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DREAM TOWN DEVELOPMENT

TRAFFIC IMPACT ANALYSIS

HAYDEN ATCHLEY
HSL DEVELOPERS
CE 664

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1. INTRODUCTION

HSL Developers is proposing the development of Dream Town, a multi-use site containing a restaurant and a mixed-use office/retail building. This section contains information on the purpose of the report and the study level of the proposed development.

PURPOSE

This report presents a Traffic Impact Analysis (TIA) for the proposed Dream Town development. This TIA was completed to fulfill requirements from Provo City and the Utah Department of Transportation (UDOT) for new development, and was done in accordance with UDOT guidelines to apply for an access permit (Utah Department of Transportation 2019). The TIA identifies current traffic patterns—including traffic volume counts—in the study area, and projects traffic volumes to opening day and 5 years after opening (2024 and 2029, respectively).

STUDY LEVEL

UDOT Administrative Rule R930-6-8(4) (Utah Department of Transportation 2019) sets forth general requirements for an access permit, including determining the application level. The proposed development will contain an 8,000 ft^2 high-turnover restaurant (Institute of Transportation Engineers (ITE) land use code 932) and a 32,000 ft^2 office/retail building, half of which (18,000 ft^2) will be a general office location (ITE land use code 710), and the remaining half (18,000 ft^2) will be a hardware store (ITE land use code 816). From the ITE Trip Generation Manual (Institute of Transportation Engineers 2021), these locations are expected to generate 1264 weekday trips and 166 PM peak trips (see Appendix C). These trip rates, along with the land use and respective development sizes, necessitate a level II application.

A Level II application requires the following:

- Analysis area includes intersection of site access drives with state highways and any signalized and un-signalized intersection within access category distance of property line

- Design years are opening day and 5 years after project completion
- Traffic is identified for weekday AM and PM peak, and special peak hour as necessary
  - **N.B. This analysis only includes PM peak traffic due to the scope of the assignment**
- Data collection includes:
- Daily and turning movement counts
- Site and adjacent roadway/intersection geometrics
- Information on traffic control devices
  - Crash data
  - Trip generation following the ITE Trip Generation Manual or other ITE procedures
  - Trip distributions and assignment (existing, site, background, and future volumes in analysis area)
  - Conflict and capacity analysis
- Traffic signal impacts
- Right-of-way identified, including no- and limited-access control lines
- Includes safe operational design needs and concerns with accompanying mitigation measures

2. PROPOSED DEVELOPMENT

This section describes the plans for the development, including site location, land use, zoning information, and the the site plan itself.

SITE DESCRIPTION

The proposed Dream Town development is located in southern Provo, in Utah. The site is located on the west side of University Ave. (US-189), between 1200 South and Towne Centre Dr. This location is just east of the Provo Towne Centre mall, which is a large retail and dining center and a large generator of trips. The location is also near (to the north of) the intersection of I-15 and University Ave. Figure 2.1 shows a map of the site area. Four intersections are included in the analysis:

- 1200 South / Towne Centre Blvd. (all-way–stop-controlled (AWSC))
- 1200 South / University Ave. (signalized)
- Towne Centre Dr. / Towne Centre Blvd. (signalized)
- Towne Centre Dr. / University Ave. (signalized)

LAND USE AND ZONING INFORMATION

The proposed Dream Town development has two development pads, with one pad containing a sit-down restaurant and the other pad containing a mixed-use office/retail location. The retail location is intended to be a hardware/paint store. Table 1 shows these land uses along with their ITE land use codes and respective square footage.

The site area is zoned as SC3, which is a Regional Shopping Center. The primary use of this land is for commercial and service uses to serve needs of people living in an entire region. It is located close to freeways & major arterials for easy access (Provo City Utah 2022a chap. 14.20). Figure 2.2 provides a section of the Provo zoning map (Provo City Utah 2022b) with the site location marked.

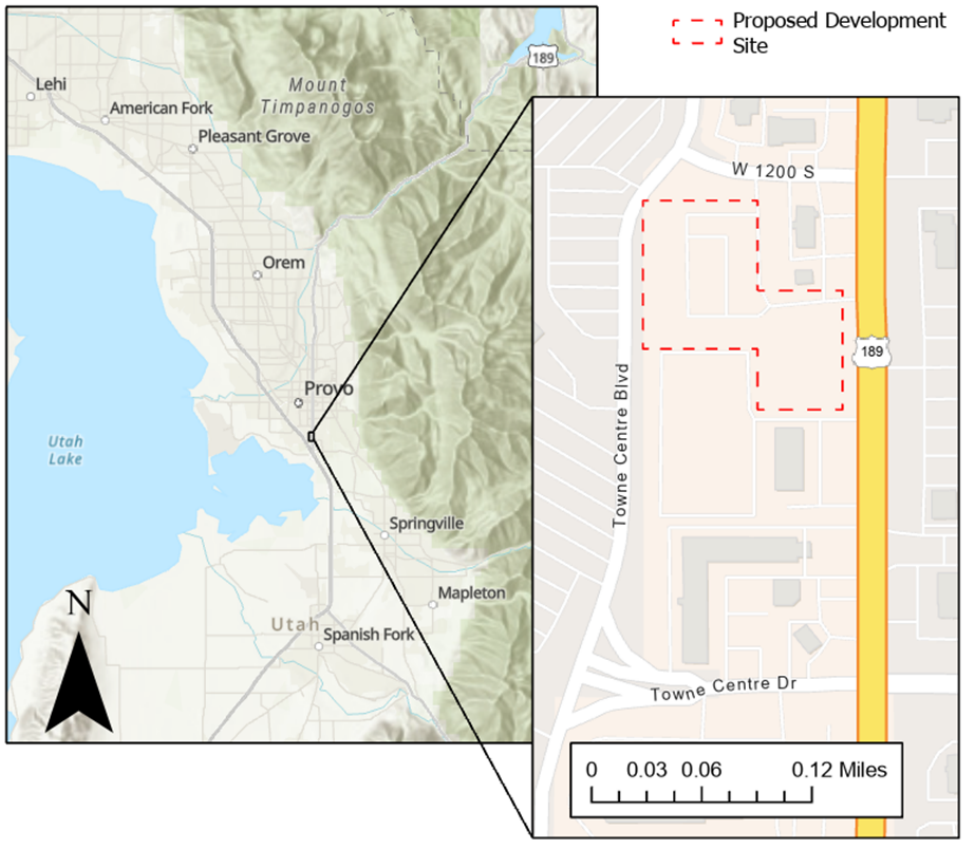

Figure 2.1: Map of the site location.

Table 1: *Proposed Land Use and Sizes*

Development Pad	Proposed Land Use	ITE Land Use Code	Area (ft^2)
A	Sit-Down Restaurant	932	8,000
B	General Office Building	710	18,000
B	Hardware/Paint Store	816	18,000

Site Plan

Figure 2.3 shows a site plan for the proposed development. Note that Pad C is not included in this analysis, as it has already been developed. This site map is still preliminary, and will be updated in a future draft of this report.

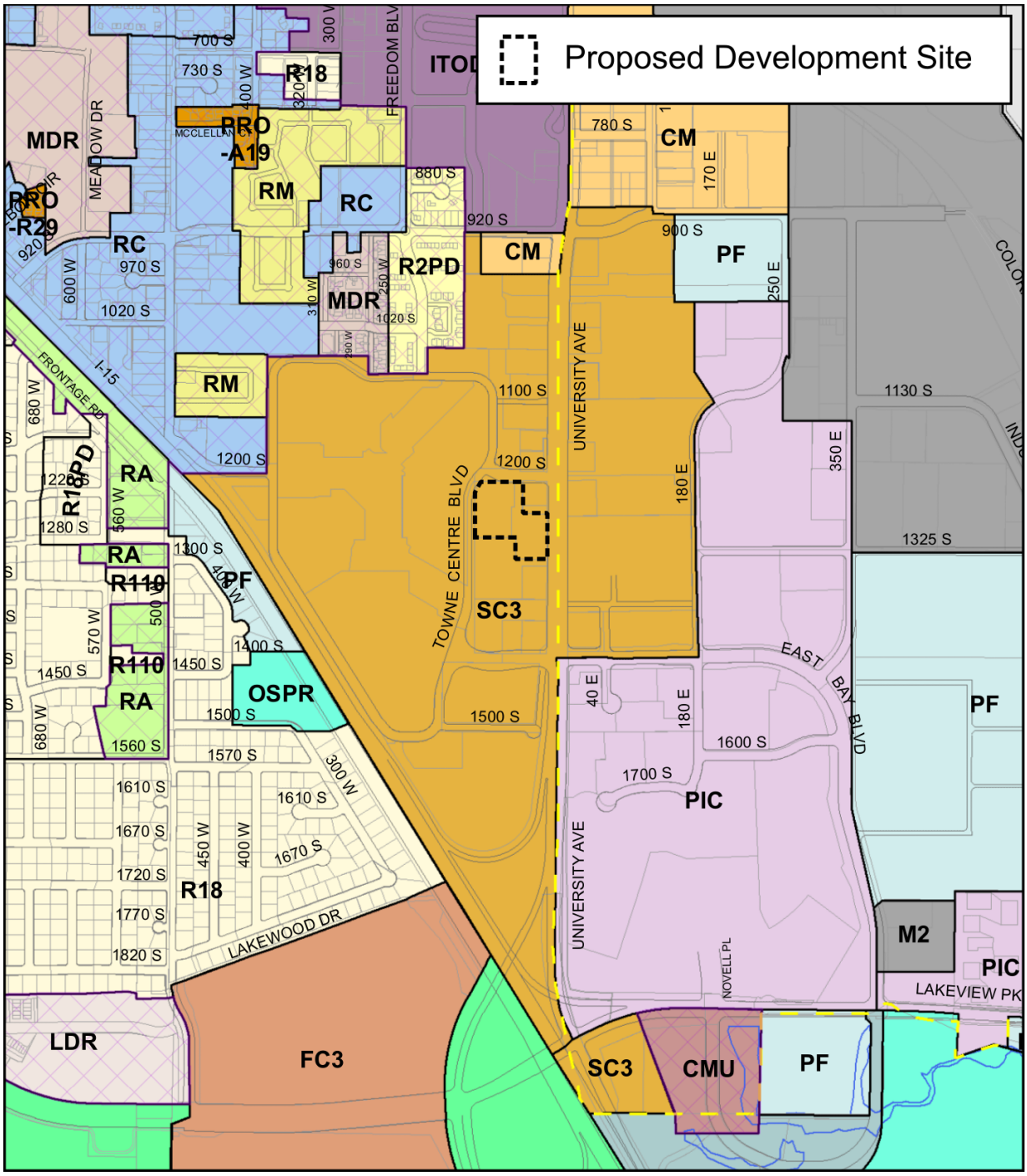

Figure 2.2: Provo zoning map, cropped to vicinity of the site.

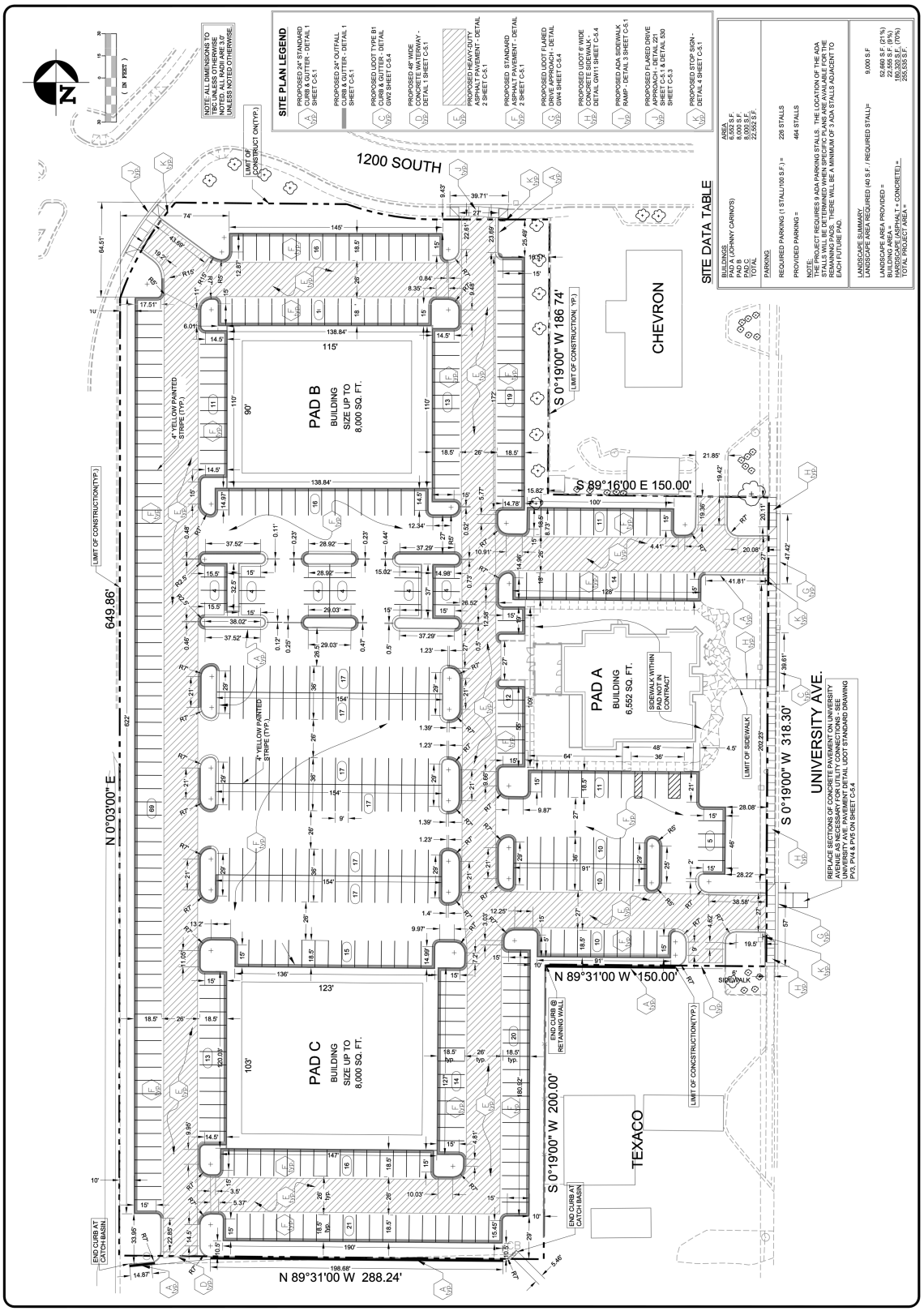

Figure 2.3: Site plan for proposed Dream Town development.

3. STUDY AREA CONDITIONS

The study area for this analysis includes the streets adjacent to the site as well as their intersections. These streets are 1200 South on the north, University Ave. (US-189) on the east, Towne Centre Blvd. on the west, and Towne Centre Dr. on the south. Note that there is existing development between Dream Town and Towne Centre Dr. All of the intersections in the TIA are signalized with the exception of the Town Centre Blvd. / 1200 South intersection, which is stop-controlled. This is shown in Figure 3.1.

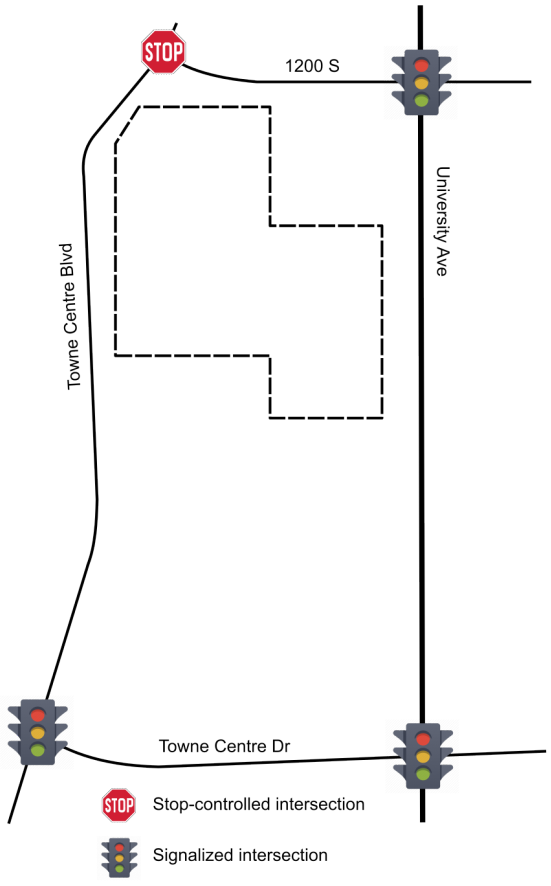

Figure 3.1: Map of basic intersection characteristics in TIA area.

STREET CONDITIONS

Detailed information on each street in the study area is provided in the following sections. This information is also summarized in Table 2.

Table 2: *Summary of Adjacent Street Configuration*

Road Name	Direction	NB/EB Lanes	SB/WB Lanes	Speed Limit (mph)	Meridian/ TWLTL[1]
1200 South	E/W	2	2	---	Median
University Ave. (US-189)	N/S	3	3	35	TWLTL
Towne Centre Blvd.	N/S	1	2	25	TWLTL
Towne Centre Dr.	E/W	2	2	30	Median

[1]Two-way--left-turn lane

1200 South

1200 South is an east-west (E/W) local road which, at least in the vicinity of the study area, exists only to offer a connection between Towne Centre Bvld. and University Ave. It runs about 350 feet along the north edge of the proposed Dream Town, and has 3 eastbound (EB) lanes and 2 westbound (WB) lanes. The 2 WB lanes offer a left- and right-turning movement, respectively (onto Towne Centre Blvd.), and there is no through movement since 1200 South and Towne Centre Bvld. form a T-intersection. The 3 EB lanes offer a left, through, and right-turn movement, either onto University Ave. for the turning movements or into a parking lot for the through movement. There is no posted speed limit, and a raised median prevents left turns onto or off of this road.

University Avenue (US-189)

University Ave. is also designated as US-189, and is a minor arterial running north-south (N/S) through Provo (Utah Department of Transportation 2023a). It is assigned an access category of 5, which is described as "Regional priority—urban importance" (Utah Department of Transportation 2023b). University Ave. connects with I-15 roughly 3000 feet south of the study area and has connections to many commercial developments on either side of the road. There are 3 through lanes in both directions in the study area, with 2

additional left- and 1 additional right-turn lanes/bays in both directions at the Towne Centre Dr. intersection and 1 additional left- and right-turn lane/bay each in both directions at the 1200 South intersection. The posted speed limit is 35 mph, and there is a two-way–left-turn lane (TWLTL) on this road for the length of the study area. There is also a 10-foot shoulder on the west side of the road, and there are sidewalks on both sides, though the sidewalk on the east is separated from the road by a grassy curb strip, and the sidewalk on the west is not.

Towne Centre Boulevard

Towne Centre Blvd. is a local street that circumnavigates the Provo Towne Centre mall. Within the study area this road runs N/S, and has 1 northbound (NB) and 2 southbound (SB) through lanes. A TWLTL runs the length of this road, though it is broken up by a bus stop located in the center of the road near the southern end of Dream Town. This bus stop serves the UVX/830X route, which is a BRT route running from the Towne Centre mall to Utah Valley University (Utah Department of Transportation n.d.). The TWLTL becomes two SB left turn bays at the Towne Centre Dr. intersection, and there is a NB free-flow right-turn bay at the same. This road has a posted speed limit of 25 mph.

Towne Centre Drive

Towne Centre Dr. is an E/W road that runs between Towne Centre Blvd. and University Ave., and becomes East Bay Blvd. east of University Ave. There is a posted speed limit of 30 mph, and there is a raised median between Towne Centre Blvd. and University Ave., though the median breaks about midway, allowing a WB left turn to access the development to the south. There are 2 left- and 1 right-turn bays at the University Ave. intersection in both directions, and 2 left-turn lanes and a right-turn free-flow lane at the Towne Centre Blvd. intersection.

Additional Information

There are several bus stops in the study area, as shown in Figure 3.2. Towne Centre Blvd. is elevated relative to Dream Town, but there is a staircase next to the bus stop that allows for pedestrian access.

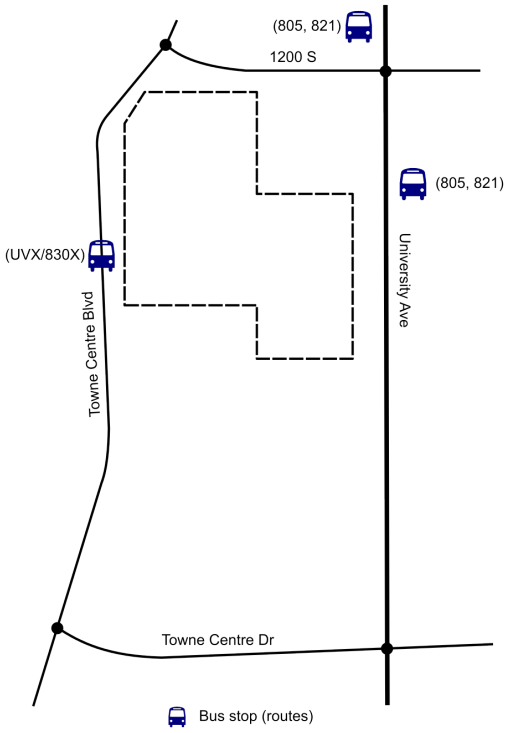

Figure 3.2: Map of bus stops on the studied streets.

ADJACENT LAND USES

As can be seen in Figure 2.2, much of the nearby land is in the same zoning category as Dream Town (SC3). This is borne out by the actual land use: there are several suburban commercial sites in this area. The most notable of these is the Provo Towne Centre mall to the east, but other locations include a Sam's Club, several fast-food and sit-down restaurants, and multiple small hotels and gas stations.

SITE ACCESSIBILITY

University Ave. provides direct access to Dream Town from I-15, as well as from downtown Provo. This is the most major road with direct access to the site, but several other roads provide access as well. Towne Centre Blvd. has connections to a neighborhood northwest of the site, and East Bay Blvd. provides access to University Ave. near the site from southeast Provo, and has a connection to Springville via Lakeview Pkwy. and I-89.

4. ANALYSIS OF EXISTING CONDITIONS

The study area contains four intersections: 1200 South / Towne Centre Blvd., a 3-way stop-controlled intersection; 1200 South / University Ave., a 4-way signalized intersection; Towne Centre Dr. / Towne Centre Blvd., a 3-way signalized intersection; and Towne Centre Dr. / University Ave., a 4-way signalized intersection (see Figure 3.1).

Much of the information regarding lane striping and turning movements for these intersections is given in Table 2. It is additionally worth noting that the east leg of the 1200 South / University Ave. intersection is a parking lot access, and the WB lane has a designated left-turn lane and a shared right/through lane. For reference, a lane configuration diagram of these intersections is provided in Figure 4.1, and timings for the signalized intersections are provided in Appendix B.

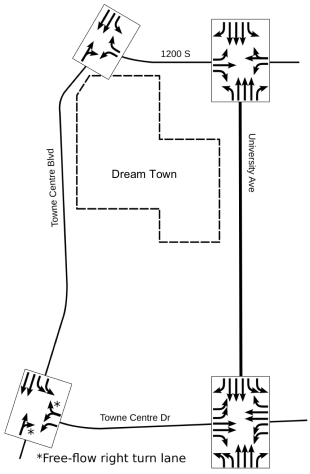

Figure 4.1: Intersection lane diagram of the study area.

TRAFFIC VOLUMES

Traffic turning volume counts were done at the Towne Centre Dr. / University Ave. and Towne Centre Dr. / Towne Center Blvd. intersections from 4:15–6:00 PM on January 24 (Tue)

and 25 (Wed), 2023, respectively. Scheduling conflicts and limited personnel necessitated that the counts be performed for only two intersections and on different days. However, for the purposes of this report this is not a significant limitation, due to the limited scope of the assignment. The two days are considered similar enough, and volumes were estimated for the other two intersections based on these counts and historical data.

From these traffic volumes, 4:30–5:30 PM was determined to be the peak hour, with a peak hour factor (PHF) of 0.92. The volumes for this peak hour are presented in Figure 4.2.

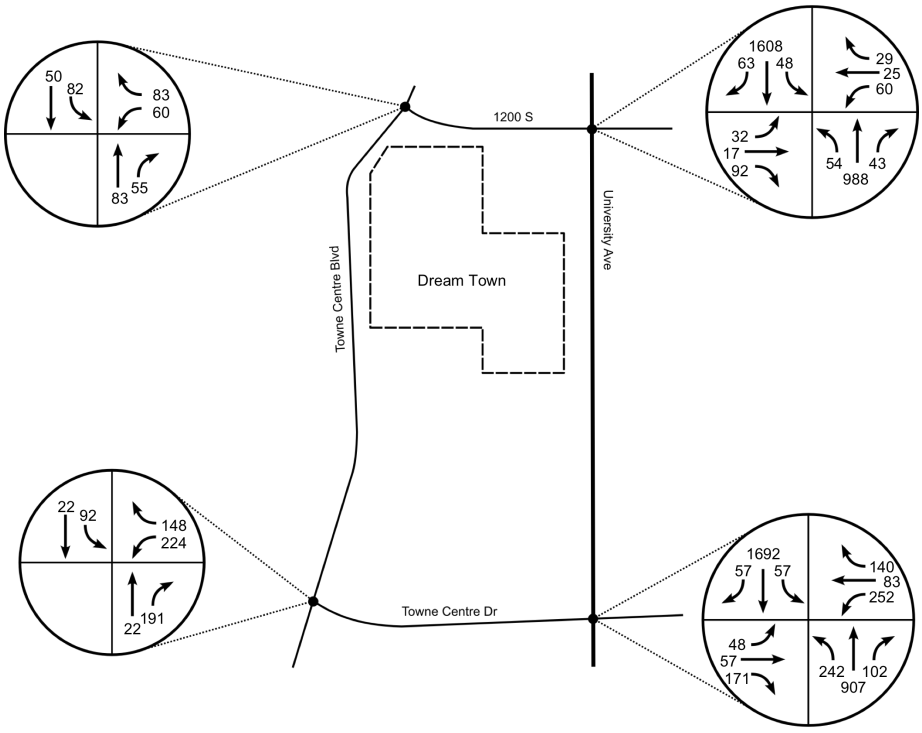

Figure 4.2: Peak hour turning volumes on the studied intersections.

LEVEL OF SERVICE

A level of service (LOS) measure was used to determine the traffic performance of each intersection (and each movement within each intersection). This LOS is a measurement of average control delay per vehicle, and bins the amount of delay into groups designated by

the letters A–F. These designations differ between signalized and unsignalized intersections, and are provided in the Highway Capacity Manual (HCM) (National Academies of Sciences, Engineering, and Medicine 2022). Table 3 summarizes these criteria. This analysis assumes a LOS of D or better represents acceptable conditions.

Table 3: *LOS Criteria for Intersections*

LOS Designation	Average Control Delay (sec/veh)	
	Signalized	Unsignalized
A	≤ 10	≤ 10
B	10–20	10–15
C	20–35	15–25
D	35–55	25–35
E	55–80	35–50
F	> 80	> 50

The existing level of service was determined based on current traffic volumes Section 4.1 and signal timings (obtained from UDOT), using the Synchro software package (Trafficware 2019). Synchro performs a LOS analysis using these and other inputs, including roadway and lane configuration. Figure 4.3 shows the average control delay for each movement and intersection, and Figure 4.4 shows the LOS of the same. The full results of the Synchro analysis are available in Appendix A.

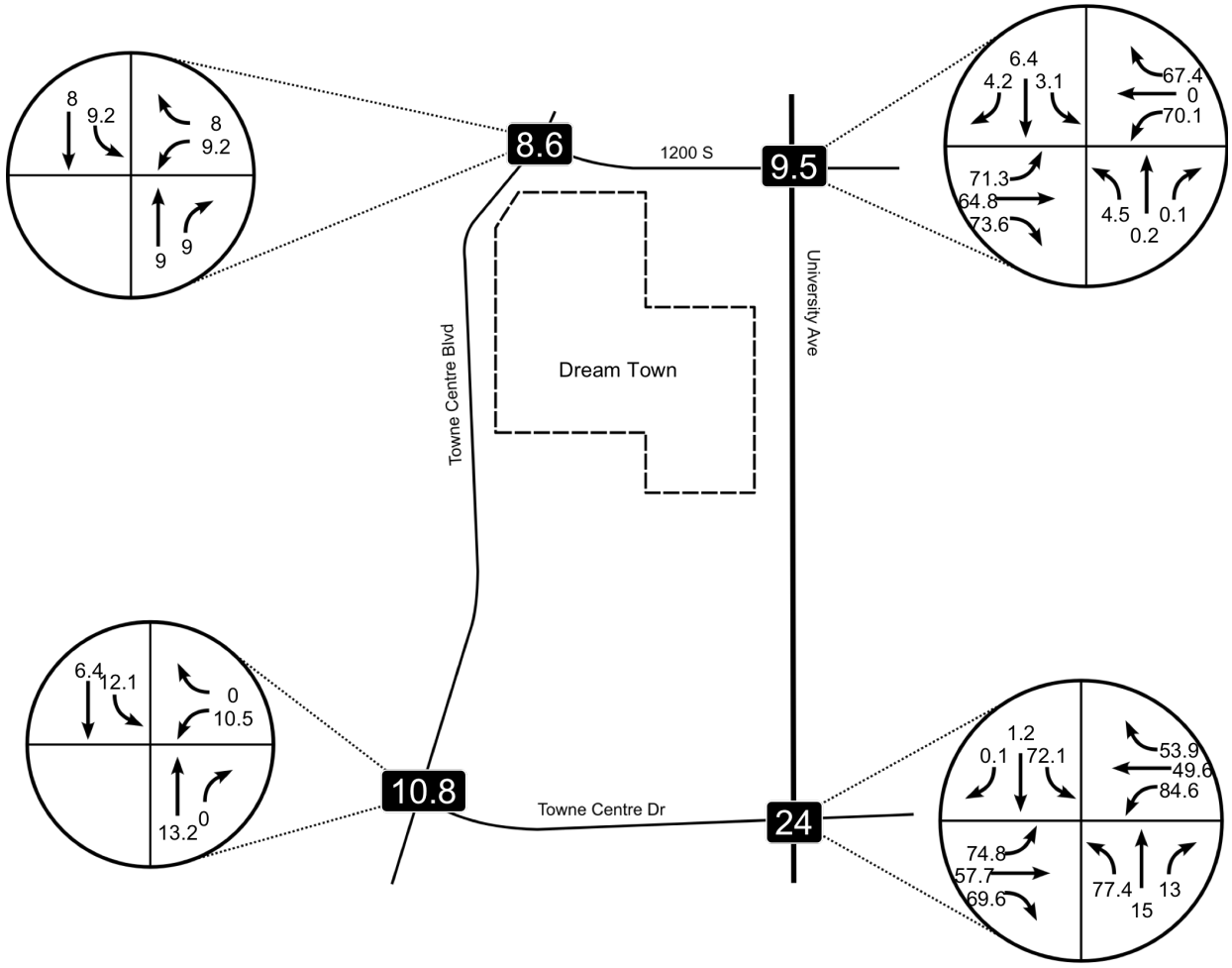

Figure 4.3: Results of existing Synchro LOS analysis for each movement and intersection studied: control delay values.

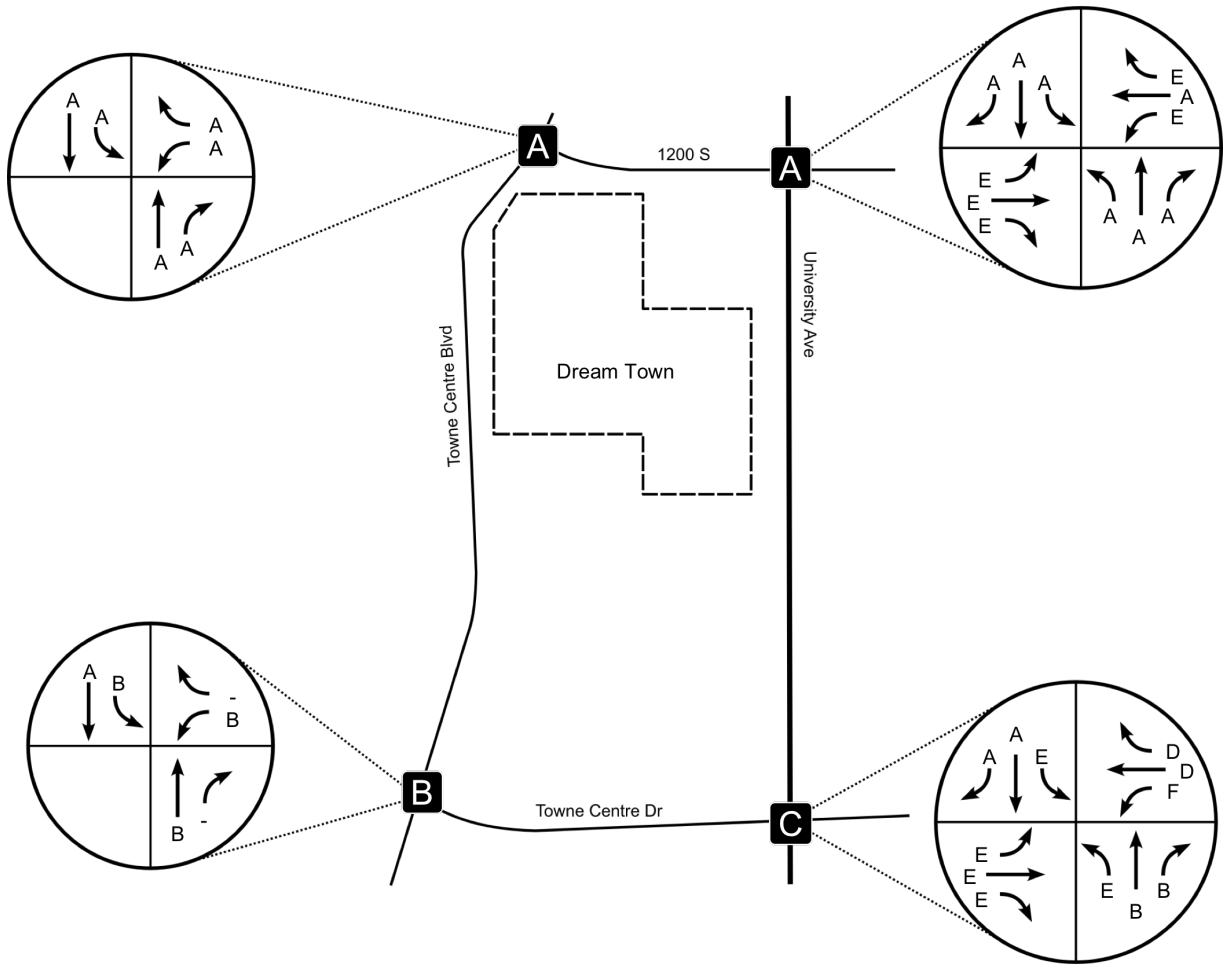

Figure 4.4: Results of existing Synchro LOS analysis for each movement and intersection studied: level of service.

It is unsurprising that the Towne Centre Blvd. intersections perform so well, since the traffic volumes at these intersections are relatively low (see Figure 4.2). It also makes sense that the through and right-turn movements on University Ave. perform well, as this is a major arterial and these movements have relatively long phase lengths (see Appendix B). The EB and WB movements at the University Ave. intersections, however, generally perform much worse. This is for the same reason: the phase lengths on these movements are significantly

shorter compared to the conflicting phase lengths. However, these movements do not have an enormous impact on the overall intersection delay(s), as the volumes are much lower than those *on* University Ave.

The overall LOS is generally good, though there are several movements with worse than LOS D (generally acceptable conditions) performance. However, these are relatively minor movements, and the intersections themselves perform much better, so this is not too much cause for concern. It is possible that something as simple as a change in signal timings may do much to improve these under-performing movements. However, further analysis into the coordination of signals on University Ave. is warranted before implementing any signal timing changes.

TRANSPORTATION SAFETY

As part of the analysis for this proposed development, a crash analysis was performed for University Ave. near the site. Recent crash data (obtained from \acr{UDOT} for 2019--2022) was used, and crashes between mileposts 0.5 and 1.0 were included in the analysis. This includes the intersections of University Ave. with both Towne Center Dr. and 1200 South, as well as the roadway segments between and either side of the intersections. Crashes occurring within 0.05 miles of an intersection are considered as "belonging" to that intersection, and all other crashes are counted on their respective roadway segments.

Equation 4.1 gives the crash rate of an intersection, and Equation 4.2 gives the crash rate of a segment, where AADT is average annual daily traffic, MEV is million entering vehicles, and MVMT is million vehicle-miles traveled. The AADT was provided by UDOT for this stretch of University Ave., and is given as 30550 vehicles per day.

$$Crash\ Rate_{Intersection} = \frac{1000000 \times crashes}{365.25 \times years \times AADT}\ \text{crashes per MEV} \qquad (4.1)$$

$$Crash\ Rate_{Segment} = \frac{1000000 \times crashes}{365.25 \times years \times AADT \times length}\ \text{crashes per MVMT} \qquad (4.2)$$

Table 4 provides the two intersections and their crash rates, and Table 5 provides the crash rates on each segment of the roadway (as calculated by Equations 4.1 and 4.2).

Table 4: *University Ave. Crash Rates (Intersections)*

Intersection	Milepost	Number of Crashes	Crash Rate (per MEV)
Towne Center Blvd.	0.66	11	0.33
1200 South	0.82	24	0.72

Table 5: *University Ave. Crash Rates (Segments)*

Intersection	Milepost Start	Milepost End	Segment Length	Number of Crashes	Crash Rate (per MVMT)
–Towne Center Blvd.	0.50	0.61	0.11	21	5.70
Towne Center Blvd.–1200 South	0.71	0.77	0.06	6	2.99
1200 South–	0.87	1.00	0.13	19	4.37

For the purposes of this assignment, the critical crash rate for intersection analysis is assumed to be 2 crashes per MEV, and the critical crash rate for the roadway segment analysis is assumed to be 8 crashes per MVMT. None of the crash rates approach these values, and so this roadway segment is deemed to be safe. However, it is also important to examine the severity of the crashes. Table 6 provides the UDOT crash severity scale, and Table 7 gives the number and proportion of crashes at each level. From Table 7 it is clear that the vast majority of crashes are Property damage only (PDO) crashes, with around 10% with confirmed injury and none fatal. This gives further evidence for the safety of the roadway corridor.

Table 6: *Crash Severity Levels (UDOT)*

Crash Severity Level	Description
5	Fatal
4	Incapacitating Injury
3	Non-incapacitating Injury
2	Possible Injury
1	Property Damage Only

Table 7: *Crashes by Severity*

Crash Severity Level	Description	Number of Crashes	Proportion of Crashes
5	Fatal	0	0.000
4	Incapacitating Injury	2	0.025
3	Non-incapacitating Injury	7	0.086
2	Possible Injury	14	0.173
1	Property Damage Only	58	0.716

5. PROJECTED TRAFFIC

Part of this analysis involves determining the number of trips that are expected to visit the site. This includes trips made with the express purpose of visiting a location in the development, as well as "pass-by" trips where the ultimate destination is somewhere else. Each of the separate land uses has distinct baseline trip rates, as well as different parameters for adjusting these rates to obtain final projected trips.

TRIP GENERATION

ITE provides several resources for estimating trip generation of new developments. The primary of these is the Trip Generation Manual (Institute of Transportation Engineers 2021), but these baseline trip generation rates do not account for trips internal to the site, or for "pass-by" trips. The following section discusses the baseline ITE-provided trip rates along with the trip reductions due to these factors. Table 11 provides the trip rates after the reductions.

Base Trip Generation

The initial estimates for trip generation are given from the ITE Trip Generation Manual. For this report, only an analysis of the weekday PM peak period is performed, due to the scope of the assignment. Table 8 gives the baseline trip generation as provided by the Manual. These initial estimates seem reasonable, noting that these are the trips in the peak hour. See Appendix C for the Manual references used in these calculations.

Table 8: *ITE Trip Generation (Baseline)*

Description	Pad	ITE Land Use Code	Variable Value	Variable Unit	Trip Generation Equation	Entering Trips	Exiting Trips	Total Trips
Sit-Down Restaurant	A	932	8	1000 ft²	$T = 9.05 \times x$	44	28	72
General Office Building	B	710	18	1000 ft²	$\ln(T) = 0.83 \times \ln(x) + 1.29$	7	33	40
Hardware/ Paint Store	B	816	18	1000 ft²	$T = 2.98 \times x$	25	29	54

Multi-use Reduction

Since these land uses share a development site, a multi-use trip reduction may be applied. This accounts for trips that are made from one location in the development site to another, and thus do not use the adjacent roadways. Information on the multi-use capture rates was obtained from the ITE Trip Generation Handbook (Institute of Transportation Engineers 2014), and the relevant information is summarized in Table 9. The reduced trip rates are given in Table 10, and Appendix C contains more detailed calculations.

Table 9: ITE Multi-use Capture Rates

Trip Movement	Capture Rate
From Office to Retail	23%
From Retail to Office	3%
To Office from Retail	31%
To Retail from Office	2%

Table 10: Trips After Multi-use Reduction

Description	ITE Land Use Code	Entering Trips	Exiting Trips	Total Trips
Sit-Down Restaurant	932	44	28	72
General Office Building	710	6	32	38
Hardware/Paint Store	816	24	28	52

Pass-by Reduction

The ITE Trip Generation Manual also provides information on pass-by trip reductions. These indicate trips that otherwise would have passed the development, and are "stopping by" the site rather than making a dedicated "new" trip to the site. Two of the proposed land uses—the restaurant and the hardware store—are given pass-by reduction rates of 43% and 26%, respectively. The office land use has no pass-by reduction, which is logical as most office trips would be for employment and not leisure. Table 11 presents the new calculated trips after these reductions.

Table 11: Trips After Pass-by Reduction

Description	ITE Land Use Code	Pass-by Reduction Rate	Entering Trips	Exiting Trips	Total Trips
Sit-Down Restaurant	932	0.43	25	16	41
General Office Building	710	0.00	6	32	38
Hardware/Paint Store	816	0.26	18	21	39

REFERENCES

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APPENDIX A. SYNCHRO LOS ANALYSIS (EXISTING)

This appendix contains the results of the Synchro LOS analysis for the existing road volumes, signal timings, and lane configurations. The analysis of the AWSC 1200 South / Towne Centre Blvd intersection is given first, followed by the analysis for the remaining (signalized) intersections.

Intersection	
Intersection Delay, s/veh	8.6
Intersection LOS	A

Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Traffic Vol, veh/h	60	83	83	55	82	50
Future Vol, veh/h	60	83	83	55	82	50
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Heavy Vehicles, %	2	2	2	2	2	2
Mvmt Flow	65	90	90	60	89	54
Number of Lanes	1	1	1	0	1	2

Approach	WB	NB	SB
Opposing Approach		SB	NB
Opposing Lanes	0	3	1
Conflicting Approach Left	NB		WB
Conflicting Lanes Left	1	0	2
Conflicting Approach Right	SB	WB	
Conflicting Lanes Right	3	2	0
HCM Control Delay	8.5	9	8.4
HCM LOS	A	A	A

Lane	NBLn1	WBLn1	WBLn2	SBLn1	SBLn2	SBLn3
Vol Left, %	0%	100%	0%	100%	0%	0%
Vol Thru, %	60%	0%	0%	0%	100%	100%
Vol Right, %	40%	0%	100%	0%	0%	0%
Sign Control	Stop	Stop	Stop	Stop	Stop	Stop
Traffic Vol by Lane	138	60	83	82	25	25
LT Vol	0	60	0	82	0	0
Through Vol	83	0	0	0	25	25
RT Vol	55	0	83	0	0	0
Lane Flow Rate	150	65	90	89	27	27
Geometry Grp	8	8	8	7	7	7
Degree of Util (X)	0.208	0.105	0.116	0.138	0.038	0.025
Departure Headway (Hd)	4.986	5.818	4.615	5.569	5.066	3.324
Convergence, Y/N	Yes	Yes	Yes	Yes	Yes	Yes
Cap	720	616	776	644	707	1074
Service Time	2.719	3.553	2.35	3.298	2.795	1.052
HCM Lane V/C Ratio	0.208	0.106	0.116	0.138	0.038	0.025
HCM Control Delay	9	9.2	8	9.2	8	6.1
HCM Lane LOS	A	A	A	A	A	A
HCM 95th-tile Q	0.8	0.4	0.4	0.5	0.1	0.1

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	32	17	92	60	25	29	54	988	43	48	1608	63
Future Volume (veh/h)	32	17	92	60	25	29	54	988	43	48	1608	63
Initial Q (Qb), veh	0	0	0	0	0	0	0	0	0	0	0	0
Ped-Bike Adj(A_pbT)	1.00		1.00	1.00		1.00	1.00		1.00	1.00		1.00
Parking Bus, Adj	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Work Zone On Approach		No			No			No			No	
Adj Sat Flow, veh/h/ln	1870	1870	1870	1870	1870	1870	1870	1870	1870	1870	1870	1870
Adj Flow Rate, veh/h	35	18	100	65	27	32	59	1074	47	52	1748	68
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Percent Heavy Veh, %	2	2	2	2	2	2	2	2	2	2	2	2
Cap, veh/h	105	143	121	128	54	69	270	3936	1222	487	3931	1220
Arrive On Green	0.08	0.08	0.08	0.08	0.08	0.08	0.06	1.00	1.00	0.03	0.77	0.77
Sat Flow, veh/h	1344	1870	1585	1074	710	903	1781	5106	1585	1781	5106	1585
Grp Volume(v), veh/h	35	18	100	69	0	55	59	1074	47	52	1748	68
Grp Sat Flow(s),veh/h/ln	1344	1870	1585	1147	0	1540	1781	1702	1585	1781	1702	1585
Q Serve(g_s), s	3.8	1.3	9.3	7.9	0.0	5.1	1.0	0.0	0.0	0.9	18.0	1.5
Cycle Q Clear(g_c), s	8.9	1.3	9.3	9.2	0.0	5.1	1.0	0.0	0.0	0.9	18.0	1.5
Prop In Lane	1.00		1.00	0.94		0.59	1.00		1.00	1.00		1.00
Lane Grp Cap(c), veh/h	105	143	121	134	0	118	270	3936	1222	487	3931	1220
V/C Ratio(X)	0.33	0.13	0.83	0.52	0.00	0.46	0.22	0.27	0.04	0.11	0.44	0.06
Avail Cap(c_a), veh/h	244	337	285	269	0	277	340	3936	1222	560	3931	1220
HCM Platoon Ratio	1.00	1.00	1.00	1.00	1.00	1.00	2.00	2.00	2.00	1.00	1.00	1.00
Upstream Filter(I)	1.00	1.00	1.00	1.00	0.00	1.00	0.96	0.96	0.96	1.00	1.00	1.00
Uniform Delay (d), s/veh	70.6	64.6	68.3	68.9	0.0	66.3	4.3	0.0	0.0	3.1	6.0	4.2
Incr Delay (d2), s/veh	0.7	0.1	5.3	1.1	0.0	1.1	0.1	0.2	0.1	0.0	0.4	0.1
Initial Q Delay(d3),s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
%ile BackOfQ(50%),veh/ln	1.4	0.7	4.0	2.7	0.0	2.1	0.3	0.1	0.0	0.3	5.9	0.5
Unsig. Movement Delay, s/veh												
LnGrp Delay(d),s/veh	71.3	64.8	73.6	70.1	0.0	67.4	4.5	0.2	0.1	3.1	6.4	4.2
LnGrp LOS	E	E	E	E	A	E	A	A	A	A	A	A
Approach Vol, veh/h		153			124			1180			1868	
Approach Delay, s/veh		72.0			68.9			0.4			6.2	
Approach LOS		E			E			A			A	

Timer - Assigned Phs	1	2		4	5	6		8				
Phs Duration (G+Y+Rc), s	8.9	121.6		19.5	9.1	121.5		19.5				
Change Period (Y+Rc), s	4.5	6.0		8.0	4.5	6.0		8.0				
Max Green Setting (Gmax), s	10.5	94.0		27.0	10.5	94.0		27.0				
Max Q Clear Time (g_c+I1), s	2.9	2.0		11.3	3.0	20.0		11.2				
Green Ext Time (p_c), s	0.0	3.6		0.1	0.0	7.4		0.2				

Intersection Summary	
HCM 6th Ctrl Delay	9.5
HCM 6th LOS	A

Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Traffic Volume (veh/h)	224	148	22	191	92	22
Future Volume (veh/h)	224	148	22	191	92	22
Initial Q (Qb), veh	0	0	0	0	0	0
Ped-Bike Adj(A_pbT)	1.00	1.00		1.00	1.00	
Parking Bus, Adj	1.00	1.00	1.00	1.00	1.00	1.00
Work Zone On Approach	No		No			No
Adj Sat Flow, veh/h/ln	1870	1870	1870	1870	1870	1870
Adj Flow Rate, veh/h	243	0	24	0	100	24
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Percent Heavy Veh, %	2	2	2	2	2	2
Cap, veh/h	611		104		332	1167
Arrive On Green	0.18	0.00	0.06	0.00	0.10	0.33
Sat Flow, veh/h	3456	1585	1870	1585	3456	3647
Grp Volume(v), veh/h	243	0	24	0	100	24
Grp Sat Flow(s),veh/h/ln	1728	1585	1870	1585	1728	1777
Q Serve(g_s), s	1.8	0.0	0.3	0.0	0.8	0.1
Cycle Q Clear(g_c), s	1.8	0.0	0.3	0.0	0.8	0.1
Prop In Lane	1.00	1.00		1.00	1.00	
Lane Grp Cap(c), veh/h	611		104		332	1167
V/C Ratio(X)	0.40		0.23		0.30	0.02
Avail Cap(c_a), veh/h	2687		1587		2443	3015
HCM Platoon Ratio	1.00	1.00	1.00	1.00	1.00	1.00
Upstream Filter(I)	1.00	0.00	1.00	0.00	1.00	1.00
Uniform Delay (d), s/veh	10.3	0.0	12.8	0.0	11.9	6.4
Incr Delay (d2), s/veh	0.2	0.0	0.4	0.0	0.2	0.0
Initial Q Delay(d3),s/veh	0.0	0.0	0.0	0.0	0.0	0.0
%ile BackOfQ(50%),veh/ln	0.5	0.0	0.1	0.0	0.2	0.0
Unsig. Movement Delay, s/veh						
LnGrp Delay(d),s/veh	10.5	0.0	13.2	0.0	12.1	6.4
LnGrp LOS	B		B		B	A
Approach Vol, veh/h	243		24			124
Approach Delay, s/veh	10.5		13.2			11.0
Approach LOS	B		B			B

Timer - Assigned Phs	1	2		4		6
Phs Duration (G+Y+Rc), s	7.7	7.6		13.0		15.3
Change Period (Y+Rc), s	5.0	6.0		8.0		6.0
Max Green Setting (Gmax), s	20.0	24.0		22.0		24.0
Max Q Clear Time (g_c+I1), s	2.8	2.3		3.8		2.1
Green Ext Time (p_c), s	0.1	0.0		0.4		0.0

Intersection Summary	
HCM 6th Ctrl Delay	10.8
HCM 6th LOS	B

Notes

Unsignalized Delay for [NBR, WBR] is excluded from calculations of the approach delay and intersection delay.

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	48	57	171	252	83	140	242	907	102	57	1692	57
Future Volume (veh/h)	48	57	171	252	83	140	242	907	102	57	1692	57
Initial Q (Qb), veh	0	0	0	0	0	0	0	0	0	0	0	0
Ped-Bike Adj(A_pbT)	1.00		1.00	1.00		1.00	1.00		1.00	1.00		1.00
Parking Bus, Adj	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Work Zone On Approach		No			No			No			No	
Adj Sat Flow, veh/h/ln	1870	1870	1870	1870	1870	1870	1870	1870	1870	1870	1870	1870
Adj Flow Rate, veh/h	52	62	186	274	90	152	263	986	111	62	1839	62
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Percent Heavy Veh, %	2	2	2	2	2	2	2	2	2	2	2	2
Cap, veh/h	87	465	207	317	702	313	307	3075	955	99	2768	859
Arrive On Green	0.03	0.13	0.13	0.09	0.20	0.20	0.09	0.60	0.60	0.06	1.00	1.00
Sat Flow, veh/h	3456	3554	1585	3456	3554	1585	3456	5106	1585	3456	5106	1585
Grp Volume(v), veh/h	52	62	186	274	90	152	263	986	111	62	1839	62
Grp Sat Flow(s),veh/h/ln	1728	1777	1585	1728	1777	1585	1728	1702	1585	1728	1702	1585
Q Serve(g_s), s	2.2	2.3	17.3	11.7	3.1	12.8	11.3	14.3	4.5	2.6	0.0	0.0
Cycle Q Clear(g_c), s	2.2	2.3	17.3	11.7	3.1	12.8	11.3	14.3	4.5	2.6	0.0	0.0
Prop In Lane	1.00		1.00	1.00		1.00	1.00		1.00	1.00		1.00
Lane Grp Cap(c), veh/h	87	465	207	317	702	313	307	3075	955	99	2768	859
V/C Ratio(X)	0.60	0.13	0.90	0.86	0.13	0.49	0.86	0.32	0.12	0.63	0.66	0.07
Avail Cap(c_a), veh/h	346	877	391	346	877	391	415	3075	955	415	2768	859
HCM Platoon Ratio	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	2.00	2.00	2.00
Upstream Filter(I)	0.99	0.99	0.99	1.00	1.00	1.00	1.00	1.00	1.00	0.90	0.90	0.90
Uniform Delay (d), s/veh	72.4	57.7	64.2	67.2	49.6	53.4	67.4	14.7	12.8	69.9	0.0	0.0
Incr Delay (d2), s/veh	2.4	0.0	5.4	17.4	0.0	0.4	10.0	0.3	0.2	2.2	1.2	0.1
Initial Q Delay(d3),s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
%ile BackOfQ(50%),veh/ln	1.0	1.1	7.4	6.0	1.4	5.2	5.4	5.6	1.7	1.2	0.3	0.0
Unsig. Movement Delay, s/veh												
LnGrp Delay(d),s/veh	74.8	57.7	69.6	84.6	49.6	53.9	77.4	15.0	13.0	72.1	1.2	0.1
LnGrp LOS	E	E	E	F	D	D	E	B	B	E	A	A
Approach Vol, veh/h		300			516			1360			1963	
Approach Delay, s/veh		68.0			69.5			26.9			3.4	
Approach LOS		E			E			C			A	

Timer - Assigned Phs	1	2	3	4	5	6	7	8
Phs Duration (G+Y+Rc), s	9.3	96.3	18.8	25.6	18.3	87.3	8.8	35.6
Change Period (Y+Rc), s	5.0	6.0	5.0	6.0	5.0	6.0	5.0	6.0
Max Green Setting (Gmax), s	18.0	58.0	15.0	37.0	18.0	58.0	15.0	37.0
Max Q Clear Time (g_c+I1), s	4.6	16.3	13.7	19.3	13.3	2.0	4.2	14.8
Green Ext Time (p_c), s	0.0	3.7	0.0	0.3	0.1	9.3	0.0	0.3

Intersection Summary	
HCM 6th Ctrl Delay	24.0
HCM 6th LOS	C

APPENDIX B. SIGNALIZED INTERSECTION SIGNAL TIMINGS

This appendix provides signal timings for the three signalized intersections in the study area (University Ave. / 1200 South, University Ave. / Towne Center Dr. (East Bay Blvd.), and Towne Center Blvd. / Towne Center Dr.). It is worth noting that Phases 1/5, 2/6, 3/7, and 4/8 are active simultaneously (in pairs), and the non–left-turn phases include both the through and right-turn movements.

MAX VIEW TIMING

TRAFFIC SIGNAL TIMING PARAMETERS

Number #: 6403 Current Date: 1/24/2020

Intersection: University Ave & 1200 S

	Phase 1	Phase 2	Phase 3	Phase 4	Phase 5	Phase 6	Phase 7	Phase 8
Direction	SBLT	NB	WBLT	EB	NBLT	SB	EBLT	WB
Min Green	5	15	0	5	5	15	0	5
Bike Green	0	0	0	0	0	0	0	0
Walk I	0	6	0	4	0	6	0	4
Walk II	0	0	0	0	0	0	0	0
Ped Clr	0	10	0	23	0	13	0	21
Veh Ext	2.0	1.2	0.0	0.9	2.0	1.2	0.0	0.9
Max I	25	45	0	25	25	45	0	25
Max II	0	0	0	0	0	0	0	0
Max III	0	0	0	0	0	0	0	0
Yellow	3.0	4.0	3.0	4.0	3.0	4.0	3.0	4.0
Red Clear	1.5	2.0	1.5	4.0	1.5	2.0	1.5	4.0
Min Recall	.	X	.	.	.	X	.	.
Max Recall	.	.	.	.	.	.	.	.
Ped Recall	.	.	.	.	.	.	.	.
Dual Entry	.	X	.	X	.	X	.	X

MAX VIEW TIMING

TRAFFIC SIGNAL TIMING PARAMETERS

Number #: 6402 Current Date: 1/24/2020

Intersection: University Ave & East Bay Blvd

	Phase 1	Phase 2	Phase 3	Phase 4	Phase 5	Phase 6	Phase 7	Phase 8
Direction	SBLT	NB	WBLT	EB	NBLT	SB	EBLT	WB
Min Green	4	10	4	6	4	10	4	6
Bike Green	0	0	0	0	0	0	0	0
Walk I	0	4	0	4	0	4	0	4
Walk II	0	0	0	0	0	0	0	0
Ped Clr	0	23	0	26	0	22	0	26
Veh Ext	0.6	1.4	0.6	1.2	0.6	1.4	0.6	1.2
Max I	30	60	30	35	30	60	30	35
Max II	0	0	0	0	0	0	0	0
Max III	0	0	0	0	0	0	0	0
Yellow	3.0	4.0	3.0	4.0	3.0	4.0	3.0	4.0
Red Clear	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0
Min Recall	.	X	.	.	.	X	.	.
Max Recall	.	.	.	.	.	.	.	.
Ped Recall	.	.	.	.	.	.	.	.
Dual Entry	.	X	.	X	.	X	.	X

MAX VIEW TIMING

TRAFFIC SIGNAL TIMING PARAMETERS

Number #: 6655 Current Date: 1/24/2020

Intersection: Town Center Dr & Town Center Blvd

	Phase 1	Phase 2	Phase 3	Phase 4	Phase 5	Phase 6	Phase 7	Phase 8
Direction	SBLT	NB	.	WB	.	SB	.	.
Min Green	5	5	0	5	0	5	0	5
Bike Green	0	0	0	0	0	0	0	0
Walk I	0	0	0	4	0	0	0	4
Walk II	0	0	0	0	0	0	0	0
Ped Clr	0	0	0	10	0	0	0	12
Veh Ext	2.0	2.0	0.0	2.0	0.0	2.0	0.0	0.0
Max I	25	30	0	30	0	30	0	30
Max II	0	0	0	0	0	0	0	0
Max III	0	0	0	0	0	0	0	0
Yellow	3.0	4.0	3.0	4.0	3.0	4.0	3.0	4.0
Red Clear	2.0	2.0	2.0	4.0	2.0	2.0	2.0	2.0
Min Recall	.	.	.	X	.	.	.	.
Max Recall	.	.	.	.	.	.	.	.
Ped Recall	.	.	.	.	.	.	.	.
Dual Entry	.	X	.	X	.	X	.	X

APPENDIX C. ITE TRIP GENERATION REFERENCE

This appendix contains the ITE Trip Generation Manual references used for trip generation, including to determine the appropriate study level for this TIA. These are land use codes 710 (General Office Building), 816 (Hardware/Paint Store), and 932 (High-Turnover (Sit-Down) Restaurant), for both the daily trips and the PM peak trips. It also contains a diagram of the multi-use trip reduction.

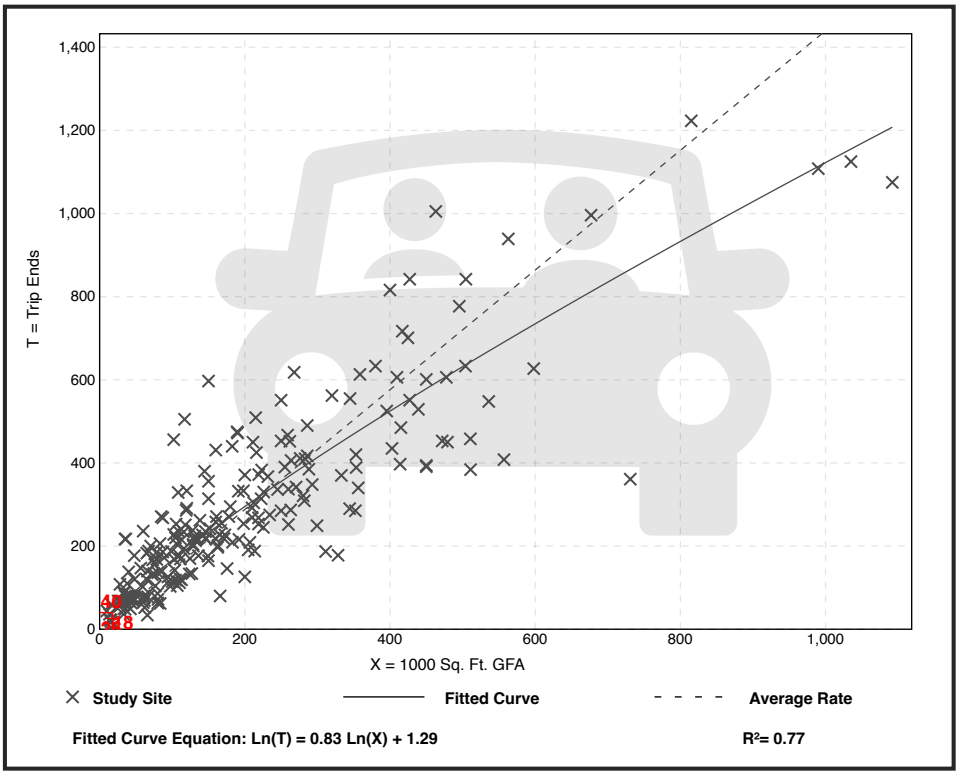
General Office Building
(710)

Vehicle Trip Ends vs: **1000 Sq. Ft. GFA**
On a: **Weekday,**
Peak Hour of Adjacent Street Traffic,
One Hour Between 4 and 6 p.m.
Setting/Location: **General Urban/Suburban**
Number of Studies: 232
Avg. 1000 Sq. Ft. GFA: 199
Directional Distribution: 17% entering, 83% exiting

Vehicle Trip Generation per 1000 Sq. Ft. GFA

Average Rate	Range of Rates	Standard Deviation
1.44	0.26 - 6.20	0.60

Data Plot and Equation



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General Office Building
(710)

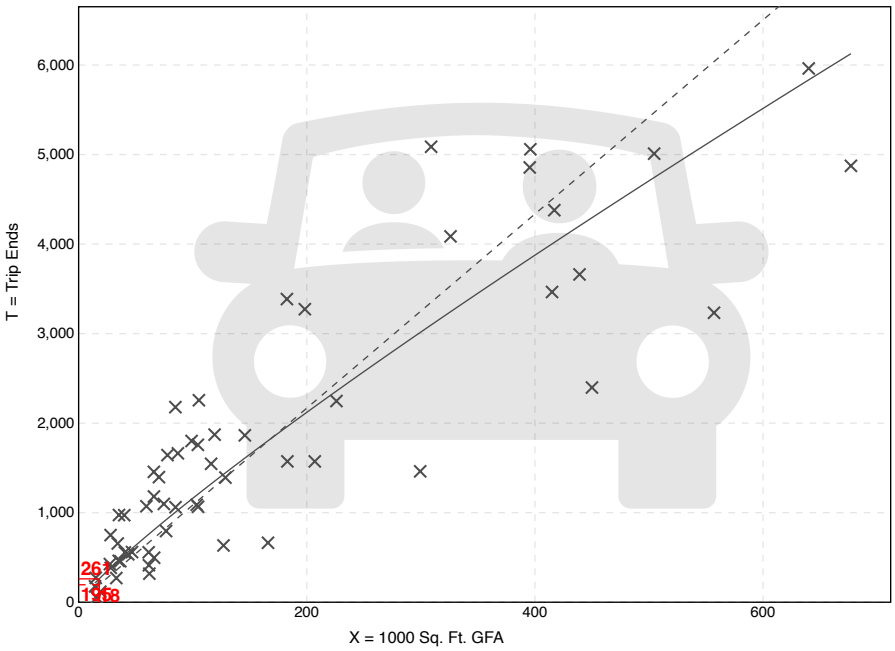
Vehicle Trip Ends vs: **1000 Sq. Ft. GFA**
On a: **Weekday**

Setting/Location: **General Urban/Suburban**
Number of Studies: 59
Avg. 1000 Sq. Ft. GFA: 163
Directional Distribution: 50% entering, 50% exiting

Vehicle Trip Generation per 1000 Sq. Ft. GFA

Average Rate	Range of Rates	Standard Deviation
10.84	3.27 - 27.56	4.76

Data Plot and Equation



Fitted Curve Equation: Ln(T) = 0.87 Ln(X) + 3.05

R^2= 0.78

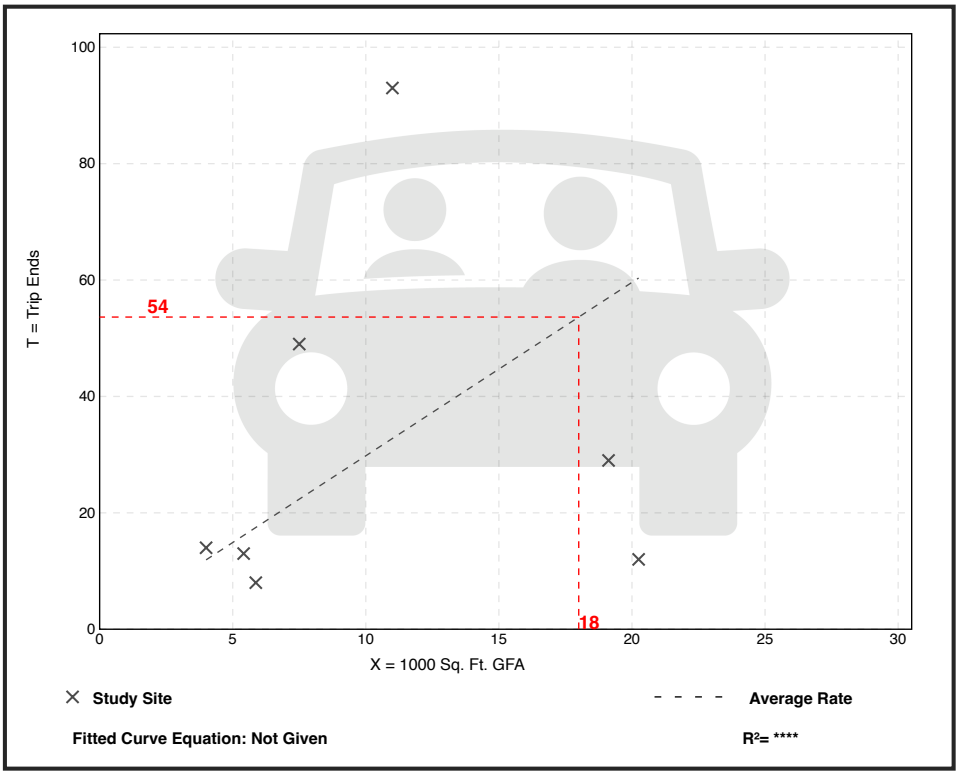
Hardware/Paint Store
(816)

Vehicle Trip Ends vs: **1000 Sq. Ft. GFA**
On a: **Weekday,**
Peak Hour of Adjacent Street Traffic,
One Hour Between 4 and 6 p.m.
Setting/Location: **General Urban/Suburban**
Number of Studies: 7
Avg. 1000 Sq. Ft. GFA: 10
Directional Distribution: 46% entering, 54% exiting

Vehicle Trip Generation per 1000 Sq. Ft. GFA

Average Rate	Range of Rates	Standard Deviation
2.98	0.59 - 8.45	3.09

Data Plot and Equation



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Hardware/Paint Store
(816)

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

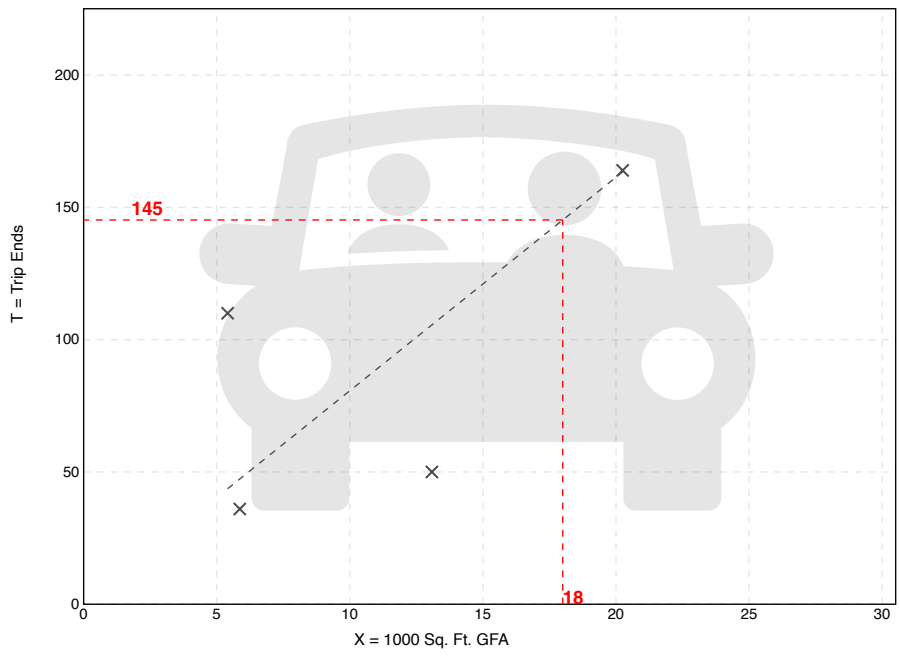
Setting/Location: **General Urban/Suburban**
Number of Studies: 4
Avg. 1000 Sq. Ft. GFA: 11
Directional Distribution: 50% entering, 50% exiting

Vehicle Trip Generation per 1000 Sq. Ft. GFA

Average Rate	Range of Rates	Standard Deviation
8.07	3.82 - 20.33	5.66

Data Plot and Equation

Caution – Small Sample Size



× **Study Site** - - - - **Average Rate**

Fitted Curve Equation: Not Given **R^2= ******

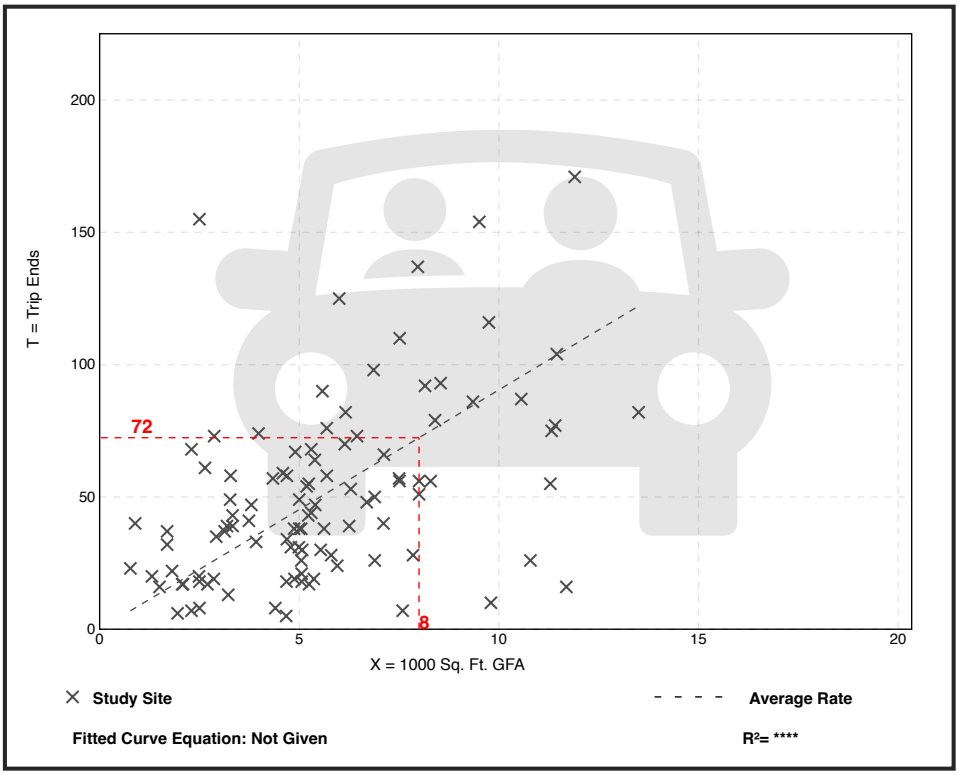
High-Turnover (Sit-Down) Restaurant
(932)

Vehicle Trip Ends vs: **1000 Sq. Ft. GFA**
On a: **Weekday,**
Peak Hour of Adjacent Street Traffic,
One Hour Between 4 and 6 p.m.
Setting/Location: **General Urban/Suburban**
Number of Studies: 104
Avg. 1000 Sq. Ft. GFA: 6
Directional Distribution: 61% entering, 39% exiting

Vehicle Trip Generation per 1000 Sq. Ft. GFA

Average Rate	Range of Rates	Standard Deviation
9.05	0.92 - 62.00	6.18

Data Plot and Equation



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High-Turnover (Sit-Down) Restaurant
(932)

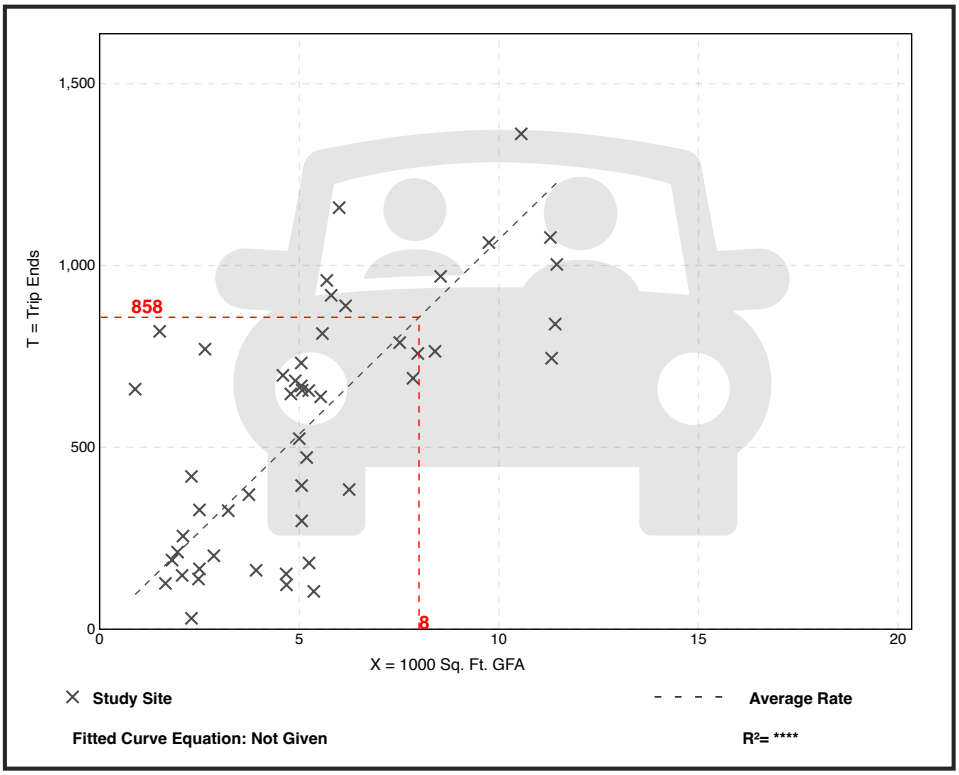
Vehicle Trip Ends vs: **1000 Sq. Ft. GFA**
On a: **Weekday**

Setting/Location: **General Urban/Suburban**
Number of Studies: 50
Avg. 1000 Sq. Ft. GFA: 5
Directional Distribution: 50% entering, 50% exiting

Vehicle Trip Generation per 1000 Sq. Ft. GFA

Average Rate	Range of Rates	Standard Deviation
107.20	13.04 - 742.41	66.72

Data Plot and Equation



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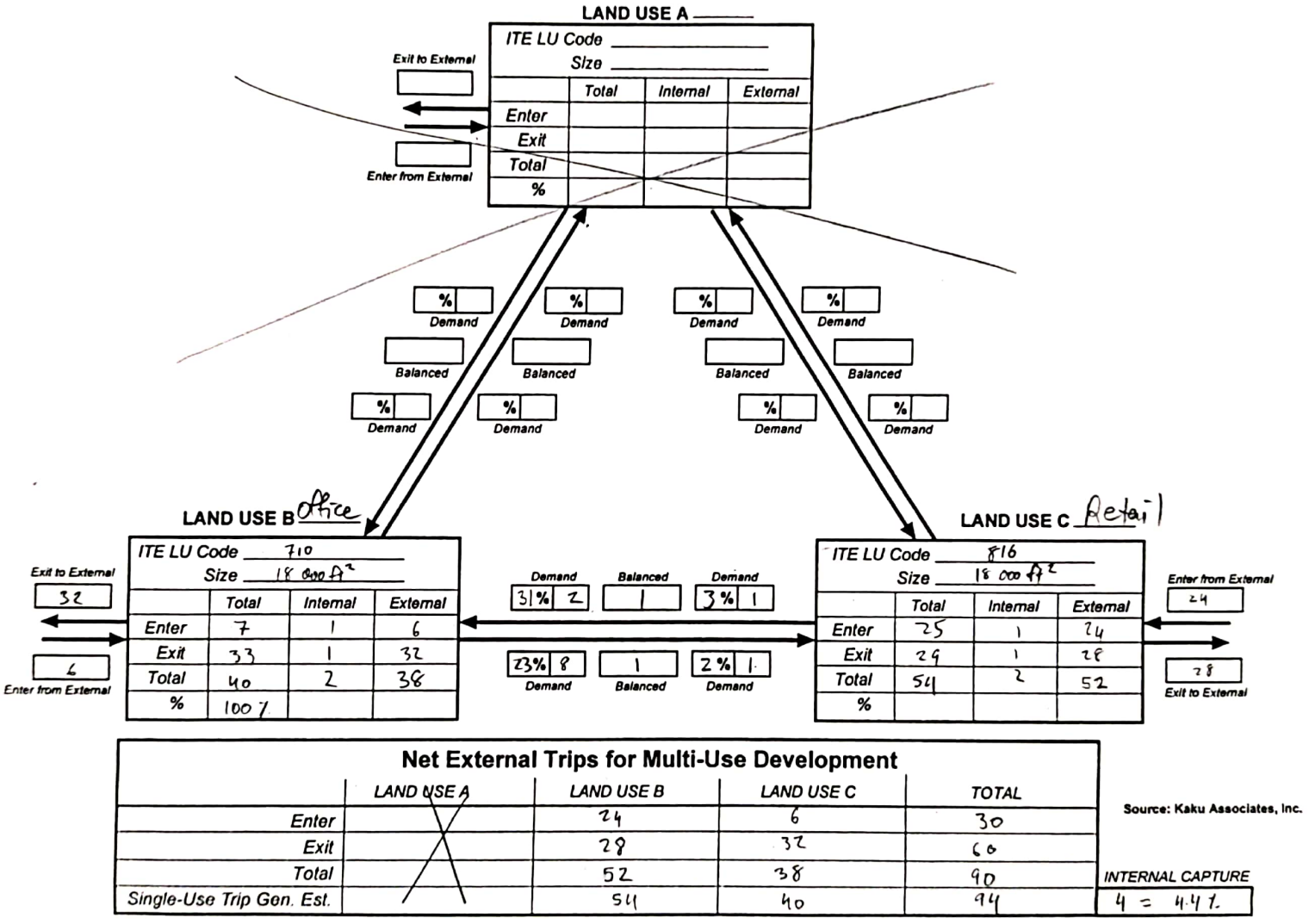
Analyst _____
Date _____

MULTI-USE DEVELOPMENT
TRIP GENERATION
AND INTERNAL CAPTURE SUMMARY

Name of Dvlpt _____
Time Period _____



Net External Trips for Multi-Use Development

	LAND USE A	LAND USE B	LAND USE C	TOTAL
Enter		24	6	30
Exit		28	32	60
Total		52	38	90
Single-Use Trip Gen. Est.		54	40	94

Source: Kaku Associates, Inc.

INTERNAL CAPTURE
4 = 4.4 %