TRIP GENERATION FOR SMART GROWTH

PLANNING TOOLS FOR THE SAN DIEGO REGION

June 2010

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INTRODUCTION AND STUDY FINDINGS

BACKGROUND

Smart growth developments are generally perceived to generate fewer vehicle trips and less demand for parking as compared to conventional suburban developments due to an increased number of trips via transit, walking, or bicycling. However, there has been a lack of empirical data to demonstrate this in the San Diego region. Current trip generation and parking supply guidelines are based on conventional suburban development, perhaps imposing a burden on developers and jurisdictions to provide more roadway and parking capacity than is necessary in smart growth environments. Application of identified trip generation and parking demand rates appropriate for smart growth development could result in cost savings for jurisdictions, developers, homebuyers, and renters.

SANDAG'S *Regional Comprehensive Plan* (RCP), adopted in 2004, offers a vision for change in the San Diego region that strongly emphasizes sustainability and smart growth. *Trip Generation for Smart Growth: Planning Tools for the San Diego Region* is called for as a strategic initiative of the RCP and is a component of the SANDAG Smart Growth Toolbox; it is intended to be a resource for local agencies as they implement smart growth development.

The results of the study are intended to provide a richer, more accurate accounting of vehicle trip reduction associated with mixed-use and transit-oriented development (TOD) in smart growth environments, compared to current local and national methods of calculating trip generation. This information is intended to supplement data in the *San Diego Traffic Generators Manual*, published by SANDAG in 2000, and the accompanying *Not-so-Brief-Guide to Trip Generation*, published by SANDAG in 2002. Whereas the *Not-so-Brief-Guide* suggests application of generic vehicle trip reductions of 5 percent for locations within one-quarter mile of transit and 10 percent for mixed-use, the method outlined in this study accounts for the uniqueness of each smart growth development site and proposes reductions based on the specific context in which each site is situated.

STUDY CONTENTS

This study presents an overview of a mixed-use development trip generation method (Mixed-Use Method) recently developed by a team led by Fehr & Peers to improve vehicle trip generation forecasts for mixed-use developments. This method was applied to a series of smart growth sites in the San Diego area. The results are presented in this study.

This study is accompanied by a spreadsheet tool designed for estimation of trip generation in smart growth settings. The spreadsheet tool applies the Mixed-Use Method described within this study. The spreadsheet tool, as well as the study, are available as a resource for local jurisdictions if they choose to use it. Local jurisdictions are under no obligation to use the tool or the study in their development approval processes.

STUDY FINDINGS

The study found that at both the site level and at the Smart Growth Opportunity Area (SGOA) level, reductions in vehicle trips were observed for smart growth development, relative to the number of trips that would be expected to occur in typical suburban developments. These findings suggest that trip generation will generally be overestimated at smart growth developments if appropriate trip reductions are not included in the calculations.

The study also identified and validated a method to account for the amounts of trip reduction attributable to smart growth development forms. This Mixed Use Method, initially developed for the United States Environmental Protection Agency (EPA) and the Institute of Transportation Engineers, accounts for the degree to which mixed-use sites internally capture travel and the extent to which smart growth site design and context result in walking, biking, and transit use. The study validated the Mixed-Use Method for use within the San Diego region by comparing the method's trip generation estimates to actual travel data from twenty of the region's SGOAs and six smaller mixed-use/transit-oriented development (TOD) sites.

It should be noted that use of this method was validated with data collected at sixteen smart growth sites nationwide, as well as with data from the sites in the San Diego region mentioned above. At the time of printing, smart growth sites suitable for data collection could not be identified in the rural, coastal, and North County areas of the region. Further data collection in a variety of smart growth settings throughout the region would help to enhance understanding about trip generation in smart growth areas, particularly among coastal communities where smart growth development takes place, and in those SGOAs designated as Rural Villages.

The Method represents a dramatic improvement over current methods of estimating trip generation for smart growth developments. The method produces reliable, though still somewhat conservative, estimates of trip generation that are highly sensitive to the context of any given development. Specifically, the trip generation method accounts for the degree to which a development can be considered "smart growth," by measuring discrete characteristics of that site such as nearby transit frequency and level of service, walkability, development density, and mix of uses. In contrast, the *San Diego Traffic Generators Manual* currently recommends generic, across-the-board trip reduction percentages of 5% for location within ¼ mile of transit, and 10% for mixed use – regardless of the frequency or level of service of the nearby transit, density, and walkability of the site in question.

THE MIXED-USE METHOD: CALCULATING TRIP GENERATION FOR SMART GROWTH SETTINGS

BACKGROUND

Development that integrates multiple land use types on a single site has become increasingly common. However, the data presented in The Institute of Transportation Engineers (ITE's) *Trip Generation* informational report and in the *San Diego Traffic Generators Manual* is primarily collected at single-use, free-standing sites. This defining characteristic limits the applicability of these "standard" trip rates to mixed-use or multi-use development projects and smart growth environments. While the number of person trips generated by individual uses may be similar to free-standing sites, the potential for interaction among on-site activities can significantly reduce the total number of vehicle trips. Additionally, mixed-use projects located in areas with a variety of nearby destinations and high-quality transit access will produce fewer vehicle trips due to a larger share of trips entering and exiting the site on foot, on bicycle, or by transit.

The SANDAG Smart Growth Concept Map provides a definition for smart growth in terms of its place type thresholds. These are as follow:

Place Type	Minimum Residential Target	Minimum Employment Target	Minimum Transit Service Characteristics
Metropolitan Center	75 du/ac	80 emp/ac	Commuter Rail/BRT
Urban Center	40 du/ac	50 emp/ac	Light Rail/Rapid Bus
Town Center	20 du/ac	30 emp/ac	Light Rail/Rapid Bus
Community Center	20 du/ac	N/A	High Frequency Local Bus w/in Transit Priority Areas
Rural Village	10.9 du/ac	N/A	N/A
Special Use Center	Optional	45 emp/ac	Light Rail/Rapid Bus
Mixed Use Transit Corridor	25 du/ac	N/A	High Frequency Local Bus

Development of the Mixed-Use Method

In order to provide a straightforward and empirically validated method of estimating vehicle trip generation at mixed-use developments, the United States EPA (under review by the ITE) sponsored a national study of the trip generation characteristics of multi-use sites. Travel survey data was gathered from 239 mixed-use developments (MXDs) in six major metropolitan regions, correlated with the characteristics of the sites and their surroundings, and validated through cordon traffic counts at 16 additional sites. The findings indicate that the amount of external traffic generated is affected by a wide variety of factors, each pertaining to one or more of the following "D" characteristics: density, diversity, design, destination accessibility, development scale, demographics, and distance to transit. It should be noted that the "D" characteristics are a simple way of summarizing the characteristics that influence trip generation in smart growth settings. The actual quantification of the "D" characteristics for the purpose of the Mixed-Use Method results in a richer set of variables with which to measure a development site. For instance, the variables listed in the "Probabilities" section below capture two characteristics that could be related back to the "D"s: walkability, and transit frequency and level of service. The following illustration demonstrates the relationship among these characteristics:

Characteristics	Corresponding "D"s	Quantified Variables (How to Measure the "D"s)
Walkability	Design	Intersection Density
Transit Frequency/ Level of Service	Destination Accessibility	Employment within a 30 minute transit trip

The "D" characteristics were related statistically to the vehicle trip reductions observed in these developments. Vehicle Trip reduction is defined as a percentage reduction that can be applied to trip generation estimates for individual land uses to account for trips internal to the site and trips taken to nearby sites by walking, bicycling, or by transit. The statistical relationships between the "D" characteristics and the trip reductions observed in the surveys produced equations, collectively known as the Mixed-Use Method, which allow the user to predict the vehicle trip reduction as a function of the D characteristics.

In practice, the Mixed-Use Method is implemented in two steps: first, one computes the theoretical vehicle counts in and out of the site from an external source of standard trip rates or equations (the product of this calculation is known as raw trips). Typically this source is the ITE *Trip Generation* informational report, but in this SANDAG-specific study, the source is the *San Diego Traffic Generators* manual. Then, one applies the predicted trip reduction percentage to the initial raw trips calculation to produce an estimate for the number of vehicle trips traveling in or out of the site.

Method Structure and Outputs

The Mixed-Use Method consists of four steps to achieve an estimate of daily vehicle trips on external roadways generated by the mixed-use development. The four steps and outputs are:

1. Compute daily trip estimates using standard rates or equations from an external source (raw trips). These estimates do not assume any internalization, and only minimal trips made by walking and/or transit modes.
2. Compute the probability of a trip staying internal to the mixed-use development.
3. Compute the probability an external trip will be made by walking or bicycling.
4. Compute the probability an external trip will be made by transit.

Mathematically, if we call the above probabilities generated in steps 2-4 above Pinternal, Pwalkbike, and Ptransit, respectively, the desired result of number of external vehicle trips generated by mixed-use/TOD is illustrated in the following equation:

External Vehicle Trips Generated by Mixed-Use/TOD Development =
Raw Trips * (1 – Pinternal) * (1 – Pwalkbike – Ptransit)

It should be noted that although the result of the above equation (the net number of external vehicle trips) has been formally validated, the component probabilities have not, largely due to lack of data for validation.

Probabilities: Accounting for the "D" Characteristics in the Method

The three probability models (Pinternal, Pwalkbike, and Ptransit) depend on variables that are characteristics of the MXD, either input or calculated by the spreadsheet. Each of these variables provides a means of quantifying each of the "D" characteristics that influence trip generation in smart growth settings.

For example,

The variables for Pinternal are:

- Employment
- Land area
- Jobs/population diversity (a measure of land use balance)
- Number of intersections per square mile (a measure of walkability and connectedness among land uses)
- Average household size
- Vehicles owned per capita

The variables for Pwalkbike are:

- Land area
- Jobs/population diversity
- Retail jobs/population diversity
- Employment within one mile (walking distance)
- Population + employment per square mile
- Number of intersections per square mile

- Average household size
- Vehicles owned per capita

The variables for Ptransit are:

- Employment
- Number of intersections per square mile
- Employment within a 30-minute trip by transit
- Average household size
- Vehicles owned per capita

These variables are all examples of the "7Ds" that are known to influence travel behavior: density, diversity, design, destination accessibility, development scale, demographics, and distance to transit.

Mixed-Use Method Validation

In the initial validation of the Mixed-Use Method, a set of 16 independent mixed-use sites that were not included in the initial analysis were tested to help validate the method. Validation sites were comprised of mixed-use developments and areas ranging in size from approximately 5 acres to over 1,000 acres, located in diverse regions across the United States, including Florida, Northern and Southern California, Georgia, and Texas.

The validation tests produced two types of performance measures: root mean squared error (RMSE) and pseudo R-squared. RMSE is a measure of the percentage by which the trip generation estimates produced by the method deviate from the actual trip generation counted at each of the study sites. The lower the RMSE deviation, the more accurate is the prediction method. R-squared is a measure of how well the prediction method accounts for the degree of variation in trip generation from one site to another, with a value of 0.5 indicating an ability to explain 50 percent of the variation among cases and a value of 1.0 indicating a perfect ability to capture the variation in trips from one site to another.

Among the validation sites, use of the Mixed-Use Method produced a significantly better root mean squared error (RMSE) and pseudo-R squared than traditional methods when comparing estimated to observed external vehicle trips. Estimates from the ITE *Trip Generation* manual had an RMSE of 40 percent and pseudo-R squared of 0.58, and modified estimates using ITE's traditional trip internalization techniques had an RMSE of 32 percent and pseudo-R squared of 0.73. Estimates produced by the Mixed-Use Method had an RMSE of only 26 percent and pseudo-R squared of 0.82. This means that the Mixed-Use Method explains roughly 82 percent of the variation in trip generation among the 16 sites, with the remaining 18 percent attributable to variables not included in the method.

APPLICATION OF THE MIXED-USE METHOD FOR SAN DIEGO SITES

To ground-truth the Mixed-Use Method for use in the San Diego region, a series of tests were performed comparing the method's estimations with actual traffic count data from a number of sites within the region. This included comparisons at both large SGOAs and smaller mixed-use and TOD sites.

Study Areas

Smart Growth Opportunity Areas

The SANDAG Smart Growth Concept Map identifies a list of SGOAs classified into one of seven place types (Metropolitan Center, Urban Center, Town Center, Community Center, Rural Village, Mixed-Use Transit Corridor, and Special Use Center). Depending on whether the areas meet land use and transit service requirements for their place type, they are identified as either existing or potential SGOAs. SANDAG identified a list of 57 existing SGOAs to be studied in this analysis. These 57 SGOAs were chosen by virtue of having residential and employment densities on the ground that currently meet the prescribed thresholds for their place types.

Travel data for a representative group of SGOAs was compiled from the SANDAG 2006 *Regional Household Travel Behavior Survey*. The large size of the SGOAs, multiple access points, and potential for through trips made it unfeasible to count vehicle trip generation for these SGOAs explicitly. As a substitute for actual counts, data from the SANDAG 2006 *Regional Household Travel Behavior Survey* was used for these sites to generate comparisons for results obtained in the Mixed-Use Method. Of the 57 selected SGOAs, 20 were found to have enough trip records from the *Travel Behavior Survey* to be considered suitable for analysis (at least 100). These are discussed in more detail below under the heading "Analysis: SGOAs." Appendix B contains more detailed information about the SGOAs that had enough trip records in the survey data to be analyzed. Appendix D contains the data sources for the SGOA land use data.

Small Mixed-Use/TOD Sites

Six additional smaller mixed-use/TOD sites were identified for comparing the Mixed-Use Method estimates to actual counts of vehicles entering and exiting each site. The selected sites were:

- Station Village at Rio Vista Trolley Station, bounded by Camino Del Este, Rio San Diego Drive, Qualcomm Way, and the trolley tracks (residential and retail; trolley station and local bus)
- La Mesa Village Plaza, bounded by La Mesa Boulevard, Acacia Avenue, Orange Avenue, and the train tracks (residential, retail, and office; trolley station)
- The Uptown Center in the Hillcrest neighborhood, bound by University Avenue, Cleveland Avenue, Richmond Street, Washington Street, and SR-163 (residential and retail; high frequency local bus)
- The Village at Morena Linda Vista Trolley Station, bound by Morena Boulevard, Linda Vista Road, Napa Street, and the train tracks (residential and retail; trolley station)
- Hazard Center, bound by SR-163, Friars Road, Frazee Road, and Hazard Center Drive (retail and office; trolley station)

- Heritage Town Center at Otay Ranch in Chula Vista, bound by Santa Rita Street, Palomar Street, Santa Andrea Street, and the southern end of the parking lot, not including the houses on Fieldbrook Street (residential, retail, and medical office).

Appendix A shows a set of maps illustrating the sites' locations and the locations where traffic counts were taken.

Data Collection

Continuous 24-hour traffic counts were conducted at the six small mixed-use/TOD sites on typical midweek weekdays: Tuesday, Wednesday, or Thursday. Counts were conducted in October of 2008 for Otay Ranch, and in May and early June of 2009 (prior to the end of the K-12 school year) for all other sites at the site entrances shown in Appendix A.

Analysis: SGOAs

The Mixed-Use Method starts with a reliable local source of suburban single-use trip generation data, such as *San Diego Traffic Generators.* It then accounts for vehicle trip reductions attributable to the mix of land uses on the site, the development density, walking and transit options, and site context and regional accessibility. The resulting trip reduction percentage produces a predicted count of vehicles entering or exiting the site. The effectiveness of the method can be tested by comparing the observed counts to the method's prediction. For most of the SGOAs, obtaining traffic counts entering and exiting the areas was not feasible due to the inability to filter out through trips; however, it also is possible to test the trip reduction percentage itself. Data from the *SANDAG Regional Household Travel Behavior Survey* was used to collect observed trip reduction percentages, which could be compared to the Mixed-Use Method's predicted trip reduction percentages.

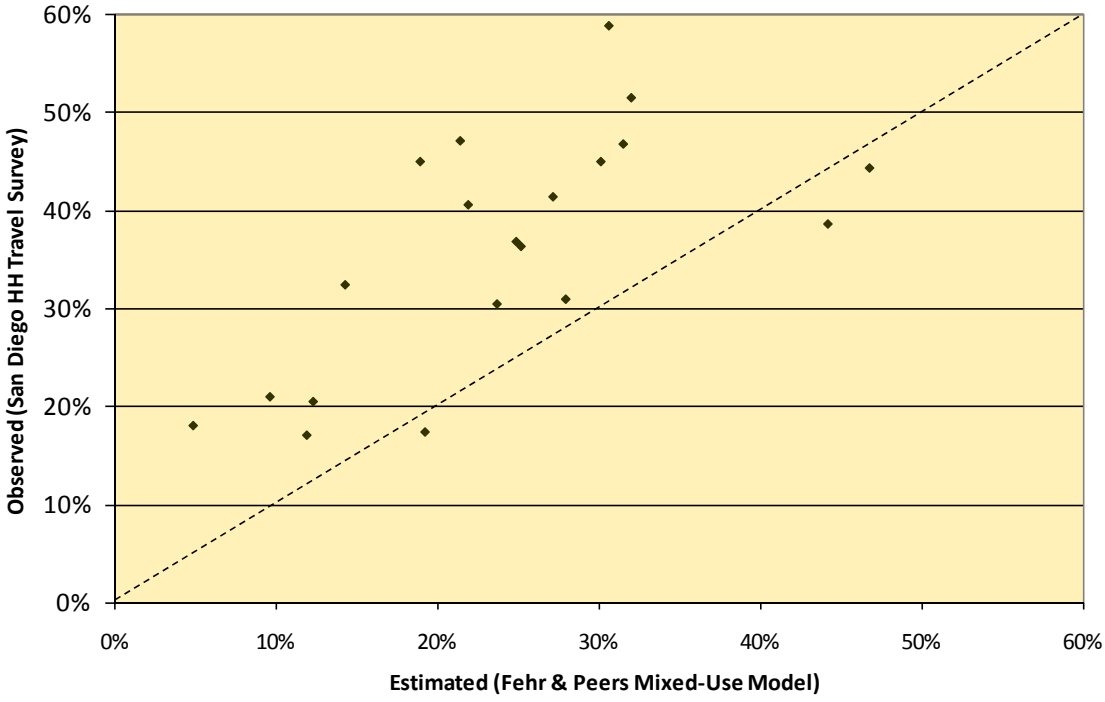
SANDAG staff provided Fehr & Peers with a data set of "flags" identifying which trips from the survey began and/or ended in one of the SGOAs. The trip data also included travel modes and party sizes. From this information, the total number of origins, destinations, and internalized trips (trips that begin and end in the same SGOA) by auto, walk, bicycle, and transit modes was computed for each SGOA. This was translated into observed values of PInternal, PWalkbike, and PTransit, as defined in the Mixed-Use Method Overview section above.

The analysis was performed for each of the 20 SGOAs that had at least 100 trips recorded in the survey. A cutoff of 100 trip records was chosen because in general, a sample size of between at least 30 to 40 is necessary for meaningful sample probabilities that are unlikely to vary significantly from their true values, and we are drawing three sample probabilities for each record (Pinternal, Pwalkbike, and Ptransit).

Figure 1 shows the estimated and observed trip reduction percentages for the 20 SGOAs. Vehicle trip reduction at the SGOA level averaged 24 percent relative to raw trip calculations and ranged from as high as 47 percent in downtown San Diego, to 32 percent in North Park/City Heights, and as low as 5 percent in Mira Mesa.

The dotted line represents an ideal model fit for comparison purposes. Overall, the Mixed-Use Method is a conservative predictor of trip reduction, underestimating trip reduction by about 10 percent on average, but the estimated and observed trip reductions are highly correlated.

Figure 1
Net Vehicle Trip Reduction for SGOAs With Greater Than 100 Survey Records



Analysis: Small Mixed-Use/TOD Sites With Counts

For the small mixed-use/TOD sites, preliminary estimates of site trip generation were calculated from *San Diego Traffic Generators* trip rates and site land uses. These estimates of raw trips use suburban trip generation rates for single use sites and do not consider the effects of mixed-use development or transit access. The Mixed-Use Method was applied to each site and the trip reduction percentages were applied to the raw trips to obtain Mixed-Use Method net trips.

SANDAG staff provided site land uses and values for most of the Mixed-Use Method input variables. Some of the variables were determined by estimation methods, as follows:

- Due to confidentiality restrictions associated with California Employment Development Department data, employment levels for some sites were not always reflective of current land uses in the SANDAG databases; in those cases, they were determined from the building areas and jobs per 1,000 square foot conversion ratios.
- VRPA Technologies performed an independent set of land use data checks, collecting data from traffic studies wherever possible, and estimated building occupancy. Those estimates were taken into account in the calculation of raw trips.
- Vehicle ownership per capita was calculated from 2000 Census data using the census block group(s) that most closely matched the sites' locations.
- SANDAG staff estimated employment within 30 minutes by transit using their regional travel demand model.

Table 1 shows the SANDAG raw trips, the Mixed-Use Method's count predictions, and the actual external vehicle trip counts. Detail behind the SANDAG raw trips calculations is provided in Appendix B.

Table 1
Mixed-Use Method Analysis for SANDAG Sites

Site Name	Location	SANDAG Raw Trips[1]	Mixed-Use Method Trip Reduction Percentage	Mixed-Use Method Net Trips[2]	External Vehicle Trip Counts[3]	Percent Deviation between Mixed-Use Method and External Vehicle Counts
Rio Vista Station Village	San Diego	6,689	17%	5,538	5,307	4%
La Mesa Village Plaza	La Mesa	5,681	20%	4,539	4,280	6%
Uptown Center	San Diego	20,214	15%	17,097	16,886	1%
The Village at Morena Linda Vista	San Diego	6,375	26%	5,251	4,712	11%
Hazard Center	San Diego	15,051	12%	13,214	11,644	13%
Heritage Center at Otay Ranch	Chula Vista	10,505	7%	9,730	7,935	23%

(1) Using San Diego *Traffic Generators* Trip Rates; see Appendix B for details
(2) Application of Fehr & Peers Mixed Use Trip Generation Reduction Percentages to (1)
(3) Actual counts
Source: Fehr & Peers, 2009

Based on the results shown in the table above, the Mixed-Use Method is an excellent predictor of external vehicle trips generated by smart growth development, tending to be slightly conservative, but without overestimating smart growth trips to the same degree as conventional trip generation methods. In all cases listed in Table 1, the Mixed-Use Method results in an estimation of external vehicle trips that is below the levels of estimated trip generation using raw trips alone and at or above the level of trips that were determined through actual counts. On average, the *San Diego Traffic Generators* trip generation rates for suburban development would overestimate traffic from the six sites by 29 percent, while the Mixed-Use Method reduces the average overestimate to 9 percent.

Additional Comments

The 20 larger SGOA sites analyzed in Figure 1 provide data for both validation of the Mixed-Use Method and for future refinements. It should be noted that the method's underestimation of trip reduction is most noticeable when it comes to the transit trips component, and additional data could help improve future versions of the Mixed-Use Method. Data collection at additional sites in urban locations with high transit usage is recommended in order to uncover statistically significant variables that are related to the "distance to transit" characteristic. This will help subsequent versions of the method to do a better job of capturing the beneficial aspects of a TOD site's proximity to transit.

It is noteworthy that at four of the six sites where actual counts were taken, the Mixed-Use Method predicts vehicle traffic generated within 10 percent of actual counts, and the average percent overestimation is 9 percent. By comparison, the best alternative method of estimating trip generation within the region, the *San Diego Traffic Generators* manual, would overestimate trip generation at the six sites by an average of 29 percent.

Participants in the study process have noted that the study was conducted during a downturn in the national and local economy. Consideration was given to adjusting the results of the study to account for reduced economic activity; however, it was decided that the results would not be adjusted to account for this factor. Historically, nationwide and local trip-generation counts have not been adjusted for the state of the economy at the time of the counts. Instead, the counts are averaged over a variety of economic conditions to produce an average trip generation rate. In the case of this study, much of the data that was used to calibrate and validate the Mixed-Use Method was collected prior to the current downturn. This includes the nationwide data on which the method was based, as well as the local data collected at SGOA sites. Data collected at the small mixed-use/TOD sites was collected during the economic downturn.

However, efforts were made to adjust the analysis to account for any unusually high vacancy rates found at the study sites. As a result, the comparison of actual traffic counts with estimates produced by the Mixed-Use Method take into account both the economy's influence on occupancies and the relative accuracy of the method for estimating traffic at a site with a given level of occupancy. Overall, the entire dataset used in the analysis reflects data collected during a variety of economic conditions.

Finally, the method has not been fully validated for application to single-use developments in smart growth settings or large auto-oriented, mixed-use developments. The following comments apply to these types of developments:

- The Mixed-Use Method was explicitly developed for the analysis of mixed-use developments. It has not been formally validated for analyzing single-use developments within mixed-use areas. For analysis of single-use development within a mixed-use area, two possible approaches are suggested:

    1. Define a mixed-use area surrounding the proposed development (and all associated input variables) and run the method with and without the development. The difference in trips between the two calculations represents the net change in the number of external trips generated by the proposed development.
    2. Select one of the SGOAs or counted sites that are documented in these guidelines that most closely resembles the area in which the development project is proposed, and use the external trip reductions from the SGOA or counted site to estimate trip reductions for the proposed development.

APPENDICES

Appendix A
Locations of Counted Sites

Smart Growth Trip Generation and Parking Demand Guidelines

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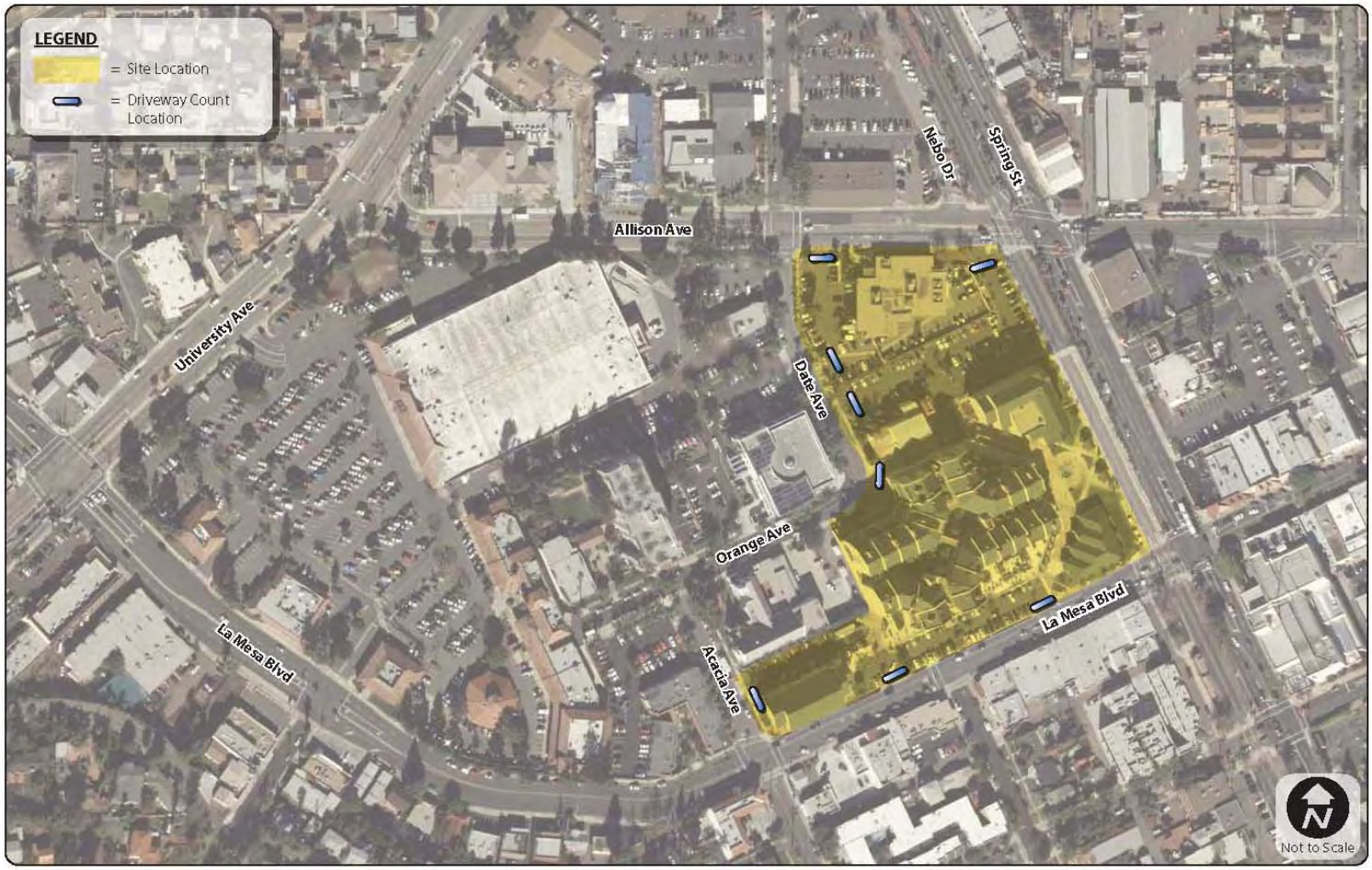
STATION VILLAGE AT RIO VISTA STATION



Smart Growth Trip Generation and Parking Demand Guidelines

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LA MESA VILLAGE PLAZA

Smart Growth Trip Generation and Parking Demand Guidelines

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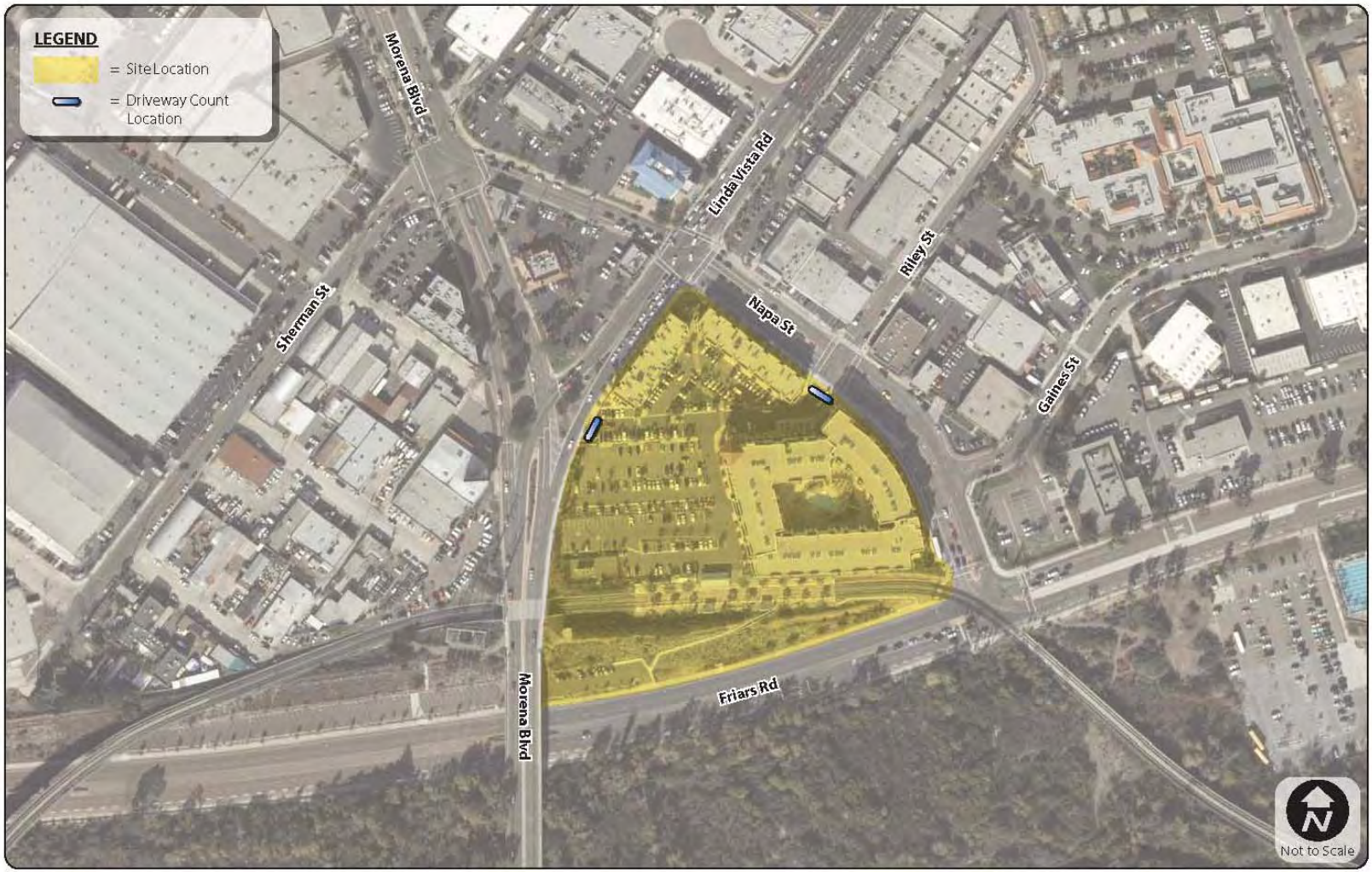
UPTOWN CENTER



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MORENDA LINDA VISTA STATION

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HAZARD CENTER

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OTAY RANCH

Appendix B
SANDAG Raw Trips Calculation Backup and Site Characteristics

APPENDIX B – SANDAG RAW TRIPS CALCULATION BACKUP

To calculate "raw trips" as shown in Table 1, the recommended rates from *San Diego Traffic Generators* were applied to land uses as provided by SANDAG staff and through VRPA Technologies' independent data checking. The tables below show the detail for each of the six sites. Some of the rates used were modified from the *(Not so) Brief Guide of Vehicular Traffic Generation Rates for the San Diego Region* report, as follows:

- The *(Not so) Brief Guide of Vehicular Traffic Generation Rates* has a rate of 1.8 trips / seat for theaters. The trip rate for the theater at Hazard Center was scaled down to 50% 0.9 to reflect the unique characteristics of this theater, consistent with the Hazard Center Traffic Impact Analysis done by Urban Systems in July of 2009.
- The Starbucks cafes at three of the sites were treated as fast food restaurants, and their building areas were estimated from street views.
- The supermarkets at Uptown Center (Ralph's and Trader Joe's) were separated out from the general neighborhood shopping center rate, and their building areas were estimated from aerials.

Rio Vista Station Village (Transit: Light Rail)					
Land Use	**Units**	**Amount**	**Occupied**	**Daily Trip Rate**	**Daily Trips**
Apartment	d.u.	970.0	95%	6	5,529
Specialty Retail	1,000 s.f.	13.0	100%	40	520
Sit Down, High Turnover Restaurant	1,000 s.f.	4.0	100%	160	640
				Total Trips	**6,689**

La Mesa Village Plaza (Transit: Light Rail)					
Land Use	**Units**	**Amount**	**Occupied**	**Daily Trip Rate**	**Daily Trips**
Office	1,000 s.f.	14.3	95%	Equation[1]	373
Sit Down High Turn Over Restaurant	1,000 s.f.	20.2	90%	160	2,906
Fast Food Restaurant (Starbucks)	1,000 s.f.	2.0	100%	700	1,400
Specialty Retail	1,000 s.f.	8.0	90%	40	288
Condominium	d.u.	94.0	95%	8	714
				Total Trips	**5,681**

[1] $\ln(T) = 0.756 \ln(x) + 3.95$

Uptown Center (Transit: High Frequency Local Bus)					
Land Use	**Units**	**Amount**	**Occupied**	**Daily Trip Rate**	**Daily Trips**
Condominium	d.u.	311.0	95%	8	2,364
Neighborhood Shopping Center	1,000 s.f.	67.2	90%	120	7,260
Supermarket	1,000 s.f.	70.0	100%	150	10,500
Government Office	1,000 s.f	3.0	100%	30	90
				Total Trips	**20,214**

The Village at Morena Linda Vista (Transit: Light Rail)					
Land Use	**Units**	**Amount**	**Occupied**	**Daily Trip Rate**	**Daily Trips**
Apartment	d.u.	185.0	95%	6	1,055
Sit-Down, High Turnover Restaurant	1,000 s.f.	14.0	100%	160	2,240
Fast Food Restaurant (Starbucks)	1,000 s.f.	3.0	100%	700	2,100
Specialty Retail	1,000 s.f.	8.0	100%	40	320
Transit Station	Occupied Parking	165.0	100%	4	660
				Total Trips	**6,375**

Hazard Center (Transit: Light Rail)					
Land Use	**Units**	**Amount**	**Occupied**	**Daily Trip Rate**	**Daily Trips**
Specialty Retail	1,000 s.f.	98.7	90%	40	3,553
Sit-Down, High Turnover Restaurant	1,000 s.f.	18.0	100%	160	2,880
Fast Food Restaurant (Starbucks)	1,000 s.f.	2.0	100%	700	1,400
Office	1,000 s.f.	284.0	90%	Equation[1]	3,432
Hotel	Rooms	300.0	80%	10	2,400
Theater	Seat	1,540.0	100%	0.9	1,386
				Total Trips	**15,051**

[1] Ln(T) = 0.756 ln(x) + 3.95

Heritage Center at Otay Ranch (Transit: Planned BRT and High Frequency Local Bus)					
Land Use	**Units**	**Amount**	**Occupied**	**Daily Trip Rate**	**Daily Trips**
Apartment	d.u.	271.0	90%	6	1,463
Gas Station With Food Mart	Fueling Station	8.0	100%	160	1,280
Medical Office	1,000 s.f.	67.4	95%	50	3,202
Neighborhood Shopping Center	1,000 s.f.	38.0	100%	120	4,560
				Total Trips	**15,505**

Appendix C
Vehicle Trip Reduction for SGOAs

Site Short Name[1]	Community Name	Place Type[2]	Area (acres)	Dwelling Units		Non-Residential Building Area (1,000 square feet)				Number of Intersections	Jobs Within One mile	Jobs Within 30 Minutes by Transit	Trip Reduction	
				Single Family	Multifamily	Retail	Office	Public	Indus-trial				Modeled	Surveyed
SD UN-2	Eastgate Mall Road, I-805, UCSD, Nobel Drive	Urban Center	818	120	11,389	2,408	6,234	112	42	37	23,510	237,386	14%	32%
SD CC-1C	Centre City Community Plan Area	Metropolitan Center[3]	389	9	5,576	2,732	7,508	2,565	23	120	71,350	324,431	47%	44%
SD UP-6	Pennsylvania Avenue/Robinson Avenue, Park Boulevard, Washington Street	Urban Center	383	703	4,070	1,922	552	68	2	160	13,950	333,063	25%	36%
ES-1	Downtown Specific Plan/Mercado Area Plan	Town Center	452	176	648	2,285	566	18	126	165	12,660	80,713	24%	30%
SD UP-1	4th Street & 5th Street from DateStreet to Pennsylvania Avenue	Mixed-Use Transit Corridor	352	317	4,384	622	1,887	113	0	151	81,240	275,189	28%	31%
SD CH-3B	University Avenue from Park Boulevard to 54th Street	Mixed-Use Transit Corridor[3]	447	1,582	3,943	798	524	85	35	200	15,440	275,848	32%	51%
SD CH-1	Meade Avenue, Wightman Street, 40th Street	Town Center	381	1,279	3,251	765	535	55	0	172	5,420	263,272	31%	59%
SD NV-1	I-8, Friars Road, San Diego River, Mission Gorge Road in the east	Town Center	244	2	432	756	511	0	984	26	13,240	282,833	10%	21%
SD NH-1	Park Boulevard at Meade Avenue continuing along Adams Avenue	Mixed-Use Transit Corridor	501	1,993	4,213	586	57	44	0	243	19,020	202,215	32%	47%
SD MV-3	I-8, SR 163, I-805, Community Boundary	Urban Center	531	122	3,188	3,975	2,389	147	73	29	8,910	365,333	12%	17%
SD CC-1E	Centre City Community Plan Area	Metropolitan Center[3]	290	0	4,492	1,004	383	46	338	47	50,890	269,903	22%	41%
SD PB-1	Grand Avenue & Garnet Avenue from Mission Boulevard to Olney Street	Mixed-Use Transit Corridor	502	1,496	4,175	1,479	135	9	0	210	12,210	206,276	25%	37%
CO-1	Downtown Coronado Town Center	Town Center	307	554	2,941	2,051	117	13	0	122	6,270	97,223	21%	47%
SD LJ-1	Prospect Street, Pearl Street, Fay Avenue, Ivanhoe Avenue	Town Center	220	170	1,585	2,220	537	95	0	89	10,830	91,444	19%	45%
SD CC-1D	Centre City Community Plan Area	Metropolitan Center[3]	346	77	6,078	1,739	259	235	1,007	133	44,610	408,616	44%	39%

Site Short Name[1]	Community Name	Place Type[2]	Area (acres)	Dwelling Units		Non-Residential Building Area (1,000 square feet)				Number of Intersections	Jobs Within One mile	Jobs Within 30 Minutes by Transit	Trip Reduction	
				Single Family	Multifamily	Retail	Office	Public	Indus-trial				Modeled	Surveyed
SD CH-3A	University Avenue from Park Boulevard to 54th Street	Mixed-Use Transit Corridor	254	735	3,888	770	151	94	32	153	16,640	263,125	30%	45%
SD UN-1	I-5, La Jolla Village Drive, Gilman Drive	Town Center	216	0	2,841	1,137	203	0	0	20	8,640	147,394	12%	20%
SD NP-2G	El Cajon Boulevard from Park Boulevard to 79th Street	Mixed-Use Transit Corridor[3]	319	785	1,519	1,039	115	44	0	102	12,360	107,950	19%	17%
SD NP-1	30th Street from Adams Avenue to Upas	Mixed-Use Transit Corridor	290	1,086	3,310	886	119	89	41	141	11,760	252,990	27%	41%
SD MM-1	Westview Parkway from Capricorn Way to Hillery Drive & Mira Mesa Boulevard from Black Mountain Road to I-15	Town Center	158	0	412	1,189	4	0	0	4	5,940	117,403	5%	18%

(1) Complete descriptions of the sites can be found in the SANDAG *Smart Growth Concept Map Site Descriptions* document, dated October 27, 2006

(2) As identified by the San Diego Regional Comprehensive Plan (RCP).

(3) Divided

Appendix D
Data Sources for SGOA Land Use Data

APPENDIX D – DATA SOURCES FOR SGOA LAND USE DATA

The following SANDAG data sources were used as inputs into the MXD model:

- Current Population Estimates, SANDAG 2008
- ES-202 and QCEW Industry Employment and Quarterly Wage Data, California Employment Development Department Labor Market Information, 2005
- SANDAG Land Use Database, 2008
- SANGIS Road Network, Q2 2008 (excludes non-pedestrian features such as freeways, but includes alleys and dedicated foot paths)
- SANDAG Transit Stop Inventory, 2008
- SANDAG Smart Growth Concept Map, 2008

  Smart Growth Opportunity Areas (SGOAs) were drawn as 2 versions:

  1. Using official boundaries as drawn on Smart Growth Concept Map
  2. With a ½ mile walkable buffer from the center street for Mixed Use Transit Corridors, and from the SGOA center point for other place types.

  Canyons, freeways, rivers, coastline, and other such impediments were clipped out of the SGOA boundaries.