

MEMORANDUM

DATE: 12/19/2018
SUBJECT: Kenwood Road & Sycamore Plaza U-Turns
PREPARED BY: TEC Engineering, Inc.
PREPARED FOR: Sycamore Township

TEC Engineering, Inc. was retained by Sycamore Township to analyze the implementation of a U-turn movement for the southbound direction at the intersection of Kenwood Road and Sycamore Plaza. The purpose of this study is to analyze the intersection capacity with respect to the U-turn, in addition to the impacts to vehicle safety, pedestrian safety, any necessary improvements for a fully functioning U-turn movement at the intersection. TEC used intersection video provided by JEP Consulting, in addition to turning movement counts from those videos to complete this analysis.

Existing Conditions

Currently, a median separates northbound and southbound Kenwood Road between this intersection and the intersection of Kenwood Road and Montgomery Road. This median prevents vehicles on the southbound side of Kenwood Road from accessing businesses on the northbound side of Kenwood Road and vice versa. The median was installed as an access management safety measure and has been effective in significantly reducing crashes on this segment of Kenwood Road. It does, however, force southbound vehicles to turn around to access the businesses on the east side of Kenwood Road.

The first point at which vehicles can turn around on Kenwood Road is at Sycamore Plaza. The intersection is signed to prohibit U-turns which forces vehicles to make either a left or right turn and then complete a U-turn in order to legally reverse course and proceed north on Kenwood Road.

Surrounding the intersection, the pavement, pavement markings, signs, and traffic signals are all in above average condition and clearly visible. The curb along Kenwood Road on the northeast corner of the intersection has clearly visible tire scuff marks, likely from southbound U-turn vehicles, based on the angle of the markings. The markings are present in Google Street View images from 2015-2018 as shown below.

2015 Google Street View



2017 Google Street View



2018 Google Street View



Video Review

TEC reviewed 12 hours of video at the intersection recorded in September 2018. During that review, TEC analyzed each individual U-turn movement with regard to time during the signal cycle (during protected left turn movement or during the permissive left turn movement), ease of maneuver, speed of maneuver, and if the vehicle contacted the curb on the east side of Kenwood Road.

During the 12-hour period, there was a total of 32 U-turns. All maneuvers were completed without stopping and all but 2 were completed during the permissive left turn portion of the signal cycle. 11 of the 32 U-turns were made with visible ease and without hitting or coming close to the curb for northbound traffic. Those vehicles consisted of sedans and small SUV's. The remaining 21 U-turns completed the maneuver, but did so slowly and either made contact with the curb or narrowly missed the curb. Those vehicles included sedans, large SUV's, mini-vans, and pick-up trucks. All vehicles that attempted the maneuver were passenger vehicles.

Capacity Analysis

From the Miovision turning movement counts in September 2018, U-turn movements were counted with the rest of the turning movements at the intersection. Extra processing was completed in order to determine the number of vehicles turning southbound left, then completing a U-turn in the Sycamore Plaza Driveway and proceeding to turn right to travel northbound on Kenwood Road. The comparison of 12-hour (6AM-7PM) volumes of southbound lefts, southbound lefts that eventually completed a U-turn on Sycamore Plaza, and southbound U-turns can be found below:

Southbound Left Turn vs. U-turn Comparison (12 Hours)

Time Period	Southbound Left	Southbound Lefts Completing Sycamore Plaza U-turns	Illegal Southbound U-turn
12-hour total	820	125	32
AM Peak (7:30-8:30)	16	9	1
PM Peak (4:45-5:45)	81	12	5

These volumes were used to create 2 different scenarios for capacity analysis. One scenario ("Existing Movements") involves all movements as they are currently happening (this includes the illegal U-turns modeled as U-turns and the southbound left vehicles making eventual U-turns as southbound left movements). The other scenario ("Allowed U-turns") takes all the southbound left vehicles completing U-turns on the Sycamore Plaza Drive and adds them to the southbound U-turn tally while removing them from the westbound right tally.

Both scenarios mentioned above were analyzed using the software program Synchro during the 3 peak traffic hours of the day. From the analysis, two useful pieces of data to analyze are the intersection delay and the Level of Service. The Level of Service (LOS) for the intersection is directly related to the average

total delay per vehicle; it ranges from (A – very low delay, to F – congested conditions with unacceptable delay). The total delay is the sum of control delay and queue delay. Control delay is the component of delay caused by the downstream control device and is calculated using the Percentile Delay Method. Queue delay is an analysis of the effects of queues and blocking on short links and short turning bays. LOS is defined in terms of delay and is a measure of driver discomfort and intersection performance with respect to vehicular capacity and quality of service provided to road users. Delay refers to total average stopped delay experienced by motorists at the referenced intersection. The results from the analysis can be seen in the table below.

Capacity Analysis Results

Kenwood Road & Sycamore Plaza											
Peak	Scenario	Northbound		Southbound		Eastbound		Westbound		Total Intersection	
AM	Existing Movements	5.1	A	9.4	A	49.9	D	49.4	D	8.9	A
	Allowed U-turns	5.1	A	9.4	A	49.9	D	49.7	D	8.9	A
MID	Existing Movements	4.1	A	9.4	A	51.7	D	59.4	E	12.2	B
	Allowed U-turns	4.1	A	9.4	A	51.7	D	59.9	E	12.1	B
PM	Existing Movements	7.6	A	9.7	A	49.4	D	60.4	E	14.3	B
	Allowed U-turns	7.6	A	9.7	A	49.4	D	60.8	E	14.2	B

In all scenarios, the intersection operates with an acceptable LOS. Shifting turning movements to model permissive U-turns at the intersection proved to have little impact to the operation of the intersection. The model with the allowed U-turns, utilized all existing signal timing and phasing. The slight changes in delay are due to a reduction of the westbound right turning volume, but also a reduction of available right turn on red time for that movement. It should be noted that while vehicles are able to make U-turns permissively now, this can pose a safety risk in trying to judge oncoming traffic, especially if a higher number of vehicles are completing the maneuver.

To make the U-turn a safer movement, the southbound left turn phase could be changed to protected-only. This scenario was also modeled, and the results are in the table on the next page.

Capacity Analysis with Protected Turn Phasing

Kenwood Road & Sycamore Plaza											
Peak	Scenario	Northbound		Southbound		Eastbound		Westbound		Total Intersection	
AM	Existing Movements	5.1	A	9.4	A	49.9	D	49.4	D	8.9	A
	Allowed U-turns	5.1	A	9.4	A	49.9	D	49.7	D	8.9	A
	Allowed U-turns (protected)	5.4	A	10.2	B	49.9	D	49.7	D	9.3	A
MID	Existing Movements	4.1	A	9.4	A	51.7	D	59.4	E	12.2	B
	Allowed U-turns	4.1	A	9.4	A	51.7	D	59.9	E	12.1	B
	Allowed U-turns (protected)	7	A	14.3	B	51.7	D	59.9	E	15.5	B
PM	Existing Movements	7.6	A	9.7	A	49.4	D	60.4	E	14.3	B
	Allowed U-turns	7.6	A	9.7	A	49.4	D	60.8	E	14.2	B
	Allowed U-turns (protected)	10	B	13.2	B	49.4	D	60.8	E	16.9	B

Changing the southbound left turn phase to protected only increases the delay for that movement, but only increases the delay for the whole intersection by 2-3 seconds throughout the day. This signal phasing is preferred in order to allow safe U-turns at the intersection.

Conclusion

From a 12-hour count in September of 2018, the total demand for the southbound U-turn movement was 157 vehicles. 32 of the vehicles completed an illegal U-turn, while 125 vehicles turned left to Sycamore Plaza and then completed a U-turn. Only 1/3 of the vehicles attempting the U-turn did so without contacting the curb on Kenwood Road. Multiple years of Google Street View show this is a common occurrence. This poses a safety risk to pedestrians on the adjacent sidewalk and to vehicles slowly completing the maneuver.

Capacity analysis shows no significant affects of allowing U-turns with permissive left turn phasing and shows only minimal delay increases if protected-only left turn phasing is used. Protected-only left turn phasing would reduce safety risks for vehicles making the U-turn.

Phase 2 of this project analyzes the geometric layout and any constraints of the intersection and will feature a plan set with proposed improvements for U-turns at the intersection.