



Town of Wake Forest Multi-Modal Transportation Impact Fee Study

Draft Report
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Introduction

Located just north of the City of Raleigh and northeast of North Carolina’s Research Triangle Park, the Town of Wake Forest (the Town) is home to approximately 58,000 residents. The town has been experiencing significant growth since its incorporation in 1880 primarily due to the activities of the Research Triangle and availability of lower cost housing. Between 1990 and 2023, the town’s population increased by approximately 52,000 residents. Recent population projections indicate 61,000 additional residents by 2040.

The Town’s ability to charge impact fees is recognized and governed by Senate Bill 576 that was passed in 1989 by the General Assembly of North Carolina. The 1989 Enabling Act allows the Town to implement impact fees for 10 services areas, including transportation (sidewalks and thoroughfare rights-of-ways). Historically, Wake Forest has implemented impact fees for fire, parks and recreation, and cultural resource facilities. At this time, the Town is also interested in implementing multi-modal transportation impact fees and has retained Benesch to prepare the impact fee study. This report presents the study methodology, findings and the resulting multi-modal transportation impact fee schedule.

Methodology

The methodology used for the multi-modal impact fee study follows a consumption-based impact fee approach in which new development is charged based upon the proportion of Person-Miles of Travel (PMT) that each unit of new development is expected to consume of a lane-mile of the transportation network.

Included in this document is the necessary support material used in the calculation of the multi-modal transportation impact fee. The general equation used to compute the impact fee for a given land use is:

$$\mathbf{[Demand \times Cost] - Credit = Fee}$$

The “demand” for travel placed on a transportation system is expressed in units of Person-Miles of Travel (daily vehicle-trip generation rate x the trip length x the percent new trips [of total trips] x person-trip factor) for each land use contained in the impact fee schedule. Trip generation represents the average daily rates to provide a stable measure of new development’s impact.

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The number of trips tends to vary significantly throughout the day by time of day depending on activity levels; however, overall daily trips tend to be stable.

The “cost” of building new capacity typically is expressed in units of dollars per person-mile of transportation capacity.

The “credit” is an estimate of future non-impact fee revenues generated by new development that are allocated to provide transportation capacity expansion. The impact fee is considered to be an “up front” payment for a portion of the cost of building a person-mile of capacity that is directly related to the amount of capacity consumed by each unit of land use contained in the impact fee schedule, that is not paid for by future tax revenues generated by the new development activity. These credits are required under the supporting case law for the calculation of impact fees where a new development activity must be reasonably assured that they are not being charged twice for the same level of service.

The input variables used in the fee equation are as follows:

Demand Variables:

- Trip generation rate
- Trip length
- Percent new trips
- Interstate & toll facility adjustment factor
- Person-trip factor

Cost Variables:

- Cost per person-mile
- Capacity added per lane mile constructed

Credit Variables:

- Equivalent gas tax credit (pennies)
- Present worth
- Fuel efficiency
- Effective days per year

Demand Component

Travel Demand

Travel demand is the amount of transportation system consumed by a unit of new land development activity. Demand is calculated using the following variables and is measured in terms of the person-miles of new travel (PMT) that a unit of development consumes on the existing transportation system:

- Number of daily trips generated (Trip Generation Rate = TGR)
- Average length of those trips (Trip Length = TL)
- Proportion of travel that is new travel, rather than travel that is already on the transportation system and is captured by new development (Percent New Trips = PNT)
- Person-trip factor (converts vehicle-miles of travel to person-miles of travel)

As part of this update, the trip characteristics variables were primarily obtained from two sources:

- The Institute of Transportation Engineers' (ITE) *Trip Generation Handbook* (11th Edition), which is primarily used for trip generation rates.
- Benesch's trip characteristics survey database (TCS database), which includes surveys conducted at individual sites and is used to measure trip length, percent new trips, and the trip generation rate for several land uses. Although this database includes studies primarily conducted in Florida, trip length measurements conducted in Wake Forest suggested that these measures are comparable.

Conversion of Vehicle-Trips to Person-Trips

In the case of the multi-modal approach, it is necessary to estimate travel in units of person-miles. Vehicle-trips were converted to person-trips by applying a vehicle-trip to person-trip conversion factor of 1.41. This value was used in the Triangle Regional Model for passenger vehicles. Given that a large portion of travel occurs via automobile, this approach is found to be reasonable.

Interstate & Toll Facility Adjustment Factor

This variable was used to recognize that interstate highway and toll facility improvements are funded by the State (specifically, the North Carolina Department of Transportation) using earmarked State and Federal funds. Typically, impact fees are not used to pay for these improvements and the portion of travel occurring on the interstate/toll facility system is subtracted from the total travel for each use.

To calculate the interstate and toll (I/T) facility adjustment factor, the loaded highway network file was generated for the Triangle Regional Model (Generation 2). Interstate and toll facilities were identified in the model roadway network for base and future year scenarios.

Currently, several interstate/toll facilities pass through Wake County¹, including I-40, I-87, I-440, I-540, 540 Triex (toll), Morrisville Pkwy, managed lanes, and ramps serving interstates and toll roads. Planned facilities in the 2050 model network were included for the future analysis. The limited access vehicle-miles of travel (Limited Access VMT) for trips on roadways within Wake County was calculated for these facilities. Next, the total VMT was calculated for all travel within Wake County for all roads, including limited access facilities.

The I/T adjustment factor of **36.7 percent** was determined by dividing the total limited access VMT by the total Wake County VMT. The total VMT within the town reduced by this factor is representative of only the roadways that are eligible to be funded with multi-modal impact fee revenues. Appendix A, Table A-1 provides further detail on this calculation.

Adjustment Factor for Travel on Town Roads

This variable reflects the travel handled by the Town roads as opposed to State roads. It was used to adjust the calculated impact fee rate for each land use to reflect the portion of the impact fee that is attributable to Town roads. As shown in Appendix A, Table A-2, approximately **six (6) percent** of the future VMT is projected to occur on Town-owned and maintained roadways.

¹ Although the Town of Wake Forest is located in both Wake and Franklin Counties, because 97% of the land mass is located in Wake County, data from Wake County was utilized for the impact fee analysis.

Table 1
Travel Demand for Town of Wake Forest

ITE LUC	Land Use	Unit	Trip Rate	Assessable Trip Length	Percent New Trips
RESIDENTIAL:					
210	Single Family (Detached); Less than 1,000 sf	du	6.75	6.62	100%
	Single Family (Detached); 1,000 to 1,999 sf	du	7.27	6.62	100%
	Single Family (Detached); 2,000 to 2,999 sf	du	8.32	6.62	100%
	Single Family (Detached); 3,000 sf or greater	du	8.86	6.62	100%
215	Single Family (Attached)	du	6.77	6.62	100%
220	Multi-Family Housing (Low-Rise, 1-3 floors)	du	6.74	5.21	100%
221/222	Multi-Family Housing (Mid/High-Rise, 4+ floors)	du	4.54	5.21	100%
240	Mobile Home Park	du	4.17	4.60	100%
251	Senior Adult Housing (Detached)	du	3.54	5.42	100%
252	Senior Adult Housing (Attached)	du	2.99	4.34	100%
LODGING:					
310	Hotel	room	5.56	6.26	66%
320	Motel	room	3.35	4.34	77%
RECREATION:					
411	Public Park	acre	0.78	5.15	90%
416	Campground/RV Park	site	1.62	4.60	100%
445	Movie Theater	screen	114.83	2.22	88%
492	Health/Fitness Club	1,000 sf	34.50	5.15	94%
INSTITUTIONS:					
520	Elementary School (Private)	student	2.27	3.31	80%
522	Middle/Junior High School (Private)	student	2.10	3.31	80%
525	High School (Private)	student	1.94	3.31	90%
540/550	University/Junior College (7,500 or fewer students) (Private)	student	2.00	6.62	90%
	University/Junior College (more than 7,500 students) (Private)	student	1.50	6.62	90%
560	Church	1,000 sf	7.60	3.93	90%
565	Day Care Center	1,000 sf	47.62	2.03	73%
MEDICAL:					
610	Hospital	1,000 sf	10.77	6.62	78%
620	Nursing Home	bed	3.02	2.59	89%
630	Clinic	1,000 sf	37.39	5.10	93%
OFFICE:					
710	General Office	1,000 sf	10.84	5.15	92%
720	Medical Office/Clinic 10,000 sq ft or less	1,000 sf	23.83	5.55	89%
	Medical Office/Clinic greater than 10,000 sq ft	1,000 sf	34.21	5.55	89%
RETAIL:					
822	Retail less than 40,000 sfgla	1,000 sfgla	54.45	1.48	48%
821	Retail 40,000 to 150,000 sfgla	1,000 sfgla	67.52	1.94	57%
820	Retail greater than 150,000 sfgla	1,000 sfgla	37.01	2.80	75%
840/841	New/Used Auto Sales	1,000 sf	24.58	4.60	79%
850	Supermarket	1,000 sf	93.84	2.08	56%
862	Home Improvement Superstore	1,000 sf	30.74	2.33	64%
880/881	Pharmacy with & without Drive-Thru	1,000 sf	103.40	2.08	32%
890	Furniture Store	1,000 sf	6.30	6.09	54%
SERVICES:					
911	Bank/Savings Walk-In	1,000 sf	57.94	2.46	46%
912	Bank/Savings Drive-In	1,000 sf	100.35	2.46	46%
930	Fast Casual Restaurant	1,000 sf	97.14	2.05	58%
931	Fine Dining (Low-Turnover) Restaurant	1,000 sf	83.84	3.14	77%
932	High-Turnover (Sit-Down) Restaurant	1,000 sf	103.46	3.17	71%
934	Fast Food Restaurant w/Drive-Thru	1,000 sf	467.48	2.05	58%
941	Quick Lube	service bay	40.00	3.62	72%
942	Automobile Care Center	1,000 sf	28.19	3.62	72%
944	Gas Station w/Convenience Market <2,000 sq ft	fuel pos.	172.01	1.90	23%
945	Gas Station w/Convenience Market 2,000-5,499 sq ft	fuel pos.	264.38	1.90	23%
	Gas Station w/Convenience Market 5,500+ sq ft	fuel pos.	345.75	1.90	23%
947	Self-Service Car Wash	service bay	43.94	2.18	68%
INDUSTRIAL:					
110	General Light Industrial	1,000 sf	4.87	5.15	92%
140	Manufacturing	1,000 sf	4.75	5.15	92%
150	Warehousing	1,000 sf	1.71	5.15	92%
151	Mini-Warehouse	1,000 sf	1.45	3.51	92%
154	High-Cube Transload & Short-Term Storage Warehouse	1,000 sf	1.40	5.15	92%

Source: Appendix D, Table D-1

Cost Component

Cost information from the Town of Wake Forest and other nearby jurisdictions in North Carolina was reviewed to develop a unit cost for all phases involved in the construction of one lane-mile of roadway capacity. Appendix B provides the data and other supporting information utilized in these analyses.

Town Roadway Cost

This section examines the right-of-way (ROW), construction, and other cost components associated with Town roads with respect to transportation capacity expansion improvements in the Town of Wake Forest/Wake County. In addition to local data, cost data for recently completed/on-going projects from nearby towns were used to supplement the cost data for town roadway improvements. The cost for each roadway capacity project was separated into four components: design, right-of-way, construction, and construction engineering/inspection (CEI).

Design and CEI

Design and CEI costs for town roads were estimated at **15 percent** of construction phase costs based on a review of local projects and projects built by other nearby jurisdictions. Additional details are provided in Appendix B, Table B-1 and Table B-5.

Right-of-Way

The ROW cost reflects the total cost of the acquisitions along a corridor that are necessary to have sufficient cross-section width to widen an existing road or, in the case of new construction, to build a new road. ROW costs for town roads were estimated at **20 percent** of construction phase costs based on a review of local projects and projects built by other nearby jurisdictions. Additional details are provided in Appendix B, Table B-2.

Construction Cost

A review of construction cost data for local roadway capacity expansion projects included two improvements in the Town of Wake Forest:

- Stadium Drive from Glenco Drive to N. Wingate
- Ligon Mill Road from South of S. Main Street to N. of Wal-Mart entrance

The construction costs for these improvements ranged from \$3.61 million per lane mile to \$3.81 million per lane mile with a weighted average cost of \$3.67 million per lane mile. Due to the

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small sample of local improvements, additional project costs from nearby jurisdictions were also reviewed. This review included seven improvements with construction costs ranging from \$1.76 million per lane mile to \$8.21 million per lane mile with a weighted average cost of \$2.76 million per lane mile.

Based on a review of these datasets a construction cost estimate of **\$3.00 million per lane mile** for town roads was utilized for the multi-modal transportation impact fee calculations, as shown in Table 2. Additional information is presented in Appendix B, Table B-3.

Table 2
Estimated Total Cost per Lane Mile for Town Roads

Cost Phase	Cost per Lane Mile
Design ⁽¹⁾	\$450,000
Right-of-Way ⁽²⁾	\$600,000
Construction ⁽³⁾	\$3,000,000
CEI ⁽⁴⁾	\$450,000
Total Cost	\$4,500,000

1) Design is estimated at 15% of construction cost.
 2) ROW is estimated at 20% of construction cost.
 3) Source: Appendix B, Table B-3
 4) CEI is estimated at 15% of construction cost.
 Note: All figures rounded to nearest \$000

State Roadway Cost

This section examines the right-of-way, construction, and other cost components associated with state roads with respect to transportation capacity expansion improvements in the Town of Wake Forest. The cost for each roadway capacity project was separated into four components: design, ROW, construction, and CEI.

Design and CEI

Given the limited data on design and CEI costs for state roads in the Town of Wake Forest and based on discussions with NCDOT and experience in other jurisdictions, the cost ratios developed for town roads were also applied to state roads.

Right-of-Way

Similarly, due to the limited data on ROW costs for state roads in the Town of Wake Forest and

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based on discussions with NCDOT and experience in other jurisdictions, the ROW cost ratio developed for town roads was also applied to state roads.

Construction

A review of the 2050 Metropolitan Transportation Plan identified seven future improvements in Wake Forest (additional detail in Appendix B, Table B-5):

- Harris Rd from US 1 to N. Main St
- Burlington Mills Rd from US 1 to US 401
- Heritage Lake Rd from Rogers Rd to NC 98
- Rogers Rd from Heritage Center Dr to Heritage Branch Rd
- NC 98 from NC 98 Bypass to US 401
- NC 98 from Debarmore St to Ligon Mill Rd (future connector)
- US 1 Alt from Harris Rd to Youngsville Southern Bypass

The estimated cost of these improvements ranged from \$5.74 million per lane mile to \$12.14 million per lane mile, with a weighted average cost of \$7.01 million per lane mile. However, these estimates are for the total cost of the improvement, not just the construction phase. Therefore, the construction cost was estimated using the design, ROW, and CEI ratios previously discussed, resulting in a construction cost estimate of **\$4.70 million per lane mile**, as shown in Table 3.

Table 3
Estimated Total Cost per Lane Mile for State Roads

Cost Phase	Cost per Lane Mile
Design ⁽¹⁾	\$705,000
Right-of-Way ⁽²⁾	\$940,000
Construction ⁽³⁾	\$4,700,000
CEI ⁽⁴⁾	\$705,000
Total Cost	\$7,050,000

1) Design is estimated at 15% of construction cost.
 2) ROW is estimated at 20% of construction cost.
 3) Source: Appendix B, Table B-4 presents the estimated total cost at \$7.0 million. Excluding Design, CEI, and ROW percentages indicated, a construction cost of \$4.7 million is calculated.
 4) CEI is estimated at 15% of construction cost.
 Note: All figures rounded to nearest \$000

Summary of Costs (Blended Cost Analysis)

The weighted average cost per lane mile for town and state roads is presented in Table 4. The resulting weighted average cost of approximately \$4.63 million per lane mile was utilized as the roadway cost input in the calculation of the multi-modal impact fee schedule. The weighted average cost per lane mile includes town and state roads and is based on the distribution of future lane miles for the capacity improvements in the 2050 Metropolitan Transportation Plan.

Table 4
Estimated Cost per Lane Mile for Town & State Roads

Cost Phase	Town Roads ⁽¹⁾	State Roads ⁽²⁾	Town and State Roads ⁽³⁾
Design	\$450,000	\$705,000	\$463,000
Right-of-Way	\$600,000	\$940,000	\$617,000
Construction	\$3,000,000	\$4,700,000	\$3,085,000
CEI	\$450,000	\$705,000	\$463,000
Total Cost	\$4,500,000	\$7,050,000	\$4,628,000
Lane Mile Distribution ⁽⁴⁾	95%	5%	100%

1) Source: Table 2
2) Source: Table 3
3) Lane mile distribution (item 4) multiplied by the design, ROW, construction, and CEI phases costs by jurisdiction to develop a weighted average cost per lane mile
4) Source: All planned improvements through 2030 are on the Town roads; slight adjustment is incorporated to account for future improvements that may be State roads.
Note: All figures rounded to nearest \$000

Person-Miles of Capacity per Lane Mile (Roadways)

An additional component of the multi-modal impact fee equation is the capacity added per lane-mile of roadway constructed. The vehicle-miles of capacity (VMC) is an estimate of capacity added per lane mile for town and state roadway improvements in the 2050 Metropolitan Transportation Plan. As shown in Table 5, each lane mile will add approximately 6,800 VMC. This figure was then converted to person-miles of capacity (PMC) using the person-trip factor (1.41 persons per vehicle) previously discussed, resulting in a weighted average PMC of 9,600 per lane mile.

Table 5
Weighted Average Vehicle-Miles of Capacity per Lane Mile

Road Type	Lane Miles Added ⁽¹⁾	Vehicle-Miles of Capacity Added ⁽¹⁾	VMC Added per Lane Mile ⁽²⁾	Vehicle-Trip to Person-Trip Factor ⁽³⁾	PMC Added per Lane Mile ⁽⁴⁾
Town Roads	31.16	204,037	6,500	1.41	9,200
State Roads	32.38	226,127	7,000	1.41	9,900
Total	63.54	430,164			
Weighted Average VMC/PMC Added per Lane Mile⁽⁴⁾			6,800	1.41	9,600

- 1) Source: Appendix B, Table B-6
- 2) Vehicle-miles of capacity added divided by lane miles added
- 3) Source: Triangle Regional Model Generation 2
- 4) VMC added per lane mile (Item 2) multiplied by the vehicle-trip to person-trip factor (Item 3)

Cost per Person-Mile of Capacity (Roadways)

The transportation cost per unit of development is assessed based on the cost per person-mile of capacity. As shown in Tables 3 and 4, the cost and capacity for roadways in the Town of Wake Forest have been calculated based on typical roadway improvements planned to be constructed in the future. As shown in Table 6, the cost for travel within the town is approximately \$482 per PMC.

The cost per PMC figure is used in the multi-modal impact fee calculation to determine the total cost per unit of development based on person-miles of travel consumed. For each person-mile of travel that is added to the roadway system, approximately \$482 of transportation capacity is consumed.

Table 6
Cost per Person-Mile of Capacity Added (Roadways)

Source	Cost per Lane Mile ⁽¹⁾	Average PMC Added per Lane Mile ⁽²⁾	Cost per PMC ⁽³⁾
Town Roads	\$4,500,000	9,200	\$489.13
State Roads	\$7,050,000	9,900	\$712.12
Weighted Average	\$4,628,000	9,600	
Weighted Average Cost per VMC Added⁽⁴⁾			\$482.08

- 1) Source: Table 4
- 2) Source: Table 5
- 3) Cost per lane mile (Item 1) divided by the average PMC added per lane mile (Item 2)

Bicycle and Pedestrian Facility Costs

Bicycle and pedestrian facilities provide for relatively small portion of the total vehicle-miles of travel due to the difference in the average distance traveled by a car trip versus pedestrian/bicycle trips. Because of their relatively small role in the urban travel scheme, they do not have a significant effect on evaluating the costs of providing for mobility. However, bike and pedestrian facilities are important and provide a source of travel for those who cannot drive or cannot afford to drive, and they are a standard part of the urban street and sometimes included in rural roadways. Their costs are included in the standard roadway cross-sections for which costs are estimated for safety and mobility reasons. Thus, the costs of these facilities on major roads are included in the multi-modal fee. The multi-modal fee provides funding for only those bike and pedestrian facilities associated with roadways on the classified road system (excluding local/neighborhood roads) and allows for facilities to be added to existing classified roadways or included in the construction of a new classified roadway or lane addition improvement.

Transit Capital Cost per Person-Mile of Travel

A model for transit service and cost was developed to establish both the capital cost per person-mile of capacity and the system operating characteristics in terms of system coverage, hours of service, and headways. The model developed for the Town of Wake Forest was based on information for the Wake Forest Loop (WFL) transit service. Components of the transit capital cost include:

- Vehicle acquisition tied to new routes
- Bus stops, shelters, and benches
- Cost of road network used by transit vehicles

Transit capital costs are computed as the cost of capital features needed to expand the transit system, as follows:

$$\text{Transit Capital Cost} = \text{Bus Infrastructure Cost} + \text{Road Capacity Cost}$$

Taking into account the infrastructure costs and the decline in potential vehicle-capacity that comes with adding transit, it was determined that the difference between constructing a lane mile of roadway (for cars only) versus constructing a roadway with transit is not significant. The

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roadway with transit cost per PMC is approximately three (3) percent higher per lane mile than the cost to simply construct a road without transit amenities. Therefore, for the multi-modal fee calculation, the cost per PMC of approximately \$482 is representative of the cost to provide transportation capacity for all modes of travel. Additional information regarding the transit capital cost calculation is included in Appendix B, Tables B-7 and B-8.

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Credit Component

Capital Improvement Credit

The credit component of the impact fee accounts for the existing Town and State funding sources that are being expended on transportation capacity expansion (excluding impact fee funds). This section summarizes the calculations utilized in the credit for non-impact fee contributions. Additional details are provided in Appendix C.

The present value of the portion of non-impact fee funding generated by new development over a 25-year period that is expected to be expended on capacity expansion projects was credited against the cost of the system consumed by travel associated with new development. In order to provide a connection to the demand component, which is measured in terms of travel, the non-impact fee dollars were converted to a fuel tax equivalency.

Town Credit

As shown in Table 7, the Town of Wake Forest spends an average of \$4.9 million per year on transportation capacity-expansion projects funded with non-impact fee revenues (general fund, grants, bonds). These expenditures equate to revenues generated from **0.7 pennies** of one-cent per gallon tax on gasoline and diesel fuels. Additional details are provided in Appendix C, Table C-2.

Additionally, the Town is using non-impact fee revenues to retire debt service used to fund transportation capacity expansion improvements. A total impact fee credit of approximately **0.5 pennies** was calculated for debt service associated with multi-modal improvements. Additional details are provided in Appendix C, Table C-3.

State Credit

As shown in Table 7, state expenditures for transportation capacity projects in Wake County were reviewed and a credit for the capacity-expansion portion attributable to state projects was estimated (excluding expenditures on limited access facilities). This review, which included 11 years of planned expenditures, indicated that NCDOT's transportation capacity spending will average \$92.5 million per year and generates a credit of **13.6 pennies** of equivalent gas tax revenue, annually. Additional details are provided in Appendix C, Table C-4.

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In summary, for transportation, the Town of Wake Forest allocates 1.2 pennies (including debt service), while the State spends an average of 13.6 pennies, annually. The portion of capital improvement funding included in the multi-modal impact fee equation for credit calculations recognizes the future capital revenue that is expected to be generated by new development from all non-impact fee revenues. This credit does not include revenues generated by the existing population.

**Table 7
Equivalent Pennies of Gas Tax Revenue**

Credit	Average Annual Expenditures	Value per Penny ⁽⁴⁾	Equivalent Pennies per Gallon ⁽⁵⁾
Town Revenues ⁽¹⁾	\$4,904,685	\$6,801,000	\$0.007
Town Debt Service ⁽²⁾	\$2,876,498	\$6,801,000	\$0.005
State Revenues ⁽³⁾	\$92,538,273	\$6,801,000	\$0.136
Total	\$100,319,456		\$0.148

1) Source: Appendix C, Table C-2
 2) Source: Appendix C, Table C-3
 3) Source: Appendix C, Table C-4
 4) Source: Appendix C, Table C-1
 5) Average annual expenditures divided by the value per penny (Item 4) divided by 100. Town debt service was slightly adjusted to account for rounding (App. C, Table C-3)

Present Worth Variables

- Facility Life: The roadway facility life used in the impact fee analysis is 25 years, which represents the reasonable life of a roadway.
- Interest Rate: This is the estimated interest rate the Town is likely to pay on future bonds. The discount rate of 4.25 percent was used in the impact fee calculation based on information provided by the Town of Wake Forest.

Fuel Efficiency

The fuel efficiency (i.e., the average miles traveled per gallon of fuel consumed) of the fleet of motor vehicles was estimated using the quantity of gasoline consumed by travel associated with a particular land use.

Appendix C, Table C-16 documents the calculation of fuel efficiency value based on the following equation, where “VMT” is vehicle miles of travel and “MPG” is fuel efficiency in terms of miles per gallon.

$$\text{Fuel Efficiency} = \sum VMT_{\text{Roadway Type}} \div \sum \left(\frac{VMT_{\text{Vehicle Type}}}{MPG_{\text{Vehicle Type}}} \right)_{\text{Roadway Type}}$$

The methodology uses non-interstate VMT and average fuel efficiency data for passenger vehicles (i.e., passenger cars and other 2-axle, 4-tire vehicles, such as vans, pickups, and SUVs) and large trucks (i.e., single-unit, 2-axle, 6-tire or more trucks and combination trucks) to calculate the total gallons of fuel used by each of these vehicle types.

The combined total VMT for the vehicle types is then divided by the combined total gallons of fuel consumed to calculate, in effect, a “weighted” fuel efficiency value that reflects the existing fleet mix of traffic on non-interstate roadways. The VMT and average fuel efficiency data were obtained from the most recent Federal Highway Administration’s *Highway Statistics 2022*. Based on the calculation completed in Appendix C, Table C-16, the fuel efficiency rate to be used in the updated impact fee equation is 19.47 miles per gallon.

Effective Days per Year

An effective 365 days per year of operation was used for all land uses in the proposed fee. However, this will not be the case for all land uses since some uses operate only on weekdays (e.g., office buildings) and/or only seasonally (e.g., schools). The use of 365 days per year, therefore, provides a conservative estimate, ensuring that non-impact fee contributions are adequately credited against the fee.

Calculated Multi-Modal Transportation Impact Fee Schedule

Detailed impact fee calculations for each land use are included in Appendix D, which includes the major land use categories and the impact fees for the individual land uses contained in each of the major categories. For each land use, Appendix D illustrates the following:

- Demand component variables (trip rate, trip length, and percent of new trips);
- Total impact fee cost;
- Annual capital improvement credit;
- Present value of the capital improvement credit; and
- Net multi-modal transportation impact fee.

For clarification purposes, it may be useful to walk through the calculation of a multi-modal transportation impact fee for one of the land use categories. In the following example, the net multi-modal transportation impact fee is calculated for the single-family residential detached (2,000 sf) land use category (ITE LUC 210) using information from the impact fee schedules included in Appendix D. For each land use category, the following equations are utilized to calculate the net impact fee:

Net Multi-Modal Transportation Impact Fee = Total Impact Cost – Capital Improvement Credit

Where:

Total Multi-Modal Impact Cost = $([\text{Trip Rate} \times \text{Adjusted Trip Length} \times \% \text{ New Trips}] / 2) \times (1 - \text{Interstate/Toll Facility Adjustment Factor}) \times (\text{Person-Trip Factor}) \times (\text{Cost per Person-Mile of Capacity})$

Capital Improvement Credit = Present Value (Annual Capital Improvement Credit), given 4.25% interest rate & a 25-year facility life

Annual Capital Improvement Credit = $([\text{Trip Rate} \times \text{Total Trip Length} \times \% \text{ New Trips}] / 2) \times (\text{Effective Days per Year} \times \$/\text{Gallon to Capital}) / \text{Fuel Efficiency}$

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Each of the inputs has been discussed previously in this document; however, for purposes of this example, brief definitions for each input are provided in the following paragraphs, along with the actual inputs used in the calculation of the fee for the single-family detached residential land use category (2,000 sq. ft.):

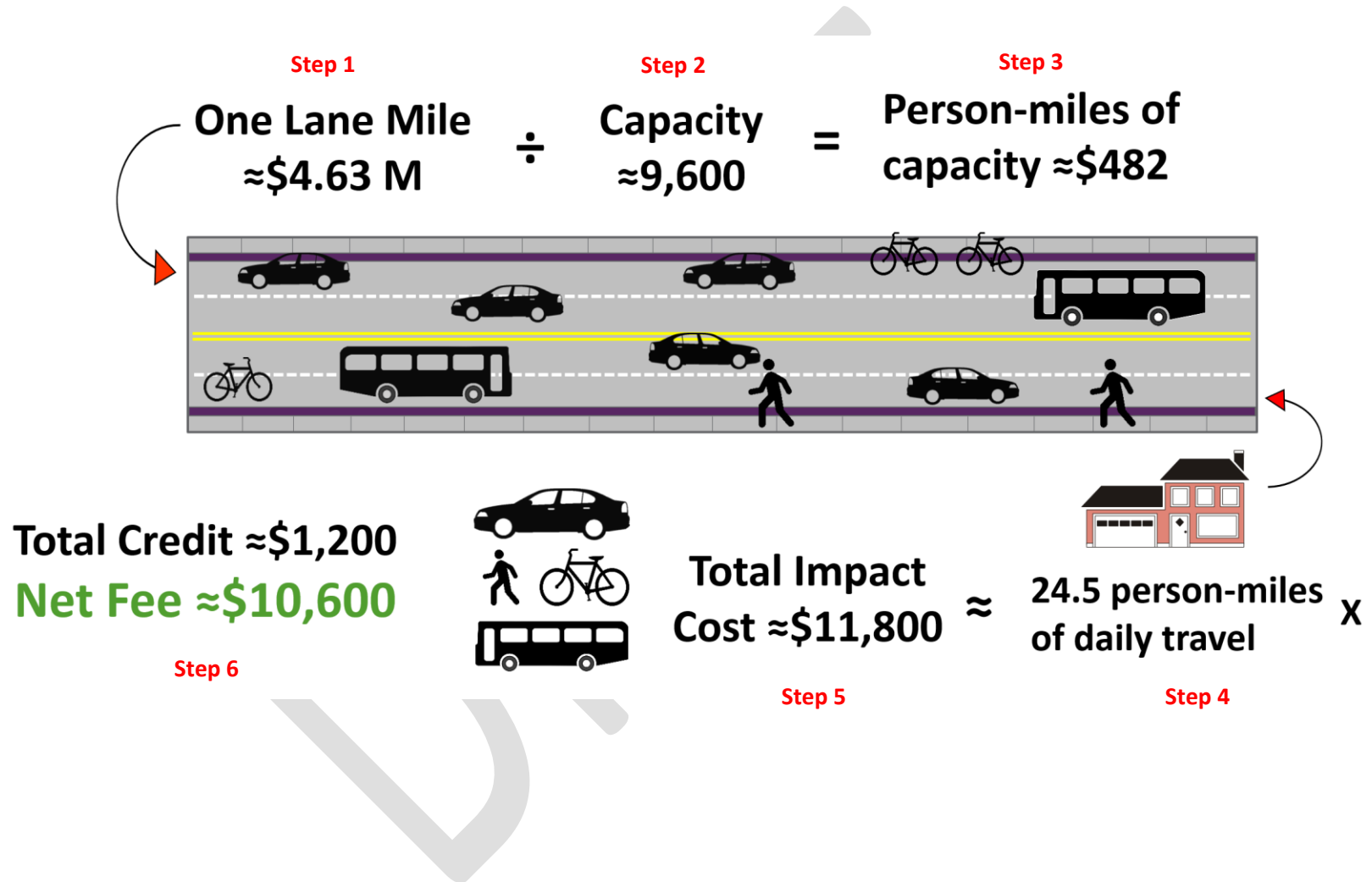
- *Trip Rate* = the average daily trip generation rate, in vehicle-trips/day (8.32)
- *Assessable Trip Length* = the average trip length on collector roads or above, for the category, in vehicle-miles (6.62)
- *Total Trip Length* = the assessable trip length plus an adjustment factor of half a mile, which is added to the trip length to account for the fact that gas taxes are collected for travel on all roads including local roads ($6.62 + 0.50 = 7.12$ miles)
- *% New Trips* = adjustment factor to account for trips that are already on the roadway (100%)
- *Divide by 2* = the total daily miles of travel generated by a particular category (i.e., rate*length*% new trips) is divided by two to prevent the double-counting of travel generated between two land use codes since every trip has an origin and a destination
- *Interstate/Toll Facility Adjustment Factor* = discount factor to account for travel demand occurring on interstate highways and/or toll facilities (36.7%)
- *Person-Trip Factor* = converts vehicle-miles of travel to person-miles of travel (1.41)
- *Cost per Lane Mile* = unit cost to construct one lane mile of roadway, in \$/lane-mile (\$4,628,000)
- *Average Person-Capacity Added per Lane Mile* = represents the average daily person-traffic on one travel lane at capacity for one lane mile of roadway, in person/lane-mile/day (9,600)
- *Cost per Person-Mile of Capacity* = unit of person-miles of capacity consumed per unit of development. Cost per person-mile divided by average capacity added per lane mile (\$482.08)
- *Present Value* = calculation of the present value of a uniform series of cash flows, gas tax payments in this case, given an interest rate, “i,” and a number of periods, “n;” for 4.25% interest and a 25-year facility life, the uniform series present worth factor is 15.2174
- *Effective Days per Year* = 365 days
- *\$/Gallon to Capital* = the amount of equivalent gas tax revenue per gallon of fuel that is used for capital improvements, in \$/gallon (\$0.148)
- *Fuel Efficiency* = average fuel efficiency of vehicles, in vehicle-miles/gallon (19.47)

Figure 1 presents a simplified impact fee calculation example while a detailed calculation is provided in the next sub-section.

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Figure 1

Simplified Multi-Modal Transportation Impact Fee Calculation: Single Family (Detached); 2,000 sq ft:



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Multi-Modal Transportation Impact Fee Calculation

Using these inputs, a net impact fee can be calculated for the single-family residential detached (2,000 sf) land use category as follows:

Multi-Modal Transportation Impact Fee:

Total Impact Cost = $([8.32 * 6.62 * 1.0] / 2) * (1 - 0.367) * (1.41) * (\$482.08) = \mathbf{\$11,849}$

Annual Cap. Improv. Credit = $([8.32 * 7.12 * 1.0] / 2) * 365 * (\$0.148 / 19.47) = \mathbf{\$82}$

Capital Improvement Credit = $\$82 * 15.2174 = \mathbf{\$1,248}$

Net Impact Fee = $\$11,849 - \$1,248 = \mathbf{\$10,601}$

Table 8 presents the full calculated multi-modal transportation impact fee rates for all land uses in the Town’s schedule and the town portion of the calculated impact fees. Additional details are provided in Appendix D, Table D-1.

The detailed definition of each land use in the Town’s multi-modal impact fee schedule corresponds to the definitions presented in the Institution of Transportation Engineer’s Trip Generation Manual, 11th Edition.

Multi-Modal Transportation Impact Fee Comparison

Table 9 presents the calculated multi-modal transportation impact fee rates for the Town of Wake Forest compared to other transportation impact fee rates from surrounding and other jurisdictions in North Carolina.

Note that differences in fee levels for a given land use can be caused by several factors, including the year of the technical study, adoption percentage, study methodology including variation in costs, credits, and travel demand, land use categories included in the fee schedule, etc.

Table 8
Calculated Multi-Modal Transportation Impact Fee Rates

ITE LUC	Land Use	Unit	Full Calculated Rates	Town Portion (6%)
RESIDENTIAL:				
210	Single Family (Detached); Less than 1,000 sf	du	\$8,593	\$516
	Single Family (Detached); 1,000 to 1,999 sf	du	\$9,258	\$555
	Single Family (Detached); 2,000 to 2,999 sf	du	\$10,601	\$636
	Single Family (Detached); 3,000 sf or greater	du	\$11,279	\$677
215	Single Family (Attached)	du	\$8,622	\$517
220	Multi-Family Housing (Low-Rise, 1-3 floors)	du	\$6,748	\$405
221/222	Multi-Family Housing (Mid/High-Rise, 4+ floors)	du	\$4,541	\$272
240	Mobile Home Park	du	\$3,670	\$220
251	Senior Adult Housing (Detached)	du	\$3,687	\$221
252	Senior Adult Housing (Attached)	du	\$2,488	\$149
LODGING:				
310	Hotel	room	\$4,425	\$266
320	Motel	room	\$2,149	\$129
RECREATION:				
411	Public Park	acre	\$687	\$41
416	Campground/RV Park	site	\$1,436	\$86
445	Movie Theater	screen	\$42,464	\$2,548
492	Health/Fitness Club	1,000 sf	\$32,066	\$1,924
INSTITUTIONS:				
520	Elementary School (Private)	student	\$1,141	\$68
522	Middle/Junior High School (Private)	student	\$1,059	\$64
525	High School (Private)	student	\$1,106	\$66
540/550	University/Junior College (7,500 or fewer students) (Private)	student	\$2,290	\$137
	University/Junior College (more than 7,500 students) (Private)	student	\$1,725	\$104
560	Church	1,000 sf	\$5,144	\$309
565	Day Care Center	1,000 sf	\$13,325	\$800
MEDICAL:				
610	Hospital	1,000 sf	\$10,701	\$642
620	Nursing Home	bed	\$1,315	\$79
630	Clinic	1,000 sf	\$34,044	\$2,043
OFFICE:				
710	General Office	1,000 sf	\$9,862	\$592
720	Medical Office/Clinic 10,000 sq ft or less	1,000 sf	\$22,614	\$1,357
	Medical Office/Clinic greater than 10,000 sq ft	1,000 sf	\$32,458	\$1,947
RETAIL:				
822	Retail less than 40,000 sf gla	1,000 sf gla	\$7,226	\$434
821	Retail 40,000 to 150,000 sf gla	1,000 sf gla	\$14,085	\$845
820	Retail greater than 150,000 sf gla	1,000 sf gla	\$14,788	\$887
840/841	New/Used Auto Sales	1,000 sf	\$17,132	\$1,028
850	Supermarket	1,000 sf	\$20,655	\$1,239
862	Home Improvement Superstore	1,000 sf	\$8,690	\$521
880/881	Pharmacy with & without Drive-Thru	1,000 sf	\$13,010	\$781
890	Furniture Store	1,000 sf	\$3,985	\$239
SERVICES:				
911	Bank/Savings Walk-In	1,000 sf	\$12,446	\$747
912	Bank/Savings Drive-In	1,000 sf	\$21,539	\$1,292
930	Fast Casual Restaurant	1,000 sf	\$21,820	\$1,309
931	Fine Dining (Low-Turnover) Restaurant	1,000 sf	\$38,649	\$2,319
932	High-Turnover (Sit-Down) Restaurant	1,000 sf	\$44,405	\$2,664
934	Fast Food Restaurant w/Drive-Thru	1,000 sf	\$104,987	\$6,299
941	Quick Lube	service bay	\$19,918	\$1,195
942	Automobile Care Center	1,000 sf	\$14,042	\$843
944	Gas Station w/Convenience Market <2,000 sq ft	fuel pos.	\$14,162	\$850
	Gas Station w/Convenience Market 2,000-5,499 sq ft	fuel pos.	\$21,782	\$1,307
	Gas Station w/Convenience Market 5,500+ sq ft	fuel pos.	\$28,473	\$1,708
947	Self-Service Car Wash	service bay	\$12,324	\$739
INDUSTRIAL:				
110	General Light Industrial	1,000 sf	\$4,431	\$266
140	Manufacturing	1,000 sf	\$4,325	\$260
150	Warehousing	1,000 sf	\$1,560	\$94
151	Mini-Warehouse	1,000 sf	\$900	\$54
154	High-Cube Transload & Short-Term Storage Warehouse	1,000 sf	\$1,275	\$77

Source: Appendix D, Table D-1

**Table 9
Transportation Impact Fee Comparison**

Land Use	Unit ⁽²⁾	Wake Forest CALCULATED ⁽³⁾		City of Durham ⁽⁴⁾			City of Raleigh ⁽⁵⁾	Town of Knightdale ⁽⁶⁾	Town of Cary ⁽⁷⁾		Town of Zebulon ⁽⁸⁾
		Full Fees	Town Portion	North	South	Downtown			Central	Base	
Date of Last Update		2024	2024	2008	2008	2008	2006	-	-	-	-
Adoption Percentage⁽¹⁾		100%	100%	50%	50%	50%	98%	-	-	-	-
Residential:											
Single Family (2,000 sf)	du	\$10,601	\$636	\$531	\$1,405	\$293	\$2,262	\$400	\$1,103	\$1,573	see note
Multi-Family, 1-3 Floors	du	\$6,748	\$405	\$326	\$862	\$180	\$1,512	\$300	\$684	\$975	
Non-Residential:											
Light Industrial	1,000 sf	\$4,431	\$266	\$389	\$1,029	\$215	\$1,770	\$181	\$869	\$1,238	see note
Office (50,000 sq ft)	1,000 sf	\$9,862	\$592	\$909	\$2,406	\$503	\$2,800	\$543	\$1,483	\$2,113	
Retail (125,000 sq ft)	1,000 sf	\$14,085	\$845	\$1,892	\$5,008	\$1,046	\$3,672	\$1,247	\$1,148	\$1,637	

- 1) Represents the portion of the maximum calculated fee for each respective jurisdiction that is actually charged. Fees may have been lowered/raised through indexing or policy discounts. Does not account for moratoriums/suspensions
- 2) Du = dwelling unit
- 3) Source: Appendix D, Table D-1
- 4) Source: City of Durham City-County Inspections Department
- 5) Source: City of Raleigh Planning and Development Department
- 6) Source: Town of Knightdale Finance Department
- 7) Source: Town of Cary Business & Development Department; “Industrial Park” rate is shown for Light Industrial
- 8) Source: Town of Zebulon Finance Department. All fees are \$1,177/peak hour trips as determined in the ITE manual

Fee Discounts/Exemptions

Local governments can adopt impact fees at a reduced rate when the reduction is applied to all land uses. Care should be given when discounting fees for select land uses and/or areas to ensure those who paid the full fee receive the associated benefit. If the discount results in a compromise of facilities that would have been built with full fees, the equity among land uses is jeopardized. The fees can be reduced for select land uses and/or geographic subareas under the following conditions:

- ***Travel Characteristics:*** If it can be demonstrated that a given land use or an area generates less travel due to certain characteristics, it is appropriate to apply a reduced fee. Examples would be a downtown core with on-street parking and a mix of land uses that result in lower trip generates.
- ***De-minimis Impact:*** If the uses that are being discounted are permitted infrequently such that revenues generated from these groups are considered de-minimis, it is possible to provide the discount without jeopardizing the Town’s transportation improvements program. As a general industry standard, if the revenues from these land uses comprise less than five (5) percent of total impact fee revenues generated, the land use is considered de-minimis. When using this methodology, it is important for the Town to set up a monitoring system to track revenue generation levels annually.

In addition to these methods, the Town has the option to buy down the fees with additional taxes and/or other non-impact fee revenue sources to support affordable housing options, economic development goals and other similar policies.

Impact Fee Indexing

In many cases, impact fees are reviewed periodically (every four to five years, etc.) as opposed to on an annual basis. If no adjustment to the impact fee schedule is made during this period, a situation can be created where major adjustments to the impact fee schedule likely become necessary due to the time between the adjustments. During periods of cost increases, the need for significant adjustments also creates major concerns in the development community. To address this issue, it is suggested that the multi-modal transportation impact fees be adjusted on an annual basis.

Producer Price Index (Highway & Street Construction)

For the multi-modal transportation impact fee, the Producer Price Index (PPI) for highway and street construction was utilized for indexing purposes. As shown in Table 10, the average annual cost increase over the past five years was 7.2 percent. The use of a rolling five-year average minimizes large fluctuations in annual increases.

Table 10
Producer Price Index (Hwy & Street Construction)

Year	Annual Average	Percent Change
2019	115.66	-
2020	113.33	-2.0%
2021	135.54	19.6%
2022	160.84	18.7%
2023	159.69	-0.7%
2024*	160.37	0.4%
Average (2019-2024)		7.2%

Source: Bureau of Labor Statistics, PPI
*thru September

Application

Table 11 presents the indexed fee schedule for the next four years using the PPI index calculated in Table 10. It is recommended the calculated index be reviewed and recalculated annually to reflect updated five-year averages, especially when the costs fluctuate significantly.

Table 11
Example Impact Fee Rates with Indexing

Land Use	Unit	Calculated Rate	Year 1	Year 2	Year 3	Year 4
Full Calculated Impact Fee Rates:						
Single Family (2,000 sf)	du	\$10,601	\$11,364	\$12,182	\$13,059	\$13,999
Multi-Family, 1-3 Floors	du	\$6,748	\$7,234	\$7,755	\$8,313	\$8,912
Light Industrial	1,000 sf	\$4,431	\$4,750	\$5,092	\$5,459	\$5,852
Office (50,000 sq ft)	1,000 sf	\$9,862	\$10,572	\$11,333	\$12,149	\$13,024
Retail (125,000 sq ft)	1,000 sf	\$14,085	\$15,099	\$16,186	\$17,351	\$18,600
Town Portion ONLY (6%):						
Single Family (2,000 sf)	du	\$636	\$682	\$731	\$784	\$840
Multi-Family, 1-3 Floors	du	\$405	\$434	\$465	\$498	\$534
Light Industrial	1,000 sf	\$266	\$285	\$306	\$328	\$352
Office (50,000 sq ft)	1,000 sf	\$592	\$635	\$681	\$730	\$783
Retail (125,000 sq ft)	1,000 sf	\$845	\$906	\$971	\$1,041	\$1,116

Source: Calculated impact fee rates from Table 9 with annual index (7.2%) applied

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Appendix A
Demand Component

Appendix A: Demand Component

This appendix presents the detailed calculations for the demand component of the multi-modal transportation impact fee study.

Interstate & Toll Facility Adjustment Factor

Table A-1 presents the interstate and toll facility adjustment factor used in the calculation of the road impact fee. This variable is based on data from the Triangle Regional Model Generation 2, specifically the 2050 projected vehicle-miles of travel of all Wake County-generated trips on all in-county roadways. It should be noted that the adjustment factor excludes all external-to-external trips, which represent traffic that goes through Wake County but does not necessarily stop in the county. This traffic is excluded from the analysis since it does not come from development within the county. The I/T adjustment factor is used to reduce the VMT that the impact fee charges for each land use.

Table A-1
Interstate/Toll Facility Adjustment Factor

Facility Type	Total	
	VMT	%
Interstate/Toll	19,329,304	36.7%
Other Roads	33,305,140	63.3%
Total	52,634,444	100.0%

Source: TRMG2

Town Road Adjustment Factor

As part of this update, the current classified roadway network was reviewed as well as the classified roads within the transportation model. Multi-modal impact fee revenues can only be spent on roadways classified as thoroughfares, and without this change in designation, the Town is limited in its ability to improve transportation performance.

Map A-1 illustrates roadway segments that were added to the transportation model as roadway that are functioning as “collectors” and the classified roadways already included in the model. All the added segments (except for Wake Dr from S Main St to Ligon Mill Rd) are identified as “collectors” in the Wake Forest Comprehensive Transportation Plan but were absent from the classified roads included in TRMG2. **Table A-2** presents the portion of travel on Town vs. State roads. This variable is based on vehicle-miles of travel data from the TRMG2, specifically the 2050

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projected VMT for all town-generated trips on all in-town roadways, excluding interstate and toll facilities. Approximately 6 percent of the calculated impact fees are associated with travel handled by Town roads only.

**Table A-2
Town Road Adjustment Factor**

Facility Type	Total	
	VMT (2050)	%
State	1,436,402	94%
Town of Wake Forest	93,592	6%
Total	1,529,994	100%

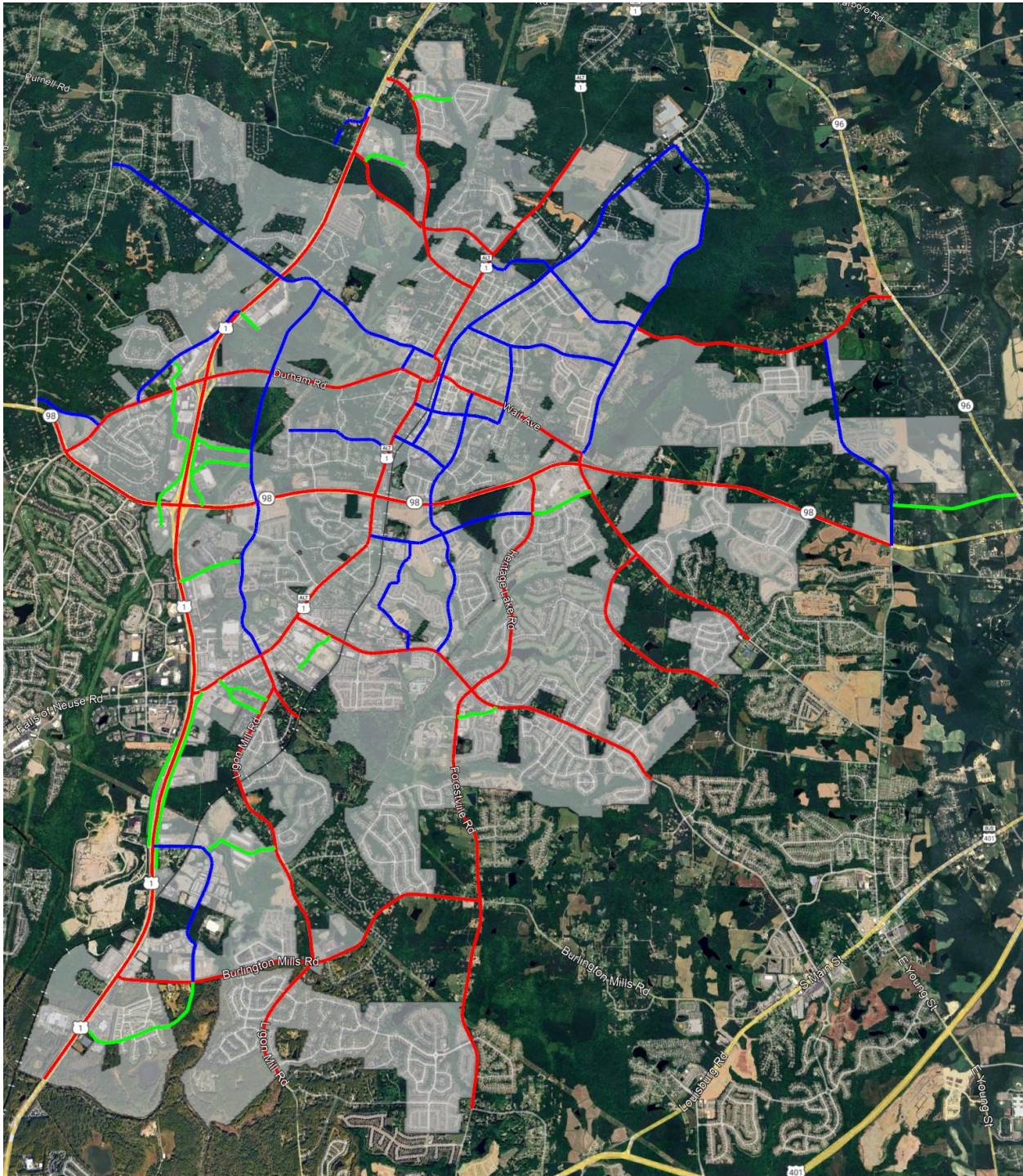
Source: Triangle Regional Model (TRMG2 v1.3.1)

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Map A-1

Town of Wake Forest Classified Roadway Network



Red = State Maintained
Blue = Town Maintained
Green = Town Maintained (added to TRMG2)

Single Family (Detached) Trip Generation Rate Tiering

As part of this study, single family (detached) trip generation rate tiering was included to reflect a four-tier analysis to ensure equity by the size of a home. To facilitate this, an analysis was completed on the comparative relationship between housing size and household travel behavior. This analysis utilized data from the 2017 National Household Travel Survey (NHTS)² and the 2021 American Housing Survey (AHS) to examine overall trip-making characteristics of households in the United States.

Table A-3 presents the trip characteristics being utilized in the proposed multi-modal impact fee schedule for the residential land use. The 2017 NHTS database was used to assess average annual household vehicle miles of travel (VMT) for various annual household income levels. In addition, the 2021 AHS database was used to compare median annual family/household incomes with housing unit size. It is important to recognize that the use of the income variable in each of these databases is completed simply to provide a convenient linking mechanism between household VMT from the NHTS and housing unit size from the AHS.

**Table A-3
Calculated Single Family (Detached) Trip Characteristics**

Calculated Values Excluding Tiering	Trip Rate	Assessable Trip Length	Daily VMT
Single Family (Detached)	7.81	6.62	51.70

Source: Table A-6

The results of the NHTS and AHS analyses are included in Tables A-4 and A-5. First, the data shown in Table A-4 presents the average income in the U.S. for families/households living in the different housing tiers. As shown, the average income for housing units between 1,500 square feet and 2,499 square feet in size (\$74,416) is higher than the overall average income for the U.S. (\$66,289). Next, in Table A-5, the annual average household VMT was calculated from the NHTS database for a number of different income levels and ranges related to the resulting AHS income data from Table A-4.

² 2022 NHTS data was available but utilizes a much smaller sample size due to a change in methodology. Therefore, the 2017 NHTS data was used instead.

Table A-4
Annual Income by Housing Size

2021 AHS Average Income Data by Housing Size	Annual Income ⁽¹⁾
Less than 1,000 sf	\$43,692
1,000 to 1,999 sf	\$63,985
1,500 to 2,499 sf	\$74,416
2,000 to 2,999 sf	\$82,472
3,000 sf or more	\$93,260
Average of All Houses	\$66,289

Source: American Housing Survey for the United States in 2021

1) Weighted average of annual income for each tier

To calculate a corresponding trip rate for the new tiers it was necessary to rely on comparative ratios. As an example, consider the \$43,692 annual income category. First, it was determined that the average annual household VMT for this income level is 17,454 miles. This figure was then compared to the overall average annual VMT per household in the U.S. and normalized to the average of the \$74,416 (20,191 miles) category to derive a ratio of 0.864 as shown in Table A-5. It should be noted that the \$74,416 (1,500 sq ft to 2,499 sq ft) category is not an impact fee tier, but rather the average home size that corresponds with the trip characteristics data shown in Table A-3.

Next, the normalized ratio was applied to the daily VMT for the average residential housing unit size (less than 1,000 sf) to generate a daily VMT of 44.67 for the new tier, as shown in Table A-6. This daily VMT figure was then divided by the proposed assessable trip length of 6.62 miles to obtain an average trip rate of 6.75 trips per day.

Table A-5
NHTS Annual VMT by Income Category

2017 NHTS Travel Data by Annual HH Income	Annual VMT/HH	Days	Daily VMT	Ratio to Mean	Normalized to 1.054
Total (All Homes)	19,167	365	52.51	1.000	-
Average of \$43,692	17,454	365	47.82	0.911	0.864
Average of \$63,985	18,800	365	51.51	0.981	0.931
Average of \$74,416	20,191	365	55.32	1.054	1.000
Average of \$82,472	21,533	365	58.99	1.123	1.065
Average of \$93,260	22,926	365	62.81	1.196	1.135

Source: 2017 National Household Travel Survey Database, Federal Highway Administration

Table A-6
Trip Generation Rate by Residential Land Use Tier

Estimation of Trip Rate by Tier	Trip Rate ⁽¹⁾	Assessable Trip Length ⁽²⁾	Daily VMT ⁽³⁾	Ratio to Mean ⁽⁴⁾
Single Family (Detached)				
Less than 1,000 sf	6.75	6.62	44.67	0.864
1,000 to 1,999 sf	7.27	6.62	48.13	0.931
1,500 to 2,499 sf	7.81	6.62	51.70	1.000
2,000 to 2,999 sf	8.32	6.62	55.06	1.065
3,000 sf or more	8.86	6.62	58.68	1.135

- 1) Daily VMT (Item 3) divided by assessable trip length (Item 2) for each tier
- 2) Source: Table A-3
- 3) Ratio to the mean (Item 4) divided by total daily VMT for the 1,500 square feet to 2,499 square feet tier for each tier
- 4) Source: Table A-5

Trip Characteristics Studies Database

The Trip Characteristics Studies (TCS) Database includes approximately 345 studies on 40 different residential and non-residential land uses collected over the last 30 years. Data from these studies include trip generation, trip length, and percent new trips for each land use. This information has been used in the development of impact/multi-modal/mobility fees and the creation of land use plan category trip characteristics for communities throughout the U.S.

Benesch estimates trip generation rates for all land uses in an impact fee schedule using data from studies in the TCS Database and the Institute of Transportation Engineers’ (ITE) *Trip Generation* reference report (11th edition). In instances, when both ITE *Trip Generation* reference report (11th edition) and TCS trip generation rate (TGR) data are available for a particular land use, the data is typically blended to increase the sample size and provide a more valid estimate of the average number of trips generated per unit of development. If no TCS data is available, only TGR data from the ITE reference report is used in the fee calculation.

The trip generation rate for each respective land use is calculated using machine counts that record daily traffic into and out of the site studied. The traffic count hoses are set at entrances to residential subdivisions for the residential land uses and at all access points for non-residential land uses.

The trip length information is obtained through origin-destination surveys that ask respondents where they came from prior to arriving at the site and where they intended to go after leaving the site. The results of these surveys were used to estimate average trip length by land use.

The percent new trip variable is based on assigning each trip collected through the origin-destination survey process a trip type (primary, secondary, diverted, and captured). The percent new trip variable is then calculated as 1 minus the percentage of trips that are captured. Benesch has published an article entitled, *Measuring Travel Characteristics for Transportation Impact Fees*, ITE Journal, April 1991, on the data collection methodology for trip characteristics studies.

Table A-6

Land Use 210: Single Family - Detached

Location	Size / Units	Date	Total # Interviews	# Trip Length Interviews	Trip Gen Rate	Time Period	Trip Length	Percent New Trips	VMT	Source
Sarasota Co, FL	76	Jun-93	70	70	10.03	-	6.00	-	60.18	Sarasota County
Sarasota Co, FL	79	Jun-93	86	86	9.77	-	4.40	-	42.99	Sarasota County
Sarasota Co, FL	135	Jun-93	75	75	8.05	-	5.90	-	47.50	Sarasota County
Sarasota Co, FL	152	Jun-93	63	63	8.55	-	7.30	-	62.42	Sarasota County
Sarasota Co, FL	193	Jun-93	123	123	6.85	-	4.60	-	31.51	Sarasota County
Sarasota Co, FL	97	Jun-93	33	33	13.20	-	3.00	-	39.60	Sarasota County
Sarasota Co, FL	282	Jun-93	146	146	6.61	-	8.40	-	55.52	Sarasota County
Sarasota Co, FL	393	Jun-93	207	207	7.76	-	5.40	-	41.90	Sarasota County
Hernando Co, FL	76	May-96	148	148	10.01	9a-6p	4.85	-	48.55	Tindale Oliver
Hernando Co, FL	128	May-96	205	205	8.17	9a-6p	6.03	-	49.27	Tindale Oliver
Hernando Co, FL	232	May-96	182	182	7.24	9a-6p	5.04	-	36.49	Tindale Oliver
Hernando Co, FL	301	May-96	264	264	8.93	9a-6p	3.28	-	29.29	Tindale Oliver
Charlotte Co, FL	135	Oct-97	230	-	5.30	9a-5p	7.90	-	41.87	Tindale Oliver
Charlotte Co, FL	142	Oct-97	245	-	5.20	9a-5p	4.10	-	21.32	Tindale Oliver
Charlotte Co, FL	150	Oct-97	160	-	5.00	9a-5p	10.80	-	54.00	Tindale Oliver
Charlotte Co, FL	215	Oct-97	158	-	7.60	9a-5p	4.60	-	34.96	Tindale Oliver
Charlotte Co, FL	257	Oct-97	225	-	7.60	9a-5p	7.40	-	56.24	Tindale Oliver
Charlotte Co, FL	345	Oct-97	161	-	7.00	9a-5p	6.60	-	46.20	Tindale Oliver
Charlotte Co, FL	368	Oct-97	152	-	6.00	9a-5p	5.70	-	37.62	Tindale Oliver
Charlotte Co, FL	383	Oct-97	516	-	8.40	9a-5p	5.00	-	42.00	Tindale Oliver
Charlotte Co, FL	441	Oct-97	195	-	8.20	9a-5p	4.70	-	38.54	Tindale Oliver
Charlotte Co, FL	1,169	Oct-97	348	-	6.10	9a-5p	8.00	-	48.80	Tindale Oliver
Collier Co, FL	90	Dec-99	91	-	12.80	8a-6p	11.40	-	145.92	Tindale Oliver
Collier Co, FL	400	Dec-99	389	-	7.80	8a-6p	6.40	-	49.92	Tindale Oliver
Lake Co, FL	49	Apr-02	170	-	6.70	7a-6p	10.20	-	68.34	Tindale Oliver
Lake Co, FL	52	Apr-02	212	-	10.00	7a-6p	7.60	-	76.00	Tindale Oliver
Lake Co, FL	126	Apr-02	217	-	8.50	7a-6p	8.30	-	70.55	Tindale Oliver
Pasco Co, FL	55	Apr-02	133	-	6.80	8a-6p	8.12	-	55.22	Tindale Oliver
Pasco Co, FL	60	Apr-02	106	-	7.73	8a-6p	8.75	-	67.64	Tindale Oliver
Pasco Co, FL	70	Apr-02	188	-	7.80	8a-6p	6.03	-	47.03	Tindale Oliver
Pasco Co, FL	74	Apr-02	188	-	8.18	8a-6p	5.95	-	48.67	Tindale Oliver
Pasco Co, FL	189	Apr-02	261	-	7.46	8a-6p	8.99	-	67.07	Tindale Oliver
Marion Co, FL	102	Apr-02	167	-	8.02	7a-6p	5.10	-	40.90	Kimley-Horn & Associates
Marion Co, FL	105	Apr-02	169	-	7.23	7a-6p	7.22	-	52.20	Kimley-Horn & Associates
Marion Co, FL	124	Apr-02	170	-	6.04	7a-6p	7.29	-	44.03	Kimley-Horn & Associates
Marion Co, FL	132	Apr-02	171	-	7.87	7a-6p	7.00	-	55.09	Kimley-Horn & Associates
Marion Co, FL	133	Apr-02	209	-	8.04	7a-6p	4.92	-	39.56	Kimley-Horn & Associates
Citrus Co, FL	111	Oct-03	273	-	8.66	7a-6p	7.70	-	66.68	Tindale Oliver
Citrus Co, FL	231	Oct-03	155	-	5.71	7a-6p	4.82	-	27.52	Tindale Oliver
Citrus Co, FL	306	Oct-03	146	-	8.40	7a-6p	3.94	-	33.10	Tindale Oliver
Citrus Co, FL	364	Oct-03	345	-	7.20	7a-6p	9.14	-	65.81	Tindale Oliver
Citrus Co, FL	374	Oct-03	248	-	12.30	7a-6p	6.88	-	84.62	Tindale Oliver
Lake Co, FL	42	Dec-06	122	-	11.26	-	5.56	-	62.61	Tindale Oliver
Lake Co, FL	51	Dec-06	346	-	18.22	-	9.46	-	172.36	Tindale Oliver
Lake Co, FL	59	Dec-06	144	-	12.07	-	10.79	-	130.24	Tindale Oliver
Lake Co, FL	90	Dec-06	194	-	9.12	-	5.78	-	52.71	Tindale Oliver
Lake Co, FL	239	Dec-06	385	-	7.58	-	8.93	-	67.69	Tindale Oliver
Hernando Co, FL	232	Apr-07	516	-	8.02	7a-6p	8.16	-	65.44	Tindale Oliver
Hernando Co, FL	95	Apr-07	256	-	8.08	7a-6p	5.88	-	47.51	Tindale Oliver
Hernando Co, FL	90	Apr-07	338	-	7.13	7a-6p	5.86	-	41.78	Tindale Oliver
Hernando Co, FL	58	Apr-07	153	-	6.16	7a-6p	8.39	-	51.68	Tindale Oliver
Collier Co, FL	74	Mar-08	503	-	12.81	7a-6p	3.05	-	39.07	Tindale Oliver
Collier Co, FL	97	Mar-08	512	-	8.78	7a-6p	11.29	-	99.13	Tindale Oliver
Collier Co, FL	315	Mar-08	1,347	-	6.97	7a-6p	6.55	-	45.65	Tindale Oliver
Collier Co, FL	42	Mar-08	314	-	9.55	7a-6p	10.98	-	104.86	Tindale Oliver
Total Size	10,380	55	13,130	Average Trip Length: 6.83		Weighted Average Trip Length: 6.62		Weighted Average Trip Generation Rate: 7.81		

Table A-7

LUC 215: Single Family Attached Housing

Location	Size / Units	Date	Total # Interviews	# Trip Length Interviews	Trip Gen Rate	Time Period	Trip Length	Percent New Trips	VMT	Source
Hernando Co, FL	31	May-96	31	31	6.12	9a-6p	-	-	-	Tindale Oliver
Hernando Co, FL	128	May-96	198	198	6.47	9a-6p	-	-	-	Tindale Oliver
Pasco Co, FL	229	Apr-02	198	198	4.77	9a-6p	-	-	-	Tindale Oliver
Pasco Co, FL	248	Apr-02	353	353	4.24	9a-6p	-	-	-	Tindale Oliver
Total Size	636		4	780	Average Trip Length: -					
ITE	2,640		22		Weighted Average Trip Length: -					
Blended total	3,276				Weighted Average Trip Generation Rate: 4.97					
					ITE Average Trip Generation Rate: 7.20					
					Blend of FL Studies and ITE Average Trip Generation Rate: 6.77					

Table A-8

LUC 220/221/222: Multi-Family/Apartment

Location	Size / Units	Date	Total # Interviews	# Trip Length Interviews	Trip Gen Rate	Time Period	Trip Length	Percent New Trips	VMT	Source
Sarasota Co, FL	212	Jun-93	42	42	5.78	-	5.20	-	30.06	Sarasota County
Sarasota Co, FL	243	Jun-93	36	36	5.84	-	-	-	-	Sarasota County
Marion Co, FL	214	Apr-02	175	175	6.84	-	4.61	-	31.53	Kimley-Horn & Associates
Marion Co, FL	240	Apr-02	174	174	6.96	-	3.43	-	23.87	Kimley-Horn & Associates
Marion Co, FL	288	Apr-02	175	175	5.66	-	5.55	-	31.41	Kimley-Horn & Associates
Marion Co, FL	480	Apr-02	175	175	5.73	-	6.88	-	39.42	Kimley-Horn & Associates
Marion Co, FL	500	Apr-02	170	170	5.46	-	5.94	-	32.43	Kimley-Horn & Associates
Lake Co, FL	250	Dec-06	135	135	6.71	-	5.33	-	35.76	Tindale Oliver
Lake Co, FL	157	Dec-06	265	265	13.97	-	2.62	-	36.60	Tindale Oliver
Lake Co, FL	169	Dec-06	212	-	8.09	-	6.00	-	48.54	Tindale Oliver
Lake Co, FL	226	Dec-06	301	-	6.74	-	2.17	-	14.63	Tindale Oliver
Hernando Co, FL	312	Apr-07	456	-	4.09	-	5.95	-	24.34	Tindale Oliver
Hernando Co, FL	176	Apr-07	332	-	5.38	-	5.24	-	28.19	Tindale Oliver
Total Size	3,467		13	2,648	Average Trip Length: 4.91					
					Weighted Average Trip Length: 5.21					

Table A-9

Land Use 240: Mobile Home Park

Location	Size / Units	Date	Total # Interviews	# Trip Length Interviews	Trip Gen Rate	Time Period	Trip Length	Percent New Trips	VMT	Source
Marion Co, FL	67	Jul-91	22	22	5.40	48hrs.	2.29	-	12.37	Tindale Oliver
Marion Co, FL	82	Jul-91	58	58	10.80	24hr.	3.72	-	40.18	Tindale Oliver
Marion Co, FL	137	Jul-91	22	22	3.10	24hr.	4.88	-	15.13	Tindale Oliver
Sarasota Co, FL	996	Jun-93	181	181	4.19	-	4.40	-	18.44	Sarasota County
Sarasota Co, FL	235	Jun-93	100	100	3.51	-	5.10	-	17.90	Sarasota County
Marion Co, FL	188	Apr-02	147	-	3.51	24hr.	5.48	-	19.23	Kimley-Horn & Associates
Marion Co, FL	227	Apr-02	173	-	2.76	24hr.	8.80	-	24.29	Kimley-Horn & Associates
Marion Co, FL	297	Apr-02	175	-	4.78	24hr.	4.76	-	22.75	Kimley-Horn & Associates
Hernando Co, FL	1,892	May-96	425	425	4.13	9a-6p	4.13	-	17.06	Tindale Oliver
Total Size	4,121		9	1,303	Average Trip Length: 4.84					
					Weighted Average Trip Length: 4.60					
					Weighted Average Trip Generation Rate: 4.17					

Table A-10

Land Use 251: Senior Adult Housing - Detached

Location	Size / Units	Date	Total # Interviews	# Trip Length Interviews	Trip Gen Rate	Time Period	Trip Length	Percent New Trips	VMT	Source
Lakeland, FL	67	3/28-4/2/90	26	24	3.50	9am-4pm	2.44	-	8.54	Tindale Oliver
Marion Co, FL	778	Apr-02	175	-	2.96	24hr.	3.49	-	10.33	Kimley-Horn & Associates
Marion Co, FL	877	Apr-02	209	-	2.91	24hr.	5.90	-	17.17	Kimley-Horn & Associates
Marion Co, FL	1,054	Apr-02	173	-	3.65	24hr.	6.00	-	21.90	Kimley-Horn & Associates
Marion Co, FL	3,076	Apr-02	198	-	2.63	24hr.	5.16	-	13.57	Kimley-Horn & Associates
Marion Co, FL	3,625	Apr-02	164	-	2.50	24hr.	5.83	-	14.58	Kimley-Horn & Associates
Total Size	9,477		6	945	Average Trip Length: 4.80					
ITE	9,690		15		Weighted Average Trip Length: 5.42					
Blended total	19,167				Weighted Average Trip Generation Rate: 2.75					
					ITE Average Trip Generation Rate: 4.31					
					Blend of FL Studies and ITE Average Trip Generation Rate: 3.54					

Table A-11

Land Use 252: Senior Adult Housing - Attached

Location	Size / Units	Date	Total # Interviews	# Trip Length Interviews	Trip Gen Rate	Time Period	Trip Length	Percent New Trips	VMT	Source
Sun City Center, FL	208	Oct-91	726	726	2.46	24hr.	-	-	-	Tindale Oliver
Total Size	208		1		Average Trip Length: -					
ITE	432		6		Weighted Average Trip Length: -					
Blended total	640				Weighted Average Trip Generation Rate: 2.46					
					ITE Average Trip Generation Rate: 3.24					
					Blend of FL Studies and ITE Average Trip Generation Rate: 2.99					

Table A-12

Land Use 310: Hotel

Location	Size (Rooms)	Date	Total # Interviews	# Trip Length Interviews	Trip Gen Rate	Time Period	Trip Length	Percent New Trips	VMT	Source
Pinellas Co, FL	174	Aug-89	134	106	12.50	7-11a/3-7p	6.30	79.0	62.21	Tindale Oliver
Pinellas Co, FL	114	Oct-89	30	14	7.30	12-7p	6.20	47.0	21.27	Tindale Oliver
Orange Co, FL	123	1997	-	-	6.32	-	-	-	-	Orange County
Orange Co, FL	120	1997	-	-	5.27	-	-	-	-	Orange County
Orange Co, FL	146	1997	-	-	7.61	-	-	-	-	Orange County
Orange Co, FL	252	1997	-	-	5.63	-	-	-	-	Orange County
Orange Co, FL	172	1997	-	-	6.36	-	-	-	-	Orange County
Orange Co, FL	170	1997	-	-	6.06	-	-	-	-	Orange County
Orange Co, FL	128	1997	-	-	6.10	-	-	-	-	Orange County
Orange Co, FL	200	1997	-	-	4.56	-	-	-	-	Orange County
Orange Co, FL	112	1998	-	-	2.78	-	-	-	-	Orange County
Orange Co, FL	130	1998	-	-	9.12	-	-	-	-	Orange County
Orange Co, FL	106	1998	-	-	7.34	-	-	-	-	Orange County
Orange Co, FL	98	1998	-	-	7.52	-	-	-	-	Orange County
Orange Co, FL	120	1998	-	-	5.57	-	-	-	-	Orange County
Orange Co, FL	70	1999	-	-	1.85	-	-	-	-	Orange County
Orange Co, FL	123	1999	-	-	4.81	-	-	-	-	Orange County
Orange Co, FL	123	1999	-	-	3.70	-	-	-	-	Orange County
Orange Co, FL	211	2000	-	-	2.23	-	-	-	-	Orange County
Orange Co, FL	144	2000	-	-	7.32	-	-	-	-	Orange County
Orange Co, FL	105	2001	-	-	5.25	-	-	-	-	Orange County
Orange Co, FL	891	2005	-	-	5.69	-	-	-	-	Orange County
Orange Co, FL	1,584	2005	-	-	5.88	-	-	-	-	Orange County
Orange Co, FL	210	2006	-	-	4.88	-	-	-	-	Orange County
Orange Co, FL	1,499	2006	-	-	4.69	-	-	-	-	Orange County
Orange Co, FL	144	-	-	-	4.74	-	-	-	-	Orange County
Orange Co, FL	148	-	-	-	7.61	-	-	-	-	Orange County
Orange Co, FL	160	-	-	-	6.19	-	-	-	-	Orange County
Orange Co, FL	130	-	-	-	4.29	-	-	-	-	Orange County
Orange Co, FL	130	-	-	-	3.40	-	-	-	-	Orange County
Orange Co, FL	144	-	-	-	7.66	-	-	-	-	Orange County
Orange Co, FL	100	-	-	-	7.37	-	-	-	-	Orange County
Orange Co, FL	190	-	-	-	4.71	-	-	-	-	Orange County
Orange Co, FL	1,501	2011	-	-	3.50	-	-	-	-	Tindale Oliver
Orange Co, FL	174	2011	-	-	7.03	-	-	-	-	Tindale Oliver
Orange Co, FL	238	2014	-	-	4.05	-	-	-	-	Tindale Oliver

Total Size	10,184	36	164	Average Trip Length:	6.25	
ITE	1,036	7		Weighted Average Trip Length:	6.26	
Blended total	11,220			Weighted Percent New Trip Average:	66.3	
				Weighted Average Trip Generation Rate:	66.3	5.31
				ITE Average Trip Generation Rate:		7.99
				Blend of FL Studies and ITE Average Trip Generation Rate:		5.56

Table A-13

Land Use 320: Motel

Location	Size (Rooms)	Date	Total # Interviews	# Trip Length Interviews	Trip Gen Rate	Time Period	Trip Length	Percent New Trips	VMT	Source
Pinellas Co, FL	48	Oct-89	46	24	-	10a-2p	2.80	65.0	-	Tindale Oliver
Pinellas Co, FL	54	Oct-89	32	22	-	12p-7p	3.80	69.0	-	Tindale Oliver
Pinellas Co, FL	120	Oct-89	26	22	-	2p-7p	5.20	84.6	-	Tindale Oliver

Total Size	222	3	104	Average Trip Length:	3.93	
ITE	654	6		Weighted Average Trip Length:	4.34	
				Weighted Percent New Trip Average:	76.6	

Table A-14

Land Use 445: Movie Theater

Location	Size (Screens)	Date	Total # Interviews	# Trip Length Interviews	Trip Gen Rate	Time Period	Trip Length	Percent New Trips	VMT	Source
Pinellas Co, FL	8	Oct-89	151	116	113.10	2p-8p	2.70	77.0	235.13	Tindale Oliver
Pinellas Co, FL	12	Sep-89	122	116	63.40	2p-8p	1.90	95.0	114.44	Tindale Oliver

Total Size	20	2	273	Average Trip Length:	2.30	
				Weighted Average Trip Length:	2.22	
				Weighted Percent New Trip Average:	87.8	
				Weighted Average Trip Generation Rate:		83.28
				ITE Average Trip Generation Rate:		220.00
				Blend of FL Studies and ITE Average Trip Generation Rate:		114.83

Table A-15

Land Use 492: Health/Fitness Club

Location	Size (1,000 sf)	Date	Total # Interviews	# Trip Length Interviews	Trip Gen Rate	Time Period	Trip Length	Percent New Trips	VMT	Source
Tampa, FL	-	Mar-86	33	31	-	-	-	94.0	-	Kimley-Horn & Associates

Total Size	-	1	33	Average Trip Length:	-	
ITE	37	8		Percent New Trip Average:	94.0	

Table A-16

Land Use 565: Day Care Center

Location	Size (1,000 sf)	Date	Total # Interviews	# Trip Length Interviews	Trip Gen Rate	Time Period	Trip Length	Percent New Trips	VMT	Source
Pinellas Co, FL	5.6	Aug-89	94	66	66.99	7a-6p	1.90	70.0	89.10	Tindale Oliver
Pinellas Co, FL	10.0	Sep-89	179	134	66.99	7a-6p	2.10	75.0	105.51	Tindale Oliver
Tampa, FL	-	Mar-86	28	25	-	-	2.60	89.0	-	Kimley-Horn & Associates
Total Size	15.6		3	301						
ITE	135.0		27							
Blended total	150.6									
							Average Trip Length:	2.20		
							Weighted Average Trip Length:	2.03		
							Weighted Percent New Trip Average:	73.2		

Table A-17

Land Use 620: Nursing Home

Location	Size (Beds)	Date	Total # Interviews	# Trip Length Interviews	Trip Gen Rate	Time Period	Trip Length	Percent New Trips	VMT	Source
Lakeland, FL	120	Mar-90	74	66	2.86	11a-4p	2.59	89.0	6.59	Tindale Oliver
Total Size	120		1	74						
ITE	480		3							
Blended total	600									
							Average Trip Length:	2.59		
							Weighted Average Trip Length:	2.59		
							Weighted Percent New Trip Average:	89.0		
							Weighted Average Trip Generation Rate:	2.86		
							ITE Average Trip Generation Rate:	3.06		
							Blend of FL Studies and ITE Average Trip Generation Rate:	3.02		

Table A-18

Land Use 630: Clinic

Location	Size (1,000 sf)	Date	Total # Interviews	# Trip Length Interviews	Trip Gen Rate	Time Period	Trip Length	Percent New Trips	VMT	Source
Largo, FL	103.9	Aug-89	614	572	37.03	7a-430p	5.10	93.0	175.63	Tindale Oliver
St. Petersburg, FL	-	Oct-89	280	252	-	9a-5p	4.10	90.0	-	Tindale Oliver
Total Size	103.9		2	894						
ITE	180.0		9							
	283.9									
							Average Trip Length:	4.60		
							Weighted Average Trip Length:	5.10		
							Weighted Percent New Trip Average:	93.0		
							Weighted Average Trip Generation Rate:	37.03		
							ITE Average Trip Generation Rate:	37.60		
							Blend of FL Studies and ITE Average Trip Generation Rate:	37.39		

Table A-19

Land Use 710: General Office Building

Location	Size (1,000 sf)	Date	Total # Interviews	# Trip Length Interviews	Trip Gen Rate	Time Period	Trip Length	Percent New Trips	VMT	Source
Sarasota Co, FL	14.3	Jun-93	14	14	46.85	-	11.30	-	529.41	Sarasota County
Gwinnett Co, GA	98.0	Dec-92	-	-	4.30	-	5.40	-	-	Street Smarts
Gwinnett Co, GA	180.0	Dec-92	-	-	3.60	-	5.90	-	-	Street Smarts
Pinellas Co, FL	187.0	Oct-89	431	388	18.49	7a-5p	6.30	90.0	104.84	Tindale Oliver
St. Petersburg, FL	262.8	Sep-89	291	274	-	7a-5p	3.40	94.0	-	Tindale Oliver
			5	736						
							Average Trip Length:	6.46		
							Weighted Average Trip Length:	5.15		
							Weighted Percent New Trip Average:	92.3		

Table A-20

LUC 720: Small Medical/Dental Office Building: 10,000 sf or Less

Site	Size (1,000 sf)	Tues., Jan 11		Wedn., Jan 12		Thur., Jan 13		TOTAL		AVERAGE		AVERAGE (per 1,000 sf)			
		IN	OUT	IN	OUT	IN	OUT	IN	OUT	IN	OUT	IN	OUT	TOTAL	
Site 1	2.100	35	35	22	22	13	13	70	70	23.33	23.33	11.11	11.11	22.22	
Site 2	3.000	40	40	52	52	53	53	145	145	48.33	48.33	16.11	16.11	32.22	
Site 3	2.000	28	28	19	21	24	26	71	75	23.67	25.00	11.84	12.50	24.34	
Site 4	1.000	30	30	52	52	57	57	139	139	46.33	46.33	46.33	46.33	92.66	
Site 5	3.024	31	32	43	43	24	24	98	99	32.67	33.00	10.80	10.91	21.71	
Site 6	1.860	22	24	19	17	11	11	52	52	17.33	17.33	9.32	9.32	18.64	
Average													17.59	17.71	35.30
Average (excluding Site 4)													11.84	11.99	23.83

Table A-21

Land Use 720: Medical/Dental Office Building

Location	Size (1,000 sf)	Date	Total # Interviews	# Trip Length Interviews	Trip Gen Rate	Time Period	Trip Length	Percent New Trips	VMT	Source
Tampa, FL	-	Mar-86	33	26	-	-	6.00	79.0	-	Kimley-Horn & Associates
Palm Harbor, FL	14.6	Oct-89	104	76	33.98	9a-5p	6.30	73.0	156.27	Tindale Oliver
St. Petersburg, FL	-	Nov-89	34	30	57.20	9a-4p	1.20	88.0	-	Tindale Oliver
Hernando Co, FL	58.4	May-96	390	349	28.52	9a-6p	6.47	89.5	165.09	Tindale Oliver
Hernando Co, FL	28.0	May-96	202	189	49.75	9a-6p	6.06	93.8	282.64	Tindale Oliver
Charlotte Co, FL	11.0	Oct-97	-	186	49.50	9a-5p	4.60	92.1	209.67	Tindale Oliver
Charlotte Co, FL	28.0	Oct-97	-	186	31.00	9a-5p	3.60	81.6	91.04	Tindale Oliver
Charlotte Co, FL	30.4	Oct-97	-	324	39.80	9a-5p	3.30	83.5	109.68	Tindale Oliver
Citrus Co, FL	38.9	Oct-03	-	168	32.26	8-6p	6.80	97.1	213.03	Tindale Oliver
Citrus Co, FL	10.0	Nov-03	-	340	40.56	8-630p	6.20	92.4	232.33	Tindale Oliver
Citrus Co, FL	5.3	Dec-03	-	20	29.36	8-5p	5.25	95.2	146.78	Tindale Oliver
Orange Co, FL	50.6	2009	-	-	26.72	-	-	-	-	Orange County
Orange Co, FL	23.5	2010	-	-	16.58	-	-	-	-	Tindale Oliver

13 763

Average Trip Length: 5.07
Weighted Average Trip Length: 5.55

Weighted Percent New Trip Average: 88.9
Average Trip Generation Rate: 32.59
ITE Average Trip Generation Rate: 36.00
Blend of FL Studies and ITE Average Trip Generation Rate: 34.21

Table A-22

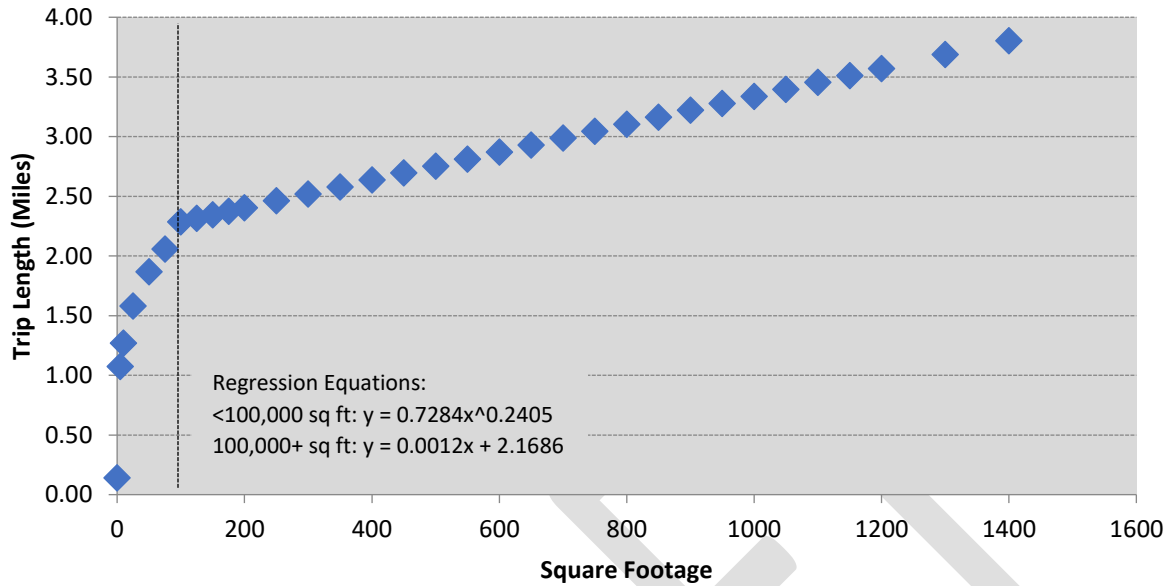
Land Use 820/821/822: Retail/Shopping Center

Location	Size (1,000 sf)	Date	Total # Interviews	# Trip Length Interviews	Trip Gen Rate	Time Period	Trip Length	Percent New Trips	VMT	Source
Tampa, FL	-	Mar-86	527	348	-	-	-	66.0	-	Kimley-Horn & Associates
Tampa, FL	-	Mar-86	170	-	-	-	1.70	-	-	Kimley-Horn & Associates
Tampa, FL	-	Mar-86	354	269	-	-	-	76.0	-	Kimley-Horn & Associates
Tampa, FL	-	Mar-86	144	-	-	-	2.50	-	-	Kimley-Horn & Associates
St. Petersburg, FL	1,192.0	Aug-89	384	298	-	11a-7p	3.60	78.0	-	Tindale Oliver
St. Petersburg, FL	132.3	Sep-89	400	368	77.00	10a-7p	1.80	92.0	127.51	Tindale Oliver
Largo, FL	425.0	Aug-89	160	120	26.73	10a-6p	2.30	75.0	46.11	Tindale Oliver
Dunedin, FL	80.5	Sep-89	276	210	81.48	9a-5p	1.40	76.0	86.69	Tindale Oliver
Pinellas Park, FL	696.0	Sep-89	485	388	-	9a-6p	3.20	80.0	-	Tindale Oliver
Seminole, FL	425.0	Oct-89	674	586	-	-	-	87.0	-	Tindale Oliver
Hillsborough Co, FL	134.0	Jul-91	-	-	-	-	1.30	74.0	-	Tindale Oliver
Hillsborough Co, FL	151.0	Jul-91	-	-	-	-	1.30	73.0	-	Tindale Oliver
Collier Co, FL	-	Aug-91	68	64	-	-	3.33	94.1	-	Tindale Oliver
Collier Co, FL	-	Aug-91	208	154	-	-	2.64	74.0	-	Tindale Oliver
Sarasota/Bradenton, FL	109.0	Sep-92	300	185	-	12a-6p	-	61.6	-	King Engineering Associates, Inc.
Ocala, FL	133.4	Sep-92	300	192	-	12a-6p	-	64.0	-	King Engineering Associates, Inc.
Sarasota Co, FL	110.0	Jun-93	58	58	122.14	-	3.20	-	-	Sarasota County
Sarasota Co, FL	146.1	Jun-93	65	65	51.53	-	2.80	-	-	Sarasota County
Sarasota Co, FL	157.5	Jun-93	57	57	79.79	-	3.40	-	-	Sarasota County
Sarasota Co, FL	191.0	Jun-93	62	62	66.79	-	5.90	-	-	Sarasota County
Hernando Co, FL	107.8	May-96	608	331	77.60	9a-6p	4.68	54.5	197.85	Tindale Oliver
Charlotte Co, FL	88.0	Oct-97	-	-	73.50	9a-5p	1.80	57.1	75.56	Tindale Oliver
Charlotte Co, FL	191.9	Oct-97	-	-	72.00	9a-5p	2.40	50.9	87.97	Tindale Oliver
Charlotte Co, FL	51.3	Oct-97	-	-	43.00	9a-5p	2.70	51.8	60.08	Tindale Oliver
Lake Co, FL	67.8	Apr-01	246	177	102.60	-	3.40	71.2	248.37	Tindale Oliver
Lake Co, FL	72.3	Apr-01	444	376	65.30	-	4.50	59.0	173.37	Tindale Oliver
Pasco Co, FL	65.6	Apr-02	222	-	145.64	9a-5p	1.46	46.9	99.62	Tindale Oliver
Pasco Co, FL	75.8	Apr-02	134	-	38.23	9a-5p	2.36	58.2	52.52	Tindale Oliver
Citrus Co, FL	185.0	Oct-03	-	784	55.84	8a-6p	2.40	88.1	118.05	Tindale Oliver
Citrus Co, FL	91.3	Nov-03	-	390	54.50	8a-6p	1.60	88.0	76.77	Tindale Oliver

30 6,346

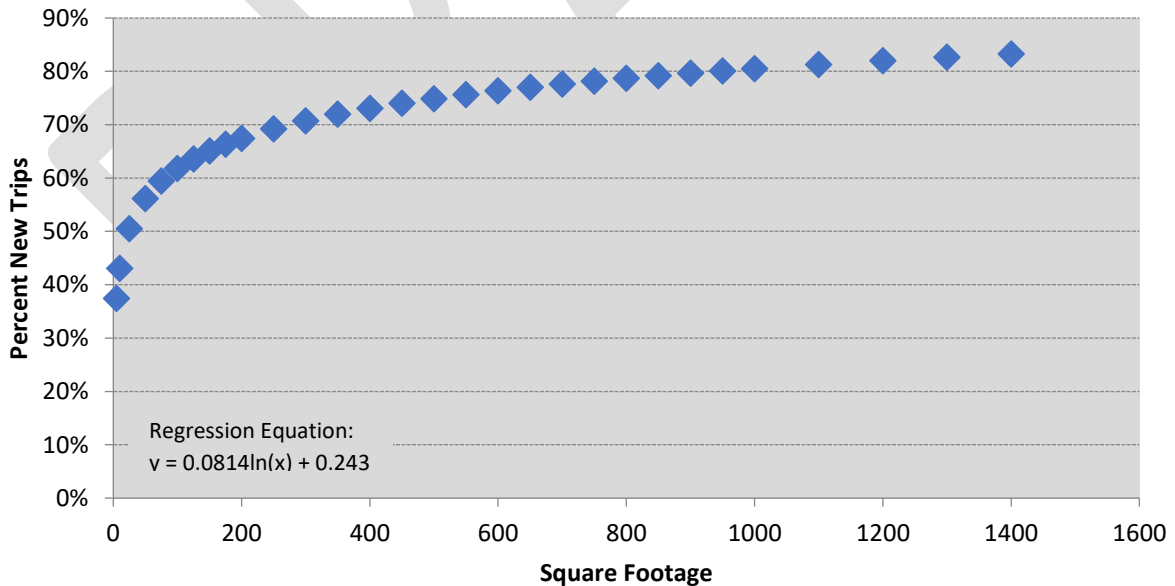
Average Trip Length: 2.71

Figure A-1
LUC 820: Retail/Shopping Center – TCS Curve Trip Length Regression



Source: Regression analysis based on TCS data for LUC 820

Figure A-2
LUC 820: Retail/Shopping Center – TCS Curve Percent New Trips Regression



Source: Regression analysis based on TCS data for LUC 820

Table A-23

Land Use 840/841: New/Used Automobile Sales

Location	Size (1,000 sf)	Date	Total # Interviews	# Trip Length Interviews	Trip Gen Rate	Time Period	Trip Length	Percent New Trips	VMT	Source
St.Petersburg, FL	43.0	Oct-89	152	120	-	9a-5p	4.70	79.0	-	Tindale Oliver
Clearwater, FL	43.0	Oct-89	136	106	29.40	9a-5p	4.50	78.0	103.19	Tindale Oliver
Orange Co, FL	13.8	1997	-	-	35.75	-	-	-	-	Orange County
Orange Co, FL	34.4	1998	-	-	23.45	-	-	-	-	Orange County
Orange Co, FL	66.3	2001	-	-	28.50	-	-	-	-	Orange County
Orange Co, FL	39.1	2002	-	-	10.48	-	-	-	-	Orange County
Orange Co, FL	116.7	2003	-	-	22.18	-	-	-	-	Orange County
Orange Co, FL	51.7	2007	-	-	40.34	-	-	-	-	L-TEC
Orange Co, FL	36.6	-	-	-	15.17	-	-	-	-	Orange County
Orange Co, FL	216.4	2008	-	-	13.45	-	-	-	-	Orange County
Total Size	618.0		10	288			Average Trip Length: 4.60			
ITE (840)	648.0		18				Weighted Average Trip Length: 4.60			
ITE (841)	28.0		14							
Blended total	1,294.0									
									Weighted Percent New Trip Average:	78.5
									Weighted Average Trip Generation Rate:	21.04
									ITE Average Trip Generation Rate (LUC 840):	27.84
									ITE Average Trip Generation Rate (LUC 841):	27.06
									Blend of FL Studies and ITE Average Trip Generation Rate:	24.58

Table A-24

Land Use 850: Supermarket

Location	Size (1,000 sf)	Date	Total # Interviews	# Trip Length Interviews	Trip Gen Rate	Time Period	Trip Length	Percent New Trips	VMT	Source
Palm Harbor, FL	62.0	Aug-89	163	62	106.26	9a-4p	2.08	56.0	123.77	Tindale Oliver
Total Size	62.0		1	163			Average Trip Length: 2.08			
ITE	1,144.0		22				Weighted Average Trip Length: 2.08			
Blended total	1,206.0									
									Weighted Percent New Trip Average:	56.0

Table A-25

Land Use 880/881: Pharmacy with and without Drive-Through Window

Location	Size (1,000 sf)	Date	Total # Interviews	# Trip Length Interviews	Trip Gen Rate	Time Period	Trip Length	Percent New Trips	VMT	Source
Pasco Co, FL	11.1	Apr-02	138	38	88.97	-	2.05	27.5	50.23	Tindale Oliver
Pasco Co, FL	12.0	Apr-02	212	90	122.16	-	2.04	42.5	105.79	Tindale Oliver
Pasco Co, FL	15.1	Apr-02	1192	54	97.96	-	2.13	28.1	58.69	Tindale Oliver
Total Size	38.2		3	1,542			Average Trip Length: 2.07			
ITE (LUC 880)	66.0		6				Weighted Average Trip Length: 2.08			
ITE (LUC 881)	208.0		16							
Blended total	312.2									
									Weighted Percent New Trip Average:	32.4

Table A-26

Land Use 890: Furniture Store

Location	Size (1,000 sf)	Date	Total # Interviews	# Trip Length Interviews	Trip Gen Rate	Time Period	Trip Length	Percent New Trips	VMT	Source
Largo, FL	15.0	7/28-30/92	64	34	-	-	4.63	52.5	-	Tindale Oliver
Tampa, FL	16.9	Jul-92	68	39	-	-	7.38	55.7	-	Tindale Oliver
Total Size	31.90		2	132			Average Trip Length: 6.01			
ITE	779.0		19				Weighted Average Trip Length: 6.09			
Blended total	810.90									
									Weighted Percent New Trip Average:	54.2

Table A-27

Land Use 912: Bank/Savings w/Drive-Thru

Location	Size (1,000 sf)	Date	Total # Interviews	# Trip Length Interviews	Trip Gen Rate	Time Period	Trip Length	Percent New Trips	VMT	Source
Tampa, FL	-	Mar-86	77	-	-	-	2.40	-	-	Kimley-Horn & Associates
Tampa, FL	-	Mar-86	211	-	-	-	-	54.0	-	Kimley-Horn & Associates
Clearwater, FL	0.4	Aug-89	113	52	-	9a-6p	5.20	46.0	-	Tindale Oliver
Largo, FL	2.0	Sep-89	129	94	-	-	1.60	73.0	-	Tindale Oliver
Seminole, FL	4.5	Oct-89	-	-	-	-	-	-	-	Tindale Oliver
Marion Co, FL	2.3	Jun-91	69	29	-	24hr.	1.33	42.0	-	Tindale Oliver
Marion Co, FL	3.1	Jun-91	47	32	-	24hr.	1.75	68.1	-	Tindale Oliver
Marion Co, FL	2.5	Jul-91	57	26	-	48hrs.	2.70	45.6	-	Tindale Oliver
Collier Co, FL	-	Aug-91	162	96	-	24hr.	0.88	59.3	-	Tindale Oliver
Collier Co, FL	-	Aug-91	116	54	-	-	1.58	46.6	-	Tindale Oliver
Collier Co, FL	-	Aug-91	142	68	-	-	2.08	47.9	-	Tindale Oliver
Hernando Co, FL	5.4	May-96	164	41	-	9a-6p	2.77	24.7	-	Tindale Oliver
Marion Co, FL	2.4	Apr-02	70	-	-	24hr.	3.55	54.6	-	Kimley-Horn & Associates
Marion Co, FL	2.7	May-02	50	-	246.66	24hr.	2.66	40.5	265.44	Kimley-Horn & Associates
Total Size	25.2		14	1,407			Average Trip Length: 2.38			
ITE	114.0		19				Weighted Average Trip Length: 2.46			
Blended total	139.2									
									Weighted Percent New Trip Average:	46.2

Table A-28

Land Use 931: Fine Dining Restaurant

Location	Size (1,000 sf)	Date	Total # Interviews	# Trip Length Interviews	Trip Gen Rate	Time Period	Trip Length	Percent New Trips	VMT	Source
Tampa, FL	-	Mar-86	76	62	-	-	2.10	82.0	-	Kimley-Horn & Associates
St. Petersburg, FL	7.5	Oct-89	177	154	-	11a-2p/4-8p	3.50	87.0	-	Tindale Oliver
Clearwater, FL	8.0	Oct-89	60	40	110.63	10a-2p/5-9p	2.80	67.0	207.54	Tindale Oliver
Total Size	15.5		3	313			Average Trip Length: 2.80			
ITE	90.0		10				Weighted Average Trip Length: 3.14			
Blended total	105.5							Weighted Percent New Trip Average:	76.7	

Table A-29

Land Use 932: High-Turnover (Sit-Down) Restaurant

Location	Size (1,000 sf)	Date	Total # Interviews	# Trip Length Interviews	Trip Gen Rate	Time Period	Trip Length	Percent New Trips	VMT	Source
Hernando Co, FL	6.2	1996	242	175	187.51	9a-6p	2.76	72.5	375.00	Tindale Oliver
Hernando Co, FL	8.2	1996	154	93	102.71	9a-6p	4.15	60.2	256.43	Tindale Oliver
St. Petersburg, FL	5.0	1989	74	68	132.60	1130-7p	2.00	92.0	243.98	Tindale Oliver
Kenneth City, FL	5.2	1989	236	176	127.88	4p-730p	2.30	75.0	220.59	Tindale Oliver
Pasco Co, FL	5.2	2002	114	88	82.47	9a-6p	3.72	77.2	236.81	Tindale Oliver
Pasco Co, FL	5.8	2002	182	102	116.97	9a-6p	3.49	56.0	228.77	Tindale Oliver
Orange Co, FL	5.0	1996	-	-	135.68	-	-	-	-	Orange County
Orange Co, FL	9.7	1996	-	-	132.32	-	-	-	-	Orange County
Orange Co, FL	11.2	1998	-	-	18.76	-	-	-	-	Orange County
Orange Co, FL	7.0	1998	-	-	126.40	-	-	-	-	Orange County
Orange Co, FL	4.6	1998	-	-	129.23	-	-	-	-	Orange County
Orange Co, FL	7.4	1998	-	-	147.44	-	-	-	-	Orange County
Orange Co, FL	6.7	1998	-	-	82.58	-	-	-	-	Orange County
Orange Co, FL	11.3	2000	-	-	95.33	-	-	-	-	Orange County
Orange Co, FL	7.2	2000	-	-	98.06	-	-	-	-	Orange County
Orange Co, FL	11.4	2001	-	-	91.67	-	-	-	-	Orange County
Orange Co, FL	5.6	2001	-	-	145.59	-	-	-	-	Orange County
Orange Co, FL	5.5	-	-	-	100.18	-	-	-	-	Orange County
Orange Co, FL	11.3	-	-	-	62.12	-	-	-	-	Orange County
Orange Co, FL	10.4	-	-	-	31.77	-	-	-	-	Orange County
Orange Co, FL	5.9	-	-	-	147.74	-	-	-	-	Orange County
Orange Co, FL	8.9	2008	-	-	52.69	-	-	-	-	Orange County
Orange Co, FL	9.7	2010	-	-	105.84	-	-	-	-	Orange County
Orange Co, FL	9.5	2013	-	-	40.46	-	-	-	-	Orange County
Orange Co, FL	11.0	2015	-	-	138.39	-	-	-	-	Orange County
Total Size	194.9		25	1,102			Average Trip Length: 3.07			
ITE	250.0		50				Weighted Average Trip Length: 3.17			
Blended total	444.9							Weighted Percent New Trip Average:	70.8	
								Weighted Average Trip Generation Rate:	98.67	
								ITE Average Trip Generation Rate:	107.20	
								Blend of FL Studies and ITE Average Trip Generation Rate:	103.46	

Table A-30

Land Use 934: Fast Food Restaurant with Drive-Through Window

Location	Size (1,000 sf)	Date	Total # Interviews	# Trip Length Interviews	Trip Gen Rate	Time Period	Trip Length	Percent New Trips	VMT	Source
Tampa, FL	-	Mar-86	61	-	-	-	2.70	-	-	Kimley-Horn & Associates
Tampa, FL	-	Mar-86	306	-	-	-	-	65.0	-	Kimley-Horn & Associates
Pinellas Co, FL	2.20	Aug-89	81	48	502.80	11a-2p	1.70	59.0	504.31	Tindale Oliver
Pinellas Co, FL	4.30	Oct-89	456	260	660.40	1 day	2.30	57.0	865.78	Tindale Oliver
Tarpon Springs, FL	-	Oct-89	233	114	-	7a-7p	3.60	49.0	-	Tindale Oliver
Marion Co, FL	1.60	Jun-91	60	32	962.50	48hrs.	0.91	53.3	466.84	Tindale Oliver
Marion Co, FL	4.00	Jun-91	75	46	625.00	48hrs.	1.54	61.3	590.01	Tindale Oliver
Collier Co, FL	-	Aug-91	66	44	-	-	1.91	66.7	-	Tindale Oliver
Collier Co, FL	-	Aug-91	118	40	-	-	1.17	33.9	-	Tindale Oliver
Hernando Co, FL	5.43	May-96	136	82	311.83	9a-6p	1.68	60.2	315.27	Tindale Oliver
Hernando Co, FL	3.13	May-96	168	82	547.34	9a-6p	1.59	48.8	425.04	Tindale Oliver
Orange Co, FL	8.93	1996	-	-	377.00	-	-	-	-	Orange County
Lake Co, FL	2.20	Apr-01	376	252	934.30	-	2.50	74.6	1742.47	Tindale Oliver
Lake Co, FL	3.20	Apr-01	171	182	654.90	-	-	47.8	-	Tindale Oliver
Lake Co, FL	3.80	Apr-01	188	137	353.70	-	3.30	70.8	826.38	Tindale Oliver
Pasco Co, FL	2.66	Apr-02	100	46	283.12	9a-6p	-	46.0	-	Tindale Oliver
Pasco Co, FL	2.96	Apr-02	486	164	515.32	9a-6p	2.72	33.7	472.92	Tindale Oliver
Pasco Co, FL	4.42	Apr-02	168	120	759.24	9a-6p	1.89	71.4	1024.99	Tindale Oliver
Total Size	48.8		18	4,463			Average Trip Length: 2.11			
ITE	213.0		71				Weighted Average Trip Length: 2.05			
Blended total	261.8							Weighted Percent New Trip Average:	57.9	

Table A-31

Land Use 942: Automobile Care Center

Location	Size (1,000 sf)	Date	Total # Interviews	# Trip Length Interviews	Trip Gen Rate	Time Period	Trip Length	Percent New Trips	VMT	Source
Largo, FL	5.5	Sep-89	34	30	37.64	9a-5p	2.40	88.0	79.50	Tindale Oliver
Jacksonville, FL	2.3	2/3-4/90	124	94	-	9a-5p	3.07	76.0	-	Tindale Oliver
Jacksonville, FL	2.3	2/3-4/90	110	74	-	9a-5p	2.96	67.0	-	Tindale Oliver
Jacksonville, FL	2.4	2/3-4/90	132	87	-	9a-5p	2.32	66.0	-	Tindale Oliver
Lakeland, FL	5.2	Mar-90	24	14	-	9a-4p	1.36	59.0	-	Tindale Oliver
Lakeland, FL	-	Mar-90	54	42	-	9a-4p	2.44	78.0	-	Tindale Oliver
Orange Co, FL	25.0	Nov-92	41	39	-	2-6p	4.60	-	-	LCE, Inc.
Orange Co, FL	36.6	-	-	-	15.17	-	-	-	-	Orange County
Orange Co, FL	7.0	-	-	-	46.43	-	-	-	-	Orange County

Total Size	86.2	9	519	Average Trip Length:		2.74				
ITE	102.0	6		Weighted Average Trip Length:		3.62				
Blended total	188.2			Weighted Percent New Trip Average:		72.2	Weighted Average Trip Generation Rate:		22.14	
	151.1						ITE Average Trip Generation Rate (adjusted):		31.10	
							Blend of FL Studies and ITE Average Trip Generation Rate:		28.19	

Table A-32

Land Use 944: Gasoline/Service Station

Location	Size (1,000 sf)	Date	Total # Interviews	# Trip Length Interviews	Trip Gen Rate	Time Period	Trip Length	Percent New Trips	VMT	Source
Largo, FL	0.6	Nov-89	70	14	-	8am-5pm	1.90	23.0	-	Tindale Oliver
Collier Co, FL	-	Aug-91	168	40	-	-	1.01	23.8	-	Tindale Oliver

Total Size	0.6	1	238	Average Trip Length:		1.46				
ITE (vfp)	144.0	18		Weighted Average Trip Length:		1.90				
							Weighted Percent New Trip Average:		23.0	

Convenience Store/Gas Station (ITE LUC 945) - Mid-Size Blend

ITE	48	Conv. Store 2,000 to 3,999 sf:	265.12
ITE	5	Conv. Store 4,000 to 5,499 sf:	257.13
	53	Blend of ITE Average Trip Generation Rates for Convenience Store/Gas Station 2,000 to 5,499 sf:	264.38

Table A-33

Land Use 947: Self-Service Car Wash

Location	Size (Bays)	Date	Total # Interviews	# Trip Length Interviews	Trip Gen Rate	Time Period	Trip Length	Percent New Trips	VMT	Source
Largo, FL	10	Nov-89	111	84	-	8am-5pm	2.00	76.0	-	Tindale Oliver
Clearwater, FL	-	Nov-89	177	108	-	10am-5pm	1.30	61.0	-	Tindale Oliver
Collier Co, FL	11	Dec-09	304	-	30.24	-	2.50	57.0	-	Tindale Oliver
Collier Co, FL	8	Jan-09	186	-	22.75	-	1.96	72.0	-	Tindale Oliver

Total Size	29	4	778	Average Trip Length:		1.94				
Total Size (TGR)	19	2		Weighted Average Trip Length:		2.18				
ITE	5	1		Weighted Percent New Trip Average:		67.7	Weighted Average Trip Generation Rate:		27.09	
Blended total	24						ITE Average Trip Generation Rate:		108.00	
							Blend of FL Studies and ITE Average Trip Generation Rate:		43.94	

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**Appendix B
Cost Component**

Appendix B: Cost Component

This appendix presents the detailed calculations for the cost component of the multi-modal transportation impact fee study. Supporting data and estimates are provided for all cost variables, including:

- Design
- Right-of-Way
- Construction
- Construction engineering/inspection
- Roadway capacity
- Transit capital costs

Design

Town Roadways

The design cost factor for town roads was estimated as a percentage of the construction cost per lane mile. This factor was determined based on a review of design-to-construction cost ratios from recent projects in and around the Town of Wake Forest. As shown in Table B-1, the design factors ranged from five (5) percent to 25 percent with a weighted average of 17 percent. For purposes of this study, the design cost for town roads was estimated at 15 percent of the construction cost per lane mile.

State Roadways

Due to a lack of recent local data, the design cost factor for state roads was estimated using the same 15 percent ratio developed for Town roads.

Table B-1
Design-to-Construction Cost Factor

On	From	To	Municipality	Improvement	Constr. Year	Length	Lanes Added	Lane Miles Added	PE/Design	Construction Cost	Design-to-Construction Factor
Town of Wake Forest											
Stadium Dr	Glenco Dr	N. Wingate St	Town of Wake Forest	Widen	2018	0.92	2	1.84	\$1,503,587	\$6,648,635	23%
Ligon Mill Rd	South of S. Main St	N. of Wal-Mart entrance	Town of Wake Forest	Widen	2020	0.36	2	0.72	\$680,765	\$2,740,516	25%
Total:								2.56	\$2,184,352	\$9,389,151	23%
Other Jurisdictions											
NW Judd Pkwy	NC 42	NC 55	Town of Fuquay-Varina	New location	2021	1.79	4	7.16	\$1,340,965	\$12,615,518	11%
Lake Pine Dr	Macgregor Pines Dr	Versailles Dr	Town of Apex	Widen	2023	0.35	2	0.70	\$377,000	\$2,369,346	16%
Holly Springs Rd Ph II	Flint Point Ln	Sunset Lake Rd	Town of Holly Springs	Widen	2025	1.50	2	3.00	\$3,650,000	\$15,838,683	23%
Avent ferry Rd	Ralph Stephens	NC 55	Town of Holly Springs	Widen	2022	0.38	2	0.76	\$91,258	\$1,958,369	5%
Reedy Creek Rd	NC 54	Harison Ave	Town of Cary	Widen	2021	1.14	2	2.28	\$872,446	\$7,332,794	12%
Total:								13.90	\$6,331,669	\$40,114,710	16%
All Projects											
Total:								16.46	\$8,516,021	\$49,503,861	17%

Source: Town of Wake Forest and other respective jurisdictions

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Right-of-Way

The ROW cost reflects the total cost of the acquisitions along a corridor that was necessary to have sufficient cross-section width to widen an existing road or, in the case of new road construction, build a new road.

Town Roadways

For multi-modal fee purposes, the ROW cost for town roads was estimated as a percentage of the construction cost per lane mile. To determine the ROW cost factor, Benesch conducted a review of ROW-to-construction cost ratios of local projects and projects completed by nearby jurisdictions. As shown in Table B-2, the ROW-to-construction factors ranged from three (3) percent to 52 percent with a weighted average of 27 percent.

Based on a review of this data set ROW costs were estimated at approximately 20 percent of the construction costs. This estimate considers the higher ratios observed outside of the Town of Wake Forest and is comparable to the ratio for the most recent improvement in the Town.

State Roadways

Similar to town roads, the ROW cost for state roads was estimated as a percentage of the construction cost per lane mile. Due to a lack of data for state roads, the ROW-to-construction cost ratio determined for town roads was also applied to state roads.

**Table B-2
Right-of-Way-to-Construction Cost Factor**

On	From	To	Municipality	Improvement	Constr. Year	Length	Lanes Added	Lane Miles Added	Right-of-Way	Construction Cost	ROW-to-Construction Factor
Town of Wake Forest											
Stadium Dr	Glenco Dr	N. Wingate St	Town of Wake Forest	Widen	2018	0.92	2	1.84	\$223,895	\$6,648,635	3%
Ligon Mill Rd	South of S. Main St	N. of Wal-Mart entrance	Town of Wake Forest	Widen	2020	0.36	2	0.72	\$527,251	\$2,740,516	19%
Total:								2.56	\$751,146	\$9,389,151	8%
Other Jurisdictions											
NW Judd Pkwy	NC 42	NC 55	Town of Fuquay-Varina	New location	2021	1.79	4	7.16	\$6,531,965	\$12,615,518	52%
Lake Pine Dr	Macgregor Pines Dr	Versailles Dr	Town of Apex	Widen	2023	0.35	2	0.70	\$127,000	\$2,369,346	5%
Morrisville Carpenter Rd	Davis Dr	NC 54	Town of Morrisville	Widen	2023	1.52	2	3.04	\$1,393,851	\$6,582,586	21%
Holly Springs Rd Ph II	Flint Point Ln	Sunset Lake Rd	Town of Holly Springs	Widen	2025	1.50	2	3.00	\$4,660,000	\$15,838,683	29%
Avent ferry Rd	Ralph Stephens	NC 55	Town of Holly Springs	Widen	2022	0.38	2	0.76	\$236,146	\$1,958,369	12%
Reedy Creek Rd	NC 54	Harison Ave	Town of Cary	Widen	2021	1.14	2	2.28	\$1,712,854	\$7,332,794	23%
Total:								16.94	\$14,661,816	\$46,697,296	31%
All Projects											
Total:								19.50	\$15,412,962	\$56,086,447	27%

Source: Town of Wake Forest and other respective jurisdictions

Construction

Town Roadways

A review of construction cost data for local town roadway capacity expansion projects included two recent improvements identified in Wake Forest, as shown in Table B-3.

- Stadium Dr from Glenco Dr to N. Wingate
- Ligon Mill Rd from South of S. Main St to N. of Wal-Mart entrance

These improvements cost approximately \$3.67 million per lane mile for construction only.

In addition to local data, a review of recently bid projects from nearby jurisdictions was conducted. As shown in Table B-3, a total of seven (7) projects in five different towns were identified with a weighted average cost of approximately \$2.76 million per lane mile.

Based on this review, the construction cost for town roads was estimated at \$3.00 million per lane mile for use in the multi-modal transportation impact fee calculation. This estimate considers the lower costs observed outside of the Town of Wake Forest to utilize a larger sample of projects and provide a conservative estimate for impact fee purposes.

**Table B-3
Construction Cost for **Town** Roads**

On	From	To	Municipality	Improvement	Section Design	Constr. Year	Length	Lanes Added	Lane Miles Added	Construction Cost	Construction Cost per Lane Mile
Town of Wake Forest											
Stadium Dr	Glenco Dr	N. Wingate St	Town of Wake Forest	Widen	Curb & Gutter	2018	0.92	2	1.84	\$6,648,635	\$3,613,389
Ligon Mill Rd	South of S. Main St	N. of Wal-Mart entrance	Town of Wake Forest	Widen	Curb & Gutter	2020	0.36	2	0.72	\$2,740,516	\$3,806,272
Total:									2.56	\$9,389,151	\$3,668,000
Other Jurisdictions											
NW Judd Pkwy	NC 42	NC 55	Town of Fuquay-Varina	New location	Curb & Gutter	2021	1.79	4	7.16	\$12,615,518	\$1,761,944
Lake Pine Dr	Macgregor Pines Dr	Versailles Dr	Town of Apex	Widen	Curb & Gutter	2023	0.35	2	0.70	\$2,369,346	\$3,384,780
Morrisville Carpenter Rd	Davis Dr	NC 54	Town of Morrisville	Widen	Curb & Gutter	2023	1.52	2	3.04	\$6,582,586	\$2,165,324
Holly Springs Rd Ph II	Flint Point Ln	Sunset Lake Rd	Town of Holly Springs	Widen	Curb & Gutter	2025	1.50	2	3.00	\$15,838,683	\$5,279,561
Avent ferry Rd	Ralph Stephens	NC 55	Town of Holly Springs	Widen	Curb & Gutter	2022	0.38	2	0.76	\$1,958,369	\$2,576,801
Reedy Creek Rd	NC 54	Harison Ave	Town of Cary	Widen	Curb & Gutter	2021	1.14	2	2.28	\$7,332,794	\$3,216,138
Apex Peakway	James St	Towee Dr	Town of Apex	New location	Curb & Gutter	2025	0.45	4	1.80	\$14,769,512	\$8,205,284
Total:									16.94	\$46,697,296	\$2,757,000
All Projects											
Total:									19.50	\$56,086,447	\$2,876,000

Source: Town of Wake Forest and other respective jurisdictions

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State Roadways

For state road improvements, the North Carolina Capital Area Metropolitan Planning Organizations' 2050 Metropolitan Transportation Plan was utilized. When isolated from the full list of recommended improvements, those within or bordering the Town have an estimated total cost of approximately \$7.01 million per lane mile, as shown in Table B-4. This estimate includes design, CEI, and ROW elements already, so they were removed using the design/ROW/CEI cost ratios-to-construction that were previously discussed. After these factors are subtracted, the construction cost estimate amounts to \$4.70 million per lane mile for urban design (curb & gutter) state road improvements in the Town of Wake Forest.

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**Table B-4
Construction Cost for State Roads**

Project ID	Juris	Road Name	From	To	Existing Lanes	Proposed Lanes	Length	Lanes Added	Lane Miles	Total Cost	Total Cost per Lane Mile
A613	State	Harris Rd	US 1	N. Main Street	2	4	1.42	2	2.84	\$34,484,398	\$12,142,394
A133	State	Burlington Mills Rd	US 1	US 401	3	4	4.77	2	9.54	\$54,806,422	\$5,744,908
A125b	State	Heritage Lake Rd	Rogers Rd	NC 98	2	4	1.73	2	3.46	\$23,937,802	\$6,918,440
A605	State	Rogers Rd	Heritage Center Dr	Heritage Branch Rd	3	5	0.35	2	0.70	\$4,307,394	\$6,153,420
A56c	State	NC 98	NC 98 Bypass	US 401	3	4	5.29	2	10.58	\$73,197,093	\$6,918,440
A608a	State	NC 98	Debarmore St	Ligon Mill Rd (future connector)	2	4	1.07	2	2.14	\$13,524,219	\$6,319,729
A760	State	US 1 Alt	Harris Rd	Youngsville Southern Bypass	3	4	1.56	2	3.12	\$22,830,851	\$7,317,580
Total									32.38	\$227,088,179	\$7,013,224

Source: Connect 2050: The Triangle Region’s Metropolitan Transportation Plan; State projects in the Town of Wake Forest only



Construction Engineering/Inspection

Town Roadways

The CEI cost factor for town roads was estimated as a percentage of the construction cost per lane mile. This factor was determined based on a review of CEI-to-construction cost ratios from recent projects in and around the Town of Wake Forest. As shown in Table B-5, the CEI factors ranged from five (5) percent to 21 percent with a weighted average of 15 percent. For purposes of this study, the CEI cost for town roads was estimated at 15 percent of the construction cost per lane mile.

State Roadways

Due to a lack of recent local data, the CEI cost factor for state roads was estimated using the same 15 percent ratio developed for Town roads.

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**Table B-5
Construction Engineering/Inspection Cost Factor**

On	From	To	Municipality	Improvement	Constr. Year	Length	Lanes Added	Lane Miles Added	CEI	Construction Cost	CEI-to-Construction Factor
Town of Wake Forest											
Stadium Dr	Glenco Dr	N. Wingate St	Town of Wake Forest	Widen	2018	0.92	2	1.84	\$357,987	\$6,648,635	5%
Ligon Mill Rd	South of S. Main St	N. of Walmart entrance	Town of Wake Forest	Widen	2020	0.36	2	0.72	\$388,161	\$2,740,516	14%
Total:								2.56	\$746,148	\$9,389,151	8%
Other Jurisdictions											
Lake Pine Dr	Macgregor Pines Dr	Versailles Dr	Town of Apex	Widen	2023	0.35	2	0.70	\$314,520	\$2,369,346	13%
Morrisville Carpenter Rd	Davis Dr	NC 54	Town of Morrisville	Widen	2023	1.52	2	3.04	\$1,038,170	\$6,582,586	16%
Holly Springs Rd Ph II	Flint Point Ln	Sunset Lake Rd	Town of Holly Springs	Widen	2025	1.50	2	3.00	\$2,691,352	\$15,838,683	17%
Avent ferry Rd	Ralph Stephens	NC 55	Town of Holly Springs	Widen	2022	0.38	2	0.76	\$418,380	\$1,958,369	21%
Reedy Creek Rd	NC 54	Harison Ave	Town of Cary	Widen	2021	1.14	2	2.28	\$1,279,198	\$7,332,794	17%
Total:								9.78	\$5,741,620	\$34,081,778	17%
All Projects											
Total:								12.34	\$6,487,768	\$43,470,929	15%

Source: Town of Wake Forest and other respective jurisdictions

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Roadway Capacity

As shown in Table B-6, the average capacity per lane miles was based on the projects in the Capital Area Metropolitan Planning Organization's (CAMPO) 2050 Metropolitan Transportation Plan project list. The listing of projects reflects the mix of improvements that will yield the vehicle-miles of capacity (VMC) that will be built in the Town of Wake Forest. The resulting weighted average capacity per lane mile of approximately 6,800 was used in the multi-modal transportation impact fee calculation.

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**Table B-6
Connect 2050: The Triangle Region's Metropolitan Transportation Plan**

Project ID	Juris	Road Name	From	To	Road Classification	Existing Lanes	Proposed Lanes	Type	Length	Lanes Added	Lane Miles	Horizon Year	Initial Capacity	Future Capacity	Added Capacity	VMC Added	VMC per Lane Mile
A834	Town	Collector Street - Wake Forest	Connector Dr	Ligon Mill Rd	Collector	0	2	NC	0.42	2	0.84	2030	0	10,200	10,200	4,284	5,100
A835	Town	Collector Street - Wake Forest	Unicon Dr	Collector Street	Collector	0	2	NC	0.40	2	0.80	2030	0	10,200	10,200	4,080	5,100
A833	Town	Holding Village Way	Highpoint St	Friendship Chapel Rd	Collector	0	2	NC	0.42	2	0.84	2030	0	10,200	10,200	4,284	5,100
A127b1	Town	Ligon Mill Rd Connector	NC 98 Bypass	Richland Creek	Major Thoroughfare	0	4	NC	0.25	4	1.00	2030	0	26,700	26,700	6,675	6,675
A127b2	Town	Ligon Mill Rd Connector	Richland Creek	NC 98	Major Thoroughfare	0	2	NC	0.75	2	1.50	2030	0	12,200	12,200	9,150	6,100
A921	Town	Rogers Branch Rd	Penfield St	Forestville Rd	Collector	0	2	NC	0.13	2	0.26	2030	0	10,200	10,200	1,326	5,100
A881	Town	Stone Monument Dr Extension	Ligon Mill Rd	End of Road	Collector	0	2	NC	0.15	2	0.30	2030	0	10,200	10,200	1,530	5,100
A127a	Town	Ligon Mill Rd	US 1A	NC 98 Bypass	Major Thoroughfare	2	4	LA	0.61	2	1.22	2030	11,700	26,700	15,000	9,150	7,500
A404	Town	S. Franklin St	NC 98 (Wake Forest Bypass)	Rogers Rd	Minor Thoroughfare	3	4	LA	1.10	2	2.20	2030	13,100	26,700	13,600	14,960	6,800
A774	Town	Friendship Chapel Rd	Holding Village Way	Heritage Hills Way	Collector	0	2	NC	0.70	2	1.40	2040	0	10,200	10,200	7,140	5,100
A124a	Town	Northside Loop (Harris Rd)	N. Main Street	N. White St	Major Thoroughfare	0	3	NC	0.44	2	0.88	2040	0	13,300	13,300	5,852	6,650
A672	Town	Unicon Drive Ext	Height Lane	Unicon Drive	Collector	0	2	NC	0.15	2	0.30	2040	0	10,200	10,200	1,530	5,100
A613	State	Harris Rd	US 1	N. Main Street	Major Thoroughfare	2	4	LA	1.42	2	2.84	2040	11,700	26,700	15,000	21,300	7,500
A127b3	Town	Ligon Mill Rd Connector	Richland Creek	NC 98	Major Thoroughfare	2	4	LA	0.75	2	1.50	2040	11,700	26,700	15,000	11,250	7,500
A127c	Town	Ligon Mill Rd Connector	NC 98	Stadium Dr	Major Thoroughfare	0	4	NC	0.78	4	3.12	2050	0	26,700	26,700	20,826	6,675
A133	State	Burlington Mills Rd	US 1	US 401	Major Thoroughfare	3	4	LA	4.77	2	9.54	2050	13,100	26,700	13,600	64,872	6,800
A125a2	Town	Forestville Rd	Buffaloe Rd	Rogers Rd	Minor Thoroughfare	3	4	LA	7.50	2	15.00	2050	13,100	26,700	13,600	102,000	6,800
A125b	State	Heritage Lake Rd	Rogers Rd	NC 98	Minor Thoroughfare	2	4	LA	1.73	2	3.46	2050	11,700	26,700	15,000	25,950	7,500
A605	State	Rogers Rd	Heritage Center Dr	Heritage Branch Rd	Major Thoroughfare	3	5	LA	0.35	2	0.70	2050	13,100	26,800	13,700	4,795	6,850
A56c	State	NC 98	NC 98 Bypass	US 401	Major Thoroughfare	3	4	LA	5.29	2	10.58	2050	13,100	26,700	13,600	71,944	6,800
A608a	State	NC 98	Debarmore St	Ligon Mill Rd (future connector)	Major Thoroughfare	2	4	LA	1.07	2	2.14	2050	11,700	26,700	15,000	16,050	7,500
A760	State	US 1 Alt	Harris Rd	Youngsville Southern Bypass	Major Thoroughfare	3	4	LA	1.56	2	3.12	2050	13,100	26,700	13,600	21,216	6,800
Total											63.54					430,164	6,800
Total (Town ONLY):											31.16	49%				204,037	6,500
Total (State ONLY):											32.38	51%				226,127	7,000
Total (New Construction ONLY):											11.24	18%				204,037	18,200
Total (Lane Addition ONLY):											52.30	82%				226,127	4,300

Source: Connect 2050: The Triangle Region's Metropolitan Transportation Plan; Projects in the Town of Wake Forest only

Transit Capital Costs

In the case of multi-modal fees, the marginal cost of adding transit infrastructure needs to be considered. This section details the difference in cost per person-mile of capacity between expanding a roadway without transit amenities versus expanding a roadway with transit amenities. This calculation also accounts for the change in roadway PMC that occurs when a bus is on the road.

First, Table B-7 calculates the person-miles of capacity added for each new transit vehicle on the road. This calculation adjusts for the fact that buses have a significantly higher person-capacity than passenger vehicles. This table also identifies transit capital cost variables that will be used to calculate the added capital cost of constructing/expanding a roadway with transit facilities.

Next, Table B-8 combines the roadway VMC and the transit PMC to calculate the marginal change in cost per PMC. First, the roadway characteristics, including cost and capacity, were used to calculate the roadway cost per VMC for a generic 15-mile roadway segment. Then, an adjustment factor was applied to recognize that incorporating transit along a segment of roadway decreases the vehicle-capacity as the bus makes intermittent stops and interrupts the free-flowing traffic. As shown in Table B-8, the bus blockage adjustment factor is much higher for a 2-lane roadway than for a 4-lane roadway. On a 2-lane road, all cars get caught behind the bus during a stop, while on a 4-lane roadway, there is an unobstructed travel lane that cars can use to pass-by or maneuver around the slower transit vehicle. This adjusted VMC was then converted to PMC using the vehicle-miles to person-miles adjustment factor previously discussed in this report. The additional person-capacity from the buses was added to the adjusted roadway PMC. The person-miles of capacity that a transit system would add to the stretch of roadway (Table B-8) mitigates the decrease in vehicle-miles of capacity due to the bus blockage adjustments.

Next, the capital cost of transit infrastructure was added to the capital cost of the roadway expansion for both new road construction (0 to 2 lanes) and lane addition (2 to 4 lanes). With the transit infrastructure included, the updated cost per PMC was calculated, which now reflects the total cost of building a new road with transit or expanding a roadway and adding transit amenities. When compared to the cost per PMC for simply building/expanding a roadway without transit, the added cost of transit is between two (2) percent and five (5) percent.

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As a final step, the increased costs were then weighted by the lane mile distribution of new road construction and lane addition improvements in the Triangle Region's Metropolitan Transportation Plan. As shown, the plan calls for fewer new road construction projects than lane addition improvements. When the marginal cost of transit is included and weighted by this ratio, the resulting percent change is approximately 3.02 percent. Essentially, adding transit does not have a significant effect on the cost per person-mile of capacity for new road construction and lane addition improvements.

As it is currently structured, the transit model detailed in Tables B-7 and B-8 assumes that transit-miles and road-miles will be added to the system at the same rate. If the Town builds more transit-miles, this will increase the bus traffic on existing roads, adding more stops, higher stop frequency, and creating additional bus blockage. As a result, the capital cost per person-mile for a roadway with transit would increase in relation to the ratio of added transit-miles vs. roadway-miles. For example, if the transit-mile investment was double that of roadway construction/expansion, the 3.02 percent change calculated in Table B-8 would increase to approximately 6.04 percent. The annual construction figures for transit-miles and road-miles should be tracked by the Town and adjusted for in subsequent multi-modal transportation impact fee update studies.

Table B-7

Multi-Modal Fee: Cost per Person-Mile of Capacity

Input	Local Transit	
Transit Person-Miles of Capacity Calculation		
Vehicle Capacity ⁽¹⁾	45	1) Source: Local transit is assumed to have 32 seats with a 40 percent standing room capacity equivalent
Number of Vehicles (20% fleet margin) ⁽²⁾	1	2) Cycle time (Item 9) divided by headway time (Item 6) increased by 20 percent to accommodate the required fleet margin
Service Span (hours) ⁽³⁾	14	3) Source: Assumption based on current Wake Forest Loop routes
Cycles/Hour (aka Peak Vehicles) ⁽⁴⁾	0.80	4) Headway time (Item 6) divided by 60
Cycles per Day ⁽⁵⁾	11	5) Service span (Item 3) multiplied by the cycles/hour (Item 4)
Headway Time (minutes) ⁽⁶⁾	75	6) Source: Assumption based on current Wake Forest Loop routes
Speed (mph) ⁽⁷⁾	20	7) Source: Integrated National Transit Database Analysis System (INTDAS). 6-yr average
Round Trip Length (miles) ⁽⁸⁾	15.00	8) Source: Average trip length of Wake Forest Loop
Cycle Time (minutes) ⁽⁹⁾	45	9) Round trip length (Item 8) divided by speed (Item 7) multiplied by 60
Total Person-Miles of Capacity ⁽¹⁰⁾	7,425	10) Vehicle capacity (Item 1) multiplied by the cycles per day (Item 5) multiplied by the round trip length (Item 8)
Load Factor/System Capacity ⁽¹¹⁾	30%	11) Source: Optimistic assumption based on future goals
Adjusted Person-Miles of Capacity ⁽¹²⁾	2,228	12) Total person-miles of capacity (Item 10) multiplied by the load factor (Item 11)
Capital Cost Variables		
Stops per Mile (w/o Shelter) ⁽¹³⁾	3	13) Source: Model assumes 3 bench stops per mile
Shelters per Mile ⁽¹⁴⁾	1	14) Source: Model assumes 1 shelter stop per mile
Vehicle Cost ⁽¹⁵⁾	\$725,000	15) Source: Industry data, average of Diesel (\$600,000) and Alt. Fuel (\$850,000)
Simple Bus Stop ⁽¹⁶⁾	\$12,000	16) Source: Assumption based on local characteristics and industry knowledge
Sheltered Bus Stop ⁽¹⁷⁾	\$25,000	17) Source: Assumption based on local characteristics and industry knowledge

Table B-8
Multi-Modal Fee: Transit Component Model

Item	New Road Construction		Lane Additions	
	Roadway	Transit	Roadway	Transit
Roadway Characteristics:				
Roadway Cost per Mile ⁽¹⁾	\$9,256,000		\$9,256,000	
Roadway Segment Length (miles) ⁽²⁾	15.00		15.00	
Roadway Segment Cost ⁽³⁾	\$138,840,000	PMC	\$138,840,000	PMC
Average Capacity Added (per mile) ⁽⁴⁾	13,600	19,176	13,600	19,176
VMC/PMC Added (entire segment) ⁽⁵⁾	204,000	287,640	204,000	287,640
Roadway Cost per VMC/PMC ⁽⁶⁾	\$680.59	\$482.55	\$680.59	\$482.55
Transit Capacity:				
Adjustment for Bus Blockage ⁽⁷⁾	3.2%	-	1.6%	-
VMC/PMC Added (transit deduction) ⁽⁸⁾	6,528	9,204	3,264	4,602
VMC/PMC Added (less transit deduction) ⁽⁹⁾	197,472	278,436	200,736	283,038
PMC Added (transit addition ONLY) ⁽¹⁰⁾		2,228		2,228
Net PMC Added (transit effect included) ⁽¹¹⁾		280,664		285,266
Road/Transit Cost per PMC (Road Capital) ⁽¹²⁾		\$494.68		\$486.70
Transit Infrastructure:				
Buses Needed ⁽¹³⁾	1	\$725,000	1	\$725,000
Stops per mile (both sides of street) ⁽¹⁴⁾	3	\$1,080,000	3	\$1,080,000
Shelters per mile (both sides of street) ⁽¹⁵⁾	1	\$750,000	1	\$750,000
Total infrastructure ⁽¹⁶⁾		\$2,555,000		\$2,555,000
Multi-Modal Cost per PMC:				
Road/Transit Cost per PMC ⁽¹⁷⁾		\$503.79		\$495.66
Percent Change ⁽¹⁸⁾		4.40%		2.72%
Weighted Multi-Modal Cost per PMC:				
Lane Mile Distribution ⁽¹⁹⁾		18%		82%
Weighted Roadway Cost per PMC ⁽²⁰⁾		\$86.86		\$395.68
Weighted Road/Transit Cost per PMC ⁽²¹⁾		\$90.68		\$406.44
Weighted Average Multi-Modal Cost per PMC:				
Weighted Average Roadway Cost per PMC (new road construction and lane additions) ⁽²²⁾		\$482.54		\$482.54
Weighted Average Road/Transit Cost per PMC (new road construction and lane additions) ⁽²³⁾		\$497.12		\$497.12
Percent Change ⁽²⁴⁾				3.02%

Source:

- 1) Source: Table 3, adjusted to cost "per mile"
- 2) Source: Average length of Wake Forest Loop route
- 3) Roadway cost per mile (Item 1) multiplied by the roadway segment length (Item 2)
- 4) Source: Table 4, adjusted to capacity "per mile"
- 5) Roadway segment length (Item 2) multiplied by the average capacity added (Item 4) for both VMC and PMC
- 6) Roadway segment cost (Item 3) divided by the VMC/PMC added (Item 5) individually (adjusted slightly for rounding)
- 7) Source: Highway Capacity Manual 7th Edition, Equation 19-12
- 8) VMC added (Item 5) multiplied by the adjustment for bus blockage (Item 7). For PMC, multiply the VMC by 1.41 persons per vehicle
- 9) VMC/PMC added (entire segment) (Item 5) less the VMC/PMC added (transit deduction) (Item 8) for VMC and PMC individually
- 10) Source: Table B-7, Adjusted Person-Miles of Capacity (Item 12)
- 11) PMC added (less transit deduction) (Item 9) plus the PMC added (transit addition ONLY) (Item 10)
- 12) Road segment cost (Item 3) divided by the net PMC added (transit effect included) (Item 11)
- 13) Number of vehicles (see Table B-7, Item 2) multiplied by the vehicle cost (see Table B-7, Item 15)
- 14) Stops per mile (3) multiplied by the roadway segment length (Item 2) multiplied by the cost per stop (Table B-7, Item 16)
- 15) Shelters per mile (1) multiplied by the roadway segment length (Item 2) multiplied by the cost per shelter (Table B-7, Item 17)
- 16) Sum of buses needed (Item 13), stops needed (Item 14), and shelters needed (Item 15)
- 17) Sum of the roadway segment cost (Item 3) and the total transit infrastructure cost (Item 16) divided by the net PMC added (Item 11)
- 18) Percent difference between the road/transit cost per PMC (Item 17) and the Roadway cost per PMC (Item 6)
- 19) Source: Table B-6. Lane mile distribution of new road construction versus lane addition
- 20) Roadway cost per PMC (Item 6) multiplied by the lane mile distribution (Item 19)
- 21) Road/Transit cost per PMC (Item 17) multiplied by the lane mile distribution (Item 19)
- 22) Sum of the weighted roadway cost per PMC (Item 20) for new road construction and lane additions
- 23) Sum of the weighted road/transit cost per PMC (Item 21) for new road construction and lane additions
- 24) Percent difference between the weighted average road/transit cost per PMC (Item 23) and the weighted average roadway cost per PMC (Item 22)

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Appendix C
Credit Component

Appendix C: Credit Component

This appendix presents the detailed calculations for the credit component of the multi-modal transportation impact fee.

Table C-1 shows the estimated revenue generation per penny of motor fuel tax in North Carolina. Using the population ratio of Wake County to the State, the County’s share of fuel tax revenues was calculated.

Table C-1
Estimated Revenue Generation per Penny of Motor Fuel Tax

Item	Amount of Levy per Gallon
Statewide Motor Fuel Tax Revenue_2024 ⁽¹⁾	\$2,520,800,000
Motor Fuel Tax Rate_2024 ⁽¹⁾	40.4
Revenue Generation per Penny	\$62,396,040
Wake County Population Percentage ⁽²⁾	10.9%
Revenue Generation per Penny; County share⁽³⁾	\$6,801,000

1) Source: North Carolina Department of Transportation
 2) Source: Bureau of Economic Analysis
 3) Revenue generation per penny multiplied by the Wake County population percentage

Capital Improvement Credit

A revenue credit for the annual expenditures on multi-modal capacity-expansion projects in the Town of Wake Forest is presented below. The components of the credit are as follows:

- Town capital project funding
- State capital project funding

The annual expenditures from each revenue source are converted to equivalent fuel tax pennies to be able to create a connection between travel by each land use and non-impact fee revenue contributions for all revenue sources.

Town Capital Project Funding

A review of historical expenditures and planned capacity expansion improvements in the Town of Wake Forest identified several lane addition, traffic signal, intersection and sidewalk

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improvements, etc. funded with non-impact fee revenues (general fund, grants, bonds). Tables C-5 and C-6 summarize the cost of these improvements. As shown in Table C-2, an equivalent credit of 0.7 pennies was calculated for capacity expansion improvements funded by the Town of Wake Forest.

**Table C-2
Town of Wake Forest Fuel Tax Equivalent Pennies**

Source	Cost of Projects	Number of Years	Revenue from 1 Penny ⁽³⁾	Equivalent Pennies ⁽⁴⁾
FY 2025-2029 Planned Expenditures ⁽¹⁾	\$38,766,500	5	\$6,801,000	\$0.011
FY 2020-2024 Historical Expenditures ⁽²⁾	\$10,280,345	5	\$6,801,000	\$0.003
Total	\$49,046,845	10	\$6,801,000	\$0.007

- 1) Source: Table C-5
- 2) Source: Table C-6
- 3) Source: Table C-1
- 4) Cost of projects divided by number of years divided by revenue from 1 penny (Item 3) divided by 100

In addition, an equivalent credit of 0.5 pennies was calculated for outstanding debt service associated with the Town of Forest, as shown in Table C-3

**Table C-3
Town of Wake Forest Debt Service Fuel Tax Equivalent Pennies**

Source	Cost of Projects	Number of Years	Revenue from 1 Penny ⁽⁹⁾	Equivalent Pennies ⁽¹⁰⁾
Public Improvement, Series 2021B ⁽¹⁾	\$4,168,337	17	\$6,801,000	\$0.000
Public Improvement, Series 2021A ⁽²⁾	\$707,250	2	\$6,801,000	\$0.001
Refunding, Series 2019 ⁽³⁾	\$1,398,269	6	\$6,801,000	\$0.000
Street Improvements ⁽⁴⁾	\$2,045,018	2	\$6,801,000	\$0.002
Street/Highway Improvements ⁽⁵⁾	\$740,849	2	\$6,801,000	\$0.001
Refunding, Series 2016 ⁽⁶⁾	\$1,135,431	3	\$6,801,000	\$0.001
Public Improvement, Series 2015 ⁽⁷⁾	\$3,005,431	11	\$6,801,000	\$0.000
Public Improvement, Series 2018B ⁽⁸⁾	\$1,569,266	14	\$6,801,000	\$0.000
Total	\$14,769,851	-	-	\$0.005

- 1) Source: Table C-7
- 2) Source: Table C-8
- 3) Source: Table C-9
- 4) Source: Table C-10
- 5) Source: Table C-11
- 6) Source: Table C-12
- 7) Source: Table C-13
- 8) Source: Table C-14
- 9) Source: Table C-1
- 10) Outstanding debt divided by number of years divided by revenue from 1 penny (Item 7) divided by 100

DRAFT

State Capital Project Funding

In the calculation of the equivalent pennies of fuel tax from the State, funding on transportation capacity-expansion projects spanning an 11-year period (from FY 2023 to FY 2033) were reviewed. This included capacity expansion projects such as lane additions, new road construction, intersection improvements, interchanges, traffic signal projects, sidewalks, bike lanes, transit, and other capacity-addition projects listed in the State Transportation Improvement Program (STIP).

The total cost of the multi-modal transportation capacity-expansion projects:

- FY 2023-2028 STIP equates to 13.9 pennies
- FY 2029-2033 STIP equates to 13.2 pennies

The combined weighted average over the 11-year period of state expenditure for capacity-expansion transportation projects results in a total of 13.6 equivalent pennies. Table C-4 documents this calculation. The specific projects that were used in the equivalent penny calculations are summarized in Table C-15.

Table C-4
State Fuel Tax Equivalent Pennies

Source	Cost of Projects ⁽¹⁾	Number of Years	Revenue from 1 Penny ⁽²⁾	Equivalent Pennies ⁽³⁾
State Transp. Impr. Program, FY 2029 to 2033	\$449,743,000	5	\$6,801,000	\$0.132
State Transp. Impr. Program, FY 2023 to 2028	\$568,178,000	6	\$6,801,000	\$0.139
Total	\$1,017,921,000	11	\$6,801,000	\$0.136

1) Source: Table C-15
 2) Source: Table C-1
 3) Cost of projects divided by number of years divided by revenue from 1 penny (Item 2) divided by 100

**Table C-5
Town of Wake Forest – 5-Year Planned Multi-Modal Expenditures, FY 2025-2029**

Project Name	FY 2025	FY 2026	FY 2027	FY 2028	FY 2029	Total
Streets						
Transportation New Sidewalk Projects	\$100,000	\$100,000	\$100,000	\$100,000	\$100,000	\$500,000
Greenways, Transportation, and Pedestrian Access						
Endeavor Charter School Expansion Offsite Improvements	\$110,000	\$110,000	\$0	\$0	\$0	\$220,000
Traffic/Pedestrian Signals	\$452,000	\$520,000	\$520,000	\$210,000	\$210,000	\$1,912,000
Bus Shelter Installations	\$140,000	\$140,000	\$70,000	\$0	\$0	\$350,000
Forbes Property Infrastructure Improvements	\$95,000	\$0	\$0	\$0	\$0	\$95,000
NCDOT S-Line Project	\$1,100,000	\$1,100,000	\$1,100,000	\$0	\$0	\$3,300,000
General Transportation Improvements	\$3,600,000	\$250,000	\$3,750,000	\$250,000	\$3,750,000	\$11,600,000
S. Franklin St Expansion	\$1,175,000	\$1,175,000	\$1,175,000	\$0	\$0	\$3,525,000
Friendship Chapel Extension	\$200,000	\$1,500,000	\$1,250,000	\$0	\$0	\$2,950,000
Road Connections	\$0	\$0	\$461,500	\$3,675,000	\$0	\$4,136,500
Rogers Rd Grade Separation	\$0	\$0	\$200,000	\$328,000	\$0	\$528,000
Sidewalk Connectivity	\$0	\$0	\$950,000	\$200,000	\$0	\$1,150,000
RCI at US 1 and Purnell	\$0	\$0	\$0	\$0	\$2,250,000	\$2,250,000
US 1 Study - Local Improvements	\$0	\$0	\$0	\$0	\$6,250,000	\$6,250,000
Total (Capacity Expansion)	\$6,972,000	\$4,895,000	\$9,576,500	\$4,763,000	\$12,560,000	\$38,766,500

Source: Town of Wake Forest Capital Improvement Plan

**Table C-6
Town of Wake Forest – Historical Transportation Expenditures**

Project Name	Improvement	FY 2020	FY 2021	FY 2022	FY 2023	FY 2024	Total
Stadium Drive	Lane Addition & Intersection Improvement	\$6,077,500	\$0	\$0	\$0	\$0	\$6,077,500
Ligon Mill	Lane Addition	\$0	\$2,616,250	\$0	\$0	\$0	\$2,616,250
Endeavor Charter	Turn Lane and Traffic Signal	\$0	\$0	\$25,000	\$110,000	\$110,000	\$245,000
Forestville Rd Access Management	Dedicated Left Turn Lane	\$0	\$6,000	\$0	\$0	\$0	\$6,000
Rogers Branch Ext.	Realign and extend from Penfield St to Forestville	\$0	\$0	\$253,000	\$504,595	\$0	\$757,595
Forbes Property Improvements	Blue Bird Ln & Traffic Signal	\$0	\$0	\$95,000	\$95,000	\$95,000	\$285,000
Transit Amenities	Three bus stops	\$0	\$0	\$10,000	\$100,000	\$0	\$110,000
Transit Plan	Study to evaluate transit needs	\$0	\$0	\$0	\$0	\$133,000	\$133,000
Heritage Lake Rd/Heritage Club Traffic Signals	Traffic Signal	\$0	\$0	\$50,000	\$0	\$0	\$50,000
Total		\$6,077,500	\$2,622,250	\$433,000	\$809,595	\$338,000	\$10,280,345

Source: Town of Wake Forest

**Table C-7
Public Improvement, Series 2021B**

Date	Principal	Interest Rate	Interest	Total Due	Balance Outstanding	Fiscal Year Debt Service
9/1/2024	\$0	5.00%	\$73,325	\$73,325	\$4,920,000	\$146,650
3/1/2025	\$0	5.00%	\$73,325	\$73,325	\$4,920,000	
9/1/2025	\$0	5.00%	\$73,325	\$73,325	\$4,920,000	\$146,650
3/1/2026	\$260,000	5.00%	\$73,325	\$333,325	\$4,920,000	
9/1/2026	\$0	5.00%	\$66,825	\$66,825	\$4,660,000	\$400,150
3/1/2027	\$315,000	5.00%	\$66,825	\$381,825	\$4,660,000	
9/1/2027	\$0	2.00%	\$58,950	\$58,950	\$4,345,000	\$440,775
3/1/2028	\$315,000	2.00%	\$58,950	\$373,950	\$4,345,000	
9/1/2028	\$0	5.00%	\$55,800	\$55,800	\$4,030,000	\$429,750
3/1/2029	\$310,000	5.00%	\$55,800	\$365,800	\$4,030,000	
9/1/2029	\$0	5.00%	\$48,050	\$48,050	\$3,720,000	\$413,850
3/1/2030	\$310,000	5.00%	\$48,050	\$358,050	\$3,720,000	
9/1/2030	\$0	2.00%	\$40,300	\$40,300	\$3,410,000	\$398,350
3/1/2031	\$310,000	2.00%	\$40,300	\$350,300	\$3,410,000	
9/1/2031	\$0	4.00%	\$37,200	\$37,200	\$3,100,000	\$387,500
3/1/2032	\$310,000	4.00%	\$37,200	\$347,200	\$3,100,000	
9/1/2032	\$0	3.00%	\$31,000	\$31,000	\$2,790,000	\$378,200
3/1/2033	\$310,000	3.00%	\$31,000	\$341,000	\$2,790,000	
9/1/2033	\$0	3.00%	\$26,350	\$26,350	\$2,480,000	\$367,350
3/1/2034	\$310,000	3.00%	\$26,350	\$336,350	\$2,480,000	
9/1/2034	\$0	2.00%	\$21,700	\$21,700	\$2,170,000	\$358,050
3/1/2035	\$310,000	2.00%	\$21,700	\$331,700	\$2,170,000	
9/1/2035	\$0	2.00%	\$18,600	\$18,600	\$1,860,000	\$350,300
3/1/2036	\$310,000	2.00%	\$18,600	\$328,600	\$1,860,000	
9/1/2036	\$0	2.00%	\$15,500	\$15,500	\$1,550,000	\$344,100
3/1/2037	\$310,000	2.00%	\$15,500	\$325,500	\$1,550,000	
9/1/2037	\$0	2.00%	\$12,400	\$12,400	\$1,240,000	\$337,900
3/1/2038	\$310,000	2.00%	\$12,400	\$322,400	\$1,240,000	
9/1/2038	\$0	2.00%	\$9,300	\$9,300	\$930,000	\$331,700
3/1/2039	\$310,000	2.00%	\$9,300	\$319,300	\$930,000	
9/1/2039	\$0	2.00%	\$6,200	\$6,200	\$620,000	\$325,500
3/1/2040	\$310,000	2.00%	\$6,200	\$316,200	\$620,000	
9/1/2040	\$0	2.00%	\$3,100	\$3,100	\$310,000	\$319,300
3/1/2041	\$310,000	2.00%	\$3,100	\$313,100	\$310,000	\$313,100
Total	\$4,920,000		\$1,593,027	\$6,513,027		\$6,513,027
Percent for Transportation Capacity						64%
Portion for Transportation Capacity						\$4,168,337
Number of Years of Remaining Payments						17

Source: Town of Wake Forest

**Table C-8
Public Improvement, Series 2021A**

Date	Principal	Interest Rate	Interest	Total Due	Balance Outstanding	Fiscal Year Debt Service
9/1/2024	\$0	5.00%	\$9,000	\$9,000	\$360,000	\$335,750
3/1/2025	\$310,000	5.00%	\$9,000	\$319,000	\$360,000	
9/1/2025	\$0	5.00%	\$1,250	\$1,250	\$50,000	\$320,250
3/1/2026	\$50,000	5.00%	\$1,250	\$51,250	\$50,000	\$51,250
Total	\$9,310,000		\$2,104,594	\$11,414,594		\$707,250
Percent for Transportation Capacity						100%
Portion for Transportation Capacity						\$707,250
Number of Years of Remaining Payments						2

Source: Town of Wake Forest

**Table C-9
Refunding Note, Series 2019**

Date	Principal	Interest Rate	Interest	Total Due	Balance Outstanding	Fiscal Year Debt Service
8/1/2024	\$0	1.79%	\$19,251	\$19,251	\$2,151,000	\$424,931
2/1/2025	\$377,000	1.79%	\$19,251	\$396,251	\$2,151,000	
8/1/2025	\$0	1.79%	\$15,877	\$15,877	\$1,774,000	\$412,129
2/1/2026	\$371,000	1.79%	\$15,877	\$386,877	\$1,774,000	
8/1/2026	\$0	1.79%	\$12,557	\$12,557	\$1,403,000	\$399,434
2/1/2027	\$363,000	1.79%	\$12,557	\$375,557	\$1,403,000	
8/1/2027	\$0	1.79%	\$9,308	\$9,308	\$1,040,000	\$384,865
2/1/2028	\$355,000	1.79%	\$9,308	\$364,308	\$1,040,000	
8/1/2028	\$0	1.79%	\$6,131	\$6,131	\$685,000	\$370,439
2/1/2029	\$347,000	1.79%	\$6,131	\$353,131	\$685,000	
8/1/2029	\$0	1.79%	\$3,025	\$3,025	\$338,000	\$356,156
2/1/2030	\$338,000	1.79%	\$3,025	\$341,025	\$338,000	\$341,025
Total	\$3,710,000		\$362,790	\$4,072,790		\$2,688,978
Percent for Transportation Capacity						52%
Portion for Transportation Capacity						\$1,398,269
Number of Years of Remaining Payments						6

Source: Town of Wake Forest

**Table C-10
Street Improvements**

Date	Principal	Interest Rate	Interest	Total Due	Balance Outstanding	Fiscal Year Debt Service
11/1/2024	\$392,857	2.74%	\$21,529	\$414,386	\$1,571,429	\$834,154
5/1/2025	\$392,857	2.74%	\$16,146	\$409,004	\$1,178,571	
11/1/2025	\$392,857	2.74%	\$10,764	\$403,621	\$785,714	\$812,625
5/1/2026	\$392,857	2.74%	\$5,382	\$398,239	\$392,857	\$398,239
Total	\$5,500,000		\$565,544	\$6,065,544		\$2,045,018
Percent for Transportation Capacity						100%
Portion for Transportation Capacity						\$2,045,018
Number of Years of Remaining Payments						2

Source: Town of Wake Forest

**Table C-11
Street/Highway Improvements**

Date	Principal	Interest Rate	Interest	Total Due	Balance Outstanding	Fiscal Year Debt Service
11/3/2024	\$150,000	3.39%	\$10,170	\$160,170	\$600,000	\$322,883
5/3/2025	\$150,000	3.39%	\$7,628	\$157,628	\$450,000	
11/3/2025	\$150,000	3.39%	\$5,085	\$155,085	\$300,000	\$312,713
5/3/2026	\$150,000	3.39%	\$2,543	\$152,543	\$150,000	\$152,543
Total	\$2,400,000		\$345,780	\$2,745,780		\$788,138
Percent for Transportation Capacity						94%
Portion for Transportation Capacity						\$740,849
Number of Years of Remaining Payments						2

Source: Town of Wake Forest

**Table C-12
Refunding Note, Series 2016**

Date	Principal	Interest Rate	Interest	Total Due	Balance Outstanding	Fiscal Year Debt Service
10/1/2024	\$0	2.05%	\$13,407	\$13,407	\$1,308,000	\$483,447
4/1/2025	\$444,000	2.05%	\$13,407	\$457,407	\$1,308,000	
10/1/2025	\$0	2.05%	\$8,856	\$8,856	\$864,000	\$466,263
4/1/2026	\$436,000	2.05%	\$8,856	\$444,856	\$864,000	
10/1/2026	\$0	2.05%	\$4,387	\$4,387	\$428,000	\$449,243
4/1/2027	\$428,000	2.05%	\$4,387	\$432,387	\$428,000	\$432,387
Total	\$5,125,000		\$614,082	\$5,739,082		\$1,831,340
Percent for Transportation Capacity						62%
Portion for Transportation Capacity						\$1,135,431
Number of Years of Remaining Payments						3

Source: Town of Wake Forest

**Table C-13
Public Improvements; Series 2015**

Date	Principal	Interest Rate	Interest	Total Due	Balance Outstanding	Fiscal Year Debt Service
10/1/2024	\$0	2.00%	\$30,369	\$30,369	\$2,365,000	\$277,888
4/1/2025	\$215,000	2.00%	\$30,369	\$245,369	\$2,365,000	
10/1/2025	\$0	2.10%	\$28,219	\$28,219	\$2,150,000	\$273,588
4/1/2026	\$215,000	2.10%	\$28,219	\$243,219	\$2,150,000	
10/1/2026	\$0	2.25%	\$25,961	\$25,961	\$1,935,000	\$269,180
4/1/2027	\$215,000	2.25%	\$25,961	\$240,961	\$1,935,000	
10/1/2027	\$0	2.30%	\$23,543	\$23,543	\$1,720,000	\$264,504
4/1/2028	\$215,000	2.30%	\$23,543	\$238,543	\$1,720,000	
10/1/2028	\$0	2.40%	\$21,070	\$21,070	\$1,505,000	\$259,613
4/1/2029	\$215,000	2.40%	\$21,070	\$236,070	\$1,505,000	
10/1/2029	\$0	2.55%	\$18,490	\$18,490	\$1,290,000	\$254,560
4/1/2030	\$215,000	2.55%	\$18,490	\$233,490	\$1,290,000	
10/1/2030	\$0	2.65%	\$15,749	\$15,749	\$1,075,000	\$249,239
4/1/2031	\$215,000	2.65%	\$15,749	\$230,749	\$1,075,000	
10/1/2031	\$0	2.75%	\$12,900	\$12,900	\$860,000	\$243,649
4/1/2032	\$215,000	2.75%	\$12,900	\$227,900	\$860,000	
10/1/2032	\$0	3.00%	\$9,944	\$9,944	\$645,000	\$237,844
4/1/2033	\$215,000	3.00%	\$9,944	\$224,944	\$645,000	
10/1/2033	\$0	3.00%	\$6,719	\$6,719	\$430,000	\$231,663
4/1/2034	\$215,000	3.00%	\$6,719	\$221,719	\$430,000	
10/1/2034	\$0	3.25%	\$3,494	\$3,494	\$215,000	\$225,213
4/1/2035	\$215,000	3.25%	\$3,494	\$218,494	\$215,000	\$218,494
Total	\$4,330,000		\$1,135,150	\$5,465,150		\$3,005,431
Percent for Transportation Capacity						100%
Portion for Transportation Capacity						\$3,005,431
Number of Years of Remaining Payments						11

Source: Town of Wake Forest

**Table C-14
Public Improvements; Series 2018B**

Date	Principal	Interest Rate	Interest	Total Due	Balance Outstanding	Fiscal Year Debt Service
12/1/2024	\$0	5.00%	\$215,738	\$215,738	\$11,670,000	\$1,276,913
6/1/2025	\$835,000	5.00%	\$215,738	\$1,050,738	\$11,670,000	
12/1/2025	\$0	5.00%	\$194,863	\$194,863	\$10,835,000	\$1,245,600
6/1/2026	\$835,000	5.00%	\$194,863	\$1,029,863	\$10,835,000	
12/1/2026	\$0	4.00%	\$173,988	\$173,988	\$10,000,000	\$1,203,850
6/1/2027	\$835,000	4.00%	\$173,988	\$1,008,988	\$10,000,000	
12/1/2027	\$0	4.00%	\$157,288	\$157,288	\$9,165,000	\$1,166,275
6/1/2028	\$835,000	4.00%	\$157,288	\$992,288	\$9,165,000	
12/1/2028	\$0	4.00%	\$140,588	\$140,588	\$8,330,000	\$1,132,875
6/1/2029	\$835,000	4.00%	\$140,588	\$975,588	\$8,330,000	
12/1/2029	\$0	4.00%	\$123,888	\$123,888	\$7,495,000	\$1,099,475
6/1/2030	\$835,000	4.00%	\$123,888	\$958,888	\$7,495,000	
12/1/2030	\$0	4.00%	\$107,188	\$107,188	\$6,660,000	\$1,066,075
6/1/2031	\$835,000	4.00%	\$107,188	\$942,188	\$6,660,000	
12/1/2031	\$0	3.00%	\$90,488	\$90,488	\$5,825,000	\$1,032,675
6/1/2032	\$835,000	3.00%	\$90,488	\$925,488	\$5,825,000	
12/1/2032	\$0	3.00%	\$77,963	\$77,963	\$4,990,000	\$1,003,450
6/1/2033	\$835,000	3.00%	\$77,963	\$912,963	\$4,990,000	
12/1/2033	\$0	3.00%	\$65,438	\$65,438	\$4,155,000	\$978,400
6/1/2034	\$835,000	3.00%	\$65,438	\$900,438	\$4,155,000	
12/1/2034	\$0	3.13%	\$52,913	\$52,913	\$3,320,000	\$953,350
6/1/2035	\$830,000	3.13%	\$52,913	\$882,913	\$3,320,000	
12/1/2035	\$0	3.13%	\$39,944	\$39,944	\$2,490,000	\$922,856
6/1/2036	\$830,000	3.13%	\$39,944	\$869,944	\$2,490,000	
12/1/2036	\$0	3.25%	\$26,975	\$26,975	\$1,660,000	\$896,919
6/1/2037	\$830,000	3.25%	\$26,975	\$856,975	\$1,660,000	
12/1/2037	\$0	3.25%	\$13,488	\$13,488	\$830,000	\$870,463
6/1/2038	\$830,000	3.25%	\$13,488	\$843,488	\$830,000	\$843,488
Total	\$15,850,000		\$6,021,525	\$21,871,525		\$15,692,663
Percent for Transportation Capacity						10%
Portion for Transportation Capacity						\$1,569,266
Number of Years of Remaining Payments						14

Source: Town of Wake Forest

Table C-16
Average Motor Vehicle Fuel Efficiency – Excluding Interstate Travel

Travel			
Vehicle Miles of Travel (VMT) @			
	22.8	7.3	
Other Arterial Rural	329,742,000,000	52,696,000,000	382,438,000,000
Other Rural	325,232,000,000	32,997,000,000	358,229,000,000
Other Urban	1,485,169,000,000	102,144,000,000	1,587,313,000,000
Total	2,140,143,000,000	187,837,000,000	2,327,980,000,000

Percent VMT	
@ 22.8 mpg	@ 7.3 mpg
86%	14%
91%	9%
94%	6%
92%	8%

Fuel Consumed			
	Gallons @ 22.8 mpg	Gallons @ 7.3 mpg	
Other Arterial Rural	14,462,368,421	7,218,630,137	21,680,998,558
Other Rural	14,264,561,404	4,520,136,986	18,784,698,390
Other Urban	65,138,991,228	13,992,328,767	79,131,319,995
Total	93,865,921,053	25,731,095,890	119,597,016,943

Total Mileage and Fuel	
2,327,980	miles (millions)
119,597	gallons (millions)
19.47	mpg

Source: U.S. Department of Transportation, Federal Highway Administration, *Highway Statistics 2022*, Section V, Table VM-1
 Annual Vehicle Distance Traveled in Miles and Related Data - 2022 by Highway Category and Vehicle Type
<http://www.fhwa.dot.gov/policyinformation/statistics.cfm>

Table C-17
Annual Vehicle Distance Travelled in Miles and Related Data – 2022⁽¹⁾
By Highway Category and Vehicle Type

Updated: February 2024								TABLE VM-1		
YEAR	ITEM	LIGHT DUTY VEHICLES SHORT WB ⁽²⁾	MOTOR-CYCLES	BUSES	LIGHT DUTY VEHICLES LONG WB ⁽²⁾	SINGLE-UNIT TRUCKS ⁽³⁾	COMBINATION TRUCKS	SUBTOTALS		ALL MOTOR VEHICLES
								ALL LIGHT VEHICLES ⁽²⁾	SINGLE-UNIT 2-AXLE 6-TIRE OR MORE AND COMBINATION TRUCKS	
	Motor-Vehicle Travel (millions of vehicle-miles):									
2022	Interstate Rural	148,757	1,164	1,601	50,143	11,677	61,652	198,900	73,328	274,993
2022	Other Arterial Rural	229,877	2,233	2,231	99,865	19,332	33,364	329,742	52,696	386,901
2022	Other Rural	221,526	3,294	2,293	103,707	19,890	13,106	325,232	32,997	363,816
2022	All Rural	600,160	6,691	6,125	253,714	50,899	108,122	853,874	159,021	1,025,711
2022	Interstate Urban	378,935	2,842	2,624	104,686	20,397	49,710	483,621	70,108	559,194
2022	Other Urban	1,158,710	14,232	9,741	326,459	64,928	37,216	1,485,169	102,144	1,611,287
2022	All Urban	1,537,646	17,074	12,365	431,144	85,325	86,927	1,968,790	172,252	2,170,481
2022	Total Rural and Urban ⁽⁵⁾	2,137,805	23,765	18,490	684,859	136,224	195,049	2,822,664	331,272	3,196,191
2022	Number of motor vehicles registered ⁽²⁾	197,080,414	9,567,664	954,119	61,464,968	11,083,997	3,249,824	258,545,382	14,333,821	283,400,986
2022	Average miles traveled per vehicle	10,847	2,484	19,379	11,142	12,290	60,018	10,917	23,111	11,278
2022	Person-miles of travel (millions) ⁽⁴⁾	3,284,669	24,369	391,991	1,007,240	136,224	195,049	4,291,909	331,272	5,039,542
2022	Fuel consumed (thousand gallons)	86,040,199	540,572	2,497,605	37,939,063	17,180,850	28,218,175	123,979,262	45,399,024	172,416,463
2022	Average fuel consumption per vehicle (gallons)	437	56	2,618	617	1,550	8,683	480	3,167	608
2022	Average miles traveled per gallon of fuel consumed	24.8	44.0	7.4	18.1	7.9	6.9	22.8	7.3	18.5
<p>(1) The FHWA estimates national trends by using State reported Highway Performance and Monitoring System (HPMS) data, fuel consumption data (MF-21), vehicle registration data (MV-1), other data such as the R.L. Polk vehicle data, and a host of modeling techniques.</p> <p>(2) Light Duty Vehicles Short WB - passenger cars, light trucks, vans and sport utility vehicles with a wheelbase (WB) equal to or less than 121 inches. Light Duty Vehicles Long WB - large passenger cars, vans, pickup trucks, and sport/utility vehicles with wheelbases (WB) larger than 121 inches. All Light Duty Vehicles - passenger cars, light trucks, vans and sport utility vehicles regardless of wheelbase.</p> <p>(3) Single-Unit - single frame trucks that have 2-Axles and at least 6 tires or a gross vehicle weight rating exceeding 10,000 lbs.</p> <p>(4) For 2021 and 2020, the vehicle occupancy is estimated by the FHWA from the 2017 National Household Travel Survey (NHTS) and the annual R.L. Polk Vehicle registration data; For single unit truck and heavy trucks, 1 motor vehicle mile traveled = 1 person-mile traveled.</p> <p>(5) VMT data are based on the latest HPMS data available; it may not match previous published results.</p>										

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Appendix D
Calculated Multi-Modal Transportation
Impact Fee Schedule

Appendix D: Calculated MMTIF Schedule

This appendix presents the detailed fee calculations for each land use in the Town of Wake Forest's multi-modal transportation impact fee schedule.

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**Table D-1
Calculated Multi-Modal Transportation Impact Fee Schedule**

		Gasoline Tax						Unit Cost per Lane Mile:				Interstate/Toll Facility Adjustment Factor:					
		\$\$ per gallon to capital:	\$0.148					\$4,628,000				36.7%					
		Facility life (years):	25	Town Revenues:		\$0.012		Average PMC per Lane Mile:		9,600		Cost per PMC:		\$482.08			
		Interest rate:	4.25%	State Revenues:		\$0.136		Fuel Efficiency:		19.47 mpg							
								Effectivedays per year:		365							
ITE LUC	Land Use	Unit	Trip Rate	Trip Rate Source	Assessable Trip Length	Total Trip Length	Trip Length Source	Percent New Trips	% New Trips Source	Net VMT ⁽¹⁾	Person-Trip Factor	Net PMC ⁽²⁾	Total Impact Cost	Annual Gas Tax	Gas Tax Credit	Net Multi-Modal Transp. Impact Fee	Town Portion (6%)
RESIDENTIAL:																	
210	Single Family (Detached); Less than 1,000 sf	du	6.75	Appendix A: Table A-5	6.62	7.12	Appendix A: LUC 210	100%	n/a	14.14	1.41	19.94	\$9,613	\$67	\$1,020	\$8,593	\$516
	Single Family (Detached); 1,000 to 1,999 sf	du	7.27	Appendix A: Table A-5	6.62	7.12	Appendix A: LUC 210	100%	n/a	15.23	1.41	21.47	\$10,354	\$72	\$1,096	\$9,258	\$555
	Single Family (Detached); 2,000 to 2,999 sf	du	8.32	Appendix A: Table A-5	6.62	7.12	Appendix A: LUC 210	100%	n/a	17.43	1.41	24.58	\$11,849	\$82	\$1,248	\$10,601	\$636
	Single Family (Detached); 3,000 sf or greater	du	8.86	Appendix A: Table A-5	6.62	7.12	Appendix A: LUC 210	100%	n/a	18.56	1.41	26.17	\$12,618	\$88	\$1,339	\$11,279	\$677
215	Single Family (Attached)	du	6.77	Appendix A: LUC 215	6.62	7.12	Same as LUC 210	100%	n/a	14.18	1.41	19.99	\$9,642	\$67	\$1,020	\$8,622	\$517
220	Multi-Family Housing (Low-Rise, 1-3 floors)	du	6.74	ITE 11th Edition	5.21	5.71	Appendix A: LUC 220/221/222	100%	n/a	11.11	1.41	15.67	\$7,555	\$53	\$807	\$6,748	\$405
221/222	Multi-Family Housing (Mid/High-Rise, 4+ floors)	du	4.54	ITE 11th Edition	5.21	5.71	Appendix A: LUC 220/221/222	100%	n/a	7.49	1.41	10.56	\$5,089	\$36	\$548	\$4,541	\$272
240	Mobile Home Park	du	4.17	Appendix A: LUC 240	4.60	5.10	Appendix A: LUC 240	100%	n/a	6.07	1.41	8.56	\$4,127	\$30	\$457	\$3,670	\$220
251	Senior Adult Housing (Detached)	du	3.54	Appendix A: LUC 251	5.42	5.92	Appendix A: LUC 251	100%	n/a	6.07	1.41	8.56	\$4,128	\$29	\$441	\$3,687	\$221
252	Senior Adult Housing (Attached)	du	2.99	Appendix A: LUC 252	4.34	4.84	Based on LUC 251 ⁽³⁾	100%	n/a	4.11	1.41	5.80	\$2,792	\$20	\$304	\$2,488	\$149
LODGING:																	
310	Hotel	room	5.56	Appendix A: LUC 310	6.26	6.76	Appendix A: LUC 310	66%	Appendix A: LUC 310	7.27	1.41	10.25	\$4,942	\$34	\$517	\$4,425	\$266
320	Motel	room	3.35	ITE 11th Edition	4.34	4.84	Appendix A: LUC 320	77%	Appendix A: LUC 320	3.54	1.41	4.99	\$2,408	\$17	\$259	\$2,149	\$129
RECREATION:																	
411	Public Park	acre	0.78	ITE 11th Edition	5.15	5.65	Same as LUC 710	90%	Based on LUC 710	1.14	1.41	1.61	\$778	\$6	\$91	\$687	\$41
416	Campground/RV Park	site	1.62	ITE 11th Edition (adjusted) ⁽⁴⁾	4.60	5.10	Same as LUC 240	100%	Same as Residential Land Uses	2.36	1.41	3.33	\$1,603	\$11	\$167	\$1,436	\$86
445	Movie Theater	screen	114.83	Appendix A: LUC 445	2.22	2.72	Appendix A: LUC 445	88%	Appendix A: LUC 445	71.00	1.41	100.11	\$48,262	\$381	\$5,798	\$42,464	\$2,548
492	Health/Fitness Club	1,000 sf	34.50	ITE 11th Edition (adjusted) ⁽⁵⁾	5.15	5.65	Same as LUC 710	94%	Appendix A: LUC 492	52.86	1.41	74.53	\$35,931	\$254	\$3,865	\$32,066	\$1,924
INSTITUTIONS:																	
520	Elementary School (Private)	student	2.27	ITE 11th Edition	3.31	3.81	50% of LUC 210 based on Transp. Modeling	80%	Based on LUC 710 (adjusted) ⁽⁶⁾	1.90	1.41	2.68	\$1,293	\$10	\$152	\$1,141	\$68
522	Middle/Junior High School (Private)	student	2.10	ITE 11th Edition	3.31	3.81	50% of LUC 210 based on Transp. Modeling	80%	Based on LUC 710 (adjusted) ⁽⁶⁾	1.76	1.41	2.48	\$1,196	\$9	\$137	\$1,059	\$64
525	High School (Private)	student	1.94	ITE 11th Edition	3.31	3.81	50% of LUC 210 based on Transp. Modeling	90%	Based on LUC 710	1.83	1.41	2.58	\$1,243	\$9	\$137	\$1,106	\$66
540/550	University/Junior College (7,500 or fewer students) (Private)	student	2.00	ITE Regression Analysis	6.62	7.12	Same as LUC 210	90%	Based on LUC 710	3.77	1.41	5.32	\$2,564	\$18	\$274	\$2,290	\$137
550	University/Junior College (more than 7,500 students) (Private)	student	1.50	ITE Regression Analysis	6.62	7.12	Same as LUC 210	90%	Based on LUC 710	2.83	1.41	3.99	\$1,923	\$13	\$198	\$1,725	\$104
560	Church	1,000 sf	7.60	ITE 11th Edition	3.93	4.43	Midpoint of LUC 710 & LUC 820 (App. A)	90%	Based on LUC 710	8.51	1.41	12.00	\$5,783	\$42	\$639	\$5,144	\$309
565	Day Care Center	1,000 sf	47.62	ITE 11th Edition	2.03	2.53	Appendix A: LUC 565	73%	Appendix A: LUC 565	22.33	1.41	31.49	\$15,182	\$122	\$1,857	\$13,325	\$800
MEDICAL:																	
610	Hospital	1,000 sf	10.77	ITE 11th Edition	6.62	7.12	Same as LUC 210	78%	Midpoint of LUC 310 & LUC 720	17.60	1.41	24.82	\$11,964	\$83	\$1,263	\$10,701	\$642
620	Nursing Home	bed	3.02	Appendix A: LUC 620	2.59	3.09	Appendix A: LUC 620	89%	Appendix A: LUC 620	2.20	1.41	3.10	\$1,498	\$12	\$183	\$1,315	\$79

Table D-1 (continued)
Calculated Multi-Modal Transportation Impact Fee Schedule

ITE LUC	Land Use	Unit	Trip Rate	Trip Rate Source	Assessable Trip Length	Total Trip Length	Trip Length Source	Percent New Trips	% New Trips Source	Net VMT ⁽¹⁾	Person-Trip Factor	Net PMC ⁽²⁾	Total Impact Cost	Annual Gas Tax	Gas Tax Credit	Net Multi-Modal Transp. Impact Fee	Town Portion (6%)	
MEDICAL:																		
630	Clinic	1,000 sf	37.39	Appendix A: LUC 630	5.10	5.60	Appendix A: LUC 630	93%	Appendix A: LUC 630	56.13	1.41	79.14	\$38,153	\$270	\$4,109	\$34,044	\$2,043	
OFFICE:																		
710	General Office	1,000 sf	10.84	ITE 11th Edition	5.15	5.65	Appendix A: LUC 710	92%	Appendix A: LUC 710	16.26	1.41	22.93	\$11,049	\$78	\$1,187	\$9,862	\$592	
720	Medical Office/Clinic 10,000 sq ft or less	1,000 sf	23.83	Appendix A: LUC 720 (Small Medical Office)	5.55	6.05	Appendix A: LUC 720	89%	Appendix A: LUC 720	37.25	1.41	52.52	\$25,323	\$178	\$2,709	\$22,614	\$1,357	
	Medical Office/Clinic greater than 10,000 sq ft	1,000 sf	34.21	Appendix A: LUC 720	5.55	6.05	Appendix A: LUC 720	89%	Appendix A: LUC 720	53.48	1.41	75.41	\$36,354	\$256	\$3,896	\$32,458	\$1,947	
RETAIL:																		
822	Retail less than 40,000 sfgla	1,000 sfgla	54.45	ITE 11th Edition	1.48	1.98	Appendix A: Fig. A-1 (19k sq ft)	48%	Appendix A: Fig. A-2 (19k sq ft)	12.24	1.41	17.26	\$8,322	\$72	\$1,096	\$7,226	\$434	
821	Retail 40,000 to 150,000 sfgla	1,000 sfgla	67.52	ITE 11th Edition	1.94	2.44	Appendix A: Fig. A-1 (59k sq ft)	57%	Appendix A: Fig. A-2 (59k sq ft)	23.63	1.41	33.32	\$16,063	\$130	\$1,978	\$14,085	\$845	
820	Retail greater than 150,000 sfgla	1,000 sfgla	37.01	ITE 11th Edition	2.80	3.30	Appendix A: Fig. A-1 (538k sq ft)	75%	Appendix A: Fig. A-2 (538k sq ft)	24.60	1.41	34.69	\$16,721	\$127	\$1,933	\$14,788	\$887	
840/841	New/Used Auto Sales	1,000 sf	24.58	Appendix A: LUC 840/841	4.60	5.10	Appendix A: LUC 840/841	79%	Appendix A: LUC 840/841	28.27	1.41	39.86	\$19,217	\$137	\$2,085	\$17,132	\$1,028	
850	Supermarket	1,000 sf	93.84	ITE 11th Edition	2.08	2.58	Appendix A: LUC 850	56%	Appendix A: LUC 850	34.59	1.41	48.77	\$23,516	\$188	\$2,861	\$20,655	\$1,239	
862	Home Improvement Superstore	1,000 sf	30.74	ITE 11th Edition	2.33	2.83	Appendix A: Fig. A-1 (135k sq ft)	64%	Appendix A: Fig. A-2 (135k sq ft)	14.51	1.41	20.46	\$9,862	\$77	\$1,172	\$8,690	\$521	
880/881	Pharmacy with & without Drive-Thru	1,000 sf	103.40	ITE 11th Edition	2.08	2.58	Appendix A: LUC 880/881	32%	Appendix A: LUC 880/881	21.78	1.41	30.71	\$14,806	\$118	\$1,796	\$13,010	\$781	
890	Furniture Store	1,000 sf	6.30	ITE 11th Edition	6.09	6.59	Appendix A: LUC 890	54%	Appendix A: LUC 890	6.56	1.41	9.25	\$4,457	\$31	\$472	\$3,985	\$239	
SERVICES:																		
911	Bank/Savings Walk-In	1,000 sf	57.94	ITE 11th Edition (adjusted) ⁽⁷⁾	2.46	2.96	Same as LUC 912	46%	Same as LUC 912	20.75	1.41	29.26	\$14,105	\$109	\$1,659	\$12,446	\$747	
912	Bank/Savings Drive-In	1,000 sf	100.35	ITE 11th Edition	2.46	2.96	Appendix A: LUC 912	46%	Appendix A: LUC 912	35.94	1.41	50.68	\$24,430	\$190	\$2,891	\$21,539	\$1,292	
930	Fast Casual Restaurant	1,000 sf	97.14	ITE 11th Edition	2.05	2.55	Same as LUC 934	58%	Same as LUC 934	36.56	1.41	51.55	\$24,848	\$199	\$3,028	\$21,820	\$1,309	
931	Fine Dining (Low-Turnover) Restaurant	1,000 sf	83.84	ITE 11th Edition	3.14	3.64	Appendix A: LUC 931	77%	Appendix A: LUC 931	64.16	1.41	90.47	\$43,610	\$326	\$4,961	\$38,649	\$2,319	
932	High-Turnover (Sit-Down) Restaurant	1,000 sf	103.46	Appendix A: LUC 932	3.17	3.67	Appendix A: LUC 932	71%	Appendix A: LUC 932	73.70	1.41	103.92	\$50,096	\$374	\$5,691	\$44,405	\$2,664	
934	Fast Food Restaurant w/Drive-Thru	1,000 sf	467.48	ITE 11th Edition	2.05	2.55	Appendix A: LUC 934	58%	Appendix A: LUC 934	175.92	1.41	248.05	\$119,580	\$959	\$14,593	\$104,987	\$6,299	
941	Quick Lube	service bay	40.00	ITE 11th Edition	3.62	4.12	Same as LUC 942	72%	Same as LUC 942	33.00	1.41	46.53	\$22,429	\$165	\$2,511	\$19,918	\$1,195	
942	Automobile Care Center	1,000 sf	28.19	Appendix A: LUC 942	3.62	4.12	Appendix A: LUC 942	72%	Appendix A: LUC 942	23.25	1.41	32.78	\$15,807	\$116	\$1,765	\$14,042	\$843	
944	Gas Station w/Convenience Market <2,000 sq ft	fuel pos.	172.01	ITE 11th Edition	1.90	2.40	Appendix A: LUC 944	23%	Appendix A: LUC 944	23.79	1.41	33.54	\$16,171	\$132	\$2,009	\$14,162	\$850	
945	Gas Station w/Convenience Market 2,000-5,499 sq ft	fuel pos.	264.38	ITE 11th Edition (adjusted) ⁽⁸⁾	1.90	2.40	Same as LUC 944	23%	Same as LUC 944	36.57	1.41	51.56	\$24,856	\$202	\$3,074	\$21,782	\$1,307	
	Gas Station w/Convenience Market 5,500+ sq ft	fuel pos.	345.75	ITE 11th Edition	1.90	2.40	Same as LUC 944	23%	Same as LUC 944	47.82	1.41	67.43	\$32,506	\$265	\$4,033	\$28,473	\$1,708	
947	Self-Service Car Wash	service bay	43.94	Appendix A: LUC 947	2.18	2.68	Appendix A: LUC 947	68%	Appendix A: LUC 947	20.62	1.41	29.07	\$14,013	\$111	\$1,689	\$12,324	\$739	
INDUSTRIAL:																		
110	General Light Industrial	1,000 sf	4.87	ITE 11th Edition	5.15	5.65	Same as LUC 710	92%	Same as LUC 710	7.30	1.41	10.29	\$4,964	\$35	\$533	\$4,431	\$266	
140	Manufacturing	1,000 sf	4.75	ITE 11th Edition	5.15	5.65	Same as LUC 710	92%	Same as LUC 710	7.12	1.41	10.04	\$4,842	\$34	\$517	\$4,325	\$260	
150	Warehousing	1,000 sf	1.71	ITE 11th Edition	5.15	5.65	Same as LUC 710	92%	Same as LUC 710	2.56	1.41	3.61	\$1,743	\$12	\$183	\$1,560	\$94	

Table D-1 (continued)
Calculated Multi-Modal Transportation Impact Fee Schedule

ITE LUC	Land Use	Unit	Trip Rate	Trip Rate Source	Assessable Trip Length	Total Trip Length	Trip Length Source	Percent New Trips	% New Trips Source	Net VMT ⁽¹⁾	Person-Trip Factor	Net PMC ⁽²⁾	Total Impact Cost	Annual Gas Tax	Gas Tax Credit	Net Multi-Modal Transp. Impact Fee	Town Portion (6%)
INDUSTRIAL:																	
151	Mini-Warehouse	1,000 sf	1.45	ITE 11th Edition	3.51	4.01	Midpoint of LUC 710 & LUC 820 (50k sq ft)	92%	Same as LUC 710	1.48	1.41	2.09	\$1,007	\$7	\$107	\$900	\$54
154	High-Cube Transload & Short-Term Storage Warehouse	1,000 sf	1.40	ITE 11th Edition	5.15	5.65	Same as LUC 710	92%	Same as LUC 710	2.10	1.41	2.96	\$1,427	\$10	\$152	\$1,275	\$77

- 1) Net VMT calculated as ((Trip Generation Rate* Trip Length* % New Trips)*(1-Interstate/Toll Facility Adjustment Factor)/2). This reflects the unit of vehicle-miles of capacity consumed per unit of development and is multiplied by the cost per vehicle
- 2) Net VMT (Item 1) multiplied by the person-trip factor (1.41)
- 3) The assessable trip length was based on LUC 251 (5.42) but then adjusted by the ratio of the single family (LUC 210) based trip length of 6.62 to the multi-family (LUC 220) trip length (5.21). Adj. = 5.21 / 6.62 = 80%. TL = 80% x 5.42 = 4.34
- 4) The ITE 11th Edition trip generation rate was adjusted to reflect the average occupancy rate of 60 percent based on data provided by the Association of RV Parks and Campgrounds
- 5) The ITE 11th Edition trip generation rate for PM Peak Hour of Adjacent traffic was adjusted by a factor of 10 to approximate the Daily TGR
- 6) The percent new trips for schools was estimated at 90% based on LUC 710, but was then adjusted to 80% to provide a conservative fee rate. This adjustment reflects the nature of elementary and middle school uses where attendees are unable to drive and are typically dropped off by parents/guardians on their way to another destination
- 7) The daily trip generation rate is estimated based on the ratio of peak hour-to-daily from the Bank w/Drive-In land use applied to the peak hour TGR for Bank w/Walk-In
- 8) Due to only slight variation, the trip generation rates for LUC 945 2,000 to 3,999 sq ft and 4,000 to 5,499 sq ft were combined into a weighted average trip generation rate for a single land use tier of 2,000 to 5,499 sq ft