TRAFFIC STUDY

Traffic Study

West Center

prepared for:

Jorgensen & Associates

Center Street and
Harmon Avenue and
Duncan Avenue

Fayetteville, Arkansas

STATE OF ARKANSAS
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Project No.: P-1604

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EXECUTIVE SUMMARY

Peters & Associates Engineers, Inc., has conducted a traffic engineering study relating to West Center, a proposed approximate 480 bed residential student apartment development in Fayetteville, Arkansas. West Center is proposed to be located on the south side of Center Street, on the east side of Harmon Avenue and on the west side of Duncan Avenue. The site will replace an existing approximate 31-unit apartment development plus a triplex and five single-family residential houses. Access to the West Center development is proposed via a fully-directional access drive (Drive A) to intersect Harmon Avenue approximately 270 feet south of Center Street and an outbound only access drive (Drive B) to intersect Duncan Avenue approximately 270 feet south of Center Street. The primary focus of this report is to assess traffic operational characteristics of the adjacent intersections of Center Street and Duncan Avenue, Center Street and Harmon Avenue and of access drives proposed to serve the site so they provide acceptable operation. The site is just south of the Oak Ridge Multi-Use Trail located along the north side of Center Street.

Hourly, 24-hour traffic counts were made at the following locations in the vicinity of the site by this consultant as a part of this study:

- Center Street approaches to Duncan Avenue
- Duncan Avenue approaches to Center Street
- Center Street approaches to Harmon Avenue
- Harmon Avenue approaches to Center Street.

Existing vehicle and pedestrian turning movement count data were gathered by this consultant for the following intersections during the AM, school PM and typical PM peak hours:

- Center Street and Duncan Avenue
- Center Street and Harmon Avenue.

Since West Center is proposed to house primarily University of Arkansas students, the number of residents is typically used as the trip-generation independent variable (approximately 480 beds or residents) for this type of land-use. Additionally, since this development will consist primarily of student housing, it is assumed that a large number of these residents will utilize public transit or walk/bike to campus des-

tinations in reasonable close proximity. This site is along the existing Razorback Transit route. Projected vehicle and pedestrian traffic volumes were calculated for the proposed student housing residential development. These projected vehicle and pedestrian site-generated trips were added to the existing traffic volumes. Existing and projected traffic conditions at the study intersections were calculated and analyzed. These volumes have been adjusted to exclude the traffic volumes already in existing traffic volume counts which are associated with the existing land uses (approximate 31-unit apartment development plus a triplex and five single-family residential houses) to be replaced by the proposed development.

Findings of this study are summarized as follows:

- Approximately 1,102 vehicle trips (combined in and out) per average weekday are projected to be generated by the proposed residential student housing land use on this site. Of this total, approximately 79 vehicle trips are estimated during the traffic conditions of the AM peak hour, approximately 90 vehicle trips are estimated during the traffic conditions of the school PM peak hour and approximately 154 vehicle trips are estimated during the traffic conditions of the PM peak hour.

- Capacity and LOS analysis results for existing traffic conditions for the study intersections indicate existing vehicle movements for existing traffic conditions at the study intersections presently operate at what calculates as an acceptable LOS "D" or better for the AM, school PM and typical PM peak hours.

- Capacity and LOS analysis results performed for projected traffic conditions for the AM, school PM and typical PM peak hours for the study intersections with the proposed widening of Center Street at Duncan Avenue and at Harmon Avenue to accommodate eastbound and westbound left-turn lane lanes and with traffic signal control at Center Street and Duncan Avenue and 4-way "Stop" sign control at Center Street and Harmon Avenue, indicate all vehicle movements at the study intersections are expected to operate at what calculates as an acceptable LOS "C" or better for the AM, school PM and typical PM peak hours. However, without traffic signal control at Cen-

ter Street and Duncan Avenue, the westbound vehicle movements at this intersection are expected to operate at what calculates as LOS "E" during the PM peak hour.

- West Center is in close proximity to the University of Arkansas campus and is along an existing Razorback Transit route. This will facilitate transit usage, biking and walking by residents and have the effect of reducing vehicular traffic generation.

- The access drives proposed to serve the West Center development will intersect Harmon Avenue and Duncan Avenue only with no direct access via Center Street. Access via Harmon Avenue and Duncan Street is better than direct access on higher volume Center Street providing; fewer non-site traffic volume conflicts with ingress and egress to the site.

- Even though the intersection of Center Street and Duncan Avenue is currently traffic signal controlled, based on volume criteria set out in the MUTCD, it was found that traffic signal warrants are currently not met for the intersection of Center Street and Duncan Avenue with existing traffic volumes. Traffic signal warrants at this intersection are not projected to be met with full build-out of this development. However, traffic control at this intersection is expected to improve traffic operations and mitigate intersection sight distance limitation if a traffic signal is installed.

- Based on volume criteria set out in the MUTCD, it was found that traffic signal warrants are currently not met for the intersection of Center Street and Harmon Avenue with existing traffic volumes. Furthermore, traffic signal warrants at this intersection are not projected to be met with full build-out of this development.

Recommendations of this study are summarized as follows:

- It is recommended to widen Center Street at Duncan Avenue and at Harmon Avenue to accommodate the addition of an eastbound and westbound left-turn lane at each of these intersections.

- It is recommended to construct the site access drive proposed to intersect Harmon Avenue to consist of an inbound lane and an outbound lane.

- It is recommended to construct the site access drive proposed to intersect Duncan Avenue to consist of an outbound lane only.

- Intersection modifications at Center Street and Duncan Avenue and at Center Street and Harmon Avenue and the new access site drives must conform to the City of Fayetteville design standards and will require approval by the City.

- If the existing traffic signal at Center Street and Duncan Avenue is replaced to accommodate the addition of an eastbound and westbound left-turn lane on Center Street, it is recommended that provisions for pedestrians be accommodated in the new traffic signal design and well-defined pedestrian crosswalks be provided across the north and west legs of this intersection.

- Since all vehicles will be required to stop at Center Street and Harmon Avenue with 4-way "Stop" sign control at this intersection (and with well defined painted crosswalks), that should provide pedestrians ample opportunity to cross and painted crosswalks and required MUTCD signage should be sufficient at this intersection.

- If traffic signal control is not installed at the intersection of Center Street and Duncan Avenue or if the intersection of Center Street and Harmon Avenue is not a 4-way "Stop" sign controlled intersection, it is recommended to install new crosswalks and required MUTCD signs at these intersections. These crosswalks could be constructed as a raised crosswalk with embedded LED lights in pavement to also serve to reduce speed by vehicles on Harmon Avenue in the vicinity due to the existing high pedestrian activity observed in this area.

- It is recommended to install pedestrian crossing warning signs per standards of the MUTCD for traffic exiting the site drives approaching Harmon Avenue and approaching Duncan Avenue. Also, it is recommended to include pedestrian crosswalk markings at the site access drive adjacent to Harmon Avenue and Duncan Avenue.

STREET SYSTEM

Center Street, at the site between Duncan Avenue and Harmon Avenue, is approximately 28 feet wide consisting of an eastbound lane and a westbound lane. This roadway is asphalt and constructed with curbs and gutters. There are sidewalks along the north side of Center Street between Duncan Avenue and Harmon Avenue. Center Street is classified as a Local Street on the City of Fayetteville Master Street Plan (MSP).

Duncan Avenue, south of Center Street, is approximately 20 feet wide with no pavement markings separating the northbound and southbound lanes. This roadway is asphalt and constructed with curbs and gutters. There are sidewalks along the west side of the street in the immediate vicinity of the site. Duncan Avenue, north of Center Street, is 28-feet wide consisting of a northbound lane and a southbound lane with sidewalks along both sides of the roadway. Duncan Avenue is classified as a Local Street on the City MSP.

Harmon Avenue, south of Center Street, is approximately 36 feet wide with no pavement markings separating the northbound and southbound lanes. This roadway is asphalt and constructed with drainage ditches, except along the west side of the roadway, immodestly south of Center Street (curbs and gutters with sidewalk). Harmon Avenue, north of Center Street, is 22 feet wide consisting of a northbound lane and a southbound lane with sidewalks along the east side of the roadway. Harmon Avenue is classified as a Local Street on the City MSP.

The intersection of Center Street and Duncan Avenue is signalized. This is a 2-phase traffic signal operation with signal indications mounted on span wires. The traffic signal does not comply with MUTCD standards. The controller is located on the southwest corner of this intersection. There is a pedestrian crosswalk along the north leg of this intersection.

The following photos show the general layout of Center Street, Harmon Avenue and Duncan Avenue. These were taken at locations as indicated on the photo captions.

TIME	Center Street and Duncan Avenue Approaches to Intersection			
	Center Street		Duncan Avenue	
	Eastbound	Westbound	Northbound	Southbound
01:00 PM	208	245	95	218
02:00 PM	190	174	70	168
03:00 PM	222	204	121	260
04:00 PM	230	212	213	139
05:00 PM	190	339	122	278
06:00 PM	207	212	129	155
07:00 PM	94	108	136	160
08:00 PM	120	138	118	161
09:00 PM	69	68	98	94
10:00 PM	77	75	56	78
11:00 PM	43	41	44	56
12:00 AM	27	29	28	44
01:00 AM	16	15	29	25
02:00 AM	7	6	17	18
03:00 AM	4	6	5	6
04:00 AM	4	3	3	4
05:00 AM	5	6	8	1
06:00 AM	24	29	41	18
07:00 AM	92	122	55	51
08:00 AM	203	273	116	99
09:00 AM	180	250	111	101
10:00 AM	146	205	99	156
11:00 AM	171	151	104	172
12:00 PM	240	257	100	208
24-Hour Total:	**2769**	**3168**	**1918**	**2670**

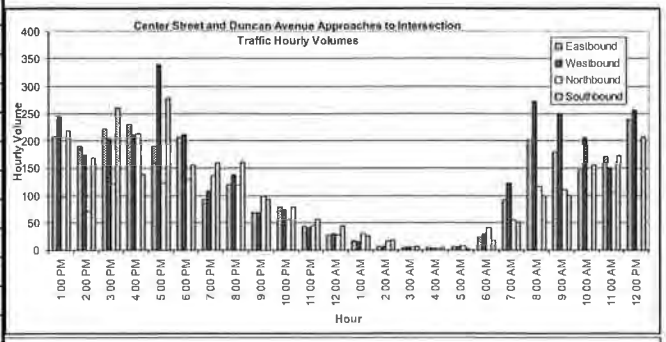
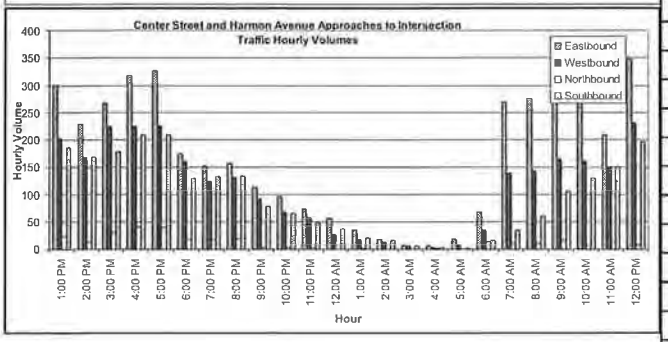


Table 1—Chart 1 24-Hour Traffic Counts
Center Street and Duncan Avenue
Approaches to Intersection

Table 2—Chart 2 24-Hour Traffic Counts
Center Street and Harmon Avenue
Approaches to Intersection



TIME	Center Street and Harmon Avenue Approaches to Intersection			
	Center Street		Harmon Avenue	
	Eastbound	Westbound	Northbound	Southbound
01:00 PM	301	202	23	186
02:00 PM	228	168	13	168
03:00 PM	267	224	31	178
04:00 PM	319	224	41	209
05:00 PM	327	225	39	209
06:00 PM	174	161	18	129
07:00 PM	151	124	17	133
08:00 PM	157	131	19	134
09:00 PM	114	92	3	78
10:00 PM	96	68	3	65
11:00 PM	72	57	3	47
12:00 AM	56	27	0	37
01:00 AM	34	18	1	21
02:00 AM	18	13	0	15
03:00 AM	7	5	0	5
04:00 AM	5	3	1	3
05:00 AM	18	7	0	1
06:00 AM	67	35	13	15
07:00 AM	269	139	10	34
08:00 AM	276	143	10	60
09:00 AM	373	164	15	106
10:00 AM	319	161	7	130
11:00 AM	209	150	12	150
12:00 PM	348	230	8	196
24-Hour Total:	**4205**	**2771**	**287**	**2309**

PEDESTRIANS

MUTCD Sign W11-2

It was observed that there is considerable pedestrian activity in the vicinity of this proposed development because of the proximity to the University of Arkansas and Fayetteville High School. Pedestrian traffic has been included in the capacity and LOS analysis. Pedestrian traffic should be taken into consideration Center Street and Duncan Avenue, Center Street and Harmon Avenue and at the proposed access drives.

It is recommended to install pedestrian crossing warning signs per the MUTCD (as shown to the left) for traffic exiting the site drive approaching Harmon Avenue and approaching Duncan Avenue. Also, it is recommended to include pedestrian crosswalk markings across the site access drives. Additionally, it is recommended to install a new crosswalk (and required MUTCD signs) across the west and south legs of Center Street and Harmon Avenue. If the intersection of Center Street and Harmon Avenue is not a 4-way "Stop" sign controlled intersection, the recommended crosswalk on the east leg of this intersection (across Center Street) could be constructed as a raised crosswalk with embedded LED lights in pavement to also serve to reduce speed by vehicles on Center Street in the vicinity. Examples are shown on the following page.

Since all vehicles will be required to stop at Center Street and Harmon Avenue with 4-way "Stop" sign control at this intersection (and with well defined painted crosswalks), that should provide pedestrians ample opportunity to cross and painted crosswalks and required MUTCD signage should be sufficient at this intersection.

If the traffic signal at Center Street and Duncan Avenue is replaced to account for the additional lanes on Center Street, provisions should also be included for pedestrians at this intersection and a new crosswalk should be provided along the east leg (across Center Street) of this intersection. The north leg of this intersection already has a crosswalk.

Additionally, the frontage of the site to public streets should include pedestrian sidewalk provision as can be expected to be a City requirement.

CAPACITY ANALYSIS

Level of Service Analysis Results

Existing Traffic Conditions

Capacity and level of service analysis was performed for existing traffic volumes (vehicles and pedestrians), lane geometry and traffic control for the AM, school PM and typical PM peak hours for the following intersections:

- Center Street and Duncan Avenue
- Center Street and Harmon Avenue.

As indicated in Table 4, "Level of Service Summary – Existing Traffic Conditions," all existing vehicle movements for existing traffic conditions at the study intersections presently operate at what calculates as an acceptable LOS "D" or better for the AM, school PM and typical PM peak hours.

Traffic volumes used for this analysis are shown on Figure 3, "Existing Traffic Volumes - AM and PM Peak Hours," and Figure 3A, "Existing Traffic Volumes - School PM Peak Hour."

EXISTING TRAFFIC CONDITIONS		Traffic Control	EB LT	EB TH	EB RT	WB LT	WB TH	WB RT	NB LT	NB TH	NB RT	SB LT	SB TH	SB RT	Overall Intersection
INTERSECTION	PEAK HR		PEAK HOUR - LEVEL OF SERVICE												
Center Street and Duncan Avenue	AM	SIGNAL	B			B			A			A			B
	School PM		A			A			A			A			A
	PM		B			B			A			B			B
Center Street and Harmon Avenue	AM	"STOP" SIGN	A			A			D			C			n/a
	School PM		A			A			B			C			n/a
	PM		A			A			C			C			n/a

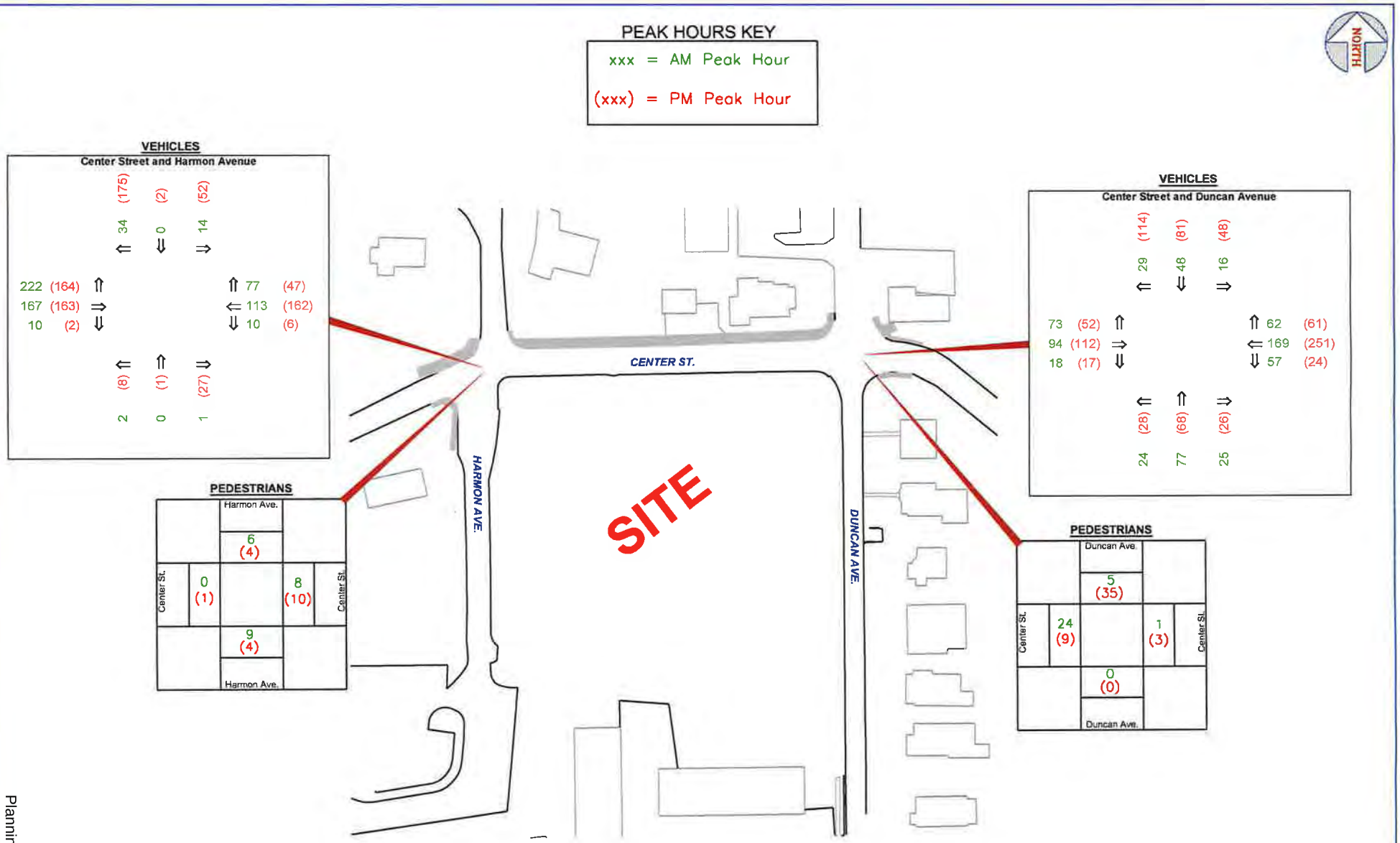
Table 4 - Level of Service Summary - Existing Traffic Conditions

PROJECTED TRAFFIC CONDITIONS		Traffic Control	EB LT	EB TH	EB RT	WB LT	WB TH	WB RT	NB LT	NB TH	NB RT	SB LT	SB TH	SB RT	Overall Intersection
INTERSECTION	PEAK HR		PEAK HOUR - LEVEL OF SERVICE												
Center Street and Duncan Avenue	AM	4-WAY "STOP" SIGN	B	B		B	B		B			B			n/a
	School PM		B	B		B	B		B			B			n/a
	PM		B	B		E	E		C			C			n/a
	AM	SIGNAL	B	B		B	C		B			B			B
	School PM		B	C		B	C		A			A			B
	PM		B	B		B	C		B			B			B
Center Street and Harmon Avenue	AM	4-WAY "STOP" SIGN	B	B		B	B		A			A			n/a
	School PM		B	B		B	B		A			B			n/a
	PM		B	B		C	C		B			C			n/a
Harmon Avenue and Drive A	AM	"STOP" SIGN				A		A		A		A			n/a
	School PM					A		A		A		A			n/a
	PM					A		A		A		A			n/a
Duncan Avenue and Drive B	AM	"STOP" SIGN	A		A				A				A		n/a
	School PM		A		A				A				A		n/a
	PM		A		A				A				A		n/a

Table 5 - Level of Service Summary - Projected Traffic Conditions

Projected traffic conditions were conducted with the following assumed:

- Widening of Center Street at Duncan Avenue and at Harmon Avenue to accommodate eastbound and westbound left-turn lane lanes at each of these intersections.
- With and without traffic signal control at Center Street and Duncan Avenue.
- Center Street and Harmon Avenue as a 4-way "Stop" sign controlled intersection.
- Drive A constructed as a fully-directional access drive to consist of an inbound lane and an outbound lane at Harmon Avenue.
- Drive B constructed as an outbound only access drive to consist of one outbound lane at Duncan Avenue.



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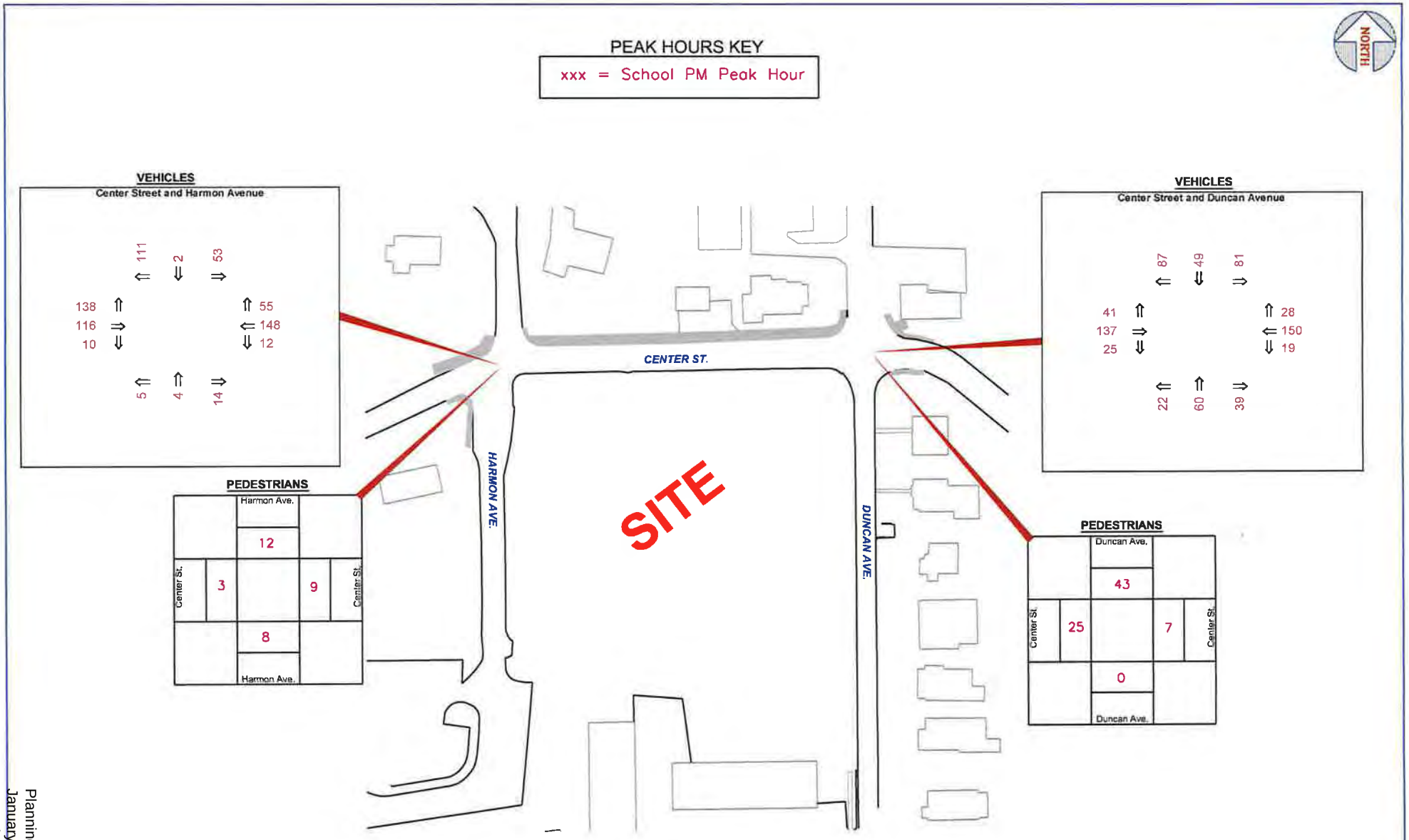
EXISTING
TRAFFIC VOLUMES
AM AND PM PEAK HOURS

FIGURE No.
3



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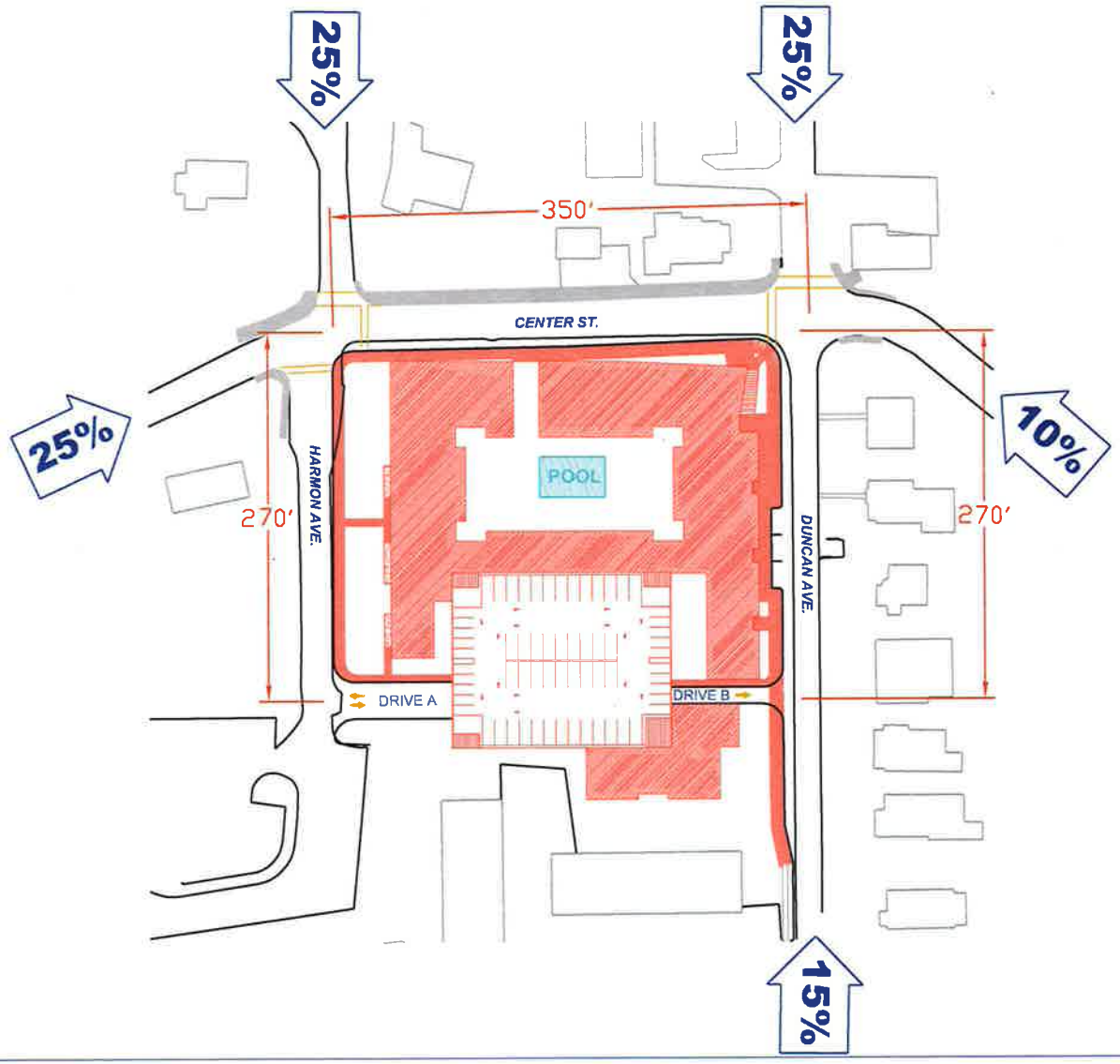
EXISTING
TRAFFIC VOLUMES
SCHOOL PM PEAK HOUR

FIGURE No.
3A



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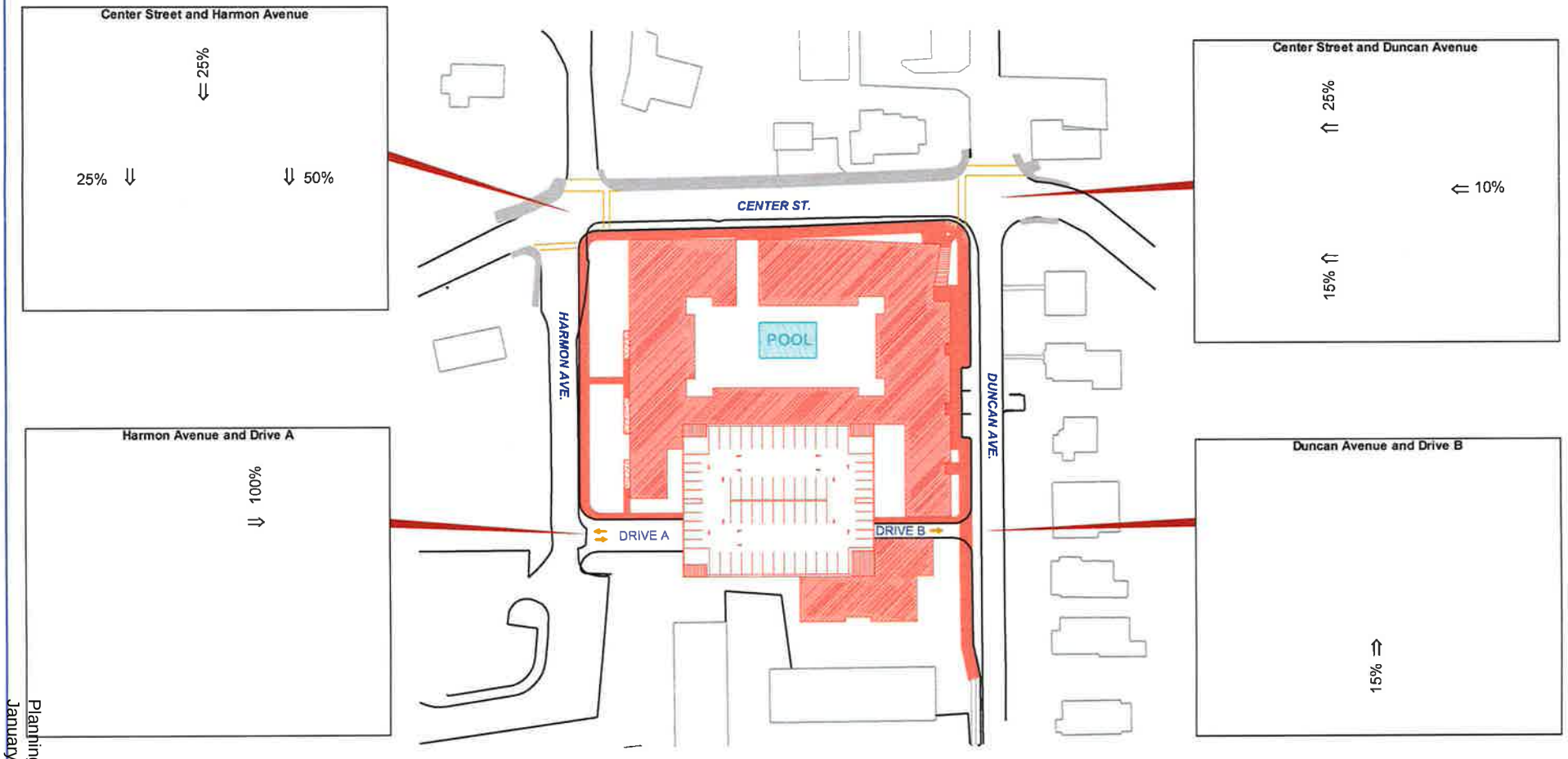
DIRECTIONAL DISTRIBUTION
SITE TRAFFIC

FIGURE No.
4



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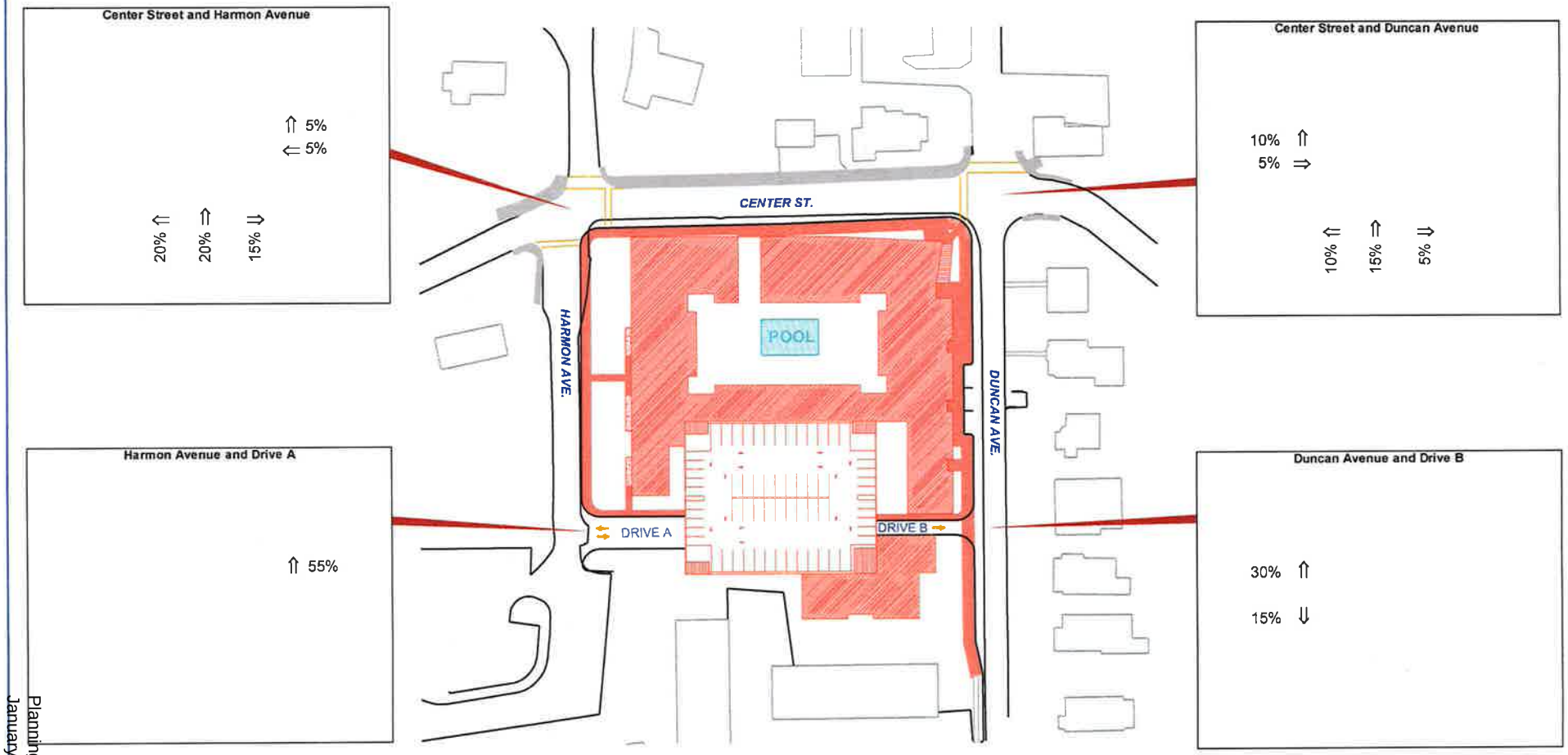
ENTERING TRAFFIC
PERCENTAGE TURNS

FIGURE No.
5



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EXITING TRAFFIC PERCENTAGE TURNS

FIGURE No.
6

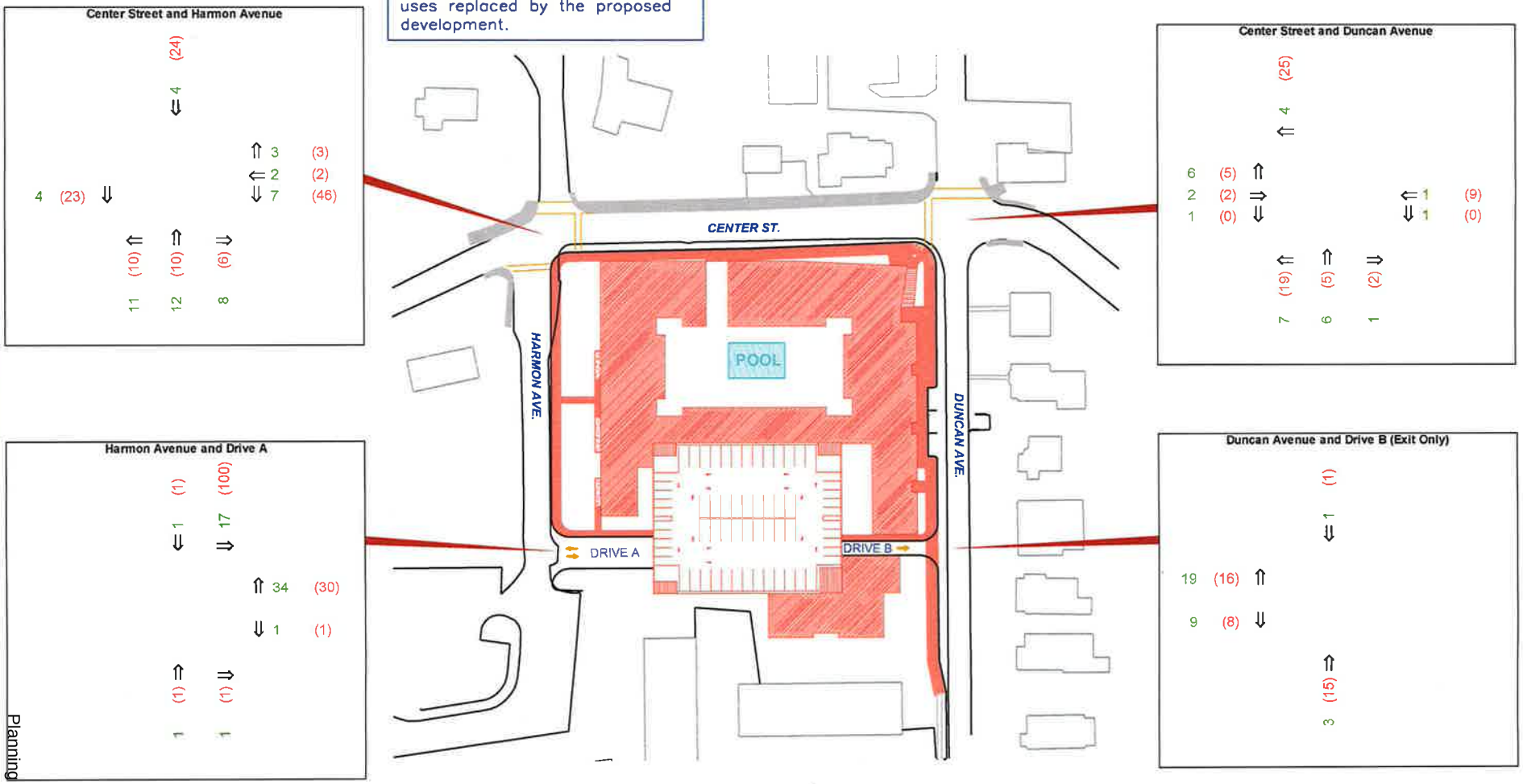
NOTE: These volumes include a reduction to vehicle traffic to account for likely pedestrian traffic and Razorback Transit riders. Additionally, these volumes have have been adjusted to exclude the traffic volumes associated with the existing land uses replaced by the proposed development.

PEAK HOURS KEY

xxx = AM Peak Hour

(xxx) = PM Peak Hour

NORTH



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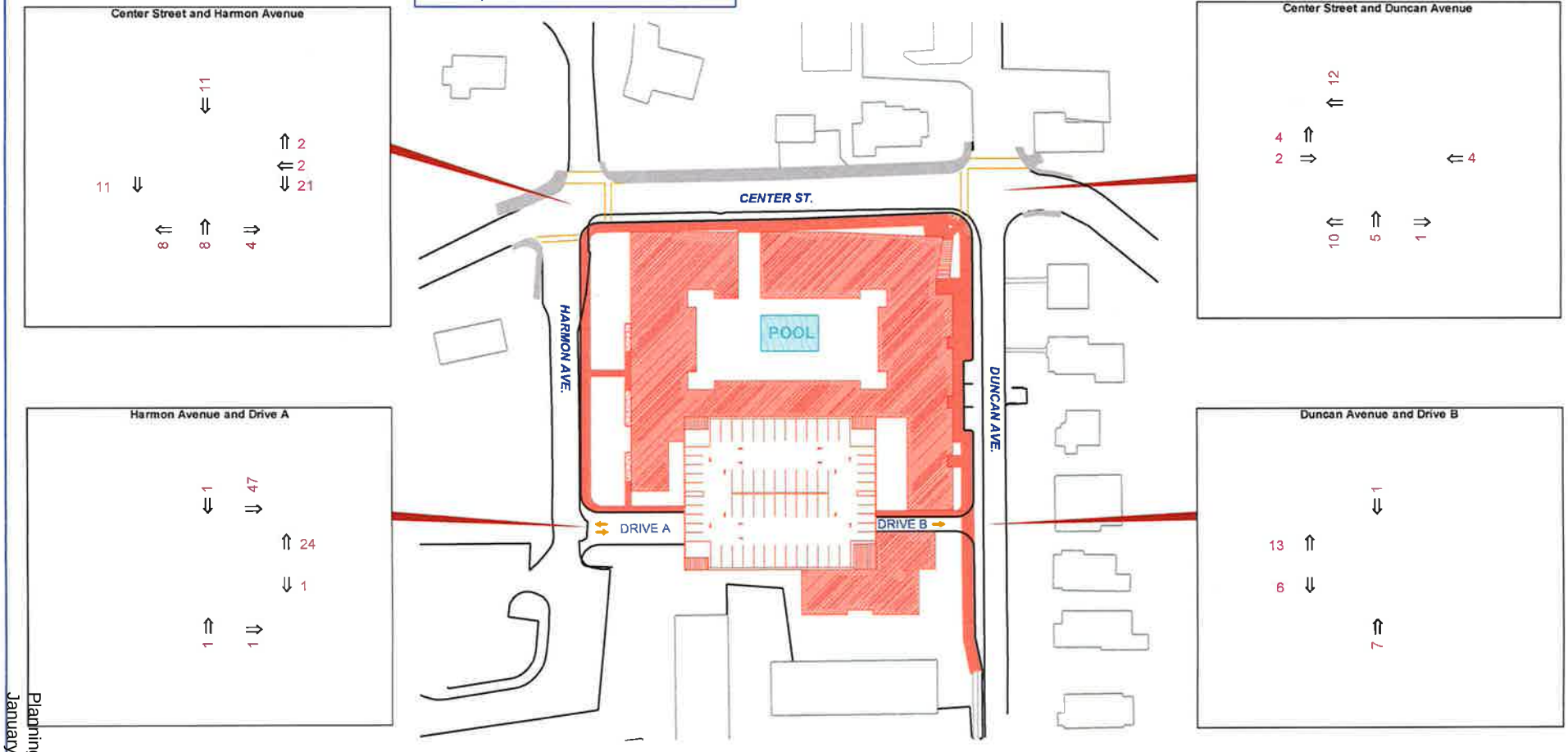
SITE-GENERATED TRAFFIC VOLUMES AM AND PM PEAK HOURS

FIGURE No. 7

NOTE: These volumes include a reduction to vehicle traffic to account for likely pedestrian traffic and Razorback Transit riders. Additionally, these volumes have have been adjusted to exclude the traffic volumes associated with the existing land uses replaced by the proposed development.

PEAK HOURS KEY

xxx = School PM Peak Hour



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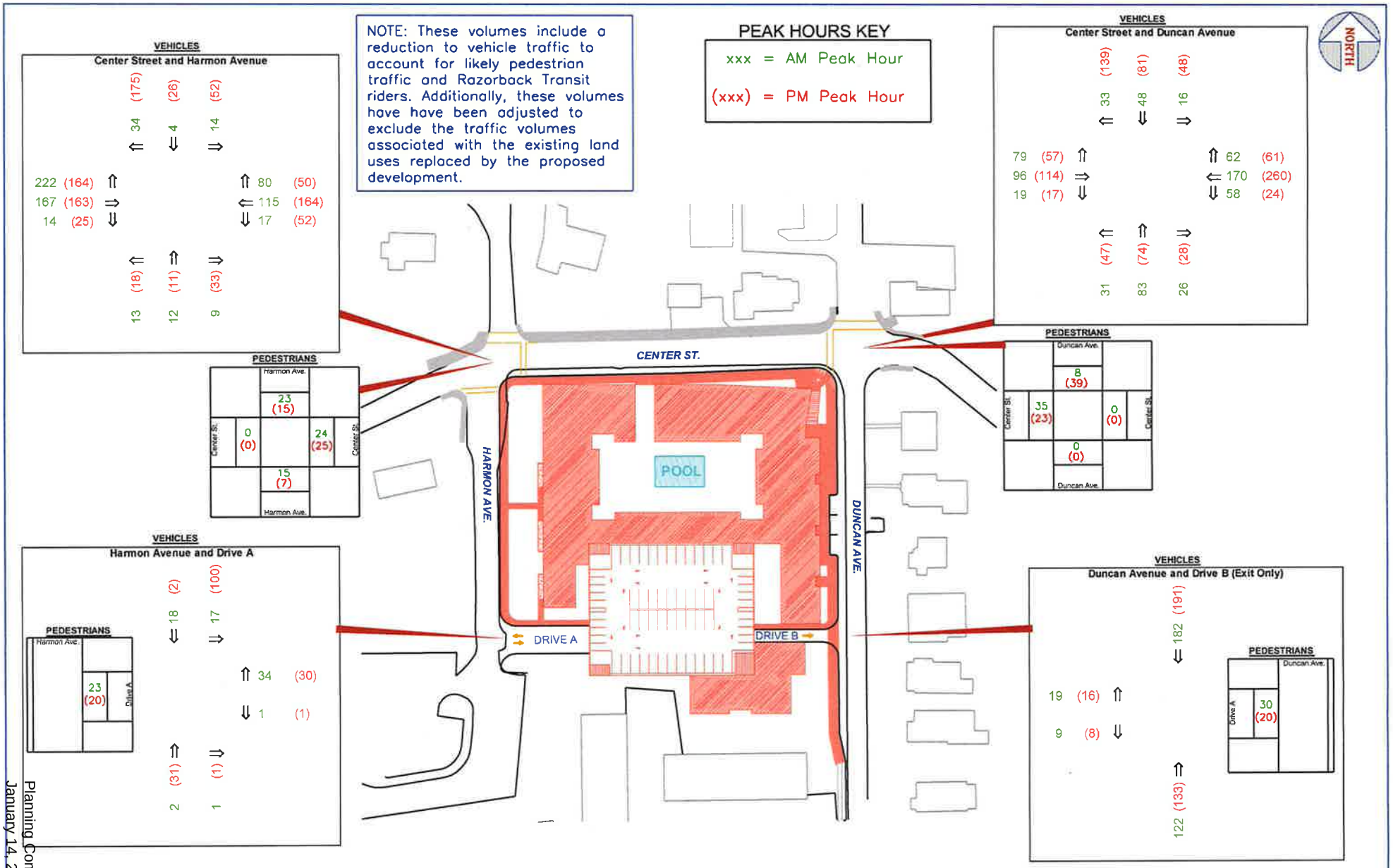
SITE-GENERATED TRAFFIC VOLUMES SCHOOL PM PEAK HOUR

FIGURE No.
7A



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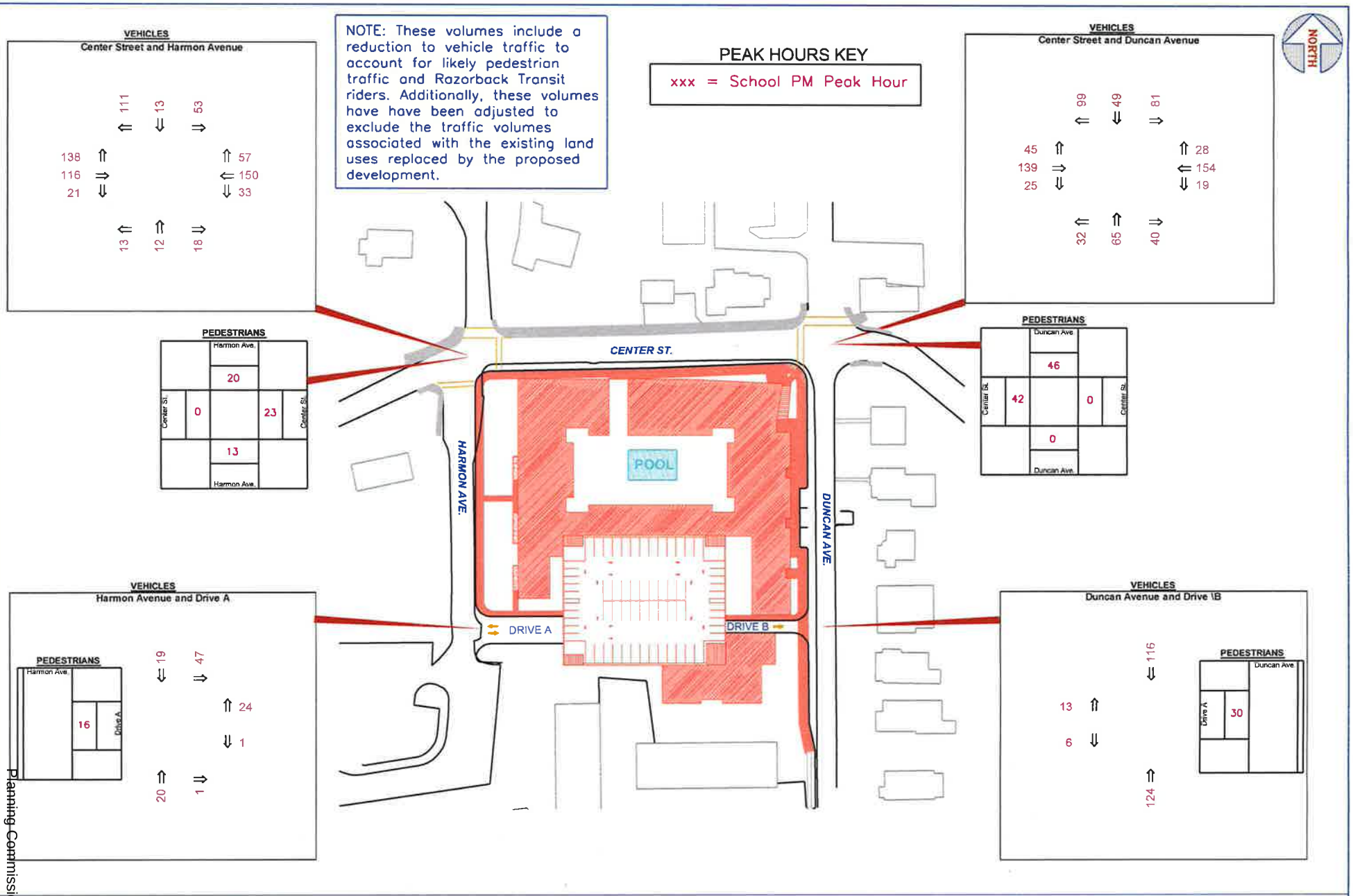
PROJECTED TRAFFIC VOLUMES AM AND PM PEAK HOURS

FIGURE No. 8



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PROJECTED TRAFFIC VOLUMES SCHOOL PM PEAK HOUR

FIGURE No.
8A

Rectangular Rapid Flash Beacon (RRFB)

May 2009
FHWA-SA-09-009

Purpose

According to the National Highway Traffic Safety Administration, there were a total of 14,340 pedestrian fatalities and 193,000 pedestrian injuries resulting from pedestrian vehicle crashes nationwide during the 2004-2006 period. Rectangular Rapid Flash Beacons (RRFB) can enhance safety by reducing crashes between vehicles and pedestrians at unsignalized intersections and mid-block pedestrian crossings by increasing driver awareness of potential pedestrian conflicts.

Alternative Names

Light Emitting Diode (LED) Rapid-Flash System, Stutter Flash or LED Beacons.

Operation

- RRFBs are user-actuated amber LEDs that supplement warning signs at unsignalized intersections or mid-block crosswalks. They can be activated by pedestrians manually by a push button or passively by a pedestrian detection system.
- RRFBs use an irregular flash pattern that is similar to emergency flashers on police vehicles.
- RRFBs may be installed on either two-lane or multi-lane roadways.

This summary is one in a series describing Innovative Intersection Safety Treatments. The summaries identify new technologies and techniques to improve intersection safety developed since NCHRP Report 500, Volumes 5 and 12, were published in 2003 and 2004, respectively. These treatments show promise for improving safety but comprehensive effectiveness evaluations are not yet available.

Potential Benefits

- RRFBs are a lower cost alternative to traffic signals and hybrid signals that are shown to increase driver yielding behavior at crosswalks significantly when supplementing standard pedestrian crossing warning signs and markings.
- An official FHWA-sponsored experimental implementation and evaluation conducted in St. Petersburg, Florida found that RRFBs at pedestrian crosswalks are dramatically more effective at increasing driver yielding rates to pedestrians than traditional overhead beacons.
- The novelty and unique nature of the stutter flash may elicit a greater response from drivers than traditional methods.
- The addition of RRFB may also increase the safety effectiveness of other treatments, such as the use of advance yield markings with YIELD (or STOP) HERE FOR PEDESTRIANS signs. These signs and markings are used to reduce the incidence of multiple-threat crashes at crosswalks on multi-lane roads (i.e., crashes where a vehicle in one lane stops to allow a pedestrian to cross the street while a vehicle in an adjacent lane, traveling in the same direction, strikes the pedestrian), but alone they only have a small effect on overall driver yielding rates.

Agency Experience

"An Analysis of the Effects of Stutter Flash LED Beacons to Increase Yielding to Pedestrians Using Multilane Crosswalks," along with "The Use of Stutter Flash LED Beacons to Increase Yielding to Pedestrians at Crosswalks," presented at the Transportation Research Board Annual Meeting in 2008, summarized the results of two studies on the effects of RRFBs when used to supplement standard pedestrian crossing warning signs at crosswalks.[1]

The former found that going from a no-beacon arrangement to a two-beacon system, mounted on the supplementary warning sign on the right side of the crossing, increased yielding from 18 percent to 81 percent. There was a further increase in yielding behavior, with a four-beacon system (with two beacons on both the right and left side of the crossing) to 88 percent. "An Analysis of the Effects of Stutter Flash LED Beacons to Increase Yielding to Pedestrians

Using Multilane Crosswalks" also evaluated the sites over a 1-year period, and found that there was little to no decrease in yielding behavior over time.

Implementation Considerations

- Including RRFBs on the roadside increases driver yielding behavior significantly. Including RRFBs on a center island or median as well can further increase driver yielding behavior, although with a lower marginal benefit than roadside beacons.
- RRFBs can use manual push-buttons or automated passive (e.g., video or infrared) pedestrian detection, and should be unlit when not activated.
- RRFBs typically receive power by standalone solar panel units, but may also be wired to a traditional power source.

Manual on Uniform Traffic Control Devices (MUTCD) Specifications

- The MUTCD gave interim approval to RRFBs for optional use in limited circumstances in July 2008. The interim approval allows for usage as a warning beacon to supplement standard pedestrian crossing warning signs and markings at either a pedestrian or school crossing; where the crosswalk approach is not controlled by a yield sign, stop sign, or traffic-control signal; or at a crosswalk at a roundabout.
- The MUTCD interim approval memo also contains other provisions for the implementation of the device and should be reviewed

Figure 1: Activated, solar-powered RRFB on a center island at an unsignalized intersection–beacons flash using an irregular flash pattern that is similar to emergency flashers on police vehicles

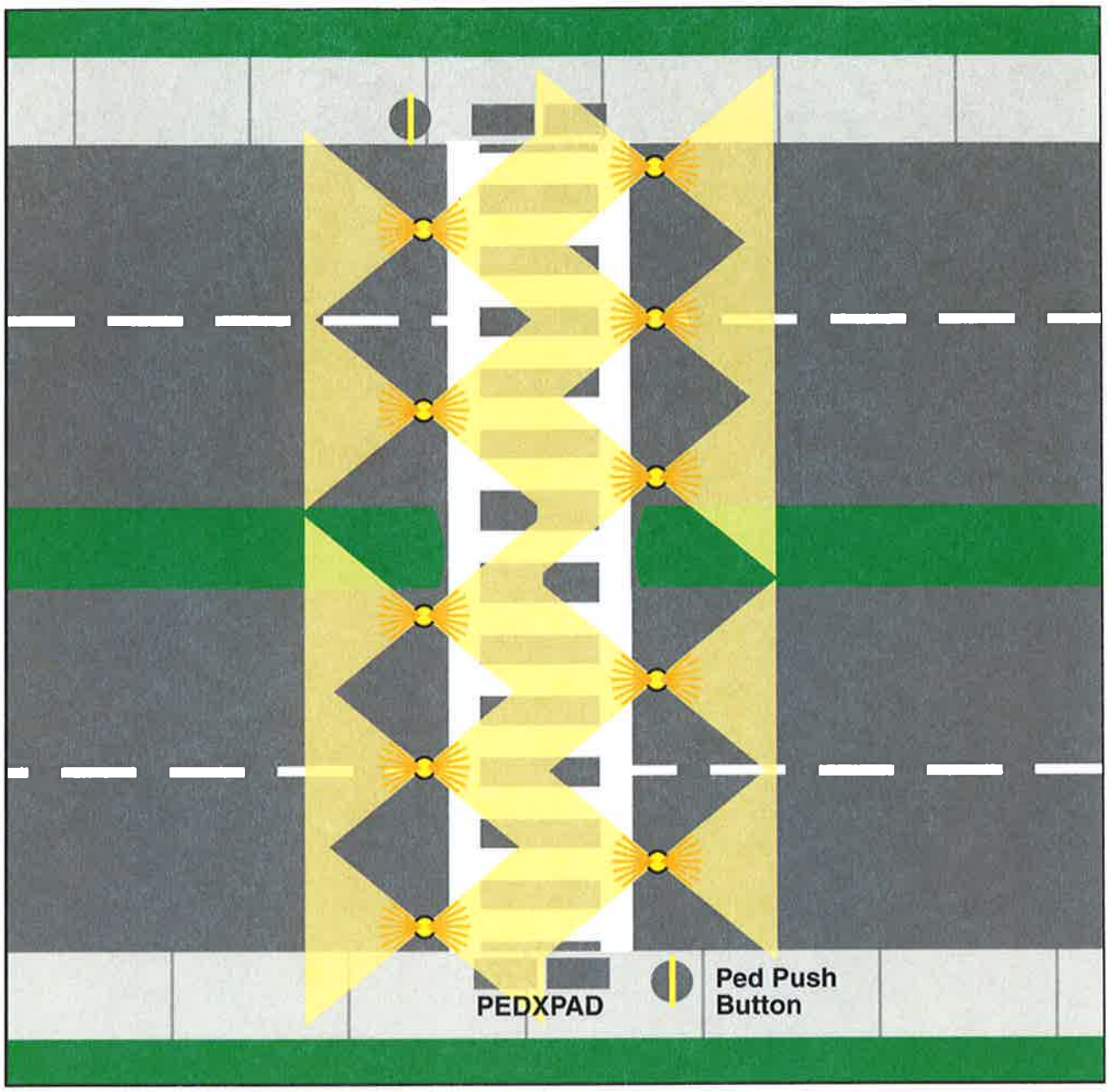
Figure 2: Activated, solar-powered, roadside RRFB at a mid-block crosswalk

Figure 3: Combined roadside and median system of solar-powered RRFB

(http://mutcd.fhwa.dot.gov/resources/interim_approval/ia11/fhwamemo.htm).

Costs

- Cost is approximately $10,000 to $15,000 for purchase and installation of two units (one on either side of a street). This includes solar panels for powering the units, pad lighting, indication units (for both sides of street) with RRFBs in the back and front of each unit, signage on both approaches, all posts, and either passive infrared detection or push buttons with audio instructions.
- Costs would be proportionately higher for additional units placed on a median island, etc.



http://www.xwalk.com/images/packages/4_lane_layout_HR.gif