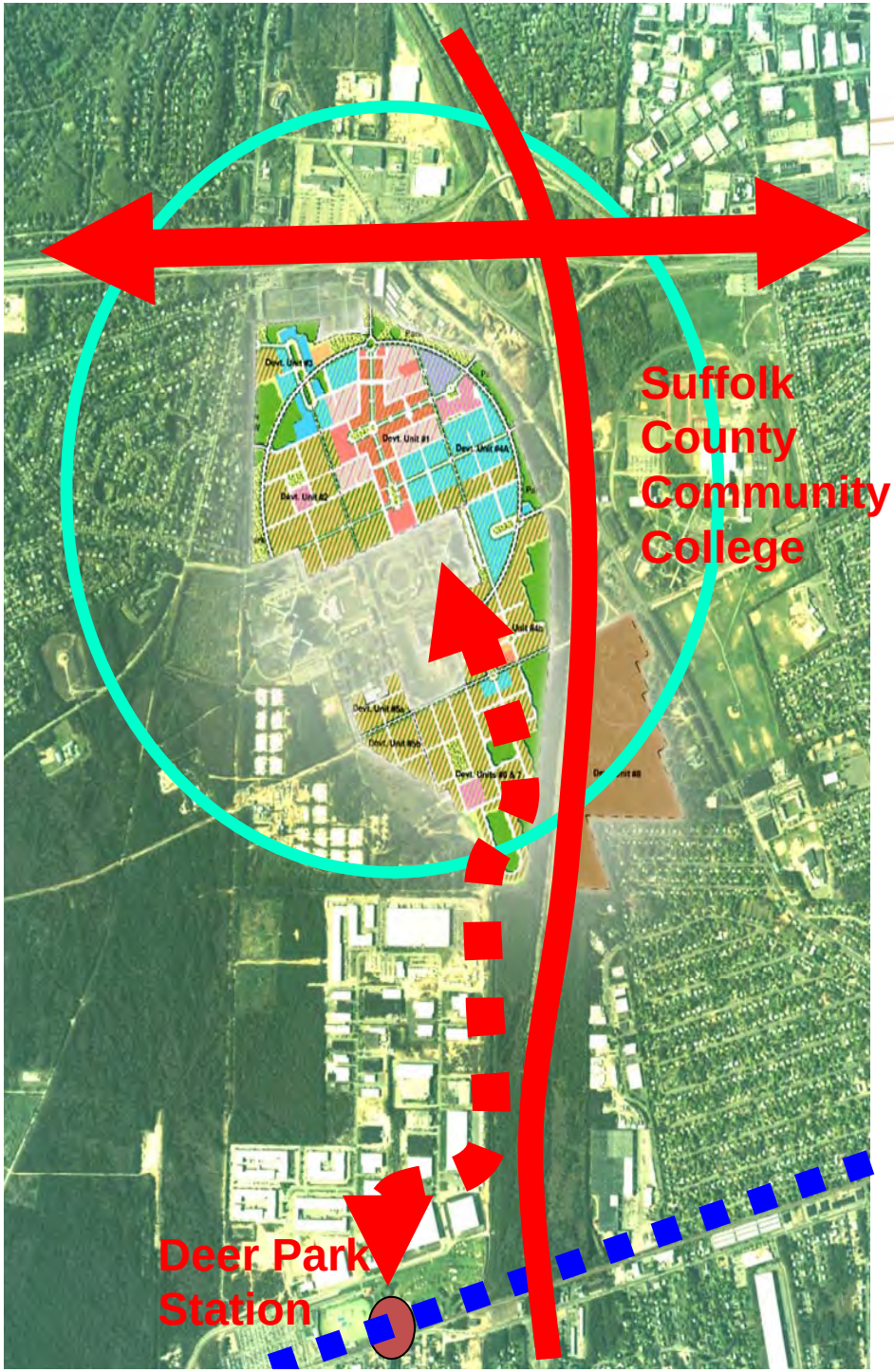
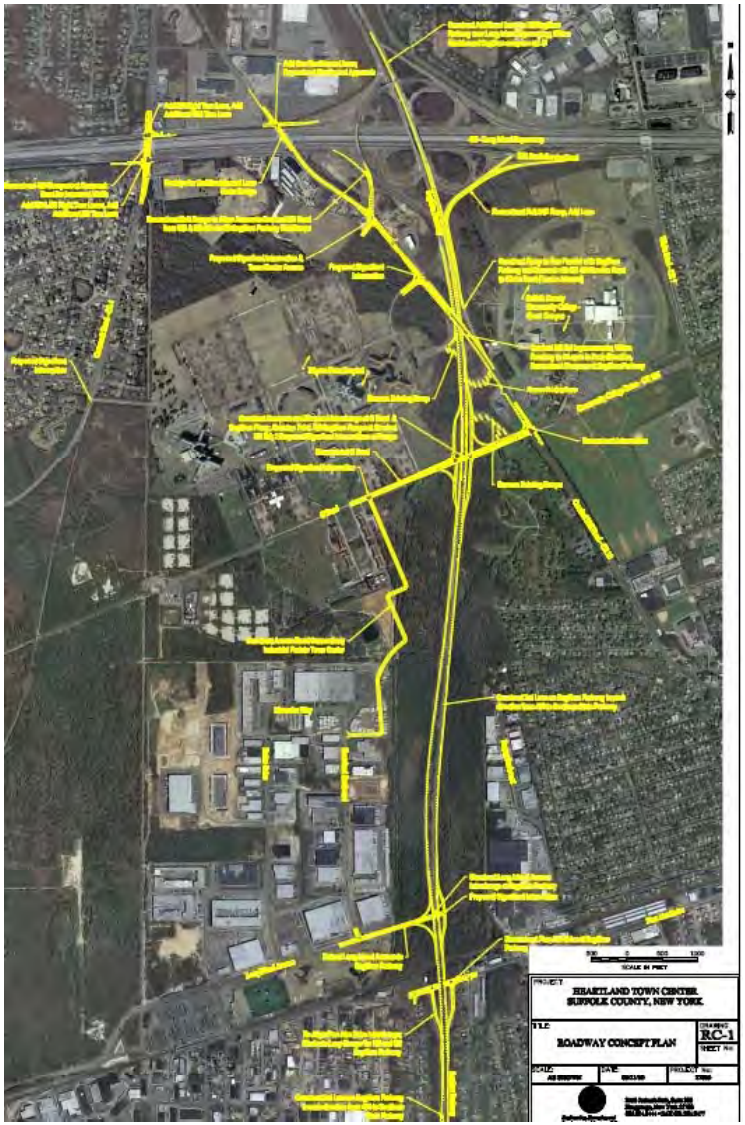


Regional Access

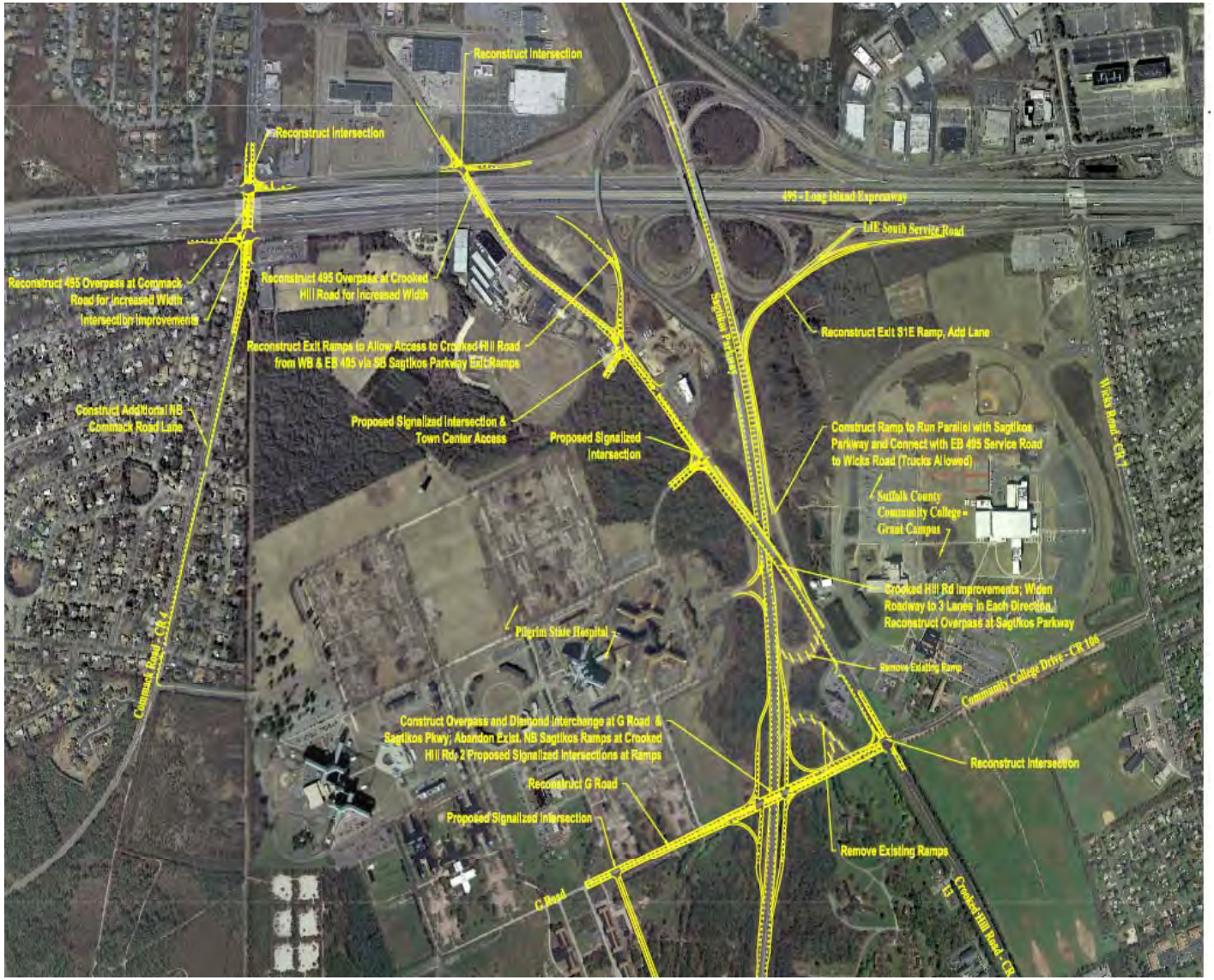
- Five minute ride to LIRR; less than an hour to NYC
- Direct access to Long Island Expressway and Sagtikos Parkway
- Less than 2 miles from Northern State Parkway
- Less than 2.5 miles from Southern State Parkway
- Less than 3.5 miles from Sunrise Highway



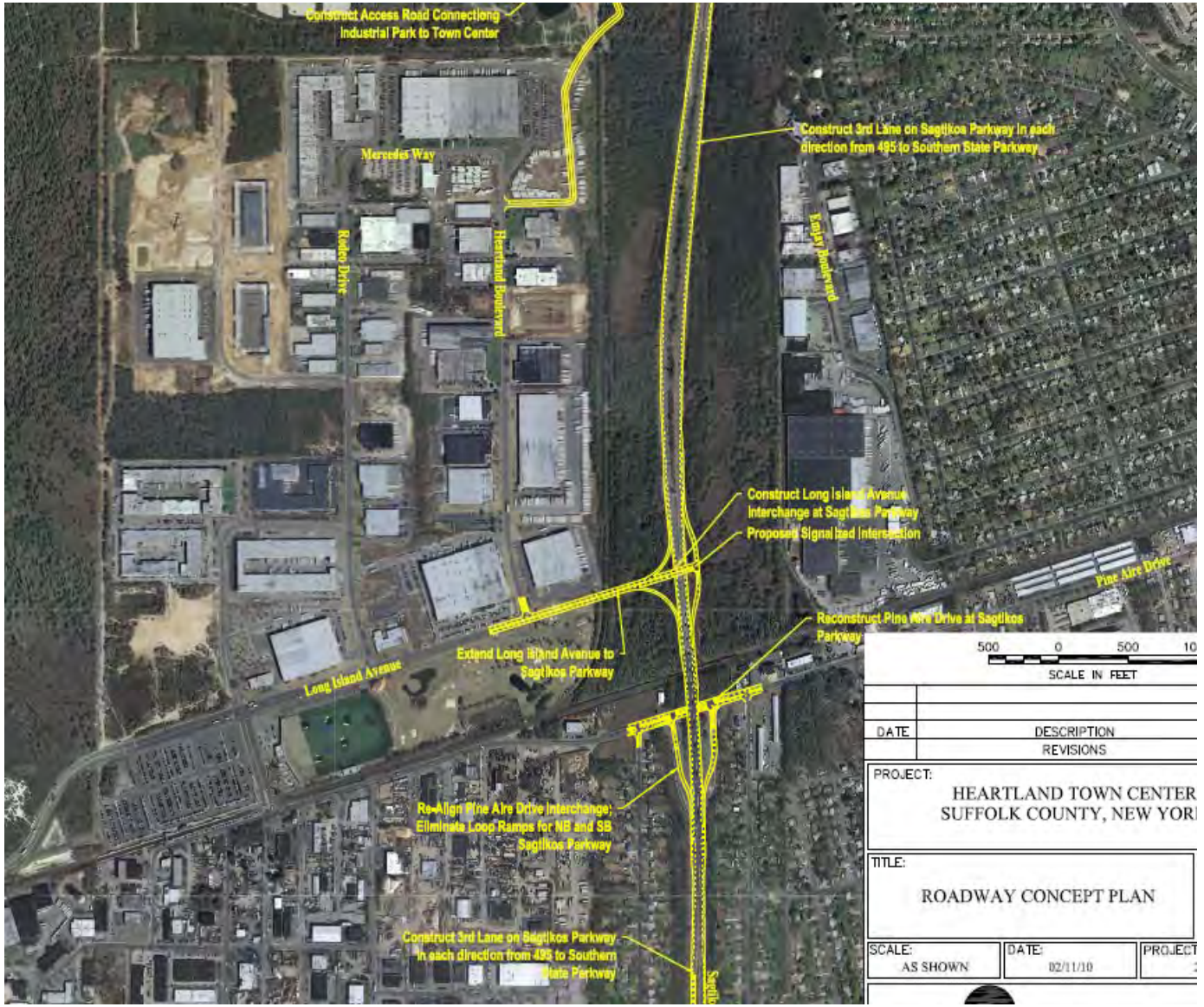
The Future

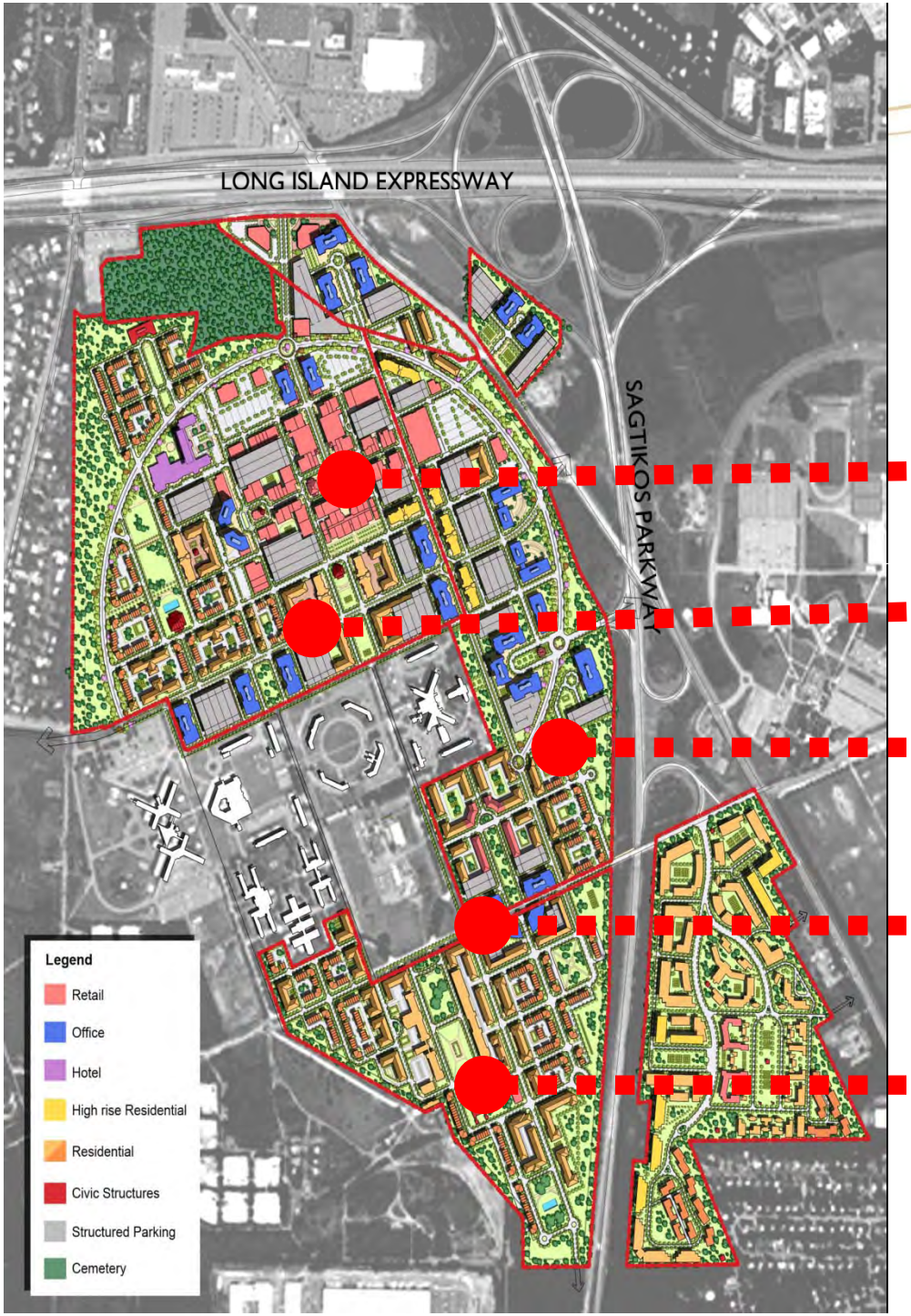
- Widen Sagtikos Parkway
- New LIE Ramp Configuration
- New Interchange
- Modified Interchange
- Intersection Improvements
- Internal Transit Service

The Future


Reconstruct Intersection
Reconstruct Intersection
495 - Long Island Expressway
LIE South Service Road
Reconstruct 495 Overpass at Commack Road for Increased Width Intersection Improvements
Reconstruct 495 Overpass at Crooked Hill Road for Increased Width
Reconstruct Exit Ramps to Allow Access to Crooked Hill Road from WB & EB 495 via SB Sagtikos Parkway Exit Ramps
Sagtikos Parkway
Reconstruct Exit 51E Ramp, Add Lane
Wicks Road - CR 7
Construct Additional NB Commack Road Lane
Proposed Signalized Intersection & Town Center Access
Proposed Signalized Intersection
Construct Ramp to Run Parallel with Sagtikos Parkway and Connect with EB 495 Service Road to Wicks Road (Trucks Allowed)
Suffolk County Community College - Grant Campus
Crooked Hill Rd Improvements; Widen Roadway to 3 Lanes in Each Direction, Reconstruct Overpass at Sagtikos Parkway
Commack Road - CR 4
Pilgrim State Hospital
Remove Existing Ramp
Community College Drive - CR 100
Construct Overpass and Diamond Interchange at G Road & Sagtikos Pkwy; Abandon Exist. NB Sagtikos Ramps at Crooked Hill Rd; 2 Proposed Signalized Intersections at Ramps
Reconstruct Intersection
Reconstruct G Road
Proposed Signalized Intersection
Remove Existing Ramps
G Road
Crooked Hill Road - CR

The Future


Construct Access Road Connecting Industrial Park to Town Center
Mercedes Way
Rodeo Drive
Heartland Boulevard
Construct 3rd Lane on Sagtikos Parkway in each direction from 495 to Southern State Parkway
Expay Boulevard
Construct Long Island Avenue Interchange at Sagtikos Parkway
Proposed Signalized Intersection
Pine Aire Drive
Reconstruct Pine Aire Drive at Sagtikos Parkway
Long Island Avenue
Extend Long Island Avenue to Sagtikos Parkway
Re-Align Pine Aire Drive Interchange; Eliminate Loop Ramps for NB and SB Sagtikos Parkway
Construct 3rd Lane on Sagtikos Parkway in each direction from 495 to Southern State Parkway
500 0 500 10
SCALE IN FEET
DATE
DESCRIPTION
REVISIONS
PROJECT:
HEARTLAND TOWN CENTER
SUFFOLK COUNTY, NEW YOR
TITLE:
ROADWAY CONCEPT PLAN
SCALE:
AS SHOWN
DATE:
02/11/10
PROJECT



Key Elements of the Conceptual Plan

- Mixed-use town center
- Pedestrian-friendly street grid
- System of interconnected public and semi-private open spaces
- Residential neighborhoods with mix of housing types
- Converting the former power plant and workshops into a Cultural Arts Center

Key Elements of the Conceptual Plan

Phase One

230 acres mixed-use development will establish the Town Center and give the community an identity and sense of place

Mixed-use includes:

- 560,000 square feet of retail
- 3,500 units of rental, for sale, and workforce housing
- 210,500 square feet of civic space
- 625,000 square feet of commercial uses (offices, hotels, etc.)

Key Elements of the Conceptual Plan

Key Elements of the Conceptual Plan

The "Main" Street

- Pedestrian-friendly with on-street parking
- Energized by street level retail, restaurants and cafes
- Generous sidewalks for easy pedestrian flow
- Office and residential space on upper floors

Key Elements of the Conceptual Plan

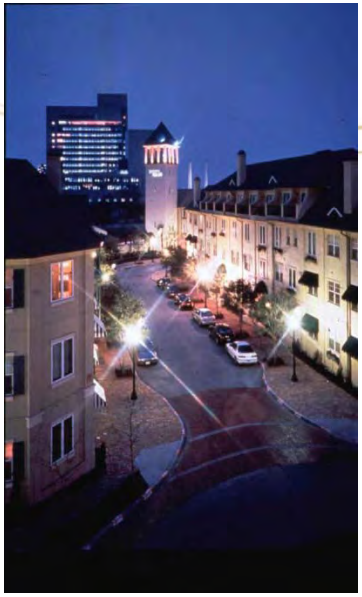
Open space for all age groups

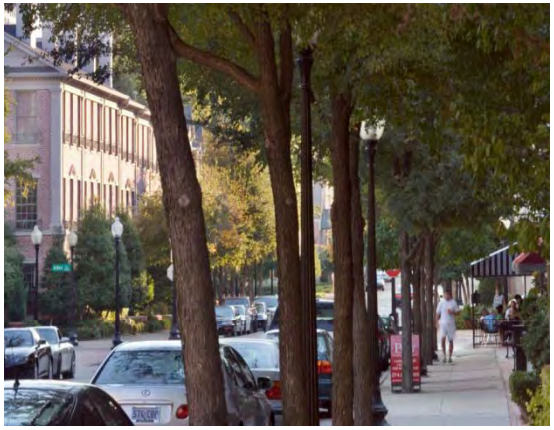
- Neighborhood Parks
- Children's Play Space
- Community Recreation Space
- Buffer Zones and Groundwater Recharge Zones

Key Elements of the Conceptual Plan

Conversion of the power plant and workshops into a Cultural Arts Center

- Community art classes
- Indoor and outdoor art exhibits & sculpture garden
- Performing arts venues for dance, drama, comedy and musical theater
- Galleries, studios and workshops





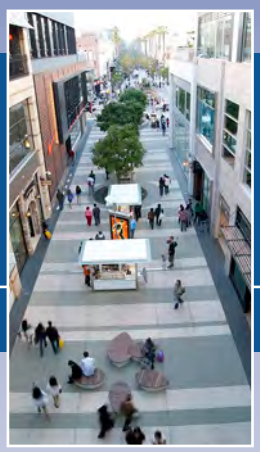
Key Elements of the Conceptual Plan

A connected, pedestrian-friendly street systems

- The “Main Street”
- Shopping Streets
- Residential Yield Streets
- Mews & Alleys
- Collector Streets
- Ring Road


Thank you

7



GETTING TRIP GENERATION RIGHT

Eliminating the Bias Against Mixed Use Development

By Jerry Walters, Brian Bochner, and Reid Ewing

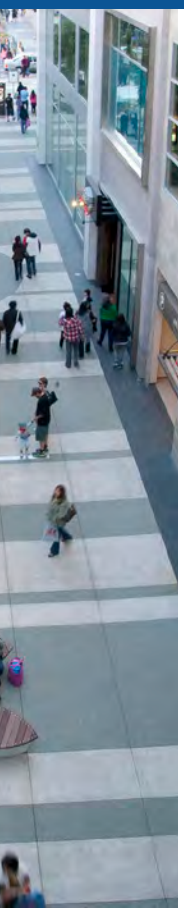
American Planning Association

Making Great Communities Happen

Originally published as a PAS Memo by the American Planning Association (APA) in May 2013. PAS Memo is a bimonthly online publication of APA's Planning Advisory Service, a subscription service providing its members with the latest planning resources and customized research assistance. Learn more at ***www.planning.org/pas/about/.***

Photos in document courtesy of Fehr & Peers.

TABLE OF CONTENTS



When planners, developers, or traffic engineers conduct traffic impact analyses for proposed developments, they typically use the trip-generation data and analysis methods published by the Institute of Transportation Engineers (ITE) in its *Trip Generation* report and *Trip Generation Handbook*. However, standard traffic engineering practice does not account for project characteristics such as the mix and balance of land uses, compactness of design, neighborhood connectivity and walkability, infill versus remote location, and the variety of transportation choices offered. This can have significant implications when the project in question is a mixed use development.

The conventional methods used by traffic engineers throughout the U.S. to evaluate traffic impacts fail to account for the benefits of mixed use and other forms of lower-impact development. They exaggerate estimates of impacts and result in excessive development costs, skewed public perceptions, and decision maker resistance. These techniques overlook the full potential for internalizing trips through interaction among on-site activities and the extent to which development with a variety of nearby complementary destinations and high-quality transit access will produce less traffic. These effects can reduce the number of vehicle trips generated to a far greater degree than recognized in standard traffic engineering practice.

The ITE trip-generation data and analysis methods apply primarily to single-use and freestanding sites, which limits their applicability to compact, mixed-use, transit oriented developments (ITE 2004, 2012). The *Handbook* does include an approach based on limited data on mixed use developments, but only from six sites in Florida, not nearly enough to cover today's diverse mixed use developments across the United States.

It is important that planners and developers recognize the implications of using standard ITE trip generation data and methodologies for mixed use developments and use methods that more accurately estimate traffic generated by these projects. Commonly used methods unjustifiably favor types of development that consume greater resources and generate greater impacts, shifting our attention away from development forms and locations that stimulate higher levels of social interaction and benefit to established communities.

Researchers have attempted to analyze how a mix of uses in a compact, walkable project design affects trip generation and on-the-ground traffic impacts. In 2011, two major studies introduced methodologies for predicting traffic generation from mixed use development. The researchers on those studies have now collaborated to combine the advantages of both and provide, in this *PAS Memo*, an even more complete and reliable approach to measuring the benefits of such forms of development. Using this new approach, planners conducting trip-generation analysis for mixed use development projects will produce more accurate forecasts of traffic generation, which will allow more appropriate on-site design features and off-site mitigation measures.

The Problem with Conventional Traffic Impact Analysis

Traffic analysis is intended to inform planners, community members, and public officials of the most suitable planning features and infrastructure elements needed to support new development. However, the conventional methods were developed during an era when most new development was single use, stand alone, highway oriented, and suburban. Standard practices ascribe similar levels of impact to mixed-use, integrated, transit-oriented, and infill development, and consequently overlook the benefits of — and impose unreasonable obstacles to — appropriate planning and approval of such "smart growth" forms.

The standard analytic process used for planning, design, and impact analysis does not account for the degree to which well-designed mixed use development places shops, restaurants, offices, and residences in close proximity to one another, shortening internal trips between them and making more trips conducive to walking, biking, or riding transit. Such reductions in traffic and vehicle miles traveled reduce fuel consumption, greenhouse-gas and other emissions, and exposure of residents to passing traffic and the related threats to comfort, health, and safety. Reduced vehicular travel can also lessen the need to construct new or wider streets and highways, allowing communities to economize on infrastructure. Mixed use developments (MXD) also create opportunities for shared parking, which can reduce the number of spaces needed in parking lot and garage construction.

Traffic-Reducing Attributes of Mixed Use Development

Many of the attributes of lower-impact development can reduce traffic generation compared with conventional single-use suburban development forms:

Diverse land uses and activities can fill basic needs nearby, thereby reducing automobile travel. They allow for linkage of trips in multipurpose trip chains, with a single auto trip to an activity center followed by several short trips on foot. Mixed use sites also create the opportunity for shared parking, which in turn encourages multipurpose trips and reduces the tendency to make separate automobile trips from one destination to the next.

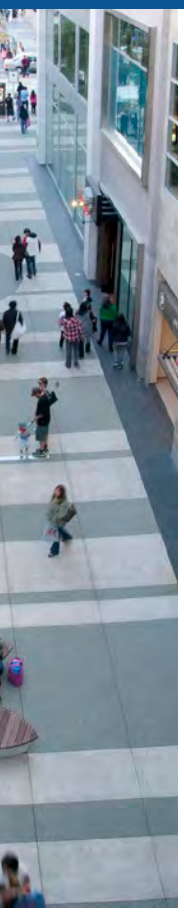
Higher densities and intensities of development provide opportunities for residents, employees, and visitors to circulate among larger numbers of businesses and activities by walking, bicycling, or making short trips by automobile. Higher concentrations of land use also support higher quality and higher-frequency transit service, offering tenants and visitors a viable alternative to driving. High land values and cost to provide parking also leads to higher parking prices, a disincentive to driving versus other available modes of travel.

Walkable urban design and interconnected streets generally reduce the perceived and real separation among destinations, encourage walking and cycling, and reduce the circuitousness and length of each trip.

Short distances to transit help make transit a viable alternative to the automobile and can create activity centers with sufficient street life, amenities, and walking connections where needs and entertainment can be accomplished without independent car trips.

Accessibility to complementary destinations outside the development reduces distances between jobs and housing, services and entertainment, and recreation, often making automobile travel unnecessary. Placed at infill locations, complementary new development that satisfies local needs can also reduce trip making by residents, employees, and shoppers in the surrounding community.

Socio-demographic compatibility can further reduce auto traffic to the extent that developments are designed to attract and accommodate residents with low auto ownership (through, for example, parking supply limits), low travel needs (based on, for example, family size,



fewer employed residents, lower income, or age range), or close affiliation with other project elements or surrounding land uses (linked, or simply compatible, jobs and residents).

Scale of development affects feasibility for communities and employers to provide travel demand options and management services that can shift traveler modes from the auto to alternative modes of travel. Residents and businesses that self-select into such sites and settings are also often more amenable to travelling less or using alternatives to the automobile. Transportation demand management (TDM) programs are both more likely to be available and more likely to be successful in compact, central, transit-supported settings.

The danger of using traditional traffic-generation data based on single-use facilities is that it misrepresents the true traffic generation impacts of mixed use development. The consequences of miscalculating the benefits of mixed-use development may include unreasonable development cost, exaggerated impacts and mitigation responsibilities, skewed public perceptions, and decision maker resistance. This penalizes mixed use development proposals, often tipping the balance in favor of projects that offer fewer benefits and ultimately generate higher impacts. Denying "smart" forms of development does not reduce the overall market demand for housing and business, so the building disallowed ends up in other locations within the region, often in less accessible locations, at lower densities, and in less-mixed use configurations. The end result can be more traffic and higher regional vehicle-miles traveled than had the smart-growth development been approved.

Understandably, communities and public reviewers want to minimize the risk of unmitigated impacts. However, doing so through the application of overly conservative project evaluation criteria undermines the pursuit of other community values, such as vibrant neighborhoods with integrated development and activities that minimize the need to travel and the impacts produced by excessive unnecessary use of the automobile.

Conservative traffic-generation estimates have supply-side impacts, affecting design and cost of streets and parking. Within constrained sites, over design of traffic elements can limit the space available for revenue-producing land uses and increase other development costs. Development fee programs also rely heavily on traffic-generation estimates from the ITE *Trip Generation Manual*; this can lead to setting excessively high fee rates on mixed use development. Unquestioning use of the ITE data can unreasonably jeopardize a MXD project's approval, financial feasibility, and design quality.

Mixed use sites can take many forms, but all offer a diversity of uses in walkable settings. Oakland City Center BART (left); RiverPlace, Portland, Oregon (opposite page).

New Research Evidence for Mixed Use Development Trip Generation

Several hundred studies over the past 20 years have confirmed that the built environment affects travel generation (Ewing and Cervero 2010). Development features associated with reduced trip rates include a series of "D" variables: density, diversity of uses, design of urban environment, distance from transit, destination accessibility, development scale, demographics of inhabitants, and demand management. In the past three years, research has examined more directly the relative influence of each factor and their interactions and has sought to corroborate the research results through field verification. Organizations such as the U.S. Environmental Protection Agency and the National Academy of Sciences Transportation Research Board have sponsored several of the more reputable studies on the subject.

The Eight "D" Variables

The most advanced research has confirmed that trip rate reductions are quantifiably associated with the attributes of mixed use development, defined in terms of these characteristics of urban development patterns:

Density: dwellings, jobs per acre. Higher densities shorten trip lengths, allow for more walking and biking, and support quality transit.

Diversity: mix of housing, jobs, retail. A diverse neighborhood allows for easier trip linking and shortens distances between trips. It also promotes higher levels of walking and biking and allows for shared parking.

Design: connectivity, walkability. Good design improves connectivity, encourages walking and biking, and reduces travel distance.

Destinations: regional accessibility. Destination accessibility links travel purposes, shortens trips, and offers transportation options.

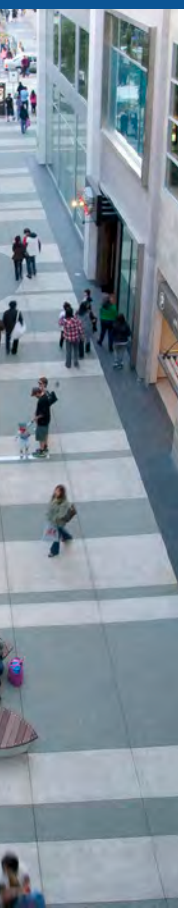
Distance to Transit: rail proximity. Close proximity to transit encourages its use, along with trip-linking and walking, and often creates accessible walking environments.

Development Scale: residents, jobs. Appropriate development scale provides critical mass, increases local opportunities, and supports transit investment.

Demographics: household size, income. Mixed use development allows self-selection by households into settings with their preferred activities and travel modes, allows businesses to locate convenient to clients, and supports a socioeconomic "fit" among residents, businesses, and activities.

Demand Management: pricing, incentives. Demand management ties incentives to the urban environment and allows alignment of auto disincentives with available alternate modes. It takes advantage of critical mass of travel resulting from density, diversity, and design.

A growing body of evidence indicates that these factors, individually or together, quantifiably explain the number of vehicle trips and vehicle-miles traveled for a development project and for a region as a whole. Each of the D factors influences traffic generation through a variety of mechanisms. There are also important interactions, both synergistic and mutually dampening, among the D factors that call for sophisticated techniques when quantifying the travel generation effects of different combinations proposed in any project or plan.



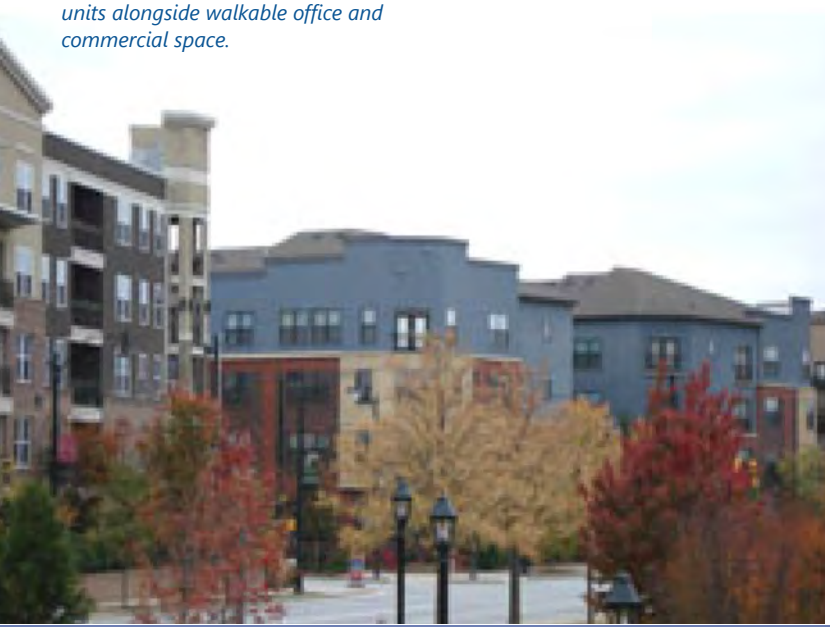
The Evidence that Conventional Methods Overstate MXD Impacts

Empirical evidence and research provides evidence that mixed-use, infill, and transit-oriented developments generate fewer external vehicle trips than equivalent stand-alone uses. A nationwide study sponsored by the U.S. EPA (Ewing et al. 2011) found statistical correlation between the D factors and increased trip internalization and increased walking and transit use. It further demonstrated, for 27 mixed-use development sites across the U.S., that:

1. On average, the sites' land uses would generate 49 percent more traffic if they were distributed among single-use sites in suburban settings, the situations to which the ITE *Trip Generation Manual* would apply.

2. The ITE *Handbook*, the current state-of-practice resource for estimating mixed use trip generation, would overestimate peak hour traffic by an average of 35 percent.

Atlantic Station offers residential units alongside walkable office and commercial space.



The following examples from recent studies demonstrate the degree by which such developments reduce traffic generation relative to what would be presumed under conventional traffic analysis methods.

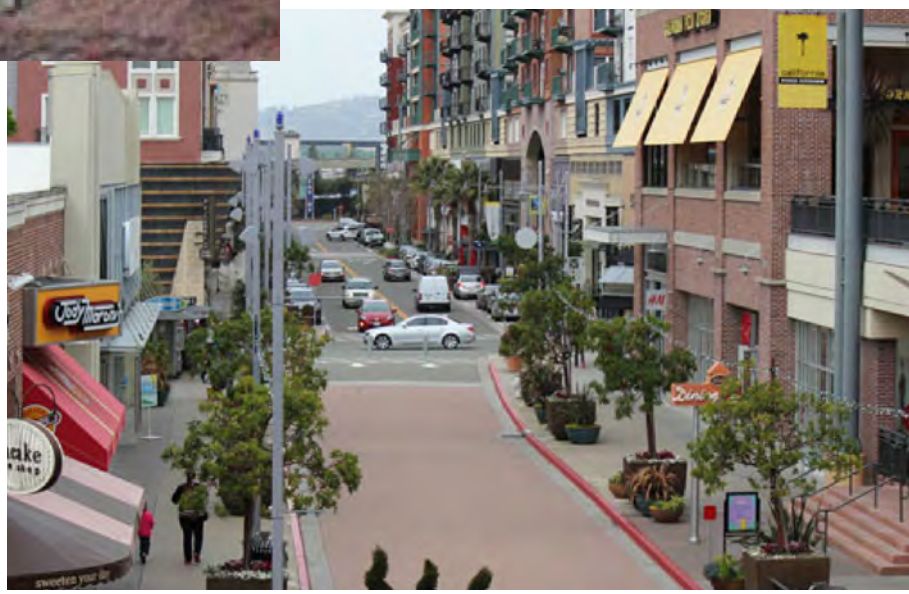
Atlantic Station in Atlanta is a major mixed-use infill development located on a 138-acre former brownfield site in midtown Atlanta, connected by nonstop shuttle service to a MARTA metro rail station about a half-mile away. At the time it was studied, the development included 798 mid- and high-rise residential units, 550,600 square feet of office space, 434,500 square feet of retail space, a 101-room hotel, a restaurant, and a cinema.

For Atlantic Station, the "internal capture rate" (proportion of generated trips that remain internal to the site) is 15 percent in the morning peak hour and about 40 percent of evening peak-hour. Of the trips entering and leaving the site, between 5 and 7 percent use transit and another 5 to 7 percent walk or bicycle.

According to standard ITE trip-generation rates, were the Atlantic Station development elements located at single-use suburban sites, they would generate 37 percent more weekday traffic and 69 percent more PM peak traffic than actually counted at the centrally located, mixed use site.

RiverPlace in Portland is an award-winning mixed use waterfront development on a former brownfield within easy walking distance of downtown Portland, Oregon. Adjacent to the Tom McCall Waterfront Park, the site contains 700 residential units (condominiums and apartments), 40,000 square feet of office space, 26,500 square feet of small retail shops and restaurants, a 300-room hotel, and a marina, cinema, and athletic club. The waterfront walking environment conveniently links all of the activities within the development site and connects the site to the Portland central business district. Transit is also available at the site; the Portland Streetcar connects RiverPlace to downtown Portland and the greater Portland area.

RiverPlace (left) offers a mix of residential, office, and commercial uses on Portland's waterfront. Photo courtesy Fehr & Peers. Bay Street's walkable urban village (below) is designed on a Main Street theme.



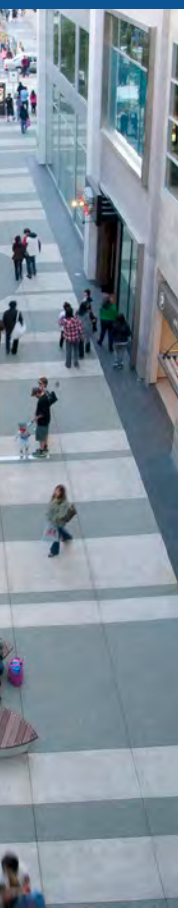
RiverPlace's internal capture rate is 36 percent. For internal and external trips combined, 40 percent are by walking and 5 percent by transit. These statistics are significantly higher than the regional averages of 15 percent of trips taken by walking and 2 percent by transit.

Bay Street in Emeryville is a vibrant, thriving recent redevelopment project in Emeryville, California, just outside San Francisco. The previously heavy-industrial area within and around Bay Street has undergone dramatic revitalization in the past two decades, and it now includes the headquarters of Pixar Studios and other businesses. Bay Street itself is a one-million-square-foot walkable urban village designed on a Main Street theme. It contains a major theater complex, hotel, and 382,000 square feet of fashionable retail shops (including an Apple Store) with 381 apartment units and offices above. The site is within walking distance of a Capitol Corridor commuter rail station and within a shuttle bus ride of BART metro rail.

Bay Street's daily traffic generation is about 41 percent less than the combined total that would be generated by similarly sized suburban shopping centers, theater complexes, residential uses, and office developments based on standard ITE trip rates for stand-alone land uses. It also generates 36 percent less daily traffic than would be estimated by traffic engineers applying the ITE *Handbook* and conventional analysis methods. In the PM peak hour, Bay Street traffic generation is 46 percent lower than would be generated by the same land uses scattered on individual suburban sites, and 41 percent lower than would be estimated by standard ITE traffic analysis.

New Models for Mixed Use Development Traffic Analysis

To address the shortcomings in conventional analysis methods, the National Cooperative Highway Research Program (NCHRP) and the U.S. EPA recently conducted significant research studies to improve quantification of the trip-reducing effects of mixed use development. Each study took a different approach: NCHRP undertook extensive visitor surveys and traffic counts at Atlantic Station and two mixed-use developments in Texas (Bochner et al. 2011), while EPA sponsored a nationwide study of more than 260 mixed use developments across the U.S. using regional travel survey data and verification traffic counts at a subset of the sites (Ewing et al. 2011). Using different analysis methods, each study developed a recommended approach to discounting traffic generation estimates to account for the mix of uses and other development characteristics. Each study represents a major advancement over conventional analysis methods.



NCHRP Report 684

National Cooperative Highway Research Program (NCHRP) Report 684, "Enhancing Internal Trip Capture Estimation for Mixed-Use Developments," analyzed internal-capture relationships of MXD sites and examined the travel interactions among six individual types of land uses: office, retail, restaurant, residential, cinema, and hotel. The study looked at three master-planned developments: Mockingbird Station, a single-block TOD in Dallas; Legacy Town C enter, a multiblock district in suburban Plano, Texas, containing fully integrated and adjacent complementary uses; and Atlantic Station (see above). It compared the survey results to those found in prior ITE studies at three Florida sites, Boca del Mar, Country Isles, and Village Commons, all containing a variety of land uses, though in single-use pods.

Based on traveler and vehicle counts and interviews, the study ascertained interactions among the six land-use types of interest and compared them with site characteristics. It then examined the percentage of visitors to each land-use type who also visited each of the other uses during the same trip. The study considered site context factors and described percentage reductions in sitewide traffic generation that might result from the availability of transit service and other factors.

Researchers then performed verification tests by comparing the analysis results to those available from ITE for three earlier studies at Florida mixed use sites. The validation confirmed that the estimated values were a reasonable match for actual counted traffic. The product of the study is a series of tables and spreadsheets that balance and apply the discovered use-to-use visitation percentages to the land uses within the project site under study. The interaction percentages are then used to discount ITE trip-generation rates and to reduce what would otherwise represent the number of trips entering and leaving the entire site.

EPA MXD

The U.S. EPA–sponsored 2011 report, "Traffic Generated by Mixed-Use Developments — A Six-Region Study Using Consistent Built Environmental Measures," investigated trip generation, mode choice, and trip length for trips produced and attracted by mixed use developments. Researchers selected six regions — Atlanta, Boston, Houston, Portland, Sacramento, and Seattle — to represent a wide range of urban scale, form, and climatic conditions. Regional travel survey data with geographic coordinates and parcel-level detail available for these areas allowed researchers to isolate trips to, from, and within MXDs and relate travel choices to fine-grained characteristics of these developments.

In each region, researchers worked with local planners and traffic engineers to identify a total of 239 MXDs that met the ITE definition of multi-use development. The MXDs ranged from compact infill sites near regional cores to low-rise freeway-oriented developments. They varied in size, population and employment densities, mixes of jobs and housing, presence or absence of transit, and locations within their regions. In total, the MXD sample for the six regions provided survey data on almost 36,000 trips.

The analysis found that one or more variables in each of seven D categories (see above) were statistically significant predictors of internal capture, external walking, external transit use, and external private vehicle trip length. Specifically, an MXD's external traffic generation was related to population and employment within the site (density); the relative balance of jobs and housing within the site and the amount of employment within 1 mile of the site (diversity); the density of intersections within the site as a measure of street connectivity (design); the presence of bus stops within a quarter mile or the presence of a rail station (distance from transit); employment within a mile of site boundaries and percentage of regional employment within 20 minutes by car, 30 minutes by car, and 30 minutes by transit (destination accessibility); the gross acreage of the development (development scale); and the average number of household members as well as

household vehicle ownership per capita(demographics). The accuracy of the EPA MXD method was verified through traffic generation comparisons at 27 mixed-use sites across the U.S.

The EPA MXD product is a series of equations and instructions captured in a spreadsheet workbook. The methodology calculates the percentage reductions in ITE trip generation resulting from the national statistical analysis of seven D effects on internal trip capture, walking, and transit use. The spreadsheets produce reduced estimates of traffic generation on a daily basis and for peak traffic hours.

Combining the Approaches

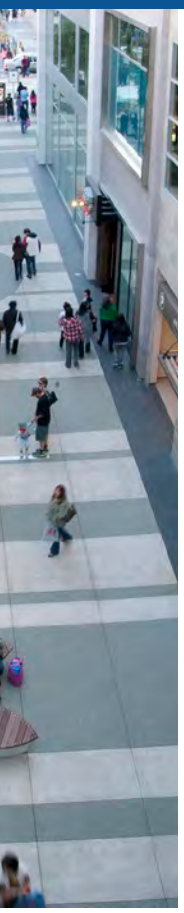
The NCHRP 684 method and EPA MXD method each derive from different research approaches and produce different methods of analyzing trip generation at mixed use developments. They focus on overlapping but not identical aspects of mixed-use development sites and their contexts and offer respective strengths and weaknesses in terms of factors considered and ease of application. Selecting which method to employ under different circumstances requires both a comparison of their capabilities as well as professional judgment of their respective strengths and weaknesses.

Report 684 includes a refined assessment of on-site land-use categories, specifically recognizing the roles of restaurants, theaters, and hotels within the site land-use mix, along with an adjustment to account for the spatial separations among individual land uses within the development site. It is directly useful for the evaluation of proposed development sites that are similar to the one or more of the three surveyed in Atlanta and Texas for the report. However, it is not responsive to factors such as regional location, transit availability, density of development, walkability factors, and the socio-demographic profile of site residents and businesses.

In contrast, the EPA MXD method accounts directly and quantitatively for these factors. However, while it accounts for the balances of retail, office, and residential development, it does not explicitly differentiate subcategories such as restaurants, theaters, and hotels. Furthermore, it requires the analyst to account for off-site development, including employment within a one-mile radius of the MXD and the number of jobs available within 30 minutes of the site.

To develop a method that captures the best of both sets of research findings, the authors of the two original studies decided to collaborate on an integrated method that recognizes the full array of on-site and context characteristics that contribute to traffic reduction and, through a focus on empirical verification, achieves greater accuracy than either method individually.

In developing the integrated approach, we compared the performances of the methods to actual traffic counts at a diverse group of mixed use developments in a variety of settings. The 27 verification sites were successful mixed-use development, exhibiting moderate to high levels of activity in terms of business sales, occupied residential units, property value, and household income, with average or above-average person trips, at the time of the survey. They included those studied for NCHRP 684, the sites used as the basis for the ITE *Trip Generation Handbook*, and others surveyed by Fehr & Peers, transportation consultants. Six of the 27 sites were located in Florida, and three were located in Atlanta and Texas. Three of these nine were nationally known examples of smart growth or transit-oriented development: Atlantic Station, Mockingbird Station, and Celebration, Florida. Six sites were located in San Diego County and were designated by local planners and traffic engineers in 2009 as representing a wide range of examples of smart growth trip generators in that region. The 12 remaining sites were MXD developments located elsewhere in California and in Utah, ranging from TOD sites (commuter rail and ferry) to conventional suburban freeway-oriented mixed use sites.



A New Approach: The MXD+ Method

The new analytical approach, the MXD+ method, combines the strengths of NCHRP 684 and EPA MXD. The authors sought to (1) address the fact that each method has strengths relative to the other, (2) create a method that is more accurate than either of the individual methods alone, and (3) reduce confusion among practitioners on which is the most appropriate method.

The proposed MXD+ method incorporates the underlying data sources and logic that the two methods share. It offers the ability to assess the effects of spatial separation of uses and recognition of more specific land-use categories and to consider the dynamic influences of local development context, regional accessibility, transit availability, development density and walkability factors, and the characteristics of residents.

To develop the preferred method, the authors experimented with different methods of integrating the two methods and arrived at a direct calibration approach. The appropriate combination of the results of the two individual methods was determined through regression analysis to identify the proportions that provided the best correlation with the traffic counted at the 27 validation sites. Table 1 presents results from the regression analysis, listing the proportions of the two methods found most effective at matching the traffic generation at the diverse set of mixed use validation sites. Weighting the results of the two individual analyses by the percentages in Table 1 and combining the results produces more accurate estimates of traffic generation and captures the effects of all of the site description variables included in the NCHRP and EPA methods.

TABLE 1 **OPTIMAL BLEND OF NCHRP 684 AND EPA MXD METHODS**

	AM PEAK TRAFFIC	PM PEAK TRAFFIC	AVERAGE DAILY TRAFFIC
NCHRP 684	10.1%	36.5%	n/a
EPA MXD	89.9%	63.5%	100%

The step-by-step method is as follows:

1. Apply the full EPA MXD methodology to predict external traffic generation as influenced by site development scale, density, accessibility, walkability and transit availability, resident demographics, and general mix of uses.

2. Apply the full NCHRP 684 method to capture the effects of detailed land-use categories, including hotel, theater, and restaurant, and the spatial separation of uses within small and medium sites.

3. Combine the results of the two methods in terms of percentages of trips remaining internal to the development site, using proportioning factors presented in the table above.

4. Apply adjustments to account for off-site walking and transit travel using the EPA MXD method.

5. Discount standard ITE traffic-generation rates by the percentages of internalization produced in step 3 and the percentage of walk and transit travel in step 4 to obtain the estimate of site- generated traffic.

TABLE 2 **COMPARISON OF THREE PRINCIPAL METHODS IN TERMS OF PROJECT CHARACTERISTICS CONSIDERED**

	EPA MXD METHOD	NCHRP 684 METHOD	MXD+ METHOD
Project Characteristics Considered			
Density of Development	♦		♦
Diversity of Uses: Jobs/Housing	♦	♦	♦
Diversity of Uses: Housing/Retail		♦	♦
Diversity of Uses: Jobs/Services		♦	♦
Diversity of Uses: Entertainment, Hotel		♦	♦
Design: Connectivity, Walkability	♦	♦	♦
Design: Separation Among Uses		♦	♦
Destination Accessibility by Transit	♦		♦
Destination Accessibility by Walk/Bike	♦		♦
Distance from Transit Stop	♦		♦
Development Scale	♦		♦
Distance from Transit Stop	♦		♦
Development Scale	♦		♦
Demographic Profile	♦		♦
Data Needs (beyond Project Site Plan)			
Average Residents per Dwelling Unit	♦		♦
Average Autos Owned per Dwelling Unit	♦		♦
Nearby (1/4 mi) Bus Stops and Rail Stations	♦		♦
Jobs Within 1 Mile of Site	♦		♦
Jobs Within 30-Minute Transit Trip	♦		♦
Regional Employment	♦		♦
Located in CBD or TOD?	♦		♦
Site Development by Classification		♦	♦
Vehicle Occupancy Estimate		♦	
Mode Split Estimate		♦	

As Table 2 indicates, the MXD+ method improves traffic generation estimates by considering the full array of 12 site development and context characteristics shown to influence internal capture and mode share, while the individual methods consider only 5 to 8 factors each. Effects considered in MXD+ that are not included in the NCHRP 684 method include household size and auto ownership, site proximity to bus and rail stops, and accessibility to local and regional jobs. Effects considered in the NCHRP 684 method that do not appear in the EPA MXD method include specific land uses and proximity of interacting land uses to each other.

Table 3 presents the statistical performance of the MXD+ integrated method with the individual performance of the individual NCHRP 684 and EPA MXD methods. We compared the ability of each of the available methods to replicate the amount of traffic generated at the 27 validation sites in terms of statistical measures including percent root mean squared error, a metric used in the transportation field to evaluate model accuracy, and the coefficient of determination (or "R-squared"), which measures the ability of the analysis method to account for the variations in traffic generation among the 27 survey sites. For daily traffic generation, MXD+ is equivalent to the EPA MXD method, as the NCHRP 684 method does not address daily analysis. For peak hour traffic generation, MXD+ performs notably better than either of the individual methods.

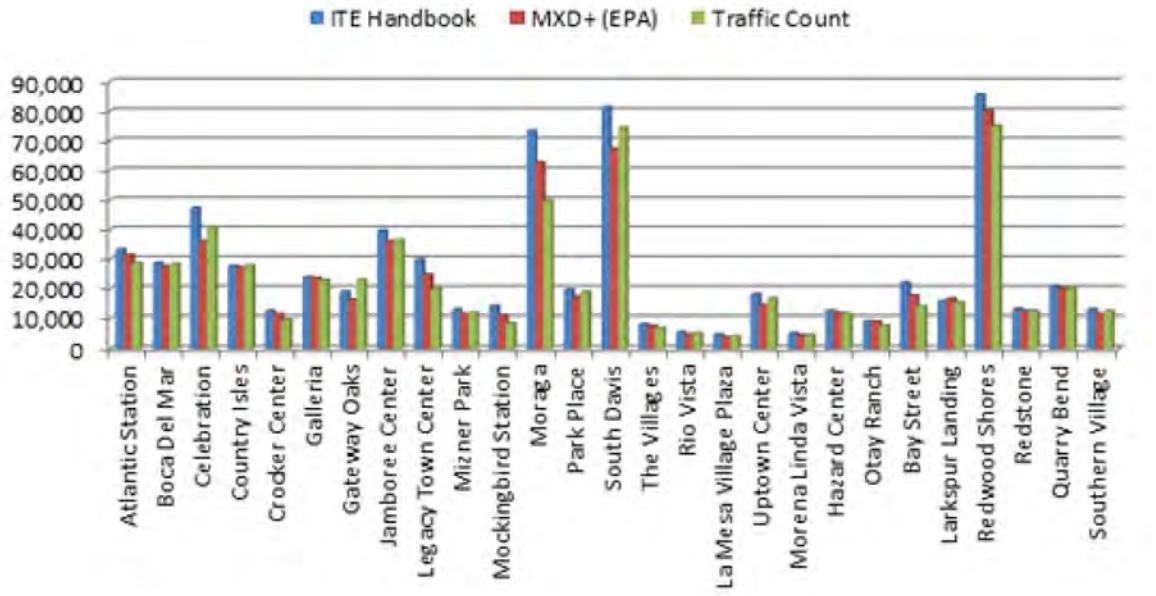
TABLE 3 **COMPARISON OF THREE PRINCIPAL METHODS IN TERMS OF PERFORMANCE AT VALIDATION SITES**

	EPA MXD METHOD	NCHRP 684 METHOD	MXD+ METHOD
Daily Traffic Generation			
R-squared	96%	89%*	**96%**
Average Error	2%	16%*	**2%**
Root Mean Square Error	17%	27%	**17%**
AM Peak Traffic Generation			
R-squared	97%	93%*	**97%**
Average Error	12%	30%	**12%**
Root Mean Square Error	21%	33%	**21%**
PM Peak Traffic Generation			
R-squared	95%	81%	**97%**
Average Error	8%	18%	**4%**
Root Mean Square Error	18%	36%	**15%**

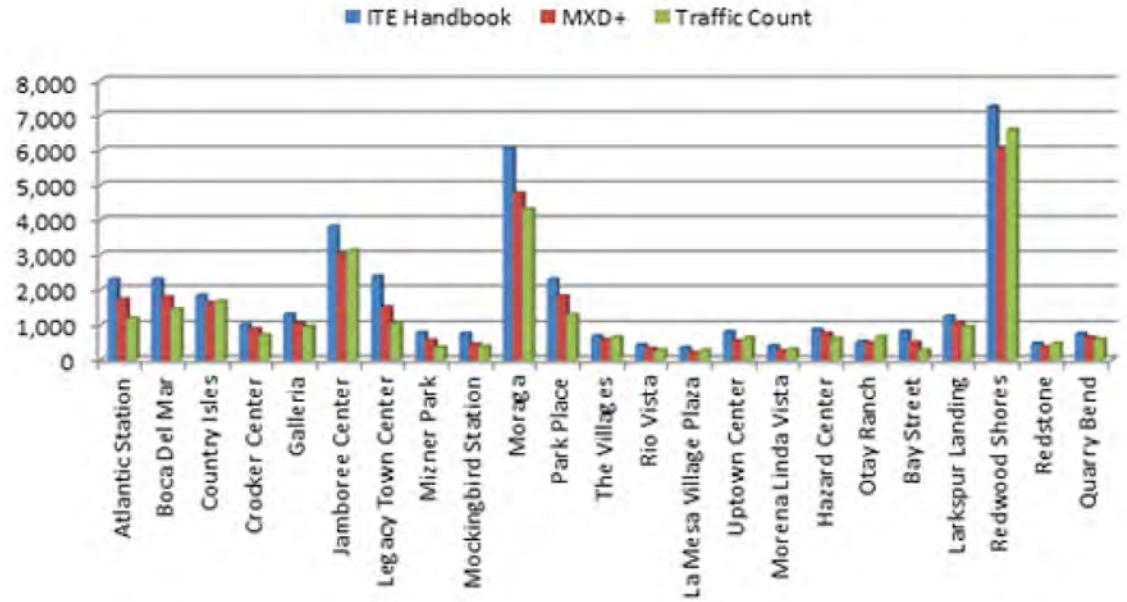
** ITE Handbook internalization statistics (NCHRP 684 method does not address daily trip generation)*

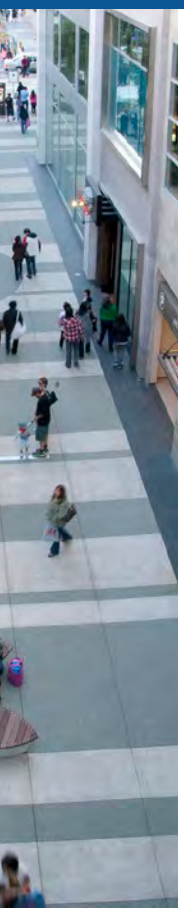
The graphs on the following page compare the performance of the MXD+ method to the ITE *Handbook* method at replicating traffic generation at the diverse group of mixed-use validation sites. Compared with the ITE *Handbook*, MXD+ method more accurately matches the amount of daily traffic actually counted at 20 of the 27 survey sites. In the AM peak hour, it is more accurate than the ITE Handbook at 21 of the 24 sites for which counts were available, and in the PM peak hour, MXD+ is more accurate than the ITE *Handbook* method at 23 of 25 sites.

DAILY TRAFFIC GENERATION COMPARISON OF ITE HANDBOOK & MXD+ METHODS

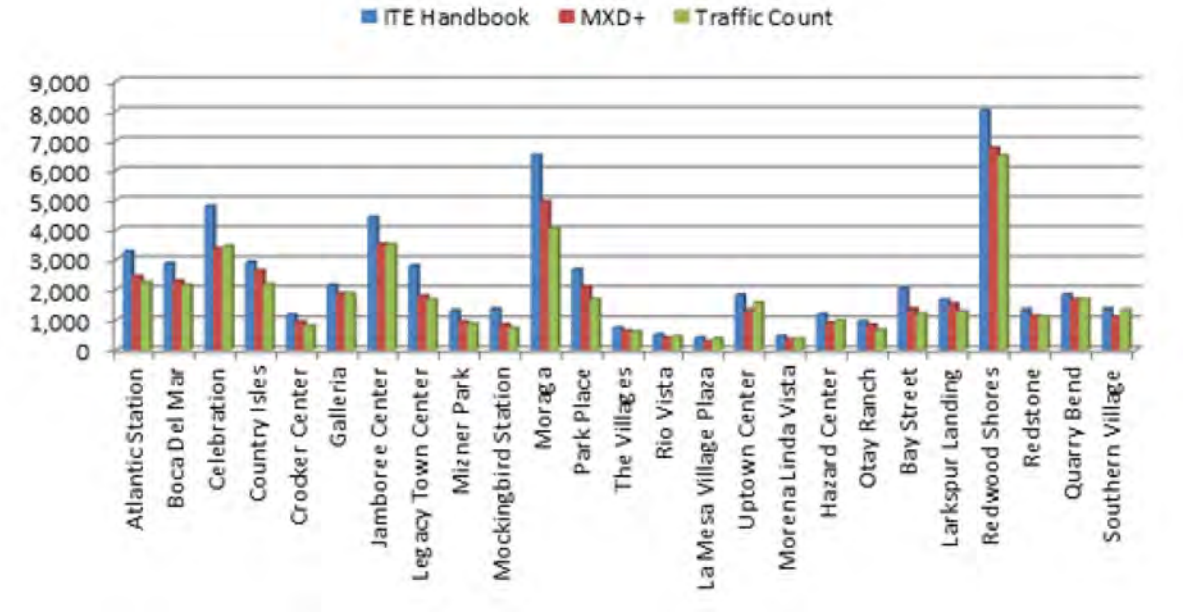


AM PEAK HOUR TRAFFIC GENERATION COMPARISON OF ITE HANDBOOK & MXD+ METHODS





PM PEAK HOUR TRAFFIC GENERATION COMPARISON OF ITE HANDBOOK & MXD+ METHODS



The MXD+ method explains 97 percent of the variation in trip generation among mixed-use developments, compared with 65 percent for the ITE *Handbook* method. On average, the *Handbook* overestimates AM peak traffic generation by 49 percent, compared with 12 percent for MXD+. For the PM peak hour, the ITE *Handbook* overestimates actual traffic by 35 percent. The MXD+ method reduces this to 4 percent, remaining slightly conservative and unlikely to understate impacts.

By combining and refining the two most advanced methodologies for estimating traffic generation for mixed-use development, the MXD+ method provides transportation planners and engineers a more accurate single approach that accounts for the most important factors that distinguish lower impact development from other forms. Doing so advances development planning and impact assessment beyond the practices that have, to date, unreasonably discouraged mixed-use development.

Recommendations for Planners

We recommend that planners adopt the latest methods for evaluating traffic generation of mixed use and other forms of smart growth, including infill and transit-oriented development. The MXD methods developed under the U.S. EPA multiregional study and the NCHRP 684 study on enhancing trip-capture estimation each represent substantial advances to the conventional practices previously available through ITE. Combining the two new methods, as described above, improves upon both individual methods. Tools for all three approaches are available for use through the references and resources listed below.

Traffic engineers are beginning to take notice of the new methods, but we expect that natural sluggishness in adopting new practices will continue to impose unfair penalties on mixed use and other forms of lower-impact development. We recommend activism on the part of all planners, development reviewers, and impact analysts on behalf of the more accurate MXD methods.

Immediate adoption of the improved methods will allow planners to account for a project's regional location, transit availability, density of development, walkability factors, and the characteristics of residents and businesses and on-site adjacencies of land uses including residential, office, retail, restaurants, theaters, and hotels. Accounting for these factors through the MXD+ method will achieve the highest levels of accuracy possible in estimating traffic impacts of mixed use development.

We recommend applying and promoting the MXD+ method for day-to-day project planning and performance-based site-plan refinement, impact analysis, and discretionary review. Doing so will eliminate what is presently a systematic bias in traffic analysis that favors single-use, isolated, suburban-style development.

Conclusion

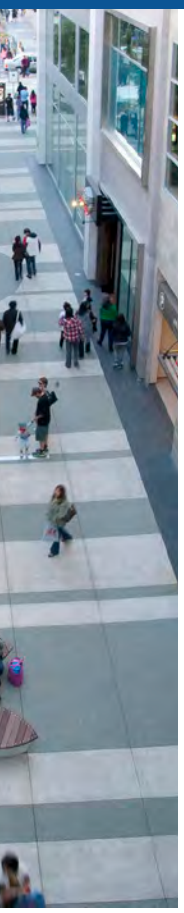
Standard traffic engineering practices are blind to the primary benefits of smart growth. A plan's development density, scale, design, accessibility, transit proximity, demographics, and mix of uses all affect traffic generation in ways unseen to prescribed methods. The Institute of Transportation Engineers (ITE) *Trip Generation Manual* and *Handbook* overestimate peak traffic generation for mixed-use development by an average of 35 percent. For conventional suburban stand-alone development, ITE rates portray the average for such sites; so hedging mixed-use analysis toward more conservative assumptions creates a systematic bias in favor of single-use suburban development.

ITE overestimation of traffic impacts reduces the likelihood of approval of mixed use and related forms of smart growth such as infill, compact, and transit-oriented development. Such overestimation escalates development costs, skews public perception, heightens community resistance, and favors isolated single-use development.

The methods of evaluating mixed use development described in this report represent a substantial improvement over conventional traffic-estimation methods. They improve accuracy and virtually eliminate overestimation bias, and they are supported by the substantial evidence of surveys and traffic counts at 266 mixed use sites across the U.S. The MXD+ analysis method explains 97 percent of the variation in trip generation among mixed use sites and all but eliminates the ITE systematic overestimation of traffic. We hope planners and other professionals will take advantage of the available spreadsheet tools listed below to help even the playing field between conventional development patterns and more sustainable, walkable, livable places.

About the Authors

Jerry Walters is a principal and sustainability practice leader with Fehr & Peers, transportation consultants. He has more than 30 years of experience in transportation planning, engineering, and travel forecasting and is a registered traffic engineer. Jerry developed project evaluation methods for the U.S. EPA study "Mixed-use Development and Vehicle Trips: Improving the Standard Estimation Methodology." He is a co-author of the book Growing Cooler – the Evidence on Urban Development and Climate Change (Urban Land Institute, 2008).



Brian S. Bochner is a senior research engineer at Texas Transportation Institute with over 40 years of experience in traffic engineering and planning. He is a certified professional traffic engineer, a professional traffic operations engineer and transportation planner, an affiliate with the Transportation Research Board, and past president and member of the International Board of Direction of the Institute of Transportation Engineers (ITE). His awards include Transportation Innovator, Texas Department of Transportation Research Program, and Transportation Engineer of the Year for the Texas Section of ITE.

Reid Ewing is a professor of city and metropolitan planning at the University of Utah, associate editor of the *Journal of the American Planning Association*, columnist for *Planning* magazine, and Fellow of the Urban Land Institute. His 2010 article, "Travel and the Built Environment: A Meta-Analysis," won the Best Article of the Year award from the American Planning Association, and his book, Best Development Practices (APA Planners Press, 1996), is listed by APA as one of the 100 essential planning books of the past 100 years.

References

Bochner, Brian, Kevin Hooper, Benjamin Sperry, and Robert Dunphy. 2011. *NCHRP Report 684: Enhancing Internal Trip Capture Estimation for Mixed-Use Developments.* Washington, D.C.: National Cooperative Highway Research Program, Transportation Research Board. http://onlinepubs.trb.org/onlinepubs/nchrp/nchrp_rpt_684.pdf

Ewing, Reid, and Robert Cervero. 2010. "Travel and the Built Environment: A Meta-Analysis." *Journal of the American Planning Association* 76(3): 265–94. www.tandfonline.com/doi/abs/10.1080/01944361003766766

Ewing, Reid, Michael Greenwald, Ming Zhang, Jerry Walters, Robert Cervero, Lawrence Frank, and John Thomas. 2011. "Traffic Generated by Mixed-Use Developments — Six-Region Study Using Consistent Built Environmental Measures." *ASCE Journal of Urban Planning and Development* 137(3): 248–61. http://ascelibrary.org/action/showAbstract?page=248&volume=137&issue=3&journalCode=jupddm&isAuthorized=no

Institute of Transportation Engineers. 2012. *Trip Generation Manual*, Ninth Edition. www.ite.org/emodules/scriptcontent/orders/ProductDetail.cfm?pc=IR-016G

Institute of Transportation Engineers. 2004. *Trip Generation Handbook*, Second Edition. www.ite.org/emodules scriptcontent/orders/ProductDetail.cfm?pc=RP-028B

San Diego Association of Governments. 2010. *Trip Generation for Smart Growth: Planning Tools for the San Diego Region*. San Diego, Calif.: SANDAG. www.sandag.org/uploads/publicationid/publicationid_1500_11604.pdf

Walters, Jerry, Reid Ewing, and John Thomas Eary. 2013. "Getting Trip Generation Right -- How to Accurately Account for Impact Reduction Attributable to Mixed-Use and Related Forms of Sustainable Development." *National Association of Environmental Professionals Conference Proceedings,* April.

Additional Resources

Description, documentation, and spreadsheet tools for the NCHRP 684 method, Enhancing Internal Trip Capture Estimation for Mixed-Use Developments may be found at www.trb.org/Main/Blurbs/165014.aspx.

Description, documentation, and spreadsheet tools for the EPA MXD Trip Generation Tool for Mixed-Use Developments may be found at www.epa.gov/smartgrowth/mxd_tripgeneration.html.

Quick-response analysis tools for applying the EPA MXD method, the combined EPA /NCHRP method MXD+, and MXD in conjunction with analysis of vehicle-miles traveled, GHG emissions, and shared parking, Plan+, may be found at http://asap.fehrandpeers.com/tools/.

WILMAPCO

Department of Transportation
Carolann Wicks, Secretary

Measuring and Accounting for Internal Trip Capture in Mixed Use Development: A Recommendation

June 2010

Measuring and Accounting for Internal Trip Capture in Mixed Use Development: A Recommendation

June 2010

Contents:

Measuring and Accounting for Internal Trip Capture in Mixed Use Development: A Recommendation

Why the Interest in Mixed Use Development?

The Delaware Department of Transportation recognizes that land use decisions play a key part in the Department's ability to plan for and execute programs and projects that help in meeting its' mission to provide for the safe and smooth flow of traffic. The Department also recognizes the importance of communities designed to encourage and facilitate walking, bicycling, and the use of transit. Collectively these modes have multiple benefits which further enhance the Department's ability to provide for the safe and smooth flow of traffic, in the broadest sense. It was taken as a given that mixed use development, if planned and designed with pedestrians, bicyclists, and bus patrons in mind, can make a difference in travel behavior and demands upon the transportation system.

Mixed use development has various definitions. For purposes of this study it was defined as *a unified and functionally compatible mixture of two or more land uses including housing, employment, recreation, retail, and community facilities intended to be within walking distance, transit accessible and pedestrian friendly, in conformance with an adopted plan.*

The Mixed Use Development Working Group

To assist in accomplishing the study, it was decided to assemble a cross-section of interested stakeholders. A committee was established under the auspices of the Wilmington Area Planning Council (WILMAPCO) in cooperation with DelDOT. The committee, or Mixed Use Development Working Group (Working Group) as it was called, was given the task of trying to answer four basic questions:

- Is there a mixed use development model, ordinance, or design with enough commonalities of interest to be replicated?
- What would be the analytical method and process used to determine effectiveness?
- How can the committee facilitate the creation of a model, initially for New Castle County?
- Can and should a model be developed that can be used throughout Delaware?

Membership in the Mixed Use Development Working Group included:

- WILMAPCO
- TMA Delaware
- New Castle County Department of Land Use
- New Castle County Economic Redevelopment Office
- New Castle County Chamber of Commerce
- Delaware Department of Transportation
- Delaware Transit Corporation
- Delaware Economic Development Office
- Delaware Office of State Planning Coordination
- Department of Natural Resources and Environmental Control
- The Reybold Group

Special efforts were made to assure that the members of the Working Group were provided with progress updates and significant benchmark materials, regardless of whether they were able to attend the meetings. Also, WILMAPCO took the lead in providing meeting invitations to every member in advance of every meeting.

A Need for Consistency Using an Analytical Approach

On various occasions over the years DelDOT has had opportunities to discuss the traffic implications of proposed mixed use development with developers and their engineering consultants. It was clear that the commonly accepted procedure for predicting the internal trip capture associated with mixed use development i.e. that in the ITE Trip Generation Handbook had significant deficiencies. It has been assumed that increasing internal trip capture would result in benefits that include reduced traffic congestion, improved air quality, reduced energy consumption and enhanced non-vehicular mobility. Thus when it became time for providing credit to developers when they designed their projects as mixed use, DelDOT was at a loss as to how to do that very effectively. It was also recognized that it was important to treat all developers consistently in respect to the credit for planning, designing and constructing mixed use communities.

In addition, it is important to continue using Traffic Mitigation Agreements as another means of promoting internal trip capture. For example, when opportunities arise for keeping trips on site, whether in a mixed use community or not, if an agreement is required then it should focus not only on encouraging a mode shift to higher occupancy vehicles or a time shift to start and end work outside of peak travel hours, but also on providing on-site employee services (deli, dry cleaning, day care, etc.) in this regard.

Working Group Products

Beginning on December 17, 2008, the Working Group met a total of seven times. The meeting agendas are attached as an appendix and reflect fairly accurately the items discussed at the respective meetings. One of the more interesting meeting exercises was the administration of a Mixed Use Development Survey prepared by WILMAPCO staff members. Results from the Working Group were shared at the March 18, 2009 meeting.

Opinions were for the most part consistent in expressing the following:

- The ideal size for a mixed use development project is 50-100 acres
- The land use mix should consist of 3 or more different uses
- Between 5% and 20% of residential units should be set aside as low-income
- The location for mixed use development in New Castle County should be in the center and core investment areas
- Proximity to transit service and reducing automobile dependence were cited as the two most important considerations, although others followed closely
- Peak hour transit service headways of 10 to 20 minutes were considered important
- Other factors ranked by importance included mix of land use types, housing density, walkability and mix of housing types

Another aspect of the Working Group's discussions was an understanding of the way DelDOT addresses internal trip capture as part of the Traffic Impact Study (TIS) review process. DelDOT staff made a presentation at the February 4, 2009 meeting at which time the limitations of using the ITE Trip Generation Handbook to account for internal trip capture for "multi-use development" were illuminated in great detail. The Trip Generation and Internal Capture Summary worksheet was described and displayed.

Yet another part of the committee's efforts included an evaluation of the two primary modeling approaches being considered from a national perspective. The first is the National Cooperative Highway Research Program (NCHRP) Project 8-51, undertaken by the Transportation Research Board. The second is the Environmental Protection Agency's Six Region Study undertaken by the transportation consulting firm of Fehr and Peers. After hearing a presentation on the EPA model presented by Mr. Reid Ewing (University of Utah) on May 13, 2009 and a demonstration of that model by WILMAPCO staff on August 26, 2009, with the support of the committee DelDOT decided to undertake an evaluation of both models. DelDOT chose six current or proposed mixed use developments in Delaware to test internal trip capture. While initial study efforts were intended to focus on New Castle County it was realized that this approach would be too limiting. There was agreement that using various Delaware development sites would hopefully provide enhanced interest inherent in familiarity with the local environment.

Using the pre-release versions of the models provided by NCHRP and EPA, DelDOT applied the models to the six developments and also did a sensitivity analysis to determine the affect of changing the independent variables.

DelDOT staff observations resulting from the evaluation are summarized below.

- Both models yield PM Peak Hour results similar to the ITE procedure, except that when restaurants and hotels are identified as part of the development the NCHRP model shows much more internal capture. The proximity of the uses is also significant in the NCHRP model.
- The EPA model consistently shows less, often much less, internal capture than the ITE and NCHRP models.
- Both models tend to show more internal capture in the PM peak hour than in the AM peak hour, but the NCHRP model shows much greater differences between AM and PM. Possible explanations include the nature of the survey instrument (on-site exit interviews vs. household travel surveys) and the size of the developments considered (some of EPA's were much larger).

Based on the analysis and the observations that resulted, DelDOT arrived at the following recommended uses in respect to the two models:

NCHRP 8-51

- Site Traffic Impact Analysis (Traffic Impact Studies and Traffic Operational Analyses.)
- Environmental Impact Analyses other than emissions and energy if sensitive to intersection or peak hour operation
- Other applications where peak hour estimates are important and/or the site plan is known

EPA

- Regional travel studies
- Vehicle emissions studies
- Energy consumption studies
- Environmental Impact Analyses other than emissions and energy if analyzing large areas or corridors or on a daily basis
- Other applications where site plan is unknown but population and employment estimates are available

A copy of the entire DelDOT evaluation, in the form of a PowerPoint presentation is included in the report appendices.

Answering the Four Original Questions – What Was Learned.

- Is there a mixed use development model, ordinance, or design with enough commonalities of interest to be replicated?

The Working Group did not intend to undertake an exhaustive search of mixed use models or designs. What it did discover was that there were two major study efforts underway which were believed worthy of evaluation and limited testing. That in fact was done by DelDOT in collaboration with WILMAPCO staff and the other members of the Working Group.

- What would be the analytical method and process used to determine effectiveness?

The most efficient approach given time and staffing limitations was felt to be a comparison of the results of applying the two models to several mixed use developments in Delaware to that of utilizing the ITE procedures for determining traffic internal trip capture. That was the approach taken. The results are reported in the document entitled Evaluation of NCHRP 8-51 and EPA Mixed Use Development Internal Capture Models. A case can be made for using either model depending upon what data inputs are available and what is deemed most important: traditional site-specific traffic impact analyses or area wide or regional travel analyses (Particularly where environmental and energy aspects are in the forefront.) As might be expected both models have pros and cons so it will be interesting to see how they are received by the Institute of Traffic Engineers.

- How can the committee facilitate the creation of a model, initially for New Castle County?

The Working Group has taken the first step by investing their time in the discussion of the topic. Unfortunately, the level of interest waned as time went on and participation in the committee's efforts was reduced to a core of about eight members. This is significant because a greater emphasis on planning, designing and building mixed use development projects has great potential for addressing a multitude of travel related issues. This was evidenced in New Castle County when they began taking a closer look at mixed used development with a view toward changes in their Unified Development Code. That effort did not gain momentum and ended without a result that the Working Group was ever made aware of. Attempts to collaborate more closely with the County in this regard, using the committee as a platform for discussion were not successful.

- Can and should a model be developed that can be used throughout Delaware?

A new model is not necessarily needed. When ITE makes a determination of how mixed use development will be addressed in the next changes to the Trip Generation Handbook, this should be used as an opportunity to garner support for the design of communities that incorporate mixed use development elements. Until that occurs, DelDOT has determined based upon the committee's study, that future reviews of mixed use development proposals will utilize the NCHRP model in completing its evaluation. The rationale, as stated earlier in this summary report, is that this model lends itself more readily to site generated traffic impact analysis, where peak hour

traffic information can be derived. This approach will be shared with DelDOT's customers so that developers and engineers, in particular, will be cognizant of this.

Next Steps

Recognizing that much has been learned by undertaking this mixed use development study, does not suggest that there has been complete closure. Challenging issues still remain which should be addressed. Among those that the Working Group believes require additional high level consideration are:

1. *How can state and local government work cooperatively to bring about a greater emphasis on and impetus for mixed use development so that its' use will bring benefits to all Delawareans?*
2. *How will it be determined what qualify as optimum mixed use development designs versus minimal designs?*
3. *How can the private sector be further engaged in the process of establishing design parameters without triggering a conflict of interest, either real or imagined?*
4. *How can information and a consistent terminology pertaining to mixed use development be provided so that misinformation is eliminated, or at least minimized?*
5. *How can credits be applied in a manner that will encourage mixed use development designs?*

Appendix A: 12/17/08 meeting materials

- **Meeting Agenda**
- **Meeting Notes**
- **Presentation: *"Review of Recent Mixed-Use/TOD Development Traffic Research"* Dan Blevins-WILMAPCO**

Wilmington Area Planning Council

850 Library Avenue, Suite 100
Newark, Delaware 19711
302-737-6205; Fax 302-737-9584
From Cecil County: 888-808-7088
e-mail: wilmapco@wilmapco.org
web site: www.wilmapco.org

Memorandum

Date: May 26, 2010

Re: 12/17/08 TMA/Mixed Use Meeting Agenda

Traffic Mitigation Agreements for Mixed Use Development Working Group Meeting

Where: WILMAPCO Conference Room

When: Wednesday, December 17th, 2008 9-11am

Agenda

1. **Goals and Objectives of Working Group**

2. **Discussion: Defining mixed-use development**
   - What is mixed use development?
   - Why consider mixed used development?
   - What are some examples of "good" mixed use developments?
   - What do these examples have in common?

3. **Presentation on current research on measuring the impacts and benefits of mixed-use development *(D. Blevins)***
   - Problems/Issues with current ITE measurement practices
   - Internal trip capture benefits of mixed use developments
   - Literature review of recent ITE/TRB publications

4. **Discussion on future steps for the working group**
   - Is there a model design, ordinance or structure with enough commonalities to be replicated?
   - What would be the analytical method and process?
   - Can and should a model be constructed that can be used throughout Delaware?
   - How can the committee facilitate the creation of a model (first for New Castle County)?

5. **Next meeting date**

12/17/08 Mixed-Use/TMA meeting notes

Attendees:
George Timko – NCC Economic Redevelopment
Dan LaCombe- DelDOT
Angelina Micheva – New Castle County Chamber of Commerce
Wayne Henderson – Delaware Transit Corporation
Jeff Stone – Delaware Economic Development Office
Ted Bishop – DelDOT
Bill Osborne – TMA Delaware
Tigist Zegeye – WILMAPCO
Dan Blevins – WILMAPCO

Meeting Notes:

Goals and Objectives of Working Group

After introductions, the purpose for the formation of this group was presented. The overall goal is to create a fair and consistent procedure to assess (through Traffic Mitigation Agreements) the benefits and net impacts of mixed-use development. With several mixed use development plans located in New Castle County, DelDOT would like to use New Castle as a model for the entire state on how to properly assess the land use types.

The group participated in an open discussion on what the term “mixed-use” mean to everyone. In general, the term is loosely based on development that contains two or more land use types. The mix of what constitutes a good blend of uses (residential vs. non-residential) was discussed as well.

The question was asked as to exactly how the DOT currently approaches the analysis of mixed use development plans. It was requested that this be a discussion at a future meeting. It was mentioned that the Institute of Transportation Engineers (ITE) was currently reviewing the state of the practice of measuring the trip generation of new mixed use development across the country. Findings from TCRP Report #128: Effects on TOD and Housing, Parking and Travel (August, 2008) are that the current ITE manual assumptions do not capture internal trips very well and that good mixed use developments generated 44 percent fewer daily trips than the 7th edition of the ITE manual suggests.

More details on the findings another study, NCHRP 08-51: Enhancing Internal Trip Capture Estimation for Mixed-Use Developments has been requested once it has been completed which is scheduled for 1/31/09 which is recommending new trip generation assumptions for mixed-use developments for the next ITE manual.

From the perspective of the developer, it was discussed that any mixed use agreement should have the burden placed on the developer, not the public. If the development fails, then the costs will be absorbed by the developer.

Next steps/future meetings:

- Review the current traffic assumptions made by DelDOT uses for modeling mixed use developments
- Review local/regional examples of “good” and “bad” mixed use development
- Addition of a representative from DNREC added to the core group.
- Additional details on the NCHRP 08-51: Enhancing Internal Trip Capture Estimation for Mixed-Use Developments (due to be completed Jan. 2009 draft final report is expected in November 2008)
- Invitation of a guest speaker (TBA) to discuss benefits of mixed use development and what is the ideal mixture of uses to prove beneficial.

Review of Recent Mixed-Use/TOD Development Traffic Research

Prepared for the Mixed-Use and Traffic Mitigation Agreement Working Group

February 4th 2009

Agenda

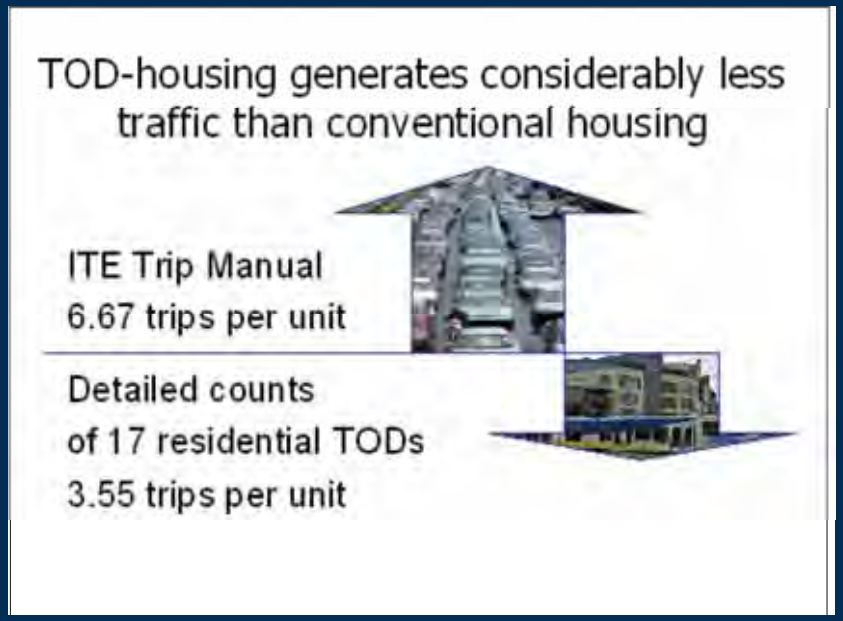
- Current issues with “traditional” traffic impact measurements of mixed-use development
- Traffic benefits of mixed-use development
- Recent TRB/ITE research

Current issues

- Current ITE Trip manual over-estimates automobile trip generations for mixed use development
- Current ITE book studied 6 sites in FL to generate figures for mixed use assumptions
- Listed as “special land uses” in ITE manual
- Misses Internal trip capture: 17.8% trips ending in development originated in same development (TCRP 128)
- Overcharging of developers; hinders attempting mixed-use development

Mixed-Use Benefits

- Internal trip capture: 17.8% trips originating and ending in same development (TCRP 128)
- Fewer daily trips generated per unit



- The weighted average differentials were even larger during peak periods – 49% lower rates during the A.M. peak and 48% lower rates during the P.M. peak.

Why focus on ITE manual?

- All TIS/TOA's base traffic impacts on latest version of ITE trip generation manual (7th edition)

Why focus on ITE manual?

- TIS/TOA's base traffic impacts on latest version of ITE trip generation manual (7th edition)

- Recent research updates will:
  - give more options for traffic engineers to choose from
  - give better trip generation rates

- Results from recent TCRP/NCHRP research will be used to revise this section

Recent Research

TCRP 128: Effects of TOD on Housing, Parking, and Travel (Completed Sept. 2008)

- Research studied actual transportation performance of 17 built TOD projects.
- Collected data using tubes stretched across the driveways and visual counts and surveys of other modes
- 4 urbanized areas of the country: Philadelphia/N.E. New Jersey; Portland, Oregon; metropolitan Washington D.C.; and the East Bay of the San Francisco Bay Area
- Over a typical weekday period, the 17 surveyed TOD-housing projects averaged 44% fewer vehicle trips than that estimated by the ITE manual (3.7 versus 6.7 daily trips per unit).
- The weighted average differentials were even larger during peak periods –
  - 49% lower rates during the A.M. peak and
  - 48% lower rates during the P.M. peak.

Recent Research

NCHRP 08-51: Enhancing Internal Trip Capture Estimation for Mixed-Use Developments (Due: January 2009)

- Acknowledges shortcomings of current versions
- Designed to address this need by providing a classification system of mixed-used developments and a data-collection framework to enhance estimates of internal capture for mixed-use developments.
- ITE advises those estimating transportation impacts of mixed-use developments to "collect additional data if possible" (TMA?)
- Since the internal capture rate used for a given mixed-use development can be politically contentious, empirical observations are needed to provide professional guidance for better estimating these impacts. By improving the methods for estimating internal capture, the process of determining developers' responsibilities for mitigating transportation impacts of mixed-use development will become more equitable, transparent, and open.

Recent Research

NCHRP 08-66 Trip-Generation Rates for Transportation Impact Analyses of Infill Developments (In progress)

- Addressing similar issues as NCHRP 08-51
- Directed at dealing with development in existing urban/suburban areas with existing major infrastructure
- Addresses understanding that rates are used during local land use review and development permitting processes
- Deals with over-estimating vehicle trips can lead to excessive traffic mitigation fees and infrastructure improvements, leading to possible neighborhood opposition (and sometimes costly and time-consuming lawsuits). This process can also result in demand for more parking spaces than may actually be needed to support the proposed development. Over-estimating can create higher development costs as well as delay and even cancellation of otherwise beneficial infill projects—impacts that can stall economic development and the provision of needed housing and job growth within existing urban and suburban redevelopment areas.

Recent Research

NCHRP 3-70 Multimodal LOS Analysis for Urban Streets (Completed Feb. 2008)

- Developed and tested methods to determine LOS on urban streets for:
  - Automobile
  - Transit
  - Bicycle
  - Pedestrian
- Consists of a set of recommended procedures for predicting traveler perceptions of quality of service and performance measures
- Level of service is a quantitative stratification of quality of service into six letter grades with letter grade “A” representing the best quality of service, and letter grade “F” representing the worst quality of service.

Recent Research

NCHRP REPORT 616: Multimodal Level of Service Analysis for Urban Streets (Completed Feb. 2008)

- Multimodal level of service (MMLOS) method is designed for evaluating "complete streets," context-sensitive design alternatives, and smart growth from the perspective of all users of the street.
- Use the MMLOS method to evaluate the tradeoffs of: the auto driver's, transit passenger's, bicyclist's, and pedestrian's perceptions of the quality of service provided by the street.
- Can be implemented in a simple spreadsheet.
- Makes use of a combination of readily available data and data normally gathered to assess auto and transit level of service. The data requirements of the MMLOS method include geometric cross-section, signal timing, the posted speed limit, bus headways, traffic volumes, transit patronage, and pedestrian volumes.
- Enables agencies to balance the LOS needs of auto drivers, transit riders, bicycle riders, and pedestrians in their street designs by providing agencies with a tool for testing different allocations of scarce street right-of-way to the different modes using the street.

Questions?

Appendix B: 2/4/09 meeting materials

- **Meeting Agenda**
- **Meeting Notes**
- **Presentation: *Mixed Use Development Trip Generation*—Todd Sammons, DelDOT**

Wilmington Area Planning Council

850 Library Avenue, Suite 100
Newark, Delaware 19711
302-737-6205; Fax 302-737-9584
From Cecil County: 888-808-7088
e-mail: wilmapco@wilmapco.org
web site: www.wilmapco.org

Memorandum

Date: January 30, 2009

Re: 2/4/09 TMA/Mixed Use Meeting Agenda

Traffic Mitigation Agreements for Mixed Use Development Working Group Meeting

Where: WILMAPCO Conference Room

When: Wednesday, February 4th, 2009 9-11am

Agenda

1. **Presentation: Current DelDOT practice of assessing impact of development – *Todd Sammons (DelDOT)***
   Todd will present DelDOT current methods on how they assess the traffic impacts of development plans citing examples from the state.

2. **Presentation: TIPS Trip Generation Software – *Todd Sammons (DelDOT)***
   Developed by the Florida Department of Transportation, a trip generation calculation tool called TIPS (Trip generation, Internal capture, and Pass-by Software) estimates the number of trips generated by specific land uses of a proposed land development. A presentation on the software and its possible application to Delaware will be discussed.

3. **Current perspective of the development process from the developer community – *Jerry Heisler (The Reybold Group)***

4. **Presentation on current research on measuring the impacts and benefits of mixed-use development *(D. Blevins)***
   - Problems/Issues with current ITE measurement practices
   - Internal trip capture benefits of mixed use developments
   - Literature review of recent ITE/TRB publications

5. **Open Discussion: Defining mixed-use development**
   - What is mixed use development?
   - What are some examples of “good” mixed use developments?
   - What do these examples have in common?

6. **Next meeting date and future objectives**

2/4/09 Mixed-Use/TMA meeting notes

Attendees:
George Timko – NCC Economic Redevelopment
Dan LaCombe - DelDOT
Jerry Heisler - The Reybold Group
Wayne Henderson – Delaware Transit Corporation
Jeff Stone – Delaware Economic Development Office
Ted Bishop – DelDOT
Todd Sammons - DelDOT
Bill Osborne – TMA Delaware
Tigist Zegeye – WILMAPCO
Dan Blevins – WILMAPCO

Meeting Notes:

Agenda Item #1: Current DelDOT practice of assessing development impacts:
Todd Sammons (DelDOT) gave a presentation titled "Mixed Use Development Trip Generation". Todd presented the current TIS (Traffic Impact Study) process in which DelDOT follows to measure the impacts of developments.

Comments regarding the presentation:

- Generally there is a dis-incentive in calculating mixed use development impacts due to lack of internal trip capture benefits in current methods. However, there is currently not enough historical data collected on trip generation in existing mixed-use developments. There is a need more of these type projects to get better readings on internal capture.

- It was mentioned that smallest component of a mixed use should be retail for it to be truly effective. Plans should also have incentives that help facilitate people to live and work on same site.

- LOS E in high density areas is needed to foster true mixed use developments

- A problem that exists with mixed-used development is that you must lay out more infrastructure up front to accommodate the entire parcel rather than incrementally with more single-use developments. This makes developers shy away from these types of developments. In addition, it is tough to obtain financing for mixed use due to national trends.

Agenda Item #2: Current perspective of the development process:

- There is a need to get transportation agencies involved early in the development process rather than later. Should be involved earlier in TIS process. Developments are easier to alter to suit earlier in the process. (DelDOT to follow up on recommendation).

- Additionally to help make mixed use development work, amenities such as bike/ped and transit facilities need to be part of the mix.

- Zoning seems to be lagging behind this type of development at the state/county level. No encouragement beyond verbal support. More concrete policy needs to be part of this process. Also, it is tough to get developers to move toward doing mixed use development.

- Starting to look at plan review process to review approach. Can't control changes to a plan, only use. First order of business is to work more closely with counties on their comp plans to point out areas which could be feasible for mixed use and the prospect of LOS E designations.

- Got to be a guide to the process with the full range of groups/agencies that need to be part of it. (i.e. Ag, DOT, transit, AQ, bike/ped), but consequences of adding more players to the process may further drive developers away from coming up with more of these developments.

- The question was raised about where the The PLUS process (Preliminary Land Use Service) fit into this equation. – 2 things; Too late in the process and it has gone beyond concept plan and have even spent funds on engineering efforts which makes it difficult to get any changes made to the plan. It functions as an advisory group that give comments, but not the ability mandate changes to a plan based on comments from the PLUS members. Mostly a process used by Kent and Sussex counties.

Agenda Item #3: Open Discussion – Defining Mixed Use Development

- No real consensus form group on what exactly mixed use development that can be promoted collectively. Suggestion was made that for next meeting all members prepare a list of what they feel represents a mixed use development. At the next meeting these would be compared.

- From the developer's perspective, LOS E is needed for mixed use development to work. Other wise is becomes cost-prohibitive. The question was raised on how can LOS E be sold to the general population? If there are certain conditions that exist, including locals and the local government.

- Transportation Investment Districts- does this need to be worked on now? For purposes of TIS waivers, used to create mechanisms that can match the infrastructure with the plan for that area. But decision must come from local government, not the DOT. Can be based on county, municipal or sub-regional plan/study.

- The thought of scheduling a speaking was brought up. It was suggested that this would be a good time in tandem with the members putting down on paper as to their thoughts and discuss at the next meeting. Once we have a consensus on what the working group believes that should be part of mixed use development for our area, then it would be compared to the NCHRP research. Once this has been competed, then the scheduling of an outside expert on the topic should be arranged.

- Update on NCHRP reports. 08-51 will be available soon.

Next steps/future meetings:

- Ask each member to write down what they consider as “mixed-use” development. Will be compiled prior to the next meeting
- Compare workgroup thoughts to recently released NCHRP efforts
- Select Speaker(s) for future meeting to give more details on possibilities for mixed use development for DE.

Mixed Use Development Trip Generation

- Todd Sammons
- TIS Group
- Division of Planning
- February 4, 2009

State of Delaware
Department of Transportation
Carleton Wicks, Secretary

A Traffic Impact Study (TIS) is:

According to DelDOT's Standards and Regulations for Subdivision Streets and State Highway Access, a TIS is:

"A study conducted during the development approval process to determine the impacts that traffic generated by the proposed development will have on the surrounding street network and the improvements needed to the transportation system in order to mitigate those impacts."

What are the applicable regulations?

1) Chapter 2 of DelDOT 's Standards and Regulations for Subdivision Streets and State Highway Access

2) Chapter 11 of New Castle County's Unified Development Code

UNIFIED DEVELOPMENT CODE
New Castle County

A Traffic Operational Analysis (TOA) is:

According to DelDOT's Standards and Regulations for Subdivision Streets and State Highway Access, an Operational Analysis is:

An evaluation or series of evaluations conducted during the TIS and site entrance reviews that is used to determine the ability of a proposed development project to operate safely and with adequate access. Analyses conducted during the heading of "Operational Analysis" may include Queueing Analysis, Highway Capacity Analyses, and Accident Analyses.

What are the applicable regulations?

1) Chapter 2 of DelDOT 's Standards and Regulations for Subdivision Streets and State Highway Access

2) Chapter 11 of New Castle County's Unified Development Code

When to use a TIS or a TOA

- DelDOT and County regulations are specific as to when a TIS may and may not be required and when the requirement can be waived.
- DelDOT regulations grant the authority to require a TOA as necessary to review a plan.
- Examples of when DelDOT might require a TOA:
  - TIS not warranted
  - TIS cannot be required by County Code
  - TIS warranted but waived
  - TIS left a relevant question unanswered

Examples

AstraZeneca = TIS

WAWA = TOA

TRAFFIC IMPACT STUDY (TIS) PROCESS

- DelDOT and Developer's Consultant have Scoping Meeting
- Developer's Consultant performs Traffic Counts
- DelDOT reviews Traffic Counts
- Developer's Consultant prepares Preliminary TIS
- DelDOT reviews Preliminary TIS
- Developer's Consultant prepares Final TIS
- DelDOT provides Final TIS to DelDOT's Consultant for review
- DelDOT's Consultant prepares Final letter/recommendations
- DelDOT reviews Final letter
- DelDOT transmits Final letter to Developer and local government

Analysis Tools used to determine Final TIS Results

- Highway Capacity Software (HCS) for estimating capacity and determining Level of Service (LOS) A through F
- SYNCHRO is used for advanced modeling techniques or instead of HCS
- aaSIDRA utilized for roundabout analysis

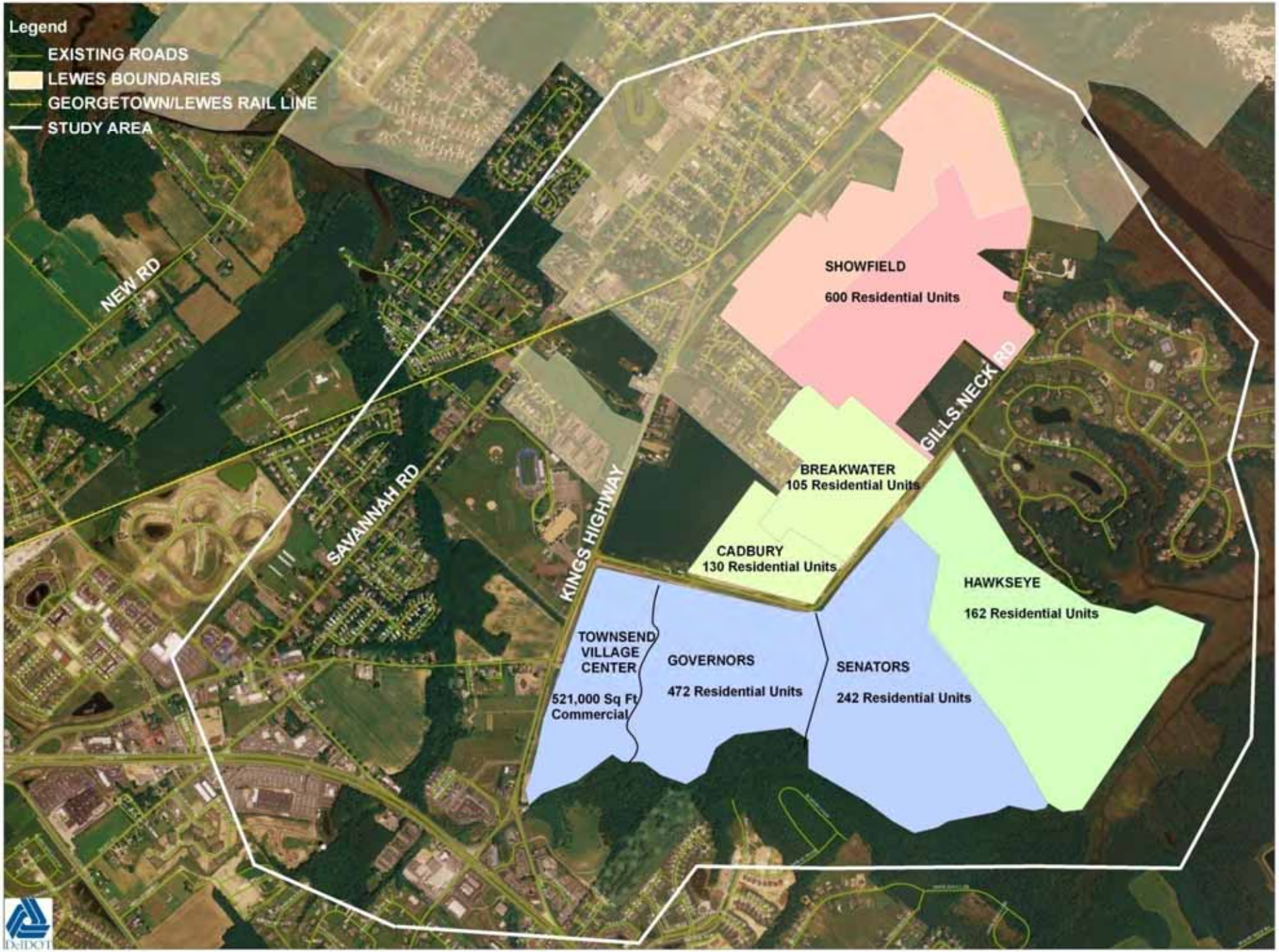
LEWES AREA
DEVELOPMENT & INFRASTRUCTURE IMPROVEMENTS

DELAWARE DEPARTMENT OF TRANSPORTATION

DIVISION OF PLANNING

P.O BOX 778

Dover, DE 19903


Legend
EXISTING ROADS
LEWES BOUNDARIES
GEORGETOWN/LEWES RAIL LINE
STUDY AREA
NEW RD
SAVANNAH RD
KINGS HIGHWAY
GILLS NECK RD
SHOWFIELD
600 Residential Units
BREAKWATER
105 Residential Units
CADBURY
130 Residential Units
HAWKSEYE
162 Residential Units
TOWNSEND VILLAGE CENTER
521,000 Sq Ft Commercial
GOVERNORS
472 Residential Units
SENATORS
242 Residential Units
DelDOT

CHAPTER 7

Multi-Use Development

7.1 Background

A basic premise behind the data presented in *Trip Generation* is that data were collected at single-use, free-standing sites. However, the development of mixed-use or multi-use sites is increasingly popular. While the trip generation rates for individual uses on such sites may be the same or similar to what they are for free-standing sites, there is potential for interaction among those uses within the multi-use site, particularly where the trip can be made by walking. As a result, the total generation of vehicle trips entering and exiting the multi-use site may be reduced from simply a sum of the individual, discrete trips generated by each land use.

A common example of this internal trip-making occurs at a multi-use development containing offices and a shopping/service area. Some of the trips made by office workers to shops, restaurants, or banks may occur on site. These types of trips are defined as internal to (i.e., "captured" within) the multi-use site.

7.2 What Is a Multi-Use Development?

For purposes of this handbook, a ***multi-use development is typically a single real-estate project that consists of two or more ITE land use classifications between which trips can be made without using the off-site road system.*** Because of the nature of these land uses, the trip-making characteristics are interrelated, and some trips are made among the on-site uses. This capture of trips internal to the site has the net effect of reducing vehicle trip generation between the overall development site and the external street system (compared to the total number of trips generated by comparable, stand-alone sites).

Multi-use developments are commonly found ***ranging in size from 100,000 sq. ft. to 2 million sq. ft.*** The data presented in this chapter correspond to multi-use developments in this size range. The recommended procedures for estimating trip generation at multi-use developments are likely applicable at even larger sites, but the analyst is encouraged to collect additional data.

A key characteristic of a multi-use development is that trips among the various land uses can be made on site and these ***internal trips are not made on the major street system.*** In some multi-use developments, these internal trips can be made either by walking or by vehicles using internal roadways without using external streets.

An ***internal capture rate*** can generally be defined as a percentage reduction that can be applied to the trip generation estimates for individual land uses to account for trips internal to the site. It is important to note that these reductions are applied externally to the site (i.e., at entrances, adjacent intersections and adjacent roadways). The trip reduction for internally captured trips is separate from the reduction for ***pass-by trips***. These are two distinct phenomena and both could be applicable for a proposed development. The internal trips, if present, should be subtracted out ***before*** pass-by trip reductions are applied (refer to Chapter 5 for a complete discussion of pass-by trip estimation).

Multi-Use Development

- **Typically planned as a single real-estate project,**
- **Typically between 100,000 and 2 million sq. ft. in size,**
- **Contains two or more land uses,**
- **Some trips are between on-site land uses, and**
- **Trips between land uses do not travel on major street system.**

Not a(n)

- **Central business district,**
- **Suburban activity center, or**
- **Existing ITE land use classification with potential for a mix of land uses, such as**
  - **Shopping center,**
  - **Office park with retail,**
  - **Office building with retail, or**
  - **Hotel with limited retail and restaurant space.**

Single-Family Detached Housing
(210)

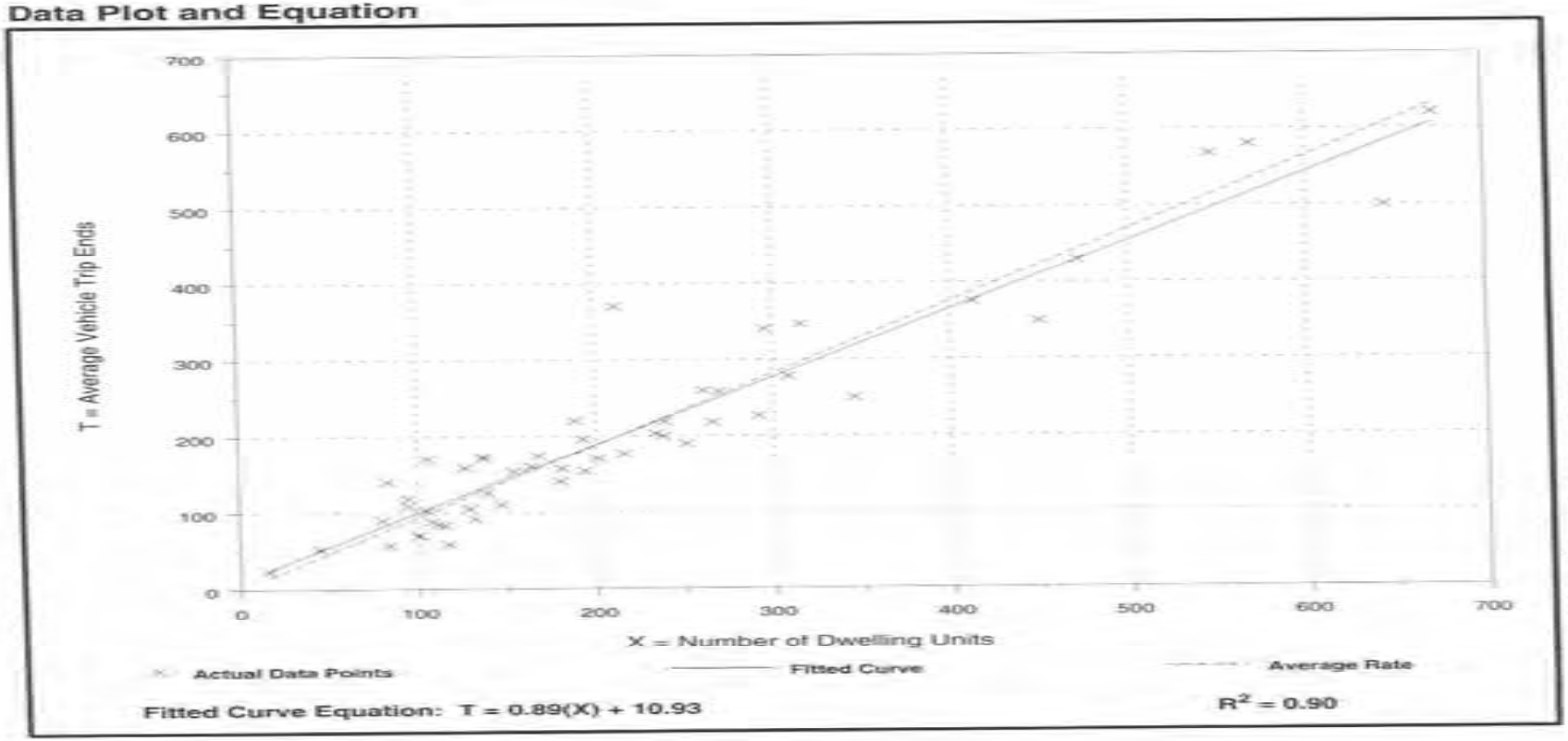
Average Vehicle Trip Ends vs: **Dwelling Units**
On a: **Saturday,**
Peak Hour of Generator

Number of Studies: 52
Avg. Number of Dwelling Units: 220
Directional Distribution: 54% entering, 46% exiting

Trip Generation per Dwelling Unit

Average Rate	Range of Rates	Standard Deviation
0.94	0.50 - 1.75	0.99

Data Plot and Equation



Fitted Curve Equation: T = 0.89(X) + 10.93

R^2 = 0.90

Residential Condominium/Townhouse
(230)

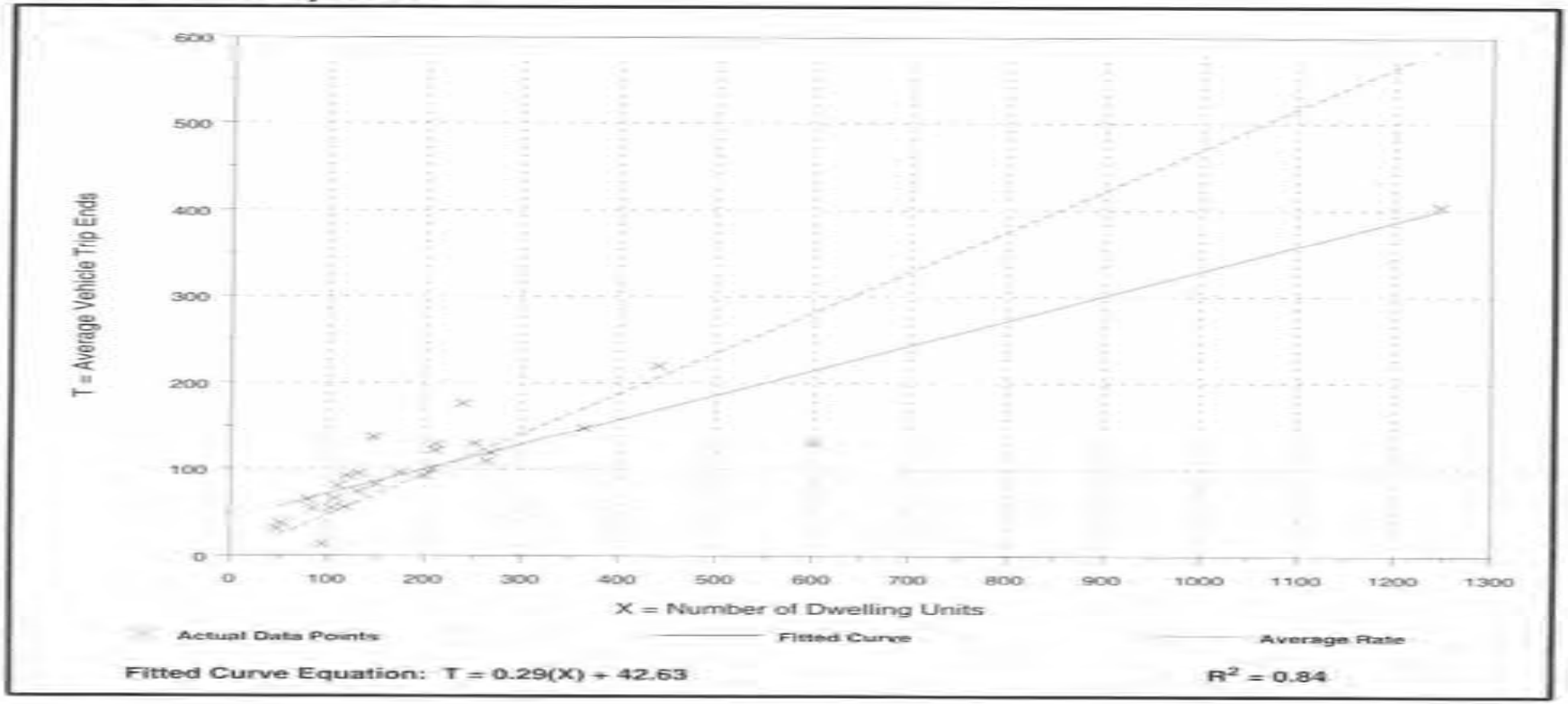
Average Vehicle Trip Ends vs: **Dwelling Units**
On a: **Saturday,**
Peak Hour of Generator

Number of Studies: 27
Avg. Number of Dwelling Units: 228
Directional Distribution: 54% entering, 46% exiting

Trip Generation per Dwelling Unit

Average Rate	Range of Rates	Standard Deviation
0.47	0.14 - 0.93	0.71

Data Plot and Equation



Fitted Curve Equation: T = 0.29(X) + 42.63

R^2 = 0.84

Shopping Center
(820)

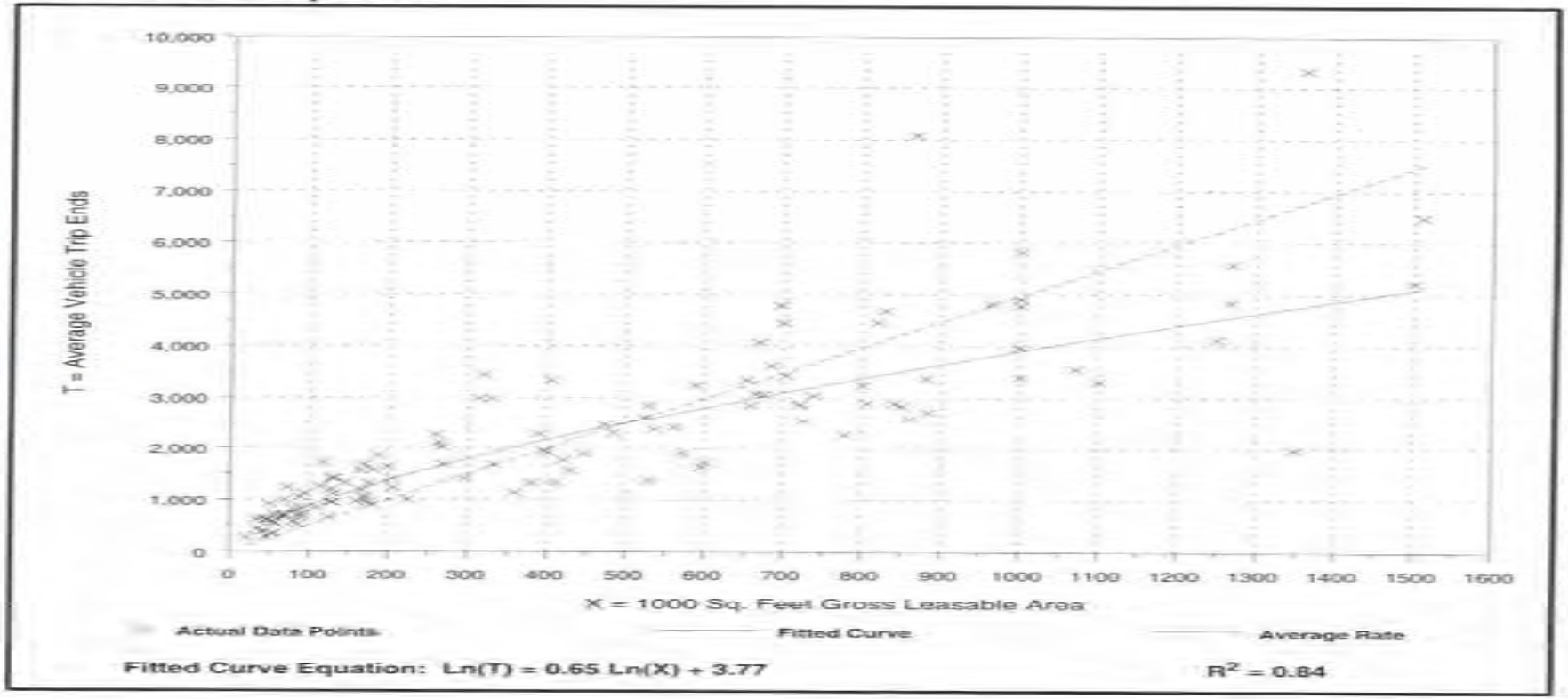
Average Vehicle Trip Ends vs: **1000 Sq. Feet Gross Leasable Area**
On a: **Saturday,**
Peak Hour of Generator

Number of Studies: 124
Average 1000 Sq. Feet GLA: 447
Directional Distribution: 52% entering, 48% exiting

Trip Generation per 1000 Sq. Feet Gross Leasable Area

Average Rate	Range of Rates	Standard Deviation
4.97	1.46 - 18.32	3.11

Data Plot and Equation



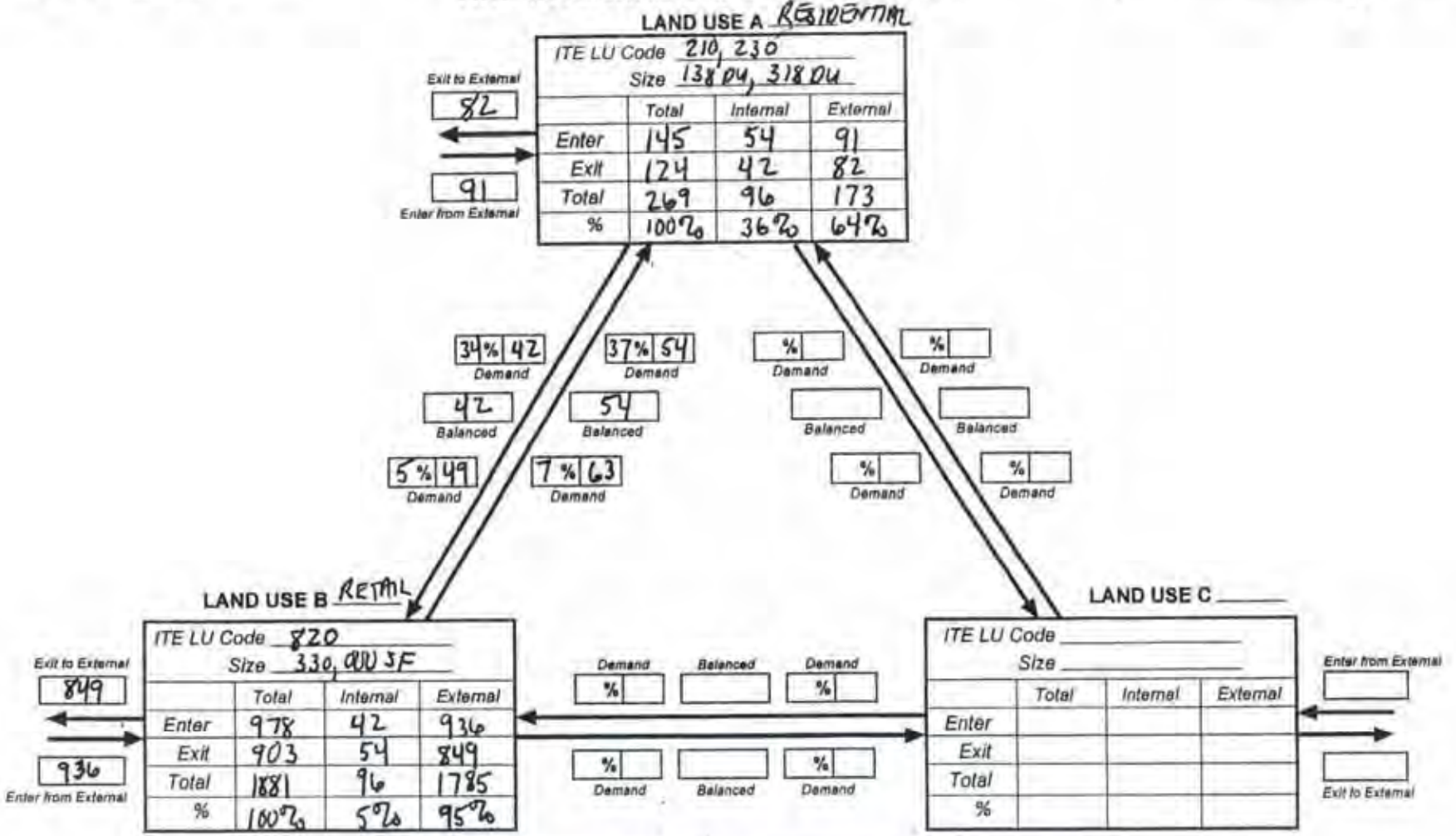
Fitted Curve Equation: Ln(T) = 0.65 Ln(X) + 3.77

R^2 = 0.84

Analyst RAM
Date 2/14/06

MULTI-USE DEVELOPMENT
TRIP GENERATION
AND INTERNAL CAPTURE SUMMARY

Name of Dvlpt GILLS NECK
Time Period SATURDAY PEAK HOUR



Net External Trips for Multi-Use Development

	LAND USE A	LAND USE B	LAND USE C	TOTAL
Enter	91	936	—	1027
Exit	82	849	—	931
Total	173	1785	—	1958
Single-Use Trip Gen. Est.	269	1881	—	2150

Source: Kaku Associates, Inc.

INTERNAL CAPTURE 9%

Table 7.2 Unconstrained Internal Capture Rates for Trip Destinations Within a Multi-Use Development

		WEEKDAY		
		MIDDAY PEAK HOUR	p.m. PEAK HOUR OF ADJACENT STREET TRAFFIC	DAILY
to OFFICE	from Office	6%	6%	2%
	from Retail	38%	31%	15%
	from Residential	0%	0%	N/A
to RETAIL	from Office	4%	2%	4%
	from Retail	31%	20%	28%
	from Residential	5%	9%	9%
to RESIDENTIAL	from Office	0%	2%	3%
	from Retail	37%	31%	33%
	from Residential	N/A	N/A	N/A

Caution: The estimated typical internal capture rates presented in this table rely directly on data collected at a limited number of multi-use sites in Florida. While ITE recognizes the limitations of these data, they represent the only known credible data on multi-use internal capture rates and are provided as illustrative of typical rates. ***If local data on internal capture rates by paired land uses can be obtained, the local data may be given preference.***

N/A—Not Available; logic indicates there is some interaction between these two land uses; however, the limited data sample on which this table is based did not record any interaction.

Table 7.1 Unconstrained Internal Capture Rates for Trip Origins within a Multi-Use Development

		WEEKDAY		
		MIDDAY PEAK HOUR	p.m. PEAK HOUR OF ADJACENT STREET TRAFFIC	DAILY
from OFFICE	to Office	2%	1%	2%
	to Retail	20%	23%	22%
	to Residential	0%	2%	2%
from RETAIL	to Office	3%	3%	3%
	to Retail	29%	20%	30%
	to Residential	7%	12%	11%
from RESIDENTIAL	to Office	N/A	N/A	N/A
	to Retail	34%	53%	38%
	to Residential	N/A	N/A	N/A

Caution: The estimated typical internal capture rates presented in this table rely directly on data collected at a limited number of multi-use sites in Florida. While ITE recognizes the limitations of these data, they represent the only known credible data on multi-use internal capture rates and are provided as illustrative of typical rates. ***If local data on internal capture rates by paired land uses can be obtained, the local data may be given preference.***

N/A—Not Available; logic indicates there is some interaction between these two land uses; however, the limited data sample on which this table is based did not record any interaction.

Figure 5.1 Types of Trips

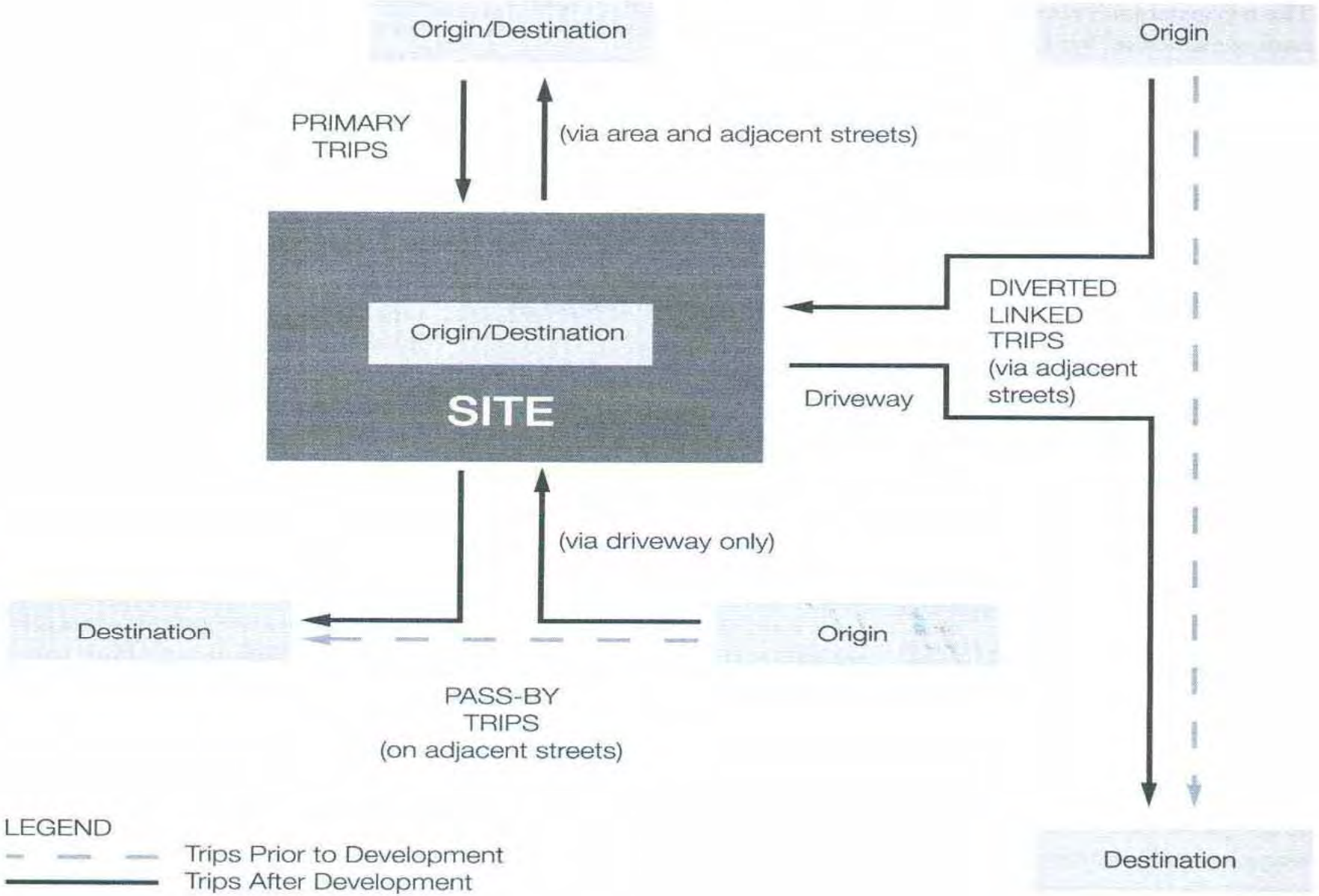
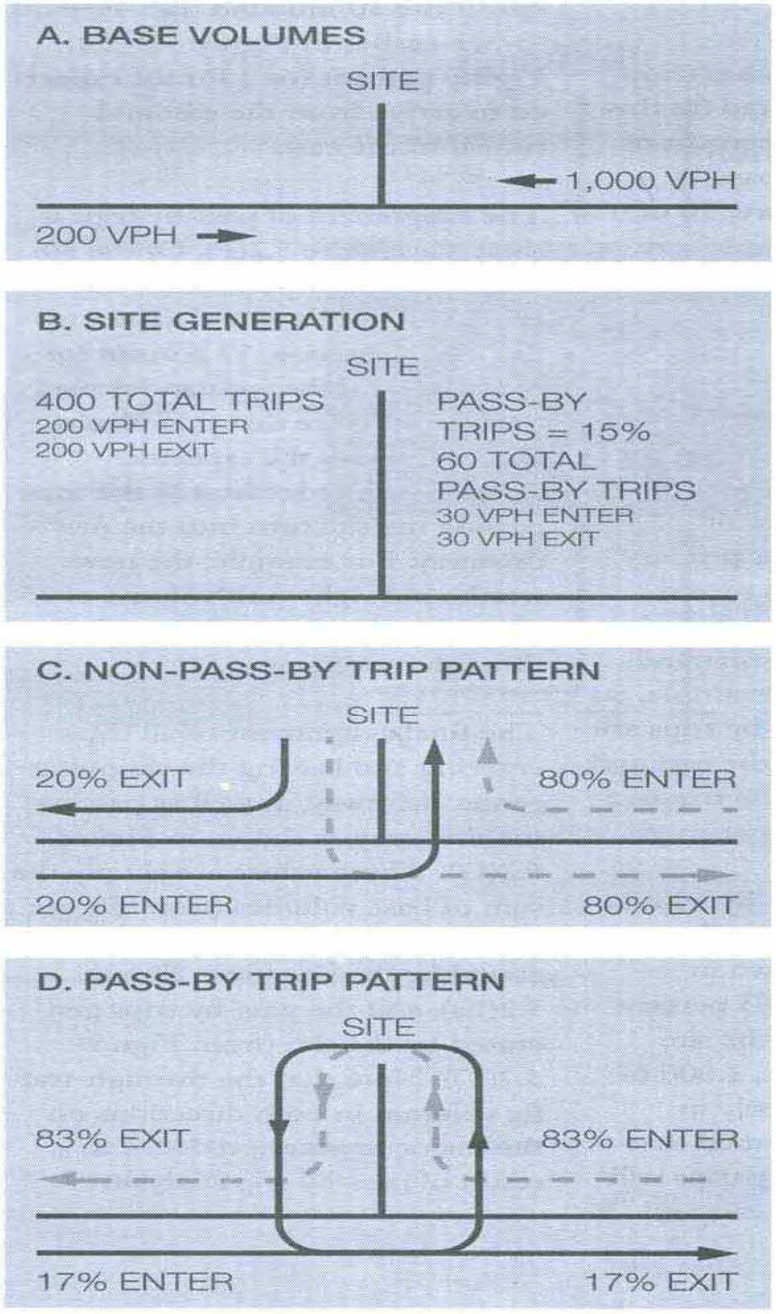


Figure 5.2 Application of Pass-By Trips



LEGEND
VPH = Vehicles per hour

Table 5.1 Land Uses and Time Periods with Pass-By Data

Land Use Code and Description	Time Period	Table	Figure
813 Free-Standing Discount Superstore	Weekday, p.m. Peak Period	5.2	—
815 Free-Standing Discount Store	Weekday, p.m. Peak Period	5.3	5.3
	Saturday, Midday Peak Period	5.4	5.4
816 Hardware/Paint Store	Weekday, p.m. Peak Period	5.5	—
820 Shopping Center	Weekday, p.m. Peak Period	5.6	5.5/5.6
	Saturday, Midday Peak Period	5.7	5.7
843 Automobile Parts Sales	Weekday, p.m. Peak Period	5.8	—
848 Tire Store	Weekday, p.m. Peak Period	5.9	—
850 Supermarket	Weekday, p.m. Peak Period	5.10	5.8
851 Convenience Market (Open 24 Hours)	Weekday, p.m. Peak Period	5.11	5.9
853 Convenience Market with Gasoline Pumps	Weekday, a.m. Peak Period	5.12	5.10
	Weekday, p.m. Peak Period	5.13	5.11
854 Discount Supermarket	Weekday, p.m. Peak Period	5.14	5.12
862 Home Improvement Superstore	Weekday, p.m. Peak Period	5.15	—
863 Electronics Superstore	Weekday, p.m. Peak Period	5.16	—
880 Pharmacy/Drugstore without Drive-Through Window	Weekday, p.m. Peak Period	5.17	—
881 Pharmacy/Drugstore with Drive-Through Window	Weekday, p.m. Peak Period	5.18	—
890 Furniture Store	Weekday, p.m. Peak Period	5.19	—
912 Drive-In Bank	Weekday, p.m. Peak Period	5.20	—
931 Quality Restaurant	Weekday, p.m. Peak Period	5.21	—
932 High-Turnover (Sit-Down) Restaurant	Weekday, p.m. Peak Period	5.22	5.13
934 Fast-Food Restaurant with Drive-Through Window	Weekday, a.m. Peak Period	5.23	—
	Weekday, p.m. Peak Period	5.24	5.14
935 Fast-Food Restaurant without Drive-Through Window and No Indoor Seating *(Specialized Land Use: Coffee/ Espresso Stand)*	Weekday	5.25/5.26	—
944 Gasoline/Service Station	Weekday, a.m. Peak Period	5.27	—
	Weekday, p.m. Peak Period	5.28	—
945 Gasoline/Service Station with Convenience Market	Weekday, a.m. Peak Period	5.29	5.15
	Weekday, p.m. Peak Period	5.30	5.16

ORA
Ork - Rodgers & Associates, Inc.
TRANSPORTATION ENGINEERS and PLANNERS

FIGURE 58

Gills Neck Saturday Peak Hour Traffic Volumes (Total)
Scenario 1
Gills Neck
LEWES, SUSSEX COUNTY, DE

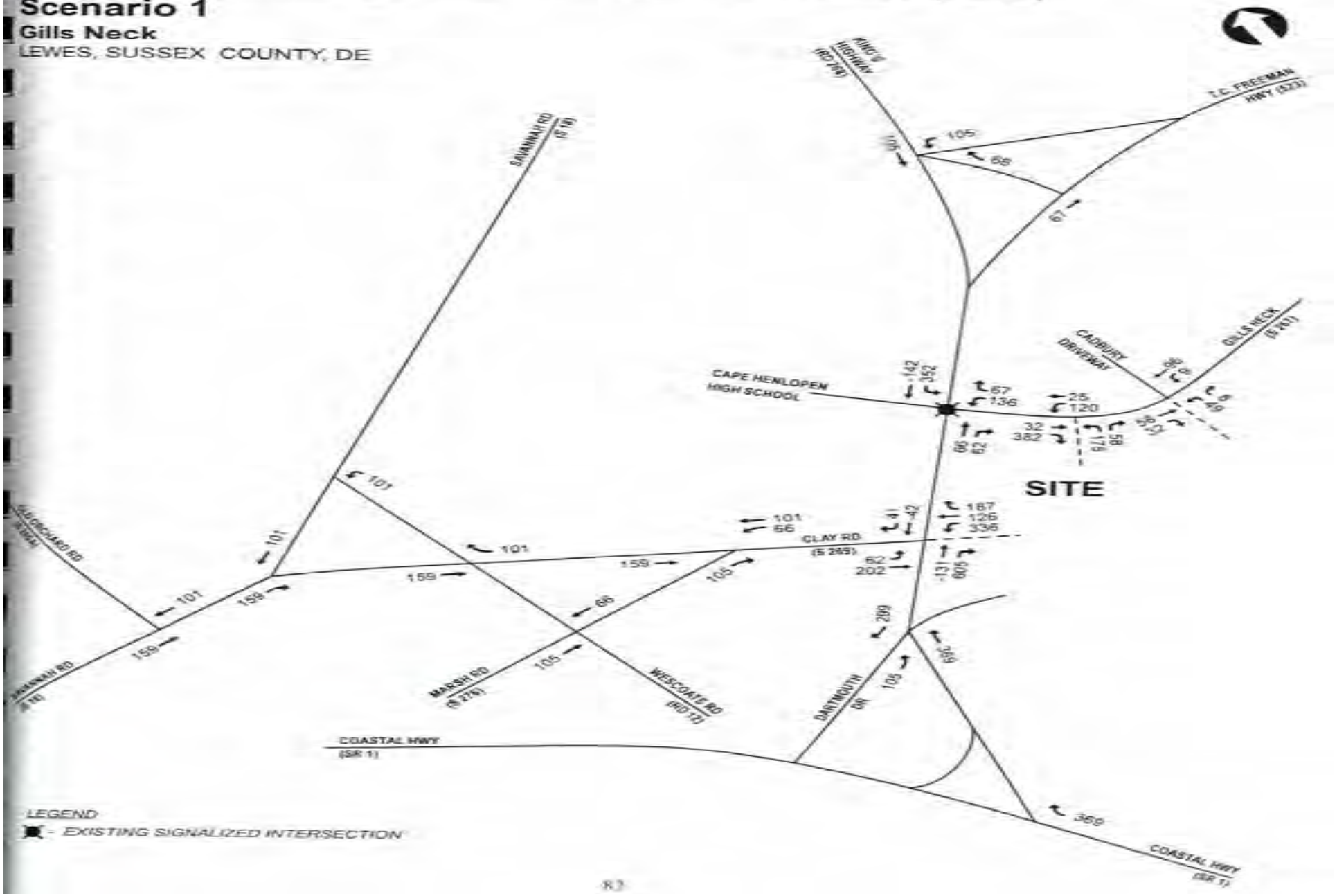


Table VI.

Gills Neck Road Subdivision – PM Peak Hour Trip Generation

Land use	ITE Code	PM peak hour			External trips			Pass-by %	Internal Trip %
		Enter	Exit	Total	Enter	Exit	Total		
138 single-family homes	210	90	53	143	62	25	87	0%	39%
318 multi-family units	230	104	51	155	72	24	96	0%	39%
1,000 seat performing arts center	441	10	10	20	10	10	20	0%	0%
330,000 SF shopping center	820	661	716	1377	439	475	914	27.6%	8%
TOTAL PM peak hour trips	-	**865**	**830**	**1695**	**583**	**534**	**1117**	-	-

Table VII.

Gills Neck Road Subdivision – Saturday Peak Hour Trip Generation

Land use	ITE Code	Saturday peak hour			External trips			Pass-by %	Internal Trip %
		Enter	Exit	Total	Enter	Exit	Total		
138 single-family homes	210	72	62	134	45	41	86	0%	36%
318 multi-family units	230	73	62	135	46	41	87	0%	36%
1,000 seat performing arts center*		330	0	330	330	0	330	0%	0%
330,000 SF shopping center	820	978	903	1881	632	583	1215	32%	5%
TOTAL Saturday peak hour trips	-	**1453**	**1027**	**2480**	**1053**	**665**	**1718**	-	-

Note: As per DelDOT's procedures, internal trip capture for Saturday was calculated using ITE's Weekday Mid-Day data.

**For the performing arts center, a rate of 0.33vehicles per seat was used to generate Saturday trips. This rate was obtained from ITE's* Parking Generation Manual, *3rd Edition.*

Trip Distribution

The distribution of the site-generated traffic was based on the type of land use and the existing traffic patterns in the study area in relation to the proposed site access point. This distribution was used to assign the site-generated traffic to the roadway network for weekday (a.m. and p.m.) and Saturday peaks. For the weekday and Saturday peaks, this report assumes the following:

- 35 percent of the site traffic will enter/exit via Delaware Route 1 from the south,
- 15 percent will enter/exit via Savannah Road (Rd 18) from the west,
- 10 percent will enter/exit via Marsh Rd (Rd 276) from the west,
- 10 percent will enter/exit via Dartmouth Road from the west,
- 10 percent will enter/exit via Kings Highway (Rd 268) from the east,
- 10 percent will enter/exit via Theodore C. Freeman Highway (Road 23) from the east, and
- 10 percent will enter/exit via Gills Neck Rd (Rd 267) from the east.

The proposed trip distribution percentage for the residential portion of the site is illustrated in Figure 36 while the trip distribution percentage for the commercial portion of the site is shown in Figure 37 and the pass-by trip distribution percentage for the retail is shown in Figure 38.

FDOT Systems Planning Office - TIPS Download - Windows Internet Explorer

http://www.dot.state.fl.us/planning/systems/sm/siteimp/tips.shtm

File Edit View Favorites Tools Help

Google Go Bookmarks 114 blocked Check Settings

Convert Select

FDOT Systems Planning Office - TIPS Download

Page Tools

TIPS: Trip Generation, Internal Capture, and Pass-by Software Download and Instructions Page

***Print this page for reference ***

The Florida Department of Transportation has developed a trip generation calculation tool called TIPS (Trip generation, Internal capture, and Pass-by Software) to estimate the number of trips generated by specific land uses of a proposed land development. This application uses rates and equations from the Institute of Transportation Engineers *Trip Generation*, 7th Edition. TIPS provides a database of over 140 land-use types as well as step-by-step guidance in performing the necessary calculations.

Download and Installation Instructions (updated 10/09/07):

- Sign up for product updates and download program
- A dialog box will appear asking you if you want to run (or open) the file from its current location or to save it to disk: Choose save to disk
- Save the file "**TIP_1.40.zip**" to any temporary directory or your desktop
- Close all programs except for those used in installation
- Double-click on the "**TIP_1.40.zip**" file

Internet 100%

NCHRP 08-51 [Active]

Enhancing Internal Trip Capture Estimation for Mixed-Use Developments

Project Data	
Funds:	$250,000
The preliminary draft final report is expected in November 2008.	
Staff Responsibility:	Christopher Hedges
Research Agency:	Texas A&M University
Principal Investigator:	Brian Bochner
Effective Date:	7/5/2005
Completion Date:	1/31/2009

BACKGROUND

As new development places increasing demands on the transportation system, community leaders, land-use planners, developers, and transportation agency administrators need techniques to enable them to reliably predict the number of net vehicle and person trips that will be generated by new or infill mixed-use development.

For site impact analysis purposes, an internal capture rate that is set too low may unfairly penalize developers by making them pay more than their fair share of costs for transportation mitigation measures. Conversely, an internal capture rate that is set too high may unfairly place this burden on the public. Both cases may result in sub-optimal build-out, particularly in urban areas.

Since the internal capture rate used for a given mixed-use development can be politically contentious, empirical observations are needed to provide professional guidance for better estimating these impacts. By improving the methods for estimating internal capture, the process of determining developers' responsibilities for mitigating transportation impacts of mixed-use development will become more equitable, transparent, and open.

The Institute of Transportation Engineers' (ITE's) report titled: *Trip Generation* (7th edition, 2003, ISBN 0-935403-79-5) provides vehicle trip generation rates for various residential, commercial, and industrial developments. ITE recently conducted a survey of its members that provides further insight on estimating internal capture for mixed-use developments The information is available on-line at: http://www.zoomerang.com/reports/public_report.zgi?ID=L2263NJNHL4U. Because ITE's rates are predominantly based on "single-use, free-standing sites," the potential exists for multi-use sites to exhibit fewer vehicle trips than would be estimated using the stand-alone rates. For example, a proposed mixed-use development that includes residential, retail, and office use may, in reality, exhibit significant internal capture and consequently lower external trip generation than would have otherwise been predicted. In addition, it has been suggested that behavioral response to contextual factors such as density, diversity, design, and regional accessibility influence travelers' trip-making decisions (Ewing, R. and R. Cervero, 2001, *Transportation Research Record: Journal of the Transportation Research Board, No. 1780*, pp. 87-113).

ITE advises those estimating transportation impacts of mixed-use developments to "collect additional data if possible." ITE's *Trip Generation Handbook* (2nd edition, 2004, ISBN 0-935403-86-8), has established a data-collection procedure for estimating multi-use trip generation; however the existing framework is based on a limited set of data that does not adequately capture elements of mixed-use development. Consequently, when considering potential transportation impacts of proposed mixed-use developments, local and state transportation planners lack a comprehensive, credible data set that can be used to confirm or deny the soundness of proposed internal capture estimates. Currently, "...so little information is available about internal capture rates that traffic impact studies for mixed-use developments become little more than exercises in speculation." (Ewing, R., M. Deanna, and S.C. Li, *Transportation Research Record 1518*, pp. 1-9). This NCHRP study will address this need by providing a classification system of mixed-used developments and a data-collection framework to enhance estimates of internal capture for mixed-use developments.

OBJECTIVE

The objective of this two-phase project is to produce a methodology for enhancing internal trip capture estimates that includes (1) a classification system of mixed-use developments that identifies the site characteristics, features, and context that are likely to influence internally captured trips and (2) a data-collection framework for quantifying the magnitude of internal travel to and around mixed-use developments to determine the appropriate reduction rates.

Accomplishment of the project objective will require at least the following tasks.

Appendix C: 3/18/09 meeting materials

- **Meeting Agenda**
- **Meeting Notes**
- **Presentation: *Results from Mixed-Use Survey-* Dan Blevins, WILMAPCO**
- **Mixed-Use Survey Questionnaire template**

Wilmington Area Planning Council

850 Library Avenue, Suite 100
Newark, Delaware 19711
302-737-6205; Fax 302-737-9584
From Cecil County: 888-808-7088
e-mail: wilmapco@wilmapco.org
web site: www.wilmapco.org

Memorandum

Date: May 21, 2009

Re: 3/18/09 TMA/Mixed Use Meeting Agenda

Traffic Mitigation Agreements for Mixed Use Development Working Group Meeting

Where: WILMAPCO Conference Room

When: Wednesday, March 18th, 2009 9-11am

Agenda

1. **Presentation: Results from Mixed-Use Survey – Dan Blevins**
   WILMAPCO staff will present the results from the completed surveys on mixed use development.

2. **Conclusions on local perspective of mixed-use development**

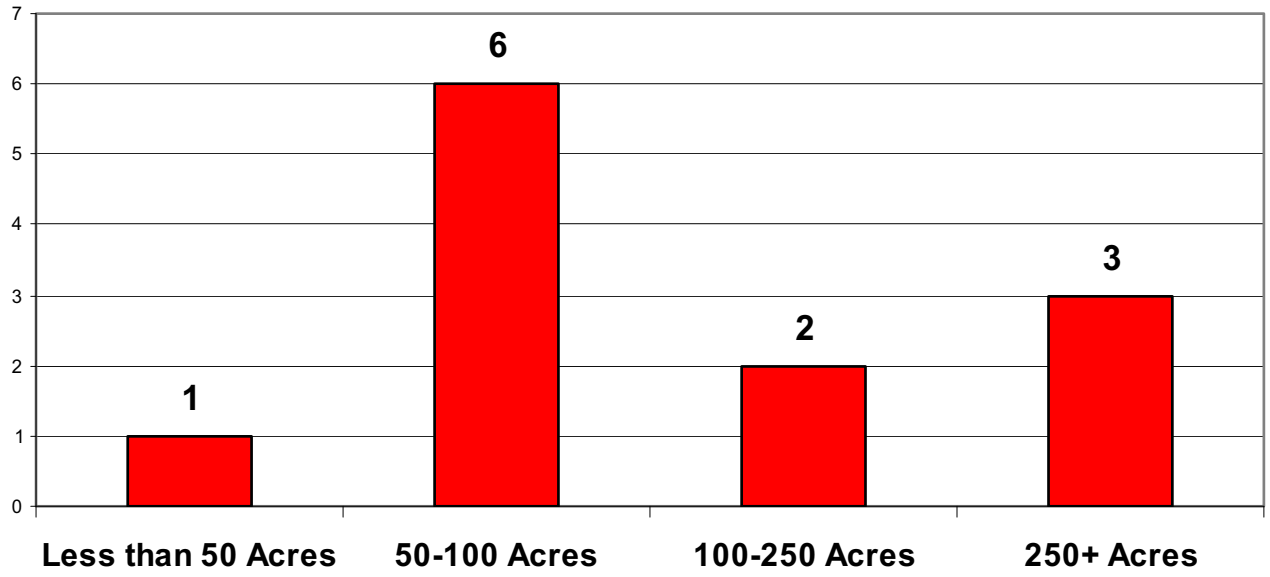
3. **Possibilities for a National Speaker to discuss national trends in mixed-use development**

4. **Next meeting date and future objectives**

Summary of Results from the Local Perception of Mixed Use Development

Presented to the Mixed-Use and Traffic Mitigation Agreement Working Group 3/18/2008

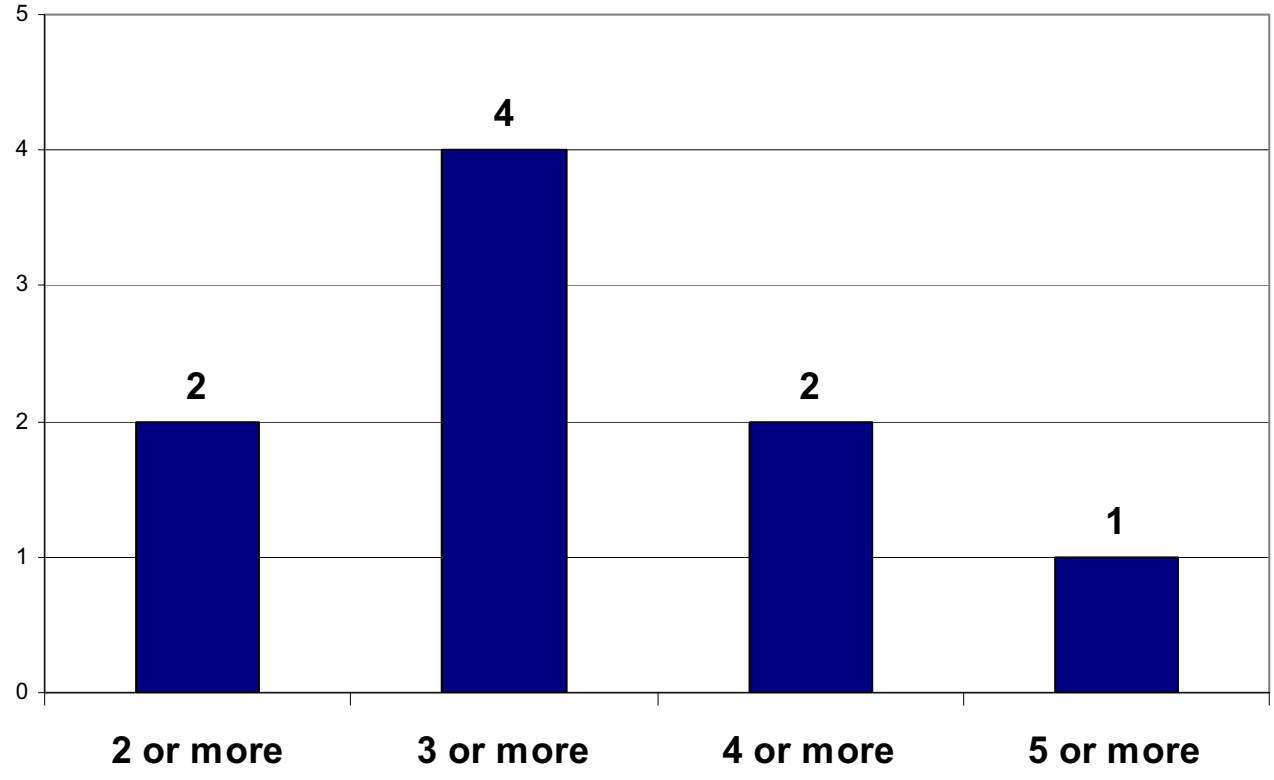
Development Size: In your opinion, what do you feel is the ideal size of a mixed-use development?



Local examples:

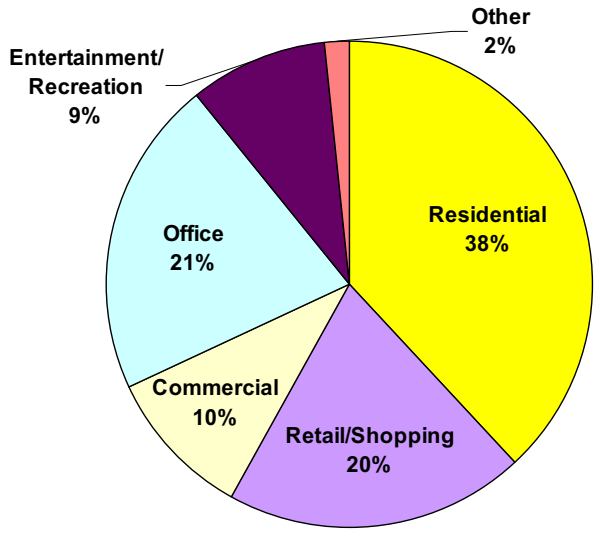
- **Lincoln Center: 56ac.**
- **Renaissance Village 51 ac.**
- **Westown 2,500 ac.**
- **Barley Mill Plaza (111ac.)**

Land Use mix: How many land uses (i.e. residential, office, retail, commercial, etc…) do you feel constitutes a good mixed use development?



In your opinion, please write the percentages of the land use types that would constitute your "ideal blend" of a mixed use development. Total should be 100%

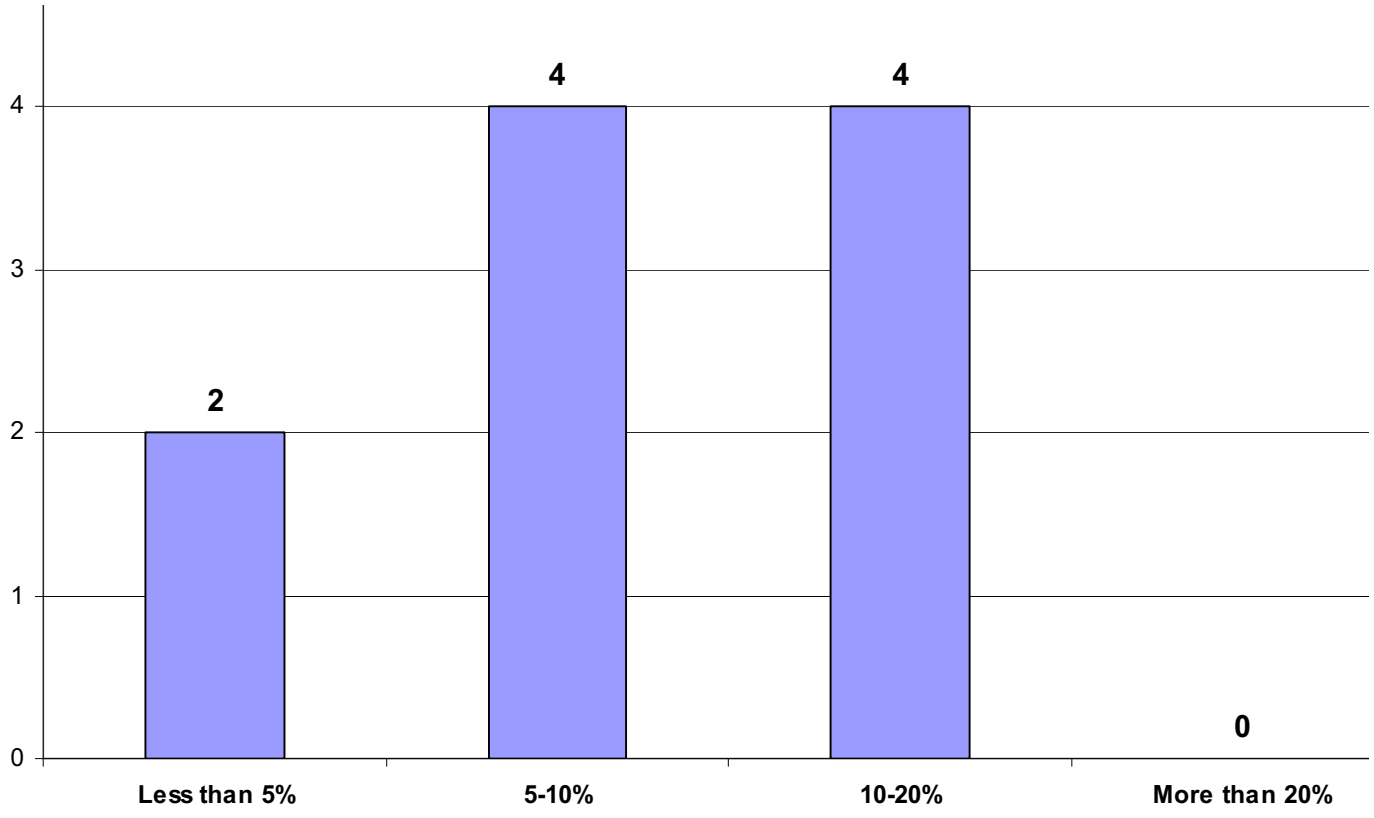
Total Survey Avg.



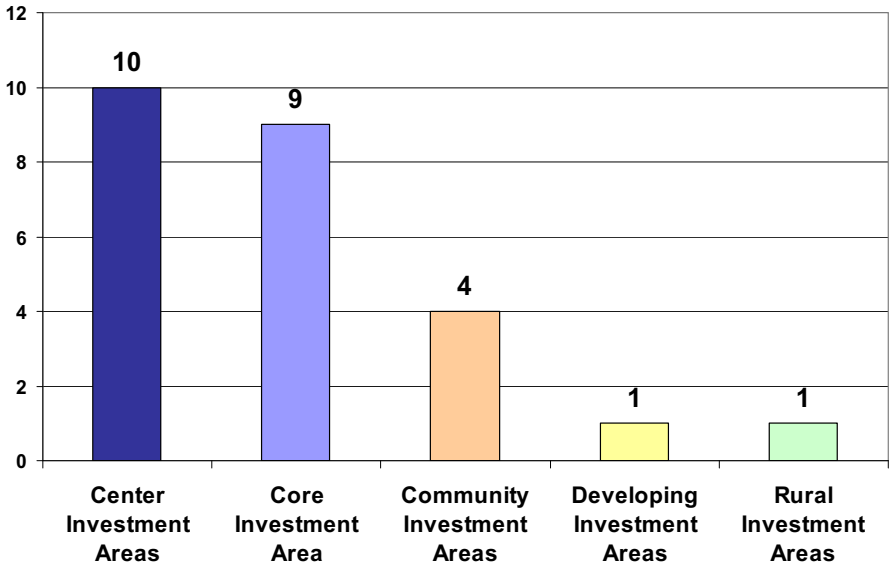
Breakdown of Individual Responses

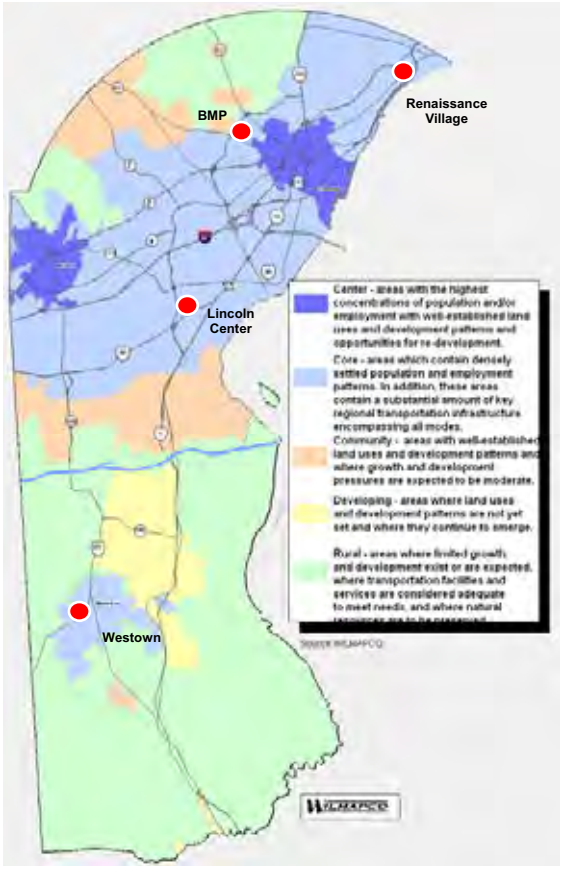
Type	#1	#2	#3	#4	#5	#6	#7	#8	#9	#10	AVG
Residential	15%	60%	35%	30%	23%	45%	65%	25%	50%	30%	38%
Retail/Shopping	30%	15%	15%	20%	19%	20%	10%	40%	15%	20%	20%
Commercial	15%	5%	15%	20%	10%	10%	8%	10%	0%	10%	10%
Office	35%	5%	20%	20%	38%	10%	10%	15%	30%	30%	21%
Ent./Rec.	5%	15%	10%	10%	5%	15%	7%	10%	5%	5%	9%
Other	0%	0%	5%	0%	5%	0%	0%	0%	0%	5%	2%

What percentage of the residential units should be set aside for low-income buyers in a mixed-use development?



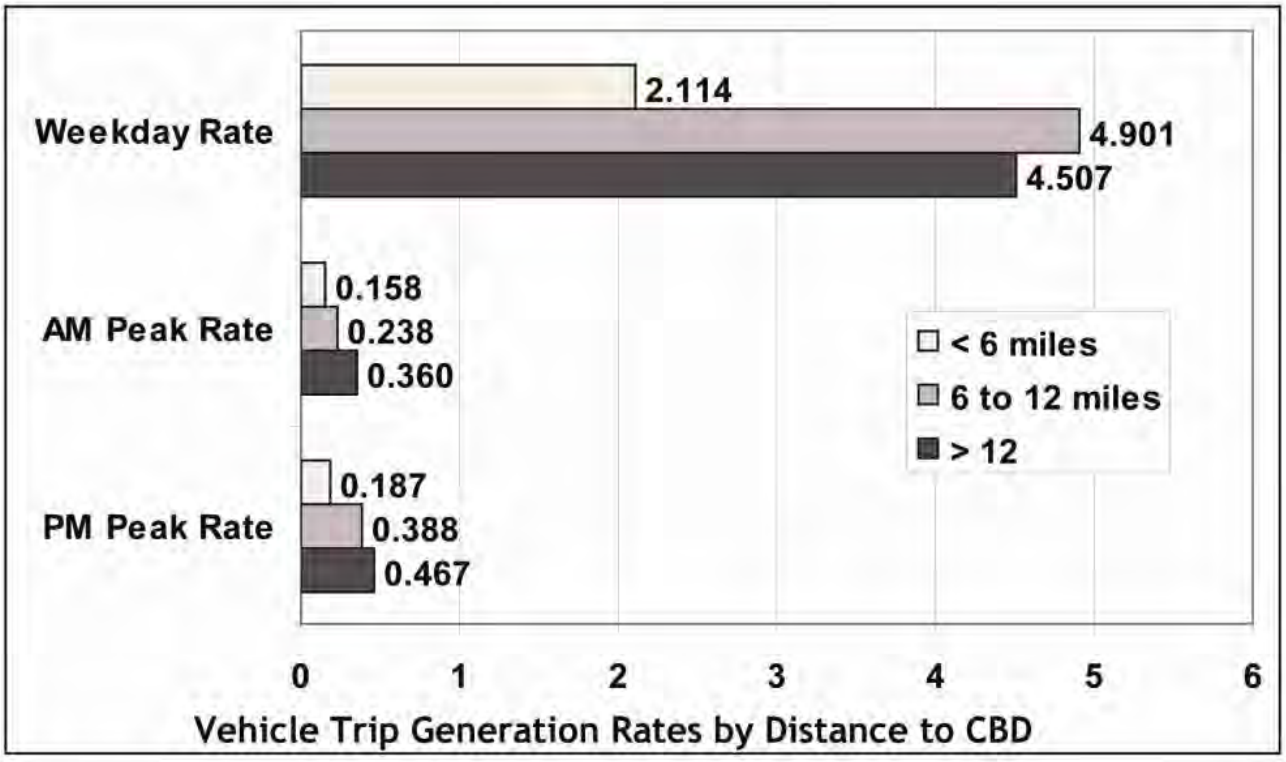
Location: Based on the WILMAPCO Transportation Investment Area map, where should higher-density mixed use developments should be allowed to occur?





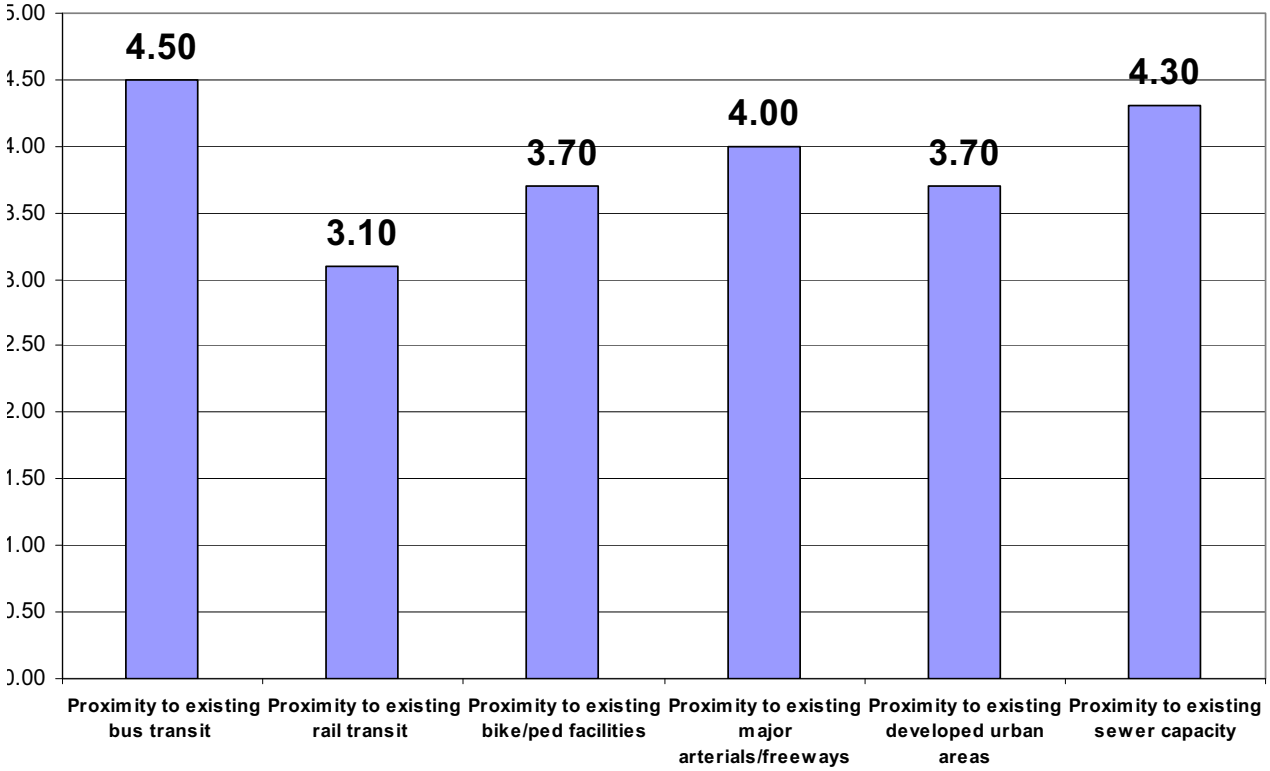
From the experts……

"Vehicle trip generation rates tend to rise as one goes farther away from the urban core."

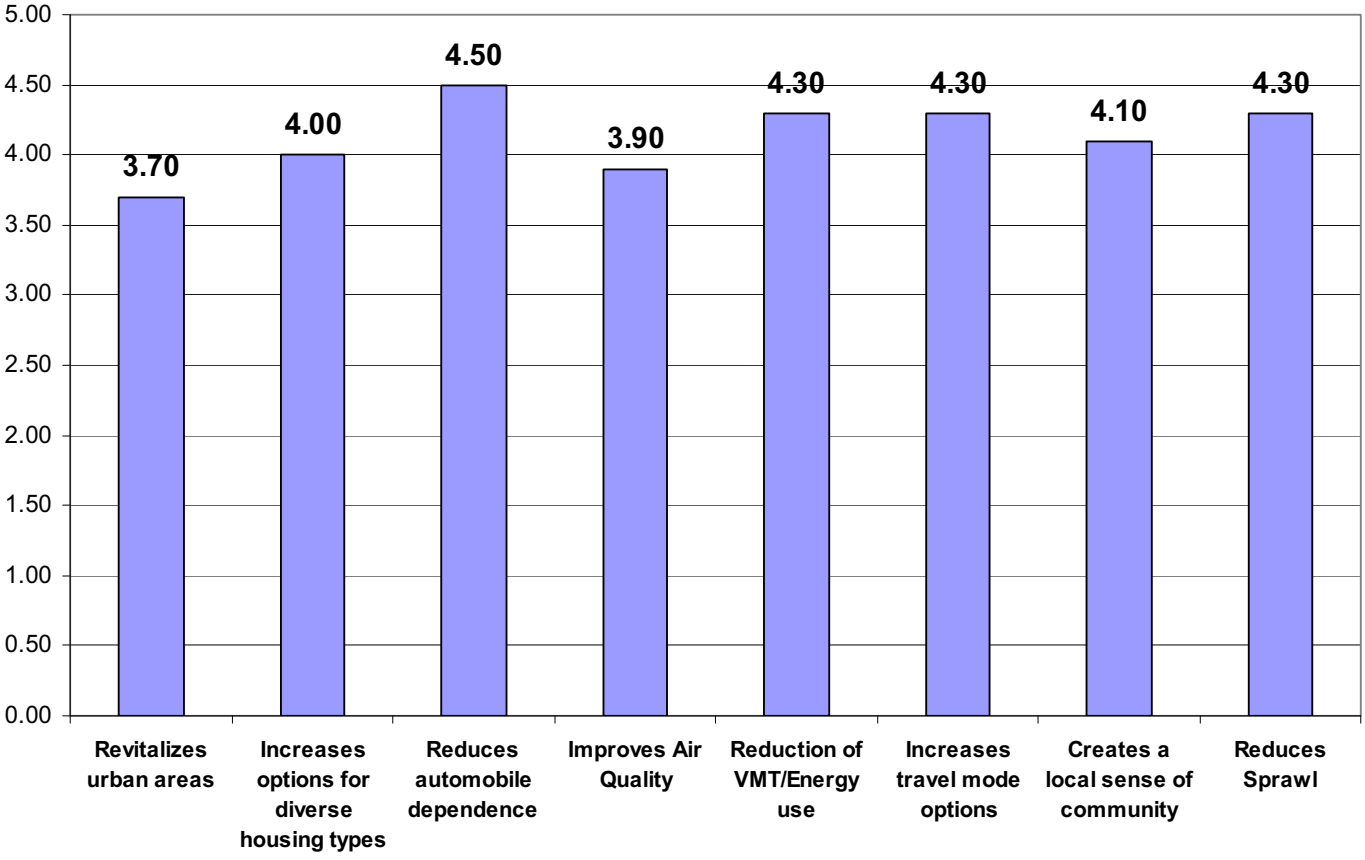


From TCRP 128: Effects of TOD on Housing, Parking and Travel

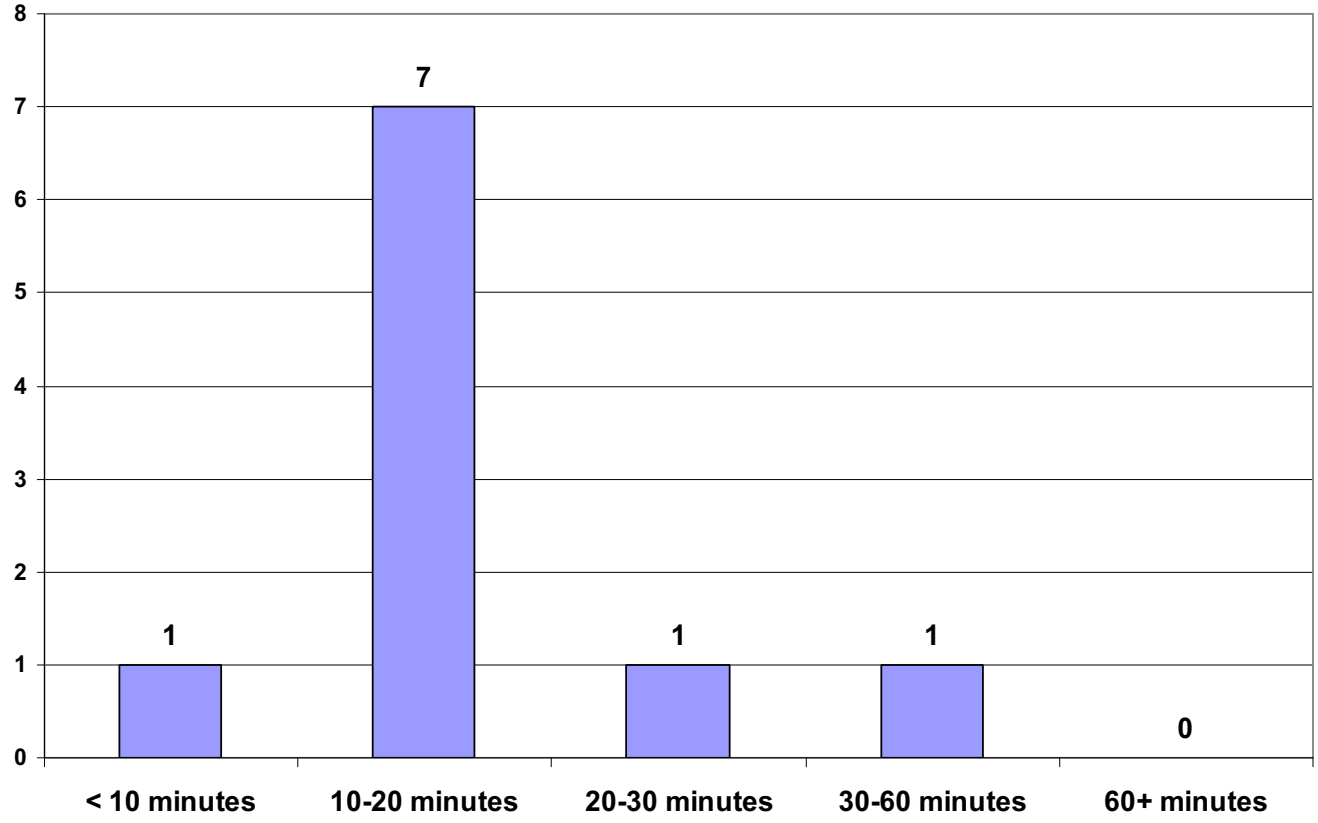
Please rate the importance of the following items in relation to infrastructure / transportation and the location of mixed-use developments:



Please rate the importance of the following items in relation to the perceived benefits of mixed-use development:



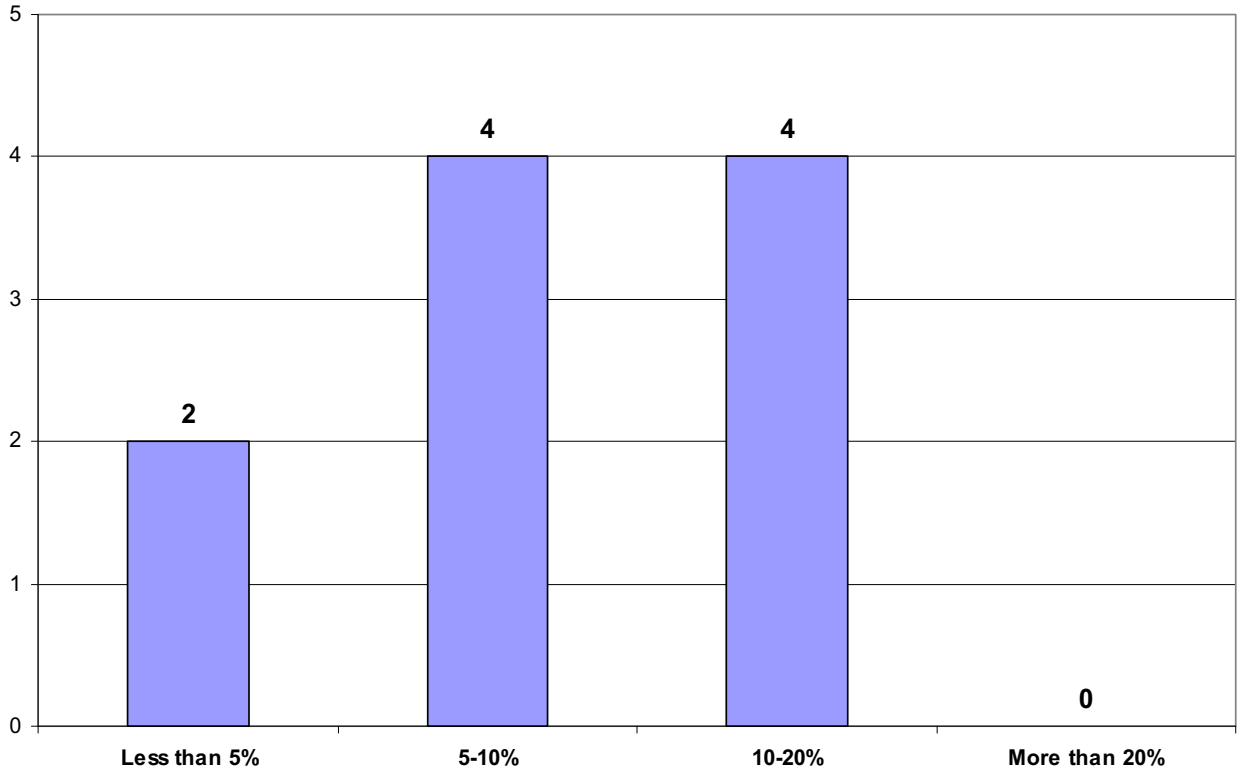
Transit: What should the peak hour transit headway threshold be for servicing a mixed-use development ?



Please rate these factors in order of importance (1 thru 8) in the consideration of planning a mixed use development:

Overall Rank	Avg. Score
1. Mix of land use types:	1.80
2. Housing Density:	2.70
3. Walkability:	3.80
4. Mix of Housing Types:	3.90
5. Transit Access:	4.20
6. Other (Design):	4.70
7. Env. & Open Space:	6.10
8. Parking:	6.80

What percentage of the residential units should be set aside for low-income buyers in a mixed-use development?



1. Level of Service (LOS) threshold: Is LOS E an acceptable LOS to allow around mixed-use development?

- Yes, internal capture computations can justify it.
- Yes, if the density is high and there are alternatives to SOV travel.
- Yes, if only during peaks.
- Yes, this might be the expectation of increased uses and density and therefore requires a different treatment than other land use
- Yes, if we can leverage LOS E with more viable mixed use, transit, affordability and density. I know that viewpoint probably does not jibe with the citizenry of New Castle County, especially after Workforce Housing.

2. Land use plan approval process: The current method is fragmented between state, county and city planning and zoning groups. What changes should be made to the current process and which agencies should be involved?

•Give 100% of the real estate transfer fee to the State if any development is outside agreed upon growth areas. Force those political jurisdictions that benefit from this source of revenue to share in the costs. Standardize the approval process and expedite it for mixed use developments. At a minimum, involve DelDOT, DNREC, Housing and Agriculture in all the major decisions on land use. Add to that core the local government with current jurisdiction such as the County or the city.

• Municipal and county governments have the most to say about land use decisions while the state basically does permitting and provides the bulk of infrastructure and services.

•Greater opportunities for collaboration and decision-making, but land use decisions must always remain at the local level.

• Consistency to encourage and support mixed use development

•The process should be web-based. An interagency working group approach would yield better comprehensive and coordinated

• There is more of a disconnect between the state and New Castle County than with the state and the other two counties because of PLUS Memoranda of Understanding. The state reviews virtually no projects (or ordinances) in New Castle vs. most projects in Kent and Sussex. DelDOT may be involved early, but State Planning, DNREC and other agencies are not. PLUS should be involved at the exploratory stage in order to provide the most meaningful suggestions that can be addressed before plans have solidified.

•There should be a blue print at the state level that carries incentive/disincentive and even enforcement. Call it smart growth, livable Delaware, walkable communities, growth boundaries, or whatever. The idea is for the state to figure out what it wants to be “when it grows up” with input from the locals. Once that is established and has real “hammer” attached to it, then locals can implement the blue print thru their process.

3. Would it be a worthwhile effort to attempt to create a greater number of Transportation Investment Districts throughout the state where they currently do not exist?

• I do not know.

•Yes. They provide opportunities for greater efficiency in the use of fiscal and protection of natural resources.

•I think so

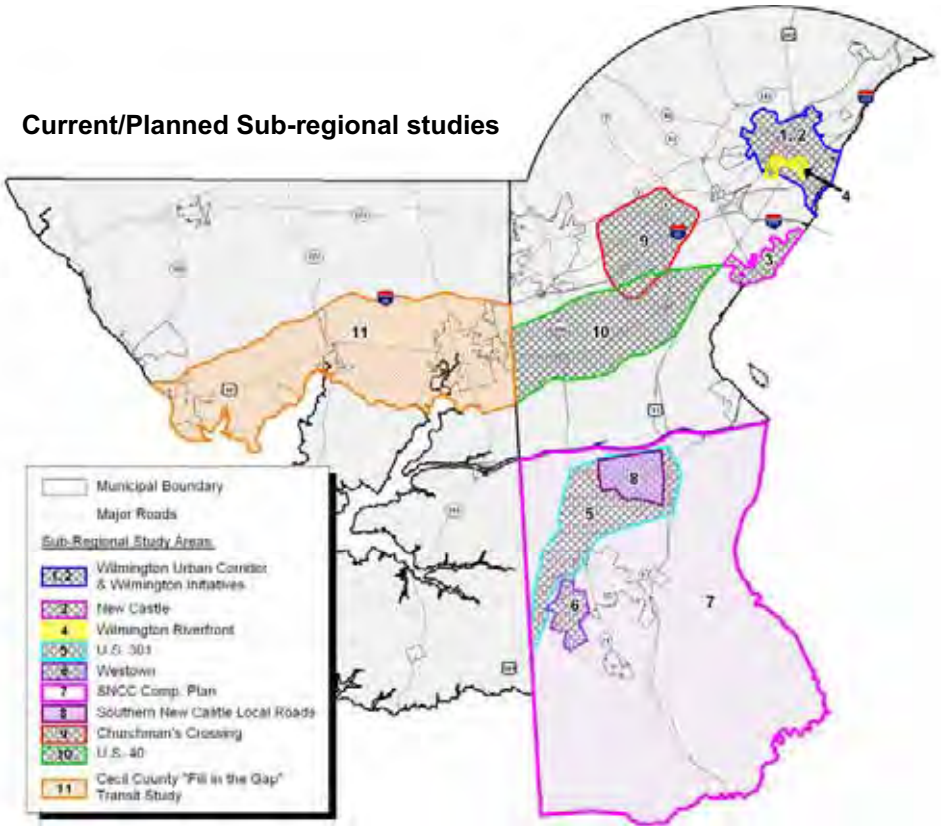
• Yes, this would help mid-range and long term agency planning. Also, developers would have a better understanding of what might be required of them to leverage agency resources.

•Yes, but can DelDOT afford the additional investment in time and dollars? Also, from the DNREC perspective, when you are planning more intense growth and investment in a particular area, you need to consider the effect on the entire watershed and try to mitigate the effects of increasing impervious cover.

•Yes

• No

• No



4. What are the biggest hurdles that exists for having more mixed use development activity in the state?

•NIMBY, permit approval process is too complex, misinformation about the impact that mixed use has on an area. The inherent limitations on perspective people have. Compared to what?

• local land use regulations. Generally there are too many hoops to jump through as opposed to typical trend patterns.

• It is an unknown quantity often equated with higher density, more traffic, more congestion, degraded air quality and overall uncertainty. Few people know of the sucessful examples.

•Public Perception

•Zoning and people's ignorance.

•1)Community and elected officials not accepting/wanting/understanding “density”
2)Unpredictable development decisions

•Getting something on the ground that actually is truly mixed use and builds out according to the original vision. Too often, a projects gets adulterated or dumbed-down by cost considerations and/or NIMBY activism. We know it works and is popular in other areas. That means getting over the density hurdle -- even with the density bonus of 50% for workforce housing in New Castle, density would still be less than the Sussex's base density of 2 units per acre. Why is base density higher in a rural county than in a metropolitan county? People need to understand the relationship between sprawl, VMT, air quality and their health.

• Too many laws

5. Please use the remaining space to add any additional comments not covered in this survey:

•There needs to be political will at all levels of government in Delaware to make improvements that will benefit the common good. Too many organizations (some Departments, Divisions, elected officials) see this from the perspective of their own "silo" and not in the broader context required for projects of this magnitude. We need to start with a blank sheet of paper rather than tweak the existing, failed process.

•we need to discuss what percents of uses constitutes mixed-use, the type of mixed-use we want to recognize as good and want to support. Then, of course, we need to develop a framework for realistically estimating the traffic impact of these developments, recognizing the internal trips.

•Measuring success will be a key element in any efforts to increase the use of mixed use developments.

Appendix D: 5/13/09 meeting materials

- **Meeting Notes**
- **Presentation: *"Traffic Generated by Mixed-Use Developments – A Six-Region Study Using Consistent Built Environmental Measures"*- Reid Ewing (Univ. of Utah)**

5/13/09 Mixed-Use/TMA meeting notes

Attendees:
Antoni Sekowski – NCC Land Use
Jerry Heisler - The Reybold Group
Ted Bishop – DelDOT
Reid Ewing – Univ. of Utah
Angelina Micheva – NCCCC
Herb Inden - DE Office of State Planning Coordination
Bill Osborne – TMA Delaware
Tigist Zegeye – WILMAPCO
Dan Blevins – WILMAPCO

Meeting Notes:

Agenda Item #1: Reid Ewing Presentation: Reid Ewing (Univ. of Utah) gave a presentation titled "*Traffic Generated by Mixed-Use Developments – A Six-Region Study Using Consistent Built Environmental Measures*". The presentation covered material that is part of an effort to refine the methodology for estimating internal trip capture in mixed use developments. The final product will be a spreadsheet based application to allow planners, developers and transportation departments to calculate expected internal trip capture of mixed use developments. This is in tandem with another effort by the NCHRP that is looking to do the same. He discussed some of the current shortcomings of the current ITE methodology (Chapter 7 of Trip Generation Handbook):

- Based on only three sites in Florida
- Covers only three land use types
- Scale of development disregarded
- Land use context disregarded
- Possibility of mode shifts disregarded
- Length of external trips disregarded

The effort that Mr. Ewing has developed performed an analysis of recent research (more than 150 studies). These were taken from 6 different areas across the country (Atlanta, Boston, Houston, Portland, Sacramento, Seattle) and has created "7D" analysis of regional travel survey data which are:

- Density
- Diversity
- Design
- Destination Accessibility
- Distance to Transit
- Development Scale
- Demographics

The approach includes a hierarchial model methodology which takes in to account the local household characteristics (i.e. household size, avg. vehicle ownership), development design including proposed transportation infrastructure

(such as intersection and sidewalks densities) and regional data such as total employment within 30 minutes of the development and street connectivity.

The model was validated against 16 existing sites and the results were compared to the results of the current ITE method. On average, the model was roughly twice as accurate in estimating the internal trip capture compared to current ITE methods.

Other Discussions:
Antoni Sekowski gave a brief description of county efforts to enhance the UDC to allow for more mixed-use development. On a grant received through BRAC, the Land Use department has hired a consultant to survey several groups in the county. The groups gave input on what is lacking and what changes might be made that would help incorporate some of the goals of the Comprehensive Plan. A priority is to help incentivize small business as much as possible as they make up the majority of established businesses in the county. The final product will be a draft of UDC ordinances to be proposed for inclusion into an expanded section dealing with mixed-use. Stipulations will be placed on location, square footage and density. The draft is looking at regulations for roughly 3 types of mixed use based on size:

- Small <5 acres. Infill up to 2 uses
- Medium 5-20 acres
- Large 20+ acres

A follow up will be given once more details are available at a future meeting. It was asked that the mixed use steering committee and the Mixed-Use working group meet to discuss jointly.

Mr. Ewing extended an offer to allow WILMAPCO to serve as a test site for the newly developed model. A meeting will set up in late May to discuss the details with the model developers in order to get WILMAPCO staff up to speed on how to use the model.

Next steps/future meetings:

- Meet with EPA to discuss receiving the model
- Begin testing local examples of mixed use development, comparing trip capture vs. current estimates. Present findings to committee
- Invite members of NCCLU mixed use steering committee to future meeting(s)

FEHR & PEERS
TRANSPORTATION CONSULTANTS

Traffic Generated by Mixed-Use Developments – A Six-Region Study Using Consistent Built Environmental Measures

Reid Ewing
Michael Greenwald
Ming Zhang
Larry Frank
Mark Feldman
Jerry Walters
Robert Cervero
Senait Kassa
John Thomas

FEHR & PEERS
TRANSPORTATION CONSULTANTS

Criteria	ITE Trip Gen.	ITE Multi-Use	Proposed MXD
Intuitively reasonable, logically correct	√	√	√
Scientifically proven for wide range of cases	√		√
Conceptual, empirical support from independent research	√		√
Transparent, understandable, easy to apply	√	√	√
Accounts for the effect of built environmental variables		√	√
Validated through independent field testing			√

FEHR & PEERS
TRANSPORTATION CONSULTANTS

Current ITE Multi-Use Development Method (Chapter 7 of Trip Generation Handbook)

- The analyst determines the amounts of different land use types (residential, retail, and office) contained within the development.
- These amounts are multiplied by ITE's per-unit trip generation rates to obtain a preliminary estimate of the number of vehicle trips generated by the site. This preliminary estimate is what the site would be expected to generate if there were no interactions among the on-site uses.
- The generated trips are then reduced by a certain percentage to account for internal-capture of trips within MXDs. The reductions are based on look-up tables. The share of internal trips from the appropriate look-up table is multiplied by total numbers of trips generated by a given use to obtain an initial estimate of internal trips for each producing use and attracting use.
- For each pair of land uses, productions and attractions are reconciled such that the number of internal trips produced by one use just equals the number attracted by the other use. The lesser of the two estimates of internal trips constrains the number of internal trips generated by the other use.

FEHR & PEERS
TRANSPORTATION CONSULTANTS

Look-Up Tables

Table 7.1 Unconstrained Internal Capture Rates for Trip Origins within a Multi-Use Development

		WEEKDAY		
		MIDDAY PEAK HOUR	p.m. PEAK HOUR OF ADJACENT STREET TRAFFIC	DAILY
from OFFICE	to Office	2%	1%	2%
	to Retail	20%	23%	22%
	to Residential	0%	2%	2%
from RETAIL	to Office	3%	3%	3%
	to Retail	29%	20%	30%
	to Residential	7%	12%	11%
from RESIDENTIAL	to Office	N/A	N/A	N/A
	to Retail	34%	53%	38%
	to Residential	N/A	N/A	N/A

Caution: The estimated typical internal capture rates presented in this table rely directly on data collected at a limited number of multi-use sites in Florida. While ITE recognizes the limitations of these data, they represent the only known credible data on multi-use internal capture rates and are provided as illustrative of typical rates. ***If local data on internal capture rates by paired land uses can be obtained, the local data may be given preference.***

N/A—Not Available; logic indicates there is some interaction between these two land uses; however, the limited data sample on which this table is based did not record any interaction.

FEHR & PEERS
TRANSPORTATION CONSULTANTS

Limitations of Current ITE Method

- Based on only three sites in Florida
- Covers only three land use types
- Scale of development disregarded
- Land use context disregarded
- Possibility of mode shifts disregarded
- Length of external trips disregarded

FEHR & PEERS
TRANSPORTATION CONSULTANTS

Approach of EPA

- Meta-analysis of recent research (more than 150 studies)
- 7D analysis of regional travel survey data

FEHR & PEERS
TRANSPORTATION CONSULTANTS

7D Analysis - Innovations

- Pooled household travel data for MXDs in six diverse regions
- Identified 239 MXDs through a bottom-up survey process
- Included internal capture, mode choice for external trips, and trip length as travel outcome measures

FEHR & PEERS
TRANSPORTATION CONSULTANTS

Additional Innovations

- Estimated large number of 7D variables consistently across regions
- Modeled travel relationships hierarchically
- Validated results through comparison to traffic generation counts at an independent set of mixed use sites in various parts of the U.S., and
- Feeding directly into traffic engineering practice ITE

FEHR & PEERS
TRANSPORTATION CONSULTANTS

Six Diverse Regions

- Atlanta
- Boston
- Houston
- Portland
- Sacramento
- Seattle

FEHR & PEERS
TRANSPORTATION CONSULTANTS

Choice of Regions Based on Data Availability

- Provide XY coordinates for trip ends, so we could zero in on individual sites when studying travel patterns to, from, and within MXDs
- Provide individual parcel data, so we could study land-use mix down to the parcel level

FEHR & PEERS
TRANSPORTATION CONSULTANTS

Identifying MXDs

Top-Down GIS-Based Approach

vs.

Bottom-Up Expert-Based Approach

FEHR & PEERS
TRANSPORTATION CONSULTANTS

ITE Definition

"…a multi-use development is typically a single real-estate project that consists of two or more ITE land use classification between which trips can be made without using the off-site road system."

FEHR & PEERS
TRANSPORTATION CONSULTANTS

ULI Definition

…three or more significant revenue producing uses; significant functional and physical integration of the different uses; and conformance to a coherent plan.

FEHR & PEERS
TRANSPORTATION CONSULTANTS

New Definition

…A mixed-use development or district consists of two or more land uses between which trips can be made using local streets, without having to use major streets. The uses may include residential, retail, office, and/or entertainment. There may be walk trips between the uses.

FEHR & PEERS
TRANSPORTATION CONSULTANTS

Example

internal capture – 36%
walking – 14%
transit – 9%

FEHR & PEERS
TRANSPORTATION CONSULTANTS

239 MXDs

	Survey Year	MXDs	Mean Acreage per MXD	Total Trip Ends	Mean Trip Ends per MXD
Atlanta	2001	24	287	6,167	257
Boston	1991	59	175	3,578	61
Houston	1995	34	401	1,584	47
Portland	1994	53	116	6,146	116
Sacramento	2000	25	179	2,487	99
Seattle	1999	44	207	15,915	362
Total		239	211	35,877	150

FEHR & PEERS
TRANSPORTATION CONSULTANTS

Multiple Outcome Measures

INTERNAL – Dummy variable indicating that a trip remains internal to the MXD (1=internal, 0=external)

WALK – Dummy variable indicating that the travel mode on an external trip is walking (1=walk mode, 0=other)

TRANSIT - Dummy variable indicating that the travel mode on an external trip is public bus or rail (1=transit, 0=other)

TDIST - Network trip distance between origin and destination locations for an external private vehicle trip, in miles

FEHR & PEERS
TRANSPORTATION CONSULTANTS

Understudied

Paper No. 01-3524

Internalizing Travel by Mixing Land Uses

Study of Master-Planned Communities in South Florida

Reid Ewing, Eric Dumbaugh, and Mike Brown

Planners, public officials, and large-scale land developers increasingly promote mixed-use developments as an alternative to sprawl. They list among the benefits of such developments the "internal capture" of trips; that is, trips that would otherwise have filtered onto the regional road network will remain on site. Yet, so little information is available about internal capture rates that traffic impact studies for mixed-use developments become little more than exercises in speculation. In an attempt to advance basic knowledge of the subject and move toward better prediction methods, 20 mixed-use communities in south Florida were studied to determine the effect of land use mix on internal capture rates. The sample of communities studied had internal capture rates ranging from 0 to 57 percent of all trip ends generated. When modeled in terms of land use and accessibility variables, both the scale of a development and regional accessibility proved significant, with the former directly related to internal capture and the latter inversely related to internal capture. The best-fit model explained just under half of the variance in internal capture rates. Controlling for scale and regional accessibility, land use mix and

In an attempt to advance basic knowledge of the subject and move toward better prediction methods, 20 mixed-use communities in south Florida were selected for study. All were built within the last 40 years and include housing, shopping, services, and recreational facilities. Some have basic employment as well. They vary sufficiently in location, size, and land use mix as to promise significant variation in internal capture rates, which, in turn, should allow internal capture rates to be modeled in terms of the same variables.

SELECTING COMMUNITIES

To identify developments appropriate for study, metropolitan and municipal planners in Dade, Broward, and Palm Beach Counties in Florida were interviewed. They were asked for lists of master-planned communities with a mix of housing, shopping, services, and recreational facilities. The interview process produced a list of 26 commu-

FEHR & PEERS
TRANSPORTATION CONSULTANTS

Substantial Variance

	Internal Capture
Atlanta	16.7%
Boston	16.9%
Houston	31.1%
Portland	15.9%
Sacramento	16.4%
Seattle	18.0%

	Walk Share	Transit Share
Atlanta	5.1%	3.1%
Boston	20.6%	7.8%
Houston	3.1%	6.1%
Portland	7.3%	4.6%
Sacramento	2.9%	0.4%
Seattle	5.8%	9.9%

FEHR & PEERS
TRANSPORTATION CONSULTANTS

7D variables consistently defined

- Density
- Diversity
- Design
- Destination Accessibility
- Distance to Transit
- Development Scale
- Demographics

FEHR & PEERS
TRANSPORTATION CONSULTANTS

Individual Level Variables

- **CHILD – Dummy variable indicating that the traveler is under 16 years of age (1=child, 0=adult)**
- **WHITE – Dummy variable indicating that a traveler is a white Caucasian (1=white, 0=other)**
- **HHSIZE – Number of members of the household**
- **VEHCAP – Number of motorized vehicles per person in the household**
- **BUSSTOP – Dummy variable indicating that the household lives within ¼ mile of a bus stop (1=yes, 0=no)**

FEHR & PEERS
TRANSPORTATION CONSULTANTS

MXD Level Variables

POPDEN – Net population density per square mile

EMPMILE – Total employment within one mile of the traffic analysis zones intersecting the MXD

EMP30T – Total employment within 30 minutes by transit of traffic analysis zones intersecting the MXD

LANDMIX – Entropy index that captures the variety of land uses based on acreage

INTDEN - Number of intersections within the MXD per square mile of gross area

SIDEWALK – Mileage of sidewalks within the MXD per centerline mile of streets

STOPDEN – Number of bus stops within the MXD per square mile of gross area

RAIL – Rail station located within the MXD (1 = yes, 0=no)

FEHR & PEERS
TRANSPORTATION CONSULTANTS

	N	Mean	S.D.
AREA	239	0.33	0.32
POP	239	2,271	3,261
EMP	239	2,696	5,572
ACTIVITY	239	4,967	6,945
POPDEN	205	21,600	35,147
EMPDEN	204	30,269	51,360
ACTDEN	239	19,780	30,669
FAR	121	0.40	0.54
DEVLAND	239	0.82	0.22
JOBPOP	239	0.46	0.31
RETPOP	205	0.46	0.31
JOBMIX	180	0.70	0.17
BUILDMIX	64	0.55	0.33
LANDMIX	239	0.52	0.20
STRDEN	239	25.4	10.5
INTDEN	239	257	203
SIDEWALK	74	0.91	0.67
EMPMILE	239	30,510	50,914
EMP10A	239	69,813	111,192
EMP20A	239	276,127	377,056
EMP30A	239	505,003	630,585
EMP30T	239	86,143	147,873
STOPDEN	239	70.75	83.63
RAILSTOP	239	0.08	0.28

FEHR & PEERS
TRANSPORTATION CONSULTANTS

Region Level Variables

REGPOP – Population within the region

REGEMP – Employment within the region

REGACT – Activity within the region (population + employment)

REGDEN – Measure of regional density developed by Ewing et al. (2002, 2003)

REGMIX – Measure of regional land use mix from same source

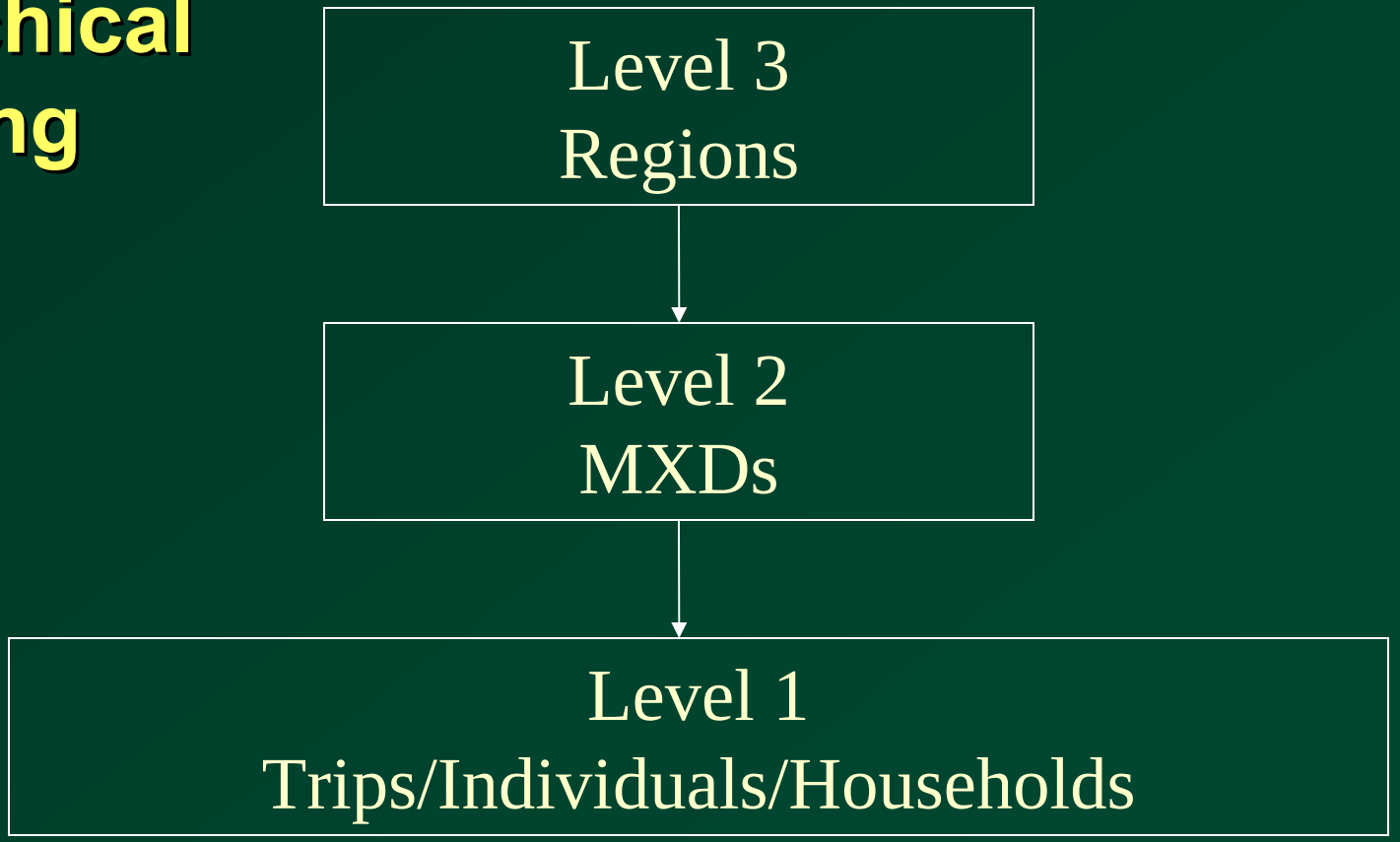
REGCEN – Measure of regional centering from same source

REGSTS – Measure of regional street accessibility from same source

SPRAWL – Measure of overall regional sprawl from same source

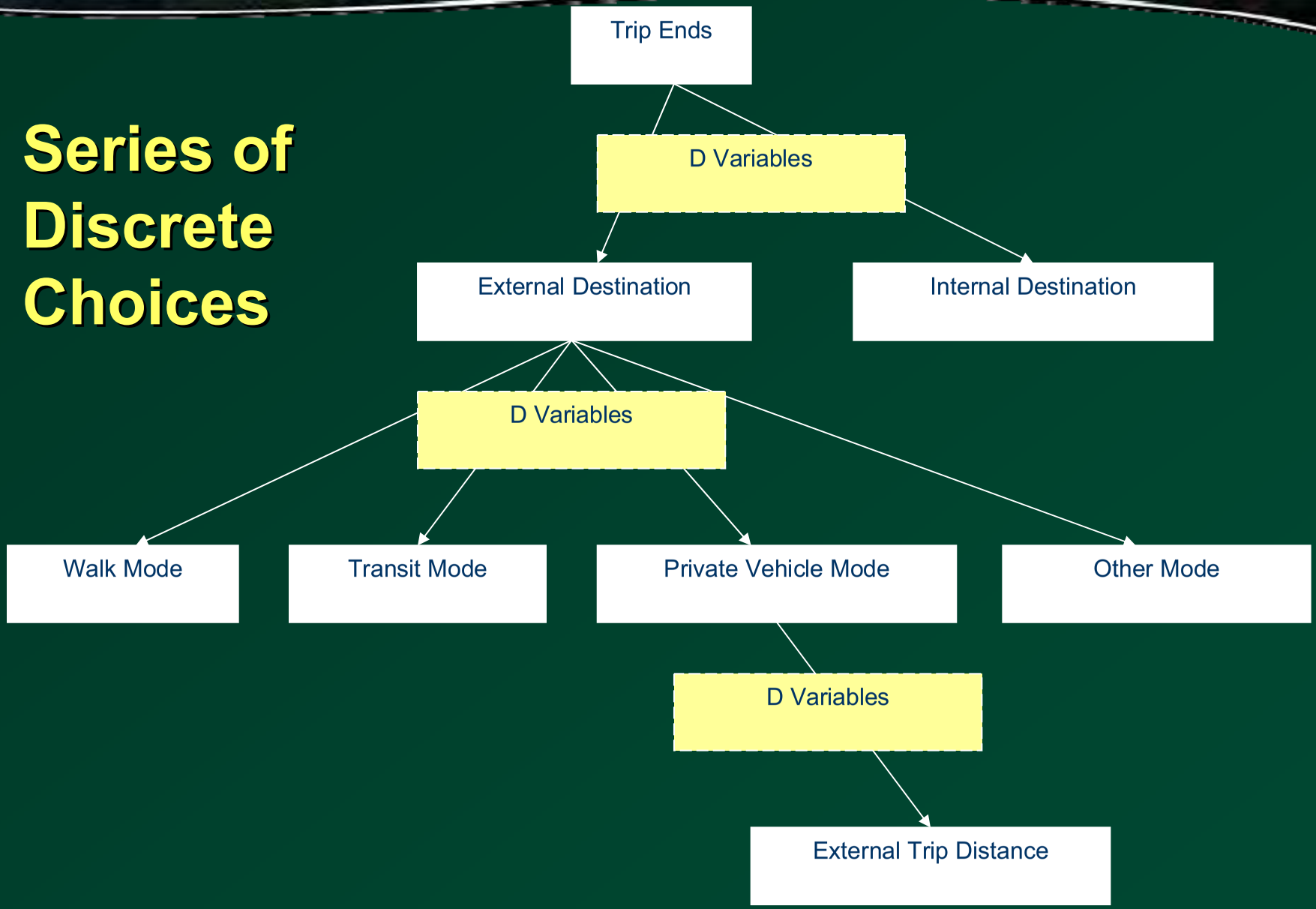
FEHR & PEERS
TRANSPORTATION CONSULTANTS

Hierarchical Modeling



FEHR & PEERS
TRANSPORTATION CONSULTANTS

Series of Discrete Choices



FEHR & PEERS
TRANSPORTATION CONSULTANTS

Log odds of internal capture

	Home-Based Work			Home-Based Other			Non-Home Based		
	coeff	t-ratio	p-value	coeff	t-ratio	p-value	coeff	t-ratio	p-value
constant	-3.62			-2.68			-1.87		
EMP							0.208	3.28	0.002
AREA				0.486	3.61	0.001	0.468	4.58	<0.001
JOBPOP	0.389	2.62	0.010	0.399	4.55	<0.001			
INTDEN				0.385	1.92	0.055	0.638	4.95	<0.001
HHSIZE	-1.33	-6.03	<0.001	-0.867	-13.0	<0.001	-0.237	-4.54	<0.001
VEHCAP	-0.990	-4.15	<0.001	-0.590	-8.19	<0.001	-0.163	-3.00	0.003
pseudo-R2	0.09			0.25			0.27		

FEHR & PEERS
TRANSPORTATION CONSULTANTS

Log odds of walking on external trips

	Home-Based Work			Home-Based Other			Non-Home Based		
	coeff	t-ratio	p-value	coeff	t-ratio	p-value	coeff	t-ratio	p-value
constant	-3.98			-3.41			-3.63		
AREA				-0.415	-4.27	<0.001			
ACTDEN				0.370	2.74	0.007	0.377	3.12	0.003
JOBPOP	0.226	2.46	0.015	0.219	3.83	<0.001			
INTDEN							0.803	5.05	<0.001
EMPMILE	0.385	3.12	0.002	0.450	5.05	<0.001	0.440	5.09	<0.001
HHSIZE	-1.57	-6.29	<0.001	-0.486	-5.05	<0.001	-0.281	-2.59	0.010
VEHCAP	-1.84	-7.00	<0.001	-0.768	-7.62	<0.001	-0.242	-2.13	0.033
pseudo-R2	0.11			0.58			0.69		

FEHR & PEERS
TRANSPORTATION CONSULTANTS

Log odds of using transit on external trips

	Home-Based Work			Home-Based Other			Non-Home Based		
	coeff	t-ratio	p-value	coeff	t-ratio	p-value	coeff	t-ratio	p-value
constant	-4.32			-5.20			-4.40		
INTDEN	1.12	4.55	<0.001						
EMP30T	0.238	3.84	0.043	0.266	3.80	<0.001	0.249	4.29	<0.001
HHSIZE	-1.14	-6.30	<0.001	-1.00	-8.45	<0.001			
VEHCAP	-1.67	-8.56	<0.001	-1.06	-8.24	<0.001	-0.276	-2.90	0.004
BUSSTOP	0.336	1.99	0.046	0.510	4.31	<0.001			
pseudo-R2	0.17			0.15			0.05		

FEHR & PEERS
TRANSPORTATION CONSULTANTS

Log distance of external automobile trips

	Home-Based Work			Home-Based Other			Non-Home Based		
	coeff	t-ratio	p-value	coeff	t-ratio	p-value	coeff	t-ratio	p-value
constant	1.77			1.37			1.43		
AREA	0.104	2.15	0.032						
JOBPOP	-0.0533	-2.55	0.012	-0.050	-2.74	0.007	-.0302	-1.94	0.053
INTDEN				-0.112	-2.13	0.034	-0.209	-4.48	<0.001
EMP10A							-0.0802	-5.13	<0.001
EMP20A				-0.0723	-3.93	<0.001			
EMP30A	-0.108	-4.20	<0.001						
HHSIZE	0.257	5.98	<0.001	0.115	4.93	<0.001	0.0931	3.20	0.002
VEHCAP	0.350	7.31	<0.001	0.270	11.0	<0.001	0.148	4.96	<0.001
pseudo-R2	0.04			0.05			0.05		

FEHR & PEERS
TRANSPORTATION CONSULTANTS

16 Nationwide Validation Sites

6 Florida sites from ITE *Trip Generation Handbook*

1 Central Florida site

1 Georgia site

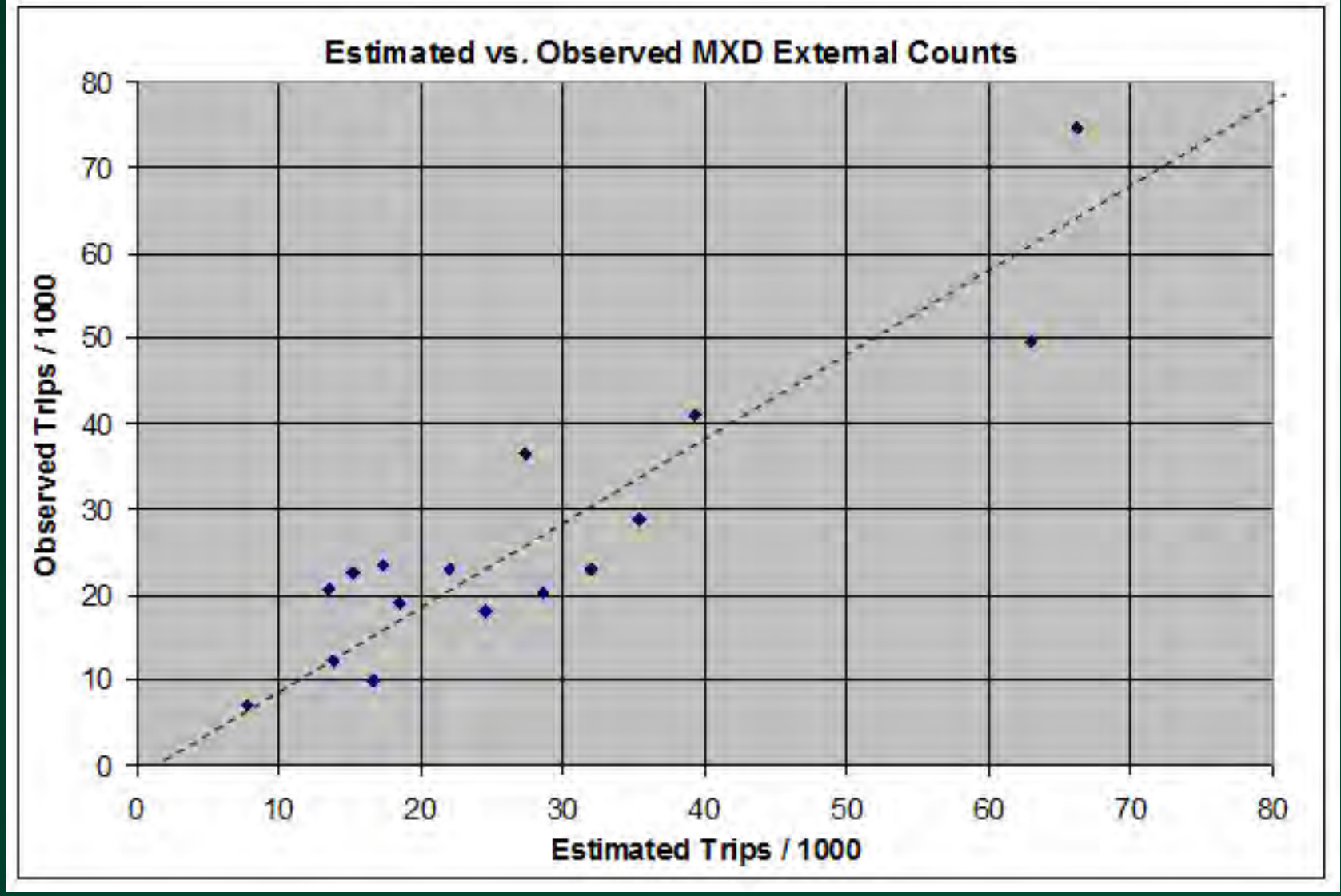
6 California sites

2 Texas sites

Prelim data from 3 sites in Texas and Georgia from NCHRP 8-51


FEHR & PEERS
TRANSPORTATION CONSULTANTS
Improving Communities
Since 1985
Gateway Oaks
© 2005 AE, LLC
© 2005 GDT, Inc

FEHR & PEERS
TRANSPORTATION CONSULTANTS



FEHR & PEERS
TRANSPORTATION CONSULTANTS

Site	ITE Gross	ITE Net	MXD Models
1	42%	25%	23%
2	7%	-4%	-4%
3	-27%	-38%	-32%
4	92%	82%	70%
5	54%	35%	39%
6	-16%	-19%	-26%
7	-14%	-22%	-25%
8	77%	50%	42%
9	31%	20%	14%
10	-19%	-26%	-35%
11	60%	49%	27%
12	10%	4%	-3%
13	10%	-5%	-11%
14	22%	17%	9%
15	45%	31%	35%
16	21%	17%	-4%
RMSE	40%	32%	26%
R^2	0.58	0.73	0.82

FEHR & PEERS
TRANSPORTATION CONSULTANTS

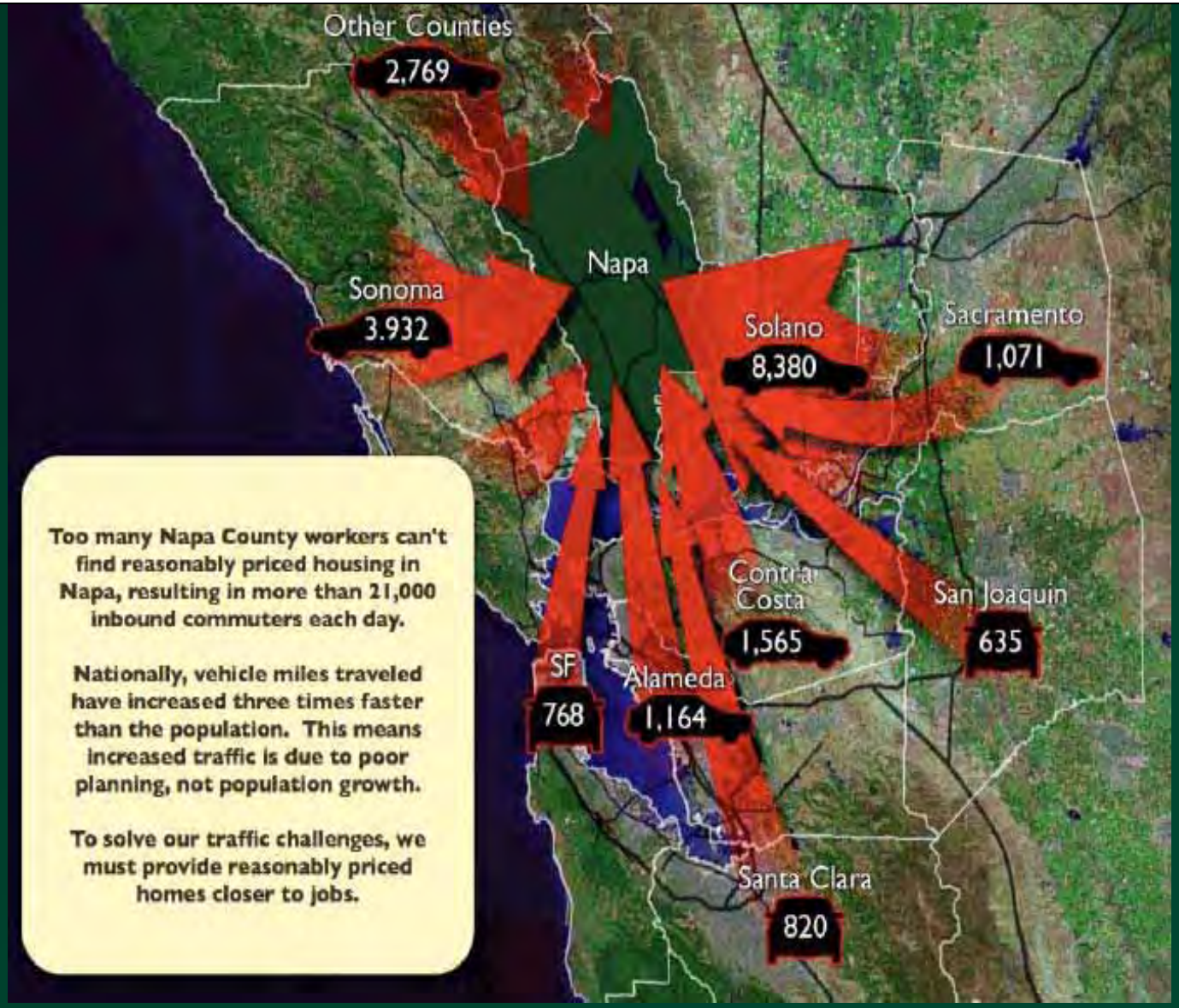
Primary Determinants of Reduction in External Auto Trips

- The total and the relative amounts of population and employment on the site
- The site size and activity density
- The size of households and their auto ownership
- The amount of employment within walking distance of the site
- The pedestrian-friendliness of the site (small block size)
- The access to employment within a 30 minute transit ride of the site.

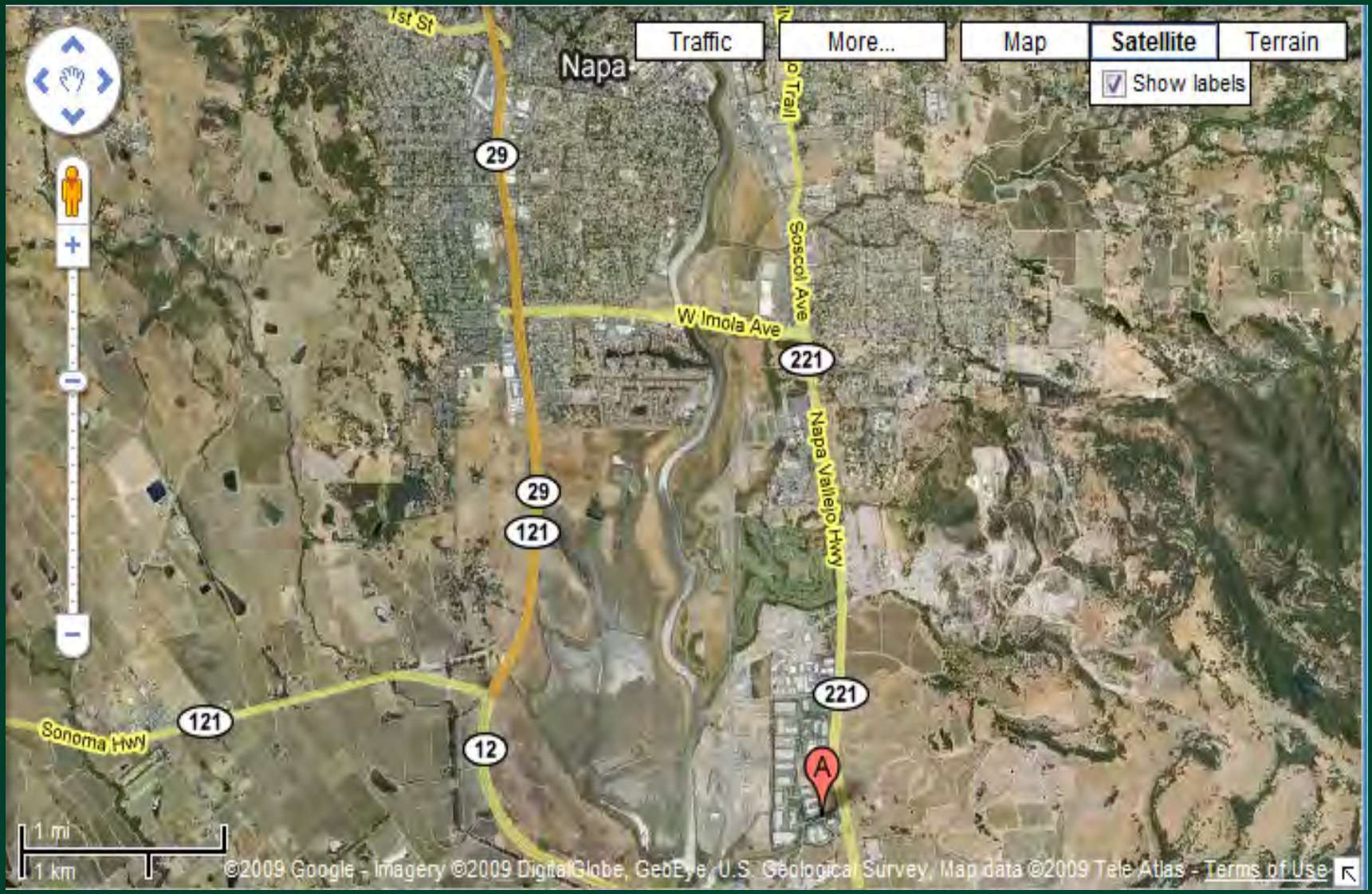
FEHR & PEERS
TRANSPORTATION CONSULTANTS

Napa Pipe Development Project

Affordable Housing in Job Rich Napa County

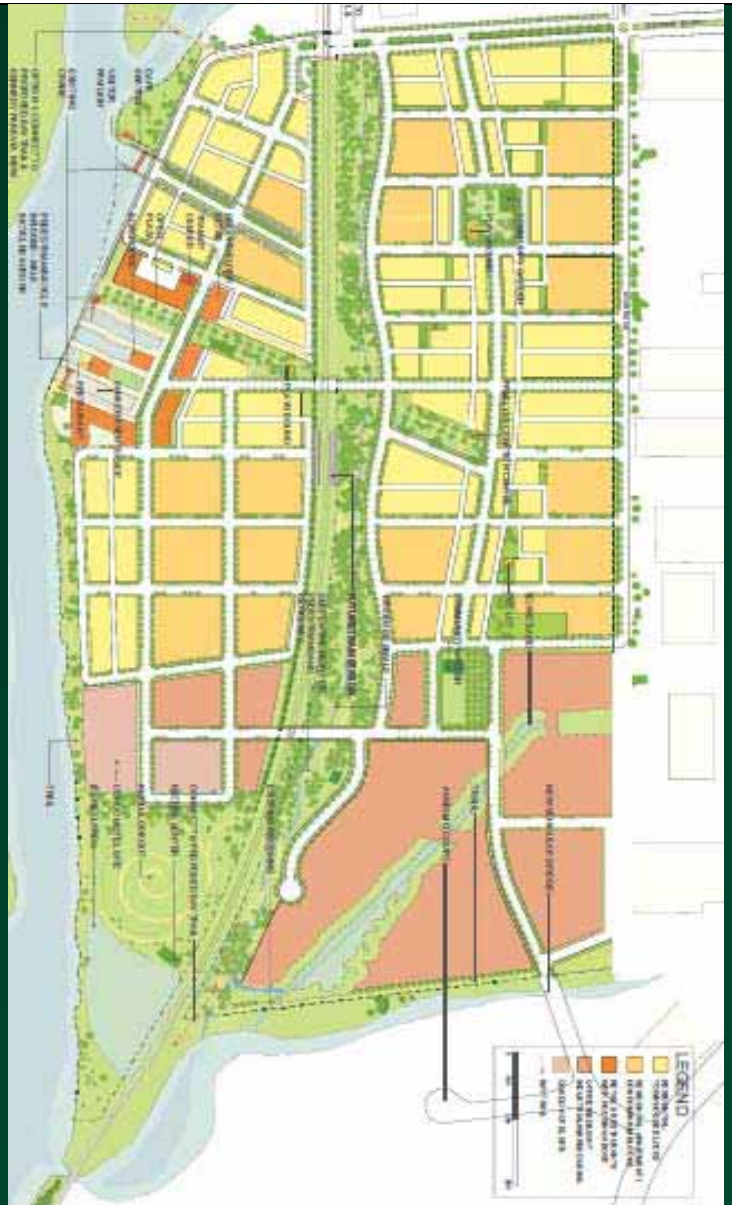


Local Context

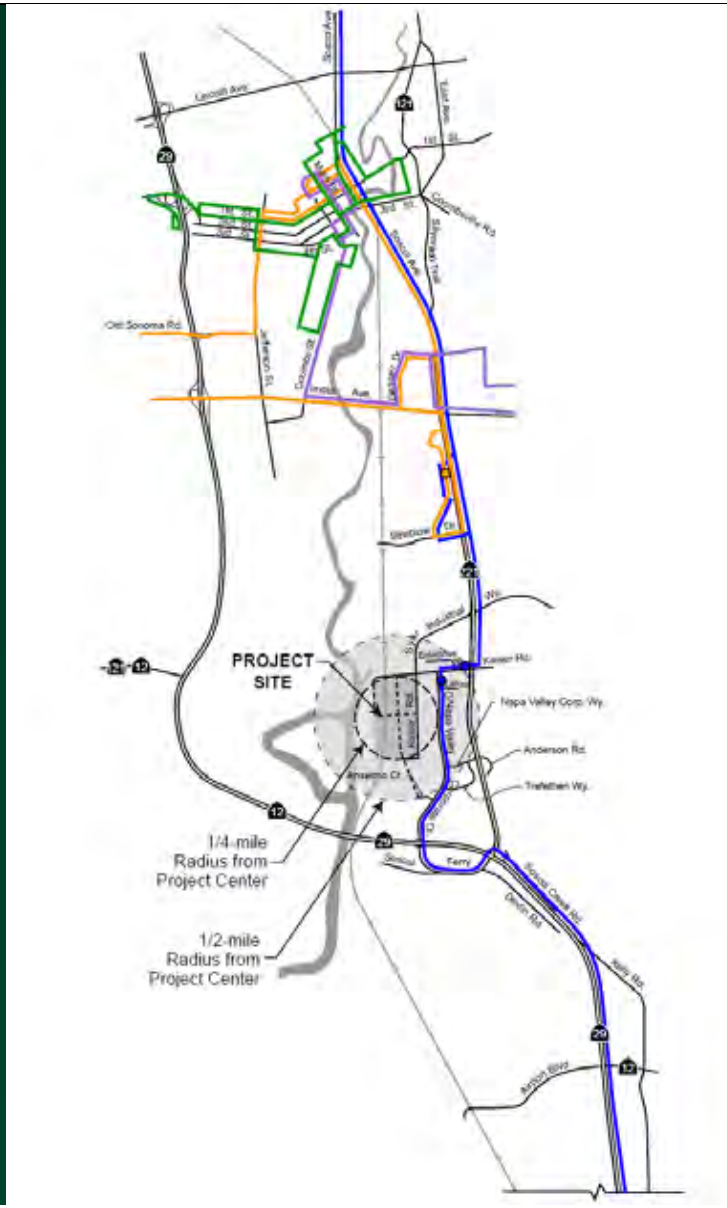


Existing Conditions

Site Plan



Transit Service



FEHR & PEERS
TRANSPORTATION CONSULTANTS

Trip Reduction Comparison

3.6% vs. 6.9%

FEHR & PEERS
TRANSPORTATION CONSULTANTS

Next Steps

Appendix E: 8/26/09 meeting materials

- **Meeting Agenda**
- **Meeting Attendance**
- **Presentation: *Demonstration of the Mixed Use "MXD" model-* Dan Blevins, WILMAPCO**

Wilmington Area Planning Council

850 Library Avenue, Suite 100
Newark, Delaware 19711
302-737-6205; Fax 302-737-9584
From Cecil County: 888-808-7088
e-mail: wilmapco@wilmapco.org
web site: www.wilmapco.org

Memorandum

Date: August 24, 2009

Re: 8/26/09 TMA/Mixed Use Meeting Agenda

Traffic Mitigation Agreements for Mixed Use Development Working Group Meeting

Where: WILMAPCO Conference Room

When: Wednesday, August 26th, 2009 9-11am

Agenda

1. **Presentation and demonstration of the mixed use "MXD" model:** WILMAPCO staff will present the beta-version of the MXD model developed by Fehr & Peers. Staff will also give a demonstration on how the model operates.

2. **Update on effort by New Castle County to enhance mixed-use development though the UDC**

3. **General discussion on next steps of TMA/Mixed-Use working group**

4. **Next meeting date**

8/26/09 Mixed-Use/TMA meeting attendance

Attendees:
Jerry Heisler - The Reybold Group
Ted Bishop – DelDOT
Dan Lacombe - DelDOT
Angelina Micheva – NCCCC
Bill Osborne – TMA Delaware
Tigist Zegeye – WILMAPCO
Wayne Henderson - DTC
Dan Blevins – WILMAPCO

Preliminary Results
MXD Model
6.10.2009

Agenda

- Summary of Model
- Model Inputs
- Data Needs
- Outputs
- Comparison to TIS/TOA counts

Background

Effort to create a more detailed analysis of the impacts of Mixed Use Developments

Background

Effort to create a more detailed analysis of the impacts of Mixed Use Developments

Limitations of Current ITE Multi-Use Development Method (Chapter 7 of Trip Generation Handbook)

- Based on only three sites in Florida
- Covers only three land use types
- Scale of development disregarded
- Land use context disregarded
- Possibility of mode shifts disregarded
- Length of external trips disregarded

Background

Approach of EPA MXD Model

- Meta-analysis of recent research (more than 150 studies)
- 7D analysis of regional travel survey data
- Pooled household travel data for MXDs in six diverse regions
- Identified 239 MXDs through a bottom-up survey process
- Included internal capture, mode choice for external trips, and trip length as travel outcome measures
- Estimated large number of 7D variables consistently across regions
- Modeled travel relationships hierarchically

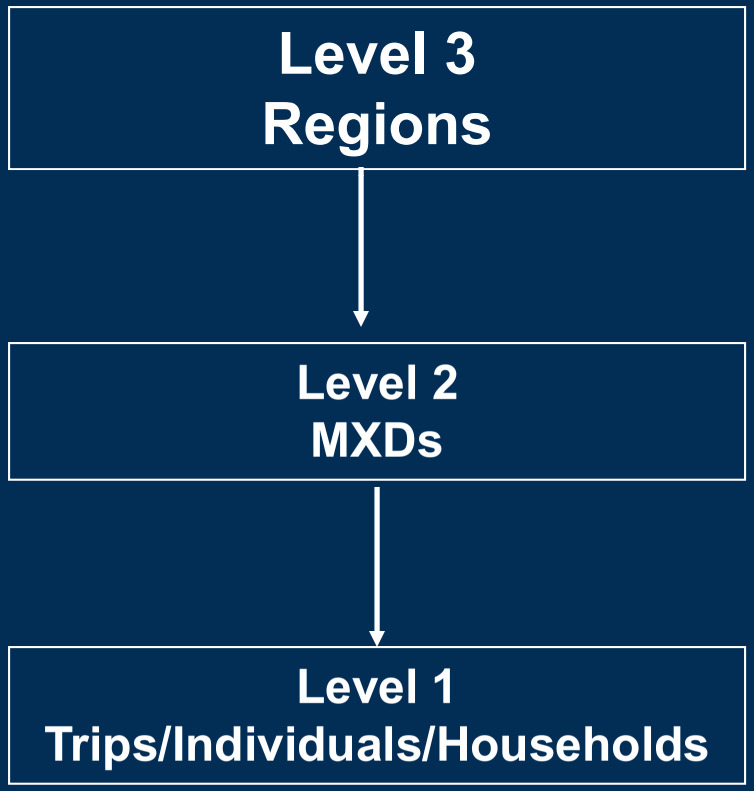
Background

7D variables consistently defined

Density
Diversity
Design
Destination Accessibility
Distance to Transit
Development Scale
Demographics

Background

Uses Hierarchical Modeling



Background

Data Validated from 16 Nationwide Sites

6 Florida sites from ITE *Trip Generation Handbook*
1 Central Florida site
1 Georgia site
6 California sites
2 Texas sites
Prelim data from 3 sites in TX and GA from NCHRP 8-51

On average, for the 16 validation sites Percent Difference in **Daily** Trip Generation Comparing Each Estimation Method with Actual Traffic Counts

Calculation Method	Avg. Deviation
ITE *Trip Generation* Manual (8th Edition) Unadjusted	25%
Trip Generation (8th) Adjusted Using Method *From Trip Generation Handbook* (2004)	14%
Trip Generation (8th) Adjusted Using MXD Models	7%

Background

The MXD method is recommended for sites ranging from about 5 acres to sites about 2000 acres.

The results indicate that the external traffic generation of an MXD is directly related to the following development characteristics:

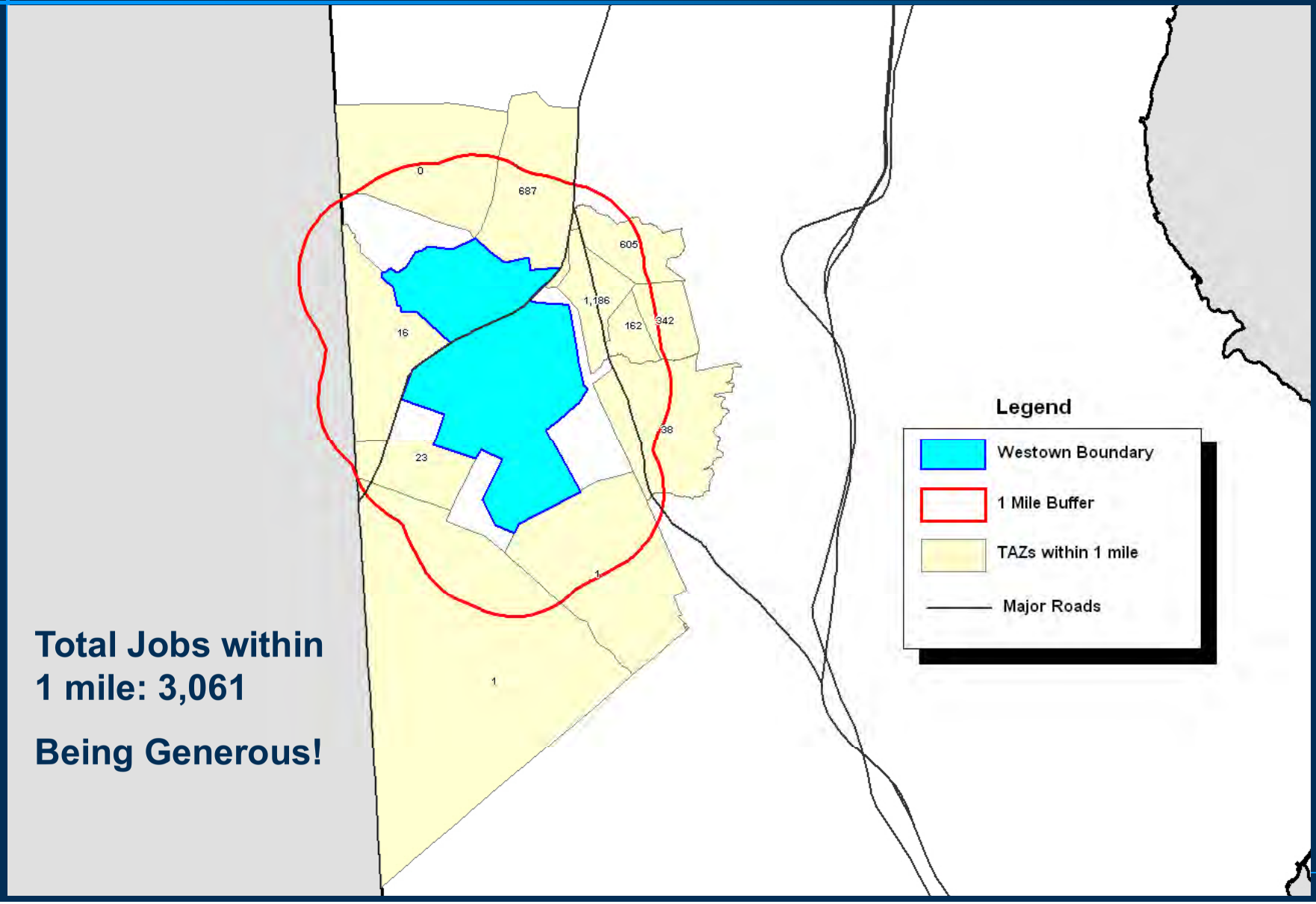
- The size of the site and its total employment
- The jobs / housing balance within the site
- The balance between housing and supporting retail within the site
- The density of development on the site
- The size of households and their auto ownership characteristics
- The amount of employment within walking distance of the site
- The pedestrian-friendliness of the site (small blocks and sidewalks)
- The level of transit service, measured as the employment within a 30 minute transit ride of the site

Site/Local/Regional Demographics

MIXED USE TRIP GENERATION MODEL		Notes / Instructions
Site Name	Average Site	
Geographic		
Area (in acres)	2500	
Number of Intersections	33	Count intersections either within or on the perimeter of the MXD. Do not count driveways.
Number of bus stops	1	Count bus stops either within or on the perimeter of the MXD
Number of rail stops	0	Count rail stops either within or on the perimeter of the MXD
		Note: Bus Stops and rail stops are not in the models, but zero out transit probability if they
Land Use - Surrounding Area		
MPO Type	3	Enter 1 if the MPO has a population of < 200K, 2 if 200-500K, 3 if 500-1000K, 4 if >1000K
Is the site in a Central Business District?	No	
Employment within one mile of the MXD	3,061	Do not include employment within the MXD itself
Employment within a 30 minute Transit Trip	4,598	If deriving from a model, can either include or not include employment within the MXD itse
Site Demographics		
Enter Population Directly?	Yes	If "No", will apply average HH size factors (on global input tab) to dwelling units below
Population	8300	Enter Population Here. You still need to enter dwelling units below.
Retail / Office / Industrial Data in Terms of Jobs or 1000 Square Feet (ksf)?	ksf	If "ksf", will apply average jobs per ksf factors (on global input tab) to ksf below
Average Vehicles Owned per Dwelling Unit	2.15	For guidance, one can look up Census 2000 Summary File 3 block group data for the closest block group to the site, at the URL indicated to the right, choosing table H44 when it prompts you for a table:
Enter Average Household Size Directly?	Yes	If "No", will apply average HH size factors (on global input tab) to dwelling units below
Average Household Size	2.93	Enter Average Household Size Here. You still need to enter dwelling units below.

Areas in YELLOW are user inputs!

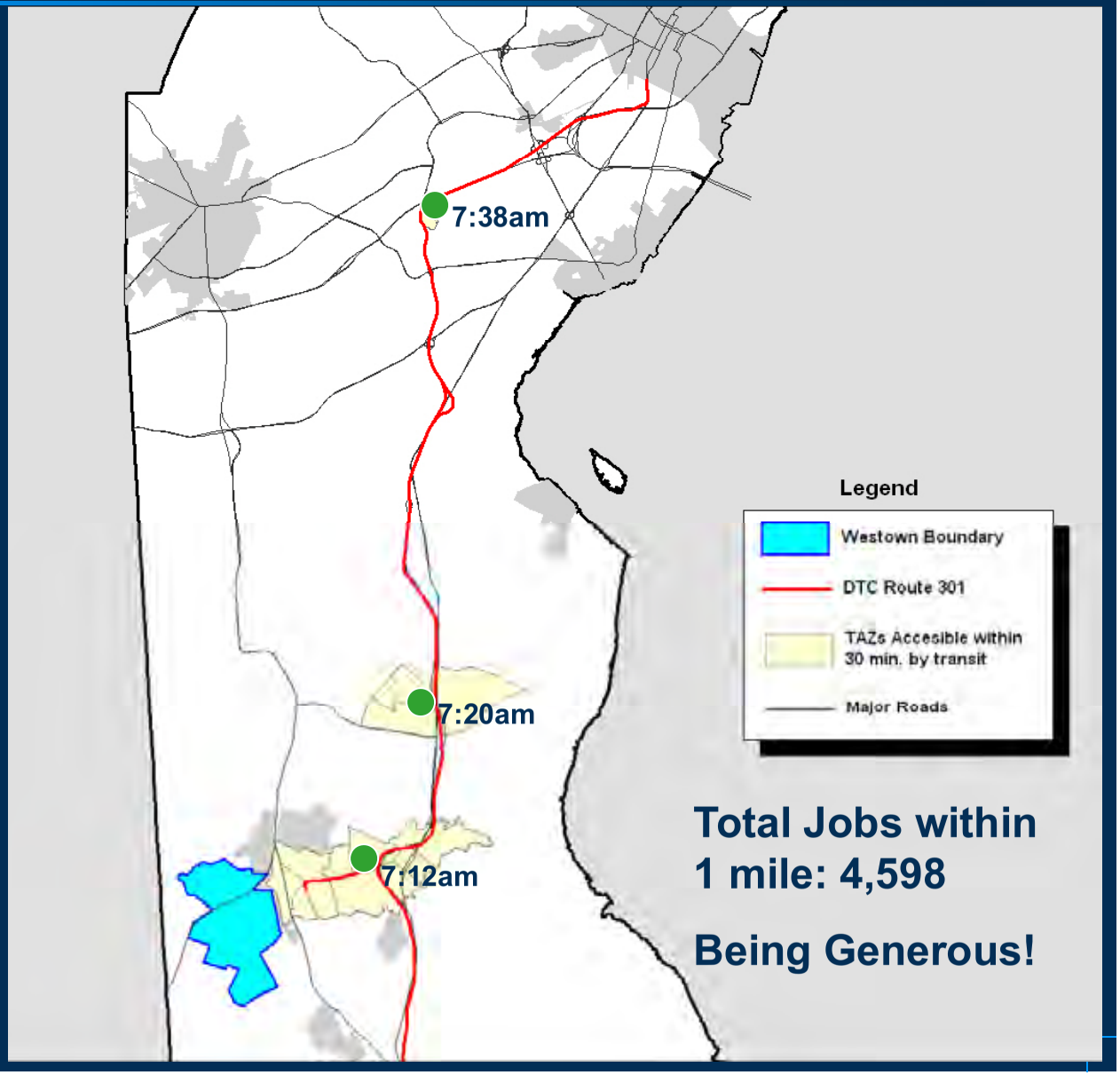
Site/Local/Regional Demographics



Total Jobs within 1 mile: 3,061

Being Generous!

Site/Local/Regional Demographics



Trip Generation Inputs by site

Land Use - for site ITE Calcs			Trip Equation Method	Total Trips
Number of Dwelling Units	Total Units			
Single Family	2,537		3	20,366
Multi-Family	700		2	4,357
High Rise Condo	0		2	0
Retail Floor Space (ksf)	Sq. Ft			
General Retail other than those listed below	2,615		3	56,662
Supermarket	0		2	0
Bank	17		2	3,320
Health Club	0		1	0
Restaurant (non-fast food)	63		1	7,998
Fast-Food Restaurant	21		1	10,220
Gas Station	0		1	0
Auto Repair	0		1	0
Office Floor Space (ksf)	Sq. Ft			
Non-Medical	1,031		3	8,042
Medical	153		1	5,528
Industrial Floor Space (ksf)	Sq. Ft			
Light Industrial	1,247		2	9,213
Manufacturing	20		2	56
Warehousing	724		3	1,756
Other				
Hotel Rooms	225		2	1,641
Movie Screens	2		1	585
School Enrollment				
Grade School	400		1	516
High School	700		3	1,295
College	400		2	1,332
	Amount	Units		Trips
Land uses not covered above ==>		Jobs		0

ITE Daily Parameters - rates for retail / office / industrial are per ksf

Code	Average Rate	Linear Multiplier	Linear Constant	Log Multipler	Log Constant
210	9.57			0.92	2.71
220	6.72	6.01	150.35		
232	4.18	3.77	223.66		
820	42.94			0.65	5.83
850	102.24	66.95	1391.56		
912	246.49	182.34	256.87		
492	32.93				
932	127.15				
934	496.12				
945	162.78				
942	31.6				
710	11.01			0.77	3.65
720	36.13				
110	6.97	7.47	-101.92		
140	3.82	3.88	-20.7		
151	2.5			1.01	0.82
310	8.17	8.95	-373.16		
445	292.5				
520	1.29				
530	1.71			0.81	1.86
550	2.38	2.23	440		

Areas in YELLOW are user inputs!

Trip Distribution Calculations

Land Use % Trips by Purpose										
Residential Production Rate	8.7									
		Productions			Attractions			Total		
	Amount	HBW	HBO	NHB	HBW	HBO	NHB	HBW	HBO	NHB
Dwelling Units	3,237	6,196	15,771		0	2,913	1,619	6,196	18,684	1,619
Retail Emp CBD	0	0	0	0	0	0	0	0	0	0
Retail Emp Non-CBD	5,431	0	0	11,133	7,874	48,875	11,133	7,874	48,875	22,265
Service Emp (Office)	3,552	0	0	2,131	5,150	6,038	2,131	5,150	6,038	4,262
Other Emp (Incl. Industrial)	4,657	0	0	1,164	6,752	2,328	1,164	6,752	2,328	2,328
Total		6,196	15,771	14,428	19,777	60,155	16,047	25,972	75,926	30,475
MXD Total Population	8,300									
MXD Total Employment	5,000									
Trip Purpose Distribution for Project Site	Number of Raw ITE Trips						Percentages			
	All Purposes		HBW	HBO	NHB		HBW	HBO	NHB	
Daily	132,888		26,073	76,221	30,593		19.6%	57.4%	23.0%	
AM Peak Hour	8,504		3,966	3,979	560		46.6%	46.8%	6.6%	
PM Peak Hour	11,519		2,912	5,496	3,111		25.3%	47.7%	27.0%	

RK&K Current Estimate: 136,000

“Adjustable” Global Inputs

Average HH Sizes		
	Single Family	3.0
	Multi-Family	2.2
	High Rise Condo	2.2
Jobs per ksf		
	Retail	2.0
	Office	3.0
	Light Industrial	2.3
	Manufacturing	0.5
	Warehousing	2.0
	Misc. Uses	2.0
Jobs from ITE rates per other unit		
Jobs per Hotel Room		0.50
Jobs per Movie Screen		4.00
Grade School Jobs per student		0.10
High School Jobs per Student		0.10
College Jobs per student		0.25

Edited to match Census Data (2000)

Model Defaults

Results Page

Trip Reduction By Purpose	Daily			AM Peak Hour			PM Peak Hour		
	HBW	HBO	NHB	HBW	HBO	NHB	HBW	HBO	NHB
Number of "Raw" ITE Trips	26,547	79,793	26,548	4,038	4,165	486	2,965	5,753	2,700
Predicted Probabilities:									
Internal Capture	2.51%	8.24%	10.49%	2.51%	8.24%	10.49%	2.51%	8.24%	10.49%
Walking External	0.94%	0.39%	0.07%	0.94%	0.39%	0.07%	0.94%	0.39%	0.07%
Transit External	0.03%	0.57%	1.23%	0.03%	0.57%	1.23%	0.03%	0.57%	1.23%
Number of Trips:									
Internal Capture	666	6,578	2,785	101	343	51	74	474	283
Walking External	244	284	17	37	15	0	27	20	2
Transit External	7	415	292	1	22	5	1	30	30
Net Number of External Vehicle Trips	**25,630**	**72,515**	**23,453**	**3,898**	**3,785**	**429**	**2,863**	**5,228**	**2,385**

Results	Raw Trips	Net Trips	Reduction %	Internal	Walk	Transit
Daily	**132,888**	**121,599**	**8.5%**	**7.5%**	**0.4%**	**0.5%**
AM Peak Hour	**8,689**	**8,113**	**6.6%**	**5.7%**	**0.6%**	**0.3%**
PM Peak Hour	**11,418**	**10,476**	**8.2%**	**7.3%**	**0.4%**	**0.5%**

Comparison to 2005 McCormick-Taylor Report:

McCormick Taylor:
AM – 0??? out of 8,561 AM trips

PM – 1,192 (8% of PM trips)
out of 14,895 PM trips

MXD Model:
AM – 576 (6.6% of AM trips)
out of 8,689 PM trips

PM – 942 (8.2% of AM trips)
out of 11,418 PM trips

Appendix F: 2/17/10 meeting materials

- **Meeting Agenda**
- **Meeting attendance**
- **Presentation: *"Evaluation of NCHRP 8-51 and EPA Mixed Use Development Internal Trip Capture Models"* - Bill Brockenbrough/Troy Brestel, DelDOT**

Wilmington Area Planning Council

850 Library Avenue, Suite 100
Newark, Delaware 19711
302-737-6205; Fax 302-737-9584
From Cecil County: 888-808-7088
e-mail: wilmapco@wilmapco.org
web site: www.wilmapco.org

Memorandum

Date: May 26, 2010

Re: 2/17/10 TMA/Mixed Use Meeting Agenda

Traffic Mitigation Agreements for Mixed Use Development Working Group Meeting

Where: WILMAPCO Conference Room

When: Wednesday, February 17th, 2010 9-11am

Agenda

1. **Presentation and comparison of the MXD & ITE models for assessing impacts of mixed-use development:**
   DelDOT staff will present their findings of comparing the MXD model developed by Fehr & Peers vs. the model developed through ITE study 08-51.

2. **General discussion on next steps of TMA/Mixed-Use working group**

3. **Next meeting date (March/April?)**

2/17/10 Mixed-Use/TMA meeting attendance

Attendees:
Ted Bishop – DelDOT
Angelina Micheva – NCCCC
Bill Osborne – TMA Delaware
Tigist Zegeye – WILMAPCO
Wayne Henderson - DTC
Dan Blevins – WILMAPCO