Kimley»Horn

Memorandum

To: Gary Kilfeather
McDonald's USA, LLC

From: Andrew T. Smith, P.E. ATS
Edward Y. Papazian, P.E. EYP

Date: July 14th, 2014

Subject: Purcellville McDonalds Queuing Analysis

INTRODUCTION

This memorandum presents the results of a vehicle queuing study for the proposed modification of the McDonalds located along North Maple Avenue. This queuing study was prepared at the request of the Town of Purcellville staff and in accordance with their instructions on the elements to be included in the study.

The existing restaurant is located along the west side of North Maple Avenue just north of East Main Street. The existing restaurant contains 3,725 square feet of gross floor area and a single drive-thru lane. The proposed modification will result in a 4,388 square foot restaurant with a double drive-thru lane at the ordering stations. This results in a 663 square foot increase. The proposed modification requires a special use permit (SUP).

There are instances in which vehicle queues at the drive-thru spill back onto Maple Avenue. The proposed modification of the restaurant will help alleviate the vehicle queuing. The restaurant footprint will be modified to result in a smoother traffic movement from North Maple Avenue to the drive-thru lanes. The restaurant will be modified from a single drive-thru lane to a double drive-thru lane at the ordering stations. The interior operation will be modified to provide for more efficient service to the drive-thru patrons.

This queuing study measures existing queuing at the drive-thru and forecasts future queuing based on improvements that will be part of the restaurant operations. This vehicle queuing study evaluates the following periods:

- Weekday AM commuter peak
- Weekday Mid-day peak
- Weekday PM commuter peak
- Saturday Mid-day peak

EXISTING CONDITIONS

The McDonald's restaurant is located on Maple Avenue just north of Main Street in Purcellville. The main entrance to the McDonalds site is located on Maple Avenue to the east of the restaurant. There are additional entrances to the site from adjacent parking lots: to the south from the Wells Fargo Bank and to the west from the shopping center. Drive-thru users travel counterclockwise around the building to one of two ordering stations in tandem (one after another in line) located on the northwest corner of the building. When the drive-thru is under heavy use, both ordering stations are operated. At other times, only the downstream ordering station is used. After placing an order, the vehicles continue driving around the building to the south side, where two windows are located. The first window on the south side of the building (cash window) is generally used for payment, and the downstream window (present window) is used for picking up the food order. Figure 1 shows the existing restaurant.

DATA COLLECTION

Counts were collected for vehicles entering the drive-thru lane for each of the peak periods in order to determine the arrival rate for customers. The counts were taken on Wednesday, June 18th from 7:00-9:00 AM (weekday AM), 11:30 AM-1:30 PM (weekday mid-day), and 5:15-7:15 PM (weekday PM), and on Saturday, June 21st from 11:30 AM-1:30 PM (Saturday mid-day). Count data was taken in five minute intervals.

Queue length (in units of vehicles), and processing times were recorded at approximate 5-minute intervals throughout the same peak periods. Overall processing time was defined as the time from when a driver stopped at the ordering station until the driver received their food at the pick-up window and began to drive away. It should be noted that queue length and service time data was not collected from 7:00-7:15 PM during the weekday evening peak period data collection. Because this data is collected continually and averaged (as opposed to being recorded continuously like the vehicle count), it does not affect the analysis. The peak hour for this period was determined to be from 5:25 PM through 6:25 PM, so queue length and processing time data was still collected during the peak of drive-thru usage.

The data was analyzed, and is included in Table 1 below. The data collection sheets are included in the Appendix.

GENERAL NOTES

1. The bearing base for this survey originated from NAD 83
2. This property has an area of [insert area] square feet or [insert acres, 4 decimal places] acres of land.
3. This property is designated by Purcellville, as Tax Map # 35A2-3-6-5A.
4. There was no observable evidence of cemeteries found at the time of this survey.
5. The property has access via North Maple Avenue, which is a public right of way.
6. Interior roadways appear to be private, variable in width and unnamed, unless otherwise shown.
7. Elevations based on NAVD 1988

SCHEDULE B - TITLE EXCEPTION NOTES

POTENTIAL ENCROACHMENT NOTES

None observed

ZONING NOTES

Zoned: XX – [insert zoning district and definition]
Permitted Use Classification: [insert permitted use]
Observed Use(s): [insert use observed from outside observations]
Existing site conditions appear (from outside observations) to fall within permitted uses as listed above in the City of [insert]'s Zoning Regulations Section [insert number] Zoning Regulations are subject to change and interpretation, for further information contact: City [or County] of [insert] (phone: XXX-XXX-XXXX)
Contact's Name: [insert name]
(email: XXX@XXXXX)

Site Restrictions:
1. Minimum building setbacks:
Front: XX' (min. provided: [insert tie distance])
Side: XX' (min. provided: [insert tie distance])
Rear: XX' (min. provided: [insert tie distance])
2. Minimum lot size: [insert restriction] (min. provided: [insert lot size])
3. Minimum lot frontage: [insert restriction] (min. provided: [insert measurement])
4. Maximum building height: [insert restriction] (max. provided: [insert height])
5. Maximum density: [Example: max. lot coverage and min. open space – if applicable]
6. Maximum floor area ratio:

Parking Tabulation:

– Regular parking space calculations are based on exterior footprint of building at ground level and are further calculated using the formula of: XX spaces per XX sq. ft. of floor space.

– Handicap spaces are calculated based on ADA requirements (Total spaces: 1–25, Required ADA spaces = 1)

Total regular spaces required: XX – provided: XX
Total handicap spaces required: XX – provided: XX
Total combined spaces required: XX – provided: XX

FLOOD ZONE NOTE

By graphic plotting only, this property is in Zone X (UNSHADED) of the Flood Insurance Rate Map, Community Panel No. 51107C0089 D, which bears an effective date of July 5, 2001 and IS NOT in a Special Flood Hazard Area. By telephone call to the National Flood Insurance Program (800-638-6620) we have learned this community DOES NOT currently participate in the program. No field surveying was performed to determine this zone and an elevation certificate may be needed to verify this determination or apply for a variance from the Federal Emergency Management Agency.

Survey Prepared By:

FIRST ORDER, LLC
1700 SULLIVAN TRAIL, SUITE 13
EASTON, PA 18040
Phone: 610-438-5840 Fax: 610-438-0004

Surveyor's Drawing No.:	3299.dwg
Surveyor's Site Ref:	3299
Checked by: JWS	Drawn by: REP

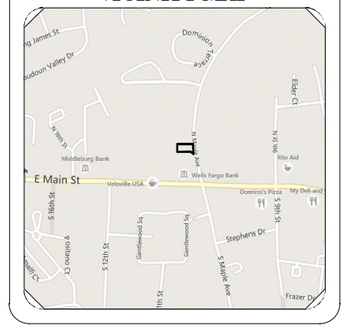
0 20' 40'
GRAPHIC SCALE: 1" = 20'

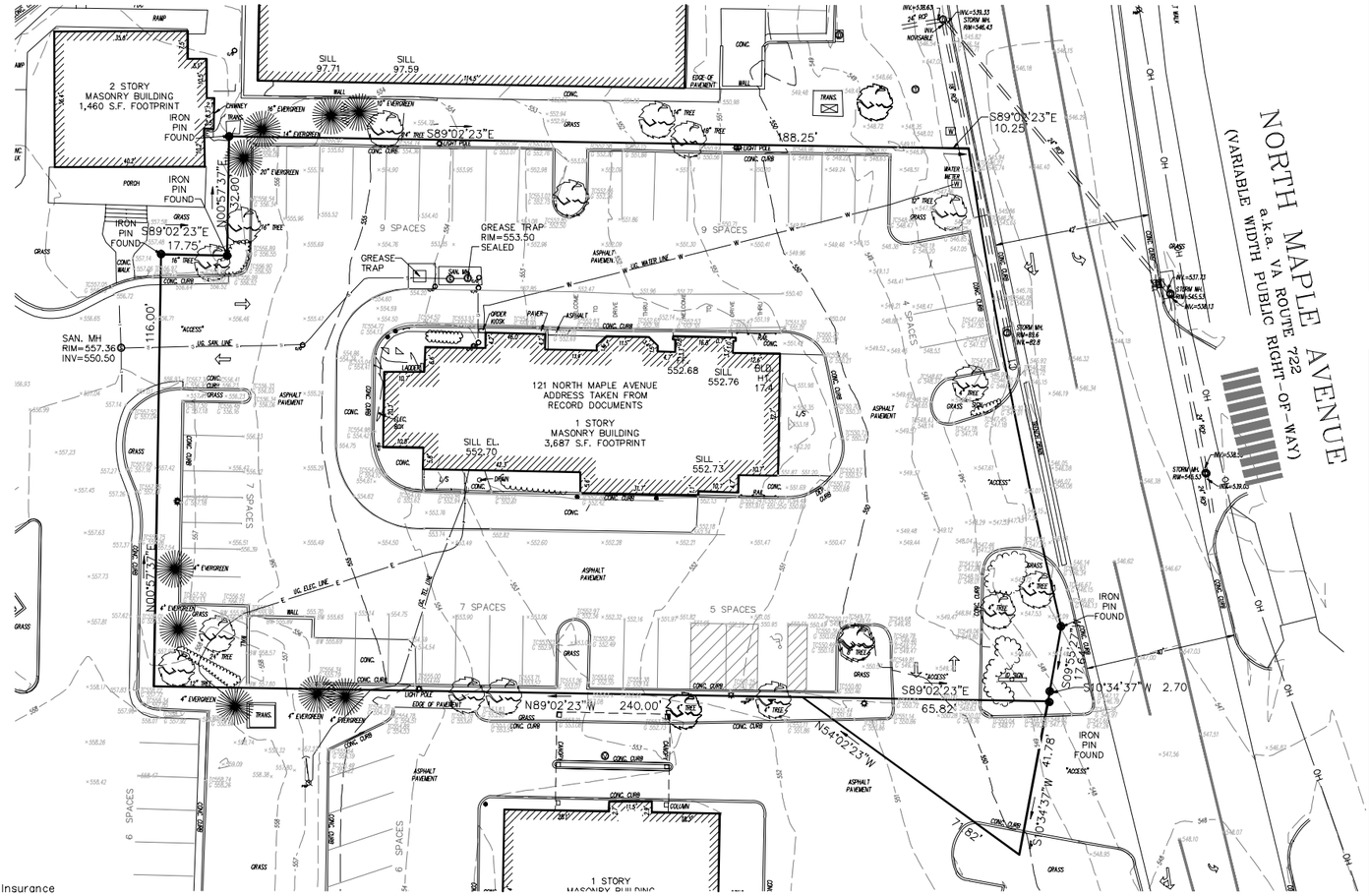
NAD 83
S.P.C. (4501 VA N)

LEGEND OF SYMBOLS & ABBREVIATIONS

MONUMENT FOUND	POWERPOLE	SS— SAN.SEWER LINE
MONUMENT SET	GUY WIRE	SEWER MANHOLE
P.K. NAIL FOUND	LIGHT POLE	CLEAN OUT
P.K. NAIL SET	STREET LIGHT POLE	STORM DRAIN MANHOLE
FND X MARK	ELEC. TRANSFORMER	STORM INLET
SET X MARK	AIR CONDITIONER	CURB INLET
R.R. SPIKE FOUND	E — BURIED ELECTRIC	PAY PHONE
R.R. SPIKE SET	OH— OVERHEAD UTILITIES	TELEPHONE BOX
BENCHMARK	ELEC. MANHOLE	TELEPHONE MANHOLE
CONC. R/W MARKER	ELECTRIC METER	X— FENCE LINE
RECORD DATA	W— WATER LINE	T— TELEPHONE LINE
MEASURED DATA	WATER MANHOLE	UNDERGROUND TELEPHONE MARKER
CALCULATED DATA	WATER VALVE	UNDERGROUND CABLE MARKER
SURVEYED DATA	WATER METER	
R.O.W. RIGHT OF WAY	HYDRANT	C— CABLE TELEVISION
AKA ALSO KNOWN AS	GAS VALVE	CABLE BOX
RCP REINFORCED CONC PIPE	GAS METER	TRAFFIC POLES
CMP CORRUGATED METAL PIPE	UNDERGROUND GAS MARKER	TRAFFIC MANHOLE
DEP DEPRESSED	FLAG POLE	TRAFFIC SIGNAL BOX
MTL METAL	GAS MANHOLE	SIGN
S.F. SQUARE FEET	G— GAS LINE	AGL ABOVE GROUND LEVEL
FT. FEET	MONITORING WELL	L/S LANDSCAPING
P.O.B. POINT OF BEGINNING	MAIL BOX	TREE
P.O.C. POINT OF COMMENCEMENT	UNKNOWN MANHOLE	EVERGREEN
CONC CONCRETE	SQUARE METAL LID	HANDICAP PARKING
BLD BUILDING	FUEL TANK LID	BOLLARD
HT HEIGHT	PID PROPERTY ID	AIR COMPRESSOR
CH BRG CHORD BEARING	CH DIST CHORD DISTANCE	VACUUM
		N/F NOW OR FORMERLY

VICINITY MAP





Curve Table					
Curve #	Radius	Length	Ch. Brg.	Ch. Dist.	Delta
C1	1457.00	130.76	S10°55'52"E	130.72	05°08'32"

LEGAL DESCRIPTION

FIGURE 1 - EXISTING RESTAURANT

ALTA/ACSM LAND TITLE SURVEY

Mcdonalds
121 N. Maple
Purcellville, VA

Surveyor's Certification

To: [to be provided by client] and MKAssociates, Inc.

This is to certify that this map or plat and the survey on which it is based were made in accordance with the 2011 Minimum Standard Detail Requirements for ALTA/ACSM Land Title Surveys, jointly established and adopted by ALTA and NSPS and includes Items 1, 2, 3, 4, 5, 6(b), 7(a), 7(b)(1), 7(c), 8, 9, 10, 11(b), 13, 14, 16, 17, 18 of Table A thereof.

The field work was completed on June 3, 2014

Date of Plat or Map: June 6, 2014.

PRELIMINARY

Surveyor's Signature

Professional Land Surveyor: Jack W. Shoemaker
Registration Number: 0403 002186
In the State of: Virginia

[Insert Surveyor's Signature/Seal]

PROJECT NAME:	MCDONALDS	MKA PROJECT No.:	6061-14-3088
ADDRESS:	121 N. MAPLE	CITY: Purcellville	STATE: VA

MKA
A National Land Services Group

For Inquiries Concerning This Survey Contact MKA
National Coordinators of Land Survey Services
6593 Commerce Court – Warrenton, Virginia 20187
Phone: (540) 428-3550 Fax: (540) 428-3560
Email: comments@mkassociates.com
www.mkassociates.com

Table 1: Drive-thru Data Collection				
	Weekday AM	**Weekday Mid-day**	**Weekday PM**	**Saturday Mid-day**
Peak Hour	8:00A-9:00A	11:30A-12:30P	5:25P-6:25P	11:35A-12:35P
Peak Hour Arrival Rate (veh/hr)	117	106	69	90
Peak Hour Average Processing Time (min:sec)	2:57	2:40	2:01	2:33
Peak Hour Average Present Window Queue Length (veh)	5.17	3.58	2.50	3.67
Peak Hour Average Ordering Station Queue Length (veh)	5.25	5.83	1.58	2.67
Maximum Observed Present Window Queue Length (veh)	6	7	6	7
Maximum Observed Ordering Station Queue Length (veh)	8	10	6	7
Maximum Total Number of Cars in Both Queues During One Observation	14	13	10	12

OBSERVATIONS AND DISCUSSION OF RESULTS

The heaviest use of the drive-thru was during the weekday AM and mid-day peaks. For each of the four collected time periods, a greater arrival rate corresponded with a longer service time. There was enough space for approximately six cars to stack at the present window before reaching the ordering station. The queue at the present window rarely reached as far back as the ordering station (once or twice per peak period). Regardless of whether the two queues interacted, the queue length at the ordering station was always measured from the same location. The ordering station queue dictated whether cars were backed up onto Maple Avenue. Depending on the size of cars in the queue, circulation around the restaurant began to be affected when 7 to 8 cars were in the ordering station queue. With this number of vehicles, the drive aisle around the restaurant could be blocked and cars were observed waiting on Maple Avenue or in the cut-through to the Wells Fargo Bank lot. This occurred several times during the heaviest use portions of the weekday AM, weekday mid-day, and Saturday mid-day peak periods, but was not observed during the weekday PM peak period.

EXISTING OPERATIONS

The ordering station queue is the driving factor that determines whether or not vehicles will be backed up into Maple Avenue. The queue for the present window is metered by patrons making their orders. As a result, the queuing analysis was performed on only the ordering station queue. The analysis was performed assuming the queue at the ordering stations follows a single-channel queuing model with Poisson arrivals and exponential service-times (M/M/1 model). This is a simplification of the queuing type that occurs in practice, and it allows the queue length to be forecast without running a simulation.

The average queue length and arrival rate were used to calculate the existing service rate of the ordering stations. This was accomplished using the following equation, applicable for M/M/1 queues:

$$Average\ number\ of\ vehicles\ in\ the\ system\ = \frac{\lambda}{\mu - \lambda}$$

where λ is the arrival rate and μ is the service rate.

The equation was rearranged to solve for μ. In this equation, the average number of vehicles in the system refers to the number of vehicles in the queue and in service. The "queue length" recorded as a part of the data collection includes vehicles being served and vehicles in the queue, and is therefore equivalent to the number of vehicles in the system.

Analysis was performed to calculate how often the existing queue will reach a length that will block circulation or reach Maple Avenue. This was accomplished using the following equation, applicable for M/M/1 queues:

$$Probability\ of\ more\ than\ k\ units\ in\ the\ system = \left(\frac{\lambda}{\mu}\right)^{k+1}$$

The results of the analysis are included in Table 2 below.

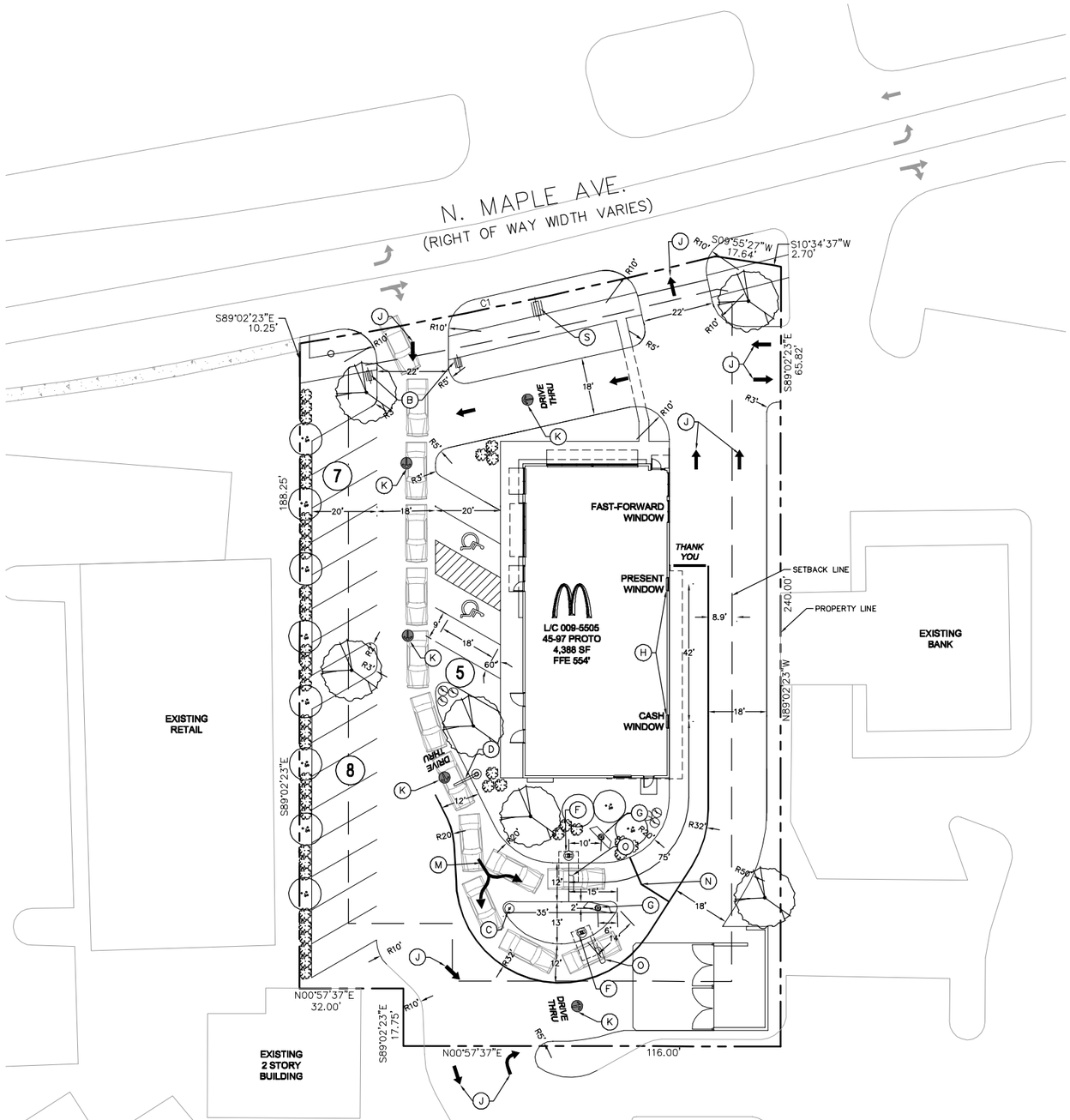
Table 2: Existing Service Rates and Queue Lengths				
	Weekday AM	**Weekday Mid-day**	**Weekday PM**	**Saturday Mid-day**
Peak Hour Arrival Rate, λ (veh/hr)	117	106	69	90
Peak Hour Average Queue Length (number of vehicles in service and queue)	5.25	5.83	1.58	2.67
Calculated Service Rate, μ (veh/hr)	139.29	124.18	112.67	123.71
Service Time (sec/veh)	25.85	28.99	31.95	29.10
Probability of more than 7 vehicles in the system (when vehicle queue blocks circulation)	24.78%	28.19%	1.98%	7.85%
Probability of more than 8 vehicles in the system (when vehicle queue extends into Maple Avenue)	20.82%	24.06%	1.21%	5.71%

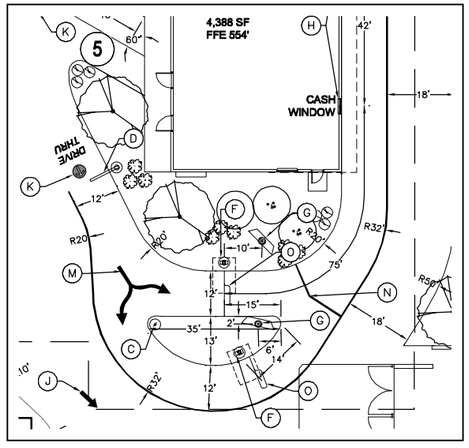
PROPOSED CONDITIONS

The proposed McDonald's site includes several enhancements, both internally and in site layout, that will improve the efficiency of drive-thru operations. The building footprint will be shifted south and all parking will be located to the north of the building. The drive aisle will be one-way counterclockwise around the entire building. Instead of two ordering stations located in tandem, the drive through is split into two lines near the two side-by-side ordering stations. This will serve two purposes: the new layout increases the stacking length upstream of the ordering stations (up to approximately 14 vehicles before reaching Maple Avenue), and the layout also ensures that both ordering stations are being utilized at all possible times. In the current tandem layout, it is possible for a vehicle ordering at the upstream ordering station to block the downstream ordering station. The new layout will not reduce the time it takes a patron to put in his or her order, but because ordering station utilization increases, it does reduce the average service time for both ordering stations *combined*, which is equivalent to increasing the service rate (i.e., μ). This will reduce time a vehicle will wait in the queue.

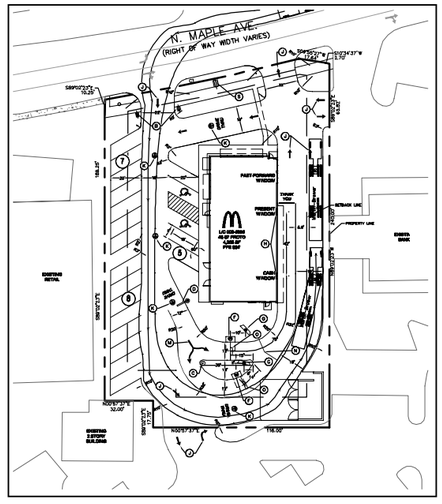
The proposed layout also features a "fast-forward window." This window allows a patron who has ordered a specialty item that will take longer to prepare to move forward from the pickup window so that they do not block the other patrons from picking up their orders which may be completed more quickly. Internally, a larger kitchen and improved headsets will enhance operations and overall processing time. The conceptual proposed site layout is shown in Figure 2.

FIGURE 2 - CONCEPTUAL PROPOSED SITE LAYOUT





DRIVE THRU DETAIL
SCALE: 1"=20'



TRUCK ROUTE ACCESS DETAIL
SCALE: 1" = 50'

NORTH

GRAPHIC SCALE IN FEET
0 10 20 40

SITE DATA

LOCATION:	PURCELLVILLE, VA	
ADDRESS:	121 N. MAPLE AVENUE	
ZONING:	MIXED COMMERCIAL	
LAND USE:	RESTAURANT	
SITE AREA:	33,540 SF	0.77 AC
SEATING CAPACITY:	87	
LOT COVERAGE:	33,540 SF	100%
BUILDING AREA:	4,388 SF	13.1%
IMPERVIOUS AREA:	22,364 SF	66.7%
PERVIOUS AREA:	6,788 SF	20.2%

PARKING SUMMARY

REQUIRED PARKING RATIO: N/A. McDONALD'S TO PROVIDE LETTER TO SUPPORT PROVIDED PARKING COUNT

	EXISTING	PROVIDED
STANDARD	36	18
ACCESSIBLE PER ADA	2	2
TOTAL PARKING	38	20

SITE LEGEND

A. HIGHWAY OR ROAD SIGN (AS ALLOWED) WITH READER BOARD (OPTIONAL) - MONUMENT SIGN ALTERNATIVE
B. DIRECTIONAL SIGN
C. "ANY TIME-ANY LANE" BOLLARD SIGN
D. GATEWAY (SINGLE OR DOUBLE ARM)
E. PRE-SELL BOARD (OPTIONAL)
F. DRIVE-THRU CANOPY WITH BUILT IN COD
G. MENU BOARD
H. NEXTGEN WINDOW POSITION SIGNS
I. DRIVE-THRU PULL FORWARD/PARK SIGNS
J. DIRECTIONAL ARROW
K. McDONALDS GOLD STANDARD TRAFFIC ARROW (PMS 123 YELLOW)
L. 6" STRIPE (PMS 123 YELLOW)
M. DOUBLE HEADED ARROW (PMS 123 YELLOW)
N. MERGE POINT
O. LOOP DETECTOR
P. FLAG POLE
Q. PULL FORWARD SPACE
R. RESERVED DRIVE-THRU SIGN
S. PROPOSED SIGN

Curve Table					
Curve #	Radius	Length	Ch. Brg.	Ch. Dist.	Delta
C1	1457.00	130.76	S10°55'52"E	130.72	05°08'32"

NOTE: THIS CONCEPTUAL SITE PLAN IS BASED ON LIMITED AVAILABLE INFORMATION WHICH MAY INCLUDE AERIAL PHOTOGRAPHY, GIS DATA, AND TAX MAP INFORMATION. IT IS INTENDED AS PRELIMINARY, FOR THE PURPOSE OF UNDERSTANDING A POTENTIAL SITE CONFIGURATION. LOCAL LAND DEVELOPMENT CODE COMPLIANCE, ACCESS POINTS, SPECIFIC TENANT REQUIREMENTS, ETC. HAVE NOT BEEN REVIEWED OR CONFIRMED WITH LOCAL JURISDICTIONAL AGENCIES DURING THE PREPARATION OF THIS CONCEPTUAL SITE PLAN. THIS PLANS WAS PREPARED WITHOUT THE BENEFIT OF A RECENT TITLE COMMITMENT OR SURVEY.

NO.	REVISIONS	DATE	BY

Kimley»Horn
© 2014 KIMLEY-HORN AND ASSOCIATES, INC.
11400 COMMERCE PARK DRIVE, SUITE 400, RESTON, VA 20191
PHONE: 703-674-1300 FAX: 703-674-1350
WWW.KIMLEY-HORN.COM

DESIGN ENGINEER: VIRGINIA REGISTRATION NUMBER:

SCALE: AS NOTED
DESIGNED BY: SM
DRAWN BY: SM
CHECKED BY: JK
DATE:

SITE AND LANDSCAPE PLAN

PURCELLVILLE REBUILD
009-5505
TOWN OF PURCELLVILLE VIRGINIA

DATE
6/26/2014

PROJECT NO.
110368002

SHEET NUMBER
CSP-1

FUTURE OPERATIONAL FORECASTING

The proposed 663 square foot expansion of the McDonalds will result in the following increases in trip generation based on trip generation rates contained in the ITE Trip Generation Manual, 9th Edition.

	IN	OUT	TWO-WAY
Weekday			
AM Peak Hour	15	15	30
AM Peak Hour of Generation	18	18	36
PM Peak Hour	11	11	22
Saturday			
Peak Hour of Generation	20	19	39

The AM Peak Hour of Generation was chosen to represent trip generation during the weekday midday because it results in more trips than the PM Peak Hour of Generation and is more conservative. It was assumed that 50% of the increased trip generation would use the drive through. The increased trip generation using the drive through was added to the existing peak hour arrival rate to create a forecast peak hour arrival rate.

McDonald's expects that the proposed enhancements will improve the expected processing time by 10 seconds, from 90 to 80 seconds. Because the expected processing times are shorter than what was observed during data collection, this 10 second reduction was applied to the observed overall processing time to determine a more conservative percentage reduction in processing time. This percentage reduction was then applied to the existing ordering window service time, and then converted into a forecast ordering window service rate.

Analysis was performed to calculate how often the ordering window queue will reach a length that will reach Maple Avenue (more than 14 vehicles). This was accomplished using the same equation as used in the existing conditions analysis.

The results of the analysis are included in Table 3 below.

Table 3: Forecast Arrival Rates, Service Rates, and Queue Lengths				
	Weekday AM	**Weekday Mid-day**	**Weekday PM**	**Saturday Mid-day**
Additional Peak Hour Trips Generated (entering site)	15	18	11	20
50% of Additional Peak Hour Generation	8	9	6	10
Forecast Total Peak Hour Arrival Rate, λ (veh/hr)	125	115	75	100
Overall processing time (sec/veh)	177	160	121	153
Overall processing time with 10 sec. reduction (sec/veh)	167	150	111	143
Percent Reduction in processing time	5.6%	6.3%	8.3%	6.5%
Service Time with % reduction (sec)	24.40	27.16	29.30	27.21
Forecast Peak Hour Service Rate, μ (veh/hr)	147.53	132.53	122.87	132.31
Calculated Peak Hour Average Queue Length (number of vehicles in service and queue)	5.55	6.56	1.57	3.10
Difference between Existing and Forecast Average Queue Lengths (veh)	0.30	0.73	-0.01	0.43
Probability of more than 14 vehicles in the system (when vehicle queue extends into Maple Avenue)	8.33%	11.91%	0.06%	1.50%
Difference between Existing and Forecast Probability of Vehicle Queues Extending into Maple Avenue	-12.49%	-12.15%	-1.15%	-4.21%

The analysis shows that the average queue lengths grow by a negligible amount. The largest change in average queue length is during the weekday mid-day peak hour, which increases from 5.83 vehicles to 6.56 vehicles, less than one vehicle difference. The weekday pm peak hour average queue length remains approximately the same. Due to the upgraded site layout, however, there is a significantly reduced chance that the queue lengths will back up into Maple Avenue. This is due to the increase from 8 to 14 in the number of vehicles that can queue before reaching Maple Avenue.

The most significant benefit that will result from the proposed modifications is indicated by the reduction in the probability that the vehicle queues will extend to Maple Avenue. In the weekday AM and mid-day peak hours, which contained the longest average observed queues, the probability that the forecast queues reach Maple Avenue are reduced significantly. During the AM peak hour, the forecast probability is 8.33% compared to 20.82% under existing conditions. During the mid-day peak hour, the forecast probability is 11.91% compared to 24.06% under existing conditions. The probability of the queues reaching Maple Avenue is also reduced during each of the other study peak hours.

CONCLUSIONS

The analyses show that with the proposed improvements, the upgrades to the McDonald's will result in significant reductions in the probability that vehicle queues will reach Maple Avenue. The shifting of the store footprint and the modification of the drive-thru ordering operation will provide for additional capacity within the site.

Weekday AM Peak Period Arrival Count

("Error" is a vehicle that appeared at first to join the drive-thru queue but did not actually become a part of the queue)

Start Date: 6/18/2014

Start Time: 7:00:00 AM

Start Time	Count	Error	Corrected Count	Hourly
07:00 AM	9	0	9	91
07:05 AM	5	0	5	90
07:10 AM	8	0	8	94
07:15 AM	13	0	13	100
07:20 AM	8	0	8	94
07:25 AM	7	0	7	96
07:30 AM	6	0	6	99
07:35 AM	7	0	7	105
07:40 AM	7	0	7	104
07:45 AM	9	0	9	109
07:50 AM	8	0	8	111
07:55 AM	4	0	4	110
08:00 AM	8	0	8	117
08:05 AM	9	0	9	
08:10 AM	14	0	14	
08:15 AM	7	0	7	
08:20 AM	10	0	10	
08:25 AM	10	0	10	
08:30 AM	12	0	12	
08:35 AM	6	0	6	
08:40 AM	12	0	12	
08:45 AM	11	0	11	
08:50 AM	8	1	7	
08:55 AM	11	0	11	

	per min	per hr
Average Arrival Rate (veh/min)	1.733333	104
Peak Hour Arrival Rate (veh/min)	1.95	117
Peak 5-min Arrival Rate (veh/min)	2.8	168

Weekday Mid-day Peak Period Arrival Count

("Error" is a vehicle that appeared at first to join the drive-thru queue but did not actually become a part of the queue)

Start Date: 6/18/2014

Start Time: 11:30:00 AM

Start Time	Count	Error	Corrected Count	Hourly
11:30 AM	10	0	10	106
11:35 AM	9	1	8	100
11:40 AM	12	0	12	98
11:45 AM	3	0	3	90
11:50 AM	5	1	4	98
11:55 AM	9	0	9	100
12:00 PM	11	0	11	98
12:05 PM	10	0	10	97
12:10 PM	10	1	9	97
12:15 PM	9	0	9	94
12:20 PM	9	0	9	90
12:25 PM	12	0	12	89
12:30 PM	4	0	4	83
12:35 PM	6	0	6	
12:40 PM	4	0	4	
12:45 PM	11	0	11	
12:50 PM	6	0	6	
12:55 PM	8	1	7	
01:00 PM	10	0	10	
01:05 PM	11	1	10	
01:10 PM	6	0	6	
01:15 PM	5	0	5	
01:20 PM	8	0	8	
01:25 PM	6	0	6	

	per min	per hr
Average Arrival Rate (veh/min)	1.575	94.5
Peak Hour Arrival Rate (veh/min)	1.766667	106
Peak 5-min Arrival Rate (veh/min)	2.4	144

Weekday PM Peak Period Arrival Count

("Error" is a vehicle that appeared at first to join the drive-thru queue but did not actually become a part of the queue)

Start Date: 6/18/2014

Start Time: 5:15:00 PM

Start Time	Count	Error	Corrected Count	Hourly
05:15 PM	2	2	0	57
05:20 PM	4	0	4	65
05:25 PM	9	0	9	69
05:30 PM	7	0	7	64
05:35 PM	8	1	7	60
05:40 PM	2	0	2	61
05:45 PM	4	0	4	65
05:50 PM	4	0	4	66
05:55 PM	7	0	7	65
06:00 PM	6	0	6	62
06:05 PM	2	0	2	62
06:10 PM	6	1	5	65
06:15 PM	8	0	8	63
06:20 PM	8	0	8	
06:25 PM	4	0	4	
06:30 PM	3	0	3	
06:35 PM	8	0	8	
06:40 PM	6	0	6	
06:45 PM	5	0	5	
06:50 PM	3	0	3	
06:55 PM	4	0	4	
07:00 PM	6	0	6	
07:05 PM	5	0	5	
07:10 PM	3	0	3	

	per min	per hr
Average Arrival Rate (veh/min)	1	60
Peak Hour Arrival Rate (veh/min)	1.15	69
Peak 5-min Arrival Rate (veh/min)	1.8	108

Saturday Mid-day Peak Period Arrival Count

("Error" is a vehicle that appeared at first to join the drive-thru queue but did not actually become a part of the queue)

Start Date: 6/21/2014

Start Time: 11:30:00 AM

Start Time	Count	Error	Corrected Count	Hourly
11:30 AM	8	0	8	90
11:35 AM	10	0	10	90
11:40 AM	5	1	4	80
11:45 AM	8	0	8	81
11:50 AM	10	0	10	82
11:55 AM	7	0	7	78
12:00 PM	8	0	8	81
12:05 PM	7	0	7	83
12:10 PM	8	0	8	82
12:15 PM	6	0	6	83
12:20 PM	4	0	4	84
12:25 PM	10	0	10	84
12:30 PM	8	0	8	78
12:35 PM	2	2	0	
12:40 PM	5	0	5	
12:45 PM	9	0	9	
12:50 PM	7	1	6	
12:55 PM	10	0	10	
01:00 PM	10	0	10	
01:05 PM	6	0	6	
01:10 PM	9	0	9	
01:15 PM	7	0	7	
01:20 PM	4	0	4	
01:25 PM	4	0	4	

	per min	per hr
Average Arrival Rate (veh/min)	1.4	84
Peak Hour Arrival Rate (veh/min)	1.5	90
Peak 5-min Arrival Rate (veh/min)	2	120

Weekday AM Peak Period Process Time and Queuing Obvserations

	6/18/2014		Purcellville Mcdonalds		
	Processing Time (sec)		Queue @ Time (# of cars)		
Start Time	1st Observation	2nd Observation	Present Window	Ordering Station	Total
7:00	100	145	2	4	6
7:05	223		5	0	5
7:10	147	150	3	0	3
7:15	104	115	4	2	6
7:20	185		6	6	12
7:25	145	152	4	3	7
7:30	132		2	2	4
7:35	136	105	1	2	3
7:40	131		3	2	5
7:45	123	101	3	2	5
7:50	119	145	4	2	6
7:55	148	84	3	0	3
8:00	106		3	2	5
8:05	152	138	5	3	8
8:10	161		6	6	12
8:15	176		6	5	11
8:20	219	150	6	3	9
8:25	188		6	2	8
8:30	235		4	8	12
8:35			5	7	12
8:40	240		6	8	14
8:45	195		6	6	12
8:50	168	193	5	7	12
8:55	161		4	6	10

Average Processing Time	152	Seconds	02:32	Min:Sec
Average Processing Rate	24			
Average Pickup Window Queue	4.25			
Average Order Window Queue	3.67			
Average Cars in both Queues	7.92			
Peak Hour Avg Processing Time	177	Seconds	02:57	Min:Sec
Peak Hour Avg Processing Rate	20			
Peak Hour Avg Pickup Window Queue	5.17			
Peak Hour Avg Order Window Queue	5.25			
Peak Hour Avg Cars in both Queues	10.42			
Max Pickup Window Queue	6			
Max Order Window Queue	8			
Max Cars in both Queues	14			

Weekday Mid-day Peak Period Process Time and Queuing Obvserations

	6/18/2014		Purcellville Mcdonalds		
	Processing Time (sec)		Queue @ Time (# of cars)		
Start Time	1st Observation	2nd Observation	Present Window	Ordering Station	Total
11:30	108		4	5	9
11:35	272		5	6	11
11:40	178		6	4	10
11:45	127	110	3	1	4
11:50	143	86	0	3	3
11:55	136		4	4	8
12:00	145	133	3	5	8
12:05	280		4	8	12
12:10	207		3	9	12
12:15			4	9	13
12:20	186		5	7	12
12:25	127		2	9	11
12:30	207		3	9	12
12:35	147		3	3	6
12:40	106	142	3	5	8
12:45	193		0	10	10
12:50	155		4	4	8
12:55	176		3	4	7
13:00	172		5	6	11
13:05	212		5	8	13
13:10	345		7	4	11
13:15			3	5	8
13:20	129		5	2	7
13:25	214		3	4	7

Average Processing Time	171	Seconds	02:51	Min:Sec
Average Processing Rate	21			
Average Pickup Window Queue	3.63			
Average Order Window Queue	5.58			
Average Cars in both Queues	9.21			
Peak Hour Avg Processing Time	160	Seconds	02:40	Min:Sec
Peak Hour Avg Processing Rate	23			
Peak Hour Avg Pickup Window Queue	3.58			
Peak Hour Avg Order Window Queue	5.83			
Peak Hour Avg Cars in both Queues	9.42			
Max Pickup Window Queue	7			
Max Order Window Queue	10			
Max Cars in both Queues	13			

Weekday PM Peak Period Process Time and Queuing Obvserations

	6/18/2014	Purcellville Mcdonalds		
	Processing Time (sec)	Queue @ Time (# of cars)		
Start Time		Present Window	Ordering Station	Total
17:15	85	0	0	0
17:20	138	2	3	5
17:25	207	3	4	7
17:30	175	6	1	7
17:35	95	3	2	5
17:40	80	0	0	0
17:45	90	0	0	0
17:50	118	1	0	1
17:55	102	2	1	3
18:00	94	5	0	5
18:05	135	2	1	3
18:10	139	0	1	1
18:15	112	4	3	7
18:20	110	4	6	10
18:25	147	4	1	5
18:30	122	2	2	4
18:35	126	4	2	6
18:40	241	6	1	7
18:45	170	4	0	4
18:50	128	1	1	2
18:55	214	1	3	4

Average Processing Time	135	Seconds	02:15	Min:Sec
Average Processing Rate	27			
Average Pickup Window Queue	2.57			
Average Order Window Queue	1.52			
Average Cars in both Queues	4.1			
Peak Hour Avg Processing Time	121	Seconds	02:01	Min:Sec
Peak Hour Avg Processing Rate	30			
Peak Hour Avg Pickup Window Queue	2.5			
Peak Hour Avg Order Window Queue	1.58			
Peak Hour Avg Cars in both Queues	4.08			
Max Pickup Window Queue	6			
Max Order Window Queue	6			
Max Cars in both Queues	10			

Saturday Mid-day Peak Period Process Time and Queuing Obvserations

	6/21/2014	Purcellville Mcdonalds		
	Processing Time (sec)	Queue @ Time (# of cars)		
Start Time		Present Window	Ordering Station	Total
11:30	140	4	1	5
11:35	125	3	3	6
11:40	98	0	1	1
11:45	115	2	3	5
11:50	123	4	4	8
11:55	145	4	3	7
12:00	200	6	3	9
12:05	143	5	1	6
12:10	195	5	0	5
12:15	110	3	1	4
12:20	144	0	3	3
12:25	165	5	5	10
12:30	278	7	5	12
12:35	155	2	1	3
12:40	103	3	1	4
12:45	122	3	2	5
12:50	175	2	5	7
12:55	135	3	4	7
13:00	137	3	6	9
13:05	153	5	7	12
13:10	247	7	5	12
13:15	134	6	3	9
13:20	164	2	2	4
13:25	96	2	3	5

Average Processing Time	150	Seconds	02:30	Min:Sec
Average Processing Rate	24			
Average Pickup Window Queue	3.58			
Average Order Window Queue	3			
Average Cars in both Queues	6.58			
Peak Hour Avg Processing Time	153	Seconds	02:33	Min:Sec
Peak Hour Avg Processing Rate	23			
Peak Hour Avg Pickup Window Queue	3.67			
Peak Hour Avg Order Window Queue	2.67			
Peak Hour Avg Cars in both Queues	6.33			
Max Pickup Window Queue	7			
Max Order Window Queue	7			
Max Cars in both Queues	12			