MOUNTAIN-PLAINS CONSORTIUM

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Does the Livability of a Residential Street Depend on the Characteristics of the Neighboring Street Network?

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ABSTRACT

Shortly after the advent of cars, a conflict arose between moving traffic and residential livability. The typical response was to push traffic off residential streets and onto nearby major roads. This line of thinking evolved into a more hierarchical approach to street network design and what are known as arterial roads designed to carry the vast majority of vehicle traffic. With many researchers – notably Donald Appleyard with his influential Livable Streets research strand – identifying traffic on residential streets as an underlying issue behind poor livability, this solution makes perfect sense. However, is the relationship between residential livability and traffic moderated by the character of the nearby arterial road? In other words, would living near a big, bad arterial road offset the livability benefits of living on a light traffic street? Alternatively, would residing near a more "livable" arterial neutralize some of the problems associated with living on a heavy traffic street?

This first part of this project sought to answer these research questions via a residential study of 10 Denver, CO, neighborhoods where we first selected 10 urban arterials that could be partitioned along two dimensions: high/low traffic and high/low design quality. Within each of the 10 surrounding neighborhoods, we selected comparable residential roads to fit Appleyard's heavy, moderate, and light traffic descriptions where we then surveyed 721 respondents living along these 30 residential streets. Our results suggest that the surrounding street network – and in particular the character of the nearby arterial road – influences residential livability across a number of livability measures. When controlling for income, high levels of traffic as well as low levels of urban design on the arterial both detract from the livability of those living in the surrounding neighborhoods. Some results even suggest that residential streets with heavy traffic near a low traffic/high design arterial are just as livable, if not more so, than residential streets with light traffic near a high traffic/low design arterial. By no means should this be taken as a call to increase traffic on residential streets; rather, planners and engineers looking to promote residential livability need to begin taking a broader, network perspective to understanding livability. Livable residential streets can only be part of the solution; we also need more livable arterial roads.
The second part of the project examined: i) how residents perceive and use arterial roads, and ii) what specific characteristics of arterial roads associate with residential satisfaction. Using factor analysis and ordinal logistic regression, the results suggest that arterials perceived as being vibrant are associated with increased residential satisfaction – above and beyond other features of the residential environment – whereas arterials with perceived illicit activity and trash are associated with lower residential satisfaction. Our study includes three different measures of residential satisfaction, and the specific influence of the arterial road depends on whether one focuses more narrowly on satisfaction with the neighborhood street, satisfaction with the neighborhood, or overall sense of happiness living there. The results of this study point to land use policies, enforcement of social norms, and the design of pedestrian and transit environments as measures to maximize the contributions of commercial arterials to neighborhood livability.

The appendices include additional details on the survey and survey methodology as well as examples of how these issues were integrated into assignments for graduate level civil engineering and urban planning classes.

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PART 1: DOES THE LIVABILITY OF A RESIDENTIAL STREET DEPEND ON THE NEIGHBORING ARTERIAL ROAD?

1. INTRODUCTION

Can traffic and livability coexist on residential streets? This issue became a concern of the Garden City movement in the early 1900s, was written about by Buchanan and his seminal work *Traffic in Towns* in the early 1960s, and was later documented by Donald Appleyard's *Livable Streets* series of works starting in the late 1960s up through the early 1980s (Appleyard, 1978; Appleyard, Gerson, & Lintell, 1981; Appleyard & Lintell, 1972; Appleyard & Lintell, 1975). Elegant in its simplicity, Appleyard's research found those living on high traffic streets tend to have lower perceived livability (in terms of issues such as traffic hazards, noise, pollution, social interactions, and territorial extent) (Appleyard & Lintell, 1972). Trying to preserve such residential livability in the face of increasing motorization and traffic was one of the many challenges that city planners continue to face. The typical response is to push traffic off residential streets and onto nearby major roads (i.e., arterials). As a result, most residential neighborhoods in the U.S. depend heavily on arterials for everyday travel and access to public transit, shopping, and other activities. It is also not uncommon for these arterial roads to carry tens of thousands of cars every day. While not necessarily ideal, the approach is logical and seemingly better than trying to accommodate significant traffic on nearby residential streets. Yet, concentrating heavy traffic onto a small fraction of the overall street network can burden adjacent neighborhoods and create barriers for pedestrians, bicyclists, and transit riders. When traffic congestion becomes a problem on arterials, drivers may choose to cut through residential neighborhoods. With this project, we revisit the livable streets research strand from a broader network perspective. For example, does living near a big, bad arterial road offset the livability benefits of living on a light traffic street? Conversely, would living near a more "livable" arterial neutralize some of the problems associated with living on a heavy traffic street?

Numerous researchers from around the world have attempted to recreate and build off Appleyard's influential study. Some of the more noteworthy papers – such as the 1999 paper "Livable Streets Revisited" by Bosselmann et al. – took into account new factors such as the design elements of multiway boulevards, finding that the effects of traffic can be alleviated with good street design (Bosselmann, Macdonald, & Kronemeyer, 1999). Our work represents a novel take on the livable streets question. The intent of this research is to shed light on the issue of residential livability and vehicle traffic with respect to how this relationship might be moderated by a nearby arterial road. To shed light on these questions, we selected 10 urban arterials in Denver, CO, partitioned along two dimensions: high/low traffic and high/low design quality. Within each of the surrounding neighborhoods, we selected comparable residential roads to fit Appleyard's heavy, moderate, and light traffic descriptions. Via a residential survey, our research team gathered data from 721 respondents living along these 30 residential streets and collected built environment data for these streets as well as the corresponding arterials. The next section presents additional background and literature review, which is followed by a more detailed description of the survey, our methods, and the data collected. We then present our results with an eye toward the implications of this work for planners, engineers, and city dwellers.

2. BACKGROUND & LITERATURE REVIEW

Most streets tend to have moving vehicle traffic, and most people tend to live on such streets. The inevitability of the resulting conflict became a cause for concern as early as 1898 with Sir Ebenezer Howard and the Garden City in the United Kingdom. (Meacham, 1999). Eventually, the Garden City movement made its way to the U.S. in Radburn, NJ, in 1929. Designed by Charles Stein and Henry Wright, Radburn was one of the first U.S. developments to explicitly limit the through movement of traffic on residential streets. Stein labeled cars a "menace to city life" and called the traditional approach to street network design "as obsolete as a fortified town wall" (Southworth & Ben-Joseph, 2003). Radburn not only kicked off an overhaul in U.S. street network design, but it also initiated a hierarchical approach to road typology. This principle was evident in Radburn and the "neighborhood units" of Clarence Perry in 1929 as well as with the "environmental areas" advocated by Colin Buchanan in *Traffic in Towns* in 1963 (Allaire, 1960; Buchanan, 1964). In both cases, shown in Figure 2.1, the design intentionally limits traffic on residential streets and displaces that traffic to the arterial streets and highways that envelop the residential neighborhoods. The underlying thinking of these planners is clear: living on a street with low levels of traffic has livability benefits.

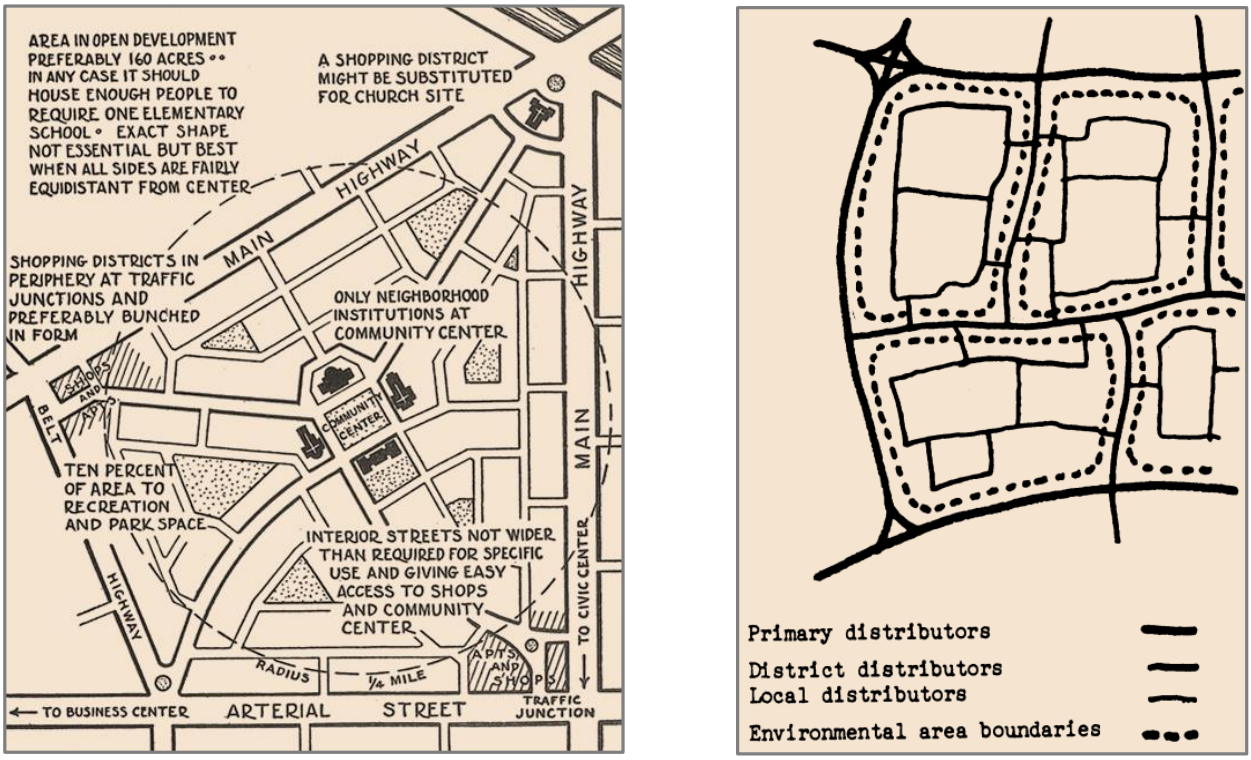

Figure 2.1 Clarence Perry's "Neighborhood Unit" & Colin Buchanan's "Environmental Area" (Allaire, 1960; Buchanan, 1964)

In the U.S., this hierarchical approach to street design was first officially supported by an unlikely entity, the Federal Housing Administration (FHA) (Southworth & Ben-Joseph, 2003). Founded in 1934, the FHA released two publications in the mid-1930s that specifically addressed such design issues. Technical Bulletins No. 5 and No. 7 reinforced the concerns of planners such as Stein and endorsed hierarchical layouts that pushed traffic to major roads. Figure 2.2, which compares a "bad" design and a "good" design example, depicts the unequivocal approach that the FHA took to the matter in these early

publications. Even though the FHA did not possess any regulatory powers, they used these guidelines in approving loans for more than 22 million properties prior to 1950 (Southworth & Ben-Joseph, 2003).

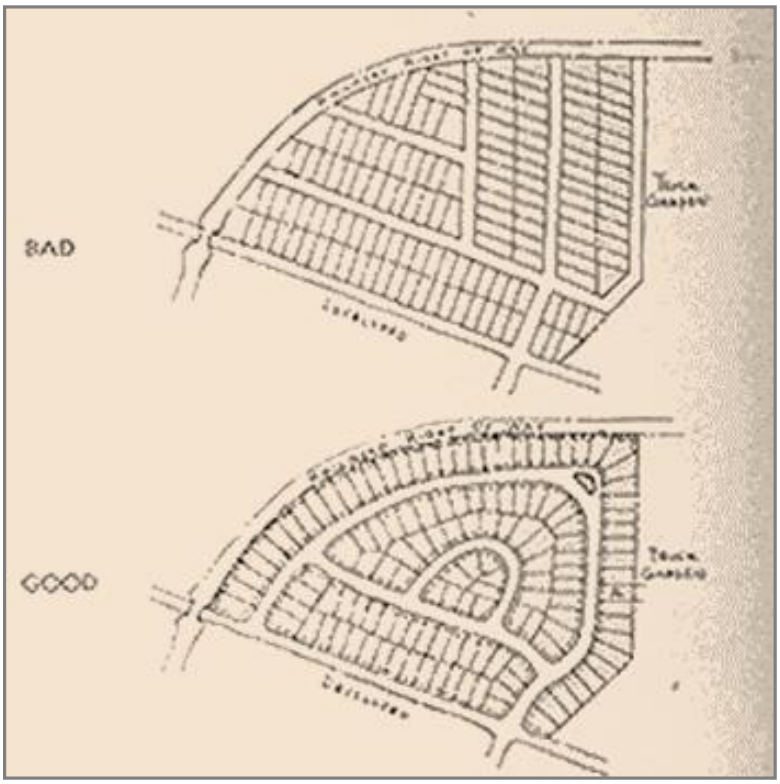

Figure 2.2 "Good" and "Bad" Neighborhood Designs from FHA Technical Bulletin No. 7: Planning Profitable Neighborhoods circa 1938 (Southworth & Ben-Joseph, 2003)

Though hierarchical networks were already prevalent, transportation engineers did not officially document their support of hierarchical networks until 1965 when the Institute of Transportation Engineers (ITE) published "Recommended Practice for Subdivision Streets" (Marshall & Garrick, 2010; Southworth & Ben-Joseph, 2003). Again, the intent was to discourage traffic on residential streets whenever possible. The advent of what is more formally known as the functional classification system came shortly afterward. The functional classification system – which has long been the basis for U.S. guidelines and has now proliferated around the world – is intended to help planners and engineers determine design criteria for a particular roadway via a categorization of that proposed roadway by type. According to AASHTO (the American Association of State Highway and Transportation Officials), two factors comprise the organizational structure of the functional classification system: facility type and land use. These two factors combine to indicate the level of mobility or accessibility one would expect on the road. In an urban setting, the basic facility types include: local streets, collectors, and arterials. Under the functional classification system, local streets theoretically provide relatively high levels of access to land uses and relatively low mobility. In contrast, arterials theoretically support high levels of mobility and low access.

In practice, local roads often accommodate more traffic than intended for what should be a low mobility road; moreover, commercial land users love to locate along high traffic urban arterials, which generate the need for a high level of access. Whereas both examples directly counter the functional classification system, both are also ubiquitous elements of modern city life. This discussion is not meant to debate the merits of the functional classification system; rather, the intent is simply to highlight that the reality of urban street networks rarely aligns with the underlying theory. While an arterial that includes land uses

and design features that promote access breaks the intent of the functional classification system, there could be associated livability benefits. Alternatively, an arterial that fits the functional classification system could overemphasize mobility, fragment a neighborhood, and downgrade livability for those living nearby. In other words, is it better to live on a light traffic residential street near what might be considered a bad arterial or on a heavy traffic residential street near what might be considered good arterial? Whatever the answer, the impact of arterials on the livability of the surrounding neighborhoods is worthy of exploration because this network perspective to understanding livability is one that has yet to be adequately studied.

2.1 The Impact of Traffic on Livability

What makes for a livable residential street? While existing research suggests that a combination of built environment features and social elements contribute to the cause, one of the most commonly cited factors is the level of vehicle traffic. Within the academic research realm, the work of Donald Appleyard first brought this finding to prominence. Out of concern for the intermixing of high traffic streets and residential land uses, the City of San Francisco hired Appleyard and Mark Lintell in the late 1960s to study the relationship between life on residential streets and the traffic on those streets. Appleyard and Lintell selected three parallel streets that differed by traffic levels but matched across as many other dimensions as possible. The "Heavy Street" carried 16,000 cars per day, the "Moderate Street" 8,000, and the "Light Street" less than 2,000. Based upon 12 interviews along each street, Appleyard and Lintell assessed differences in livability for these streets and first published the findings in a 1972 paper (Appleyard & Lintell, 1972). While defining abstract concepts such as sustainability and livability is famously subjective (Lovejoy, Handy, & Mokhtarian, 2010; Marshall, 2013), Appleyard's research focused on a handful of more tangible issues including traffic hazards; stress, noise, and pollution; social interaction; environmental awareness; and privacy/home territory (Appleyard & Lintell, 1972). Those living on the heavy street generally conveyed greater traffic-related safety concerns and higher perceived negative impact from traffic noise and pollution. Residents of the heavy street reported lower social interaction with 3X fewer friends and 2X fewer acquaintances living on their street as opposed to the light street. Street activity was less common on the heavy street, and overall there was a lower sense of community. Heavy Street residents also tended to withdraw from the physical environment (e.g., smaller reported home territories and less feeling of ownership over the street space). The light streets fell at the other end of the spectrum along all of these livability measures with the moderate streets typically in between. With his strand of follow-up research, Appleyard opted for a more formal survey instrument instead of purely open-ended questions. However, the bottom line finding – that vehicle traffic along a residential street diminishes livability and quality of life – never swayed.

Many researchers replicated various elements of Appleyard's study and found similar findings in wide-ranging locations such as New York City and Bristol, England (Hart & Parkhurst, 2011; Transportation Alternatives, 2006). Other researchers looked to extend Appleyard's work in interesting new directions. For instance, Bosselmann et al. compared high-traffic multiway boulevards in Brooklyn and Chico, CA, (24,000 to 44,000 cars per day) to more conventionally designed streets with less traffic (4,000 to 14,000 cars per day) and via 99 interviews and found the multiway boulevards to be at least as livable, if not more so (Bosselmann et al., 1999). The study concluded that street design elements can mitigate the negative impacts of traffic for the residents of that road (Bosselmann et al., 1999). In a more recent study, Koorey et al. conducted residential surveys along streets in New Zealand in a manner similar to Appleyard in order to determine a threshold of traffic needed for streets to be livable (Koorey, Leckie, & Chesterman, 2013). While Appleyard often cited numbers between 2,000 and 3,000 cars per day, the results of Koorey et al. suggest volumes between 1,500 and 2,000 cars per day.

Our research takes Appleyard's work into a heretofore unexplored area: how does the presence of a nearby arterial road – and the relative traffic and design quality of that arterial – impact livability on the surrounding neighborhood? Beyond the existing research on livable streets, this research also draws upon the more general research strand related to measuring and understanding residential satisfaction and quality of place (Andrews, 2001; Lovejoy et al., 2010). The next section describes our methods and the subsequent data collected.

3. RESEARCH STRATEGY, METHODOLOGY, & DATA

3.1 Site Selection

The study city for our work is Denver, CO. Denver is an ideal candidate for this topic due to its development under what was known as the Denver Parks and Parkways System (Goodstein, 1994). Initially inspired by the City Beautiful movement and then later by Garden Cities concepts, Mayor Robert Speer created a system of 34 parkways covering more than 60 miles of roads during the early 1900s (Etter & Etter, 2006). Figure 3.1 depicts the original 1894 plan by Edward Rollandet. This system of parkways now comprises much of today's arterial network in Denver. The result is a vast array of arterial road types to draw upon in attempting to approximate Appleyard's three-street approach and extend it to include arterials and neighborhoods. Simply put, our hope was to select a handful of neighborhoods – each with residential heavy, moderate, and light streets – that differed by the presence of a "good" or "bad" arterial road. This process commenced with the initial selection of 20 prospective arterials. We focused on arterials with commercial nodes that would be more likely to function as a livability amenity to the surrounding neighborhoods. For each of the 20 arterials, shown in Figure 3.2, the research team collected primary built environment data via field visits and secondary data via the U.S. Census, GIS layers from the city and county of Denver, and traffic counts from the Colorado DOT and the regional MPO. The arterials and the surrounding neighborhoods were partitioned along the following dimensions:

- High or low traffic arterial
- High or low urban design arterial
- Higher or lower income surrounding neighborhood

We then inspected the residential streets around each potential arterial in hopes of finding heavy, moderate, and light streets that differed principally by traffic count. Due to a lack of secondary data, this required conducting our own 24-hour traffic counts on these residential streets, as depicted in Figure 3.3. Since some neighborhoods did not possess one or more of the requisite residential street types by traffic volume, this facilitated the elimination of some neighborhoods and helped narrow the dataset down to 10 arterial roads, each with its own set of residential streets that could be classified as heavy, moderate, or light. The residential survey (described it the next section) was conducted on these 30 streets (i.e., 10 heavy streets, 10 moderate streets, and 10 light streets).

Table 3.1 summarizes the data collected for the arterial streets and the surrounding neighborhoods while Figure 3.4 maps the selected sites. The high traffic arterials averaged over 40,000 cars per day while the low traffic arterials averaged fewer than 13,000. Our assessment of the quality of urban design for the arterials derived via the extensive process laid out by Ewing and Clemente in their book *Measuring Urban Design: Metrics for Livable Places* (Ewing & Clemente, 2013). Via a visual assessment survey of 588 street segments by an expert panel, this book details a rigorously validated process for measuring urban design quality (see Ewing & Clemente, 2013, for additional details). The resulting urban design scores measured five qualities: imageability, enclosure, human scale, transparency, and complexity. Imageability refers to the "quality of a place that makes it distinct, recognizable, and memorable" (Ewing & Clemente, 2013). Enclosure describes the "degree to which streets… are visually defined by buildings, walls, trees, and other vertical elements" (Ewing & Clemente, 2013). Human scale is the "size, texture, and articulation of physical elements that match the size and proportions of humans and, equally important, correspond to the speed at which humans walk" (Ewing & Clemente, 2013). Transparency refers to "the degree to which people can see or perceive human activity beyond the edge of a street or other public space" (Ewing & Clemente, 2013). Lastly, complexity is about the "visual richness of a place" in terms of the "numbers and kids of buildings, architectural diversity and ornamentation, landscape elements, street furniture, signage, and human activity" (Ewing & Clemente, 2013).

Combining these quantitative data with our own visual assessment of the arterials – by a single investigator to maximize consistency – facilitated dividing the arterials by high or low urban design. Based upon the statistical analysis presented by Ewing and Clemente, the scores from each urban design category are weighted so they represent the relative contribution to the overall quality of urban design. Figure 3.5 compares images from 23rd Avenue (low traffic, high design) with images from Colfax Avenue (high traffic, low design), while Figure 3.6 depicts examples of our selected residential streets.

The lower section of Table 3.1 displays the block group level census data collected for the surrounding neighborhoods. In neighborhoods with two or more adjoining census block groups coming together, we weighted the data by population and then split the neighborhoods by high or low median household income (with the high group reaching close to $80,000 and the low just under $40,000).

3.2 Survey

The primary data source for this analysis was an original survey administered door-to-door in the city and county of Denver by a team of 15 graduate students during summer 2014. During all survey field work, the students dressed in branded university clothing and wore official university ID cards on their shirt, as shown in Figure 3.7. The 33-question survey itself included questions across the following four categories: i) the respondent's residential street, ii) the respondents' nearby arterial road, iii) the respondent's neighborhood, and iv) personal and household social and demographic characteristics. The survey also included two map-based questions where we asked, for example, respondents to define their neighborhood boundaries. Using bright colors and abundant spacing to help make the survey feel accessible, we printed on an 11x17 sheet and folded it in half. Survey respondents were offered a five-dollar gift card for participating. The study was reviewed and approved by our university Institutional Review Board.

For each of the 30 sampled residential streets, we visited all residential units located within one-half mile of the arterial road a minimum of two and sometimes three times. With the first visit, student survey interviewers placed a door hanger at each residence announcing the survey and that interviewers would be coming to their neighborhood on a specified day the following week. During the second visit, teams of two graduate student interviewers rang doorbells and attempted to conduct an in-person survey. If a resident answered the door, they were presented two additional options: i) taking the survey on their own and having a research team member pick it up later in the afternoon, or ii) taking the survey at a later time on their own and returning by mail via a prepaid envelope. If a monolingual Spanish speaker answered the door, students offered an informational flyer regarding the survey in Spanish with the contact information of a bilingual interviewer. The address was recorded in notes so the bilingual interviewer could return during the next round with a Spanish language survey.

If nobody answered the door, the students placed a second door hanger with a "we missed you" message and additional dates when the survey interviewers would be returning and a contact number to schedule a visit, if preferred. Fifteen individuals called for appointments, and they were all interviewed within a one-week time frame. The other houses that received a "we missed you" door hanger were again visited during the third and final visit. Those who answered the door were presented the same options as before (i.e., complete in the moment, complete for pick-up, mail-in, or refuse). For the remaining unanswered doors, survey interviewers left a cover letter, survey, return envelope, and slip giving the option of receiving the incentive by e-mail. In total, we visited 1,849 housing units and received 721 completed surveys for an overall response rate of 39%. Of the completed surveys, 401 (56%) were conducted in person with the student interviewers present, and 319 (44%) were returned by mail.

Six members of the research team then coded the paper surveys into electronic form. The team leader double-checked at least 5% of the surveys coded by each person for consistency purposes. During this data cleaning process, we eliminated eight surveys due to various data discrepancy issues, which left 713 for analysis. With respect to the questions where respondents drew maps, we first translated the results into Google Earth before then transferring them to ArcGIS for analysis. For example, with the question where we asked respondents to draw the boundaries of their neighborhood, we estimated the total area of their defined neighborhood as well as the percentage of that area on the side of the arterial where the respondent lived.

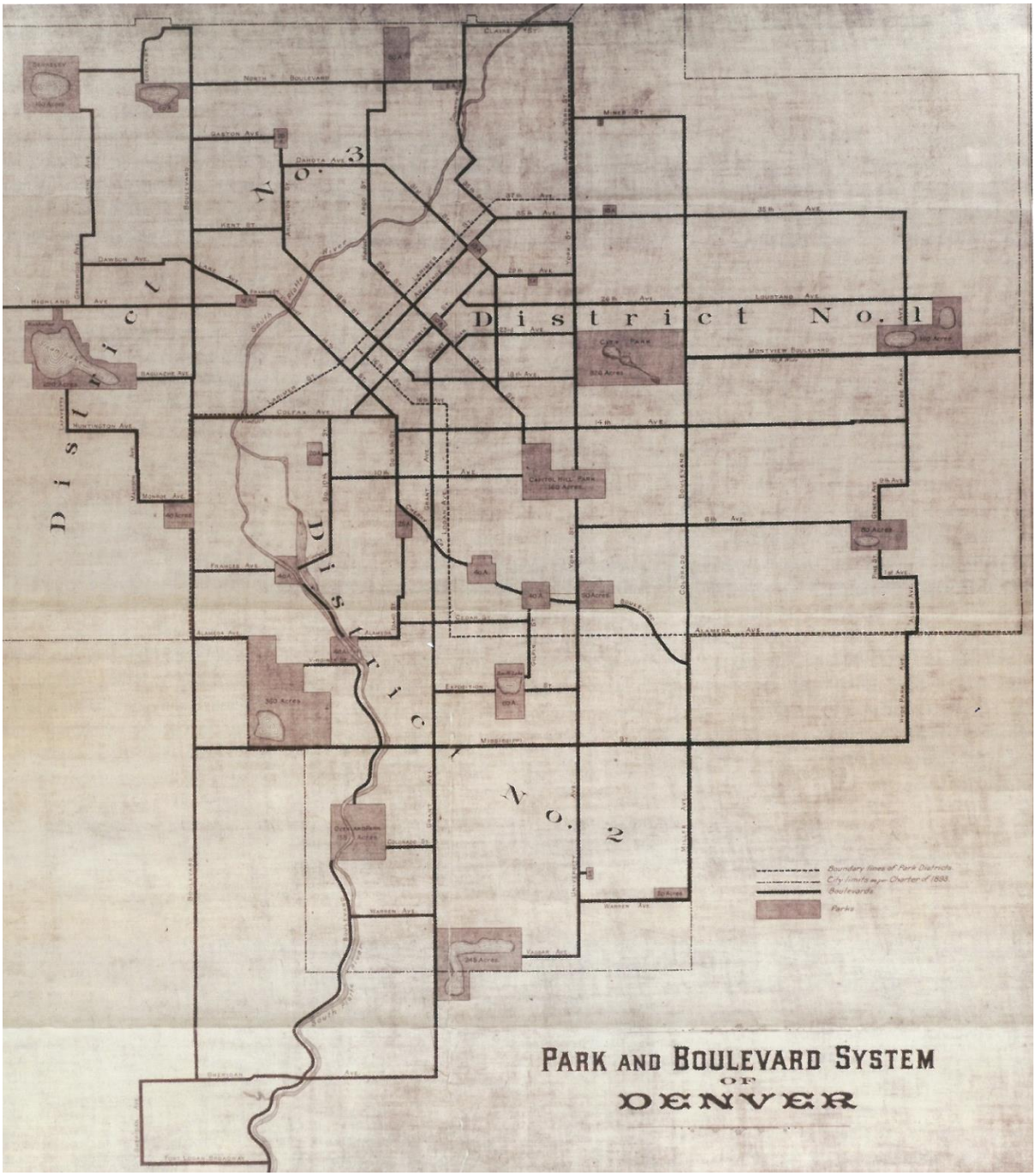

Figure 3.1 "Park and Boulevard System of Denver" plan from 1894 by Edward Rolladet (Etter & Etter, 2006)

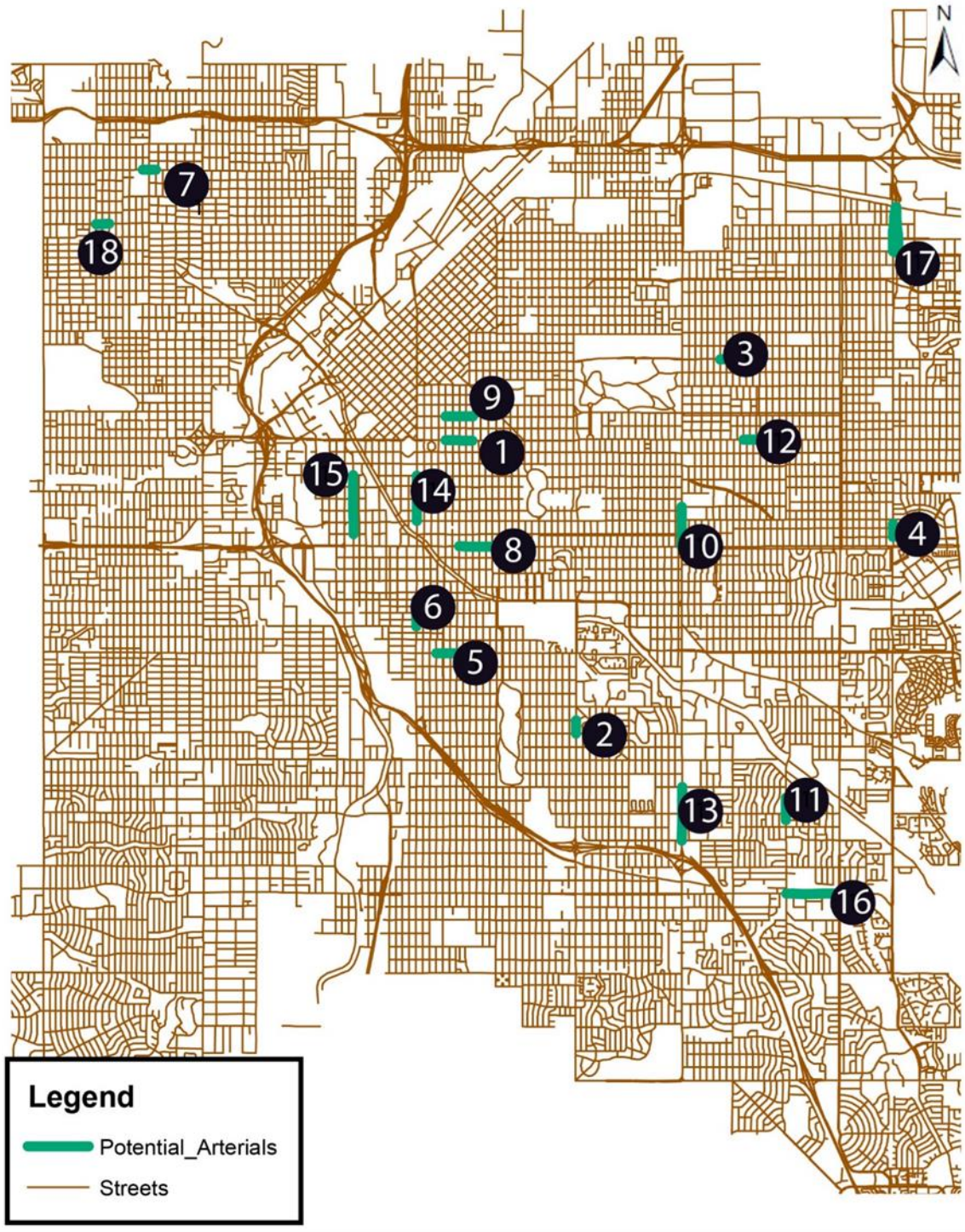

Figure 3.2 Potential Arterial Sites Studied

Figure 3.3 CU Denver Students Collecting Traffic Count Data

Table 3.1 Arterial Streets & Neighborhood Data

		All Arterial Streets	High Traffic Arterials	Low Traffic Arterials	Signif.	High Design Arterials	Low Design Arterials	Signif.	High Income Neighborhoods	Low Income Neighborhoods	Signif.
	Arterial Street Descriptors	**Mean (n=10)**	**Mean (n=5)**	**Mean (n=5)**		**Mean (n=6)**	**Mean (n=4)**		**Mean (n=6)**	**Mean (n=4)**	
Arterial Street Data	Average Annual Daily Traffic (AADT)	26,524	40,384	12,663	**	23,595	30,917		30,180	21,040	
	Average No. of Lanes	3.9	5.1	2.6	**	3.3	4.6		4.0	3.6	
	Average Street Width (feet)	63.0	76.6	49.4	*	62.3	64.0		68.2	55.3	
	Average Sidewalk Width (feet)	10.1	12.0	8.2		11.7	7.8		12.7	6.3	*
	Condition of Sidewalk[1]	2.7	2.8	2.6		2.5	3.0		2.8	2.5	
	Presence of Tree Lawn (0, 1)	0.2	0.0	0.4		0.3	0.0		0.3	0.0	
	Condition of Tree Lawn[1]	0.6	0.4	0.8		1.0	0.0		0.7	0.5	
	Presence of Bike Lanes (0, 1)	0.0	0.0	0.0		0.0	0.0		0.0	0.0	
	Presence of Median (0, 1)	0.1	0.2	0.0		0.0	0.3		0.2	0.0	
	Presence of On-Street Parking (0, 1)	0.8	0.8	0.8		1.0	0.5	*	0.7	1.0	
	Percent Tree Canopy	15.3%	11.4%	19.1%		21.6%	5.8%	*	20.7%	7.2%	
	Number of Pedestrians per Hour	102.9	128.8	76.9		130.0	62.2		110.5	91.4	
	Number of Bicyclists per Hour	18.7	21.0	16.3		20.1	16.5		18.5	18.9	
	Noise Reading at Property Line (db)	54.6	58.8	50.4	**	53.0	57.0		54.0	55.5	
	Urban Design Score: Imageability[2]	4.6	4.2	5.0		5.4	3.4		4.4	4.8	
	Urban Design Score: Enclosure[2]	0.7	0.9	0.6		0.7	0.8		0.6	1.0	
	Urban Design Score: Human Scale[2]	1.9	2.1	1.8		2.3	1.4		2.0	1.8	
	Urban Design Score: Transparency[2]	3.1	3.2	3.0		3.4	2.7		3.2	3.0	
	Urban Design Score: Complexity[2]	6.9	7.0	6.7		6.8	7.1		6.0	8.3	*
	Sum of 5 Urban Design Scores[2]	17.3	17.5	17.1		18.5	15.4		16.2	18.9	
	Neighborhood Descriptors	**Mean (n=10)**	**Mean (n=5)**	**Mean (n=5)**		**Mean (n=6)**	**Mean (n=4)**		**Mean (n=6)**	**Mean (n=4)**	
Neighborhood-Level Data	Total Neighborhood Population	3,253	3,949	2,557	*	2,953	3,705		2,551	4,308	*
	Median Age	37.6	37.1	38.0		38.2	36.6		39.4	34.9	
	Percent of Neighborhood Population 18 and younger	15.9%	11.6%	20.2%	*	18.0%	12.8%		18.9%	11.5%	
	Percent of Neighborhood Population 60 and older	15.3%	13.1%	17.6%		14.6%	16.4%		17.7%	11.8%	
	Percent Males	50.8%	51.3%	50.3%		49.0%	53.5%	*	50.0%	52.0%	
	Median Household Income	$63,068	$63,680	$62,456		$76,430	$43,026		$79,083	$39,046	**
	Percent Owner Occupied	54.3%	42.7%	66.0%		60.2%	45.5%		67.2%	35.0%	*
	Percentage White	12.3%	10.0%	14.6%		9.3%	16.9%		7.1%	20.2%	**
	Percentage Black	7.0%	10.6%	3.3%		9.8%	2.8%		2.9%	13.0%	
	Percentage Hispanic or Latino	78.0%	80.4%	75.6%		81.8%	72.4%		83.2%	70.3%	*
	Average Commute Time (min)	24.9	24.8	25.1		25.6	23.9		25.3	24.3	
	Gridded Neighborhood Street Network (0, 1)	0.7	0.6	0.8		0.8	0.5		0.5	1.0	

[1](1=poor; 2=fair; 3=good; 4=excellent)

[1]Higher scores are better (see Ewing & Clemente, 2013)

* p <.10; ** p < .05; *** p< .01

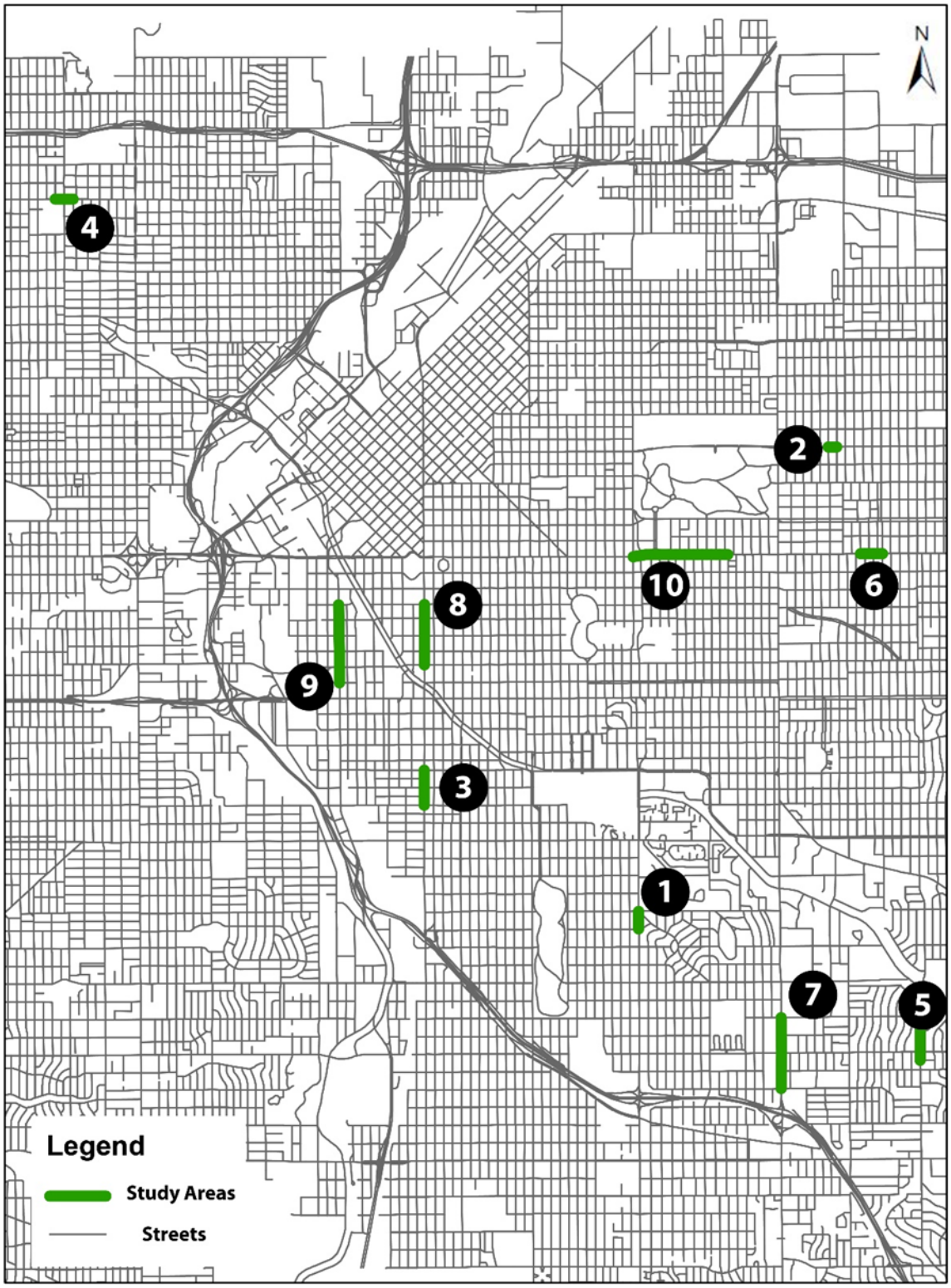

Figure 3.4 Selected Denver, CO, Sites

Figure 3.5 Arterial Comparison Example

Figure 3.6 Residential Street Examples

Figure 3.7 CU Denver Student Surveyors in the Field

4. RESULTS

Our 30-street sample of residents on heavy, moderate, and light streets successfully approximated Appleyard's results. On nearly every front, residents of the light streets tended to report the highest livability while those living on the heavy street leaned towards the lowest. However, the arterial street also matters. When accounting for the traffic levels and character of the nearby arterial, we found significant differences on many livability-related questions. Some results even suggest that living on a heavy or moderate street near an arterial road with lower traffic and high design may have greater livability than living on a light street near what could be considered a big, bad arterial. When trying to improve residential livability, planners and engineers can no longer focus entirely on the residential street in question. Livable cities require a network-level approach that looks beyond accounting for the livability of individual streets. The remainder of this section presents the highlights of our results.

4.1 The Appleyard Study

Appleyard's original study explored three streets and 36 residents. We studied 30 streets and over 700 respondents, and our findings only further substantiated Appleyard's work. Other than traffic levels and the average curb-to-curb street width, there were no other statistically significant physical differences between the heavy, moderate, and light streets in our survey. The heavy streets averaged close to 12,000 cars per day, the moderate streets over 3,000, and the light street approximately 550 cars per day. Table 4.1 portrays these results. The last column in the table depicts this level of statistical significance using the Kruskal-Wallis H test, which is similar to a t-test or ANOVA but does not require normal distributions and also allows for the comparison of more than two groups simultaneously (Laerd Statistics; UCLA Statistical Consulting Group).

Organizing ourselves around some of Appleyard's primary measures – traffic hazards, stress, noise and pollution, social interaction, and environmental awareness – we find heavy street respondents at a significant disadvantage across every domain. For instance, when prompted "the amount of traffic is a problem on my street" and presented with a five-point Likert scale, those living on the heavy streets suggested that this was a bigger problem than those on the light streets. Previous research suggests that younger people possess more laissez-faire attitudes toward traffic and traffic-related issues (Koorey et al., 2013; Lovejoy et al., 2010). While our heavy street respondents were significantly younger than other respondents, they still found traffic to be a bigger problem than those on living on the lower traffic streets. With respect to issues such as noise and pollution, we found the same street type trends (i.e., noise, pollution, and trash were perceived to be more of a nuisance to those living on the heavy streets). The same can be said about social interaction (e.g., higher traffic levels corresponded with fewer friends on the street) and environmental awareness (e.g., heavy streets not as well cared for by residents).

If we stopped here, the results were clear and explicitly match Appleyard's findings: high levels of traffic on a residential street detract from livability. However, we wanted to take a broader, network-level look at this issue to see if the type of nearby arterial streets moderates these findings.

4.2 A Network-Level Approach to Understanding Livable Streets

If we hypothesize that the presence of a particularly good or bad arterial has no impact on the livability of those living on the nearby residential streets, then we would expect to see no significant difference in responses when we account for the arterial. For example, if we disaggregate our heavy street residents into two groups – those that live near a high traffic arterial and those that live near a low traffic arterial – our hypothesis would hold true if both groups gave us the same answers. This was not always the case.

4.2.1 Results by High/Low Arterial Traffic & High/Low Urban Design

Table 4.2 disaggregates the findings by adjacency to high and low traffic arterials; Table 4.3 does so by high and low design arterials (both tables present statistical significant using the same Kruskal-Wallis statistical test). On most measures, perceived livability increases when living near a low traffic arterial or an arterial with a higher level of urban design. For instance, when controlling for the level of traffic on residential streets, people are more likely to know their neighbors when living near a low traffic or high design arterial. The same can be said for the street being well cared for as well as for kids being able to play on the street. One interesting divergence was for the heavy street residents' perception of traffic; those who lived near the low traffic arterial suggested that the amount and speed of traffic on their own residential street was worse than those living near the high traffic arterial. This result did not carry over to the moderate and light streets. For the heavy residential streets, this result suggests there might be issues with overflow traffic or cars cutting through these residential neighborhoods instead of using the nearby arterial. Despite the high car volumes on many of these arterials, they are often unpleasant to drive and avoided by many drivers. Looking at the high design arterials, however, the opposite trend for heavy street residents is suggested. When near a high design arterial, those living on heavy streets perceived traffic and vehicle speeds as significantly less of an issue when their arterial was well designed.

Considering the issue of home territory, we asked respondents to define their neighborhood by drawing boundaries onto on a color map provided in the survey. One intention with this question was to compare how much of their home territory falls on one side of the arterial versus the other. Table 4.2 shows that for all types of residential streets, respondents near the high traffic arterial defined a significantly higher percentage of their home territory on the side of the arterial where they lived. In other words, those living near a high traffic arterial defined approximately 90% of their home territory on their home side of the arterial; in contrast, those living near a low traffic arterial defined less than 80% and included a great proportion of the area across the arterial in their defined neighborhood. These results suggest that high traffic arterials serve as a barrier to one's home territory, which could negatively impact businesses located on the other side of an arterial.

A related, yet unexpected, finding from the neighborhood definition question could be found in the total area defined. On average, respondents near the low traffic arterial defined their neighborhood to be over 1.1 square miles (over 700 acres) in size; however, those living near the high traffic arterial typically defined an area of less than 0.75 miles (less than 500 acres) in size. Thus, the barrier that a high traffic arterial is to the extension of one's home territory does not simply shift home territory, it also shrinks it. Again, high versus low arterial design did not play as big of a role as arterial traffic.

We also asked people to rate the quality of their neighborhood on a scale of 1 to 10. Whether the respondent lived near a high or low design arterial seemed to play a much bigger role than the level of traffic. For all three residential street types, living near a high design arterial significantly correlated to improved neighborhood quality.

4.2.2 Controlling for Income

A relatively simple argument against the above results might have to do with income. Living near a low traffic arterial with good urban design is likely to be in higher demand and cost more. Accordingly, it would not be surprising to find the higher income neighborhoods located near low traffic arterials with good urban design qualities; and all else being equal, residents may perceive a higher income neighborhood as more livable than a lower income neighborhood. Are our results due to differences in the traffic levels or design qualities of arterial itself or simply due to differences in neighborhood income levels?

Looking back at Table 3.1 demonstrates that the arterials near the high income neighborhoods actually average both higher traffic levels and lower urban design quality. While this finding is noteworthy in itself and strengthens the case for a nearby arterial playing a key role in livability, we disaggregated the survey a bit further to break down the results by income. Accordingly, Table 4.4 groups the responses into higher and lower income neighborhoods for several representative responses while still disaggregating by: high versus low traffic arterials; high versus low design arterials; and heavy, moderate, or light residential street. If the arterial does not play a role in livability, then the responses should not change significantly while moving from left to right across the table. For instance, the first question asks respondents whether kids play on their street. The left-hand side of the table shows the responses for the higher income neighborhoods and the right-hand side for the lower income neighborhoods. Starting with the second row of data for the heavy streets category, the response increases from 2.4 to 2.7 when going from living near a high traffic arterial with low urban design to a low traffic arterial (still with low urban design). The third data column for the heavy street row drops down to 2.2 for those living near high traffic arterial with high urban design. Then it jumps to 3.9 for those living near a low traffic arterial with high urban design. If arterial traffic or design did not impact neighborhood livability, these results would not change, but they do and the differences with respect to whether kids play on the street are highly significant.

Looking more closely at these results highlights many instances that differ significantly based on arterial traffic or design quality. Generally, living near an arterial with low traffic and/or high urban design suggests higher livability responses across a number of dimensions, including the street being perceived as well cared for, social interaction and knowing one's neighbors, and the overall feeling of community on that street. While we only find a couple instances of significant differences by arterial when asking about the quality of the residential street, we do find some interesting differences in residential duration, particularly in the lower income neighborhoods. Residential duration is often considered a good proxy for perceived livability (Adams, 1992; Ahlbrandt, 1984). Thus, it is instructive to see that those respondents living near a high traffic/low urban design arterial have only lived there about two years (see Table 4.4). Average residential duration jumps significantly in neighborhoods near either a lower traffic arterial or one with a higher level of urban design. It jumps even more when living near an arterial with both lower traffic and higher urban design. In fact, residential duration in lower income neighborhoods near a "good" arterial are the only responses in the vicinity of the higher income neighborhoods. Also, it is interesting to note that residential duration – especially for lower income neighborhoods – varies much more based on the traffic and character of the nearby arterial than on whether one lives on a heavy, moderate, or light street. These results suggest that – while controlling for the income level of the neighborhood – there are significant differences in responses related to livability based on the level of arterial traffic as well as the level of urban design on that arterial.

With the neighborhood questions, we found significant differences in the total area defined for the higher income neighborhoods (e.g., those living near low traffic arterials tend to specify larger home areas) as well as with the percent of the neighborhood on the home side of the arterial for the lower income neighborhoods (e.g., those living near low traffic or high design arterials tend to show more of their home area extends past the arterial). Our results also suggest that low traffic on the arterial and good urban design improve overall neighborhood quality. These differences were particularly important for lower income neighborhoods. The implication of these results for planners and engineers is that improving the livability of the arterial roads in lower income neighborhoods could be as effective, and much less costly, than trying to improve the livability on each and every residential street.

4.2.3 The Instructive Oxymoron: Heavy Traffic on a Livable Street?

Given Appleyard's work, it seems highly unlikely that a heavy residential street could be considered anywhere near as livable as a light residential street. Bosselmann et al. expand upon this line of thinking to show that street design makes a difference based upon their findings that the livability along a multiway boulevard with heavy traffic was generally higher than the livability along a conventionally designed street with moderate traffic. We took this a step further by asking whether a heavy residential street could be as livable as a light residential street due to differences in the nearby arterial. In other words, could a heavy street near a low traffic/high design arterial be perceived as livable as a light residential street near a high traffic/low design arterial? Table 4.5 depicts this example for the same survey questions from Table 4.4.

Looking first at the high income neighborhoods on the left side of Table 4.5, the heavy residential street (near a low traffic, high urban design arterial) is just as livable as the light residential street (near a high traffic, low urban design arterial) across all dimensions except residential duration. While several responses show no significant difference, some insinuate that the heavy Street is actually more livable than the light street. This includes livability measures such as kids playing on the street, social interaction and whether they know their neighbors, and the overall feeling of community. For these livability measures – as well as the questions regarding home territory and overall neighborhood quality – the results suggest that living on a heavy traffic residential street near a low traffic, high design arterial could be preferable over living on a light traffic residential street near a high traffic, low design arterial.

For lower income neighborhoods, the light street respondents (near a high traffic, low urban design arterial) indicate a higher feeling of community and residential street quality as compared with the heavy street respondents (near a low traffic, high urban design arterial). With the home territory questions, those living on the heavy street – near a low traffic, high urban design arterial – defined larger neighborhoods that were more likely to extend across the arterial. The other livability questions did not suggest any significant difference between the heavy street and the light street for the lower income neighborhoods.

Table 4.1 Heavy, Moderate, & Light Residential Street "Appleyard" Results

		All Streets		Heavy Streets		Moderate Streets		Light Streets		Significant
	Residential Street Descriptors	Mean (n=30)		Mean (n=10)		Mean (n=10)		Mean (n=10)		
Residential Street Data	Average Annual Daily Traffic (AADT)	5,160		11,879		3,046		555		***
	Average Street Width (feet)	35.9		40.7		34.9		32.1		**
	Average Sidewalk Width (feet)	5.9		6.3		5.8		5.6		
	Condition of Sidewalk[1]	2.3		2.2		2.4		2.3		
	Presence of Tree Lawn (0, 1)	0.7		0.5		0.8		0.8		
	Condition of Tree Lawn[1]	1.8		1.1		2.2		2.1		
	Presence of Bike Lane (0, 1)	0.1		0.3		0.1		0.0		
	Presence of Median (0, 1)	0.0		0.0		0.0		0.0		
	Presence of On-Street Parking (0, 1)	0.8		0.7		0.9		1.0		
	Percent Tree Canopy	35.8%		29.8%		35.0%		42.5%		
	Average Vehicle Travel Speed (mph)	25.0		28.0		24.0		23.1		**
	Number of Pedestrians per Hour	64.3		78.4		47.7		66.9		
	Number of Bicyclists per Hour	17.4		21.6		13.0		17.5		
	Avg. Noise Reading at Property Line (db)	50.7		58.6		49.0		44.5		***
	Survey Results	n	Mean	n	Mean	n	Mean	n	Mean	
Respondent Information	Age	705	44.3	178	40.1	196	47.7	331	44.5	***
	Percent Female Respondents	645	44.5%	164	42.7%	186	41.4%	295	47.8%	
	Annual Household Income	656	$83,918	169	$72,663	178	$93,048	309	$84,264	**
	Percent Home Ownership	713	69.6%	181	55.3%	199	78.9%	333	71.5%	***
	Level of Education[2]	713	5.9	181	5.6	199	6.0	333	5.9	**
	White/Causcasian	713	86.1%	181	82.3%	199	88.9%	333	86.5%	
	Black/African-American	713	3.2%	181	3.3%	199	2.5%	333	3.6%	
	Native American/Alaskan Native	713	1.8%	181	3.9%	199	1.0%	333	0.9%	**
	Asian/Pacific Islander	713	2.1%	181	1.1%	199	1.0%	333	3.3%	
	Latino or Hispanic Origin	713	10.0%	181	12.2%	199	6.5%	333	10.8%	
	School-aged Children in Household	713	33.8%	181	29.8%	199	38.2%	333	33.3%	
	No. of Automobiles in Household	713	1.7	181	1.6	199	1.7	333	1.8	**
	No. of Bicycles in Household	713	1.8	181	1.7	199	1.7	333	1.8	
	Drive to Work Mode Share	713	64.3%	181	66.3%	199	63.3%	333	63.4%	
	Transit to Work Mode Share	713	12.9%	181	16.0%	199	9.6%	333	13.5%	
	Walk to Work Mode Share	713	8.2%	181	11.1%	199	6.0%	333	8.1%	
	Bicycle to Work Mode Share	713	17.4%	181	22.7%	199	15.1%	333	16.2%	
Street Livability Survey Results	How long have you lived on your street?	713	10.6	181	7.6	199	11.8	333	11.6	**
	How satisfied are you with the overall quality of your street?	713	6.9	181	6.1	199	6.9	333	7.3	***
	My street is good for walking[3]	713	4.2	181	3.9	199	4.3	333	4.4	***
	My street is good for biking[3]	713	3.5	181	3.0	199	3.5	333	3.7	***
	The lighting is good on my street[3]	713	3.4	181	3.4	199	3.2	333	3.4	
	My street is well maintained by the city[3]	713	3.3	181	3.2	199	3.2	333	3.5	**
	My street is well cared for by residents[3]	713	3.6	181	3.2	199	3.7	333	3.8	***
	The speed of traffic is a problem on my street[3]	713	3.2	181	3.6	199	3.3	333	3.1	***
	The amount of traffic is a problem on my street[3]	713	3.1	181	3.6	199	3.1	333	2.9	***
	Pollution from traffic is a problem on my street[3]	713	2.7	181	3.2	199	2.7	333	2.5	***
	Noise is a problem on my street[3]	713	2.9	181	3.5	199	3.0	333	2.6	***
	Trash and litter are a problem on my street[3]	713	2.7	181	3.2	199	2.7	333	2.5	***
	I see people out and about on my street[3]	713	4.3	181	4.3	199	4.3	333	4.4	*
	Kids play on my street[3]	713	3.1	181	2.6	199	3.2	333	3.3	***
	My street is safe from crime[3]	713	3.2	181	3.0	199	3.2	333	3.3	**
	My street is safe from traffic[3]	713	2.7	181	2.2	199	2.7	333	2.9	***
	I feel responsible for what happens on my street[3]	713	3.5	181	3.3	199	3.5	333	3.5	**
	There is a feeling of community on my street[3]	713	3.5	181	3.1	199	3.5	333	3.8	***
	I am very happy to live on my street[3]	713	4.1	181	3.8	199	4.2	333	4.2	***
	I know my neighbors[3]	713	3.8	181	3.5	199	3.9	333	3.9	***
	I have friends or relatives on my street[3]	713	3.0	181	2.6	199	3.0	333	3.3	***

[1](1=poor; 2=fair; 3=good; 4=excellent)

[2](1=HS degree; 2-4=some college/technical training or associate's degree; 5=college degree; 6=master's degree; 7=professional degree; 8=doctorate)

[3](1=strongly disagree; 2=disagree; 3=neutral; 4=agree; 5=strongly agree)

[4](1=usually unhappy; 2=sometimes unhappy; 3=happy; 4=very happy; 5=extremely happy)

* p <.10; ** p < .05; *** p< .01

Table 4.2 Results by Adjacency to High or Low Traffic Arterial

		All Respondents		ALL RESPONDENTS				HEAVY STREETS				Significant	MODERATE STREETS				Significant	LIGHT STREETS				Significant
				Near High Traffic Arterials		Near Low Traffic Arterials		Near High Traffic Arterials		Near Low Traffic Arterials			Near High Traffic Arterials		Near Low Traffic Arterials			Near High Traffic Arterials		Near Low Traffic Arterials		
	Survey Results	n	Mean	n	Mean	n	Mean	n	Mean	n	Mean		n	Mean	n	Mean		n	Mean	n	Mean	
Respondent Information	Age	713	44.3	304	42.0	409	46.0	84	35.3	97	44.3	***	71	45.7	128	48.7		149	43.7	184	45.1	
	Percent Female Respondents	645	44.5%	276	48.4%	369	41.6%	78	41.0%	86	44.2%		63	46.0%	123	39.0%		135	54.1%	160	42.5%	**
	Annual Household Income	656	$83,918	281	$79,344	375	$87,387	83	$60,542	86	$84,360	**	62	$87,137	116	$96,207		136	$86,820	173	$82,254	
	Percent Home Ownership	713	69.6%	304	60.2%	409	76.6%	84	39.3%	97	69.1%	***	71	69.0%	128	84.4%	**	149	67.1%	184	75.0%	**
	Level of Education[1]	713	5.86	304	5.91	409	5.81	84	5.52	97	5.60		71	6.01	128	6.06		149	6.05	184	5.75	
	White/Causcasian	713	86.1%	304	88.7%	409	84.2%	84	88.1%	97	77.3%	*	71	90.1%	128	88.3%		149	88.6%	184	84.8%	
	Black/African-American	713	3.2%	304	2.6%	409	3.7%	84	3.6%	97	3.1%		71	2.8%	128	2.3%		149	2.0%	184	4.9%	
	Asian/Pacific Islander	713	2.1%	304	2.9%	409	1.5%	84	1.2%	97	1.0%		71	1.4%	128	0.8%		149	4.7%	184	2.2%	
	Native American/Alaskan Native	713	1.8%	304	1.3%	409	2.2%	84	2.4%	97	5.2%		71	0.0%	128	1.6%		149	0.7%	184	1.1%	
	Latino or Hispanic Origin	713	10.0%	304	4.5%	409	14.1%	84	4.8%	97	18.6%	**	71	2.8%	128	8.6%		149	4.7%	184	15.8%	**
	School-aged Children in Household	713	33.8%	304	25.2%	409	40.2%	84	19.1%	97	39.2%	**	71	29.6%	128	43.0%	*	149	26.9%	184	38.6%	**
	No. of Automobiles in Household	713	1.7	304	1.6	409	1.8	84	1.3	97	1.8	***	71	1.6	128	1.8		149	1.7	184	1.8	
	No. of Bicycles in Household	713	1.8	304	1.6	409	1.9	84	1.4	97	1.9	**	71	1.5	128	1.8		149	1.8	184	1.9	
	Drive to Work Mode Share	713	64.3%	304	60.8%	409	66.9%	84	64.3%	97	68.0%		71	62.0%	128	64.1%		149	57.7%	184	67.9%	
	Transit to Work Mode Share	713	12.9%	304	14.2%	409	11.9%	84	17.9%	97	14.4%		71	9.9%	128	9.4%		149	14.8%	184	12.5%	
	Walk to Work Mode Share	713	8.2%	304	11.7%	409	5.6%	84	16.7%	97	6.2%	**	71	8.5%	128	4.7%		149	10.7%	184	6.0%	
	Bicycle to Work Mode Share	713	17.4%	304	16.8%	409	17.8%	84	21.4%	97	23.7%		71	16.9%	128	14.1%		149	14.8%	184	17.4%	
	How long have you lived on your street?	713	10.6	304	8.8	409	12.0	84	5.0	97	9.9	**	71	10.1	128	12.7		149	10.1	184	12.8	**
	How satisfied are you with the overall quality of your street?	713	6.9	304	7.1	409	6.8	84	6.2	97	6.0		71	6.9	128	7.0		149	7.7	184	7.1	**
Street Livability	My street is good for walking[2]	713	4.2	304	4.2	409	4.2	84	3.9	97	3.9		71	4.2	128	4.3		149	4.4	184	4.3	
	My street is good for biking[2]	713	3.5	304	3.4	409	3.5	84	2.8	97	3.2		71	3.5	128	3.5		149	3.8	184	3.6	
	The lighting is good on my street[2]	713	3.4	304	3.3	409	3.4	84	3.4	97	3.5		71	3.0	128	3.3		149	3.4	184	3.4	
	My street is well maintained by the city[2]	713	3.3	304	3.5	409	3.3	84	3.2	97	3.2		71	3.1	128	3.3		149	3.8	184	3.3	**
	My street is well cared for by residents[2]	713	3.6	304	3.6	409	3.7	84	3.0	97	3.4	**	71	3.5	128	3.9	**	149	3.9	184	3.7	
	The speed of traffic is a problem on my street[2]	713	3.2	304	3.2	409	3.3	84	3.3	97	3.8	**	71	3.1	128	3.4		149	3.1	184	3.0	
	The amount of traffic is a problem on my street[2]	713	3.1	304	3.1	409	3.1	84	3.5	97	3.7	*	71	3.1	128	3.1		149	2.9	184	2.8	
	Pollution from traffic is a problem on my street[2]	713	2.7	304	2.8	409	2.7	84	3.3	97	3.1		71	2.8	128	2.7		149	2.5	184	2.4	
	Noise is a problem on my street[2]	713	2.9	304	3.0	409	2.8	84	3.6	97	3.4		71	3.2	128	2.8	**	149	2.6	184	2.5	
	Trash and litter are a problem on my street[2]	713	2.7	304	2.8	409	2.7	84	3.3	97	3.2		71	2.9	128	2.6	**	149	2.5	184	2.5	
	I see people out and about on my street[2]	713	4.3	304	4.4	409	4.3	84	4.4	97	4.2		71	4.3	128	4.3		149	4.4	184	4.4	
	Kids play on my street[2]	713	3.1	304	2.8	409	3.3	84	2.4	97	2.8	*	71	2.9	128	3.4	**	149	3.0	184	3.6	**
	My street is safe from crime[2]	713	3.2	304	3.1	409	3.2	84	2.9	97	3.1		71	3.1	128	3.2		149	3.3	184	3.2	
	My street is safe from traffic[2]	713	2.7	304	2.7	409	2.7	84	2.3	97	2.2		71	2.7	128	2.6		149	3.0	184	2.9	
	I feel responsible for what happens on my street[2]	713	3.5	304	3.4	409	3.5	84	3.1	97	3.4	*	71	3.3	128	3.6	**	149	3.6	184	3.5	
	There is a feeling of community on my street[2]	713	3.5	304	3.4	409	3.6	84	3.0	97	3.2		71	3.2	128	3.7	***	149	3.7	184	3.8	*
	I am very happy to live on my street[2]	713	4.1	304	4.1	409	4.1	84	3.8	97	3.8		71	4.1	128	4.3	**	149	4.3	184	4.1	
	I know my neighbors[2]	713	3.8	304	3.6	409	4.0	84	3.2	97	3.8	**	71	3.6	128	4.0	**	149	3.8	184	4.1	**
	I have friends or relatives on my street[2]	713	3.0	304	2.8	409	3.2	84	2.5	97	2.8		71	2.7	128	3.2	**	149	3.1	184	3.4	**
	Use & Perception of Arterial/Neighborhood																					
	Total Neighborhood Area Defined by Respondent (acres)	554	607.3	237	474.5	317	706.5	62	525.6	72	723.3	**	50	451.6	101	714.1	**	125	458.3	144	692.9	**
	% of Neighborhood on the Side where the Respondent Lives	470	83.4%	219	89.1%	251	78.4%	61	81.2%	53	72.9%	**	42	90.5%	74	81.1%	**	116	92.7%	124	79.2%	***
	How do you rate the overall quality of your neighborhood?	713	7.8	304	7.8	409	7.8	84	7.1	97	7.3	*	71	7.7	128	8.0		149	8.3	184	7.8	**

[1](1=HS degree; 2-4=some college/technical training or associate's degree; 5=college degree; 6=master's degree; 7=professional degree; 8=doctorate)

[2](1=strongly disagree; 2=disagree; 3=neutral; 4=agree; 5=strongly agree)

[3](1=usually unhappy; 2=sometimes unhappy; 3=happy; 4=very happy; 5=extremely happy)

* p <.10; ** p < .05; *** p< .01

Table 4.3 Results by Adjacency to High or Low Design Arterial

		All Respondents		ALL RESPONDENTS				HEAVY STREETS				Significant	MODERATE STREETS				Significant	LIGHT STREETS				Significant
				Near High Design Arterials		Near Low Design Arterials		Near High Design Arterials		Near Low Design Arterials			Near High Design Arterials		Near Low Design Arterials			Near High Design Arterials		Near Low Design Arterials		
	Survey Results	n	Mean	n	Mean	n	Mean	n	Mean	n	Mean		n	Mean	n	Mean		n	Mean	n	Mean	
Respondent Information	Age	713	44.3	471	46.0	242	41.1	119	40.5	62	39.3		150	48.7	49	44.4	*	202	47.0	131	40.6	**
	Percent Female Respondents	645	44.5%	441	44.1%	204	45.4%	110	40.9%	54	46.3%		142	42.3%	44	38.6%		189	47.6%	106	48.1%	
	Annual Household Income	656	$83,918	433	$95,723	223	$60,781	111	$76,081	58	$66,121		137	$103,777	41	$57,195	***	185	$100,878	124	$59,476	***
	Percent Home Ownership	713	69.6%	471	77.2%	242	54.7%	119	54.6%	62	56.5%		150	86.0%	49	57.1%	***	202	83.2%	131	53.4%	***
	Level of Education[1]	713	5.86	471	6.16	242	5.26	119	5.86	62	5.00	**	150	6.30	49	5.25	**	202	6.21	131	5.39	**
	White/Causcasian	713	86.1%	471	90.2%	242	78.2%	119	85.7%	62	75.8%	*	150	93.3%	49	75.5%	**	202	90.1%	131	80.9%	**
	Black/African-American	713	3.2%	471	3.1%	242	3.3%	119	2.5%	62	4.8%		150	3.3%	49	0.0%		202	3.5%	131	3.8%	
	Asian/Pacific Islander	713	2.1%	471	0.8%	242	4.5%	119	0.8%	62	1.6%		150	0.0%	49	4.1%	**	202	1.5%	131	6.1%	**
	Native American/Alaskan Native	713	1.8%	471	1.5%	242	2.5%	119	3.4%	62	4.8%		150	0.7%	49	2.0%		202	0.5%	131	1.5%	
	Latino or Hispanic Origin	713	10.0%	471	6.7%	242	16.5%	119	10.9%	62	14.5%		150	3.3%	49	16.3%	**	202	6.9%	131	16.8%	**
	School-aged Children in Household	713	33.8%	471	35.9%	242	29.6%	119	27.7%	62	33.9%		150	40.7%	49	30.6%		202	37.1%	131	27.5%	*
	No. of Automobiles in Household	713	1.7	471	1.8	242	1.5	119	1.7	62	1.4	*	150	1.8	49	1.5	**	202	1.9	131	1.5	***
	No. of Bicycles in Household	713	1.8	471	1.9	242	1.6	119	1.7	62	1.7		150	1.8	49	1.4	**	202	2.0	131	1.5	***
	Drive to Work Mode Share	713	64.3%	471	67.7%	242	57.6%	119	73.1%	62	53.2%	**	150	64.7%	49	59.2%		202	66.3%	131	58.8%	
	Transit to Work Mode Share	713	12.9%	471	11.5%	242	15.6%	119	15.1%	62	17.7%		150	8.7%	49	12.2%		202	11.9%	131	16.0%	
	Walk to Work Mode Share	713	8.2%	471	4.8%	242	14.8%	119	8.4%	62	16.1%		150	3.3%	49	14.3%	**	202	4.0%	131	14.5%	**
	Bicycle to Work Mode Share	713	17.4%	471	17.6%	242	16.9%	119	22.7%	62	22.6%		150	16.0%	49	12.2%		202	16.3%	131	16.0%	
Street Livability	How long have you lived on your street?	713	10.6	471	11.3	242	9.3	119	7.4	62	8.0		150	12.4	49	9.9		202	12.8	131	9.7	**
	How satisfied are you with the overall quality of your street?	713	6.9	471	7.0	242	6.7	119	6.1	62	6.1		150	7.0	49	6.7		202	7.5	131	7.1	**
	My street is good for walking[2]	713	4.2	471	4.3	242	4.0	119	4.1	62	3.5	**	150	4.3	49	4.1		202	4.5	131	4.2	**
	My street is good for biking[2]	713	3.5	471	3.5	242	3.5	119	3.1	62	2.8		150	3.5	49	3.6		202	3.7	131	3.7	
	The lighting is good on my street[2]	713	3.4	471	3.4	242	3.3	119	3.5	62	3.3		150	3.2	49	3.1		202	3.4	131	3.3	
	My street is well maintained by the city[2]	713	3.3	471	3.3	242	3.5	119	3.1	62	3.3		150	3.1	49	3.5	**	202	3.5	131	3.5	
	My street is well cared for by residents[2]	713	3.6	471	3.8	242	3.3	119	3.4	62	3.0	**	150	3.8	49	3.4	**	202	4.0	131	3.5	***
	The speed of traffic is a problem on my street[2]	713	3.2	471	3.3	242	3.2	119	3.4	62	3.9	**	150	3.4	49	3.2		202	3.1	131	2.9	
	The amount of traffic is a problem on my street[2]	713	3.1	471	3.2	242	3.0	119	3.5	62	3.9	**	150	3.2	49	2.7	**	202	2.9	131	2.8	
	Pollution from traffic is a problem on my street[2]	713	2.7	471	2.7	242	2.7	119	3.1	62	3.3		150	2.8	49	2.6		202	2.5	131	2.5	
	Noise is a problem on my street[2]	713	2.9	471	2.9	242	3.0	119	3.4	62	3.7		150	3.0	49	2.9		202	2.5	131	2.6	
	Trash and litter are a problem on my street[2]	713	2.7	471	2.7	242	2.9	119	3.1	62	3.5	**	150	2.7	49	2.7		202	2.4	131	2.7	**
	I see people out and about on my street[2]	713	4.3	471	4.4	242	4.2	119	4.4	62	4.0	**	150	4.3	49	4.3		202	4.5	131	4.2	**
	Kids play on my street[2]	713	3.1	471	3.3	242	2.8	119	2.7	62	2.3	**	150	3.3	49	3.0		202	3.6	131	3.0	**
	My street is safe from crime[2]	713	3.2	471	3.2	242	3.1	119	3.1	62	2.8	*	150	3.1	49	3.4	*	202	3.3	131	3.2	
	My street is safe from traffic[2]	713	2.7	471	2.6	242	2.8	119	2.3	62	2.0	**	150	2.6	49	2.8		202	2.8	131	3.1	**
	I feel responsible for what happens on my street[2]	713	3.5	471	3.5	242	3.3	119	3.2	62	3.3		150	3.5	49	3.3	**	202	3.7	131	3.3	**
	There is a feeling of community on my street[2]	713	3.5	471	3.7	242	3.2	119	3.3	62	2.8	**	150	3.7	49	3.0	**	202	4.0	131	3.4	***
	I am very happy to live on my street[2]	713	4.1	471	4.2	242	3.9	119	3.9	62	3.5	**	150	4.2	49	4.1		202	4.3	131	4.0	***
	I know my neighbors[2]	713	3.8	471	3.9	242	3.6	119	3.5	62	3.6		150	4.0	49	3.6	**	202	4.1	131	3.6	***
	I have friends or relatives on my street[2]	713	3.0	471	3.2	242	2.7	119	2.8	62	2.3	**	150	3.1	49	2.5	**	202	3.5	131	2.9	**
	Use & Perception of Arterial/Neighborhood																					
	Total Neighborhood Area Defined by Respondent (acres)	554	607.3	372	628.1	182	564.6	92	628.1	42	640.0		118	660.8	33	507.1		162	604.3	107	552.8	
	% of Neighborhood on the Side where the Respondent Lives	470	83.4%	295	85.1%	175	80.4%	77	77.2%	37	77.6%		84	85.4%	32	82.1%	*	134	89.6%	106	80.9%	**
	How do you rate the overall quality of your neighborhood?	713	7.8	471	8.1	242	7.2	119	7.7	62	6.3	***	150	8.1	49	7.4	**	202	8.4	131	7.5	***

[1](1=HS degree; 2-4=some college/technical training or associate's degree; 5=college degree; 6=master's degree; 7=professional degree; 8=doctorate)

[2](1=strongly disagree; 2=disagree; 3=neutral; 4=agree; 5=strongly agree)

[3](1=usually unhappy; 2=sometimes unhappy; 3=happy; 4=very happy; 5=extremely happy)

* p <.10; ** p < .05; *** p< .01

Table 4.4 Selected Results for High/Low Traffic & High/Low Design Arterial by Neighborhood Income Level

	Higher Income Neighborhoods					Lower Income Neighborhoods				
	Low Urban Design		High Urban Design		Significant	Low Urban Design		High Urban Design		Significant
	High Traffic Arterial	Low Traffic Arterial	High Traffic Arterial	Low Traffic Arterial		High Traffic Arterial	Low Traffic Arterial	High Traffic Arterial	Low Traffic Arterial	
Kids play on my street[1]										
ALL STREETS	2.8	3.3	3.1	3.7	***	1.8	3.1	3.0	3.0	***
HEAVY	2.4	2.7	2.2	3.9	***	1.9	2.1	2.9	1.9	**
MODERATE	3.5	3.1	3.2	3.6		2.0	3.1	2.6	3.2	**
LIGHT	2.7	3.7	3.6	3.6	**	1.8	3.5	3.3	3.8	***
Street is well cared for by residents[1]										
ALL STREETS	3.6	3.6	3.7	3.7	*	3.4	3.0	3.5	3.9	***
HEAVY	2.8	3.1	2.9	3.9	***	3.4	2.8	3.3	3.2	
MODERATE	3.9	3.3	3.9	4.0		3.0	3.4	3.2	4.1	**
LIGHT	3.8	4.0	4.2	3.8		3.6	3.0	3.9	4.2	***
I know my neighbors[1]										
ALL STREETS	3.7	3.8	3.8	4.1	**	3.1	3.7	3.3	4.0	***
HEAVY	3.4	3.0	3.0	4.1	**	3.1	3.7	3.1	3.5	
MODERATE	4.2	4.1	4.0	4.1	**	2.5	3.9	3.5	4.0	**
LIGHT	4.0	4.4	4.2	4.2	**	3.3	3.5	3.4	4.4	***
There is a feeling of community[1]										
ALL STREETS	3.0	3.4	3.7	3.9	***	3.2	3.2	3.2	3.7	**
HEAVY	2.7	2.8	3.1	4.0	***	2.9	2.8	2.9	2.8	
MODERATE	2.7	3.3	3.8	3.9	**	3.0	3.2	2.9	3.8	**
LIGHT	3.4	4.0	4.1	3.8	**	3.4	3.3	3.7	4.4	***
Residential Duration (years)										
ALL STREETS	11.8	14.3	10.1	12.9		2.1	9.0	8.0	12.4	***
HEAVY	6.6	10.5	4.7	8.7	*	2.5	10.4	5.5	10.7	**
MODERATE	11.0	19.5	14.1	13.0		1.0	9.1	8.9	12.8	**
LIGHT	14.8	14.7	11.7	15.0		1.7	8.4	8.8	13.1	***
Quality of Residential Street (1-10)										
ALL STREETS	7.0	7.3	7.3	6.9		7.1	6.1	6.8	7.0	**
HEAVY	6.3	5.6	6.6	6.5		6.6	5.9	6.9	7.1	
MODERATE	7.1	7.9	7.1	7.0		6.0	6.3	6.9	7.1	
LIGHT	7.4	8.2	7.8	7.0	*	7.7	6.2	7.6	7.9	***
Respondent Defined "Neighborhood" (acres)										
ALL STREETS	611	824	389	823	***	497	458	503	673	
HEAVY	855	653	369	836	**	490	511	632	745	
MODERATE	491	871	334	780	**	447	418	558	720	
LIGHT	532	921	421	849	***	516	453	393	556	
% of "Neighborhood" on Home Side of Arterial										
ALL STREETS	94.4%	79.1%	86.8%	82.5%	**	90.8%	66.0%	87.0%	87.0%	***
HEAVY	86.4%	98.2%	77.3%	77.4%		95.2%	55.3%	79.0%	73.1%	**
MODERATE	99.1%	76.8%	87.2%	81.8%		94.1%	71.2%	89.1%	90.9%	**
LIGHT	97.0%	73.5%	92.8%	85.7%	***	88.5%	67.9%	91.3%	90.3%	***
Quality of Neighborhood (1-10)										
ALL STREETS	7.6	7.7	8.1	8.2	**	7.6	6.5	7.7	8.2	***
HEAVY	6.5	6.8	7.3	8.5	***	6.7	5.7	7.3	7.3	**
MODERATE	7.8	8.0	8.0	8.2		7.9	6.9	7.4	8.4	***
LIGHT	8.1	8.2	8.6	8.1	*	7.9	6.6	8.2	8.6	***

[1](1=strongly disagree; 2=disagree; 3=neutral; 4=agree; 5=strongly agree)

* p <.10; ** p < .05; *** p< .01

Table 4.5 Selected Results for Extreme Example

	HEAVY RESIDENTIAL STREET	LIGHT RESIDENTIAL STREET		HEAVY RESIDENTIAL STREET	LIGHT RESIDENTIAL STREET	
	Higher Income Neighborhoods		Significant	Lower Income Neighborhoods		Significant
	High Urban Design	Low Urban Design		High Urban Design	Low Urban Design	
	Low Traffic Arterial	High Traffic Arterial		Low Traffic Arterial	High Traffic Arterial	
Kids play on my street[1]	3.9	2.7	**	1.9	1.8	
Street is well cared for by residents[1]	3.9	3.8		3.2	3.6	
I know my neighbors[1]	4.1	4.0	**	3.5	3.3	
There is a feeling of community[1]	4.0	3.4	**	2.8	3.4	**
Residential Duration (years)	8.7	14.8	*	10.7	1.7	***
Quality of Residential Street (1-10)	6.5	7.4		7.1	7.7	***
Respondent Defined "Neighborhood" (acres)	836	532	**	745	516	*
% of "Neighborhood" on Home Side of Arterial	77.4%	97.0%	***	73.1%	88.5%	**
Quality of Neighborhood (1-10)	8.5	8.1	*	7.3	7.9	**

[1](1=strongly disagree; 2=disagree; 3=neutral; 4=agree; 5=strongly agree)

* p <.10; ** p < .05; *** p< .01

5. CONCLUSIONS

It has long been a nearly universally held truth that high levels of fast-moving traffic on the street where you live detract from livability. We do not want to dispute this conceptualization; rather, it is our hope to simply show that what is happening on the surrounding major roads also makes a significant difference when it comes to livability. In other words, living near a big, bad arterial detracts from the livability of nearby residential streets while living near what could be a considered a good arterial (lower traffic with higher urban design quality) enhances livability. Based on our findings, the marching orders are clear. If planners and engineers really want to promote livability on residential streets, they can no longer push all the traffic out to the arterial and hope for the best. Livable residential streets can only be part of the solution. If we want livable cities, we also need to plan for livable arterial roads.

Far too often, urban arterials have become de facto barriers between neighborhoods and considerable obstructions to walking and biking. With respect to arterials in this research, we focused on the quality of the urban design and the relative traffic levels on the arterial. For planners and engineers, there are often major obstacles to taking on either issue.

While improving street design often becomes a funding issue, many cities attempting to redesign an arterial run into conflicts with state DOTs that have designated these arterials as state highways. Such roads often fall under a different set of design guidelines that make such improvements more difficult – but not impossible. In the past, it was not uncommon for DOTs to cede control of the road (as well as the maintenance) over to the city. This arrangement would usually provide cities enough design flexibility to improve the arterial without having to contend with DOT guidelines. Today, federal transportation agencies have formally approved manuals – such as the NACTO Urban Street Design Guide and the CNU/ITE Designing Walkable Urban Thoroughfares Recommended Practice – that already provide such flexibility if a planner or engineer is willing to take on a new approach to street design. Also, if residing on a multiway boulevard is more livable than a conventionally designed street, as the research of Bosselmann et al. suggests, it stands to reason that livability on the residential streets near such a boulevard design would also improve. These kinds of innovative arterial designs that have the ability to improve livability deserve more research.

Traffic levels are typically a more difficult issue for planners and engineers to tackle. For instance, many cities rely upon regional traffic models to tell them how much traffic to expect at some distant future time horizon. The not-so-subtle implication is that it is up to the city to accommodate these future cars. As a result, it was not uncommon for cities to widen arterials for some future traffic demand in hopes of staving off the ill effects of congestion. The result? Unfortunately, there is little evidence to support the assumption that increasing capacity reduces traffic congestion in the long run. A growing body of literature demonstrates that attempts to relieve congestion with additional vehicle lane-miles typically induce more demand, and this additional capacity fills far earlier than expected (Cervero, 2002; Cervero & Hansen, 2002; Downs, 1992, 2006; Duranton & Turner, 2011; Jorgensen, 1947; Noland, 2001, 2007). Many cities now realize that you cannot build your way out of congestion and focus more on performance metrics revolving around moving people and not cars.

The bottom line is that the livability differences between a heavy residential street and a light one are nowhere near what they were when accounting for the presence of a “good” or “bad” arterial. Understanding livability for a residential street requires more than looking at just that residential street. Planners and engineers need to take a network-level approach to examining the issue of livable streets. We do not intend for this to be a call for trying to shift traffic off arterials and onto residential streets; rather, it should be a call to make our arterials more livable and better understand the implications of network-level design decisions. Compact and connected street networks, which have been shown to

reduce VMT, increase walking and biking, and improve health outcomes (Marshall & Garrick, 2010, 2012; Marshall, Piatkowski, & Garrick, 2014), can still move people efficiently at safe speeds. In contrast, large arterials – and in particular, the intersection of two large arterials – too easily result in difficulties trying to accommodate pedestrians and bicyclists (Bern & Marshall, 2013; Kulash, 1990).

For far too long, our focus with residential livability was solely on the residential street itself. While the Appleyard findings still hold, we now know that what impacts residential livability requires accounting for the nearby arterial street as well. Awareness of this disconnect should lead planners and engineers to consider a combination of network-level strategies when trying to design more livable streets. When it comes to livability, the *Tale of Two Cities* approach to city planning – where we surround walkable and bike-friendly, low traffic residential streets with car-centric, high traffic arterials – leaves much to be desired. We need a broader, more comprehensive perspective if we really want to achieve more livable cities. Arterial streets in cities are both our greatest obstacle and our greatest opportunity.

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PART 2: CHARACTERISTICS OF COMMERCIAL ARTERIAL ROADS ASSOCIATED WITH RESIDENTIAL SATISFACTION & NEIGHBORHOOD LIVABILITY

7. INTRODUCTION

Nearly everywhere, arterials – or major roads – thwart cities' attempts to build transportation systems that serve multiple purposes and multiple users. Efforts to enhance public transit service, create well-connected bicycle and pedestrian networks, and revitalize neighborhoods – functions that cities increasingly want streets to serve – implicate arterials as a critical part of the strategy. Conflicts occur because arterials carry fast, heavy motorized traffic, and with the exception of certain boulevards and parkways, they do not have designs that accommodate a range of activities beyond this.

Arterials' special function in hierarchical transportation networks contributes to their complicated nature. In theory, they provide mobility by aggregating local traffic and moving it as quickly as possible across cities and regions, sometimes channeling it to limited-access highways. In practice, however, arterials provide more than this. Arterials give access to surrounding land uses. They are often the location of drive-through restaurants, gas stations, auto repair shops, car dealerships, dive bars, dollar stores, and various hole-in-the-wall establishments. Occasionally, these buildings have the architectural flair of an older motor age, with jetting angles or futuristic curves (Wachs and Crawford, 1992). Providing access to these places creates a tradeoff with mobility. In response to the competing demands placed on them, arterials lined with commercial land uses are frequently the object of interventions to increase their traffic capacity, either through traffic operations or through their physical design.

However, certain arterials, usually those located in gentrified or affluent areas, can adapt differently. Although they still allow for relatively high traffic volumes, they can become neighborhood main streets. Neighborhood main streets can typically serve the dual demand for travel and leisure activities (e.g., shopping). These arterials manage to support a vibrant street life, and they can be designed to support multiple travel modes.

Thinking about arterial roads helps understand a larger problem facing contemporary transportation systems – "balancing the tension between place and node" – or how streets contribute to a sense of place while at the same time functioning as part of a regional network (Belzer et al., 2004: 45). Arterials advance (or hinder) urban policies such as infill housing, enhanced transit service, and transit-oriented development because these initiatives benefit from streets that perform both place and transportation network functions (Cherry et al., 2006; Mejias and Deakin, 2005).

Research about one specific kind of arterial – residential arterials with a boulevard design – found that residents living on them are happy despite the traffic, and that these major roads can be more livable than nearby streets with lower traffic volumes (Bosselmann et al., 1999). Yet, residential arterials with a boulevard design are relatively rare, and they are less problematic than commercial arterials. What is not known is whether commercial arterials can also have a positive effect on neighborhood livability, and if they do, under what conditions.

Our study aims to learn what specific design, social, and traffic-related features of commercial arterial roads make them "livable" from the perspective of nearby residents. We also investigate the hypothesis that residents' satisfaction reflects not only the quality of their own residential street but also the quality of the arterial roads in their neighborhood. This study contributes critical knowledge about how the design and planning of arterial roads can mitigate some of the negative externalities of their traffic.

Our cross-sectional study includes 10 cases of commercial arterial roads in Denver, Colorado – each with a node of clustered retail but with varying amounts of traffic and differing street designs. For each case, we administered a door-to-door residential survey to learn about neighbors' residential satisfaction and how they use their local arterial road. In addition, for each of the 10 cases, we collected information about the engineering and urban design characteristics of the streets.

We use three outcome variables that capture different dimensions of residential satisfaction. We found that arterial streets are associated with residential satisfaction for all three variables, above and beyond other factors. Arterials' association varies depending on the specific dimension of residential satisfaction. Arterials have more associations with respondents' neighborhood satisfaction than with their satisfaction with their residential street, for example. Based on these results, we suggest that interventions focusing on land uses that foster a vibrant street life, maintenance of social norms, and enhancements to the pedestrian environment would benefit arterials' residential neighbors.

Section 8 presents a review of literature and discusses how and why arterial roads were once considered the *solution* to livability problems and how they became so challenging. Section 9 describes our research design and methods, including the design and implementation of our survey. Section 10 presents results of the analysis, and Section 11 presents our interpretation of the results. Section 12 concludes with further discussion of the implications for transportation policy, planning, and practice with an emphasis on how arterials roads can and should be included in comprehensive approaches to city planning to improve their performance with respect to their residential neighbors.

8. BACKGROUND & LITERATURE

8.1 Arterial Roads & Livability

In this research, we place arterial roads in the context of livability. This is because the concept of livability highlights the connection between tangible aspects of places – blocks, streets, and buildings – and broader concepts of sustainability such as economic development, environmental protection, and equity (Godschalk, 2004).

Our framing of the problem of livable arterials draws upon decades of interest in managing the negative spillovers of motorized traffic. Since cars became commonplace in the early twentieth century, planning, urban design, and traffic engineering have been used in combination to protect residents from the noise, pollution, and speed of motorized traffic. In cases of new development, superblocks and single-use residential subdivisions separated automobile traffic and residents, with many examples drawing inspiration from the urban form and street network modeled by Radburn (Birch, 1980). In these designs, arterials were the *solution* to the traffic-livability problem. In places such as London, where major new development was impossible, traffic engineering could be used to approximate the superblock by establishing a hierarchical street network to create "environmental areas" that were protected from high volumes of motorized traffic (Buchanan, 1963).

In the 1970s, Appleyard's work on livable streets changed the discourse (1972, 1973). He mostly accepted the idea that neighborhoods should be protected from traffic, but he isolated the problems created by the hierarchical street network and associated land use policies. In particular, roads with heavy traffic take a toll on livability. To Appleyard, traffic produced the feeling of vulnerability, and his concept of livability emphasized protection from traffic: "a…place where one can live in reasonable safety (especially for children), comfort, health, without excessive crowding, noise, pollution, and hazards" (Appleyard, 1983).

The main contribution of *Livable Streets* was to introduce the street itself – in contrast to only dwellings or neighborhoods – as an appropriate unit of analysis for livability. Just as streets with heavy traffic could take away from livability, streets could also contribute to it through their design and also through their use as quasi-private spaces. One of Appleyard's illustrations – a convertible car used as a planter and play space – exemplifies how he imagined streets as an intimate part of daily life.

Extending this idea, Jacobs (1993), Jacobs et al. (2002), and Bosselmann et al. (1999) acknowledge the conflict between traffic and livability but assert that they are not mutually exclusive. Traffic can make certain streets dynamic and interesting, despite also being a source of noise and pollution. In particular, street design can be used to buffer neighbors and road users from noise, pollution, and other negative effects of traffic.

In this way, accepting car traffic as an element of neighborhood vitality allows one to ask questions that are critical for contemporary transportation policy, such as how to design for transit-oriented and residential infill development in settings where cars remain a priority. Certain important questions have not been answered, such as what positive and negative characteristics of commercial arterials extend into surrounding neighborhoods. In this study, we are interested specifically in livability as perceived by residents in surrounding neighborhoods, in contrast to prior work that has investigated the experience of residents who live on the arterial itself (Bosselmann et al., 1999).

8.2 Characteristics of Arterial Roads

The difficulties of urban arterial roads have been documented in planning, engineering, urban design, and public health literature (Mindell and Karlsen, 2012; Dumbaugh and Rae, 2009; Dowling et al., 2008; Hebbert, 2005; Miles-Doan and Thompson, 1999). These difficulties range from travel delay and travel time unreliability to exposure to traffic safety hazards, direct exposure to noise and near-roadway pollution, and physical barriers that limit access and lead to community severance.

The specific design features of arterial roads vary and have implications for their livability. Figure 8.1 presents examples of the range of arterial designs from Denver. The arterials in (a) and (b) both carry more than 25,000 vehicles per day, but the design of (b) includes one edge with a pedestrian-focused design that uses parking and trees to create a buffer between the traffic lanes and sidewalk. A similar contrast exists for smaller scale arterials too. Examples (c) and (d) carry only about 13,000 vehicles per day, but (d) creates a feeling of enclosure because it does not have building setbacks and it includes a bus stop with street furniture. The final example offers a more extreme contrast. Arterial (e) carries 60,000 per day, whereas (f) carries only about one-tenth that amount of traffic (even though it is an officially designated arterial by the City of Denver). The smaller arterial functions as a neighborhood main street, whereas the larger one is an important link to the interstate highway.

In addition to their role as travel corridors, previous studies of arterial roads highlight their importance as neighborhood assets (McAndrews and Marcus, 2014; McAndrews et al., 2006; Bosselmann et al., 1999). In particular, they are places that nearby residents use with some frequency, despite their traffic and related hazards.

For example, residential arterials designed as boulevards were used for exercise such as walking, jogging, and bicycling, and they were used as parks where people would walk dogs, interact, or sit and watch the activity. In comparison to conventional neighboring streets with light traffic, these boulevards were less often used by children, with or without their parents (Bosselmann et al., 1999).

With respect to physical aspects of the street, traffic volumes, traffic speed, noise levels, the potential to support transit and the attractiveness of the streetscape are all important characteristics (Seto et al., 2007; McAndrews et al., 2006; Mejias and Deakin 2005).

Social interactions on the street and norms of its use are interconnected. For example, along one such arterial road, San Pablo Avenue in California, street activity increased and criminal activity decreased. This decline in criminal activity was favorable for infill development because lenders were more willing to finance projects as the neighborhoods became safer (Mejias and Deakin, 2005).

8.3 Relating Arterial Roads to Residential Satisfaction

Research consistently finds that traffic has a negative effect on residential satisfaction (Hur and Morrow-Jones, 2008). But living close to roads could have accessibility benefits. Hamersma et al. (2014) investigated residential satisfaction of households living near highways in seven different neighborhoods in the Netherlands (N=1,225). This study accounted for easy access to the highway as a possible positive feature and nuisance (noise, air pollution) as the primary negative features.

One challenge for measuring residential satisfaction is heterogeneity in how people perceive and value built and social environments. For instance, the value placed upon physical characteristics varies with the background of respondents, and social factors such as crime and discrimination may be more important to some residents than physical characteristics (Hur and Morrow-Jones, 2008). This finding reflects a

fundamental issue: satisfaction reflects both endogenous psychological processes and exogenous factors that affect one's life (Dissart and Deller, 2000). Therefore, residential satisfaction research needs to establish a connection between objective measures of environments with subjective perceptions of well-being (Andrews, 2001).

The literatures about the quality of place, residential satisfaction, and streets discuss the probable characteristics of livable arterials. These literatures focus on four categories of variables that capture information about the relationship between residential environments and streets, including: 1) objectively measured environmental characteristics of the road, 2) residents' perceptions of social characteristics of the road and street activities, 3) residents' use of the road and attitudes toward cars and travel, and 4) objectively measured environmental characteristics of the neighborhood. In addition to these characteristics, studies consider personal and household characteristics such as length of residence and the presence of children in the household.

(a) Emphasis on travel lanes
AADT = 25,000

(b) Parking, trees buffer pedestrian-focused edge
AADT = 35,750

(c) Sidewalks, lacking pedestrian-focused design
AADT = 13,214

(d) Buildings create enclosure, design of bus stop
AADT = 12,700

(e) Intensity and speed of traffic
AADT = 62,493

(f) Parking, sharrows, turn lane, scale of buildings
AADT = 6,203

Figure 8.1 Example Characteristics of Arterial Roads, Denver, Colorado, with Average-Annual Daily Traffic (AADT)

9. DATA & METHODS

9.1 Study Area & Site Selection

The study area is the city of Denver, Colorado. Within Denver, our goal in site selection was to capture a range of commercial arterials' potentially good and bad qualities, such as high/low traffic volumes and good/bad urban design, while maintaining their comparability with respect to their commercial nodes and surrounding residential neighborhoods.

We began the site selection process by identifying all street segments in Denver officially designated as an "arterial" that also have commercial nodes. To further narrow down our list of potential sites, we considered a variety of factors including the features of the arterials (e.g., average annual daily traffic, number of lanes), their surrounding land uses, the surrounding street types, and comparability with other sites within the pool. For example, we excluded sites that were dominated by hospitals, schools, or industrial land uses. We conducted field visits at 34 potential sites and selected 10 cases that represented differences in traffic, urban design, and income characteristics of the surrounding census blocks (see Figure 9.1).

	High Traffic	**Low Traffic**
High urban design	Higher socio-economic status	Higher socio-economic status
	Lower socio-economic status	Lower socio-economic status
	High Traffic	**Low Traffic**
Low urban design	Higher socio-economic status	Higher socio-economic status
	Lower socio-economic status	Lower socio-economic status

Figure 9.1 Site Selection Strategy

For each of the 10 sites, we selected three nearby residential streets on which to administer a residential survey. These nearby streets were selected based on their traffic volumes (high, medium, and low). Table 9.1 presents socio-demographic information about the sites' residential populations.

Table 9.1 Population Characteristics of the 10 Arterial Sites

Arterial Street	Population	Proportion non-Hispanic white	Proportion Hispanic	Average median household income	Proportion homeowner	Proportion college graduate
23rd Ave	1,714	0.84	0.01	104,479	0.95	0.48
44th St	3,451	0.81	0.16	46,240	0.74	0.38
So. Broadway Ave	1,590	0.79	0.16	65,893	0.42	0.49
Upper Broadway	4,663	0.77	0.11	39,504	0.28	0.47
Colfax Ave node	1,553	0.81	0.08	81,275	0.63	0.52
E Colfax Ave	5,923	0.73	0.13	43,419	0.32	0.46
Colorado Blvd	4,087	0.81	0.08	66,334	0.45	0.42
Holly St	2,876	0.81	0.07	53,516	0.91	0.44
Santa Fe Ave	3,193	0.50	0.41	27,021	0.26	0.24
University Ave	3,484	0.92	0.02	133,826	0.88	0.58

9.2 Residential Survey

We developed an original survey and administered it door-to-door for each of the 10 sites during the summer of 2014. The survey included 33 questions across four categories, including questions regarding: 1) the respondent's residential street, 2) the respondent's neighborhood, 3) the respondents' nearby arterial street, and 4) personal and household social and demographic characteristics. The study was reviewed and approved by our university Institutional Review Board.

For each of the three sampled streets for the 10 sites (30 streets total), we administered the survey to all residential units located within 0.5 miles of the arterial road. For the first visit, a team of survey interviewers placed a door hanger at the residence to announce the survey and inform residents that interviewers would be coming to their neighborhood on a specified day. For the second visit, teams of two interviewers rang doorbells and attempted to conduct the survey in person at that moment. If a resident came to the door, they were also given the option of taking the survey privately and having it picked up later in the afternoon, or taking the survey privately and returning it by mail in a prepaid envelope. Survey respondents were offered a five-dollar gift card for participating.

If a resident did not answer, a different door hanger was placed at their door with a "we missed you" message and additional dates when the survey interviewers would be returning as well as a contact number to schedule a visit, if preferred. Those who called for appointments were interviewed within one week.

If a monolingual Spanish speaker answered the door, he or she was given an informational flyer about the survey in Spanish with the contact number of a bilingual interviewer. The address was recorded in notes so that the bilingual interviewer could return during the next round with a Spanish language survey.

During the third and final visit, interviewer teams visited all the units that had not answered the door. A resident who came to the door had the same options as before (i.e., complete in the moment, complete for pick-up, mail-in, or refuse). If no one responded at the door, survey interviewers left a cover letter, survey, return envelope, and slip giving the option of receiving the incentive by e-mail.

We visited a total of 1,849 housing units and received 721 completed surveys. Of these, 319 (44%) were returned by mail and 401 (56%) were conducted in person. The overall response rate was 39%.

Table 9.2 presents a summary of the socio-demographic characteristics of the survey respondents. The sampling strategy to include streets with high, medium, and low traffic volumes resulted in certain types of variation among respondents. Respondents on streets with higher traffic were more likely to have household incomes below $45,000 per year and they were more likely to be younger. Residents on high-traffic streets were also less likely to have a college degree and less likely to own their unit. Residents on streets with medium traffic volumes were less likely to be Hispanic.

Table 9.2 Summary of Survey Respondents' Social & Demographic Characteristics

			Traffic level of sampled residential street					
	N	**Min/max**	**Pooled**	**Low**	**Med**	**High**	**KW test[a]**	**Sig**
Socio-demographic variables								
Respondent is female	675	0/1	56%	55%	57%	57%	0.858	
Respondent's HH income < $45k/year	664	0/1	26%	28%	18%	33%	0.004	**
Respondent has bachelor's degree or higher	712	0/1	78%	78%	83%	72%	0.025	*
Children under age 18 in household	723	0/1	29%	30%	31%	26%	0.647	
Respondent is white	717	0/1	87%	86%	90%	84%	0.506	
Respondent is Hispanic	661	0/1	12%	13%	7%	14%	0.199	
Respondent owns (versus rents) current unit	702	0/1	70%	69%	82%	57%	<0.0001	***
Respondent is Millennial	713	0/1	34%	34%	25%	46%	<0.0001	***
Respondent is Gen X	713	0/1	36%	36%	38%	31%	0.101	
Respondent is Baby Boomer	713	0/1	25%	25%	32%	18%	0.016	*
Respondent is Greatest Generation	713	0/1	5%	4%	5%	5%	0.918	
Mean number of years lived on one's street	716	0/70	11	11	12	9	0.075	

(a) Kruskal-Wallis test

9.3 Environmental Assessment of Arterials & Neighborhood Streets

To create a measurement of the urban design of the 10 arterial sites, we used a methodology developed by Ewing and Clemente (2013). This method disaggregates urban design into five categories: imageability, enclosure, human scale, transparency, and complexity. For each category, the method is operationalized through numerous metrics, or items to count and measure, resulting in an urban design "score."

We used administrative data for information about traffic counts, street width, number of lanes, and tree canopy of each arterial site. We conducted our own two-hour pedestrian counts at the 10 sites. In addition, we conducted 24-hour traffic counts of the sampled high, medium, and low traffic residential streets on which we conducted surveys. Table 9.3 presents information about the physical characteristics of the sites.

Table 9.3 Physical Characteristics of the 10 Arterial Sites

Arterial street	24-hour traffic count	Number of lanes	Curb-to-curb width (ft)	Percentage tree canopy	Urban design score (higher is better)
23rd Ave	6,203	2	50	0.33	17.4
44th St	6,200	2	46	0.20	16.4
So. Broadway Ave	35,750	4	75	0.15	19.6
Upper Broadway	35,259	5,6	72	0.10	17.1
Colfax Ave node	30,000	4	66	0.09	16.8
E Colfax Ave	25,000	4	80	0.28	17.9
Colorado Blvd	62,493	8	113	0.13	10.8
Holly St	13,214	2	34	0.22	8.5
Santa Fe Ave	12,700	3	37	0.11	25.2
University Ave	38,418	4	57	0.31	23.1

9.4 Analytical Approach & Variable Descriptions

9.4.1 Factor Analysis to Create Typology of Arterials

We interpreted questions about what respondents like best about their neighborhood arterial (e.g., good for walking) and what they like least about it (e.g., not good for walking) using principle factor analysis. The factors produced by the analysis capture common variance among the respondents' selection of "good" and "bad" characteristics and describe latent constructs of arterial quality.

We used principle factor analysis with a varimax rotation to separately analyze 15 original variables describing positive attributes of arterials, and another 15 variables describing the negative aspects of arterials. The Kaiser measure of sampling adequacy (MSA) for the analysis of positive attributes was 0.80, and the MSA score for the analysis of negative attributes was 0.70; both were sufficiently high to indicate the viability of factor analysis. We selected factors based on scree plots and interpretability. In addition, we estimated factor scores and use these as explanatory variables in regression analyses.

9.4.2 Ordinal Logistic Regression of Residential Satisfaction

Our study includes three dependent variables that capture different dimensions of residential satisfaction: 1) whether one is happy living on their street (1=strongly disagree, 5=strongly agree); 2) one's perception of the overall quality of their residential street (1=lowest, 10=highest); and 3) one's perception of the overall quality of their neighborhood (1=lowest, 10=highest). These ordinal categorical variables rank respondents' perceptions of quality, but the true intervals representing perceived quality are not known.

Following previous studies of residential satisfaction, we estimated models for each of the outcome variables by sequentially adding categories of explanatory variables (i.e., socio-demographic, residential quality factors, arterial quality factors, built environment characteristics) (Lovejoy et al., 2010; Lu, 1999). We made decisions about model specification based on bivariate relationships between explanatory and outcome variables, AIC, and the interpretability of the model results.

All analyses were carried out in SAS 9.4.

10. RESULTS

10.1 How Residents Perceive & Use Arterial Roads

Across all three street types, survey respondents highlighted the utility of their local arterial street. The majority of respondents (66%) said their local arterial is good for walking, and nearly half said it has good sidewalks and amenities such as shopping (49% and 48%, respectively). These perceptions align with residents' use of their local arterial. The vast majority of respondents go to restaurants on their arterial (88%) and nearly three-quarters of respondents (73%) said they shop at stores on the arterial. More than half of the residents report visiting the arterial at least three times per week, and 64% report that they walk to destinations on the arterial.

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With reference to the arterial's role in the larger transportation network, 42% said their arterial offers good access to highways. The majority of respondents (57%) said they use the arterial simply by "passing through."

With respect to the arterials' negative qualities, more than half of the respondents said the speed of traffic on the arterial is too fast (52%). Noise (50%) and trash (40%) on the arterials were also problematic. Notably, only 33% of respondents said parking is a problem.

Table 10.1 Descriptive Statistics of Selected Survey and Environmental Variables

			Traffic level of sampled residential street					
	N	Min/max	Pooled	Low	Med	High	KW test[a]	Sig
Residents' perception of arterial								
Good for walking	721	0/1	66%	66%	64%	68%	0.551	
Good sidewalks	721	0/1	49%	47%	52%	50%	0.208	
Good amenities and shopping	721	0/1	48%	49%	44%	51%	0.285	
Good access to highways	721	0/1	42%	43%	40%	44%	0.372	
Good lighting	721	0/1	42%	44%	41%	41%	0.774	
Traffic too fast	721	0/1	52%	48%	52%	58%	0.125	
Too much noise	721	0/1	50%	44%	49%	60%	0.002	**
Too much trash	721	0/1	40%	34%	41%	46%	0.049	
Lack of parking	721	0/1	33%	35%	28%	34%	0.325	
Lack of trees	721	0/1	27%	24%	29%	28%	0.450	
Poor for bicycling	721	0/1	27%	24%	28%	29%	0.402	
Mean rating of arterial quality	696	1/10	6.2	6.3	6.0	6.2	0.396	
Residents' use of arterial								
Go to restaurants	721	0/1	88%	89%	90%	87%	0.891	
Shop	721	0/1	73%	73%	74%	74%	0.977	
Passing through	721	0/1	57%	58%	59%	54%	0.800	
Auto-related services	721	0/1	43%	43%	41%	45%	0.817	
Bars, clubs, discos	721	0/1	42%	38%	40%	49%	0.103	
Visits at least three times in a typical week	712	0/1	52%	48%	56%	55%	0.091	
Respondent walks to destinations on arterial	721	0/1	64%	66%	65%	59%	0.220	
Characteristics of arterial								
Mean 24-hour traffic count	N/A	6,200/62,493	26,524	25,473	22,036	25,340	0.014	
Mean percentage tree canopy coverage	N/A	9%/33%	19%	19%	20%	18%	0.366	
Mean urban design score	N/A	8.5/25.2	17.3	17.9	17.7	17.5	0.443	

(a) Kruskal-Wallis test

10.2 Factors Representing what Nearby Residents Like Best & Least about their Arterial

Factor analysis of what survey respondents like best about their neighborhood arterial yielded two factors. The factor analysis of what respondents liked least about their arterial also yielded two factors. Table 10.2 presents the factor loadings for a typology of arterial streets based on these unappealing and appealing composite features.

Negative composite features associated with streets include those that are noisy, unpleasant, and dominated by traffic. The second negative factor indicates that unappealing arterials may also be socially sketchy, not safe from crime, and dirty.

With respect to positive features of arterials, neighbors like those with a quiet and clean environment, as well as features associated with places that are vibrant and busy with transportation services such as

sidewalks and transit access. These two factors seem to indicate a trade-off between being vibrant or calm.

Table 10.2 Unappealing and Appealing Features of the Case Arterials, Factor Loadings Based on Rotated Factor Pattern

Unappealing composite features			Appealing composite features		
Variable	1.Unpleasant environment	2. Socially sketchy	Variable	1. Quiet and calm	2. Vibrant with transportation
Not pedestrian-friendly	**0.61**	0.07	Quiet, calm	**0.55**	0.06
Not bike-friendly	**0.51**	-0.02	Clean, no trash	**0.53**	0.16
Lack of sidewalks	**0.43**	0.02	Bike-friendly	**0.46**	0.19
Empty, no atmosphere	**0.35**	0.10	Trees	**0.45**	0.14
Noisy	**0.34**	0.16	Safe from crime	0.38	0.30
Lack of trees	**0.32**	0.13	Pedestrian-friendly	0.35	0.33
Inadequate transit	0.30	0.15	Speeds acceptable	0.27	0.22
Inadequate lighting	0.25	0.24	Ample parking	0.21	0.08
Speeds too fast	0.22	0.09	Sidewalks adequate	0.12	**0.49**
Crime, not safe	0.11	**0.52**	Lighting adequate	0.11	**0.48**
Trashy, dirty street	0.12	**0.51**	People on the street	0.34	0.42
People on the street	0.09	**0.44**	Transit access	0.10	**0.40**
Poor highway access	0.05	0.23	Vibrant atmosphere	0.14	**0.40**
Poor amenities, shops	0.20	0.21	Amenities, shopping	0.14	**0.36**
Lack of parking	0.02	0.19	Access to highway	0.17	0.25

Figure 10.1 uses the factor scores to distribute each of the 10 cases within matrices of the appealing and unappealing features of arterials. The most extreme unappealing case, East Colfax Avenue, has relatively high scores for both negative factors and low scores for both positive features; it is a case of a bad arterial with no good qualities. The other example of an arterial with high scores for both negative factors is the "Colfax node," which is also on Colfax Avenue, but in this case it is vibrant and therefore has an appealing feature.

No case has the combination of high scores for both positive factors and low scores for both negative factors (i.e., a good arterial with no bad qualities). Two cases, 44th Ave and 23rd Ave, had low scores for each of the negative factors, and in this way there was nothing "bad" about these two arterials. With respect to appealing features of arterials, two cases, South Broadway and the Bonnie Brae node, have high scores for both of the positive factors.

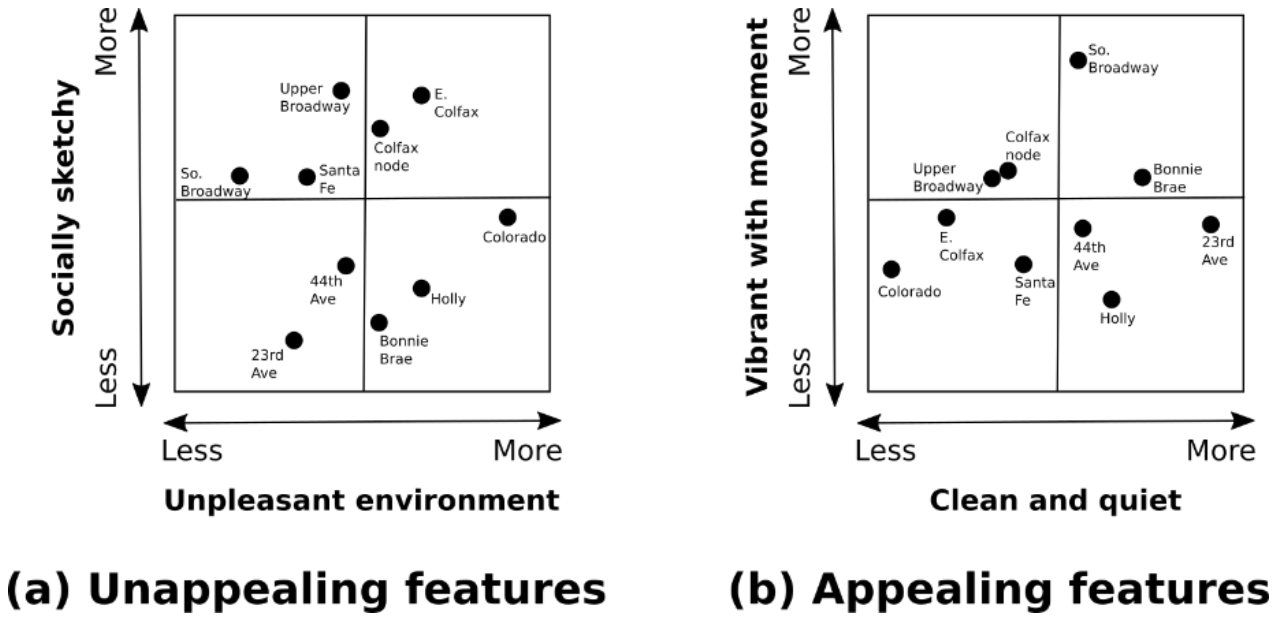

Figure 10.1 Distribution of the Cases within the Typology of Unappealing & Appealing Composite Features of Arterials

10.3 Characteristics of Arterial Roads Associated with Residential Satisfaction

Three variables in our survey measure aspects of residential satisfaction. These include respondents' scoring of the overall quality of their residential street and their neighborhood (scale for both is 1 to 10), and their level of agreement with the statement, "I am happy to live on my street."

The distributions of scores rating the overall quality of respondents' residential streets and neighborhoods are presented in Figure 10.2, with their ratings of their arterial road for comparison. All three variables skew toward higher scores, with neighborhood quality receiving the highest scores (mean= 7.8), arterials receiving the lowest scores (mean=6.2), and residential streets in between (mean=7.2).

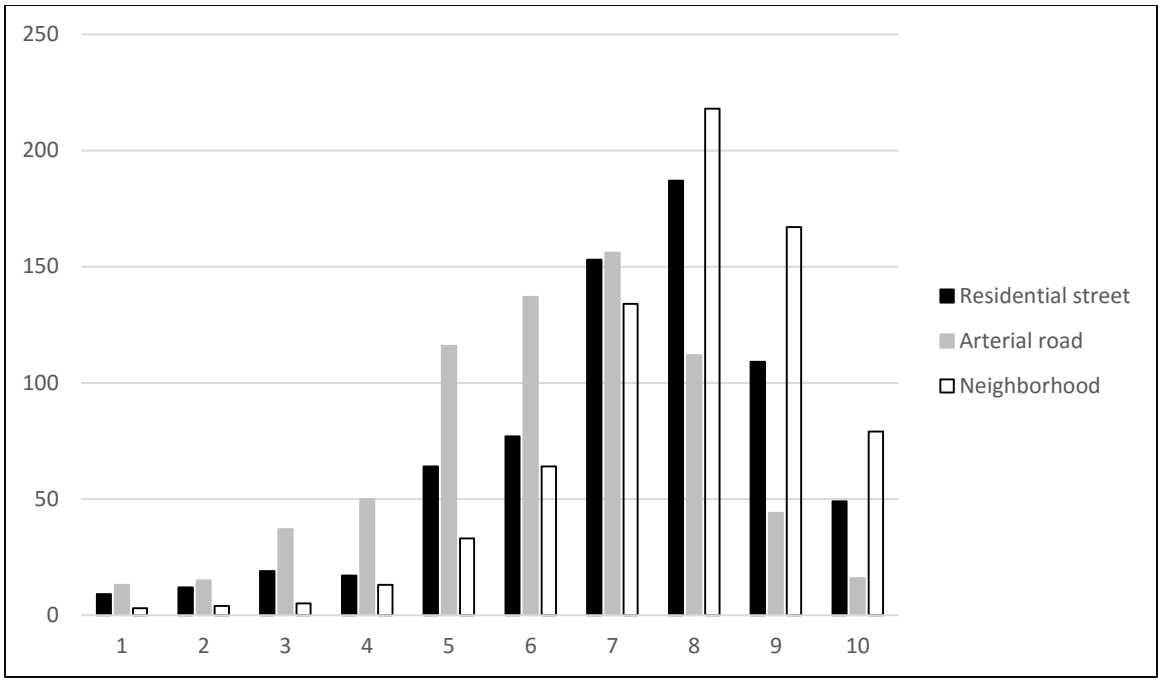

Figure 10.2 Distribution of Respondents' Ratings of the Overall Quality of their Residential Street, Arterial Road, & Neighborhood

Table 10.3 shows results for ordered logit models of the three different residential satisfaction variables. All three models include explanatory variables representing the socio-demographic characteristics of respondents and their households, features of respondents' residential streets, and features of respondents' arterial roads.

Table 10.3: Ordered Logit Models of Three Measures of Residential Satisfaction

	I am happy to live on my street		Overall quality of my residential street		Overall quality of my neighborhood	
Variables	**β-hat**	**p-value**	**β-hat**	**p-value**	**β-hat**	**p-value**
Low to moderate income			0.13	0.228	-0.16	0.151
Homeowner						
Long tenure	0.19	0.113			0.14	0.193
Millennial age group						
Overall happiness in life	0.26	0.038	0.30	0.007	0.31	0.005
Residential street - too much traffic factor	-1.09	<.0001	-1.12	<.0001	-0.43	<.0001
Residential street - good infrastructure factor	0.71	<.0001	1.20	<.0001	1.01	<.0001
Residential street - feeling of community factor	1.62	<.0001	0.79	<.0001	0.81	<.0001
Residential street - trash, lack of care factor			-0.34	0.008	-0.42	0.001
Arterial street - quiet factor						
Arterial street - vibrant factor	0.52	0.000	0.20	0.112	0.37	0.003
Arterial street - unpleasant environment factor						
Arterial street - socially sketchy factor			-0.22	0.090	-0.28	0.030
Log of tree canopy					0.81	0.000
Urban design score of arterial					-0.04	0.053
Intercept – 10			-4.57	<.0001	-2.05	0.002
Intercept – 9			-2.75	<.0001	-0.08	0.901
Intercept – 8			-0.79	0.220	1.67	0.009
Intercept - 7			0.81	0.212	3.28	<.0001
Intercept – 6			1.90	0.004	4.42	<.0001
Intercept – 5	-1.83	0.014	3.21	<.0001	5.61	<.0001
Intercept – 4	1.86	0.012	3.64	<.0001	6.29	<.0001
Intercept – 3	4.42	<.0001	4.69	<.0001	7.05	<.0001
Intercept - 2	6.42	<.0001	5.81	<.0001	8.19	<.0001
N		497		486		500
AIC		813.0		1537.9		1509.5
Max-rescaled R-square (Cox-Snell)		0.542		0.521		0.462

The table presents information for variables with p-values <0.25.

Of the four factor variables representing respondents' perceptions of their local arterial roads – vibrant, quiet, unpleasant environment, and socially sketchy – being vibrant and having good access to transit has a positive association with all three outcome variables. This relationship is true when controlling for characteristics of the residential streets and socio-demographic characteristics of respondents. Living close to a vibrant arterial has a relatively stronger statistical association with the outcome variables that capture broad satisfaction, such as being happy to live on one's street and the overall quality of the neighborhood. It has a relatively weaker statistical association with one's perception of the overall quality of their own residential street.

The arterial factor variable representing a lack of enforcement of social norms (i.e., socially sketchy) has a negative association with residential satisfaction. This variable has a stronger statistical association with respondents' perceptions of the overall quality of their street and the overall quality of their neighborhood, and a weak statistical association with their happiness to live on their street.

The built environment characteristics of the arterial roads are also statistically associated with residential satisfaction but only for the variable expressing respondents' perception of the overall quality of their neighborhood. Having a high proportion of tree canopy is a positive feature. The urban design score also

has a statistical association with neighborhood quality, but its sign is negative and its effect size is relatively smaller.

Arterials that are relatively quiet and clean and those that have unpleasant environments do not have strong statistical associations with any of the three outcome variables.

Socio-demographic and residential street-level variables are also associated with residential satisfaction, primarily whether one is generally happy or satisfied with life (positive association) and whether there is too much traffic on one's residential street (negative association). Having a feeling of community among neighbors on one's street has a larger effect size when thinking about one's happiness, whereas having good infrastructure has a larger effect size when thinking about one's satisfaction with the street itself.

11. DISCUSSION

Most residential neighborhoods in the U.S., and many throughout the world, depend heavily on arterial or major roads – roads that carry high volumes of fast traffic – for everyday travel and access to public transit, nearby shopping, and other activities. This analysis shows how the nature of these arterial roads matters for neighbors' perception of the quality of their residential street, including their happiness to live there and their perception of the overall quality of their neighborhood.

Overall, arterial roads are associated both positively and negatively with residential satisfaction. Living close to a vibrant arterial with transit, sidewalks, and activities is associated with higher levels of residential satisfaction, above and beyond the characteristics of one's own residential street. Similarly, living close to an arterial that is socially sketchy, with possible crime and lack of enforcement of social norms, is associated with lower levels of residential satisfaction.

The patterns of these associations depended on the outcome variable used to measure residential satisfaction. Vibrant arterials had the most robust result, with statistically significant association across all three of the outcome variables. The effect size was larger for outcome variables that expressed a broader sense of satisfaction (i.e., happiness, neighborhood quality) than for the variable expressing satisfaction with the residential street itself. This may indicate that, for these cases, the vibrant arterials do not directly influence nearby residential streets, but that they do contribute to a sense of place in positive ways. Therefore, arterials' specific influence varies depending on the construct used to represent residential satisfaction.

The effects of other explanatory variables, such as the perception there is too much traffic on one's residential street, also varied depending on the construct used to represent residential satisfaction. Traffic had a stronger negative effect on the sense of being satisfied with one's residential street, and a weaker effect when considering the neighborhood. It was also true for having a sense of community among neighbors. This effect was most relevant to one's happiness to live on their street and was somewhat less relevant to the perceived quality of their neighborhood.

These associations cannot be interpreted as causal, as residents have selected dwelling, streets, and neighborhoods that satisfy them. However, it is noteworthy to observe how arterials operate as part of the larger set of social and environmental factors that make certain places appealing.

These results are also meaningful because they outline the parameters of arterials' performance with respect to their residential neighbors. Arterial roads are important because of their land use and social features, not only because of their traffic. Understanding streets and traffic as part of a larger system of "nodes and places" is a critical step for advancing sustainable transportation policy and practice.

12. CONCLUSIONS

Since the 1920s, traffic engineers and planners have systematically removed traffic from residential streets and channeled it onto major roads because people want to live on quiet residential streets, and arterial roads can be designed to accommodate high traffic flows. Yet, creating networks of single-purpose streets has produced a new set of conflicts. Arterials concentrate heavy traffic into one place, which can burden adjacent neighborhoods and create barriers for pedestrians, bicyclists, and transit riders. Traffic congestion is also a problem on arterials, and drivers may choose to cut through residential neighborhoods when streets are not designed to protect from this kind of through-traffic. In response, policy makers, engineers, and designers search for strategies to help make traffic more livable.

In this research, we investigated the hypothesis that residents' perception of the quality of their residential street reflects not only the quality of their own residential street but also the quality of the arterial roads in their neighborhood. Decades of qualitative and quantitative research have looked at the livability of residential streets, but these studies have not analyzed residential streets in the context of their networks.

We used surveys of neighboring residents to provide information about perceptions of the arterial road and residential satisfaction, and combined this individual-level information with environmental measures such as urban design scores and measures of tree canopy. Using residential surveys provides relatively comprehensive and systemic information about the interaction between traffic, urban development, and quality of life. It is also a source of information that complements what is learned in public forums, where discussions of traffic can incite controversy, and where many residents do not participate.

Our results point to three types of interventions that could enhance the livability of commercial arterials in ways that matter to surrounding neighbors: 1) land uses that foster street life, 2) maintenance of social norms, and 3) enhancements to the pedestrian environment, particularly those that support transit access. These are interventions that could be advanced by both city governments and markets.

Arterials are places with heavy motorized traffic, and that is not likely to change. But they can have other characteristics such as being interesting, useful, and vibrant places that attract people. These positive characteristics are associated with residential satisfaction. The positive attributes of arterials lie within the realm of public policy to advance.

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PART 3: APPENDICES

14. SURVEY MATERIALS

14.1 Survey Summary

The Livable Arterials Study

The Denver Neighborhood Connections Survey is one of the key elements of a wider *Livable Arterials* project being conducted by researchers at the University of Colorado Denver. The aim of the study is to better understand how arterial streets – those with fast and heavy traffic – impact local neighborhoods around Denver. In addition to the survey, the project will also look at design features, traffic speeds, and other built environment features of Denver streets.

Description of Survey

The Denver Neighborhood Connections Survey takes about 10 to 15 minutes to complete. The survey asks residents to answer questions about their neighborhood, their travel patterns, their local street, and about an arterial street located near their residence. The survey asks questions about how residents use their streets and about their opinions and perceptions of their neighborhood.

Where the Survey will be Conducted

The survey was conducted door-to-door in neighborhoods that are near major streets in 10 areas of Denver.

Study areas include:

1. South University Blvd. between Exposition Ave. and Ohio Ave.
2. East 23rd Ave. between Cherry St. and Dexter St.
3. South Broadway St. between 1st Ave. and Bayaud Ave.
4. 44th Ave. between Meade St. and King St.
5. South Holly St. between Ivanhoe Way and Gunnison Pl.
6. East Colfax Ave. between Elm St. and Forest St.
7. South Colorado Blvd. between Louisiana Ave. and Mexico Ave.
8. Broadway St. between 8th Ave. and 12th Ave.
9. Santa Fe Dr. between 12th Ave. and 7th Ave.
10. East Colfax Ave. between York St. and Cook St.

How Neighborhoods were Selected

These residential neighborhoods were selected because they are located near arterial streets with some existing commercial development. We chose arterial streets with a variety of features, such as varying levels of traffic, speeds, and design features such as sidewalks, road widths, and street trees. The intent is to better understand how these different characteristics might influence the way that nearby residents perceive their streets as well as how they use them or choose not to use them.

Expected Findings:

After the survey, we expect to see some connections between street characteristics and how residents report using the streets and how residents feel about their local streets. For example, we may see that residents are more likely to walk to a nearby commercial area if there are wide sidewalks available. Findings from the study could help create streets that serve many users comfortably, safely, and efficiently.

14.2 Survey Methods

14.2.1 Overview of Survey

The researchers used an original survey, which was conducted in Denver, CO, in the summer of 2014. The survey contained 33 questions, which were divided into four sections containing questions about the respondents' street, neighborhood, nearby arterial street, and household demographics. Each survey was accompanied by a cover letter explaining the survey background and research intent.

14.2.2 Survey Design

Survey design was guided by a desire to measure street and neighborhood perceptions using a variety of question types and techniques. Donald Appleyard's San Francisco work was an influence. The researchers included two map sections that asked respondents to define their neighborhood and write notes about their favorite places. A second map asked about places along their nearby arterial street. In the survey design stage, the team used a question table to identify the research aim that would be achieved with each survey question. This also allowed the team to build in redundancy on important concepts. The table included question, question type, aim of question, and relationship to research question. This helped keep the survey shorter by avoiding redundancy on less important aspects. The team also paid attention to question type, priming, and question order. The team put more straightforward questions first and left thought-provoking and open-ended questions to the end of each section. We included a mix of open-ended and closed-ended questions and allowed spaces for residents to input additional comments. The final section was a page of demographic questions.

The physical design of the survey was an 11x17 two-sided sheet that divided the survey into the four content areas (street, neighborhood, arterial, household). We used bright colors and abundant spacing to make the survey feel accessible and tested a pilot survey with various student groups on campus.

14.2.3 Conducting the Survey

We recruited students from the College of Engineering and the College of Architecture and Planning to participate as survey interviewers. One of the graduate research assistants served as the survey coordinator field organizer. Survey interviewers were trained in four key areas before going into the field:

- Methodology (i.e., correct sampling while in the field, avoiding bias, not leading questions, etc.)
- Aims and scope of project
- Safety (i.e., spatial awareness, going in groups of two, not entering homes, not revealing personal information, setting boundaries, going during daylight hours)
- Confidentiality (i.e., correct way to address respondents, not recording identifying information, not discussing participants to anyone outside of research team, etc.)

The project was divided into 10 sites with each containing three streets (i.e., 30 total). The surveying process had three stages, and the interviewing team visited each street three times. Teams wore university shirts and clipped on student IDs to increase perceived legitimacy. For each street visit, the interviewer team used a paper map of the street produced by the research team with building outlines and exact home addresses marked. These residences were chosen because they were within a half-mile of the arterial street. The house number on the map also indicated the number of units expected to be there (i.e., 1500-3 would indicate a triplex at 1500 X Street). This helped the survey interviewers leave the correct number of surveys at the door. In some cases, the number of units was incorrect, and the survey team took notes to correct this. The team also noted vacant buildings or misidentified buildings (commercial rather than residential). These were rare but did occur. The team also noted when direct access was impossible, such as a locked external fence or a loose dog in the front yard.

In the first visit, a team of survey interviewers used the street maps and placed a door hanger that announced the survey with basic information and the project logo. The door hanger announced that interviewers would be coming to their neighborhood and gave a date range for their return. There was no doorbell ringing at this stage and generally no direct interaction with residents.

At the second visit, in teams of two, the survey interviewers rang doorbells or knocked on doors and attempted to conduct the survey in person. If a resident came to the door, they were also given the option to take the survey and have it picked up later in the afternoon or to be given a postage-paid envelope to return the survey by mail. Survey respondents were offered a five-dollar gift card for participating.

If a resident did not answer, a different door hanger was placed at their door with a "we missed you" message and additional dates when the survey interviewers would be returning as well as a contact number to schedule a visit, if preferred. Those who called for appointments were answered and scheduled by the graduate research assistant. Those appointments usually took place in the week following the visit. These calls were not frequent (roughly 15 total across sites) but did give residents an option to interact with the survey team in a different manner and may have increased the response rate.

The same street map was used as a guide, and survey interviewers checked off houses visited on the map. Additionally, survey interviewers carried a clipboard with a form where they recorded each house visit by house number and then recorded the type of response:

- No answer - left door hanger
- Answered and took survey to mail back
- Answered and completed survey
- Answered and refused to participate

If a monolingual Spanish speaker answered the door, he or she was given an informational flyer about the survey in Spanish with the contact number of the bilingual graduate research assistant. The household was also marked in the notes section so that the bilingual survey interviewer could return at the next round with a Spanish language survey. In practice, this only happened a handful of times, and the Spanish language surveys had to be left at the door because no one answered. In a few cases, the Spanish speaker preferred to take an English language survey in the moment and had an English-speaking family member fill out the survey and return by mail.

At the third and final visit, survey interviewer teams revisited all of the houses on the map that had not had a resident come to the door at the second visit. New maps were prepared in advance with the houses that needed a second visit circled, and houses already visited crossed out. The same type of form was used to record notes of the visits. These sheets were later used to calculate the response rate.

If residents came to the door, they had the same options as before (complete in the moment, complete for pick-up, mail-in, or refuse). If no one responded to the door, survey interviewers left a cover letter, survey, return envelope, and slip giving the option of receiving a gift card by email.

14.2.4 Collecting Surveys & Data Entry

After surveys were collected in person, we put them into files at the end of the day. Surveys returned by mail went to a campus box, where they were collected periodically and added to the files. All of the returned surveys (by mail and in person) were labeled in the top right corner with a unique ID number composed of the site ID number, the street ID letter, and the numbered survey (i.e., 1m15). We noted which surveys were collected in person and which were collected by mail, and this was included in the data entry. Each survey was coded into Excel. Checked boxes on the survey were converted into a numeric system for coding. Each written response was included in Excel exactly as it appeared. Six students participated in the coding. The lead survey research assistant double-checked approximately 5% of each student's data entry to check for consistency.

14.2.5 Data Clean-up

The main research assistant did the first stage of data cleanup. The first piece was to spot-check data entry, which did not uncover any major errors or issues. She then looked at the entire dataset to seek out erroneous entries, sorted each section ascending, and then scanned for values outside the range as well as text or double entries. If there was an unusual entry, she went to the original survey to check and correct the value. When two categorical answers were selected when this was not an option in the survey, or both yes and no were selected, the answers were removed (values thrown out) and replaced with a blank. This was recorded in the notes section. When a numerical value such as a scale was chosen twice, we averaged the two answers. Likewise, when someone chose an option between two numbers (i.e., marking an X between 8 and 9), we averaged the two numbers. When the question asking about highest level of education was chosen twice (this happened infrequently but more than once), we left the higher value because the question asks for the highest level. This was also recorded in the notes section.

14.2.6 Future Survey Suggestions

This intensive on-the-street survey method likely increased participation and created more positive responses when residents opened the door, since most were aware of who we were and what we were doing. Even though the door hangers were labor intensive, we estimate that they helped the response rate. In the future, we would not put a blank for writing in dates (as this was labor intensive also) and instead simply state that a team would stop by in the next week. This could also be done for the round two door hangers, which would also help the reuse value.

Allowing mail-in surveys together with in-person surveys also likely increased participation by meeting differing preferences. We also had good responses from people who wanted to fill it out and have us come back an hour later to fill it out. This was a hybrid between conducting in person and by mail but allowed us to guarantee completion.

Because the survey was designed to be used both in person and by mail, it was critical to design questions that could be understood easily for a self-administered response. We believe this was generally the case.

It also might be good in the future to have a place for survey interviewers to record additional in-person comments from residents that came up during the in-person interaction. There are a few questions that could be tweaked, such as the number of children (needs an N/A option). It may be worthwhile to also capture household size.

For the emailed gift cards, the process was labor intensive to download and then also to email out. There may be a way to do emailed gift cards more easily and efficiently through a different provider.

14.3 Survey

14.3.1 Promotional Door Hanger

We will be in your neighborhood during the week of_____ to learns your opinions about your street, traffic, and how they could be improved.

Each survey taker will recieve a **$5 gift card** for participating.

Your participation is greatly appreciated. We look forward to seeing you soon!

University of Colorado Denver

14.3.2 ‘Sorry We Missed You’ Door Hanger

We are sorry we missed you!
We came by today to conduct a survey to learn your opinions about your street, neighborhood, and how they could be improved.

We will be returning the week of_____
To schedule an appointment call Laia 303. 532.9734

Each survey taker will recieve a $5 gift card for participating.

University of Colorado Denver

14.3.3 Survey Cover Letter

June 2014

Dear Resident,

The University of Colorado Denver is conducting a study about neighborhoods, streets, and traffic in Denver communities. We request your participation in this survey, which will take about 10-15 minutes of your time. Your participation is completely voluntary. If you choose to participate, you may take the survey now, complete it later and return it by mail, or schedule an appointment for another time.

One adult (age 18 or older) per household is eligible to participate.

If you participate in the survey, you will receive a $5.00 gift card.

If you have any questions about this survey, please contact the project principal investigators: Dr. Wes Marshall by phone at (303) 352-3741 or by e-mail wesley.marshall@ucdenver.edu, or Dr. Carolyn McAndrews by phone at (303) 315-0028 or by e-mail at carolyn.mcandrews@ucdenver.edu. Questions, concerns, or feedback about this survey may also be shared with the Colorado Multiple Institutional Review Board by phone at (303) 724-1055 or by e-mail at comirb@ucdenver.edu.

Description of the Survey

The Denver Neighborhood Connections Survey asks questions about your neighborhood, how you travel, and your local streets. We are collecting this information to better understand how streets and traffic affect local neighborhoods around Denver.

Confidentiality and Consent

This survey is completely voluntary. You may decide not to participate, and if you do participate, you may skip questions or stop the survey at any time.

This survey is completely confidential. Your name will not be collected, nor will your address be linked to your responses. We will record the name of your street only to identify which neighborhood you live in.

By filling in the survey you agree to share your responses for research and planning purposes. Findings from the study could help create streets that serve many users comfortably, safely, and efficiently.

Thank you!

Kind regards,

Carolyn McAndrews and
Wesley Marshall

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14.3.4 Example Survey

Denver Neighborhood Connections Survey

Please help us learn about the community where you live, work, and play. Your answers may be used for research, and to plan for neighborhood improvements, but they are strictly confidential. We do not collect your name or address. This survey is conducted by the University of Colorado Denver. Thanks for Participating!

Instructions: The survey should be filled in by any adult (age 18 or older) in the household and returned to the survey interviewer, or return by mail to: Carolyn McAndrews, Department of Planning and Design, Campus Box 126, PO Box 173364, Denver, CO, 80217-3364.

Your Street

1. How long have you lived on your street?

_____Years _____Months

2. On a scale of one to ten, how satisfied are you with the overall quality of your street? *Circle your answer*

Lowest quality 1 2 3 4 5 6 7 8 9 10 **Highest quality**

3. Thinking about your street, ***mark the box that best represents how much you agree or disagree with the statement:***

	Strongly agree	Agree	Neither agree nor disagree	Disagree	Strongly disagree	N/A
My street is good for walking						
My street is good for biking						
The lighting is good on my street						
My street is well maintained by the city						
My street is well cared for by residents						
The speed of traffic is a problem on my street						
The amount of traffic is a problem on my street						
Pollution from traffic is a problem on my street						
Noise is a problem on my street						
Trash and litter are a problem on my street						

4. Thinking about the social life on your street, ***mark the box that best represents how much you agree or disagree with the statement:***

	Strongly agree	Agree	Neither agree nor disagree	Disagree	Strongly disagree	N/A
I see people out and about on my street						
Kids play on my street						
My street is safe from crime						
My street is safe from traffic						
I feel responsible for what happens on my street						
There is a feeling of community on this street						
I am very happy to live on my street						
I know my neighbors						
I have friends or relatives on this street						

5. What are some things you like or dislike about your street?

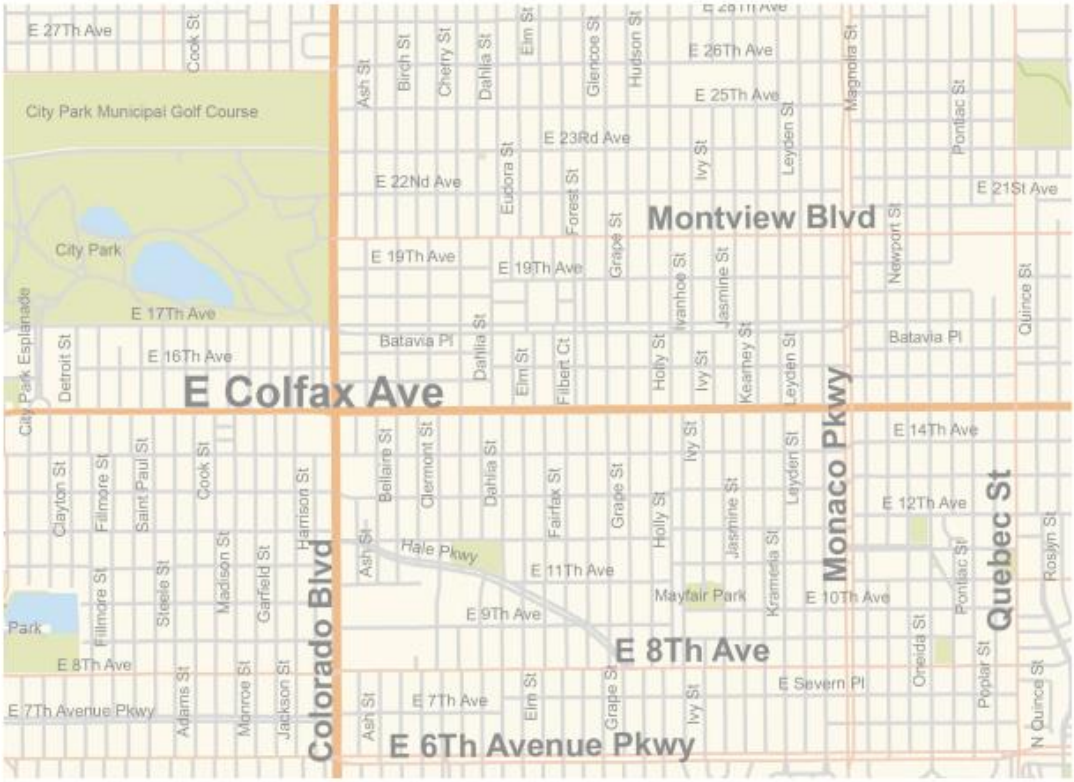
_____

_____

_____

Your Neighborhood

1. **Looking at this map, what are the boundaries of the area that you consider to be your neighborhood?**
   Please draw a line showing the boundary



2. **How long have you lived in this neighborhood?**

   ____Less than 1 year ____1 - 3 years ____4 - 6 years ____7 years or more

3. **On a scale of one to ten, how do you rate the <u>overall quality</u> of your neighborhood?** ***Circle your answer***

   Lowest quality 1 2 3 4 5 6 7 8 9 10 **Highest quality**

4. **On the map above,** ***mark and label your <u>favorite</u> places in your neighborhood.***
   Examples: parks, schools, shops, restaurants, friends' houses, libraries, churches, etc. Do not mark your home.

5. **Thinking about the places you marked on the map, how do you usually get to those places?**

	Most of the time	Sometimes	Rarely	Never
Motor vehicle (car, truck, motorcycle, etc.)				
Bicycle				
Walk				
Transit				

6. **If you walk or bike in your neighborhood:**
   Using the map above, ***circle the locations*** **where you avoid crossing the street.**

7. What are the best features of your neighborhood?

8. What are the worst features of your neighborhood?

Colfax Avenue

1. On a scale of one to ten, how do you rate the overall quality of Colfax Avenue? *Circle your answer*

Lowest quality 1 2 3 4 5 6 7 8 9 10 **Highest quality**

2. Which of the following activities do you do on Colfax Avenue in your neighborhood? *Choose all that apply*

____Work/school
____Shopping
____Child care
____Restaurant/café
____Religious services
____Community activity
____Bars, clubs, or disco
____Passing through
____Recreation, games
____Auto repair, gasoline
____None of these
____Other_____

3. How often do you visit places on Colfax Avenue in your neighborhood in a typical week?

___Never ___1-2 times ___3-4 times ___5 or more times

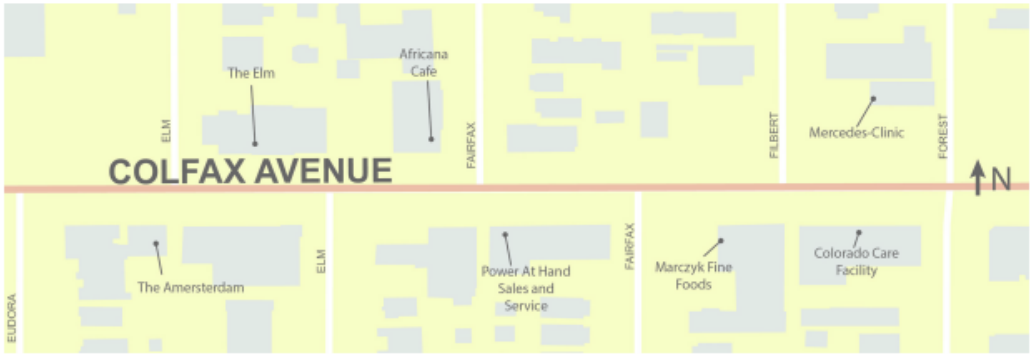
4. What are the best features of Colfax Avenue in your neighborhood? *Choose all that apply*

____Trees
____Walkable
____Bikeable
____Quiet/calm
____Clean, no trash
____Ample parking
____Cars go at acceptable speeds
____The people on the street
____Vibrant atmophere
____Safe from crime
____Adequate lighting
____Adequate sidewalks
____Nice amenities/ shopping
____Adequate transit
____Good access to highway
____None of these
____Other_____

5. What are the worst features of Colfax Avenue in your neighborhood? *Choose all that apply*

____Lack of trees
____Not walkable
____Not bikeable
____Noisy
____Trash, dirty street
____Lack of parking
____Cars going too fast
____The people on the street
____Empty/no atmophere
____Crime/ not safe
____Inadequate lighting
____Inadequate sidewalks
____Poor amenities
____Inadequate transit
____Poor access to highway
____None of these
____Other_____

6. If you go to Colfax Avenue *mark and label* where you go and how you get there (car, walk, bike, etc):



7. Is there anything else you like or dislike about Colfax Avenue?

Household Information

This information is for statistical purposes only, and like all of your responses, will be confidential.

1. **Are there any children in your household in these age ranges?** ***Please check all that apply***

____0 - 4 years old ____5 - 9 years old ____10 - 14 years old ____15-18 years old

2. **What is your gender?**_____

3. **What was your 2013 household annual income before taxes?**

____Less than $15,000
____$15,000 to $24,999
____$25,000 to $44,999
____$45,000 to $74,999
____$75,000 to $99,999
____$100,000 to $124,999
____$125,000 to $149,999
____$150,000 or more

4. **What is your highest level of education?**

____Some high school
____High school graduate or GED
____Some college
____Trade/technical/vocational training
____Associate degree
____Bachelor's degree
____Master's degree
____Professional degree
____Doctorate degree

5. **Do you consider yourself:** ***Check all that apply***

____White/Caucasian
____Black/African-American
____ Asian/Pacific Islander
____Native American/Alaskan Native
____Other _____

6. **Do you consider yourself to be of Latino, or Hispanic orgin?** ___Yes ___No

7. **What is your age?**

____18-24 years old
____25-34 years old
____35-44 years old
____45-54 years old
____55-64 years old
____65-74 years old
____75 years or older

8. **Do you own or rent your home?** ____Rent ____Own

9. **I consider myself engaged in my community. (I.e. attend city/school meetings, neighborhood association, commmunity events, etc.).**

____Strongly agree ____Agree ____Neither agree or disagree ____Disagree ____Strongly disagree ____N/A

10. **How many automobiles, vans, and trucks are kept at home for use by members of this household?**

____None ____1 ____2 ____3 or more

11. **How many bicycles are kept at home for use by members of this household?**

____None ____1 ____2 ____3 or more

12. **If you work outside the home, how do you get to work?**

____Don't work/work at home ____Drive alone ____Carpool ____Public transportation ____Bicycle ____Walk

13. **Thinking about your life in general these days, how happy or unhappy are you on the whole?**

____Extremely happy ____Very happy ____Happy ____Sometimes unhappy ____Usually unhappy

Thank you for completing this community survey!
Your input is valuable and greatly appreciated.

Site 12____

14.3.5 Example Spanish Language Survey

Vecindario de Denver
Encuestas de Conexiones

Por favor, ayúdanos a aprender acerca de la comunidad donde usted vive, trabaja y juega. Sus respuestas pueden ser utilizadas para la investigación, y para planificar mejorias en el vecindario, pero son estrictamente confidenciales. No recogemos su nombre o dirección. Esta encuesta es realizada por la Universidad de Colorado en Denver. Gracias por participar!

Instrucciones: La encuesta debe ser completada por cualquier adulto (18 años o más) en la casa y regresarse al entrevistador de la encuesta, o la devolver por correo a: Carolyn McAndrews, Carolyn McAndrews, Campus Box 126, PO Box 173364, Denver, CO, 80217-3364

Su calle

1. ¿Cuánto tiempo hace que vive en su calle?

_____**Años** _____**Meses**

2. En una escala del uno al diez, ¿qué tan satisfecho está usted con la calidad general de su calle? Circule su respuesta

Calidad mas baja 1 2 3 4 5 6 7 8 9 10 Calidad mas bajo

3. Pensando en su calle, marque la caja que mejor represente su grado de acuerdo o en desacuerdo con la siguiente afirmación:

	Totalmente De acuerdo	De acuerdo	Ni de acuerdo ni desacuerdo	Desacuerdo	Totalmente Desacuerdo	N/A
Mi calle es buena para caminar						
Mi calle es buena para el ciclismo						
La iluminación es buena en mi calle						
Mi calle está bien mantenida por la ciudad						
Mi calle está bien cuidado por los residentes						
La velocidad del tráfico es un problema en mi calle						
La cantidad de tráfico es un problema en mi calle						
La contaminación del tráfico es un problema en mi calle						
El ruido es un problema en mi calle						
La basura y los desechos son un problema en mi calle						

4. Pensando en la vida social en su calle, marque la caja que mejor represente su grado de acuerdo o en desacuerdo con la siguiente afirmación:

	Totalmente De acuerdo	De acuerdo	Ni de acuerdo Ni desacuerdo	Desacuerdo	Totalmente en descauerdo	N/A
Veo a la gente andar en mi calle						
Los niños juegan en mi calle						
Mi calle está libre de crimen						
Mi calle está libre de tráfico						
Me siento responsible por lo que sucede en mi calle						
Hay un sentimiento de comunidad en esta calle						
Estoy muy feliz de vivir en mi calle						
Conozco a mis vecinos						
Tengo amigos o familiares en esta calle						

5. ¿Cuáles son algunas cosas que le gusta o desagrada de su calle?

Su Vecindario

1. En cuanto a este mapa, ¿cuáles son los límites de la zona que usted considera que su vecindario? Favor de dibujar una linea mostrando los limites

2. ¿Cuánto tiempo ha vivido en este vecindario?

____Menos de 1 año ____1 - 3 años ____4 - 6 años ____7 años o más

3. En una escala del uno al diez, ¿cómo calificaría la calidad general de su vecindario? Circule su respuesta

Calidad más baja 1 2 3 4 5 6 7 8 9 10 Calidad m ás alta

4. En el mapa de arriba, marque y etiquete sus lugares favoritos en su vecindario
Ejemplos: parques, escuelas, tiendas, restaurantes, casas de amigos, bibliotecas, iglesias, etc. No marque su hogar.

5. Pensando en los lugares que ha marcado en el mapa, ¿cómo llega generalmente a esos lugares?

	La mayoría del tiempo	Algunas veces	Rara Vez	Nunca
Vehículos de motor (coche, camión, motocicleta, etc.)				
Bicicleta				
Caminando				
Tránsito				

6. Si usted camina o anda en bicicleta en su vecindario:
Utilizando el mapa de arriba, circule las ubicaciones en las que evitar cruzar la calle.

4. ¿Cuáles son las mejores características de su vecindario?

5. ¿Cuáles son las peores características de su vecindario?

University Boulevard

1. En una escala del uno al diez, ¿cómo calificaría la calidad general de la University Blvd? Circule su respuesta

Calidad más baja 1 2 3 4 5 6 7 8 9 10 Calidad m ás alta

2. ¿Cuál de las siguientes actividades hace en la University Boulevard en su vecindario? Seleccione todas las que apliquen

____Trabajo/Escuela
____Compras
____Cuidado de niños
____Restaurante/café
____Servicios Religiosos
____Actividades Comunitarias
____Bares, clubs, or discos
____De pasada
____Recreacion, partidos
____ Reparaciones de auto/gasolin
____Ninguno de estos
____Otros_____

3. ¿Que tan seguido visita lugares en la University Boulevard en su vecindario, en una semana normal?

___Nunca ___1-2 veces ___3-4 veces ___5 o mas veces

4. ¿Cuáles son las mejores características de la University Boulevard en su vecindario? Seleccione todas las que apliquen

____árboles
____Transitable
____Apto para andar en bicicleta
____Calmado, tranquilo
____Limpio, sin basura
____Suficiente estacionamiento
____Coches van a velocidades aceptables
____La gente en la calle
____Ambiente vibrante
____Seguro del crimen
____iluminación adecuada
____Banquetas adecuadas
____Buenas comodidades/compras
____Transito adecuado
____Buen acceso a la autopista
____Ninguno de estos
____Otros_____

5. ¿Cuáles son las peores características de la University Boulevard en su vecindario? Seleccione todas las que apliquen

____Falta de árboles
____Transitable
____No apto para andar en bicicleta
____ Ruidoso
____Basura/Calles sucias
____Falta de estacionamiento
____Coches a velocidades altas
____La gente en la calle
____Vacío / sin ambiente
____Crimen/no es seguro
____ iluminación inadecuada
____Banquetas inadecuadas
____Malas comodidades
____Transito inadecuado
____Mal aceceso a la autopista
____Ninguno de estos
____Otros_____

6. Si vas por la University Blvd, marca y etiqueta a donde y como llegas alli. (coche, a pie, en bicicleta, etc):

7. ¿Hay algo más que te gusta o disgusta de la University Boulevard?

Información del Hogar

Esta información es sólo para fines estadísticos, y al igual que todas sus respuestas, serán confidenciales.

1. ¿Hay algún niño en su hogar entre estas edades? Por favor, marque todas las que le correspondan

____0 - 4 años ____5 - 9 años ____10 - 14 años ____15-18 años

2. ¿Cuál es su sexo? _____

3. ¿Cuál fue su ingreso anual de 2013 antes de impuestos?

____Menos de $15,000
____$15,000 a $24,999
____$25,000 a $44,999
____$45,000 a $74,999
____$75,000 a $99,999
____$100,000 a $124,999
____$125,000 a $149,999
____$150,000 o mas

4. ¿Cuál es su nivel de educación?

____Algo de secundaria/preparatoria
____Graduado de la preparatoria/GED
____Algo de colegio
____Formación técnica/capacitación vocacional
____Diplomado
____Licenciatura
____Maestría
____título profesional
____Doctorado

5. ¿Se considera usted: Marque todas las que correspondan

____Blanco / Caucásico
____Negro / Afro-Americano
____ Asiático / Islas del Pacífico
____Nativo Americano / Nativo de Alaska
____Otro_____

6. ¿Se considera ser de orgin latino o hispano? ___Si ___No

7. ¿Cuál es su edad?

____18-24 años de edad
____25-34 años de edad
____35-44 años de edad
____45-54 años de edad
____55-64 años de edad
____65-74 años de edad
____75 años o mayor

8. ¿Es dueño o alquila su casa? ____Alquila ____Dueño

9. Me considero activo en mi comunidad. (Es decir, asistir a las reuniones de la ciudad / de la esc asociación de vecinos, eventos comunitarios, etc.)

____Totalmente de acuerdo ____De acuerdo ____Ni de acuerdo ni en desacuerdo ____Desacuerdo ____Totalmer

10. ¿Cuántos automóviles y camionetas hay en casa para uso de los miembros de este hogar?

____Ni uno ____1 ____2 ____3 o mas

11. ¿Cuántas bicicletas hay en casa para uso de los miembros de este hogar?

____Ni uno ____1 ____2 ____3 o mas

12. Si usted trabaja fuera de casa, ¿cómo llega al trabajo?

____No trabajo/Trabajo en el hogar ____Conducir solo ____Comparte coche ____Transporte publico ____

13. Pensando en su vida en general ultimamente, que tan feliz o infeliz se siente en lo general?


____Extremadamente feliz


____ Muy feliz


____Feliz


____A veces infeliz

Gracias por completar esta encuesta de su comunidad
Su opinión es valiosa y muy apreciada.

14.3.6 Example of Completed Survey

Denver Neighborhood Connections Survey

Please help us learn about the community where you live, work, and play. Your answers may be used for research, and to plan for neighborhood improvements, but they are strictly confidential. We do not collect your name or address. This survey is conducted by the University of Colorado Denver. Thanks for Participating!

Instructions: The survey should be filled in by any adult (age 18 or older) in the household and returned to the survey interviewer, or return by mail to: Carolyn McAndrews, Department of Planning and Design, Campus Box 126, PO Box 173364, Denver, CO, 80217-3364.

Your Street

1. How long have you lived on your street?

1 Years _____ Months

2. On a scale of one to ten, how satisfied are you with the overall quality of your street? *Circle your answer*

Lowest quality 1 2 3 4 5 (6) 7 8 9 10 Highest quality

3. Thinking about your street, *mark the box that best represents how much you agree or disagree with the statement:*

	Strongly agree	Agree	Neither agree nor disagree	Disagree	Strongly disagree	N/A
My street is good for walking	X					
My street is good for biking	X					
The lighting is good on my street		X				
My street is well maintained by the city			X	X		
My street is well cared for by residents		X				
The speed of traffic is a problem on my street				X		
The amount of traffic is a problem on my street				X		
Pollution from traffic is a problem on my street				X		
Noise is a problem on my street				X		
Trash and litter are a problem on my street				X		

4. Thinking about the social life on your street, *mark the box that best represents how much you agree or disagree with the statement:*

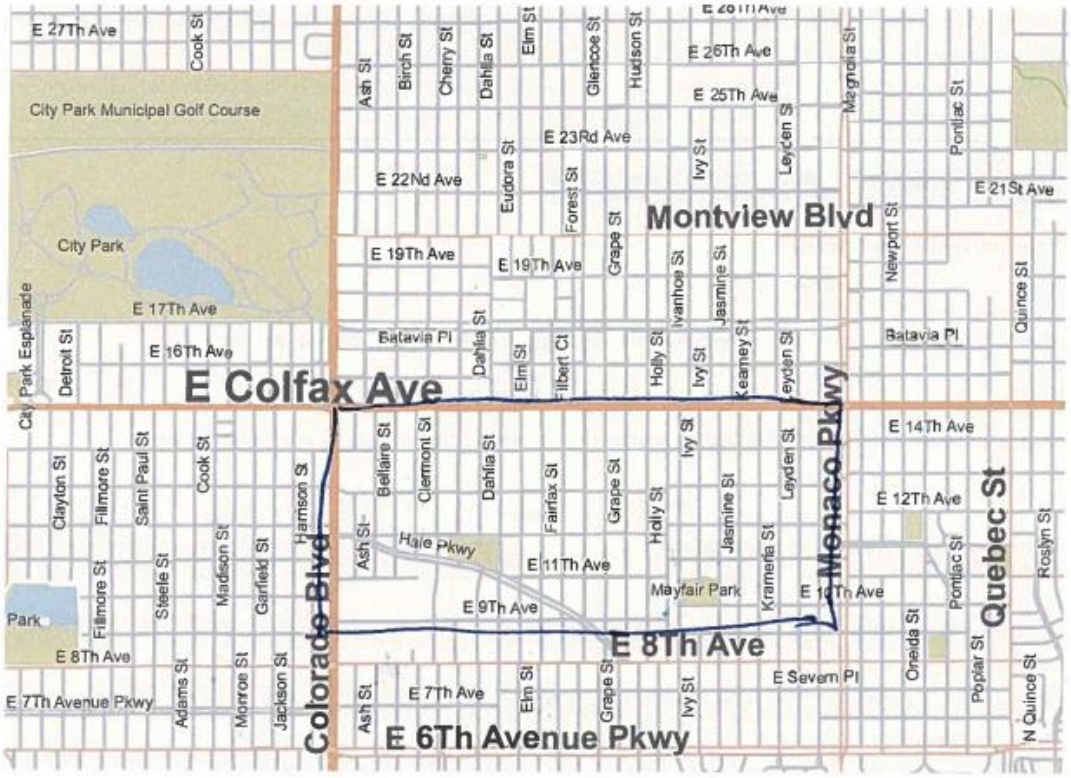
	Strongly agree	Agree	Neither agree nor disagree	Disagree	Strongly disagree	N/A
I see people out and about on my street		X				
Kids play on my street			X			
My street is safe from crime		X				
My street is safe from traffic			X			
I feel responsible for what happens on my street			X			
There is a feeling of community on this street		X				
I am very happy to live on my street		X				
I know my neighbors		X				
I have friends or relatives on this street			X			

5. What are some things you like or dislike about your street?

Dislike - quality/condition of streets & sidewalks

Your Neighborhood

1. **Looking at this map, what are the boundaries of the area that you consider to be your neighborhood?**
   Please draw a line showing the boundary



2. **How long have you lived in this neighborhood?**

   ___Less than 1 year X 1 - 3 years ___4 - 6 years ___7 years or more

3. **On a scale of one to ten, how do you rate the <u>overall quality</u> of your neighborhood?** ***Circle your answer***

   Lowest quality 1 2 3 4 5 6 7 (8) 9 10 **Highest quality**

4. **On the map above, *mark and label your <u>favorite</u> places in your neighborhood.***
   Examples: parks, schools, shops, restaurants, friends' houses, libraries, churches, etc. Do not mark your home.

5. **Thinking about the places you marked on the map, how do you usually get to those places?**

	Most of the time	Sometimes	Rarely	Never
Motor vehicle (car, truck, motorcycle, etc.)		X		
Bicycle			X	
Walk	X			
Transit				X

6. **If you walk or bike in your neighborhood:**
   Using the map above, *circle the locations* where you avoid crossing the street.

7. What are the best features of your neighborhood?

8. What are the worst features of your neighborhood?

marijuana dispensary

Colfax Avenue

1. On a scale of one to ten, how do you rate the overall quality of Colfax Avenue? *Circle your answer*

Lowest quality 1 2 3 4 (5) 6 7 8 9 10 Highest quality

2. Which of the following activities do you do on Colfax Avenue in your neighborhood? *Choose all that apply*

___Work/school	X Restaurant/café	___Bars, clubs, or disco	___Auto repair, gasoline
___Shopping	___Religious services	___Passing through	___None of these
___Child care	___Community activity	___Recreation, games	___Other_____

3. How often do you visit places on Colfax Avenue in your neighborhood in a typical week?

___Never X 1-2 times ___3-4 times ___5 or more times

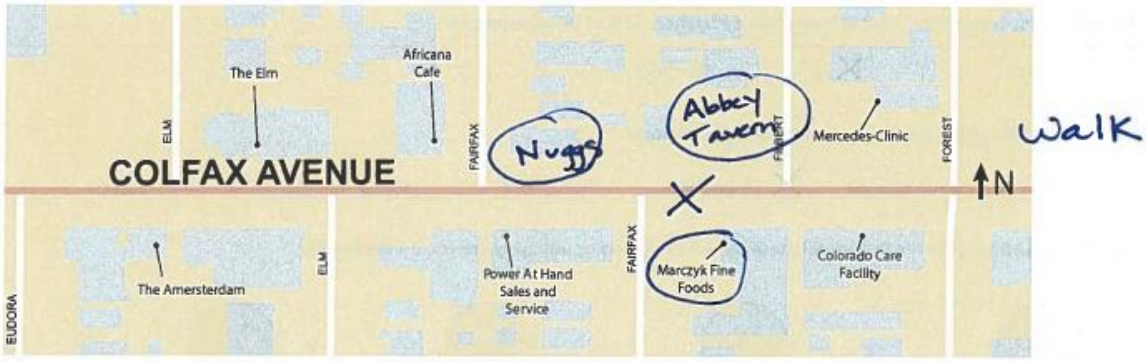
4. What are the best features of Colfax Avenue in your neighborhood? *Choose all that apply*

___Trees	___Ample parking	___Adequate lighting	X None of these
___Walkable	___Cars go at acceptable speeds	___Adequate sidewalks	___Other_____
___Bikeable	___The people on the street	___Nice amenities/ shopping	
___Quiet/calm	___Vibrant atmophere	___Adequate transit	
___Clean, no trash	___Safe from crime	___Good access to highway	

5. What are the worst features of Colfax Avenue in your neighborhood? *Choose all that apply*

___Lack of trees	___Lack of parking	___Inadequate lighting	___None of these
___Not walkable	___Cars going too fast	___Inadequate sidewalks	___Other_____
___Not bikeable	___The people on the street	___Poor amenities	
X Noisy	___Empty/no atmophere	___Inadequate transit	
X Trash, dirty street	X Crime/ not safe	___Poor access to highway	

6. If you go to Colfax Avenue *mark and label* where you go and how you get there (car, walk, bike, etc):



7. Is there anything else you like or dislike about Colfax Avenue?

Fun bars & restaurants - Like

Lots of bums - dislike

Household Information

This information is for statistical purposes only, and like all of your responses, will be confidential.

1. Are there any children in your household in these age ranges? ***Please check all that apply*** N/A

____0 - 4 years old ____5 - 9 years old ____10 - 14 years old ____15-18 years old

2. What is your gender? MALE

3. What was your 2013 household annual income before taxes?

____Less than $15,000
____$15,000 to $24,999
____$25,000 to $44,999
____$45,000 to $74,999
____$75,000 to $99,999
____$100,000 to $124,999
X $125,000 to $149,999
____$150,000 or more

4. What is your highest level of education?

____Some high school
____High school graduate or GED
____Some college
____Trade/technical/vocational training
X Associate degree
____Bachelor's degree
____Master's degree
____Professional degree
____Doctorate degree

5. Do you consider yourself: ***Check all that apply***

X White/Caucasian
____Black/African-American
____ Asian/Pacific Islander
____Native American/Alaskan Native
____Other _____

6. Do you consider yourself to be of Latino, or Hispanic orgin? ___Yes X No

7. What is your age?

____18-24 years old
X 25-34 years old
____35-44 years old
____45-54 years old
____55-64 years old
____65-74 years old
____75 years or older

8. Do you own or rent your home? ____Rent X Own

9. I consider myself engaged in my community. (I.e. attend city/school meetings, neighborhood association, commmunity events, etc.).

____Strongly agree ____Agree X Neither agree or disagree ____Disagree ____Strongly disagree ____N/A

10. How many automobiles, vans, and trucks are kept at home for use by members of this household?

____None ____1 ____2 X 3 or more

11. How many bicycles are kept at home for use by members of this household?

____None ____1 X 2 ____3 or more

12. If you work outside the home, how do you get to work?

____Don't work/work at home X Drive alone ____Carpool ____Public transportation ____Bicycle ____Walk

13. Thinking about your life in general these days, how happy or unhappy are you on the whole?

____Extremely happy X Very happy ____Happy ____Sometimes unhappy ____Usually unhappy

Thank you for completing this community survey!
Your input is valuable and greatly appreciated.

Site 12 71

15. TEACHING MATERIALS

This following first shows the livable arterials assignment from CVEN 5633: Case Studies in Sustainable Transportation, followed by two examples of student work. It then does the same with an assignment from URPL 6650: Transportation Planning and Policy.

15.1 Assignment from CVEN 5633: Sustainable Transportation

Case Study No. 1 – Livable Arterials?
CVEN 5633: Case Studies in Sustainable Transportation
Dr. Wes Marshall, University of Colorado Denver

Due Date
March 13th; please upload your report and presentation in Canvas before class.

Overview
This case study project will have you investigate and compare some major roads with commercial development– and the neighborhoods that surround them – in Denver.

So the basic intent is to first conduct a paired comparison of two arterial roads, through two methods:

1. Using conventional traffic engineering measures such as traffic counts and speed data; and
2. Via more comprehensive measures that illustrate concepts of sustainability and livability.

In terms of what I am looking for with the first task, you should initiate your work by investigating what secondary data is already available for your sites (e.g. traffic counts, speed data, crash data, etc.). Such information will help you determine what data you will need to collect yourself. While I do not want to be overly explicit about what data you need to have, here are a handful of ideas to get you started:

- Functional classification street map showing your site and the area within a quarter-mile or so (i.e. identifying what streets are local roads, collectors, arterials, or highways)
- Traffic counts (vehicles/hour), ideally taken during a peak weekday time (e.g. 4 PM to 6 PM), although you may be able to find Average Daily Traffic values (vehicles/day) or delay
- Vehicle speed data (I have several radar guns you can borrow)
- Percent of on-street parking occupied
- Corner radii dimension at intersections

Also, please measure a typical cross-section for each of your sites, and create some representative graphics using http://streetmix.net. "Streetmix" is a fairly easy to use and intuitive tool for illustrating a street, as shown below (although taking some actual pictures would be good too).

With respect to the second task and trying to conduct a more comprehensive assessment, I again do not want to be too set about specific requirements. The intent is for you to determine what are some appropriate measures as well as how to interpret them, but here are some initial thoughts:

- Pedestrian, bicycle, and bus counts
- Crash data (both the City and DRCOG have such data available)
- Crime data (available from the City)
- Noise level data (there are free apps available for this) which may measure, for instance, the perfect of the time the noise level is above 65 decibels

Based on your *data* whenever possible, but also your own *observations*, I want you to answer questions such as the following:

1. How do these streets function and compare in terms of mobility?
2. How do they function and compare in terms of accessibility?
3. How are these sites similar and how do these sites differ in terms of sustainability?
4. How are these sites similar and how do these sites differ in terms of livability?
5. How are these sites similar and how do these sites differ in terms of street vitality?
6. What is the differing impact of these arterials on the residential neighborhoods around them? (e.g. do they serve as a destination; do they function as a barrier?)
7. How do the surrounding neighborhoods differ in terms of sustainability and livability?
8. What else did you learn about these sites and how to measure their impact, both conventionally and more comprehensively for broader goals?
9. What additional data would be good to have but wasn't feasible to collect?

Deliverables

Everybody should produce the following:

1. A final report:
    - There are no minimum or maximum lengths with the report, although ideally it would be less than 10 pages of text (not including pictures, data, tables, or figures)
    - Please cite and reference all sources properly (see the syllabus for more info.)
2. A final presentation:
    - This presentation (no more than 15 minutes per person) coincides with the final report due date on Thursday, March 13th.

To complete this assignment, everybody will need to select one of the following pairs of Denver sites (that you can see in greater detail on this map that I created: http://bit.ly/1nvgOrt):

PAIR	SITE A	SITE B
1	University (btw. Exposition & Ohio)	Holly (btw. Ivanhoe Way & Gunnison)
2	Broadway (btw. 1st & Bayaud)	Colorado (btw. Louisiana & Mexico)
3	23rd (btw. Cherry & Dexter)	44th (btw. Meade & King)
4	Broadway (btw. 8th & 12th)	Broadway (btw. 1st & Bayaud)
5	Colfax (btw. York & Cook)	Holly (btw. Ivanhoe Way & Gunnison)
6	Santa Fe (btw. 12th & 7th)	Alameda (btw. Grant & Washington)
7	Colorado (btw. Louisiana & Mexico)	Colorado (btw. 6th & 9th)

http://bit.ly/1nvgOrt

This case study will require background research,
independent thought, field work, and creativity…

When linking your data or observations with a
particular outcome (such as sustainability),
be sure to explain the connection.

For instance, if you are trying to connect crash data to sustainability,
you could note how crashes are a measure of human health and,
in turn, an indicator of social sustainability.

Best of luck!
I'm looking forward to seeing your work…

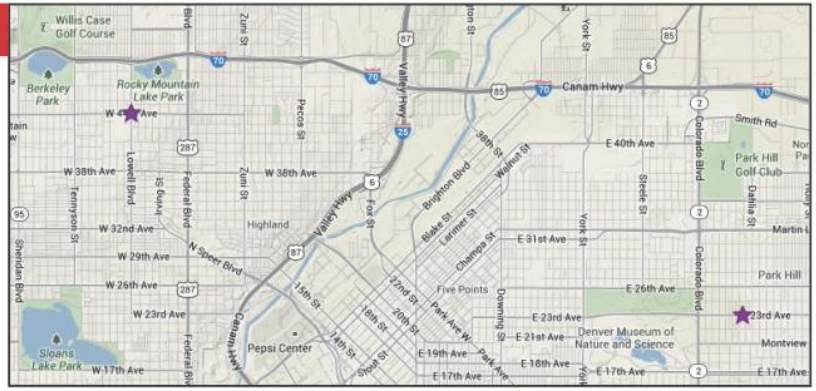
15.1.1 Example of Student Output No. 1 for CVEN 5633

"The streets of our cities and towns are an important part of the livability of our communities. They ought to be for everyone, whether young or old, motorist or bicyclist, walker or wheelchair user, bus rider or shopkeeper. But too many of our streets are designed only for speeding cars, or worse, creeping traffic jams.

Now, in communities across the country, a movement is growing to "complete" the streets. States, cities, and towns are asking their planners and engineers to build roads that are safer, more accessible, and easier for everyone. In the process, they are creating better communities for people to live, play, work, and shop."
- National Complete Streets Coalition

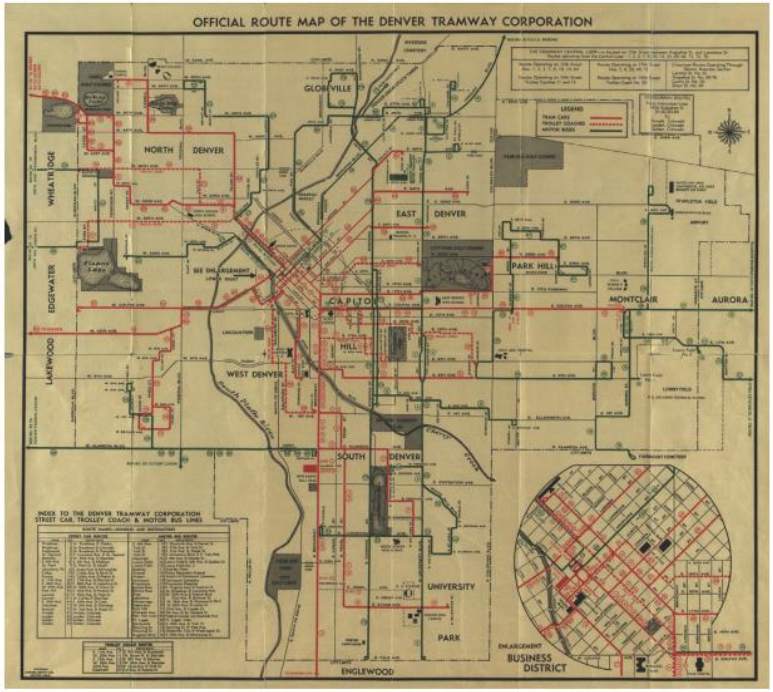
Livable Arterial Study

Study Areas in Denver



This is an examination of two similar corridors in Denver. They were platted and developed at nearly the same point in history and have similar street network design. However development, engineering and transportation decisions over time have resulted in different outcomes with respect to sustainability, walkability, safety, and other factors. This study will identify the distinctions between these two corridors and how that affects place.

Official Route of Denver Tramway Corporation



Source: Daniel Smith Company. *Official Route Map of Denver Tramway Company.* Circa 1933.
http://digital.denverlibrary.org/cdm/ref/collection/p15330coll8/id/674

Denver's beginnings were in gold found in the sands of the South Platte River and Cherry Creek in 1858, but greater financial rewards for Denver residents were in the creation of transportation networks and supply provision for the productive mines in the nearby mountains. As the use of irrigation spread, the surrounding agricultural plains were also a financial source benefitting the city. When the city industrialized and boosters promoted the semi-arid climate, the population grew quickly. Before 1890, it held over 100,000 residents, and over 200,000 by 1910. The city's footprint grew to accommodate this growth, and by 1903 it encompassed over 60 square miles.

The areas of this study are in the Park Hill and Berkeley neighborhoods. Both integrated into Denver in the first decade of the 1900's. Primarily residential neighborhoods, they share a similar street network design, residential home styles, and are almost an equal 3 miles distant from the heart of downtown Denver. Both neighborhoods were impacted by the City Beautiful movement, although proposed designs were completed to a greater degree in the Park Hill area. City Park near Park Hill and Rocky Mountain Lake Park near Berkeley are classic examples of City Beautiful parks.

The neighborhoods were developed with similar transportation networks. 44th Ave in Berkeley and 23rd Ave in Park Hill were both streetcar routes, presumably with stops near 23rd Ave and Dexter St and 44th Ave and Lowell Blvd that supported the small commercial nodes that developed along the intersections

The area surrounding 44th Avenue between King Street and Meade Street is one of juxtaposition. When approaching from the east along 44th Ave, well-kept bungalows beside tree-lined streets lend a pleasant and safe perception. The area has seen a re-surgence over the past decade, as an urbanist lifestyle has become preferred by young families and baby boomers. Nearby Highland neighborhood is becoming increasingly expensive and this area further west is more affordable for those seeking an older home in a walkable area.

Continuing west along 44th Ave, change occurs abruptly west of the Lowell Blvd intersection. The commercial land use changes from zero setbacks with on-street parking to deep setbacks and off-street parking.

The area is home to Mount St. Vincent Children's Home, as seen in the grassy area toward the center bottom of the aerial photo. Safeway stores purchased the land at the corner of 44th Ave and Lowell Blvd, building their first store in that location in 1955. The current store at that location was built in 1983.

Aerial Photo, Study Area Outlined

Source: Google Earth

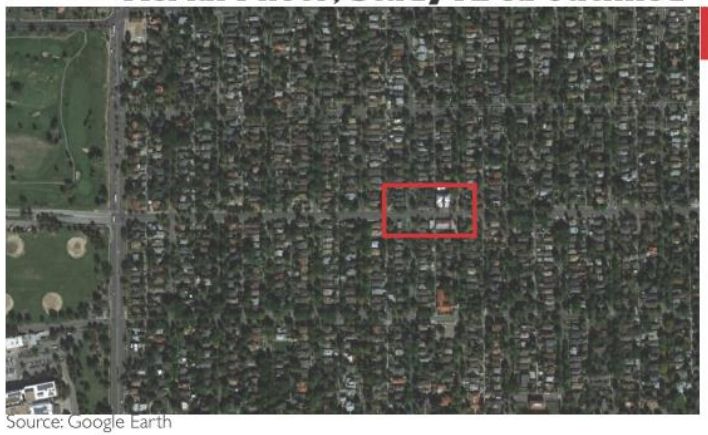
Safeway Parking Lot with a Monument Discussing a Historic Site

Photo credit: Lisa Ritchie

Mount St. Vincent Home

Source: http://www.msvhome.org/referrals-and-admissions/families.html

Aerial Photo, Study Area Outlined



Source: Google Earth

Park Hill School, 1929

Source: Hyskill, Roy. *Park Hill School.* 1929
http://cdm16079.contentdm.oclc.org/cdm/singleitem/collection/p15330coll23/id/10178/rec/4

W.H. Ferguson Park

Source: http://www.walkscore.com/score/4716-e-23rd-ave-denver-co-80207

23rd Avenue feels cohesive in many aspects in contrast to the 44th Avenue area. The residences and commercial architecture blend well, as they have not been modified to a great degree since the neighborhood was established. The scale of all neighborhood elements blend well, with the commercial area's structures balancing well with residences immediately adjacent. The area is served almost entirely with on-street parking, buffering the pedestrians on every corridor from traffic. The small park at the corner of 23rd and Dexter provides a place to gather for families and was observed to be well used on nice weather weekends.

Figure 1. Figure Ground of Quarter Mile Area

The figure ground study reveals the different spatial pattern of development that occured in the area south-west of 44th Ave and Lowell Blvd. Off-street parking is located primarily in the large spaces off 44th Ave, while Mount St. Vincent's grounds are further south. Both areas have a commercial area that is revealed in the larger sized buildings along the arterials.

Source:
Data.Denver.gov

Figure 2. Figure Ground of Quarter Mile Area

The functional street classifications for the areas are shown on these maps, reflecting a similar grid pattern of primarily local streets with residential development. The 44th Ave arterial study area is bisected by a street with a collector classification, whereas 23rd Ave is only crossed by locals in the vicinity of the study area.

The age of construction for buildings (shown by parcel) is also reflected on these maps. This reveals these areas developed over time, with the most recent construction in a study area occuring at the Safeway site along 44th Ave.

Figure 3. Age of Construction & Street Classification

Source: Data.Denver.gov

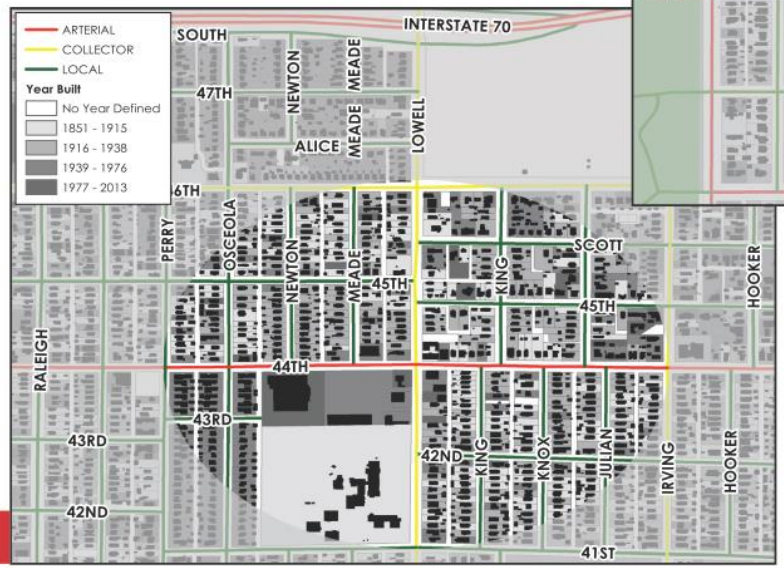
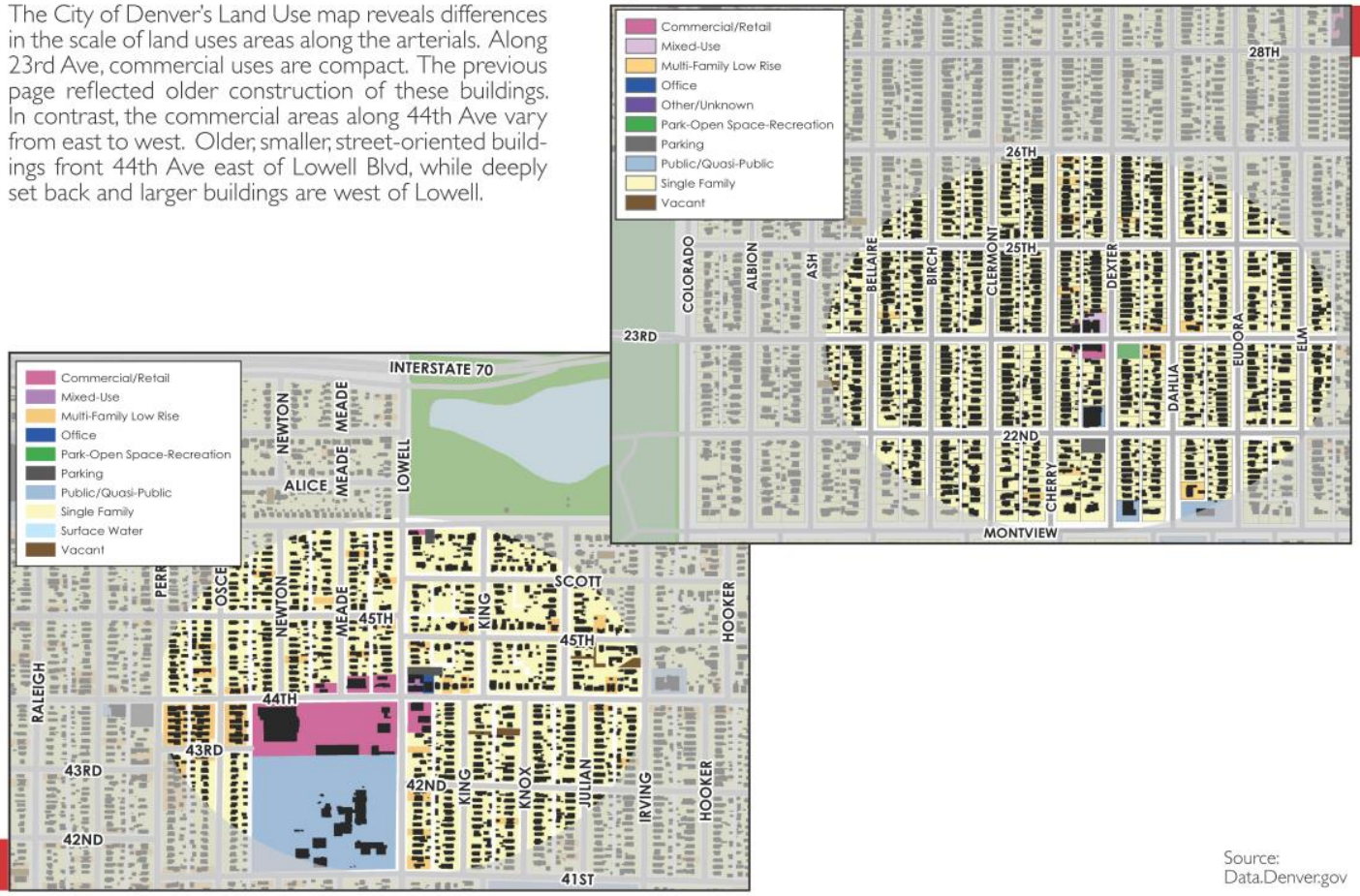


Figure 4. Age of Construction & Street Classification

The City of Denver's Land Use map reveals differences in the scale of land uses areas along the arterials. Along 23rd Ave, commercial uses are compact. The previous page reflected older construction of these buildings. In contrast, the commercial areas along 44th Ave vary from east to west. Older, smaller, street-oriented buildings front 44th Ave east of Lowell Blvd, while deeply set back and larger buildings are west of Lowell.

Figure 5. Land Use Classifications



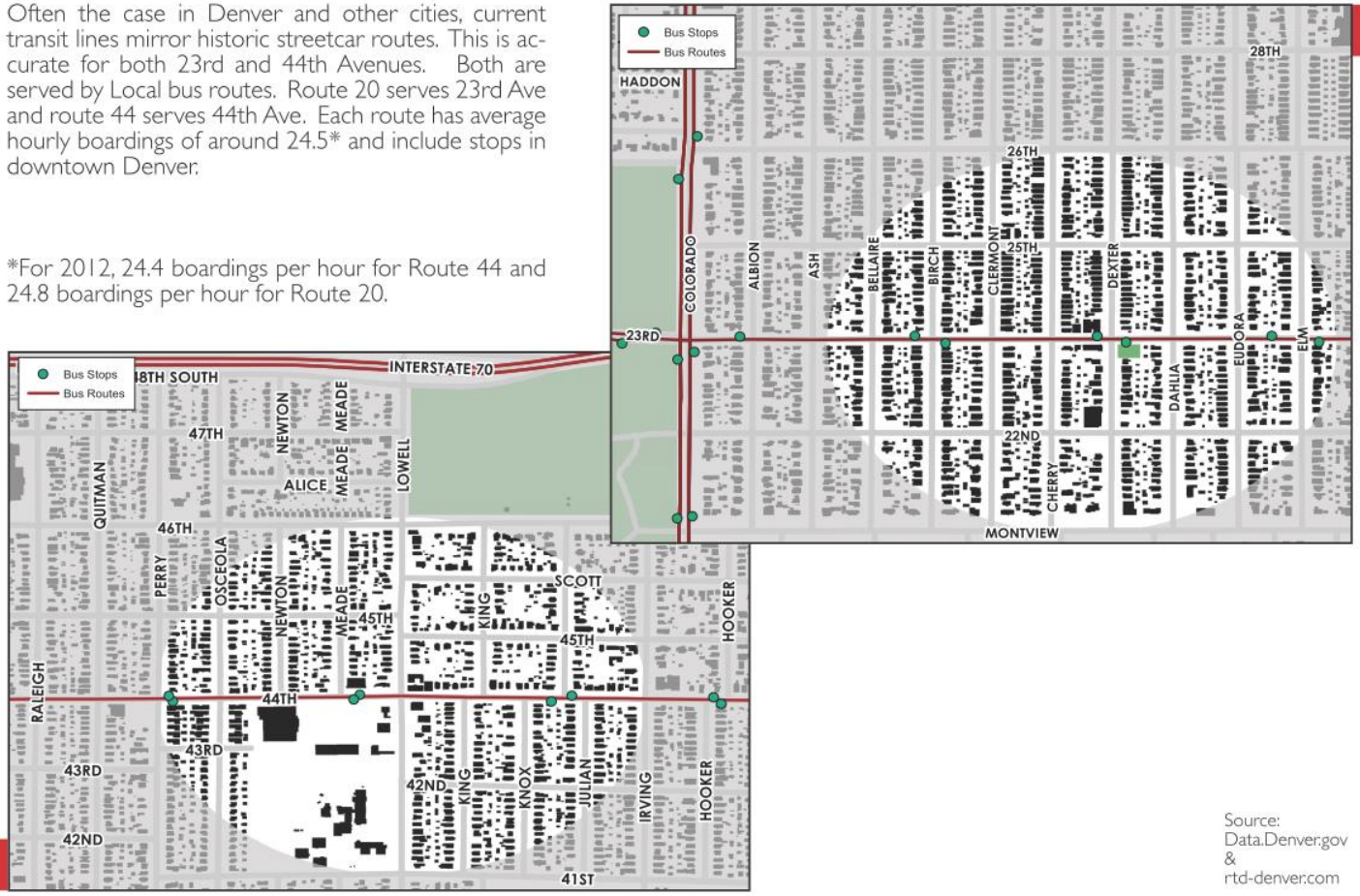
Source:
Data.Denver.gov

Figure 6. Land Use Classifications

Often the case in Denver and other cities, current transit lines mirror historic streetcar routes. This is accurate for both 23rd and 44th Avenues. Both are served by Local bus routes. Route 20 serves 23rd Ave and route 44 serves 44th Ave. Each route has average hourly boardings of around 24.5* and include stops in downtown Denver.

*For 2012, 24.4 boardings per hour for Route 44 and 24.8 boardings per hour for Route 20.

Figure 9. Bus Routes & Bus Stops



Source:
Data.Denver.gov
&
rtd-denver.com

Figure 10. Bus Routes & Bus Stops

Source:
Streetmix.net

Figure 11. Street Section

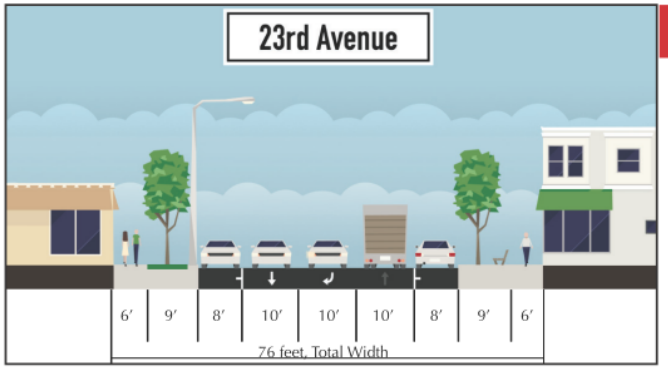
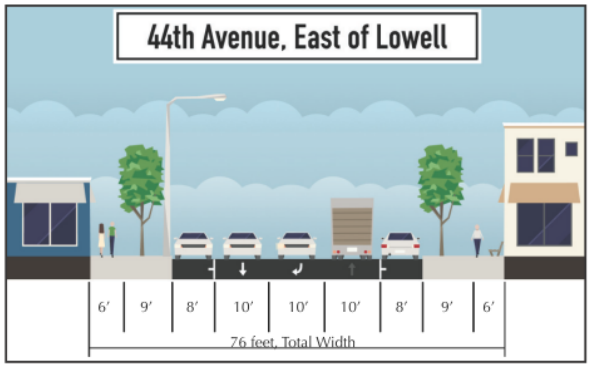


Figure 12. Street Section



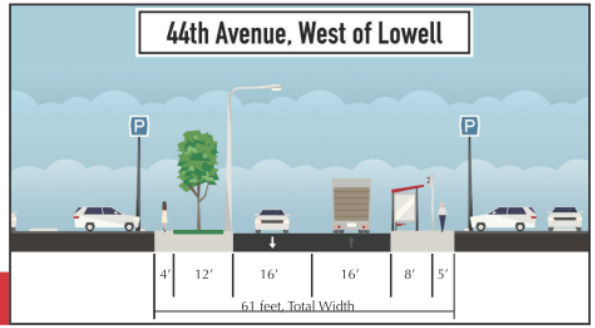
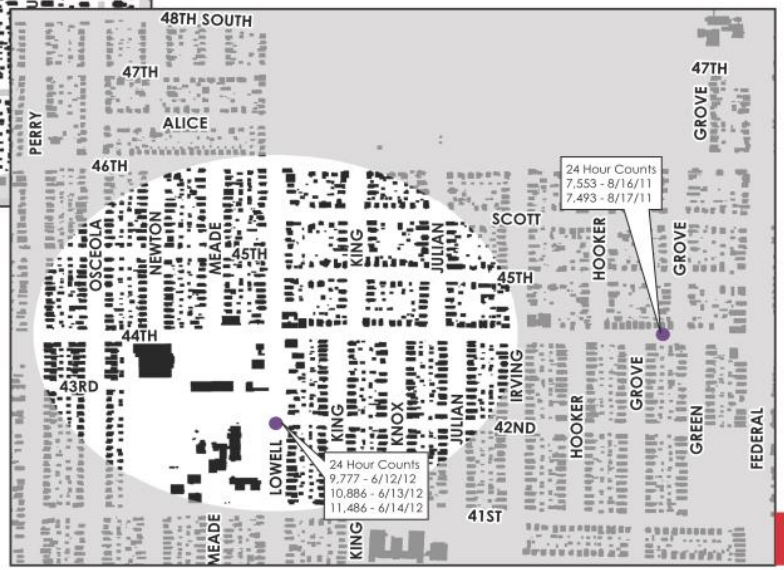


Figure 13. Street Section

Due to their simultaneous historical development timing, each arterial has areas that are very similar. 23rd Ave along the entire study area and 44th Ave east of Lowell Blvd are nearly identical. As previous discussion examined the differences along 44th Ave west of Lowell Blvd, another is revealed on the street section illustrations. Travel lane width, a lack of on-street parking, and off-street parking immediately adjacent to the sidewalk result in a dramatically different street section.

Figure 14. Traffic Counts

As mentioned in the functional classification section, 44th Ave is bisected by a Lowell Blvd, a street with a collector classification. Interestingly, Lowell Blvd carries more average daily traffic than 44th Ave, as an arterial. This results in substantially more auto traffic traveling through that study area. When simply comparing the arterials, 23rd Ave handles slightly more average daily traffic.

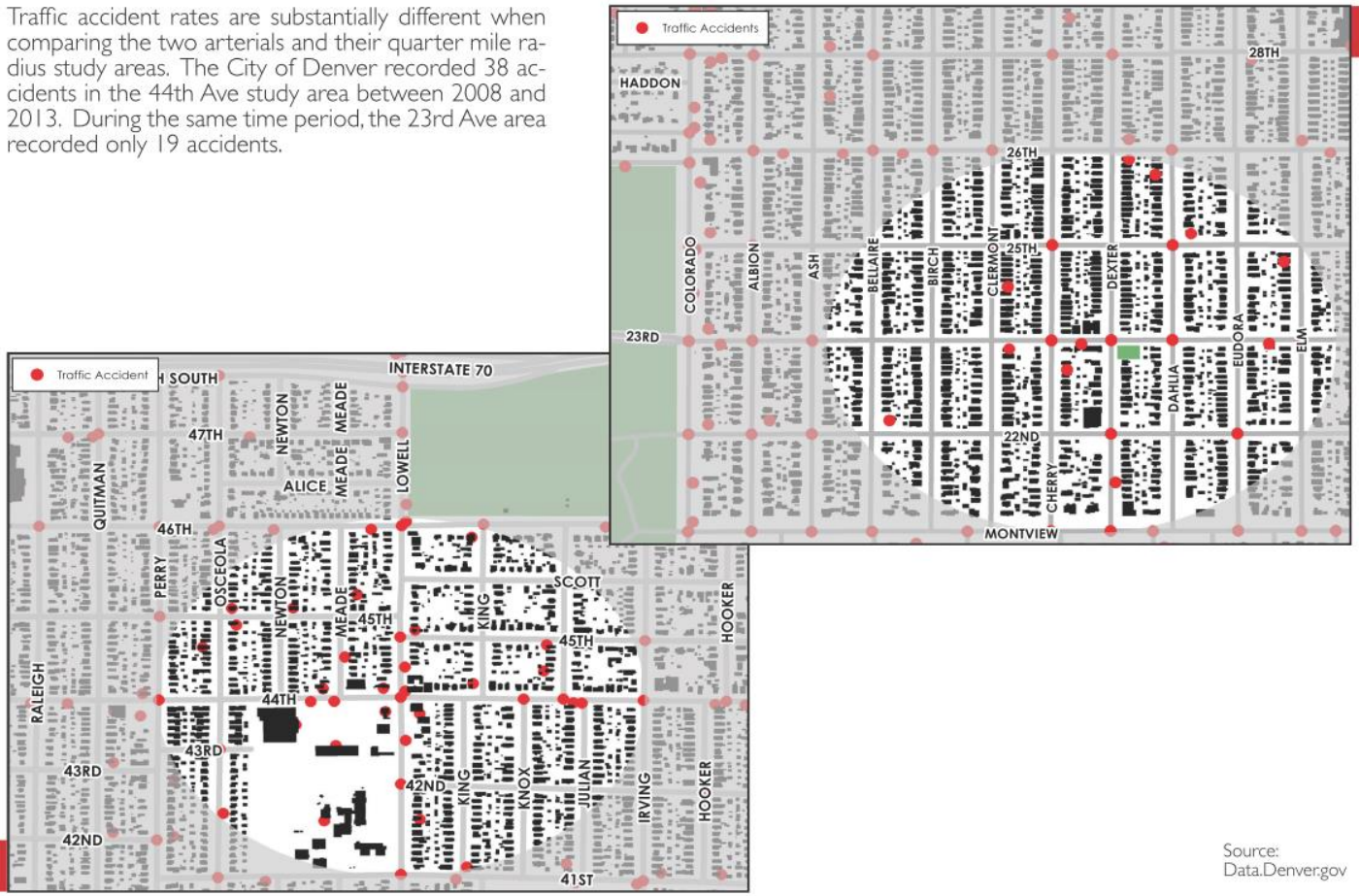


Source:
Drcog.org

Figure 15. Traffic Counts

Traffic accident rates are substantially different when comparing the two arterials and their quarter mile radius study areas. The City of Denver recorded 38 accidents in the 44th Ave study area between 2008 and 2013. During the same time period, the 23rd Ave area recorded only 19 accidents.

Figure 16. Accidents by Location

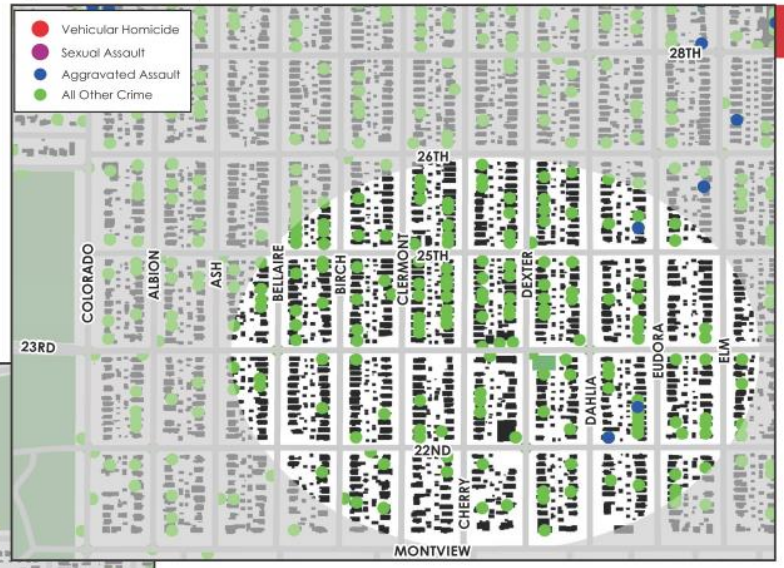


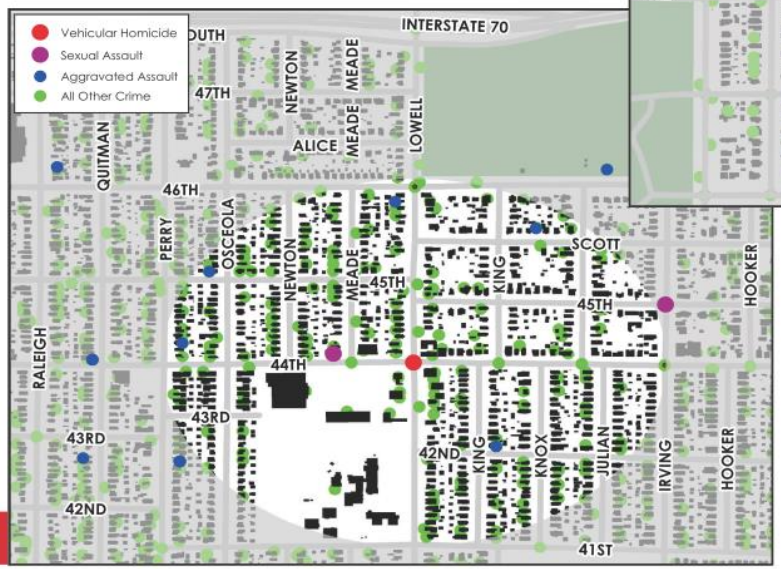
Source:
Data.Denver.gov

Figure 17. Accidents by Location

These maps show the extent to which the neighborhoods are affected by crime. The 44th Ave area suffered 320 crimes from 2009 through early 2014. During the same time frame, the 23rd Ave area suffered 222 crimes. Additionally, the 44th Ave area experienced greater rates of violent crime, including a vehicular homicide directly in the study area at 44th Ave and Lowell Blvd. Admittedly, there is more to crime rates than street design, however the higher crime rates are sure to impact the area.

Figure 18. Crime Types by Location

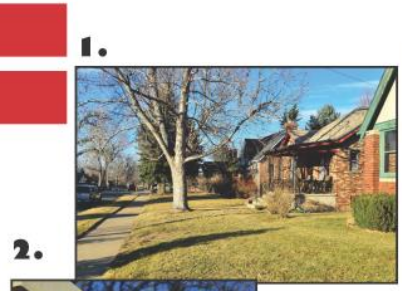


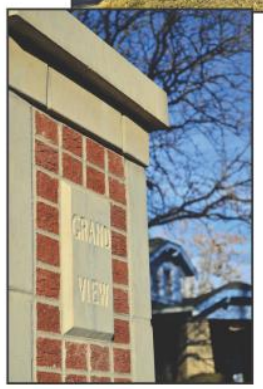


Source:
Data.Denver.gov

Figure 19. Crime Types by Location

44th Avenue: King to Meade — Photo Study





1. Bungalows facing King St
2. Grandview monument, 44th Ave & King St
3. Commercial storefront, 44th Ave, east of Lowell
4. Commercial storefront, 44th Ave, east of Lowell
5. 44th and Lowell intersection, with cyclist
6. Commercial storefront, 44th Ave, east of Lowell
7. Commercial storefront, 44th Ave, west of Lowell
8. 44th Ave, at King St, looking east
9. Commercial storefronts, 44th Ave, west of Lowell
10. Safeway parking lot, 44th Ave, west of Lowell
11. Father and daughter walking along 44th Ave
12. Father picking up daughter as they approach street section with parking lot frontage
13. 44th Ave, west of Lowell, looking west

Photos:
Lisa Ritchie

Photo Study

23rd Avenue: Cherry to Dexter

1.

4.

7.

2.

6.

8.

9.

3.

5.

Photos:
Lisa Ritchie

1. Bungalows facing Dexter St
2. W. H. Ferguson Park, 23rd and Dexter
3. Commercial storefronts, 23rd Ave
4. Residences facing Cherry St
5. 44th and Lowell intersection, with cyclist
6. Commercial storefronts, 23rd Ave
7. Multi-Modal corridor, 23rd Ave
8. Commercial storefronts, 23rd Ave
9. Commercial storefronts, 23rd Ave

Comparisons

Average Speed

44th Ave	25mph
23rd Ave	27mph

Corner Radii

44th Ave	12 ft typ
23rd Ave	6 ft typ

Study Distances

23rd Ave, Cherry to Dexter	694 ft (both sides)
Sidewalks	79% - 546 ft
Alleys/Intersections/Drives	21% - 148 ft
44th Ave, King to Meade	1,370 ft (both sides)
Sidewalks	82% - 1,118 ft
Alleys/Intersections/Drives	18% - 251 ft

Other Observations

Impressions of these places are very different, despite their many similarities. Clearly, auto travel is prioritized to a great degree in both areas, as evidenced by arterial street status and design. However, the pedestrian experience is pleasant throughout the 23rd Avenue study area. The pedestrian experience within the 44th Avenue area varies, with areas east of Lowell feeling much like 23rd Ave with areas cleary fostering pedestrian comfort. In contrast, on 44th Avenue west of Lowell Blvd, the pedestrian space is sandwiched between the arterial street and parking lots, both oriented to auto use.

On multiple visits, particularly on weekends, the areas were observed to be well traveled by those on foot, and somewhat by bicycle. The commerical node at 23rd Ave is smaller in scale, and feels very neighborhood oriented, with many walking to the coffee shop, restaurant and market. In contrast, 44th Ave had both smaller scale commercial as well as a large concept grocer, with abundant off-street parking that most patrons traveled to via auto. There are a few smaller restaurants and shops that residents in the surrounding neighborhoods easily access on foot. Overall, in spite of their differences, both areas were generally pleasant places to be.

23rd Avenue: Positives

Walkable - encourages non-motorized transport

Tree Cover - provides air quality, climate, and comfort benefits

Multi-Modal Access - allows transportation in addition to the auto

Relatively Dense Single Family Land Use - when compared to suburbs

Original Architecture - using existing buildings is generally more sustainable that tearing down and constructing new

Gathering Places - encourages relationships and community by allowing mingling of residents where conversations and connections can occur.

Neighborhood Oriented Commercial - fosters a sense of place for those who reside there.

44th Avenue: Positives

Areas that are Walkable - encourages non-motorized transport

Tree Cover - provides air quality, climate, and comfort benefits

Multi-Modal Access - allows transportation in addition to the auto

Relatively Dense Single Family Land Use - when compared to suburbs

Gathering Places - encourages relationships and community by allowing mingling of residents where conversations and connections can occur.

Neighborhood Oriented Commercial - fosters a sense of place for those who reside there.

23rd Avenue: Areas for Improvement

High Traffic Speeds - safety concerns and acts as a barrier

Quality of Built Environment - infrastructure and amenities are falling into disrepair, could create safety hazards and economic decline

Lack of Energy Efficient Structures - while older buildings can be more sustainable, energy efficiency efforts should be made

Lack of Permeable Surfaces - the streetscape should incorporate materials other than concrete as a primary material

Source: http://developing-sustainable-entrepreneurship.com/index.php/define-sustainable-development/

44th Avenue: Areas for Improvement

High Traffic Speeds - safety concerns and acts as a barrier

Overabundance in Off-Street Parking - parking lots are underutilized, with stormwater quality effects, areas not safe or pleasant for walking, and create missed economic opportunities.

High Rates of Crime - safety and perceptions of safety affect residents' stress levels and degree to which they will walk and interact with their neighbors.

High Accident Rates - the higher rates of accidents create public health and safety concerns.

Sources

National Complete Streets Coalition. *Fundamentals*. NP, ND. Retreived March 2, 2014 at http://www.smartgrowthamerica.org/complete-streets/complete-streets-fundamentals

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15.1.2 Example of Student Output No. 2 from CVEN 5633

Case Study No. 1 – Livable Arterials?
Colfax Between York & Cook vs. S. Holly Between Ivanhoe & Gunnison

Introduction to Arterials, Methodology & Data Collection

This study examines and compares segments of two arterials in Denver, Colorado—Colfax between York & Cook and Holly between Ivanhoe & Gunnison. Primary and secondary data collection methods were used to examine characteristics including the degree of mobility, accessibility, sustainability, livability and vitality for each arterial. The Complete Streets movement and its criteria as articulated by the National Complete Streets Coalition were loosely used as a framework for evaluating the aforementioned characteristics of each street.

By using the ruler tool in Google Earth, it was established that the segment of Colfax studied is 0.67 miles in length (as shown in Figure 1), and the segment of Holly studied is 0.21 miles in length (as shown in Figure 2). Determining the length of the study segments for each arterial was particularly helpful in normalizing data so that the two data sets could be compared in an apples-to-apples manner on a per mile basis whenever appropriate.

Figure 1: Colfax Arterial Study Area

Source: Google Earth[1]

Figure 2: Holly Arterial Study Area

Source: Google Earth[2]

Site visits revealed the most representative cross section of each arterial, as well their street level characteristics. For each representative cross section, Google Earth's ruler tool was also used to determine the widths of various right of way components for each cross section, including street, travel lane, on street parking lane and sidewalk widths. Streetmix was used to graphically represent the typical components of a typical cross section for each street.

Before any primary data was collected, research revealed many secondary data sets from the City of Denver Open Data Catalogue and DR COG Regional Data Catalogue that proved helpful for map creation and data isolation in GIS, as well as data extraction for further analysis in excel. These secondary data sets were used to create maps and/or analyze data in excel for Functional Street Classification, Speed Limits, Land Uses, Surrounding 2010 Census Block Populations, Tree Canopy, Bike

[1] "Colfax"

[2] "Holly"

Facilities (including routes, bike racks and B-cycle stations), Crashes in 2006, Crimes from 2009 to present, RTD Bus Stops, and Average Daily Traffic Volumes.

Primary data was collected from each arterial for traffic signal intervals, noise levels (measured for 10 minutes using the iPhone DecibelMeter app), speeds for 50 vehicles (using a radar gun on a non-peak Sunday afternoon with little congestion), one-hour pedestrian and bike counts (as observed from each arterial segment's most active retail development on a warm Sunday afternoon), number of curb cuts, and sidewalk amenities. Table 1 shows the dates, times and weather for each of the site visits.

Table 1: Arterial Data Collection Times, Dates and Weather

	Colfax 1	Holly 1	Colfax 2	Holly 2
Date	21-Feb	28-Feb	9-Mar	9-Mar
Time	11am-2pm	11am-2pm	3:15pm-4:45pm	1:30pm-3pm
Weather	Sunny; Low 40s	Sunny; Mid 40s	Sunny; Low 70s	Sunny; Low 70s

Degree of Mobility, Accessibility, Sustainability, Livability and Vitality as Measured by Complete Streets Criteria

Incomplete streets are almost solely designed to benefit the automobile and allow for its easy movement; they often completely lack accommodations for pedestrians, cyclists and transit riders[3]. A 'complete' street is designed for safe, comfortable, and convenient movement both along and across the right-of-way by people of all ages and abilities, using multiple modes"[4]. Complete Streets can provide many benefits to all road users and the surrounding community, including high mobility and accessibility (at least when all modes are considered); sustainability; livability; and vitality. Below, the degree to which the Colfax and Holly arterial segments represent these desired elements are examined through the lens of complete street characteristics that "focus on accommodating the full range of mobility options and consider the entire right of way"[5].

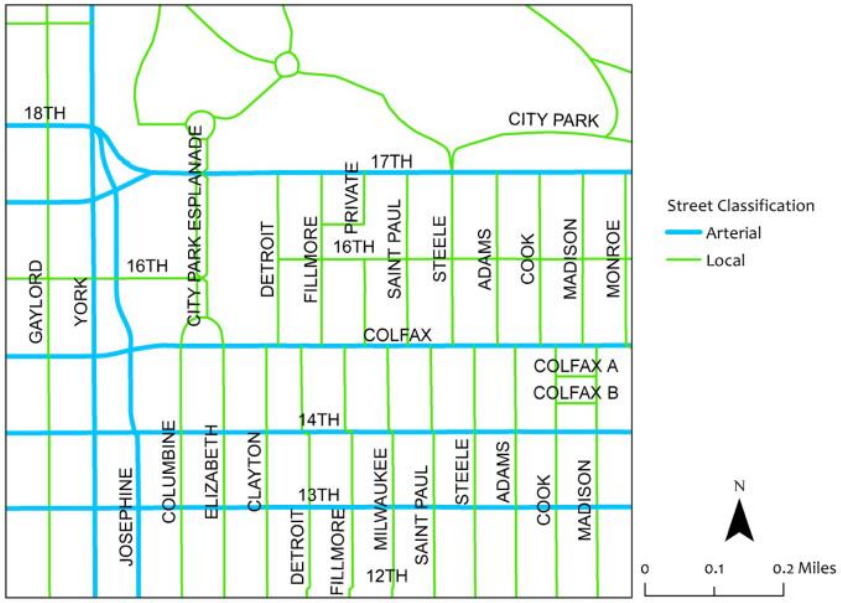
[3] Trumlin, 46
[4] Trumlin, 46
[5] Trumlin, 46

Are the Arterials Providing High Access and Mobility for All Transportation Modes and Users?

Typically, the access and mobility transportation measures are auto-centric, gaging the degree to which vehicles are easily able to access properties at each end of their trip and whether they are easily and quickly able to move through the route without significant delays[6]. Figures 3 and 4 indicate that Colfax and Holly are functionally classified as arterials, meaning that they should be providing automobiles "the highest level of service at the greatest speed for the longest uninterrupted distance [referring to mobility], with some degree of access control [referring to access]"[7].

Figure 3

Colfax Between York and Cook Functional Street Classification



Source: City and County of Denver[8]

[6] "Flexibility in Highway Design"
[7] "Flexibility in Highway Design"
[8] "Functional Street Classification"

Figure 4

Holly Between Ivanhoe & Gunnison Functional Street Classification

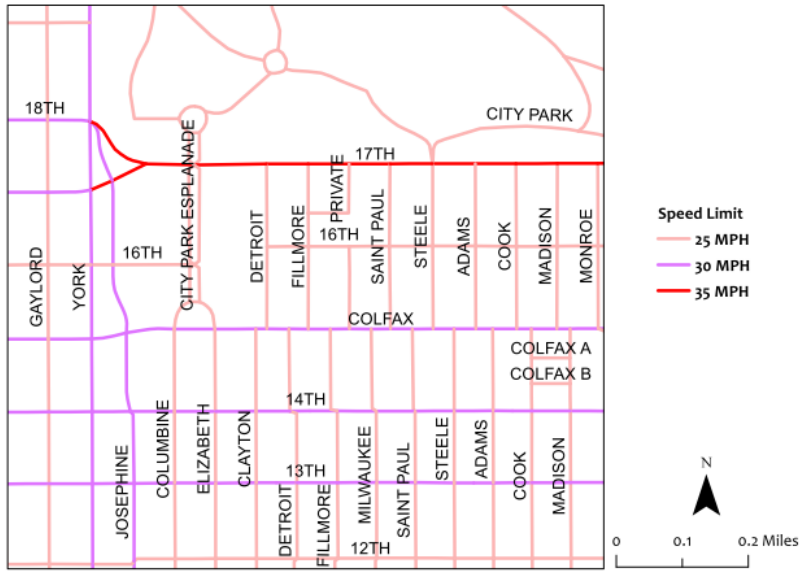
Source: City and County of Denver

Remaining auto-centric for a moment, there are several data sets that help to determine whether Colfax and Holly are high-performing arterials according to the definition. To determine whether Colfax and Holly are highly mobile for automobiles, or whether they are providing for the "greatest speed for the longest uninterrupted distance," the speed limit, number of traffic signals, and average daily traffic volumes data sets were examined.

Figures 5 and 6 show the respective speed limits, indicating that Colfax's speed limit allows vehicles to move 5 miles per hour faster than Holly (30 miles per hour for Colfax vs. 25 miles per hour for Holly). Therefore, Colfax provides a higher degree of mobility for automobiles.

Figure 5

Colfax Between York and Cook Speed Limits

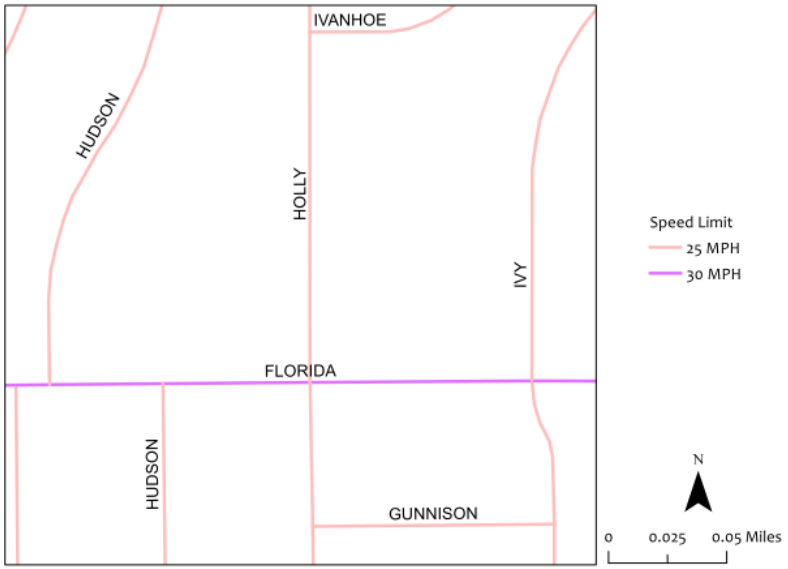


Source: City and County of Denver[9]

[9] "Speed Limit"

Figure 6

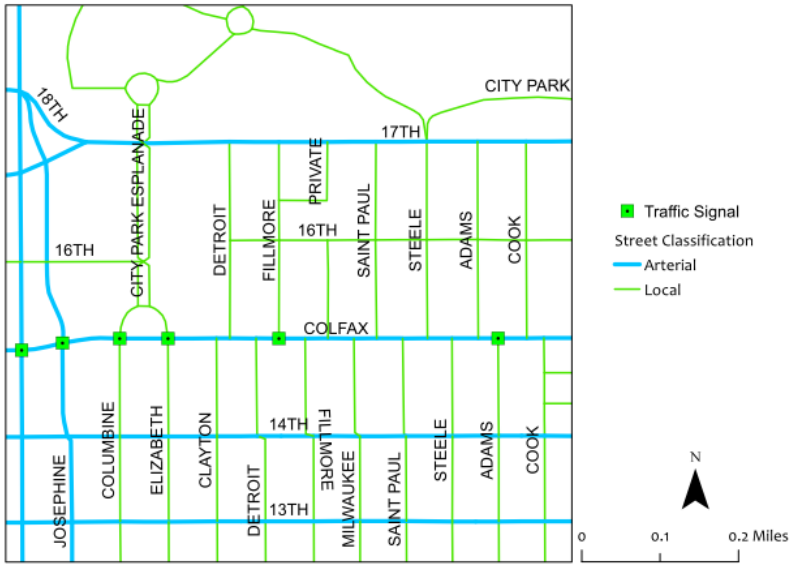
Holly Between Ivanhoe & Gunnison Speed Limits



Source: City and County of Denver

Figure 7

Colfax Between York and Cook Traffic Signal



Source: City and County of Denver

Table 2 helped to determine which arterial provides the "longest uninterrupted distance;" when compared per mile, Colfax had 47% more traffic signals, or opportunities for traffic to be interrupted, thereby decreasing mobility. Figures 7 and 8 show the placement of the signals.

Table 2: Traffic Signals

	Colfax	Holly	% Difference
Number of Traffic Signals	6	1	83%
Number of Traffic Signals Per Mile	9	5	47%

Source: City of Denver[10]

[10] "Traffic Signals"

Figure 8

Holly Between Ivanhoe & Gunnison Traffic Signals

Source: City and County of Denver

"Level of Service" refers in part to traffic volumes, implying that arterials providing high levels of mobility move high volumes of traffic through with few delays due to congestion. Table 3 indicates that on average, Colfax moves twice as much traffic through when compared to Holly on a daily basis, potentially indicating a higher degree of mobility for Colfax. It was not feasible to collect data that would have represented traffic delays associated with congestion, but that information could also have been helpful in determining which arterial provides greater mobility for automobiles.

Table 3: Average Daily Traffic Volumes

	Traffic Volume	Date
Colfax Ave East of York St	28,526	10/18/11
Colfax Ave West of Adams St	32,115	4/15/10
Average for Colfax	30,321	
Holly North of Evans Ave*	15,119	9/21/11

*0.75 Miles S of Study Area

Source: DRCOG[11]

"Some degree of access control" suggests that access would typically be fairly limited for arterials. To examine the level of access to properties for automobiles beginning and ending trips, number of curb cuts were examined. Table 4 indicates that on a per mile basis, Colfax has 84% fewer than Holly, suggesting that Colfax provides a lower degree of access for automobiles, which is fairly typical of an arterial.

Table 4: Arterial Curb Cuts

	Colfax	Holly	% Difference
Number of Curb Cuts	26	15	42%
Number of Curb Cuts Per Mile	39	71	-84%

Source: City and County of Denver[12]

An examination of parking options adds an interesting element to the mix, however, as frequent on-street parking opportunities provide greater access to properties along the street, especially to those that do not have dedicated parking lots. Colfax provided a lot of on-street parking, while Holly provided none (save for a few spots intended for an apartment unit just southeast of the intersection of Holly and Florida), potentially indicating a higher degree of access for Colfax.

Table 5

Summary: Colfax vs. Holly on Which is Most "Arterial-Like" (High Mobility, Low Access)		
	Colfax	Holly

[11] "Average Daily Traffic Volumes"
[12] "Traffic Signals"

High speed limit (high mobility)	✓	
Few traffic signals (high mobility)		✓
High traffic volumes (high mobility)	✓	
Few curb cuts (low access)	✓	
Few on-street parking opportunities (low access)		✓
Totals	**3**	**2**

A quick tally of the high mobility, low access elements that are most typical of arterials reveals that Colfax is the most arterial-like, but a more comprehensive approach is needed to examine access and mobility in the eyes of the Complete Streets criteria.

More "complete" definitions of mobility and accessibility are not auto-centric; mobility is "physical movement… provided by [driving], walking, cycling, public transit, [etc.]"[13]. Accessibility is "the ability to reach desired goods, services, activities and destinations," and should be inclusive of all transportation modes as well as all user ages and abilities[14]. Access also accounts for "the generalized costs (time, money, discomfort and risk) needed to reach activities"[15]. The answer to the original question—"Are the Arterials Providing High Access and Mobility for All Transportation Modes and Users?"—is better answered using other Complete Streets criteria throughout the remainder of this case study.

Are the Arterials Providing Transportation Options (i.e. Multiple Modes)?

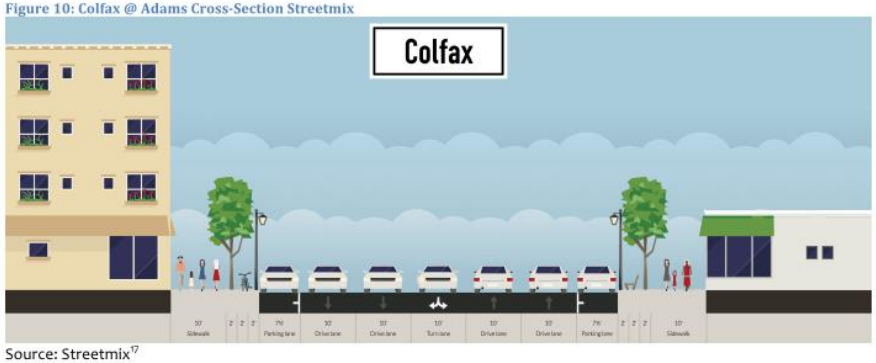
Complete streets are designed for multiple modes and include dedicated amenities for cars, pedestrians, bikes, and public transit. Streets that offer non-vehicle and non-motorized options contribute the following benefits: encouraging healthy living by inspiring higher activity levels through walking and biking; reducing carbon dioxide emissions by incorporating low-to-no emission modes; offering greater access for those with age and ability limitations; and lowering transportation costs for families by offering the opportunity to replace car trips with more inexpensive options[16].

[13] "Accessibility and Mobility Differences"
[14] "Accessibility and Mobility Differences"
[15] "Accessibility and Mobility Differences"
[16] "Fact Sheets"

Representative cross sections, photos, and RTD Bus Stops and Bike Facilities data helped to determine which modes are being served by each arterial. Figures 9 and 10 show the photo and graphical representation of a typical Colfax cross-section at its intersection with Adams. The right of way includes two drive lanes in each direction, parking lanes on both sides (that, in addition to providing parking for cars creates a barrier from street traffic for pedestrians, especially because spots are typically occupied at a rate of 80% or higher), as well as pleasantly street-scaped, wide 16' sidewalks for pedestrians that incorporate street trees, benches, streetlights, and wastebaskets. Bike amenities such as bike racks are present, indicating some level of accommodation for that mode. No dedicated bus lane exists, but bus stops are present, indicating the accommodation of a public transit mode.

Figure 9: Colfax @ Adams Cross-Section Photo

Figure 10: Colfax @ Adams Cross-Section Streetmix

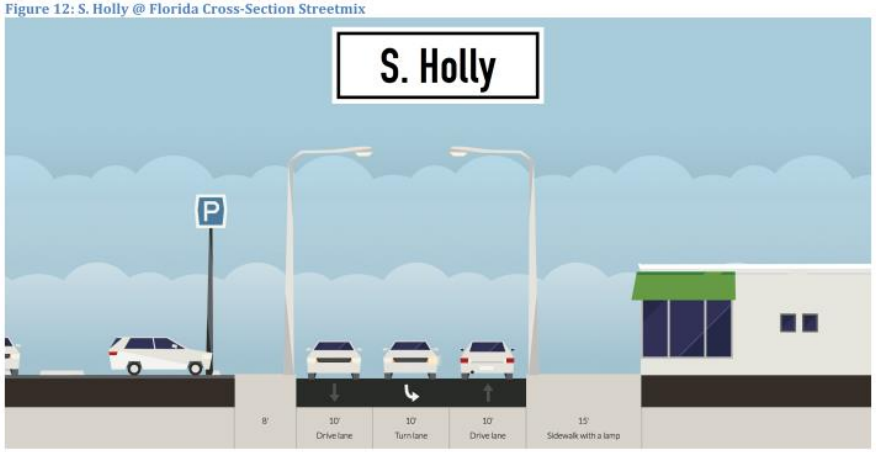


Source: Streetmix[17]

Figures 11 and 12 show the photo and graphical representation of a typical Holly cross-section at its intersection with Florida. The right of way includes one drive lane in each direction. The sidewalks for pedestrians are of varying lengths and are barren except for streetlights, which does not provide for a pleasant walking environment. No bike amenities exist and no dedicated bus lanes or bus stops are present, indicating a lack of accommodation for those modes.

Figure 11: S. Holly @ Florida Cross-Section Photo

Figure 12: S. Holly @ Florida Cross-Section Streetmix



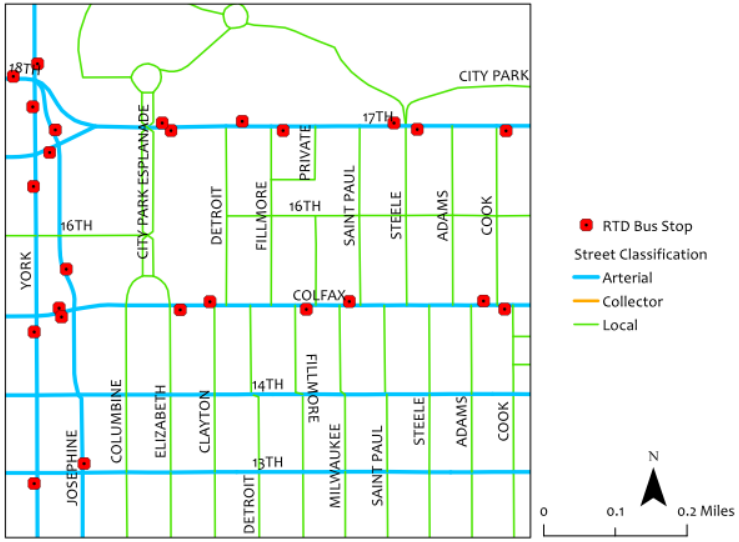
[17] "Cross-Section

Source: Streetmix

The RTD Bus Stops maps (Figures 13 and 14) for each arterial confirm their commitment or lack thereof to incorporating a public transit mode. The segment of Colfax studied has 8 stops, which translates to 12 stops per mile, while Holly does not have any stops and its closest stops are over a half mile away.

Figure 13

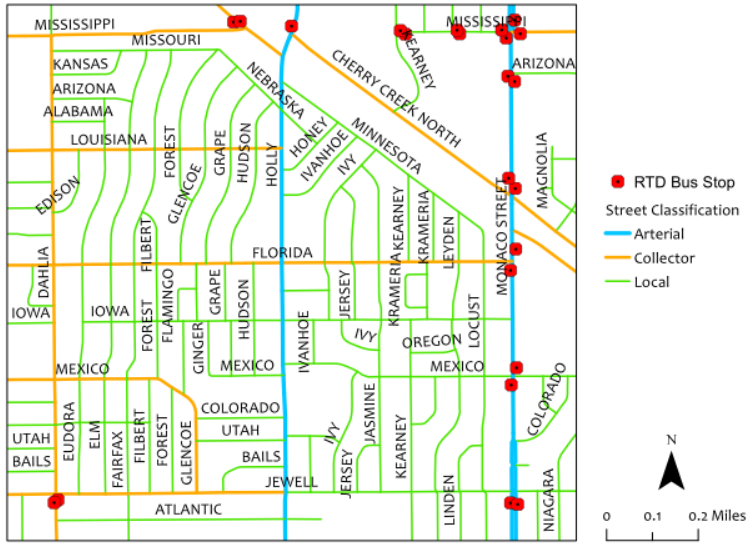
Colfax Between York and Cook Bus Stops



Source: DRCOG[18]

Figure 14

Holly Between Ivanhoe & Gunnison RTD Bus Stops



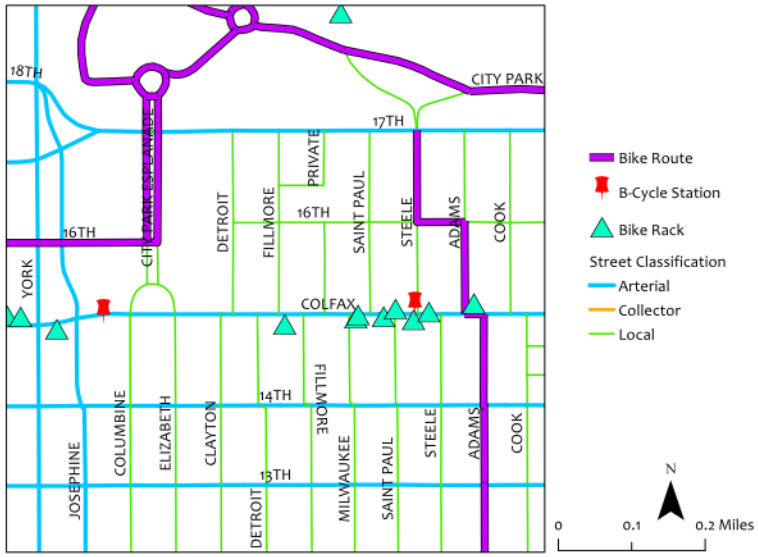
Source: DRCOG

The Bike Facilities maps (Figures 15 and 16) for each arterial further confirm their commitment or lack thereof to incorporating bikes as a transit mode. While the segment of Colfax studied is not included in the City's bike routes, it intersects with one bike route at Adams and has another route accessible less than a block away near the intersection of Elizabeth. It also has many bike racks and two B-Cycle Stations, indicating a moderate level of commitment to bicycles. Holly is not included in the City's bike routes either, but Florida is included and intersects with Holly. No bike racks or B-Cycle stations are present, indicating a very low level of commitment to bikes.

[18] "RTD Bus Stops"

Figure 15

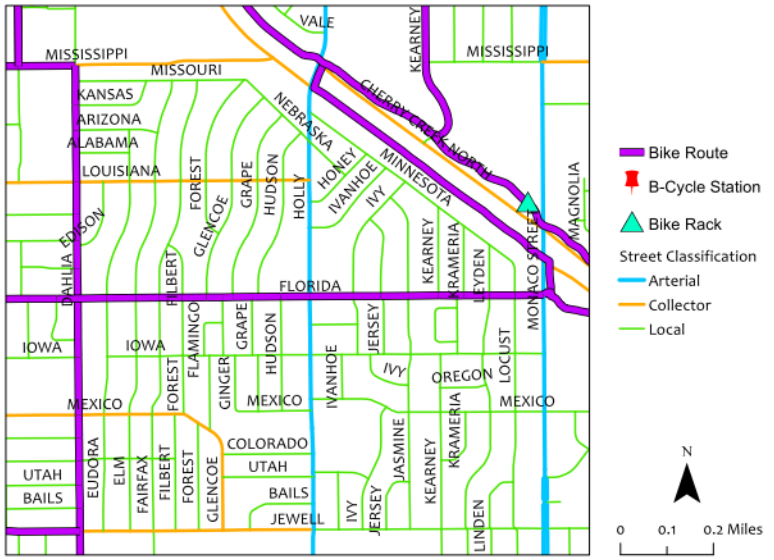
Colfax Between York and Cook Bike Facilities



Source: City and County of Denver[19]

Figure 16

Holly Between Ivanhoe & Gunnison Bike Facilities



Source: City and County of Denver

Table 6

Summary: Colfax vs. Holly on Providing Transit Options (i.e. Multiple Modes)		
	Colfax	**Holly**
Car travel lanes	✓	✓
Car on-street parking lanes	✓	
Wide sidewalks for pedestrians	✓	✓
Streetscaped sidewalks for pedestrians	✓	
Bike lane		
Access to bike routes	✓	✓

[19] "Bike Facilities

Bike racks	✓	
B-Cycle stations	✓	
Dedicated bus lane		
Bus stops	✓	
Totals	**8 out of 10**	**3 out of 10**

Are the Arterials Accessible to More Vulnerable Populations Including Elderly, Disabled, and Youth?

Complete Streets are accessible to everyone, regardless of age or ability[20]. The elderly, disabled and youth segments of the population are particularly vulnerable when streets are not designed to meet their needs. All three segments can face physical and cognitive challenges that can threaten their ability to be mobile and independent, isolating them from their communities if they are unable to drive due to age or ability limitations[21].

Complete Streets are easily navigable for all users and easy to travel by foot, bike and public transit. Both arterials were examined to determine whether they met the following Complete Streets criteria: crossings should be frequent, crossing signals should be timed to account for slower walking speeds, sidewalks should have curb ramps installed, sidewalk pavement should be in good condition, mid-block medians or sidewalk bulb outs should be provided to shorten crossing distances, and places to sit should be readily available, especially near transit stops[22].

As Table 2 and Figures 7 and 8 indicated earlier, Colfax has nearly twice as many crossings per mile than Holly (9 versus 5), indicating that Colfax is far more pedestrian friendly in that sense. That being said, there is one four block stretch on Colfax that does not have a pedestrian crossing, which should be remedied at some point, especially since there are many lively retail amenities along that stretch that pedestrians should have access to without having to walk long distances on one side of the street in order to find a crossing to the other side and then essentially double back.

Crossing signal intervals were examined at one major intersection for each arterial; measurements were taken for both crossing the arterial as well as the intersecting street. While Figure 17 suggests that when compared to their intersecting streets, Total Walk Intervals are much shorter for the arterials, accounting for about 25% of the total light cycle for both Colfax and Holly, all intersection walk signal intervals allot ample time for slower walking speeds. A study of 7,123 pedestrians revealed that pedestrians over 65 move at an average rate of 4.11 feet per second, while those younger than 65 move at an average rate of 4.95 feet per second[23]. Thus, timing signals so that pedestrians walking at an average pace of 4 feet per second can complete their crossing before the walk signal ends, even if they begin crossing as the DON'T WALK signal begins to flash should be sufficient to account for the slower speeds of more vulnerable populations. Using this criterion, as Table 7 shows, all the intersections allow enough time for a 4 feet per second walking rate.

Figure 17

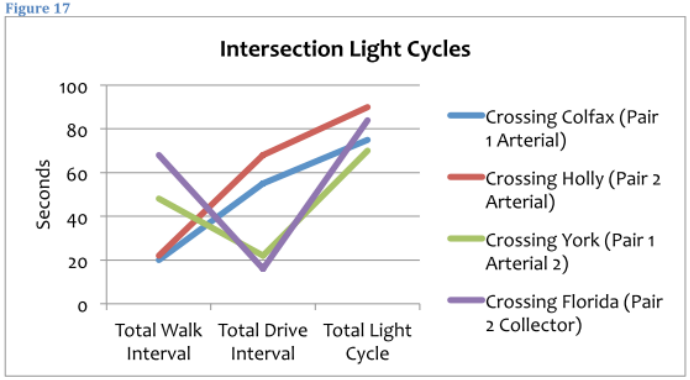


Table 7: Arterial Walk Signal Interval Sufficiency for Slower Pedestrians

	Crossing Colfax	Crossing York	Crossing Holly	Crossing Florida
Flashing Signal to Red Stop Signal (Seconds)	14	12	15	10
Street Width to Cross (Feet)	50	34	30	30
Distance Traveled at Rate of 4'/Second of Flash to Stop Interval (Feet)	56	48	60	40
Time Sufficient?	Yes	Yes	Yes	Yes

[20] "Fact Sheets"
[21] "Fact Sheets"
[22] "Fact Sheets"
[23] "Study Compares"

No non-visual signal cues are provided at any of the intersections along any of the arterials, which makes crossing difficult for blind pedestrians.

Curb ramps were observed at the intersections on both Colfax and Holly. Additionally, sidewalk conditions are good along both arterials. It's worth noting, however, that just north of the retail center and school near Holly & Florida, the sidewalk width decreases to about 3.5 feet in front of the single family residential homes making up the surrounding neighborhood, which would be hard for a wheelchair to navigate.

Neither mid-block medians nor sidewalk bulb outs were observed at either site, meaning that all pedestrians must cross the full expanse of the arterials' intersections in one walk interval without any special amenities to assist them.

As Figure 18 shows, ample seating is frequently available along Colfax's sidewalks and at transit stops (shelter is also available at transit stops); no seating amenities are available on Holly.

Figure 18

Table 8

Summary: Colfax vs. Holly on Being Accessible to More Vulnerable Populations Including Elderly, Disabled and Youth

	Colfax	Holly
Frequent street crossings	✓	
Walk signal interval accommodates slower walking speeds	✓	✓
Pedestrian signals provide non-visual cues, too		
Sidewalk curb ramps installed	✓	✓
Sidewalk pavement in good condition	✓	✓
Presence of mid-block medians or sidewalk bulb outs		
Readily available seating	✓	
Totals	**5 out of 7**	**3 out of 7**

Are the Arterials Improving Safety?

Pedestrians and bicyclists are particularly vulnerable to injury and death on arterial roadways, which are typically designed to be wide and fast. Complete Streets help reduce crashes for all road users[24]. One of the major ways that Complete Street roadway design and engineering approaches does this is by calming traffic and reducing speeds[25]. This has the impact of decreasing injuries and fatalities when collisions do occur.

As Table 9 and Figures 19 and 20 show, the study segment of Colfax had 86% more crashes in 2006 and 56% more crashes per mile in 2006 than Holly. Additionally, Colfax had 3 collisions with pedestrians and one fatality, while Holly had none. Holly did, however, have a bike crash. Colfax also had 80% more crash injuries than Holly did. Most of these figures indicate that, at least in terms of numbers of crashes, Colfax is less safe than Holly. One interesting figure to note, however, is that when speed data was analyzed for any vehicle that was in motion during the crash, only 1% of Colfax crashes involved vehicles that were going over the speed limit, versus Holly wherein 33% of vehicles involved were going over the speed limit. This figure indicates that Colfax is doing a better job of limiting vehicle speeds to the posted speed limits.

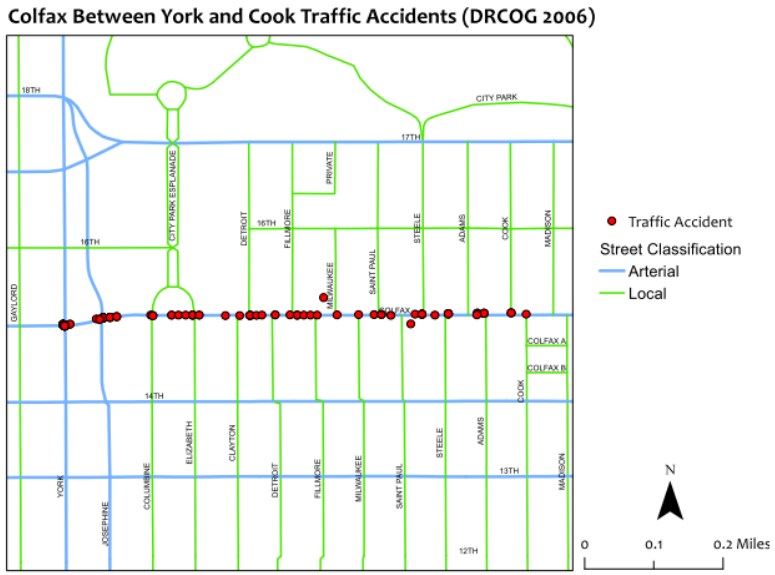
[24] "Fact Sheets"
[25] "Fact Sheets"

Table 9: Arterial 2006 Crashes (DRCOG)

	Colfax	Holly	% Difference
Number of Crashes in 2006	110	15	86%
Number of Crashes Per Mile in 2006	164	71	56%
Number of Collisions with Pedestrians	3	0	100%
Number of Collisions with Bikes	0	1	#DIV/0!
Number Killed	1	0	100%
Number Injured	10	2	80%
Percentage of Moving Vehicle's Speed Over Speed Limit	1%	33%	-32%

Source: DRCOG[26]

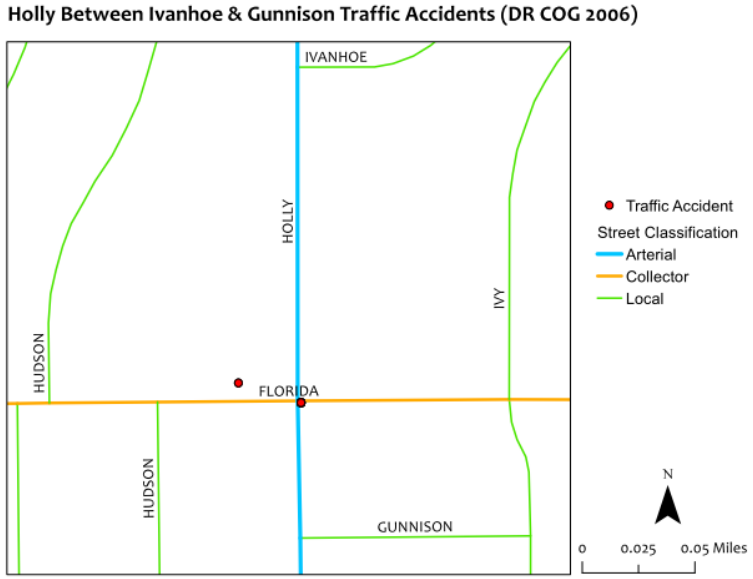
Figure 19



Source: DRCOG

[26] "Traffic Accidents

Figure 20



Source: DRCOG

This assumption was further backed by measuring and analyzing the speeds of 50 cars on each arterial. As Table 10 and Figure 21 show, the average speed of Colfax's measured vehicles was 12 percent less than the posted speed limit, while Holly's was 17 percent more. As for Colfax's most common measured speed, or mode, it was 20% less than the posted speed limit, while Holly's was 22% more.

Table 10: Arterial Speed Limits vs. Speed Measures for 50 Cars

	MPH Difference from Speed Limit	% Difference from Speed Limit
Colfax Average Speed	-3	-12%
Colfax Mode Speed	-5	-20%
Holly Average Speed	5	17%
Holly Mode Speed	7	22%

Figure 21

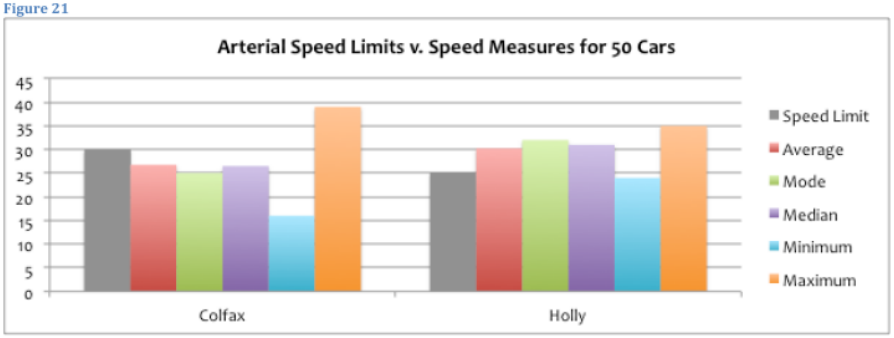


Table 11

Summary: Colfax vs. Holly on Being Safer		
	Colfax	**Holly**
Low frequency of crashes per year		✓
Low frequency of crashes per mile		✓
Higher frequency of lower speeds	✓	
Totals	**1 out of 3**	**2 out of 3**

Are the Arterials Fostering Strong, Social and Livable Communities?

Low density, sprawling communities and incomplete streets force Americans into their cars, eroding the social cohesion and livability of communities. Safe and pleasant pedestrian environments linking home, work, school, and retail services in buildings that front the street encourage a lively and social public realm that facilitate friendly and strong communities. Streets that cater to a variety of transportation options allow everyone, regardless of age, income, or ability level to get out and stay connected with their communities[27].

When the 2010 population density of the Census Blocks within 2 blocks of all boundaries of the study segment of each arterial is compared on a per mile basis as (as show in Table 12), it is revealed that Colfax is over 60% more dense. This means that there are far more residents to service within a short distance of the commercial retail nodes along Colfax, which can lead to a particularly lively street setting.

Table 12: 2010 Population of Census Blocks Within 2 Blocks of All Boundaries

	Colfax	Holly	% Difference
Population	6,363	768	729%
Population Per Mile	9,479	3,657	61%

Source: City and County of Denver[28]

Figures 22 and 23 show the most active retail centers along each arterial; non-motorized counts for pedestrians, bikes and dogs were taken for one hour from a central spot near each retail center on the warm Sunday afternoon of March 9, 2014 to capture data at a peak time for non-vehicular road users. The Colfax retail center fronts the street and is a good pedestrian scale of one story. All of its buildings are in good condition, have high transparency, and many have sidewalk café space. As discussed earlier, the sidewalks are wide, well streetscaped, provide some amenities for bicyclist and are protected from most street traffic due to the lane of on-street parking. The Holly retail center, on the other hand, is set back a great distance from the street in order to accommodate an expansive parking lot. As discussed earlier, the sidewalks are wide near the retail center, but there are very few pedestrian or bike amenities provided and there is no protection from street traffic due to the lack of an on-street parking lane.

[27] "Fact Sheets"

[28] "Population"

Figure 22: Retail Center on North side of Colfax and Adams

Figure 23: Retail Center on West side of Holly and Florida

Figures 24 and 25 visually capture the difference in the vitality and social nature of each commercial center along each arterial.

Figure 24: Sidewalk at Retail Center on North Side of Colfax and Adams

Figure 25: Sidewalk at Retail Center on West Side of Colfax and Adams

The resulting pedestrian, bike and dog counts were drastically different as Table 13 and 14 show. On the same beautiful afternoon, Colfax attracted nearly 200 pedestrians as well as some bikes and dogs walking with their owners. Holly drew less than fifteen and only a couple of bikes and dogs walking with their owners. On a per mile basis, Colfax had nearly 80% more pedestrians and 50% more bikes. There were over 200% fewer dogs per mile, but this is likely due to the fact that the street is so social in nature, requiring dog owners to leave their pets at home while they go to restaurants and shops. The Holly segment likely attracts some pedestrians that are only on foot for the purpose of walking the dog.

Table 13: Arterial Non-Motorized Counts on a Warm Sunday Afternoon

	Colfax	Holly
Pedestrian Counts	193	14
Bike Counts	19	3
Dog Counts	14	2

Table 14: Arterial Non-Motorized User Counts Per Mile on a Warm Sunday Afternoon

	Colfax	Holly	% Difference
Pedestrians Per Mile	288	67	77%
Bikes Per Mile	28	14	50%
Dogs Per Mile	21	67	-219%

Higher population densities and more road users of every type are generally positive characteristics, but there are some negative consequences as well; as Table 15 and Figures 26 through 28 show, higher crime rates can result. Over a 5.25 year period, Colfax experienced 93% more crimes and 79% more crimes per mile. Ideally, more eyes on the streets at all hours of the day provide greater safety for users and help to curb crime, but there are also more users to generate crime.

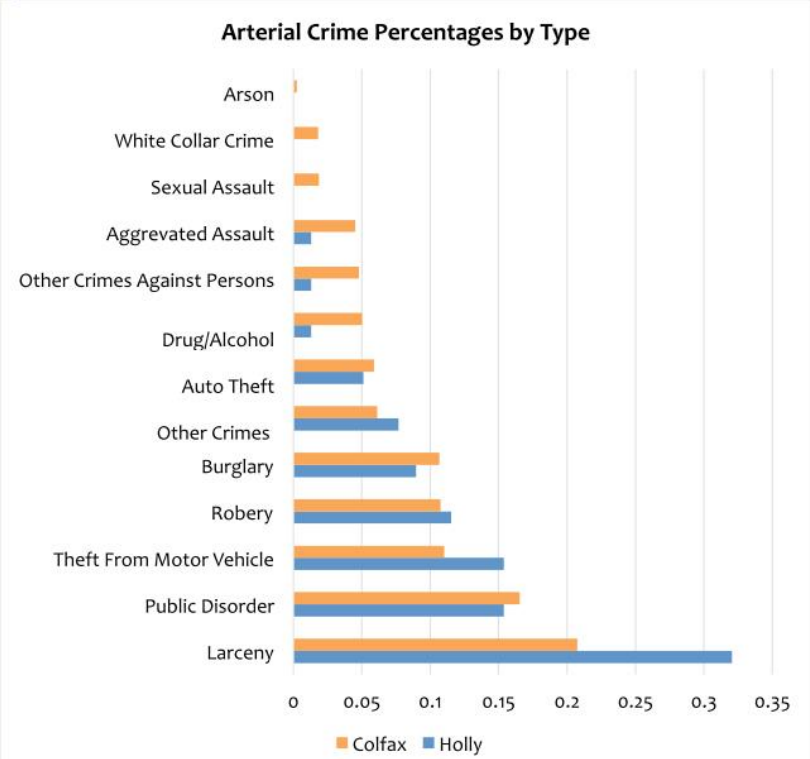
Table 15: Arterial Crimes 2009-2014

	Colfax	Holly	% Difference
Total Crimes	1,172	78	93%
Crimes Per Year	223	15	93%
Crimes Per Mile	1,749	371	79%

Source: City of Denver[29]

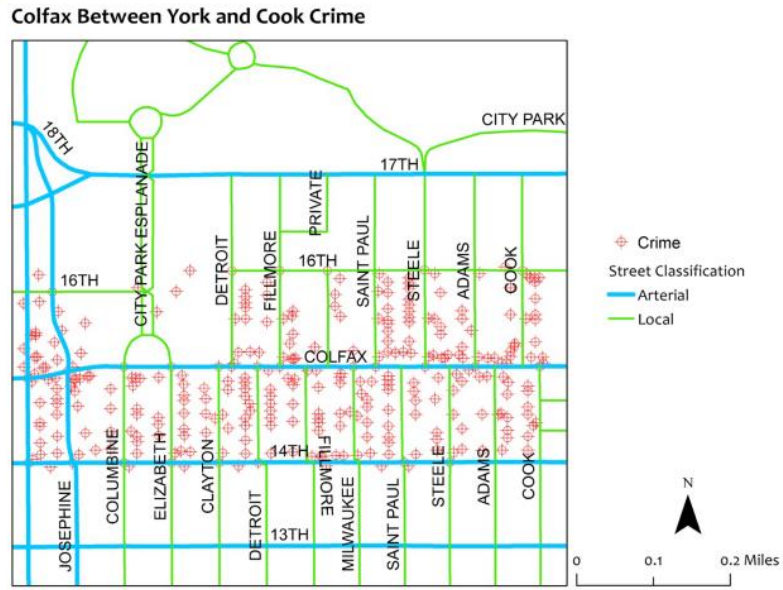
[29] "Crime"

Figure 26



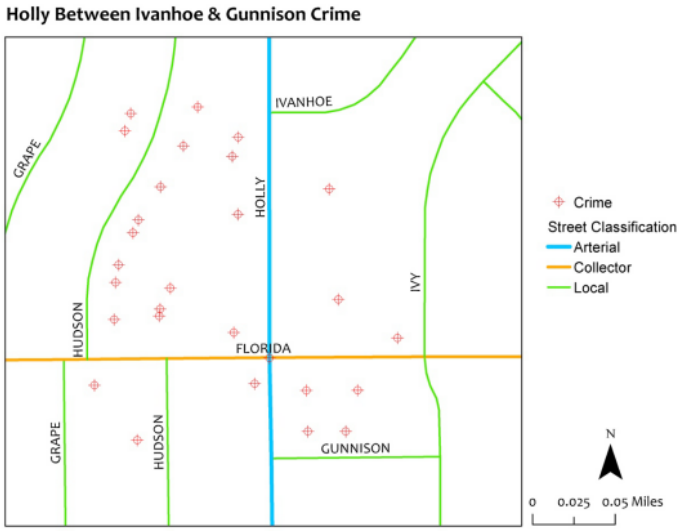
Source: City and County of Denver

Figure 27



Source: City and County of Denver

Figure 28



Source: City and County of Denver

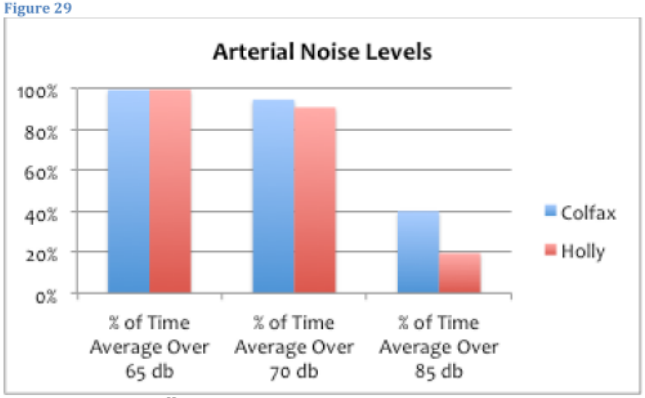
Another indicator of livability is noise level. Ten minute decibel meter measures were taken along each arterial and the resulting data was analyzed to figure out the percentage of time that the average decibel readings were over certain levels. A street's noise level at 65 decibels would allow pedestrians and sidewalk-café patrons to enjoy conversation at a normal level; as Table 16 and Figure 29 reveal, both Colfax and Holly had noise levels above 65 decibels 100% of the time[30]. Freeway traffic is around 70 decibels; Colfax and Holly had noise levels above 70 decibels 90% of the time, indicating that some level of interference with a pleasant pedestrian experience is inevitable on both arterials[31]. Heavy traffic noises are at 85 decibels; results showed Colfax's noise levels above 85 decibels 40% of the time and Holly's 20% of the time[32]. Both streets experience heavy traffic noise, which interferes with the sociability and livability for non-vehicular users of these arterials.

[30] "Noise Induced Hearing Loss"
[31] "Common Environmental Noise Levels Fact Sheet"
[32] "Noise Induced Hearing Loss"

Table 16: Arterial Ten-Minute Decibel Meter Measures

	Colfax	Holly
% of Time Average Over 65 db	99%	100%
% of Time Average Over 70 db	95%	91%
% of Time Average Over 85 db	40%	20%

Figure 29



Source: City of Denver[33]

Table 17

Summary: Colfax vs. Holly on Fostering Strong and Livable Communities		
	Colfax	Holly
High population density	✓	
Retail centers fronting the street	✓	
Social and lively public realm	✓	
High non-motorized user counts	✓	
Low crime rate		✓
Low noise levels supporting a pleasant pedestrian		

[33] Dominic Watson

experience		
Totals	**4 out of 6**	**1 out of 6**

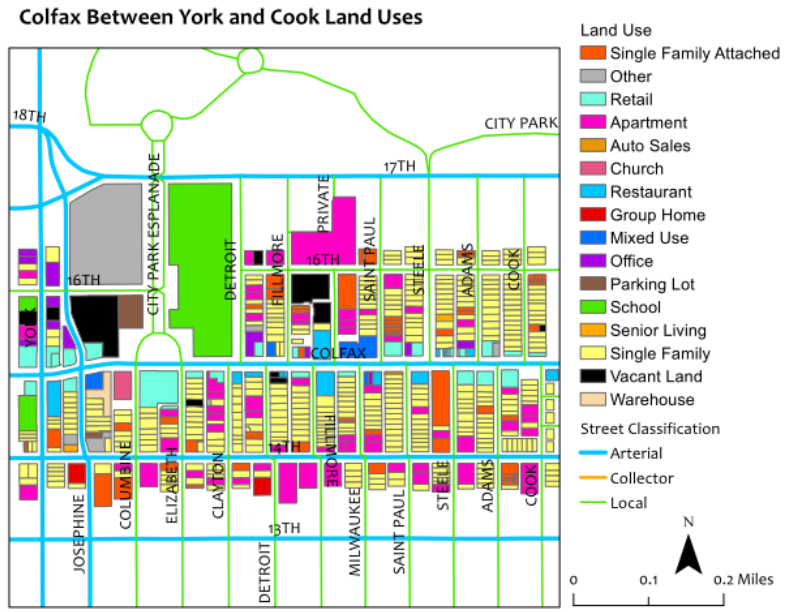
Are the Arterials Economically Vital?

Complete Streets that make it easier for residents and visitors to take transit, walk or bike often do well economically. This is because Complete Streets are often destinations that offer a wide variety of products, services and entertainment options for street users that are often best experienced and accessed on foot or by bike. In fact, many businesses see sales increase when infrastructure for walking, biking and transit is improved and those activities increase. Additionally, switching from driving private vehicles to cheaper or even free modes of transit collectively saves residents a lot of money, which allows for that money to be spent in other ways such as on housing, nearby restaurants and entertainment and keeps that money circulating in the local economy[34]. Complete Streets also stimulate private investment[35].

As discussed earlier, there are many users to serve on the Colfax arterial. Figure 30 indicates that there are many types of uses to serve those users, with a high concentration of active ground floor restaurant, retail, and mixed uses fronting the street. Many destinations are along this stretch of Colfax, including the Bluebird Theater and Tattered Cover/Sie Film Center. It is worth noting that few auto services front the street, which shows that Colfax is committed to serving other non-motorized users; as Table 18 shows, there is only one gas station within the study segment. Even the new 7-Eleven, which typically offers gasoline, fronts the street and does not offer gas services (see Figure 32). On Holly, as Figure 31 shows, there are some retail uses (which can hardly be classified as attractive destinations), but as discussed before, they are set back from the street and are best accessed by car. There are two gas stations cattycorner from one another on Holly, which means that there are ten times as many gas stations per mile on that arterial (as indicated by Table 18). Clearly, Holly is most committed to supporting auto users.

[34] "Fact Sheet"
[35] "Fact Sheet"

Figure 30



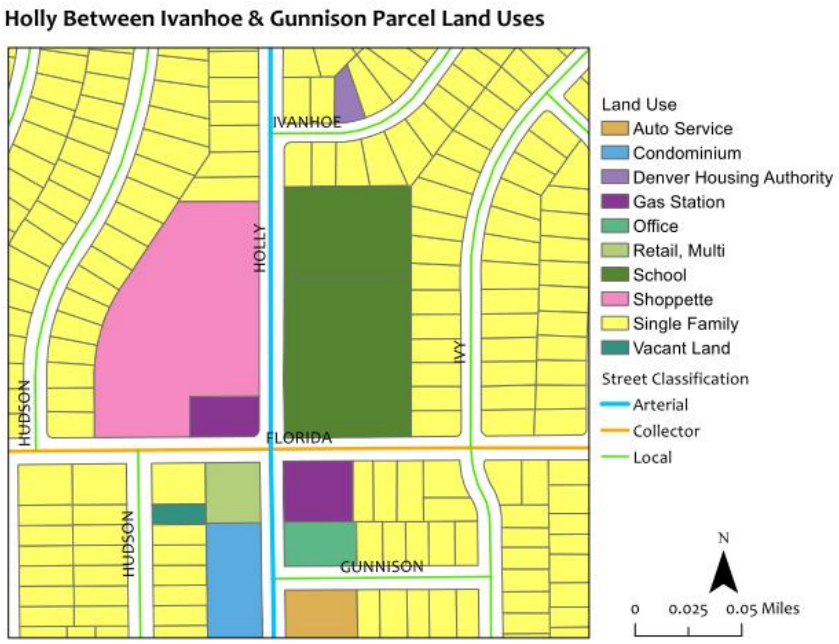
Source: City of Denver[36]

Table 18: Arterial Auto Services

	Colfax	Holly
Number of Gas Stations	1	2
Gas Stations Per Mile	1	10

[36] "Land Use"

Figure 31



Source: City of Denver

Another indication of economic vitality is the presence of new private investment. Colfax has several Business Improvement Districts, including the Bluebird BID that falls within the study area. BIDs are quasi-governmental entities funded by a portion of property taxes on businesses within the BID boundaries, and businesses have to vote to form the district; revenues are then used to improve and maintain the public realm, creating an even better pedestrian experience[37]. The presence of this district directly indicates private investment. Additionally, Colfax has many new and refurbished developments, two of which are shown in Figure 32 (including the aforementioned 7-Eleven). Holly does not have a Business Improvement District or new development, aside from a new 7-Eleven gas station set back from the street (as shown in Figure 33).

[37] "Bluebird Beat"; http://colfaxave.com/home/about-us

Figure 32: New Developments Along Colfax

Figure 33: New Gas Station on Holly

An analysis of real estate values near the arterials would also have been helpful in demonstrating the economic vitality, or lack thereof, of each arterial, as Complete Streets often raise property values due to the walkability of amenities, but this analysis was not feasible for this study[38].

Table 19

Summary: Colfax vs. Holly on Being Economically Vital

	Colfax	Holly
Wide variety of active ground floor restaurant, retail, and mixed uses fronting the street	✓	
Presence of Business Improvement District	✓	
New Development	✓	✓
Totals	**3 out of 3**	**1 out of 3**

Are the Arterials Attempting to be Environmentally Sustainable?

The transportation sector is the fastest growing carbon dioxide source in the U.S., and driving must be curbed in order to prevent carbon emission levels from transportation from rising 41 percent above today's levels in just 15 years[39]. Modal shifts from driving to walking, bicycling and transit is a key mitigation strategy, as walking and bicycling are zero-emission transportation modes and transit is a lower-emission mode[40].

As previously discussed, Colfax does a much better job of acting as a Complete Street in making it possible for users to drive less and use other modes of transportation. Another way that Complete Streets can contribute to mitigating climate change is through the inclusion of numerous street trees that both serve as attractive pedestrian amenities as well as help to reduce the heat island effect and offset carbon dioxide emissions[41]. As Figures 35 and 36 show, there are some street trees along each arterial, but there are a lot of gaps that must be addressed.

[38] "Fact Sheets"

[39] "Fact Sheets"
[40] "Fact Sheets"
[41] "Fact Sheets"

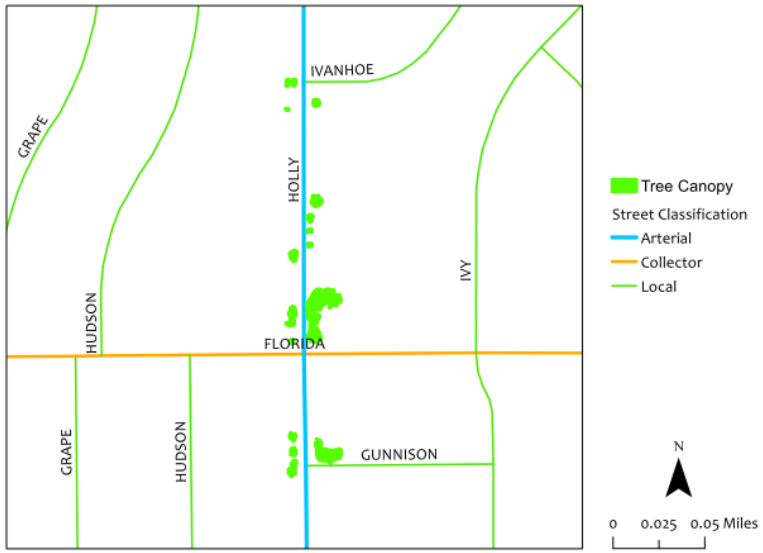
Figure 34

Colfax Between York and Cook Tree Canopy

Source: City of Denver[42]

Figure 35

Holly Between Ivanhoe & Gunnison Tree Canopy



Source: City of Denver

A study of nearby resident vehicle miles traveled would have been helpful in determining if Colfax helps its community decrease its vehicle miles traveled more than Holly does, and thus its carbon dioxide emissions, but this was not feasible for this case study.

Table 20

Summary: Colfax vs. Holly on Being Environmentally Sustainable		
	Colfax	**Holly**
Incorporates low to no-carbon dioxide emitting transit options	✓	
Presence of numerous street trees		

[42] "Tree Canopy"

Totals	**1 out of 2**	**0 out of 2**

Conclusion: Which Street is Most Complete?

Table 21 shows that while Colfax is most classically "arterial" in that it technically best meets the functional classification definition provided by the Federal Highway Administration, it is also the most complete when examined within the framework of a Complete Street design. Therefore, Colfax is much more mobile and accessible for all users, as well as more sustainable, livable and vital than Holly.

Table 21

Summary: Colfax vs. Holly		
	Colfax	**Holly**
Most classically "arterial"	✓	
Provides the most transit options	✓	
Most Accessible to more vulnerable populations	✓	
Safest		✓
Best fosters strong, social and livable communities	✓	
Most Economically Vital	✓	
Most Environmentally Sustainable	✓	

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15.2 Assignment from URPL 6550: Transportation Planning & Policy

Arterials Environmental Analysis
URPL 6550 Transportation Planning and Policy

Due: November 11, 2013 by 9:30 a.m.
Points = 25

Summary

The objective of this assignment is to practice the environmental observation and measurement skills necessary for transportation planning fieldwork and analysis. Students will become familiar with a methodology for collecting transportation and built-environment data.

For this assignment, each student will work individually or in pairs. Each student or pair will select or be assigned one study area, and will examine the transportation and built environments within about a ¼-mile radius (or about a five-minute walk) around a central node or segment. The assessment includes topics such as safety, accessibility, livability, and transportation functionality.

Study Areas

Colfax Avenue at Elm Street
Colfax Avenue at Adams Street
23rd Avenue at Dexter Street
38th Avenue between Wolff Street and Tennyson Street

Data Collection and Analysis

The objective of the assignment is to examine the built/transportation environment, including the motorized traffic, pedestrian and bicyclist travel, and use of public space. The methodology for collecting data includes multiple parts:

1. The Pedestrian Environmental Quality Index (PEQI) Survey that was developed by the San Francisco Department of Public Health. The PEQI Survey forms should be filled out for each intersection within the study area (1/4-mile radius around the node or segment). Groups/individuals should bring a stopwatch to time the pedestrian signal phase of traffic signals, and should be able to estimate intersection lengths based on one's average stride length (need to figure out one's average stride length before doing the assignment).

   For more information about the PEQI Survey, use this website: http://peqiwalksafe.com/. Each student is expected to work through the training manual independently before beginning fieldwork.

   The PEQI Survey includes some fields that are not relevant to the project (e.g., Intersection CNN), so don't worry about filling in these sections. For street type use: commercial urban arterial, neighborhood residential, or other designations that most closely reflect the street conditions (use a street design manual, e.g., San Francisco's, ITE's for more information).

   Do not enter data into the PEQI Survey Access database.

   The documents you need to make the PEQI Survey assessment include:
   - http://peqiwalksafe.com/docs/PEQI2.0_TrainingManual.pdf
   - http://peqiwalksafe.com/docs/PEQI2.0_AuditForm.pdf
   - http://peqiwalksafe.com/docs/PEQI2.0_CheatSheet.pdf

2. Conduct a visual/experiential assessment of the area (using a digital camera, drawings, mapping) to get a better understanding of the land use context, physical design, and relationship between the transportation environment and its context. Take detailed notes, either on the PEQI Survey instrument or in a separate notebook/sketchbook. Explain your visual/experiential assessment methodology in the memo and your findings.

3. Select one or two sites in the study area to carry out an extended field visit (at least one hour each) in which you collect data about road user behavior (e.g., motorists, pedestrians, others), including people who are using surrounding areas (e.g., parks, parking lots, sidewalks, commercial sites). Be sure to consider the time of day and environmental conditions in which you carry out this part of the assignment. Discuss how you selected your sites and time/day for observation in your memo, as well as your findings.

   See example of methods for doing behavioral observation:
   https://www.dropbox.com/s/kmh8tkho8p3notd/Macdonald_2005.pdf.

Safety

Use caution when traveling to the sites and when collecting data in the roadway or in traffic. Follow traffic laws, and if you are riding a bike, wear a helmet and use front and rear lights. Be aware of your surroundings (traffic, social) and do not pursue the data collection if you feel uncertain about your safety, uncomfortable, or threatened. Move to another location/site if you are not comfortable.

Deliverable

The final deliverable for this assignment should be submitted on Canvas in a single document (PDF format), and it includes multiple parts.

1. Turn in scanned copies of the audit forms for each street segment that you analyze with PEQI Survey (raw data).
2. Turn in a collection of representative photos, sketches, or other representations of important characteristics of the study area (raw data, curated).
3. Synthesize the data collected in a memo (not exceeding four single-spaced pages) discussing the safety, accessibility, environmental quality, and transportation functionality of the study area (use these aspects as subheadings to organize the memo). The memo should begin by stating the objective of the memo, the data collected, and the methodologies used. Toward the end of the memo, also include a discussion of any limitations encountered. The memo should also answer the question, "What are the mobility/accessibility tradeoffs in the study area, if any?" Include a list of all intersections and sites visited/studied in an appendix.
4. Draw on the assigned readings and class discussions to inform the analysis.

15.2.1 Example of Student Output No. 1 for URPL 6550

TO: Carolyn McAndrews

FROM:

DATE: November 11, 2013

SUBJECT: Arterial Environmental Observations, 38th St. between Wolff and Tennyson, Denver, CO

This memo discusses the aesthetic, environmental, and livability aspects in the Highlands neighborhood in Denver, Colorado, on and around 38th Street. 38th Street is a major Denver arterial that has since roughly 2008 undergone significant change. Per this change, observations were taken on two separate dates, November 2 and 9, 2013, using Pedestrian Environmental Quality Index methodology, photography, and simple observation. The goal is to contribute to the understanding of the livability factors along and around a major arterial (13,189 vehicle trips per day in 1999, the most recent data available from CDOT and the City/County of Denver)

Data collection, including observations, reveals four distinct neighborhood characters, each with their own transportation characteristics, but all largely relying on car use. These four characters are 1) the 38th St. corridor; 2) south of 38th; 3) north of 38th but not including; 4) Tennyson St. between 38th and 39th streets: this is the only section that does not rely on the car but presumably attracts mostly "locals."

38th Street is a relatively high speed arterial. Walking along it, at least on it north side is not only unpleasant, it is dangerous. There is technically a sidewalk, but most of the five blocks included in the 38th St. section are very unpleasant to traverse. This is the only section that I consider wholly unsafe.

The south side of 38th is easily navigated. It appears that significant attention has given to the south side of 38th street. Businesses such as a Sprouts Farmers Market attract significant traffic daily. This section is walkable and further, has been retrofitted to be so. In addition, the south side of 38th easily integrates its land uses into the neighborhoods farther south. Nowhere is this the case on the north side of 38th, say arguably for Tennsyson St.

Farther south is a new urbanist development named Trocadero Apartments, which includes several subsidiaries such housing for senior citizens. Here, I sat at a community garden and observed pedestrians with dogs, children,

strollers, and other emblems of young families. Some pedestrians carried grocery bags or wore gym clothes (destination likely either to or from the 24-hour Fitness on the south side of 38th St.).

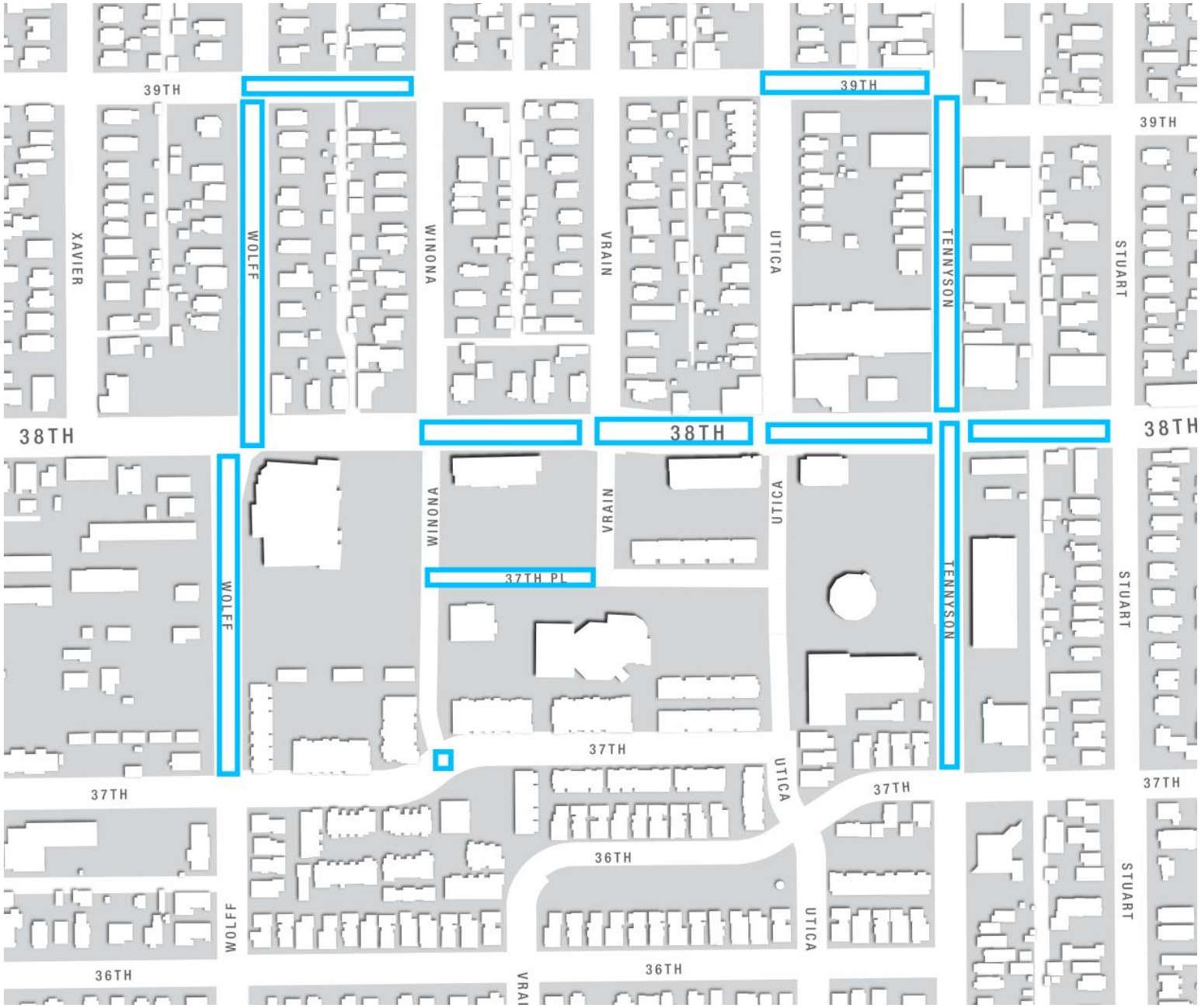
The distinct neighborhood to the north of 38th St. is very residential, walkable, with no real limitations, and of very good environmental quality. Crossing streets is not an issue. There are inadvertant traffic calming measures: there are drainage "dips" at three intersections. There are no crosswalks, but nor is there a need to be. There is very little pedestrian traffic and futher, there is nowhere really to go except to 38th an Tennsyon to either the bar, the ReMax, or the bowling alley.

Tennyson between 38th and 39th streets is a unique area in this neighborhood. It is the only section that "feels" like a main street, unlike the new urbanist development to the south which has the necessities of groceries and wine. Tennsyon is a walkable destination. This is, of course, assuming that one is near Tennyson. Arriving there from outside the neighborhood is problematic, however. The area is destination for who appear to be the "local" but it is unlclear how much of a draw this one-block area would have. The bowling alley is, interestingly, designated as its own land use by Denver's Community Planning and Development Office (CPD). In fact, a land use map of the area reveals a dizzyingly complex and dizzyingly over-enumerated land use classification. Present land use classifications are shown at right for illustration purposes. This diversity of land use is not, in this case, lending itself to a variety of transportation options. With 38th Street functioning as the obvious arterial, it also serves as a very severe edge, in Kevin Lynch's definition, within the area observed. Crossing 38th on foot is challenging. The only marked crosswalks are at Wolff, which has an irregular chicane from north to south across 38th and at Tennyson. The Tennyson intersection is the more prominent between the two. There is also a clear distinction between the aesthetic quality between the areas north and south of 38th Street.

Sprouts market and the new urbanist development that adjoins it blends well with the single family homes farther to the south. These uses, on observation, draw few pedestrians. The artificial street grid between Wolff and Tennyson circulates traffic (automobile) within and functions more of a parking overflow to the nearby businesses. These internal blocks are not heavily walked. The two blocks comprising 37th Place are, in fact, not pleasant at night. The area is not poorly lit, but the lack of activity does not inspire confidence in a would be pedestrian.

Though violent crime is not a serious concern in these three areas, the lasting impression is that the north side of 38th Street is not impassible, but any other choice of route, if walking, would be preferable. Further, crossing 38th Street is nearly impossible during daylight hours other than at Tennyson or Wolff. The entire area is free of debilitating or offensive trash or other noxious concerns, though dumpsters do face several of the side streets (Wolff, Utica).

In conclusion, the final page shows where PEQI observations were taken. The blue boxes link to the data sheets for each intersection and segment.


39TH
39TH
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XAVIER
WOLFF
WINONA
VRAIN
UTICA
TENNYSON
STUART
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UTICA
STUART
36TH
36TH
VRAI

15.2.2 Example of Student Output No. 2 for URPL 6550

Memorandum

To: Carolyn McAndrews

From:

Date: October 27, 2013

Subject: 23rd and Dexter Arterials Environmental Analysis

1 OBJECTIVE

The purpose of this memorandum is to provide a detailed analysis of transportation and built-environment data on the area around 23rd and Dexter Street. The methodology for collecting data included The Pedestrian Environmental Quality Index (PEQI) Survey to understand the motorized traffic, pedestrian and bicycle travel, and use of public space. Additionally, we also documented our experience and the physical conditions of the area with a digital camera. We collected extemporaneous, anecdotal evidence comprising primarily of brief interviews and observations of the arterial.

The intersection of 23rd and Dexter Street is located in the historic neighborhood of Park Hill, east of downtown Denver. The site is categorized as neighborhood residential and the two lane streets were observed as safe and pedestrian friendly.

2 SAFETY

We analyzed the area within the context of pedestrian and vehicle safety. Overall, we concluded the area feels and functions in a safe manner relative to other arterials throughout the city. In particular, we identified excellent walking conditions along the arterial as major contributors to the safety of the primary intersection and along the arterial. Additionally, other factors such as the built environment of the neighborhood and commercial vitality at the 23rd and Dexter encourages a sense of safety for users of all modes.

The west side of the primary intersection is anchored by popular and active retail storefronts. These include several cafes and a grocery that serves as a neighborhood market for surrounding residents. The east side of the same intersection is anchored by a park, surrounded by a low fence. The park is active and well maintained. Throughout our visits, these locales generated healthy pedestrian activity, drawing in residents from the surrounding residential streets.

Some of the physical attributes that contributed to the safety of the site intersections are relatively wide sidewalks and unimpeded throughways. Safety features such as traffic signals and demarcated crosswalks also increase the safety of pedestrians. Although the area lacks specific traffic calming measures, the physical streetscape uses indirect traffic calming features (such as the regular presence of trees). Drivers have a perception of the area as being human-scaled, which encourages slower travel

speeds. Pedestrianism, engagement with visually interesting street frontage and small-scale commercial activity, are the primary measures that affect perceptual traffic calming along 23rd.

The presence of parallel parking along both the main arterial and residential side streets acts as a buffer from moving traffic and pedestrians. We noticed through both observation and anecdotal interviews that the safety of the area is prized here. Passersby commented that they feel safe in their neighborhood. We observed small children walking by themselves, dogs being left on their leashes outside storefronts, bikes being unlocked in front of shops, and cars left running with the keys in them.

When crossing the streets (outside of the study window), we did not use the safety features available at the primary intersection as intended. The speed and safety of the arterial allowed us to interact with the street and traffic in an informal way. The wait time at the signal was in excess of 50 seconds. Due to the low volume of road traffic, we felt that we could safely cross without adhering to the pedestrian signaling. Likewise, we did not use the demarcated crosswalks, instead crossing midblock to the opposite side, which was nearer to the point of interest (in this case, Spinelli's Market).

Along the arterial, similar walking conditions were found in a relatively consistent fashion. We noted that the urban character of the area was fine grained and seemed slow to change, as evidenced by the consistent character of housing, varying degrees of home maintenance and mature trees. Residential local streets intersected the arterial every 300 feet. At these intersections, there were no identified crosswalks unless there was a traffic signal. Within one half-mile along the arterial, there were only 3 traffic lights. However, traffic volumes are light and slow-moving, and pedestrian safety signals at every intersection seem unnecessary. There has clearly been infrastructure investment into the area, as sidewalks along the whole arterial are complete with new paving and curb ramps on all four corners.

3 ACCESSIBILITY

The area is accessible for most users, including those that are mobility impaired. All of the intersections included curb ramps and textured slopes for the visually impaired.

The consistent presence of curbs ramps throughout the area was augmented by new sidewalk construction. The high quality of these curb cuts and new paving suggest that maintenance in the area is frequent or at the very least, that this area has strong support from local government in ensuring that paving remains in good condition. The only tricky spots were at the far ends of the arterial, where the sidewalk crosses north-south alleys. The pavement at these points, due to high traffic generated from back drive garages and heavy vehicles (such as garbage trucks) is crumbly in some places. However, most of the impediments in paving were less than one-half inch high and gravel pieces were small, still allowing wheelchairs, walkers and strollers access.

Despite the absence of bike lanes, slow speeds and ample roadway provided an accessible network for bicyclists. Additionally, the provision of bike racks in the commercial area adds to the bicycle infrastructure present within the area. Wide throughways of at least 5 feet provide ample wandering space for unsteady toddlers. Throughout the entire study area, sidewalks are wide and well maintained. Additionally, throughways are specifically clear from any large obstructions (even in the residential areas, flower pots and bird fountains are kept well clear from the throughway).

Short blocks provide for shorter walking distances. Those with limited walking distance ability are more engaged to walk in this environment due to the shorter trips needed to access places of interest or necessity.

4 ENVIRONMENTAL QUALITY

The arterial is consistently lined with mature trees providing shade, visual interest and carbon sequestration directly along the roadway. The sidewalks and roadspace are kept clean, with minimal (or nonexistent) litter. At the primary intersection, provision of trashcans, postal boxes and public seating allows for increased pedestrian engagement along the space. Commercial buildings are well maintained, being free of chipping paint, crumbling brick and other signs of blight. Fences and walls along the arterial and side streets are also well maintained and free from graffiti.

The low traffic volumes and primarily residential and neighborhood retail character contribute to the lack of pollution and exhaust fumes. Eyes on the street and higher incomes also affect the walking quality and service provision. In the residential area in particular, this is reinforced by the large number of active porches and stoops, and a neighborhood culture of yard maintenance and extension of private space out to the sidewalk in front of one's home. Alleys are free from overflowing garbage and there is a distinct lack of urban odor for an urban neighborhood. Additionally, the walking quality is affected by the absence of loiterers and homeless. Pedestrians of all ages were free to move throughout the space unimpeded by interpersonal tension between users.

In particular, the area is full of rich details that make walking an interesting and enjoyable experience. The high quality and richness of landscaping along the arterial and especially in front of homes increases the holistic experience of the area tremendously. Additionally, being the peak of Autumn color, the leaves on the ground along the sidewalk add seasonal richness to the pedestrian experience. We frequently passed other pedestrians in a neighborly manner, and the feeling of community and mutual respect increased the sense of security in the area. We repeatedly watched neighbors and friends meeting in front of the commercial spaces at the primary intersection. Witnessing small talk and gossip encouraged us to stick around longer than necessary and enjoy a meal at Adagio Bakery, not once, but twice.

5 TRANSPORTATION FUNCTIONALITY

We choose to observe the site on two different days. During the weekday visit, 23rd was being street cleaned. Large street sweepers navigated the residential areas as well as the main arterial itself. These large vehicles needed at least twice the right of way space as a regular passenger car, forcing vehicles to go around them at increased speeds. Likewise, the street sweepers needed access to the curbs which shifted parking from one side of the street to another. Failure to repark residential cars may result in fines or towing, and restricted parking along roadways often means that some residents may have to park farther away from their homes in order to secure a parking spot on the legal side of the street.

During our weekend visit, we noticed a lot more vehicular traffic in addition to increased pedestrian traffic. Cars are still able to move through the area along the arterial at an unimpeded speed. The posted

speed limit is 30 mph, however, anecdotal interview evidence supports that vehicles frequently travel 5-10 mph over the posted speed limit.

During our visits, we did not see any bus service, although there are several bus stops along the arterial in this section. This implies that even though the area is pedestrian friendly, it is primarily localized and that most commuting takes place in cars.

6 LIMITATIONS AND TRADEOFFS

Since public transit services were limited, residents were more efficient driving their vehicles to and from the neighborhood. Residents have access to services within walking distances to their homes, however they must drive in and out due to the lack of public transportation. This presents a challenge for those who don't have access to cars as they must choose to patronize services within their neighborhood instead of easily commuting out.

There is evidence that the neighborhood still prioritizes vehicular access and function. The unimpeded movement along the arterial and lack of official traffic-slowing interventions supports this. In a way, encouraging vehicles to move through the neighborhood along the arterial at quick speeds is still valued. This system has provided for relatively quick commutes from a neighborhood that is considered close to downtown. For this reason, property values are higher because of its quick commute to downtown.

It seems that the high-quality walking environment of the area comes from the history of being a streetcar suburb that has retrofitted to serve the car. One might imagine that there has traditionally been very little conscious effort to prioritize walking along this arterial, since the car became the dominant mode of transportation for Denver in the 1950's.

The number of children and young families observed on the street supports our assessment that this arterial is a safe and healthy arterial for pedestrians and cars alike.

APPENDIX A

Visited Intersections/Site Locations

- 23rd and Dexter (Primary Intersection)
- 23rd and Cherry
- 23rd and Clermont
- 23rd and Birch
- 23rd and Bellaire
- 23rd and Dahlia
- 23rd Eudora
- 23rd and Elm
- 23rd and Fairfax
- Adagio Baking Company
- Spinelli's Market
- Cherry Tomato Café
- W.H. Ferguson Park

APPENDIX B

Representitive Photos

The light post is tied to the tree. This was the only infringement to the area that we noticed.

Crosswalks were marked and sidewalks were well maintained with curb ramps on all four corners of the intersection of 23rd and Dexter.

Although bike lanes were not present, bikers seemed safe enough share the road with on coming traffic.

Outdoor seating was provided outside the market. The area had friendly people and friendly dogs.

Surrounding neighborhood had continuous shade coverage from the mature trees.

Bus stop near the intersection of 23rd and Dexter didn't seem busy. The bus may not come frequently because both visits, we did not see people waiting or a bus travel by.

W.H. Ferguson Park seemed active with parents, children, and pets. The park was located on the corner of 23rd and Dexter near the commercial developments.

A low fence along W.H. Ferguson Park acted as a small barrier to the site. There were plenty of shade from the trees lined along the street segments.

23rd and Dexter offers high visability cross walks on all four sides. Sometimes the pedestrian engineering countermeasures were not necessary to use due to low volume of traffic on arterial.

Street lights are additional safety feature along the main arterial that lines the commercial spaces.

Parallel parking act as a buffer to street segments. Many cars were parked for a few minutes to run in and out of the store and proceeding out of the arterial.

There were some available seating areas near the commercial spaces that were popular meeting spaces for many visitors. Dogs were also tied to the seating areas while the owners went into the stores.

Pedestrian Environmental Quality Index (PEQI)

Street & Intersection Audit Form

Date entered into database: ___/___/___

Project: ARTERIAL'S ASSIGNMENT **Survey Date:** OCT 24, 2013

Auditor(s): STEPHANIE WONG

INTERSECTION

This is the intersection of: 23RD *(The street you plan to walk down)* **and:** CHERRY *(The street you will cross)*

Intersection CNN: _____

Are these two lane or one lane streets and alleys? **Yes** ☑ **No** ☐ Street type NEIGHBORHOODS RES.

	All ways	1 missing	2 missing	3 missing	None
1. Crosswalks	☐	☐	☐	☐	☑
2. High visibility crosswalks	☐	☐	☐	☐	☑

	4+ streetlights	3 streetlights	2 streetlights	1 streetlight	None
3. Intersection lighting	☐	☐	☐	☑	☐

	Traffic Signal	Stop All Way	Yield (no roundabout)	Roundabout	Uncontrolled
4. Traffic Control (none.)	☐	☐	☐	☐	☐

Skip questions 5-8 unless there is a traffic signal

5a. Is there a signal for pedestrians? All ways ☐ Some ways ☐ None ☐

5b. If YES does the signal count down? All ways ☐ Some ways ☐ None ☐

6. Wait time ☐ (seconds) 7. Time to Cross ☐ (seconds) 8. Crossing Distance ☐ (feet)

9. Pedestrian Refuge Island ☑ None ☐ Yes, 4 ft or narrower ☐ Yes, wider than 4 ft

10. Curb ramps ☐ Missing one or more ramp ☑ All corners ramped

11. Intersection traffic calming features

Check all that apply.

TOTAL # Ø

- ☐ *a) Raised crosswalks*
- ☐ *b) Pavement treatments*
- ☐ *c) Bike lane thru intersection*
- ☐ *d) Bulb-outs*
- ☐ *e) Diagonal diverter*
- ☐ *f) Partial closure*
- ☐ *g) Traffic calming circle*
- ☐ *h) Mini-circle*

12. Pedestrian Engineering Countermeasures

Check all that apply.

TOTAL # Ø

- ☐ *a) Flashing beacon*
- ☐ *b) No Turn on Red Signs*
- ☐ *c) Additional signs*
- ☐ *d) Crosswalk scramble*
- ☐ *e) Red visibility curb*
- ☐ *f) Advanced stop/yield lines*
- ☐ *g) Pedestrian leading interval*

STREET SEGMENT

This street is: 23RD **between:** CLERMONT **and:** DEXTER

Side A CNN: _____ *Side B CNN:* _____ *Street type:* _____

13. Number of lanes: ☐ Shared / pedestrian only street ☐ 1 ☑ 2 ☐ 3 ☐ 4+

14. Posted speed limit: ☐ 25 mph / none posted ☐ Under 25 mph ☑ Over 25 mph (35)

15. Street traffic calming features

Check all that apply.

TOTAL # Ø

- ☐ *a) Trees in median*
- ☐ *b) Speed hump / bump*
- ☐ *c) Speed enforcement*
- ☐ *d) Protected bike lane*
- ☐ *e) Chicane*

Please indicate whether Side A and Side B are North, South, East, or West relative to the street centerline.	SIDE A N / S / E / W	SIDE B N / S / E / W
*For questions 16-22 you will select one answer for **each** side of the street*		
16. Continuous sidewalk	No ☐ Yes ☑	Yes ☑ No ☐
17. Width of sidewalk *(if no sidewalk, skip #17-20, this side)*	Less than 5 ft ☐ 5 ft to 8 ft ☐ 8 ft to 12 ft ☑ 12 ft or more ☐	☐ Less than 5 ft ☐ 5 ft to 8 ft ☑ 8 ft to 12 ft ☐ 12 ft or more *(if no sidewalk, skip #17-20, this side)*
18. Width of throughway *The throughway is the part without furniture, signs, plantings, newspaper or utility boxes.*	Less than 4 ft ☐ 4 ft to 6 ft ☑ 6 ft to 8 ft ☐ 8 ft or more ☐	☐ Less than 4 ft ☑ 4 ft to 6 ft ☐ 6 ft to 8 ft ☐ 8 ft or more
19. Large sidewalk obstructions: *An obstruction is any object in the throughway.*	None ☑ Temporary ☐ Permanent ☐	☑ None ☐ Temporary ☐ Permanent
20. Sidewalk impediments: *Anything that poses a tripping hazard.*	None ☑ Minor ☐ Significant ☐	☑ None ☐ Minor ☐ Significant
21. Trees	None ☐ Sporadically lined ☑ Continuously lined ☐	☐ None ☑ Sporadically lined ☐ Continuously lined
22. Driveway cuts	☐ None ☑ 1-5 ☐ > 5	☐ None ☑ 1-5 ☐ > 5
For questions 23-26, check Yes or No on each side:	Yes ☑ No ☐	Yes ☑ No ☐
23. Presence of buffers *Check all that apply.*	Non-peak parallel parking ☑ Parallel parking ☑ Bike lane ☐	☑ Non-peak parallel parking ☑ Parallel parking ☐ Bike lane
24. Planters and gardens	☑ ☐	☑ ☐
25. Public seating	☐ ☑	☐ ☑
26. Public art/historical sites	☐ ☑	☐ ☑
For questions 27-28, select one answer for each side of the street:		
27. Retail use and public places *Retail that covers an entire block counts as three or more.*	None ☑ 1 or 2 ☐ 3 or more ☐	☑ None ☐ 1 or 2 ☐ 3 or more
28. Pedestrian-scale lighting	None ☐ Sporadic ☑ Continuous ☐	☐ None ☑ Sporadic ☐ Continuous
For questions 29-31, check Yes or No on each side:	Yes ☐ No ☑	Yes ☐ No ☑
29. Illegal graffiti *Select NO if there is only a little*	☐ ☑	☐ ☑
30. Litter *Select NO if there is only a little*	☐ ☑	☐ ☑
31. Empty spaces *Check all that apply*	☐ ☑ Abandoned buildings ☐ Vacant lots ☐ Parking lots ☐ Construction sites ☐	☐ ☑ ☐ Abandoned buildings ☐ Vacant lots ☐ Parking lots ☐ Construction sites

Perceived Walkability

This street is: 23RD **between:** CLERMONT **and:** DEXTER

For questions 32-36, please circle the number that your team thinks best describes this street.

32. Street segment is visually attractive for walking.	Strongly disagree 1	Disagree 2	Neutral 3	Agree 4	Strongly agree (5)
33. Street segment feels safe for walking.	Strongly disagree 1	Disagree 2	Neutral 3	Agree (4)	Strongly agree 5
34. Are there obvious strong odors anywhere on this street segment (e.g. vehicle exhaust, urine stench, rotting garbage, etc.)**?**	A lot of odors 1	Some odors 2	A little odor 3	No odor (4)	Only good odors 5
35. On a scale of 1 to 10, how walkable do you find this street segment?	Not walkable 1 2 3 4 5 6 7 8			Very Walkable (9)	10

Notes & Questions:

- QUIET NEIGHBORHOOD - NOT A LOT OF VEHICULAR TRAFFIC COMPARED TO OTHER ARTERIALS I'VE SEEN.
- SOME OBSTRUCTIONS IN SIDEWALK (CRACKED & UNEVEN) → BUT STILL ~~NOT~~ VERY WALKABLE
- MOSTLY NO ODORS - SOME GOOD ODORS FROM PLANTERS.
- IF I WERE WALKING AT NIGHT, NOT SURE IF THE STREET LIGHTS WOULD BE HELPFUL. B/C THERE IS NOT MANY.

Pedestrian Environmental Quality Index (PEQI)

Street & Intersection Audit Form

Date entered into database: ___/___/___

Project: ARTERIAL'S ASSIGNMENT **Survey Date:** OCT 24, 2013

Auditor(s): STEPHANIE WONG

INTERSECTION

This is the intersection of: 23RD (The street you plan to walk down) **and:** CLERMONT (The street you will cross)

Intersection CNN: _____

Are these two lane or one lane streets and alleys? Yes ☑ No ☐ Street type NEIGHBORHOOD RES.

	All ways	1 missing	2 missing	3 missing	None
1. Crosswalks	☐	☐	☐	☐	☑
2. High visibility crosswalks	☐	☐	☐	☐	☑

	4+ streetlights	3 streetlights	2 streetlights	1 streetlight	None
3. Intersection lighting	☐	☐	☐	☐	☑

	Traffic Signal	Stop All Way	Yield (no roundabout)	Roundabout	Uncontrolled
4. Traffic Control (none.)	☐	☐	☐	☐	☐

Skip questions 5-8 unless there is a traffic signal

5a. Is there a signal for pedestrians? All ways ☐ Some ways ☐ None ☐

5b. If YES does the signal count down? All ways ☐ Some ways ☐ None ☐

6. Wait time ☐ (seconds) 7. Time to Cross ☐ (seconds) 8. Crossing Distance ☐ (feet)

9. Pedestrian Refuge Island ☑ None ☐ Yes, 4 ft or narrower ☐ Yes, wider than 4 ft

10. Curb ramps ☐ Missing one or more ramp ☑ All corners ramped

11. Intersection traffic calming features
Check all that apply.
TOTAL # Ø

- ☐ a) Raised crosswalks
- ☐ b) Pavement treatments
- ☐ c) Bike lane thru intersection
- ☐ d) Bulb-outs
- ☐ e) Diagonal diverter
- ☐ f) Partial closure
- ☐ g) Traffic calming circle
- ☐ h) Mini-circle

12. Pedestrian Engineering Countermeasures
Check all that apply.
TOTAL # Ø

- ☐ a) Flashing beacon
- ☐ b) No Turn on Red Signs
- ☐ c) Additional signs
- ☐ d) Crosswalk scramble
- ☐ e) Red visibility curb
- ☐ f) Advanced stop/yield lines
- ☐ g) Pedestrian leading interval

STREET SEGMENT

This street is: 23RD **between:** BIRCH **and:** CHERRY

Side A CNN: _____ *Side B CNN:* _____ *Street type:* NEIGHBORHOOD RES.

13. Number of lanes: ☐ Shared / pedestrian only street ☐ 1 ☑ 2 ☐ 3 ☐ 4+

14. Posted speed limit: ☐ 25 mph / none posted ☐ Under 25 mph ☑ Over 25 mph

15. Street traffic calming features
Check all that apply.
TOTAL # Ø

- ☐ a) Trees in median
- ☐ b) Speed hump / bump
- ☐ c) Speed enforcement
- ☐ d) Protected bike lane
- ☐ e) Chicane

Please indicate whether Side A and Side B are North, South, East, or West relative to the street centerline.	SIDE A N / S / E / W	SIDE B N / S / E / W
*For questions 16-22 you will select one answer for **each** side of the street*		
16. Continuous sidewalk	No ☐ Yes ☑	Yes ☑ No ☐
17. Width of sidewalk *(if no sidewalk, skip #17-20, this side)*	Less than 5 ft ☐ 5 ft to 8 ft ☐ 8 ft to 12 ft ☐ 12 ft or more ☑	☐ Less than 5 ft ☐ 5 ft to 8 ft ☐ 8 ft to 12 ft ☑ 12 ft or more *(if no sidewalk, skip #17-20, this side)*
18. Width of throughway *The throughway is the part without furniture, signs, plantings, newspaper or utility boxes.*	Less than 4 ft ☐ 4 ft to 6 ft ☑ (est) 6 ft to 8 ft ☐ 8 ft or more ☐	☐ Less than 4 ft ☑ 4 ft to 6 ft ☐ 6 ft to 8 ft ☐ 8 ft or more
19. Large sidewalk <u>obstructions</u>: *An obstruction is any object in the throughway.*	None ☑ Temporary ☐ Permanent ☐	☑ None ☐ Temporary ☐ Permanent
20. Sidewalk impediments: *Anything that poses a tripping hazard.*	None ☑ Minor ☐ Significant ☐	☑ None ☐ Minor ☐ Significant
21. Trees	None ☐ Sporadically lined ☑ Continuously lined ☐	☐ None ☑ Sporadically lined ☐ Continuously lined
22. Driveway cuts	☐ None ☑ 1-5 ☐ > 5	☐ None ☑ 1-5 ☐ > 5
For questions 23-26, check Yes or No on each side:	Yes / No	Yes / No
23. Presence of buffers *Check all that apply.*	Non-peak parallel parking ☑ ☐ Parallel parking ☑ ☐ Bike lane ☐ ☐	☑ ☐ Non-peak parallel parking ☑ ☐ Parallel parking ☐ ☐ Bike lane
24. Planters and gardens	☑ ☐	☑ ☐
25. Public seating	☐ ☑	☐ ☑
26. Public art/historical sites	☐ ☑	☐ ☑
For questions 27-28, select one answer for each side of the street:		
27. Retail use and public places *Retail that covers an entire block counts as three or more.*	None ☑ 1 or 2 ☐ 3 or more ☐	☑ None ☐ 1 or 2 ☐ 3 or more
28. Pedestrian-scale lighting	None ☐ Sporadic ☑ Continuous ☐	☐ None ☑ Sporadic ☐ Continuous
For questions 29-31, check Yes or No on each side:	Yes / No	Yes / No
29. Illegal graffiti *Select NO if there is only a little*	☐ ☑	☐ ☑
30. Litter *Select NO if there is only a little*	☐ ☑	☐ ☑
31. Empty spaces *Check all that apply*	☐ ☑ Abandoned buildings ☐ Vacant lots ☐ Parking lots ☐ Construction sites ☐	☐ ☑ ☐ Abandoned buildings ☐ Vacant lots ☐ Parking lots ☐ Construction sites

Perceived Walkability

This street is: 23RD **between:** BIRCH **and:** CHERRY

For questions 32-36, please circle the number that your team thinks best describes this street.

32. Street segment is visually attractive for walking.	Strongly disagree 1	Disagree 2	Neutral 3	Agree (4)	Strongly agree 5
33. Street segment feels safe for walking.	Strongly disagree 1	Disagree 2	Neutral 3	Agree (4)	Strongly agree 5
34. Are there obvious strong odors anywhere on this street segment (e.g. vehicle exhaust, urine stench, rotting garbage, etc.)?	A lot of odors 1	Some odors 2	A little odor 3	No odor (4)	Only good odors 5
35. On a scale of 1 to 10, how walkable do you find this street segment?	Not walkable 1 2 3 4 5 6 7 8 (9) 10			Very Walkable	

Notes & Questions:

- FRIENDLY PEOPLE WALKING DOGS & CHILDREN (SAID HELLO RIGHT-OF-WAY)
- "HOUSING" SEEMS OLDER IN STYLE
- CLOSEST TO 23RD & DEXTER - PEOPLE ARE ~~[illegible]~~ MORE ACTIVE NEAR THIS STREET SEGMENT.

Pedestrian Environmental Quality Index (PEQI)

Street & Intersection Audit Form

Date entered into database: ___/___/___

Project: ARTERIAL'S ASSIGNMENT **Survey Date:** OCT 24, 2013

Auditor(s): STEPHANIE WONG

INTERSECTION

This is the intersection of: 23RD **and:** BIRCH

(The street you plan to walk down) (The street you will cross)

Intersection CNN: _____

Are these two lane or one lane streets and alleys? **Yes** ☑ **No** ☐ Street type NEIGHBORHOOD RES.

	All ways	1 missing	2 missing	3 missing	None
1. Crosswalks	☑	☐	☐	☐	☑
2. High visibility crosswalks	☐	☐	☐	☐	☑

	4+ streetlights	3 streetlights	2 streetlights	1 streetlight	None
3. Intersection lighting	☐	☐	☐	☑	☑

	Traffic Signal	Stop All Way	Yield (no roundabout)	Roundabout	Uncontrolled
4. Traffic Control (NONE).	☐	☐	☐	☐	☐

Skip questions 5-8 unless there is a traffic signal

5a. Is there a signal for pedestrians? All ways ☐ Some ways ☐ None ☐

5b. If YES does the signal count down? All ways ☐ Some ways ☐ None ☐

6. Wait time ☐ (seconds) 7. Time to Cross ☐ (seconds) 8. Crossing Distance ☐ (feet)

9. **Pedestrian Refuge Island** ☑ None ☐ Yes, 4 ft or narrower ☐ Yes, wider than 4 ft

10. **Curb ramps** ☐ Missing one or more ramp ☑ All corners ramped

11. **Intersection traffic calming features** *Check all that apply.* TOTAL # Ø

- ☐ *a) Raised crosswalks*
- ☐ *b) Pavement treatments*
- ☐ *c) Bike lane thru intersection*
- ☐ *d) Bulb-outs*
- ☐ *e) Diagonal diverter*
- ☐ *f) Partial closure*
- ☐ *g) Traffic calming circle*
- ☐ *h) Mini-circle*

12. **Pedestrian Engineering Countermeasures** *Check all that apply.* TOTAL # Ø

- ☐ *a) Flashing beacon*
- ☐ *b) No Turn on Red Signs*
- ☐ *c) Additional signs*
- ☐ *d) Crosswalk scramble*
- ☐ *e) Red visibility curb*
- ☐ *f) Advanced stop/yield lines*
- ☐ *g) Pedestrian leading interval*

STREET SEGMENT

This street is: 23RD **between:** BELLAIRE **and:** CLERMONT

Side A CNN: _____ *Side B CNN:* _____ *Street type:* _____

13. **Number of lanes:** ☐ Shared / pedestrian only street ☐ 1 ☑ 2 ☐ 3 ☐ 4+

(35mph) 14. **Posted speed limit:** ☑ 25 mph / none posted ☐ Under 25 mph ☑ Over 25 mph

15. **Street traffic calming features** *Check all that apply.* TOTAL # Ø

- ☐ *a) Trees in median*
- ☐ *b) Speed hump / bump*
- ☐ *c) Speed enforcement*
- ☐ *d) Protected bike lane*
- ☐ *e) Chicane*

Perceived Walkability

This street is: 23RD **between:** BELLAIRE **and:** CLERMONT

For questions 32-36, please circle the number that your team thinks best describes this street.

32. Street segment is visually attractive for walking.	Strongly disagree 1	Disagree 2	Neutral 3	Agree (4)	Strongly agree 5
33. Street segment feels safe for walking.	Strongly disagree 1	Disagree 2	Neutral 3	Agree (4)	Strongly agree 5
34. Are there obvious strong odors anywhere on this street segment (e.g. vehicle exhaust, urine stench, rotting garbage, etc.)?	A lot of odors 1	Some odors 2	A little odor 3	No odor (4)	Only good odors 5
35. On a scale of 1 to 10, how walkable do you find this street segment?	Not walkable 1 2 3 4 5 6 7 8 (9) 10			Very Walkable	

Notes & Questions:

- NOTICABARLY MORE ALLEYS FOR PRIVATE RESIDENCE WITH MORE TREE - MAYBE AS INFORMAL BARRIERS?
- SMALLER (MAYBE NEWLY PLANTED) TREES ON SOUTH SIDE NEAR CLEMONT ST.
- VERY WELL, KEPT AREA - SAFE!

Perceived Walkability

This street is: 23RD **between:** BELLAIRE **and:** CLERMONT

For questions 32-36, please circle the number that your team thinks best describes this street.

32. Street segment is visually attractive for walking.	Strongly disagree 1	Disagree 2	Neutral 3	Agree (4)	Strongly agree 5
33. Street segment feels safe for walking.	Strongly disagree 1	Disagree 2	Neutral 3	Agree (4)	Strongly agree 5
34. Are there obvious strong odors anywhere on this street segment (e.g. vehicle exhaust, urine stench, rotting garbage, etc.)**?**	A lot of odors 1	Some odors 2	A little odor 3	No odor (4)	Only good odors 5

35. On a scale of 1 to 10, how walkable do you find this street segment?

Not walkable — Very Walkable

1 2 3 4 5 6 7 8 (9) 10

Notes & Questions:

- NOTICABARBLY MORE ALLEYS FOR PRIVATE RESIDENCE WITH MORE TREE - MAYBE AS INFORMAL BARRIERS?
- SMALLER (MAYBE NEWLY PLANTED) TREES ON SOUTH SIDE NEAR CLEMONT ST.
- VERY WELL, KEPT AREA - SAFE!

Pedestrian Environmental Quality Index (PEQI)

Street & Intersection Audit Form

Date entered into database: ___/___/___

Project: ARTERIAL'S ASSIGNMENT **Survey Date:** OCT 24, 2013

Auditor(s): STEPHANIE WONG

INTERSECTION

This is the intersection of: 23RD (The street you plan to walk down) **and:** BELLAIRE (The street you will cross)

Intersection CNN: _____

Are these two lane or one lane streets and alleys? **Yes** ☑ **No** ☐ Street type NEIGHBORHOOD RES.

	All ways	1 missing	2 missing	3 missing	None
1. Crosswalks	☐	☐	☐	☐	☑
2. High visibility crosswalks	☐	☐	☐	☐	☑

	4+ streetlights	3 streetlights	2 streetlights	1 streetlight	None
3. Intersection lighting	☐	☐	☐	☑	☐

	Traffic Signal	Stop All Way	Yield (no roundabout)	Roundabout	Uncontrolled
4. Traffic Control none.	☐	☐	☐	☐	☐

Skip questions 5-8 unless there is a traffic signal

5a. Is there a signal for pedestrians? All ways ☐ Some ways ☐ None ☐

5b. If YES does the signal count down? All ways ☐ Some ways ☐ None ☐

6. Wait time ☐ (seconds) 7. Time to Cross ☐ (seconds) 8. Crossing Distance ☐ (feet)

9. Pedestrian Refuge Island ☑ None ☐ Yes, 4 ft or narrower ☐ Yes, wider than 4 ft

10. Curb ramps ☐ Missing one or more ramp ☑ All corners ramped

11. Intersection traffic calming features *Check all that apply.* TOTAL # Ø

- ☐ a) Raised crosswalks
- ☐ b) Pavement treatments
- ☐ c) Bike lane thru intersection
- ☐ d) Bulb-outs
- ☐ e) Diagonal diverter
- ☐ f) Partial closure
- ☐ g) Traffic calming circle
- ☐ h) Mini-circle

12. Pedestrian Engineering Countermeasures *Check all that apply.* TOTAL # Ø

- ☐ a) Flashing beacon
- ☐ b) No Turn on Red Signs
- ☐ c) Additional signs
- ☐ d) Crosswalk scramble
- ☐ e) Red visibility curb
- ☐ f) Advanced stop/yield lines
- ☐ g) Pedestrian leading interval

STREET SEGMENT

This street is: 23RD **between:** ASH **and:** BIRCH

Side A CNN: _____ *Side B CNN:* _____ *Street type:* _____

13. Number of lanes: ☐ Shared / pedestrian only street ☐ 1 ☑ 2 ☐ 3 ☐ 4+

14. Posted speed limit: ☐ 25 mph / none posted ☐ Under 25 mph ☑ Over 25 mph (35 mph)

15. Street traffic calming features *Check all that apply.* TOTAL # Ø

- ☐ a) Trees in median
- ☐ b) Speed hump / bump
- ☐ c) Speed enforcement
- ☐ d) Protected bike lane
- ☐ e) Chicane

Please indicate whether Side A and Side B are North, South, East, or West relative to the street centerline.	SIDE A (N) / S / E / W	SIDE B N / (S) / E / W
*For questions 16-22 you will select one answer for **each** side of the street*		
16. Continuous sidewalk	No ☐ Yes ☑	Yes ☑ No ☐
17. Width of sidewalk *(if no sidewalk, skip #17-20, this side)*	Less than 5 ft ☐ 5 ft to 8 ft ☐ 8 ft to 12 ft ☐ 12 ft or more ☑	☐ Less than 5 ft ☐ 5 ft to 8 ft ☑ 8 ft to 12 ft ☑ 12 ft or more *(if no sidewalk, skip #17-20, this side)*
18. Width of throughway *The throughway is the part without furniture, signs, plantings, newspaper or utility boxes.*	Less than 4 ft ☐ (SK) 4 ft to 6 ft ☑ 6 ft to 8 ft ☐ 8 ft or more ☐	☐ Less than 4 ft ☑ 4 ft to 6 ft ☐ 6 ft to 8 ft ☐ 8 ft or more
19. Large sidewalk obstructions: *An obstruction is any object in the throughway.*	None ☑ Temporary ☐ Permanent ☐	☑ None ☐ Temporary ☐ Permanent
20. Sidewalk impediments: *Anything that poses a tripping hazard.*	None ☑ Minor ☐ Significant ☐	☑ None ☐ Minor ☐ Significant
21. Trees	None ☐ Sporadically lined ☐ Continuously lined ☑	☐ None ☑ Sporadically lined ☐ Continuously lined
22. Driveway cuts	☐ None ☑ 1-5 ☐ > 5	☐ None ☑ 1-5 ☐ > 5
For questions 23-26, check Yes or No on each side:	Yes ☑ No ☐	Yes ☑ No ☐
23. Presence of buffers *Check all that apply.*	Non-peak parallel parking ☑ Parallel parking ☑ Bike lane ☐	☑ Non-peak parallel parking ☑ Parallel parking ☐ Bike lane
24. Planters and gardens	☑ ☐	☑ ☐
25. Public seating	☐ ☑	☐ ☑
26. Public art/historical sites	☐ ☑	☐ ☑
For questions 27-28, select one answer for each side of the street:		
27. Retail use and public places *Retail that covers an entire block counts as three or more.*	None ☑ 1 or 2 ☐ 3 or more ☐	☑ None ☐ 1 or 2 ☐ 3 or more
28. Pedestrian-scale lighting	None ☐ Sporadic ☑ Continuous ☐	☐ None ☑ Sporadic ☐ Continuous
For questions 29-31, check Yes or No on each side:	Yes ☐ No ☑	Yes ☐ No ☑
29. Illegal graffiti *Select NO if there is only a little*	☐ ☑	☐ ☑
30. Litter *Select NO if there is only a little*	☐ ☑	☐ ☑
31. Empty spaces *Check all that apply*	☐ ☑ Abandoned buildings ☐ Vacant lots ☐ Parking lots ☐ Construction sites ☐	☐ ☑ ☐ Abandoned buildings ☐ Vacant lots ☐ Parking lots ☐ Construction sites

Perceived Walkability

This street is: 23RD **between:** ASH **and:** BIRCH

For questions 32-36, please circle the number that your team thinks best describes this street.

32. Street segment is visually attractive for walking.	Strongly disagree 1	Disagree 2	Neutral 3	Agree (4)	Strongly agree 5
33. Street segment feels safe for walking.	Strongly disagree 1	Disagree 2	Neutral 3	Agree (4)	Strongly agree 5
34. Are there obvious strong odors anywhere on this street segment (e.g. vehicle exhaust, urine stench, rotting garbage, etc.)?	A lot of odors 1	Some odors 2	A little odor 3	No odor (4)	Only good odors 5

35. On a scale of 1 to 10, how walkable do you find this street segment?

Not walkable — Very Walkable

1 2 3 4 5 6 7 8 (9) 10

Notes & Questions:

- QUIET NEIGHBORHOOD
- NICE, VISUAL PLANTER ON NORTH SIDE NEAR SIDEWALKS.
- VERY WALKABLE AREA WITH CLEAN, SIDEWALKS (AND NO OBSTRUCTIONS)
- LOTS OF SHADE, EVEN THOUGH TREES WERE SPORADIC.

Pedestrian Environmental Quality Index (PEQI)

Street & Intersection Audit Form

Date entered into database: ___/___/___

Project: ARTERIAL'S ENVIRONMENTAL ASSESS **Survey Date:** OCT 24, 2013

Auditor(s): STEPHANIE WONG

INTERSECTION

This is the intersection of: (23RD) DEXTER **and:** (CHERRY) 23RD

(The street you plan to walk down) (The street you will cross)

Intersection CNN: _____

Are these two lane or one lane streets and alleys? **Yes** ☑ **No** ☐ Street type NEIGHBORHOOD RES.

	All ways	1 missing	2 missing	3 missing	None
1. Crosswalks	☑	☐	☐	☐	☐
2. High visibility crosswalks	☑	☐	☐	☐	☐

	4+ streetlights	3 streetlights	2 streetlights	1 streetlight	None
3. Intersection lighting	☑	☐	☑	☐	☐

	Traffic Signal	Stop All Way	Yield (no roundabout)	Roundabout	Uncontrolled
4. Traffic Control	☑	☑	☐	☐	☐

Skip questions 5-8 unless there is a traffic signal

5a. Is there a signal for pedestrians? All ways ☐ Some ways ☑ None ☐

5b. If YES does the signal count down? All ways ☐ Some ways ☐ None ☑

6. Wait time 50s. (seconds) **7. Time to Cross** 12s. (seconds) **8. Crossing Distance** 27FT. (feet)

9. Pedestrian Refuge Island ☑ None ☐ Yes, 4 ft or narrower ☐ Yes, wider than 4 ft

10. Curb ramps ☐ Missing one or more ramp ☑ All corners ramped

11. Intersection traffic calming features *Check all that apply.* TOTAL # Ø

- ☐ a) Raised crosswalks
- ☐ b) Pavement treatments
- ☐ c) Bike lane thru intersection
- ☐ d) Bulb-outs
- ☐ e) Diagonal diverter
- ☐ f) Partial closure
- ☐ g) Traffic calming circle
- ☐ h) Mini-circle

12. Pedestrian Engineering Countermeasures *Check all that apply.* TOTAL # 3

- ☑ a) Flashing beacon
- ☐ b) No Turn on Red Signs
- ☑ c) Additional signs
- ☐ d) Crosswalk scramble
- ☐ e) Red visibility curb
- ☑ f) Advanced stop/yield lines
- ☐ g) Pedestrian leading interval

STREET SEGMENT

This street is: (Primary) 23RD **between:** (Street #1) CHERRY **and:** (Street #2) DAHLIA

Side A CNN: _____ *Side B CNN:* _____ *Street type:* _____

13. Number of lanes: ☐ Shared / pedestrian only street ☐ 1 ☑ 2 ☐ 3 ☐ 4+

14. Posted speed limit: ☐ 25 mph / none posted ☐ Under 25 mph ☑ Over 25 mph → 35 MPH.

15. Street traffic calming features *Check all that apply.* TOTAL # Ø

- ☐ a) Trees in median
- ☐ b) Speed hump / bump
- ☐ c) Speed enforcement
- ☐ d) Protected bike lane
- ☐ e) Chicane

Please indicate whether Side A and Side B are North, South, East, or West relative to the street centerline.	SIDE A (N)/S/E/W	SIDE B N/S/E/W
*For questions 16-22 you will select one answer for **each** side of the street*		
16. Continuous sidewalk	No ☐ Yes ☑	Yes ☑ No ☐
17. Width of sidewalk *(if no sidewalk, skip #17-20, this side)*	Less than 5 ft ☐ 5 ft to 8 ft ☑ 8 ft to 12 ft ☐ 12 ft or more ☑	☐ Less than 5 ft ☐ 5 ft to 8 ft ☐ 8 ft to 12 ft ☑ 12 ft or more *(if no sidewalk, skip #17-20, this side)*
18. Width of throughway *The throughway is the part without furniture, signs, plantings, newspaper or utility boxes.*	Less than 4 ft ☐ 4 ft to 6 ft ☑ 6 ft to 8 ft ☐ 8 ft or more ☐	☐ Less than 4 ft ☑ 4 ft to 6 ft ☐ 6 ft to 8 ft ☐ 8 ft or more
19. Large sidewalk <u>obstructions</u>: *An obstruction is any object in the throughway.*	None ☑ Temporary ☐ Permanent ☐	☑ None ☐ Temporary ☐ Permanent (SOME TREES HUNG LOW, BUT DIDN'T FEEL LIKE AN OBSTRUCTION)
20. Sidewalk impediments: *Anything that poses a tripping hazard.*	None ☑ Minor ☐ Significant ☐	☑ None ☐ Minor ☐ Significant
21. Trees	None ☐ Sporadically lined ☐ Continuously lined ☑	☐ None ☑ Sporadically lined ☐ Continuously lined
22. Driveway cuts	☐ None ☑ 1-5 ☐ > 5	☐ None ☑ 1-5 ☐ > 5
For questions 23-26, check Yes or No on each side:	Yes No	Yes No
23. Presence of buffers *Check all that apply.*	☑ ☐ Non-peak parallel parking ☑ Parallel parking ☑ Bike lane ☐	☑ ☐ ☑ Non-peak parallel parking ☑ Parallel parking ☐ Bike lane
24. Planters and gardens	☑ ☐	☑ ☐
25. Public seating	☑ ☐	☑ ☐
26. Public art/historical sites	☐ ☐	☐ ☐
For questions 27-28, select one answer for each side of the street:		
27. Retail use and public places *Retail that covers an entire block counts as three or more.*	None ☐ 1 or 2 ☐ 3 or more ☑	☐ None ☐ 1 or 2 ☑ 3 or more
28. Pedestrian-scale lighting	None ☐ Sporadic ☑ Continuous ☐	☐ None ☑ Sporadic ☐ Continuous
For questions 29-31, check Yes or No on each side:	Yes No	Yes No
29. Illegal graffiti *Select NO if there is only a little*	☐ ☑	☐ ☑
30. Litter *Select NO if there is only a little*	☐ ☑	☐ ☑
31. Empty spaces *Check all that apply*	☐ ☑ Abandoned buildings ☐ Vacant lots ☐ Parking lots ☐ Construction sites ☐	☐ ☑ ☐ Abandoned buildings ☐ Vacant lots ☐ Parking lots ☐ Construction sites

Perceived Walkability

This street is: 23RD **between:** CHERRY **and:** DAHLIA

For questions 32-36, please circle the number that your team thinks best describes this street.

32. Street segment is visually attractive for walking.	Strongly disagree (1)	Disagree 2	Neutral 3	Agree 4	Strongly agree (5)
33. Street segment feels safe for walking.	Strongly disagree 1	Disagree 2	Neutral 3	Agree (4)	Strongly agree 5
34. Are there obvious strong odors anywhere on this street segment (e.g. vehicle exhaust, urine stench, rotting garbage, etc.)**?**	A lot of odors 1	Some odors 2	A little odor 3	No odor (4)	Only good odors 5
35. On a scale of 1 to 10, how walkable do you find this street segment?	Not walkable 1 2 3 4 5 6 7 8 (9) 10			Very Walkable	

Notes & Questions:

DATES VISITED: THURSDAY, OCT 24, 2013 - 11AM
SUNDAY, OCT 27, 2013 - 10AM

- FEELS VERY SAFE
- LOTS OF CHILDREN, DOGS, + FRIENDLY FACES
  EVERYONE THAT PASSED US SAID "HELLO"
- DIDN'T SEEM BUSY + BEING CONSIDERED AN ARTERIAL ROAD (35 MPH)
- (1) BUS STOP - NO PEOPLE WAITING
  NO BUSES SEEN DURING VISIT.
- NO BIKE LANES
- ~~PEDESTRIAN/PARKING/TRAFFIC~~
- BIKE RACKS AVAILABLE: BUT MOST BIKES WERE LEFT OUTSIDE RETAIL SPACES UNLOCKED ← SAFE!

Pedestrian Environmental Quality Index (PEQI)

Street & Intersection Audit Form

Date entered into database: ___/___/___

Project: 23rd + Dexter **Survey Date:** 10/24/13

Auditor(s): Nick Fazio

INTERSECTION

This is the intersection of: 23rd Dexter **and:** ~~Dexter~~ 23rd

(The street you plan to walk down) (The street you will cross)

Intersection CNN: NA

Are these two lane or one lane streets and alleys? **Yes** ☑ **No** ☐ Street type Neighborhood

	All ways	1 missing	2 missing	3 missing	None
1. Crosswalks	☑	☐	☐	☐	☐
2. High visibility crosswalks	☑	☐	☐	☐	☐

	4+ streetlights	3 streetlights	2 streetlights	1 streetlight	None
3. Intersection lighting	☒	☐	☑	☐	☐

	Traffic Signal	Stop All Way	Yield (no roundabout)	Roundabout	Uncontrolled
4. Traffic Control	☑	☐	☐	☐	☐

Skip questions 5-8 unless there is a traffic signal

5a. Is there a signal for pedestrians? All ways ☐ Some ways ☑ None ☐

5b. If YES does the signal count down? All ways ☐ Some ways ☐ None ☐

6. Wait time 50 (seconds) **7. Time to Cross** 12 (seconds) **8. Crossing Distance** 27 (feet)

9. Pedestrian Refuge Island ☒ None ☐ Yes, 4 ft or narrower ☐ Yes, wider than 4 ft

10. Curb ramps ☐ Missing one or more ramp ☑ All corners ramped

11. Intersection traffic calming features

Check all that apply.

TOTAL # 0

- ☐ *a) Raised crosswalks*
- ☐ *b) Pavement treatments*
- ☐ *c) Bike lane thru intersection*
- ☐ *d) Bulb-outs*
- ☐ *e) Diagonal diverter*
- ☐ *f) Partial closure*
- ☐ *g) Traffic calming circle*
- ☐ *h) Mini-circle*

12. Pedestrian Engineering Countermeasures

Check all that apply.

TOTAL # 3

- ☑ *a) Flashing beacon*
- ☐ *b) No Turn on Red Signs*
- ☑ *c) Additional signs*
- ☐ *d) Crosswalk scramble*
- ☐ *e) Red visibility curb*
- ☑ *f) Advanced stop/yield lines*
- ☐ *g) Pedestrian leading interval*

STREET SEGMENT

This street is: 23 **between:** Cherry **and:** Dahlia

Side A CNN: NA *Side B CNN:* NA *Street type:* Neighborhood

13. Number of lanes: ☐ Shared / pedestrian only street ☐ 1 ☒ 2 ☐ 3 ☐ 4+

14. Posted speed limit: ☐ 25 mph / none posted ☐ Under 25 mph ☑ Over 25 mph

15. Street traffic calming features

Check all that apply.

TOTAL # 0

- ☐ *a) Trees in median*
- ☐ *b) Speed hump / bump*
- ☐ *c) Speed enforcement*
- ☐ *d) Protected bike lane*
- ☐ *e) Chicane*

Please indicate whether Side A and Side B are North, South, East, or West relative to the street centerline.	SIDE A N / S / E / W	SIDE B N / S / E / W
*For questions 16-22 you will select one answer for **each** side of the street*		
16. Continuous sidewalk	No ☐ Yes ☑	Yes ☑ No ☐
17. Width of sidewalk *(if no sidewalk, skip #17-20, this side)*	Less than 5 ft ☐ 5 ft to 8 ft ☐ 8 ft to 12 ft ☐ 12 ft or more ☑	☐ Less than 5 ft ☐ 5 ft to 8 ft ☐ 8 ft to 12 ft ☑ 12 ft or more
18. Width of throughway *The throughway is the part without furniture, signs, plantings, newspaper or utility boxes.*	Less than 4 ft ☐ 4 ft to 6 ft ☑ 6 ft to 8 ft ☐ 8 ft or more ☐	☐ Less than 4 ft ☑ 4 ft to 6 ft ☐ 6 ft to 8 ft ☐ 8 ft or more
19. Large sidewalk <u>obstructions</u>: *An obstruction is any object in the throughway.*	None ☑ Temporary ☐ Permanent ☐	☑ None ☐ Temporary ☐ Permanent
20. Sidewalk impediments: *Anything that poses a tripping hazard.*	None ☑ Minor ☐ Significant ☐	☑ None ☐ Minor ☐ Significant
21. Trees	None ☐ Sporadically lined ☐ Continuously lined ☑	☐ None ☑ Sporadically lined ☐ Continuously lined
22. Driveway cuts	☐ None ☑ 1-5 ☐ > 5	☐ None ☑ 1-5 ☐ > 5
For questions 23-26, check Yes or No on each side:	Yes No	Yes No
23. Presence of buffers *Check all that apply.*	☑ ☑ Non-peak parallel parking ☑ Parallel parking ☑ Bike lane ☐	☑ ☐ ☐ Non-peak parallel parking ☑ Parallel parking ☐ Bike lane
24. Planters and gardens	☑ ☐	☑ ☐
25. Public seating	☑ ☐	☑ ☐
26. Public art/historical sites	☐ ☑	☐ ☑
For questions 27-28, select one answer for each side of the street:		
27. Retail use and public places *Retail that covers an entire block counts as three or more.*	None ☐ 1 or 2 ☒ 3 or more ☑	☐ None ☐ 1 or 2 ☑ 3 or more
28. Pedestrian-scale lighting	None ☐ Sporadic ☑ Continuous ☐	☐ None ☑ Sporadic ☐ Continuous
For questions 29-31, check Yes or No on each side:	Yes No	Yes No
29. Illegal graffiti *Select NO if there is only a little*	☐ ☑	☐ ☑
30. Litter *Select NO if there is only a little*	☐ ☑	☐ ☑
31. Empty spaces *Check all that apply*	☐ ☑ Abandoned buildings ☐ Vacant lots ☐ Parking lots ☐ Construction sites ☐	☐ ☑ ☐ Abandoned buildings ☐ Vacant lots ☐ Parking lots ☐ Construction sites

Perceived Walkability

This street is: 23rd **between:** Cherry **and:** Dahlia

For questions 32-36, please circle the number that your team thinks best describes this street.

32. Street segment is visually attractive for walking.	Strongly disagree 1	Disagree 2	Neutral 3	Agree 4	Strongly agree (5)
33. Street segment feels safe for walking.	Strongly disagree 1	Disagree 2	Neutral 3	Agree (4)	Strongly agree 5
34. Are there obvious strong odors anywhere on this street segment (e.g. vehicle exhaust, urine stench, rotting garbage, etc.)**?**	A lot of odors 1	Some odors 2	A little odor 3	No odor (4)	Only good odors 5

35. On a scale of 1 to 10, how walkable do you find this street segment?

Not walkable — Very Walkable

1 2 3 4 5 6 7 8 (9) 10

Notes & Questions:

People feel safe.
Lots of children, families, dogs.

11am ⇔ 12pm

Friendly than normal "said hello"

Inquisitive

doesn't feel like alot of traffic at the moment

Pedestrian Environmental Quality Index (PEQI)

Street & Intersection Audit Form

Date entered into database: ___/___/___

Project: Arterials **Survey Date:** Oct 24 2013

Auditor(s): NrkFaz:o

INTERSECTION

This is the intersection of: 23rd **and:** Dahlia

(The street you plan to walk down) (The street you will cross)

Intersection CNN: _____

Are these two lane or one lane streets and alleys? Yes ☑ No ☐ Street type Neighborhood Res

	All ways	1 missing	2 missing	3 missing	None
1. Crosswalks	☐	☐	☐	☐	☑
2. High visibility crosswalks	☐	☐	☐	☐	☑

	4+ streetlights	3 streetlights	2 streetlights	1 streetlight	None
3. Intersection lighting	☐	☐	☐	☑	☐

	Traffic Signal	Stop All Way	Yield (no roundabout)	Roundabout	Uncontrolled
4. Traffic Control	☐	☐	☐	☐	☑

Skip questions 5-8 unless there is a traffic signal

5a. Is there a signal for pedestrians? All ways ☐ Some ways ☐ None ☐

5b. If YES does the signal count down? All ways ☐ Some ways ☐ None ☐

6. Wait time ☐ (seconds) 7. Time to Cross ☐ (seconds) 8. Crossing Distance ☐ (feet)

9. Pedestrian Refuge Island ☑ None ☐ Yes, 4 ft or narrower ☐ Yes, wider than 4 ft

10. Curb ramps ☐ Missing one or more ramp ☑ All corners ramped

11. Intersection traffic calming features

Check all that apply.

TOTAL # 0

- ☐ *a) Raised crosswalks*
- ☐ *b) Pavement treatments*
- ☐ *c) Bike lane thru intersection*
- ☐ *d) Bulb-outs*
- ☐ *e) Diagonal diverter*
- ☐ *f) Partial closure*
- ☐ *g) Traffic calming circle*
- ☐ *h) Mini-circle*

12. Pedestrian Engineering Countermeasures

Check all that apply.

TOTAL # 0

- ☐ *a) Flashing beacon*
- ☐ *b) No Turn on Red Signs*
- ☐ *c) Additional signs*
- ☐ *d) Crosswalk scramble*
- ☐ *e) Red visibility curb*
- ☐ *f) Advanced stop/yield lines*
- ☐ *g) Pedestrian leading interval*

STREET SEGMENT

This street is: 23rd **between:** Dexter **and:** Eudora

Side A CNN: _____ *Side B CNN:* _____ *Street type:* _____

13. Number of lanes: ☐ Shared / pedestrian only street ☐ 1 ☑ 2 ☐ 3 ☐ 4+

14. Posted speed limit: ☐ 25 mph / none posted ☐ Under 25 mph ☑ Over 25 mph

15. Street traffic calming features

Check all that apply.

TOTAL # 0

- ☐ *a) Trees in median*
- ☐ *b) Speed hump / bump*
- ☐ *c) Speed enforcement*
- ☐ *d) Protected bike lane*
- ☐ *e) Chicane*

Please indicate whether Side A and Side B are North, South, East, or West relative to the street centerline.	SIDE A (N) / S / E / W	SIDE B N / (S) / E / W
*For questions 16-22 you will select one answer for **each** side of the street*		
16. Continuous sidewalk	No ☐ Yes ☑	Yes ☐ No ☑
17. Width of sidewalk *(if no sidewalk, skip #17-20, this side)*	Less than 5 ft ☐ 5 ft to 8 ft ☐ 8 ft to 12 ft ☐ 12 ft or more ☑	☐ Less than 5 ft ☐ 5 ft to 8 ft ☐ 8 ft to 12 ft ☑ 12 ft or more *(if no sidewalk, skip #17-20, this side)*
18. Width of throughway *The throughway is the part without furniture, signs, plantings, newspaper or utility boxes.*	Less than 4 ft ☐ 4 ft to 6 ft ☑ 6 ft to 8 ft ☐ 8 ft or more ☐	☐ Less than 4 ft ☑ 4 ft to 6 ft ☐ 6 ft to 8 ft ☐ 8 ft or more
19. Large sidewalk obstructions: *An obstruction is any object in the throughway.*	None ☑ Temporary ☐ Permanent ☐	☑ None ☐ Temporary ☐ Permanent
20. Sidewalk impediments: *Anything that poses a tripping hazard.*	None ☑ Minor ☐ Significant ☐	☑ None ☐ Minor ☐ Significant
21. Trees	None ☐ Sporadically lined ☐ Continuously lined ☑	☐ None ☐ Sporadically lined ☑ Continuously lined
22. Driveway cuts	☐ None ☑ 1-5 ☐ > 5	☐ None ☑ 1-5 ☐ > 5
For questions 23-26, check Yes or No on each side:	Yes No	Yes No
23. Presence of buffers *Check all that apply.*	☑ ☐ Non-peak parallel parking ☑ Parallel parking ☑ Bike lane ☐	☑ ☐ ☑ Non-peak parallel parking ☑ Parallel parking ☐ Bike lane
24. Planters and gardens	☑ ☐	☑ ☐
25. Public seating	☐ ☑	☐ ☑
26. Public art/historical sites	☐ ☑	☐ ☑
For questions 27-28, select one answer for each side of the street:		
27. Retail use and public places *Retail that covers an entire block counts as three or more.*	None ☐ 1 or 2 ☑ 3 or more ☐	☐ None ☑ 1 or 2 ☐ 3 or more
28. Pedestrian-scale lighting	None ☐ Sporadic ☑ Continuous ☐	☐ None ☑ Sporadic ☐ Continuous
For questions 29-31, check Yes or No on each side:	Yes No	Yes No
29. Illegal graffiti *Select NO if there is only a little*	☐ ☑	☐ ☑
30. Litter *Select NO if there is only a little*	☐ ☑	☐ ☑
31. Empty spaces *Check all that apply*	☐ ☑ Abandoned buildings ☐ Vacant lots ☐ Parking lots ☐ Construction sites ☐	☐ ☑ ☐ Abandoned buildings ☐ Vacant lots ☐ Parking lots ☐ Construction sites

Perceived Walkability

This street is: 23rd **between:** Dexter **and:** Eudora

For questions 32-36, please circle the number that your team thinks best describes this street.

32. Street segment is visually attractive for walking.	Strongly disagree 1	Disagree 2	Neutral 3	Agree 4	Strongly agree (5)
33. Street segment feels safe for walking.	Strongly disagree 1	Disagree 2	Neutral 3	Agree 4	Strongly agree (5)
34. Are there obvious strong odors anywhere on this street segment (e.g. vehicle exhaust, urine stench, rotting garbage, etc.)?	A lot of odors 1	Some odors 2	A little odor 3	No odor (4)	Only good odors 5

35. On a scale of 1 to 10, how walkable do you find this street segment?

Not walkable — Very Walkable

1 2 3 4 5 6 7 8 9 (10)

Notes & Questions:

Pedestrian Environmental Quality Index (PEQI)

Street & Intersection Audit Form

Date entered into database: ___/___/___

Project: Arterials **Survey Date:** Oct 24 2013

Auditor(s): Nick Fazio

INTERSECTION

This is the intersection of: 23rd **and:** Eudora

(The street you plan to walk down) (The street you will cross)

Intersection CNN: _____

Are these two lane or one lane streets and alleys? **Yes** ☑ **No** ☐ Street type Neighborhood Res

	All ways	1 missing	2 missing	3 missing	None
1. Crosswalks	☐	☐	☐	☐	☑
2. High visibility crosswalks	☐	☐	☐	☐	☑

	4+ streetlights	3 streetlights	2 streetlights	1 streetlight	None
3. Intersection lighting	☐	☐	☐	☑	☐

	Traffic Signal	Stop All Way	Yield (no roundabout)	Roundabout	Uncontrolled
4. Traffic Control	☐	☐	☐	☐	☑

Skip questions 5-8 unless there is a traffic signal

5a. Is there a signal for pedestrians? All ways ☐ Some ways ☐ None ☐

5b. If YES does the signal count down? All ways ☐ Some ways ☐ None ☐

6. Wait time ☐ (seconds) **7. Time to Cross** ☐ (seconds) **8. Crossing Distance** ☐ (feet)

9. Pedestrian Refuge Island ☑ None ☐ Yes, 4 ft or narrower ☐ Yes, wider than 4 ft

10. Curb ramps ☐ Missing one or more ramp ☑ All corners ramped

11. Intersection traffic calming features

Check all that apply.

TOTAL # 0

- ☐ *a) Raised crosswalks*
- ☐ *b) Pavement treatments*
- ☐ *c) Bike lane thru intersection*
- ☐ *d) Bulb-outs*
- ☐ *e) Diagonal diverter*
- ☐ *f) Partial closure*
- ☐ *g) Traffic calming circle*
- ☐ *h) Mini-circle*

12. Pedestrian Engineering Countermeasures

Check all that apply.

TOTAL # 0

- ☐ *a) Flashing beacon*
- ☐ *b) No Turn on Red Signs*
- ☐ *c) Additional signs*
- ☐ *d) Crosswalk scramble*
- ☐ *e) Red visibility curb*
- ☐ *f) Advanced stop/yield lines*
- ☐ *g) Pedestrian leading interval*

STREET SEGMENT

This street is: 23rd **between:** Dahlia **and:** Elm

Side A CNN: _____ *Side B CNN:* _____ *Street type:* _____

13. Number of lanes: ☐ Shared / pedestrian only street ☐ 1 ☑ 2 ☐ 3 ☐ 4+

14. Posted speed limit: ☐ 25 mph / none posted ☐ Under 25 mph ☑ Over 25 mph

15. Street traffic calming features

Check all that apply.

TOTAL # 0

- ☐ *a) Trees in median*
- ☐ *b) Speed hump / bump*
- ☐ *c) Speed enforcement*
- ☐ *d) Protected bike lane*
- ☐ *e) Chicane*

Please indicate whether Side A and Side B are North, South, East, or West relative to the street centerline.	SIDE A (N) / S / E / W	SIDE B N / (S) / E / W
*For questions 16-22 you will select one answer for **each** side of the street*		
16. Continuous sidewalk	No ☐ Yes ☑	Yes ☑ No ☐
17. Width of sidewalk *(if no sidewalk, skip #17-20, this side)*	Less than 5 ft ☐ 5 ft to 8 ft ☐ 8 ft to 12 ft ☐ 12 ft or more ☑	☐ Less than 5 ft ☐ 5 ft to 8 ft ☐ 8 ft to 12 ft ☑ 12 ft or more *(if no sidewalk, skip #17-20, this side)*
18. Width of throughway *The throughway is the part without furniture, signs, plantings, newspaper or utility boxes.*	Less than 4 ft ☐ 4 ft to 6 ft ☑ 6 ft to 8 ft ☐ 8 ft or more ☐	☐ Less than 4 ft ☑ 4 ft to 6 ft ☐ 6 ft to 8 ft ☐ 8 ft or more
19. Large sidewalk obstructions: *An obstruction is any object in the throughway.*	None ☑ Temporary ☐ Permanent ☐	☑ None ☐ Temporary ☐ Permanent
20. Sidewalk impediments: *Anything that poses a tripping hazard.*	None ☑ Minor ☐ Significant ☐	☑ None ☐ Minor ☐ Significant
21. Trees	None ☐ Sporadically lined ☑ Continuously lined ☐	☐ None ☑ Sporadically lined ☐ Continuously lined
22. Driveway cuts	☐ None ☑ 1-5 ☐ > 5	☐ None ☑ 1-5 ☐ > 5
For questions 23-26, check Yes or No on each side:	Yes No	Yes No
23. Presence of buffers *Check all that apply.*	Non-peak parallel parking ☑ ☐ Parallel parking ☑ ☐ Bike lane ☐ ☐	☑ ☐ Non-peak parallel parking ☑ ☐ Parallel parking ☐ ☐ Bike lane
24. Planters and gardens	☑ ☐	☑ ☐
25. Public seating	☐ ☑	☐ ☑
26. Public art/historical sites	☐ ☑	☐ ☑
For questions 27-28, select one answer for each side of the street:		
27. Retail use and public places *Retail that covers an entire block counts as three or more.*	None ☑ 1 or 2 ☐ 3 or more ☐	☑ None ☐ 1 or 2 ☐ 3 or more
28. Pedestrian-scale lighting	None ☑ Sporadic ☐ Continuous ☐	☑ None ☐ Sporadic ☐ Continuous
For questions 29-31, check Yes or No on each side:	Yes No	Yes No
29. Illegal graffiti *Select NO if there is only a little*	☐ ☑	☐ ☑
30. Litter *Select NO if there is only a little*	☐ ☑	☐ ☑
31. Empty spaces *Check all that apply*	☐ ☑ Abandoned buildings ☐ Vacant lots ☐ Parking lots ☐ Construction sites ☐	☐ ☑ ☐ Abandoned buildings ☐ Vacant lots ☐ Parking lots ☐ Construction sites

This street is: 23rd between: Dahlia and: Elm

For questions 32-36, please circle the number that your team thinks best describes this street.

32. Street segment is visually attractive for walking.	Strongly disagree 1	Disagree 2	Neutral 3	Agree 4	Strongly agree (5)
33. Street segment feels safe for walking.	Strongly disagree 1	Disagree 2	Neutral 3	Agree 4	Strongly agree (5)
34. Are there obvious strong odors anywhere on this street segment (e.g. vehicle exhaust, urine stench, rotting garbage, etc.)?	A lot of odors 1	Some odors 2	A little odor 3	No odor (4)	Only good odors 5

35. On a scale of 1 to 10, how walkable do you find this street segment?

Not walkable 1 2 3 4 5 6 7 8 9 (10) Very Walkable

Notes & Questions:

Pedestrian Environmental Quality Index (PEQI)

Street & Intersection Audit Form

Date entered into database: ___/___/___

Project: Arterials **Survey Date:** Oct 24 /2013

Auditor(s): Nick Farro

INTERSECTION

This is the intersection of: 23rd **and:** Elm

(The street you plan to walk down) (The street you will cross)

Intersection CNN: _____

Are these two lane or one lane streets and alleys? **Yes** ☑ **No** ☐ Street type Neighborhood Re

1. Crosswalks — All ways ☑ | 1 missing ☐ | 2 missing ☐ | 3 missing ☐ | None ☑

2. High visibility crosswalks — ☐ | ☐ | ☐ | ☐ | ☑

3. Intersection lighting — 4+ streetlights ☐ | 3 streetlights ☐ | 2 streetlights ☑ | 1 streetlight ☐ | None ☐

4. Traffic Control — Traffic Signal ☑ | Stop All Way ☐ | Yield (no roundabout) ☐ | Roundabout ☐ | Uncontrolled ☐

Skip questions 5-8 unless there is a traffic signal

5a. Is there a signal for pedestrians? All ways ☑ | Some ways ☐ | None ☐

5b. If YES does the signal count down? All ways ☐ | Some ways ☑ | None ☐

6. Wait time 50 (seconds) **7. Time to Cross** 10 (seconds) **8. Crossing Distance** 27 (feet)

9. Pedestrian Refuge Island ☑ None ☐ Yes, 4 ft or narrower ☐ Yes, wider than 4 ft

10. Curb ramps ☐ Missing one or more ramp ☑ All corners ramped

11. Intersection traffic calming features

Check all that apply.

TOTAL # 0

- ☐ *a) Raised crosswalks*
- ☐ *b) Pavement treatments*
- ☐ *c) Bike lane thru intersection*
- ☐ *d) Bulb-outs*
- ☐ *e) Diagonal diverter*
- ☐ *f) Partial closure*
- ☐ *g) Traffic calming circle*
- ☐ *h) Mini-circle*

12. Pedestrian Engineering Countermeasures

Check all that apply.

TOTAL # 0

- ☐ *a) Flashing beacon*
- ☐ *b) No Turn on Red Signs*
- ☐ *c) Additional signs*
- ☐ *d) Crosswalk scramble*
- ☐ *e) Red visibility curb*
- ☐ *f) Advanced stop/yield lines*
- ☐ *g) Pedestrian leading interval*

STREET SEGMENT

This street is: 23rd **between:** Eudora **and:** Fairfax

Side A CNN: _____ *Side B CNN:* _____ *Street type:* _____

13. Number of lanes: ☐ Shared / pedestrian only street ☐ 1 ☑ 2 ☐ 3 ☐ 4+

14. Posted speed limit: ☐ 25 mph / none posted ☐ Under 25 mph ☑ Over 25 mph

15. Street traffic calming features

Check all that apply.

TOTAL # 0

- ☐ *a) Trees in median*
- ☐ *b) Speed hump / bump*
- ☐ *c) Speed enforcement*
- ☐ *d) Protected bike lane*
- ☐ *e) Chicane*

Please indicate whether Side A and Side B are North, South, East, or West relative to the street centerline.

SIDE A (N) / S / E / W

SIDE B N / (S) / E / W

*For questions 16-22 you will select one answer for **each** side of the street*

	SIDE A	SIDE B
16. Continuous sidewalk	☐ No ☑ Yes	☑ Yes ☐ No
17. Width of sidewalk *(if no sidewalk, skip #17-20, this side)*	☐ Less than 5 ft ☐ 5 ft to 8 ft ☐ 8 ft to 12 ft ☑ 12 ft or more	☐ Less than 5 ft ☐ 5 ft to 8 ft ☐ 8 ft to 12 ft ☑ 12 ft or more *(if no sidewalk, skip #17-20, this side)*
18. Width of throughway *The throughway is the part without furniture, signs, plantings, newspaper or utility boxes.*	☐ Less than 4 ft ☑ 4 ft to 6 ft ☐ 6 ft to 8 ft ☐ 8 ft or more	☐ Less than 4 ft ☑ 4 ft to 6 ft ☐ 6 ft to 8 ft ☐ 8 ft or more
19. Large sidewalk obstructions: *An obstruction is any object in the throughway.*	☑ None ☐ Temporary ☐ Permanent	☐ None ☑ Temporary ☐ Permanent
20. Sidewalk impediments: *Anything that poses a tripping hazard*	☑ None ☐ Minor ☐ Significant	☐ None ☑ Minor ☐ Significant
21. Trees	☐ None ☑ Sporadically lined ☐ Continuously lined	☐ None ☑ Sporadically lined ☐ Continuously lined
22. Driveway cuts	☐ None ☑ 1-5 ☐ > 5	☐ None ☑ 1-5 ☐ > 5

For questions 23-26, check Yes or No on each side:

	SIDE A Yes	SIDE A No	SIDE B Yes	SIDE B No
23. Presence of buffers *Check all that apply.*	☑	☐	☑	☐
Non-peak parallel parking	☑		☑	
Parallel parking	☑		☑	
Bike lane	☐		☐	
24. Planters and gardens	☑	☐	☑	☐
25. Public seating	☐	☑	☐	☑
26. Public art/historical sites	☐	☑	☐	☑

For questions 27-28, select one answer for each side of the street:

	SIDE A	SIDE B
27. Retail use and public places *Retail that covers an entire block counts as three or more.*	☑ None ☐ 1 or 2 ☐ 3 or more	☑ None ☐ 1 or 2 ☐ 3 or more
28. Pedestrian-scale lighting	☑ None ☐ Sporadic ☐ Continuous	☑ None ☐ Sporadic ☐ Continuous

For questions 29-31, check Yes or No on each side:

	SIDE A Yes	SIDE A No	SIDE B Yes	SIDE B No
29. Illegal graffiti *Select NO if there is only a little*	☐	☑	☐	☑
30. Litter *Select NO if there is only a little*	☐	☑	☐	☑
31. Empty spaces	☐	☑	☐	☑
Abandoned buildings	☐		☐	
Vacant lots	☐		☐	
Parking lots	☐		☐	
Construction sites	☐		☐	

Check all that apply

This street is: **between:** **and:**

For questions 32-36, please circle the number that your team thinks best describes this street.

32. Street segment is visually attractive for walking.	Strongly disagree 1	Disagree 2	Neutral 3	Agree (4)	Strongly agree 5
33. Street segment feels safe for walking.	Strongly disagree 1	Disagree 2	Neutral 3	Agree (4)	Strongly agree 5
34. Are there obvious strong odors anywhere on this street segment (e.g. vehicle exhaust, urine stench, rotting garbage, etc.)?	A lot of odors 1	Some odors 2	A little odor 3	No odor (4)	Only good odors 5

35. On a scale of 1 to 10, how walkable do you find this street segment?

Not walkable 1 2 3 4 5 6 7 (8) 9 10 Very Walkable

Notes & Questions:

This intersection needs a little TLC. sidewalk needs to be repaired in front of a couple houses. Elm st. feels a little "incomplete"

Pedestrian Environmental Quality Index (PEQI)

Street & Intersection Audit Form

Date entered into database: ___/___/___

Project: Arterials **Survey Date:** Oct 24 2013

Auditor(s): Nick Fazio

INTERSECTION

This is the intersection of: 23rd (The street you plan to walk down) **and:** Fairfax (The street you will cross)

Intersection CNN: _____

Are these two lane or one lane streets and alleys? Yes ☑ No ☐ Street type Neighborhood Res

	All ways	1 missing	2 missing	3 missing	None
1. Crosswalks	☐	☐	☐	☐	☑
2. High visibility crosswalks	☐	☐	☐	☐	☑

	4+ streetlights	3 streetlights	2 streetlights	1 streetlight	None
3. Intersection lighting	☐	☐	☐	☑	☐

	Traffic Signal	Stop All Way	Yield (no roundabout)	Roundabout	Uncontrolled
4. Traffic Control	☐	☐	☐	☐	☑

Skip questions 5-8 unless there is a traffic signal

5a. Is there a signal for pedestrians? All ways ☐ Some ways ☐ None ☐

5b. If YES does the signal count down? All ways ☐ Some ways ☐ None ☐

6. Wait time ☐ (seconds) 7. Time to Cross ☐ (seconds) 8. Crossing Distance ☐ (feet)

9. Pedestrian Refuge Island ☑ None ☐ Yes, 4 ft or narrower ☐ Yes, wider than 4 ft

10. Curb ramps ☐ Missing one or more ramp ☑ All corners ramped

11. Intersection traffic calming features
Check all that apply.
TOTAL # 0

- ☐ *a) Raised crosswalks*
- ☐ *b) Pavement treatments*
- ☐ *c) Bike lane thru intersection*
- ☐ *d) Bulb-outs*
- ☐ *e) Diagonal diverter*
- ☐ *f) Partial closure*
- ☐ *g) Traffic calming circle*
- ☐ *h) Mini-circle*

12. Pedestrian Engineering Countermeasures
Check all that apply.
TOTAL # 0

- ☐ *a) Flashing beacon*
- ☐ *b) No Turn on Red Signs*
- ☐ *c) Additional signs*
- ☐ *d) Crosswalk scramble*
- ☐ *e) Red visibility curb*
- ☐ *f) Advanced stop/yield lines*
- ☐ *g) Pedestrian leading interval*

STREET SEGMENT

This street is: 23rd **between:** Elm **and:** Forest

Side A CNN: _____ *Side B CNN:* _____ *Street type:* _____

13. Number of lanes: ☐ Shared / pedestrian only street ☐ 1 ☑ 2 ☐ 3 ☐ 4+

14. Posted speed limit: ☐ 25 mph / none posted ☐ Under 25 mph ☑ Over 25 mph

15. Street traffic calming features
Check all that apply.
TOTAL # 0

- ☐ *a) Trees in median*
- ☐ *b) Speed hump / bump*
- ☐ *c) Speed enforcement*
- ☐ *d) Protected bike lane*
- ☐ *e) Chicane*

Please indicate whether Side A and Side B are North, South, East, or West relative to the street centerline.

SIDE A (N) / S / E / W

SIDE B N / (S) / E / W

*For questions 16-22 you will select one answer for **each** side of the street*

	SIDE A	SIDE B
16. Continuous sidewalk	☐ No ☑ Yes	☑ Yes ☐ No
17. Width of sidewalk *(if no sidewalk, skip #17-20, this side)*	☐ Less than 5 ft ☐ 5 ft to 8 ft ☐ 8 ft to 12 ft ☑ 12 ft or more	☐ Less than 5 ft ☐ 5 ft to 8 ft ☐ 8 ft to 12 ft ☑ 12 ft or more *(if no sidewalk, skip #17-20, this side)*
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20. Sidewalk impediments: *Anything that poses a tripping hazard.*	☐ None ☑ Minor ☐ Significant	☐ None ☑ Minor ☐ Significant
21. Trees	☐ None ☑ Sporadically lined ☐ Continuously lined	☐ None ☑ Sporadically lined ☐ Continuously lined
22. Driveway cuts	☐ None ☑ 1-5 ☐ > 5	☐ None ☑ 1-5 ☐ > 5

For questions 23-26, check Yes or No on each side:

	SIDE A Yes	SIDE A No	SIDE B Yes	SIDE B No
23. Presence of buffers *Check all that apply.*	☑	☐	☑	☐
Non-peak parallel parking	☑		☑	
Parallel parking	☑		☑	
Bike lane	☐		☐	
24. Planters and gardens	☑	☐	☑	☐
25. Public seating	☐	☑	☐	☑
26. Public art/historical sites	☐	☑	☐	☑

For questions 27-28, select one answer for each side of the street:

	SIDE A	SIDE B
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For questions 29-31, check Yes or No on each side:

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30. Litter *Select NO if there is only a little*	☐	☑	☐	☑
31. Empty spaces	☐	☑	☐	☑
Abandoned buildings	☐		☐	
Vacant lots	☐		☐	
Parking lots	☐		☐	
Construction sites	☐		☐	

Check all that apply

This street is:	between:	and:

For questions 32-36, please circle the number that your team thinks best describes this street.

32. Street segment is visually attractive for walking.	Strongly disagree 1	Disagree 2	Neutral 3	Agree (4)	Strongly agree 5
33. Street segment feels safe for walking.	Strongly disagree 1	Disagree 2	Neutral 3	Agree (4)	Strongly agree 5
34. Are there obvious strong odors anywhere on this street segment (e.g. vehicle exhaust, urine stench, rotting garbage, etc.)**?**	A lot of odors 1	Some odors 2	A little odor 3	No odor (4)	Only good odors 5

35. On a scale of 1 to 10, how walkable do you find this street segment?

Not walkable — Very Walkable

1 2 3 4 5 6 7 (8) 9 10

Notes & Questions:

Sidewalk needs repairs in some sections.

Traffic moving faster on these part of the street than closer to Dexter.

16. STAKEHOLDER INFORMATION LETTER

PI Wesley Marshall

University of Colorado Denver

DENVER NEIGHBORHOOD CONNECTIONS SURVEY

Denver Neighborhood Connections
Survey Summary

The Livable Arterials Study

The Denver Neighborhood Connections Survey is one of the key elements of a wider *Livable Arterials* project being conducted by researchers at the University of Colorado Denver. The aim of the study is to better understand how arterial streets – those with fast and heavy traffic – impact local neighborhoods around Denver. In addition to the survey, the project will also look at design features, traffic speeds, and other built environment features of Denver streets.

Description of Survey

The Denver Neighborhood Connections Survey takes about ten to fifteen minutes to complete. The Survey asks residents to answer questions about their neighborhood, their travel patterns, their local street, and about an arterial street located near their residence. The survey asks questions about how residents use their streets and about their opinions and perceptions of their neighborhood.

Where the Survey will be Conducted

The survey will be conducted door-to-door in neighborhoods that are near major streets in ten areas of Denver. A map of the study areas is provided on the back of this page.

Study areas include:

1. South University Blvd. between Exposition Ave. and Ohio Ave.
2. East 23rd Ave. between Cherry St. and Dexter St.
3. South Broadway St. between 1st Ave. and Bayaud Ave.
4. 44th Ave. between Meade St. and King St.
5. South Holly St. between Ivanhoe Way and Gunnison Pl.
6. East Colfax Ave. between Elm St. and Forest St.
7. South Colorado Blvd. between Louisiana Ave. and Mexico Ave.
8. Broadway St. between 8th Ave. and 12th Ave.
9. Santa Fe Dr. between 12th Ave. and 7th Ave.
10. East Colfax Ave. between York St. and Cook St.

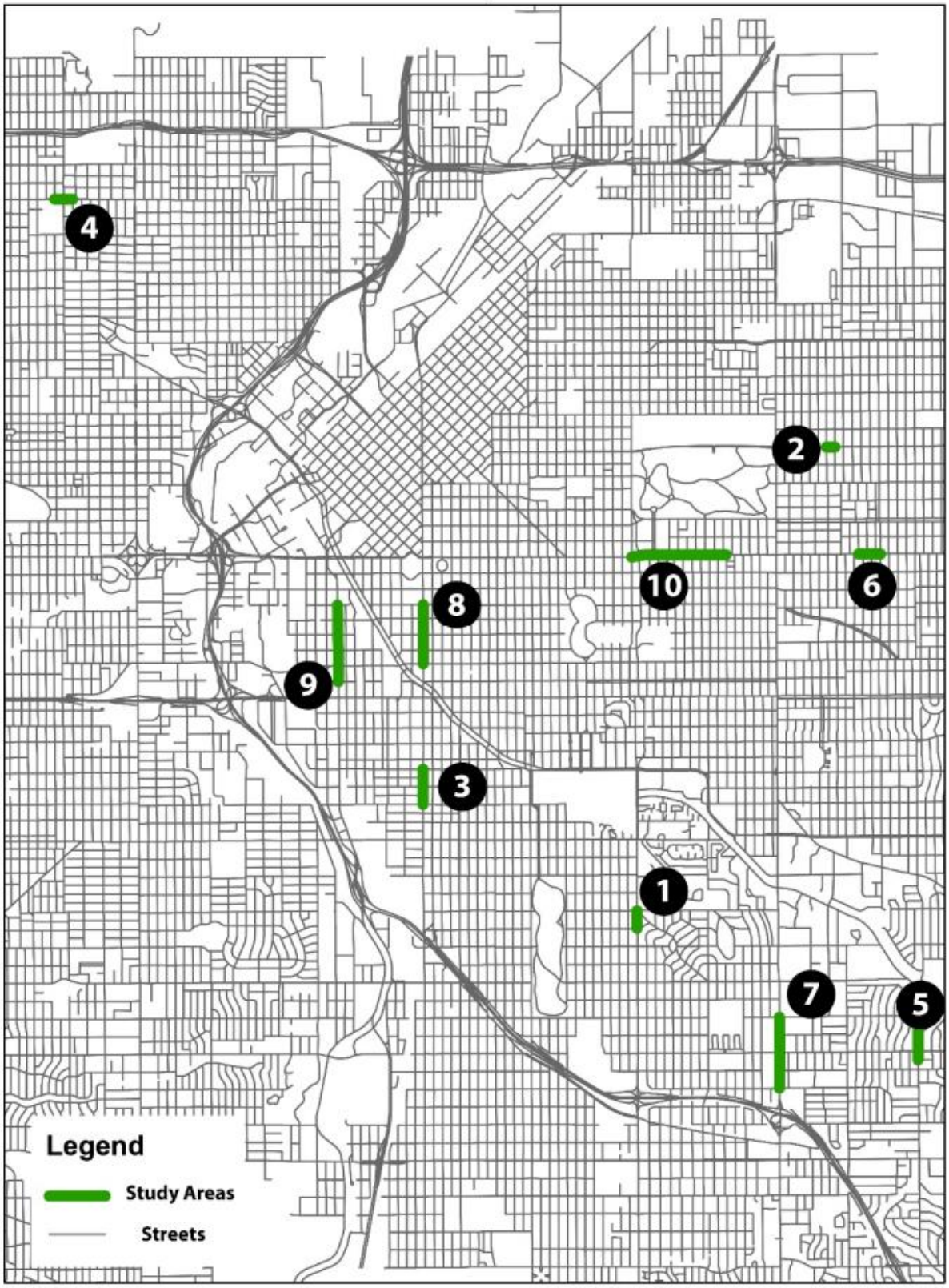
How Neighborhoods were Selected

These residential neighborhoods were selected because they are located near arterial streets with some existing commercial development. We chose arterial streets with a variety of features, such as varying levels of traffic, speeds, and design features such as sidewalks, road widths, and street trees. The intent is to better understand how these different characteristics might influence the way that nearby residents perceive their streets as well as how they use them or choose not to use them.

Expected Findings:

After the survey, we expect to see some connections between street characteristics and how residents report using the streets and how residents' feel about their local streets. For example, we may see that residents are more likely to walk to a nearby commercial area if there are wide sidewalks available. Findings from the study could help create streets that serve many users comfortably, safely, and efficiently.

Study Areas



STREET VITALITY AND URBAN DESIGN

University of Colorado Denver

Craig Fisher, craigmf05@gmail.com, 303.819.5204, Research Assistant, Master's in Urban and Regional Planning Candidate
Laia Mitchel, laiacmitchel@gmail.com, Research Assistant, Master's in Urban and Regional Planning Candidate
Carey McAndrews *PhD, MCP, MS,* carolyn.mcandrews@ucdenver.edu, Assistant Professor, College of Architecture and Planning, University of Colorado Denver
Wesley Marshall, *PhD, PE,* wesley.marshall@ucdenver.edu, Assistant Professor, Civil Engineering Transportation, University of Colorado Denver

Denver Neighborhood Connections

INTRODUCTION

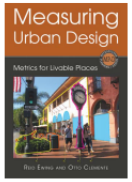
Note: This is a subset of a larger study exploring the following: Does the livability of a residential street depend on the characteristics of the neighboring street network?

Is it possible to accommodate large amounts of fast traffic on commercial-lined arterial roads, while also creating an intimate, vibrant streetscape along the arterial for pedestrians to safely enjoy? Many neighborhood serving commercial districts in Denver lie on major arterial roads. These arterial roads are designed to accommodate large amounts of traffic at high speeds. Meanwhile can an energetic, vibrant, and pedestrian friendly commercial district survive amidst all the traffic? My study looks at the correlation between high traffic arterial roadways and the vibrancy of the adjacent commercial district, and seeks to answer the following questions:

- Can effective, good urban design mitigate the nuances caused by high traffic and result in a safe, inviting, in interesting, economically solvent place?
- How can urban design be measured without subjective bias?
- Is a commercial lined arterial with god urban design better off than a similar commercial lined arterial with bad urban design?
- How does the design of the arterial affect nearby eris dents?

An example of a commercial lined arterial: Santa Fe Drive, Denver, Colorado.

URBAN DESIGN PRINCIPLES



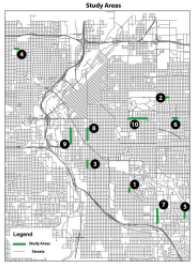
To objectively quantify the urban design characteristics of a commercial lined arterial street various methodologies were explored before settling on the principles and measurement tools outlined in Measuring Urban Design by Reid Ewing and Otto Clemente. Measuring Urban Design, published in 2013 by Island Press outlines basic urban design features that "are presumed to intervene between physical features and behavior, encouraging people to walk." (1) Their methodology for measuring urban design is divided into the following five categories:

- **Imageability**: The quality of a place that makes it distinct, recognizable, and memorable.
- **Enclosure**: The degree to which streets and other public spaces are visually defined by buildings, walls, trees, and other vertical ele ments.
- **Human Scale**: The size, texture, and articulation of physical elements that match the size and proportions of humans, and equally important, correspond to the speed at which humans walk.
- **Transparency:** The degree to which people can see or per ceive what lies beyond the edge of a street or other public space and, more specifically the degree to which people can see or perceive human activity beyond the edge of a street or other public space.
- **Complexity:** The visual richness of a place. (1)

SITE SELECTION

Each of the sites is centered on commercial lined arterial roadways in the City and County of Denver. To narrow down the list of study areas a variety of environmental data, and socio-economic data was explored including: medium household income, annual average daily traffic(AADT), education level, and urban design characteristics. Census blocks adjacent to each of the arterials were examined to find at least one arterial that fell into one of the eight available areas, as illustrated in the following matrix:

	High Traffic	Low Traffic
High Urban Design	1. High Income	2. High Income
	3. Low Income	4. Low Income
Low Urban Design	5. High Income	6. High Income
	7. Low Income	8. Low Income



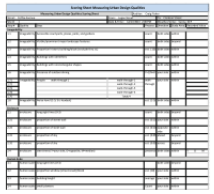
	AADT	Median Household Income
1. University Boulevard Exposition Avenue to Ohio Avenue	38418	$133,825.50
2. 23rd Avenue Cherry Street to Dexter Street	6203	$104,479.00
3. Broadway 8th Avenue to 12th Avenue	35750	$65,893.00
4. 44th Avenue Meade Street to King Street	6200	$46,239.50
5. Holly Street Ivanhoe Place to Gunnison Way	13214	$53,516.25
6. Colfax Avenue Elm Street to Forest Street	25000	$81,274.50
7. Colorado Boulevard Louisiana Avenue to Mexico Avenue	62493	$66,334.00
8. Broadway 1st Avenue to Bayaud Avenue	35259	$39,503.75
9.Santa Fe Drive 7th Avenue to 12th Avenue	12700	$27,021.00
10. Colfax Avenue York Street to Cook Street	30000	$43,418.60

The site locations are highlighted in green in the above map, and the extent of each are is outlined in the table to the right. Select data is also provided for each of the ten study areas.

DATA AND METHODS

Environmental data was provided by the City and County of Denver. Social and economic data was taken from the 2010 American Community Survey(ACS). ACS data was analyzed for census blocks adjacent to each study area. In some cases multiple (up to four) census blocks touched the study area. In those cases an average of the data was computed to see the statistics for the area.

To compute the urban design score the 'Scoring Sheet Measuring Urban Design Qualities' in Ewing and Clemente's book Measuring Urban Design was utilized. Instructions for completing the analysis as outlined in the book were closely followed to ensure accuracy and an unbiased score was computed. An example of page 1 of the four page worksheet is pictured to the left.



RESULTS

	Imageability Score	Enclosure Score	Human Scale Score	Transparency Score	Complexity Score	Total Score
1. University Boulevard Exposition Avenue to Ohio Avenue	3.0	0.8	3.35	3.7	7.3	**21.06**
2. 23rd Avenue Cherry Street to Dexter Street	5.6	1.4	2.5	3.7	4.1	**17.4**
3. Broadway 8th Avenue to 12th Avenue	0.5	1.5	2.5	4.1	7	**15.6**
4. 44th Avenue Meade Street to King Street	5.0	-0.5	1.6	2.1	7.2	**16.4**
5. Holly Street Ivanhoe Place to Gunnison Way	2.0	-0.8	0.3	1.7	4.4	**8.5**
6. Colfax Avenue Elm Street to Forest Street	5	0.2	2.1	3.7	6.8	**17.9**
7. Colorado Boulevard Louisiana Avenue to Mexico Avenue	0.8	0.4	1.9	2.9	5.8	**10.7**
8. Broadway 1st Avenue to Bayaud Avenue	4.1	1.5	1.7	3	6.9	**17**
9.Santa Fe Drive 7th Avenue to 12th Avenue	5.6	2.6	2.3	3.7	11	**25.2**
10. Colfax Avenue York Street to Cook Street	3.6	0.8	1.7	2.9	7.8	**16.7**

The results of the analysis are illustrated in the table above. Study area 9, or the Santa Fe Drive area scored the highest, with University Boulevard, or study area 1 coming in a close second. Study area 5, Holly Street received the lowest score with Colorado Boulevard, or study area 7 receiving the second lowest score. The average score received was 16.6, with a range of 16.7.

Study area 2, along 23rd Avenue.

FUTURE STEPS

To complete this portion of the study pedestrian counts will be manually conducted at each of the ten study areas. Pedestrians will be counted for 2 hours in each study area during the same time of day on a weekday Monday through Friday. Counting the number of pedestrians present will provide us with a accurate measure of street vitality. Will areas with a high urban design score receive a high pedestrian count? Will the inverse be also true, will areas receiving a low urban design score have a low pedestrian count?

As mentioned this is a subset of a larger study being conducted by professors Carey McAndrews, Wesley Marshall, and assistant researchers Laia Mitchell, and Craig Fisher of the University of Colorado Denver. The larger study will include an in depth survey of residents living near each of the study areas to learn how they use and perceive their nearby commercial lined arterial road. Will the opinions and views of local residents match the urban design score?

References

1. Ewing, Reid, and Otto Clemente. Measuring Urban Design, Metrics for Livable Places. 2013 Island Press.

GIS Data: City and County of Denver Open GIS Catalog. http://data.denvergov.org/

MEASURE! -- Perceptions -- View points – Feelings – Opinions – Thoughts – Impressions – MEASURE! -- Attitudes -- Ideas – Frustrations – Reactions – Outlooks -- Uses – MEASURE! – Beliefs – Convictions – Choices – Behaviors – Emotions – Concerns – MEASURE!

University of Colorado Denver

Measuring the Livability of Streets: Neighborhood Surveys

Laia C. Mitchell, Masters of Urban Planning Student Research Assistant
as part of *Livable Arterials Research Team* with Dr. Carey McAndrews PhD, MCP, MS;
Dr. Wes Marshall PhD, PE; and Craig Fisher, Masters of Urban Planning Student Research Assistant

Denver Neighborhood Connections

Surveys in Transportation

What Types of Surveys?
- By phone, mail or in person
- Self-administered or directed
- Open-ended or closed questions
- Travel diaries
- Maps or interactive features
- Behavior, perception, opinion
- Polling focus

Why Conduct a Survey?
- Discover correlations between built environment and reported behavior
- Discover correlations between perception and behavior
- Get local, context-specific data
- Capture qualitative stories and experiences
- Capture opinions of under-represented groups
- Test the willingness for new innovations or taxes

Who conducts Transportation Surveys?
- National Household Travel Survey- FHWA
- Census (vehicle ownership, commute)
- Academic research
- Foundations/ Non-profits
- Municipal agencies – Public Works, Planning Departments
- State/Regional Council of Governments

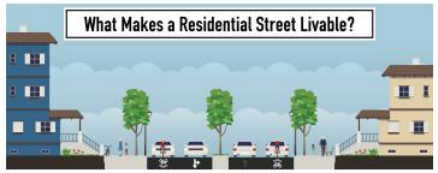
Factors to consider:
- Geographic scope
- Content scope
- Length/time of Survey
- Incentives
- Target audience/ population
- Sampling methods
- Cost

Defining Livability

Six Livability features were defined in 2009 by HUD-DOT-EPA as part of the Partnership for Sustainable Communities:
- Provide more Transportation Options
- Promote Equitable Affordable Housing
- Enhance Economic Competitiveness
- Support Existing Communities
- Coordinate and Leverage Federal Policies and Investments
- Value Communities and Neighborhoods

Livability and Street Design

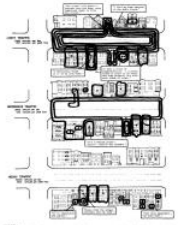
Sidewalk width? Traffic noise? Transit options? Traffic speeds? Traffic volume? Street trees? Parking? Vibrant atmosphere? Clean/No trash? Friendly neighbors? Walkable? Close to school/work? Bikeable? Adequate lighting? Close to Parks? Quiet/Calm? Feels safe?



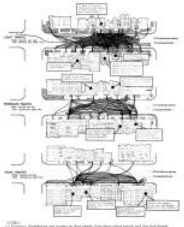
Using Surveys to Measure Livability – Appleyard and Beyond

In the 1970s Donald Appleyard of UC Berkeley conducted residential surveys to examine if traffic volumes impacted the social cohesion and livability of three parallel streets with low, medium and high traffic levels. He found that social interaction, sense of home territory, and perceptions of livability were all impacted by increased traffic.

Reported Feeling of Home Territory

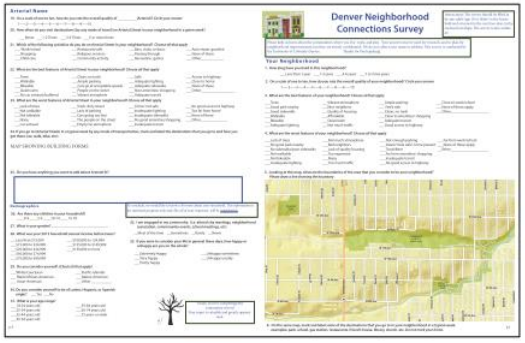


Reported Social Connections



Examples of other research examining livable streets:
- Koorey, G., Leckie, A., & Chesterman, R. Assessing the Environmental Capacity of Local Residential Streets. (2013).
- Bosselmann, Peter, Elizabeth Macdonald, and Thomas Kronemeyer. "Livable streets revisited." *Journal of the American Planning Association* 65.2 (1999): 168-180.
- Ben-Joseph, Eran. "Residential Street Standards and Neighborhood Traffic Control: A Survey of Cities' Practices and Public Officials' Attitudes." (1995).
- The Denver Livable Arterials Study, currently being conducted:

The *Livable Arterials Study*, conducted by researchers at the University of Colorado Denver, revisits the work of Donald Appleyard by examining how environmental features, design features, and traffic volumes affect Denver streets. The aim of the study is to better understand how arterial streets – those with fast and heavy traffic – impact local neighborhoods around Denver. The study incorporates the residential survey with an examination of design features, traffic speeds, and other built environment features of Denver streets. Findings from the study could help create streets that serve many users comfortably, safely, and efficiently.



The Denver Neighborhood Connections Survey

Description of Survey

The Denver Neighborhood Connections Survey is a key element of the *Livable Arterials Project* and will be conducted in Denver in 2014. The survey asks residents about their neighborhood, their travel patterns, their local street, and about an arterial street located near their residence. The survey asks about how residents use their streets and about their opinions and perceptions of their neighborhood. The Denver Neighborhood Connections Survey takes about ten to fifteen minutes to complete. The neighborhoods in our study areas were selected because they are located near arterial streets with some existing commercial development. Study areas include:

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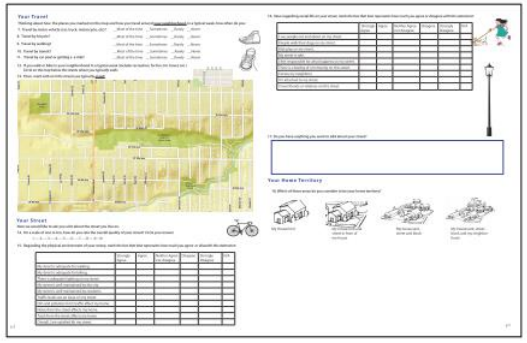
East 23rd Ave. between Cherry St. and Dexter St.
South Broadway St. between 1st Ave. and Bayaud Ave.
44th Ave. between Meade St. and King St.
South Holly St. between Ivanhoe Way and Gunnison Pl.
East Colfax Ave. between Elm St. and Forest St.
South Colorado Blvd. between Louisiana Ave. and Mexico Ave.
Broadway St. between 8th Ave. and 12th Ave.
Santa Fe Dr. between 12th Ave. and 7th Ave.
East Colfax Ave. between York St. and Cook St.

Expected Findings

After the survey, we expect to see some connections between street characteristics and how residents report using the streets and how residents' feel about their local streets. For example, we may see that residents are more likely to walk to a nearby commercial area if there are wide sidewalks available. Findings from the study could help create streets that serve many users comfortably, safely, and efficiently.



MEASURE! -- Perceptions -- View points – Feelings – Opinions – Thoughts – Impressions – MEASURE! -- Attitudes -- Ideas – Frustrations – Reactions – Outlooks -- Uses – MEASURE! – Beliefs – Convictions – Choices – Behaviors – Emotions – Concerns – MEASURE!