TRAFFIC IMPACT STUDY

Proposed Development
Brooks Street & Trout Avenue
Norman, Oklahoma

Prepared for:

Inland American Communities Acquisitions, LLC

November 2014

Prepared by:

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TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

1.0 INTRODUCTION

Traffic Engineering Consultants, Inc. (TEC) was retained by Inland American Communities Acquisitions, L.L.C to perform a traffic impact study for a proposed multi-family residential development to be located in Norman, Oklahoma. The study was requested to determine the effects the proposed development would have on the adjacent street system, to review the available access to the development and to provide recommendations for improvements that may be necessary to accommodate the traffic expected to be generated by the development.

2.0 BACKGROUND

The site of the proposed development is located north of Brooks Street and east of Trout Avenue as shown in **Figure 1**. The development is proposed to include an apartment complex with 418 units. This location is currently occupied by the Bishop's Landing apartment complex which will be razed to make way for the construction of the proposed development.

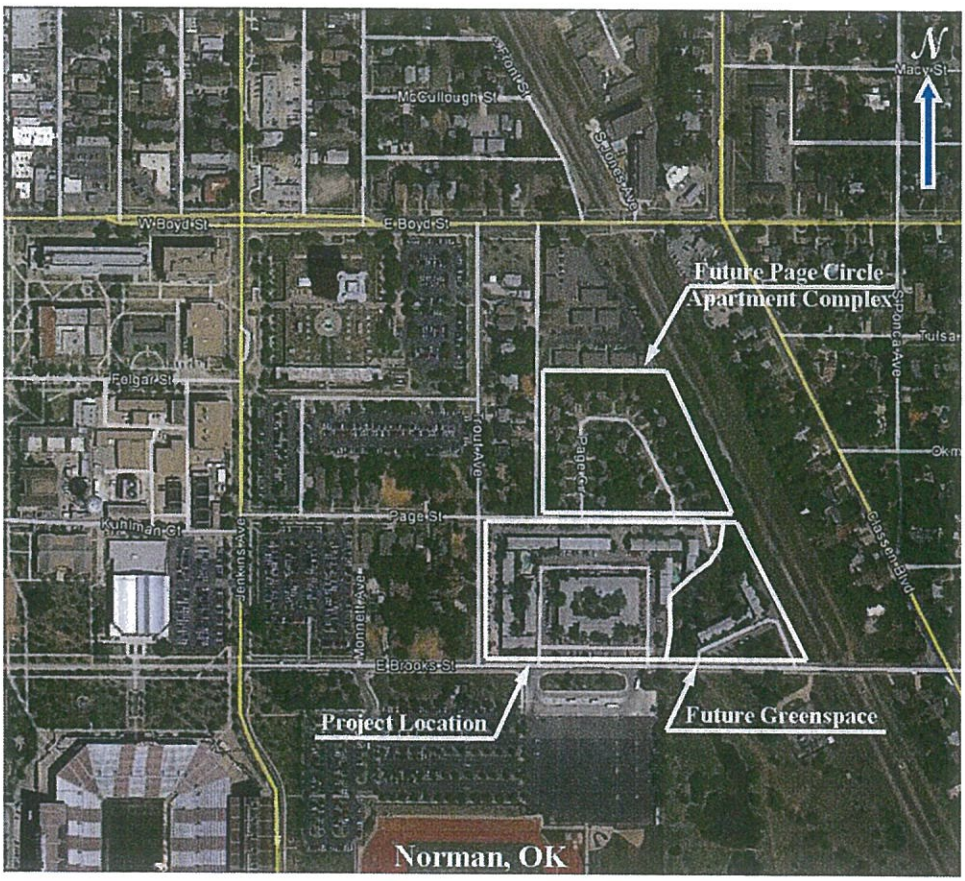

Figure 1 – General Location Map

Access to the new development, as shown in **Figure 2**, is proposed via one full-access driveway on Brooks Street and one full-access driveway on Page Street. The two driveways will both access a central parking garage. Brooks Street is a two lane east/west collector street. It has a posted speed limit of 25 mph and carries an approximate average daily traffic (ADT) of 4,700 vehicles per day (vpd) in the area. Trout Avenue is a two lane north/south local street with an approximate ADT of 2,400 vpd in the area. Page Street is a two lane east/west local street with an approximate ADT of 650 vpd in the area.

3.0 TRAFFIC DATA COLLECTION

Existing traffic volume data was collected adjacent to the proposed development in September of 2014. Peak hour turning movement volumes were collected at the intersections of Brooks Street and Classen Boulevard, Brooks Street and Trout Avenue, Page Street and Jenkins Avenue, Page Street and Trout Avenue and Trout Avenue and Boyd Street. The data was collected during the a.m. (7:00 to 9:00) and p.m. (4:00 to 6:00) peak hour periods while schools were in session to reflect the school traffic. Additionally, 24-hour traffic volume data was collected along Brooks Street, Trout Avenue and Page Street. The 2014 existing traffic is summarized in **Figure 3** and detailed printouts of all the traffic count data are included in the appendix.

The 2014 existing traffic data was utilized to determine the background traffic for 2017. The 2017 design period was selected as the year the development is projected to be completed. The background traffic was determined for the 2017 design year by applying an average annual growth rate of 1% to the 2014 existing traffic. The 1% annual growth rate was provided by the City of Norman and represents the typical annual growth in the area. The 2017 projected background traffic is summarized in **Figure 4**.

4.0 PROJECTED TRAFFIC

4.1 Future Development Traffic

A similar apartment complex is being proposed to be constructed directly north of the proposed development. The traffic generated by the future apartment complex is not reflected in the existing traffic data and, therefore, must be projected and included in the analyses to properly model future conditions.

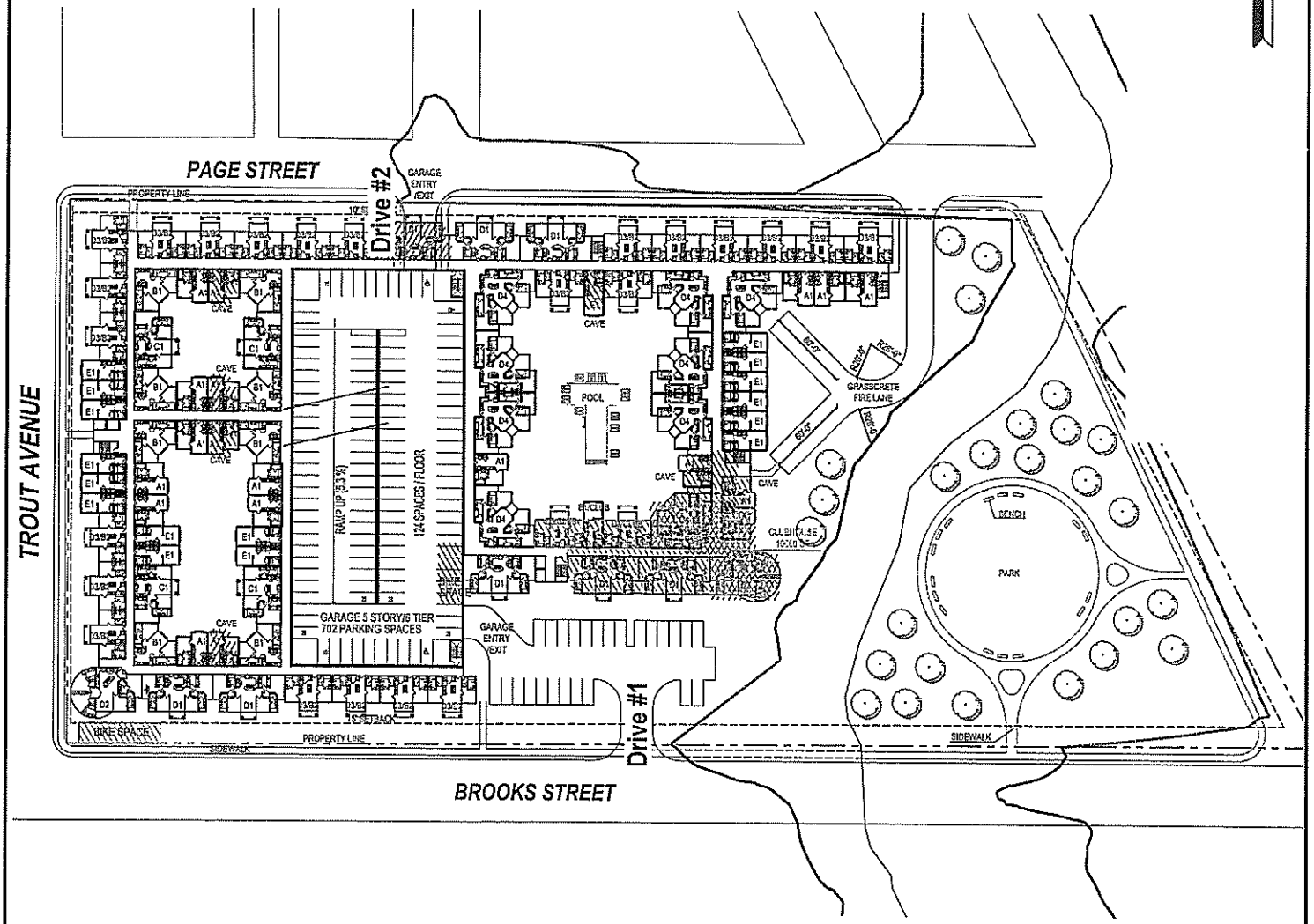

FIGURE 2. Proposed Site Plan

TEC
A CLEAR DIRECTION

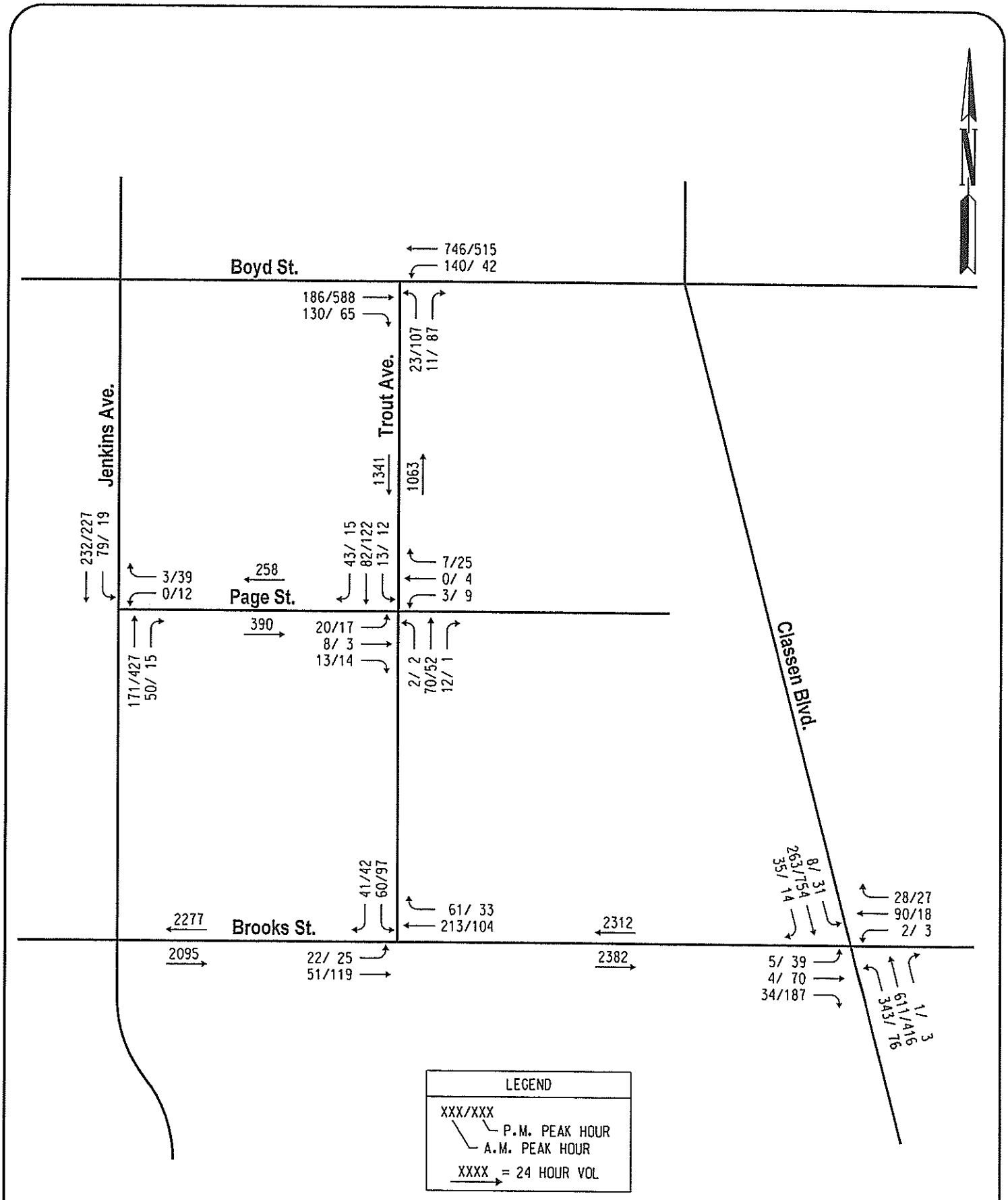

FIGURE 3. 2014 Existing Traffic

TEC
A CLEAR DIRECTION

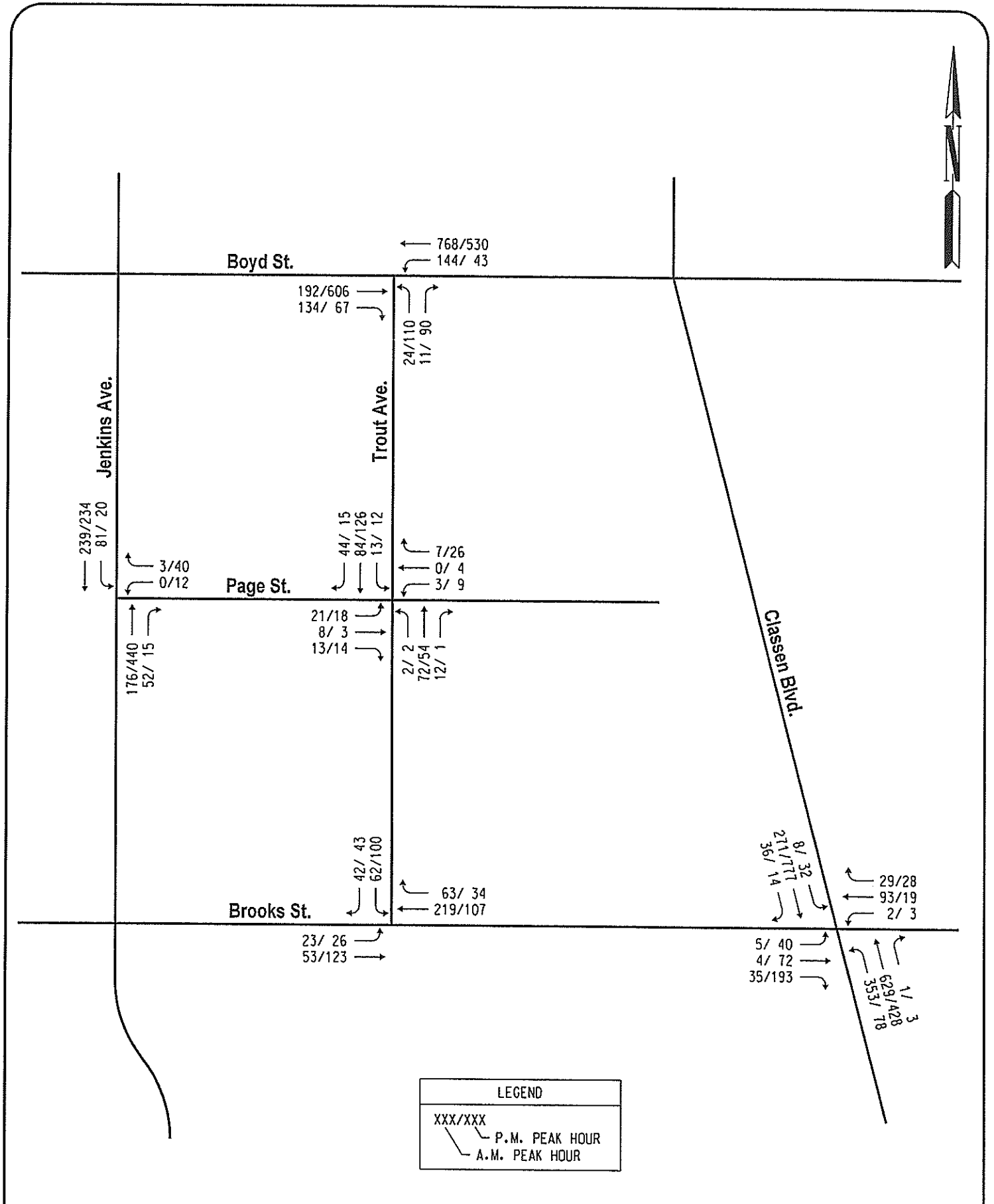

FIGURE 4. 2017 Projected Background Traffic

The resulting traffic volumes projected to be generated by the Page Circle apartment complex once fully developed are summarized in **Figure 5**. The future apartment complex traffic was then added to the 2017 projected background traffic and is summarized in **Figure 6**. This data is the base or background traffic to which the new development traffic was added for conducting the reviews and analyses.

4.2 Site Generated Traffic

To determine the effects a new development will have on an existing street system, the new or additional traffic must be projected. The latest edition of the *Trip Generation Manual*, published by the Institute of Transportation Engineers, was used to determine the amount of traffic the development is expected to generate. The report is a nationally accepted reference which provides trip rates for determining the traffic expected to be generated by different land use types.

The new apartment complex development will provide leasing opportunities to people of all ages and demographics, but due to the close proximity to the University of Oklahoma will greatly appeal to college students. Additionally, there are separate bike lanes along Brooks Street which connect to Norman's city wide bicycle network as well as a CART (Cleveland Area Rapid Transit) transfer station directly across the street which provides public transportation throughout Norman. It is believed that many of the future residents will not drive to and from campus or their destination, but rather walk, bike or take public transportation. Based on the specific type of occupant and the location of the development relative to the occupant's primary trip, the *Apartment* land use category does not accurately reflect the expected site generated traffic and, therefore, other trip rate data was required.

Upon the approval of the City of Norman staff, TEC located two very similar apartment complex developments located within close proximity to the Oklahoma State University campus located in Stillwater, Oklahoma. The two apartment developments have been recently constructed and are 100% occupied according to the management. TEC collected entering and exiting traffic volume data at each of these developments to determine trip rates for these specific types of developments. The results of the data, including the average values from both sites are summarized in **Table 1** and detailed printouts of all the traffic count data are included in the appendix.

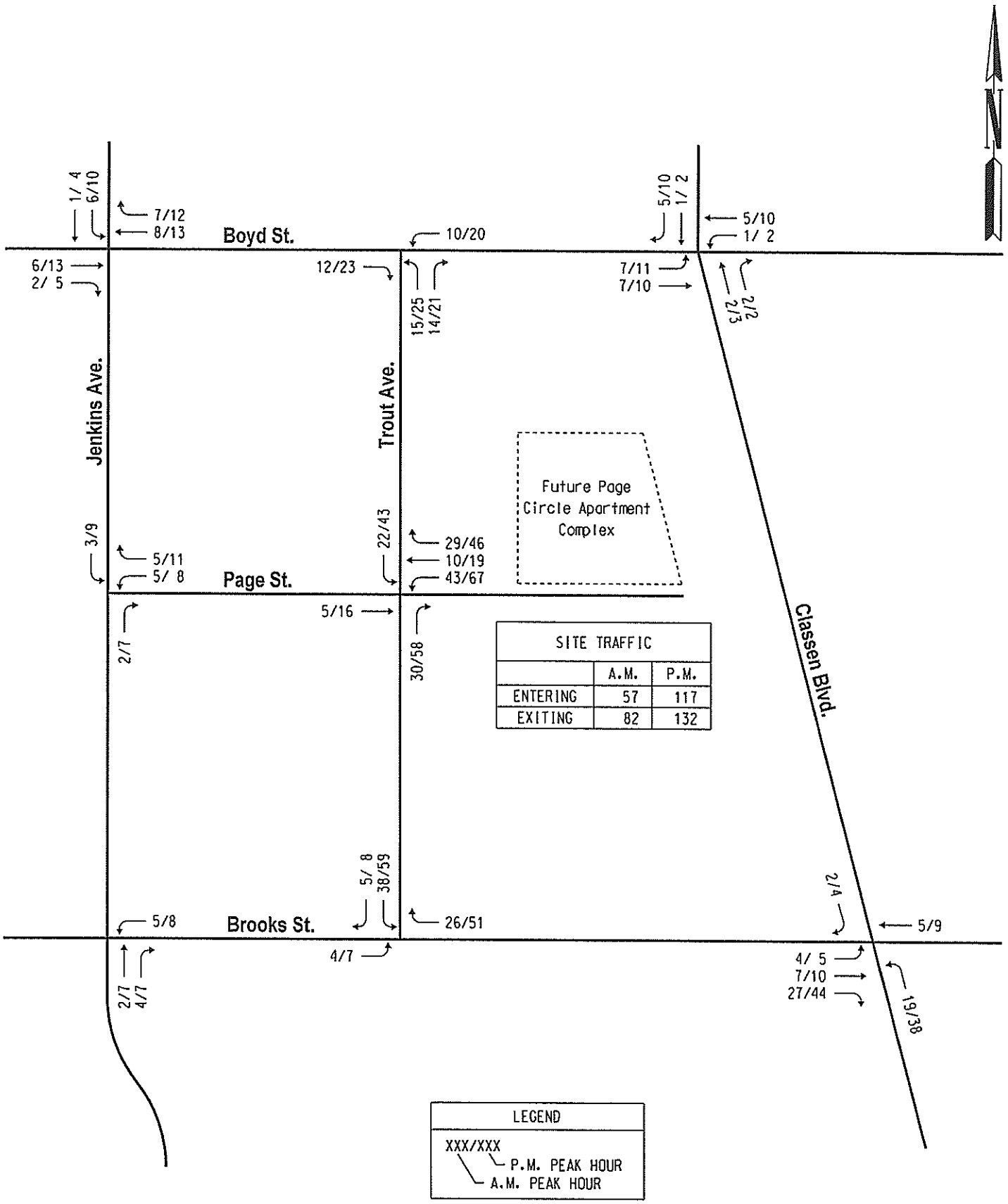

FIGURE 5. Projected Traffic for Future Page Circle Apartment Complex

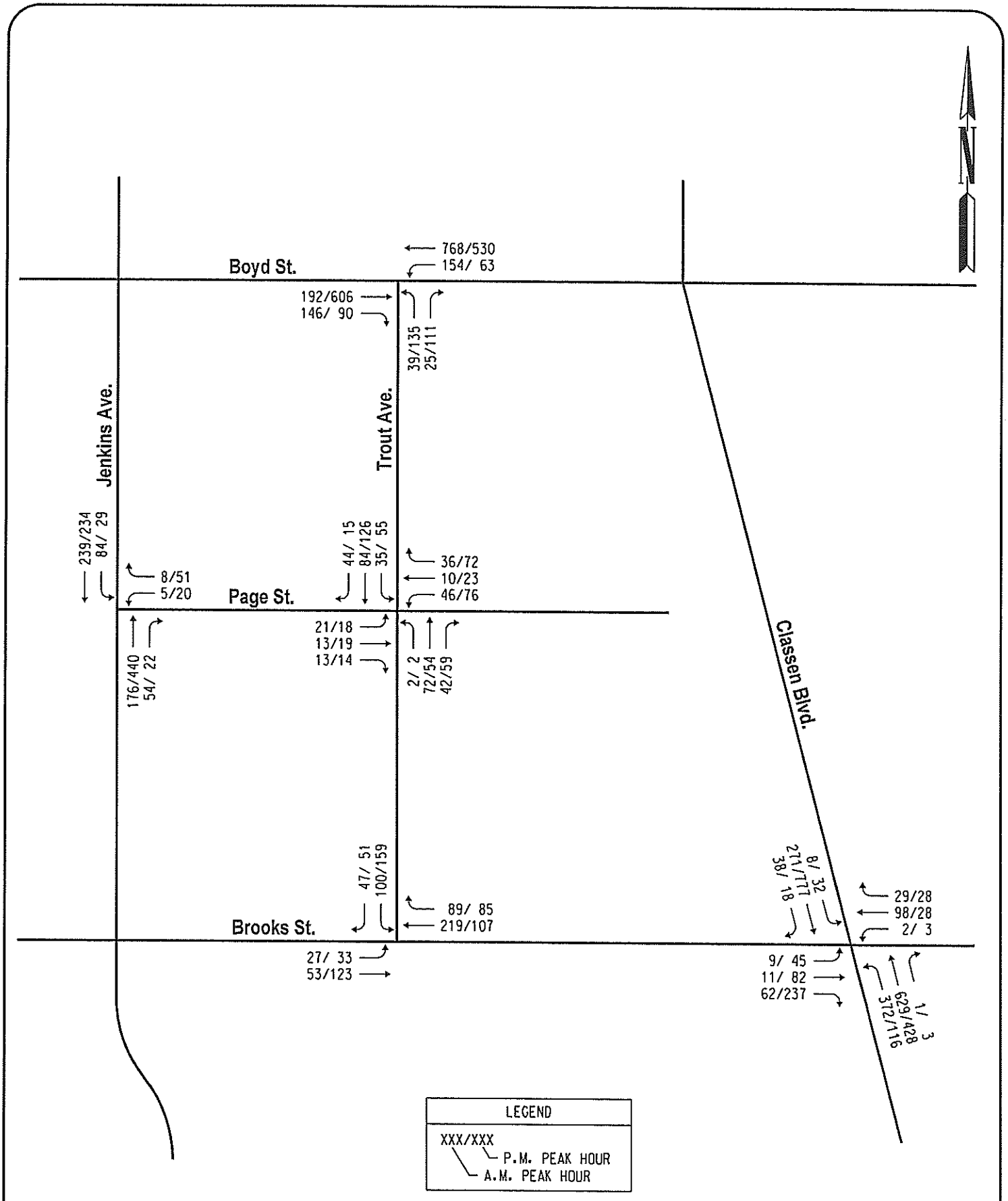

FIGURE 6. 2017 Projected Background Traffic with Future Page Circle Apartment Complex Traffic

TABLE 1.

Student Housing Apartments
Trip Rate Analysis

Elm St. Apartments						
No. of Units	199					
No. of Bedrooms	272					
Observed Traffic Data:	Daily		AM		PM	
	In	Out	In	Out	In	Out
Hourly Volumes	540	540	17	24	45	41
Hourly Total Volumes	1080		41		86	
% of Total	50.00%	50.00%	41.46%	58.54%	52.33%	47.67%
Rate per DU	5.43		0.21		0.43	
Rate per Bedroom	3.97		0.15		0.32	

Hester St. Apartments						
No. of Units	107					
No. of Bedrooms	165					
Observed Traffic Data:	Daily		AM		PM	
	In	Out	In	Out	In	Out
Hourly Volumes	255	255	6	9	19	32
Hourly Total Volumes	510		15		51	
% of Total	50.00%	50.00%	40.00%	60.00%	37.25%	62.75%
Rate per DU	4.77		0.14		0.48	
Rate per Bedroom	3.09		0.09		0.31	

Average between Elm St. and Hester St. Apartments						
No. of Units	153					
No. of Bedrooms	219					
Observed Traffic Data:	Daily		AM		PM	
	In	Out	In	Out	In	Out
Hourly Volumes	398	398	12	17	32	37
Hourly Total Volumes	795		28		68.5	
% of Total	50.00%	50.00%	41.07%	58.93%	46.72%	53.28%
Rate per DU	5.20		0.18		0.45	
Rate per Bedroom	3.64		0.13		0.31	

Based on the traffic volumes collected at the two apartment complexes, the average trip rate for a similar land use was determined to be 5.20 vehicles per day per dwelling unit, 0.18 vehicles per hour per dwelling unit during the a.m. peak hour and 0.45 vehicles per hour per dwelling unit during the p.m. peak hour. However, due to the low rate determined for the a.m. peak hour, City staff indicated that the accepted value for this period would be 50% of the standardized ITE trip rate which calculates to 0.25 vehicles per dwelling unit during the a.m. peak hour.

The trip rates were applied to the proposed development. The resulting traffic volumes projected to be generated by the site once it is fully developed are indicated in **Table 2**.

TABLE 2

PROJECTED SITE GENERATED TRAFFIC VOLUMES

Building Type (Land Use)	Land Use Code	Approx. Gross Floor Area or Other	Average Weekday Vehicle Trip Ends			Average AM Peak Hour Directional Distribution		Average AM Peak Hour Directional Volume		Average PM Peak Hour Directional Distribution		Average PM Peak Hour Directional Volume	
			PER DAY	Per Peak Hour of Adjacent Street Traffic									
				One Hour Between 7am & 9am	One Hour Between 4pm & 6pm								
			(vpd)	(vph)**	(vph)	IN	OUT	IN	OUT	IN	OUT	IN	OUT
Trip Rate* Student Housing Apartment	---	(dwelling units)	5.20	0.25	0.45	0.41	0.59	43	62	0.47	0.53	88	100
		418	2,174	105	188								

* Trip rate determined from data collected at two comparable student housing apartment complexes in Stillwater, Oklahoma.
** Trip rate determined through discussion with the City of Norman as 50% of the ITE standardized apartment trip rate for the a.m. peak hour.

The existing traffic volumes collected for this traffic study included the Bishop's Landing apartment complex traffic. Since the existing apartment complex will be removed, the traffic generated from the complex should also be removed from the roadway network. The Bishop's Landing apartment complex has six driveways on Brooks Street and three driveways on Page Street. Due to the vast number of driveways and project time constraints, peak hour turning movement counts could not be collected at the existing driveways. The existing apartment complex and proposed complex both primarily house students and are identical distance from campus. Therefore, the existing apartment dwelling units will be subtracted from the proposed apartment dwelling units to determine the new traffic added to the roadway network. The Bishop's Landing apartment complex contains 261 dwelling units and currently operates at 85% capacity. The 222 presently occupied dwelling units will be subtracted from the proposed 418 dwelling units to estimate the additional traffic generated by the proposed development verses the existing apartment complex. The additional traffic volumes projected to be generated by the proposed development are indicated in **Table 3**.

TABLE 3

PROJECTED SITE GENERATED TRAFFIC VOLUMES WITH BISHOP'S LANDING DWELLING UNITS REMOVED

Building Type (Land Use)	Land Use Code	Approx. Gross Floor Area or Other	Average Weekday Vehicle Trip Ends			Average AM Peak Hour Directional Distribution		Average AM Peak Hour Directional Volume		Average PM Peak Hour Directional Distribution		Average PM Peak Hour Directional Volume	
			PER DAY	Per Peak Hour of Adjacent Street Traffic									
				One Hour Between 7am & 9am	One Hour Between 4pm & 6pm								
			(vpd)	(vph)**	(vph)	IN	OUT	IN	OUT	IN	OUT	IN	OUT
Trip Rate* Student Housing Apartment	---	(dwelling units)	5.20	0.25	0.45	0.41	0.59	20	29	0.47	0.53	41	47
		196	1,019	49	88								

* Trip rate determined from data collected at two comparable student housing apartment complexes in Stillwater, Oklahoma.
** Trip rate determined through discussion with the City of Norman as 50% of the ITE standardized apartment trip rate for the a.m. peak hour.

4.3 Trip Distribution

The additional traffic expected to be generated by the proposed development was then distributed among the surrounding street system as well as the various points of access for the a.m. and p.m. peak hours. The distribution of the site generated traffic was based on anticipated usage of the site and is summarized in **Figure 7**. The directional distribution of the site generated traffic for the proposed development is expected to be:

- 33% to/from Classen Boulevard southeast of the development
- 15% to/from Boyd Street northwest of the development
- 12% to/from Jenkins Avenue northwest of the development
- 12% to/from Jenkins Avenue southwest of the development
- 10% to/from Classen Boulevard northeast of the development
- 10% to/from Boyd Street northeast of the development
- 08% to/from Brooks Street east of the development

The projected site generated traffic was then added to the background traffic for the 2017 design year. The 2017 projected combined traffic (2017 projected background traffic with future Page Circle apartment complex traffic + site generated traffic) for each access point to the proposed development, as well as the surrounding street system, are summarized in **Figure 8.**

5.0 CAPACITY ANALYSIS

The capacity analyses were conducted using *Synchro 7.0*, which is a software package for modeling and optimizing traffic signal timings at signalized intersections and analyzing unsignalized intersections in accordance with the methodology of the latest edition of the *Highway Capacity Manual.* The *Highway Capacity Manual* is published by the Transportation Research Board of the National Research Council, Washington, D.C. The information has been widely accepted throughout the U.S. as a guide for defining and solving transportation challenges. The information is approved and distributed by the U.S. Department of Transportation, Federal Highway Administration.

The capacity analysis provides a measure of the amount of traffic that a given facility can accommodate. Traffic facilities generally operate poorly at or near capacity. The analysis is intended to estimate the maximum amount of traffic that can be accommodated by a facility while maintaining prescribed operational qualities. The definition of operational criteria is accomplished using levels-of-service. The

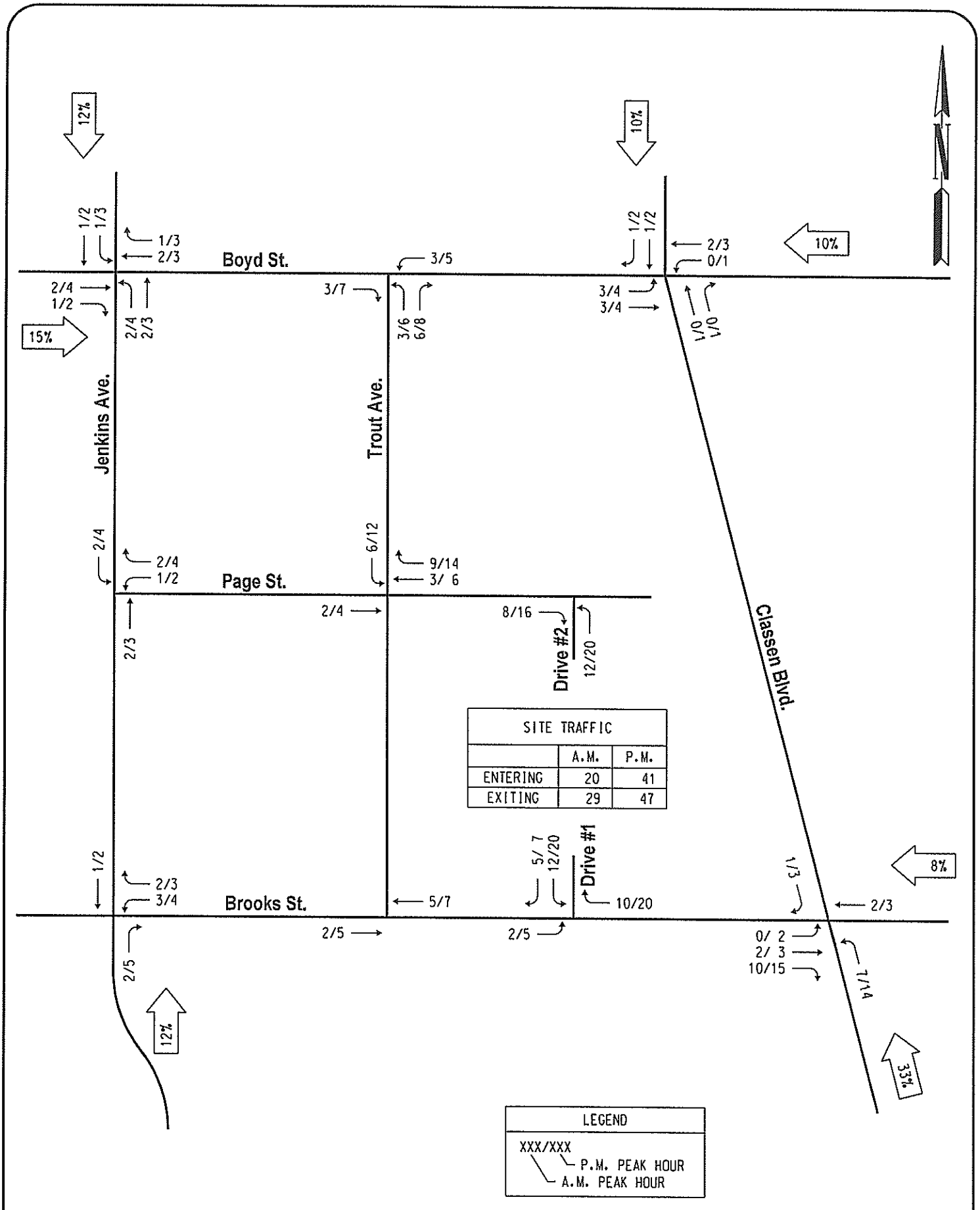

FIGURE 7. Distribution of Additional Site Generated Traffic

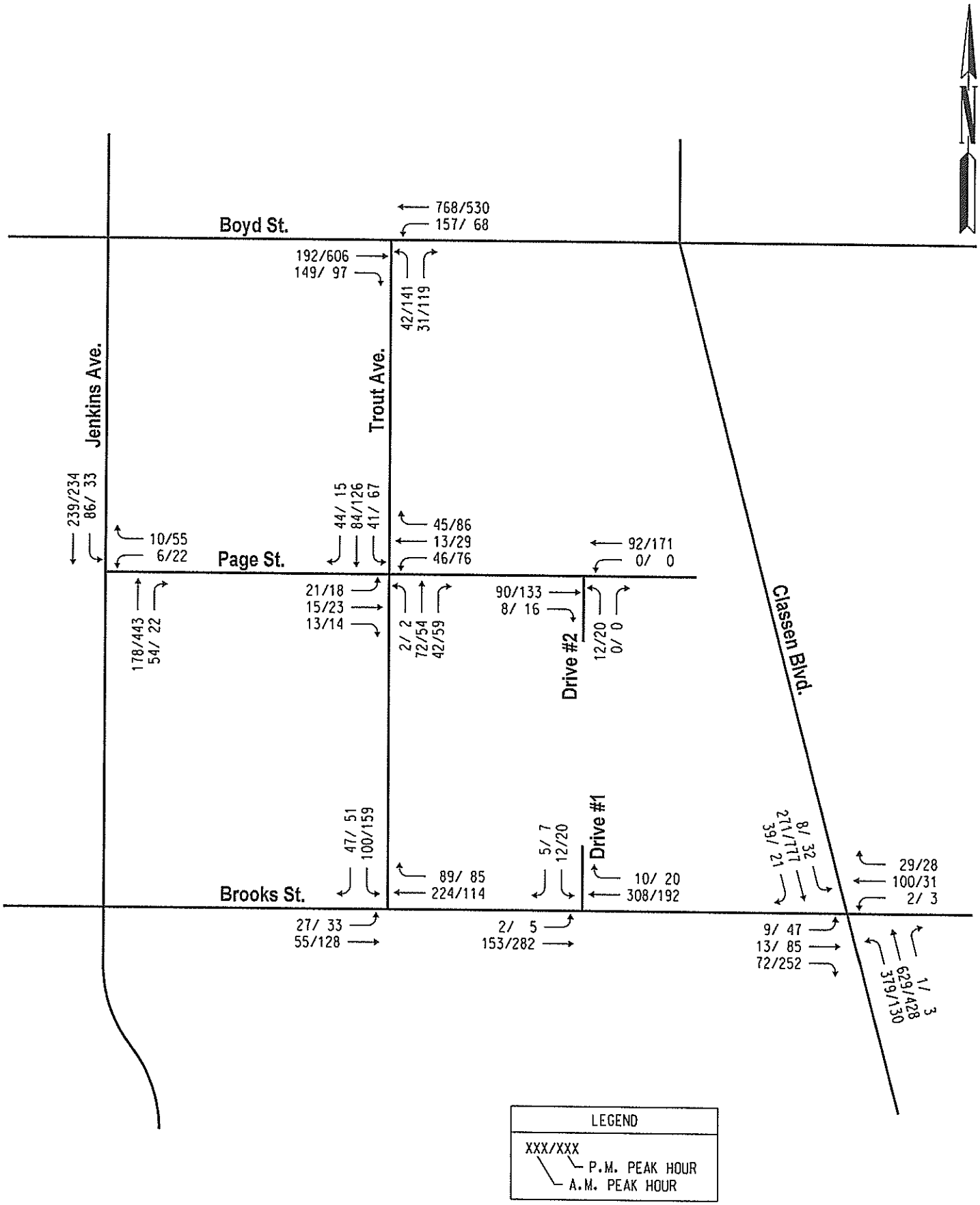

FIGURE 8. 2017 Projected Combined Traffic

concept of levels-of-service is defined as a qualitative measure and describes operational conditions in terms of such factors as speed and travel time, freedom to maneuver, traffic interruptions, comfort and convenience, and safety. Six levels-of-service are defined for each type of facility for which analysis procedures are available. They are given letter designations, from "A" to "F", with level-of-service "A" representing the best operating conditions and level-of-service "F" the worst.

The average control delay for signalized intersections is estimated for each lane group and aggregated for each approach and for the intersection as a whole. The level-of-service for this type of traffic control is directly related to the control delay value. The level-of-service criteria for signalized intersections are indicated below.

SIGNALIZED INTERSECTIONS

Level-of-Service	Control Delay per Vehicle (s/veh)
A	0-10
B	> 10-20
C	> 20-35
D	> 35-55
E	> 55-80
F	> 80

The criteria for stop controlled or unsignalized intersections have different threshold values than do those for signalized intersections. A higher level of control delay has been determined to be acceptable at a signalized intersection for the same level-of-service. The level-of-service criteria for unsignalized intersections are indicated below.

UNSIGNALIZED INTERSECTIONS

Level-of-Service	Control Delay per Vehicle (s/veh)
A	0-10
B	> 10-15
C	> 15-25
D	> 25-35
E	> 35-50
F	> 50

Capacity analyses were conducted for the a.m. and p.m. peak hours at each access point to the proposed development as well as the intersections of Brooks Street and Classen Boulevard, Brooks Street and Trout Avenue, Page Street and Jenkins Avenue, Page Street and Trout Avenue and Trout Avenue and Boyd Street. The intersections were analyzed and reviewed under the 2014 existing traffic, 2017 projected background traffic, 2017 projected background traffic with future Page Circle apartment complex traffic and 2017 projected combined traffic. For purposes of this report, an overall intersection level-of-service "D" or better and a critical approach (approach with the lowest level-of-service) level-of-service "E" or better was considered an acceptable level-of-service. The results of the capacity analyses conducted are summarized in **Table 4** and the raw data sheets have been included in the appendix.

TABLE 4
Capacity Analysis Summary

Intersection	Type of Traffic Control	AM Peak Hour					PM Peak Hour				
		Critical Approach			Intersection		Critical Approach			Intersection	
		Approach	Delay (sec/veh)	LOS	Delay (sec/veh)	LOS	Approach	Delay (sec/veh)	LOS	Delay (sec/veh)	LOS
2014 Existing Traffic											
Brooks Street & Classen Boulevard	Signalized	WB	21.7	C	6.9	A	EB	12.6	B	8.0	A
Brooks Street & Trout Avenue	Unsignalized	SB	11.4	B	3.0	A	SB	11.3	B	4.2	A
Page Street & Jenkins Avenue	Unsignalized	WB	9.4	A	1.5	A	WB	12.8	B	1.2	A
Page Street & Trout Avenue	Unsignalized	EB	10.1	B	2.3	A	EB	10.1	B	2.9	A
Trout Avenue & Boyd Street	Unsignalized	NB	19.6	C	1.7	A	NB	40.0	E	5.9	A
2017 Projected Background Traffic											
Brooks Street & Classen Boulevard	Signalized	WB	22.4	C	7.1	A	EB	12.8	B	8.2	A
Brooks Street & Trout Avenue	Unsignalized	SB	11.5	B	3.0	A	SB	11.4	B	4.3	A
Page Street & Jenkins Avenue	Unsignalized	WB	9.4	A	1.5	A	WB	13.0	B	1.2	A
Page Street & Trout Avenue	Unsignalized	EB	10.1	B	2.3	A	EB	10.1	B	2.9	A
Trout Avenue & Boyd Street	Unsignalized	NB	20.6	C	1.8	A	NB	46.3	E	6.8	A
2017 Projected Background Traffic + Future Page Circle Apartment Traffic											
Brooks Street & Classen Boulevard	Signalized	WB	22.7	C	7.7	A	EB	13.0	B	9.4	A
Brooks Street & Trout Avenue	Unsignalized	SB	12.6	B	3.9	A	SB	13.2	B	5.5	A
Page Street & Jenkins Avenue	Unsignalized	WB	11.4	B	1.7	A	WB	13.9	B	1.6	A
Page Street & Trout Avenue	Unsignalized	EB	11.1	B	4.4	A	WB	12.7	B	6.1	A
Trout Avenue & Boyd Street	Unsignalized	NB	22.3	C	2.3	A	NB	98.3	F	16.3	C
2017 Projected Background Traffic + Future Page Circle Apartment Traffic with Traffic Signal											
Trout Avenue & Boyd Street	Signalized	NB	14.1	B	6.0	A	NB	11.3	B	8.5	A
2017 Projected Background Traffic + Future Page Circle Apartment Traffic + Proposed Site Traffic											
Brooks Street & Classen Boulevard	Signalized	WB	22.9	C	7.9	A	EB	13.5	B	9.8	A
Brooks Street & Trout Avenue	Unsignalized	SB	12.7	B	3.9	A	SB	13.4	B	5.4	A
Page Street & Jenkins Avenue	Unsignalized	WB	11.4	B	1.8	A	WB	14.2	B	1.8	A
Page Street & Trout Avenue	Unsignalized	EB	11.4	B	4.7	A	WB	13.3	B	6.7	A
Trout Avenue & Boyd Street	Signalized	NB	14.3	B	6.2	A	NB	11.7	B	8.7	A
Brooks Street & Drive #1	Unsignalized	SB	11.6	B	0.4	A	SB	11.8	B	0.7	A
Page Street & Drive #2	Unsignalized	NB	9.7	A	0.6	A	NB	10.7	B	0.6	A

The analyses conducted under the 2014 existing traffic conditions indicated that each intersection currently operates at acceptable levels-of-service during the a.m. and p.m. peak hours. Under the 2017 projected background traffic, each intersection would continue to operate at acceptable levels-of-service. Once the future Page Circle apartment complex traffic was added to the 2017 projected background traffic, each intersection would be expected to operate at acceptable levels-of-service except Boyd Street and Trout Avenue. The critical approach at this intersection would become level-of-service "F" during the

p.m. peak hour. With a traffic signal installed at this intersection, the critical approach would be expected to operate at level-of-service "B" during the a.m. and p.m. peak hours. Once the site generated traffic was added to the 2017 projected background traffic, each intersection would operate at acceptable levels-of-service.

The site generated traffic was analyzed entering the development via the existing through lanes on Brooks Street and Page Street. Due to the anticipated low turning volumes into the site and low-speed traffic on the adjacent roadways, the construction of exclusive turn lanes are not necessary.

6.0 TRAFFIC SIGNAL WARRANT ANALYSIS

In order to determine the need for additional traffic control measures at the intersection of Boyd Street and Trout Avenue, a traffic signal warrant analysis was conducted. The analysis was conducted in accordance with the *Manual on Uniform Traffic Control Devices (MUTCD)*. This publication has eight warrants that may be evaluated at an intersection to determine whether or not a traffic signal should be considered to reduce accidents or delay. If one of the warrants is met the installation of a traffic signal should be considered.

The results indicated that the intersection of Boyd Street and Trout Avenue satisfied the peak hour vehicular volumes warrant during the p.m. peak hour under the 2017 projected background traffic with future Page Circle apartment traffic. Despite the fact that the intersection satisfies a signal warrant, does not indicate that a traffic signal must be installed. The intersection currently operates at acceptable levels-of-service and is expected to do so through 2017 and the installation of a traffic signal is not recommended at this time. Once the two apartment complexes are fully constructed, the intersection should be reevaluated for the installation of a traffic signal. Due to the close spacing of the existing traffic signals at Boyd Street and Jenkins Avenue and Boyd Street and Classen Boulevard, a signal at this location would have to be coordinated with the existing signals on Boyd Street to prevent vehicle backups between intersections. The computer printouts of the warrant analyses have been included in the appendix.

7.0 DRIVEWAY SPACING

In accordance with *"City of Norman Engineering Criteria for Streets, Storm Drainage, Waterlines and Sanitary Sewers", July 11, 2006* the following types of driveway criteria were evaluated:

1) Corner clearance for driveways next to public road intersections

According to the above mentioned publication, the corner clearance for a driveway next to a public road intersection is based on the posted speed limit of the adjacent street which the driveway intersects and the traffic control at the intersection. The intersections of Brooks Street and Trout Avenue and Page Street and Trout Avenue are unsignalized and the speed limit on each street is 25 mph. Based on these criteria, the required corner clearance from the intersection to the development drives is 100 feet centerline to centerline. Drive #1 is approximately 440 feet east of Trout Avenue and Drive #2 is approximately 300 feet east of Trout Avenue and, therefore, both driveways easily satisfy the City of Norman's minimum required corner clearance.

8.0 CONCLUSIONS AND RECOMMENDATIONS

TEC was requested to conduct a traffic impact study on a proposed multi-family residential development in Norman, Oklahoma. Existing traffic volume data was collected adjacent to the proposed development. The 2014 existing traffic was utilized to determine the background traffic for 2017 by applying an average annual growth rate of 1% for three years. The 2017 design period was selected as the year the development is projected to be completed. The projected traffic volumes for a future apartment complex in the vicinity were added to the 2017 projected background traffic. The traffic expected to be generated by the proposed development was determined and distributed among the points of access to the development, as well as the adjacent street intersections. The proposed development traffic was added to the 2017 projected background traffic for conducting the reviews and analyses.

The analyses conducted under the 2014 existing traffic and 2017 projected background traffic indicated that each intersection would operate within acceptable levels-of-service. With the future Page Circle apartment complex traffic added to the 2017 projected background traffic, the critical approach at the intersection of Boyd Street and Trout Avenue would be expected to operate at level-of-service "F" during the p.m. peak hour.

A traffic signal warrant analysis was conducted on the intersection. The results indicated that the intersection of Boyd Street and Trout Avenue satisfied the peak hour vehicular volumes warrant under the 2017 projected background traffic with future Page Circle apartment traffic. Despite the intersection satisfying a signal warrant, a traffic signal should not be immediately installed. Once the proposed

apartment complex and future Page Circle apartment complex are fully constructed, the intersection should be reevaluated for the installation of a traffic signal.

With a traffic signal installed, the critical approach at the intersection of Boyd Street and Trout Avenue would operate at level-of-service "B" during the peak hours. Once the site generated traffic was applied to the 2017 projected background traffic with future Page Circle apartment traffic, each intersection would be expected to continue operating within acceptable levels-of-service. Based on the results of the analyses conducted, no geometric roadway improvements are necessary for traffic to operate at an acceptable level-of-service both now and for many years in the future.

The developer may be responsible for a portion of the cost of a future traffic signal at the intersection of Boyd Street and Trout Avenue based on the additional traffic the development would be expected to add to the intersection. The development is expected to add 39 vehicles (3% additional traffic) to the intersection during the a.m. peak hour and 69 vehicles (4% additional traffic) to the p.m. peak hour. These percentages are based on the 2017 projected combined traffic volumes.