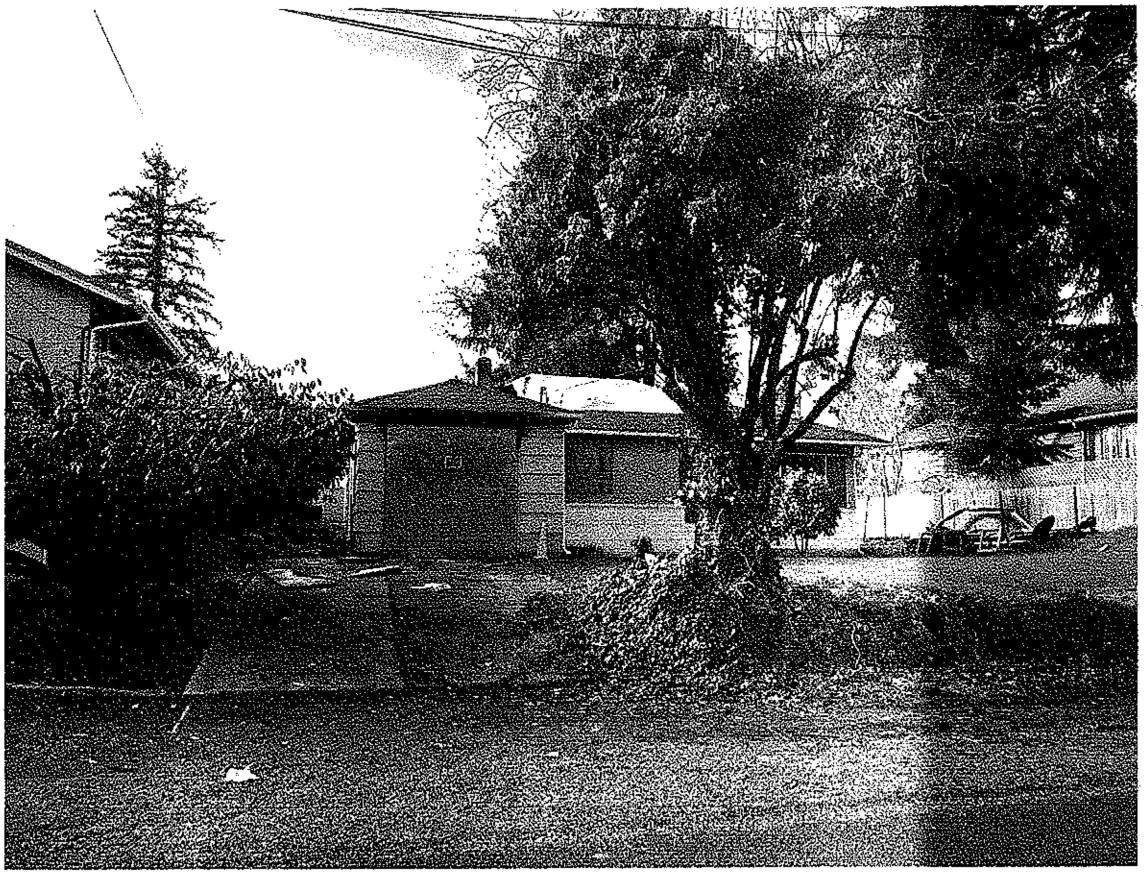
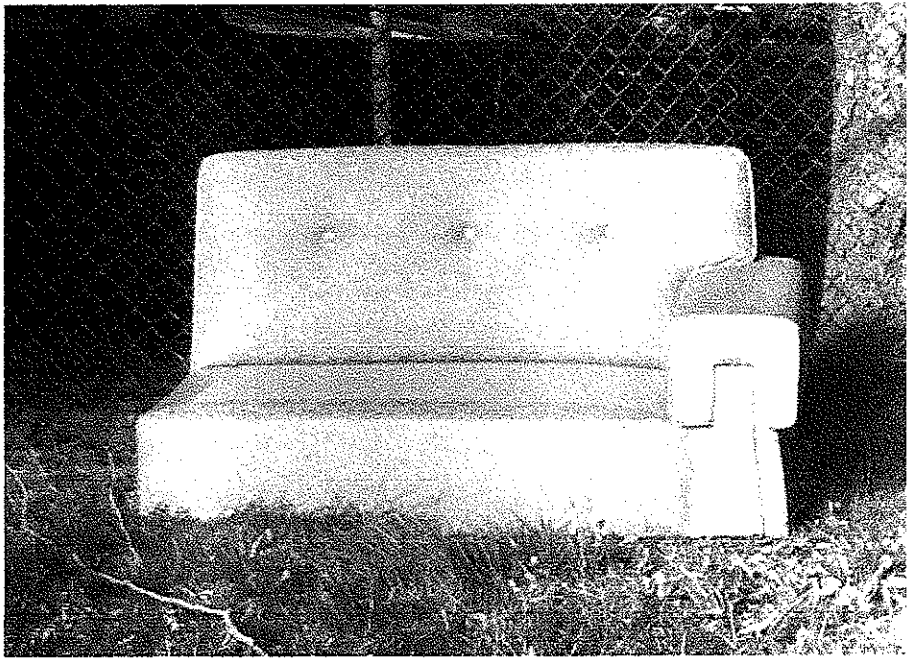
Shoreline-Congestion-145th-S

LIGHT RAIL doesn't go where people want/need to go. <u>The planners teach: Build high rise apartments near the stations.</u> My wife and I spent 10 days in Singapore, which is said to have the best light rail in the world. I noted that the apartments near the stations were for the poor, with laundry lines shared between adjacent apartments on the same floor. Where we lived (with daughter and Professor-husband). The apartments were completely modern with four elevators in each building up 30+ floors. Six of these surrounded a huge swimming pool with beautiful adjacent nature fish/water plant pools. These were about a mile from two stations. Although the cars cost about three times our prices, it was cheaper to take a taxi with the four of us (after his teaching activities were done for the day). <u>[Recent studies have shown that each Taxi type of vehicle in use, leads to 15 fewer cars on the highways.]</u>

PM rush hour:



This Briarcrest neighborhood was rezoned commercial as part of the Briarcrest subarea Plan on a 20-year timeline. Not much has changed since the subarea was adopted in 2009 except the neighborhood has become more run down, as developers have been buying up property but not maintaining it. How many more years will it be before high-density residential buildings actually built? Do we want this kind of "redevelopment" for the rest of Shoreline?



Here is a piece of furniture that adds to the Appalachian ambiance of this block.

Valentine's Day brings a gift with it other than chocolates. We receive our tax statements. Nearly 50% of my assessment goes go the school district and fire department. In the discussion of costs associated with development, I have heard no discussion of impact fees to recover the costs these special purpose districts will be required to ultimately pass on to us.

The following actions and the subsequent increases in expected population as calculated from the city deis reports are 145th St: 5314 people; 185th St: 5399 people; Aurora Square 2477 people; Town Center: 2600 people; Point Wells: 6000 new residents. These alone total 21,760 new residents.

Left out of these calculations are the North City business district, the possible expansion at Fircrest, the Crista master plan, south east area sub plan, Lake Forest Park's gateway project, and the Shoreline Community College master plan. I will leave it to you to ask for the figures from these projects.

From a current population of 53,000 residents, if all of these plans come to pass the population could easily top 85,000 people.

This would create the second most densely populated city in the state in population per square mile, exceeded only by Seattle.

Let me put these numbers into perspective. For each 1000 people numerous professional sources recommend 1.3 firefighters. This would add approximately 40 firefighters to the payroll. Likely 4 new stations would be needed. We currently have only 1 ladder truck with backup coming from the Seattle fire department at 105th and Aurora. We need at least one more plus retrofitting existing equipment to meet these anticipated needs.

The FBI reports that the average police force provides for 3.4 employees per thousand, both sworn and civilian combined, which at the rates mentioned above would mean over 100 new employees.

The school district figures are even more staggering. The school budget would have to accommodate a 50% population growth and a subsequent increase in capital budget while the city looks to market their excess property for development.

The above mentioned actions are not stagnant. Things are changing with additional unanticipated consequences.

The expected dormitory at Shoreline CC fell through and the loss of this project will increase the traffic impacts in the Aurora and train station corridors.

The Aurora CRA planned on a 360 stall garage on the WSDOT site. Instead WSDOT will expand increasing traffic. There is no hydrology or geology report on the CRA site

No study has been undertaken to determine the existence of piped streams that may be required to be day lighted as part of development. There is a critical area habitat along Aurora that was addressed in the sighting of the train station as part of the reason for the I-5 location. Improvements to the fire station at 155th are not identified.

The property tax exemption program is scheduled to become permanent so that the increases in property taxes needed to fund many of these projects will not be available. This is just a snap shot of some of the uncalculated costs associated with development. Thanks for the 3 minutes.

Liz Poitras February 19, 2015
Shoreline

I keep hearing in City Council meetings that we need to have more housing choices for the people in Shoreline and that is one of the benefits of rezoning in the station subareas. That is a great goal.

I was looking at a map in the DEIS, in Section 3, called
Figure 3.2-3 Affordable Housing Units by Income Group in Shoreline
The map indicates its source as the Comprehensive Plan 2012.

I built a table from that showing the available stock of housing units affordable by Low median income ($40,000 - $60,000) and Very Low income ($5,000 - $40,000). For just the Low median income range the house values range $99,720 – $265,999. I sorted them from most units to least units by neighborhood.

Neighborhood	**# Houses Affordable by Median Income of $40,000 - $60,000 "Low"**	**# Houses Affordable by Median Income of $5,000 - $40,000 "Very Low"**
Ridgecrest	1495	0
North City	1208	0
Echo Lake	769	0
Meridian Park	735	3
Briarcrest	596	0
Parkwood	583	0
Richmond Highlands	461	0
Hillwood	458	0
Ballinger	317	2
Highland Terrace	291	0
Richmond Beach	162	2
Westminster Triangle	126	0
Innis Arden	0	0
The Highlands	0	0
TOTAL	**7201**	**7**

Ridgecrest has 20% of all of these houses in Shoreline. If you take those neighborhoods affected most by the light rail station subareas (Ridgecrest, North City, Echo Lake, and Parkwood) you have 56% of this type of house in Shoreline. Obviously not all these houses are in proposed rezone areas.

Now there are a lot of different ways you can spin this data, depending on what you want to sell.
You could say that these folks are in these homes because they can't find lovely little apartments to rent or townhomes to buy because Shoreline doesn't provide enough in this price range. But to many people affordable housing might mean a small house with a yard for the children to play and an area to grow vegetables or a small house to have a hobby.

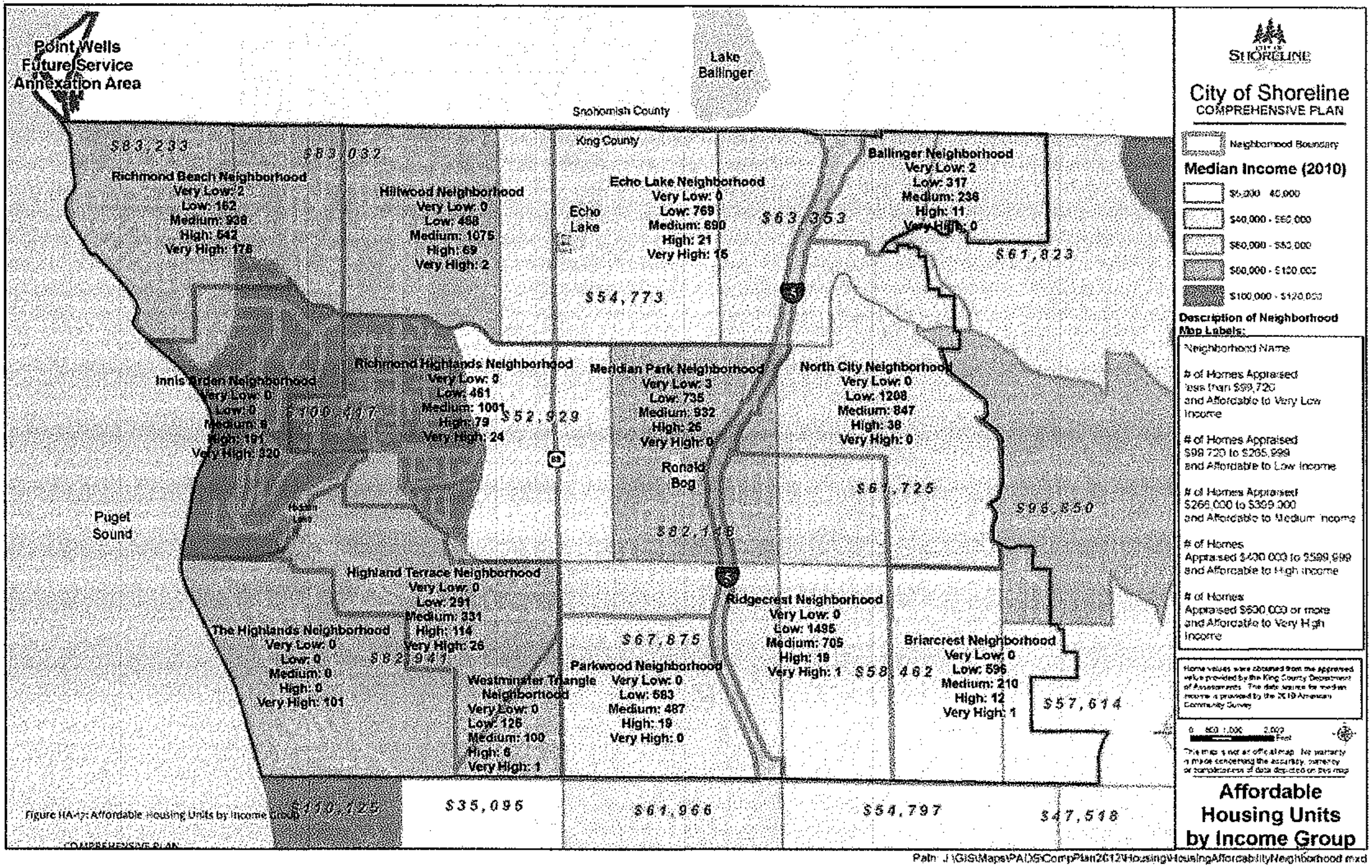
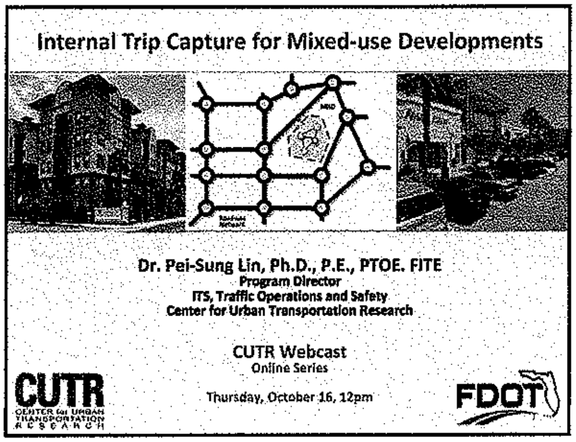


Figure 3.2-3 Affordable Housing Units by Income Group in Shoreline

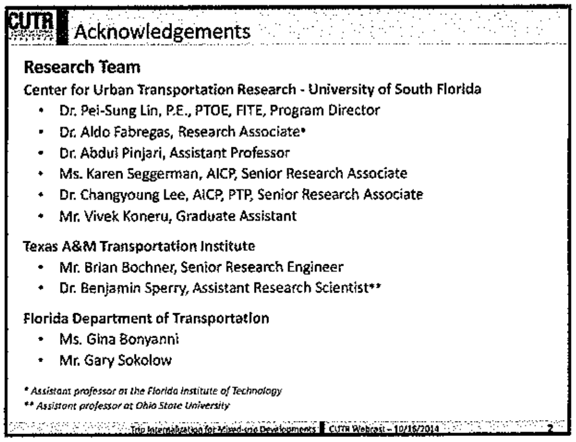


Internal Trip Capture for Mixed-use Developments

Dr. Pei-Sung Lin, Ph.D., P.E., PTOE. FITE
Program Director
ITS, Traffic Operations and Safety
Center for Urban Transportation Research

CUTR Webcast
Online Series

Thursday, October 16, 12pm



Acknowledgements

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Florida Department of Transportation
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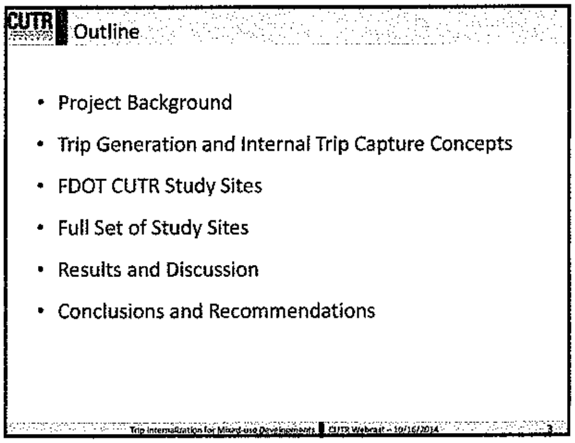
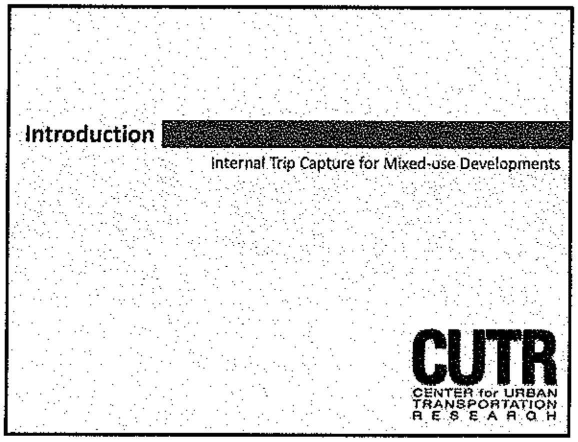


Outline

- Project Background
- Trip Generation and Internal Trip Capture Concepts
- FDOT CUTR Study Sites
- Full Set of Study Sites
- Results and Discussion
- Conclusions and Recommendations



Introduction

Internal Trip Capture for Mixed-use Developments

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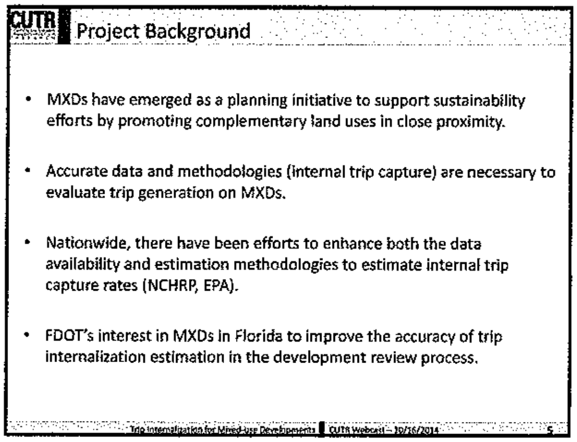
RESEARCH



Project Background

- MXDs have emerged as a planning initiative to support sustainability efforts by promoting complementary land uses in close proximity.
- Accurate data and methodologies (internal trip capture) are necessary to evaluate trip generation on MXDs.
- Nationwide, there have been efforts to enhance both the data availability and estimation methodologies to estimate internal trip capture rates (NCHRP, EPA).
- FDOT's interest in MXDs in Florida to improve the accuracy of trip internalization estimation in the development review process.

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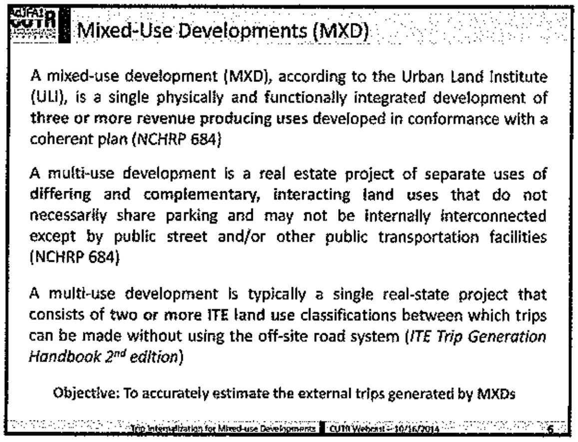

Mixed-Use Developments (MXD)

A mixed-use development (MXD), according to the Urban Land Institute (ULI), is a single physically and functionally integrated development of three or more revenue producing uses developed in conformance with a coherent plan (NCHRP 684)

A multi-use development is a real estate project of separate uses of differing and complementary, interacting land uses that do not necessarily share parking and may not be internally interconnected except by public street and/or other public transportation facilities (NCHRP 684)

A multi-use development is typically a single real-state project that consists of two or more ITE land use classifications between which trips can be made without using the off-site road system (*ITE Trip Generation Handbook 2nd edition*)

Objective: To accurately estimate the external trips generated by MXDs

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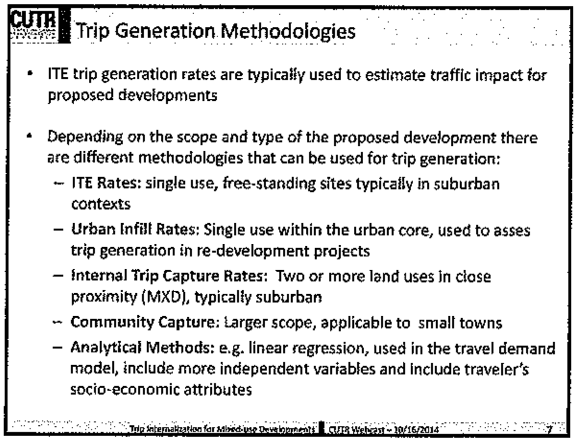
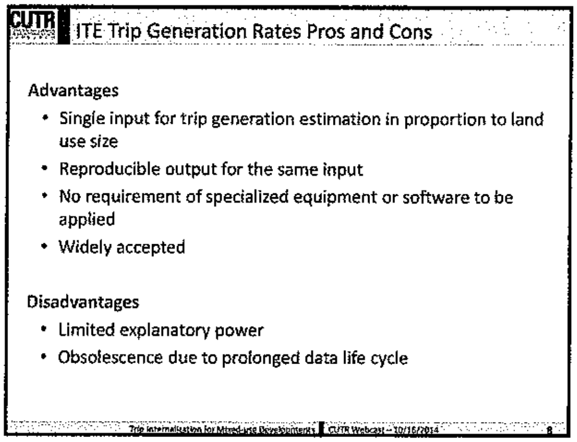
Slide 6

AdJFA1 This slide can be improved
Aldo de Jesus Fabregas Ariza, 6/20/2014



Trip Generation Methodologies

- ITE trip generation rates are typically used to estimate traffic impact for proposed developments
- Depending on the scope and type of the proposed development there are different methodologies that can be used for trip generation:
  - **ITE Rates:** single use, free-standing sites typically in suburban contexts
  - **Urban Infill Rates:** Single use within the urban core, used to asses trip generation in re-development projects
  - **Internal Trip Capture Rates:** Two or more land uses in close proximity (MXD), typically suburban
  - **Community Capture:** Larger scope, applicable to small towns
  - **Analytical Methods:** e.g. linear regression, used in the travel demand model, include more independent variables and include traveler's socio-economic attributes



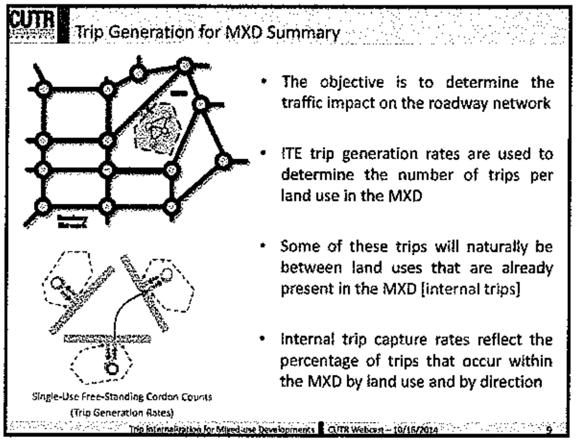
ITE Trip Generation Rates Pros and Cons

Advantages

- Single input for trip generation estimation in proportion to land use size
- Reproducible output for the same input
- No requirement of specialized equipment or software to be applied
- Widely accepted

Disadvantages

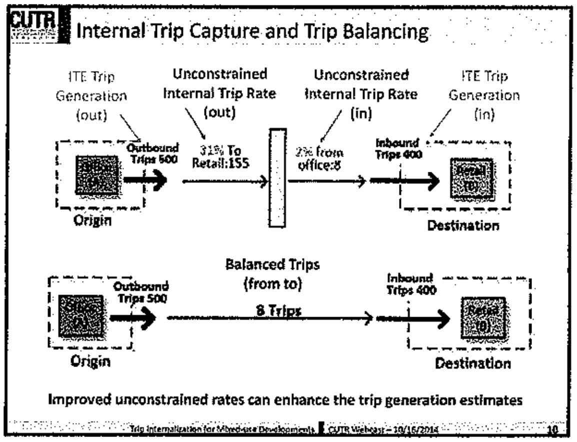
- Limited explanatory power
- Obsolescence due to prolonged data life cycle



Trip Generation for MXD Summary

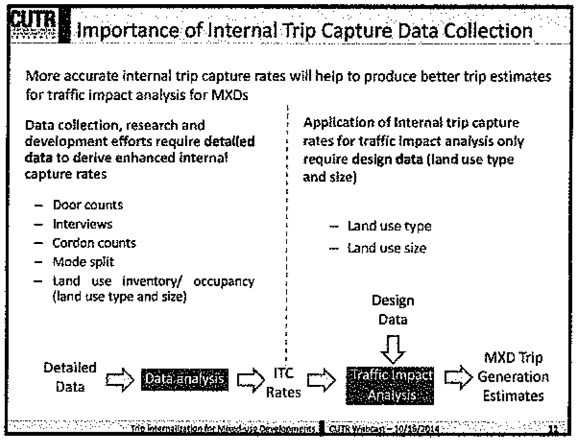
- The objective is to determine the traffic impact on the roadway network
- ITE trip generation rates are used to determine the number of trips per land use in the MXD
- Some of these trips will naturally be between land uses that are already present in the MXD [internal trips]
- Internal trip capture rates reflect the percentage of trips that occur within the MXD by land use and by direction

Single-Use Free-Standing Cordon Counts
(Trip Generation Rates)



Internal Trip Capture and Trip Balancing

Improved unconstrained rates can enhance the trip generation estimates



Importance of Internal Trip Capture Data Collection

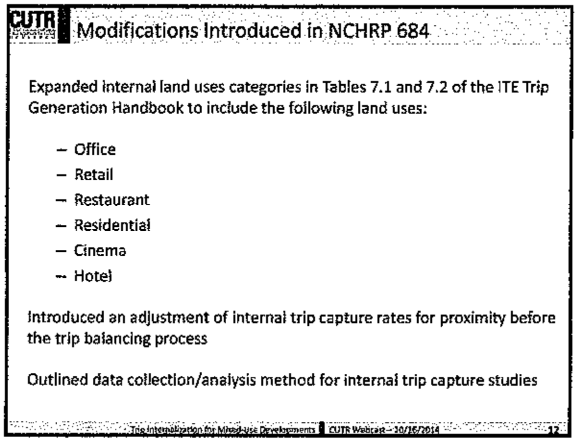
More accurate internal trip capture rates will help to produce better trip estimates for traffic impact analysis for MXDs

Data collection, research and development efforts require detailed data to derive enhanced internal capture rates

- Door counts
- Interviews
- Cordon counts
- Mode split
- Land use inventory/ occupancy (land use type and size)

Application of internal trip capture rates for traffic impact analysis only require design data (land use type and size)

- Land use type
- Land use size



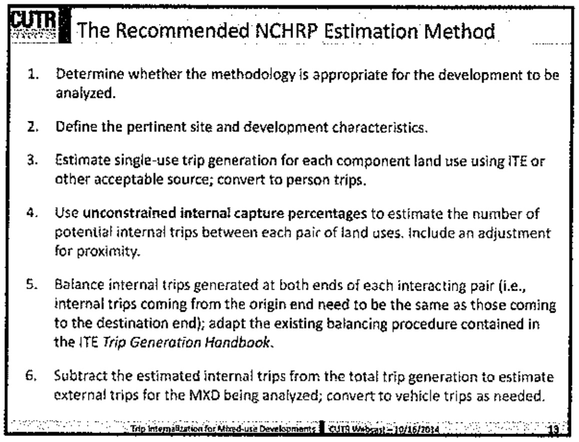
Modifications Introduced in NCHRP 684

Expanded internal land uses categories in Tables 7.1 and 7.2 of the ITE Trip Generation Handbook to include the following land uses:

- Office
- Retail
- Restaurant
- Residential
- Cinema
- Hotel

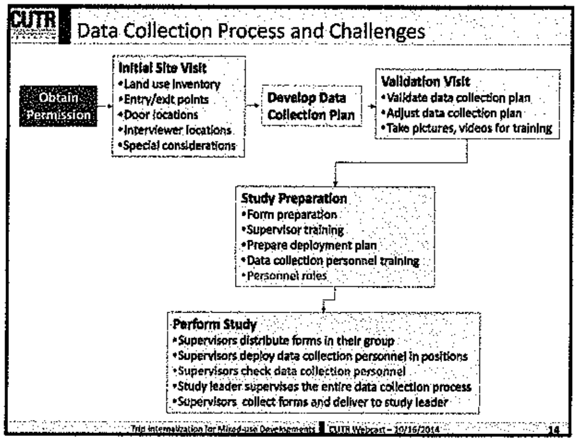
Introduced an adjustment of internal trip capture rates for proximity before the trip balancing process

Outlined data collection/analysis method for internal trip capture studies



The Recommended NCHRP Estimation Method

1. Determine whether the methodology is appropriate for the development to be analyzed.
2. Define the pertinent site and development characteristics.
3. Estimate single-use trip generation for each component land use using ITE or other acceptable source; convert to person trips.
4. Use **unconstrained internal capture percentages** to estimate the number of potential internal trips between each pair of land uses. Include an adjustment for proximity.
5. Balance internal trips generated at both ends of each interacting pair (i.e., internal trips coming from the origin end need to be the same as those coming to the destination end); adapt the existing balancing procedure contained in the ITE *Trip Generation Handbook*.
6. Subtract the estimated internal trips from the total trip generation to estimate external trips for the MXD being analyzed; convert to vehicle trips as needed.



Data Collection Process and Challenges

Obtain Permission

Initial Site Visit
- Land use inventory
- Entry/exit points
- Door locations
- Interviewer locations
- Special considerations

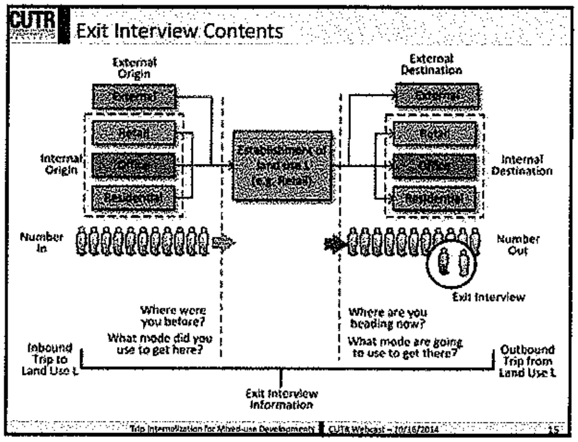
Develop Data Collection Plan

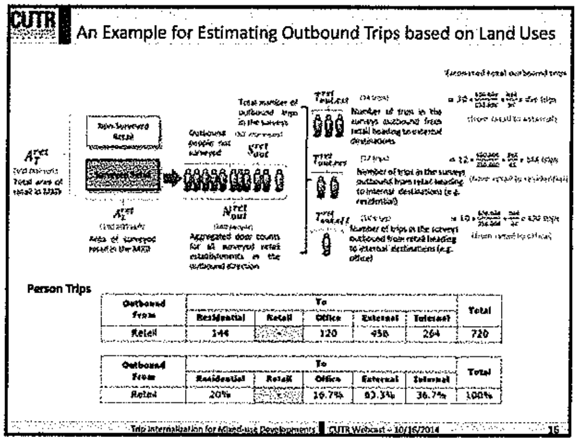
Validation Visit
- Validate data collection plan
- Adjust data collection plan
- Take pictures, videos for training

Study Preparation
- Form preparation
- Supervisor training
- Prepare deployment plan
- Data collection personnel training
- Personnel roles

Perform Study
- Supervisors distribute forms in their group
- Supervisors deploy data collection personnel in positions
- Supervisors check data collection personnel
- Study leader supervises the entire data collection process
- Supervisors collect forms and deliver to study leader

Exit Interview Contents





An Example for Estimating Outbound Trips based on Land Uses

Person Trips

Outbound From	To					Total
	Residential	Retail	Office	External	Internal	
Retail	144	-	120	456	264	720

Outbound From	To					Total
	Residential	Retail	Office	External	Internal	
Retail	20%	-	16.7%	63.3%	36.7%	100%

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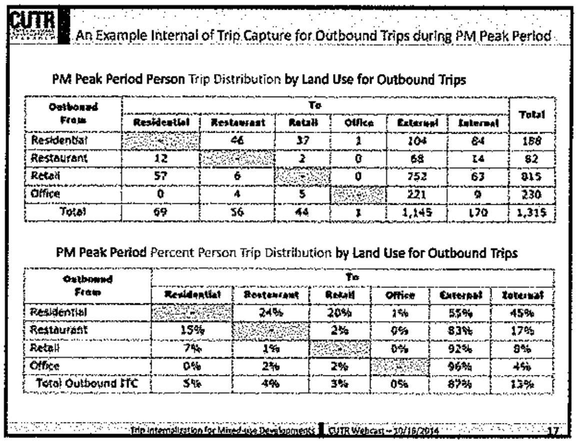

An Example Internal of Trip Capture for Outbound Trips during PM Peak Period

PM Peak Period Person Trip Distribution **by Land Use for Outbound Trips**

Outbound From	To						Total
	Residential	Restaurant	Retail	Office	External	Internal	
Residential	-	46	37	1	104	84	188
Restaurant	12	-	2	0	68	14	82
Retail	57	6	-	0	752	63	815
Office	0	4	5	-	221	9	230
Total	69	56	44	1	1,145	170	1,315

PM Peak Period Percent Person Trip Distribution **by Land Use for Outbound Trips**

Outbound From	To					
	Residential	Restaurant	Retail	Office	External	Internal
Residential	-	24%	20%	1%	55%	45%
Restaurant	15%	-	2%	0%	83%	17%
Retail	7%	1%	-	0%	92%	8%
Office	0%	2%	2%	-	96%	4%
Total Outbound ITC	5%	4%	3%	0%	87%	13%

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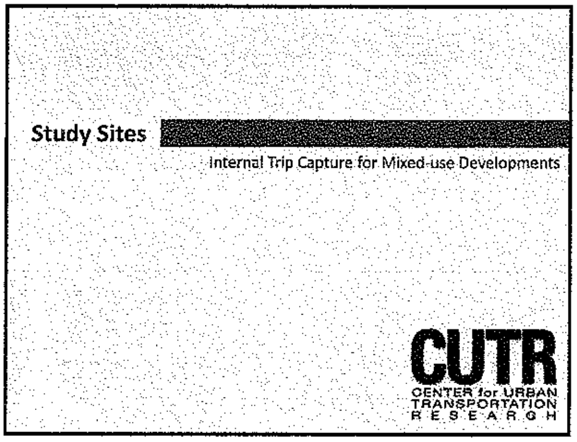

Study Sites

Internal Trip Capture for Mixed-use Developments

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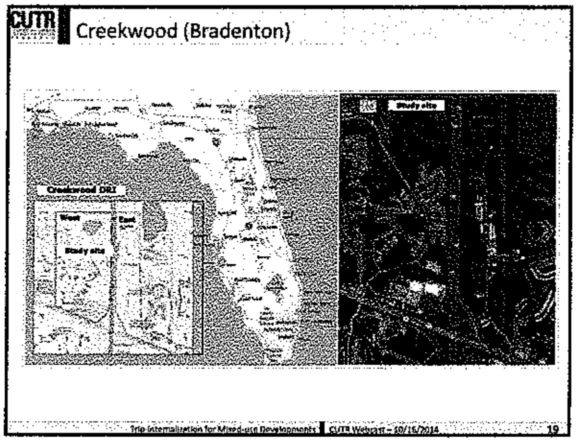
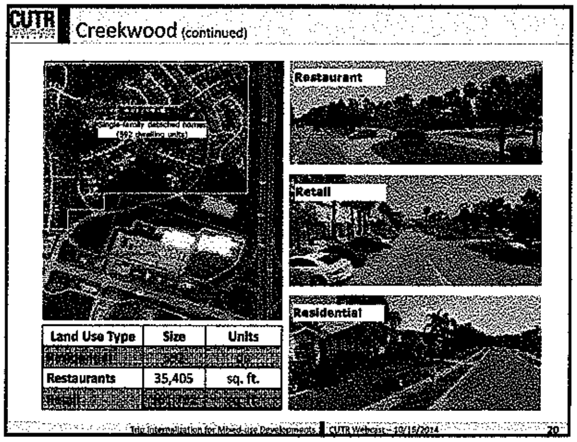
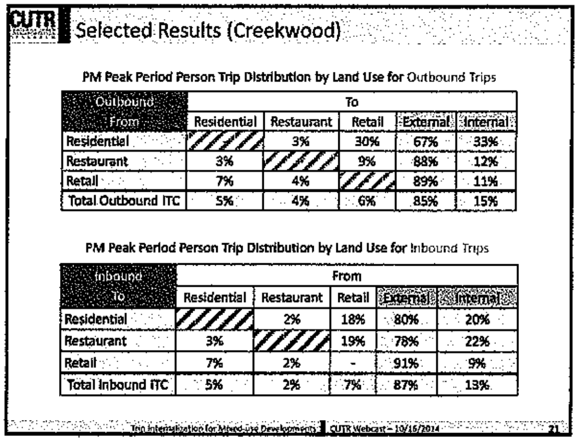


Creekwood (Bradenton)



Creekwood (continued)

Land Use Type	Size	Units
[illegible]	[illegible]	[illegible]
Restaurants	35,405	sq. ft.
[illegible]	[illegible]	[illegible]



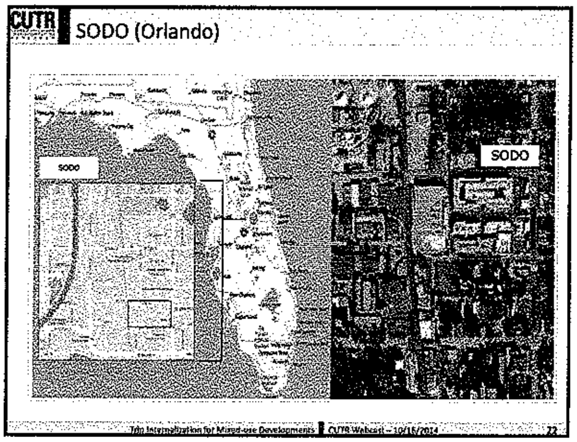
Selected Results (Creekwood)

PM Peak Period Person Trip Distribution by Land Use for Outbound Trips

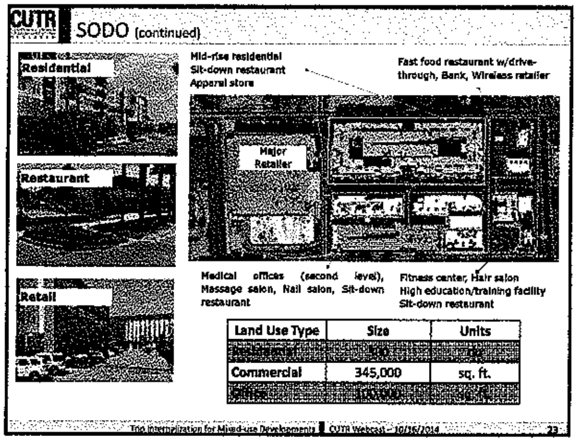
Outbound From	To				
	Residential	Restaurant	Retail	External	Internal
Residential	▨	3%	30%	67%	33%
Restaurant	3%	▨	9%	88%	12%
Retail	7%	4%	▨	89%	11%
Total Outbound ITC	5%	4%	6%	85%	15%

PM Peak Period Person Trip Distribution by Land Use for Inbound Trips

Inbound To	From				
	Residential	Restaurant	Retail	External	Internal
Residential	▨	2%	18%	80%	20%
Restaurant	3%	▨	19%	78%	22%
Retail	7%	2%	-	91%	9%
Total Inbound ITC	5%	2%	7%	87%	13%



SODO (Orlando)



SODO (continued)

Mid-rise residential
Sit-down restaurant
Apparel store

Fast food restaurant w/drive-through, Bank, Wireless retailer

Medical offices (second level), Massage salon, Nail salon, Sit-down restaurant

Fitness center, Hair salon
High education/training facility
Sit-down restaurant

Land Use Type	Size	Units
[illegible]	[illegible]	[illegible]
Commercial	345,000	sq. ft.
[illegible]	[illegible]	[illegible]

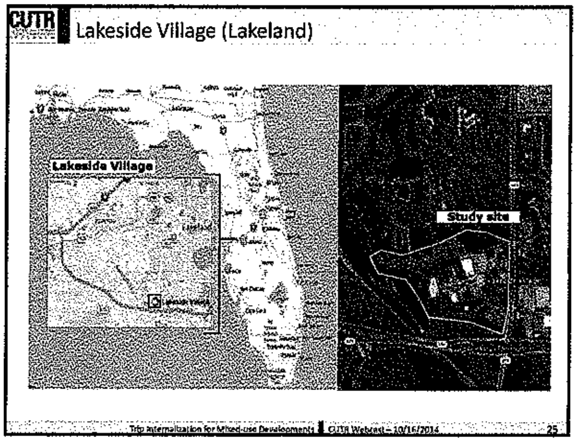
Selected Results (SODO)

PM Peak Period Person Trip Distribution by Land Use for Outbound Trips

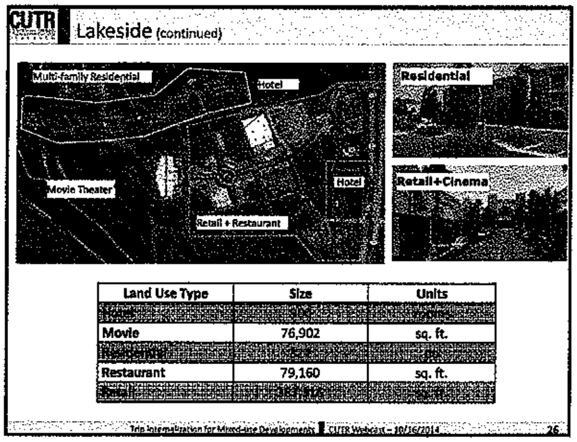
Outbound From	To					
	Residential	Restaurant	Office	Retail	External	Internal
Residential	▨	24%	20%	1%	55%	45%
Restaurant	15%	▨	2%	0%	83%	17%
Retail	7%	1%	▨	0%	92%	8%
Office	0%	2%	2%	▨	96%	4%
Total Outbound ITC	5%	4%	3%	0%	87%	13%

PM Peak Period Person Trip Distribution by Land Use for Inbound Trips

Inbound To	From					
	Residential	Restaurant	Retail	Office	External	Internal
Residential	▨	9%	42%	0%	49%	51%
Restaurant	33%	▨	4%	3%	60%	40%
Retail	4%	0%	▨	1%	95%	5%
Office	3%	0%	0%	▨	97%	3%
Total Inbound ITC	7%	1%	5%	1%	86%	14%

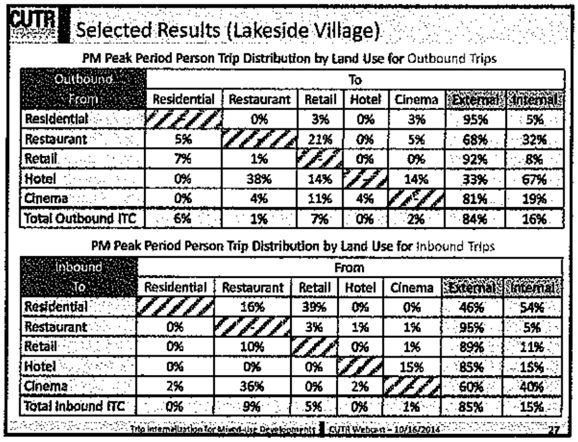


Lakeside Village (Lakeland)



Lakeside (continued)

Land Use Type	Size	Units
[illegible]	[illegible]	[illegible]
Movie	76,902	sq. ft.
[illegible]	[illegible]	[illegible]
Restaurant	79,160	sq. ft.
[illegible]	[illegible]	[illegible]



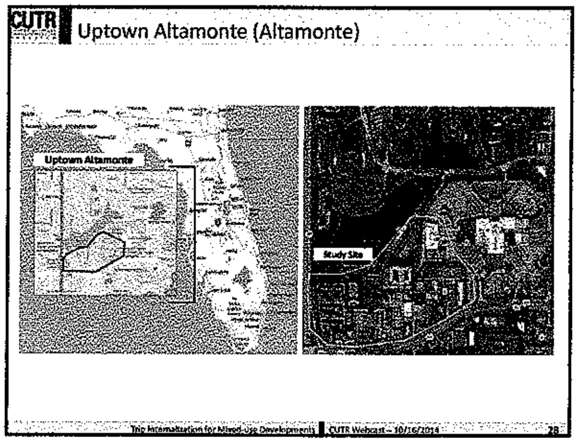
Selected Results (Lakeside Village)

PM Peak Period Person Trip Distribution by Land Use for Outbound Trips

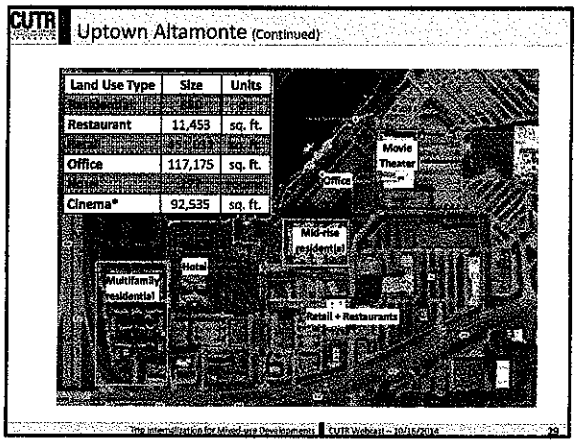
Outbound	To						
From	Residential	Restaurant	Retail	Hotel	Cinema	External	Internal
Residential	▨	0%	3%	0%	3%	95%	5%
Restaurant	5%	▨	21%	0%	5%	68%	32%
Retail	7%	1%	▨	0%	0%	92%	8%
Hotel	0%	38%	14%	▨	14%	33%	67%
Cinema	0%	4%	11%	4%	▨	81%	19%
Total Outbound ITC	6%	1%	7%	0%	2%	84%	16%

PM Peak Period Person Trip Distribution by Land Use for Inbound Trips

Inbound	From						
To	Residential	Restaurant	Retail	Hotel	Cinema	External	Internal
Residential	▨	16%	39%	0%	0%	46%	54%
Restaurant	0%	▨	3%	1%	1%	95%	5%
Retail	0%	10%	▨	0%	1%	89%	11%
Hotel	0%	0%	0%	▨	15%	85%	15%
Cinema	2%	36%	0%	2%	▨	60%	40%
Total Inbound ITC	0%	9%	5%	0%	1%	85%	15%

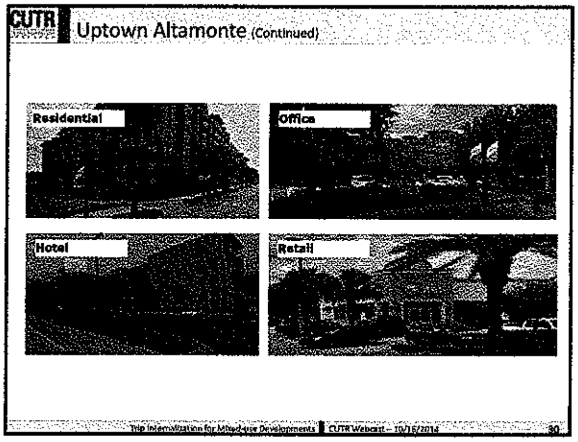


Uptown Altamonte (Altamonte)

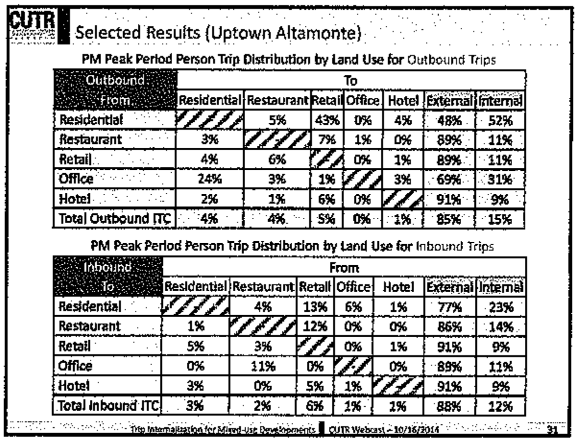


Uptown Altamonte (Continued)

Land Use Type	Size	Units
[illegible]	[illegible]	[illegible]
Restaurant	11,453	sq. ft.
[illegible]	[illegible]	[illegible]
Office	117,175	sq. ft.
[illegible]	[illegible]	[illegible]
Cinema*	92,535	sq. ft.



Uptown Altamonte (Continued)



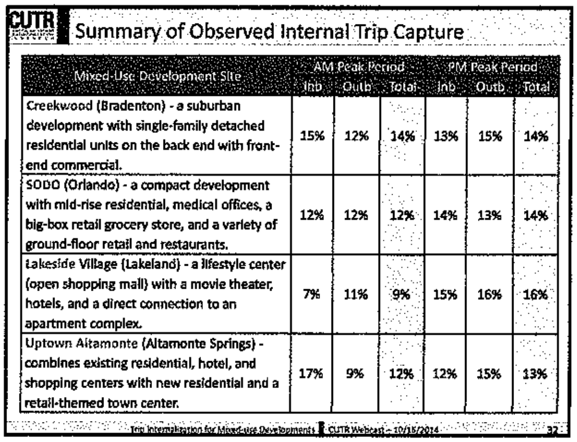
Selected Results (Uptown Altamonte)

PM Peak Period Person Trip Distribution by Land Use for Outbound Trips

Outbound From	To						
	Residential	Restaurant	Retail	Office	Hotel	External	Internal
Residential	▨	5%	43%	0%	4%	48%	52%
Restaurant	3%	▨	7%	1%	0%	89%	11%
Retail	4%	6%	▨	0%	1%	89%	11%
Office	24%	3%	1%	▨	3%	69%	31%
Hotel	2%	1%	6%	0%	▨	91%	9%
Total Outbound ITC	4%	4%	5%	0%	1%	85%	15%

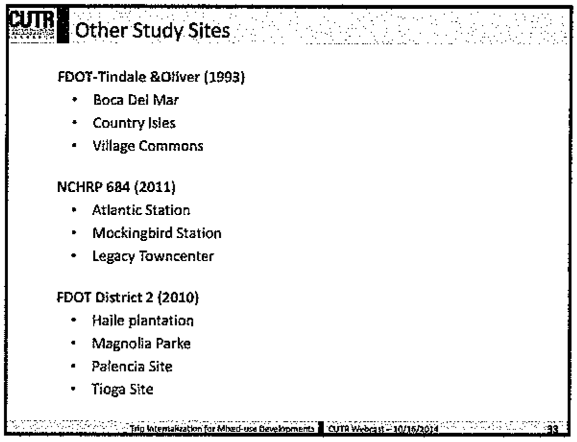
PM Peak Period Person Trip Distribution by Land Use for Inbound Trips

Inbound To	From						
	Residential	Restaurant	Retail	Office	Hotel	External	Internal
Residential	▨	4%	13%	6%	1%	77%	23%
Restaurant	1%	▨	12%	0%	0%	86%	14%
Retail	5%	3%	▨	0%	1%	91%	9%
Office	0%	11%	0%	▨	0%	89%	11%
Hotel	3%	0%	5%	1%	▨	91%	9%
Total Inbound ITC	3%	2%	6%	1%	1%	88%	12%



Summary of Observed Internal Trip Capture

Mixed-Use Development Site	AM Peak Period			PM Peak Period		
	Inb	Outb	Total	Inb	Outb	Total
Creekwood (Bradenton) - a suburban development with single-family detached residential units on the back end with front-end commercial.	15%	12%	14%	13%	15%	14%
SODO (Orlando) - a compact development with mid-rise residential, medical offices, a big-box retail grocery store, and a variety of ground-floor retail and restaurants.	12%	12%	12%	14%	13%	14%
Lakeside Village (Lakeland) - a lifestyle center (open shopping mall) with a movie theater, hotels, and a direct connection to an apartment complex.	7%	11%	9%	15%	16%	16%
Uptown Altamonte (Altamonte Springs) - combines existing residential, hotel, and shopping centers with new residential and a retail-themed town center.	17%	9%	12%	12%	15%	13%



Other Study Sites

FDOT-Tindale &Oliver (1993)
- Boca Del Mar
- Country Isles
- Village Commons

NCHRP 684 (2011)
- Atlantic Station
- Mockingbird Station
- Legacy Towncenter

FDOT District 2 (2010)
- Haile plantation
- Magnolia Parke
- Palencia Site
- Tioga Site

Results & Discussion

Internal Trip Capture for Mixed-use Developments

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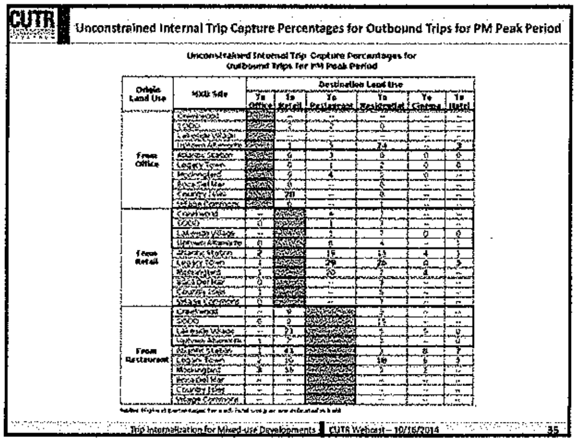

Unconstrained Internal Trip Capture Percentages for Outbound Trips for PM Peak Period

Unconstrained Internal Trip Capture Percentages for Outbound Trips for PM Peak Period

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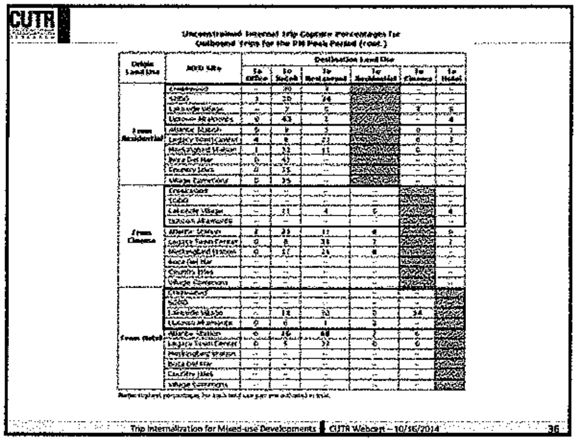

Unconstrained Internal Trip Capture Percentages for Outbound Trips for the PM Peak Period (cont.)

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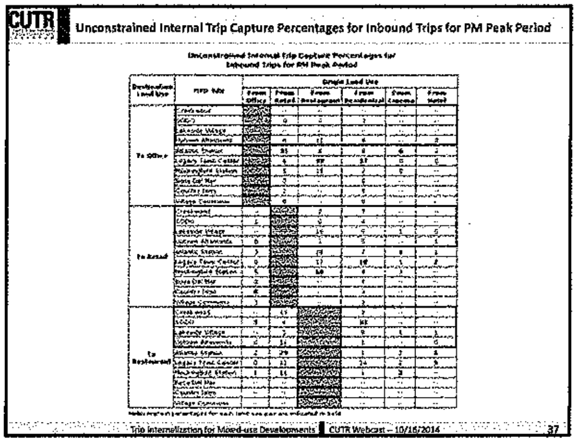

Unconstrained Internal Trip Capture Percentages for Inbound Trips for PM Peak Period

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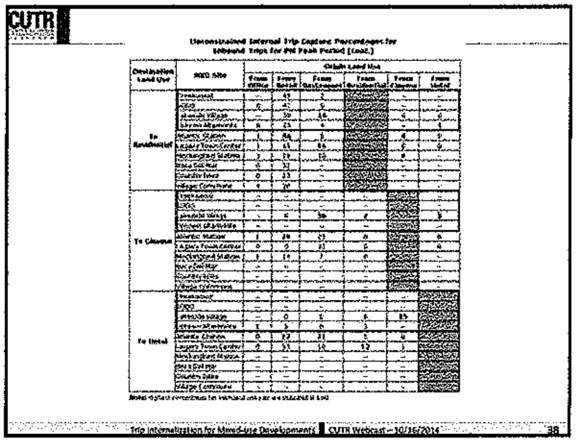

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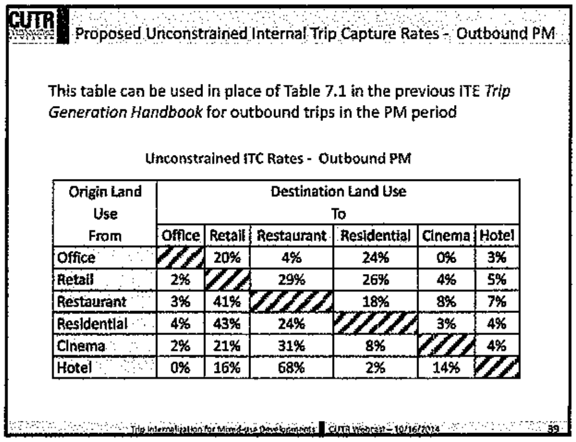

Proposed Unconstrained Internal Trip Capture Rates - Outbound PM

This table can be used in place of Table 7.1 in the previous ITE *Trip Generation Handbook* for outbound trips in the PM period

Unconstrained ITC Rates - Outbound PM

Origin Land Use From	Destination Land Use To					
	Office	Retail	Restaurant	Residential	Cinema	Hotel
Office	▨	20%	4%	24%	0%	3%
Retail	2%	▨	29%	26%	4%	5%
Restaurant	3%	41%	▨	18%	8%	7%
Residential	4%	43%	24%	▨	3%	4%
Cinema	2%	21%	31%	8%	▨	4%
Hotel	0%	16%	68%	2%	14%	▨

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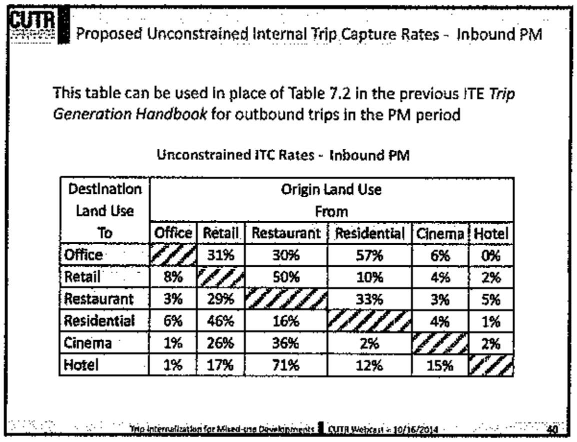
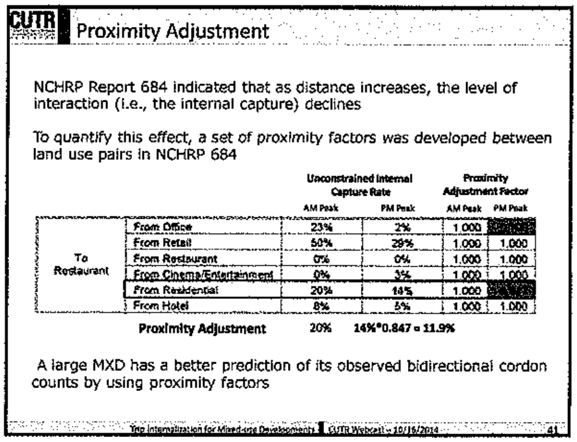


Proposed Unconstrained Internal Trip Capture Rates - Inbound PM

This table can be used in place of Table 7.2 in the previous ITE *Trip Generation Handbook* for outbound trips in the PM period

Unconstrained ITC Rates - Inbound PM

Destination Land Use To	Origin Land Use From					
	Office	Retail	Restaurant	Residential	Cinema	Hotel
Office	▨	31%	30%	57%	6%	0%
Retail	8%	▨	50%	10%	4%	2%
Restaurant	3%	29%	▨	33%	3%	5%
Residential	6%	46%	16%	▨	4%	1%
Cinema	1%	26%	36%	2%	▨	2%
Hotel	1%	17%	71%	12%	15%	▨



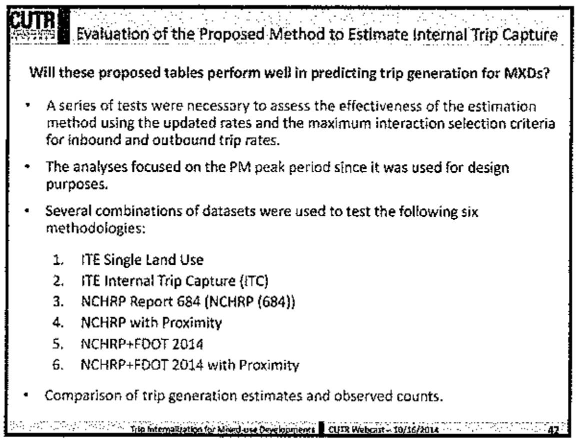
Proximity Adjustment

NCHRP Report 684 indicated that as distance increases, the level of interaction (i.e., the internal capture) declines

To quantify this effect, a set of proximity factors was developed between land use pairs in NCHRP 684

		Unconstrained Internal Capture Rate		Proximity Adjustment Factor	
		AM Peak	PM Peak	AM Peak	PM Peak
To Restaurant	From Office	23%	2%	1.000	[illegible]
	From Retail	50%	29%	1.000	1.000
	From Restaurant	0%	0%	1.000	1.000
	From Cinema/Entertainment	0%	3%	1.000	1.000
	From Residential	20%	14%	1.000	[illegible]
	From Hotel	8%	5%	1.000	1.000
	Proximity Adjustment	20%	14%*0.847 = 11.9%		

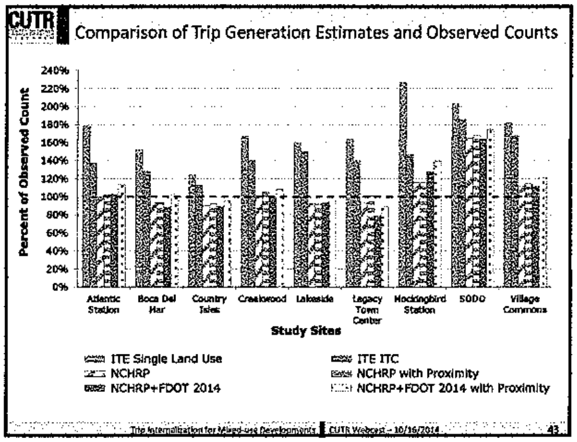
A large MXD has a better prediction of its observed bidirectional cordon counts by using proximity factors



Evaluation of the Proposed Method to Estimate Internal Trip Capture

Will these proposed tables perform well in predicting trip generation for MXDs?

- A series of tests were necessary to assess the effectiveness of the estimation method using the updated rates and the maximum interaction selection criteria for inbound and outbound trip rates.
- The analyses focused on the PM peak period since it was used for design purposes.
- Several combinations of datasets were used to test the following six methodologies:
  1. ITE Single Land Use
  2. ITE Internal Trip Capture (ITC)
  3. NCHRP Report 684 (NCHRP (684))
  4. NCHRP with Proximity
  5. NCHRP+FDOT 2014
  6. NCHRP+FDOT 2014 with Proximity
- Comparison of trip generation estimates and observed counts.



Comparison of Trip Generation Estimates and Observed Counts

Summary of Estimation Tests

The combined data (NCHRP+FDOT 2014) improved the prediction in five out of eight test cases, **with** one test case tied

Development	NCHRP 684	NCHRP+ FDOT 2014	Size (acres)	Best Estimate
Atlantic Station	100%	103%	117	NCHRP
Boca Del Mar	94%	103%	296	NCHRP+FDOT 2014 with Proximity
Country Isles	92%	96%	71	NCHRP+FDOT 2014 with Proximity
Creekwood	101%	99%	43	NCHRP or NCHRP + FDOT 2014 (tie)
Lakeside Village	92%	96%	74	NCHRP+FDOT 2014 with Proximity
Legacy Town Center	101%	89%	77	NCHRP with Proximity
Mockingbird Station	116%	128%	11	NCHRP
SODO	165%	164%	18	NCHRP+FDOT 2014
Village Commons	112%	111%	101	NCHRP+FDOT 2014

The estimator without proximity performed better when the area of an MXD is within 43 acres. **For an MXD with at least 71 acres, estimators with proximity were the best predictors (7 out of 9 or 78%)**

Conclusions & Recommendations

Internal Trip Capture for Mixed-use Developments

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Selected Conclusions

- The minimum data elements needed to perform an internal trip capture study are door counts and interviews for origin and destination locations.
- The observed ITC rates of four study MXD sites in Florida for the PM peak period ranged from 13–16 percent and from 9–14 percent for the AM peak period.
- This study verified that the NCHRP enhanced the ITC method to produce more accurate estimates than the previous ITC method.
- The combined data approach (NCHRP+FDOT 2014) improved the prediction capability of the existing data-method combination in five out of eight test cases, with one test case tied.
- This research project produced revised unconstrained ITC rates for further improving the trip generation estimated for MXDs.

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Selected Conclusions (Continued)

- This research contributed to the collective knowledge of internal trip capture by incorporating unconstrained internal trip capture rates for the AM peak period
- The estimator without proximity performed better when the area of an MXD is within 43 acres. For an MXD with at least 71 acres, estimators with proximity were the best predictors (7 out of 9 or 78%)
- If adopted, the updated unconstrained trip rates for PM inbound trips will be comprised of 70 percent NCHRP data and 30 percent FDOT 2014 data. For PM outbound trips the composition will be 67 percent NCHRP data, 30 percent FDOT 2014 data, and 3 percent FDOT 1993 data

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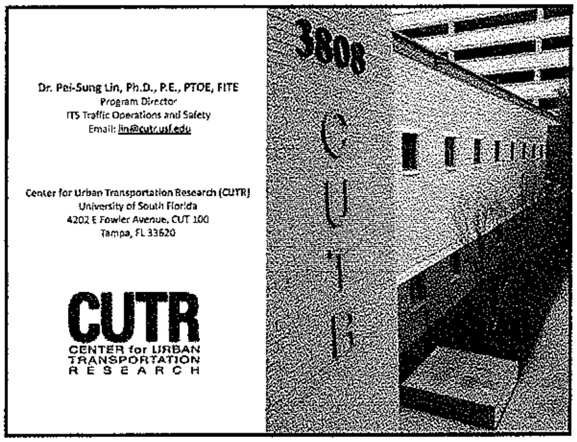
Selected Recommendations

- Perform additional internal trip capture studies, keeping track of detailed land uses and distances between them. In this way, more land use categories can be added to an internal trip capture database
- It is recommended that the proximity factors be considered when the area of an MXD is greater than 55 acres
- Further understanding on proximity of land uses within an MXD and proximity of competitive land uses outside the MXD could potentially shed some light for further improvement on internal trip capture estimation methodologies



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15. SUPPLEMENTARY NOTES

16. ABSTRACT

The Institute of Transportation Engineers'(ITE), Trip Generation Manual provides estimates of the number of trips per unit size that a new development is likely to generate. Most of the data on which ITE bases its trip-generation rates is obtained at suburban locations. As a result, these rates may not accurately reflect the trip generation patterns at smart growth sites where close proximity to other destinations as well as transit and bike facilities make non-vehicular forms of travel more prevalent.

To address this bias, Schneider et al. (2013a) developed a methodology for producing more accurate trip-generation rates for smart growth sites across California. The original study produced a data collection methodology, a smart growth factor incorporating 8 variables representing the degree to which a site reflects smart growth characteristics, trip generation adjustment models for both AM and PM peak hours, and a spreadsheet tool for use by practitioners. The trip-generation models were based on data from more than 50 sites in California. Validation of these models was conducted using data from several sites left out of the estimation process.

Follow-up work was done to test and improve the PM model developed in the original study. The follow-up work supplements the original trip generation data collected in California with data collected at 78 sites in the Portland region by Kelly Clifton and others (2012) at Portland State University. These new sites were located across the Portland area in both smart growth and non-smart growth developments. The following sections describe the work done to verify the original model, re-estimate a new PM model based on the combined dataset, and conduct validati

17. KEY WORDS Transportation Modeling, Smart Growth, Urban In-fill, Land Use, Methodology, Vehicle Trips, Mitigation, Institute of Transportation Engineers, ITE, Trip Generation Manual, Trip-Generation Rates, California Study, Portland Oregon Study, pedestrian, bicycle, transit, automobile	18. DISTRIBUTION STATEMENT No restrictions. This document is available to the public through the National Technical Information Service, Springfield, VA 22161

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FINAL REPORT
California Smart-Growth Trip Generation Rates Study
University of California, Davis for the California Department of Transportation
March 2013

AUTHORS
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Robert Schneider, Ph.D., University of California, Davis

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Final Report for the California Smart-Growth Trip Generation Rates Study

1. Introduction

The California Environmental Quality Act (CEQA) and other state, federal, and local laws require the identification, analysis, and mitigation of transportation-related impacts of proposed land use projects. The first step in preparing a transportation impact analysis is to estimate the number of trips by cars, trucks, and other modes of travel that may result from a proposed land use project – a process commonly referred to as "trip-generation." Currently, practitioners typically use trip-generation rates published by the Institute of Transportation Engineers (ITE), a national professional organization.

For the most part, ITE's trip-generation rates are based on data obtained at suburban locations that lack good transit or bicycle and pedestrian facilities. Not surprisingly, studies indicate that these rates often significantly over-estimate the number of trips from cars and trucks for land use projects located in urban areas near transit and within easy walking distance of other land uses (Tindale Oliver and Associates 1993; Steiner 1998; Muldoon and Bloomberg 2008; Arrington and Cervero 2008; Kimley Horn Associates 2009; Bochner *et al*. 2011). In fact, ITE guidelines state that their trip-generation rates data should not be used for such projects, here labeled "smart growth" projects.

However, there is currently no commonly accepted methodology in the U.S. for estimating multi-modal trip-generation rates associated with smart-growth projects. This makes it very difficult for practitioners to accurately estimate the traffic impacts of such projects, or to identify and recommend appropriate or adequate transportation "mitigations," including walking, biking, and transit facilities. By following existing guidelines, transportation engineers often over-prescribe automobile infrastructure in smart-growth locations, resulting in wider roadways, more turning lanes, and more parking spaces than necessary. In addition, there is no established approach to recommend adequate pedestrian, bicycle, or public transit facilities that may improve conditions for traveling by these other modes.

The goal of this project was to develop a methodology and spreadsheet tool that practitioners can use to estimate multi-modal trip-generation rates for proposed smart-growth land use development projects in California. The project involved multiple tasks (Table 1), carried out between September 2009 and February 2013. The UC Davis Project Team (Table 2) collected trip-generation data at 30 smart growth sites in California and used this information, along with trip generation data from other studies, to develop a method built into a spreadsheet tool that adjusts trip-generation estimated based on ITE rates. The technical advisory panel for the project, called the "Practitioners Panel," provided important input throughout the project. The Panel comprised representatives from state, regional, and local agencies as well as private consulting firms and non-governmental organizations (Table 3).

This report describes three key steps in the process of developing the tool: the identification and evaluation of existing tools, the development and implementation of a data collection methodology, and the development of the trip generation method. Appendices A-F present the detailed results of the project (Table 4). This report and the appendices are available at: http://ultrans.its.ucdavis.edu/projects/smart-growth-trip-generation.

Table 1. Project Tasks

Task	Description	Appendix
1	Operating procedures and acceptance criteria	-
2	Definitions: define key terms required for this effort	A
3	Identification, review, summary and evaluation of available information	B
4	Practitioners Panel	-
5	Design door count procedures	E
6	Evaluate existing analysis methodologies	C, D
7	Select or modify existing methodology, or develop a new methodology	F
8	Draft and Final Summary Reports of the Entire Study	-
9	Design Data Collection Procedures and Intercept Survey	E
10	Site selection	E
11	Pilot count and summary	E
12	Cordon count collection and summary	E
13	Cordon count analysis and report	E

Table 2. Project Team

Terry Parker, M.A., Caltrans Project Manager Dr. Susan Handy, Principal Investigator Dr. Kevan Shafizadeh Dr. Robert Schneider Dr. Richard K. Lee Dr. Deborah Niemeier Dr. Brian Bochner, Texas Transportation Institute Dr. Benjamin Sperry, Texas Transportation Institute	Rachel Maiss, graduate student Josh Miller, graduate student David van Herick, graduate student Nanako Tenjin, graduate student Calvin Thigpen, graduate student Mary Madison Campbell, project assistant

Table 3. Practitioner Panel Members

Organization	Representative
State & Regional Agencies	
Caltrans – (Calif. Dept. of Transportation)	Marc Birnbaum, Supervising Senior Transportation Planner (HQ Traffic Operations Division)
Metropolitan Planning Organization	
San Diego Association of Governments (SANDAG)	Christine Eary, Associate Regional Planner

Local Government	
City of San Diego – Planning Department	Samir Hajjiri, Senior Traffic Engineer (PE)
Non-profit organizations	
TransForm (SF Bay Area)	Ann Cheng, Senior Planner, GreenTRIP manager Jennifer West, GreenTRIP Program Associate
Consultants, etc.	
Economic & Planning Systems (EPS)	Ed Sullivan, GIS Senior Technical Associate
Gibson Transportation Consulting	Pat Gibson, President (PTOE)
Pang Ho PHA Associates	Pang Ho, Principal, PH Associates (PE)
Parsons Brinckerhoff (PB)	Donald Hubbard, Senior Supervising Planner
Townworks + DPZ	Paul Crabtree, Principal (PE)
TPG Inc.	Charles Clouse, Principal (AICP, PCP)
VRPA Technologies, Inc.	Erik Ruehr, Director of Traffic Engineering (PE)

Table 4. Appendices to the Final Report

Appendix A. Definition of "smart growth"
Appendix B. Annotated review of land use & transportation literature
Appendix C. Summary & comparison of existing tools worldwide
Appendix D. Evaluation of the operation & accuracy of available methodologies
Appendix E. UCD's Data Collection Methodology and Results
Appendix F. Method for Adjusting ITE Trip Generation Estimates for Smart Growth Projects
Smart Growth Trip-Generation Adjustment Tool

2. Existing Tools

The UC Davis Project Team searched for existing tools that provide trip generation estimates for smart growth projects (as described in Appendices C and D). A key consideration was the tool's ability to respond to location, density, mixed land uses, and other design characteristics that have been found to facilitate non-motorized travel and thereby reduce vehicle trips. In general, the search emphasized tools that are more context-sensitive than the traditional ITE *Trip Generation* method.

The Team identified eight existing tools. A majority of the identified tools adjust the ITE trip generation rates (or an alternative set of rates compiled by the San Diego Association of Governments (SANDAG)) to better reflect the effects of location, density, mixed land uses, and other design characteristics on trip generation. In addition to this type of tool, the team identified two other types: tools that provide rates based on trip generation data collected at sites with smart growth characteristics, and one tool that uses person-trip data from a travel survey. All of these tools showed the potential to be better than the traditional ITE *Trip Generation* method, though none was without obvious limitations.

Table 5. Existing Tools Identified and Assessed

Tool	Included in Assessment?
Adjustments to ITE/SANDAG Rates	
ITE Mixed-Use	Yes
EPA Mixed-Use Model/SANDAG Mixed-Use Model	Yes
URBEMIS	Yes
NCHRP 8-51 Method and Spreadsheet Tool	Yes
Eakland's Model	No – San Diego only
Organized Empirical Database Tools	
UK's TRICS	No – UK data only
New Zealand Trips and Parking Database	No – NZ data only
Person-Trip Based Tools	
San Francisco Method/MTC Survey Method	Yes

The Team undertook an evaluation of five of these tools. The evaluation consisted of two parts:

1. An assessment of their operational characteristics, based on criteria identified by an expanded Practitioners Panel;
2. An analysis of the accuracy of each tool in estimating trip generation for 22 sites in California for which observed trip counts were available.

Operational Criteria

An expanded Practitioners Panel that included 20 representatives from various local and regional agencies, non-profit groups, and consulting firms identified key operational criteria by which the tools were assessed. During several conference calls, the panelists discussed the qualities – in addition to accuracy – that they most require in a tool for estimating trip generation for smart growth land use projects. From these discussions, the Team compiled a list of operational criteria and reviewed them with the panelists. The operational criteria were grouped into the following categories: 1) Ease of use; 2) Sensitivity to key smart growth elements; 3) Input requirements; 4) Output features; and 5) Usability of a methodology or tool in helping to define smart growth projects based on their performance.

Based on its experience in applying each method (to analyze their accuracy, as described below), the Team rated the methods/tools on each criterion. The Team then invited panelists to rate the criteria as to their relative importance via an on-line survey. Eight members of the Practitioners Panel responded to the on-line survey. Respondents were asked to rate each criterion from one to six with one being "least important" and six being "most important." The eleven top-rated criteria are shown in Table 6. The Team then assessed tools based on the combination of the performance rating and the importance rating. This assessment showed that no one tool met every operational goal, and thus none emerged as a clear "winner."

Table 6. Most Important Operational Criteria

Criterion	Criterion Type	Rating (on 6 point scale)
Sensitivity of outputs to inputs	Input requirements	6.0
Results replicable by other analysts	Output	5.8
Results should not fluctuate excessively	Additional criteria	5.6
Method measures the performance of different kinds of land use policies	Additional criteria	5.6
AM/PM/daily/other time frames reported	Output	5.4
Auto vs. other trip generation rates	Output	5.3
LU context variables	Sensitivity	5.1
Internal capture shown	Output	5.0
Project-level variables	Sensitivity	5.0
Transport variables	Sensitivity	4.9
Project description by land use(s) and size	Output	4.9

Accuracy

The Practitioners Panel identified the ability to accurately predict trip generation for projects as the most important criterion against which each method or tool should be evaluated. To assess the relative accuracy of each of the five candidate methods, the Team compared available cordon counts at ten multi-use sites and twelve infill sites in California against estimates from the five candidate methodologies (see Appendix D). These methods were also compared to the industry standard ITE trip generation rates for single land uses.

Traffic count data used to evaluate the accuracy of the candidate methodologies come from two sources: 1) daily and peak-hour traffic counts at 10 sites in California originally collected for validation of the EPA/SANDAG mixed-use method (referred to as the "multi-use sites"); and 2) peak hours cordon count and intercept survey data for 12 infill sites that was gathered for Caltrans' *Trip-Generation Rates for Urban Infill Land Uses in California* study (referred to as the "infill sites"). Most of the multi-use sites are medium to large-scale developments (5 to 200+ acres) located outside urban cores. By contrast, the Infill sites are single uses located in urban cores close to high-quality transit. Appendix D provides information about each of the sites.

The results of the accuracy analysis also did not identify a clear "winner." For the multi-use sites, the EPA mixed-use method produced the most accurate estimate for the greatest number of sites, particularly for daily counts. This was not surprising, given that these sites were chosen based on their similarity to the sites used to calibrate the method. For the sites for which the EPA method was not most accurate, no one method proved best: the other four methods were each most accurate for at least two site-time period combinations. For the single-use urban infill sites, a clearly best method did not emerge, with each method proving most accurate for some number of site-time period combinations. However, the results showed that all of the methods performed better than the ITE rates for both multi-use and infill sites.

Given the limitations of the available tools for estimating trip generation at smart growth sites with respect to both operational characteristics and accuracy, the Project Team under the guidance of the Practitioners Panel proceeded to pursue the development of an entirely new method based on the data used in accuracy assessment as well as additional data collected at smart growth sites in California as a part of this project.

3. Data Collection

The UC Davis Project Team, with input from a subcommittee of the Practitioners Panel, next developed a data collection and analysis methodology to document the number of pedestrian, bicycle, public transit, and automobile trips generated by developments in smart-growth areas in California (as described in detail in Appendix E). The methodology builds upon established methods so that it can be integrated easily into standard transportation engineering and planning practice. It can be replicated and refined in other communities seeking to collect trip generation data in smart-growth areas.

The Team applied the methodology in the field at 30 study locations in California during spring 2012. Study locations consisted of a single land use within a smart growth development site; detailed descriptions of the sites and the criteria by which they were selected are provided in Appendix E. Field data collection involved a combination of door counts and intercept surveys. The core component at each study location was a count of all people entering and exiting the site or targeted land use. In-person intercept surveys were administered to a sample of people as they exited doors at each study location. These surveys were designed to determine 1) the mode, time of day, origin, and length of inbound trips to the study location and 2) the mode, time of day, destination, and length of outbound trips from the study location. The intercept surveys also collected information about vehicle occupancy so that the person-trip counts for automobile users could be compared to ITE vehicle-based trip rates.

Overall, the door counters recorded a total of 31,515 individual entries and exits at the 30 locations. The surveyors approached a total of 5,501 people and of these, 3,371 (61%) provided at least a basic response with their current travel mode (2,129 refused to participate and one did not provide a travel mode). The 3,371 respondents reported a total of 5,170 trips. Based on these data, the Team calculated peak-hour person trips by mode for each location and compared peak-hour vehicle trips to estimates of such trips based on ITE rates. The analysis showed that automobile person-trips accounted for fewer than half of morning peak-hour trips at 10 study locations and fewer than half of afternoon peak-hour trips at 11 study locations. As a result, the numbers of vehicle trips at these smart growth sites were, on average, approximately half as high as predicted by standard ITE trip generation rates.

This data collection methodology has several advantages over existing approaches that use automated technologies to count automobiles entering and exiting access points to developments. These advantages are particularly important in urban areas with mixed-use developments, mixed-use buildings, and a variety of parking arrangements. Existing methods that only capture automobile trips would have missed more than half of all person-trips recorded at the study locations: overall, 27% of person-trips were made by walking, 21% by transit, and 3% by bicycle.

4. Trip Generation Method

Although vehicle trips at the 30 California smart growth locations for which UC Davis collected data were, on average, much lower than ITE rates would predict, the difference between actual and ITE-estimated vehicle trips varied from site to site (Table 7). In order to provide the best possible estimates of vehicle trips at new development sites in smart-growth areas, it is necessary to account for this variation. To this end, the UC Davis Project Team developed a method that can be used by practitioners to adjust estimates based on existing ITE rates to produce more accurate weekday AM and PM peak hour vehicle trip generation rate estimates at developments with smart-growth characteristics.

The method takes estimates of vehicle trips based on ITE rates and adjusts them based on characteristics of the proposed development project and its surrounding context (as described in detail in Appendix F). At the core of the method are simple linear regression equations with the AM or PM adjustment factor as the dependent variable and easily-measured site and context characteristics as the explanatory variables. These AM and PM models were developed using a database of vehicle trip counts and site/context data for a sample of 50 "smart-growth" sites in California. This sample was drawn from the 30 locations for which UC Davis collected data in Spring 2012, the 22 sites used in the assessment of existing tools (see Section 2, above), and sites from other studies; sites not used in developing the equations were reserved for validating the equations.

The starting point for the model development process was the extensive literature on the connections between characteristics of the built environment and travel behavior. Empirical evidence points to the importance of factors such as population density and land use mix as

Table 7. Actual Peak-hour Vehicle-Trips versus Estimated Vehicle-Trips from Published ITE Rates

	Targeted Land Uses (ITE Use Code)[1]				AM Peak Hour								PM Peak Hour							
Site Name	Mid- to High-Density Residential	Office	Commercial Retail Goods	Coffee/Donut Shop	Actual Total Person Trips[2]	Actual Auto Person Trips[3]	Actual Auto Occupancy[4]	**Actual Vehicle Trips**	ITE-Estimated Vehicle Trips[5]	Actual-ITE Vehicle Trips	ITE/Actual Vehicle Trips[6]	ITE-Estimated Total Person Trips[7]	Actual Total Person Trips[2]	Actual Auto Person Trips[3]	Actual Auto Occupancy[4]	**Actual Vehicle Trips**	ITE-Estimated Vehicle Trips[5]	Actual-ITE Vehicle Trips	ITE/Actual Vehicle Trips[6]	ITE-Estimated Total Person Trips[7]
Pegasus	222				136	42	1.18	**36**	**92**	-56	2.56	109								
Sakura Crossing	223				106	85	1.10	**77**	**66**	11	0.86	73	152	68	1.10	**61**	**86**	-25	1.40	95
Argenta	222				89	33	1.34	**25**	**53**	-28	2.14	71	107	29	1.34	**22**	**62**	-40	2.85	83
Fremont Building	223				50	31	1.23	**25**	**20**	5	0.80	25	42	28	1.23	**23**	**26**	-3	1.13	32
Artisan on 2nd	223				62	41	1.28	**32**	**34**	-2	1.06	44	51	40	1.28	**31**	**44**	-13	1.41	56
Terraces Apartment Homes[8]	223				88	69	1.29	**54**	**78**	-24	1.45	101	85	47	1.29	**37**	**101**	-64	2.76	130
Holly Street Village[9]	223				175	144	1.33	**108**	**107**	1	0.99	142	185	125	1.33	**94**	**139**	-45	1.48	185
Broadway Grand	223				72	36	1.57	**23**	**32**	-9	1.42	50	85	34	1.57	**22**	**42**	-20	1.93	66
Archstone at Del Mar Station	223				98	66	1.31	**50**	**66**	-16	1.32	86	102	60	1.31	**46**	**86**	-40	1.87	113
The Sierra	223				121	74	1.47	**50**	**66**	-16	1.31	97	166	90	1.47	**61**	**86**	-25	1.40	126
Terraces at Emery Station	223				159	112	1.12	**100**	**30**	70	0.30	34	138	98	1.12	**87**	**39**	48	0.45	44
Victor on Venice	223				61	51	1.17	**44**	**33**	11	0.76	39	76	59	1.17	**50**	**43**	7	0.85	50
343 Sansome[10]		710			316	103	1.43	**72**	**355**	-283	4.93	508	333	84	1.43	**58**	**341**	-283	5.83	488
Convention Plaza		710			514	214	1.17	**183**	**481**	-298	2.63	563	491	193	1.17	**165**	**462**	-297	2.80	541
Charles Schwab Building		710			510	104	1.77	**59**	**498**	-439	8.45	881	401	76	1.77	**43**	**479**	-436	11.17	848
Park Plaza		710											53	36	1.27	**28**	**95**	-67	3.36	121
Park Tower		710			617	383	1.20	**319**	**645**	-326	2.02	774	566	374	1.20	**312**	**620**	-308	1.99	744
Oakland City Center		710			248	128	1.28	**100**	**297**	-197	2.96	380	221	75	1.28	**59**	**286**	-227	4.88	366
180 Grand Avenue		710			184	96	1.21	**80**	**271**	-191	3.40	328	143	79	1.21	**65**	**261**	-196	4.02	316
Emery Station East		710			298	151	1.14	**133**	**365**	-232	2.75	416	251	140	1.14	**123**	**351**	-228	2.86	400
181 Second Avenue		710			101	101	1.10	**92**	**77**	15	0.84	85	114	94	1.10	**85**	**74**	11	0.87	81
Oakland City Center			880										479	0	1.28	**0**	**93**	-93	Undefined	119
Paseo Colorado			820										1551	1208	1.57	**770**	**1856**	-1086	2.41	2914
Fruitvale Station			867										116	99	1.50	**66**	**102**	-36	1.54	153
343 Sansome[10]				936	356	41	1.43	**29**	**129**	-100	4.45	184								
Convention Plaza				936	259	62	1.17	**53**	**182**	-129	3.46	213	80	25	1.17	**21**	**63**	-42	2.97	74
Park Tower				936	430	94	1.20	**78**	**194**	-116	2.48	233	90	23	1.20	**19**	**67**	-48	3.55	80
Oakland City Center[11]				936																
Broadway Grand				936	316	141	1.57	**90**	**152**	-62	1.69	239	237	57	1.57	**36**	**53**	-17	1.46	83
Fruitvale Station				936									192	179	1.50	**119**	**54**	65	0.45	81
					5365	2403		**1911**	**4323**	-2412	2.26	5673	6508	3419		**2504**	**6011**	-3507	2.40	8389

1) ITE Use Codes are from the ITE Trip Generation Manual, Eighth Edition.

2) Actual total person trips trips is the total number of person trips during the peak hour at the study location. The estimated number of trips was adjusted for gender bias and different mode shares at each door. Locations with fewer than 30 surveyed trips during a data collection period were not analyzed because they were determined to have insufficient data to estimate mode shares.

3) Actual automobile person trips is the total number of person trips that used an automobile mode at each site.

4) Automobile occupancy was estimated from the total morning or afternoon survey responses at each site.

5) ITE-estimated vehicle trips were calculated using standard Trip Generation Manual (2008) trip rates.

6) The ratio of ITE vehicle trips to actual vehicle trips is undefined when the estimate of actual peak hour vehicle trips was 0.

7) ITE-estimated total person trips were calculated by multiplying the ITE-estimated vehicle trips by the average automobile occupancy for each site. This assumes that the ITE estimates are based sites with 100% automobile mode share.

8) PM data collection at Terraces Apartment Homes was from 3:30 p.m. to 6:30 p.m.

9) PM data collection at Holly Street Village was from 3:30 p.m. to 6:30 p.m.

10) AM data collection at 343 Sansome was from 6:30 a.m. to 9:30 a.m.; PM data collection at 343 Sansome was from 4:00 p.m. to 6:30 p.m.

11) Results were not reported for the Oakland City Center coffee shop because there were fewer than 30 surveys in both the AM and PM study periods.

predictors of trip frequency and mode choice (see Appendix B). Guided by this evidence, the Team created a database of potential explanatory factors—variables that may predict the difference between actual trip counts at smart-growth development projects and trip estimates based on ITE rates. The Team focused on variables that would be relatively easy to measure or acquire using data from the U.S. Census, Google Maps, transit agencies, and other sources.

In order to create theoretically-sound models that are also practical to use, the Team tested many variables and many model structures. Because smart growth characteristics are commonly found together (e.g. it is unusual to find high population density without frequent transit service, and vice versa), many of the potential explanatory factors were statistically correlated, a problem in fitting linear regression equations. To address this problem, the Team settled on a two-stage approach, which was presented to and approved by the Practitioners Panel. In the first stage, a smart growth factor is calculated as a function of eight site and context characteristics (see Table 8). In the second stage, the calculated smart growth factor, a dummy variable for the particular land use, and a dummy variable for proximity to a university are plugged into a linear regression equation to estimate an adjustment factor (see Table 9). The equations, their derivation, and their application are discussed in detail in Appendix F.

Table 8. Variables in Smart Growth Factor Equation

Residential population within a 0.5-mile, straight-line radius (000s)
Jobs within a 0.5-mile, straight-line radius (000s)
Straight-line distance to center of major central business district (CBD) (miles)
Average building setback distance from sidewalk (feet)
Metered on-street parking within a 0.1-mile, straight-line radius (1=yes, 0=no)
Individual PM peak-hour bus line stops passing within a 0.25-mile, straight-line radius
Individual PM peak-hour train line stops passing within a 0.5-mile, straight-line radius
Proportion of site area covered by surface parking lots (0.00 to 1.00)

Table 9. Variables in Adjustment Factor Equation

Smart-Growth Factor
Office land use (1 = yes, 0 = no)
Coffee shop land use (1 = yes, 0 = no)
Multi-use development (1 = yes, 0 = no)
Within 1 mile of a university (1 = yes, 0 = no)
Office land use (1 = yes, 0 = no)

The AM and PM models were validated using the sites with available vehicle trips counts that were not used in developing the equations. Validation was done by comparing the ratio of actual to ITE-estimated vehicle trips from the models with the observed data at the validation sites. This comparison showed that the models predicted the smart-growth adjustment accurately at some validation sites (e.g. the model ratio was within 50% of the observed ratio) but lacked accuracy at other sites. In general, the models overestimated the ratio of actual to ITE vehicle trips at sites with the least accurate model predictions (i.e., actual trip data showed that sites had fewer vehicle trips than the model predicted). Thus, the models produced conservative adjustments relative to ITE-based trip estimates.

It is important to note that the resulting models are only appropriate for analysis at single-use sites or single land uses that are a part of multi-use sites and only for such sites that are in smart-growth areas. In consultation with the Practitioners Panel, the Team defined specific criteria that should be met in order to apply the model (Table 10). For sites that do not meet these criteria, the models may overestimate the adjustment to ITE rates and thus underestimate vehicle trips.

Table 10. Criteria for Applying Models

Land Uses	ITE Trip Generation Land Use Codes: Residential (220, 222, 223, 230, 232), office (710), restaurant (925, 931), and coffee/donut shop (936); potentially applicable to retail land use codes.
Development	▪ The area within a 0.5-mile radius of the site is mostly developed, and ▪ There is a mix of land uses within a 0.25-mile radius of the site, and ▪ J>4,000 and R>(6,900-0.1J), where J is the number of jobs within a 0.5-mile radius of the site and R is the number of residents within a 0.5-mile radius of the site, and ▪ There are no special attractors within a 0.25-mile radius of the site (e.g., stadiums, military bases, commercial airports, etc).
Transit service	During a typical weekday PM peak hour, there are at least 10 bus stop locations on all bus lines that pass within any part of a 0.25-mile radius around the study site, or 5 individual train stop locations on all train lines that pass within any part of a 0.5-mile radius around the study site during a typical weekday PM peak hour.
Pedestrian or bicycle infrastructure	There is at least one designated bicycle facility within two blocks of the edge of the site (designated bicycle facilities include multi-use trails, cycle tracks, and bicycle lanes), or there is >50% sidewalk coverage on streets within a 0.25-mile radius of the site.

The UC Davis Project Team developed a spreadsheet tool that practitioners can use to apply the method. The first page of the spreadsheet outlines the criteria for applying the method. The practitioner enters data for the development project for each of the criteria. If the development project meets the criteria, the practitioner can then move to the second page, where he or she enters additional data needed by the models, and the spreadsheet then calculates the adjustment factors and trip generation estimates. The Practitioners Panel reviewed draft versions of the spreadsheet tool and made many useful suggestions to improve its usability. The spreadsheet tool is available at:

http://downloads.ice.ucdavis.edu/ultrans/smartgrowthtripgen/CA_SGTG_Spreadsheet_Tool_1.0.xlsx

5. Conclusions

This project addressed the need for a methodology that practitioners can use to estimate multi-modal trip-generation rates for proposed smart-growth land use development projects in California. After identifying and assessing existing alternatives to ITE trip generation rates, the UC Davis Project Team concluded that a new method, based on new data, was needed. The Team collected multi-model trip-generation data at 30 locations in California and used these data, along with available data from other studies, to develop a smart-growth trip-generation tool.

This tool represents a significant step forward, but additional work is needed. It is likely that the small-sample models do not account for all of the complex variation in sites, including different levels of economic activity at particular locations. Additional data collection is needed at a wider range of land uses and at sites with a wider range of characteristics. Given enough data, it may be possible to develop separate models for different land use categories to account for the specific ways that smart growth characteristics affect trip generation for those uses. In addition, given enough data, it may be possible to develop models that estimate trips directly as a function of site characteristics rather than as an adjustment to ITE-based estimates. Ultimately, the results of this and future studies will benefit practitioners seeking to evaluate developments that support sustainable transportation and land use systems.

Comments Presented to the Planning Commission
City of Shoreline

Regarding the 145th St. Station Light Rail Subarea Plan Public Hearing

February 19, 2015

Submitted by Brian Derdowski

On behalf of

Public Interest Associates
Sensible Growth Alliance
and
Shoreline Preservation Society

The following comments are in response to the February 19 staff report. The quoted sections are followed by our comments in bold italics.

1)

"The City built on information in Sound Transit's DEIS, including traffic modeling and other environmental analysis to create the 145SSSP DEIS."

If the staff "built on information", then where is that information in the DEIS? This information must be specifically included in the DEIS in order for it to be reviewable by the public and parties of record, fairly considered by the decision makers, and subject to appeal. If the staff considered this information useful and important, why wasn't it included in the DEIS?

2)

"Transportation staff that were very involved in review and commenting on Sound Transit's DEIS have advised that there is no substantial reason to wait for Sound Transit to publish their FEIS before moving forward with station subarea planning."

With all due respect, transportation staff are not 'the deciders' when it comes to what should be included in a DEIS. The point the various commenters were making is that the extensive analysis that Sound Transit is doing regarding transportation impacts, station design, construction impacts, land use impacts, stormwater impacts and other issues should be included in the DEIS for the 145th Station Project. Sound Transit's project and the City's subarea plan are inextricably linked. The City's subarea plan is based on Sound Transit's project, and was initiated as a direct result of that project. It is not consistent with SEPA law and rules to separate these two projects.

3)

"Sound Transit will be responsible for mitigating impacts caused by the stations, parking garages, rail lines, and the traffic caused by users getting to either of the stations. Their FEIS will identify (and their Board will make a decision on) impacts and mitigations for which they will be responsible."

The City is responsible for evaluating Sound Transit's impacts, and, as the permitting agency, should be the lead agency in doing the SEPA review. If the City includes Sound Transit's impacts in its DEIS, then it will have the authority to condition that development appropriately. Other cities have used this approach in dealing with Sound Transit, and Shoreline should too. By trusting Sound Transit to "identify impacts and mitigations", residents might even suggest that the staff is being naïve, and failing to adequately defend the interests of the City and its citizens and businesses.

4)

"Impacts and mitigations that are not attributed to Sound Transit stations, parking, rail lines, or commuter traffic will need to be implemented by the City as capital projects, or developers who build new projects in the subarea."

This statement makes no sense in the context of the public comment. The purpose of SEPA review is to identify impacts. Properly documented, they provide the basis for imposing SEPA mitigation conditions. By incorporating the Sound Transit SEPA review into the subarea SEPA review, any SEPA gap can be identified and mitigated. Once the City finalizes its SEPA review, it would be time consuming and costly to revise its FEIS based on findings and recommendations in Sound Transit's review.

5)

"The City and community will have additional opportunities to work with Sound Transit through Transit-way and Development Agreements, and their design process for stations, parking garages, the 185th Street overpass, and 195th Street pedestrian bridge."

What does "opportunities to work" mean? The City's authority to condition Sound Transit's project is based on its development code and SEPA. Not including Sound Transit's project in its 145th Station DEIS means that the City will not have the authority to use SEPA as a regulatory tool. Since the City's development code does not fully address all of the issues that rail stations typically pose, this would be a significant risk to the public and the City.

6)

"Should 185th and 145th impacts and mitigations be combined into one EIS?- Staff does not anticipate a problem with having two separate EIS documents because the two sets of analysis are being looked at by the City collectively and cumulatively."

This statement is not documented, and is incorrect. Staff may "not anticipate a problem", but a protracted legal appeal would be a major problem. This comment, in fact, would be good evidence against the City's procedure. If it is true that both projects are being looked at "collectively" and "cumulatively", then that meets the legal test for requiring them to be considered in the same SEPA process and documents.

7)

"For the 145th DEIS, "upstream" and "uphill" redevelopment of the 185th subarea was a consideration in the utilities and surface water analysis and as addressed in those sections of Chapter 3."

This statement is not documented, and is incorrect. The peak flow and watershed analysis are not consolidated or even consistent with each other.

8)

"The transportation analyses of both EISs considered known cumulative traffic forecasts (inclusive of both subareas, traffic forecasted in the City's transportation master plan, and traffic related to Point Wells)."

This statement is not documented, and is incorrect. The stated Baseline Forecast assumptions for both station projects are somewhat different and do not mention that the rezone proposals for both station sub areas were considered together. If the data was consolidated when the models were run, then this should be documented in the record. A review of the findings, however, strongly suggest that the various alternatives for both stations were <u>not</u> modeled together.

9)

"The percentages of increased surface water flow calculated for each alternative are the unmitigated expected increases in flow."

This statement is incorrect. The DEIS analyzed "peak flow", not "flow". The method used was the "Rational Method", which only measures peak, not volume. In order to identify current capacity constraints and project future mitigations, the staff should have used a "Modified Rational Method", or other more accurate methodology.

10)

"Because of constitutional and statutory limits on the amount property taxes can increase, such as the 1% limit, it is safe to assume that an increase in property values and assessed values will not automatically lead to an equivalent increase in property taxes."

This statement is misleading. While there are limitations to overall tax collections, there are no limits to increases on individual properties.

The following additional comments are offered:

1. The traffic analysis does not accurately predict mode splits, background traffic, existing demand capacity, projected demand and capacity or cumulative impacts of related land use decisions.

2. The staff did not apply best practices in its use of "MXD". Best practices and the limitations and values of this traffic modeling methodology are documented by two documents submitted under separate cover: "California Smart Growth Trip Generation Rates Study" dated March 2013 and "Internal Trip Capture for Mixed-use Development" by Dr. Pei-Sung Lin, et al. dated October 16, 2014.

3. The DEIS states that: "This analysis provides a planning-level assessment of the level of improvements that will be needed to accommodate growth." **This level of analysis is inappropriate for Planned Actions where implementing projects are exempt from additional SEPA review.**

4. The DEIS states that: "The analysis of change in peak discharge was for DEIS planning purposes only and does not reflect actual expected post-redevelopment conditions. The purpose of the study was to receive a relative understanding of a conservative ("worst-case scenario") unmitigated potential increase in surface water discharge potential zoning increases will have on the current surface water collection system." **This level of analysis is inappropriate for Planned Actions where implementing projects are exempt from additional SEPA review. Moreover, the study does not present a "worst case scenario" because it utilized a fairly low level storm event and utilized the Rational Method that is recognized as inadequate in predicting levels and timing of actual flood events.**

5. The DEIS does not address the full range of stormwater impacts which are related to increases in population such as increased chemicals, metals, and other pollutants.

6. The DEIS appears to use the same twenty year market demand forecast as the 185th Station project, and thus doubles the projected demand.