March 27, 2023

Mr. Michael Scarbrough
3K1 Consulting Services, LLC
11811 N. Tatum Boulevard
Suite 1051
Phoenix, AZ 85028

Re: Quick N Clean – SWC Pine Lane and Parker Road
Traffic Compliance Letter
Parker, Colorado

Dear Mr. Scarbrough:

This traffic study letter has been prepared to provide a trip generation comparison to identify compliance with the original traffic impact study for a Quick N Clean car wash to be developed as part of the Parker and Pine project in Parker, Colorado. An approximate 5,366 square foot Quick N Clean car wash is proposed within a portion of the Parker and Pine site. The proposed car wash is located on a parcel within the development on the southwest corner of the Pine Lane and Parker Road intersection. Specifically, Quick N Clean is proposed on the southernmost portion of the site on Lot 4 (site plan attached). The site is currently undeveloped land. Kimley-Horn completed the "Parker and Pine Traffic Impact Study" in April 2020 which included this development area. The trip generation of this proposed car wash is compared with the trip generation for the applicable use evaluated as part of the original traffic study within the same development area. Applicable documents from the original traffic study are attached for reference.

Site Information and Trip Generation Comparison

Quick N Clean is proposed to contain an approximate 5,366 square foot car wash. The original Parker and Pine traffic study identified development of one 5,400 square car wash; therefore, the originally studied car wash was compared with the development of this proposed Quick N Clean car wash on Lot 4. Therefore, the purpose of this letter is to summarize a comparison of the trip generation from the proposed Quick N Clean site to the originally studied car wash use.

Site-generated traffic estimates are determined through a process known as trip generation. Rates and equations are applied to the proposed land use to estimate traffic generated by the development during a specific time interval. The acknowledged source for trip generation rates is the *Trip Generation Manual*[1] published by the Institute of Transportation Engineers (ITE). ITE has established trip rates in nationwide studies of similar land uses.

Trip generation for the original traffic study and the currently proposed land use is based on the ITE Trip Generation, 10th Edition (most current edition) average rates for Automated Car Wash (ITE Land Use Code 948). The following table compares the trip generation from the original study compared to the expected trip generation for the proposed Quick N Clean site. The trip generation calculation sheets from the original traffic study, as well as from the current proposal are attached for reference.

1 Institute of Transportation Engineers, *Trip Generation Manual*, Tenth Edition, Washington DC, 2017.

Trip Generation Comparison: Original Study vs. Current Proposal

Use and Size	Daily Vehicle Trips	Weekday Vehicle Trips					
		AM Peak Hour			PM Peak Hour		
		In	Out	Total	In	Out	Total
Original Traffic Study – Automated Car Wash							
Automated Car Wash (ITE 948) – 5,400 Square Feet	760	38	38	76	38	38	76
Current Proposal – Quick N Clean Car Wash							
Automated Car Wash (ITE 948) – 5,366 Square Feet	760	38	38	76	38	38	76
Net Difference in Trips	***0***	***0***	***0***	***0***	***0***	***0***	***0***

As summarized in the table, the car wash originally studied was anticipated to generate approximately 760 weekday daily trips, with 76 of these trips occurring during both the morning and afternoon peak hours. This actual proposed Quick N Clean car wash is expected to generate approximately 760 weekday daily trips, with 76 of these trips occurring during both the morning and afternoon peak hours according to the ITE trip equations based on building area. The proposed Quick N Clean is anticipated to generate the same number of daily trips, morning peak hour trips, and afternoon peak hour trips as previously studied. Since trips are anticipated to be the same, the results and conclusions of the original traffic study remain valid. It is believed that the recommended improvements to the surrounding street network will be sufficient to accommodate the traffic to be generated by this project.

Queue Information

Quick N Clean is proposed to contain three entry lanes to the car wash. There is approximately 120 feet of space per lane available between the vehicle check-in station and the north/south roadway internal to the site. With the three lanes, this will accommodate up to 4.8 vehicles per lane (12 total vehicles) of queue space in the approximately 360 feet of queue length provided (at 25 feet per vehicle). The 4.8-vehicle per lane (12 total vehicles) queue exceeds the 10-vehicle design queue best practice standard for a car wash as referenced in the ITE Summer 2012, Drive-Through Queue Generation, 1st Edition, written by Mike Spack (attached). Of note, this vehicle queue length is calculated conservatively. it's quite possible that at many times 5 or 6 vehicles can be accommodated within each lane if the space occupied is closer to 24 feet per vehicle or 20 feet per vehicle, respectively. Therefore, the proposed project is anticipated to include the appropriate space necessary to accommodate the queue onsite. It is understood that the Car Wash Owner/Developer cannot utilize the internal shared drive aisle for queueing.

Conclusions
The proposed Quick N Clean within the Parker and Pine development is anticipated to generate the same number of daily trips, morning peak hour trips, and afternoon peak hour trips as was previously studied within the original "Parker and Pine Traffic Impact Study" prepared by Kimley-Horn and Associates, dated April 2020. The original study included evaluation of a car wash, so this use is in traffic and use compliance. Therefore, it is believed that development of this 5,366 square foot Quick N Clean car wash to be located on Lot 4 within the Parker and Pine development will not change the results or conclusions of the original traffic study. It is believed that the surrounding street network has been constructed sufficiently to accommodate the traffic to be generated by this project. Please let us know if you have any questions or require anything further.

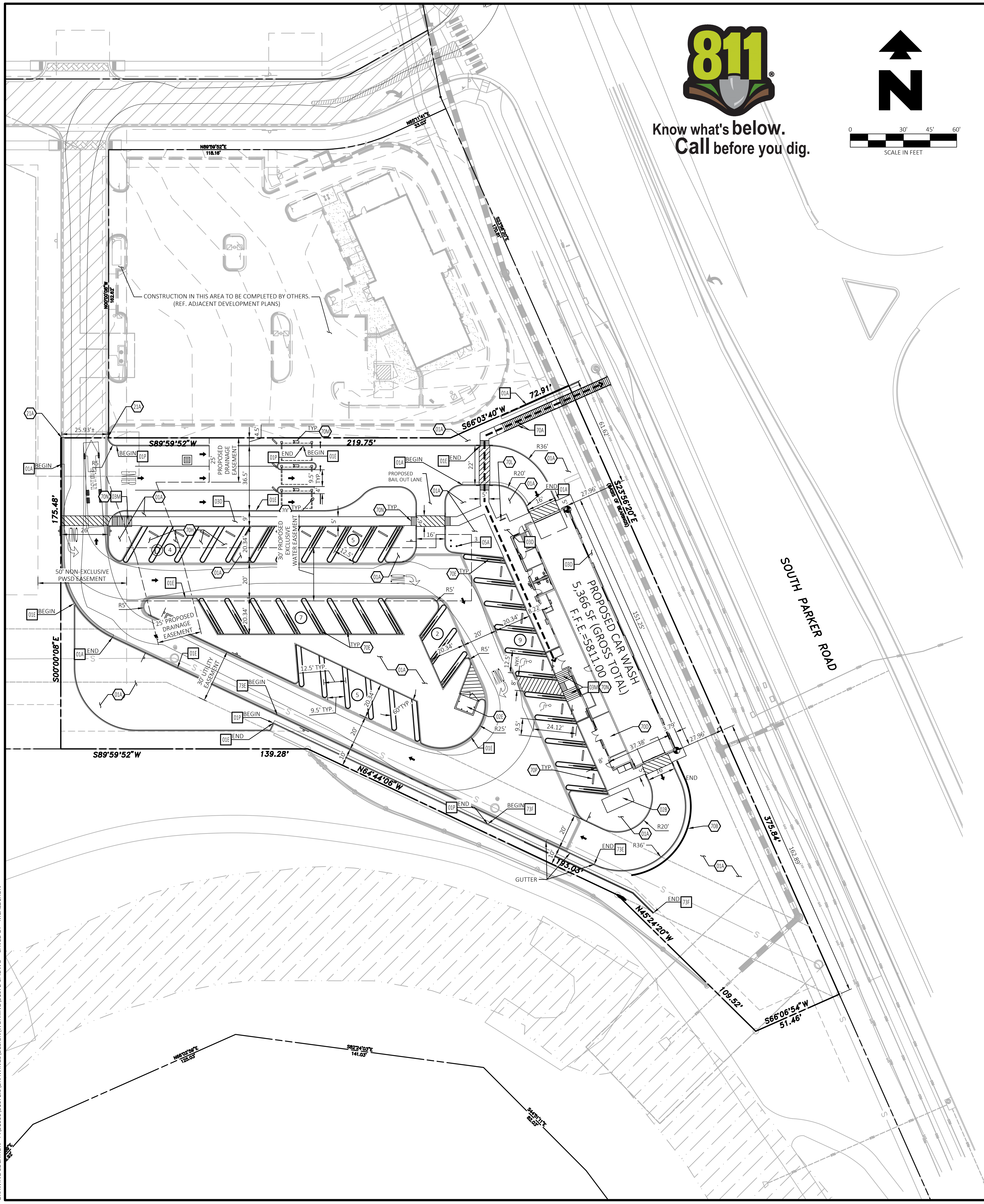
Sincerely,

KIMLEY-HORN AND ASSOCIATES, INC.

Curtis D. Rowe, P.E., PTOE
Vice President

COLORADO REGISTERED PROFESSIONAL ENGINEER
CURTIS DANIEL ROWE
36355
03/27/2023

Conceptual Site Plan



LEGAL DESCRIPTION

REFERENCE C1 - COVER SHEET FOR LEGAL DESCRIPTION.

BENCHMARK

DOUGLAS CONTROL MONUMENT #1.095035, A 3 $\frac{1}{4}$" ALUMINUM CAP.

ELEVATION = 5906.34 FEET (NAVD1988). AS PUBLISHED BY DOUGLAS COUNTY

BASIS OF BEARINGS

THE BEARINGS ARE BASED ON THE WEST ROW LINE OF SOUTH PARKER ROAD ASSUMED TO BEAR S23°56'20"E BETWEEN MONUMENTS FOUND AND DESCRIBED HEREON.

FLOOD ZONE INFORMATION

SUBJECT PROPERTY IS LOCATED WITHIN ZONE "X", AREAS OF MINIMAL FLOOD HAZARD, AS DETERMINED BY THE NATIONAL FLOOD INSURANCE PROGRAM.
MAP NUMBER: 08035C0067G
EFFECTIVE DATE: MARCH 16, 2016

NOTE:

SEE ARCHITECTURAL PLANS FOR EXACT LOCATIONS AND DIMENSIONS OF PORCHES, RAMPS, VESTIBULE, SLOPED PAVING, TRUCK DOCKS, BUILDING UTILITY ENTRANCE LOCATIONS AND PRECISE BUILDING DIMENSIONS.

GENERAL SITE NOTES

A. ALL WORK AND MATERIALS SHALL COMPLY WITH ALL CITY/COUNTY REGULATIONS AND CODES AND O.S.H.A. STANDARDS.
B. PRIOR TO CONSTRUCTION WITHIN ANY EXISTING PUBLIC RIGHT-OF-WAY, THE CONTRACTOR SHALL OBTAIN ALL NECESSARY PERMITS FROM THE AUTHORITY HAVING JURISDICTION.
C. CONTRACTOR SHALL REFER TO THE ARCHITECTURAL PLANS FOR EXACT LOCATIONS AND DIMENSIONS OF VESTIBULES, SLOPE PAVING, SIDEWALKS, EXIT PORCHES, TRUCK DOCKS, PRECISE BUILDING DIMENSIONS AND EXACT BUILDING UTILITY ENTRANCE LOCATIONS.
D. ALL DISTURBED AREAS ARE TO RECEIVE FOUR INCHES OF TOPSOIL, SEED, MULCH AND WATER UNTIL A HEALTHY STAND OF GRASS IS ESTABLISHED. .
E. ALL CURBED RADII ARE TO BE 2' OR 10' UNLESS OTHERWISE NOTED. STRIPED RADII ARE TO BE 5'.
F. ALL DIMENSIONS AND RADII ARE TO THE FACE OF CURB UNLESS OTHERWISE NOTED.
G. EXISTING STRUCTURES TO REMAIN WITHIN CONSTRUCTION LIMITS ARE TO BE ABANDONED, REMOVED OR RELOCATED / ADJUSTED AS NECESSARY. ALL COST SHALL BE INCLUDED IN BASE BID.
H. CONTRACTOR SHALL BE RESPONSIBLE FOR ALL RELOCATIONS, (UNLESS OTHERWISE NOTED ON PLANS) INCLUDING BUT NOT LIMITED TO, ALL UTILITIES, STORM DRAINAGE, SIGNS, TRAFFIC SIGNALS & POLES, ETC. AS REQUIRED. ALL WORK SHALL BE IN ACCORDANCE WITH GOVERNING AUTHORITIES REQUIREMENTS AND SHALL BE APPROVED BY SUCH. ALL COST SHALL BE INCLUDED IN BASE BID.
I. SITE BOUNDARY, TOPOGRAPHY, UTILITY AND ROAD INFORMATION TAKEN FROM A SURVEY BY A LAND SURVEYOR.
J. THE SITE WORK FOR THIS PROJECT SHALL MEET OR EXCEED THE PROJECT CONTRACT REQUIREMENTS.
K. REFER TO ARCH. PLANS FOR PYLON AND/OR MONUMENT SIGNS.
L. REFER TO ARCH. PLANS FOR SITE LIGHTING ELECTRICAL PLAN.
M. ALL ACCESSIBLE STALLS SHALL BE MARKED WITH THE INTERNATIONAL SYMBOL OF ACCESSIBILITY AND A WARNING THAT VEHICLES IN VIOLATION OF THE LOCAL MUNICIPAL CODE SHALL BE TOWED AWAY. THE INTERNATIONAL SYMBOL AND TOW-AWAY WARNING SHALL BE POSTED CONSPICUOUSLY ON SEVEN-FOOT POLES.
N. ALL ACCESSIBLE PARKING STALLS SHALL BE PLACED ADJACENT TO FACILITY ACCESS RAMPS OR IN STRATEGIC AREAS WHERE THE OPERATOR SHALL NOT HAVE TO WHEEL OR WALK BEHIND PARKED VEHICLES WHILE TRAVELING TO OR FROM ACCESSIBLE PARKING STALLS AND RAMPS.
O. MAXIMUM SLOPE IN ACCESSIBLE PARKING AREAS SHALL NOT EXCEED 2% (1:48) IN ANY DIRECTION.
P. ANY FACILITIES THAT ARE TO REMAIN AND ARE DAMAGED BY THE CONTRACTOR AS A RESULT OF CONSTRUCTION, SHALL BE REPLACED PER CURRENT CONTRACT REQUIREMENTS AT THE SOLE EXPENSE OF THE CONTRACTOR.
Q. CONTRACTOR SHALL ENSURE ADA CONFORMANCE OF ALL EXISTING SIDEWALKS AND CURB RAMPS WITHIN PUBLIC RIGHT-OF-WAY WITHIN THE PROJECT LIMITS. ALL EXISTING SIDEWALKS AND CURB RAMPS SHALL CONFORM TO THE LATEST ADOPTED VERSION (AND ALL AMENDMENTS) OF THE ADA STANDARDS FOR ACCESSIBLE DESIGN & THE ARCHITECTURAL BARRIERS TEXAS ACCESSIBILITY STANDARDS (TAS), ANY EXISTING SIDEWALK THAT IS NOT IN CONFORMANCE WITH ADA REGULATIONS SHALL BE REMOVED AND REPLACED PER CITY OF DALLAS CODES AND COST SHALL BE INCLUDED IN BASE BID.
R. ALL ADA SIGNS SHALL BE PERMITTED SEPARATELY.

SITE DETAILS (REF DETAIL SHEET C4.1)

01A TYPE A CONCRETE CURB AND GUTTER
01C TYPE C CONCRETE RAISED CURB AND GUTTER
01E TYPE E CURB
01P RAISED CURB AND GUTTER
03D CONCRETE SIDEWALK
03M WHEELCHAIR RAMP IN SIDEWALK
05A GUARD POST (SINGLE)
70A CONCRETE ACCESSIBLE RAMP AND HANDRAIL
73E REINFORCED REVERSED CURB WITHOUT FOOTING
73F REINFORCED REVERSED CURB WITH FOOTING

SITE NOTES

01A SEEDED GREEN AREA.
02B TRANSFORMER PAD (PER ELEC. CO. AND/OR ARCH. PLANS).
02E TRASH DUMPSTER ENCLOSURE (PER ARCH. PLANS).
21A TAPER CURB TO MATCH EXISTING CURB.
70B FOUR (4) FOOT SCREEN WALL (REF ARCH PLANS).
70C ''VACUTECH'' SHADE CLOTH CANOPY, REF ARCHITECTURAL PLANS VACUUM CANOPY BY OTHERS AND SHOWN ON THIS PLAN FOR REFERENCE. REFER TO VENDOR PLANS FOR FINAL PLACEMENT AND INSTALL REQUIREMENTS.
70D ''VACUTECH'' VACUUM ENCLOSURE, REF ARCHITECTURAL PLANS VACUUM CANOPY BY OTHERS AND SHOWN ON THIS PLAN FOR REFERENCE. REFER TO VENDOR PLANS FOR FINAL PLACEMENT AND INSTALL REQUIREMENTS.
70E ''VACUTECH'' VACUUM (PALM ARCH), REF ARCHITECTURAL PLANS VACUUM CANOPY BY OTHERS AND SHOWN ON THIS PLAN FOR REFERENCE. REFER TO VENDOR PLANS FOR FINAL PLACEMENT AND INSTALL REQUIREMENTS.
70H EMPLOYEE PARKING & ESTABLISHMENT PARKING
70L BICYCLE RACK (PER ARCH. PLANS)
70M PAY STATION (REF ARCH. PLANS)
70N 3' DEEP DETECTABLE WARNING TO BE INSTALLED AT FULL WIDTH OF LANDING
70P WHEEL STOP, REF. ARCH. PLANS FOR FINAL PLACEMENT

Vicinity Map

1"=2,000'

PROJECT INFORMATION	
PROJECT NAME:	QUICK N CLEAN (CAR WASH)
PROJECT ADDRESS:	9572 TWENTY MILE ROAD, PARKER, COLORADO
PROJECT DESCRIPTION:	DEVELOPMENT OF A FREE-STANDING EXPRESS CAR WASH BUILDING WITH ASSOCIATED VACUUM (23) AND PAY STATION CANOPIES (3).
SITE INFORMATION	
PROPOSED PROPERTY	1.85± AC. / 80,607± S.F.
BUILDING AREA	5,380± S.F.
LANDSCAPE AREA (ONSITE & FRONTAGE)	0.73± AC. / 31,882± S.F.
SITE LANDSCAPE RATIO	39.55%
ZONING INFORMATION	
JURISDICTION:	PARKER
EXISTING ZONING:	PLANNED DEVELOPMENT
PROPOSED USE:	CAR WASH
MAX. BUILDING HEIGHT ALLOWED:	45'
PROPOSED BUILDING HEIGHT:	24'-8"
SETBACKS:	BUILDING:
	FRONT YARD: 40 FT SIDE YARD : 0 FT REAR YARD: 25 FT
	LANDSCAPE: (f) LANDSCAPING, EACH SITE SHALL BE LANDSCAPED IN ACCORDANCE WITH CHAPTER 13.06 OF THIS TITLE.
PARKING REQUIREMENTS	
PARKING REQUIRED:	CAR WASH: 1 PER ESTABLISHMENT PLUS 1 PER STAFF MEMBER PER MAXIMUM SHIFT
PARKING PROVIDED:	EMPLOYEE: 4 (12.5' X 18') NON-VACUUM: 5 (12.5' X 18') VACUUM: 21 (12.5' X 18') ACCESSIBLE (VACUUM): 2 (12.5' X 18') (8' ACCESS AISLE) TOTAL PARKING:32
BICYCLE PARKING REQUIRED:	2
BICYCLE PARKING PROVIDED:	2

EXISTING LEGEND

- PROPERTY LINE/RIGHT OF WAY LINE
- COMMUNICATIONS MANHOLE
- SANITARY SEWER MANHOLE
- STORM SEWER MANHOLE
- GAS — UNDERGROUND GAS LINES
- COM — UNDERGROUND COMMUNICATIONS LINES
- STM — UNDERGROUND STORM SEWER LINES

PROPOSED

- CONCRETE CURB
- BUILDING CONTROL POINT
- # PROPOSED PARKING SPACES
- PEDESTRIAN PATH OF TRAVEL
- Fire Truck — FIRE APPARATUS (REFER TO C4.2 - SITE DETAILS FOR SPECIFICATIONS)

THE TOWN OF PARKER REVIEW CONSTITUTES GENERAL COMPLIANCE WITH THE TOWN'S STANDARDS AND APPROVED VARIANCES, SUBJECT TO THESE PLANS BEING STAMPED, SIGNED, AND DATED BY THE PROFESSIONAL ENGINEER OF RECORD. REVIEW BY THE TOWN DOES NOT CONSTITUTE APPROVAL OF THE PLAN DESIGN OR ACCURACY AND CORRECTNESS OF ENGINEERING CALCULATIONS. ERRORS IN THE DESIGN OR CALCULATIONS REMAIN THE RESPONSIBILITY OF THE REGISTERED PROFESSIONAL ENGINEER WHOSE STAMP AND SIGNATURE ARE AFFIXED TO THIS DOCUMENT.

THIS REVIEW DOES NOT CONSTITUTE APPROVAL OF ANY PRIVATE ON-SITE IMPROVEMENTS WHICH MAY BE CONSTRUCTION CANNOT COMMENCE UNTIL ALL REQUIRED DRAINAGE/TRAFFIC REPORT(S), FINAL DEVELOPMENT PLAN(S), SPECIAL REVIEW(S), GRADING PERMIT, AND/OR OTHER PERMITS ARE COMPLETE, APPROVED AND ON FILE WITH THE TOWN OF PARKER.

TOWN OF PARKER, DIRECTOR OF ENGINEERING / PUBLIC WORKS DATE

CEI
Solutions for Land and Life

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710 W. PINEDALE AVE.
FRESNO, CA 93711
PHONE: (559) 447-3119
FAX: (559) 447-3129

3K1 CONSULTING SERVICES
CLIENT
3K1 CONSULTING SERVICES, LLC.
11811 N. TATUM BOULEVARD,
PHOENIX, ARIZONA 85028
PHONE: (602) 850-8101

QUICK N CLEAN
PLANS PREPARED FOR
QUICK N CLEAN
7291 E. ADOBE DRIVE, SUITE 115
SCOTTSDALE, AZ. 85255
PHONE: (480) 707-3531

REVISION

NO.	DESCRIPTION	DATE

FOR REVIEW ONLY
NOT FOR
CONSTRUCTION

QUICK N CLEAN
9572 TWENTY MILE ROAD
PARKER, COLORADO

CONSTRUCTION DOCUMENTS

PROFESSIONAL OF RECORD	TAB
PROJECT MANAGER	ASD
DESIGNER	RM
CEI PROJECT NUMBER	31672
DATE	3/23/2023
REVISION	REV-6

SITE PLAN
SHEET TITLE
SHEET NUMBER
C4

Trip Generation Calculations

Kimley»Horn

Project	Quick N Clean Traffic Compliance Letter				
Subject	Trip Generation for Automated Car Wash				
Designed by	TES	*Date*	September 23, 2021	*Job No.*	096554018
Checked by		*Date*		*Sheet No.*	*of*

TRIP GENERATION MANUAL TECHNIQUES

ITE Trip Generation Manual 10th Edition, Average Rate Equations

Land Use Code - Automated Car Wash (948)

Independent Variable - 1000 Square Feet Gross Floor Feet (X)
Gross Floor Area = 5,366
X = 5.4
T = Average Vehicle Trip Ends

Peak Hour of Adjacent Street Traffic, One Hour Between 7 and 9 a.m. (Utilized PM Peak Hour Rates)

Directional Distribution: 50% ent. 50% exit.

T = 14.20(X)
T = 14.20 * 5.366

T = 76 Average Vehicle Trip Ends
38 entering 38 exiting

Peak Hour of Adjacent Street Traffic, One Hour Between 4 and 6 p.m. (900 Series Page 382)

Directional Distribution: 50% ent. 50% exit.

T = 14.20(X)
T = 14.20 * 5.366

T = 76 Average Vehicle Trip Ends
38 entering 38 exiting

Weekday (10% K-Factor from PM Peak Hour)

Average Weekday

(T) = PM Peak Total / K Factor 0.1

Directional Distribution: 50% entering, 50% exiting
T = 760 Average Vehicle Trip Ends
380 entering 380 exiting

380 + 380 = 760

Original Traffic Study Documents

T R A F F I C   I M P A C T   S T U D Y

Parker and Pine

Parker, Colorado

Prepared for
Eisenberg Company
2710 E Camelback Rd #210
Phoenix, AZ 85016

Prepared by
Kimley-Horn and Associates, Inc.
4582 South Ulster Street
Suite 1500
Denver, Colorado 80237
(303) 228-2300

April 2020

This document, together with the concepts and designs presented herein, as an instrument of service, is intended only for the specific purpose and client for which it was prepared. Reuse of and improper reliance on this document without written authorization and adaptation by Kimley-Horn and Associates, Inc. shall be without liability to Kimley-Horn and Associates, Inc.

anticipated during the weekday morning and afternoon peak hours, respectively. **Table 1** summarizes the estimated trip generation for the proposed Parker and Pine development. The trip generation worksheets are included in **Appendix D**.

Table 1 – Parker and Pine Traffic Generation

Land Use	Quantity	Daily Trips	AM Peak Hour			PM Peak Hour		
			In	Out	Total	In	Out	Total
Total Trips								
Mid-Rise Multifamily Residential (ITE 221)	175 Units	952	15	44	59	46	30	76
Day Care Center (ITE 565)	13,000 SF	620	74	69	143	68	77	145
Shopping Center (ITE 820)	17,000 SF	642	10	6	16	31	34	65
Fast Food Restaurant w/ D.T. (ITE 934)	3,000 SF	1,414	62	59	121	51	47	98
Fast Food Restaurant w/ D.T. (ITE 934)	3,000 SF	1,414	62	59	121	51	47	98
Gas Station w/ Convenience (ITE 945)	16 Positions	3,286	102	98	200	114	110	224
Automated Car Wash (ITE 948)	5,400 SF	760	38	38	76	38	38	76
Total	-	9,088	363	373	736	399	383	782
Total Trips After Internal Capture (ITE Methodology)								
Mid-Rise Multifamily Residential (ITE 221)	175 Units	857	14	40	53	41	27	68
Day Care Center (ITE 565)	13,000 SF	558	67	62	129	61	69	131
Shopping Center (ITE 820)	17,000 SF	642	10	6	16	31	34	65
Fast Food Restaurant w/ D.T. (ITE 934)	3,000 SF	1,273	56	53	109	46	42	88
Fast Food Restaurant w/ D.T. (ITE 934)	3,000 SF	1,273	56	53	109	46	42	88
Gas Station w/ Convenience (ITE 945)	16 Positions	2,957	92	88	180	103	99	202
Automated Car Wash (ITE 948)	5,400 SF	684	34	34	68	34	34	68
Total	-	8,244	329	336	664	362	347	710
Non Pass-By Trips								
Mid-Rise Multifamily Residential (ITE 221)	175 Units	857	14	40	53	41	27	68
Day Care Center (ITE 565)	13,000 SF	558	67	62	129	61	69	131
Shopping Center (ITE 820)	17,000 SF	546	9	5	14	26	29	55
Fast Food Restaurant w/ D.T. (ITE 934)	3,000 SF	1,082	48	45	93	39	36	75
Fast Food Restaurant w/ D.T. (ITE 934)	3,000 SF	1,082	48	45	93	39	36	75
Gas Station w/ Convenience (ITE 945)	16 Positions	2,513	78	75	153	88	84	172
Automated Car Wash (ITE 948)	5,400 SF	684	34	34	68	34	34	68
Total	-	7,322	298	306	603	328	315	644
Pass-By Trips								
Shopping Center (ITE 820)	17,000 SF	96	0	0	0	5	5	10
Fast Food Restaurant w/ D.T. (ITE 934)	3,000 SF	191	8	8	16	7	6	13
Fast Food Restaurant w/ D.T. (ITE 934)	3,000 SF	191	8	8	16	7	6	13
Gas Station w/ Convenience (ITE 945)	16 Positions	444	14	13	27	15	15	30
Total	-	922	30	29	59	34	32	66

Note: ITE does not provide AM trip generation information for Automated Car Wash (ITE 948) although car washes are open in the morning. Therefore, the PM trip generation was duplicated for the AM trip generation.

Kimley»Horn

Project	Parker and Pine				
Subject	Trip Generation for Automated Car Wash				
Designed by	JRP	*Date*	October 07, 2019	*Job No.*	096502001
Checked by		*Date*		*Sheet No.*	1 *of* 1

TRIP GENERATION MANUAL TECHNIQUES

ITE Trip Generation Manual 10th Edition, Average Rate Equations

Land Use Code - Automated Car Wash (948)

Independent Variable - 1000 Square Feet Gross Floor Feet (X)
Gross Floor Area = 5,400
X = 5.4
T = Average Vehicle Trip Ends

Peak Hour of Adjacent Street Traffic, One Hour Between 7 and 9 a.m. (Utilized PM Peak Hour Rates)

Directional Distribution: 50% ent. 50% exit.

T = 14.20(X)
T = 14.20 * 5.4

T = 76 Average Vehicle Trip Ends
38 entering 38 exiting

Peak Hour of Adjacent Street Traffic, One Hour Between 4 and 6 p.m. (900 Series Page 382)

Directional Distribution: 50% ent. 50% exit.

T = 14.20(X)
T = 14.20 * 5.4

T = 76 Average Vehicle Trip Ends
38 entering 38 exiting

Weekday (10% K-Factor from PM Peak Hour)

Average Weekday

(T) = PM Peak Total / K Factor 0.1

Directional Distribution: 50% entering, 50% exiting
T = 760 Average Vehicle Trip Ends
380 entering 380 exiting

380 + 380 = 760

Queue Length Data Information

Drive-Through Queue Generation

Mike Spack, PE, PTOE, Max Moreland, EIT, Lindsay de Leeuw, Nate Hood

1.0 Introduction

This report provides queuing data for businesses with drive-through services. It is intended to be an aid for site designers and reviewers, similar to the Institute of Transportation Engineers' *Trip Generation* and *Parking Generation* reports. The data presentation is modeled on the *Parking Generation* report and data is provided based on at least six sites, similar to data sets marked as statistically significant in *Trip Generation*.

Businesses with drive-through lanes are very common in the United States and having data that gives usage information for drive-through lanes will assist designers as well as cities in determining the appropriate amount of storage needed for proposed drive-through businesses. Data for drive-through queues was published by the ITE Technical Council Committee 5D-10 in 1995 based on information collected between the late 1960's and the 1990's. A paper was also published in 2009 by Mark Stuecheli, PTP giving updated information for bank and coffee shop drive-through lanes. The results from the 2009 study are incorporated into this paper (thank you Mark for your assistance).

2.0 Data Collection

Data was collected using COUNTcam video recording systems at a total of 30 drive-through locations in Minneapolis, MN and several surrounding suburbs between 2010 and 2012 (26 of the 30 videos were recorded in February of 2012, which should represent peak usage in the cold Minnesota winter). Videos of drive-through lanes were collected at banks, car washes, coffee shops, fast food restaurants and pharmacies. A total of six locations were selected for each of the five different land uses. Each location was recorded for between one and five days where the majority of locations were recorded for two consecutive days. The days of the week that each video was recorded on varies.

The 24-hour videos were watched at high speeds with the PC-TAS counting software and maximum queues throughout the day were noted. Most of the COUNTcams were set up such that the entire queue lane could be seen, but at a few locations the drive-through lanes wrapped around the building in a way that the entire queue length would not be able to be seen. For these situations, the COUNTcams were set up so that the ordering window and back of the queue could be seen and it was noted how many vehicles could fit between the ordering window and the front of the queue. For drive-through locations with multiple lanes, the number of lanes was noted but the maximum queue is defined as the sum of the queues at each lane for any given point in time, not the queue per lane. This approach provides overall demand, which may assist designers in determining how many drive through lanes are appropriate in addition to determining how long they should be.

Once the maximum queue for each day at each location was determined, the data was compiled and statistics for each land use were calculated. The average maximum queue, standard deviation, coefficient of variation, range, 85th percentile and 33rd percentile were calculated for each land use.

Data for drive-through coffee shops and banks from the Kansas City, Kansas metropolitan area was published in the 2009 paper New Drive-Through Stacking Information for Banks and Coffee Shops by Mark Stuecheli. This data is included in the analysis.

3.0 Data Analysis

Based on the peak queue lengths, it is apparent that each land use will require a different minimum drive through stacking distance. The results for each land use can be found below. The peak queue lengths for each location, broken down by land use and day of the week, can be found in the Appendix.

3.1 Banks

Data collection was done at six banks with drive-through services (including one credit union) in August 2011 and February 2012. Twelve days of data were collected. The banks were located in the cities of Minneapolis, Robbinsdale and St. Louis Park, MN.

All of the locations had a lane with a drive-through ATM and at least two other lanes. Though service times may differ for ATM lanes compared to the regular lanes, the maximum queues were counted together. This is because based upon what was observed, vehicles would occasionally switch the lane they were in. For example, a vehicle waiting in the ATM line with a queue of three vehicles may move over to a regular line with a queue of only one vehicle. Much of what can be done at the bank's drive-through lane can also be accomplished at that bank's ATM and vice versa. Vehicles being served were counted as being in the queue.

Nine days of data from the Kansas City, Kansas area is also included. This data does not factor in vehicles in ATM lanes.

Table 3.1 – Drive-Through Bank Maximum Queue Statistics

	Minnesota Data	Minnesota + Kansas Data
Number of Data Points	12	21
Average Maximum Queue (Vehicles)	5.83	5.76
Standard Deviation (Vehicles)	1.85	2.21
Coefficient of Variation	32%	38%
Range (Vehicles)	3 to 8	1 to 10
85th Percentile (Vehicles)	8.00	8.00
33rd Percentile (Vehicles)	5.00	5.00

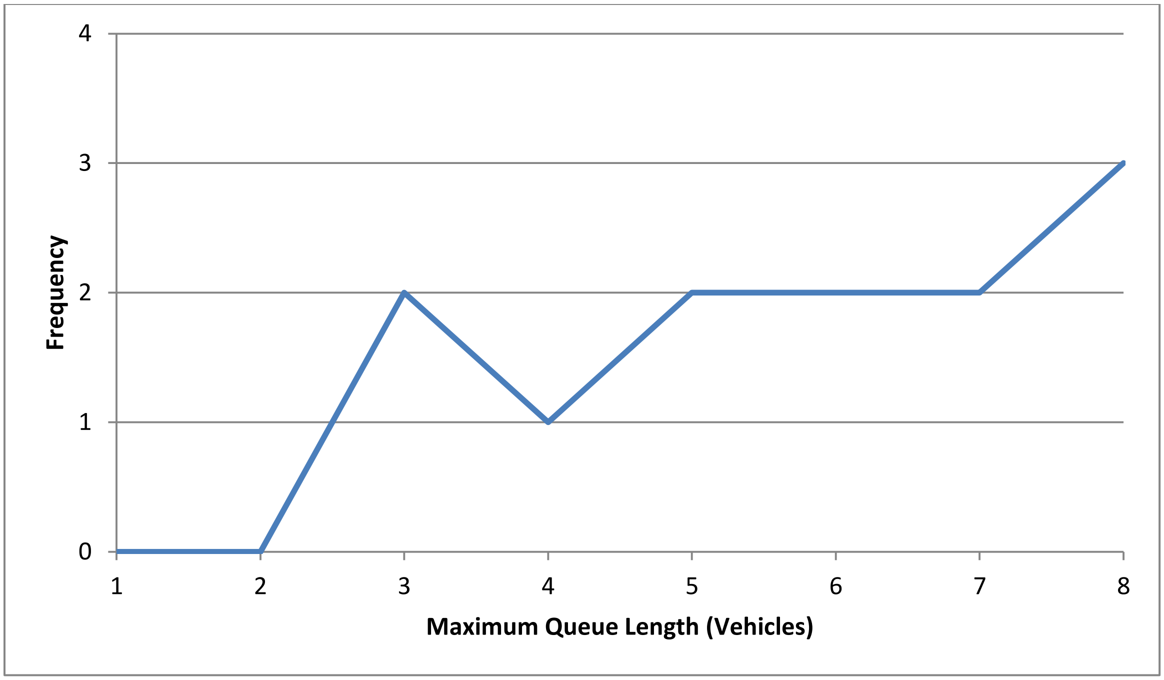


Figure 3.1.1 – Drive-Through Bank Maximum Queue Frequency – Minnesota Data

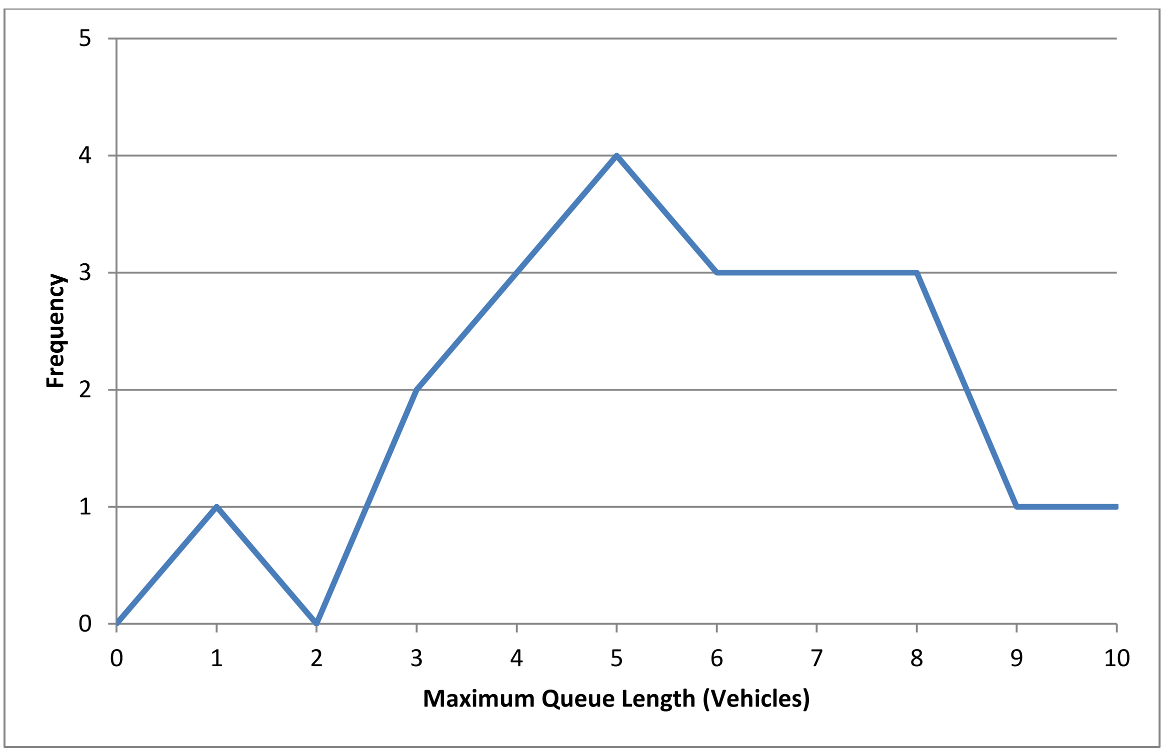


Figure 3.1.2 – Drive-Through Bank Maximum Queue Frequency – Minnesota + Kansas Data

The data for Kansas banks was collected between 4:30pm and 6:00pm. While many of the maximum queues for the data collected in Minnesota were between these times, maximum queues occurred between 8:30am and 5:30pm so it is possible that some of the Kansas data does not capture the actual maximum queues for the day.

The number of available lanes at banks, not including the ATM lane, ranged from two to seven lanes (though the most open at one time was five lanes). Even though plenty of lanes were available, cars often stacked at the lane closest to the building, thus additional lanes may not result in shorter queues. With an 85th percentile maximum queue of eight vehicles, the data suggests that banks with drive-through lanes should be able to accommodate 160 feet of vehicle stacking.

3.2 Car Washes

Data collection was done at six car washes with drive-through services (including one full-service car wash) in February 2012. Twelve days of data were collected. The car washes were located in the cities of Falcon Heights, Hopkins, Minneapolis, Roseville and St. Louis Park, MN. Five of the six car washes (excluding the full-service car wash) were located at gas stations. Only the vehicles waiting in line were counted; vehicles being washed were not added to the queue.

Table 3.2 – Drive-Through Car Wash Maximum Queue Statistics

Number of Data Points	**12**
Average Maximum Queue (Vehicles)	**4.42**
Standard Deviation (Vehicles)	**2.31**
Coefficient of Variation	**52%**
Range (Vehicles)	**1 to 10**
85th Percentile (Vehicles)	**6.20**
33rd Percentile (Vehicles)	**3.00**

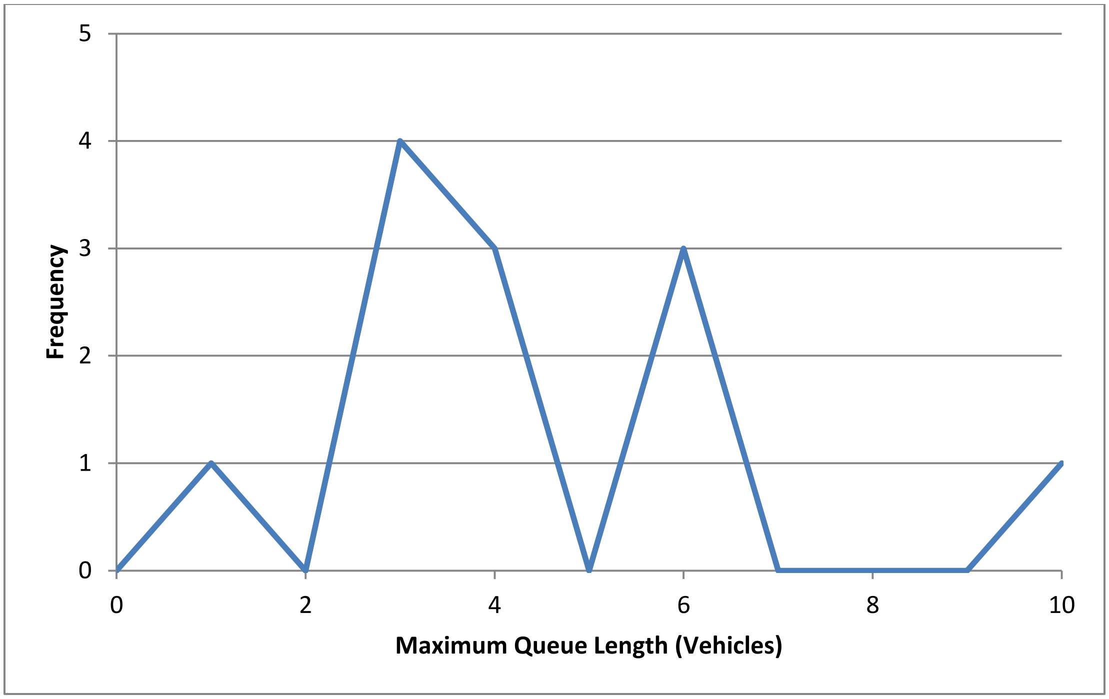


Figure 3.2 – Drive-Through Car Wash Maximum Queue Frequency

Two of the car washes had two lanes while the other four were one lane car washes. The full-service car wash had two lanes and also produced the highest maximum queue of 10 vehicles. The maximum queues for car washes were spread throughout the afternoon from 12:30pm to 8:30pm. With an 85th percentile maximum queue of more than six vehicles, the data suggests that car washes with drive-through lanes should be able to accommodate 140 feet of vehicle stacking throughout the day.

3.3 Coffee Shops

Data collection was done at six coffee shops with drive-through services in November 2010, August 2011 and February 2012. Fourteen days of data were collected. The coffee shops were located in the cities of Edina, Hopkins, Minneapolis, Roseville and St. Louis Park, MN. Vehicles being served were counted as being in the queue. Twelve days of data from the Kansas City, Kansas area is also included.

Table 3.3 – Drive-Through Coffee Shop Maximum Queue Statistics

	Minnesota Data	Minnesota + Kansas Data
Number of Data Points	14	26
Average Maximum Queue (Vehicles)	11.00	10.23
Standard Deviation (Vehicles)	2.25	2.76
Coefficient of Variation	20%	27%
Range (Vehicles)	7 to 16	3 to 16
85th Percentile (Vehicles)	13.50	13.00
33rd Percentile (Vehicles)	10.00	9.91

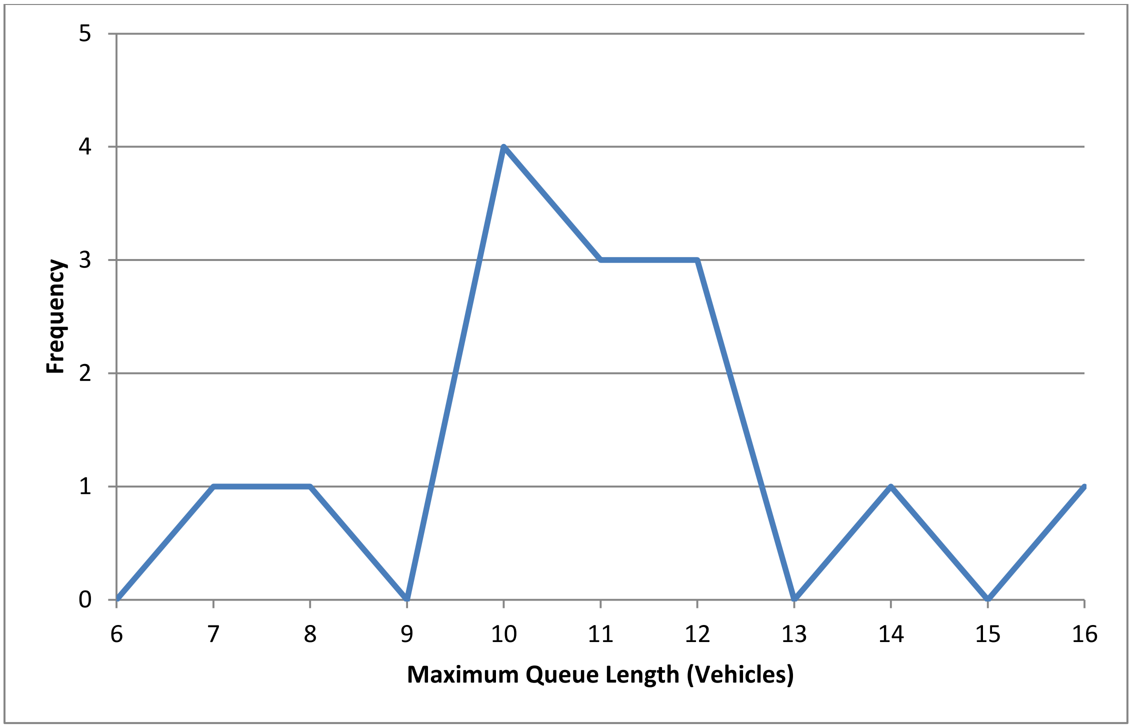


Figure 3.3.1 – Drive-Through Coffee Shop Maximum Queue Frequency – Minnesota Data

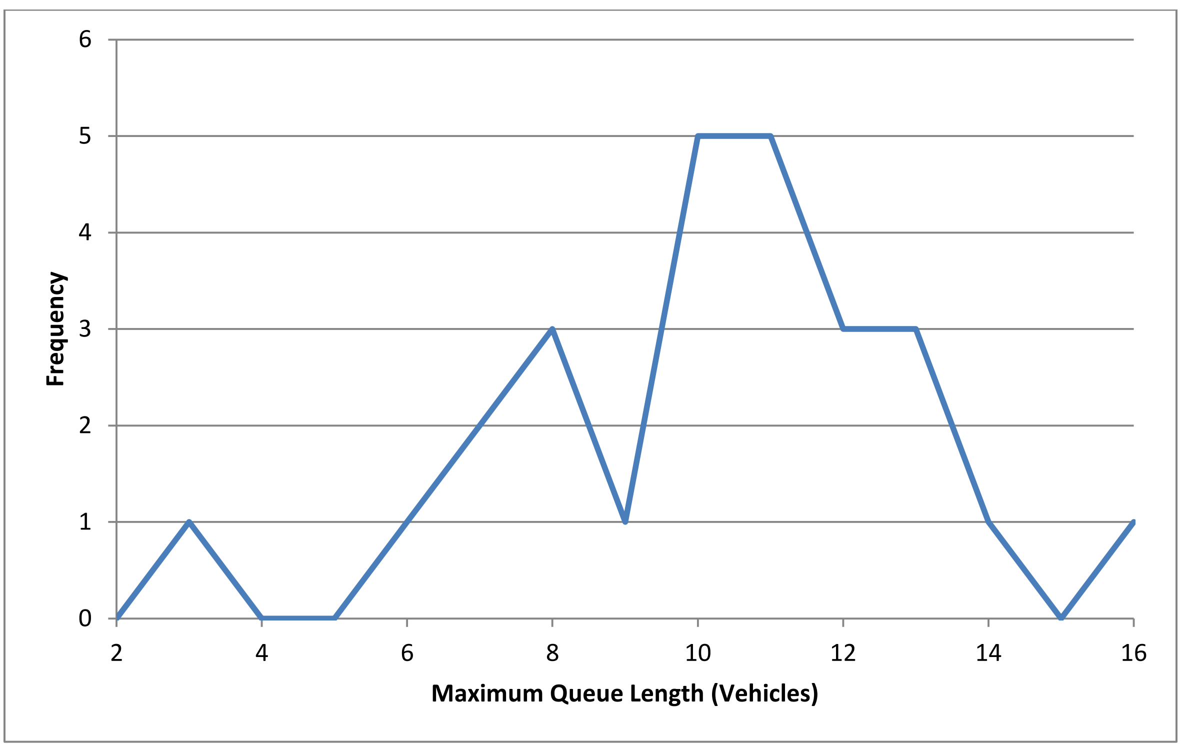


Figure 3.3.2 – Drive-Through Coffee Shop Maximum Queue Frequency – MN + KS Data

Coffee shops produced the longest maximum queues of any of the land uses in this study with all of the maximum queues occurring in the morning. In four of the six cases, the queues spilled out of the parking lot and into the street. These spillovers would typically only happen once or twice a day and last only a few minutes, however, one location had stacking into the street for about 15 minutes in addition to multiple periods of several minutes where cars would queue in the street.

With an 85^{th} percentile maximum queue of 13 vehicles, the data suggests that coffee shops with drive-through lanes should be able to accommodate at least 260 feet of vehicle stacking during morning hours.

3.4 Fast Food Restaurants

Data collection was done at six fast food restaurants with drive-through services in August 2011 and February 2012. Fourteen days of data were collected. The restaurants were located in the cities of Golden Valley, Hopkins, Minneapolis and St. Louis Park, MN. Vehicles being served were counted as being in the queue.

Table 3.4 – Drive-Through Fast Food Restaurant Maximum Queue Statistics

Number of Data Points	**14**
Average Maximum Queue (Vehicles)	**8.50**
Standard Deviation (Vehicles)	**2.68**
Coefficient of Variation	**32%**
Range (Vehicles)	**5-13**
85th Percentile (Vehicles)	**12.00**
33rd Percentile (Vehicles)	**7.90**

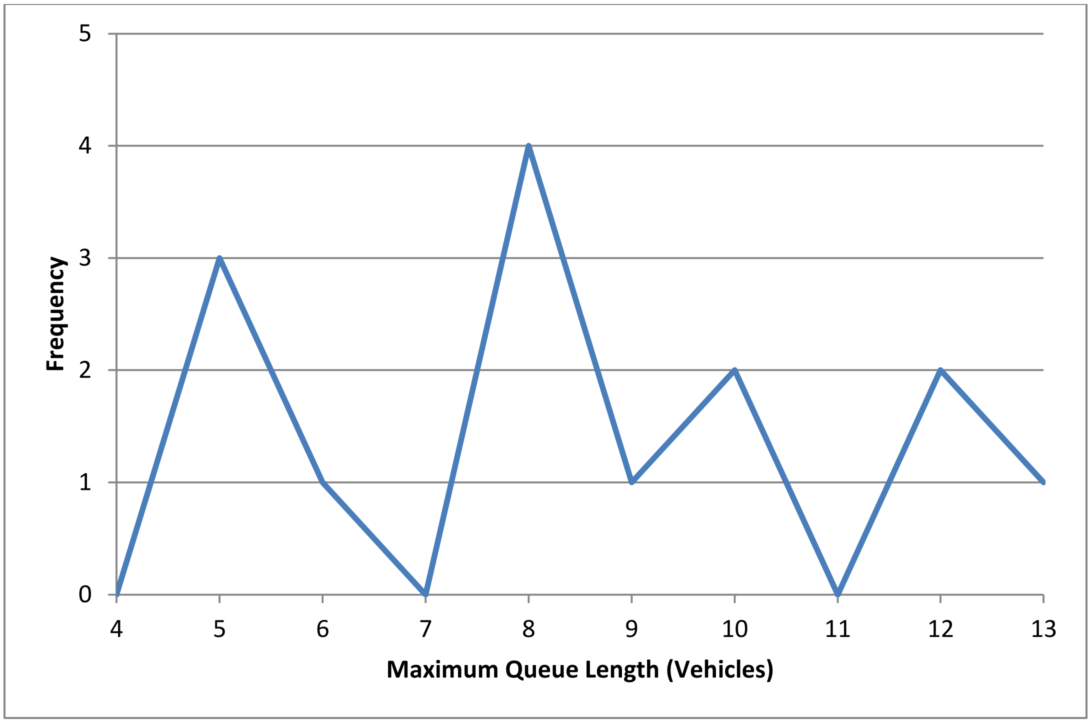


Figure 3.4 – Drive-Through Fast Food Restaurant Maximum Queue Frequency

The maximum queues for fast food restaurants were spread throughout the day from 8:00am to 10:00pm. With an 85th percentile maximum queue of 12 vehicles, the data suggests that fast food restaurants with drive-through lanes should be able to accommodate 240 feet of vehicle stacking throughout the day.

3.5 Pharmacies

Data collection was done at six pharmacies with drive-through services in February 2012. Twelve days of data were collected. The pharmacies were located in the cities of Hopkins, Minneapolis, New Hope and Robbinsdale, MN. Vehicles being served were counted as being in the queue.

Table 3.5 – Drive-Through Pharmacy Maximum Queue Statistics

Number of Data Points	12
Average Maximum Queue (Vehicles)	2.92
Standard Deviation (Vehicles)	1.16
Coefficient of Variation	40%
Range (Vehicles)	1-5
85th Percentile (Vehicles)	4.05
33rd Percentile (Vehicles)	2.00

Figure 3.5 – Drive-Through Pharmacy Maximum Queue Frequency

The maximum queues for pharmacies were spread throughout the day from 8:00am to 10:00pm. With an 85th percentile maximum queue of more than 4 vehicles, the data suggests that pharmacies with drive-through lanes should be able to accommodate 100 feet of vehicle stacking throughout the day.

4.0 Conclusions

The 85th percentile maximum queue lengths for each land use are: 160 feet for banks (eight vehicles), 140 feet for car washes (seven vehicles), 260 feet for coffee shops (13 vehicles), 240 feet for fast food restaurants (12 vehicles) and 100 feet for pharmacies (five vehicles).

While some of the locations observed have an excess of space dedicated to drive-through lanes (i.e. some banks and pharmacies), others could occasionally use additional space for drive-through lanes (i.e. coffee shops in the morning).

Fast food restaurants and coffee shops have the longest maximum queues of the five land uses observed. Coffee shops have a tendency for the morning queues to build so long that they spill out onto the street, though, as is expected, their afternoon and evening queues are minimal. Fast food restaurants also have large queues, but they tended to have enough dedicated space that stacking did not go beyond the designated queuing area.

The data collected for this paper along with the data from the papers by Mark Stuecheli and the ITE Technical Committee 5D-10 (see Appendix for both of these) will hopefully provide useful data for traffic engineers and others trying to analyze drive-through queuing storage areas.

5.0 Labor Savings of the COUNTkit

Deploying people in the field to perform this data collection would not have been feasible. Using the COUNTcam video system made it possible to observe the drive through lanes 24 hours a day and the PC-TAS software made the data reduction practical. One location was recorded in November 2010 for 6 hours, three locations were recorded in August 2011 for a total of 202 hours and 26 locations were recorded in February 2012 for a total of 1012 hours. These 1220 hours of video were counted with a total of 120 hours of labor, meaning the videos were watched at approximately 10x speed. Installation of a COUNTcam takes approximately 10 minutes and retrieval takes approximately 5 minutes. This whole project was completed in approximately 3 weeks.

6.0 References

1. Stuecheli, M. (2009). New Drive-Through Stacking Information for Banks and Coffee Shops. *ITE 2009 Annual Meeting and Exhibit.* Print.
2. ITE Technical Committee 5D-10. "Queuing Areas for Drive-Thru Facilities." *ITE Journal* (May 1995): 38-42. Print.
3. Institute of Transportation Engineers. *Parking Generation.* 4th ed. Washington, DC: Institute of Transportation Engineers, 2010. Print.
4. Institute of Transportation Engineers. *Trip Generation.* 8th ed. Washington, DC: Institute of Transportation Engineers, 2008. Print.

7.0 Appendix

A – Day of Week Maximum Queues
B – New Drive-Through Stacking Information for Banks and Coffee Shops
C – ITE Technical Committee 5D-10: Queuing Areas for Drive-Thru Facilities
D – Drive-Through Data Forms

Appendix A

Day of Week Maximum Queues

		Sunday	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday
Fast Food	Arby's				5	5		
	Burger King	6	12				10	8
	McDonald's				12	13		
	McDonald's				9	8		
	Taco Bell				10	8		
	White Castle				8	5		
Car Wash	BP				6	6		
	BP			1	3			
	BP			4	3			
	Holiday				3	4		
	Mister Car Wash				10	6		
	Mobil				4	3		
Coffee	Caribou				11	10		
	Caribou	7	10	12			12	8
	Starbucks				14	16		
	Starbucks				10	11		
	Starbucks			10	12			
	Starbucks				11			
Bank	Citizens Independent Bank			5	5			
	SharePoint Credit Union				3	3		
	TCF	4					8	8
	US Bank				7	7		
	Wells Fargo			8	6			
	Wells Fargo			6				
Pharmacy	CVS			1	2			
	CVS			4	4			
	CVS			2	2			
	Walgreens				4	5		
	Walgreens			3	3			
	Walgreens			3	2			

Appendix B

New Drive-Through Stacking Information for Banks and Coffee Shops

Mark Stuecheli, PTP

Abstract

This paper provides updated queuing information for drive-in banks and new queuing data for coffee shops with drive-through lanes. The data is presented in a format similar to that used in the report for **ITE Technical Council Committee 5D-10**, originally published in 1995.

Significant changes have occurred in the way that bank patrons conduct business with their banks. In recognition of those changes, ITE has adjusted the trip generation information included in the Eighth Edition of **Trip Generation, an ITE Informational Report** to include only data collected since 2000, and the revised trip generation totals are significantly lower than in previous editions. Clearly, the reduced trip generation figures indicate a reduction in bank drive-through business. This report summarizes queuing information included in counts taken in the Kansas City metropolitan area.

In the last few years coffee shops with drive-through lanes have become prevalent throughout the country. Because those businesses were uncommon when the 1995 report was prepared, no data was gathered for those operations. This paper contains information on counts taken at those establishments, once again in the Kansas City metropolitan area.

Based on the count data, recommendations are included for the minimum amount of stacking distance to require for the two types of drive-through businesses that were studied.

Background

ITE Technical Council Committee 5D-10 was formed in 1987 to produce a database of queuing information for various types of drive-through lanes. The report of the findings of the Committee, published in the May 1995 **ITE Journal**, included information on the characteristics of drive-through lane stacking for fast-food restaurants, drive-in banks, car washes, day care centers and dry cleaners. The counts that were included in the Committee report were conducted from the late 1960s through the late 1980s in a limited number of mid-western, southern and eastern states.

As a former member of that Committee, and having submitted drive-through counts for the effort, I am in a position to make some observations about the change in drive-through usage.

Appendix B

This paper analyzes two types of drive-through operations – one that is greatly modified and another that is new since the original report was published. First, significant changes have occurred in the ways that bank patrons conduct business with their financial institutions. On-line banking, direct deposit and the wide usage of ATMs have resulted in greatly reduced trip generation totals for drive-in banks. In recognition of that fact, ITE adjusted the trip generation information for drive-in banks in the Eighth Edition of **Trip Generation, an ITE Informational Report,** to include only data collected since 2000. The trip generation rates during the p.m. peak hour for the newer data are about 44% lower than rates in the Seventh Edition.

The amount of stacking provided for bank drive-through lanes often has a critical impact on the potential site design alternatives for proposed bank properties. If the information included in the 1995 Report were to be used as the basis for establishing stacking requirements, a large area would need to be allocated to the drive-through lanes. On tight sites, that limitation could preclude developing an acceptable layout.

Clearly, the major drop in trip generation rates indicates that fewer customers are using drive-through lanes. That reduction in drive-through usage has an impact on queue lengths and other operational characteristics observed at those facilities. This paper includes updated information on queuing in bank drive-through lanes based on counts taken in the City of Overland Park, Kansas, a suburban community of 171,000 residents in the Kansas City metropolitan area.

The second area of analysis in this paper pertains to observed queuing characteristics for coffee shops with drive-through lanes. In the last few years, drive-through coffee shops have become common throughout the country. Because those businesses were an insignificant factor when the report for **ITE Technical Council Committee 5D-10** was completed, no counts were conducted for that land use category. This paper contains data on queuing for coffee shops with drive-through lanes, based on counts conducted predominantly in the Kansas suburbs of the Kansas City metropolitan area.

As is the case for drive-in banks, the length of stacking required for a site has a major impact on potential site layouts. If a relatively short stacking distance is permitted, the lanes can be fit into very restricted sites or be more easily retrofitted to work with existing buildings. But if more queuing occurs than is provided for in a dedicated lane, the flow of traffic within a parking lot can be seriously restricted by that excess queue. In the worst case, if the drive-through stacking is located close to a public street and the excess queue extends into or near the street, the operation of the adjoining public street may be negatively impacted.

Appendix B

Drive-In Banks

Counts were conducted at ten suburban drive-in banks located throughout Overland Park in the fall of 2008 and the spring of 2009. Both established locations and sites that were relatively new were counted, although all banks had been open for business for at least one year. All but one location had drive-through ATMs. Based on the results of counts taken at a single bank location during a mid-week lunch hour, a mid-week p.m. peak hour, a Friday lunch hour, and a Friday p.m. peak hour; the maximum queue lengths occurred during the Friday p.m. peak hour. Therefore, all counts used in the study were conducted during the Friday p.m. peak hour time period.

The counting process involved noting the maximum per lane and total queues for the drive-through lanes at each location in fifteen minute increments, along with collecting information on the stacking of any drive-through ATM. In all cases the vehicles in the service positions were included in the counts. Where possible, the volumes of vehicles entering and exiting the parking lot also were tabulated. As a way to evaluate the frequency of various maximum queue lengths, the total queue lengths were noted at five minute intervals.

The queuing data was analyzed in ways similar to the methods used in the 1995 Report. Table 1 lists the observed frequency of maximum queue lengths per lane. Figure 1 plots the per lane maximum queue lengths using both the 2009 data and the data that was presented in 1995 (please note that the 1995 data involved fifteen counts, compared to the ten counts in the 2009 data). Figure 2 plots the probability that the queue lengths per lane will not exceed a given maximum queue length, once again presenting both 2009 and 1995 data.

Table 1 – Drive-In Bank 2009 Maximum Queue Length Per Lane

Queue Length	Frequency	Cumulative Frequency	$P(q \leq N)$
0	0	0	0.00
1	1	1	.10
2	4	5	.50
3	4	9	.90
4	1	10	1.00

Note: $P(q \leq N)$ indicates probability, based on sample, of queue length of “q” not exceeding length “N”

Appendix B

Figure 1 – Drive-In Bank 1995 And 2009 Maximum Queue Length Per Lane Data Plot

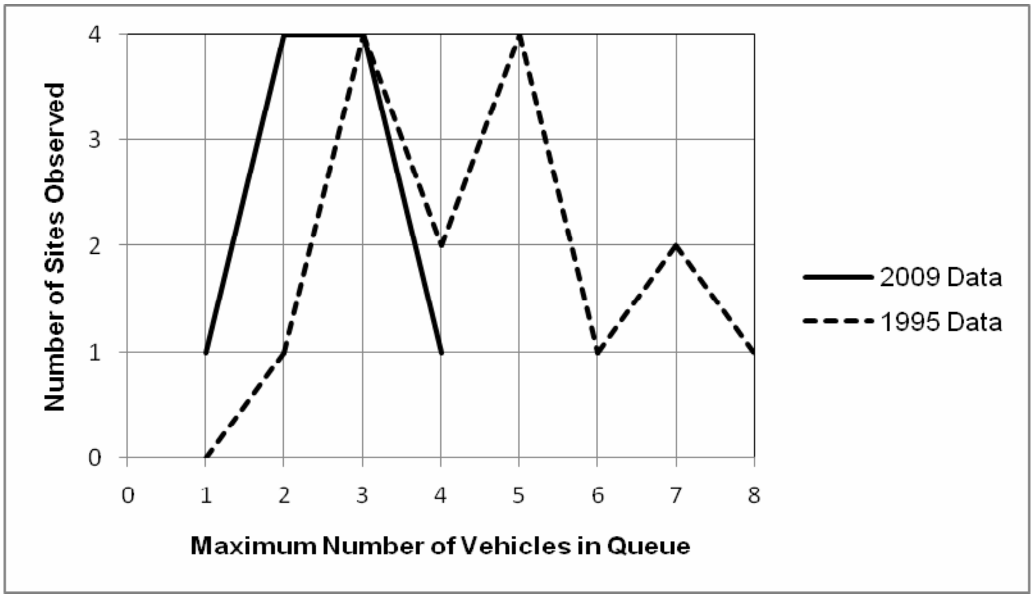
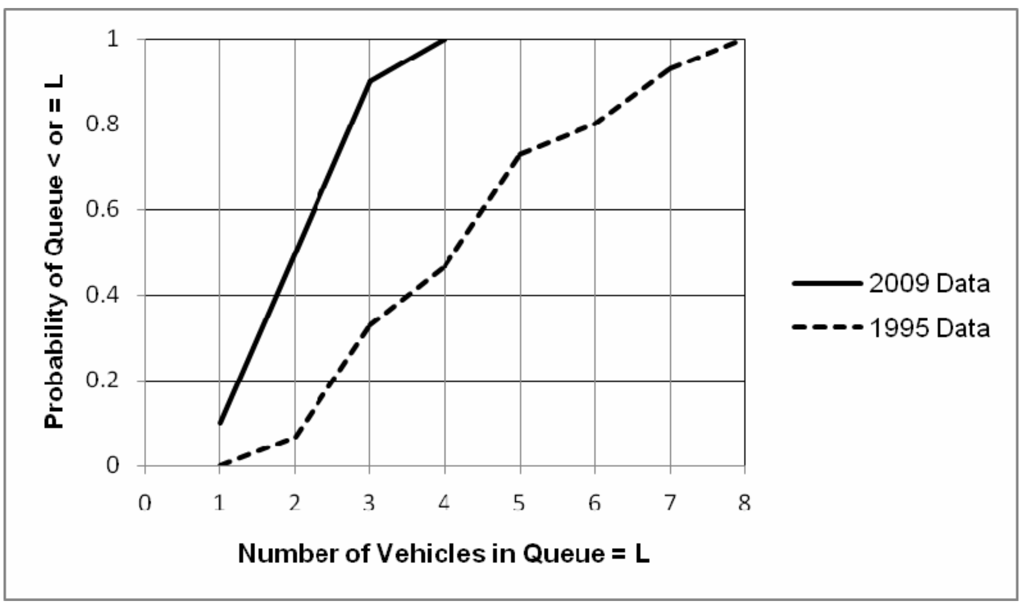


Figure 2 – Drive-In Bank 1995 And 2009 Cumulative Maximum Queue Length Per Lane Data Plot



The differences between the 1995 Report data (as noted earlier, actually based on counts conducted from the late 1960s to the late 1980s) and the 2009 counts are dramatic. The maximum per-lane queue lengths in the current counts were half what they were in the 1995 data.

An attempt was made to determine if such factors as adjoining major street traffic volumes or the size of the building could predict the queuing results, but no correlation was found.

Observations

Some banks, especially those that have been in operation for several years, have a surplus of drive-through lanes and stacking area. That is because those sites were designed to accommodate the much higher demands that existed many years ago. Consequently, they often open only a portion of the available lanes.

In one case, for a main office bank location where it was possible to make a direct comparison between a count conducted in 1988 and a new count in 2008 (actually taken almost precisely 20 years apart), the difference was dramatic. The p.m. peak hour drive-through volumes for the 2008 count were 65% lower than the 1988 count, a much greater drop than would have been indicated by the reduced ITE trip generation figures discussed earlier. The maximum total number of vehicles queued and the maximum queue lengths per lane were correspondingly lower, dropping from 29 to 8 and 7 to 3, respectively. The demographics and development characteristics of the surrounding area have changed little since 1988 and the bank has continued as a stable operation. Considering all of those factors, it is reasonable to assume that the differences are associated with changes in customers' banking habits.

The one incidence of a four car per lane maximum stack was a single occurrence that lasted for only a few minutes. Based on that information, it is reasonable to consider the practical maximum required queue length to be three vehicles.

The maximum queue lengths for ATMS ranged from two to five vehicles. Only one location experienced the longer queue lengths and only for a short time period. All other locations had maximum queue lengths of three vehicles or less.

Coffee Shops With Drive-Through Lanes

Counts were conducted in the fall of 2008 and the spring of 2009 at twelve coffee shops located in the Kansas suburbs of Merriam, Olathe and Overland Park in the Kansas City metropolitan area and also in suburban Kansas City, Missouri. All but two of the establishments were situated in free-standing buildings, and several were located within shopping centers. Three were drive-through-only operations and the remaining nine were full-service locations that included both drive-through lanes and inside seating facilities. Because this type of use is busiest in the morning peak hour, all counts were completed during that time period.

Similar to the process used for drive-in banks, the counting process involved noting the maximum number of vehicles queued in the drive-through lane at each location for fifteen minute increments. As was done for the drive-in bank counts, the vehicle in the service position was included in the counts. Information on the number of vehicles entering and leaving the parking lot was collected for full-service operations (drive-through-only locations did not have any parking activity). The queuing information was tabulated for both the total length of queue and for the number of vehicles behind the menu board. The observed queue length was noted at five minute intervals as a way to evaluate the frequency of various queue lengths.

Once again, the queuing data was analyzed in ways similar to the methods used in the 1995 Report. Table 2 lists the observed frequency of maximum queue lengths. Figure 3 plots the per-lane maximum queue lengths and Figure 4 plots the probability that the queue will not exceed a given maximum queue length.

Table 2 – Coffee Shop With Drive-Through Maximum Queue Length

Queue Length	Frequency	Cumulative Frequency	P(q≤N)
0	0	0	0.00
1	0	0	0.00
2	0	0	0.00
3	1	1	.08
4	0	1	.08
5	0	1	.08
6	1	2	.17
7	1	3	.25
8	2	5	.42
9	1	6	.50
10	1	7	.58
11	2	9	.75
12	0	9	.75
13	3	12	1.00

Note: P(q≤N) indicates probability, based on sample, of queue length of “q” not exceeding length “N”

Appendix B

Figure 3 – Coffee Shop With Drive-Through Maximum Queue Length Data Plot

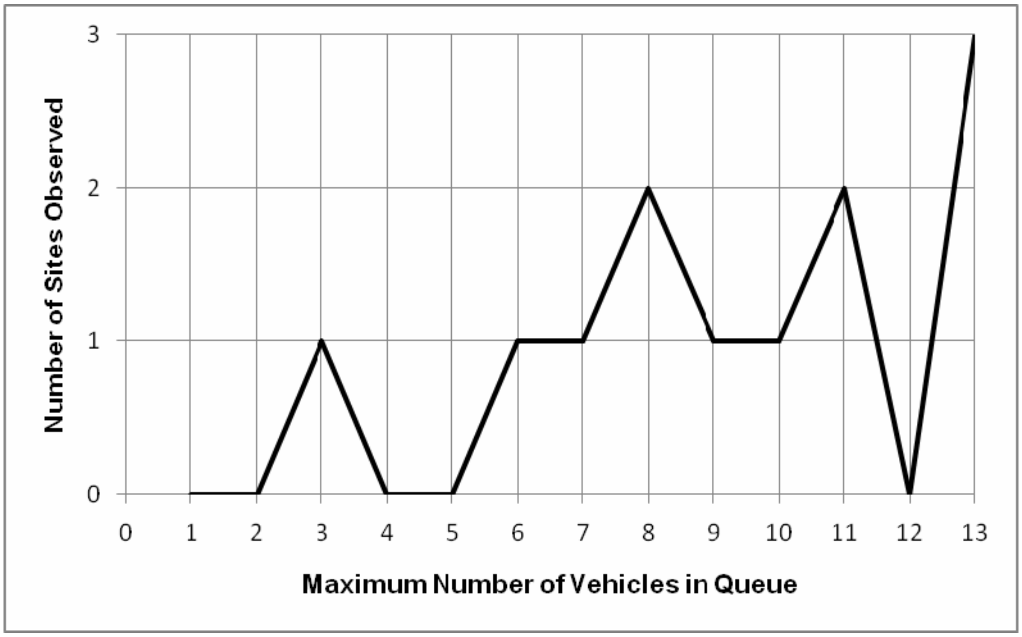
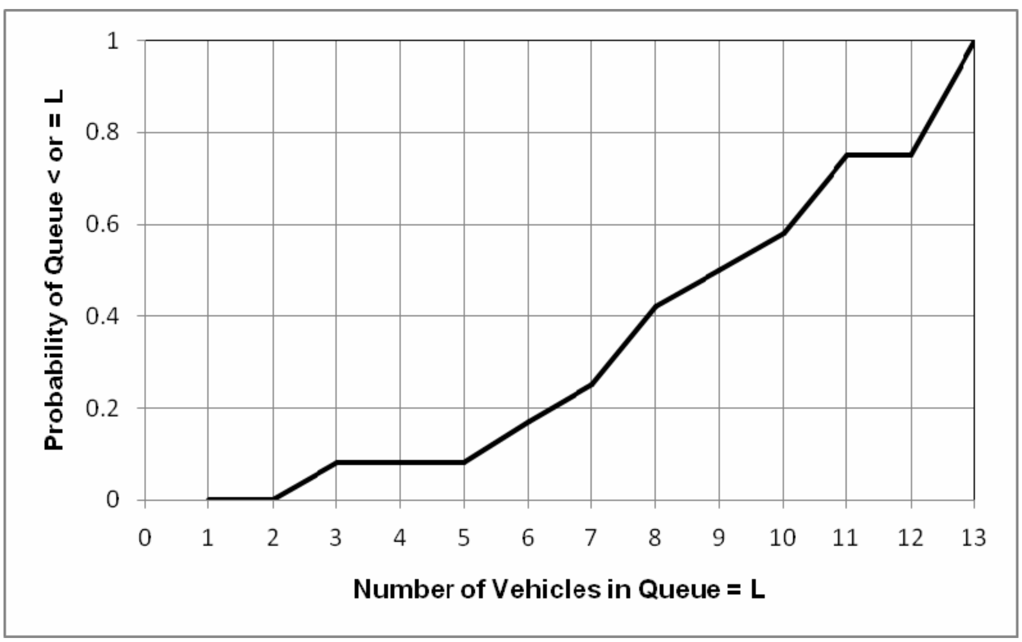


Figure 4 – Coffee Shop With Drive-Through Cumulative Maximum Queue Length Data Plot



Appendix B

The total trip generation figures were compared to the a.m. peak hour ITE rates for Land Use Code 937, Coffee/Donut Shop with Drive-Through Window, and Land Use Code 938, Coffee/Donut Shop with Drive-Through Window and No Indoor Seating. The observed counts generally fell within the range of counts included in those categories, although two of the rates for the No Indoor Seating category exceeded the published range. No correlation was found between the adjoining major street traffic volumes or the size of the building and either the queuing or the trip generation results.

Observations

Several of the drive-through lanes were under-designed for the usage that was observed and queues spilled-out into parking lot circulation areas. In most cases the excess stacking did not result in disruptions of the operations of surrounding uses, since most other businesses were not open in the early morning. But for those sites where the end of the drive-through lane extended into the coffee shop parking lot, the excess queue often disrupted the movements of drivers who were trying to enter or exit parking spaces or the site itself.

One interesting facet of the data is that the three lowest observed maximum queue lengths were for the drive-through-only locations. The highest observed queue length for those operations was seven vehicles, which occurred only once at one location and only for a very short period of time. A six vehicle maximum stack was a more common occurrence.

The data shows that the volume of drive-through traffic and, therefore, the required stacking distance, is higher for full-service coffee shops than for drive-through-only operations. When total trip generation (both drive-through business and customers who park and walk in) is factored in, the full-service coffee shops did, on average, about two and one-half times the business of drive-through-only facilities. Since all of the full-service operations were Starbucks locations, it may be possible to apply the results of those counts to other proposed suburban Starbucks locations elsewhere in the country.

Total vehicular stacking available for a drive-through lane is an important consideration, but the location of the menu board relative to the pick-up window also impacts the efficiency of a drive-through lane operation. If the spacing is too short, stacking behind the pick-up window will extend into the menu board area, delaying ordering for those farther back in the line. In the counts conducted for this study, the pick-up window to menu board available stacking distances ranged from two to five vehicles.

The operation with the two car stack between the pick-up window and menu board regularly resulted in delays for drivers waiting to order at the menu board. The location with a five car stack rarely experienced delays for those ordering. Based on field observations, if an unlimited amount of stacking were available at a proposed site, the five car spacing would be ideal. Realizing that space for stacking nearly always is limited, an acceptable alternative would be the four car spacing.

Appendix B

Conclusions

Drive-in bank usage has dropped dramatically, as illustrated in the data provided in this report. Consequently, a reduced amount of stacking is required. That reduced area for drive-through stacking can provide more flexibility in the design of bank sites, allowing for development on smaller sites or the provision of increased landscaped areas.

Based on the data that was gathered, the City of Overland Park has reduced its previous requirement for a minimum five car stack per lane to a three car stack (a distance of 60 feet per lane, assuming average vehicle spacing to be 20 feet). That design should be sufficient to accommodate virtually all situations. Vehicular stacking requirements for ATMs have been established, also at a minimum of three car lengths.

Coffee shop drive-through lanes are most heavily used during the morning peak period, and therefore it is important to design sites to accommodate that peak demand. The following recommended minimum stacking lengths should be appropriate in most cases. The only exceptions would be situations in which excess queuing could impact a nearby street or major drive, in which case a more conservative approach should be taken.

Based on the data that was gathered for drive-through-only operations, it appears reasonable to require that a dedicated drive-through lane be provided with a stack of 120 feet – enough to handle six vehicles. That should be sufficient to accommodate nearly all vehicles that are likely to arrive during the morning peak hour time period.

For full service establishments, a 220-foot long drive-through lane, providing eleven cars of total storage, should be adequate to handle the vast majority of the drive-through lane volumes that might be encountered. In those cases where more than eleven vehicles were counted, the duration of the extreme queue lasted for only a few minutes. For the most efficient operation, the distance between the pick-up window and menu board should be at least 80 feet to accommodate four vehicles.

References

1. Gattis, J. L., Chair of ITE Technical Council Committee 5D-10. “Queuing Areas for Drive-Thru Facilities, by ITE Technical Council Committee 5D-10.” *ITE Journal* (May 1995): 38-42.

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Queuing Areas For Drive-Thru Facilities

BY ITE TECHNICAL COUNCIL COMMITTEE 5D-10

ITE Technical Council Committee 5D-10 was formed to collect and analyze basic information that may be used to estimate and evaluate lengths of automobile queues at drive-thru facilities. In addition to fulfilling this objective, this Informational Report constitutes a starting point for compiling a database for drive-thru facility queue length information.

Introduction

When faced with the need to evaluate the future impacts of a planned development, the transportation engineer often employs some form of analogy, estimating the future impacts of as-yet unbuilt development by using the attributes of existing land uses having a similar nature. For instance, the engineer may refer to published trip generation rates, derived from observations made at existing developments, to obtain a figure by which to estimate volumes that will occur at the proposed development.

J. L. Gattis, P.E., was Chair of Technical Council Committee 5D-10. He is an Assistant Professor in the Department of Civil Engineering at the University of Arkansas in Fayetteville, Ark. He is a Member of ITE.

Many types of businesses (such as fast-food restaurants, banks and cleaners) utilize drive-thru systems. A similar form of drive-thru operation can be found at sites where passenger pick-up operations occur (such as parents picking up schoolchildren). These drive-thru systems are comprised of a server position (often at a service "window"), and vehicle queuing space in advance

QUEUING DATA SHEET

1. Type of Service Provided ____________
2. Day(s) of Week — Sun Mon Tue Wed Thu Fri Sat
3. Time(s) of Day ____________
4. Type of Area — CBD ☐ Surburban ☐ Rural ☐
5. Competition in Area (For Same Services) — High ☐ Medium ☐ Low ☐
6. Service Rate Measured (Per Window or Aisle or Lane) ________ Vehicles/Time
7. Arrival Rate Measured (Per Window or Aisle or Lane) Avg ____ Max ____ Vehicles/Time
8. Uniformity Rating ________ (1 - 10)
9. Capacity of Queue Storage Area ________ (Vehicles)
10. Measured Average Queue ________ (Vehicles)
11. Measured Maximum Queue ________ (Vehicles)
12. Excess Demand Volume ________ (Vehicles)
13. Excess Demand Frequency ____________
14. Size Sample or Length of Count Data ____________
15. Narrative Description of Service ____________

Figure 1. Data gathering form used in survey.

of the service position, for waiting in line as those ahead are served first.

When attempting to project lengths of automobile queues at proposed drive-thru facilities, the municipal or private consulting engineers may not find available data by which a projection can be made. While such data may be known by larger business chains that have drive-thru operations, the data do not seem to be generally available to the average traffic engineer trying to size or evaluate automobile queue storage area. True, some publications present results of queuing studies or equations for estimating queue lengths based on known system arrival and service rates.[1-9] But the proposed-site arrival and service rates may be unknown, and the proposed system may not possess attributes (such as negative exponential service time rates) needed for certain equations to properly predict queue lengths.

Drive-thru facilities are perceived as time-savers; as a convenience to the physically challenged, elderly and parents with young children; and as a way to avoid going out into inclement weather. Due to vehicle idling while in line, drive-thru facilities may also be viewed as causing unnecessary fuel consumption and air pollution. The popularity of drive-thru services creates a need to evaluate the queuing capacities of the varied drive-thru facilities. This report provides some basic drive-thru facility queue length information. It is hoped that the database will continue to grow, so that a comprehensive analytical tool may be available for the transportation professional.

Methods

The queue length data gathering form shown in Figure 1 was distributed to committee members in November 1987. The form was accompanied by specific user-instructions to ensure uniformity of procedures and compatibility of results.

Completed forms were returned to the committee chair and data were cataloged by land-use type. The maximum observed queue lengths and the maximum observed queue length frequencies were compiled. Cumulative frequencies and the probability that queues would not exceed an absolute maximum were calculated and shown graphically.

Table 1. Ranges of Fast Food Queue Lengths by Food Type

Food Type	*Maximum Queue Range (# in system)*	*Average Maximum Queue (# in system)*	*Studies*
Donuts	4	4	2
Steak	4	4	2
Chicken	2–9	5	5
Fish	5	5	1
Sandwiches	5	5	1
Mexican	7	7	1
Roast Beef	6–8	7	2
Hamburgers	4–13	7	27

Table 2. Fast Food Queue Lengths

Maximum Queue Length (# in system)	*Frequency*	*Cumulative Frequency*	*P(q≤N)*
1	0	0	0.00
2	2	2	0.05
3	0	2	0.05
4	6	8	0.18
5	4	12	0.27
6	7	19	0.43
7	10	29	0.66
8	7	36	0.82
9	5	41	0.93
10	1	42	0.95
11	0	42	0.95
12	1	43	0.98
13	1	44	1.00

Note: P(q≤N) indicates probability, based on sample, of queue length "q" not exceeding length "N".

Findings

Within this report, data have been compiled for banks, car washes, day care facilities, dry cleaners and fast-food restaurants.

Fast Food

This category includes restaurants characterized by food being prepared in advance of, or shortly after, ordering; by high turnover for eat-in customers; and by long business hours. The ITE land-use codes (LUCs) for this use are LUC 834 (*Trip Generation*, 1991) and 836 (*Parking Generation*, 1987).

Forty-four fast-food restaurants were observed for this study. They ranged from those serving chicken to the hamburger chains. All sites were suburban locations. Queuing was observed mainly during the weekday mid-day peak from the 1970s through the 1990s, at sites in Florida, Kansas, Illinois, Minnesota, Montana, New Jersey, Oklahoma, Pennsylvania and Texas. All fast-food facilities observed for this study had a single-window drive-thru system. The industry is changing, with double- and even triple-window systems being utilized. Further information will be needed on queuing characteristics of these facilities.

The average observed service rate was 54 vehicles per hour (vph); the maximum rate was 108 vph. The maximum observed queue lengths (number of vehicles in line, including vehicle at service position) ranged from two to 13 vehicles (see Table 1). Where there was a menu-order board followed by a service window, the combined total of vehicles in both sequential lines was reported.

The restaurants featuring hamburgers had maximum queues in the upper part of the range. Table 2 shows the frequencies of the observed maximum queue lengths, as well as a probability of a queue of less than a given number

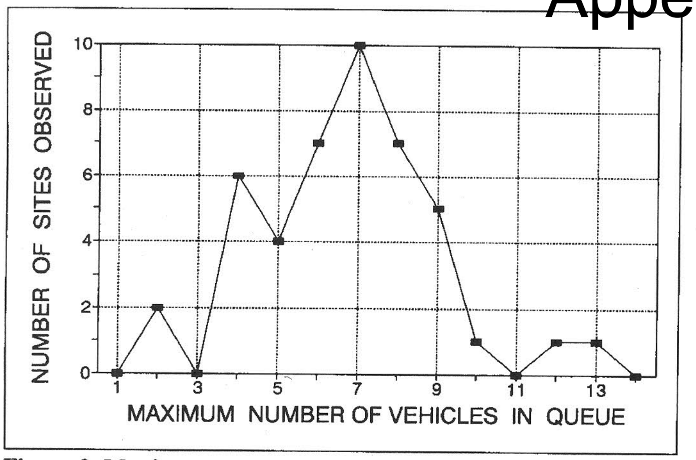

Figure 2. Maximum queue lengths at fast-food.

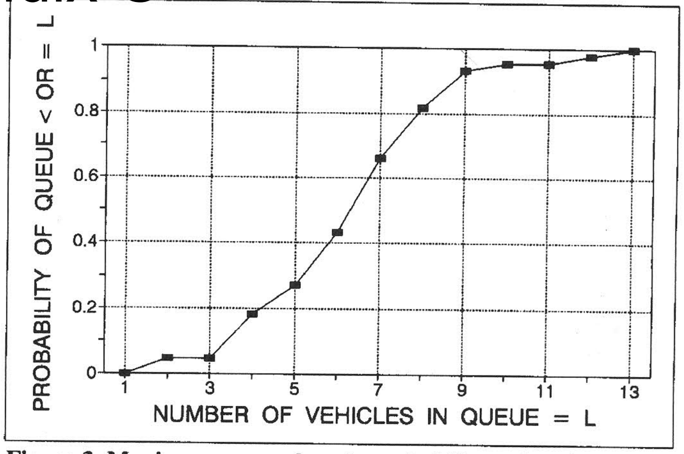

Figure 3. Maximum queue length probability at fast-food.

of vehicles. Figure 2 plots maximum queue length against the observed frequency of occurrence. Figure 3 depicts the probability that at any fast-food site, the queue will not exceed a given maximum queue length. From Table 2 or Figure 3, it can be seen that there was a 95 percent probability that the maximum queue at a site would be no more than 10 vehicles.

The maximum queues were evaluated against days of the week and were found to have no statistical relationship. Likewise, when evaluated against different levels of competition within the area and against service rates, there was no statistical relationship.

Bank

This category includes savings-and-loans with or without automatic teller machines (ATMs) and commercial banks with or without ATMs. Although there were historical differences between banks and savings-and-loans, they are now often indistinguishable to the public. The ITE land-use codes for this use are LUC 912 and 914 (*Trip Generation*, 1991) and LUC 912 (*Parking Generation*, 1987).

The studies analyzed were conducted from the late 1960s through the late 1980s; many were in Illinois, Minnesota, New Jersey and Texas. The size of the bank drive-thru facilities ranged from a minimum of one lane with one teller-window up to an institution with 10 lanes and four tellers.

Observed service rates for these institutions went up to a maximum of 35 vehicles per lane-hour. Maximum observed queues per lane ranged from two to eight vehicles. The maximum system queue lengths (all lanes combined) ranged from five to 29 vehicles. At two sites, it was observed that a queue length exceeding eight vehicles per lane was not tolerated by customers. When the queue length became excessive, customers would park and use walk-in facilities rather than the drive-thru. Thus the collected data reflect a maximum queue per lane of eight vehicles.

Table 3 shows the observed frequency of occurrence of maximum queue lengths per lane. Figure 4 plots the maximum number of vehicles per lane observed. On the basis of the studies received, there is a 100 percent probability that the queue length at a bank drive-thru facility will not exceed eight vehicles per lane, as Figure 5 shows.

Table 4 presents the maximum number of vehicles in an entire drive-thru system (all lanes combined) by ranges, along with the frequency of occurrence. This table shows that the most common maximum number-in-the-system at a bank drive-thru facility fell between six and 10 vehicles, as most observed facilities consisted of two lanes. Table 4 also

Table 3. Bank Queue Lengths

	Maximum Queue Per Lane		
Queue Length	*Frequency*	*Cumulative Frequency*	*P(q≤N)*
0	0	0	0.00
1	0	0	0.00
2	1	1	0.07
3	4	5	0.33
4	2	7	0.47
5	4	11	0.73
6	1	12	0.80
7	2	14	0.93
8	1	15	1.00

Note: P(q≤N) indicates probability, based on sample, of queue length "q" not exceeding length "N".

Table 4. Maximum Number of Vehicles in Bank System (All Lanes)

# in system	*Frequency*	*Cumulative Frequency*	*P(q≤N)*
0 – 5	2	2	0.13
6 – 10	6	8	0.53
11 – 15	3	11	0.73
16 – 20	2	13	0.87
21 – 25	1	14	0.93
26 – 30	1	15	1.00

Note: P(q≤N) indicates probability, based on sample, of queue length "q" not exceeding length "N".

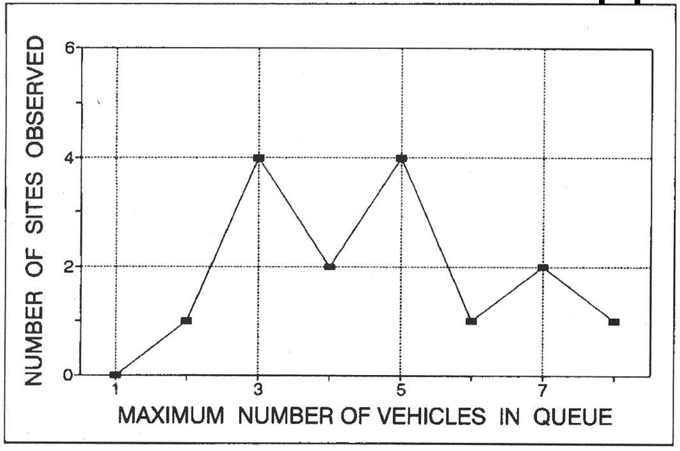

Figure 4. Maximum queue length per lane at bank.

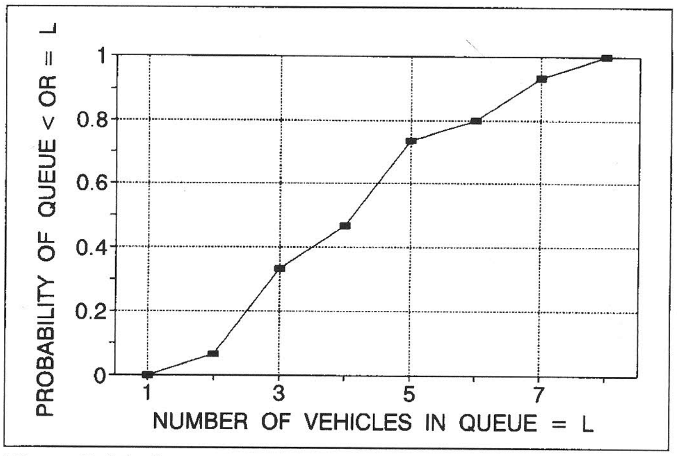

Figure 5. Maximum per lane queue length probability at bank.

gives the probability, based on the studies received, that the number of vehicles in the system will not exceed a certain range.

It should be noted that queuing lengths may be affected by time-of-day banking habits. There may be differences between the central city and a suburb. An area with a large proportion of retired persons may experience unique banking-time behaviors. In addition, the effects of banks incorporating ATMs into drive-thru aisles may also need to be investigated in future queuing studies.

Car Wash

This category includes full-service car washes (offering vacuuming and towel-drying services), exterior tunnel operation (vacuuming and towel drying not a part of the "in-line" operation, but may be offered at separate stations to the side), and self-service car washes (where customers pull into a wash bay, insert coins into a box, and proceed to wash). The ITE land-use code for these uses is LUC 847 (*Trip Generation*, 1991). This land use was not included in the 1987 *Parking Generation* report.

The studies analyzed were conducted from the late 1960s through the late 1980s in Kansas, Illinois, Montana, New Jersey and Texas. They included seven full service car washes, two exterior tunnel car washes, and nine self-service car washes. The number of self-service bays ranged from six to 14 per site. The self-service car washes typically had one or more parallel wash bays; the full-service car wash operations tended to have a single tunnel to serve customers.

Studies at the full-service car washes were made during winter or early spring months. Both full-service car washes consisted of a single tunnel. Observed service rates were 35 vph (maximum queue of nine vehicles) and 27 vph (maximum queue of 26 vehicles). At the site with a 26-vehicle queue, the queue extended off the site and onto an adjacent private street with light traffic volumes.

The self-service car wash studies were conducted on Saturday and Thursday, during late spring and/or summer months. Service rates at self-service car washes ranged from 4.1 vehicles per bay-hour to 5.4 vehicles per bay-hour. The average service rate was 4.77 vehicles per bay-hour. The maximum queue observed at two study sites was three vehicles, and at a third study site the maximum observed was one vehicle. No distinction was made as to whether these were maximum queues per bay or total maximum queues (per entire operation).

Day Care

This category includes facilities that provide a place for children during the day, often while parents are at work. After-school care may also be provided. The ITE land-use code is LUC 565 (*Trip Generation*, 1991). This land use was not included in the 1987 *Parking Generation* report.

Data were submitted for one daycare facility in Texas, during the evening peak hour. The facility had 99 children enrolled and 94 present the day the study was conducted. The daycare facility handled children age 2 through first grade. The facility was operated in a manner that required the parents to park their cars and go inside to get their children.

The hour service rate was 46 vehicles. A maximum of eight vehicles in

This is an Informational Report of the Institute of Transportation Engineers prepared by Technical Council Committee 5D-10. The information in this report has been obtained from experiences of transportation engineering professionals and research. ITE Informational Reports are prepared for informational purposes only and do not include Institute recommendations on which is the best course of action or the preferred application of the data.

Members of Technical Council Committee 5D-10 were J. L. Gattis, P.E. (M), Chair; Grant A. Bacchus, P. Eng. (F); Benedict G. Barkan (F); Robert R. Marvin, P.E. (M); Dale B. McKinney, P.E. (F); Robert A. Nelson, P.E. (F); Seyed M. Safavian (M); James M. Schoen (A); David K. Sorenson, P.E. (A); Mark J. Stuecheli (M); and Jack Wierzenski (A).

Members of the Technical Council Department 5 Standing Committee at the time of approval of this report were Dennis O'Malley (F), Chair; Carol H. Walters, P.E. (M), Assistant Chair; Robert D. McMillen, P.E. (FL); Wamahdri W. Williams (A); and Donald J. Galloway, P.E. (F). Brian S. Bochner, P.E. (F), was the Chair of Technical Council, and John M. Mason, P.E. (F), was the Assistant Chair.

Table 5. Summary of Observed Queue Distances at Drive-Thru Facilities

	Near-maximum number of queued vehicles observed in system (does not include vehicle at service position)	Lane Length needed to store near-maximum queue (does not include) vehicle at service position)
Fast-Food (Hamburger)	10 – 1 = 9	60 m (198 feet)
Bank	8 – 1 = 7	47 m (154 feet)
Car Wash (self-service)	3 – 1 = 2	13 m (44 feet)
Day Care	10 – 1 = 9	can store in parallel
Dry Cleaner	3 – 1 = 2	13 m (44 feet)

5 minutes (if sustained, equivalent to 96 vph) were observed; a 20-minute period had 28 vehicles (84 per hour). The maximum number of waiting vehicles was 10 vehicles.

VanWinkle and Kinton reported the results of 29 field studies at day-care establishments in Tennessee. Their findings are in the July 1994 *ITE Journal*.[8]

Dry Cleaners

This category includes facilities that clean clothing and other fabrics that should not be laundered. Often a walk-up window is present. No information is provide for this land use in either the ITE 1991 *Trip Generation* report or the ITE 1987 *Parking Generation* report.

One study was conducted at a dry cleaner with drive-thru facilities in Montana during a weekday p.m. peak period. An average service rate of 41 vph was measured at the single window. The observed maximum queue was three vehicles long. Forty-five percent of the customers used the drive-thru facility.

Conclusions

Table 5 summarizes the observed maximum or near-maximum observed queue lengths, and also lists the stacking distance needed to accommodate these observed queues, based on a front bumper-to-front bumper space occupied length of 22 feet (ft) per vehicle. This 22 ft may not be the exact space that vehicles occupy, but a value ranging from 20 ft to 25 ft seems appropriate for many situations. Because only one day-care facility was observed, and because parents picking up children may park in parallel or in a lot instead of in a single-file line, no stacking length was calculated for this land use.

Due to a change of committee personnel during the course of the data-gathering effort, some of the original forms submitted by committee members are not available. There are some apparent errors in the tables. For instance, the number of studies tallied in Table 1 is 41, while the number in Table 2 is 44. It is not known whether three studies were not included in Table 1, or whether there was double counting in Table 2. The unavailability of the original data forms makes it impossible to recheck the numbers.

The size of this drive-thru facility queuing characteristic database was limited. There is a need to accumulate and analyze more drive-thru queuing system data, so transportation engineers and site planners can be better informed. Additional observations of service rates are also needed in order to determine relationships between service rates and queue lengths, and to evaluate long-term trends in service rates. Finally, investigations of the amount of space occupied per vehicle within a queue are needed so that engineers will have the ability to project not only the number of vehicles that will be in the maximum queue for a given site, but also the queue storage length required for a site.

When collecting queuing data, the recorder should clearly indicate whether the number of vehicles recorded includes or excludes the vehicle(s) in the service position (that is, at the window). The data record must indicate which numbers are for a single queuing line and which totals are for the entire system of multiple queuing lines. An observer should also note instances of arriving vehicles balking or refusing to enter a queue due to excessive length, and how many vehicles were in the queue when the next arrival balked.

Other types of drive-thru operations that could be studied include those at credit unions, funeral homes, gas stations (either gas only, full-service, self-service, or a combination with convenience stores or car washes), libraries, liquor stores, movie theater ticket booths, parking lots and garages (either pick-up ticket or pay, or key, tag, or card), post offices, pre-schools, baby-sitting or school combinations, lower grade schools, stadium ticket sales machines, truck stops and places of worship.

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Appendix D

Drive-Through Queuing Data Form

ITE Land Use Code:	912
Land Use/Building Type*:	Drive-in Bank
Name of Business:	Citizens Independent Bank
Address:	3700 W Broadway Ave
City:	Robbinsdale
State:	MN
Zip Code:	55422
Date(s)	February 7-8, 2012 (Tuesday-Wednesday)
Weather Conditions	High 32 °F and Clear

Location Within Area (select one):

CBD	
Urban (non-CBD)	
Suburban (non-CBD)	X
Suburban CBD	
Rural	
Not Given	

Competition Within Area (select one):

High	
Medium	X
Low	

Drive-Through Description	4 Lanes + 1 ATM Lane
Gross Floor Area (estimated)	6300

	Maximum Queue	Time Max Queue Occurred
Sunday		
Monday		
Tuesday	**5**	**3:36pm**
Wednesday	**5**	**2:37pm**
Thursday		
Friday		
Saturday		

Appendix D

Drive-Through Queuing Data Form

ITE Land Use Code:	912
Land Use/Building Type:	Drive-in Bank
Name of Business:	SharePoint Credit Union
Address:	3670 Aquila Ave S
City:	St. Louis Park
State:	MN
Zip Code:	55426
Date(s)	February 1-2, 2012 (Wednesday-Thursday)
Weather Conditions	High 32-36 °F and Fog

Location Within Area (select one):

CBD	
Urban (non-CBD)	
Suburban (non-CBD)	X
Suburban CBD	
Rural	
Not Given	

Competition Within Area (select one):

High	
Medium	X
Low	

Drive-Through Description :	2 Lanes + 1 ATM Lane
Gross Floor Area (estimated)	7,850 sq. ft

	Maximum Queue	Time Max Queue Occurred
Sunday		
Monday		
Tuesday		
Wednesday	**3**	**3:28pm**
Thursday	**3**	**8:51am, 10:37am**
Friday		
Saturday		

Appendix D

Drive-Through Queuing Data Form

ITE Land Use Code:	912
Land Use/Building Type:	Drive-in Bank
Name of Business:	TCF Bank
Address:	8020 Highway 7
City:	St. Louis Park
State:	MN
Zip Code:	55426
Date(s)	August 5-7, 2011 (Friday-Sunday)
Weather Conditions	High 84-88 °F and Clear

Location Within Area (select one):

CBD	
Urban (non-CBD)	
Suburban (non-CBD)	X
Suburban CBD	
Rural	
Not Given	

Competition Within Area (select one):

High	
Medium	X
Low	

Drive-Through Description :	5 Lanes + 1 ATM Lane
Gross Floor Area (estimated)	6,000 sq. ft

	Maximum Queue	Time Max Queue Occurred
Sunday	**4**	**5:18pm**
Monday		
Tuesday		
Wednesday		
Thursday		
Friday	**8**	**12:20pm, 2:20pm**
Saturday	**8**	**11:40am**

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Drive-Through Queuing Data Form

ITE Land Use Code:	912
Land Use/Building Type:	Drive-in Bank
Name of Business:	US Bank
Address:	4000 W Broadway Ave
City:	Robbinsdale
State:	MN
Zip Code:	55422
Date(s)	February 7-8, 2012 (Tuesday-Wednesday)
Weather Conditions	High 32 °F and Clear

Location Within Area (select one):

CBD	
Urban (non-CBD)	
Suburban (non-CBD)	X
Suburban CBD	
Rural	
Not Given	

Competition Within Area (select one):

High	
Medium	X
Low	

Drive-Through Description :	3 Lanes + 1 ATM Lane
Gross Floor Area (estimated)	21,550 sq. ft.

	Maximum Queue	**Time Max Queue Occurred**
Sunday		
Monday		
Tuesday	**7**	**4:47pm, 5:04pm**
Wednesday	**7**	**3:00pm, 5:26pm**
Thursday		
Friday		
Saturday		

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Drive-Through Queuing Data Form

ITE Land Use Code:	912
Land Use/Building Type:	Drive-in Bank
Name of Business:	Wells Fargo
Address:	425 E Hennepin Ave
City:	Minneapolis
State:	MN
Zip Code:	55414
Date(s)	February 7, 2012 (Tuesday)
Weather Conditions	High 32 °F and Clear

Location Within Area (select one):

CBD	
Urban (non-CBD)	X
Suburban (non-CBD)	
Suburban CBD	
Rural	
Not Given	

Competition Within Area (select one):

High	
Medium	X
Low	

Drive-Through Description :	4 Lanes + 1 ATM Lane
Gross Floor Area (estimated)	12,000 sq. ft.

	Maximum Queue	Time Max Queue Occurred
Sunday		
Monday		
Tuesday	**6**	**1:18pm**
Wednesday		
Thursday		
Friday		
Saturday		

Appendix D

Drive-Through Queuing Data Form

ITE Land Use Code:	912
Land Use/Building Type:	Drive-in Bank
Name of Business:	Wells Fargo
Address:	2329 Central Ave NE
City:	Minneapolis
State:	MN
Zip Code:	55418
Date(s)	February 7-8, 2012 (Tuesday-Wednesday)
Weather Conditions	High 32 °F and Clear

Location Within Area (select one):

CBD	
Urban (non-CBD)	X
Suburban (non-CBD)	
Suburban CBD	
Rural	
Not Given	

Competition Within Area (select one):

High	
Medium	X
Low	

Drive-Through Description :	7 Lanes (4-5 Lanes were open at various points) + 1 ATM Lane
Gross Floor Area (estimated)	20,125 sq. ft.

	Maximum Queue	Time Max Queue Occurred
Sunday		
Monday		
Tuesday	**8**	**4:41pm**
Wednesday	**6**	**11:27am, 1:48pm, 2:23pm, 4:32pm, 5:25pm**
Thursday		
Friday		
Saturday		

Appendix D

Drive-Through Queuing Data Form

ITE Land Use Code:	948
Land Use/Building Type:	Automated Car Wash
Name of Business:	BP
Address:	3012 Excelsior Blvd
City:	Minneapolis
State:	MN
Zip Code:	55416
Date(s)	February 1-2, 2012, (Wednesday-Thursday)
Weather Conditions	High 32-36 °F and Fog

Location Within Area (select one):

CBD	
Urban (non-CBD)	X
Suburban (non-CBD)	
Suburban CBD	
Rural	
Not Given	

Competition Within Area (select one):

High	
Medium	
Low	X

Drive-Through Description :	1 Lane. Only counted the vehicles waiting in line, not the vehicles currently being washed.
Gross Floor Area (estimated)	3,375 sq. ft

	Maximum Queue	Time Max Queue Occurred
Sunday		
Monday		
Tuesday		
Wednesday	**6**	**3:08pm**
Thursday	**6**	**3:07pm**
Friday		
Saturday		

Appendix D

Drive-Through Queuing Data Form

ITE Land Use Code:	948
Land Use/Building Type:	Automated Car Wash
Name of Business:	BP
Address:	2441 Fariview Ave N
City:	Roseville
State:	MN
Zip Code:	55113
Date(s)	February 7-8, 2012 (Tuesday-Wednesday)
Weather Conditions	High 32 °F and Clear

Location Within Area (select one):	
CBD	
Urban (non-CBD)	
Suburban (non-CBD)	X
Suburban CBD	
Rural	
Not Given	

Competition Within Area (select one):	
High	
Medium	
Low	X

Drive-Through Description :	1 Lane. Only counted the vehicles waiting in line, not the vehicles currently being washed.
Gross Floor Area (estimated)	3,150 sq. ft

	Maximum Queue	Time Max Queue Occurred
Sunday		
Monday		
Tuesday	**1**	**12:58pm**
Wednesday	**3**	**2:53pm**
Thursday		
Friday		
Saturday		

Appendix D

Drive-Through Queuing Data Form

ITE Land Use Code:	948
Land Use/Building Type:	Automated Car Wash
Name of Business:	BP
Address:	1691 Snelling Ave N
City:	Falcon Heights
State:	MN
Zip Code:	55113
Date(s)	February 7-8, 2012 (Tuesday-Wednesday)
Weather Conditions	High 32 °F and Clear

Location Within Area (select one):

CBD	
Urban (non-CBD)	
Suburban (non-CBD)	X
Suburban CBD	
Rural	
Not Given	

Competition Within Area (select one):

High	
Medium	
Low	X

Drive-Through Description : 1 Lane. Only counted the vehicles waiting in line, not the vehicles currently being washed.

Gross Floor Area (estimated) 1,500 sq. ft.

	Maximum Queue	Time Max Queue Occurred
Sunday		
Monday		
Tuesday	**4**	**1:48pm**
Wednesday	**3**	**4:29pm**
Thursday		
Friday		
Saturday		

Appendix D

Drive-Through Queuing Data Form

ITE Land Use Code:	948
Land Use/Building Type:	Automated Car Wash
Name of Business:	Holiday Gas Station Carwash
Address:	5430 Minnetonka Blvd
City:	St. Louis Park
State:	MN
Zip Code:	55416
Date(s)	February 1-2, 2012 (Wednesday-Thursday)
Weather Conditions	High 32-36 °F and Fog

Location Within Area (select one):

CBD	
Urban (non-CBD)	
Suburban (non-CBD)	X
Suburban CBD	
Rural	
Not Given	

Competition Within Area (select one):

High	
Medium	
Low	X

Drive-Through Description :	1 Lane. Only counted the vehicles waiting in line, not the vehicles currently being washed.
Gross Floor Area (estimated)	3,000 sq. ft

	Maximum Queue	Time Max Queue Occurred
Sunday		
Monday		
Tuesday		
Wednesday	**3**	**12:37pm, 1:50pm, 3:43pm, 4:41pm, 5:10pm, 7:04pm, 7:30pm**
Thursday	**4**	**2:38pm, 4:20pm**
Friday		
Saturday		

Appendix D

Drive-Through Queuing Data Form

ITE Land Use Code:	948
Land Use/Building Type:	Automated Car Wash
Name of Business:	Mister Car Wash
Address:	8650 Highway 7
City:	St. Louis Park
State:	MN
Zip Code:	55426
Date(s)	February 1-2, 2011 (Wednesday-Thursday)
Weather Conditions	High 32-36 °F and Fog

Location Within Area (select one):

CBD	
Urban (non-CBD)	
Suburban (non-CBD)	X
Suburban CBD	
Rural	
Not Given	

Competition Within Area (select one):

High	
Medium	
Low	X

Drive-Through Description :	2 Lanes, Full Service Wash, only vehicles in line were counted, not the vehicles being washed.
Gross Floor Area (estimated)	8,250 sq. ft

	Maximum Queue	Time Max Queue Occurred
Sunday		
Monday		
Tuesday		
Wednesday	**10**	**1:03pm**
Thursday	**6**	**4:02pm**
Friday		
Saturday		

Appendix D

Drive-Through Queuing Data Form

ITE Land Use Code:	948
Land Use/Building Type:	Automated Car Wash
Name of Business:	Mobil Car Wash
Address:	3864 Hopkins Crossroad
City:	Minnetonka
State:	MN
Zip Code:	55305
Date(s)	February 1-2, 2012 (Wednesday-Thursday)
Weather Conditions	High 32-36 °F and Fog

Location Within Area (select one):

CBD	
Urban (non-CBD)	
Suburban (non-CBD)	X
Suburban CBD	
Rural	
Not Given	

Competition Within Area (select one):

High	
Medium	
Low	X

Drive-Through Description :	2 lanes. Only vehicles in line were counted, not vehicles being washed.
Gross Floor Area (estimated)	1,225 sq. ft

	Maximum Queue	Time Max Queue Occurred
Sunday		
Monday		
Tuesday		
Wednesday	**4**	**6:03pm**
Thursday	**3**	**4:37pm, 6:28pm, 7:39pm, 7:51pm, 8:04pm, 8:23pm**
Friday		
Saturday		

Appendix D

Drive-Through Queuing Data Form

ITE Land Use Code:	937
Land Use/Building Type:	Coffee/Donut Shop w/ Drive Thru
Name of Business:	Caribou Coffee
Address:	4745 Cedar Ave S
City:	Minneapolis
State:	MN
Zip Code:	55407
Date(s)	February 1-2, 2012 (Wednesday-Thursday)
Weather Conditions	High 32-36 °F and Fog

Location Within Area (select one):

CBD	
Urban (non-CBD)	X
Suburban (non-CBD)	
Suburban CBD	
Rural	
Not Given	

Competition Within Area (select one):

High	
Medium	X
Low	

Drive-Through Description :	1 Lane
Gross Floor Area (estimated)	1,950 sq. ft.

	Maximum Queue	Time Max Queue Occurred
Sunday		
Monday		
Tuesday		
Wednesday	**11**	**8:50am**
Thursday	**10**	**7:57am**
Friday		
Saturday		

Appendix D

Drive-Through Queuing Data Form

ITE Land Use Code:	937
Land Use/Building Type:	Coffee/Donut Shop w/ Drive Thru
Name of Business:	Caribou Coffee
Address:	5330 Cedar Lake Rd
City:	St. Louis Park
State:	MN
Zip Code:	55416
Date(s)	August 5-9, 2011 (Friday-Tuesday)
Weather Conditions	High 82-88 °F and Clear

Location Within Area (select one):

CBD	
Urban (non-CBD)	
Suburban (non-CBD)	X
Suburban CBD	
Rural	
Not Given	

Competition Within Area (select one):

High	
Medium	X
Low	

Drive-Through Description :	1 Lane
Gross Floor Area (estimated)	3,600 sq. ft

	Maximum Queue	Time Max Queue Occurred
Sunday	**7**	**9:39am, 9:41am**
Monday	**10**	**8:39am**
Tuesday	**12**	**9:26am**
Wednesday		
Thursday		
Friday	**12**	**8:12am**
Saturday	**8**	**8:52am, 10:24am**

Appendix D

Drive-Through Queuing Data Form

ITE Land Use Code:	937
Land Use/Building Type:	Coffee/Donut Shop w/ Drive Thru
Name of Business:	Starbucks
Address:	5121 Gus Young Lane
City:	Edina
State:	MN
Zip Code:	55436
Date(s)	February 7-8, 2012 (Tuesday-Wednesday)
Weather Conditions	High 32 °F and Clear

Location Within Area (select one):

CBD	
Urban (non-CBD)	
Suburban (non-CBD)	X
Suburban CBD	
Rural	
Not Given	

Competition Within Area (select one):

High	
Medium	
Low	X

Drive-Through Description :	1 Lane
Gross Floor Area (estimated)	3,000 sq. ft

	Maximum Queue	Time Max Queue Occurred
Sunday		
Monday		
Tuesday		
Wednesday	**14**	**7:22am, 7:49am**
Thursday	**16**	**8:56am**
Friday		
Saturday		

Drive-Through Queuing Data Form

ITE Land Use Code:	937
Land Use/Building Type:	Coffee/Donut Shop w/ Drive Thru
Name of Business:	Starbucks
Address:	1505 Highway 7
City:	Hopkins
State:	MN
Zip Code:	55305
Date(s)	February 1-2, 2012 (Wednesday-Thursday)
Weather Conditions	High 32-36 °F and Fog

Location Within Area (select one):

CBD	
Urban (non-CBD)	
Suburban (non-CBD)	X
Suburban CBD	
Rural	
Not Given	

Competition Within Area (select one):

High	
Medium	X
Low	

Drive-Through Description :	1 Lane, Queuing Went Out Onto the Street
Gross Floor Area (estimated)	1,800 sq. ft

	Maximum Queue	**Time Max Queue Occurred**
Sunday		
Monday		
Tuesday		
Wednesday	**10**	**7:42am, 8:41am, 8:59am**
Thursday	**11**	**7:33am**
Friday		
Saturday		

Appendix D

Drive-Through Queuing Data Form

ITE Land Use Code:	937
Land Use/Building Type:	Coffee/Donut Shop w/ Drive Thru
Name of Business:	Starbucks
Address:	4201 Minnetonka Blvd
City:	St. Louis Park
State:	MN
Zip Code:	55416
Date(s)	November 3, 2010 (Wednesday)
Weather Conditions	High 56 °F and Clear

Location Within Area (select one):

CBD	
Urban (non-CBD)	
Suburban (non-CBD)	X
Suburban CBD	
Rural	
Not Given	

Competition Within Area (select one):

High	
Medium	X
Low	

Drive-Through Description :	1 Lane, Queue Lengths Recorded at 5 min Intervals
Gross Floor Area (estimated)	2,550 sq. ft.

	Maximum Queue	Time Max Queue Occurred
Sunday		
Monday		
Tuesday		
Wednesday	**11**	**8:45am**
Thursday		
Friday		
Saturday		

Appendix D

Drive-Through Queuing Data Form

ITE Land Use Code:	937
Land Use/Building Type:	Coffee/Donut Shop w/ Drive Thru
Name of Business:	Starbucks
Address:	2305 Fairview Ave
City:	Roseville
State:	MN
Zip Code:	55113
Date(s)	February 7-8, 2012 (Tuesday-Wednesday)
Weather Conditions	High 32 °F and Clear

Location Within Area (select one):

CBD	
Urban (non-CBD)	
Suburban (non-CBD)	X
Suburban CBD	
Rural	
Not Given	

Competition Within Area (select one):

High	
Medium	X
Low	

Drive-Through Description :	1 Lane
Gross Floor Area (estimated)	1,500 sq. ft

	Maximum Queue	Time Max Queue Occurred
Sunday		
Monday		
Tuesday	**10**	**8:09am**
Wednesday	**12**	**7:57am**
Thursday		
Friday		
Saturday		

Appendix D

Drive-Through Queuing Data Form

ITE Land Use Code:	934
Land Use/Building Type:	Fast Food with Drive Thru
Name of Business:	Arby's
Address:	1116 W Lake St
City:	Minneapolis
State:	MN
Zip Code:	55408
Date(s)	February 1-2, 2012 (Wednesday-Thursday)
Weather Conditions	High 32-36 °F and Fog

Location Within Area (select one):

CBD	
Urban (non-CBD)	X
Suburban (non-CBD)	
Suburban CBD	
Rural	
Not Given	

Competition Within Area (select one):

High	
Medium	X
Low	

Drive-Through Description :	1 Lane
Gross Floor Area (estimated)	3,000 sq. ft

	Maximum Queue	Time Max Queue Occurred
Sunday		
Monday		
Tuesday		
Wednesday	**5**	**6:04pm**
Thursday	**5**	**6:55pm**
Friday		
Saturday		

Appendix D

Drive-Through Queuing Data Form

ITE Land Use Code:	934
Land Use/Building Type:	Fast Food with Drive Thru
Name of Business:	Burger King
Address:	6660 Wayzata Blvd
City:	Golden Valley
State:	Minnesota
Zip Code:	55426
Date(s)	August 5-8, 2011
Weather Conditions	High 82-88 °F and Clear

Location Within Area (select one):

CBD	
Urban (non-CBD)	
Suburban (non-CBD)	X
Suburban CBD	
Rural	
Not Given	

Competition Within Area (select one):

High	
Medium	X
Low	

Drive-Through Description :	1 Lane
Gross Floor Area (estimated)	3,300 sq. ft

	Maximum Queue	Time Max Queue Occurred
Sunday	**6**	**4:30pm**
Monday	**12**	**12:10pm**
Tuesday		
Wednesday		
Thursday		
Friday	**10**	**12:12pm**
Saturday	**8**	**9:38pm**

Appendix D

Drive-Through Queuing Data Form

ITE Land Use Code:	934
Land Use/Building Type:	Fast Food with Drive Thru
Name of Business:	McDonald's
Address:	5200 Excelsior Blvd
City:	St. Louis Park
State:	MN
Zip Code:	55416
Date(s)	February 1-2, 2012 (Wednesday-Thursday)
Weather Conditions	High 32-36 °F and Fog

Location Within Area (select one):

CBD	
Urban (non-CBD)	
Suburban (non-CBD)	X
Suburban CBD	
Rural	
Not Given	

Competition Within Area (select one):

High	
Medium	X
Low	

Drive-Through Description :	2 Order Stations
Gross Floor Area (estimated)	3,600 sq. ft

	Maximum Queue	**Time Max Queue Occurred**
Sunday		
Monday		
Tuesday		
Wednesday	**12**	**11:46am**
Thursday	**13**	**12:23pm**
Friday		
Saturday		

Appendix D

Drive-Through Queuing Data Form

ITE Land Use Code:	934
Land Use/Building Type:	Fast Food with Drive Thru
Name of Business:	McDonald's
Address:	2929 Hennepin Ave S
City:	Minneapolis
State:	MN
Zip Code:	55408
Date(s)	February 1-2, 2012 (Wednesday-Thursday)
Weather Conditions	High 32-36 °F and Fog

Location Within Area (select one):

CBD	
Urban (non-CBD)	X
Suburban (non-CBD)	
Suburban CBD	
Rural	
Not Given	

Competition Within Area (select one):

High	
Medium	X
Low	

Drive-Through Description :	1 Lane
Gross Floor Area (estimated)	3,825 sq. ft.

	Maximum Queue	Time Max Queue Occurred
Sunday		
Monday		
Tuesday		
Wednesday	**9**	**8:48am**
Thursday	**8**	**8:54am**
Friday		
Saturday		

Appendix D

Drive-Through Queuing Data Form

ITE Land Use Code:	934
Land Use/Building Type:	Fast Food with Drive Thru
Name of Business:	Taco Bell
Address:	819 Cambridge St
City:	Hopkins
State:	MN
Zip Code:	55343
Date(s)	February 1-2, 2012 (Wednesday-Thursday)
Weather Conditions	High 32-36 °F and Fog

Location Within Area (select one):

CBD	
Urban (non-CBD)	
Suburban (non-CBD)	X
Suburban CBD	
Rural	
Not Given	

Competition Within Area (select one):

High	
Medium	X
Low	

Drive-Through Description :	1 Lane
Gross Floor Area (estimated)	2,500 sq. ft

	Maximum Queue	Time Max Queue Occurred
Sunday		
Monday		
Tuesday		
Wednesday	**10**	**12:26pm**
Thursday	**8**	**12:17pm, 6:57pm**
Friday		
Saturday		

Appendix D

Drive-Through Queuing Data Form

ITE Land Use Code:	934
Land Use/Building Type:	Fast Food with Drive Thru
Name of Business:	White Castle
Address:	1111 Cambridge St
City:	Hopkins
State:	MN
Zip Code:	55343
Date(s)	February 1-2, 2012 (Wednesday-Thursday)
Weather Conditions	High 32-36 °F and Fog

Location Within Area (select one):

CBD	
Urban (non-CBD)	
Suburban (non-CBD)	X
Suburban CBD	
Rural	
Not Given	

Competition Within Area (select one):

High	
Medium	X
Low	

Drive-Through Description :	1 Lane
Gross Floor Area (estimated)	1,750 sq. ft

	Maximum Queue	Time Max Queue Occurred
Sunday		
Monday		
Tuesday		
Wednesday	**8**	**5:26pm**
Thursday	**5**	**8:13am, 12:10pm, 1:25pm, 3:22pm, 8:54pm**
Friday		
Saturday		

Appendix D

Drive-Through Queuing Data Form

ITE Land Use Code:	881
Land Use/Building Type:	Pharmacy/Drugstore w/ Drive-Thru
Name of Business:	CVS Pharmacy
Address:	Medicine Lake Rd & Winnetka Ave
City:	New Hope
State:	MN
Zip Code:	55427
Date(s)	February 7-8, 2012 (Tuesday-Wednesday)
Weather Conditions	High 32 °F and Clear

Location Within Area (select one):

CBD	
Urban (non-CBD)	
Suburban (non-CBD)	X
Suburban CBD	
Rural	
Not Given	

Competition Within Area (select one):

High	X
Medium	
Low	

Drive-Through Description :	2 Lanes
Gross Floor Area (estimated)	18, 700 sq. ft.

	Maximum Queue	Time Max Queue Occurred
Sunday		
Monday		
Tuesday	**1**	**13 times**
Wednesday	**2**	**5:55pm**
Thursday		
Friday		
Saturday		

Appendix D

Drive-Through Queuing Data Form

ITE Land Use Code:	881
Land Use/Building Type:	Pharmacy/Drugstore w/ Drive-Thru
Name of Business:	CVS
Address:	2426 W Broadway Ave
City:	Minneapolis
State:	MN
Zip Code:	55411
Date(s)	February 7-8, 2012 (Tuesday-Wednesday)
Weather Conditions	High 32 °F and Clear

Location Within Area (select one):

CBD	
Urban (non-CBD)	
Suburban (non-CBD)	X
Suburban CBD	
Rural	
Not Given	

Competition Within Area (select one):

High	
Medium	X
Low	

Drive-Through Description :	2 Lanes
Gross Floor Area (estimated)	14,200 sq. ft

	Maximum Queue	Time(s) Max Queue Occurred
Sunday		
Monday		
Tuesday	**4**	**5:28pm**
Wednesday	**4**	**6:38pm**
Thursday		
Friday		
Saturday		

Appendix D

Drive-Through Queuing Data Form

ITE Land Use Code:	881
Land Use/Building Type:	Pharmacy/Drugstore w/ Drive-Thru
Name of Business:	CVS
Address:	3655 Central Ave NE
City:	Minneapolis
State:	MN
Zip Code:	55418
Date(s)	February 7-8, 2012 (Tuesday-Wednesday)
Weather Conditions	High 32 °F and Clear

Location Within Area (select one):

CBD	
Urban (non-CBD)	X
Suburban (non-CBD)	
Suburban CBD	
Rural	
Not Given	

Competition Within Area (select one):

High	
Medium	X
Low	

Drive-Through Description :	2 Lanes
Gross Floor Area (estimated)	14,200 sq. ft

	Maximum Queue	Time(s) Max Queue Occurred
Sunday		
Monday		
Tuesday	**2**	**1:57pm, 3:35pm, 5:48pm, 6:07pm, 7:10pm**
Wednesday	**2**	**3:03pm, 3:52pm, 4:07pm, 4:46pm, 5:12pm, 5:20pm, 6:43pm**
Thursday		
Friday		
Saturday		

Appendix D

Drive-Through Queuing Data Form

ITE Land Use Code:	881
Land Use/Building Type:	Pharmacy/Drugstore w/ Drive-Thru
Name of Business:	Walgreens
Address:	540 Blake Rd N
City:	Hopkins
State:	MN
Zip Code:	55343
Date(s)	February 1-2, 2012 (Wednesday-Thursday)
Weather Conditions	High 32-36 °F and Fog

Location Within Area (select one):

CBD	
Urban (non-CBD)	
Suburban (non-CBD)	X
Suburban CBD	
Rural	
Not Given	

Competition Within Area (select one):

High	
Medium	X
Low	

Drive-Through Description :	2 Lanes
Gross Floor Area (estimated)	14,375 sq. ft

	Maximum Queue	**Time(s) Max Queue Occurred**
Sunday		
Monday		
Tuesday		
Wednesday	**4**	**2:33pm, 3:31pm, 4:46pm, 4:57pm, 5:28pm, 6:26pm, 6:38pm, 8:20pm, 9:20pm**
Thursday	**5**	**4:30pm, 4:52pm, 5:56pm, 6:00pm**
Friday		
Saturday		

Appendix D

Drive-Through Queuing Data Form

ITE Land Use Code:	881
Land Use/Building Type:	Pharmacy/Drugstore w/ Drive-Thru
Name of Business:	Walgreens
Address:	4200 Winnetka Ave N
City:	New Hope
State:	MN
Zip Code:	55428
Date(s)	February 7-8, 2012 (Tuesday-Wednesday)
Weather Conditions	High 32 °F and Clear

Location Within Area (select one):

CBD	
Urban (non-CBD)	
Suburban (non-CBD)	X
Suburban CBD	
Rural	
Not Given	

Competition Within Area (select one):

High	X
Medium	
Low	

Drive-Through Description :	2 Lanes
Gross Floor Area (estimated)	16675 sq. ft.

	Maximum Queue	Time(s) Max Queue Occurred
Sunday		
Monday		
Tuesday	**3**	**4:03pm**
Wednesday	**3**	**8:34am, 4:04pm, 4:51pm**
Thursday		
Friday		
Saturday		

Appendix D

Drive-Through Queuing Data Form

ITE Land Use Code:	881
Land Use/Building Type:	Pharmacy/Drugstore w/ Drive-Thru
Name of Business:	Walgreens
Address:	4100 W Broadway Ave
City:	Robbinsdale
State:	MN
Zip Code:	55422
Date(s)	February 7-8, 2012 (Tuesday-Wednesday)
Weather Conditions	High 32 °F and Clear

Location Within Area (select one):

CBD	
Urban (non-CBD)	
Suburban (non-CBD)	X
Suburban CBD	
Rural	
Not Given	

Competition Within Area (select one):

High	X
Medium	
Low	

Drive-Through Description :	1 Lane
Gross Floor Area (estimated)	14,400 sq. ft.

	Maximum Queue	Time(s) Max Queue Occurred
Sunday		
Monday		
Tuesday	**3**	**4:49pm**
Wednesday	**2**	**12:49pm**
Thursday		
Friday		
Saturday		