Arapahoe County Parking Utilization Study

Concerning Residential Transit Oriented Development

Christopher A. Topp

University of Colorado Denver
School of Public Affairs

Committee Members:

Dr. George Busenberg
Instructor and Advisor
University of Colorado Denver

Dr. Chris Weible
Second Reader
University of Colorado Denver

Mr. Ronald Hovland
Client Representative
Arapahoe County Department
of Public Works and Development

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Executive Summary

The 3rd edition of *Parking Generation* provides parking demand data for 171 distinct land uses. While this amount seems mind-boggling, Donald Shoup, a respected authority on parking identifies an astounding 662 distinct land uses interweaved into the American Landscape. Given the shear number of different land uses, basing supply requirements on land use may ultimately be an exercise in futility as evidenced by the predominance of parking oversupply throughout the nation. As this research will show, demand is determined by combination of factors impacting each land use. These factors include general development and demographic characteristics such as the number of bedrooms in each unit and housing tenure--whether units are occupied by the owner or a renter. Incorporating these variables into supply considerations increases potential parking efficiency while maintaining a broad applicability appropriate for local development code. Additionally, demand for parking transit oriented developments is influenced strongly by factors such as density and design. Potentially placing significant downward pressure on demand, indivudal site characteristics should be considered on a case by case basis. For local code requirements to serve as effective regulatory tool, understanding the relationship between parking and development is key.

Introduction

This project explores the parking supply for residential transit oriented developments within Arapahoe County, Colorado as impacted by land use regulations. While the subject of parking often lacks the glamour of other issues on the public agenda, the economic and environmental impact of parking is both pervasive and widespread. To put this claim in perspective, consider the following: to provide ample parking for each of the 250 million cars in the United States, Americans devote land equal in size to the state of Connecticut (Shoup, The HIgh Cost of Free Parking 2005). As the cost of parking is often free for end users, management of parking often falls into the public domain, functionally regulated by local land development code instead of controlled by market forces. These codes generally specify a parking supply requirement dependant on a variable characteristic of a respective land use. For example, commercial development requirements express supply in terms of spaces per square retail foot. *Parking Generation,* a manual published by the Institute of Transportation Engineers (ITE), serves as the primary resource available local planners attempting to determine appropriate supply requirements. Currently in its third edition, *Parking Generation* is a compilation of national parking utilization studies, reporting demand data for specific land uses.

The body of literature on parking indicates a complex web of factors contributing to parking demand, suggesting that defining requirements with respect to land use may over-simply the process, resulting in false estimations of future parking demand. Understanding the contributing factors, as opposed to defining the end product (land-use) is key to balancing the supply and demand relationship. Given the complexity of the subject, local jurisdictions have neither the time nor the resources to devote to this issue in the absence of large sums of grant money or the attentions of an overly ambitious graduate student. Therein lies the goal of this project. The goal is to establish a framework for calculating existing appropriate supply requirements based on demand generating factors rather than individual land use. This will enhance the ability of local officials to correctly set supply requirements at an efficient level. It seeks to achieve several objectives:

» Review and summarize existing studies to outline the benefits associated with reduced requirements relative to the objectives of the Arapahoe County Comprehensive

Development Plan.

» Observe and determine existing demand at two residential developments within Arapahoe County to identify potential oversupply, and compare the results to other similar studies.

» Characterize each site in terms of the factors that contribute to observed demand, identifying those with significant correlation. Report identified factors in terms of potential impact.

These objectives will provide guidance in answering the overall research question: does the combination of observed parking demand ratios and demographic data related to auto ownership and transit mode choice characteristics warrant an adjustment of zoning requirements in Arapahoe County? After providing an overview of the background for the project and briefly reviewing key elements within the literature, the study is divided into two parts. First, existing demand is determined through physical observations parking space utilization at 2 residential developments. The second part involves the identification of factors contributing to the observed demand at these developments.

The conclusion reports observed demand ratios indicating the existence of parking oversupply at two residential developments in Arapahoe County, with supply exceeding demand by thirty percent. These findings are consistent with those of similar studies conducted elsewhere. The process of identifying key demand generating variables reveals that an analysis these variables using national data sets is the best method for exploring relationships at the national, state and county level revealing both housing tenure and the number of bedrooms in each unit as those with the greatest potential to influence demand at this scale. However, individual site characteristics such as density and distance to transit facilities can potentially play an equally important role. Considering these factors on a case by case basis will enhance the potential for creating a balance between supply and demand.

Background

This study targets two residential developments within Arapahoe County, Colorado, specifically located adjacent to light rail stations. Defined as transit oriented developments, or TOD, these sites are identified by mixed use, compact development and are becoming

increasingly popular. The demand growth of transit oriented developments provides the basis for this research as it allows the county a unique opportunity to better understand the forces that will shape future development pattern.

Arapahoe County Land Development

The Arapahoe County Comprehensive Development Plan serves as a blueprint for the county's future with respect to land development and growth. Last updated in 2001, the plan establishes objectives in 8 areas including growth management, neighborhoods and housing, transportation, natural and cultural resources and the environment and fiscal/ economic impacts (Arapahoe County 2001). The vision outlined for each categories is broad. For example, with respect to "neighborhoods and housing" the county intends that "in the future, both new and existing neighborhoods should contain a mix of land uses…as well as a mix of houses. The arrangement of land uses within neighborhoods should allow residents to walk and bicycle to and from their daily activities and easily travel to nearby neighborhoods (Arapahoe County 2001, 77)." Direction takes form as policy directives and strategies specific to each area. Again using "neighborhoods and housing" to illustrate the point, the plan identifies the amendment of zoning code to allow for a mixture of housing densities in the urban growth area as a top priority for the county (Implementation Approach, Strategy NH1.2(a)).

Transit Oriented Developments

Arguably, the highly developed and more mature urban areas in the United States, such as New York, Chicago, Boston and Washington D.C. all share a common backbone—integrated mass transit. The subway, the "L", the "T" and the "Metro" as they are respectively nicknamed, allows people in each of those cities incredible mobility, in terms. Residents and visitors are not tethered to the automobile as a sole means of transportation as they are in urban areas characterized by homogenous, low-diversity development. By voting to fund FasTracks in 2004, Denver metro residents voiced their desire to better integrate mass transit into the urban infrastructure.

Transit Oriented Developments, or TODs, are the offspring of mass transit. They are developments that exhibit "appropriate building densities and land uses within walking

distance of transit stops, permitting public transit to become a viable alternative to the automobile" (Congress for the New Urbanism 2000, 101). The characteristics of TODs include:

» Development within a ½ mile radius of, or 10 minute walk to the station.

» Development patterns are mixed in use to include residential, commercial and business elements.

» A range of home styles and affordability aimed at increasing neighborhood diversity.

» Be built at density levels high enough to promote easy access to and from the station.

As the elements of transit oriented developments mirror the vision of future development outlined in the Arapahoe County Development Code, TOD developments are the target of this report. The potential impact with respect to future development in this area is immense. According to data compiled by the Denver Regional Council of Governments, there are 214 residential and mixed use TOD projects either planned or under construction in the Denver metro area along 9 transit corridors. Of those 9 corridors, 3 run through Arapahoe County and include 14 stations that exist currently or are under development. For Arapahoe County, transit oriented developments will be a key driver of future growth.

Figure 1 - Arapahoe County Light Rail Station Map

Regulating Parking Supply Through Local Development Code

The common denominator shared by the county's development plan and TOD is parking. Parking supply is referenced as the "crucial variable" that can be targeted by jurisdictions striving to achieve mixed use, compact communities. (Kuzmyak and Pratt 2003). Parking management, therefore is as an effective way to impact development patterns and transit

choices. (Evans IV and Pratt 2007). While there are a wide range of strategies employed to manage parking at the local level, from price controlling to transit based incentives, the most direct and applicable method with respect to this project involves the regulation of parking supply through building and zoning code (Kuzmyak and Pratt 2003).

The use of zoning ordinances as a method of regulating parking supply is a relatively simple matter. It involves determining and publishing the number of spaces required per unit of development (square feet, dwelling units etc). The problem with this process involves

Table 1- **Comparison of Existing Supply Requirements**	Arapahoe County Dev. Code	Wal-Mart ECR (CityCenter)	Residential Development Handbook	Parking Generation 3rd ed.
Guest Spaces	0.25	1.5	na	na
Efficiency	N/A	1.5	1.25	1
1 Bedroom	1.5	1.5	1.5	1.5
2 Bedroom	2	1.5	1.75	1.5
3 Bedroom	2	1.5	2	2
4 or more Bedroom	2.5	1.5	2	2

correctly ***estimating*** a demand ratio for each land use. As local jurisdictions lack the resources to establish collect the data necessary to establish demand baselines, planners often rely on the information disseminated by the Institute of Transportation Engineer's *Parking Generation* manual. The current iteration was released as the third edition in 2004. *Parking Generation* is primarily a database, synthesizing and reporting data from individual parking utilization studies across the country to provide an estimate of parking demand categorized by land use.

The method outlined by ITE to determine parking utilization involves physical observation of vehicles using a parking facility during a period identified as "peak demand." Peak demand periods vary by land use: it is often during Christmas at the mall, during dinner time at a restaurant or at night for residential sites. Observed totals from the peak demand period are expressed as a ratio to an independent variable for each land use. While straightforward , a deeper analysis of this process reveals several shortcomings. Respective criticism of this process is in no short supply (Shoup, The High Cost of Free Parking 2005; Wilson 2005). These authors identify several issues associated with using peak demand as the sole means to set

supply levels:

- For land uses that typically exhibit variations in seasonal demand, the peak demand is calculated using a design day. Often, the design day identified as the 5th busiest day each year. For this day, supply requirements are set at a level where maximum capacity would only be realized during the single busiest *hour*. In other words demand only equals regulated supply during the busiest hour on the five busiest days each year. Supply exceeds demand the other 8,755 hours.
- Studies referenced by McCourt (2004) indicate that users perceive a parking lot as full when it reaches 90% capacity, noting that illegal parking increases when capacity exceeds 80%. Therefore, a common best practice involves adding a 10% buffer to supply levels. Over-supply is compounded when this buffer is added to *estimated* demand levels based on the design day.
- As mentioned earlier, supply levels are set based on an independent variable for each land use. For example, for retail land use, this variable is gross square feet. Yet the design day is represented in terms of the adjective "busy." Missing, however, is a unit quantifying the "busy" capacity of a square foot. In other words there is not a quantified, direct relationship between the dependant and independent variables.

The result is a process of estimation that errors heavily on the side of supply. As free parking is both expected and demanded by drivers, the cost of producing an oversupply of parking is diffused across society while attracting little attention.[1] The impact of negative externalities associated with parking oversupply continue to compound. The potential benefits associated with lowering supply requirements are explored in the following section.

Benefits of Lower and Correct Parking Requirements

Historical analysis of zoning regulations and their changes over time indicates that the majority of municipal parking codes are based on minimum requirements. The justification for establishing supply minimums, according to Kuzmyak and Pratt (2003) was to increase competitiveness, minimize walking distances and prevent spillover. These reasons are

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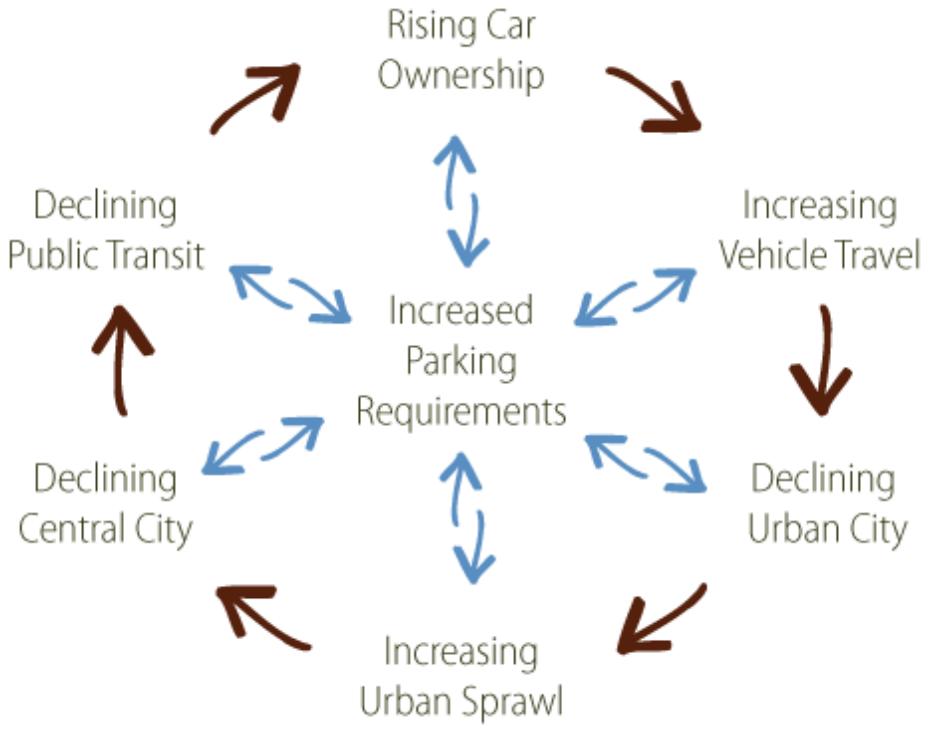
1This statement summarizes the backbone of *The High Cost of Free Parking.* by Donald Shoup (2005). It was the most comprehensive resource encountered while researching this project. It is highly recommend it for anyone seeking more information on this subject.

philosophically "auto-centric." Copious parking and minimal walking were perceived to provide a competitive edge. The result of this perception is a landscape dominated by structures surrounded by an ever expanding parking donut. Zoning requirements that require parking levels at levels higher than demand can result in development patterns of low density that are highly fragmented. Conversely, setting requirements at levels that underestimate demand can lead to parking spillover and are known to inhibit development (Kuzmyak and

Figure 2 - Parking Impact Cycle



* From *The High Cost of Free Parking* (Shoup 2005)

Pratt 2003). This relationship is illustrated in figure two. By definition, urban sprawl is this cycle in action. Recognizing the cyclical and spiral relationship between parking supply, auto dependency, and urban sprawl, many local jurisdictions are now employing parking maximums to encourage higher development densities and promote transit use (Kuzmyak and Pratt 2003).

Affordability

In a regulatory sense, parking requirements impose the largest cost burden on developers. These costs are as much as four times higher than the cost of all other regulations combined

(Shoup, The High Cost of Free Parking 2005). Generally, the cost of parking is "bundled" into the price of homes, adding to either the overall purchase price or monthly rent prices. In turn, this impacts the ability of a developer to offer affordable housing. (Wilson 2005) As the cost of this parking is not separated from the actual price or rent of a residential unit, parking appears free. There are many estimates of the actual cost of this free parking:

» In the typical housing complex, the cost of including one space per unit adds 12.5% to the capital cost of a home while 2 spaces adds 25% (Litman, Parking Requirements Impacts on Housing Affordability 2009).

» The type of parking offered (surface, structured or underground) and the location of the development (cost of land implications) greatly impacts the capital construction cost of each parking space. Estimates range from $3,000 per space for suburban on-street projects to $35,000 per space for underground parking projects in Central Business Districts (Litman, Parking Costs, Pricing and Revenue Calculator 2007).

» If the cost of financing, operation and maintenance, and additional public infrastructure is considered, each additional parking space adds an additional $52,000-$117,000 to the cost of a typical urban housing unit (Greenberg 2005).

Density

An inverse relationship exists between parking space requirements and total housing units constructed. This is expressed in terms of development density. Several studies implicate the role of density as highly correlated to auto ownership and vehicle travel. It is estimated that the number of vehicles per household decreases 16% each time residential unit density per residential acre doubles (Holtzclaw 1994). In addition to creating increase auto dependence, low density has a variety of impacts.

» Property tax revenues are lost as the proportion of land dedicated to parking increases as compared to housing to impact the county's revenue stream as potential high value property tax dollars are lost to asphalt and concrete structures.

» Low density development increases the strain on local government to provide high quality public goods and services as water, sewer and other infrastructure elements must expand with growth.

» Density impacts the efficiency of public transportation. As population centers expand

geographically more routes must be integrated into the system. Decreasing the systems efficiency, this jeopardizes the ability of transit to operate cost effectively.

Environmental Impacts

From an environmental perspective, high levels of parking supply levels have the potential to impact both air and water quality. Corresponding low densities can impact species habitat though the consumption of greenspace as well as increasing both point and non-point pollution sources. The California Air Resource Board conducted a study involving TOD households and corresponding vehicle miles traveled (VMT). The study found that these households typically drove 20-30% less than they typically drove other similar households. This reduction corresponds to an annual savings of 2.5 to 3.7 tons for each household (Parker and Arrington 2002). The reason for this reduction is that TOD commuters typically use transit two to five times more than other commuters in the region (Arrington and Cervero 2008) and at the same time are twice as likely not to own a car at all. On average TOD residents own half as many cars as similar residents outside TOD boundaries (Renne 2005 from Arrington and Cervero 2008).

Excessive parking supplies also impact local water quality. In a 1998 study by biology students at the University of Southern Mississippi studied parking utilization rates at 10 commercial center parking lots at standard peak period intervals in 1996 and 1997. The study found that peak demand for these lots did not exceed 50% during any observation period. At the same time, researchers sampled the variety of fish species in local streams observing lower species diversity and lower total fish quantities in streams in streams adjacent to parking facilities. They identify surface runoff as the primary difference between water samples, postulating reduced parking supply requirements reflective of observed demand would certainly decrease stream degradation. (Albanese and Matlack 1998).

Part I - Determination of Existing Parking Demand

Site Selection

Meeting the first objective of this project required a determination of existing demand levels at transit oriented residential developments in Arapahoe County by observing utilization at two sites. These sites were selected to meet the following criteria:

» Located in Arapahoe County within .5 miles of an existing RTD Light Rail Station as to be considered "transit-oriented development."

» Identical in terms of land use categories identified using ITE classification scheme to validate comparison of observed demand.

The first site selected is AMLI at Inverness. Located .46 miles from the Dry Creek Light Rail Station, AMLI is a mix of 309 one, two and three bedroom apartment units. It began accepting occupants in 2007. The second is Alexan at CityCenter. This development consists of two phases, containing 227 and 211 units respectively. Open in 2000, CityCenter is also a mix of one, two and three bedroom apartment units. It is located adjacent to the Englewood Light Rail Station (less than .2 miles) Initially, three sites were identified adjacent to the Dry Creek Light Rail Station. However, only one of the three property management companies agreed to cooperate with the project. As a result, CityCenter was added to the project as a substitute. The difficulty experienced in attaining cooperation from potential sites was both unexpected and unexplained. As a potential problem, it should be noted and planned for as part of future residential demand studies. Finally, it should be noted that rent is the only tenure option for residents at both City Center and AMLI. This is important as research identifies home ownership as positively correlated to parking demand (Cervero 1994).

Methodology

The process used to determine demand is adapted from the methodology outlined in *Parking Generation*. Comparing demand observations with development requirements

Required Development Ratio

$$\frac{\Sigma[\text{Number of (occupied) units with x bedrooms} * \text{space/unit req.}]}{\text{total (occupied) units}} + [\text{guest space requirement/unit} * \text{total (occupied) units}]$$

Observed Demand Ratio

$$\frac{\text{Highest counted vehicle total during peak period}}{\text{total occupied units}}$$

Built Supply Ratio

$$\frac{\text{Total Constructed Parking Spaces}}{\text{Total Units}}$$

requires three calculations listed below.

The numbers for these equations was acquired through the following steps:

» Collect site data to determine total number of existing parking spaces, total number of units, and total amount of occupied units. The number of bedrooms in each occupied

unit was also recorded.

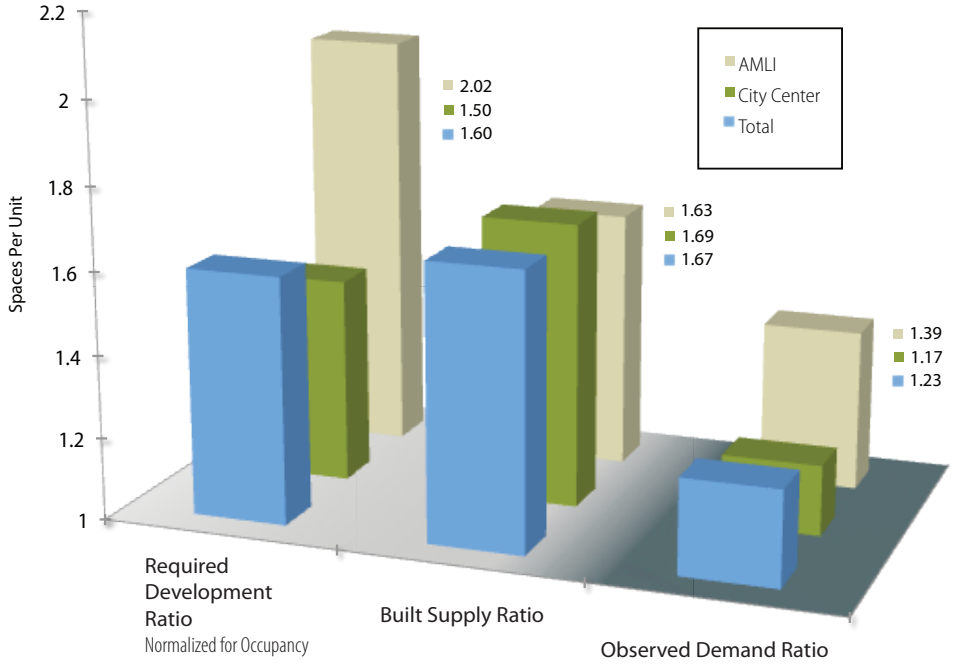
» Observed and recorded total number of automobiles present at parking facilities during identified peak demand period.

» Calculated demand ratio in terms of total units, occupied units, and occupied bedrooms.

» Compared calculated demand ratio to supply ratio.

Observations at the two sites stretched between March 16th and April 1st 2009. *Parking Generation* identifies periods of peak demand for each land use based on the data of previous studies. CityCenter and AMLI are classified as Land Use 221: Low/Mid-Rise Apartments in Parking Generation. This land use exhibits peak demand between 9:00pm and 5:00am. Data collection efforts for this project corresponded with the peak demand period as calculations were made using the highest observed total at each site. The results are reported in figure 3. Complete results of the data collection effort is included in the appendix.

Figure 3 - Comparison of Supply Requirements and Observed Demand



Results

The data collected as part of this project provides evidence that observed residential parking demand is lower than supply levels regulated by local development codes. Demand at AMLI is 45% lower than required, while residents at CityCenter currently demand 72% of

the provided parking. Cumulatively, the supply of parking at CityCenter and AMLI exceeds demand by thirty percent. Additional key facts associated with the findings include:

» As AMLI was only 30% occupied during the observation period, the average development requirement is normalized by occupancy to provide a more accurate basis for comparison.

» Realized supply amounts often differ from development requirements. Planning officials have the authority to adjust requirements lower under special circumstances. Also, developers may choose to exceed development requirements if parking maximums are not subject to regulation.

» The data collected in this study was submitted to the Institute of Transportation Engineers for review and possible inclusion in the upcoming 4th edition of Parking Generation. The collection of data followed guidance of ITE with one important exception. The parking mix at CityCenter phase I include 66 individual garages, 51 of which are currently under lease. This study assumes those garages are occupied as part of peak demand calculations. It is reasonable to conclude that residents choosing to lease garages are using them to store personal vehicles as opposed to storage. While their inclusion is undeniably a source of error, the effect is assumed significantly smaller than omission.

Table 2 compares the findings of this and other key studies done across the nation. The results of this study are consistent with comparable parking utilization studies, indicating a general prevalence of parking oversupply compared to demand.

Table 2- **Comparison of Parking Utilization Studies**	Study Total	Parking Generation 3rd ed..*	Energy Pathways 1994	Cali TOD 1996	University of Victoria
Expected Dev. Requirement/Unit	1.6	unavailable	1.73	unknown	1.5
Built Supply Average/Unit	1.67	1.4	1.54	unknown	1.27
Observed Peak Demand/Unit	1.23	1.2	1.28	1.12	0.69
Parking Oversupply	30%	14%	35%	unavailable	117%

* Data provided for Land Use 221 - Low/Mid-Rise Apartment

Sources: Energy Pathways and University of Victoria studies cited in Litman (2009), Cali 1994 Study cited in Arrington and Cervero (2008)

The fractional difference between existing requirements and demand may seem inconsequential. The importance becomes clear when the difference is expressed in terms of the hidden costs discussed earlier. Table 3 estimates hypothetical differences in terms of development costs, and the impact on affordability.

Table 3- **Estimated Parking Facility Construction and Operation Cost**	**CityCenter**			**AMLI**		
	Observed	***Built***	*Expected*	*Observed*	***Built***	*Expected*
Parking Ratio	1.17	**1.69**	1.5	1.39	**1.63**	1.8
Capital Costs (Parking)	$10,206,079	**$12,756,977**	$11,322,761	$6,310,727	**$7,400,349**	$8,172,165
Difference	-$2,550,898	**$0**	-$1,434,216	-$1,089,622	**$0**	$771,816
Annual Parking Cost/Unit	$2,294	**$3,314**	$2,941	$2,486	**$2,916**	$3,220
Monthly Parking Cost/Unit	$191	**$276**	$245	$207	**$243**	$268
Monthly Savings	$85	**$0**	$31	$36	**$0**	$25
Savings as % of Avg Rent	8.6%	**0%**	3.2%	3.2%	**0%**	-2.2%

Actual capital construction costs for AMLI and Dry Creek are unavailable. These figures are estimates and should only be used for comparison. Construction and operation/maintenance cost estimates are derived from Litman (2007).

Capital costs include land aquision and construction costs only. Annual and monthly figures are annualized to include ongoing financing and maintenance costs.

Monthly savings assume that all savings are passed directly to residents through a reduction in lease prices.

Savings are calculated using the built ratio and corresponding figures as a baseline.

Key Findings

The findings of this study, coupled with the growing body of similar studies provide several key pieces of information to planners:

» The level of parking required by regulation impacts several key land use characteristics including development cost, density, and affordability. There are also environmental concerns associated with parking supply requirements that can negatively impact local and regional air and water quality.

» Existing residential parking requirements exceed demand resulting in excess parking supply.

» While providing evidence for an adjustment of parking minimums, the relationship between parking supply and future growth objectives warrant the inclusion of parking

supply maximums into the regulatory forum.

While these statements provide a foundation to evaluate existing standards, they represent only part of the equation. Accurate regulation of supply involves successfully planning for future development. Practical regulation also requires a process that assists planners in making educated decisions in *estimating* future demand.

Part II - Estimating Demand

Identifying Demand Generating Variables

Establishing existing demand and identifying oversupply represents only the first half of the supply equation. To balance regulated supply with demand, a better understanding of the factors contributing to demand is essential. Just as Kyzmayak and Pratt (2003) argue the important role parking requirements play in the development of mixed use communities, the factors contributing to demand play an equally important role in determining demand. *Parking Generation* underscores this fact. Reporting demand values in terms of spaces per unit fails to include factors that impact differentiating factors involving the unit itself. The end result is a manual that identifies demand based on 171 different land uses. The publication of the 4th edition of parking demand will likely include additional uses. Consider the sites studied in this project. While they both share an identical land use identification from the Parking Generation perspective, each site is potentially subclassified with differently using the TOD station typology criteria developed by Dittmer and Ohland (2004). Using this criteria, CityCenter exhibits characteristics similar to a suburban center, while AMLI borders as an urban neighborhood. Typologies are defined by land use diversity, density, transit connectivity and transit frequency. Each of these factors is referenced by studies as a significantly correlated factor with parking demand.

Incorporating the compiled demand ratios of 171 different land uses into the Arapahoe County Development Code is impractical. It is more appropriate to base standards on quantifiable demand generating factors. The purpose of this section of the project involves identifying relevant demand generating factors. Identifying these factors begins in the literature. Multiple studies including Cervero (1996, 2004), Holzclaw (1994) Soltani and Somenahalli (2005) and Litman (2005, 2007) have concentrated on identifying key

components relative to parking and transit use. These works cumulatively suggest five variables have the greatest predictive influence on parking: household tenure, development density, household income, household size and the number of individuals living in the household. To understand these factors specific to residential TOD parking demand in Arapahoe County, a comprehensive site profile was created for AMLI and City Center.

Table 4- TOD Typology	Land Use Mix	Minimum Density	Regional Connectivity	Frequencies
Urban Downtown	Residential, Retail, Class B Commercial	> 60 units per acre	High - Hub of regional system	<10 minutes
Urban Neighborhood	Residential, Retail, Class B Commercial	>20 units per acre	Medium access to downtown - Sub reginal hub	10 minutes peak, 20 minutes off peak
Suburban Center	Office Center, Urban Entertainment, Multiple Family Retail	>50 units per acre	High access to downtown - Sub regional hub	10 minutes peak, 20 minutes off peak
Suburban Neighborhood	Residential, Neighborhood retail, local office	>12 units per acre	Medium access to suburban center,Access to downtown	20 minutes peak 30 minutes off peak
Neighborhood	Residential, Neighborhood retail	>7 units per acre	Low	25-30 minutes, Demand Responsive

Methodology - Creating Site Profiles

To acquire data specific to demographic factors, a survey was distributed to City Center and AMLI residents. Four primary areas were targeted by survey: housing, automobile and parking, work and travel, and demographics. While the survey includes questions specifically targeting the aforementioned demand generating variables, it includes a variety of additional questions intended to enhance the general subject knowledge in this area, hopefully providing future benefit to the county or other information seekers.

Much of the survey is a compilation of questions borrowed from the 2005 Merrick and 2004 California TOD Studies. This was necessary to minimize pre-screening of questions given the time constraints of this project. It also allows the data generated by this survey to be compared to those larger studies as well as future research efforts. The expertise of Don Dillman was consulted, using his 2009 text to employ techniques aimed at maximizing response rates. It was distributed to the doorsteps of AMLI residents on March 1st and CityCenter residents on March 23rd. Residents had the option to complete the survey online, return it via mail or to the leasing office.

Specific design and developmental elements were also compiled for each site. These elements include information development density, average rent, proximity and availability of transit, distance to the station, walking time to station, occupancy totals. This data was compiled through an analysis of site development plans, interviews with property management companies and physical observations. The complete list of these data points is included in the appendix.

Finally, to strengthen the discussion of factors contributing to demand, an analysi of several larger data sets including: the 2001 National Household Transportation Survey, 2000 United States Census and the 2005-2007 three year estimates from the American Community Survey is integrated into the findings. Using vehicles per household as the dependant variable, data is plotted to illustrate ownership ratios specific to Colorado and Arapahoe County using household tenure, total income, income per person and number of the number of bedrooms as independent variables.. These variables represent the same factors identified in the literature with the exception of density which is compared separately. A line of best fit shows the degree of linearity between the variables (r^2 value) as well as the expected impact on overall vehicle ownership from the independent variable (slope of line).

Results

Survey

A total of 487 surveys were distributed to the AMLI and CityCenter residents. Eight-one participants generated a response rate of 18%. Unfortunately, the resulting sample size restricts the certainty of any statistical assertions based on an analysis of the data as the margin of error is roughly 10% (Dillman 2009). The response rate certainly introduces sample bias into the results as well.[2] After compiling and validating the data, analysis was conducted using SPSS.

As previously mentioned, the response rate realized by the survey effort interferes with the level of analytical precision beyond identifying correlated factors. Research suggests that regression analysis involving vehicle ownership utilize either a multinomial logit analysis as opposed to a standard ordinary lease squares regression (Soltani 2005). However, this type

2 Further discussion on the specifics of the survey, including a break down of the response rate, an identification of potential sample biases and the survey instrument can be found in the appendix

of regression requires the use of independent variables with low levels of inter-correlation. The independent variables exhibiting significant correlation with auto ownership in this case also exhibit correlations with one another.[3] Therefore, the results should be interpreted accordingly as the data is best suited as an educational tool, assisting in the process of making an informed decision relative to parking supply rather than as an authoritative data source. It is also has comparative value, helping to strengthen conclusions made by existing studies and vice versa. To prevent over analysis of the data, the extent of statistical interpretation is limited to descriptive characterization of the variables and a standard bivariate correlation analysis (table 5).

Using automobiles per household as the dependant variable, SPSS embarked on a correlational journey, comparing a wide variety of independent socioeconomic variables contained within the survey data. Most of the variables were found to either have little correlation or were statistically insignificant. However, the analysis returned four variables displaying significant positive correlation: monthly rent, total household size, total individuals living in home and total individuals over 16 living in home. These variables correspond with the same key variables identified by other studies, supporting further discussion relative to parking demand at individual sites.

Table 5- **Significant Variable Comparison (Per Unit Ratio)**	AMLI		City Center		Total		Correlation To Vehicles/Unit
	Mean	*Standard Error*	*Mean*	*Standard Error*	*Mean*	*Standard Error*	*Pearson Value*
Bedroom	1.5	.1	1.4	.1	1.4	.1	.541
Total Household Size	1.9	.1	1.6	.1	1.7	.1	.591
Total Individual Over 16	1.7	.1	1.5	.1	1.5	.1	.771
Rent ($x1000)	1.17	.04	1.03	.04	1.06	0.03	.446
Autos	1.6	.1	1.3	.1	1.4	0.1	-

Residential Demographic Variables

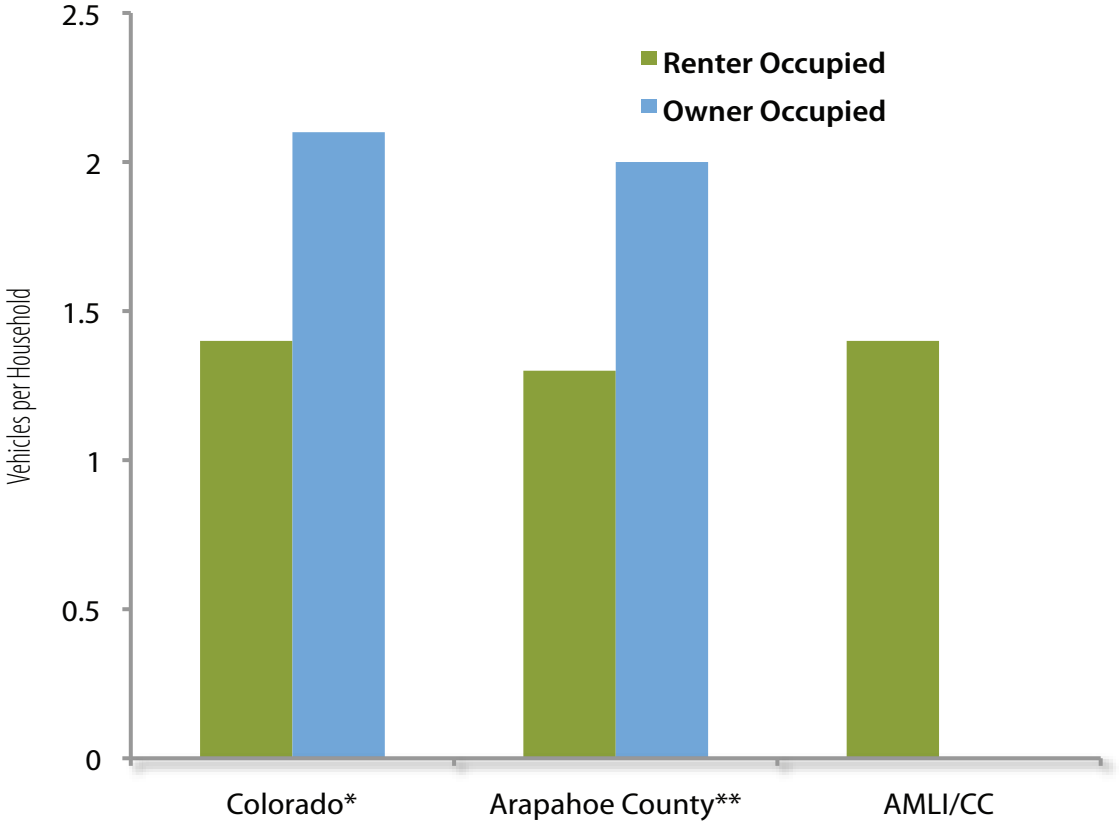
Housing Tenure

The first factor influencing automobile ownership that warrants discussion is housing tenure. On average, home ownership increases vehicle ownership with no existing studies provide evidence to the contrary. Data provided by the NTHS and 2000 Census further

3 A cross tabulation of variable correlations can be found in the appendix.

evidence this claim. Average vehicle availability ratios by housing tenure is illustrated in figure 4 for both the state of Colorado and Arapahoe County. The difference in demand stemming from tenure is considerable. For both Colorado at large and Arapahoe County, per household vehicle demand is 50% higher in owner occupied residences compared to renter occupied. The cumulative ratio for AMLI and City Center is similar to both the county and state ratio. As both developments are exclusively renter occupied, no measure of owner occupied units is provided.

Figure 4 - Mean Vehicle Ownership by Housing Tenure



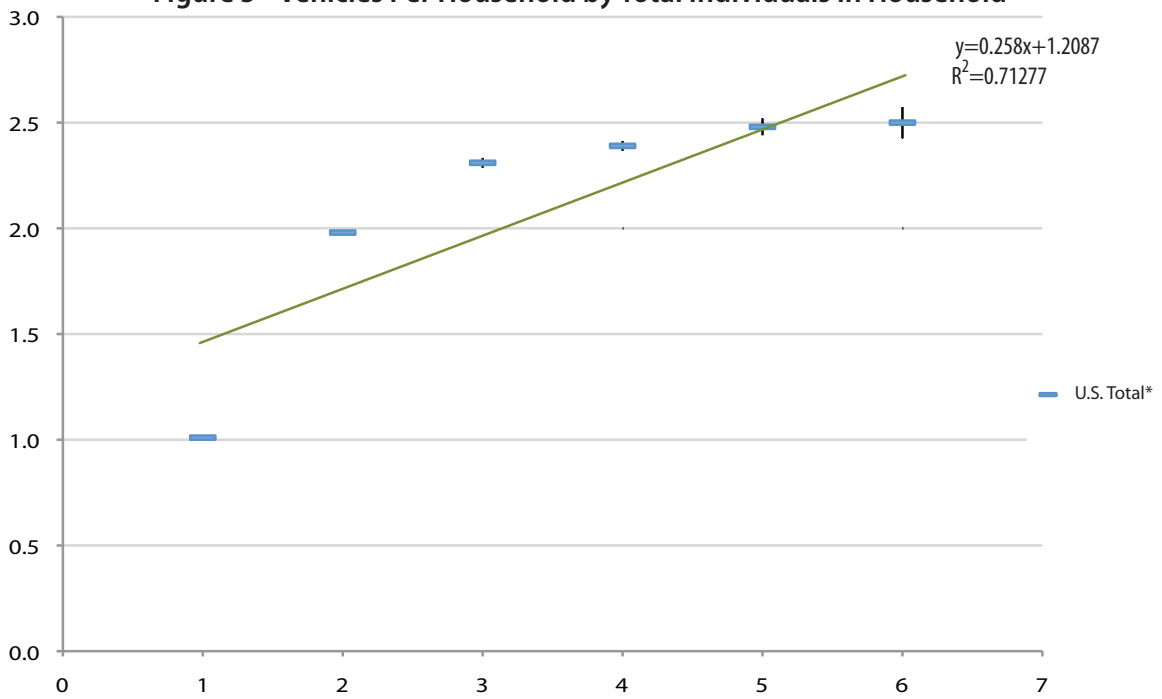
Source: * 2000 Census Summary File 3 (Table QT11)
** 2000 Census Summary File 3

Housing Size - Individuals

Based on AMLI and CityCenter resident demographics, the variables exhibiting the strongest linear relationship involve the total number of individuals living in a household and the number of individuals over age 16 living in each household. Given the national ratio

of vehicles to individuals over age 16 is .998 (NTHS 2001), this correlation is not surprising. Plotting the average vehicle availabilities per unit by household size, one would expect to see similar correlations. As illustrated in figure 5, this is not the case. The line of best fit does not indicate high linearity (r^2 = .71) and the ratios for individuals per home and autos per home do not correspond to a 1:1 ratio for either the state or county.

Figure 5 - Vehicles Per Household by Total Individuals in Household

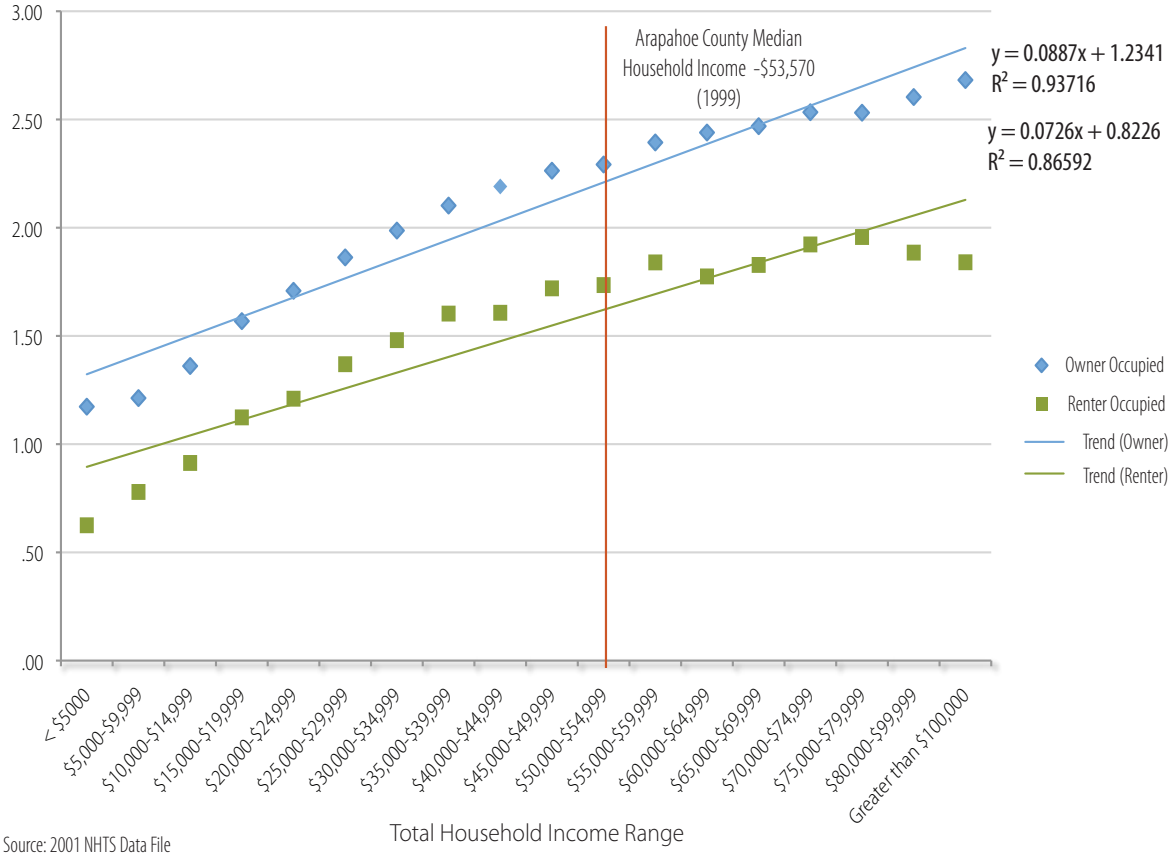


Source: 2001 National Household Travel Survey, household file, U.S. Dept. of Transportation

Total Household Income

Several studies implicate household income as a significant factor in determining the amount of vehicles available per residential unit (Litman, Cervero). While the data provided by CityCenter and AMLI residents indicate a significant relationship between household income and vehicles, a significant relationship does exist between monthly rent and the vehicle/unit ratio. For the AMLI/CityCenter data set the lack of significant correlation is likely the result of the large range of income groupings paired with the sample size. This

Figure 6 - Vehicle Ownership per Household by Total Household Income



Source: 2001 NHTS Data File

relationship is better illustrated using NTHS 2001 data. The relationship between household income and vehicles per household does exhibit a linear relationship for both renter and owner occupied homes. The relationship indicates that for each $5,000 rise in household income, vehicle ownership increases by roughly 1/10th of an automobile.

Using household income as the independent variable is deceptive. This is because household income is dependant on the number of household inhabitants. Consider the following two hypothetical data points:

	Total Income	Total Size	Income Earners	Vehicles	Bedrooms
Family 1	$75,000	3	2	2	2
Famly 2	$75,000	1	1	1	1

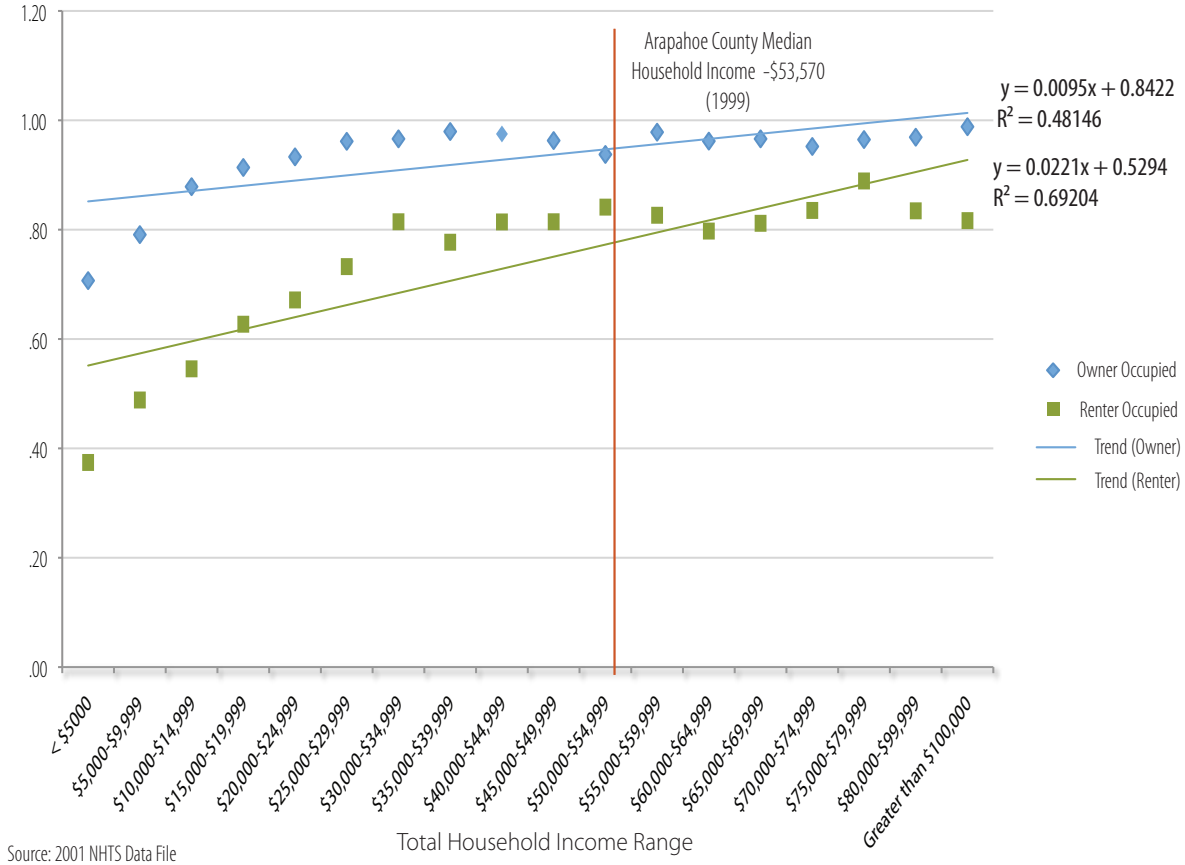
The relationship between household income and vehicle ownership is also a product of income earners and potentially the number of drivers in the home. This highlights the problems associated with developing demand equations while also showing the need for

requirements more specific than vehicles per unit.

Total Household Income per Person

To reduce the influential factors in the above example, the relationship between vehicles available and per capita income potentially provides a clearer understanding of the variables at play. This removes household size from the equation. The results are shown in figure seven. While the line of best fit for both tenure options exhibits a comparatively low level of linearity, an important conclusion can be drawn from the chart. Household income per person appears to impact vehicle ownership to a point before leveling off. This implies that at lower per capita income levels, vehicle ownership may be a function of cost concerns that are nonexistent at higher income levels. To provide perspective, the graph also includes the median income for Arapahoe County. This graph allows a usable assumption: demand for vehicles becomes increasingly inelastic as per capita income increases. Therefore the inclusion of income into supply level regulation process should garner increasing attention as the target income market for a development decreases.

Figure 7 - Vehicle Ownership per Household by Per Capita Income

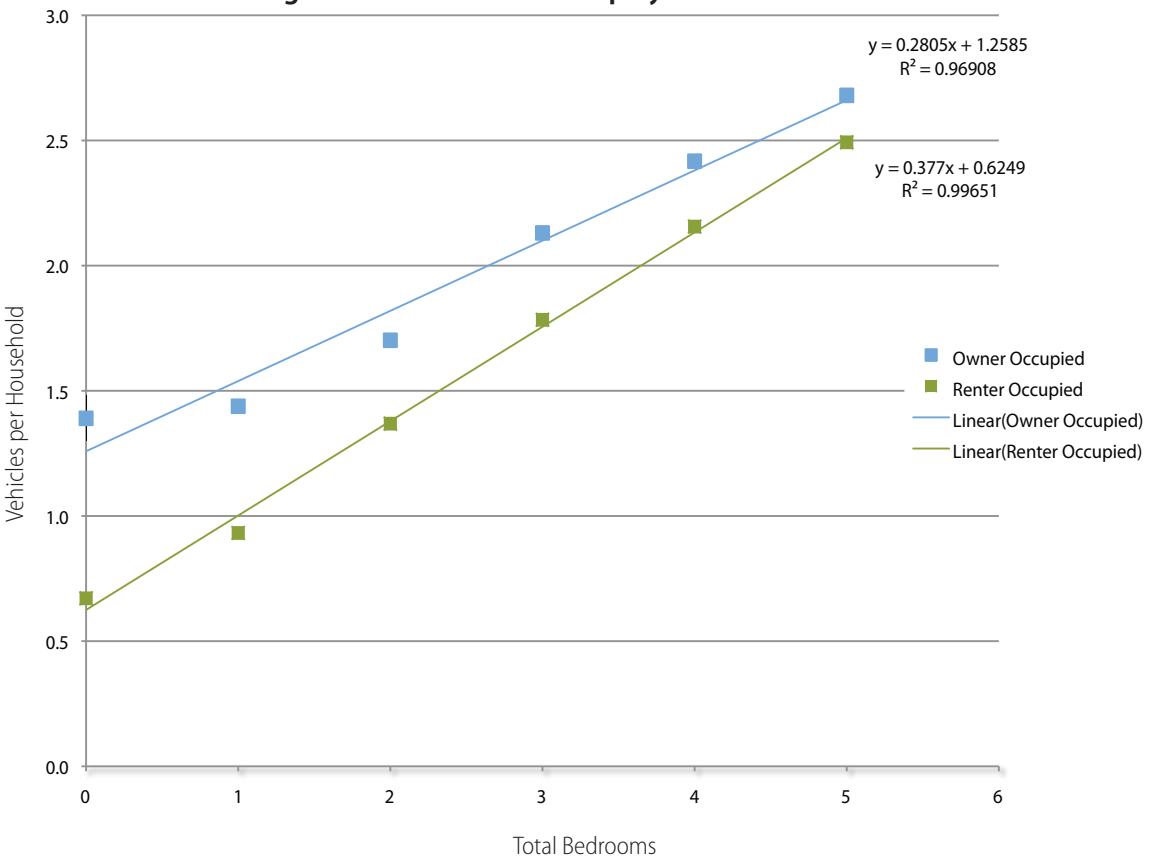


Source: 2001 NHTS Data File

Household Size - Total Bedrooms

The final variable analyzed using census data was the number of bedrooms in each household. It is worth noting that bedroom size is incorporated into many development codes, including that of Arapahoe County. The graph of plotted data points is contained within figure Evidenced by the r^2 value for the line of best fit seen in Figure 8, the relationship between the number of bedrooms and the number of vehicles available exhibits excellent linearity regardless of tenure. For each additional bedroom in a unit, the number of vehicles available increases by .38 for renter occupied units and .28 for those occupied by the owner. This relationship also lends validity to the y-intercept of each equation. It indicates the average number of vehicles for residences with 0 bedrooms (efficiency units).

Figure 8 - Vehicle Ownership by Total Bedrooms



* Source: 2005-2005 American Community Survey - State of Colorado

Of the four independent variables plotted against vehicle ownership per unit, the number of bedrooms in each unit exhibited the strongest linear relationship. This relationship exists regardless of housing tenure, although housing tenure impacts the overall level of vehicles per household per bedroom. The degree of linearity and the potential impact of each development variables is summarized in table 9.

Table 6- **Linear Relationship with Vehicles/Unit as Dependent Variable**

Independent Variable	Tenure	r^2 value	Potential Impact
Household Size	Total Universe	.71	Additional 1.21 vehicles per person
Total Household Income	Owner Occupied	.94	Additional .09 vehicles per $5,0000 increase in income per person
	Renter Occupied	.87	Additional .07 vehicles per $5,000 increase in income per person
Household Income per Capita	Owner Occupied	.48	Additional .02 vehicles per $5,000 increase in income per person
	Renter Occupied	.69	Additional .01 vehicles per $5,000 increase in income per person
Number of Bedrooms	Owner Occupied	.97	Additional .28 vehicles per bedroom
	Renter Occupied	1	Additional .38 vehicles per bedroom

Individual Site Design Variables

While the combination of the Census and NHTS datasets allow an analysis of trends at the state, regional and even census tract level, it lacks the specificity with respect to individual site design characteristics. Individual site characteristics are equally important contributors to parking demand. These factors are identified by Cervero and Kockelman (1997) as density, diversity and design. Survey data from AMLI and CityCenter evidence the impact of these variables on the transit use, vehicle ownership, parking demand relationship.

Table 9- **Current Neighborhood Impact on Vehicle Ownership**	Frequency (n)
No, but I/we are considering getting rid of a vehicle because of the characteristics of the neighborhood.	8.9%
No, but I/we are considering getting another vehicle because of the characteristics of the neighborhood.	1.3%
No, moving to this place has had no impact on the number of vehicles available to my household.	82.3%
Yes, I/we got rid of a vehicle because of the characteristics of the neighborhood.	7.6%
Yes, I/we got an additional vehicle because of the characteristics of the neighborhood.	0.0%

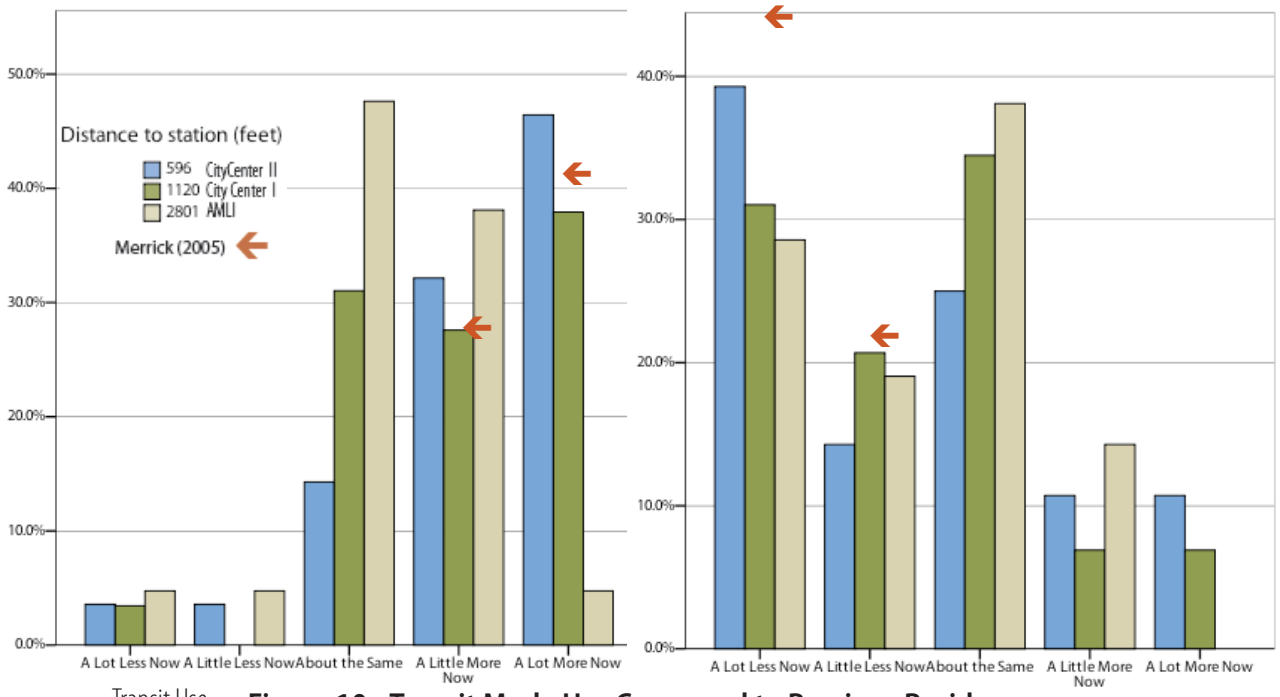


Figure 10 - Transit Mode Use Compared to Previous Residence

Table 7- **Resident Neighborhood Opinion Scale**	Strongly Disagree (1)	Disagree (2)	Neutral (3)	Agree (4)	Strongly Agree (5)	Mean	(n)
My neighborhood has an adequate number of good sidewalks.	1%	8%	0%	46%	46%	4.3	79
My neighborhood has frequent bus or light rail services.	0%	0%	3%	27%	70%	4.7	77
The buses or other transit services in my neighborhood serve areas in which I frequently need to travel.	1%	4%	12%	40%	42%	4.2	77
My home has adequate room for parking two or more cars.	12%	18%	21%	27%	22%	3.3	78
Biking in my neighborhood is safe and enjoyable.	3%	10%	42%	31%	9%	3.4	77
My home is conveniently located to where I work or go to school.	0%	16%	21%	22%	38%	3.9	76
In a neighborhood like mine, I can exercise by walking or bicycling.	1%	8%	15%	49%	27%	3.9	75
In a neighborhood like mine, I can walk to stores, restaurants and other activities .	1%	14%	10%	41%	34%	3.9	79
In a neighborhood like mine, I can take public transportation to work or for other trips.	1%	4%	3%	42%	51%	4.4	77
In a neighborhood like mine, my household can own fewer cars.	7%	12%	20%	37%	20%	3.5	75
Overall, I am very satisfied with my current neighborhood.	1%	4%	15%	57%	23%	4.0	79

- One of every 6 respondents indicate that they either got rid of a vehicle or are considering doing so because of neighborhood characteristics. This compares to 25% of Merrick residents.
- Overall, 57% of residents either agree or strongly agree that owning fewer cars is an option given the characteristics of their neighborhood.
- Seventy percent of residents strongly agree that their AMLI and CityCenter has frequent bus or light rail service. Ninety seven percent agree with that statement in some capacity.

Resident survey data did not reveal any significant correlation between variables related to either density, diversity or design. The lack of significantly correlated factors within the CityCenter and AMLI dataset provide further evidences the difficulty in distinguishing between these variables with respect to parking demand. Integrating these variables into the framework for setting supply requirements therefore requires incorporating the results of other research.

Density

The density variable can act as a surrogate for several demand contributing factors. For example, higher density developments can be situated closer to transit access, increasing walkability. Higher density also facilitates the inclusion of a greater variety of uses into a parcel of land decreasing the potential vehicle need. Holtzclaw (1994) identifies density as the primary variable impacting both automobile ownership and vehicle miles traveled. Specific to auto ownership, his analysis identifies density as responsible for predicting 79%-96% of auto ownership variance. Using data collected from 27 San Francisco neighborhoods, he found that doubling density development correlates with a 16% reduction in vehicle ownership. He posits a complex formula to determine both vehicle ownership and vehicle miles traveled as a function of density using socioeconomic variables of household size and income and location design and diversity variables. He reports the highest level of correlation between vehicles per household and residential density per residential acre.

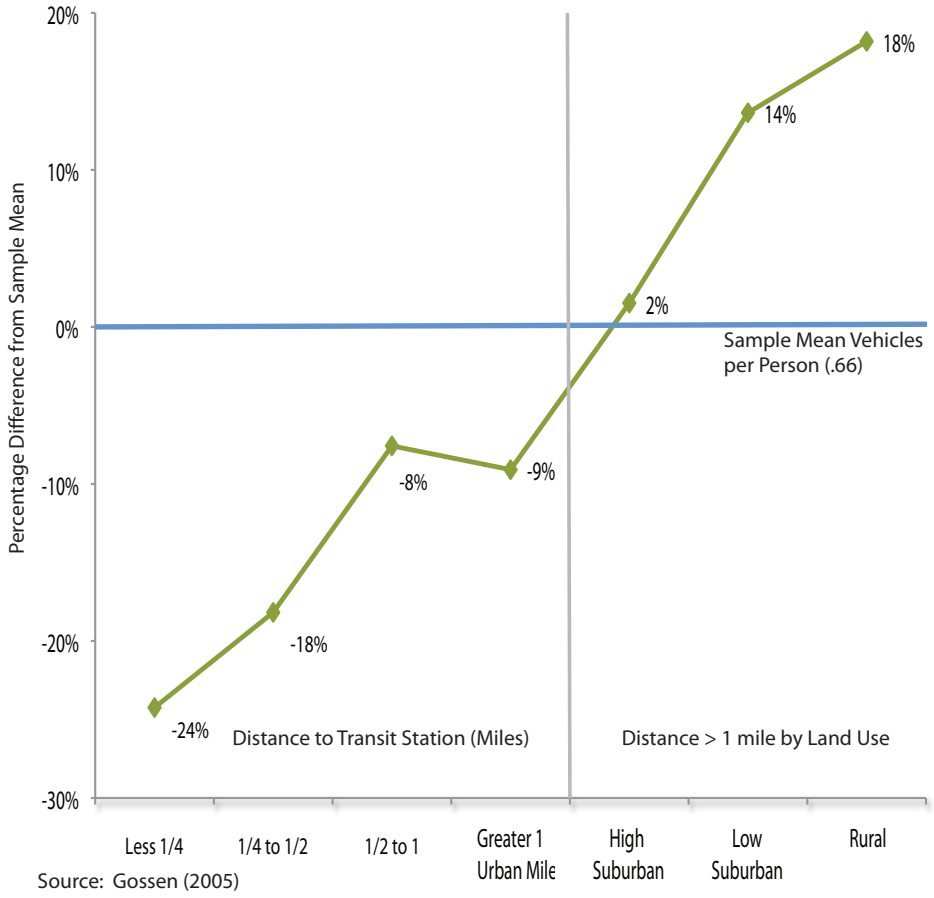
The relationship between density and vehicle ownership does not appear to exhibit linear characteristics. Rather research indicates a density threshold of between 30-40 residential units per acre as a minimum threshold for impacting the transit use/vehicle ownership/

urban design relationship (Soltani 2005). Data provided by the Federal Highway Transit Administration suggests that development densities below 10-17 units per acre, show little if any indication of the relationship between density, design and diversity with respect to travel characteristics (Arrington and Cervero 2008).

Distance

While the distance between residential units and transit stations may be a function of density, they are not mutually exclusive in terms of development characteristics and therefore warrant separate mention. In other words, high density developments might be situated closer to transit, but it distance does not cause density and vice versa. Rachael Gossen analyzed the relationship between demographic characteristics and transit location proximity using data from the 2000 Bay Area Travel Study. Figure 10 displays her findings as the change in vehicle ownership per person as the distance to transit stations increase. The potential impact of distance is substantial, with vehicle per person ratios decreasing up to 24% from the overall sample mean for developments located within 1/4 mile of transit station.

Figure 9 - Distance to Light Rail Station Impact on Vehicle Ownership



Source: Gossen (2005)

Additional Variables for Consideration

Assuming the inverse relationship between transit use and vehicle ownership, several additional factors have the potential to lessen parking demand. These factors involve resident possession of transit passes, distance to and from work, transit travel times and parking costs considerations. The likely impact of these factors on transit use by AMLI and CityCenter residents is shown in table 8.

Table 8- **Potential Transit Use Drivers**	*Much Less Likely*	*Less Likely*	*About the Same*	*More Likely*	*Much More Likely*
Free transit pass from employer	1%	6%	**33%**	28%	32%
Free transit from housing complex	1%	3%	29%	32%	**35%**
Work or school closer to transit	1%	3%	**40%**	31%	25%
Transit shorter than driving	2%	3%	23%	34%	**38%**
Transit cost less	0%	4%	36%	33%	26%
Gasoline cost more	0%	4%	**40%**	37%	19%
Parking cost increased at work	0%	6%	**38%**	37%	19%
Parking cost increased at home	3%	9%	**50%**	21%	17%

Conclusion

We return to the original research questions to conclude the study: "do the combination of observed parking demand ratios and demographic data related to auto ownership and transit mode choice characteristics warrant an adjustment of zoning requirements in Arapahoe County?" In short, yes. In long, the combination of observed parking demand ratios at AMLI and CityCenter developments combined with the negative externalities associated with parking oversupply provide a basis for adjusting code requirements. First, this study adds to the growing body of research strongly suggesting that local regulation of parking requirements has led to an oversupply of parking relative to demand. The existing supply of parking at the AMLI and CityCenter developments exceed observed demand by 30%. This is consistent with the observed demand for transit oriented developments across the nation. The results of these studies show parking demand to range from .69-1.28 spaces per unit.

Further, as evidenced by the literature, the impacts of parking over-supply are wide ranging. Parking requirements represent the largest financial burden facing developers (Shoup, The High Cost of Free Parking 2005). With a capital cost ranging between $3,000 and $35,000 per space, developers include this in the cost of housing (Litman, Parking Cost, Pricing and Revenue Calculator, 2007). This process is known as bundling and creates an illusion of free parking while negatively impacting affordability. Higher development requirements also reduce development density, contributing to the cycle of reduced transit use, reduced land use diversity and increased auto reliance. This corresponds to more driving, increased vehicle emissions and negatively impacts water quality through increasing runoff.

Each of these considerations contradict the stated goals and objectives of the Arapahoe County Comprehensive Plan. Considering the stated intent of the county to promote mixed use, with multi modal transit options, evidence clearly supports an adjustment of minimum requirements. The inclusion of maximum requirements are also supported to prevent further over supply.

Framework for Estimating Demand

General Development Factors

The regulation of parking supply through local development code is a two part process. In addition to gauging existing demand, a process for estimating future demand is essential. While methodology provided by the Institute of Transportation Engineers is commonly used as a basis for determining requirements, creating requirements based estimated demand per unit fails to account for a multiple additional factors. Despite the small sample size provided by the survey of AMLI and CityCenter residents, the data identified significantly correlated independent variables consistent with other studies. Using Colorado specific data from national data sets, an analysis of the linear relationship between vehicles per unit and independent variable factors identifies two appropriate variables for expressing supply requirements. The first is housing tenure. Housing units occupied by the owner consistently report higher levels of vehicle ownership per unit. This difference exceeds 50% for both Colorado and Arapahoe County on average. The second is vehicle availability per bedroom.

Expression of supply requirements based the number of bedrooms is a method utilized

by local land development codes including Arapahoe County. There are two primary benefits to developing code requirements based on unit size. First, it integrates the impact of total individuals per unit into the equation. Consider the national statistic: 97% of residential bedrooms are occupied by 1 or fewer inhabitants (ACS 2005). Second, the number of bedrooms is easily measurable through review of individual development plans.

Site Specific Factors

While the relationship between housing tenure, bedrooms per unit and vehicle availability provides a foundation for setting development requirements, the potential for individual site characteristics to impact overall demand levels warrants consideration on a case by case basis. These variables include development density, distance to transit, and the use of transportation demand management (TDM) principles such as pricing controls and transit ridership incentives. Generally, a doubling of density can contribute to a 16% reduction in vehicle ownership (Holtzclaw 1994) while residents of developments within $^{1}/_{4}$ mile of transit stations own up to 24% fewer automobiles. The intricacies of TDM strategies is outside the scope of this project, however the Victoria Transportation Policy Institute provides comprehensive information on the topic at **www.vtpi.org.** The web site includes estimates of potential supply reductions reflective of various strategies calculated by resident expert Todd Litman. A copy of this document is provided in the appendix.

Policy Recommendations

The 2000 United States Census, 2001 National Household Transportation Survey and 2005-2007 American Community Survey data sets are a valuable resource for acquiring data necessary to understand the relationship between demand contributing factors and parking demand. It provides data specific the individual census tract and is a useful tool to understand development characteristics at a local level. Thorough consideration of the demand generating variables identified in this report may provide localities with a better understanding of development indicators beyond the scope of ITE methodology. Devoting resources at the regional level to the distillation of usable census data relative to these factors would in turn provide county planners a valuable resource necessary to make educated decisions on parking code minimum and maximums for future development. Filtering the

data using various GIS tools may enhance usability, allowing planners the flexibility to account for localized development nuances.

Given the relationship between residential unit and family size on vehicle ownership (thus parking demand), at minimum it is in the best interest of local authorities to differentiate requirements based on unit size. This distinction is already recognized within Arapahoe County's development code. Setting requirements based on bedrooms per unit integrates the impact of household size on vehicle ownership into the requirements while exhibiting the highest degree of linearity of the variables discussed in this study. This means the potential for accurately predicting demand based on supply per unit will be greatest using bedrooms per unit as the independent variable. Further accuracy may be gained by incorporating tenure distinctions into supply requirements.

When considering individual site factors it is important for local planners to characterize the site as accurately to include information on the factors outlined in this report. Relative to AMLI and CityCenter, relevant details are compiled and listed in the appendix. Using a similar template to record data for future developments may be useful in establishing relationships unique at the local level within the Denver metro region. Establishing a database accessible by local governments will also increase the ability of local planners to accurately gauge demand levels for future development based.

Realizing the ambitious, yet common sense goals of Arapahoe County's Comprehensive Development plan will require new methods of innovation in addition to the continued commitment of public servants to realize this vision. Given parking's effect spanning reach the plan's policy impact spectrum, an innovative approach using the methods discussed in this report may help the county realize its future development vision.

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Appendix A - Expanded Tables and Data

Observation Records

AMLI Observations			City Center Observations				
Date	Time	Total	Date	Time	Phase 1	Phase 2	Total
Mar 16, 2009	*10:30PM*	147	**Mar 28, 2009**	*10:30PM*	224	225	449
Mar 17, 2009	*10:30PM*	139	**Mar 29, 2009**	*10:30PM*	216	222	438
Mar 18, 2009	*10:30PM*	144	**Mar 30, 2009**	*10:30PM*	219	225	444
Mar 23, 2009	*7:00AM*	147	**Mar 31, 2009**	*11:30PM*	224	230	454
Mar 18, 2009	*1:30PM*	59	**Apr 4, 2009**	*12:00AM*	224	226	450
Mar 19, 2009	*11:30PM*	146	**Mar 29, 2009**	*12:00AM*	220	221	441
Mar 23, 2009	*6:00AM*	149					
Mar 19, 2009	*1:00AM*	145					
Mar 23, 2009	*2:00PM*	107					

Demand Calculations	AMLI	City Center		
		Phase 1	*Phase II*	*Total*
Total Sq Foot	100275	197585	192071	389,656.00
Total Occupied Units	106	215	209	424.00
Total Bedrooms	170	316	331	647.00
Total Rent	$119,165	$211,560	$205,656	$417,216.00
Average Size (sq ft.)	946	919	919	919.00
Average Bedroom	1.6	1.47	1.584	1.53
Average Rent per Month	$1129	$984	$984	$984
Rent/Bedroom	$704	$669	$621	$644
Rent/Sq Foot	$1.19	$1.07	$1.07	$1.07
Auto/Unit	**1.41**	**1.03**	**1.08**	**1.07**
Auto/Bedroom	**.88**	**0.70**	**0.68**	**0.70**
Auto/Unit+Garage	**na**	**1.26**	**na**	**1.19**
Auto/Bedroom+Garage	na	0.86	na	0.78

Variable Correlation Results		Household Vehicles	Total individuals over 16	Career Classify	Age	Education Level	Distance to station (feet)	Total bedrooms in home	Household Income Group	Density	Total individuals in home	Monthly rent	Months at residence.
Household Vehicles	*Pearson Correlation*	1	.711**	-.077	-.021	-.052	.140	.541**	.119	-.084	.591**	.446**	-.280*
	Sig. (2-tailed)		.000	.509	.860	.657	.228	0.000	.311	.473	0.000	.000	.014
	N	76	75	76	71	75	76	76	74	76	76	75	76
Total individuals over 16	*Pearson Correlation*	.711**	1	-.053	-.078	.027	.123	.524**	.268*	-.033	.805**	.520**	-.202
	Sig. (2-tailed)	.000		.648	.516	.816	.283	.000	.021	.773	.000	.000	.076
	N	75	78	76	71	75	78	78	74	78	78	77	78
Career Classify	*Pearson Correlation*	-.077	-.053	1	-.013	.121	-.031	-.133	-.182	.013	-.127	-.087	.078
	Sig. (2-tailed)	.509	.648		.914	.297	.789	.250	.119	.909	.270	.454	.499
	N	76	76	77	72	76	77	77	75	77	77	76	77
Age	*Pearson Correlation*	-.021	-.078	-.013	1	.096	-.130	.102	.163	.066	-.035	.159	.333**
	Sig. (2-tailed)	.860	.516	.914		.425	.276	.396	.177	.584	.768	.184	.004
	N	71	71	72	72	71	72	72	70	72	72	71	72
Education Level	*Pearson Correlation*	-.052	.027	.121	.096	1	-.083	.242*	.233*	.120	.056	.251*	.120
	Sig. (2-tailed)	.657	.816	.297	.425		.475	.035	.046	.301	.631	.030	.301
	N	75	75	76	71	76	76	76	74	76	76	75	76
Distance to station (feet)	*Pearson Correlation*	.140	.123	-.031	-.130	-.083	1	.073	.221	-.738**	.130	.113	-.308**
	Sig. (2-tailed)	.228	.283	.789	.276	.475		.525	.057	0.000	.253	.323	.006
	N	76	78	77	72	76	79	79	75	79	79	78	79
Total bedrooms in home	*Pearson Correlation*	.541**	.524**	-.133	.102	.242*	.073	1	.153	-.010	.611**	.745**	-.055
	Sig. (2-tailed)	0.000	.000	.250	.396	.035	.525		.189	.929	0.000	0.000	.628
	N	76	78	77	72	76	79	79	75	79	79	78	79
Household Income Group	*Pearson Correlation*	.119	.268*	-.182	.163	.233*	.221	.153	1	-.120	.192	.337**	-.159
	Sig. (2-tailed)	.311	.021	.119	.177	.046	.057	.189		.306	.099	.003	.174
	N	74	74	75	70	74	75	75	75	75	75	74	75
Density	*Pearson Correlation*	-.084	-.033	.013	.066	.120	-.738**	-.010	-.120	1	-.014	.025	.032
	Sig. (2-tailed)	.473	.773	.909	.584	.301	0.000	.929	.306		.905	.829	.780
	N	76	78	77	72	76	79	79	75	79	79	78	79
Total individuals in home	*Pearson Correlation*	.591**	.805**	-.127	-.035	.056	.130	.611**	.192	-.014	1	.619**	-.205
	Sig. (2-tailed)	0.000	.000	.270	.768	.631	.253	0.000	.099	.905		0.000	.070
	N	76	78	77	72	76	79	79	75	79	79	78	79
Monthly rent	*Pearson Correlation*	.446**	.520**	-.087	.159	.251*	.113	.745**	.337**	.025	.619**	1	-.032
	Sig. (2-tailed)	.000	.000	.454	.184	.030	.323	0.000	.003	.829	0.000		.784
	N	75	77	76	71	75	78	78	74	78	78	78	78
Months at residence	*Pearson Correlation*	-.280*	-.202	.078	.333**	.120	-.308**	-.055	-.159	.032	-.205	-.032	1
	Sig. (2-tailed)	.014	.076	.499	.004	.301	.006	.628	.174	.780	.070	.784	
	N	76	78	77	72	76	79	79	75	79	79	78	79

** *Correlation is significant at the 0.01 level (2-tailed).

* Correlation is significant at the 0.05 level (2-tailed).

TDM Reduction Strategy Estimates	Description	Typical Reduction
Shared Parking	Parking spaces serve multiple users and destinations	10-30%
Parking Regulations	Regulations favor higher value uses such as service vehicles, deliveries, customers, quick errands and people with special needs	10-30%
More Accurate and Flexible Standards	Adjust parking standards to more accurately reflect demand in aparticular situation.	10-30%
Parking Maximums	Establish maximum parking standards.	10-30%
Remote Parking	Provide off-site or urban fringe parking facilities.	
Smart Growth	Encourage more compact, mixed, multi-modal development to allow more parking sharing and use of alternative modes.	10-30%
Walking and Cycling Improvements	Improve walking and cycling conditions to expand the range of destinations serviced by a parking facility.	5-15%
Increase Capacity of Existing Facilities	Increase parking supply by using otherwise wasted space, smaller stalls, car stackers and valet parking.	5-15%
Mobility Management	Encourage more efficient travel patterns, including changes in mode, timing, destination and vehicle trip frequency.	10-30%
Parking Pricing	Charge motorists directly and efficiently for using parking facilities.	10-30%
Improve Pricing Methods	Use better charging techniques to make pricing more convenient and cost effective.	Varies
Financial Incentives	Provide financial incentives to shift mode such as parking cash out.	10-30%
Unbundle Parking	Rent or sell parking facilities separately from building space.	10-30%
Parking Tax Reform	Change tax policies to support parking management objectives.	5-15%
Bicycle Facilities	Provide bicycle storage and changing facilities.	5-15%
Improve Information and Marketing	Provide convenient and accurate information on parking availability and price, using maps, signs, brochures and the Internet.	5-15%
Improve Enforcement	Insure that regulation enforcement is efficient, considerate and fair.	Varies
Transport Management Association	Establish member-controlled organizations that provide transport and parking management services in a particular area.	Varies
Overflow Parking Plans	Establish plans to manage occasional peak parking demands.	Varies
Address Spillover Problems	Use management, enforcement and pricing to address spillover problems.	Varies
Parking Facility Design and Operation	Improve parking facility design and operations to help solve problems and support parking management	Varies

* Source: *Parking Management: Strategies, Evaluation and Planning. Todd Litman (2009)*

Site Profiles	AMLI at Inverness				Alexan at CityCenter							
Address	10001 E. Dry Creek Road Englewood, Colorado 80112				801 Englewood Parkway Englewood, Colorado 80110							
Development Date	2007				2000							
Development Phase	N/A				Phase I				Phase II			
Development Cost	$40,180,000				$155,000,000							
Units	Total	# Occup	% Occup	Avg. Rent	Total	# Occup.	% Occup.	Avg. Rent	Total	# Occup	% Occup.	Avg. Rent
Total Units	309	106	34%	$1128	227	215	95%	$984	211	200	95%	$984
1 Bedroom Units	192	46	24%			123				111		
2 Bedroom Units	99	57	58%			83				74		
3 Bedroom Units	18	3	17%			9				15		
Total Parking Supply	505				427				317			
Parking Supply by Category	Total	Rented	Cost/Mth	Guest	Total	Rented	Cost	Guest	Total	Rented	Cost	Guest
Surface Lot	206	N/A	$0	0	335	N/A	$0	0	0	N/A	N/A	0
Car Port	40	13	$40	0	26	21	$35	0	0	N/A	N/A	0
Parking Structure	259	0	$75	0	0	N/A	N/A	0	317	N/A	$20*	0
Individual Garage	0	N/A	N/A	N/A	66	51	$100	0	0	N/A	N/A	0
Expected Development Ratio (Entire Complex)	1.80				1.50				1.50			
Expected Development Ratio (Normalized for Occupancy)	2.02				1.50				1.50			
Built Ratio (Difference from Expected)	1.63		-9.2%		1.88		25.4%		1.50		0%	
TDM Practices?	none				none				none			
Walking Distance to Station	2525′-3077′				678′-1562′				135′-1058′			
Walking Time to Light Rail**	9:37 - 12:29				2:42-6:18				:32-4:11			
Multimodal Options	Routes	Distance	Frequency		Routes	Distance	Frequency		Routes	Distance	Frequency	
Local Bus	1	1320′	30 minutes		5	678′	5-35 minutes		5	135′	5-35 minutes	
Regional Bus	0	N/A	N/A		1	678′	Twice/Day		1	135′	Twice/Day	
Light Rail	4	2525′	5-15 minutes		2	678′	5-15 minutes		2	135′	5-15 minutes	
call-n-Ride	2	N/A	on call		N/A	N/A	N/A		N/A	N/A	N/A	
Development Size (Acres)	10.09				7				4.7			
Density (Units/Acre)	30.6				32.4				44.9			
Land Coverage (Build, Park)	27%		34%									

* Cost is bundled into the monthly unit rent

**Average reported as range between back and front of complex in minutes

Resident Attitude Summary	Strongly Disagree (1)	Disagree (2)	Neutral (3)	Agree (4)	Strongly Agree (5)	Rating Average	Response Count
I would like to own at least one more car.	**40%**	25%	6%	9%	18%	2.39	77
I prefer to take transit rather than drive whenever possible.	6%	26%	22%	**27%**	18%	3.25	77
I prefer to live in a neighborhood where I can combine exercising and commuting.	1%	5%	21%	**45%**	27%	3.91	75
Air quality is a major problem in this region.	4%	**34%**	29%	22%	12%	3.04	77
I need a car to do many of the things I like to do.	1%	8%	9%	**58%**	23%	3.93	74
I am willing to pay a toll or tax to pay for new highways.	16%	28%	**30%**	21%	5%	2.72	76
I like driving.	4%	16%	21%	**38%**	22%	3.58	77
I prefer to bike rather than drive whenever possible.	14%	**36%**	31%	10%	6%	2.56	70
Public transit can sometimes be easier for me than driving.	4%	19%	13%	**40%**	23%	3.60	77
I try to limit my driving to help improve air quality.	9%	**29%**	25%	28%	8%	2.96	76
When practical, I would choose transit over driving to protect the environment.	6%	19%	25%	**32%**	16%	3.32	77
Getting to work without a car is a hassle.	9%	11%	20%	26%	**29%**	3.58	76
I prefer to organize my errands so that I make as few trips as possible.	0%	3%	5%	44%	**48%**	4.37	75
The price of gasoline affects the choices I make about my daily travel.	8%	16%	23%	**38%**	13%	3.33	77
Fuel efficiency is an important factor for me in choosing a vehicle.	4%	6%	8%	**45%**	34%	4.01	77
We could manage pretty well with one fewer car than we have (or with no car).	19%	**31%**	16%	16%	13%	2.70	77
Vehicles should be taxed on the basis of the amount of pollution they produce.	9%	21%	**33%**	24%	13%	3.11	76
When I need to buy something, I prefer to get it at the closest store possible.	3%	9%	9%	**59%**	21%	3.86	78
The region needs to build more highways to reduce traffic congestion.	4%	28%	**38%**	19%	11%	3.06	79
My household spends too much money on owning and driving our cars.	11%	**37%**	28%	20%	3%	2.65	79
I am concerned about global warming and/or climate change.	6%	14%	22%	**37%**	21%	3.51	78
I love the freedom and independence that owning several cars provides for my household.	6%	15%	22%	**32%**	10%	3.28	78
I think I am wasting too much time driving in congestion.	5%	**39%**	18%	25%	10%	2.96	77
I think I should spend more time walking or riding a bicycle just to be healthier.	0%	9%	16%	**57%**	18%	3.84	79
I think I should be more active in doing my part to protect the environment.	1%	9%	25%	**49%**	15%	3.67	75
Protecting the environment should be given top priority, even if it means an increase in taxes.	6%	19%	**39%**	18%	17%	3.19	77
I'd be willing to drive less to reduce my use of foreign oil.	5%	14%	**23%**	41%	12%	3.42	78
Economic growth and protection of jobs should have a higher priority than environmental protection.	10%	13%	**38%**	24%	14%	3.19	78
Automobiles contribute significantly to air pollution in our country.	0%	5%	14%	**44%**	37%	4.13	79
Staying active and getting regular exercise is a top priority for me.	1%	9%	18%	**37%**	33%	3.94	78
It would be hard for me to reduce my auto mileage and use of gasoline.	4%	22%	18%	41%	14%	3.40	79
I prefer to walk rather than drive whenever possible.	3%	15%	29%	40%	13%	3.45	78

Appendix B - Survey Instrument

Survey Response Breakdown by Site and Mode	ID Series	Pop. Size	Internet	Mail	Office	Total	Rate
AMLI	7	102	12	4	5	21	20.5%
City I	3	195	13	10	7	30	15.3%
City II	5	190	16	9	5	30	15.7%
Totals		487	41	23	17	81	16.6%

» The survey was implemented as a mixed-mode survey. Respondents were given the option to complete a web –based questionnaire www.arapahoeparkingsurvey.com or complete a paper form and return it to his or her leasing office. A third option allowed residents to mail the survey to the home of the researcher. Envelopes included a self address (un)stamped envelop. Interestingly, a larger number of residents chose to affix postage and mail the survey as opposed to returning it to the leasing office. This indicates the potential for a higher response rate if return envelopes included postage.

» A reminder and thank you letter was delivered 7-14 days after initial distribution.

» Twenty individuals unaffiliated with the study tested the survey to check for errors and other computer based problems. Adjustments were made accordingly.

» Arapahoe County generously purchased gift certificates to Maggiano's Little Italy for use as incentives for completing the survey.

» The low response rate incurred by the survey likely introduced significant sample bias into the results. This is evident by the large proportion of respondants indicating possession of a college degree.

Arapahoe County
Colorado's First

Public Works and Development

10730 E. Briarwood Avenue, Suite 100
Centennial, Colorado 80112-3853
Phone: 720-874-6500
Fax: 303-794-3201
TDD: 720-874-6574
www.co.arapahoe.co.us
works@co.arapahoe.co.us

DAVID M. SCHMIT, P.E.
Director

11 February 2008

Arapahoe County Parking Utilization Study
Transit Oriented Developments
Residential Development Involvement Summary

What?

The purpose of this study is to gather parking and demographic data on residential developments within Arapahoe County.

Why?

This data will be used to gauge the adequacy of parking ratio requirements for residential developments within proximity of RTD Light Rail stations in Arapahoe County.

Who?

This project is being conducted by Christopher Topp, Masters Candidate at the University of Colorado at Denver School of Public Affairs in conjunction with the Arapahoe County Department of Public Works and Development.

Where?

Your development was one of three selected for this study. Each site was selected based on a set of shared similar characteristics including development date and distance to the Dry Creek Light Rail Station.

How?

This study will profile each site using two methods: physical observation of parking utilization at the site and a small residential demographic and transportation survey. A description of each method can be found on the following page.

When?

Weather permitting, all observations and survey work will occur during March 2009.

Next Step:

Please contact the primary researcher for this project as soon as possible with any questions or concerns. Contact information can be found on the following page. To keep this project on schedule, the goal is to finalize all details by Friday, February 20th, 2009. You will be contacted on Monday, February 16th, 2009 to discuss the project further.

Thank you:

On behalf of Arapahoe County and the University of Colorado at Denver, thank you. Your cooperation with and participation in this study will help the county better understand development patterns today so it can better serve you tomorrow.

Explanation of Study Procedures

Part 1: Parking Observations

This part of the study involves a physical count of cars parked on premise at certain intervals over a 10-day period. The number of cars present at each interval will be the only data collected during this process. This will require access to all shared parking facilities (surface and garage) for a short period at each time interval. These intervals will be provided to you prior to the beginning of data collection.

Part 2: Residential Survey

To better understand the relationship between parking utilization and alternative transit choice, a short Internet survey will be distributed to your residents. Questions will be designed to create a demographic profile of your residents relating to his or her transportation choices. The survey will be voluntary and anonymous, posing general questions to residents regarding household size, car ownership and transit choice. The basic method involves placing an envelope at the door of each unit with an explanation of the survey and web address inside. This method, however, is designed to be flexible. This study recognizes the existence of different management policies regarding resident privacy, and intends to work with you to develop a way to distribute the information that meets the needs of all those involved.

Miscellaneous:

As previously stated, generating sufficient data to assist the county will require a comprehensive profile of each development. Any additional information that can be provided by the property managers will be appreciated. This includes but is not limited to:

- Total number of units under lease or private ownership.
- Amount of vehicles registered with the facility (if such information is required).
- Range of rent and/or purchase price of occupied units.
- Transportation Demand Management strategies (such as issuance of RTD EcoPass, if applicable)
- Any available development cost data

Again, all of this information will be kept confidential and will only be used for the purposes of this study.
Please do not hesitate to contact any of those listed below if you have any questions. Chris will be in touch with you on Monday February 16th.

Contact Information:

Primary Research Coordinator

Christopher Topp
University of Colorado at Denver
School of Public Affairs
Christopher.Topp@gmail.com
303-718-6631

Arapahoe County Contacts

Jan Yeckes
Planning Division Manager
Department of Public Works and Development
10730 E. Briarwood Ave., Ste 100
Centennial, Colorado 80112
jyeckes@co.arapahoe.co.us
303-874-6574

Ron Hovland
Planning Program Manager
Department of Public Works and Development
10730 E. Briarwood Ave., Ste 100
Centennial, Colorado 80112
rhovland@co.arapahoe.co.us
720-874-6574

Survey Participation Invitation

23 March 2009

Resident - Englewood City Center
801 Englewood Parkway
Englewood, Colorado
80110

Dear Sir or Madam,

Hello. My name is Christopher Topp. I am a graduate student at the University of Colorado at Denver. In May, I will graduate with a Master's of Public Administration. This semester I am completing my capstone research project with the Arapahoe County Department of Public Works and Development. I am studying to determine if amount of parking required by the County sufficiently meets the needs of residents living near light rail stations. Your complex is one of three being studied for this project near light rail stations within Arapahoe County

Your input is tremendously important to this study. You are being asked to complete a short survey designed to help uncover the factors contributing to parking demand. I would greatly appreciate if you would take a few minutes responding to a short list of questions about your home, family, cars, and transportation habits. At most, the survey should take 10 minutes to complete.

There are two ways to complete this survey. If you prefer the click of a keyboard, you can complete it on the Internet. If you believe in the power of the pen, the printed version is for you. Please flip over this paper for a short "how-to" on each method.

The survey is both confidential and voluntary. The information you provide will neither be used to identify you nor contact you beyond the scope of this project. If there are questions you do not feel comfortable answering, please skip them. If you have any questions involving the survey, please call or send me an e-mail. Comments are also welcome and appreciated. You may also contact Jan Yeckes with Arapahoe County at 720.874.6655.

I often feel there are not enough hours in the day for everything there is to do. I imagine you feel the same. Therefore, on behalf of myself, the University of Colorado at Denver and the Arapahoe County Department of Public Works and Development, thank you. Thank you for your time reading this letter and for contributing a few minutes of your day to complete the survey. In addition to helping me graduate, you will also be providing Arapahoe County with the information necessary to make future planning decisions that best meet your needs as a resident.

Please note: While Alexan CityCenter has agreed to cooperate with this study, it is *not* a participant. It is neither providing any personal information to the project nor is it collecting any in return.

Very sincerely,

Christopher Topp
Master's Candidate
University of Colorado Denver-School of Public Affairs
Christopher.Topp@gmail.com
303.718.6631

To show our appreciation for your participation, we will hold a drawing for two $50 gift cards to Maggiano's Little Italy for each of the three developments involved in the study. You will have the option to submit your e-mail or telephone number for the drawing after completing the survey.

Option 1 - For the Digital Lifestyle: The Internet

Whether you are logged on at your local coffee hotspot or avoiding completing another "TPS Report," you can complete the survey any time, any place. It is accessible via the following link (intentionally easy to remember, so saying you forgot isn't an option!):

www.arapahoeparkingsurvey.com

You will be asked to enter this Survey ID Code

Survey ID Code	310203

Here is a little sticky note to make yourself a reminder. Genius huh? This couldn't be any easier!

- The only purpose of this code is to prevent duplicate surveys
- There will be additional details on the welcome page for the survey.
- If you have any questions, don't hesitate to shoot me an e-mail! (Christopher.Topp@gmail.com)
- Remember it shouldn't take longer than 10-15 minutes max!

Option 2 - Fans of Sharpies and Pencils: The Printed Form

Feel free to choose your writing utensil. Be creative! (So long as its legible) Sharpies, colored pencils or a felt tip pen will all suffice. A printed copy of the survey is enclosed in this envelope. After you finish it, please take it to your leasing office. They will have a big box to put it in. Or, if you prefer, you can mail it back to me snail-mail style. Either way, be sure to finish and turn it in by April 6th.

- Please notice the survey is printed on both the front and back side of the page (this project is eco-friendly!)
- If you have any questions, don't hesitate to call me! (303.718.6631)
- Remember it shouldn't take longer than 10-15 minutes max!
- Have fun!

Remember - This study values your privacy.
No attempt will be made to identify you using the information you provide.
Please complete the survey accurately and to the fullest possible extent

Please complete by April 6th, 2009!!

Resident Follow up Letter

March 30th, 2009

Dear Resident,

On March 23rd, 2009 you received a request to participate in my Master's Capstone Project by completing a short survey. The survey included questions involving your living situation, parking at your residential complex and transportation choices. This letter serves two purposes. It is a thank you to those who completed the survey and a reminder for those who have not yet done so (remember, the survey is anonymous so I do not know who has and who has not).

A Reminder:

The other day in the mail I got a survey from Nielsen. It had a dollar bill inside the envelope to help boost the response rate. It wasn't a brand new dollar bill though. It had definitely seen the inside of a washing machine and who knows what else. I felt cheated. "They can't even send me a 'new' dollar bill??!!" I didn't want to fill the survey out, but didn't want to tempt karma so I did.

I can't enclose cash. As it turns out, grad students don't have that much. But you can win dinner at Maggiano's worth $50.** (Don't worry, I can't win my own drawing, although I wish I could.) All you have to do is take 10 minutes to either fill out the printed survey you received on March 23rd, or log onto the web and complete it there.

Otherwise, all I can do is ask as nicely as possible that you take the time to help with this project. The number of responses so far has not been very high. The strength of the project's conclusions depends directly on the number of surveys I get back. So please take a few minutes to complete the survey by April 6th. If you forgot or misplaced your Survey ID, please email or call me for another one.

You can either turn it into the box in the leasing office, drop it in the mail or visit:

www.arapahoeparkingsurvey.com

A Thank You:

To those of you who returned the survey, you have my sincerest appreciation. Your answers will be put to good use as I combine and analyze them for my final report. For those who chose to enter the drawing, you will find out if you were selected to receive a gift certificate during the second week in April.

Christopher Topp
Master's Candidate - University of Colorado at Denver
School of Public Affairs
303-718-6631
Christopher.Topp@gmail.com

** Just a quick FYI-- Say you spend 10 minutes completing the survey and you win the gift certificate, that is equivalent to $300/hour for your time!!! How can you beat that? (You can't, so stop procrastinating and do your survey!)

Survey Instrument

Arapahoe County Residential Parking Survey

This survey is designed to understand the factors contributing to parking demand for residential complexes located near RTD Light Rail Stations within Arapahoe County. The results will be used by the county to help determine the adequacy of developmental code requirements.

We understand that your time is valuable. This survey is designed to be complete in 10 minutes. Please answer all questions as accurately as possible. All of the information will be held strictly confidential and none of it will be used to identify you in any way. Your participation is greatly appreciated. If you have any questions, contact information can be found at the end of the survey. Please do not hesitate to contact me!

If you prefer, you may also complete the survey online: You will be asked to enter the "Survey ID Code" listed above. The purpose of this code is to prevent duplicate submissions. The survey can be accessed via the following link:

www.arapahoeparkingsurvey.com

Thank you for your help!

Christopher Topp

University of Colorado at Denver, School of Public Affairs

Housing Questions

Your residence is a(n)...

- ❑ single family home.
- ❑ duplex/townhouse.
- ❑ apartment/condominium.
- ❑ mobile home.
- ❑ other? _____

How many bedrooms are in your home?

- ❑ efficiency (0)
- ❑ one
- ❑ two
- ❑ three or more

How many total people live in your home? _____

How many of the individuals living in your home are over the age of 16? _____

Do you rent or own your home?

- ❑ rent
- ❑ own

What is the approximate value of your current home? If you are unsure of the answer, please give your best estimate. $_____

What is your total household monthly rent or mortgage? If you are unsure of the answer, please give your best estimate. $_____

How long have you lived at your current residence? _____ years _____ months

The following statements indicate feelings and attitudes toward your neighborhood. Please give your opinion on each statement using the scale from "strongly disagree" to "strongly agree."

	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
My neighborhood has an adequate number of good sidewalks.	❑	❑	❑	❑	❑
My neighborhood has frequent bus or light rail services.	❑	❑	❑	❑	❑
The buses or other transit services in my neighborhood serve areas in which I frequently need to travel.	❑	❑	❑	❑	❑
My home has adequate room for parking two or more cars.	❑	❑	❑	❑	❑
Biking in my neighborhood is safe and enjoyable.	❑	❑	❑	❑	❑
My home is conveniently located to where I work or go to school.	❑	❑	❑	❑	❑
In a neighborhood like mine, I can exercise by walking or bicycling.	❑	❑	❑	❑	❑
In a neighborhood like mine, I can walk to stores, restaurants and other activities.	❑	❑	❑	❑	❑
In a neighborhood like mine, I can take public transportation to work or for other trips.	❑	❑	❑	❑	❑
In a neighborhood like mine, my household can own fewer cars.	❑	❑	❑	❑	❑
Overall, I am very satisfied with my current neighborhood.	❑	❑	❑	❑	❑

Automobile and Parking Questions

Do you have a driver's license?

❑ Yes. ❑ No.

Earlier, you indicated the number of people over age 16 living in your home. How many of those individuals have a driver's license? _____

How many motorized* vehicles are available to you and members of your household for daily travel?

❑ 0
❑ 1
❑ 2
❑ 3
❑ Other. How many? _____

Approximately how many miles do you drive in a typical week (including weekends)? _____

During a typical week, how many people usually travel in the vehicle with you for each trip (including the driver)? _____

What type of parking do you use most often at your current home location?

❑ private garage for 2 or more cars
❑ private driveway or carport for 2 or more cars
❑ street parking
❑ parking lot (hourly fee)
❑ other (please describe) : _____
❑ private garage for 1 car only
❑ private driveway or carport for 1 car only
❑ parking lot (free)
❑ parking lot or garage (monthly rental)

Does your housing complex have…

❑ not enough parking.
❑ just the right amount of parking.
❑ too much parking.

Please think about the vehicles you had at your previous residence just before you moved.

How many motorized vehicles were available to you and members of your household for daily travel just before you moved?

❑ 0
❑ 1
❑ 2
❑ 3
❑ More than 3. How many? _____

* This includes all cars, trucks, sport utility vehicles, vans, motorcycles, scooters or any other vehicle that is able to be driven on public roadways.

Did the number of vehicles available for daily travel by your household change as a result of the characteristics of your current neighborhood?

B9

- ❑ No, but I/we are considering getting rid of a vehicle because of the characteristics of the neighborhood.
- ❑ No, but I/we are considering getting another vehicle because of the characteristics of the neighborhood.
- ❑ No, moving to this place has had no impact on the number of vehicles available to my household.
- ❑ Yes, I/we got rid of a vehicle because of the characteristics of the neighborhood.
- ❑ Yes, I/we got an additional vehicle because of the characteristics of the neighborhood.

	A lot less now	A little less now	About the same	A little more now	A lot more now
How much do you drive now, compared to when you lived at your previous residence?	❑	❑	❑	❑	❑
How much do you use public transit (bus or rail) now, compared to when you lived at your previous residence?	❑	❑	❑	❑	❑

Work and Travel Questions

Do you work or go to school outside your place of residence? (Check all that apply)

- ❑ Yes, I work outside of home.
- ❑ Yes, I attend school outside of home.
- ❑ No, I work/take courses at home.
- ❑ No, I am not employed or in school.

What is your ONE-WAY commute distance to work or school? If you are unsure of the answer, please give your best estimate. (If you go to work AND go to school, please answer this question for the place you go most often.)

- ❑ 1/3 mile or less
- ❑ more than 1/3 mile to 1 mile
- ❑ more than 1 mile to 2.0 miles
- ❑ more than 2.0 miles to 5.0 miles
- ❑ more than 5.0 miles to 10 miles
- ❑ more than 10 miles to 20 miles
- ❑ more than 20 miles to 30 miles
- ❑ more than 30 miles
- ❑ I do not work or go to school outside my home.

Does your employer? (check all that apply)

- ❑ allow you to work flexible hours
- ❑ allow you to work from home
- ❑ pay for transit
- ❑ help pay for tolls, fuel or other commuting costs
- ❑ I am not employed or do not commute to work.
- ❑ provide free parking
- ❑ help pay for transit (subsidized cost of transit pass)
- ❑ provide a car for use during the day
- ❑ organize or encourage employee carpooling efforts

At this time of year, **how often do you use each of the following as your primary means of transportation to work/school? By "primary" we mean the means of transportation you use for the longest portion of your trip.**

	4-5 times per week	2-3 times per week	1 time per week	1-3 times per month	Less than 1 time per month	Never
Drive alone (including motorcycle)	❑	❑	❑	❑	❑	❑
Carpool	❑	❑	❑	❑	❑	❑
RTD light rail	❑	❑	❑	❑	❑	❑
RTD bus/call-n-Ride	❑	❑	❑	❑	❑	❑
Walk or bicycle	❑	❑	❑	❑	❑	❑
Other: _____	❑	❑	❑	❑	❑	❑

During the summer or when it's warmer and not raining, how often do you use each of the following as your primary means of transportation to work/school?

	4-5 times per week	2-3 times per week	1 time per week	1-3 times per month	Less than 1 time per month	Never
Drive alone (including motorcycle)	❑	❑	❑	❑	❑	❑
Carpool	❑	❑	❑	❑	❑	❑
RTD light rail	❑	❑	❑	❑	❑	❑
RTD bus/call-n-Ride	❑	❑	❑	❑	❑	❑
Walk or bicycle	❑	❑	❑	❑	❑	❑
Other: _____	❑	❑	❑	❑	❑	❑

For the following situations, please indicate whether you would be more or less likely to use transit (bus and light rail) than you indicated above.

	Much less likely	Less likely	About the same	More likely	Much more likely
I received a free transit pass from my employer.	❑	❑	❑	❑	❑
I received a transit pass from my housing complex.	❑	❑	❑	❑	❑
My school or place of employment was closer to a transit station.	❑	❑	❑	❑	❑
My commute to work or school was substantially shorter using transit than driving.	❑	❑	❑	❑	❑
The cost of transit was cheaper.	❑	❑	❑	❑	❑
The cost of gas was more expensive.	❑	❑	❑	❑	❑
The cost of parking at work or school increased.	❑	❑	❑	❑	❑
The cost of parking at home increased.	❑	❑	❑	❑	❑

Do you have a monthly or other type of transit pass that you use regularly (such as EcoPass) to use RTD? (If "no" please skip next question.)

❑ Yes. ❑ No.

How did you obtain your transit pass? (check all that apply)

❑ Purchased it myself through RTD or another location.
❑ Received it for free from my housing complex.
❑ Received it at a discount through my housing complex.
❑ Other? _____
❑ Received it for free from my employer.
❑ Received it at a discount through my employer.
❑ Received it through school.

General Questions About You

Gender:

❑ male ❑ female

Age: _____

What is your relation to the head of your household?

❑ I am the head of household.
❑ spouse
❑ child
❑ sibling (brother or sister)
❑ unmarried partner
❑ parent
❑ other family member
❑ friend

Ethnicity or race:

- ❑ African American
- ❑ Caucasian
- ❑ Hispanic/Latino(a)
- ❑ Pacific Islander
- ❑ American Indian
- ❑ Asian
- ❑ Other _____

Current occupation:

- ❑ accounting/financial
- ❑ clerical/secretarial
- ❑ manager/administrator
- ❑ craftsman
- ❑ not currently employed
- ❑ other _____
- ❑ sales
- ❑ service
- ❑ professional
- ❑ laborer
- ❑ student

Approximate household income after taxes:

- ❑ $15,000 or less
- ❑ $15,001 - $30,000
- ❑ $30,001 - $45,000
- ❑ $45,001 - $60,000
- ❑ $60,001 - $75,000
- ❑ $75,001 - $100,000
- ❑ $100,001-$150,000
- ❑ $150,001 and over

What is the highest grade or year of school you have completed?

- ❑ less than high school graduate
- ❑ high school graduate, including GED
- ❑ some college or associates degree (including business, vocational or trade school)
- ❑ bachelor's degree
- ❑ graduate or professional school degree

Do you have any physical or anxiety condition that seriously limits or prevents you from doing any of the following?

Driving a vehicle.	❑ Yes	❑ No
Walking outside the home.	❑ Yes	❑ No
Riding a bicycle.	❑ Yes	❑ No
Using public transit.	❑ Yes	❑ No

The following statements indicate several opinions related to parking and transportation issues. Please indicate your opinion to each statement using a scale from "strongly disagree" to "strongly agree."

	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
I would like to own at least one more car.	❑	❑	❑	❑	❑
I prefer to take transit rather than drive whenever possible.	❑	❑	❑	❑	❑
I prefer to live in a neighborhood where I can combine exercising and commuting.	❑	❑	❑	❑	❑
Air quality is a major problem in this region.	❑	❑	❑	❑	❑
I need a car to do many of the things I like to do.	❑	❑	❑	❑	❑
I am willing to pay a toll or tax to pay for new highways.	❑	❑	❑	❑	❑
I like driving.	❑	❑	❑	❑	❑
Public transit can sometimes be easier for me than driving.	❑	❑	❑	❑	❑
I try to limit my driving to help improve air quality.	❑	❑	❑	❑	❑
When practical, I would choose transit over driving to protect the environment.	❑	❑	❑	❑	❑
Getting to work without a car is a hassle.	❑	❑	❑	❑	❑
I prefer to organize my errands so that I make as few trips as possible.	❑	❑	❑	❑	❑
The price of gasoline affects the choices I make about my daily travel.	❑	❑	❑	❑	❑
Fuel efficiency is an important factor for me in choosing a vehicle.	❑	❑	❑	❑	❑

	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
We could manage pretty well with one fewer car than we have (or with no car).	❑	❑	❑	❑	❑
Vehicles should be taxed on the basis of the amount of pollution they produce.	❑	❑	❑	❑	❑
When I need to buy something, I prefer to get it at the closest store possible.	❑	❑	❑	❑	❑
The region needs to build more highways to reduce traffic congestion.	❑	❑	❑	❑	❑
My household spends too much money on owning and driving our cars.	❑	❑	❑	❑	❑
I am concerned about global warming and/or climate change.	❑	❑	❑	❑	❑
I love the freedom and independence that owning several cars provides for my household.	❑	❑	❑	❑	❑
I think I am wasting too much time driving in congestion.	❑	❑	❑	❑	❑
I think I should spend more time walking or riding a bicycle just to be healthier.	❑	❑	❑	❑	❑
I think I should be more active in doing my part to protect the environment.	❑	❑	❑	❑	❑
I think that environmental concerns are overblown.	❑	❑	❑	❑	❑
Protecting the environment should be given top priority, even if it means an increase in taxes.	❑	❑	❑	❑	❑
I'd be willing to drive less to reduce my use of foreign oil.	❑	❑	❑	❑	❑
Economic growth and protection of jobs should have a higher priority than environmental protection.	❑	❑	❑	❑	❑
Automobiles contribute significantly to air pollution in our country.	❑	❑	❑	❑	❑
Staying active and getting regular exercise is a top priority for me.	❑	❑	❑	❑	❑
It would be hard for me to reduce my auto mileage and use of gasoline.	❑	❑	❑	❑	❑
I prefer to walk rather than drive whenever possible.	❑	❑	❑	❑	❑

Congratulations!!

The survey is complete.

Please return the survey to your leasing office or mail it to the address listed below no later than:

April 6th, 2009

If you have any questions, please do not hesitate to call or e-mail me using the information listed below.

Thank you again for your participation!!

Christopher Topp
Masters Candidate
University of Colorado - School of Public Affairs
Christopher.Topp@gmail.com
303-718-6631

Survey Return Address:
Arapahoe Parking Survey
2698 Marion St.
Denver, CO
80205

To be entered for a chance to win one of six* $50 gift certificates to Maggiano's Little Italy, please enter your e-mail OR phone number below.
This information will be separated from the survey to maintain confidentiality.

E-mail:_____ Phone Number:_____

* Two gift certificates will be awarded to each of the three residential study areas.

Appendix C -Academic Curriculum Contributions

Knowledge gained throughout the program contributed to the development, pursuit, and completion of this project. While the lessons and skills from each course are involved either directly or indirectly in this project, some were more pertinent than others. The following provides a description of those courses and their applicability.

- URP 6651 - Environmental Impact Assessment: Taken as an elective for the Environmental Management, Policy and Law Concentration, this course focused on the National Environmental Policy Act and the regulations contained within. The semester was devoted to synthesizing an Environmental Impact Assessment for a transportation issue in the Denver. This project piqued my interest in both FastTracks and Transit Oriented Development. I relied heavily on resources from the Denver Regional Council of Governments for the project and my residual interest drove me to pursue a capstone project through that agency. In turn, DRCOG directed me to the Arapahoe County Department of Public Works and Development, the eventual client for this project.
- PAD 5005 - The Policy Process and Democracy: One of the more valuable classes in the program, this course provided a functional skill set heavily employed during this project. First it facilitated the ability to recognize public policy needs and assisted in understanding the role of regulation in achieving policy objectives. Given the impact of parking and the objectives of the Arapahoe County Comprehensive Development Plan, there is a clear policy window with respect to parking. This opportunity provides the foundation for this project.
- PAD 5003 - Pubic Finance and Economics: This course provided knowledge necessary to understand the supply and demand principles discussed in this project and the role of government as a provider of public goods and a regulator of the free market. In this case, government provision of parking is creating an oversupply. The resultant cost of the negative externalities are discussed in this paper.