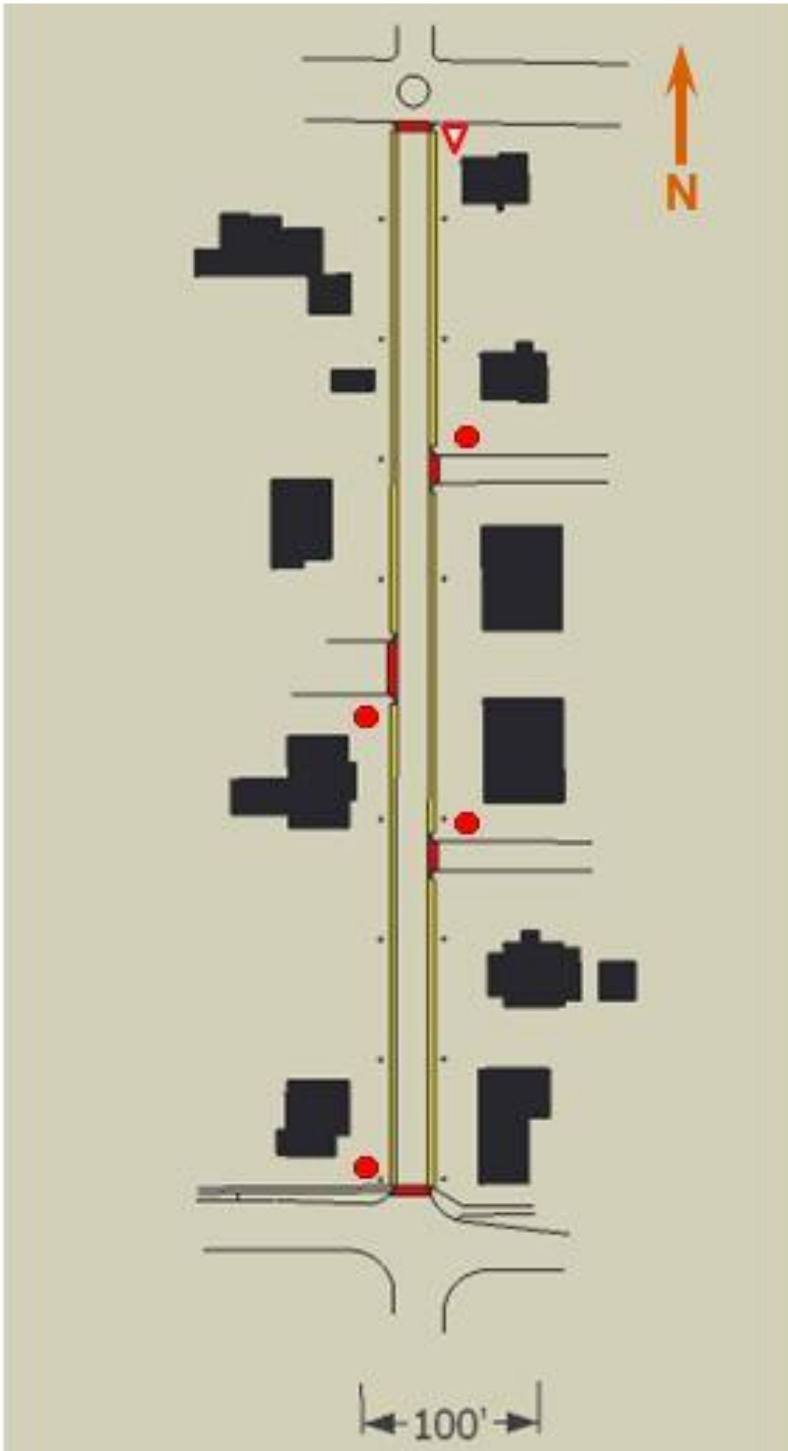


Figure 5-2. Plan view of NW 15th Street after design recommendations. Yellow areas represent the paved pedestrian realm; red areas represent the buffed surfacing at intersections; and small black dots represent the lighting poles. Red dots indicate stop sign traffic control installations. Red-rimmed triangles with white background show yield sign locations.

Table 5-1. Summary of safety perceptions

Statement	Haile Village Center Response	College Park Response
As a pedestrian, I feel safe crossing the street at all intersections in my neighborhood.	90% either agree or strongly agree	80% either agree or strongly agree
As a pedestrian, I feel safe crossing anywhere along the street in my neighborhood.	88.8% either agree or strongly agree	70% either agree or strongly agree
Drivers in my neighborhood do not pay enough attention.	Only 22.6% either agree or strongly agree	45% either agree or strongly agree
Pedestrians in my neighborhood do not pay enough attention.	Only 26.3% either agree or strongly agree	45% either agree or strongly agree
Bicyclists in my neighborhood do not pay enough attention.	Only 20.3% either agree or strongly agree	50% either agree or strongly agree
Drivers go too fast in my neighborhood.	Only 21.3% either agree or strongly agree	45% either agree or strongly agree
The streets in my neighborhood are safe enough for children to play on during daytime hours.	Only 21.5% either agree or strongly agree	55% either disagree or strongly disagree
Overall, the streets in my neighborhood are safe for pedestrians.	92.4% either agree or strongly agree	65% either agree or disagree

Table 5-2. Design best practice and livable street speeds compared to segment results

Source	Street Context	Speed (mph)
Typical U.S. Standard (Ewing, 1996)	residential	30.0
ULI, NAHB, ASCE, & ITE (2001)	residential collector on level terrain	30.0
NW 15th Street 85th percentile speed	residential	28.3
Nelessen (1994)	for small communities	25.0
NW 15th Street mean speed	residential	24.5
NW 13th Terrace 85th percentile speed	residential	22.4
SW 91 Terrace 85th percentile speed	residential/office	20.4
SW 91 Drive 85th percentile speed	residential	20.2
ULI, NAHB, ASCE, & ITE (2001)	local street on level terrain	20.0
Southworth and Ben-Joseph (1997)	residential	below 20.0
Netherlands standards	slow speed street	19.0
NW 13th Terrace mean speed	residential	18.3
SW 91 Terrace mean speed	residential/office	18.2
SW 91 Driver mean speed	residential	17.3
Appleyard (1981)	residential with children playing	below 15.0

Table organized from to bottom by highest to lowest speed. Segment results in bolded italics.

Table 5-3. Segment speed results compared to desired neighborhood speed

Segment	Mean speed (mph)	85th percentile speed (mph)	Average desired speed (mph)
SW 91 Terrace	18.2	20.4	17.8
SW 91 Drive	17.3	20.2	17.8
NW 15th Street	24.5	28.3	21.8
NW 13th Terrace	18.3	22.4	21.8

Table 5-4. Street segment traffic volumes

Segment	Four-hour observed vehicle count	Observed peak period traffic volume (vehicles per hour)	Double traffic scenario peak period traffic volume (vehicles per hour)
SW 91 Terrace	149	37.3	74.6
SW 91 Drive	59	14.8	29.6
NW 15th Street	250	62.5	125.0
NW 13th Terrace	87	21.8	43.6

CHAPTER 6
CONCLUSION

In the United States, streets are often viewed only as channels of automobile movement, rather than places for all would-be users. High traffic volumes and excessive speeds threaten the safety and experience of residents along the street and pedestrians. Reducing volumes and speeds has been accomplished using physical traffic calming devices that deflect vehicles either horizontally or vertically.

In recent decades, psychological traffic calming techniques have proved a successful and popular alternative to traditional, physical means in many countries outside the United States. As defined by Kennedy (2005), psychological calming schemes contain five basic elements of design: (a) context, such as road type and environmental character; (b) scale, regarding road width and building height; (c) proportion, like the enclosure formed by the juxtaposition of road width and building height; (d) roadside activity, via pedestrians, cyclists, and parked vehicles; (e) road surface, including color and texture. Instead of forcing drivers to slow down like physical traffic calming, psychological traffic calming compels drivers to slow down through environmental stimuli. Up until now, however, few studies have documented the effectiveness of existing schemes in America.

The results suggested a considerable presence of psychological traffic calming elements in both neighborhoods, particularly along the selected study segments. Overall, most residents in both neighborhoods perceived their streets to be safe for pedestrians – 92.4% in Haile Village Center compared to 65% in the College Park study area. For three out of four study segments, the 85th percentile speeds were below the 25 mph design speed recommended by Nelessen (1994) for comfortable pedestrian streets in small communities. The fourth segment, NW 15th Street, was victim to large amounts of cut-through traffic but still had an 85th percentile speed below the 30 mph speed limit of local streets in Gainesville. Cumulatively, these conditions implied that psychological traffic calming schemes methods can work in the United States, both intentionally in a master-designed private community like Haile Village Center and informally on a public street grid like College Park.

Future research into the effectiveness of psychological traffic calming should look to expand the study population to include not only neighborhood residents but also business owners, visitors, and children. All these groups have a stake in and perspective about the safety of their streets. Ideally, speed and volume observations would be performed on a network scale, rather than using example segments and measuring only speed, as done in this study. Research that is comprehensive in scope, meticulous in analysis, and easy for the public to understand will be necessary if psychological traffic calming is ever to replace conventional physical methods in the United States.

APPENDIX A
RESEARCH QUESTIONNAIRES

University of Florida
Gainesville, FL 32611
Department of Urban and Regional Planning
431 ARCH Building

Dear Neighborhood Resident:

I am a graduate student at the University of Florida in the Department of Urban and Regional Planning. As part of my coursework I am conducting a questionnaire, the purpose of which is to better understand street safety within your neighborhood. I am asking you to participate in this questionnaire because you likely use your neighborhood's streets on a daily basis and have acquired many experiences on them and opinions about them. It is not exactly known how people like you view neighborhood street safety issues, so I am attempting to find out. The questionnaire will take about 5 minutes to complete and is enclosed with this letter.

You will not have to answer any question you do not wish to answer. None of the questions relate to personal identity. Any incidental sources of identity, such as your return address, will be kept confidential to the extent provided by law and will not be used in compiling survey results or preparing the final manuscript.

There are no anticipated risks, compensation, or other direct benefits to you as a participant in this research questionnaire.

If you have any additional questions about my research protocol, please contact me by email at **(redacted)** or by phone at **(redacted)**. My faculty supervisor, Dr. Ruth Steiner, may be contacted at **(redacted)**. The results of my research will be available in November, and I would be happy to address any inquiries about these results by email or phone. Questions or concerns about your rights as a research participant may be directed to the IRB02 office, University of Florida, Box 112250, Gainesville, FL 32611; (352) 392-0433.

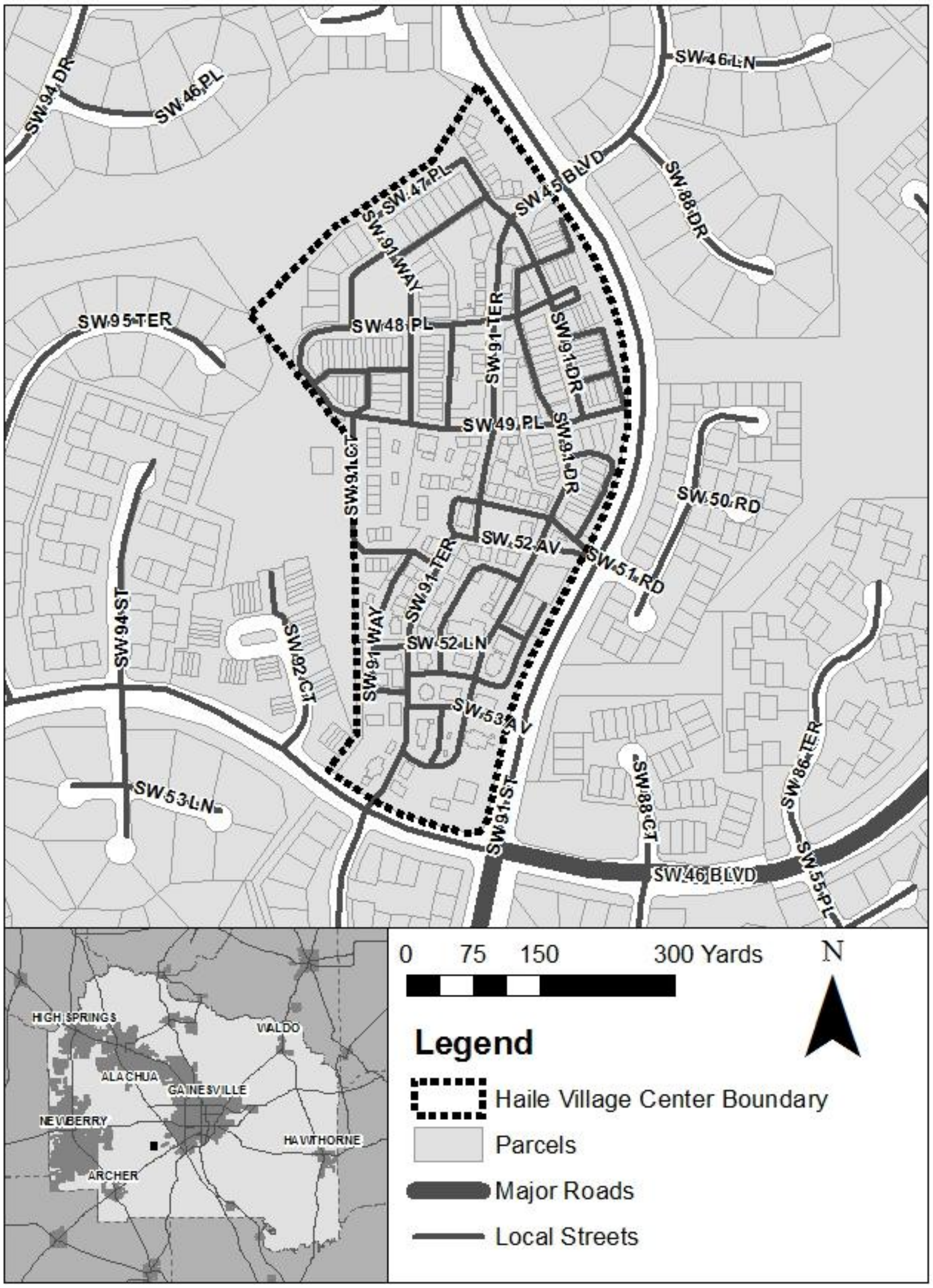
Completed questionnaires may be returned using the enclosed prepaid envelope. By returning this questionnaire, you agree to participate in this research, certify that you are above 18 years of age, and give me permission to report your responses anonymously in the final manuscript to be submitted to my faculty supervisor as part of my course work. Your participation is completely voluntary, and you may withdraw your consent at anytime without penalty. You may keep this letter for your records.

Sincerely,

William Lisska

Haile Village Center Street Safety Questionnaire

Please fill out this questionnaire regarding the safety of Haile Village Center's streets. My research is primarily concerned with the area enclosed by the **dotted black outline**, seen on the map below. When "Haile Village Center" is mentioned in this questionnaire, it refers to the part of the neighborhood contained within the **dotted black outline**. Estimated time to complete questionnaire: 5 minutes.



Map of Haile Village Center Research Area

Experiences as a Driver

For questions 1 through 4, please fill in the circle that best fits your response to the question.

1. Do you have access to a car? (If no, you may skip questions 2 through 4)

○ Yes ○ No

2. How frequently do you drive to reach destinations? (If never, you may skip questions 3 and 4)

○ Regularly ○ Occasionally ○ Rarely ○ Never

3. Does your driving behavior change when you enter Haile Village Center from a main road (i.e., SW 91 Street or SW 46 Boulevard)?

○ Yes ○ No ○ Sometimes

3a. Do you typically slow down?

○ Yes ○ No ○ Sometimes

3b. Do you ever communicate with pedestrian, bicyclists, or other drivers in a non-verbal manner (e.g. eye contact, hand gestures)?

○ Yes ○ No ○ Sometimes

4. As a driver, have you ever had a collision or close call with a pedestrian in Haile Village Center?

○ Yes, collision ○ Yes, close call ○ No

Experiences as a Pedestrian

For questions 5 and 6, please fill in the circle that best fits your response to the question.

5. How frequently do you walk to reach destinations?

○ Regularly ○ Occasionally ○ Rarely ○ Never

6. As a pedestrian, have you ever had a collision or close call with a car in Haile Village Center?

○ Yes, collision ○ Yes, close call ○ No

For questions 7 and 8, please indicate whether you strongly agree, agree, neither agree nor disagree, disagree, or strongly disagree with the following statements by filling in the appropriate circle.

Question	Scale of Reaction				
	Strongly agree	Agree	Neither agree nor disagree	Disagree	Strongly disagree
7. As a pedestrian, I feel safe crossing the street at all intersections in Haile Village Center.	○	○	○	○	○
8. As a pedestrian, I feel safe crossing anywhere along the street in Haile Village Center.	○	○	○	○	○

Safety Perceptions

For questions 9 through 17, please indicate whether you strongly agree, agree, neither agree nor disagree, disagree, or strongly disagree with the following statements by filling in the appropriate circle.

Question	Scale of Reaction				
	Strongly agree	Agree	Neither agree nor disagree	Disagree	Strongly disagree
9. Drivers in Haile Village Center do not pay enough attention.	○	○	○	○	○
10. Pedestrians in Haile Village Center do not pay enough attention.	○	○	○	○	○
11. Bicyclists in Haile Village Center do not pay enough attention.	○	○	○	○	○
12. Drivers go too fast in Haile Village Center.	○	○	○	○	○
13. Pedestrian safety is a matter of transportation infrastructure design (street, sidewalk, and intersection).	○	○	○	○	○
14. It is important for streets to have sidewalks to create a safe environment for pedestrians.	○	○	○	○	○
15. The streets in Haile Village Center are safe enough for children to play on during daytime hours.	○	○	○	○	○

Question	Scale of Reaction				
	Strongly agree	Agree	Neither agree nor disagree	Disagree	Strongly disagree
16. There is sufficient traffic control (e.g. stop signs, road markings, speed limit signs) in Haile Village Center.	○	○	○	○	○
17. Overall, the streets in Haile Village Center are safe for pedestrians.	○	○	○	○	○

For question 18, please write in your answer.

18. What do you think a reasonable speed limit for Haile Village Center's streets would be (in miles per hour)?

____

Additional Feedback

For questions 19 and 20, please write in your answer.

19. Do any streets in Haile Village Center stand out in your mind as unsafe? Please be specific.

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20. Please share any additional comments about the safety or quality of the streets in your neighborhood; suggestions to improve safety; or experiences as a driver, pedestrian, or bicyclist.

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General Information

For questions 21 through 23, please fill in the circle to indicate your answer.

21. What is your gender?

○	○
Male	Female

22. What is your present age?

○	○	○	○	○
18 - 24	25 - 34	35 - 44	45 - 54	55+

23. What is the highest level of education that you have completed?

○	○	○	○	○	○	○
Some high school	Completed high school	Some college	Associate's degree	Bachelor degree	Some graduate work	Graduate degree

For questions 24, please write in your answer.

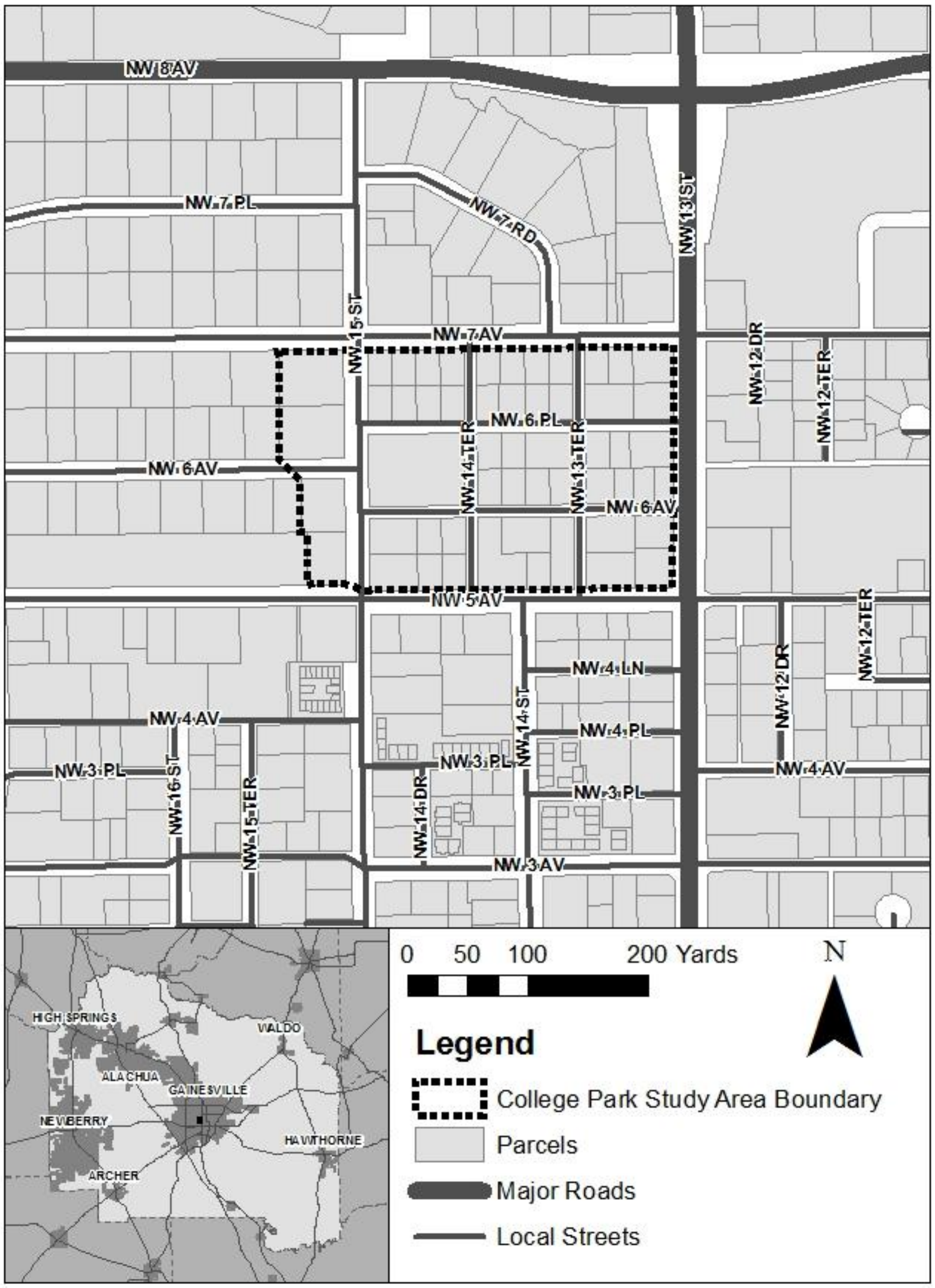
24. How long have you lived in Haile Village Center?

____

Thank you for taking the time to fill out my questionnaire. Please return the questionnaire in the prepaid return envelope by August 19, 2011. Your expertise and input, as part of my research, are greatly appreciated.

College Park Street Safety Questionnaire

Please fill out this questionnaire regarding the safety of streets in the College Park neighborhood. My research is primarily concerned with the streets in the area enclosed by the **dotted black outline**, seen on the map below. When "your neighborhood" is mentioned in this questionnaire, it refers to the part of the College Park neighborhood contained within the **dotted black outline**. Estimated time to complete questionnaire: 5 minutes.



Map of College Park Study Area

Experiences as a Driver

For questions 1 through 4, please fill in the circle that best fits your response to the question.

1. Do you have access to a car? (If no, you may skip questions 2 through 4)

○ Yes ○ No

2. How frequently do you drive to reach destinations? (If never, you may skip questions 3 and 4)

○ Regularly ○ Occasionally ○ Rarely ○ Never

3. Does your driving behavior change when you enter your neighborhood from a main road (i.e., NW 13 Street, NW 5 Avenue, or NW 7 Avenue)?

○ Yes ○ No ○ Sometimes

3a. Do you typically slow down?

○ Yes ○ No ○ Sometimes

3b. Do you ever communicate with pedestrian, bicyclists, or other drivers in a non-verbal manner (e.g. eye contact, hand gestures)?

○ Yes ○ No ○ Sometimes

4. As a driver, have you ever had a collision or close call with a pedestrian in your neighborhood?

○ Yes, collision ○ Yes, close call ○ No

Experiences as a Pedestrian

For questions 5 and 6, please fill in the circle that best fits your response to the question.

5. How frequently do you walk to reach destinations?

○ Regularly ○ Occasionally ○ Rarely ○ Never

6. As a pedestrian, have you ever had a collision or close call with a car in your neighborhood?

○ Yes, collision ○ Yes, close call ○ No

For questions 7 and 8, please indicate whether you strongly agree, agree, neither agree nor disagree, disagree, or strongly disagree with the following statements by filling in the appropriate circle.

Question	Scale of Reaction				
	Strongly agree	Agree	Neither agree nor disagree	Disagree	Strongly disagree
7. As a pedestrian, I feel safe crossing the street at all intersections in my neighborhood.	○	○	○	○	○
8. As a pedestrian, I feel safe crossing anywhere along the street in my neighborhood.	○	○	○	○	○

Safety Perceptions

For questions 9 through 17, please indicate whether you strongly agree, agree, neither agree nor disagree, disagree, or strongly disagree with the following statements by filling in the appropriate circle.

Question	Scale of Reaction				
	Strongly agree	Agree	Neither agree nor disagree	Disagree	Strongly disagree
9. Drivers in my neighborhood do not pay enough attention.	○	○	○	○	○
10. Pedestrians in my neighborhood do not pay enough attention.	○	○	○	○	○
11. Bicyclists in my neighborhood do not pay enough attention.	○	○	○	○	○
12. Drivers go too fast in my neighborhood.	○	○	○	○	○
13. Pedestrian safety is a matter of transportation infrastructure design (street, sidewalk, and intersection).	○	○	○	○	○
14. It is important for streets to have sidewalks to create a safe environment for pedestrians.	○	○	○	○	○
15. The streets in my neighborhood are safe enough for children to play on during daytime hours.	○	○	○	○	○

Question	Scale of Reaction				
	Strongly agree	Agree	Neither agree nor disagree	Disagree	Strongly disagree
16. There is sufficient traffic control (e.g. stop signs, road markings, speed limit signs) in my neighborhood.	○	○	○	○	○
17. Overall, the streets in my neighborhood are safe for pedestrians.	○	○	○	○	○

For question 18, please write in your answer.

18. What do you think a reasonable speed limit for your neighborhood's streets would be (in miles per hour)?

____

Additional Feedback

For questions 19 and 20, please write in your answer.

19. Do any streets in your neighborhood stand out in your mind as unsafe? Please be specific.

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20. Please share any additional comments about the safety or quality of the streets in your neighborhood; suggestions to improve safety; or experiences as a driver, pedestrian, or bicyclist.

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General Information

For questions 21 through 23, please fill in the circle to indicate your answer.

21. What is your gender?

○ Male ○ Female

22. What is your present age?

○ 18 - 24 ○ 25 - 34 ○ 35 - 44 ○ 45 - 54 ○ 55+

23. What is the highest level of education that you have completed?

○ Some high school ○ Completed high school ○ Some college ○ Associate's degree ○ Bachelor degree ○ Some graduate work ○ Graduate degree

For questions 24, please write in your answer.

24. How long have you lived in your neighborhood?

____

Thank you for taking the time to fill out my questionnaire. Please return the questionnaire in the prepaid return envelope by August 19, 2011. Your expertise and input, as part of my research, are greatly appreciated.

APPENDIX B
VISUAL INVENTORY OF STUDY AREAS

Figure A-1. Southbound progression of SW 91 Terrace (left) and SW 91 Drive (right)

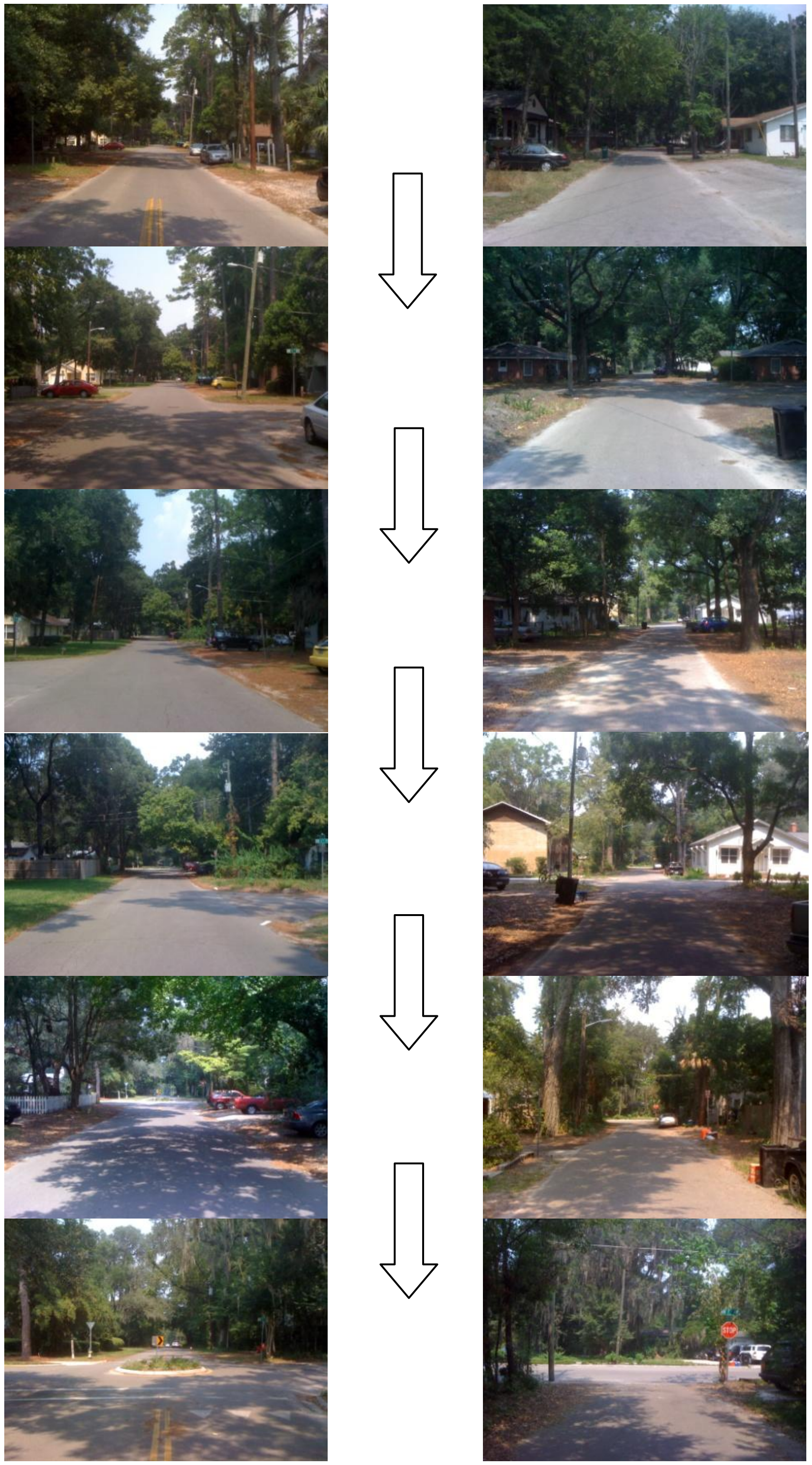
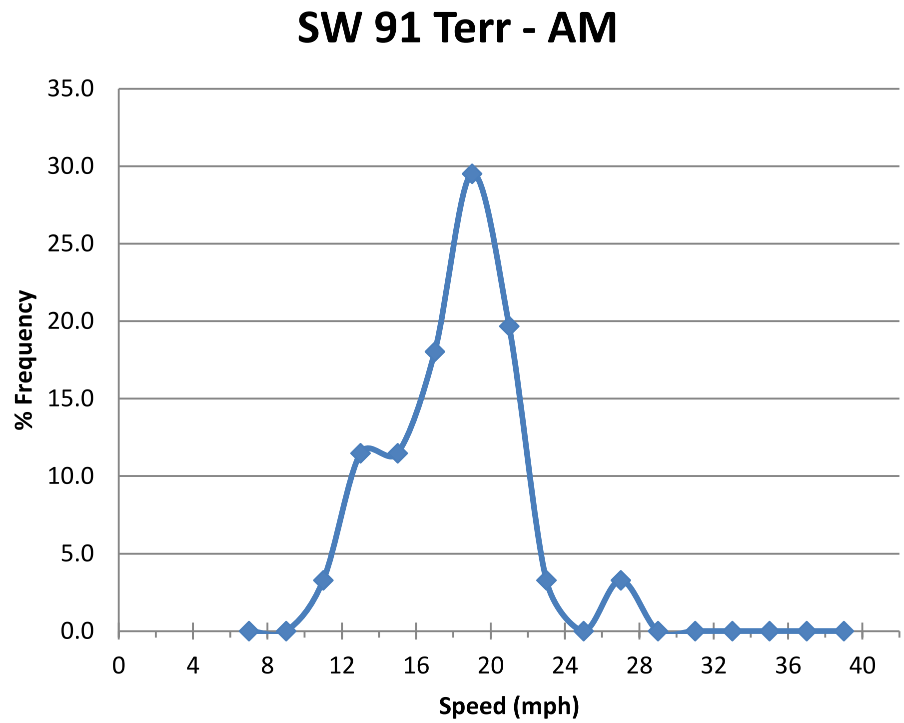


Figure A-2. Northbound progression of NW 15th Street (left) and NW 13th Terrace (right)

APPENDIX C
SPOT SPEED STUDY DATA

Table C-1. Distribution table for SW 91 Terrace AM spot speed study

Speed Group AM Lower Limit (mph)	Upper Limit (mph)	Middle Speed (mph)	Observed Frequency in Group	% Freq. in Group	Cum. % Freq
6	8	7	0	0.0	0.0
8	10	9	0	0.0	0.0
10	12	11	2	3.3	3.3
12	14	13	7	11.5	14.8
14	16	15	7	11.5	26.2
16	18	17	11	18.0	44.3
18	20	19	18	29.5	73.8
20	22	21	12	19.7	93.4
22	24	23	2	3.3	96.7
24	26	25	0	0.0	96.7
26	28	27	2	3.3	100.0
28	30	29	0	0.0	100.0
30	32	31	0	0.0	100.0
32	34	33	0	0.0	100.0
34	36	35	0	0.0	100.0
36	38	37	0	0.0	100.0
38	40	39	0	0.0	100.0
			61	100.0	



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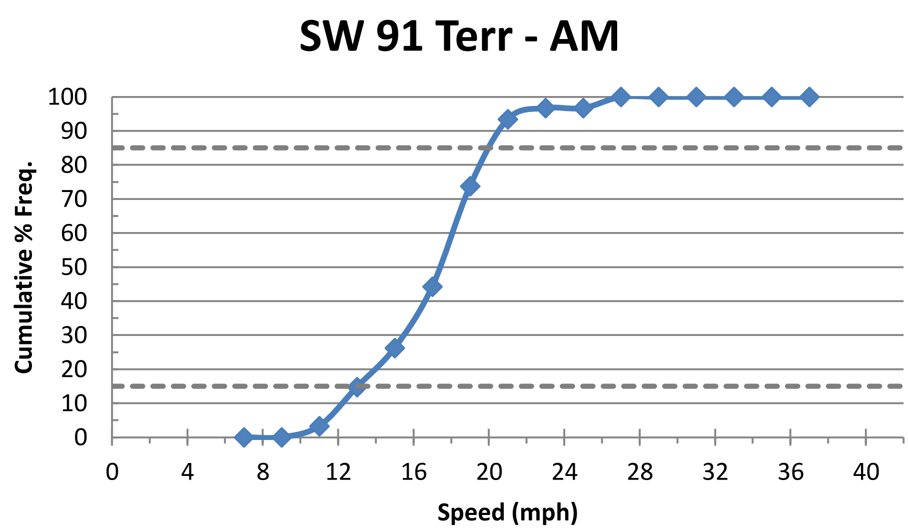
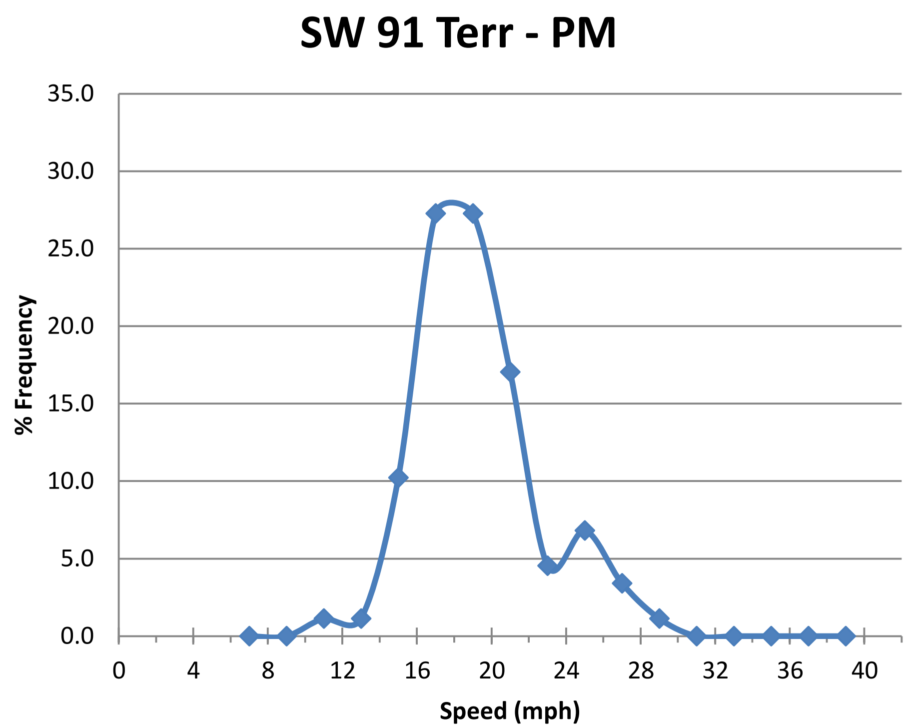


B

Figure C-1. Distribution curves for SW 91 Terrace AM spot speed study. A) Frequency curve. B) Cumulative frequency curve with 85th and 15th percentile levels marked by dotted grey lines.

Table C-2. Distribution table for SW 91 Terrace PM spot speed study

Speed Group PM Lower Limit (mph)	Upper Limit (mph)	Middle Speed (mph)	Observed Frequency in Group	% Freq. in Group	Cum. % Freq
6	8	7	0	0.0	0.0
8	10	9	0	0.0	0.0
10	12	11	1	1.1	1.1
12	14	13	1	1.1	2.3
14	16	15	9	10.2	12.5
16	18	17	24	27.3	39.8
18	20	19	24	27.3	67.0
20	22	21	15	17.0	84.1
22	24	23	4	4.5	88.6
24	26	25	6	6.8	95.5
26	28	27	3	3.4	98.9
28	30	29	1	1.1	100.0
30	32	31	0	0.0	100.0
32	34	33	0	0.0	100.0
34	36	35	0	0.0	100.0
36	38	37	0	0.0	100.0
38	40	39	0	0.0	100.0
			88	100.0	



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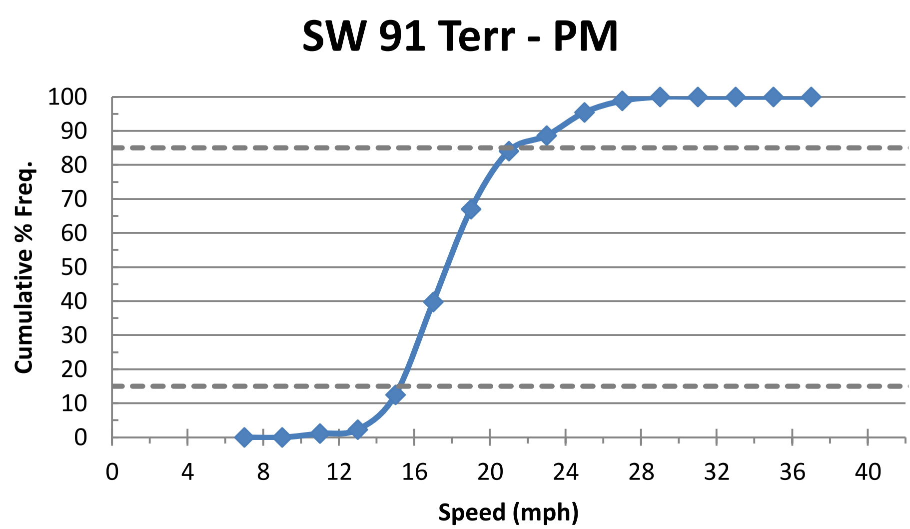
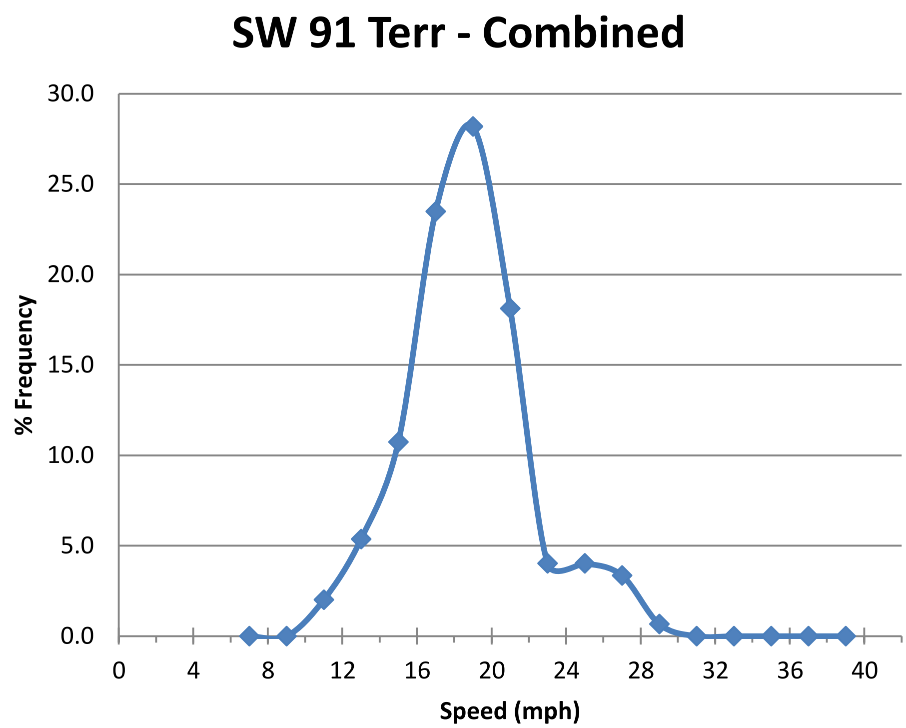


B

Figure C-2. Distribution curves for SW 91 Terrace PM spot speed study. A) Frequency curve. B) Cumulative frequency curve with 85th and 15th percentile levels marked by dotted grey lines.

Table C-3. Distribution table for SW 91 Terrace combined spot speed study

Speed Group Combined Lower Limit (mph)	Upper Limit (mph)	Middle Speed (mph)	Observed Frequency in Group	% Freq. in Group	Cum. % Freq
6	8	7	0	0.0	0.0
8	10	9	0	0.0	0.0
10	12	11	3	2.0	2.0
12	14	13	8	5.4	7.4
14	16	15	16	10.7	18.1
16	18	17	35	23.5	41.6
18	20	19	42	28.2	69.8
20	22	21	27	18.1	87.9
22	24	23	6	4.0	91.9
24	26	25	6	4.0	96.0
26	28	27	5	3.4	99.3
28	30	29	1	0.7	100.0
30	32	31	0	0.0	100.0
32	34	33	0	0.0	100.0
34	36	35	0	0.0	100.0
36	38	37	0	0.0	100.0
38	40	39	0	0.0	100.0
			149	100.0	



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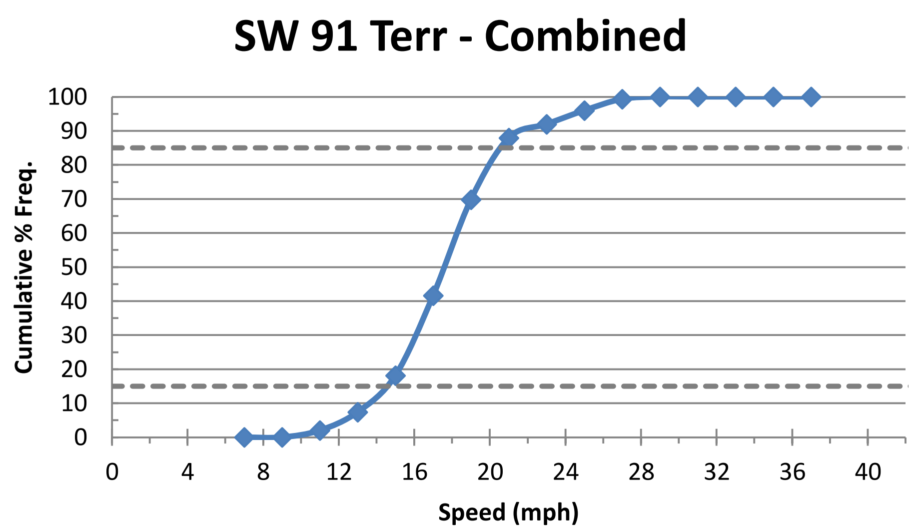
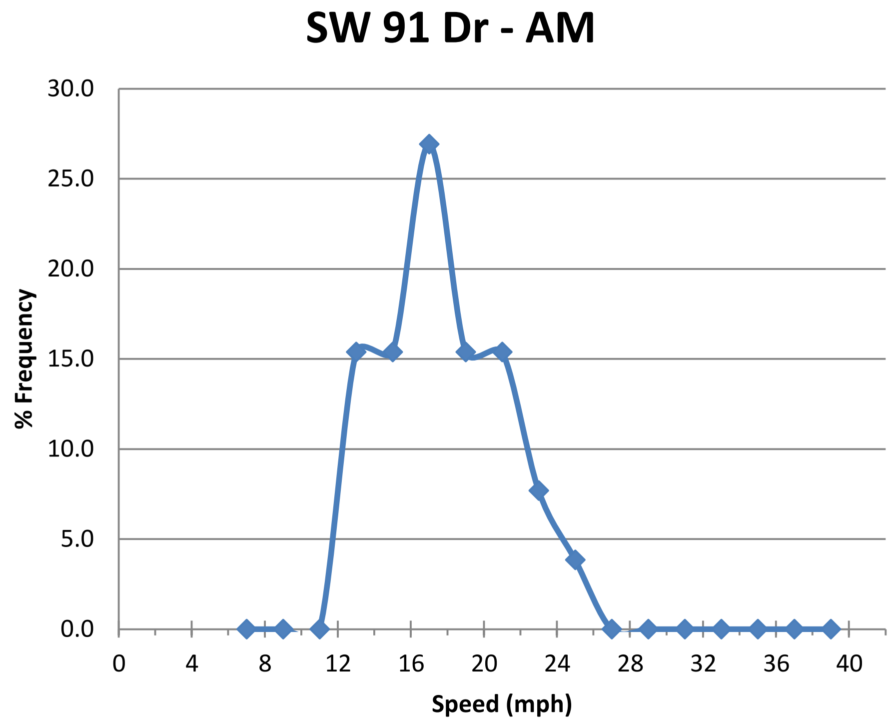


B

Figure C-3. Distribution curves for SW 91 Terrace combined spot speed study. A) Frequency curve. B) Cumulative frequency curve with 85th and 15th percentile levels marked by dotted grey lines.

Table C-4. Distribution table for SW 91 Drive AM spot speed study

Speed Group AM Lower Limit (mph)	Upper Limit (mph)	Middle Speed (mph)	Observed Frequency in Group	% Freq. in Group	Cum. % Freq
6	8	7	0	0.0	0.0
8	10	9	0	0.0	0.0
10	12	11	0	0.0	0.0
12	14	13	4	15.4	15.4
14	16	15	4	15.4	30.8
16	18	17	7	26.9	57.7
18	20	19	4	15.4	73.1
20	22	21	4	15.4	88.5
22	24	23	2	7.7	96.2
24	26	25	1	3.8	100.0
26	28	27	0	0.0	100.0
28	30	29	0	0.0	100.0
30	32	31	0	0.0	100.0
32	34	33	0	0.0	100.0
34	36	35	0	0.0	100.0
36	38	37	0	0.0	100.0
38	40	39	0	0.0	100.0
			26	100.0	



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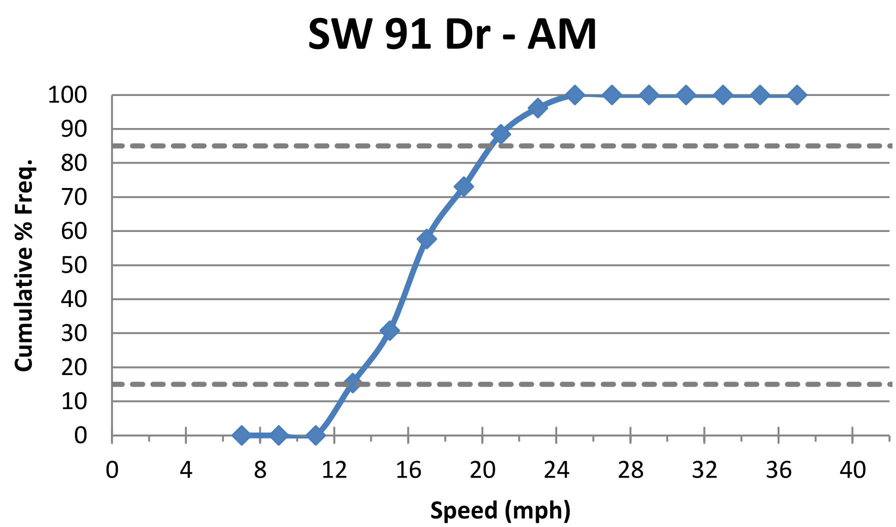
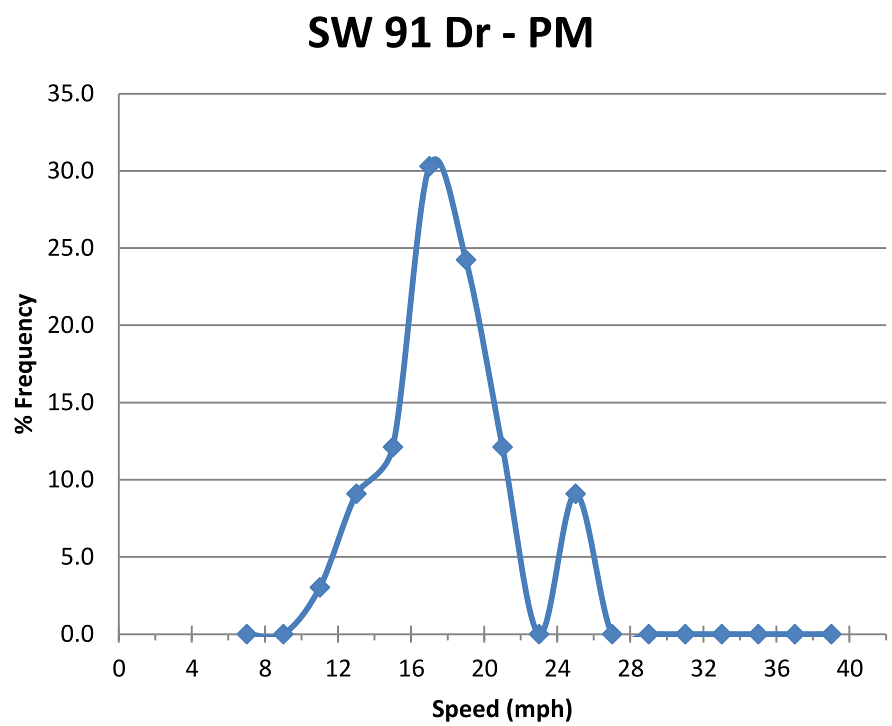


B

Figure C-4. Distribution curves for SW 91 Drive AM spot speed study. A) Frequency curve. B) Cumulative frequency curve with 85th and 15th percentile levels marked by dotted grey lines.

Table C-5. Distribution table for SW 91 Terrace PM spot speed study

Speed Group PM Lower Limit (mph)	Upper Limit (mph)	Middle Speed (mph)	Observed Frequency in Group	% Freq. in Group	Cum. % Freq
6	8	7	0	0.0	0.0
8	10	9	0	0.0	0.0
10	12	11	1	3.0	3.0
12	14	13	3	9.1	12.1
14	16	15	4	12.1	24.2
16	18	17	10	30.3	54.5
18	20	19	8	24.2	78.8
20	22	21	4	12.1	90.9
22	24	23	0	0.0	90.9
24	26	25	3	9.1	100.0
26	28	27	0	0.0	100.0
28	30	29	0	0.0	100.0
30	32	31	0	0.0	100.0
32	34	33	0	0.0	100.0
34	36	35	0	0.0	100.0
36	38	37	0	0.0	100.0
38	40	39	0	0.0	100.0
			33	100.0	



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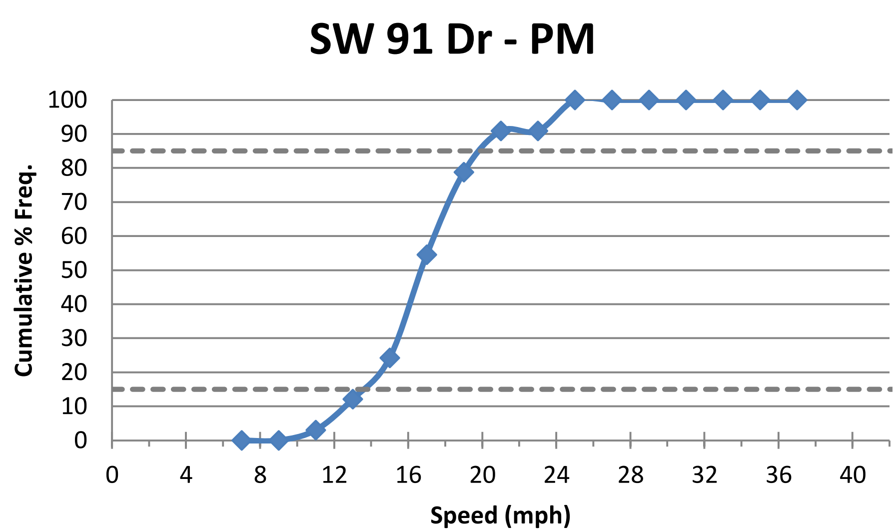
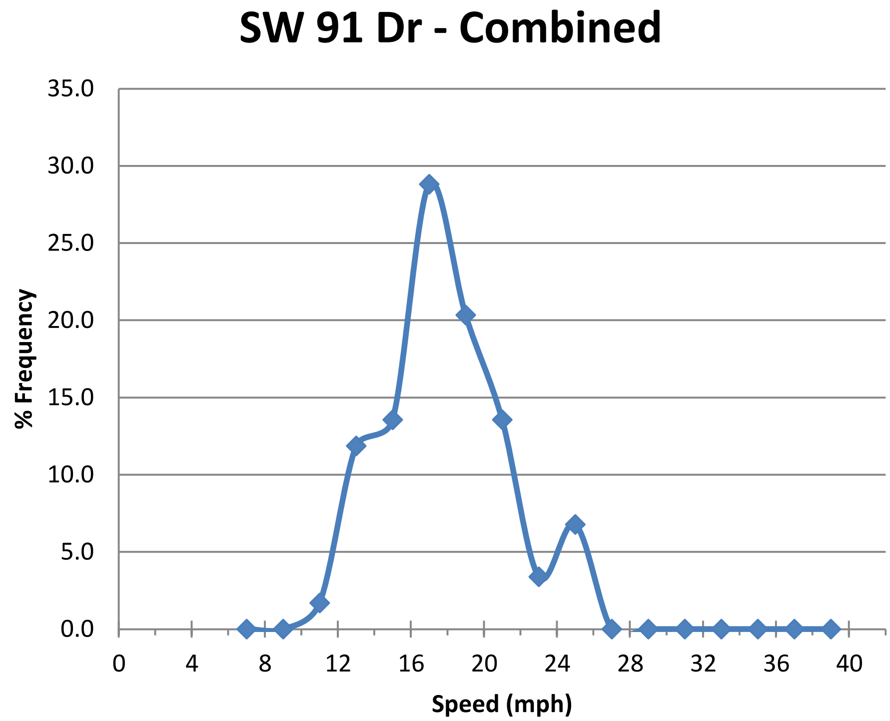


B

Figure C-5. Distribution curves for SW 91 Drive PM spot speed study. A) Frequency curve. B) Cumulative frequency curve with 85th and 15th percentile levels marked by dotted grey lines.

Table C-6. Distribution table for SW 91 Terrace combined spot speed study

Speed Group Combined Lower Limit (mph)	Upper Limit (mph)	Middle Speed (mph)	Observed Frequency in Group	% Freq. in Group	Cum. % Freq
6	8	7	0	0.0	0.0
8	10	9	0	0.0	0.0
10	12	11	1	1.7	1.7
12	14	13	7	11.9	13.6
14	16	15	8	13.6	27.1
16	18	17	17	28.8	55.9
18	20	19	12	20.3	76.3
20	22	21	8	13.6	89.8
22	24	23	2	3.4	93.2
24	26	25	4	6.8	100.0
26	28	27	0	0.0	100.0
28	30	29	0	0.0	100.0
30	32	31	0	0.0	100.0
32	34	33	0	0.0	100.0
34	36	35	0	0.0	100.0
36	38	37	0	0.0	100.0
38	40	39	0	0.0	100.0
			59	100.0	



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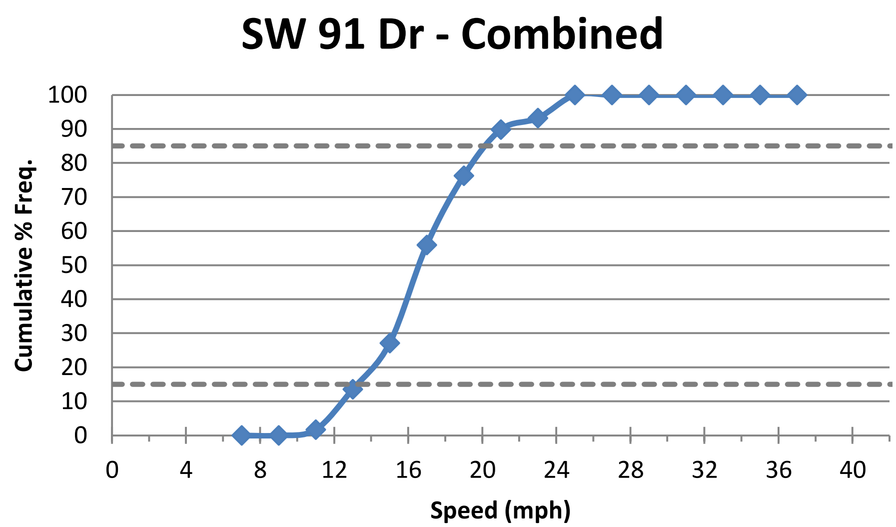
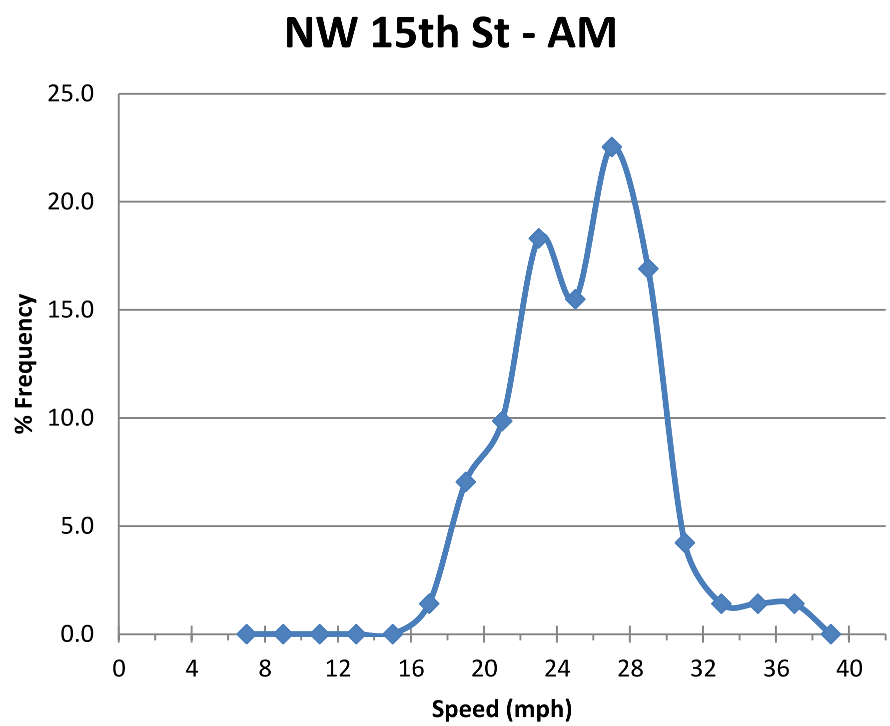


B

Figure C-6. Distribution curves for SW 91 Drive combined spot speed study. A) Frequency curve. B) Cumulative frequency curve with 85th and 15th percentile levels marked by dotted grey lines.

Table C-7. Distribution table for NW 15th Street AM spot speed study

Speed Group AM Lower Limit (mph)	Upper Limit (mph)	Middle Speed (mph)	Observed Frequency in Group	% Freq. in Group	Cum. % Freq
6	8	7	0	0.0	0.0
8	10	9	0	0.0	0.0
10	12	11	0	0.0	0.0
12	14	13	0	0.0	0.0
14	16	15	0	0.0	0.0
16	18	17	1	1.4	1.4
18	20	19	5	7.0	8.5
20	22	21	7	9.9	18.3
22	24	23	13	18.3	36.6
24	26	25	11	15.5	52.1
26	28	27	16	22.5	74.6
28	30	29	12	16.9	91.5
30	32	31	3	4.2	95.8
32	34	33	1	1.4	97.2
34	36	35	1	1.4	98.6
36	38	37	1	1.4	100.0
38	40	39	0	0.0	100.0
			71	100.0	



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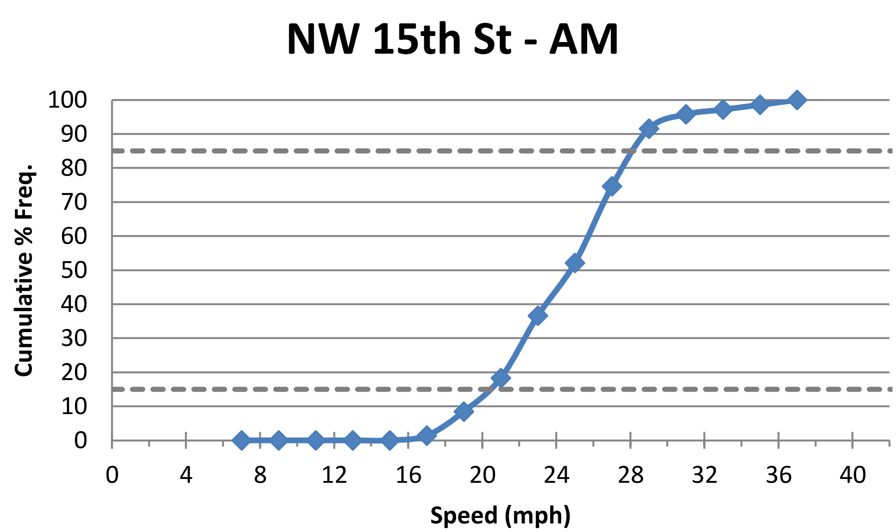
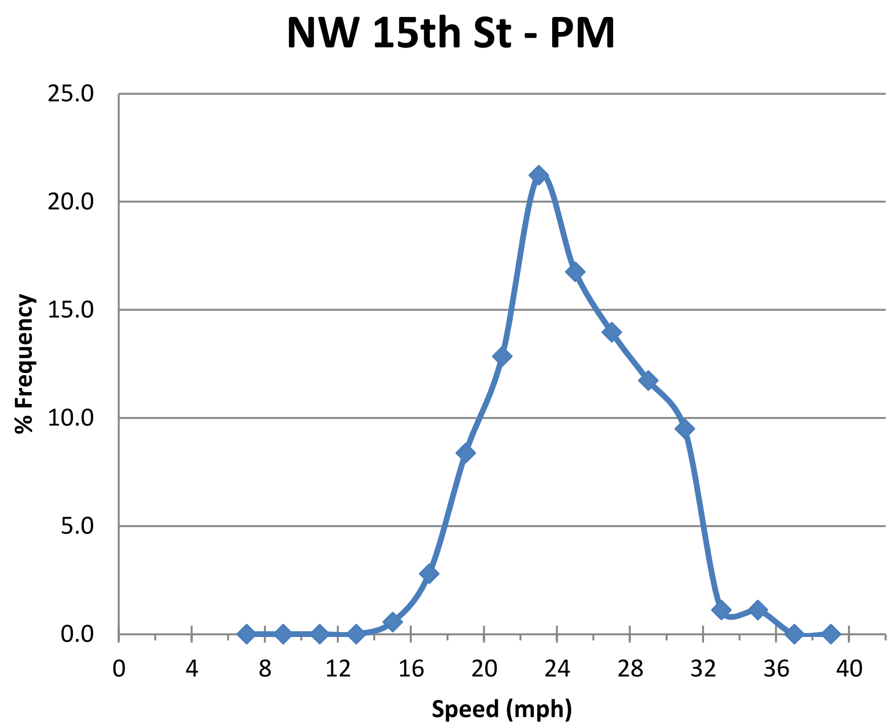


B

Figure C-7. Distribution curves for NW 15th Street AM spot speed study. A) Frequency curve. B) Cumulative frequency curve with 85th and 15th percentile levels marked by dotted grey lines.

Table C-8. Distribution table for NW 15th Street PM spot speed study

Speed Group PM Lower Limit (mph)	Upper Limit (mph)	Middle Speed (mph)	Observed Frequency in Group	% Freq. in Group	Cum. % Freq
6	8	7	0	0.0	0.0
8	10	9	0	0.0	0.0
10	12	11	0	0.0	0.0
12	14	13	0	0.0	0.0
14	16	15	1	0.6	0.6
16	18	17	5	2.8	3.4
18	20	19	15	8.4	11.7
20	22	21	23	12.8	24.6
22	24	23	38	21.2	45.8
24	26	25	30	16.8	62.6
26	28	27	25	14.0	76.5
28	30	29	21	11.7	88.3
30	32	31	17	9.5	97.8
32	34	33	2	1.1	98.9
34	36	35	2	1.1	100.0
36	38	37	0	0.0	100.0
38	40	39	0	0.0	100.0
			179	100.0	



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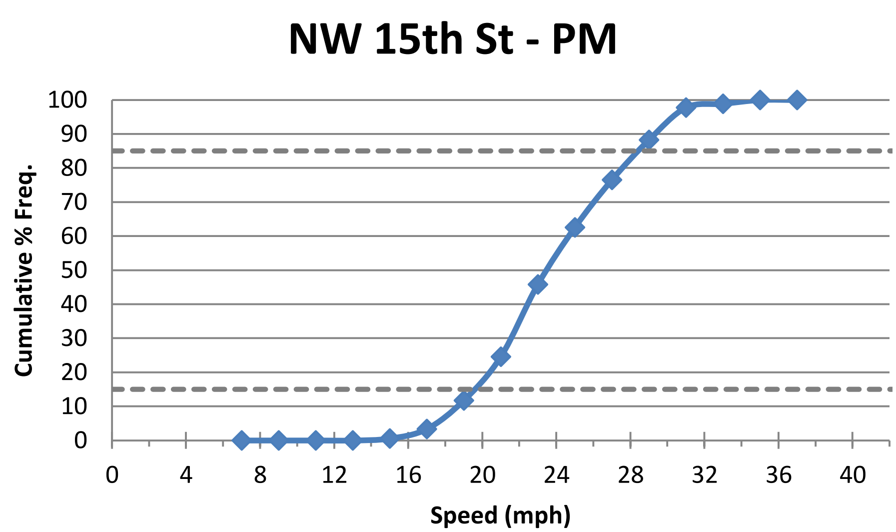
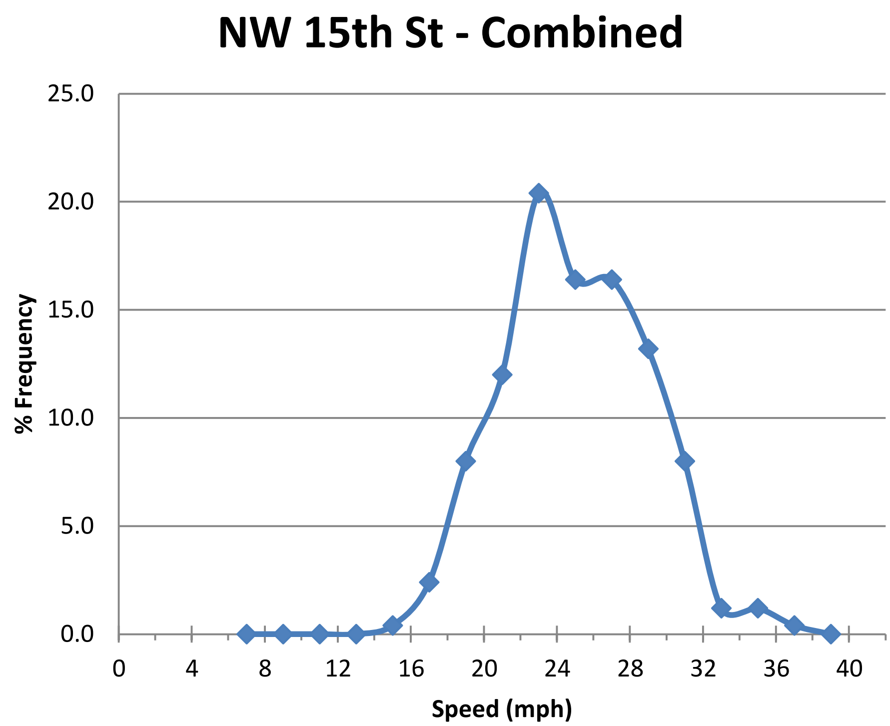


B

Figure C-8. Distribution curves for NW 15th Street PM spot speed study. A) Frequency curve. B) Cumulative frequency curve with 85th and 15th percentile levels marked by dotted grey lines.

Table C-9. Distribution table for NW 15th Street combined spot speed study

Speed Group Combined Lower Limit (mph)	Upper Limit (mph)	Middle Speed (mph)	Observed Frequency in Group	% Freq. in Group	Cum. % Freq
6	8	7	0	0.0	0.0
8	10	9	0	0.0	0.0
10	12	11	0	0.0	0.0
12	14	13	0	0.0	0.0
14	16	15	1	0.4	0.4
16	18	17	6	2.4	2.8
18	20	19	20	8.0	10.8
20	22	21	30	12.0	22.8
22	24	23	51	20.4	43.2
24	26	25	41	16.4	59.6
26	28	27	41	16.4	76.0
28	30	29	33	13.2	89.2
30	32	31	20	8.0	97.2
32	34	33	3	1.2	98.4
34	36	35	3	1.2	99.6
36	38	37	1	0.4	100.0
38	40	39	0	0.0	100.0
			250	100.0	



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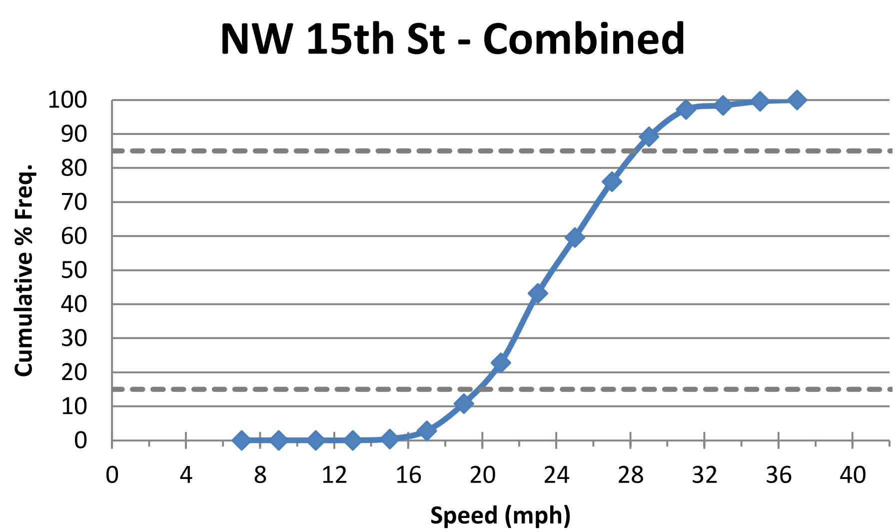
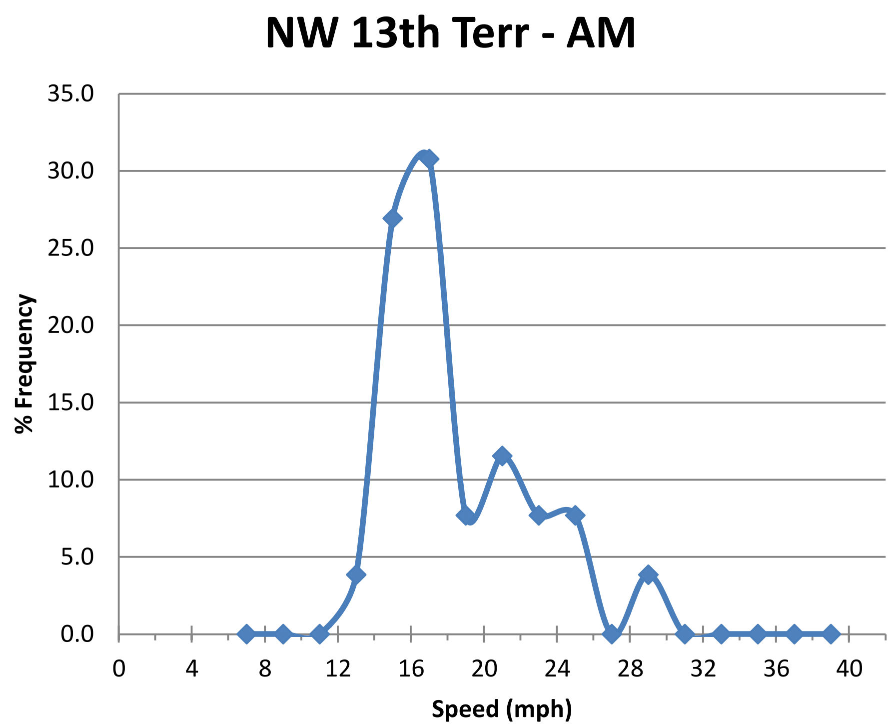


B

Figure C-9. Distribution curves for NW 15th Street combined spot speed study. A) Frequency curve. B) Cumulative frequency curve with 85th and 15th percentile levels marked by dotted grey lines.

Table C-10. Distribution table for NW 13th Terrace AM spot speed study

Speed Group AM Lower Limit (mph)	Upper Limit (mph)	Middle Speed (mph)	Observed Frequency in Group	% Freq. in Group	Cum. % Freq
6	8	7	0	0.0	0.0
8	10	9	0	0.0	0.0
10	12	11	0	0.0	0.0
12	14	13	1	3.8	3.8
14	16	15	7	26.9	30.8
16	18	17	8	30.8	61.5
18	20	19	2	7.7	69.2
20	22	21	3	11.5	80.8
22	24	23	2	7.7	88.5
24	26	25	2	7.7	96.2
26	28	27	0	0.0	96.2
28	30	29	1	3.8	100.0
30	32	31	0	0.0	100.0
32	34	33	0	0.0	100.0
34	36	35	0	0.0	100.0
36	38	37	0	0.0	100.0
38	40	39	0	0.0	100.0
			26	100.0	



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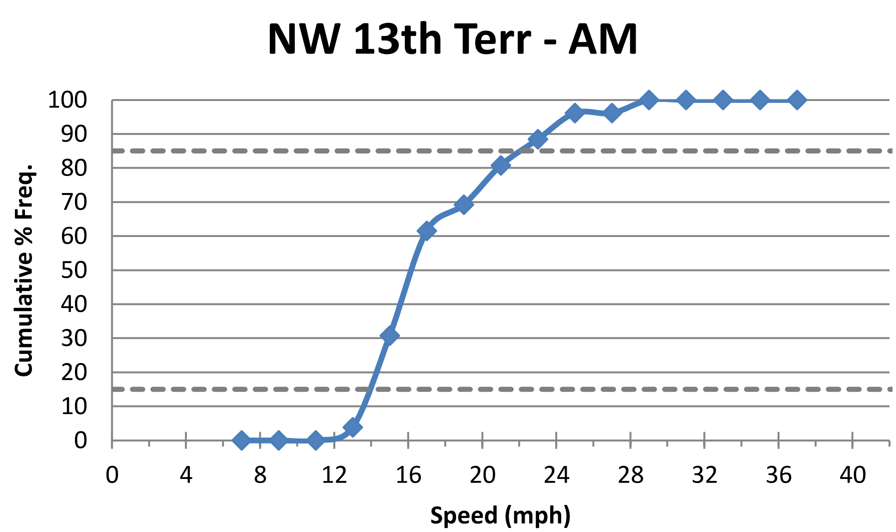

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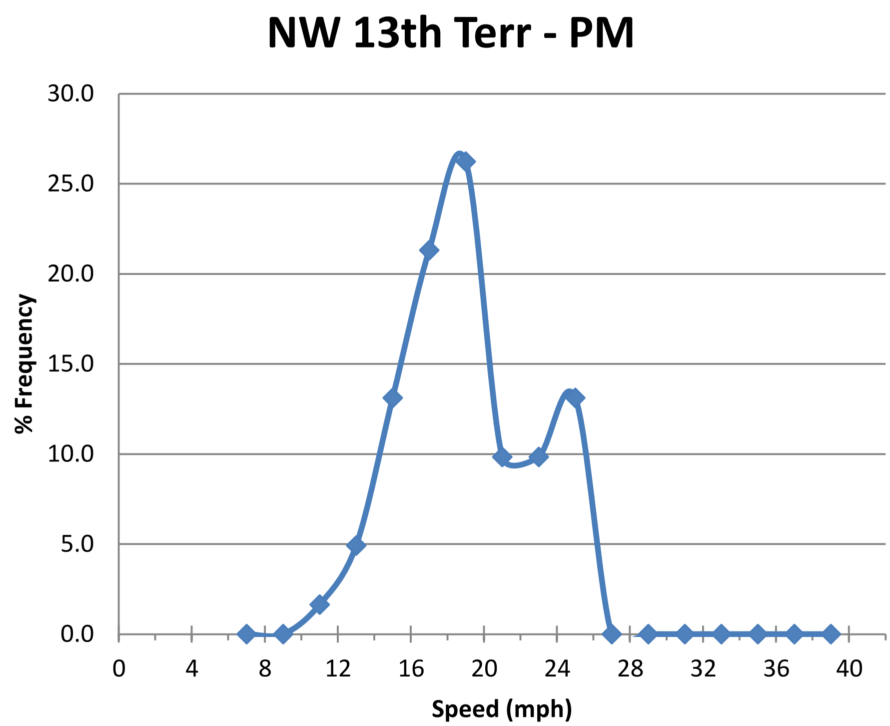
Figure C-10. Distribution curves for NW 13th Terrace AM spot speed study. A) Frequency curve. B) Cumulative frequency curve with 85th and 15th percentile levels marked by dotted grey lines.

Table C-11. Distribution table for NW 13th Terrace PM spot speed study

Speed Group PM Lower Limit (mph)	Upper Limit (mph)	Middle Speed (mph)	Observed Frequency in Group	% Freq. in Group	Cum. % Freq
6	8	7	0	0.0	0.0
8	10	9	0	0.0	0.0
10	12	11	1	1.6	1.6
12	14	13	3	4.9	6.6
14	16	15	8	13.1	19.7
16	18	17	13	21.3	41.0
18	20	19	16	26.2	67.2
20	22	21	6	9.8	77.0
22	24	23	6	9.8	86.9
24	26	25	8	13.1	100.0
26	28	27	0	0.0	100.0
28	30	29	0	0.0	100.0
30	32	31	0	0.0	100.0
32	34	33	0	0.0	100.0
34	36	35	0	0.0	100.0
36	38	37	0	0.0	100.0
38	40	39	0	0.0	100.0
			61	100.0	



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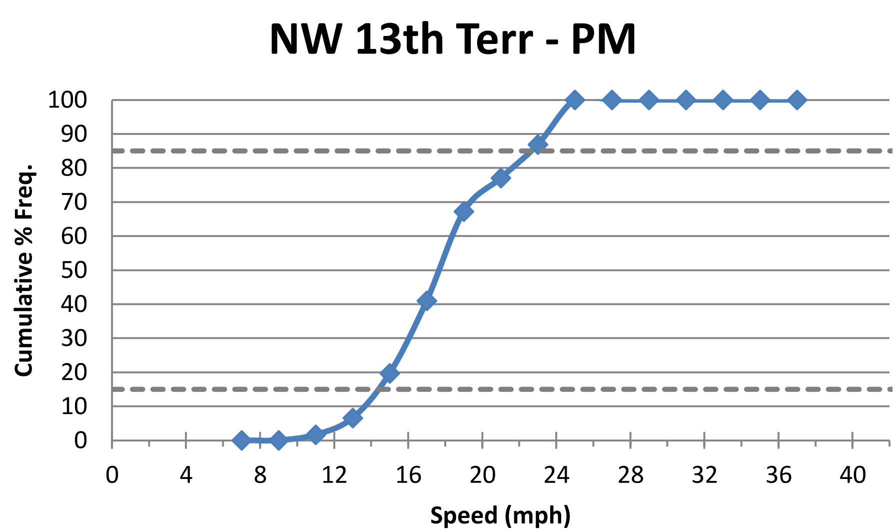
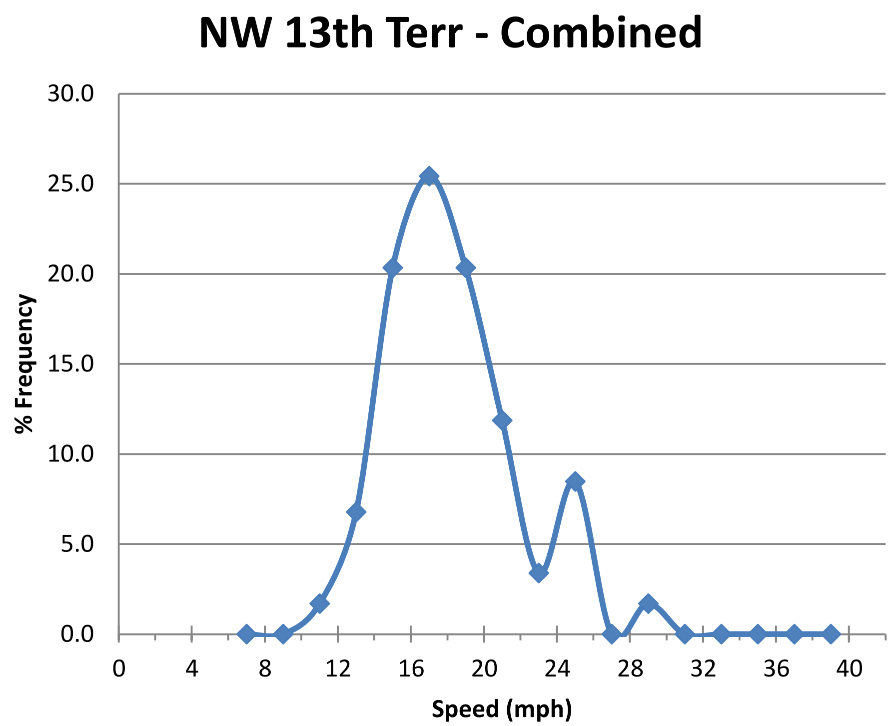


B

Figure C-11. Distribution curves for NW 13th Terrace PM spot speed study. A) Frequency curve. B) Cumulative frequency curve with 85th and 15th percentile levels marked by dotted grey lines.

Table C-12. Distribution table for NW 13th Terrace combined spot speed study

Speed Group Combined Lower Limit (mph)	Upper Limit (mph)	Middle Speed (mph)	Observed Frequency in Group	% Freq. in Group	Cum. % Freq
6	8	7	0	0.0	0.0
8	10	9	0	0.0	0.0
10	12	11	1	1.7	1.7
12	14	13	4	6.8	8.5
14	16	15	12	20.3	28.8
16	18	17	15	25.4	54.2
18	20	19	12	20.3	74.6
20	22	21	7	11.9	86.4
22	24	23	2	3.4	89.8
24	26	25	5	8.5	98.3
26	28	27	0	0.0	98.3
28	30	29	1	1.7	100.0
30	32	31	0	0.0	100.0
32	34	33	0	0.0	100.0
34	36	35	0	0.0	100.0
36	38	37	0	0.0	100.0
38	40	39	0	0.0	100.0
			59	100.0	



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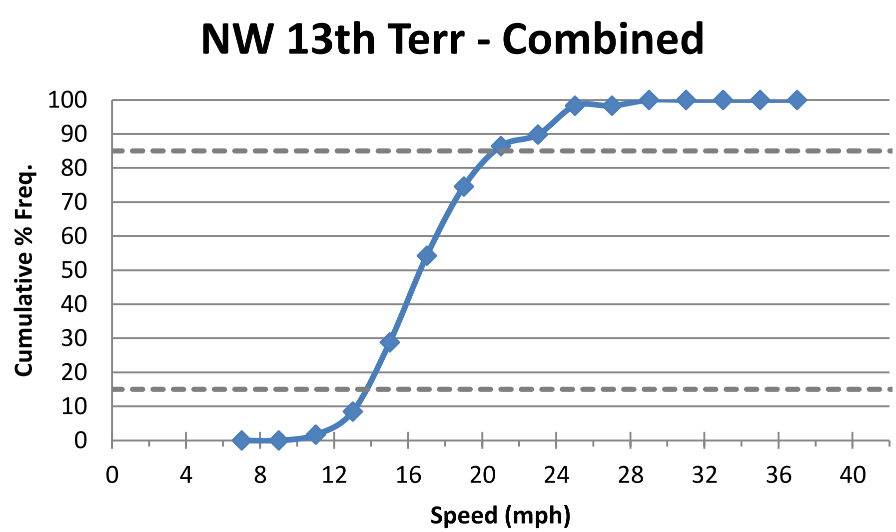

B

Figure C-12. Distribution curves for NW 13th Terrace combined spot speed study. A) Frequency curve. B) Cumulative frequency curve with 85th and 15th percentile levels marked by dotted grey lines.

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BIOGRAPHICAL SKETCH

William (Will) Retherford Lisska was born and raised in Jacksonville, Florida. After graduating high school in 2005, he attended Vanderbilt University in Nashville, Tennessee. In Nashville, Will came to appreciate city living, witnessed the first bowl win for the Vanderbilt Commodores in fifty-three years, and learned to tolerate country music. He graduated with a Bachelor of Civil Engineering in 2009. At one time Will was ready for a career in traffic engineering and highway planning, but because of his interests in multimodal transportation and urban design he decided to pursue a Master of Arts in Urban and Regional Planning at the University of Florida. It was a good decision. Will enjoys college and professional football, international travel, biking, cooking, and mixology.