NEW DATA FOR A NEW ERA

A Summary of the SMARTRAQ *Findings*

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Linking Land Use, Transportation, Air Quality and Health in the Atlanta Region

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January 2007

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Preface

As a major metro area in a Sunbelt state, Metro Atlanta's population has doubled to over 4 million in the last 20 years. Over the next 25 years, it is projected to increase by another 2.5 million. These newcomers are the equivalent to the population of greater Denver coming to Atlanta – and staying.

With increasing traffic and development, it is not surprising that many residents say "close the door to new arrivals." But as demonstrated by a recent high-profile Task Force on growth in Metro Atlanta, attitudes seem to be shifting in important ways among the region's business, governmental and civic leaders.

Recently, the Metro Atlanta Chamber of Commerce persuaded business, neighborhood, environmental, and civic leaders, prominent elected officials and State and regional agency heads to join a Quality Growth Task Force and commit to personally attend monthly meetings.

The group's mandate:

- To arrive at consensus on what it will take to accommodate the next 2.5 million people (land development strategies, linkage with infrastructure (transportation and water), etc; and
- To identify the policies and tools that can be implemented realistically.

A national consulting firm worked pro bono, committees were formed and chaired by Task Force leaders, and for more than a year they researched and analyzed the issues, studied other metropolitan areas, identified best practices and modeled alternative development strategies.

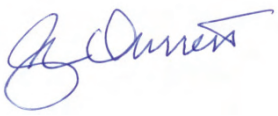
The work led to some surprising conclusions - and unanimous consensus - on specific recommendations. The region can accommodate the next 2.5 million people and actually improve its quality of life, even reducing traffic congestion from today's levels, although improved links among transportation, land use, sewers and other infrastructure are clearly needed. The Task Force agreed that certain centers and corridors were ripe for redevelopment, taking growth pressure off the region as a whole. With redevelopment, more residents would be able to live closer to jobs and services, reinvigorating communities and furthering market choice.

But how best to turn recommendations into reality? The final recommendation was to create a formal, independent and diverse Livable Communities Coalition - now fully funded for the first 3 years of operation - with an "action bias" to activate grassroots support, make change happen, and raise the leadership quotient around these issues. Today, approximately 35 organizations and institutions are Coalition members, who work together to implement the Quality Growth Task Force recommendations.

The findings of the SMARTRAQ research program and the policy implications regarding better linkage of transportation and development decisions, and satisfying consumer demand for more housing choice, support and bear out the work of the Livable Communities Coalition and its genesis, the Quality Growth Task Force.

We recommend this summary report to all who wish to better understand how our growth and development choices and decisions impact our quality of life and our ability to create and maintain a sustainable region.

Kevin Green
Public Policy Division
Metro Atlanta Chamber of Commerce



Jim Durrett
Executive Director
Livable Communities Coalition

Foreword: Charting New Waters

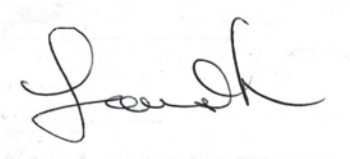
SMARTRAQ is a groundbreaking effort, designed to challenge the status quo with new methods, and results that shed light on new facets of urban planning issues. As a result, SMARTRAQ publications have gotten a great deal of local, national, and international press and constitute some of the strongest evidence to date linking the built environment with public health.

In the process, we have aroused some strong opinions around these issues. The prospect that community design is at least partially accountable for emerging public health problems, climate change, and poor air quality is likely to bait considerable challenge. After all, it would be remiss not to point out that a large part of the economic base in the Atlanta region (and likewise throughout the US) is in the conversion of raw land to urban use and is inextricably tied to our "car culture."

Our analyses of SMARTRAQ data, published in 2004 and 2005 in the American Journal of Preventive Medicine went through an extensive peer review process, as would any legitimate piece of research. Additionally, these papers were co-authored by the Centers for Disease Control and Prevention, which means they were subjected to an additional layer of review. This ensured that they met the rigorous standards of medical publications and the methods used were consistent with commonly adopted research in the medical profession. Not only are our findings replicable, a growing number of recent studies from other regions around the country have published similar results.

The amount of press and attention given to the obesity epidemic is far too attractive to not draw new researchers who want to "weigh in" to the debate. This has the potential to be a healthy part of scholarly discourse. However, it is all the more important that a careful reading of the motivation of such efforts, and that funding sources, methods, the interpretation of new findings, and how those findings relate to already published efforts be carefully assessed for accuracy and objectivity.

Further, for all the tangible benefits SMARTRAQ has associated with a walkable built environment - better air quality, more transportation options and increased levels of physical activity – there are also almost countless intangible benefits. Decreases in health care costs and air pollution are measurable and worthy goals, and even better, achieving them means achieving many other benefits that are impossible to quantify. Even though it may not be possible to measure the pleasure of taking a stroll around the neighborhood, the beauty of a clear sky, or the security of being able to safely cross the street with your children, these are the qualities of a place that make it truly livable.



Dr. Lawrence D. Frank
Principal SMARTRAQ Investigator and Co-Project Director

J. Armand Bombardier Chair in Sustainable Transportation Systems,
University of British Columbia
Senior Non-Resident Fellow, Brookings Institution
President, Lawrence Frank & Co., Inc.

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SMARTRAQ: STRATEGIES FOR METROPOLITAN ATLANTA'S TRANSPORTATION AND AIR QUALITY

THE PRIMARY GOAL: "Develop a framework for assessing land use and transportation policies having the greatest potential for reducing the level of auto dependence and vehicle emissions in the Atlanta metropolitan area while sustaining the economic vitality and environmental health of the region."

New Data for a New Era: REPORT ACKNOWEDGEMENTS

Layout and cover illustration by Gina Tolentino. Thanks to Jim Durrett, Kevin Green, and Elke Davidson for their helpful comments.

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Executive Summary

SMARTRAQ: THE FACTS

The SMARTRAQ project began in 1998 when the Atlanta region's transportation plan was forecast to violate emissions standards under the federal Clean Air Act. Barred from using federal road money until a complying plan could be approved, the Atlanta region's spread-out growth patterns were making it increasingly clear that addressing traffic congestion, choke points, and mobility would need a broader understanding of land use, transportation and air quality relationships. Around the same time, public health officials and urban planners alike were beginning to speculate about a possible connection between auto-dependent land use patterns and skyrocketing obesity rates.

Thus, SMARTRAQ emerged as a multidisciplinary collaboration including federal and state transportation, environmental and health agencies, a local foundation and other non-profit organizations, and university researchers. Its funders included the Georgia Department of Transportation, Georgia Regional Transportation Authority, Federal Highway Administration, Centers for Disease Control and Prevention, Atlanta Regional Commission, Environmental Protection Agency, Turner Foundation, and others. Collectively, its budget exceeded $4.5 million. SMARTRAQ therefore integrates policy issues pertaining to both the Clean Air Act and the obesity epidemic.

THE HIGHLIGHTS: WHAT WE FOUND

How Atlantans Travel

The travel surveys conducted for SMARTRAQ provide the most detailed snapshot available of how people in the Atlanta region get around in everyday life.

Atlantans, on average, drive almost 35 miles a day. This is more than most other regions of the nation.
This already-large average distance driven grows steadily as counties get farther from the urban core. Residents in the central counties (Clayton, Cobb, DeKalb, Fulton, Gwinnett, Douglas) drive an average of 32.7 miles/59 minutes daily per person, while those in the outlying counties drive an average of almost 44 miles/72 minutes daily.

Daily work commutes are often the longest trips people make.
The average commute distance in the region is 16.5 miles. Commuters in outlying counties drive far more than that. The average commute trip in Paulding County is 31.6 miles, almost twice the regional average.

People drive nearly as much on weekends as weekdays.
The average distance driven on the weekend is just 6 percent lower than on the weekdays.

Most trips in the region are made by private vehicle.
Just five counties, Forsyth, Clayton, Douglas, DeKalb, and Fulton, reported that more than ten percent of trips were made via public transit, bicycling, walking, carpooling, or all other means combined. Across the region, fewer than five percent of all trips were made on foot; just over 2 percent were made by bus or train. Transit trips make up more than five percent of total trips only in the two counties that have rail transit, Fulton and DeKalb.

Neighborhood Walkability and Driving

People in walkable neighborhoods drive less.

SMARTRAQ found that people who live in neighborhoods with the lowest walkability drive an average of 39 miles per person each weekday, 30 percent more than those who live in areas with the highest walkability. The difference for weekend travel was even greater. On average, residents in the most walkable neighborhoods drive about 40 percent less on the weekend than their counterparts in low-walkability neighborhoods.

People in closer-in, high-walkability neighborhoods take more trips by bicycling, walking or transit.

Transit trips also generally involve a significant amount of walking - three fourths of all trips arriving or departing from MARTA stations are on foot. DeKalb and Fulton counties, the region's most central counties, account for almost 70 percent of the walking trips reported in the entire region, despite being home to only 40 percent of the sampled population.

Less driving reduces a household's expenses.

SMARTRAQ estimates show that households in the most auto oriented areas of the region consume an average of 1048 gallons of gas and spend $2600 per year (assuming two cars per household and $2.50/gallon). Those living in the most walkable areas of the region save substantial amounts of gas and money - on average, two person households in walkable neighborhoods save an estimated 262 gallons of gas a year and spend $640 less.

Neighborhood Walkability and the Environment

Neighborhood walkability is linked to fewer per capita air pollutants. The SMARTRAQ air quality analysis found that each step up the five-part walkability scale results in a 6 percent reduction in NOx and a 3.7 percent reduction in VOC, which combine to form ozone. Ozone is Atlanta's biggest air quality problem and has been linked to respiratory illnesses.

Neighborhood walkability is linked to fewer per capita greenhouse gases. Carbon Dioxide (CO2) is the primary contributor to greenhouse gases and global warming. Travel patterns of residents in the region's least walkable neighborhoods generated about 20 percent higher CO2 emissions than travel by those who live in the most walkable neighborhoods – about 2,000 extra grams of CO2 per person each weekday.

Neighborhood Walkability, Obesity and Physical Activity

Neighborhood walkability is linked to more moderate physical activity.

Residents of the most walkable areas of the Atlanta Region are 2.4 times more likely to get the level of activity necessary to maintain health. Thirty-seven percent of people in high-walkability neighborhoods met the US Surgeon General's recommended 30 minutes of daily moderate activity, compared to just 18 percent of residents living in the least walkable neighborhoods.

Neighborhood walkability is linked to lower obesity levels.

People who live in neighborhoods with a mix of shops and businesses within easy walking distance are 7 percent less likely to be obese than those living in a mix level equal to the lower regional average. Although this difference appears small, the relative decrease in the actual probability of obesity is much greater - approximately 35 percent. A typical white male living in a compact community with nearby shops and services is expected to weigh ten pounds less than a similar white male living in a low density, residential-only cul-de-sac subdivision.

Time spent driving is linked to obesity.

Every additional hour spent in a car each day translated into a 6 percent greater chance of being obese. In metro Atlanta, 31 percent of SMARTRAQ travel survey participants on average spend more than an hour and a half a day sedentary in a car.

Youth and Walkability

Open space and neighborhood walkability are linked to youth physical activity and walking.

The amount youth walk is strongly linked with the design of their neighborhood. The presence of at least one recreational open space within a kilometer of where youth live was consistently associated with walking in youth of all age groups (between ages 5 and 20). The relationship between walking and neighborhood design was found to increase in strength as youth approach driving age, and then decline once driving is an option. Young teens (ages 12 to 15) were 2.5 times more likely to report they walk if there was recreational open space within one kilometer of home, and 2.6 times more likely to the report they walked if there was a commercial destination within a kilometer of their home. These same amenities also predicted whether they walked at least half a mile per day. Youth from households with two cars were 1.4 times more likely to report they walked compared with youth from households with 3 or more cars. Those from one-car households were 2.6 times more likely to walk.

The Market for Walkable Neighborhoods

Most neighborhoods in the region are not walkable.

About 60 percent of survey respondents said they are unable to walk to nearby shops and services. We estimate that only about one in 20 homes in metro Atlanta are in compact and walkable neighborhoods.

There is a considerable demand for more walkable neighborhoods in the region.

After comparing survey respondents' neighborhood preferences with their actual neighborhood choices, researchers believe that in many instances there is a mismatch between the residential environment people choose and the one they actually would prefer. In all, about a third of metro Atlantans living in conventional suburban development would have preferred a more walkable environment, but apparently traded it off for other reasons such as affordability, school quality, or perception of crime in addition to lack of supply. It is likely that this mismatch between community preference and choice is due to an undersupply of walkable environments.

A "substantial minority" of Atlanta residents have strong preferences for features of walkable neighborhoods.

Many different neighborhood characteristics were evaluated in the survey, and depending on which characteristics people preferred, between 20 and 40 percent of survey participants have a very strong preference for the most compact and walkable neighborhoods. Forty-nine percent of survey respondents said they would prefer a neighborhood where residents can walk to nearby shopping to one where the homes are separated from the shopping areas. Fifty-five percent of respondents would prefer to live in a community that affords shorter travel distances to work, even if it meant smaller residential lots.

Introduction

This report summarizes the results of one of the largest, most comprehensive planning studies yet undertaken for a large metropolitan area. Dubbed SMARTRAQ (Strategies for Metro Atlanta's Transportation and Air Quality), it is an ambitious attempt to understand how the layout of our neighborhoods, cities and region affects the amount of driving, walking or riding on transit that we do, and how those travel patterns in turn affect our personal and environmental health. Beyond that, the study probes the neighborhood preferences of metro residents to gain a sense of the market for various alternatives. The study was sponsored by an unprecedented array of federal and state transportation, environmental and health agencies, with assistance from a local foundation and non-profit organizations.

THE BACKGROUND

Though it came to involve many others, the SMARTRAQ research was initiated in 1998 through a collaboration between Georgia Tech, initiated by Dr. Lawrence D. Frank, and the Georgia Department of Transportation, at a time when metro Atlanta had reached a crisis over compliance with the national Clean Air Act. Because the region's transportation plan was forecast to violate emissions caps, the 13 counties in metro Atlanta had been barred from using federal road money until a complying plan could be approved. Atlanta's spread-out growth patterns were making it increasingly difficult to address existing traffic congestion or to prevent the emergence of new choke points across the vast region. Local, state and federal planners all needed to better understand the interplay between the transportation system, development patterns, housing markets and environmental impacts.

At the same time, public health officials at the Centers for Disease Control and Prevention in Atlanta and elsewhere had growing questions about the role played by automobile-oriented communities in Americans' stubbornly low exercise levels and growing obesity rates. SMARTRAQ offered a chance to study those questions in a bellwether Sunbelt metro area. Additionally, as both public and private sector officials set about devising solutions to Atlanta's growth-related challenges, they wanted a sense of the public's appetite for changing the way we build our neighborhoods, towns and region. SMARTRAQ, therefore, would examine not only how metro residents live today, but also how they would prefer to live as the region grows. Nearly a decade later, it is easy to see that SMARTRAQ was ahead of its time by integrating all of these issues; this effort remains unprecedented in scope and scale to this day.

As one might imagine, a project attempting to address so many questions at once was complex and time-consuming. The first two years of SMARTRAQ involved a major outreach program convening decision makers and local leaders. At the same time, researchers were determining just how to gather all the necessary data, as well as developing a series of survey questionnaires that would meet scientific rigor.

SMARTRAQ's Supporting Agencies:

Transportation:
- Georgia Department of Transportation
- Federal Highway Administration
- Georgia Regional Transportation Authority
- Atlanta Regional Commission

Environment:
- U.S. Environmental Protection Agency
- Turner Foundation
- Georgia Conservancy

Public health:
- Centers for Disease Control and Prevention

Land and economic development:
- Urban Land Institute
- Metro Atlanta Chamber of Commerce

Other:
- Georgia Governor's Office - State Treasury

The research demonstrates a pent-up demand for less automobile-dependent environments in the Atlanta region, and finds that if more walkable neighborhoods are built, a substantial portion of the people who elect to live in them will drive less and walk and take public transportation more often.

A team of leading scientific experts met in Atlanta to help assist in the decision-making process.[1] Surveys and data-gathering took place in 2001-2002. The time since has been occupied with generating numerous analyses of the data, a process that is ongoing with researchers in North America, Europe, and Australia.[2] Results from the SMARTRAQ project have been featured in over 300 newspapers, on ABC, CNN, Time Magazine, Men's Health, and other media outlets worldwide. This report represents the highlights of the findings thus far.

While the research is complex, the basic findings are clear. The research suggests that there is a pent-up demand for more walkable environments in the Atlanta region. More walkable neighborhoods are associated with a larger proportion of residents who elect to drive less and walk and take public transportation more often. These findings can mean significant benefits for residents who live in areas that are more compact rather than spread out, that offer shopping and/or jobs close to where people live, and that have a well-connected street network. In these neighborhoods, people drive fewer miles and spend less time driving, generate less air pollution and greenhouse gas emissions, and are more physically active and less likely to be obese. Additionally, the study is among the first to document that, even after taking people's lifestyle preferences into account, walkable environments are associated with both less driving and more walking, bicycling and transit use - confirming that both preferences and neighborhood environment impact travel choices. That is, even if you do not prefer a walkable neighborhood, living in a walkable neighborhood can mean more walking and less driving.

In addition to looking at the region's population as a whole, SMARTRAQ research has examined how results can differ by age, race or ethnicity, gender, and disability. Results show that these subsets of the population have different travel and physical activity patterns, and may be influenced by different preferences, or by different features of the urban environment.

One caution as we begin: In no way should these conclusions be construed as a judgment about individuals' "lifestyle choice". Indeed, there would be no basis for such a judgment. People choose where they live based on many factors, not the least of which are what is available and what

SMARTRAQ's data can help planners answer many of their questions:

- Do residents truly drive more in suburban areas with roads that end in cul de sacs and buildings that are surrounded by parking lots, and by how much? To what degree does that contribute to air pollution?
- What development practices might help traffic in growing areas? What kind of mass transit, if any, might help traffic, and in which areas?
- Do people walk more in traditional neighborhoods, downtown, in suburban office parks or in subdivisions?
- If we build more walkable communities, will people want to live in them?
- What defines a walkable environment for the elderly and for our youth?

[1] Expert panel names are listed on p. 49.

[2] A listing of publications from SMARTRAQ including technical reports, published papers, and papers under review are provided in Appendix A and are available at http://www.act-trans.ubc.ca/

they can afford. As the research discovered, there are relatively few housing options for metro Atlantans to choose from, for those preferring a less driving-intensive lifestyle. The region, by and large, is not built that way. It is built around the car. The researchers found that there is a strong unmet demand among many residents for more options in housing and neighborhood types and locations, along with a desire for safer and more inviting places to walk. This suggests that at least part of the response to metro Atlanta's transportation and development challenges could be based on removal of regulatory and financial obstacles to the development of walkable and transit-friendly neighborhoods. For more information on this topic see the report "Trends, Implications & Strategies for Balanced Growth in the Atlanta Region" (full citation in Appendix A).

ABOUT THIS REPORT

SMARTRAQ's broad reach means it has a lot to say about travel, land use, air quality, and health consequences in the Atlanta region. We begin with the basics – how people travel and why. Then, we'll review what the study found about the relationship of travel to neighborhood design, followed by the consequences those travel choices may be having on health. Finally, we'll review what the market research said about the places that people want to live and the ways they'd like to travel. The final sections of this report provide more detail on how this groundbreaking study was conducted and how it is being used.

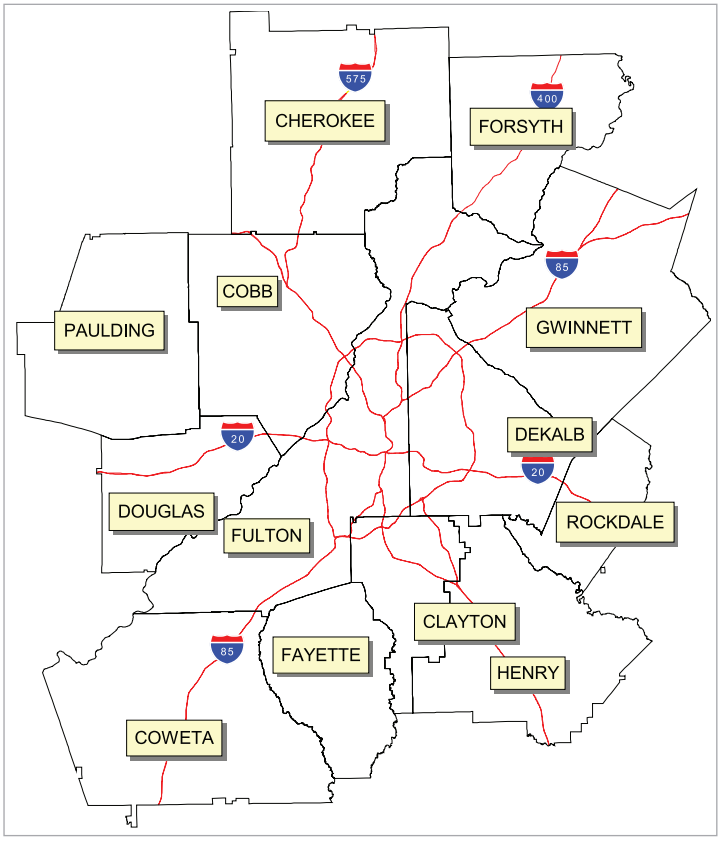


FIGURE 1 - The Atlanta Region

Part One

THE FINDINGS: TRAVEL AND LAND USE

The SMARTRAQ research program consisted of five key components, all designed to interact with and inform each other, in order to draw a rich portrait of the region (For more details about each element of the study and how the findings are being used, see Part 4). These components included:

- A travel survey of more than 8,000 households
- Construction of a regional 13 county land use database
- A sub-survey of physical activity of 1000 people in different households
- A market survey of 1500 people in different households
- An outreach program to public and private sector actors in planning and development.

A. HOW WE GET AROUND AND WHY WE TRAVEL

The travel surveys conducted for SMARTRAQ provide a detailed snapshot of how people in the Atlanta region get around in their everyday life. We start with a summary of how travel patterns vary by county, and then we take a closer look, examining travel according to the type of neighborhood where people live, which turns out to have a significant relationship with their travel behavior. For a more detailed look at regional travel patterns, see the report "Performance Measures for Regional Monitoring" (full citation in Appendix A).

Travel Patterns by County

On average, residents of the Atlanta region travel about four trips each day. But how far they travel, and how they get there, varies significantly among counties. SMARTRAQ found that people who live in outlying coun-

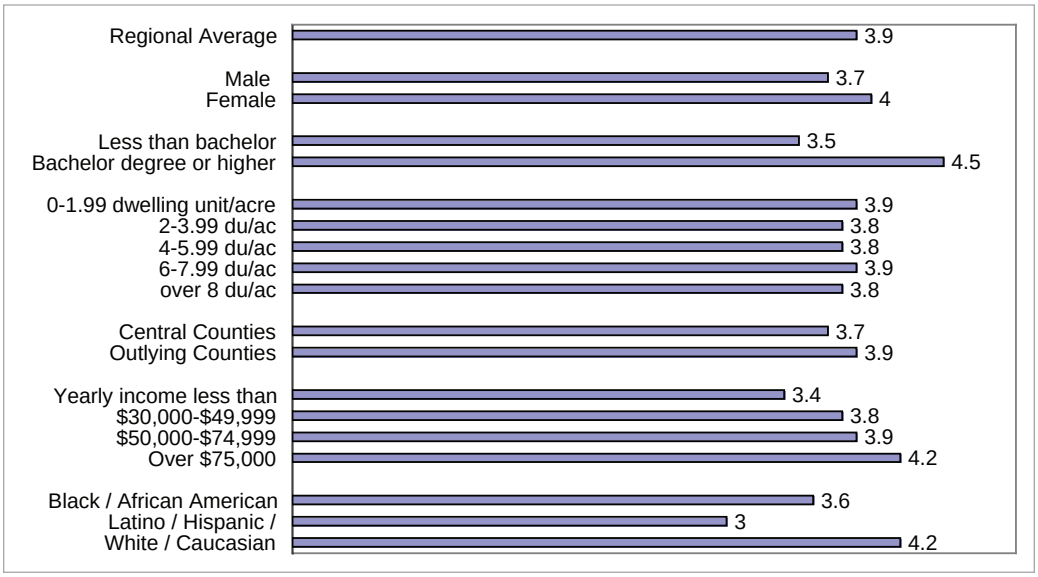


FIGURE 2 - Average Number of Trips (per person, per day)

[3] In order to make it generalizable to the region, the travel survey data used to develop the numbers in this report has been weighted to be representative of the region's population.

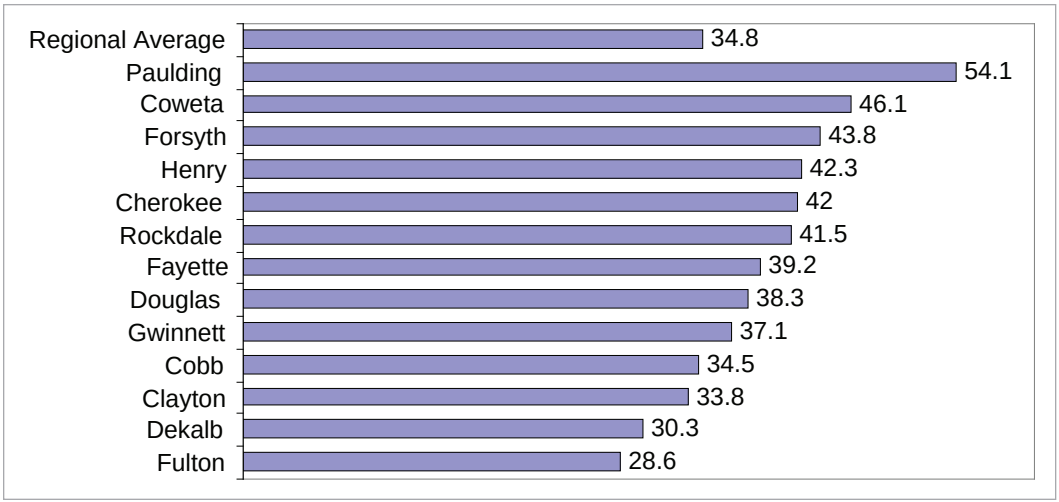


FIGURE 3 - Average Daily Vehicle Miles by County (per person, weekdays)

ties where distances are the greatest drive the most miles each day, spend the most time in their cars, and are less likely to take transit, walk, or bicycle to get where they are going. Residents in the central counties (Clayton, Cobb, DeKalb, Fulton, Gwinnett, Douglas) drive an average of 32.7 miles a day per person, with nearly 59 minutes spent in the car – while those in the outlying counties drive an average of almost 44 miles a day, with more than 72 minutes spent driving per person. The distance driven grows steadily as counties get farther from the urban core. According to the Federal Highway Administration (2003), Atlantans on average drive more miles daily than residents of most other regions of the nation.

While many factors influence the amount people drive, sheer distances between destinations is the primary factor. Even though they make up a small portion (about one quarter) of a household's daily trips, daily commutes during the congested peak hours are often the longest trips (both time and distance) people make. Commutes are also often linked to other trips on the way to or from work, such as picking up a child from daycare. This is especially the case for longer commutes. Commuters in outlying counties drive far more than the 16.5 mile regional average to reach their jobs. The average commute trip in Paulding County is 31.6 miles, almost twice the already long regional average. Commute trips in Fulton, DeKalb, and Cobb counties fall below the regional average. Currently, the region's activity centers and major corridors are

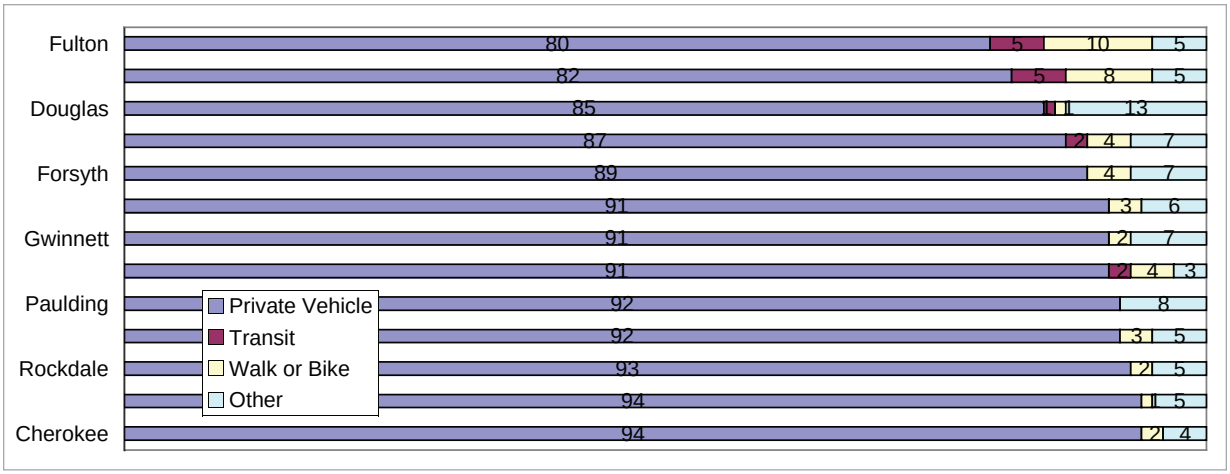


FIGURE 4 - Mode Share by County

concentrations of jobs, but without nearby housing and services people have limited opportunities to live closer to their workplace.

While planners and most research focuses on weekday commute patterns, SMARTRAQ measured weekend travel as well. It found the average distance driven per person on the weekend is just 6 percent lower than on the weekdays – and a higher percentage of trips are made by private vehicle on Saturday than on any other day of the week. This new information demonstrates the need to expand the focus of regional travel analysis and investment decisions beyond the weekday and the journey to work.

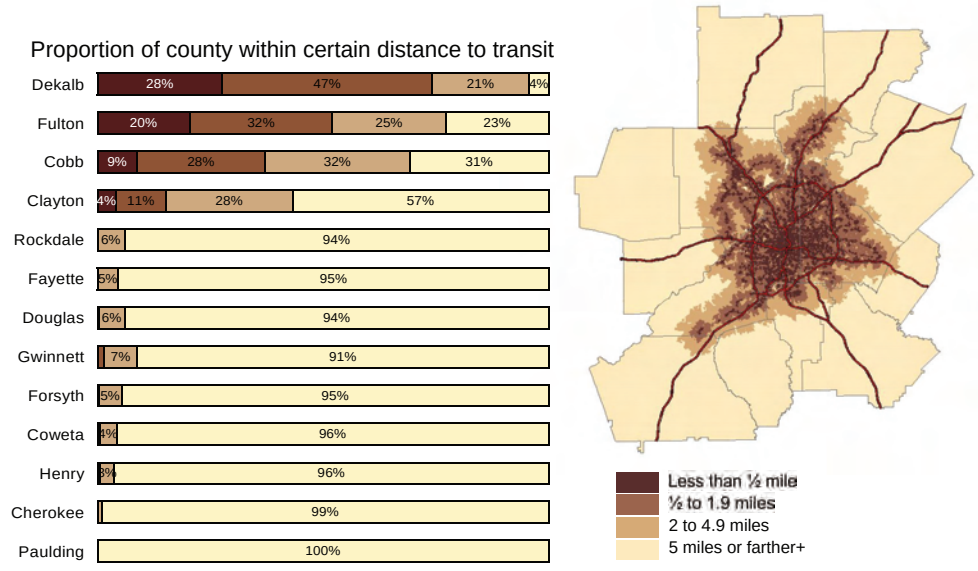
The spread-out development pattern in most areas of the region makes walking, transit, and biking unappealing or impossible for most people, the survey found. Cars are used for nearly all travel purposes, and even most shorter non-work trips are made in private vehicles. In Paulding, Coweta, Rockdale, Henry and Cherokee counties, between 92 and 94 percent of trips are made by private vehicle. Just five counties - Forsyth, Clayton, Douglas, DeKalb and Fulton - reported that more than ten percent of trips were made via public transit, bicycling, walking, carpooling, or all other means combined. Across the region, fewer than five percent of all trips were made on foot; just over 2 percent were made by bus or train. The most prevalent other mode of travel was school buses, which account for 5.3 percent of all trips.

Availability of Alternatives

The most obvious reason that people in outlying counties don't use alternatives is that they are not available. As Figure 5 shows, in Henry, Paulding, Cherokee and other outlying counties, the closest transit stop (bus or rail) during the 2001-2002 survey period was over five miles away from most homes, a distance too far for transit to be viable for most trips. As would be expected, residents in Henry County reported 0.2 percent of trips were by transit; Paulding and Cherokee residents reported no transit trips at all. Transit trips make up more than five percent of total trips only in the two counties that have rail transit, Fulton and DeKalb.

Neighborhood Level Travel Patterns

Counties encompass a variety of community types, and travel patterns can be greatly influenced by condi-



People who live in the least walkable neighborhoods drive 30 percent more each day than those with the highest walkability.

FIGURE 5 - Transit Accessibility

Adjusting for Demographic Differences

Travel patterns vary by gender, income, and ethnicity, as Figure 2 on p. 15 shows. In general, women, those with higher incomes, and Caucasian Atlantans drive more ^ more trips, more time, and more miles - per day. For thisstudy, it was important to isolate the influence of land use patterns from the influence of demographic differences. Without controlling for such factors, we would not know if, for example, the higher levels of driving in Paulding County were simply because more people of higher incomes lived there. The researchers used statistical techniques to isolate relationships between travel, air quality, greenhouse gases, physical activity, and obesity with walkability. These techniques result in our ability to convey a more accurate relationship between neighborhood form and travel behavior.

tions at the neighborhood level. SMARTRAQ included a more detailed look at how neighborhood characteristics might influence travel patterns. This part of the research compared people of similar demographic characteristics (see Adjusting for Demographic Differences, in the boxes at left) and isolated three land use factors for study: neighborhood density, street connectivity, and mix of nearby land uses (For an explanation of why that is so, see Neighborhood Factors, in the boxes in the box on the following page).

Researchers have been looking at the relationships between neighborhood land use patterns and transportation behavior for years. From this research, a relatively strong link has been established between higher densities (Cervero and Kockelman 1997; Ewing and Cervero 2001; Holtzclaw 1994; Frank et al. 2006; King County ORTP 2005), a mix of land uses (Cervero and Kockelman 1997; Lee and Moudon 2004; Moudon and Lee 2003; Hess 2001; King County ORTP 2005), interconnected street networks (King County ORTP 2005; WSDOT 2005; Kitamura et al.1997; Greenwald and Boarnet 2001) and higher levels of bicycling, walking and transit use.

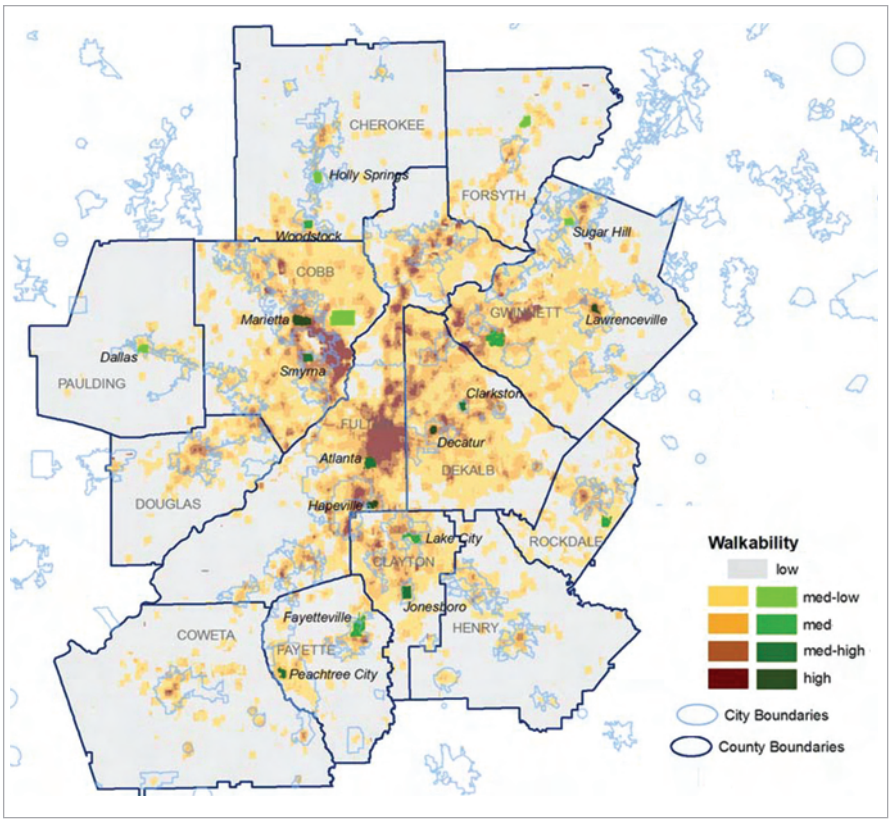


FIGURE 6 - Walkability

The SMARTRAQ data on these three factors were combined into a walkability index to measure the environment people encounter in everyday life. The map in Figure 6 shows the five categories (quintiles) of walkability, from 'lowest' to 'high', and where they are present in the Atlanta region. The index measures walkability at a neighborhood scale, by dividing the region into squares measuring about 200 meters (656 feet – roughly twice the length of a football field) on a side. Each square was "buffered" by the ring of three squares surrounding it. The average urban form values for this cluster of 49 squares was assigned to the center square. Squares where residential density is low and there is one dominant use, such as homes or businesses, are shown to be the 'least' walkable designations. These

areas also have few connected streets, measured by the number of intersections within the square. On the other hand, the 'high' walkability squares are marked by higher residential density, and also include a mix of businesses and retail. They have many connected streets, so travel to destinations can be more direct.

This index of walkability is just a starting point - several additional factors are required for it to be a complete measure of a neighborhood's walkability. For example, sidewalks are not included in this index, nor are locations where crosswalks are designated for pedestrians. However, the walkability index has been shown to be a highly significant predictor of travel patterns, air pollution, greenhouse gas, physical activity, and obesity in Atlanta. In general, the walkability index rises the closer the neighborhood is to downtown Atlanta or within older town centers, such as Marietta or Decatur. Getting around on foot is much more common in DeKalb and Fulton counties. These counties account for almost 70 percent of the walking trips reported in the entire region, despite being home to only 40 percent of the sampled population.

In addition to being associated with the amount of walking people do, as the walkability index increases, the amount of driving people do also declines as Figure 7 shows. SMARTRAQ found that people who live in neighborhoods with the lowest walkability drive an average of 39 miles per person each weekday, 30 percent more than those who live in areas with the highest walkability who drive 30 miles a day per person, on average. This pattern holds true regardless of many other factors that influence travel patterns, including the respondents' age, whether they had a driver's license, their household income, vehicles per household, household size, transit accessibility and regional location.[4]

Neighborhood factors that influence how people travel

SMARTRAQ evaluated the characteristics of an area within one kilometer of each respondent's home, according to three common land use measures: street connectivity, residential density, and the mix of residential, commercial and office development. These factors were combined to create a walkability index.

Connectivity considers how many of the streets connect to each other and whether they provide direct pathways to nearby destinations. The number of intersections influences the ability to bicycle or walk, because most people will walk only short distances and fairly direct routes, so a higher level of connectivity facilitates more walking. Typical suburban neighborhoods with few through-streets have lower connectivity, while grid street patterns have more connectivity. The difference between the "crow-fly" distance between two points and the distance that must be walked on the street network is an indicator of the transportation network's efficiency.

Land use mix: How many stores, offices, or institutions are within one mile of home? This was determined by creating a land use mix scale, with zero representing a single-use area, and one representing an area with a perfectly even balance of homes, shops, offices, and institutions. In Atlanta, the average mix was .15, and the maximum mix was .64, a very low mix by national standards. Many studies have found that when people live close to more destinations, they are much more likely to walk to accomplish their daily activities.

Net residential density. SMARTRAQ measured the number of homes per acre of residential land to establish the housing density in various parts of the region. This measure turns out to have the strongest association with vehicle miles traveled; researchers believe density is a proxy for many other factors that influence travel patterns, including connectivity and land-use mix. It is important to note that densities do not have to be particularly high to allow use of alternative travel modes: single-family homes on quarter-acre lots can be sufficient to support a transit system, if the neighborhood has sidewalks and good connections to other walkable neighborhoods. The net residential density is determined using the number of housing units from the Census block group and number of residential acres from the parcel data.

[4] These differences in travel distance are greater than the county-level findings reported earlier. This is because of the more precise measurement of walkability and how it varies within each county.

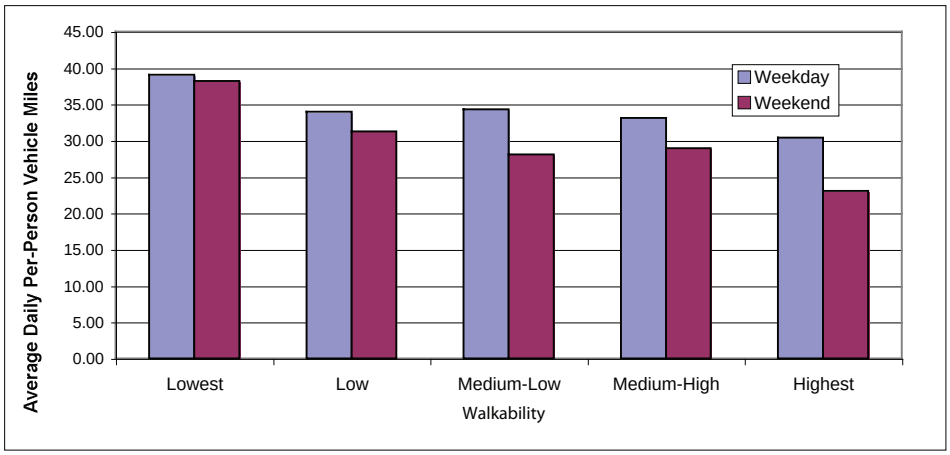


FIGURE 7 - Walkability and Driving

The analysis found an even greater difference across neighborhoods for weekend travel, perhaps because more weekend trips are focused on short errands. On average, people in the neighborhoods with the lowest walkability drove almost the same amount as on the weekdays – about 38 miles per person per day. But average driving per person by those living in the most walkable neighborhoods fell by seven miles, for a daily average of 23 miles per person. On average, residents in the most walkable neighborhoods drive about 40 percent less on the weekend than their counterparts in low-walkability neighborhoods.

The walkability index illustrates that although land use mix, density and street connectivity are each associated with travel behavior on their own, they were found to be more important when combined together. In practice, they are almost inseparable – take away the residential density, and the neighborhood is left with no one to support the shops and services that exist; take away the complementary land uses, and residents are left without convenient services, nearby jobs, or gathering places; reduce the street connectivity, and it will be too far to walk to those destinations, as Figure 8 shows.

B. HOW TRAVEL AND LAND USE AFFECT OUR HEALTH, THE ENVIRONMENT, AND THE QUALITY OF LIFE

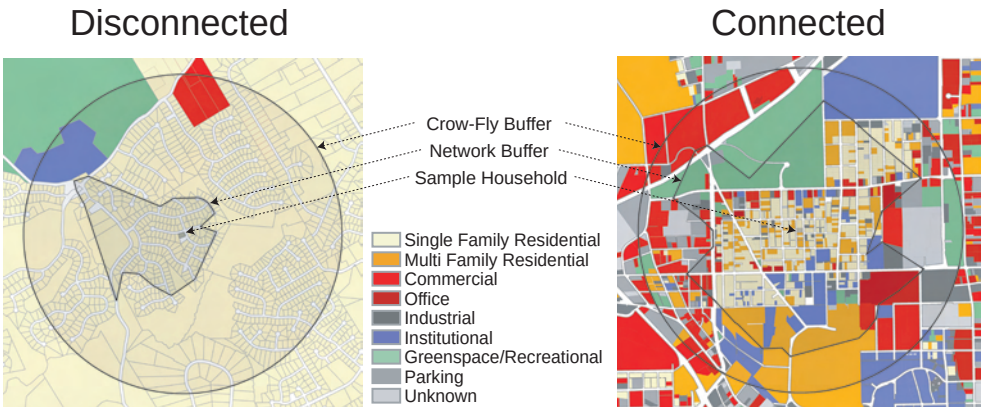
The travel patterns reported by survey participants make a difference in the health of the people of the Atlanta region, because they are associated with both the quality of the air and the degree to which residents are likely to get healthy physical activity as part of daily life. The next two sections discuss those effects, as measured by further SMARTRAQ analysis.

Air Quality

How people travel has a big impact on air quality. A significant share of key pollutants in the region comes from "mobile sources", mostly cars and trucks. Air quality is of particular importance in metro Atlanta, which has been in violation of federal health standards since they were established in the 1970s. The issue came to a head in the late 1990s, when the region was barred temporarily from spending federal funds on major road projects because it could not show that its transportation plans would curb driving-related emissions enough to conform to health standards. Regional leaders speculated that much of the difficulty arose from development patterns that require many people to drive increasing distances, and that make walking

[4] These differences in travel distance are greater than the county-level findings reported earlier. This is because of the more precise measurement of walkability and how it varies within each county.

Residents in the most walkable neighborhoods drive about 40 percent less on the weekend than their counterparts in low-walkability neighborhoods.



This diagram contrasts a household located in a typical low-density, disconnected neighborhood with separated uses on the left with a household located in a more compact, connected, mixed use neighborhood on the right. The circle represents a 1-kilometer radius (the 'crow-fly' distance) from each household, while the asymmetrical 'network' buffer inside the circle captures the 1-km area actually walkable on the street network. This diagram shows not only how a disconnected street network pattern can impact walking accessibility (directness), but how a low-density, single use land use pattern restricts the number of accessible destinations within walking distance (proximity). From Frank et al., 2004.

FIGURE 8 - A Tale of Two Neighborhoods

and public transportation unworkable. They asked SMARTRAQ to study these connections.

The analysis has focused on volatile organic compounds (VOC) and nitrogen oxides (NOx), because these are the pollutants that combine to form ozone, Atlanta's most serious air quality problem. Over 50 percent of NOx emissions are generated by household travel within the region (Clean Air Campaign 2007). Ozone is linked to respiratory problems, and increases as small as 10 parts per billion have been linked to increases in the death rate in large urban areas (Clean Air Campaign 2004). The analysis also measured emission of the major 'greenhouse gas,' carbon dioxide (CO2).

The neighborhood design characteristics noted above which comprise walkability (land use mix, density and street connectivity) have been also been associated with per capita emissions such as VOCs and NOx in previous research in Atlanta (Frank and Stone 1998; Frank et al. 2000) and in the Seattle region as well (WSDOT 2005; King County ORTP 2005; Frank et al 2006). Transportation planners routinely predict automobile-based air pollution levels using models that factor in vehicle type, distance traveled, acceleration rates, travel speeds and number of "cold" starts (when engines are off for long enough that emissions control devices are less efficient). The SMARTRAQ emissions analysis was able to go farther than previous studies by determining the estimated speed of each road segment for all of the 116,750 trips made by survey participants. The emissions estimates were then correlated with the layout of the communities in which participants lived and worked, as well as other destinations visited.

Socio-demographic factors explain a significant portion of the difference in total vehicle emissions produced by different household types. For example, larger households tend to have lower per-person emissions

because they share trips more frequently. Those owning more cars and making more money generally are associated with higher emissions. But even after accounting for age, income and other socio-demographic factors, the three land-use variables measured around each respondent's home play a significant role in how much people pollute. The research found that as density, street connectivity and land use mix increase, per capita emissions decline.

The analysis found that the main impact of the land use factors on the emissions tested was through reducing the distance driven as opposed to the numbers of trips taken, even after adjusting for highly polluting cold starts. Emissions levels for NOx, VOCs, carbon monoxide and carbon dioxide were found to be higher for participants who lived in areas that were less walkable. Emissions were also higher for residents who live in parts of the region with fewer nearby jobs. Therefore, both how communities are designed and where growth is located are associated with how much air pollution is generated through driving.

When the three land-use variables were combined into the walkability index, community design had a clear correlation with air pollution. The air quality analysis found that each step up the five-part (quintiled) walkability scale was associated with a 6 percent reduction in NOx and a 3.7 percent reduction in VOC.

As Figure 9 illustrates, travel by residents in the lowest walkability neighborhoods produces an average of 25 grams of NOx and 10 grams of VOC per person each weekday, while travel by residents in the most walkable neighborhoods emits fewer than 23 grams of NOx and fewer than 9 grams of VOC. This two-gram drop in NOx and one-gram drop in VOC per person represent reductions of 8 percent and 10 percent, respectively. These are significant changes compared to estimated affects of other, emission reduction measures. However, it is important to note that these changes will require a significant commitment to changing the ways in which future communities are designed in the region.

Greenhouse Gases and Energy Consumption

While automobile travel has long been associated with greenhouse gas emissions, SMARTRAQ is one of the few studies to date to examine how the built environment may be contributing to climate change. The results show that the travel patterns of residents of the least walkable neighborhoods (those in the lowest quintile of the Walkability Index scale) result in about 20 percent higher CO2 emissions than travel by those who live in the most walkable neighborhoods. That comes to about 2,000 more grams of CO2 per person each weekday.

Less driving also reduces a household's expenses. SMARTRAQ estimates show that households in the most auto oriented areas of the region consume an average of 1048 gallons of gas and spend $2600 per year (assuming two drivers per household and $2.50/gallon). Those living in the most

Air Pollutants

Ozone – This lung irritant forms when sunlight interacts with nitrogen oxides (NOx) and volatile organic compounds (VOC), both emitted by automobiles. Ozone is closely associated with vehicle travel, and is Atlanta's main air quality problem.

Carbon Monoxide – A colorless, odorless, poisonous gas that results from incomplete burning of carbon in fuels.

Greenhouse gases – Gases that help trap heat in the atmosphere, contributing to global warming and climate change. The primary greenhouse gas is carbon dioxide (CO2); others are methane (CH4), chlorofluorocarbons (CFCs) and nitrous oxides (N20).

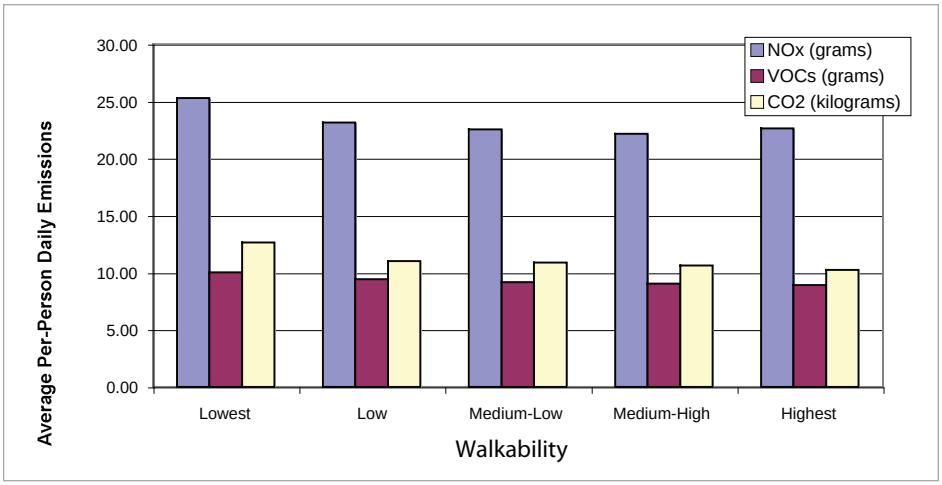


FIGURE 9 - Walkability and Emissions

Every additional hour spent in a car each day translated into a 6 percent greater chance of being obese.

walkable areas of the region save substantial amounts of gas and money - on average, two person households in walkable neighborhoods save an estimated 262 gallons of gas a year and spend $640 less. According to a recent report, Atlanta region households spend an average of 19 percent of their yearly income on all transportation expenses, and 55 percent of their income on housing and transportation combined – the fourth largest share in the country (STPP/CNT 2005).

Physical Activity and Obesity

Public health researchers have paid increasing attention to neighborhood design as an important element in encouraging or discouraging people to get physical activity as an incidental part of daily life. The US Surgeon General recommends adults get 30 minutes of moderate physical activity five or more days a week in order to maintain health, through intentional exercise or as a routine part of daily life.

SMARTRAQ's findings, which show a clear association between the built environment and physical activity/obesity, are consistent with and supported by a growing body of similar evidence (Active Living Research 2005). While results are mixed in the literature, most studies to date show an association between community design and obesity as well (Ewing et al. 2003; Frumkin et al. 2004; Frank et al. 2003; Lopez 2004; Sturm and Cohen 2004, Saelens et al. 2003). Several extensive literature reviews examine these issues in depth (Sallis et al. 2004; Transportation Research Board / Institute of Medicine 2005; Boarnet and Crane 2001; USEPA 2001; Kuzmyak and Pratt 2003; Frank and Engelke 1999, 2001; Bento et al. 2003).

SMARTRAQ took a close look at the impact of urban form on physical activity by conducting a sub-survey of about 800 respondents to gauge how much physical activity they get. About 520 of the respondents wore an accelerometer (like a pedometer) that objectively measures physical activity levels. The analysis (based on a subset of 357 respondents) indicates that living in walkable neighborhoods may have a positive impact on overall physical activity levels. Thirty-seven percent of people in high-walkability neighborhoods met the US Surgeon General's recommended 30 minutes of daily moderate activity, compared to just 18 percent of residents living in the quarter of neighborhoods that are least walkable. As noted above, results showed that residents of the most walkable areas of the Atlanta Region are 2.4 times more likely to get the level of activity necessary to maintain health after controlling for demographic factors (Frank et al 2005).

The larger travel survey of 18,000 respondents asked respondents to report their weight and height, and these measurements were used to calculate a Body Mass Index, which indicates whether people are of average weight, overweight, or obese. SMARTRAQ was the first (and possibly the only) major regional travel survey to collect this data. An analysis using this information and other SMARTRAQ data found a strong overall correlation between time spent driving and obesity: for the overall sample we found that every additional hour spent in a car each day translated into a 6 percent greater chance of being obese. In metro Atlanta, 31 percent of the respondents spend more than an hour and a half a day in the sedentary act of riding in a car (Frank et al. 2004). Two other independent studies (one in Australia and another in California) have found similar relationships between driving and obesity since it was first discovered as part of SMARTRAQ (Lopez-Zetina et al. 2006, Wen et al. 2006).

The study also found that each additional kilometer (just over a half mile) walked each day is associated with about a five percent reduction in the odds of being obese. What these results suggest is that our daily choices for active or sedentary forms of travel translate into increased or decreased odds of having a healthy body weight.

People in closer-in, high-walkability neighborhoods are able to take more trips by bicycling, walking or transit -- and transit trips generally involve a significant amount of walking. Three fourths of all trips arriving or departing from MARTA stations are on foot. The results from the SMARTRAQ study confirm recent research documenting that transit users are more likely to meet recommended physical activity requirements through active transportation (Besser and Dannenberg 2006).

The link between physical activity and land use mix

The physical activity sub-survey results also show that people in neighborhoods with a greater balance between homes, stores, and offices report more walk trips to these destinations than people in the least mixed use environments of the region. Unlike many other analyses presented in this paper, our analyses of obesity and land use mix was based on a quartiling of land use mix. Our analysis of obesity showed that people who live in neighborhoods with a mix of shops and businesses within easy walking distance are seven percent less likely to be obese than those living in a mix level equal to the regional average. Although this difference appears small, the relative decrease in the actual probability of obesity is much greater - approximately 35 percent. Data from the larger travel survey supports this finding. A typical white male living in a compact community with nearby shops and services is expected to weigh ten pounds less than a similar white male living in a low density, residential-only cul-de-sac subdivision, the study found.

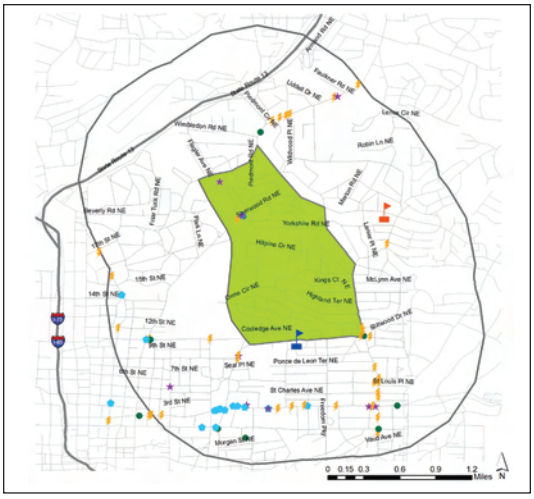
Body Mass Index

Body Mass Index measures weight in relation to height. BMI is highly correlated with body fat, and can indicate that a person is overweight or obese. People with a Body Mass Index of 25 or higher are considered overweight, while those with a BMI of 30 or higher are considered obese. Both groups are considered at risk for premature death and disability as a consequence of being overweight. Obesity in the state of Georgia increased from 9 percent to 23.5 percent between 1991 and 2002.

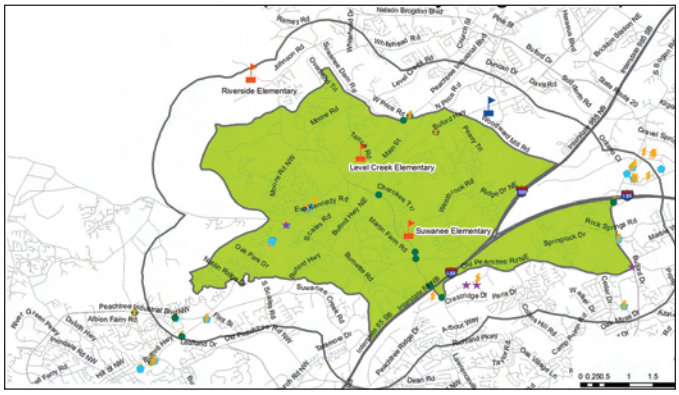
C. SMARTRAQ'S SECOND GENERATION – FIVE NEW STUDIES

A good piece of research may well generate more questions than it answers, and the initial SMARTRAQ papers prompted even more questions. Is there an urban planning link to the other side of the obesity puzzle – the food people consume, and could one's surroundings in-

1) Virginia Highland: High Walkability - High Income



3) Mall of Georgia: Low Walkability - High Income



4) South Fulton: Low Walkability - Low Income

2) West End: High Walkability - Low Income

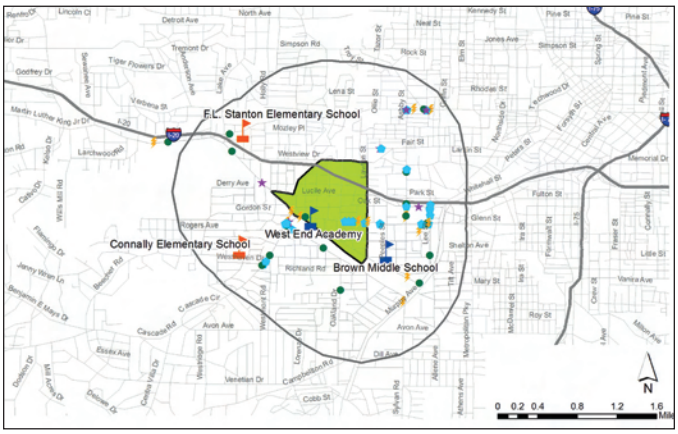


FIGURE 10 - The Food Environment (Frank et al. 2007)

fluence their food choices? How does the land use/travel relationship change across age ranges, gender and ethnicity? Don't consumers prefer more single-use, low-density communities? And finally, the fact that SMARTRAQ studies are cross-sectional means that the researchers still cannot claim that land use patterns actually cause changes in body weight or physical activity. People may be living in auto-oriented or walkable neighborhoods because they prefer to drive more or walk less, and if you move someone from an auto-oriented neighborhood to a walkable one, they may not change their behavior. This "second generation" of studies based on the original SMARTRAQ data is a first, important step to answering some of these questions.

The Food Environment

Neighborhood food environments are just beginning to be considered as another important influence on public health (Glanz et al 2005). Although eating and food choices are ultimately an individual act, we are influenced by accessibility to food, as well as food advertising and marketing. Walkability, including access

	BLACK MALES (weighted n=1519)	BLACK FEMALES (weighted n=2245)	WHITE MALES (weighted n=3504)	WHITE FEMALES (weighted n=3604)
Body Mass Index	27.31	27.21	26.83	23.99
Walk distance (kilometers)	0.25 [2.39][a]	0.38 [2.59][a]	0.15 [2.51][a]	0.15 [2.18][a]
Car time, minutes/day	64.15	60.24	80.38	71.82

[a]Figures in brackets represent average walking distance for those who actually walk.

FIGURE 11 - Average BMI, Walk Distance, and Time Spent Driving - Differences by Gender and Ethnicity

to healthy food, is likely to be even more important for youth and elderly, and for others unable to drive. For that reason, researchers used SMARTRAQ data to select communities that contrast in walkability and income to perform a detailed audit of food quality around middle and elementary schools in four Atlanta-area communities (see Frank, Glanz et al 2007, in press). The findings showed that that the neighborhood food environment (including available healthy choices, good prices, and variety) is more often linked to neighborhood income levels than their walkability. This approach to systematically evaluate food outlets, as the Nutrition Environment Measures Survey (NEMS), is led by Dr. Karen Glanz at Emory University (see http://www.sph.emory.edu/NEMS/in2.htm) and is funded by the Robert Wood Johnson Foundation and the Georgia Cancer Coalition. More importantly, the audit approach the researchers developed and validated (Glanz et al forthcoming (stores); Saelens et al forthcoming (restaurants)) is being used by researchers and public health programs across the nation and beyond. The NEMS audit tool is a useful way for school districts, public health agencies, neighborhood planners and others evaluate food outlet quality as part of the process of planning for healthier communities.

Looking at Demographics

Most of the findings in this report used statistical controls to strip out the strong influence of demographic factors such as gender, ethnicity and age. The basic findings of SMARTRAQ -- that the probability of obesity is related to neighborhood mix, the distance walked, and time spent in an automobile – thus hold true when accounting for gender, ethnicity, income, age, and other demographic factors. But SMARTRAQ also took a closer look at how different groups are affected by the built environment, particularly in relation to walking and its impact on health. These findings can help planners and policy makers tailor changes to fit the people who live in a neighborhood. A few of these demographic-specific results follow. To examine these results in more detail, see the report "Analysis of Travel Patterns of Traditionally Underserved Populations" (full citation in Appendix A).

Youth

While children cannot drive, the SMARTRAQ research found that the amount that they walk is linked to the form of their neighborhood. The strongest associations were found for young teens from 12 to 15 years old. This age group were more likely to report they walked if they lived in areas with higher street connectivity, a greater mix of uses, higher residential density, and more open space. The amount of walking among young children – 5 to 8 years old – was related to the presence of recreational areas or open space, but not to the other factors. Across all age groups, from 5 to 20 years old, having a recreational space within one kilometer of home was the most consistent predictor of walking (Frank et al. 2007b, in press). In another study (Kerr et al. forthcoming) researchers further evaluated differences in walking across demographic characteristics in youth.

Gender & Ethnicity

Figure 11 shows the mean body mass index, time spent in cars, and distance walked, broken down by gender and ethnicity. This table suggests that black men and women walk more and drive less than their white counterparts. They are also more likely to be obese. However, results from SMARTRAQ also show black people's travel patterns and obesity levels are less related with neighborhood design. White men showed the greatest degree of change in walking, driving, and body mass index in relation to urban form, while black men showed the least, all else being equal. While these results adjust for income, it may be that diet and lack of access to affordable healthy food choices are playing a role in explaining obesity rates among different demographic groups. Another study by the SMARTRAQ team is currently in progress and is investigating these questions in much greater detail.

Seniors, Handicapped & Disabled

Analysis is beginning to address factors that may have an impact on travel and health behaviors for disabled or handicapped populations and senior citizens. Because these two groups are more frequently unable to drive than the general population, better transportation access is crucial. For both groups living in a walkable neighborhood can mean maintaining independence, rather than relying on friends or family to drive them to doctor's appointments or to the store. It also makes it possible to continue to feel part of the community, rather than feeling isolated or marginalized. As our population ages, the need to address housing and transportation needs for these two groups will be more and more crucial.

In an analysis of SMARTRAQ data for the Center for Assistive Technology and Environmental Access (CATEA) at Georgia Tech, researchers found disabled respondents - those with a medical condition that makes it difficult to travel outside of the home - to be significantly older, more likely to be in fair or poor health, with a higher average Body Mass Index and a greater likelihood of obesity when compared to those without disabilities. Disabled respondents were also significantly less physically active, and made significantly fewer walking trips than the non-disabled (CATEA 2006).

Seniors (those aged 65 and over) were, like the disabled respondents, generally less mobile - whether by foot or vehicle. Senior survey respondents were significantly less likely than people 24 to 64 years old to have a driver's license or to make a trip as the driver of a vehicle - and were more likely to make a vehicle trip as passenger. The lack of independent mobility for seniors and disabled respondents can contribute to isolation from the community at large.

Neighborhood Preferences, Travel Choice, and Health

SMARTRAQ was designed to advance our understanding of the relationships between the built environment and travel choices. Past research confirms the presence of an association between community design and travel choice (Ewing and Cervero 2001; Frank 2000). However, there is no definitive evidence documenting causation – that specific changes in the built environment will cause changes in travel choices and related outcomes (such as air pollution, greenhouse gas emissions and obesity). This is because we choose living environments at least partially based on our travel and lifestyle preferences (self selection). Self selection makes it difficult to determine how much of the relationship between neighborhood walkability and travel choice is actually due to our physical environment, as opposed to our preferences (TRB / IOM Report 282, 2005).

	Walkability & Preference Groups		Percent Taking a Walk Trip (n)	Average Daily Vehicle Miles Traveled (n)	Percent Obese (n)
	Preference for Neighborhood Walkability	Walkability of Current Neighborhood			
I	High	Low	16.0% (188)	36.6 (188)	14.9% (161)
II	High	High	33.9% (446)	25.8 (446)	11.7% (386)
III	Low	Low	3.3% (246)	43.0 (246)	21.4% (215)
IV	Low	High	7.0% (43)	25.7 (43)	21.6% (37)

FIGURE 12 - Walking, Driving, and Obesity by Neighborhood Preference and Walkability

In order to understand the effects of people's preferences on their travel choices, SMARTRAQ researchers assessed the preferences of the 1466 participants who completed the Community Preference Survey, discussed in more detail in Part 2 of this report. In summation, both preferences and neighborhood environments seem to impact travel patterns. However, the absolute amount of walking done by those preferring a more auto oriented environment is very small regardless of neighborhood design features. Figure 12 provides an overview of the participants that reported they walked over a two day period, mean vehicle miles traveled, and percent obese for those that:

I) Prefer a walkable environment and do not live in one
II) Prefer a walkable environment and live in one
III) Do not prefer a walkable environment and do not live in one
IV) Do not prefer a walkable environment and live in one.

Results convey that those preferring a walkable environment walk more and drive considerably fewer miles when they live in a walkable neighborhood as opposed to a less walkable one. These participants also have a slightly lower prevalence of obesity when located in a walkable environment (11.7 percent vs 14.9 percent). However, those that do not prefer walkable neighborhoods walk very little regardless of their environments, but do seem to drive considerably fewer miles when located in a walkable neighborhood (25.7 vs 43.0 miles). For those preferring low walkability neighborhoods, the prevalence of obesity is virtually unchanged - about 21% regardless of neighborhood type. Researchers found that when controlling for neighborhood preference and demographic factors, each quartile increase in walkability was associated with a 5.5 mile reduction in vehicle miles traveled (Frank et al. 2007c, in process).

Disentangling the effects of preferences versus neighborhood design on travel patterns and obesity is an important first step toward understanding causation and self selection. This and other recent papers (Handy, Cao, Mokhtarian, 2006, Khattak & Rodriguez, 2005, Kitamura, Mokhtarian & Laidet, 1997, Schwannen & Mokhtarian, 2004, 2005a, 2005b) have found that both land use patterns and attitudes and preferences for neighborhood type impact travel outcomes. SMARTRAQ is the first study to directly assess the relationship between preferences, actual neighborhood environments, and obesity.

The results from SMARTRAQ also suggest an undersupply of walkable development in the Atlanta region – and in many cases a mismatch between the neighborhoods that are being built and the neighborhoods people actually would prefer to live in. A "substantial minority" of the survey respondents expressed strong preferences for features of walkable neighborhoods (Levine and Frank 2007, in press). These findings will be discussed in more detail in Part 2.

Part Two

THE FINDINGS: RESIDENTIAL PREFERENCE SURVEY

A. WHERE WE'D LIKE TO LIVE: A MARKET SURVEY

SMARTRAQ was designed to be useful in the real world of policy-making and community building. Any policy decisions arising from the research need to be workable in the society and marketplace in which we live. In other words, decision-makers should enable their constituents to live the lives they want to lead.

In order to understand what that means to metro Atlanta residents, SMARTRAQ asked 1,466 travel survey respondents to answer questions about the kinds of neighborhoods and homes that appeal to them. This Community Preference Survey is the largest such study to date and reveals what features people in the Atlanta area want to see in their neighborhoods. More detail on the Community Preference Survey and its results can be found in the report "Transportation and Land-Use Preferences and Atlanta Residents' Neighborhood Choices" (full citation in Appendix A).

Using illustrations and descriptions, the survey asked people about where they live now: Do they live in subdivisions of similar homes, or is there a mix of housing types (large and small houses, townhouses, apartments, etc.)? Are they within walking distance of shops, or must they drive? Do most streets end in cul-de-sacs, or is there an interconnected network of streets?

Respondents also were asked to think about the features they would look for if they were to move. But they were asked to make real-world tradeoffs: Would they trade a smaller house for a shorter commute? A smaller lot for a more walkable neighborhood? Would they prefer a cul-de-sac, even if it meant a lot more time in the car?

The goal was to get a sense of the degree to which current residents' preferences match up with the places they live. That, in turn, gives an indication of how much of a market there might be for alternatives to the predominant neighborhood offering – cul-de-sac subdivisions dependent on high levels of vehicle use. For those who are largely satisfied with that arrangement, the survey attempted to learn which neighborhood features were essential and which were less so. In order to focus on neighborhood design and location features, respondents were asked to make choices as though they were choosing between equally affordable homes, and as if school quality stayed constant.

B. HOW WELL DOES METRO ATLANTA'S HOUSING STOCK MATCH PEOPLE'S PREFERENCES?

The zoning practiced by most metro jurisdictions since World War II separates homes from shopping districts and requires a car trip to get from one to the other. Indeed, about 60% of survey respondents said they are unable to walk to nearby shops and services. When asked their preference, about one-half -- 48 percent – said they would prefer such a neighborhood, where homes are distant from shopping. Forty-nine percent of survey respondents said they would choose neighborhoods where residents can walk to nearby shopping. The rest wanted some features of both.

In all, about a third of metro Atlantans living in conventional suburban development would have preferred a more walkable environment, but apparently traded it off for other reasons including affordability, school quality, or perception of crime.

Auto-Oriented Neighborhoods

RESIDENTIAL

Even though the buildings are a relatively high density, this typical auto-oriented residential development in the photo below performs poorly from a walkability perspective in both its internal site design and its regional location. The development itself is exclusively residential, with no shopping, schools, entertainment or other common destinations either within its boundaries or adjacent. Its far-flung location means that residents have no choice but to drive – and drive a lot – just to meet their daily needs. Although there are pathways present, the lack of destinations means they will remain little-used and largely ornamental.

COMMERCIAL

In addition to being an unattractive place to walk, this standard strip mall fails all three 'tests' of walkability - mix of uses, density, and street connectivity. Most of the low-density site is taken up by the by the enormous parking lot out front, resulting in a exceedingly low Floor Area Ratio (FAR, the standard measure of retail density, measures the ratio of total building square footage to parcel size). Rather than being conveniently located close to the sidewalk, pedestrians need to walk another ¼ - ½ mile just to get to a store entrance. The one-story buildings have no room to include apartments or offices that might benefit from being located next to shops.

Walkable Neighborhoods

RESIDENTIAL

At approximately the same level of density, the apartment building pictured below supports active transport in its location and design. Its location next to a regional park and close to an urban center means that residents have the means to access both recreational and utilitarian destinations on foot, by bicycle or transit. The tree-lined street with wide sidewalks coupled with the well-designed building façade provides a welcoming environment for pedestrians and slows traffic.

COMMERCIAL

This photo of a street in a mixed-use neighborhood supports all kinds of street life. This community is compact and mixed-use - the buildings which contain the shops also have apartments and offices on the upper floors. As part of a neighborhood built on a street grid, rather than a system of large arterials and superblocks, pedestrians can easily circulate. The street trees, iron lampposts, and benches help to create an welcoming outdoor living room for shoppers and residents to sit, stroll, and do business.

photo credit: Gordon Price

FIGURE 13 - Auto-Oriented vs. Walkable Neighborhoods

Fifty-five percent metro residents would prefer to live in a community that affords shorter travel distances to work, even if it meant smaller residential lots. Many different neighborhood characteristics were evaluated - but all in all, depending on which characteristics people were asked about, between 20 and 40 percent of survey participants have a very strong preference for the most compact and walkable neighborhoods. Yet at the time of the survey, only about one in 20 homes in metro Atlanta are in neighborhoods that meet those criteria. In total, about a third of metro Atlantans living in conventional suburban development would have preferred a more walkable environment, but apparently traded it off for other reasons such as affordability, school quality, or perception of crime in addition to lack of supply. Those who want a walkable community are not well sorted into such environments. Respondents preferring auto oriented places more often reside in environments that match their preferences.

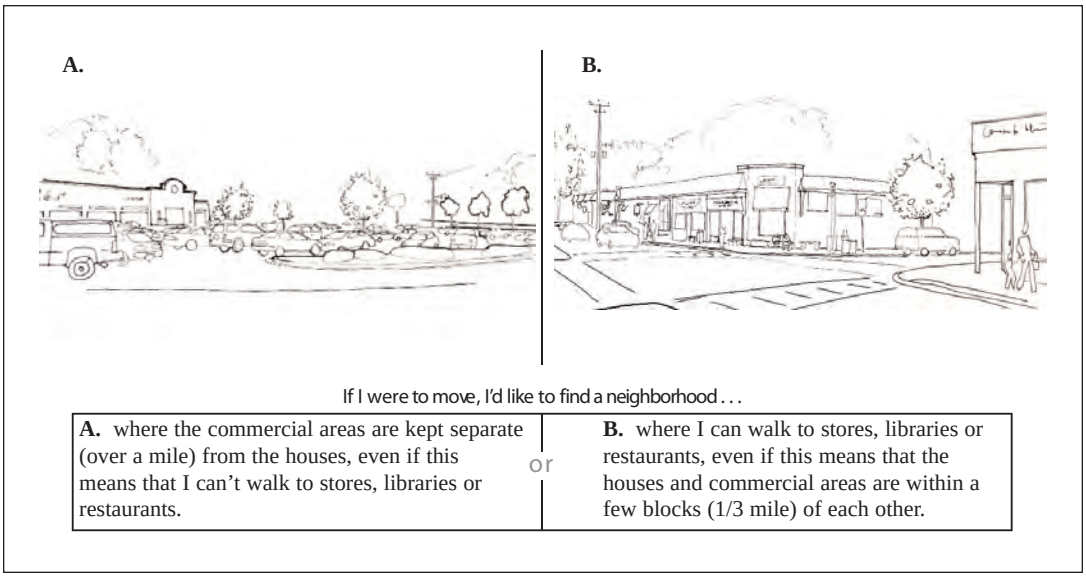
C. A CLOSER LOOK AT THE TRADE-OFFS

In the following questions, people were asked to make tradeoffs by choosing between pairs of neighborhoods with different attributes. After viewing an image and reading a description for each pair, respondents were asked to rank their preferences along a ten-point scale, both in terms of where they would like to move and how the described neighborhoods compare with where they live now.

Tradeoff 1: Mixed or Separated Uses?

Mixing land uses – putting a pedestrian-oriented shopping district within a few blocks of houses and apartments, for example – is one key way to make it possible for people to accomplish daily activities with fewer car trips.

That opportunity does not exist for most Atlantans. Over one-third of households have no retail within an easy walk of their homes, and 57 percent have very limited options, with less than 10,000 square feet of shopping area nearby. And many of those homes that do have nearby shopping are cut off from it by dead-end streets and busy arterial roads.



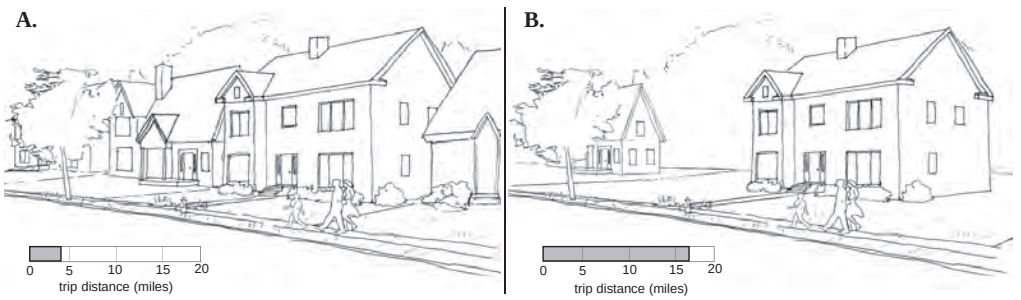
Figures 14-18 were drawn by Mr. Christopher Leerssen.

FIGURE 14 - Mixed or Seperated Uses

Tradeoff 2: Closer to Work or Larger Lot?

As metro Atlanta has grown, builders have had to go many miles out from current job centers to find large tracts of land available for large-lot subdivisions, meaning that their buyers have increasingly long commutes. Home seekers who hope to avoid lengthy drives often must forego large lots to locate closer in, near jobs. The questions about residential density sought to probe just how much tolerance people have for living far from work in pursuit of large house lots. In other, words, the question was how much private yard space a respondent would be willing to forego to avoid a long commute. Again, it must be emphasized that respondents were asked to assume that the options were equally affordable, in the knowledge that people often look to the metro fringe and beyond in search of homes they can afford.

Fifty-five percent of survey respondents indicated a preference for shorter commutes, even if residential densities were higher and lot sizes smaller. Thirty-three percent of respondents indicated they would prefer such an option, but did not currently live in this type of neighborhood.



If I were to move, I'd like to find a neighborhood . . .

A. within 3 to 4 miles of work, school, or my other important destinations, even if this means that the houses are close together--on lots of 1/2 acre or less.	or	**B.** with houses farther apart--on lots of 1 acre or more, even if this means traveling 15 to 18 miles to work, school or my other important destinations.

FIGURE 15 - Closer to Work or Larger Lot?

Tradeoff 3: Travel Options or Larger House?

Survey participants were also asked if they would be willing to trade a smaller house size in order to get more travel options.

The survey found that 56 percent of respondents indicated they would prefer a neighborhood where they had an easy option to walk, cycle or take transit, even if it meant a somewhat smaller house - over a larger house in a neighborhood where they had to drive for everything. Thirty-seven percent would prefer living in such an area, but did not currently.

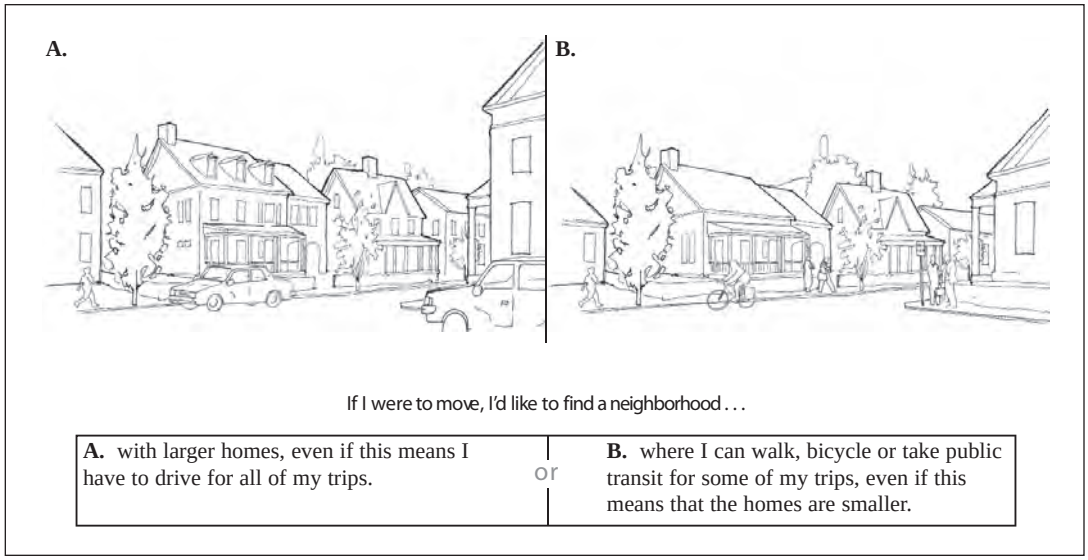


FIGURE 16 - Travel Options or Larger House?

Tradeoff 4: Close to Work or Cul-de-Sac?

Cul-de-sacs offer certain advantages, such as safety from high speed traffic, and less noise and air pollution. However, SMARTRAQ research and results from other studies assert that these benefits to certain individuals come with considerable costs to society at large. French for "bottom of the bag", cul-de-sacs are ever-present in Atlanta. Indeed, a majority of survey respondents identified the asphalt circles as a feature of their neighborhoods. While many residents perceive homes on dead-end streets as being shielded from car traffic, street networks with numerous truncated streets force pedestrians and cars alike to take circuitous routes and exit onto busy arterial roads. People in the Atlanta region were asked whether they preferred this pattern, or if they would trade the cul-de-sac lifestyle for a more connected street network with destinations close by.

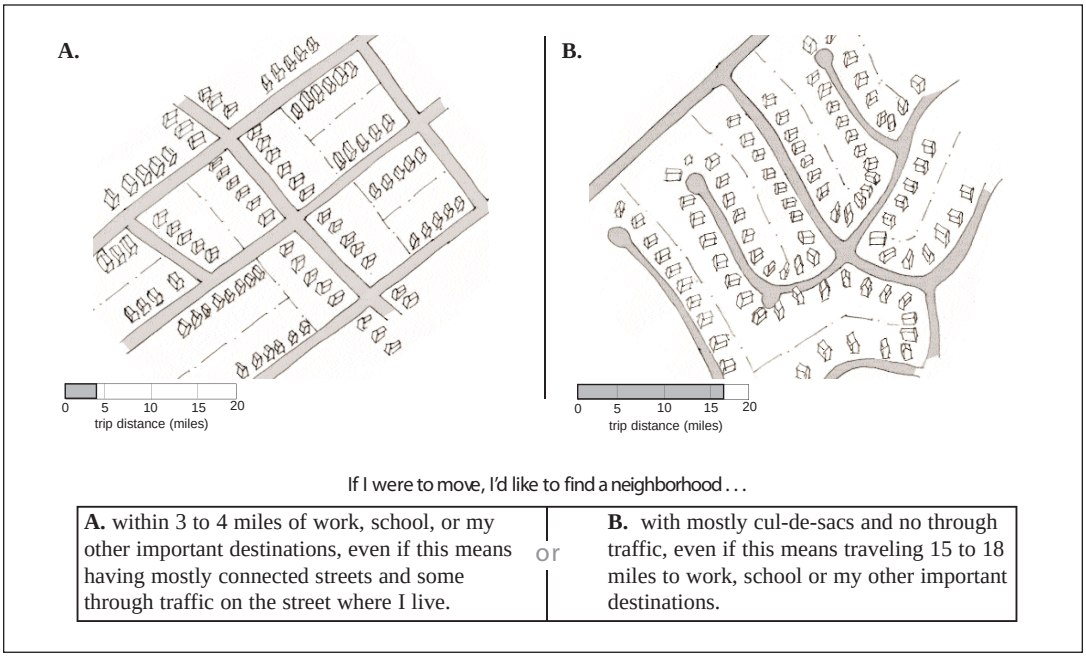


FIGURE 17 - Close to Work or Cul-de-Sac?

The preference for cul-de-sacs declines when set against other important considerations. For a majority of Atlantans, a home on a cul-de-sac is less important than being closer to work. Asked to think about their neighborhood preference, 53 percent chose a neighborhood where connected streets made for easy walking and cycling, versus 43 percent who would seek cul-de-sacs. Thirty percent wanted, but did not currently live where streets are better connected and travel distances are shorter.

Tradeoff 5: More space for walking & biking, or more space for cars?

Suburban street patterns often leave little room for bicycling and walking, which would give residents more travel options as well as providing healthy physical activity. But providing for walking and bicycling can reduce the road space available for cars, and might sometimes slow down traffic. Which would residents prefer?

Nearly four in ten respondents held particularly strong preferences for neighborhoods that limit space given to cars relative to cyclists and pedestrians; but 26 percent did not live in such a neighborhood.

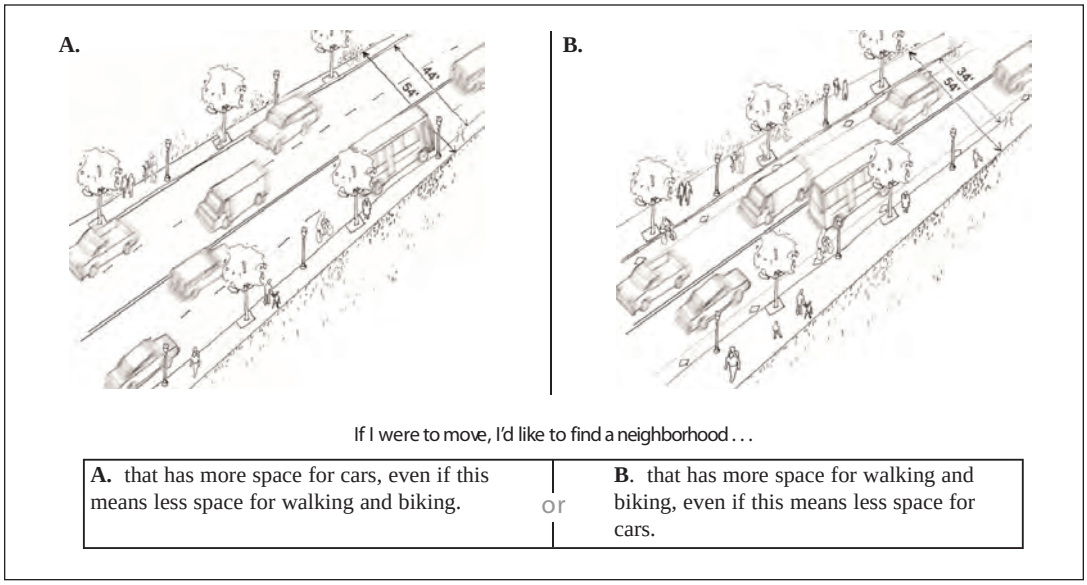


FIGURE 18 - More space for walking & biking, or more space for cars?

SUPPLY VERSUS DEMAND

Each of these trade-offs document a significant proportion of metro area residents that would prefer to live in more walkable environments, even if it means trading off certain amenities such as lot size. Residents are reporting that more compact neighborhoods are appealing to them, particularly when they offer the advantages of proximity to work, shopping and activities, a range of choices in housing types and travel options, and people-friendly streets.

These results are well supported in the marketplace. In fact, the survey results may well be the base level of demand for such attributes, rather than the ceiling. At the time of the 2002 survey, there were very few local examples of new "neo-traditional" neighborhoods that combine the features of walkability, mixed uses and housing types and transportation options. Since then, several new projects have found extraordinary

success in the market place, both in suburban and in-town locations. Developments such as Vickery in Forsyth County, Glenwood Park in east Atlanta and Atlantic Station in Midtown have sold well, demonstrating that well-executed design can overcome many doubts about unfamiliar features of such neighborhoods. This comports with the experience in many other cities, where high-quality, neo-traditional projects have appealed to buyers who might otherwise have gravitated toward conventional subdivisions.

In addition, several demographic and cultural shifts indicate a trend away from the predominance of single-family subdivisions, which traditionally are marketed to families with children. Nationally, the proportion of households with children has been dropping in recent years – there now are more single-person households than households with children. In metro Atlanta, over the next 25 years the share of homes with children will hover at one in four. The population also is aging. Today one in five residents is over the age of 55, but over the next 25 years the figure is expected to rise to one in three, as the number of Atlantans over age 65 triples (ANDP 2004).

Other Market Indicators

Developer survey

A survey conducted for the Urban Land Institute shows developers perceive a much stronger market for alternatives than regulation usually allows. (Levine and Inam 2004). A significant majority of respondents to the survey of developer-members of the ULI perceived inadequate supply of alternatives to sprawling development relative to market demand; felt that municipal regulations were the most significant barrier to such development; and indicated that relaxation of such barriers would lead them to develop in a more dense and mixed-use fashion, particularly in close-in suburban locales.

National consumer survey

A 2004 survey by the National Association of Realtors and Smart Growth America found that concern over lengthening commutes is leading more Americans to seek walkable neighborhoods in close-in suburbs and cities. A commute time of 45 minutes or less is the top priority in deciding where to live for 79 percent of Americans. Other top priorities include easy access to highways (75%) and having sidewalks and places to walk (72%). Among people planning to buy a home in the next three years, 87 percent name a shorter commute as their top priority. Asked to choose between two communities, six in ten prospective homebuyers chose a neighborhood that offered a shorter commute, sidewalks and amenities like shops, restaurants, libraries, schools and public transportation within walking distance over a sprawling community with larger lots, limited options for walking and a longer commute. Those who are in the market to buy a home are also more likely to say they want to be in or near a city as opposed to living in a farther out suburb or rural area (Belden Russonello & Stewart 2004).

Part Three

APPLYING THE FINDINGS: EVALUATING THE LIVABLE CENTERS INITIATIVE

The results of SMARTRAQ show that building more convenient, walkable neighborhoods that allow people to reduce their reliance on cars will have a positive impact on congestion, air pollution, and human health. The Community Preference Survey shows that a substantial number of residents in the Atlanta region would prefer this option. SMARTRAQ is also helping to quantify the effects of a range of policies aimed at providing those options.

One such policy already in effect is the Atlanta Regional Commission's Livable Centers Initiative, or LCI. The initiative was created as a way to encourage local entities to think creatively about how they plan for and focus their growth. A local government, community improvement district or other qualified entity can compete for money to create innovative plans for a variety of projects, such as redeveloping a town center, road corridor or a strip shopping corridor, focusing development around transit stations, or converting commercial-only areas into live-work-play districts. Winning jurisdictions with successful plans are then in line to receive implementation money from the region's transportation funds.

In order to gauge their potential impact, the ARC asked the SMARTRAQ team to evaluate three LCI community plans. Using ARC and SMARTRAQ data and computer models, the team predicted the degree to which miles of driving, air pollution, transit ridership and many other factors would change in coming years under the LCI plans. They compared this to continuing with current planning and zoning. The three sites -- the City of Marietta in Cobb County, the Perimeter Center area in DeKalb and Fulton counties and the West End in the City of Atlanta -- were chosen based on their regional location and development type (suburban town center, inner-ring "edge city" and center-city neighborhood), as well as on the availability of data.

FIGURE 19 - LCI Study Area Locations

In all three cases, the SMARTRAQ analysis found that the LCI plan would reduce the miles of driving per person, increase use of transit, improve walking conditions and reduce vehicle emissions over the projection of status-quo trends. They do so by allowing more people to live in proximity to jobs, shopping and public transportation.

The Perimeter Center LCI in particular makes a stark case for the potential of land use planning

to affect transportation. According to the analysis, adding housing and pedestrian amenities to Perimeter Center, an employment hub with an existing MARTA rail line, would help to cut emissions, vehicle miles driven and trips by about one-fourth over continuing with current trends. Of the three test cases, the plan for Perimeter Center resulted in the largest declines in emissions, travel distance and time.

In the Marietta LCI plan, the addition of a proposed rail transit line and station very near the central square would serve 3,000 riders a day and help reduce emissions, distance driven per person, and the number of vehicle trips by nearly 6 percent from current development trends. The Marietta plan also reduces travel distance and time. For more detail on the LCI analysis, see the report "Before and After Study: Livable Centers Initiative Report" (full citation in Appendix A).

MARIETTA TOWN CENTER

Before (actual photo)

After (graphic realization)

1. Clearly marked bicycle lane created to offer nonmotorized transportation alternative
2. Interesting streetlamps added to enhance pedestrian experience and safety
3. Building setback reduced to eliminate surface parking and offer more appealing walking environment
4. Automobile-scale advertisements and billboards removed to improve aesthetic of streetscape
5. Unsightly telephone lines buried and poles removed

FIGURE 20 - Creating Walkable Streets

PERIMETER CENTER

The Perimeter Center study area, lying to the east of Georgia 400 near its intersection with I-285, is one of metro Atlanta's oldest and largest suburban job centers. The area's office parks and shopping centers grew up around a regional mall, and are designed to be reached by car. Even the MARTA rail line that has served the area since the 1990s is used primarily by people who drive to and from the stations - few nearby destinations or residential development undermines pedestrian access. Since Perimeter Center was chosen as a LCI community in 2001, the community improvement district and surrounding jurisdictions have been working to add housing so as to create a better balance with jobs, and to make it easier to move around within the area without a car.

The SMARTRAQ study compared the current conditions to two possible futures. The "current trends case" shows what the area would be like in 2030 under existing plans and zoning. The "LCI case" predicts changes

based on a plan that would redevelop some of the broad parking lots as housing, while mixing more shops and restaurants into the office-only zones and developing an inviting pedestrian network of connected sidewalks, safe crossings and shady streets.

While both future scenarios project gains in population and jobs, the LCI plan would accommodate nearly 11,000 more residents than would be possible under existing plans, and an additional 2,600 jobs. It would do so while developing less open space than the status quo plan; in fact, the LCI plan adds two parks. Because most new residents would be accommodated in apartments or condominiums built adjacent to the mall and office parks, the existing single-family residential neighborhoods would change hardly at all.

Transportation and air quality effects

The LCI plan would put more people in close proximity to rail stations, reducing the average distance between home and a station from 1.5 miles to about a mile, though many residents would be within an easy walking distance (about a third of a mile). Partly as a result, the predicted number of people boarding the rail station each day would increase four-fold under LCI, from 4,473 to 17,709. The plan also would eliminate the need for one vehicle trip in four, resulting in a 25 percent reduction in the number of miles driven per person each day. That in turn cuts by one-quarter the emissions of air pollutants and greenhouse gases.

	Current Conditions	LCI	Trend
Total Population	6,639	18,319	7,473
Total Jobs	99,630	110,120	107,520
Single-Family Dwelling Share	51%	23%	50%
Multi-Family Dwelling Share	49%	74%	50%
Rail Transit Boardings (daily total)	4,473	17,709	4,473
Vehicle Trips (trips/day/person)	4.01	3.03	3.95
Vehicle Miles Traveled (miles/day/person)	18.41	13.88	18.21
Air Pollutant Emissions (lbs/yr/person)	252	190	248
Greenhouse Gases (lbs/yr/person)	6,720	5,066	6,650

FIGURE 21 - Perimeter Center - LCI results

MARIETTA TOWN CENTER

Founded in 1834 as the county seat of Cobb County, Marietta is older than the city of Atlanta, which lies 20 miles to the southeast. Though it is known for its quaint courthouse square, the city has in many ways been overshadowed by the suburban development that has surrounded it. Indeed, regional planners' projections show the city's population of nearly 9,000 declining to 3,000, should current trends hold.

The SMARTRAQ study compared that scenario, based on existing planning, zoning and market conditions, with the LCI plans that have been under development in Marietta since 2000. That approach includes encouraging added housing in a few higher-density, mixed use projects near a proposed transit station downtown (the mode was assumed to be either light rail or bus rapid transit, in accordance with regional plans). At the same time, the city would add sidewalks and other pedestrian attractions, including a new park. In all, 2,700 additional residents and 6,500 employees were assumed to be distributed across specific parcels the city identified as important for redevelopment. Most of these were adjacent to the transit stop or along central thoroughfares, leaving current residential areas largely unaffected.

The results show that, rather than losing residents and becoming a city populated primarily in the daytime by government-related workers, Marietta would become a balanced city of both residents and employees, all of whom had greatly improved transportation access.

Transportation and air quality effects.

The study found that the addition of a proposed rail or bus rapid transit line and station very near the city's central square would serve 3,000 riders a day and help reduce vehicle miles, trips and emissions by nearly 6% from current levels. The research also projects reductions in travel distance and time. Marietta lends itself well to such improvements by virtue of its existing, walkable scale and streets, as well as a convenient mix of uses close to downtown.

	Current Conditions	LCI	Trend
Total Population	8,820	11,607	3,049
Total Jobs	23,368	29,574	15,565
Single-Family Dwelling Share	82%	58%	92%
Multi-Family Dwelling Share	18%	42%	8%
Rail Transit Boardings (daily total)	--	2,998	--
Vehicle Trips (trips/day/person)	2.79	2.63	2.92
Vehicle Miles Traveled (miles/day/person)	18.28	17.15	19.03
Air Pollutant Emissions (lbs/yr/person)	195	184	204
Greenhouse Gases (lbs/yr/person)	6,672	6,260	6,942

FIGURE 22 - Marietta Town Center - LCI results

WEST END HISTORIC DISTRICT

Founded in the 1830s at the intersection of White Hall (now Lee Street) and Sandtown (now Ralph David Abernathy) roads, the West End neighborhood hit its stride as a prototype suburban neighborhood with the arrival, first, of a railroad line and later, a trolley to downtown Atlanta. The population peaked in the 1930s at about 22,000, before West End fell on hard times. The construction of Interstate 20, intended to spark "urban renewal" by improving the connection to downtown, physically separated the white and black areas of West End. Today, it is served by MARTA's north-south rail line.

The West End Master Plan envisions making greater use of the existing MARTA station by redeveloping under-used or abandoned properties with a broader mix of uses and higher-density housing, while improving walking and transit connections to the surrounding area, including the West End Mall and businesses on Ralph David Abernathy drive. The plan would add pedestrian plazas, streetscaping, safer intersections, a pedestrian bridge and other features to neighborhood streets. Based on current trends, West End's population is expected to stagnate, while the employment base would decline by 2,100 jobs. The LCI plan, by contrast, contemplates adding about 1500 new residents and 800 jobs.

Results for the West End LCI analysis were less dramatic than the others, in large part because the area already possesses many elements of a walkable environment: small block sizes for connectivity, a mix of land uses, balanced jobs and housing and transit service. The LCI gains arise mainly from reversing the decline of the area and capitalizing on its strengths. The introduction of more neighborhood amenities – including shopping districts, a mix of housing types, and pleasant pedestrian environment – along with

transit-accessible jobs would benefit the region by providing more close-in housing, and make greater use of the MARTA system. This is in addition to the benefits of the modest reductions in vehicle travel and emissions noted in the study.

	Current Conditions	LCI	Trend
Total Population	2,651	4,179	2,651
Total Jobs	3,124	3,948	1,005
Single-Family Dwelling Share	24%	16%	24%
Multi-Family Dwelling Share	76%	79%	76%
Rail Transit Boardings (daily total)	1,327	1,668	1,124
Vehicle Trips (trips/day/person)	1.59	1.52	1.60
Vehicle Miles Traveled (miles/day/person)	11.48	11.09	11.62
Air Pollutant Emissions (lbs/yr/person)	115	110	116
Greenhouse Gases (lbs/yr/person)	4,190	4,044	4,241

FIGURE 23 - West End Historic District - LCI results

The travel survey collected data on more than 18,326 people in 8,069 households in each of the 13 counties.

Part Four

THE STUDY: HOW IT WAS DONE AND HOW IT IS BEING USED

The SMARTRAQ research program consisted of five main components:

- a travel survey of more than 8,000 households,
- construction of a regional 13 county land use database,
- a sub-survey of physical activity targeted at 1000 people in different households,
- a market survey of 1500 in different households; and
- an outreach program to public- and private-sector actors in planning and development.

The land use database and travel survey were combined in order to determine the land uses and the extent of the street network within one kilometer of each respondent's home and workplace. This allowed the researchers to pinpoint the ways that residents' surroundings may influence the way they travel.

TRAVEL SURVEY

Administered in 2001-2002 by the Atlanta Regional Commission, metro Atlanta's regional planning agency, the travel survey gathered detailed information about the comings and goings of people in more than 8,000 households across the region. Participants were asked to keep a paper diary of all the trips made in the course of two days; some of the participants measured weekend as well as weekday travel. The survey noted the starting and ending point, duration and length of each trip, how each person traveled, their demographic characteristics, and more. Participants then relayed this information in a telephone interview that also gathered additional data.

The survey was intended in part to update a 1991 travel survey, but it went well beyond previous efforts in both size and scope. While the previous survey had largely collected data from drivers in suburban environments, SMARTRAQ made special efforts to reach residents in a variety of settings, from low-density subdivisions to traditional in-town neighborhoods to edge cities and downtowns. Researchers went to special lengths to gather information on walking trips and transit riders. Most notably, SMARTRAQ, through a collaboration with the Atlanta Neighborhood Development Partnership, conducted an unprecedented recruitment of minority and low-income households who largely had been missed in the past. This involved holding meetings with residents and community leaders in neighborhoods such as Reynoldstown and Mechanicsville in Atlanta and the Beaver Ruin Road corridor in Gwinnett County, using Spanish-speaking interviewers when desired by participants, and other strategies.

In the end, the travel survey collected data on more than 21,339 people in 8,069 households in each of the 13 counties.

LAND USE DATABASE

The researchers also developed an unprecedented database of the land uses in the metro area, showing whether and in what form each parcel is developed. This effort was done in partnership with the Center for Geographic Information Systems at Georgia Tech. The information allowed researchers to begin to evaluate the neighborhood design of the area around the house of each survey respondent so they could examine how travel patterns might be affected by factors such as the proximity of shopping and other activities, the road network, the degree to which houses are spread out or closer together and other factors. The database also included information about the size of commercial and office buildings and the land area occupied by the different uses. Each county uses its own land use categories, so creating a regional land use database with a consistent set of categories was one of the most expensive elements of the program (at a cost of $1 million). The researchers collected tax assessor parcel data from each of the 13 counties and recoded the land uses for about 1.3 million parcels. For more information about the land use database development process, see the technical report "Regional Land Use Database: Descriptive Analysis" (full citation in Appendix).

SMARTRAQ'S Influence on Subsequent Research

The models, surveys and other methods developed in the SMARTRAQ program have been applied to a variety of other leading edge studies. Reports and published papers from these studies are identified in Appendix A. One such effort is a $6.5 million suite of grants from the National Institutes of Health as part of the "Neighborhood Quality of Life Study" to assess how the built environment affects health in Seattle, Baltimore, Cincinnati and San Diego. Other efforts are the King County - Seattle based HealthScape (formerly LUTAQH) Study, the PLACE study in Australia, and IPEN - the International Physical Activity & Network. http://www.ipenproject.org/

The U.S. Environmental Protection Agency, Robert Wood Johnson Foundation, Ford Foundation, Urban Land Institute, Metro Atlanta Chamber of Commerce, The Brookings Institution and others have continued to fund research based on the data that was collected. Products include cutting edge assessments on built environment influences on physical activity and travel patterns of youth to school and obesity and travel patterns of the elderly. Several metro regions are adopting the survey design and sampling methods developed in SMARTRAQ in their own travel surveys in order to connect them with land use patterns and to estimate the effects of potential growth and development scenarios on public health and the environment. Numerous published papers and studies currently underway reference the methods pioneered and published by the leaders of the SMARTRAQ Study.

PUBLIC HEALTH ELEMENTS

SMARTRAQ considerably advanced our understanding of how neighborhood characteristics are associated with air pollution, obesity, and physical activity. However, it was on the latter question that SMARTRAQ broke truly new ground. To do this, the researchers included questions about height, weight and other health and activity characteristics on the confidential travel survey, so that this information could be matched to the respondents' neighborhood characteristics. This integrated approach to transportation and health related data collection was unprecedented and established a national model for other regions to follow. A subset of the travel survey participants, from over 800 different households, completed a physical activity survey asking how much exercise they get, where and how they get it, and the level of social interaction they have with their neighbors. Respondents also were asked to use one of two devices to measure the amount of physical activity in their daily lives -- driving a car, running an errand, performing their jobs, etc. They used either an accelerometer that measures total activity or a Palm Pilot-

like device linked to a global positioning satellite. Accelerometers provide a better measure of overall physical activity – whether from travel or otherwise - since they capture nearly all forms of physical activity and measure it objectively through an electronic device.

In addition, the increased understanding of public health concerns furnished by SMARTRAQ's integrated approach to transportation and health related data collection has strengthened the collaborative relationship between the Atlanta Regional Commission and the Atlanta Regional Health Forum (www.arhf.net) as they seek to integrate health, broadly defined, into regional planning through the use of health impact assessments and other tools. There is an important opportunity for the ARHF to develop the findings from SMARTRAQ into policy options for the region.

MARKET SURVEY

To gauge the degree to which current residents are finding the types of neighborhoods they prefer, and to get a sense of any unmet demand for different neighborhood styles, SMARTRAQ turned to a market research technique known as the stated or community preference survey, the results of which are summarized in Part II of this document.

OUTREACH

In addition to providing the information necessary for informed planning and policy decisions, SMARTRAQ also sought input from the people involved in making those decisions. Their thoughts helped shape the research and also allowed the investigators to assess the existing policies, practices and thinking habits that shape our communities. The outreach was accomplished through a series of conferences held in turn with local officials, developers and lending institutions. They included recognized experts from across the nation. These events were well supported by the community and two featured addresses from then-Governor Roy P. Barnes. Afterward, local officials, developers, and lenders were brought together for a final event to discuss together the barriers to innovative changes that could ease some of the impacts of growth and address unmet market demand. The findings of this outreach were summarized in the SMARTRAQ publication, "Trends, Implications and Strategies for Balanced Growth in the Atlanta Region". Individual summary reports were also produced for each event (available at www.act-trans.ubc.ca).

PUTTING THE DATA TO USE

Though many potential uses for SMARTRAQ data remain, the findings already have been put to work in a variety of ways:

Travel models.
The travel survey was used to update and expand the capacity of the computer models that regional planners use to predict the performance of the 13-county transportation network under various scenarios. These models help the Atlanta Regional Commission, whose members allocate transportation funding in the region, test potential solutions and decide which projects to build and the priority to give them.

Performance measures.
SMARTRAQ also has developed recommended indicators and potential benchmarks to be used by the Georgia Regional Transportation Authority to evaluate the region's progress on maintaining and improving quality of life, economic opportunity, housing options, environmental health and other areas. Tracking performance measures such as these is one of the key duties of GRTA under the legislation that created the agency in 1999. A report on the results of this work, "Performance Measures for Regional Monitoring," is available at www.act-trans.ubc.ca.

Policy evaluation.
SMARTRAQ researchers also have used the data to evaluate the likely effectiveness of a key Atlanta Regional Commission policy innovation, the Livable Centers Initiative. Under LCI, local communities that would like to capture a substantial portion of the region's future growth within a certain center or corridor may apply for funding to help them prepare to handle the influx, while creating high-quality neighborhoods in the process. In evaluating three LCI plans, SMARTRAQ helped assess the program's prospects for success. The findings of those assessments are highlighted in Part 3 of this report.

Part Five

CONCLUSION:
NOW THAT WE KNOW: POLICY IMPLICATION OF THE SMARTRAQ FINDINGS

Now that they have the SMARTRAQ data and analysis, what could decision-makers do with the information? Before summarizing some of the broad implications for policy, it might be useful to review the baseline conclusions from this research program:

Travel and development patterns are strongly linked.

The pattern of development – whether daily activities are spread out or more compact, whether jobs and housing are integrated or separated by great distances, etc. – has a large effect on travel patterns. People who live in more compact, complete and walkable neighborhoods drive less and walk and take transit more often, regardless of whether they put a high personal value on such activity. People who live in closer proximity to job and activity centers also spend less time behind the wheel. While these results vary considerably for different populations, overall there is a clear linkage between community design and travel choice. The transportation land use connection differs across demographic groups. This is highlighted in all of the papers and reports developed from SMARTRAQ and has important policy implications.

Connectivity of the road system matters.

In most of metro Atlanta beyond the urban core, SMARTRAQ found a road network with a poor level of connectivity. Most residential streets end in cul-de-sacs and thwart direct connections for either motorists or pedestrians. Commerce is strung along overcrowded roadways and the lack of connectivity often forces motorists to use those same overburdened corridors for through trips. As a result, SMARTRAQ found, people drive greater distances and make fewer trips by other travel modes than they otherwise would. These conditions contribute significantly to metro Atlanta's high levels of congestion and growing vehicles hours of travel – the time people spend behind the wheel.

Current conditions are not the result of perfect market performance.

While SMARTRAQ's neighborhood preference survey found substantial demand for conventional subdivisions, it also revealed a large, underserved market for more walkable neighborhoods with varying housing types, access to shopping and restaurants and a potential for shorter commutes. This market is not being served fully by Atlanta's development industry and points to the likelihood that regulatory public investment patterns and ingrained private-sector practices are preventing it. Indeed, many participants in the four SMARTRAQ outreach conferences made this observation.

The travel-land use interaction has serious implications for children, general public health and social fairness.

SMARTRAQ documented that environments designed for reliance on the automobile are associated with higher emissions and poor air quality. Likewise, people living in those environments tend to get less exercise as a part of their daily routines, and are more likely to be overweight as a result. Development patterns that present a dangerous and inconvenient environment for people on foot constrain

the mobility and independence of senior citizens and children. The suburbanization of jobs and their location in automobile-oriented zones beyond the reach of public transportation also is shutting low-income minorities out of opportunities.

POLICY IMPLICATIONS

Long-term solutions to the growth in traffic congestion will require the metro region to coordinate transportation investment and development.

The region's activity centers and major corridors have far more jobs than housing or services. These areas provide great opportunities for increasing the mix of uses (and thus walkability) within the region, as they have existing transportation access, water/sewer infrastructure and underused parcels, such as failing strip retail centers that are ripe for redevelopment. SMARTRAQ's results show that more housing opportunities closer to jobs will reduce the distances workers must travel. Clustered, higher density, walkable development that combines jobs, housing and services in appropriate places can also support better transit service.

Meeting the demand for greater choice in housing and location will require new approaches from local governments.

Conventional zoning often prevents the development of walkable, mixed-use neighborhoods by strictly separating uses so that they must be connected by a car trip. In addition, many local jurisdictions have used zoning and other means to restrict the construction of apartments, townhouses, senior housing or traditional neighborhoods with mixed housing types. Easing these restrictions in order to allow appropriate community-sanctioned growth will be important. In many local markets, where well-located land may be more expensive and difficult to assemble, making these new choices affordable to people with a wide range of incomes may require additional government incentives. It is important to remember that zoning is predicated on protecting health, safety, and welfare.

Accommodating significant growth in well-designed neighborhoods in the region's centers and corridors will require prioritizing transportation investments in those areas.

The places that accommodate higher-density development must be assured that the region will make infrastructure improvements such as road, transit, pedestrian and bicycle upgrades to serve these areas. The region's edge cities and redeveloped commercial corridors will need to be retrofitted to make their streets safe and inviting for pedestrians. The state, Atlanta Regional Commission, local governments and other organizations charged with identifying and prioritizing major transportation infrastructure investments should ensure that these investments are coordinated with the appropriate land use. In some regions, jurisdictions that encourage development patterns that promote the efficient use of transportation investments receive funding priority.

Preventing future congestion and maintaining the region's quality of life will require cities and counties to more carefully coordinate and plan investments in newly developing areas.

The ad hoc development of subdivisions and strip commercial corridors continues in once-rural parts of metro Atlanta. To avoid exacerbating the problems associated with a poorly connected road network and an automobile-dependent environment, these jurisdictions should consider phasing their growth. They could phase development in conjunction with extension of water, sewer, schools and other ser-

vices, as well as to the extension of a connected street network. Outlying jurisdictions that can do so will be able to create walkable neighborhoods that reduce the amount of time residents must spend in their cars and will make future transit service viable, should it become desirable.

Informed in part by previous reports from the SMARTRAQ program, governments in the Atlanta Region have already embraced many of these policies. The Livable Centers Initiative, which now has been expanded to address commercial corridors as well as activity centers, is one established framework for acting on the research findings. The city of Atlanta's Beltline concept is being developed along these principles, and can benefit from the SMARTRAQ findings presented here and through alternative scenarios for the future. Communities from Smyrna to Suwanee to Fayetteville are acting to fulfill their own aspirations, are creating mixed-use town centers and offering new housing and living choices. This truly is an emerging new era in metro Atlanta, and the new data and analysis from SMARTRAQ ensures that communities can move forward in the knowledge that they are on a sound course. It is through the development of meaningful partnerships that span health, environment, land development, and transportation investment that we can truly make a difference. Working together it is possible to share and leverage each others' resources. Rising health care and energy costs are threatening our quality of life. Savings gained by reducing these costs can be used to build more sustainable communities and will help to make Atlanta an even more competitive and attractive region for generations to come. Achieving this will require broad based thinking and most of all, leadership that is willing to make some tough choices.

Project Credits

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Appendix A:

REPORTS, ARTICLES, AND RESOURCES

SMARTRAQ reports and publications can be downloaded on the SMARTRAQ website: **www.act-trans.ubc.ca**

SMARTRAQ-BASED JOURNAL ARTICLES

Lawrence Frank, Karen Glanz (PI), Meg McCarron, James Sallis, Brian Saelens, James Chapman (in press). **The Spatial Distribution of Food Outlet Type and Quality around Schools in Differing Built Environment and Demographic Contexts.** *Berkeley Planning Journal*

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