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Does the ITE Trip Generation Manual Overestimate the Trip Generation of Stores in Northeast Ohio?

Shawn Monahan
sdm133@uakron.edu

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University of Akron

Civil Engineering Department

Contents

Introduction 1

Trip Generation 2

Hypothesis 3

Analysis Procedure 4

Data Collection 5

Data Comparison 8

Conclusion 12

Appendix 13

List of Tables

Table 1: Superstore Contact List & Results 5

Table 2: Vehicle Occupancy Collection Results 6

Table 3: Calculated Trip Generation Data 7

Table 4: ITE Trip Generation Manual Volumes 7

Table 5: % Difference Between TGM & Calculated Trip Generation 11

List of Figures

Figure 1: ITE Trip Generation 8

Figure 2: Calculated Trip Generation 9

Figure 3: ITE vs. Calculated Trip Generation 10

Figure 4: % Difference Between ITE & Calculated Trip Generation 11

Introduction

Regional growth is necessary for communities to thrive. New houses attract residents, which in turn attracts businesses, which also require employees. This cycle continues, usually happening on new undeveloped land. As this undeveloped land is turned into housing developments, stores and offices, the traffic along the existing roadways also experiences growth. This can pose serious problems regarding the existing roadway network and existing traffic control devices. Traffic problems like congestion can cause safety issues, greater levels of pollution, loss of productivity and extreme drive times for drivers. To combat these traffic problems caused by new developments and regional growth, cities, counties and government agencies have established procedures and permits that must be completed before developers are able to develop their parcels of land. Each state, county, city and village can have their own process; however, the end result is usually the same. In order to develop their land, a developer must analyze the existing roadway and traffic control devices, with an emphasis on the new traffic created by their new development. This is standardly known as a Traffic Study. There can be many names for these types of studies, for example the Ohio Department of Transportation (ODOT) relies on their State Highway Access Management Manual (SHAMM), to determine how intricate the traffic study is required to be. There are two studies in the SHAMM, with the bigger study being called a Traffic Impact Study, and the smaller study being called a Traffic Analysis[1]. Regardless of the extent of the study, the procedure of them stays relatively the same. First, existing traffic counts are collected in the vicinity around the site of the development. Then an estimate is created for the traffic volumes created by the new development, after which the traffic both

[1] "State Highway Access Management Manual" (January 2023), ODOT Office of Roadway Engineering

without and with the development traffic is grown to future conditions, to examine the impact of the development on the surrounding road network. Each step mentioned above has standard engineering processes used in the overall analysis. This research project will be examining the use of one of these engineering standard practices, the estimation of development traffic which is known as Trip Generation.

Trip Generation

The estimation of development traffic, or Trip Generation, is calculated through the use of the Trip Generation Manual (TGM). This manual is currently on its 11th edition, having first been published in 1976, with the latest 11th edition being published in September 2021. This publication is created by the Institute of Transportation Engineers, which is an international association of transportation professionals who work to improve mobility and safety for all transportation system users[2]. This manual has compiled several different Land Use Codes, which refer to the type of development. For example, there are Industrial Land Uses with codes in the 100s, Residential Land Uses in the 200s, Recreational Land Uses in the 400s, and Retail Land Uses in the 800s. The TGM has collected several surveys documenting the number of vehicle trips to and from these land use codes, with respect to a independent variable, such as square-footage, number of drive through lanes, or dwelling units. Every estimation that the TGM provides, is in vehicle trips. A vehicle trip is defined by the TGM as "a single or one-direction person or vehicle movement with either the origin or destination inside a study site." For example, if a person were to go to a local grocery store, there would be two trips required: the nomenclature depends on the reference point. If the house is being examined, then it has a

[2] "Trip Generation Manual – 11th Edition" (September 2021), Institute of Transportation Engineers1

exiting trip from the house to the store and a entering trip from the store to the house. If the grocery store is being examined, then it has an entering trip of the house to the store and an exiting trip from the store to the house. The TGM provides trip generation data for several different time periods such as the adjacent street peak hour (the highest volume of traffic on an adjacent street in a one-hour period) or weekday total trips (the average number of trips per weekday). This data is used across the nation as a standard of trip generation, and is continually updated, however this data may not fully represent the volume of vehicles currently being experienced. Since the data was collected, several changes have happened in daily life, such as the Corona Virus pandemic and the increase of online shopping. For the purposes of this research project, the Land Use Code of 813, *Free-Standing Discount Superstore*, was compared with data that has been collected at local Northeast Ohio Walmarts. Based upon the TGM, a Free-Standing Discount Superstore is defined as a discount superstore that also contains a full-service grocery department that shares entrances and exits with the discount store area. These stores typically maintain long store hours, 7 days a week and may have a garden center or vehicle service station in operation with the discount store. Based upon this definition, the Walmart store chain meets the description of the Land Use Code 813, *Free-Standing Discount Superstore*, and the trip generation data will be used. Attached to this report will be the TGM's full definition of Land Use Code 813.

Hypothesis

It is believed that the trip generation through ITE's Trip Generation Manual will overestimate the number of trips generated by free-standing discount superstores in the northeast region of Ohio.

Analysis Procedure

In order to conduct this analysis, several groups of data must be collected. For Land Use Code 813, *Free-Standing Discount Superstore*, the independent variable of square-footage is used. Using Google Earth, an outline can be drawn to estimate the square-footage of each store. The corporate division of Walmart was approached to obtain any information regarding the number of vehicles trips per day at individual stores. They responded by suggesting that the information could be available, but only if the individual stores were contacted themselves. Unfortunately, the individual stores did not have data regarding the number of vehicles, but they could provide average number of customers per day and average number of employees per day. To turn this collected data into vehicle trips, manual counts were taken to observe and calculate the vehicle occupancy rate. Using this vehicle occupancy rate on the average number of customers, an average number of vehicles per day can be estimated. This average number of vehicles per day can be turned into average trips per day by doubling the number of vehicles. This is due to both the entering and exiting trip of each vehicle. The vehicle occupancy rate for the employees was assumed to be 1.00, so no additional calculations were required to determine the trips generated by employees. Once these values are obtained, they can be compared with the estimation provided by the online version of the TGM, which provides a drop-down menu to select the Land Use Code and asks for the independent variable (in this case the square-footage). Using the entered data, TGM provides an estimation for calculated average trip rate.

Data Collection

Fifteen stores were contacted asking for estimates regarding how many customers visited each store per day and how many employees worked per day. As seen below in *Table 1: Superstore Contact List & Results.* Attempts were made to contact not only Walmart superstores, but also Meijer's, however due to company policy, data was not available for use in this study. Out of the fifteen contacted stores, five returned data. Of the Walmart superstores that did not return data, some were due to lack of information regarding customer counts, while others never returned calls or voicemails that were left with the store associates and managers. The square-footage was collected using the measurement tool of Google Earth[3].

Table 1: Superstore Contact List & Results

Stores Contacted	Square-footage	Results
Walmart – Akron	183,000	4,500 customers/day, 250 employees/day
Walmart – Alliance	-	Data Not Available
Walmart – Aurora	206,000	7,500 customers/day, 270 employees/day
Meijer's – Brimfield Township	-	Data Not Available
Walmart – Brimfield Township	244,000	4,000 customers/day, 220 employees/day
Meijer's - Canton	-	Data Not Available
Walmart – Canton (Tusc.)	-	Data Not Available
Walmart – Fairlawn	-	Data Not Available
Walmart – Massillon	268,000	7,000 customers/day 280 employees/day
Walmart – New Philadelphia	-	Data Not Available
Walmart – North Canton	-	Data Not Available
Walmart – Ravenna	-	Data Not Available
Walmart – Salem	-	Data Not Available
Walmart – Stow	-	Data Not Available
Walmart – Wadsworth	220,000	8,000 customers/day, 200 employees/day

[3] "Google Earth v. 9.185.0.0" (2023), *Various Walmart's in Northeast Ohio*

The vehicle occupancy collection was done in the parking lot of a Walmart superstore in Canton, Ohio on Wednesday March 23rd, Thursday March 24th, and Friday March 25th. A sample of approximately 100 vehicles was conducted each day, to reach a total sample size of 300 vehicles. The breakdown of number of cars, number of passengers and time period in which they were collected is shown below in *Table 2: Vehicle Occupancy Collection Results*.

Table 2: Vehicle Occupancy Collection Results

Time Period	Number of Cars	Number of Passengers
Wednesday, March 23rd 7:30 – 8:00 am	97	101
Thursday, March 24th 11:40 am – 12:00 pm	99	114
Friday, March 25th 5:10 – 5:30 pm	104	112
Total	300	327

Based upon the data collected, the vehicle occupancy ratio is the total number of passengers divided by the total number of cars. The calculated vehicle occupancy ratio is equal to 1.09. This value will be used to turn the customers per day results into vehicles per day. Shown on the next page is *Table 3: Calculated Trip Generation*. The *Adjusted for Occupancy Rate* value is the *Customers/day* volume divided by the occupancy rate (1.09). To calculate the *Weekday Trips* volume, the sum of *Adjusted for Occupancy Rate* and *Employees/day* is doubled to account for both the entering and exiting trip of the vehicle to the superstore. These values will then be compared to the estimation by the TGM.

Table 3: Calculated Trip Generation Data

Stores	Customers/day	Adjusted for Occupancy Rate	Employees/day	Weekday Trips
Walmart – Akron	4,500	4,129	250	8,757
Walmart - Aurora	7,500	6,881	270	14,302
Walmart – Brimfield Township	4,000	3,670	220	7,780
Walmart – Massillon	7,000	6,423	280	13,406
Walmart – Wadsworth	8,000	7,340	200	15,079

The online version of the Trip Generation Manual was used to compute the values for this study. Using the Land Use Code of 813, *Free-Standing Discount Superstore*, the Weekday Trips were estimated for each of the stores where data was collected. Attached in the Appendix of this report will be the ITE Trip Generation plots, which will show the survey results collected by ITE and the line of best fit, which is used to calculate the estimated weekday trips.

Table 4: ITE Trip Generation Manual Volumes

Land Use Code (813)	Square-footage	Weekday Trips
Walmart – Akron	183,000	9,245
Walmart – Aurora	206,000	10,407
Walmart – Brimfield Township	244,000	12,327
Walmart - Massillon	268,000	13,539
Walmart – Wadsworth	220,000	11,114

Data Comparison

Using the data collected from the online version of the TGM, the plotted points are shown below for the five stores which data was collected from. Because the TGM uses a regression line of its existing data points to determine its estimation, all five of the trip ends fall directly on the linear regression line. This line estimates that for every 1,000 square-foot of gross floor area, there are 50 trip ends generated. See *Figure 1: ITE Trip Generation*, below for a graphical representation of the estimation provided by ITE. This figure uses a x-axis of 1,000 square-foot of gross floor area and a y-axis of trip ends.

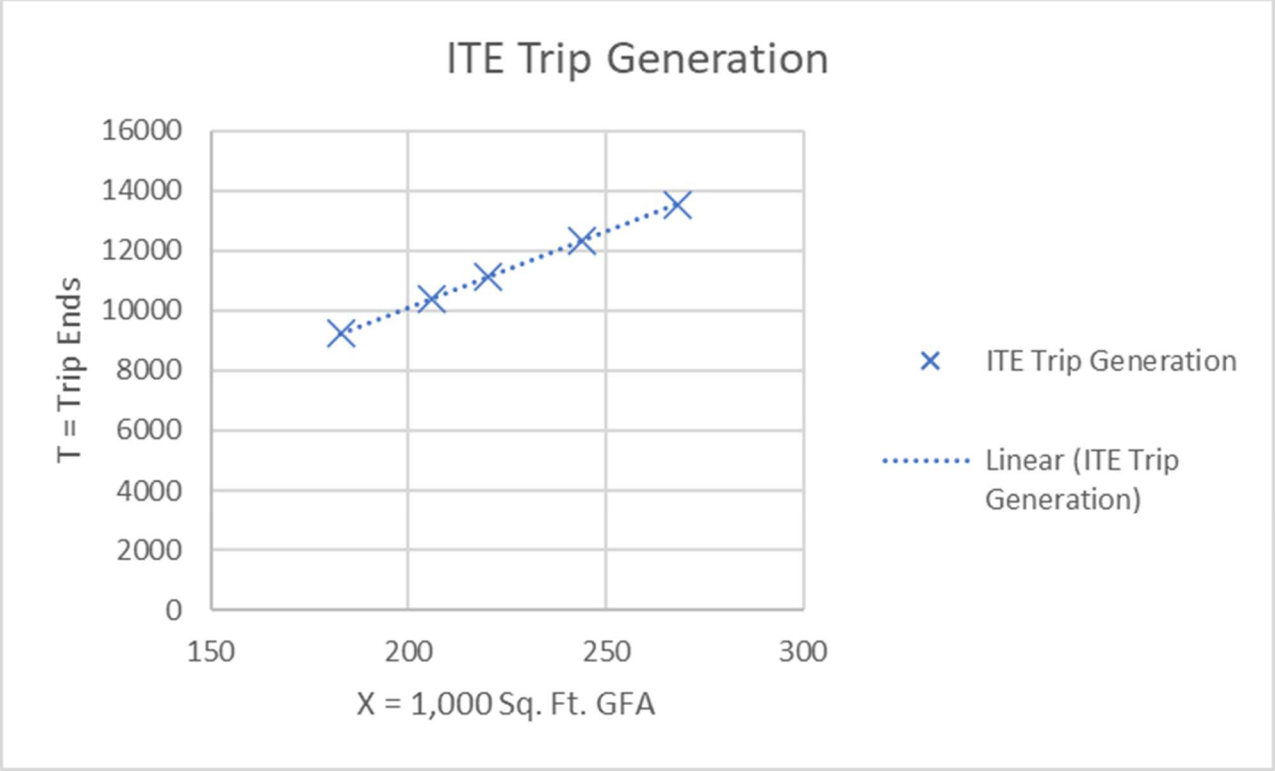


Figure 1: ITE Trip Generation

Shown below is *Figure 2: Calculated Trip Generation*. This shows the calculated trip generation, based upon the survey data collected, plotted against the estimation line used by the TGM to estimate trip ends for Land Use code 813, *Free-Standing Discount Superstore*. As seen below, the trips calculated for this report vary, both over and under-estimating the trip ends based upon the estimate provided by the TGM.

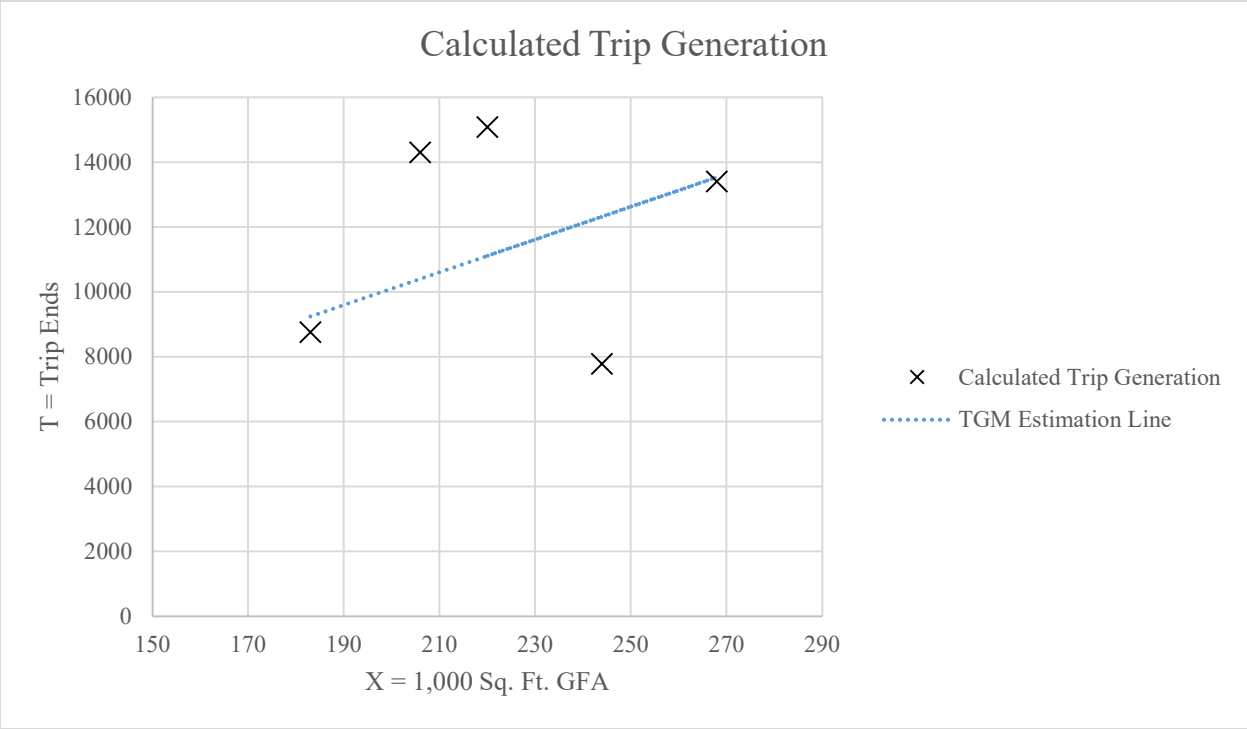


Figure 2: Calculated Trip Generation

When examining these data points based upon the expected trip generation (TGM) and the calculated trip generation, using a figure, such as the one found on the next page, can be beneficial to examine the difference on a site-by-site basis. On the next page, *Figure 3: ITE vs. Calculated Trip Generation*, can be found. This provides the location of each of the five

superstores examined and the estimated trip generation by the TGM and the calculated trip generation based upon the methods used in this study.

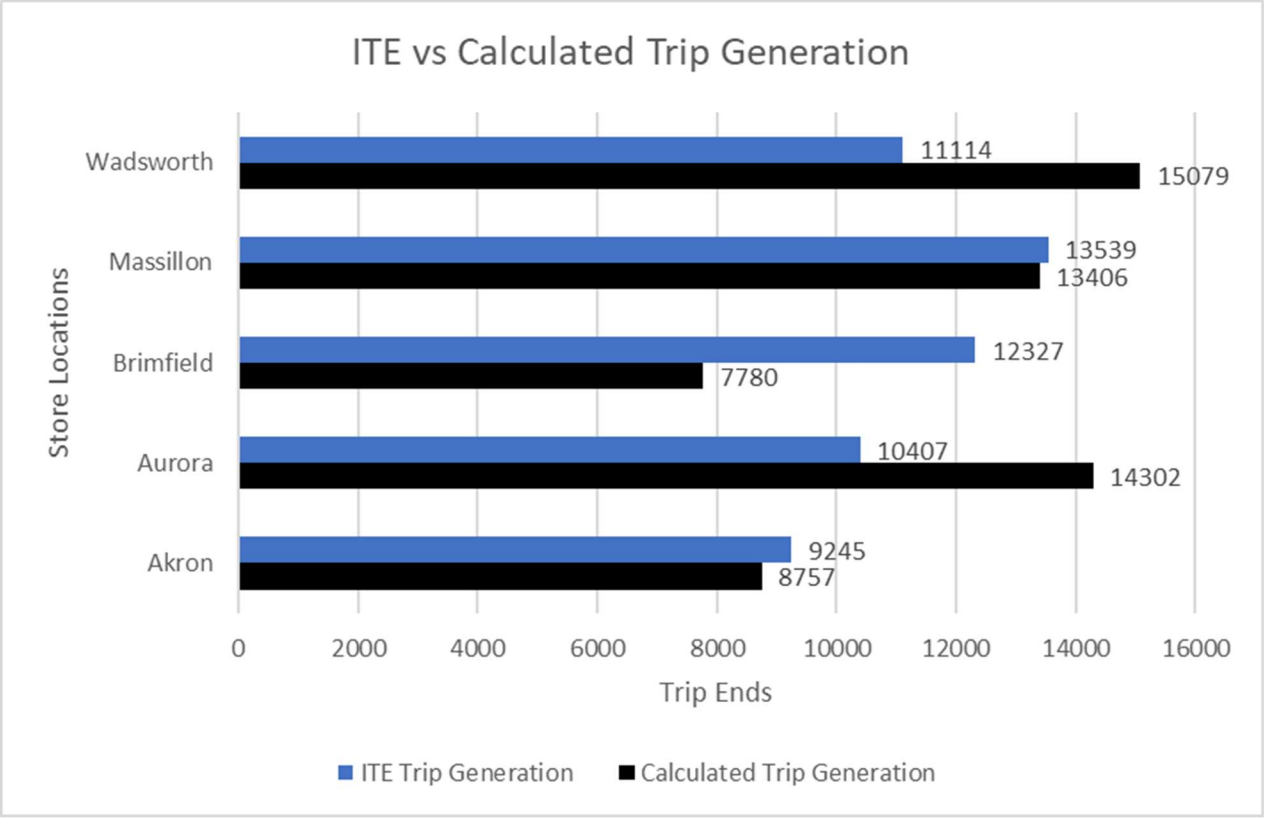


Figure 3: ITE vs. Calculated Trip Generation

When examining the data shown above, there is a no apparent correlation between the calculated trip generation and the estimated trip generation (done by the TGM). For two of the stores, Wadsworth and Aurora, the calculated trip generation is much greater than the estimation provided by the TGM. Meanwhile, for the stores located in Massillon and Akron, the calculated and estimated trip generation is almost identical. The store in Brimfield Township is the only store that experienced a large over-estimation by the TGM based upon the calculated trip generation done in this report.

Shown below in both tabular and graphical form in *Table 5: % Difference Between ITE & Calculated Trip Generation,* and *Figure 4: % Difference Between ITE & Calculated Trip Generation*, is the percent difference of the calculated trip generation from the TGM's estimation. This only further supports a non-correlation between the data collected and the estimation provided by the TGM.

Table 5: % Difference Between TGM & Calculated Trip Generation

Land Use Code (813)	TGM Trip Generation	Calculated Trip Generation	% Difference
Walmart – Akron	9,245	8,757	-5.3 %
Walmart – Aurora	10,407	14,302	37.4%
Walmart – Brimfield Township	12,327	7,780	-36.9%
Walmart - Massillon	13,539	13,406	-1.0%
Walmart – Wadsworth	11,114	15,079	35.7%

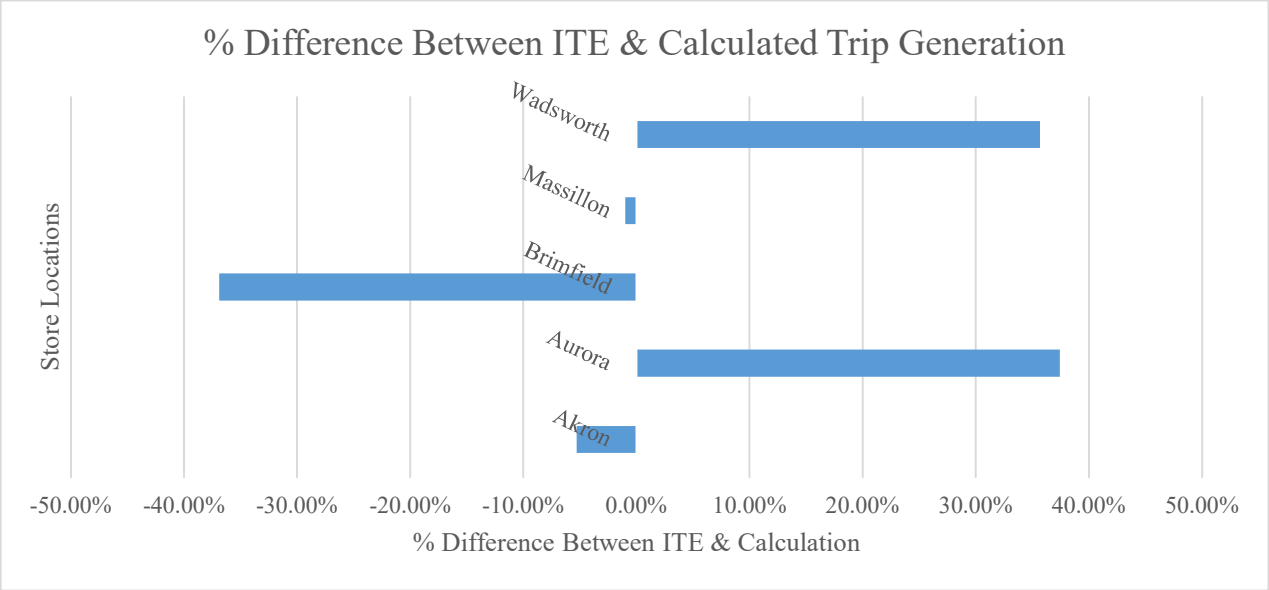


Figure 4: % Difference Between ITE & Calculated Trip Generation

Conclusion

Based upon the data collected, no significant correlation could be determined, regarding the TGM's method of estimating trip generation. Therefore, the hypothesis, that the TGM over-estimates the trip ends generated for superstores, such as Walmart in Northeast, Ohio, cannot be supported based upon the inconclusive results. This, however, could be attributed to the size of the survey completed, both the amount of stores contacted/data collected from and the size of the vehicle occupancy study. If these collections were greatly increased, then the data may show more of a correlation, simply due to a larger sample size. Additionally, the estimated customers and employees per day was obtained through Walmart superstore managers and/or associates, which may have led to over or under reporting of their customers/employees per day.

Appendix

Land Use: 813
Free-Standing Discount Superstore

Description

A discount superstore is similar to a free-standing discount store described in Land Use 815 with the exception that it also contains a full-service grocery department under the same roof that shares entrances and exits with the discount store area. These stores usually offer a variety of customer services, centralized cashiering, and a wide range of products. They typically maintain long store hours 7 days a week. The stores included in this land use are often the only ones on the site, but they can also be found in mutual operation with a related or unrelated garden center or service station, or as a part of a shopping center, with or without their own dedicated parking area. Freestanding discount store (Land Use 815) is a related use.

Additional Data

A garden center contained within the principal outside faces of the exterior building walls is included in the reported gross floor area. An outdoor or fenced-in area outside the principal faces of the exterior walls is excluded. Several sites included in this land use indicate the presence of fenced/covered space.

A Texas Transportation Institute study titled “Nationwide Discount Supercenter Study” published in 2008 provides information on trip generation rates for what the study defines as “typical” and “peak” seasons. The peak season is defined as the period between the week after Thanksgiving and the week prior to Christmas. The typical season is defined as September through mid-November when sales transactions are close to the annual average. The following are their key findings:

- Weekday trip generation rates are similar in both seasons
- Saturday trip generation rates are 13 to 20 percent higher during the peak season than the typical season
- Sunday trip generation rates are 6 to 10 percent higher during the peak season

The weighted average truck trip generation rates from approximately 30 sites surveyed for this land use are summarized in the table below. The average gross floor area of these facilities is 206,000 square feet.

Day/Time Period	Weighted Average Truck Trip Generation Rate (Trip ends per 1,000 square feet)
Weekday	0.87
Weekday AM Peak Hour of Adjacent Street Traffic	0.05
Weekday PM Peak Hour of Adjacent Street Traffic	0.03
Weekday AM Peak Hour of Generator	0.06
Weekday PM Peak Hour of Generator	0.04
Saturday	0.59
Saturday Peak Hour of Generator	0.04
Sunday	0.43
Sunday Peak Hour of Generator	0.02

To assist in the future analysis of this land use, it is important to collect and include information on the presence and size of garden centers, outdoor fenced-in space, and service stations in trip generation data submissions.

The technical appendices provide supporting information on time-of-day distributions for this land use. The appendices can be accessed through either the ITETripGen web app or the trip generation resource page on the ITE website (https://www.ite.org/technical-resources/topics/trip-and-parking-generation/).

The sites were surveyed in the 1990s, the 2000s, and the 2010s in Alabama, Arkansas, California, Colorado, Florida, Georgia, Idaho, Illinois, Indiana, Iowa, Kansas, Kentucky, Louisiana, Massachusetts, Minnesota, Missouri, Nebraska, Nevada, North Carolina, Ohio, Oklahoma, Oregon, Pennsylvania, Texas, Virginia, West Virginia, and Wisconsin.

Source Numbers

354, 522, 577, 595, 607, 609, 612, 618, 625, 630, 636, 651, 652, 661, 731, 735, 851, 866, 946, 960, 1067, 1071, 1072

Free-Standing Discount Superstore
(813)

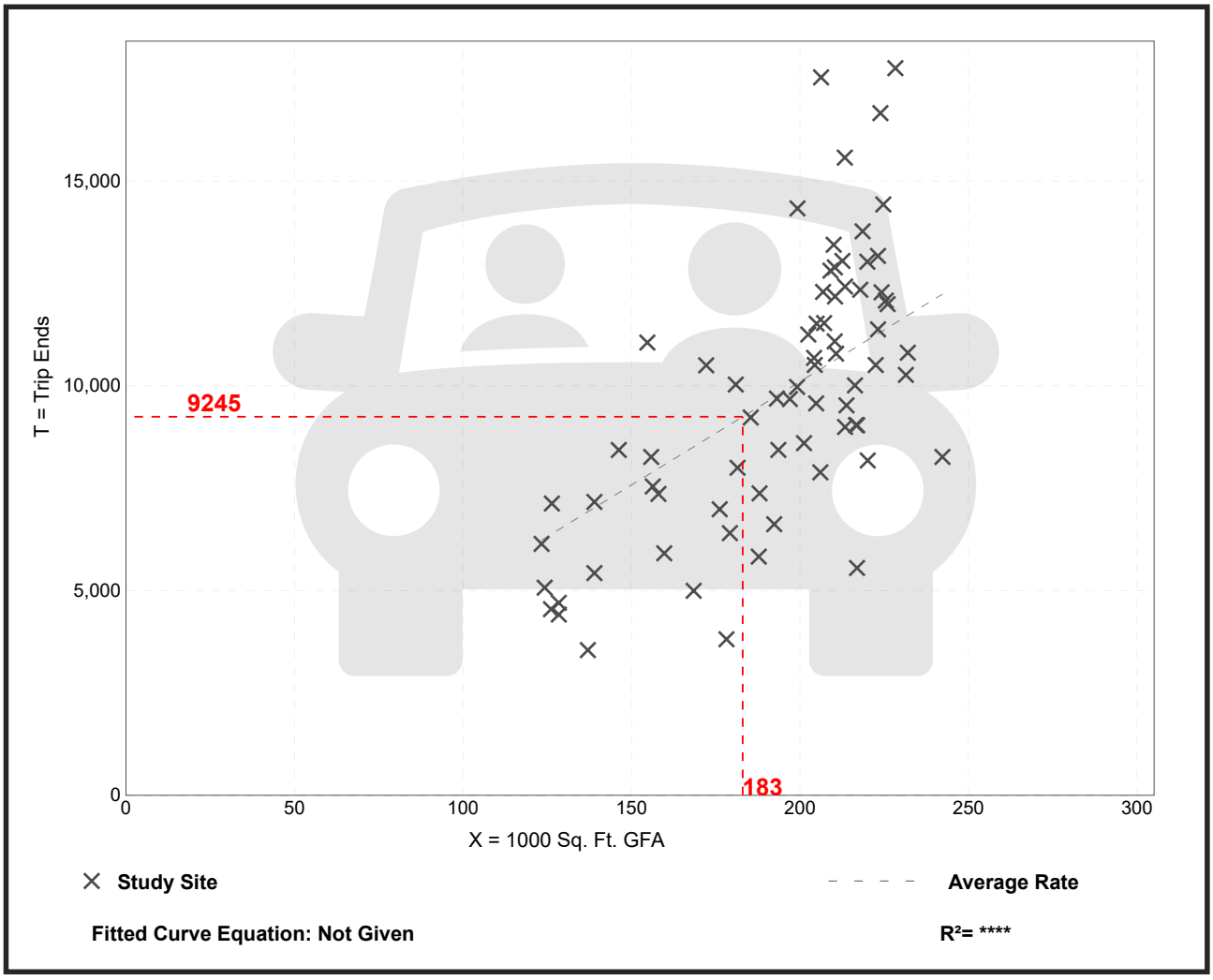
Vehicle Trip Ends vs: **1000 Sq. Ft. GFA**
On a: **Weekday**

Setting/Location: **General Urban/Suburban**
Number of Studies: 72
Avg. 1000 Sq. Ft. GFA: 193
Directional Distribution: 50% entering, 50% exiting

Vehicle Trip Generation per 1000 Sq. Ft. GFA

Average Rate	Range of Rates	Standard Deviation
50.52	21.39 - 85.01	12.61

Data Plot and Equation



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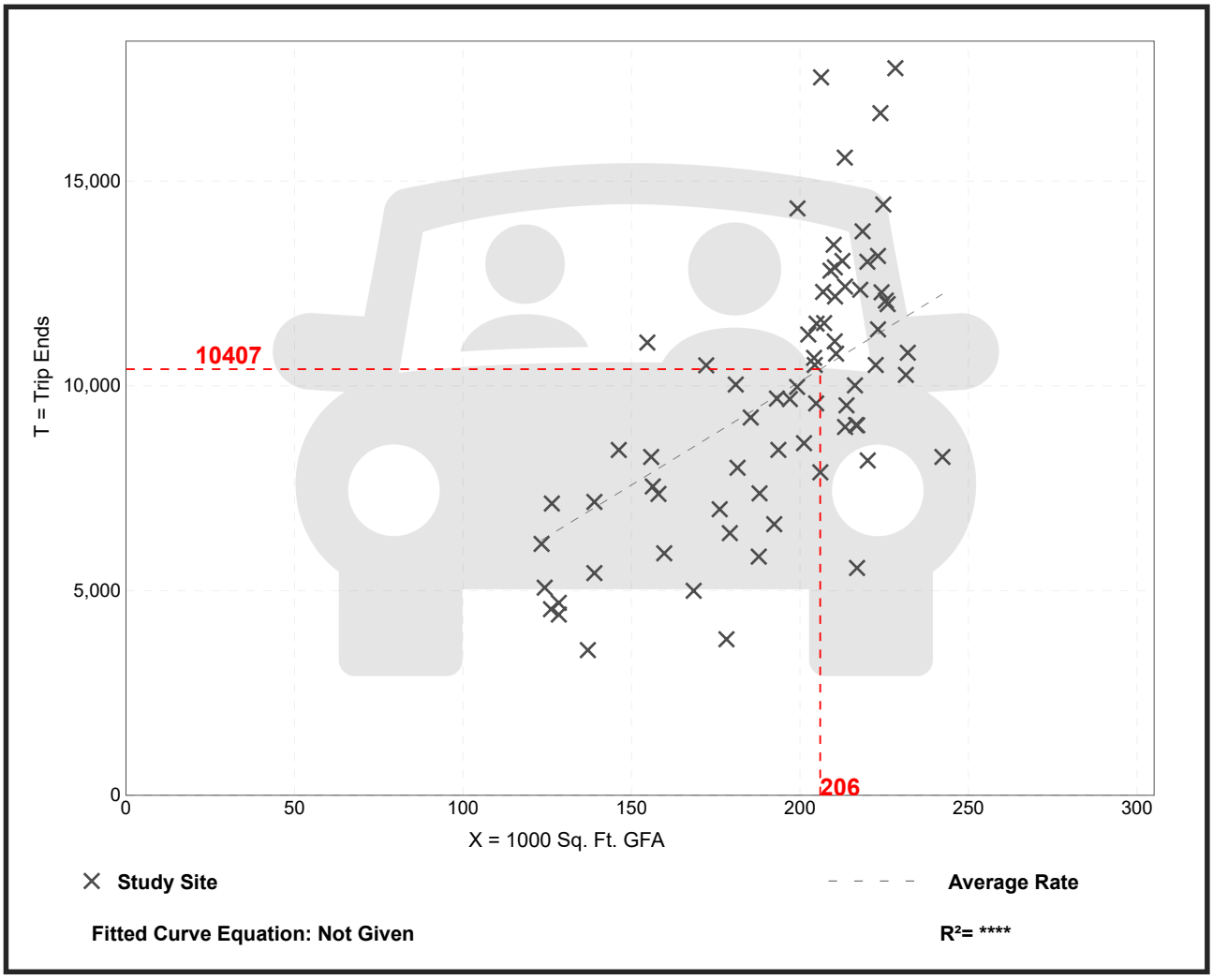

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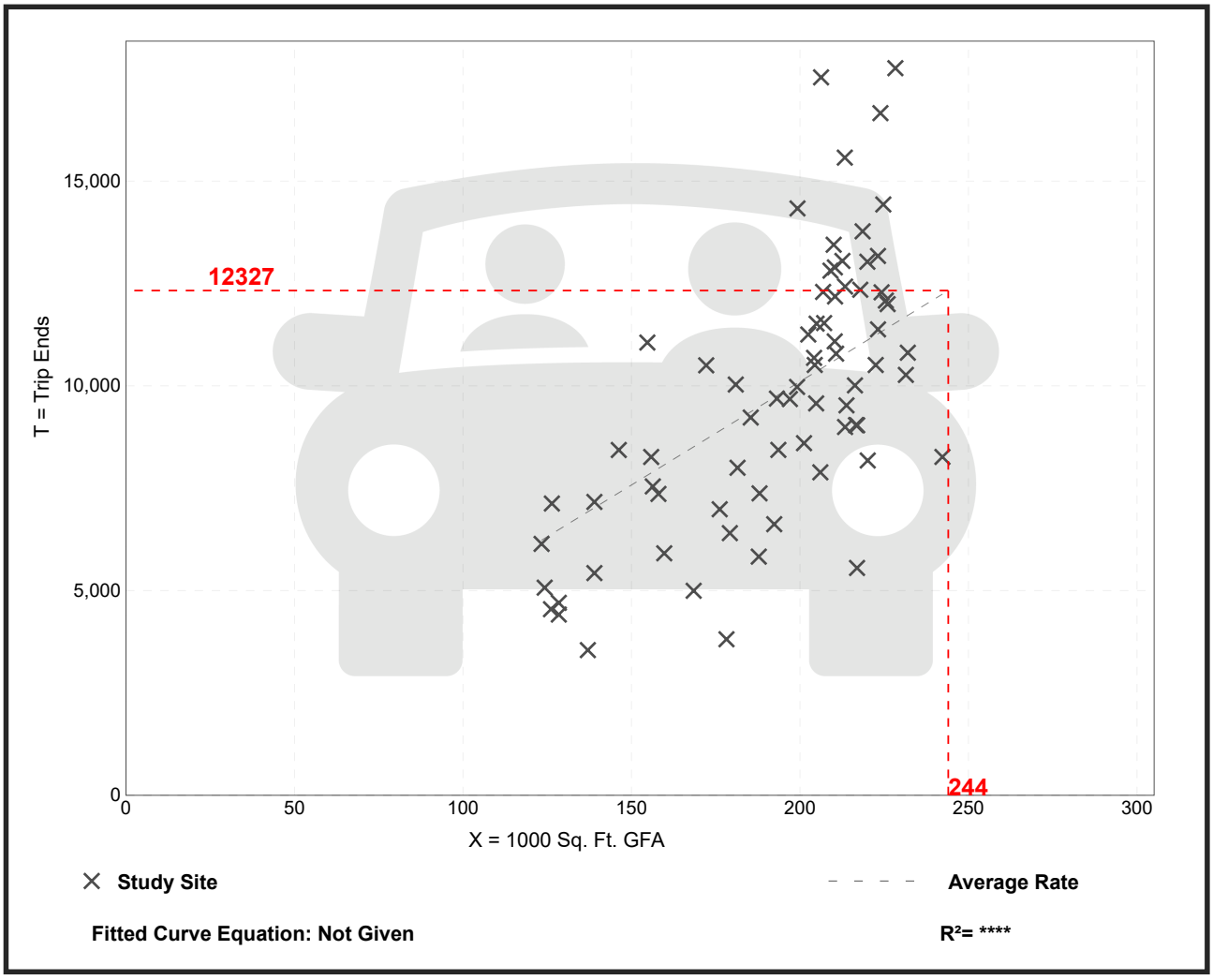

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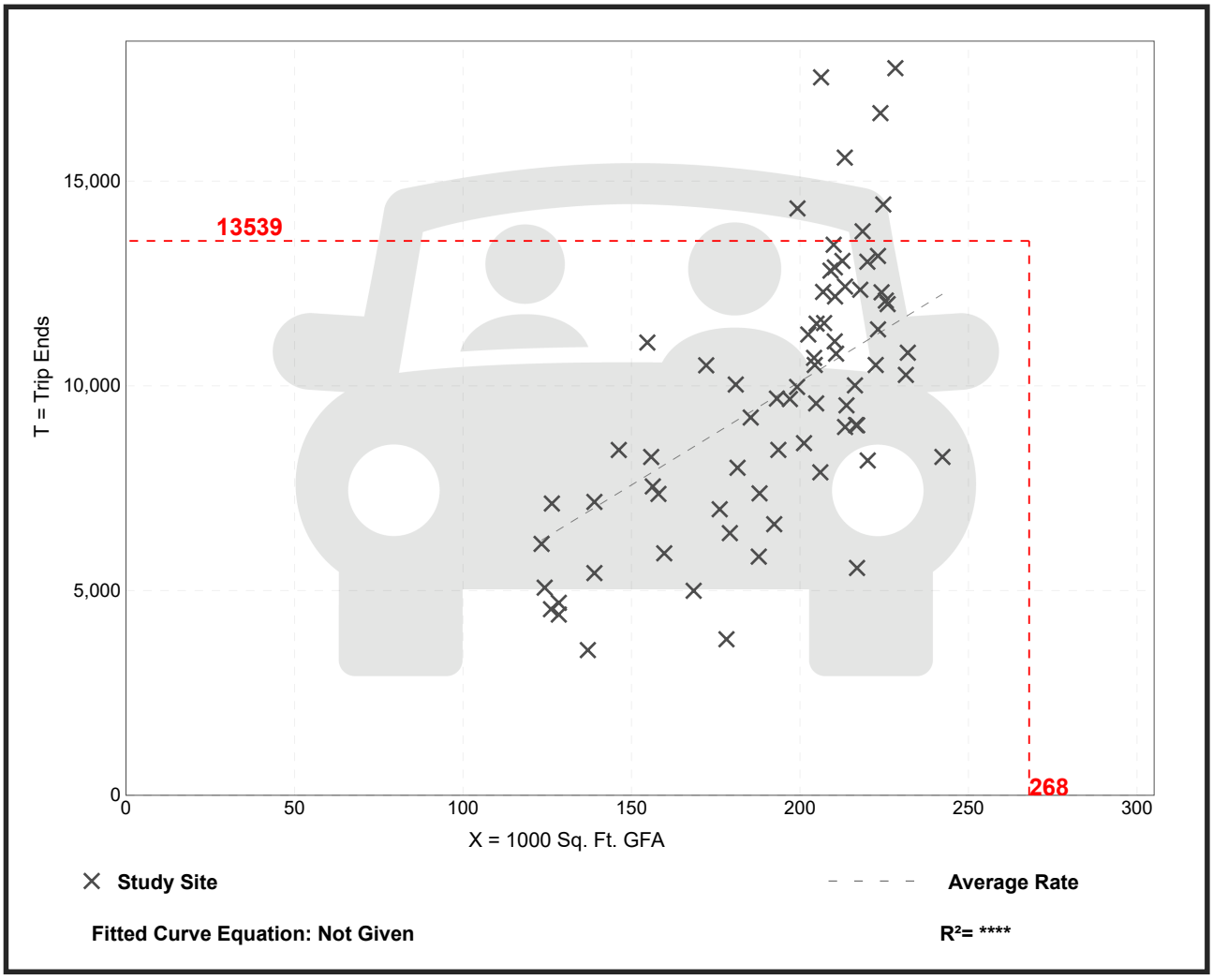

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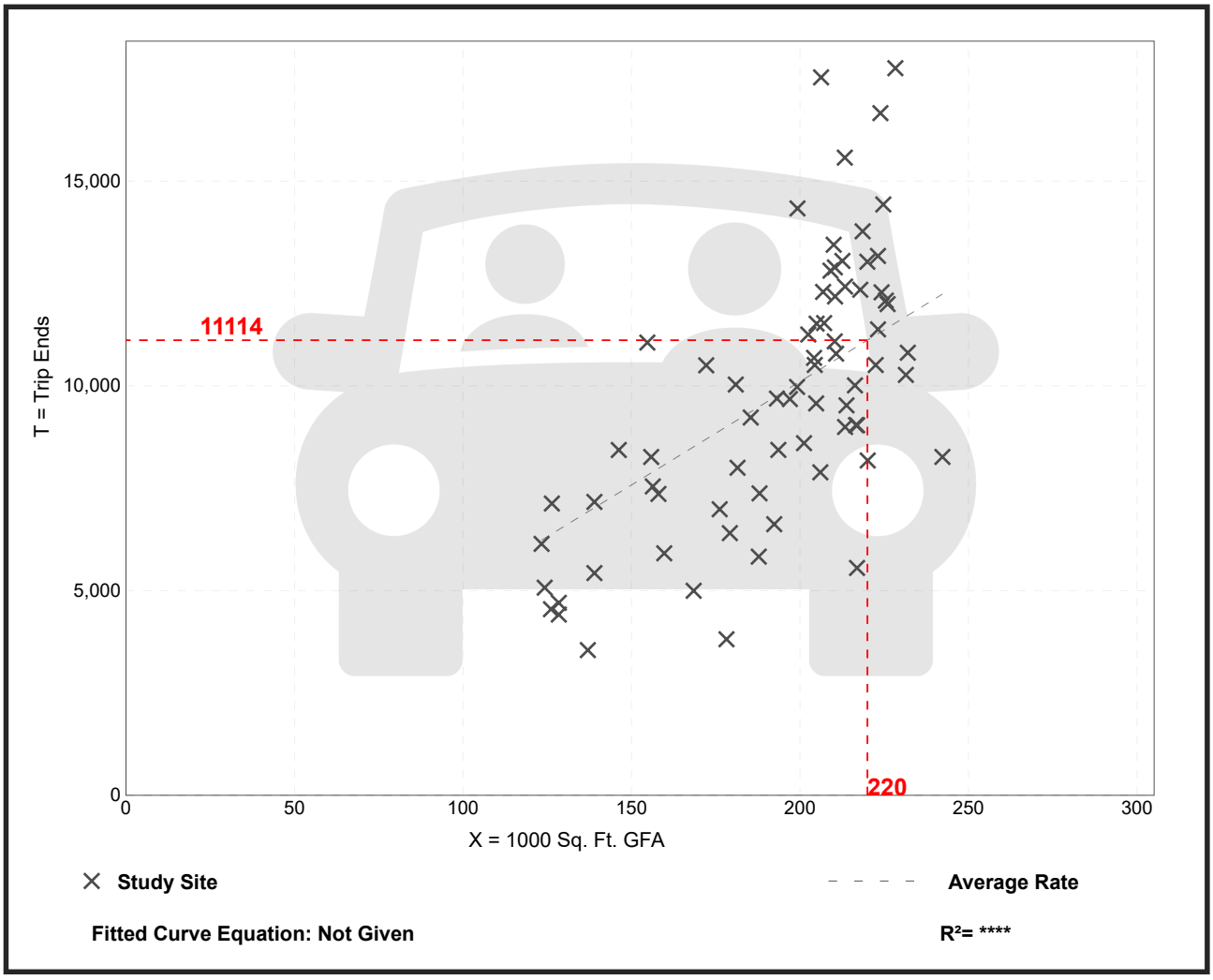

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