

Final Report

Hwy. 91 STEP Innovation Study (Jonesboro) (S)

Job 100977



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HIGHWAY 91 STEP INNOVATION STUDY (Jonesboro) (S)

CRAIGHEAD COUNTY

FINAL TRAFFIC REPORT



Prepared by Garver for the
Northeast Arkansas Regional Transportation Planning Commission
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1.0 Introduction

This Traffic Report was developed in order to achieve the following goals:

- Identify the pedestrian and bicyclist safety issues that exist at the intersection of Highway 91 and State Street.
- Identify and evaluate potential countermeasures to address current and long-term needs.
- Evaluate the effectiveness of the temporary pedestrian crossing.
- Recommend select countermeasures for implementation.

1.1 Background

Highway 91, also known as Johnson Avenue, serves as a principal arterial facility running east-west connecting Arkansas State University to downtown Jonesboro. The existing facility consists of four traffic lanes with a two-way left turn lane (TWLTL), with curb and gutter and sidewalks present along both sides of the roadway. Highway 91 has a posted speed limit of 45 miles per hour (mph).

The intersection of Highway 91 and State Street is a four-leg intersection with two-way stop control (TWSC) on the minor approaches (State Street). The eastbound and westbound approaches include a left turn lane, a through lane, and shared through/right lane. The northbound and southbound approaches consist of a shared left/through/right lane. The study intersection is shown in **Figure 1** on the following page. **Figure 2** shows a pedestrian crossing Highway 91 on the west leg of this intersection, which is a common occurrence.

Figure 1: Highway 91 and State Street Intersection

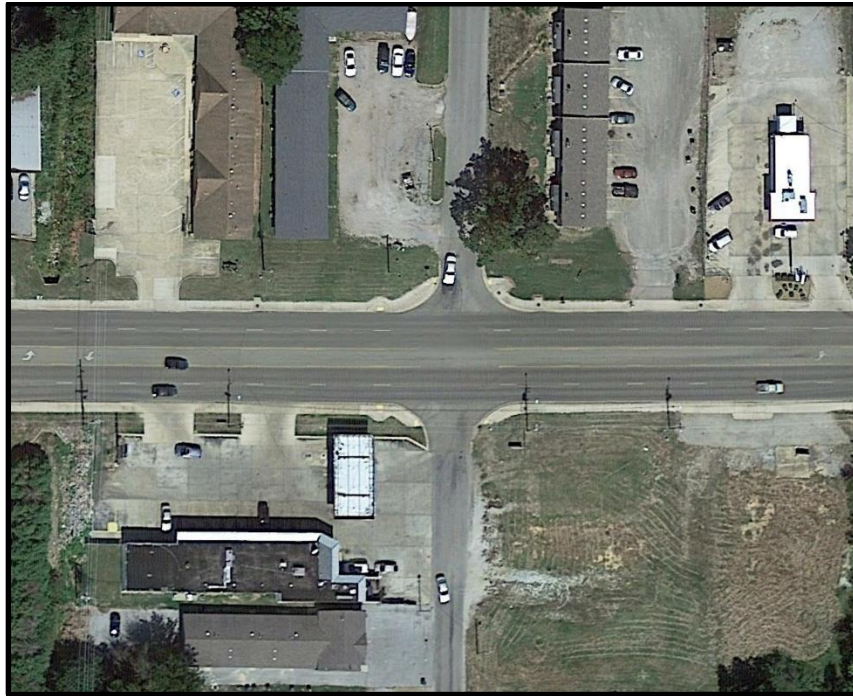
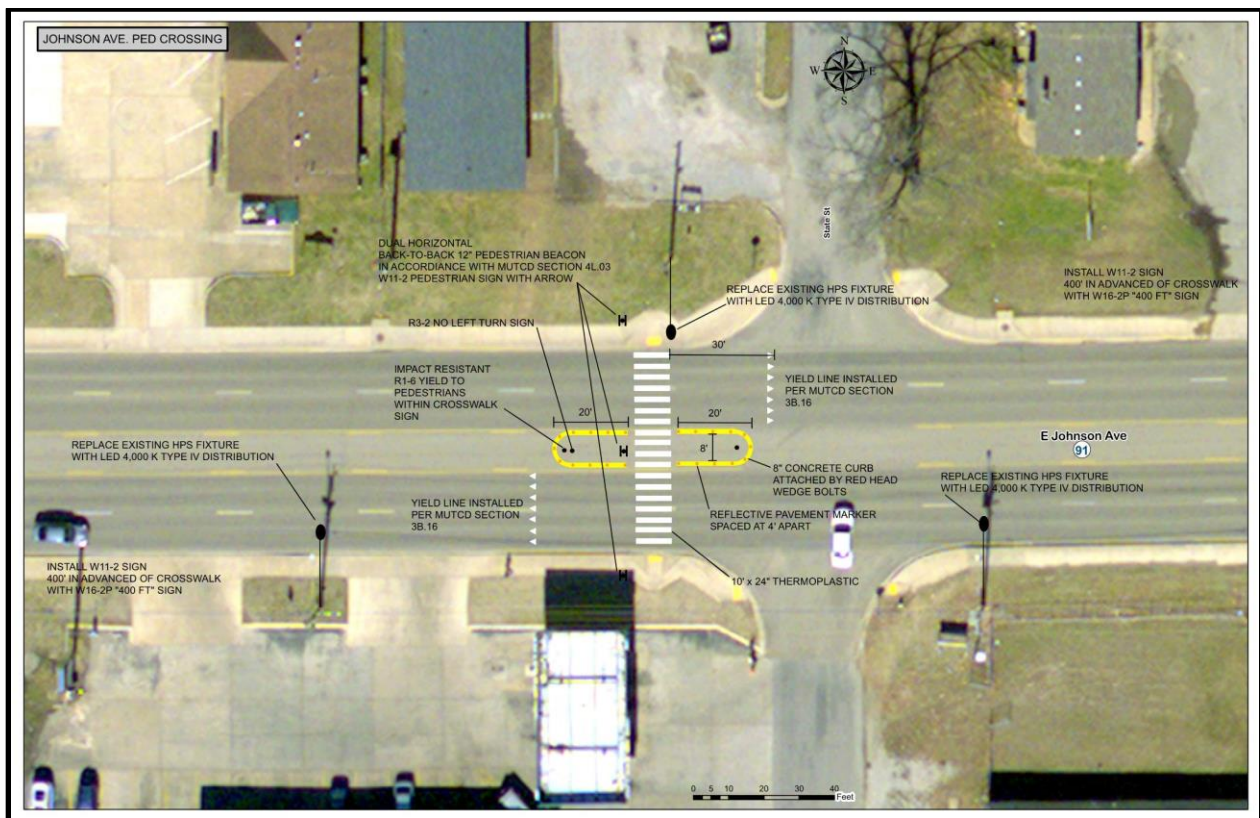


Figure 2: Pedestrian Crossing Highway 91 prior to Installation



On September 27, 2019, a temporary pedestrian crossing was installed west of the study intersection. The temporary pedestrian crossing consists of a marked crosswalk with continental type markings, W11-2 pedestrian signs with arrow on each end of the crosswalk and in the median, warning beacons for each pedestrian sign, concrete curbs within the median, yield markings, advance signs located 400 feet prior to the crosswalk, and improved lighting at the crosswalk. **Figure 3** shows the layout of the temporary pedestrian crossing.

Figure 3: Temporary Pedestrian Crossing



2.0 Existing Conditions

In order to identify and evaluate appropriate countermeasures for pedestrian and bicyclist safety issues for the intersection of Hwy 91 and State Street, data was collected, and existing conditions were observed prior to and after installation of the temporary pedestrian crossing. The findings from this effort are described in the following subsections.

2.1 Data Collection

The following data was collected for this study:

- Prior to installation of the temporary pedestrian crossing
 - Crash data from 2014 to 2018 were compiled for the study intersection. Data revealed angle crashes to be the most common crash type. An average of 11 crashes per year occurred at the study intersection.
 - Crash reports involving pedestrians from 2009 to 2017 at or near the study intersection were provided. This data revealed that five pedestrian-related crashes occurred on Highway 91 between State Street and Melrose Avenue, which is located approximately 525 feet east of State Street.
 - The City of Jonesboro provided vehicular and pedestrian counts for the study intersection conducted on April 29, 2019 from 7:00 AM to 8:00 PM. **Table 1** summarizes the pedestrian counts collected. Complete traffic data is provided in **Appendix A – Traffic Data**. As shown in **Table 1**, the highest crossing activity occurred across the west leg of the intersection with 174 pedestrians crossing Highway 91 within the 13-hour period. Data show the

pedestrian peak hour to be from 4:00 PM to 5:00 PM with 27 pedestrians per hour (pph) crossing Highway 91 at State Street.

- The Average Daily Traffic (ADT) volume for Highway 91 was obtained from an ARDOT permanent count station (Station ID 160201 located east of Melrose Street), which shows a 2018 ADT of 19,000 vehicles per day (vpd).

Table 1: Pedestrian Crossing Counts Prior to Installation

Time Period		Pedestrian Counts at Hwy 91 and State St Intersection				
From	To	North	East	South	West	East + West
7:00 AM	8:00 AM	0	0	1	10	10
8:00 AM	9:00 AM	1	0	2	7	7
9:00 AM	10:00AM	5	3	5	8	11
10:00 AM	11:00 AM	2	3	0	12	15
11:00 AM	12:00 PM	7	0	4	5	5
12:00 PM	1:00PM	3	1	5	7	8
1:00 PM	2:00 PM	11	0	0	21	21
2:00 PM	3:00 PM	1	1	3	7	8
3:00 PM	4:00 PM	7	0	1	12	12
4:00 PM	5:00 PM	7	1	3	26	27
5:00 PM	6:00 PM	1	0	2	19	19
6:00 PM	7:00 PM	9	0	5	25	25
7:00 PM	8:00 PM	3	1	2	15	16
Total		57	10	33	174	184

- After installation of the temporary pedestrian crossing
 - Pedestrians and bicyclists crossing Highway 91 at the temporary pedestrian crossing were counted during peak time periods on Thursday, October 3, 2019 and Wednesday, March 4, 2020. **Table 2** in the following page summarizes the results of these counts. This data is also provided in **Appendix A – Traffic Data**. No bicyclists were present during either count.

Table 2: Pedestrian Crossing Counts After Installation

Time Period		Pedestrian Counts at Hwy 91 and State St Intersection	
From	To	3-Oct-19	4-Mar-20
7:00 AM	9:00 AM	32	21
11:30 AM	1:30 PM	15	26
4:00 PM	6:00PM	26	33
Total		73	80

- ARDOT provided crash data for crashes that occurred after installation of the temporary pedestrian crossing (September 27, 2019 to March 19, 2020). A total of 11 crashes occurred at the intersection including one pedestrian related crash.

2.2 Site Visit Observations

Highway 91 is comprised of two lanes in each direction with a TWLTL. The speed limit is 45 mph, but vehicles often speed through this area. Just west of State Street is a Citgo gas station to the south of Highway 91 and apartment complexes to the north of Highway 91. Pedestrians often cross Highway 91 to go between the gas station and the apartment complexes. The proximity of this site to Arkansas State University also generates heavy pedestrian and bicyclist traffic. Prior to the temporary pedestrian crossing, pedestrians were observed to cross Highway 91 roughly every 5 to 10 minutes throughout the rush hours. These pedestrians often had difficulty finding adequate gaps in traffic. On September 27, 2019, the temporary pedestrian crossing shown in **Figures 4 and 5** was installed across Highway 91 just west of State Street. This crossing has been monitored to determine its effectiveness at improving safety for pedestrians and bicyclists.

Figure 4: Temporary Pedestrian Crossing across Highway 91



Figure 5: Temporary Pedestrian Crossing across Highway 91



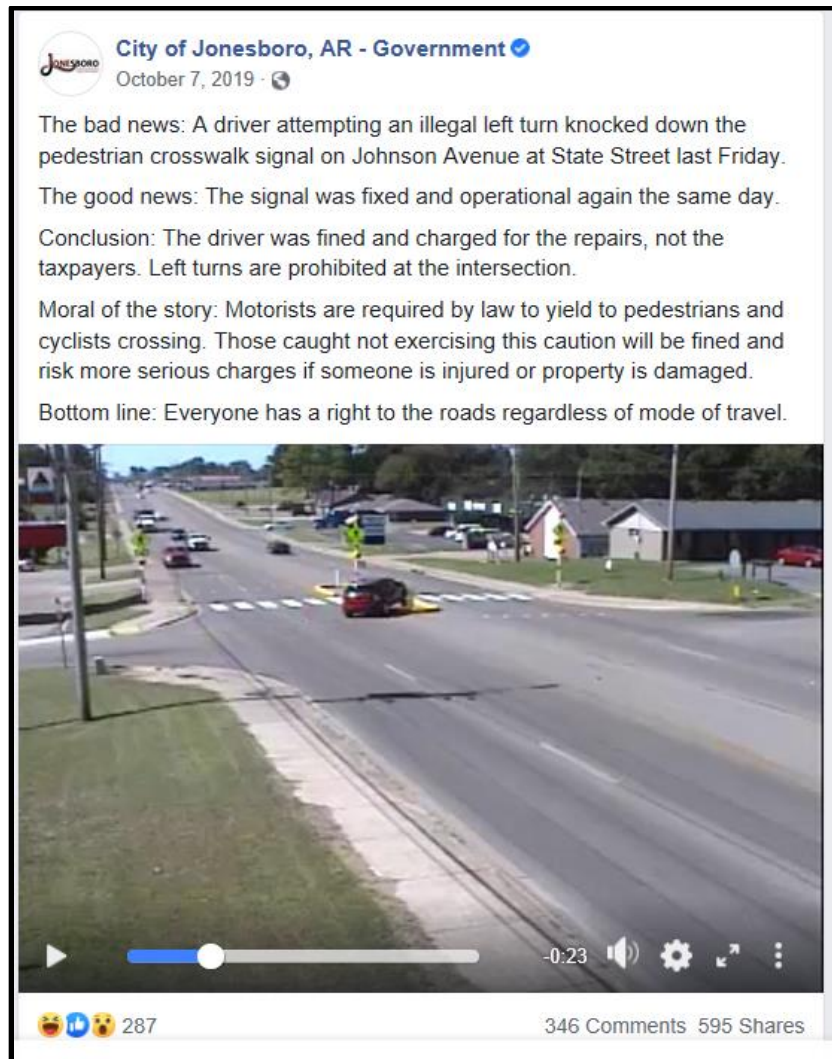
On October 3, 2019, observations were conducted by MPO staff during the morning, midday, and evening peaks. Pedestrians within the area provided overwhelmingly positive feedback on the installment of the temporary crossing. While most pedestrians utilized the crossing installation, a few pedestrians were observed during each of the peak periods crossing within just 2-5 feet of the actual crossing installation (mainly on the west

side). It was also noted that some pedestrians utilized the crossing installation without activating the lights. Vehicular traffic often did not yield to pedestrians even when the pedestrians were already crossing at the installation and the crossing lights were activated. Some motorists expressed annoyance with the crossing.

Public education and outreach efforts were employed in response to the unsafe driver behaviors that were observed. In addition, the Jonesboro Police Department sent available officers to patrol and monitor the site when possible. With police presence, the motorists generally drove cautiously and yielded to pedestrians. However, in the absence of police enforcement, problematic driving behaviors continued. Several crashes occurred at this location even months after the installation. Video clips of the crashes were reviewed, and the incidents are summarized in the following paragraphs.

Two crashes occurred on October 7, 2019. The first crash happened at approximately 11:00 AM when a speeding motorcyclist rear-ended a vehicle after the vehicle changed lanes without signaling. No injuries and no damage to the crossing resulted from this incident. At approximately 2:00 PM, another crash occurred when a vehicle made an illegal left turn from State Street onto Highway 91 and ran over the pedestrian island and signal. No pedestrians were present at the time of this incident, and no injuries occurred. The signal was repaired within the same day. As shown in **Figure 6**, this incident was reported to the public using news and social media such as Facebook to raise awareness of the crossing, the prohibited left turn, and enforcement of these regulations.

Figure 6: Public outreach in response to October 7 Crashes



On November 26, 2019, a pedestrian activated the flashing lights and was nearly half-way across the crosswalk when a speeding, distracted driver rear-ended a truck that was stopped and waiting for the pedestrian to cross. The pedestrian was able to back out of the way of the collision, and nobody was injured. **Figure 7** shows the pedestrian running backwards to avoid this crash in the top picture, and the vehicular damage resulting from the crash in the bottom picture.

Figure 7: Rear-End Crash on November 26



On February 8, 2020, over four months after the temporary pedestrian crossing was installed, a pedestrian was hit and injured. The video footage of this incident demonstrates the widespread disregard of motorists for this pedestrian crossing. The pedestrian actuated the light and then had to wait 16 seconds before a driver finally stopped. During that 16 seconds of waiting, 10 vehicles sped through the crossing without

even slowing down. After a vehicle stopped in the inside lane, the pedestrian began to cross, and then two more vehicles sped through the crossing. One of these vehicles narrowly missed the pedestrian, as shown in the top picture of **Figure 8**. Two seconds later, three more vehicles sped through the crossing, and one of these vehicles hit the pedestrian as shown in the bottom picture of **Figure 8**.

Figure 8: Pedestrian Injury on February 8



On February 13, another rear-end crash occurred at the crosswalk. No injuries resulted, and the cause of the crash did not appear to be related to the pedestrian crossing. Speeding as well as turning into oncoming traffic at the last minute were contributing factors in this crash which is shown in **Figure 9**.

Figure 9: Crash on February 13



As is demonstrated by these crashes and ongoing observations, the following driver behaviors remain problematic even months after the temporary crossing has been installed: **speeding, distracted driving, and failure to yield to pedestrians**. In addition, the temporary crossing does not command a strong presence to drivers. The lights are not always activated by the pedestrians, and the signs do not draw drivers' attention to the crossing. Modifications in driver behavior and improved pedestrian safety were only achieved during active police presence.

3.0 Safety Analysis

Crash data for the intersection of Highway 91 and State Street were collected prior to and after installation of the temporary pedestrian crossing. As previously mentioned, available crash data for the last five years (2014 to 2018) were compiled along with crash data from September 27, 2019 to March 19, 2020. **Table 3** presents the crash summary

based on crash type. At the study intersection, a total of 57 crashes were recorded from 2014 to 2018, which included two pedestrian-related crashes. Angle crashes were found to be the most prominent. After installation of the temporary pedestrian crossing, a total of 11 crashes occurred within six (6) months, approximately twice the crash rate of the previous five years. The majority of the crashes with the temporary installation in place were rear end crashes. One pedestrian-related crash took place on February 8, 2020. The pedestrian was walking on the crosswalk when struck by a vehicle traveling westbound on Highway 91.

Table 3: Crash Summary by Crash Type

Time Period	Angle	Backing	Head On	Rear End	Sideswipe, Opposite Direction	Sideswipe, Same Direction	Single Vehicle Crash	Pedestrian	Total
2014 to 2018	27	0	0	13	1	12	2	2	57
9/27/2019 to 3/19/2020	2	0	0	6	0	2	0	1	11

4.0 Potential Countermeasures

Potential countermeasures to improve pedestrian safety were selected based on review of data collected and field observations as well as STEP Countermeasure tables provided by the Federal Highway Administration (FHWA).

The following potential countermeasures were identified:

- Apply countermeasures to reduce vehicle speeds through the area including raised medians, landscaping, and speed-monitoring trailers.
 - Raised medians and landscaping can change the character of the street and reduce speeds. Appropriate vegetation can be planted in the raised

medians and existing buffer area between the sidewalk and street to reduce the visual width of the roadway. The speed-monitoring trailers can enhance speed compliance prior to implementing traffic-calming treatments.

- Install a traffic signal with pedestrian signal heads at the intersection of Highway 91 and State Street.
 - This countermeasure may be considered if one or more traffic signal warrants are met.

Table 4 was produced by FHWA and shows STEP countermeasures that should be considered based on the lane configuration, posted speed limit and AADT of the corridor. The Highway 91 corridor has a posted speed limit of 45 mph and an AADT of 19,000 vpd. This corridor has two lanes in each direction and no raised median.

Table 4: Application of Pedestrian Crash Countermeasures by Roadway Feature (from FHWA)

Roadway Configuration	Posted Speed Limit and AADT								
	Vehicle AADT <9,000			Vehicle AADT 9,000–15,000			Vehicle AADT >15,000		
	≤30 mph	35 mph	≥40 mph	≤30 mph	35 mph	≥40 mph	≤30 mph	35 mph	≥40 mph
2 lanes (1 lane in each direction)	① 2 4 5 6	① 7 9	① 5 6 ⑦ ⑨	① 4 5 6	① 7 9	① 5 6 ⑦ ⑨	① 4 5 6 7 9	① 7 9	① 5 6 ⑦ ⑨
3 lanes with raised median (1 lane in each direction)	① 2 3 4 5	① ③ 5 6 7 9	① ③ 5 6 ⑦ ⑨	① 3 4 5 7 9	① ③ 5 6 ⑦ ⑨	① ③ 5 6 ⑦ ⑨	① ③ 4 5 7 9	① ③ 5 6 ⑦ ⑨	① ③ 5 6 ⑦ ⑨
3 lanes w/o raised median (1 lane in each direction with a two-way left-turn lane)	① 2 3 4 5 6 7 9	① ③ 5 6 7 9	① ③ 5 6 ⑦ ⑨	① 3 4 5 6 7 9	① ③ 5 6 ⑦ ⑨	① ③ 5 6 ⑦ ⑨	① ③ 4 5 6 7 9	① ③ 5 6 ⑦ ⑨	① ③ 5 6 ⑦ ⑨
4+ lanes with raised median (2 or more lanes in each direction)	① ③ 5 6 7 8 9	① ③ 5 6 7 8 9	① ③ 5 6 ⑦ ⑨	① ③ 5 6 7 8 9	① ③ 5 6 ⑦ ⑨	① ③ 5 6 ⑦ ⑨	① ③ 5 6 ⑦ ⑨	① ③ 5 6 ⑦ ⑨	① ③ 5 6 ⑦ ⑨
4+ lanes w/o raised median (2 or more lanes in each direction)	① ③ 5 6 7 8 9	① ③ 5 6 7 8 9	① ③ 5 6 ⑦ ⑨	① ③ 5 6 ⑦ ⑨	① ③ 5 6 ⑦ ⑨	① ③ 5 6 ⑦ ⑨	① ③ 5 6 ⑦ ⑨	① ③ 5 6 ⑦ ⑨	① ③ 5 6 ⑦ ⑨
<p>Given the set of conditions in a cell,</p> <ul style="list-style-type: none"> # Signifies that the countermeasure is a candidate treatment at a marked uncontrolled crossing location. ● Signifies that the countermeasure should always be considered, but not mandated or required, based upon engineering judgment at a marked uncontrolled crossing location. ○ Signifies that crosswalk visibility enhancements should always occur in conjunction with other identified countermeasures.* <p>The absence of a number signifies that the countermeasure is generally not an appropriate treatment, but exceptions may be considered following engineering judgment.</p>					<ol style="list-style-type: none"> 1 High-visibility crosswalk markings, parking restrictions on crosswalk approach, adequate nighttime lighting levels, and crossing warning signs 2 Raised crosswalk 3 Advance Yield Here To (Stop Here For) Pedestrians sign and yield (stop) line 4 In-Street Pedestrian Crossing sign 5 Curb extension 6 Pedestrian refuge island 7 Rectangular Rapid-Flashing Beacon (RRFB)** 8 Road Diet 9 Pedestrian Hybrid Beacon (PHB)** 				

*Refer to Chapter 4, “Using Table 1 and Table 2 to Select Countermeasures,” for more information about using multiple countermeasures.

**It should be noted that the PHB and RRFB are not both installed at the same crossing location.

This table was developed using information from: Zegeer, C.V., J.R. Stewart, H.H. Huang, P.A. Lagerwey, J. Feaganes, and B.J. Campbell. (2005). Safety effects of marked versus unmarked crosswalks at uncontrolled locations: Final report and recommended guidelines. FHWA, No. FHWA-HRT-04-100, Washington, D.C.; FHWA. Manual on Uniform Traffic Control Devices, 2009 Edition. (revised 2012). Chapter 4F, Pedestrian Hybrid Beacons. FHWA, Washington, D.C.; FHWA. Crash Modification Factors (CMF) Clearinghouse. <http://www.cmfclearinghouse.org/>; FHWA. Pedestrian Safety Guide and Countermeasure Selection System (PEDSAFE). <http://www.pedbikesafe.org/PEDSAFE/>; Zegeer, C., R. Srinivasan, B. Lan, D. Carter, S. Smith, C. Sundstrom, N.J. Thirsk, J. Zegeer, C. Lyon, E. Ferguson, and R. Van Houten. (2017). NCHRP Report 841: Development of Crash Modification Factors for Uncontrolled Pedestrian Crossing Treatments. Transportation Research Board, Washington D.C.; Thomas, Thirsk, and Zegeer. (2016). NCHRP Synthesis 498: Application of Pedestrian Crossing Treatments for Streets and Highways. Transportation Research Board, Washington, D.C.; and personal interviews with selected pedestrian safety practitioners.

Based on the information provided in **Table 4**, the following countermeasures should be considered for Highway 91:














































- High-visibility crosswalk markings, parking restrictions on crosswalk approach, adequate nighttime lighting levels, and crosswalk warning signs.
 - Parking restrictions on crosswalk approach are not applicable to the study area since parking on the street is currently not allowed.
 - The high-visibility crosswalk markings, adequate nighttime lighting levels, and crosswalk warning signs were installed as part of the temporary pedestrian crossing.
- Advance Yield Here To (Stop Here For) Pedestrians sign and yield (stop) line.
 - These were installed as part of the temporary pedestrian crossing.
- Curb extension
 - This countermeasure is not applicable since on-street parking is not allowed on this corridor.
- Pedestrian refuge island
 - This countermeasure was installed as part of the temporary pedestrian crossing.
- Road Diet
 - This countermeasure is not considered due to the high traffic volumes along Highway 91 (19,000 vpd).
- Pedestrian Hybrid Beacon (PHB)
 - This countermeasure may be appropriate if pedestrians are unable to find adequate gaps in vehicular traffic to safely cross Highway 91. Further investigation of this countermeasure is performed in Section 5.0.

All applicable countermeasures from **Table 4** are currently installed with the temporary pedestrian crossing except for the PHB.

As shown in **Table 5** on the following page, FHWA provides another table of STEP countermeasures which are listed according to the safety issues that they address. The following safety issues were observed at the temporary pedestrian crossing:

- Conflicts at crossing locations
- Excessive vehicle speed
- Inadequate conspicuity/visibility
- Drivers not yielding to pedestrians in crosswalks

Table 5: Safety Issues Addressed Per Countermeasure (from FHWA)

Pedestrian Crash Countermeasure for Uncontrolled Crossings	Safety Issue Addressed				
	Conflicts at crossing locations	Excessive vehicle speed	Inadequate conspicuity/visibility	Drivers not yielding to pedestrians in crosswalks	Insufficient separation from traffic
Crosswalk visibility enhancement					
High-visibility crosswalk markings*					
Parking restriction on crosswalk approach*					
Improved nighttime lighting*					
Advance Yield Here To (Stop Here For) Pedestrians sign and yield (stop) line*					
In-Street Pedestrian Crossing sign*					
Curb extension*					
Raised crosswalk					
Pedestrian refuge island					
Pedestrian Hybrid Beacon					
Road Diet					
Rectangular Rapid-Flashing Beacon					

*These countermeasures make up the STEP countermeasure “crosswalk visibility enhancements.” Multiple countermeasures may be implemented at a location as part of crosswalk visibility enhancements.

Table 6 on the following page summarizes the countermeasures that were identified as applicable to the study area and shows the source(s) of the countermeasure recommendations. The countermeasures with asterisks will be investigated further in Section 5.0 in order to determine whether they should be included in the recommendations.

Table 6: Potential Countermeasures for Highway 91 at State Street

Countermeasure	Data Collected and Site Visit	FHWA
		Table 4
Add raised medians, landscaping, and speed-monitoring trailers to reduce vehicle speeds	X	
*Install traffic signal with pedestrian signal heads at the intersection of Highway 91 and State Street	X	
*Pedestrian Hybrid Beacon		X

*Countermeasure will be investigated further before including as a recommendation.

5.0 Investigation of Countermeasures

Two (2) of the potential countermeasures that were identified require further investigation before being selected as a recommendation. These countermeasures are the PHB and traffic signal. The investigation of these countermeasures is detailed in the following subsections.

5.1 Pedestrian Hybrid Beacon

The PHB should be considered if a signal is not warranted but gaps in traffic are inadequate to permit pedestrians to cross. According to the *Traffic Control Devices Handbook, Second Edition*, an average of one gap per minute (60 gaps per hour) is needed to adequately allow pedestrians to cross the road. The number of available gaps of adequate length were estimated based on the road width, average pedestrian walking speed, and hourly vehicular volume. The volumes on the west approach of the intersection of Highway 91 at State Street were used for this analysis since this is a potential location for the PHB. **Table 7** shows the results of the gap analysis. Based on

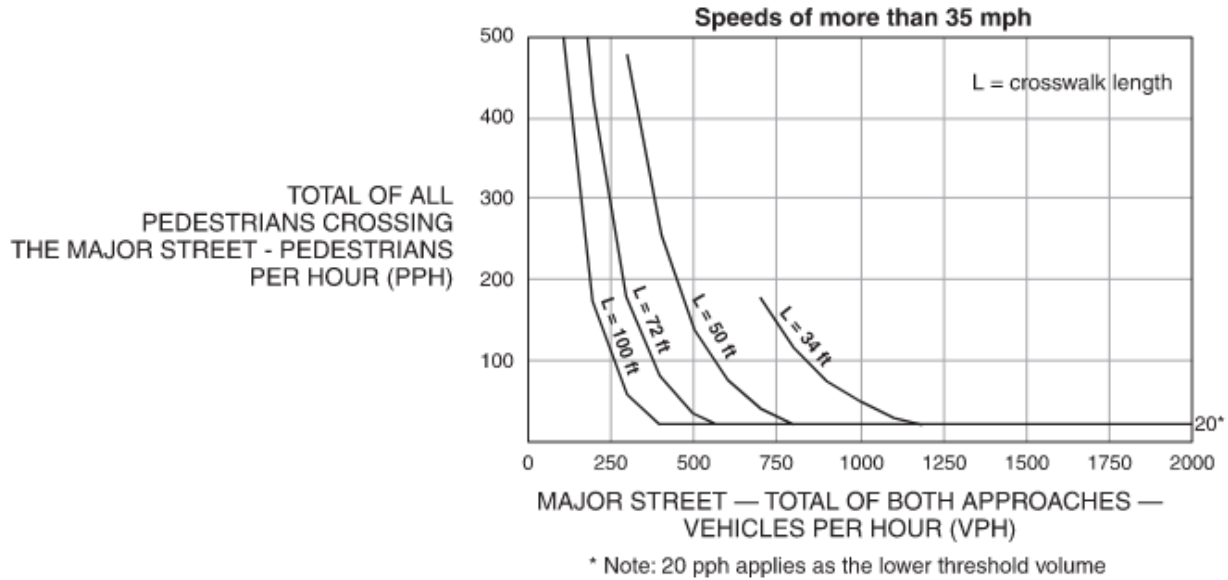
these results, pedestrians do not experience enough gaps in traffic of adequate length to safely cross Highway 91 during the day.

Table 7: Gap Analysis for the Pedestrian Hybrid Beacon

From Time	To Time	Contributing Movement Volumes				# Veh Crossing	Headway	Flow rate	Probability of no vehicles arriving during needed time to cross	Adequate Length Gaps/hr	Meets critical volume
		EB	NBL	WBT	SBR						
7:00 AM	8:00 AM	688	6	834	21	1549	2.32	0.43	0.07%	1	fail
8:00 AM	9:00 AM	622	11	617	22	1272	2.83	0.35	0.25%	3	fail
9:00 AM	10:00AM	557	12	445	23	1037	3.47	0.29	0.75%	8	fail
10:00 AM	11:00 AM	525	6	517	18	1066	3.38	0.30	0.65%	7	fail
11:00 AM	12:00AM	640	5	553	21	1219	2.95	0.34	0.32%	4	fail
12:00 PM	1:00PM	681	10	680	28	1399	2.57	0.39	0.14%	2	fail
1:00 PM	2:00 PM	590	7	625	23	1245	2.89	0.35	0.28%	3	fail
2:00 PM	3:00 PM	638	14	697	31	1380	2.61	0.38	0.15%	2	fail
3:00 PM	4:00 PM	814	15	769	41	1639	2.20	0.46	0.04%	1	fail
4:00 PM	5:00 PM	836	7	795	32	1670	2.16	0.46	0.04%	1	fail
5:00 PM	6:00 PM	876	12	840	27	1755	2.05	0.49	0.03%	0	fail
6:00 PM	7:00 PM	589	15	615	37	1256	2.87	0.35	0.27%	3	fail

The *Manual on Uniform Traffic Control Devices (MUTCD)* provides a table of guidelines for the installation of PHB on high-speed roadways (more than 35 mph) as shown in **Figure 10** on the following page. These guidelines are not meant as mandatory warrants but rather as guidance. Based on this figure, a minimum of 20 pedestrians crossing per hour would be cause for considering the installation of a PHB. Pedestrian crossing data exhibited in **Table 2** show the highest crossing activity occurred across Highway 91 between 4 pm to 5 pm with 27 pph. Hence, a PHB was considered further as an option to improve pedestrian safety and address the inadequacy of gaps in vehicular traffic for crossing safely.

Figure 10: Guidelines for Installation of PHB (MUTCD Figure 4F-2)



5.1.1 Vehicle Delay

In order to evaluate the impact to vehicular traffic resulting from the installation of a PHB, *SimTraffic* was used to compare the average delay per vehicle traveling through the study area under existing conditions (without the temporary crossing) versus conditions with one PHB installation west of State Street. The model utilized vehicular and pedestrian volumes for the vehicular PM peak hour (4:30 pm to 5:30 pm) because the PM peak has the highest vehicular volumes and the highest pedestrian volumes. The model assumed that the PHB signal was actuated 18 times during the PM peak hour which is conservatively high based on pedestrian crossing data during the PM peak hour. The model also assumed 26 seconds for each pedestrian crossing phase (7 seconds of Walk time, 16 seconds of flashing Don't Walk time, and 3 seconds of all-red time). The flashing Don't Walk time was calculated based on *MUTCD* guidelines. The

results of the *SimTraffic* analysis are provided in **Appendix B – Operational Analysis Results** and are summarized in **Table 8**. As shown, installing one PHB would increase the average delay experienced by drivers within the study area during the busiest peak period by as much as 3.0 seconds per vehicle (an increase from 3.8 seconds per vehicle to 6.8 seconds per vehicle). It should be noted that the total delay added to vehicular traffic is directly related to the number of times the PHB is actuated, and a conservative value was assumed for this analysis in order to show a reasonable worst case scenario on the vehicular impact during the peak hour.

Table 8: Vehicular Delays with and without Pedestrian Hybrid Beacon

<i>SimTraffic</i> Results	¹ Existing	One Pedestrian Hybrid Beacon
Vehicles Entered	1908	1919
Total Delay (hr)	2.0	3.6
Avg. Delay (sec/veh)	3.8	6.8

¹Without the temporary pedestrian crossing

Based on this investigation, a PHB is a viable option for installation on the west leg of the intersection of Highway 91 at State Street. However, the following challenges would have to be overcome:

- The *MUTCD* states the PHB should be installed at least 100 feet from side streets or driveways controlled by STOP or YIELD signs. Due to the number of driveways and cross streets within the study area, this spacing will be a challenge to maintain and will likely force the location of the PHB further west than would be ideal for pedestrian use. This may result in less pedestrians using the PHB.

- Vehicular traffic demonstrated widespread disregard for the temporary crosswalk installation. This poor driver behavior may continue with a PHB installation. To command the attention and respect of drivers, advance stop lines should be placed 20 to 50 feet in advance of the marked crosswalk. The PHB should also be installed in conjunction with ample signage. Increased, ongoing police enforcement will be necessary to ensure proper driver behavior.

5.2 Traffic Signal

In order to establish if a traffic signal at the intersection of Highway 91 and State Street would be a feasible countermeasure for the Highway 91 corridor, a traffic signal warrant analysis was performed. The MUTCD standard practice requires that at least one traffic signal warrant be met in order for a traffic signal to be considered at an intersection.

Warrant 1 – Eight-Hour Vehicular Volume

Warrant 2 – Four-Hour Vehicular Volume

Warrant 3 – Peak Hour

Warrant 4 – Pedestrian Volume

Warrant 5 – School Crossing

Warrant 6 – Coordinated Signal System

Warrant 7 – Crash Experience

Warrant 8 – Roadway Network

Warrant 9 – Intersection Near a Grade Crossing

Warrant 1 – Eight-Hour Vehicular Volume

Warrant 1 typically applies where the volume of intersecting traffic throughout the average day is significant or the intersecting traffic causes excessive delay to the minor street traffic. It is made up of two conditions. Condition A considers the volume of traffic crossing the intersection while Condition B takes into account the delay and number of conflicts for the minor street traffic. Conditions A and B are independent of one another in determining whether or not the warrant is satisfied; however, if neither condition is satisfied for 8 hours of an average day, a combination of the warrants may be considered at 80% of the required vehicles per hour (vph).

Warrant 2 – Four-Hour Vehicular Volume

Warrant 2 applies where the volume of intersecting traffic, usually during peak times, is the primary reason for considering a traffic signal. If it is found that, for any four hours of an average day, the side street traffic suffers undue delay which would be remedied by a traffic signal, then, a signal may be justified.

Warrant 3 – Peak Hour

Warrant 3 typically applies only to facilities that attract or discharge large numbers of vehicles over a short time. It is made up of two conditions. For Condition A, three criteria must occur for this warrant to be met. First, the total stopped time delay for one side street approach must equal or exceed 4 vehicle-hours (one lane approach) or 5 vehicle-hours (2 lane approach). Second, the volume for this side street approach must exceed 100 vph (one lane approach) or 150 vph (two-lane approach). Finally, the total volume entering the intersection must exceed 650 vph (one lane approach) or 800 vph (two-lane

approach) for the same hour as the first two criteria. For Condition B, the warrant is determined graphically.

Warrant 4 – Pedestrian Volume

Warrant 4 applies to a location where the traffic volume on a major street is heavy enough that pedestrians experience excessive delay in crossing the major street. The minimum pedestrian volume should be 133 pedestrians per hour (pph) for one hour or 107 pph for each of four consecutive hours. This minimum volume increases as the major street total volume drops below 1100 vph. Figures 4C-5 thru 4C-8 in the MUTCD are used for Warrant 4.

Warrant 7 – Crash Experience

Warrant 7 applies to a location where the severity and frequency of crashes deem the need for a traffic signal to be considered. The following three criteria must be met for this warrant:

- Adequate trial of alternatives
- Five or more reported crashes that can be corrected by a traffic signal within a 12-month period
- Meet 80% of the volume criteria for Warrant 1 or Warrant 4.

5.2.1 Signal Warrant Analysis

The Highway Capacity Software (HCS) was used to compare 2019 turning movement volumes at the intersection of Highway 91 and State Street against the criteria for signalization established in Warrants 1, 2, and 3. For Warrant 4, 2019 volumes and

corresponding pedestrian volumes were compared to the criteria set forth in Figures 4C-5 and 4C-7 in the MUTCD. The pedestrian volumes crossing Highway 91 in the vicinity of the State Street intersection did not meet the minimum pedestrian volume for Warrant 4.

Table 9 summarizes the results of the signal warrant analysis. Refer to **Appendix C – Signal Warrants** for signal warrant reports. Based on the current information and volumes, a traffic signal is warranted at the intersection of Highway 91 and State Street based on Warrant 7 – Crash Experience.

Table 9: Traffic Signal Warrant Summary

Warrant	Condition
Warrant 1	Not Met
Warrant 2	Not Met
Warrant 3	Not Met
Warrant 4	Not Met
Warrant 7	Met

In order to evaluate the impact to vehicular traffic resulting from the installation of a traffic signal, *SimTraffic* was used to compare the average delay per vehicle traveling through the study area under existing conditions (without the temporary crossing) versus conditions with a traffic signal at the intersection of Highway 91 at State Street. The models utilized vehicular and pedestrian volumes for the vehicular PM peak hour (4:30 pm to 5:30 pm) because the PM peak has the highest vehicular volumes and the highest pedestrian volumes. The results of the *SimTraffic* analysis are provided in **Appendix B – Operational Analysis Results** and are summarized in **Table 10**. The delays

and corresponding Level of Service (LOS) experienced for each vehicular movement at the intersection of Highway 91 at State Street are listed in **Table 11**. As shown, installing a traffic signal would increase the average delay experienced by drivers within the study area during the busiest peak period by as much as 8.7 seconds per vehicle (an increase from 3.8 seconds per vehicle to 12.5 seconds per vehicle). The delay experienced for each vehicular movement through the intersection as well as the overall operation of the traffic signal corresponds to acceptable LOS B or better.

Table 10: Vehicular Delays with and without Traffic Signal

<i>SimTraffic</i> Results	¹ Existing	Traffic Signal
Vehicles Entered	1908	1905
Total Delay (hr)	2	6.6
Avg. Delay (sec/veh)	3.8	12.5

¹Without the temporary pedestrian crossing

Table 11: Vehicular Delays and LOS with and without Traffic Signal

Intersection	Control	MOE	Hwy 91 Movements						State Street Movements						Overall
			EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR	
Hwy 91 at State St	Two-Way Stop	Delay (sec/veh)	6.8	2.0	1.6	4.4	0.7	0.2	22.2	32.2	7.5	26.7	28.0	7.3	2.2
		LOS	A	A	A	A	A	A	C	D	A	D	D	A	A
	Signal	Delay (sec/veh)	13.5	8.6	5.6	13.1	9.1	4.5	10.9	12.4	5.3	11.5	9.7	5.0	8.9
		LOS	B	A	A	B	A	A	B	B	A	B	A	A	A

Based on this investigation, a traffic signal is a viable option for installation based on crash history and will provide acceptable levels of service for vehicular traffic with an anticipated overall increase in delay of 8.7 seconds per vehicle. If a traffic signal is implemented, pedestrian accommodations and marked crosswalk(s) should be provided in conjunction with the traffic signal installation.

6.0 Conclusions

The purpose of this Traffic Study was to evaluate the effectiveness of the temporary pedestrian signal that was installed across Highway 91 to the west of State Street, identify the pedestrian and bicyclist safety issues that exist, and identify and evaluate potential countermeasures. After the installation of the temporary pedestrian signal, drivers continued to speed and often failed to yield to pedestrians. Crashes continued to occur at a high rate, one of which involved a pedestrian and resulted in injury. Based on these observations, the installation did not effectively improve safety for pedestrians and bicyclists. Therefore, STEP Countermeasure tables were consulted in conjunction with these observations to identify potential countermeasures including a PHB and a traffic signal. These two countermeasures were evaluated for their feasibility as well as their impact to vehicular traffic. The following conclusions were reached concerning the two possible countermeasures:

- Pedestrian Hybrid Beacon (PHB)
 - Feasible/warranted
 - Less increase in delay to vehicular traffic (up to 3.0 seconds per vehicle when compared to a traffic signal)
 - May not command attention and respect of drivers since this has been an issue with the temporary pedestrian signal. To ensure proper driver behavior and safety of pedestrians, increased and ongoing police enforcement will be necessary with the PHB.

- May be difficult to achieve adequate spacing between PHB and driveways/cross streets
- Traffic Signal
 - Feasible/warranted
 - More increase in delay to vehicular traffic (up to 8.7 seconds per vehicle), but still provides acceptable performance for all vehicular movements and overall for the intersection.
 - Likely to resolve issue of vehicles failing to yield to pedestrians without requiring increased and ongoing police enforcement.

6.1 Value of Time Lost

The value of time lost due to the installation of the PHB or the traffic signal at the intersection of Highway 91 and State Street was calculated based on the total delays tabulated in **Tables 8 and 9**. Annualized delays were calculated by multiplying the total delays in the peak hours by the number of workdays per year. The value of lost time was determined by applying the value of travel for automobiles to the difference in annualized delays due to the countermeasure. **Table 12** displays various parameters and their values used for value of time lost calculations. The value of automobile travel was determined based on the hourly rate per person and the average occupancy for travel for Craighead County, Arkansas. **Table 13** displays the value of time lost due to the installation of either the PHB or the traffic signal.

Table 12: Parameters and Values

Parameter	Values
¹ Value of automobile travel (\$/hour)	\$21.36
No. of working days in a year	250

Table 13: Value of Time Lost

Alternatives	Annualized Delay (hr)	Value of Time Lost
¹ Existing	1000	-
PHB	1800	\$17,088.00
Traffic Signal	3300	\$49,128.00

¹Without the temporary pedestrian crossing

6.2 Unit Cost

The unit cost of a PHB and a traffic signal is approximately \$60,000 and \$190,000, respectively.



FINAL REPORT

Job 100977

CRAIGHEAD COUNTY



GarverUSA.com

Final Report Appendices

Hwy. 91 STEP Innovation Study (Jonesboro) (S)

Job 100977



Prepared For:
Arkansas Department of Transportation
July 2020



Appendix A – Traffic Data

Hwy. 91 at State St. - TMC

Mon Apr 29, 2019

Full Length (8:15 AM-8 PM, 7 AM-8:15 AM)

All Classes (Lights, Articulated Trucks, Buses and Single-Unit Trucks, Pedestrians, Bicycles on Road, Bicycles on Crosswalk)

All Movements

ID: 648145, Location: 35.845267, -90.685252

Provided by: City of Jonesboro (AR)

515 West Washington Avenue,

Jonesboro, AR, 12345, US

Leg Direction	North Southbound						East Westbound						South Northbound						West Eastbound						Int
	R	T	L	U	App	Ped*	R	T	L	U	App	Ped*	R	T	L	U	App	Ped*	R	T	L	U	App	Ped*	
2019-04-29 8:15AM	4	2	0	0	6	0	0	158	2	0	160	0	1	2	6	0	9	1	7	141	2	0	150	0	325
8:30AM	7	1	3	0	11	1	3	133	8	0	144	0	1	2	2	0	5	0	5	152	6	0	163	5	323
8:45AM	3	2	1	0	6	0	2	150	10	0	162	0	3	1	1	0	5	1	6	137	4	0	147	2	320
Hourly Total	14	5	4	0	23	1	5	441	20	0	466	0	5	5	9	0	19	2	18	430	12	0	460	7	968
9:00AM	8	1	1	0	10	1	1	103	7	0	111	0	4	2	2	0	8	1	5	125	1	0	131	1	260
9:15AM	5	1	0	0	6	2	1	109	4	0	114	1	3	2	1	0	6	3	2	142	5	0	149	4	275
9:30AM	6	1	1	0	8	1	2	102	2	0	106	2	1	0	3	0	4	0	1	130	3	0	134	0	252
9:45AM	4	3	2	0	9	1	1	131	6	0	138	0	2	2	6	0	10	1	6	132	5	0	143	3	300
Hourly Total	23	6	4	0	33	5	5	445	19	0	469	3	10	6	12	0	28	5	14	529	14	0	557	8	1087
10:00AM	5	2	1	0	8	0	3	130	0	0	133	0	8	2	1	0	11	0	3	117	6	0	126	1	278
10:15AM	5	3	2	0	10	0	2	119	4	0	125	3	5	5	1	0	11	0	2	115	4	0	121	3	267
10:30AM	5	2	1	0	8	0	2	129	7	0	138	0	8	2	3	0	13	0	4	122	5	0	131	6	290
10:45AM	3	3	2	0	8	2	1	139	5	0	145	0	6	4	1	0	11	0	2	139	6	0	147	2	311
Hourly Total	18	10	6	0	34	2	8	517	16	0	541	3	27	13	6	0	46	0	11	493	21	0	525	12	1146
11:00AM	8	6	3	0	17	0	3	144	5	0	152	0	10	3	2	0	15	1	4	130	10	0	144	1	328
11:15AM	4	1	1	0	6	4	0	133	5	0	138	0	7	1	2	0	10	1	2	144	5	0	151	1	305
11:30AM	3	2	1	0	6	2	3	131	5	0	139	0	7	0	1	0	8	1	3	162	3	0	168	2	321
11:45AM	6	1	3	0	10	1	3	145	5	0	153	0	8	3	0	0	11	1	7	163	7	0	177	1	351
Hourly Total	21	10	8	0	39	7	9	553	20	0	582	0	32	7	5	0	44	4	16	599	25	0	640	5	1305
12:00PM	8	1	0	0	9	0	1	172	4	0	177	0	12	5	4	0	21	1	10	179	6	0	195	3	402
12:15PM	6	2	0	0	8	1	2	182	8	0	192	1	8	4	1	0	13	1	2	153	7	0	162	1	375
12:30PM	6	2	1	0	9	0	1	152	6	0	159	0	2	3	4	0	9	1	9	157	9	0	175	3	352
12:45PM	8	3	0	0	11	2	2	174	7	0	183	0	6	2	1	0	9	2	7	135	7	0	149	0	352
Hourly Total	28	8	1	0	37	3	6	680	25	0	711	1	28	14	10	0	52	5	28	624	29	0	681	7	1481
1:00PM	7	3	2	0	12	0	2	139	4	0	145	0	8	1	0	0	9	0	4	127	6	0	137	1	303
1:15PM	4	2	2	0	8	1	2	155	4	0	161	0	3	2	1	0	6	0	2	154	5	0	161	1	336
1:30PM	6	1	0	0	7	5	5	157	5	0	167	0	4	1	4	0	9	0	6	133	5	0	144	11	327
1:45PM	6	2	2	0	10	5	0	174	7	0	181	0	4	1	2	0	7	0	4	141	3	0	148	8	346
Hourly Total	23	8	6	0	37	11	9	625	20	0	654	0	19	5	7	0	31	0	16	555	19	0	590	21	1312
2:00PM	6	3	8	0	17	0	5	167	6	0	178	0	1	3	1	0	5	0	2	133	10	0	145	2	345
2:15PM	11	1	3	0	15	0	4	175	1	0	180	0	5	0	4	0	9	1	7	148	6	0	161	1	365
2:30PM	12	4	0	0	16	1	4	152	4	0	160	1	9	2	7	0	18	0	2	162	4	0	168	2	362
2:45PM	2	4	2	0	8	0	1	203	3	0	207	0	4	1	2	0	7	2	7	150	7	0	164	2	386
Hourly Total	31	12	13	0	56	1	14	697	14	0	725	1	19	6	14	0	39	3	18	593	27	0	638	7	1458
3:00PM	9	4	1	0	14	1	8	171	3	0	182	0	3	3	3	0	9	0	4	169	13	0	186	2	391
3:15PM	10	1	4	0	15	2	6	189	8	0	203	0	6	1	1	0	8	0	3	180	14	0	197	0	423
3:30PM	12	8	1	0	21	0	1	198	6	0	205	0	2	2	5	0	9	1	11	249	4	0	264	1	499
3:45PM	10	3	2	0	15	4	3	211	6	0	220	0	6	0	6	0	12	0	4	157	6	0	167	9	414
Hourly Total	41	16	8	0	65	7	18	769	23	0	810	0	17	6	15	0	38	1	22	755	37	0	814	12	1727
4:00PM	5	1	5	0	11	6	3	205	7	0	215	0	4	1	2	0	7	1	7	185	6	0	198	7	431
4:15PM	9	4	7	0	20	0	5	218	6	0	229	0	7	1	2	0	10	1	7	186	7	0	200	8	459
4:30PM	8	0	7	0	15	0	4	189	5	0	198	0	3	5	3	0	11	1	7	221	14	0	242	4	466
4:45PM	10	3	2	0	15	1	9	183	3	0	195	1	7	2	0	0	9	0	3	181	12	0	196	7	415
Hourly Total	32	8	21	0	61	7	21	795	21	0	837	1	21	9	7	0	37	3	24	773	39	0	836	26	1771
5:00PM	10	4	5	0	19	0	8	222	7	0	237	0	10	1	4	0	15	1	5	253	10	0	268	5	539
5:15PM	4	2	2	0	8	0	3	249	4	0	256	0	6	2	1	0	9	0	5	205	8	0	218	1	491
5:30PM	7	1	4	0	12	0	5	203	7	0	215	0	8	4	5	0	17	0	3	198	5	0	206	4	450
5:45PM	6	5	5	0	16	1	7	166	3	0	176	0	5	3	2	0	10	1	5	172	7	0	184	9	386
Hourly Total	27	12	16	0	55	1	23	840	21	0	884	0	29	10	12	0	51	2	18	828	30	0	876	19	1866
6:00PM	11	3	0	0	14	4	2	169	4	0	175	0	11	4	4	0	19	1	6	158	5	0	169	10	377
6:15PM	11	5	5	0	21	3	4	130	3	0	137	0	0	5	1	0	6	2	3	133	11	0	147	9	311
6:30PM	8	4	1	0	13	2	2	158	1	0	161	0	7	1	7	0	15	1	6	132	4	0	142	5	331
6:45PM	7	1	1	0	9	0	2	158	5	0	165	0	3	2	3	0	8	1	2	121	8	0	131	1	313
Hourly Total	37	13	7	0	57	9	10	615	13	0	638	0	21	12	15	0	48	5	17	544	28	0	589	25	1332
7:00PM	7	1	4	0	12	0	3	137	6	0	146	1	1	1	2	0	4	1	1	145	6	0	152	7	314
7:15PM	9	2	1	0	12	2	2	127	1	0	130	0	1	3	3	0	7	1	2	130	12	0	144	1	293
7:30PM	11	5	1	0	17	1	4	118	3	0	125	0	7	3	1	0	11	0	4	150	6	0	160	1	313
7:45PM	5	1	2	0	8	0	4	90	4	0	98	0	4	2	2	0	8	0	2	109	9	0	120	6	234
Hourly Total	32	9	8	0	49	3	13	472	14	0	499	1	13	9	8	0	30	2	9	534	33	0	576	15	1154
2019-04-30 7:00AM	4	0	1	0	5	0	0	179	1	0	180	0	2	1	2	0	5	0	1	120	1	0	122	2	312
7:15AM	4	2	0	0	6	0	1	219	5	0	225	0	3	0	1	0	4	0	5	162	2	0	169	0	404
7:30AM	9	4	2	0	15	0	0	223	3	0	226	0	0	1	2	0	3	0	5	183	4	0	192	6	436
7:45AM	4	2	1	0	7	0	1	213	9	0	223	0	4	0	1	0	5	1	3	194	8	0	205	2	440
Hourly Total	21	8	4	0	33	0	2	834	18	0	854	0	9	2	6	0	17	1	14	659	15	0	688	10	1592
8:00AM	8	2	4	0	14	0	2																		

Leg Direction	North Southbound						East Westbound						South Northbound						West Eastbound						Int						
	R	T	L	U	App	Ped*	R	T	L	U	App	Ped*	R	T	L	U	App	Ped*	R	T	L	U	App	Ped*							
Time																															
% Lights	95.2%	94.5%	99.1%	0%	95.8%	-	98.6%	96.5%	89.1%	0%	96.3%	-	97.2%	98.1%	100%	0%	98.1%	-	98.2%	96.2%	97.3%	0%	96.3%	-							96.3%
Articulated Trucks	0	0	0	0	0	-	0	61	0	0	61	-	1	0	0	0	1	-	1	70	0	0	71	-							133
% Articulated Trucks	0%	0%	0%	0%	0%	-	0%	0.7%	0%	0%	0.7%	-	0.4%	0%	0%	0%	0.2%	-	0.4%	0.9%	0%	0%	0.8%	-							0.7%
Buses and Single-Unit Trucks	12	2	1	0	15	-	2	239	26	0	267	-	5	1	0	0	6	-	3	237	6	0	246	-							534
% Buses and Single-Unit Trucks	3.4%	1.6%	0.9%	0%	2.5%	-	1.4%	2.8%	10.5%	0%	3.0%	-	2.0%	1.0%	0%	0%	1.2%	-	1.3%	2.9%	1.8%	0%	2.8%	-							2.9%
Bicycles on Road	5	5	0	0	10	-	0	0	1	0	1	-	1	1	0	0	2	-	0	0	3	0	3	-							16
% Bicycles on Road	1.4%	3.9%	0%	0%	1.7%	-	0%	0%	0.4%	0%	0%	-	0.4%	1.0%	0%	0%	0.4%	-	0%	0%	0.9%	0%	0%	-							0.1%
Pedestrians	-	-	-	-	-	51	-	-	-	-	-	10	-	-	-	-	-	31	-	-	-	-	-	171							
% Pedestrians	-	-	-	-	-	89.5%	-	-	-	-	-	100%	-	-	-	-	-	93.9%	-	-	-	-	-	98.3%							-
Bicycles on Crosswalk	-	-	-	-	-	6	-	-	-	-	-	0	-	-	-	-	-	2	-	-	-	-	-	3							
% Bicycles on Crosswalk	-	-	-	-	-	10.5%	-	-	-	-	-	0%	-	-	-	-	-	6.1%	-	-	-	-	-	1.7%							-

*Pedestrians and Bicycles on Crosswalk. L: Left, R: Right, T: Thru, U: U-Turn

Hwy. 91 at State St. - TMC

Mon Apr 29, 2019

Full Length (8:15 AM-8 PM, 7 AM-8:15 AM)

All Classes (Lights, Articulated Trucks, Buses and Single-Unit Trucks, Pedestrians, Bicycles on Road, Bicycles on Crosswalk)

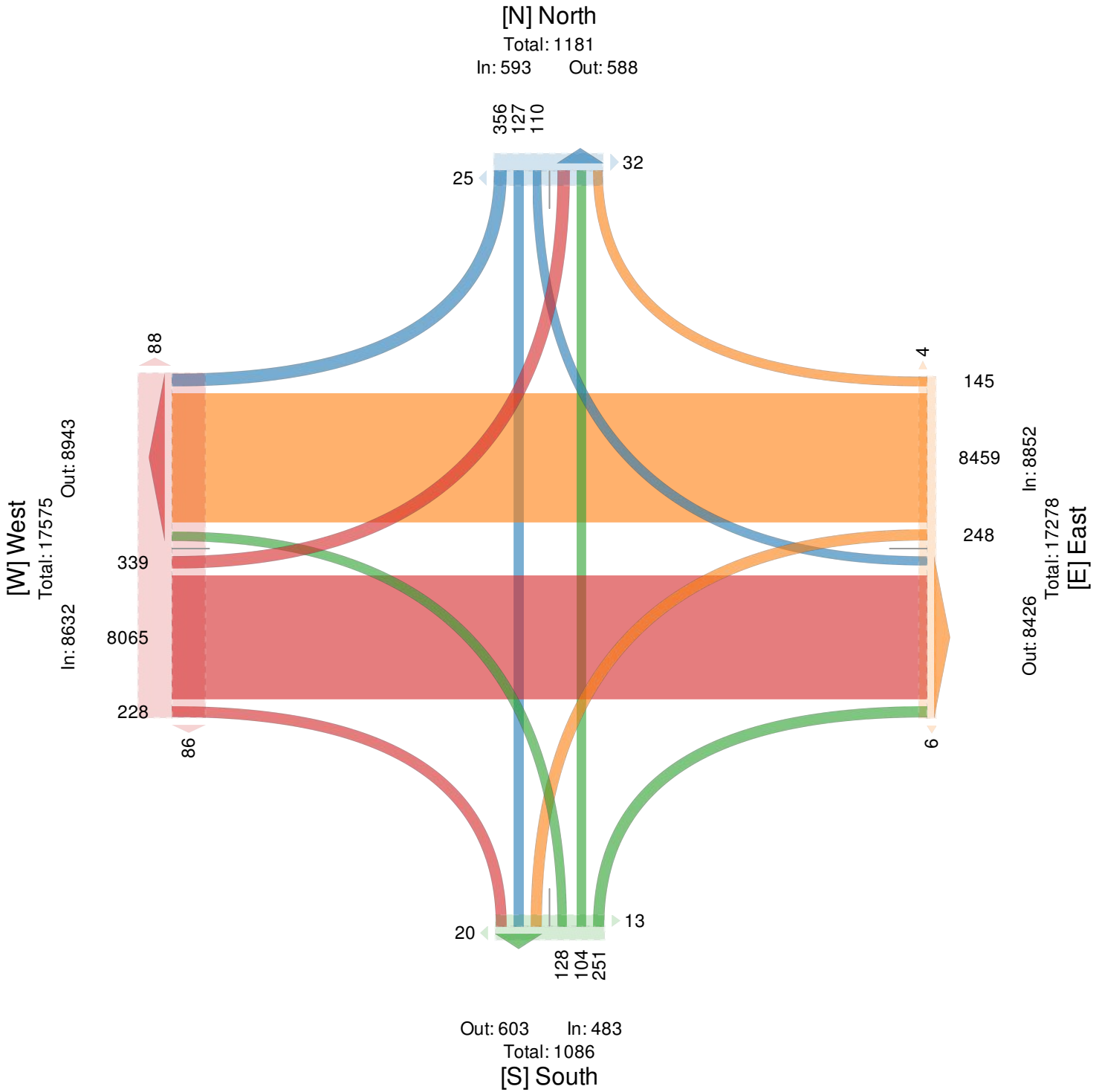
All Movements

ID: 648145, Location: 35.845267, -90.685252

Provided by: City of Jonesboro (AR)

515 West Washington Avenue,

Jonesboro, AR, 12345, US



Hwy. 91 at State St. - TMC

Mon Apr 29, 2019

Midday Peak (Apr 29 2019 12PM - 1 PM)

All Classes (Lights, Articulated Trucks, Buses and Single-Unit Trucks, Pedestrians, Bicycles on Road, Bicycles on Crosswalk)

All Movements

ID: 648145, Location: 35.845267, -90.685252

Provided by: City of Jonesboro (AR)

515 West Washington Avenue,

Jonesboro, AR, 12345, US

Leg Direction	North Southbound						East Westbound						South Northbound						West Eastbound						Int
	R	T	L	U	App	Ped*	R	T	L	U	App	Ped*	R	T	L	U	App	Ped*	R	T	L	U	App	Ped*	
2019-04-29 12:00PM	8	1	0	0	9	0	1	172	4	0	177	0	12	5	4	0	21	1	10	179	6	0	195	3	402
12:15PM	6	2	0	0	8	1	2	182	8	0	192	1	8	4	1	0	13	1	2	153	7	0	162	1	375
12:30PM	6	2	1	0	9	0	1	152	6	0	159	0	2	3	4	0	9	1	9	157	9	0	175	3	352
12:45PM	8	3	0	0	11	2	2	174	7	0	183	0	6	2	1	0	9	2	7	135	7	0	149	0	352
Total	28	8	1	0	37	3	6	680	25	0	711	1	28	14	10	0	52	5	28	624	29	0	681	7	1481
% Approach	75.7%	21.6%	2.7%	0%	-	-	0.8%	95.6%	3.5%	0%	-	-	53.8%	26.9%	19.2%	0%	-	-	4.1%	91.6%	4.3%	0%	-	-	-
% Total	1.9%	0.5%	0.1%	0%	2.5%	-	0.4%	45.9%	1.7%	0%	48.0%	-	1.9%	0.9%	0.7%	0%	3.5%	-	1.9%	42.1%	2.0%	0%	46.0%	-	-
PHF	0.844	0.667	0.250	-	0.818	-	0.750	0.934	0.781	-	0.926	-	0.583	0.813	0.625	-	0.638	-	0.700	0.872	0.806	-	0.873	-	0.922
Lights	27	8	1	0	36	-	6	661	23	0	690	-	28	12	10	0	50	-	28	596	29	0	653	-	1429
% Lights	96.4%	100%	100%	0%	97.3%	-	100%	97.2%	92.0%	0%	97.0%	-	100%	85.7%	100%	0%	96.2%	-	100%	95.5%	100%	0%	95.9%	-	96.5%
Articulated Trucks	0	0	0	0	0	-	0	5	0	0	5	-	0	0	0	0	0	-	0	6	0	0	6	-	11
% Articulated Trucks	0%	0%	0%	0%	0%	-	0%	0.7%	0%	0%	0.7%	-	0%	0%	0%	0%	0%	-	0%	1.0%	0%	0%	0.9%	-	0.7%
Buses and Single-Unit Trucks	0	0	0	0	0	-	0	14	2	0	16	-	0	1	0	0	1	-	0	22	0	0	22	-	39
% Buses and Single-Unit Trucks	0%	0%	0%	0%	0%	-	0%	2.1%	8.0%	0%	2.3%	-	0%	7.1%	0%	0%	1.9%	-	0%	3.5%	0%	0%	3.2%	-	2.6%
Bicycles on Road	1	0	0	0	1	-	0	0	0	0	0	-	0	1	0	0	1	-	0	0	0	0	0	-	2
% Bicycles on Road	3.6%	0%	0%	0%	2.7%	-	0%	0%	0%	0%	0%	-	0%	7.1%	0%	0%	1.9%	-	0%	0%	0%	0%	0%	-	0.1%
Pedestrians	-	-	-	-	-	3	-	-	-	-	-	1	-	-	-	-	-	5	-	-	-	-	-	-	7
% Pedestrians	-	-	-	-	-	100%	-	-	-	-	-	100%	-	-	-	-	-	100%	-	-	-	-	-	-	100%
Bicycles on Crosswalk	-	-	-	-	-	0	-	-	-	-	-	0	-	-	-	-	-	0	-	-	-	-	-	-	0
% Bicycles on Crosswalk	-	-	-	-	-	0%	-	-	-	-	-	0%	-	-	-	-	-	0%	-	-	-	-	-	-	0%

*Pedestrians and Bicycles on Crosswalk. L: Left, R: Right, T: Thru, U: U-Turn

Hwy. 91 at State St. - TMC

Mon Apr 29, 2019

Midday Peak (Apr 29 2019 12PM - 1 PM)

All Classes (Lights, Articulated Trucks, Buses and Single-Unit Trucks, Pedestrians, Bicycles on Road, Bicycles on Crosswalk)

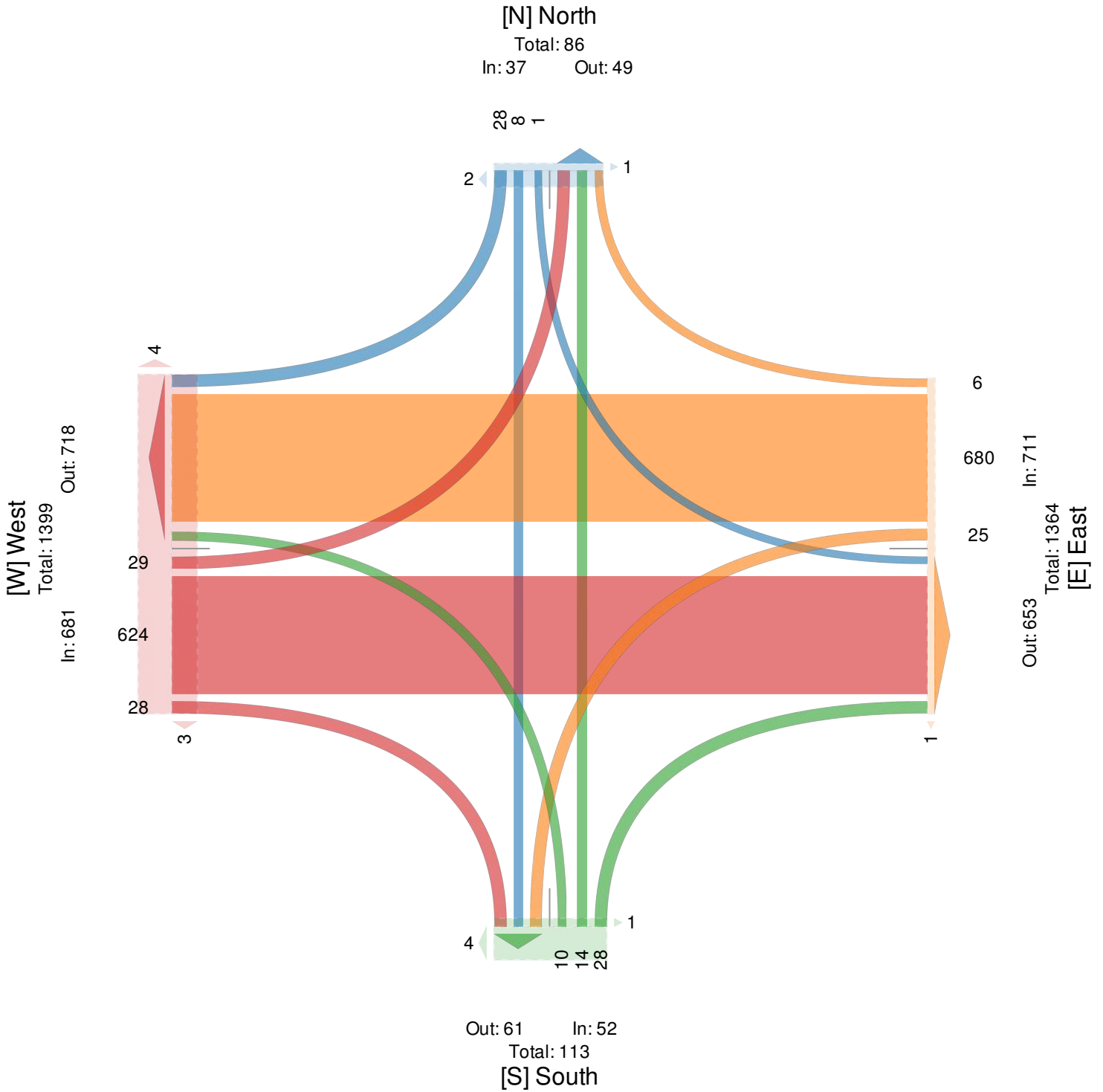
All Movements

ID: 648145, Location: 35.845267, -90.685252

Provided by: City of Jonesboro (AR)

515 West Washington Avenue,

Jonesboro, AR, 12345, US



Hwy. 91 at State St. - TMC

Mon Apr 29, 2019

PM Peak (Apr 29 2019 4:30PM - 5:30 PM) - Overall Peak Hour

All Classes (Lights, Articulated Trucks, Buses and Single-Unit Trucks, Pedestrians, Bicycles on Road,

Bicycles on Crosswalk)

All Movements

ID: 648145, Location: 35.845267, -90.685252

Provided by: City of Jonesboro (AR)

515 West Washington Avenue,

Jonesboro, AR, 12345, US

Leg Direction	North Southbound						East Westbound						South Northbound						West Eastbound						Int
	R	T	L	U	App	Ped*	R	T	L	U	App	Ped*	R	T	L	U	App	Ped*	R	T	L	U	App	Ped*	
2019-04-29 4:30PM	8	0	7	0	15	0	4	189	5	0	198	0	3	5	3	0	11	1	7	221	14	0	242	4	466
4:45PM	10	3	2	0	15	1	9	183	3	0	195	1	7	2	0	0	9	0	3	181	12	0	196	7	415
5:00PM	10	4	5	0	19	0	8	222	7	0	237	0	10	1	4	0	15	1	5	253	10	0	268	5	539
5:15PM	4	2	2	0	8	0	3	249	4	0	256	0	6	2	1	0	9	0	5	205	8	0	218	1	491
Total	32	9	16	0	57	1	24	843	19	0	886	1	26	10	8	0	44	2	20	860	44	0	924	17	1911
% Approach	56.1%	15.8%	28.1%	0%	-	-	2.7%	95.1%	2.1%	0%	-	-	59.1%	22.7%	18.2%	0%	-	-	2.2%	93.1%	4.8%	0%	-	-	-
% Total	1.7%	0.5%	0.8%	0%	3.0%	-	1.3%	44.1%	1.0%	0%	46.4%	-	1.4%	0.5%	0.4%	0%	2.3%	-	1.0%	45.0%	2.3%	0%	48.4%	-	-
PHF	0.800	0.563	0.571	-	0.750	-	0.667	0.846	0.679	-	0.865	-	0.650	0.500	0.500	-	0.733	-	0.714	0.850	0.786	-	0.862	-	0.886
Lights	32	9	16	0	57	-	24	825	17	0	866	-	26	10	8	0	44	-	20	846	44	0	910	-	1877
% Lights	100%	100%	100%	0%	100%	-	100%	97.9%	89.5%	0%	97.7%	-	100%	100%	100%	0%	100%	-	100%	98.4%	100%	0%	98.5%	-	98.2%
Articulated Trucks	0	0	0	0	0	-	0	8	0	0	8	-	0	0	0	0	0	-	0	3	0	0	3	-	11
% Articulated Trucks	0%	0%	0%	0%	0%	-	0%	0.9%	0%	0%	0.9%	-	0%	0%	0%	0%	0%	-	0%	0.3%	0%	0%	0.3%	-	0.6%
Buses and Single-Unit Trucks	0	0	0	0	0	-	0	10	2	0	12	-	0	0	0	0	0	-	0	11	0	0	11	-	23
% Buses and Single-Unit Trucks	0%	0%	0%	0%	0%	-	0%	1.2%	10.5%	0%	1.4%	-	0%	0%	0%	0%	0%	-	0%	1.3%	0%	0%	1.2%	-	1.2%
Bicycles on Road	0	0	0	0	0	-	0	0	0	0	0	-	0	0	0	0	0	-	0	0	0	0	0	-	0
% Bicycles on Road	0%	0%	0%	0%	0%	-	0%	0%	0%	0%	0%	-	0%	0%	0%	0%	0%	-	0%	0%	0%	0%	0%	-	0%
Pedestrians	-	-	-	-	-	1	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	17
% Pedestrians	-	-	-	-	-	100%	-	-	-	-	-	100%	-	-	-	-	-	-	-	-	-	-	-	-	100%
Bicycles on Crosswalk	-	-	-	-	-	0	-	-	-	-	-	0	-	-	-	-	-	-	-	-	-	-	-	-	0
% Bicycles on Crosswalk	-	-	-	-	-	0%	-	-	-	-	-	0%	-	-	-	-	-	-	-	-	-	-	-	-	0%

*Pedestrians and Bicycles on Crosswalk. L: Left, R: Right, T: Thru, U: U-Turn

Hwy. 91 at State St. - TMC

Mon Apr 29, 2019

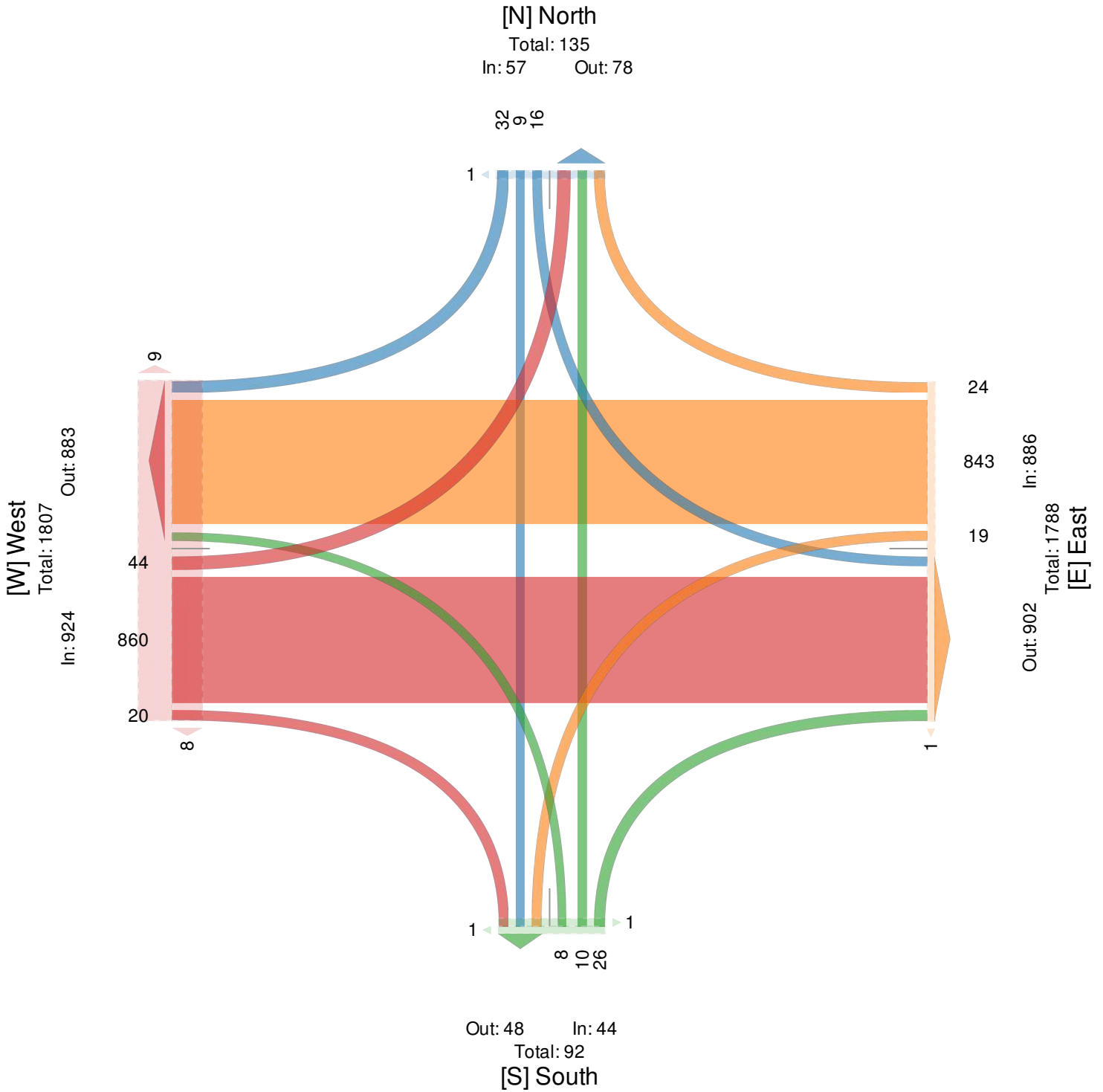
PM Peak (Apr 29 2019 4:30PM - 5:30 PM) - Overall Peak Hour

All Classes (Lights, Articulated Trucks, Buses and Single-Unit Trucks, Pedestrians, Bicycles on Road, Bicycles on Crosswalk)

All Movements

ID: 648145, Location: 35.845267, -90.685252

Provided by: City of Jonesboro (AR)
 515 West Washington Avenue,
 Jonesboro, AR, 12345, US



Hwy. 91 at State St. - TMC

Tue Apr 30, 2019

AM Peak (Apr 30 2019 7:15AM - 8:15 AM)

All Classes (Lights, Articulated Trucks, Buses and Single-Unit Trucks, Pedestrians, Bicycles on Road, Bicycles on Crosswalk)

All Movements

ID: 648145, Location: 35.845267, -90.685252

Provided by: City of Jonesboro (AR)

515 West Washington Avenue,

Jonesboro, AR, 12345, US

Leg Direction	North Southbound					East Westbound					South Northbound					West Eastbound					Int				
	R	T	L	U	App Ped*	R	T	L	U	App Ped*	R	T	L	U	App Ped*	R	T	L	U	App Ped*					
2019-04-30 7:15AM	4	2	0	0	6	0	1	219	5	0	225	0	3	0	1	0	4	0	5	162	2	0	169	0	404
7:30AM	9	4	2	0	15	0	0	223	3	0	226	0	0	1	2	0	3	0	5	183	4	0	192	6	436
7:45AM	4	2	1	0	7	0	1	213	9	0	223	0	4	0	1	0	5	1	3	194	8	0	205	2	440
8:00AM	8	2	4	0	14	0	2	176	4	0	182	0	1	0	2	0	3	0	3	149	10	0	162	0	361
Total	25	10	7	0	42	0	4	831	21	0	856	0	8	1	6	0	15	1	16	688	24	0	728	8	1641
% Approach	59.5%	23.8%	16.7%	0%	-	-	0.5%	97.1%	2.5%	0%	-	-	53.3%	6.7%	40.0%	0%	-	-	2.2%	94.5%	3.3%	0%	-	-	-
% Total	1.5%	0.6%	0.4%	0%	2.6%	-	0.2%	50.6%	1.3%	0%	52.2%	-	0.5%	0.1%	0.4%	0%	0.9%	-	1.0%	41.9%	1.5%	0%	44.4%	-	-
PHF	0.694	0.625	0.438	-	0.700	-	0.500	0.932	0.583	-	0.947	-	0.500	0.250	0.750	-	0.750	-	0.800	0.887	0.600	-	0.888	-	0.932
Lights	22	10	7	0	39	-	4	799	19	0	822	-	7	1	6	0	14	-	16	658	22	0	696	-	1571
% Lights	88.0%	100%	100%	0%	92.9%	-	100%	96.1%	90.5%	0%	96.0%	-	87.5%	100%	100%	0%	93.3%	-	100%	95.6%	91.7%	0%	95.6%	-	95.7%
Articulated Trucks	0	0	0	0	0	-	0	6	0	0	6	-	0	0	0	0	0	-	0	6	0	0	6	-	12
% Articulated Trucks	0%	0%	0%	0%	0%	-	0%	0.7%	0%	0%	0.7%	-	0%	0%	0%	0%	0%	-	0%	0.9%	0%	0%	0.8%	-	0.7%
Buses and Single-Unit Trucks	3	0	0	0	3	-	0	26	2	0	28	-	1	0	0	0	1	-	0	24	2	0	26	-	58
% Buses and Single-Unit Trucks	12.0%	0%	0%	0%	7.1%	-	0%	3.1%	9.5%	0%	3.3%	-	12.5%	0%	0%	0%	6.7%	-	0%	3.5%	8.3%	0%	3.6%	-	3.5%
Bicycles on Road	0	0	0	0	0	-	0	0	0	0	0	-	0	0	0	0	0	-	0	0	0	0	0	-	0
% Bicycles on Road	0%	0%	0%	0%	0%	-	0%	0%	0%	0%	0%	-	0%	0%	0%	0%	0%	-	0%	0%	0%	0%	0%	-	0%
Pedestrians	-	-	-	-	-	0	-	-	-	-	-	0	-	-	-	-	-	1	-	-	-	-	-	-	8
% Pedestrians	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	100%	-	-	-	-	-	-	100%
Bicycles on Crosswalk	-	-	-	-	-	0	-	-	-	-	-	0	-	-	-	-	-	0	-	-	-	-	-	-	0
% Bicycles on Crosswalk	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0%	-	-	-	-	-	-	0%

*Pedestrians and Bicycles on Crosswalk. L: Left, R: Right, T: Thru, U: U-Turn

Hwy. 91 at State St. - TMC

Tue Apr 30, 2019

AM Peak (Apr 30 2019 7:15AM - 8:15 AM)

All Classes (Lights, Articulated Trucks, Buses and Single-Unit Trucks, Pedestrians, Bicycles on Road, Bicycles on Crosswalk)

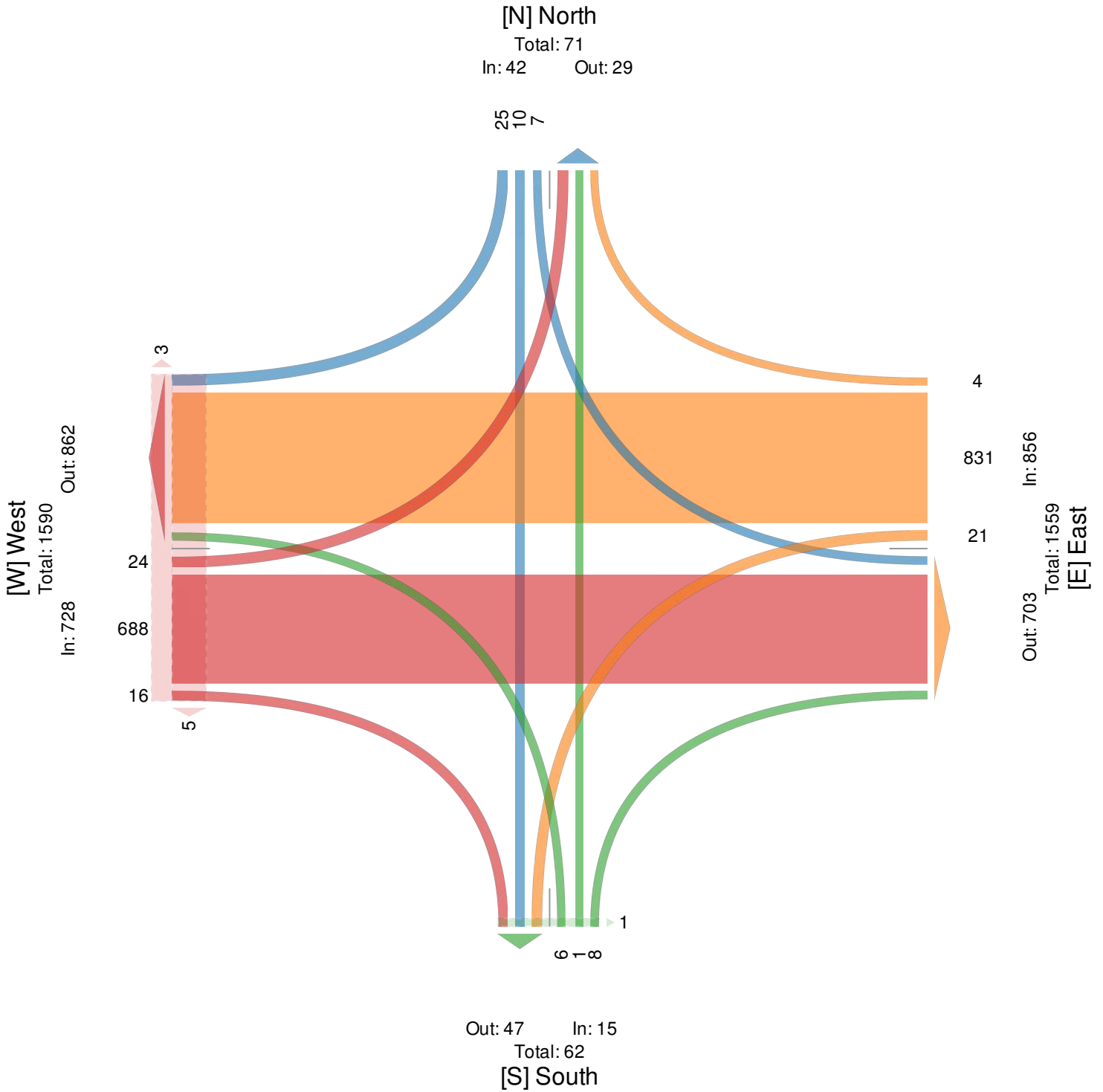
All Movements

ID: 648145, Location: 35.845267, -90.685252

Provided by: City of Jonesboro (AR)

515 West Washington Avenue,

Jonesboro, AR, 12345, US



Date of Counts: Thursday, October 3, 2019

Full video footage of count shift times available

AM Shift 7:00 am to 9:00 am
 Midday Shift 11:30 am to 1:30 pm
 Evening Shift 4:00 pm to 6:00 pm

State Street Intersection			
Observer	Shift	Pedestrians	Cyclists
MPO Staff	AM	32	0
	Midday	15	0
	Evening	26	0
Total		73	0

Items of Note By Staff
<i>*Citgo gas station appears to be a major destination for pedestrian activity</i>
<i>*Majority pedestrians utilized crossing installation, but a handful from each peak period crossed within just 2-5 feet (mainly west) of actual crossing installation</i>
<i>*Some pedestrians utilized crossing installation without activating the lights</i>
<i>*A significant number of motorists refused to yield for pedestrians even if crossing lights were activated and/or if pedestrians were actively crossing at installation</i>
<i>*During actual site visits by staff, pedestrians and residents in apartments directly adjacent to crossing installation stated most pedestrian traffic occurs during AM for school & employment purposes, and that vehicle traffic is not accommodating to that activity</i>

Date of Counts: Wednesday, March 4, 2020

Full video footage of count shift times available as well

AM Shift 7:00 am to 9:00 am
Midday Shift 11:30 am to 1:30 pm
Evening Shift 4:00 pm to 6:00 pm

State Street Intersection		
Observer	Shift	Pedestrians
MPO Staff	AM	21
	Midday	26
	Evening	33
Total		80

Items of Note By Staff

**Citgo gas station still a popular destination for pedestrian activity*

**Majority pedestrians utilized crossing installation, but a number from each peak period crossed within just a few feet east or west of actual crossing installation*

**Some pedestrians still utilized crossing installation without activating the lights*

Appendix B – Operational Analysis Results

Summary of All Intervals

Run Number	1	2	3	4	5	Avg
Start Time	4:20	4:20	4:20	4:20	4:20	4:20
End Time	5:30	5:30	5:30	5:30	5:30	5:30
Total Time (min)	70	70	70	70	70	70
Time Recorded (min)	60	60	60	60	60	60
# of Intervals	5	5	5	5	5	5
# of Recorded Intervals	4	4	4	4	4	4
Vehs Entered	1956	1915	1900	1856	1919	1908
Vehs Exited	1951	1909	1894	1865	1927	1909
Starting Vehs	32	28	24	35	31	29
Ending Vehs	37	34	30	26	23	28
Denied Entry Before	0	0	0	0	0	0
Denied Entry After	0	0	0	0	0	0
Travel Distance (mi)	1390	1356	1343	1323	1366	1356
Travel Time (hr)	33.9	33.0	32.6	32.0	33.0	32.9
Total Delay (hr)	2.2	2.1	2.0	1.9	2.0	2.0
Total Stops	136	122	150	119	126	130
Fuel Used (gal)	37.5	36.5	36.3	35.3	36.8	36.5

Interval #0 Information Seeding

Start Time	4:20
End Time	4:30
Total Time (min)	10
Volumes adjusted by Growth Factors, Anti PHF.	
No data recorded this interval.	

Interval #1 Information Recording

Start Time	4:30
End Time	4:45
Total Time (min)	15
Volumes adjusted by Growth Factors, Anti PHF.	

Run Number	1	2	3	4	5	Avg
Vehs Entered	468	444	458	478	475	466
Vehs Exited	466	432	452	483	481	463
Starting Vehs	32	28	24	35	31	29
Ending Vehs	34	40	30	30	25	31
Denied Entry Before	0	0	0	0	0	0
Denied Entry After	0	0	0	0	0	0
Travel Distance (mi)	333	312	320	346	340	330
Travel Time (hr)	8.1	7.4	7.8	8.4	8.2	8.0
Total Delay (hr)	0.5	0.4	0.4	0.5	0.5	0.5
Total Stops	32	19	34	29	27	29
Fuel Used (gal)	9.1	8.3	8.5	9.2	9.0	8.8

Interval #2 Information Recording

Start Time	4:45
End Time	5:00
Total Time (min)	15
Volumes adjusted by PHF, Growth Factors.	

Run Number	1	2	3	4	5	Avg
Vehs Entered	554	544	520	496	553	533
Vehs Exited	555	544	511	511	530	530
Starting Vehs	34	40	30	30	25	31
Ending Vehs	33	40	39	15	48	33
Denied Entry Before	0	0	0	0	0	0
Denied Entry After	0	0	0	0	0	0
Travel Distance (mi)	392	387	366	356	387	378
Travel Time (hr)	9.6	9.4	9.0	8.6	9.5	9.2
Total Delay (hr)	0.7	0.7	0.6	0.6	0.7	0.6
Total Stops	42	33	37	30	47	37
Fuel Used (gal)	10.6	10.5	10.0	9.6	10.6	10.2

Interval #3 Information Recording

Start Time	5:00
End Time	5:15
Total Time (min)	15
Volumes adjusted by Growth Factors, Anti PHF.	

Run Number	1	2	3	4	5	Avg
Vehs Entered	482	449	454	441	458	458
Vehs Exited	476	459	455	423	479	458
Starting Vehs	33	40	39	15	48	33
Ending Vehs	39	30	38	33	27	33
Denied Entry Before	0	0	0	0	0	0
Denied Entry After	0	0	0	0	0	0
Travel Distance (mi)	339	321	322	309	330	324
Travel Time (hr)	8.4	7.9	7.7	7.5	7.8	7.9
Total Delay (hr)	0.6	0.5	0.4	0.4	0.4	0.5
Total Stops	32	37	37	25	26	31
Fuel Used (gal)	9.1	8.5	8.7	8.1	8.9	8.7

Interval #4 Information Recording

Start Time	5:15
End Time	5:30
Total Time (min)	15

Volumes adjusted by Growth Factors, Anti PHF.

Run Number	1	2	3	4	5	Avg
Vehs Entered	452	478	468	441	433	453
Vehs Exited	454	474	476	448	437	459
Starting Vehs	39	30	38	33	27	33
Ending Vehs	37	34	30	26	23	28
Denied Entry Before	0	0	0	0	0	0
Denied Entry After	0	0	0	0	0	0
Travel Distance (mi)	325	336	334	312	309	323
Travel Time (hr)	7.8	8.2	8.1	7.5	7.5	7.8
Total Delay (hr)	0.4	0.5	0.5	0.4	0.4	0.4
Total Stops	30	33	42	35	26	33
Fuel Used (gal)	8.7	9.1	9.1	8.4	8.3	8.7

2: Performance by movement

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Denied Delay (hr)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Denied Del/Veh (s)	1.2	0.2	0.2	2.4	0.2	0.3	0.1	0.1	0.1	0.1	0.2	0.1
Total Delay (hr)	0.1	0.5	0.0	0.0	0.2	0.0	0.0	0.1	0.1	0.1	0.1	0.1
Total Del/Veh (s)	6.8	2.0	1.6	4.4	0.7	0.2	22.2	32.2	7.5	26.7	28.0	7.3
Stop Delay (hr)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.1	0.1	0.1	0.1
Stop Del/Veh (s)	3.5	0.0	0.0	3.4	0.0	0.0	20.7	29.6	7.0	25.0	25.9	6.8
Total Stops	24	0	0	12	0	0	7	9	28	15	7	28
Stop/Veh	0.63	0.00	0.00	0.71	0.00	0.00	1.00	1.00	1.00	1.00	1.00	1.00
Travel Dist (mi)	19.7	473.4	9.8	3.2	163.6	4.4	0.5	0.6	1.8	1.0	0.4	1.9
Travel Time (hr)	0.6	11.2	0.2	0.1	3.9	0.1	0.1	0.1	0.1	0.2	0.1	0.1
Avg Speed (mph)	36	43	40	30	43	37	7	6	12	6	6	13
Vehicles Entered	37	884	18	17	836	23	7	9	28	15	6	28
Vehicles Exited	37	883	18	17	837	23	7	9	28	15	7	28
Hourly Exit Rate	37	883	18	17	837	23	7	9	28	15	7	28
Input Volume	44	860	20	19	843	24	8	10	26	16	9	32
% of Volume	85	103	91	91	99	96	85	88	108	95	76	87
Denied Entry Before	0	0	0	0	0	0	0	0	0	0	0	0
Denied Entry After	0	0	0	0	0	0	0	0	0	0	0	0
Density (ft/veh)												
Occupancy (veh)	1	11	0	0	4	0	0	0	0	0	0	0

2: Performance by movement

Movement	All
Denied Delay (hr)	0.1
Denied Del/Veh (s)	0.2
Total Delay (hr)	1.2
Total Del/Veh (s)	2.2
Stop Delay (hr)	0.4
Stop Del/Veh (s)	0.8
Total Stops	130
Stop/Veh	0.07
Travel Dist (mi)	680.3
Travel Time (hr)	16.8
Avg Speed (mph)	41
Vehicles Entered	1908
Vehicles Exited	1909
Hourly Exit Rate	1909
Input Volume	1911
% of Volume	100
Denied Entry Before	0
Denied Entry After	0
Density (ft/veh)	735
Occupancy (veh)	17

Total Network Performance

Denied Delay (hr)	0.1
Denied Del/Veh (s)	0.2
Total Delay (hr)	1.9
Total Del/Veh (s)	3.5
Stop Delay (hr)	0.4
Stop Del/Veh (s)	0.8
Total Stops	130
Stop/Veh	0.07
Travel Dist (mi)	1355.6
Travel Time (hr)	32.9
Avg Speed (mph)	41
Vehicles Entered	1908
Vehicles Exited	1909
Hourly Exit Rate	1909
Input Volume	3822
% of Volume	50
Denied Entry Before	0
Denied Entry After	0
Density (ft/veh)	374
Occupancy (veh)	33

Intersection: 2:

Movement	EB	EB	WB	WB	NB	SB
Directions Served	L	TR	L	TR	LTR	LTR
Maximum Queue (ft)	46	4	28	8	70	68
Average Queue (ft)	16	0	9	0	28	33
95th Queue (ft)	42	3	28	6	58	60
Link Distance (ft)		2826		1028	338	348
Upstream Blk Time (%)						
Queuing Penalty (veh)						
Storage Bay Dist (ft)	100		100			
Storage Blk Time (%)						
Queuing Penalty (veh)						

Network Summary

Network wide Queuing Penalty: 0

Summary of All Intervals

Run Number	1	2	3	4	5	Avg
Start Time	4:20	4:20	4:20	4:20	4:20	4:20
End Time	5:30	5:30	5:30	5:30	5:30	5:30
Total Time (min)	70	70	70	70	70	70
Time Recorded (min)	60	60	60	60	60	60
# of Intervals	5	5	5	5	5	5
# of Recorded Intervals	4	4	4	4	4	4
Vehs Entered	1952	1977	1874	1915	1879	1919
Vehs Exited	1954	1956	1872	1919	1894	1919
Starting Vehs	32	26	28	28	47	30
Ending Vehs	30	47	30	24	32	33
Denied Entry Before	0	0	0	0	0	0
Denied Entry After	0	0	0	0	0	0
Travel Distance (mi)	1370	1374	1317	1354	1319	1347
Travel Time (hr)	35.8	35.3	33.2	33.9	33.6	34.4
Total Delay (hr)	4.4	3.8	3.2	3.0	3.5	3.6
Total Stops	357	297	269	235	297	291
Fuel Used (gal)	38.9	38.7	36.6	37.5	37.5	37.9

Interval #0 Information Seeding

Start Time	4:20
End Time	4:30
Total Time (min)	10
Volumes adjusted by Growth Factors, Anti PHF.	
No data recorded this interval.	

Interval #1 Information Recording

Start Time	4:30
End Time	4:45
Total Time (min)	15
Volumes adjusted by Growth Factors, Anti PHF.	

Run Number	1	2	3	4	5	Avg
Vehs Entered	479	471	467	456	478	471
Vehs Exited	485	464	464	457	494	473
Starting Vehs	32	26	28	28	47	30
Ending Vehs	26	33	31	27	31	28
Denied Entry Before	0	0	0	0	0	0
Denied Entry After	0	0	0	0	0	0
Travel Distance (mi)	340	333	331	321	341	333
Travel Time (hr)	9.1	8.6	8.4	8.0	8.8	8.6
Total Delay (hr)	1.3	1.0	0.8	0.7	1.1	1.0
Total Stops	116	77	71	56	90	80
Fuel Used (gal)	9.9	9.5	9.0	9.1	9.8	9.4

Interval #2 Information Recording

Start Time	4:45
End Time	5:00
Total Time (min)	15
Volumes adjusted by PHF, Growth Factors.	

Run Number	1	2	3	4	5	Avg
Vehs Entered	565	533	504	557	539	539
Vehs Exited	550	530	493	546	533	530
Starting Vehs	26	33	31	27	31	28
Ending Vehs	41	36	42	38	37	38
Denied Entry Before	0	0	0	0	0	0
Denied Entry After	0	0	0	1	0	0
Travel Distance (mi)	383	361	347	386	368	369
Travel Time (hr)	10.4	9.1	8.9	9.9	9.4	9.6
Total Delay (hr)	1.6	0.9	1.0	1.1	1.0	1.1
Total Stops	124	75	78	75	82	84
Fuel Used (gal)	11.1	10.0	9.9	10.7	10.6	10.5

Interval #3 Information Recording

Start Time	5:00
End Time	5:15
Total Time (min)	15
Volumes adjusted by Growth Factors, Anti PHF.	

Run Number	1	2	3	4	5	Avg
Vehs Entered	428	455	454	443	445	445
Vehs Exited	445	453	463	444	447	450
Starting Vehs	41	36	42	38	37	38
Ending Vehs	24	38	33	37	35	32
Denied Entry Before	0	0	0	1	0	0
Denied Entry After	0	0	0	0	0	0
Travel Distance (mi)	303	321	318	321	312	315
Travel Time (hr)	7.7	8.2	8.0	7.9	8.1	8.0
Total Delay (hr)	0.8	0.8	0.7	0.6	1.0	0.8
Total Stops	61	67	69	47	92	67
Fuel Used (gal)	8.4	8.9	9.0	8.8	8.9	8.8

Interval #4 Information Recording

Start Time	5:15
End Time	5:30
Total Time (min)	15

Volumes adjusted by Growth Factors, Anti PHF.

Run Number	1	2	3	4	5	Avg
Vehs Entered	480	518	449	459	417	464
Vehs Exited	474	509	452	472	420	465
Starting Vehs	24	38	33	37	35	32
Ending Vehs	30	47	30	24	32	33
Denied Entry Before	0	0	0	0	0	0
Denied Entry After	0	0	0	0	0	0
Travel Distance (mi)	344	359	320	327	299	330
Travel Time (hr)	8.6	9.3	7.9	8.1	7.2	8.2
Total Delay (hr)	0.7	1.1	0.6	0.6	0.4	0.7
Total Stops	56	78	51	57	33	56
Fuel Used (gal)	9.5	10.3	8.7	9.0	8.2	9.1

Summary of All Intervals

Run Number	Hwy 91 STEP	Design	Traffic	Synchro	Synchro	Hwy 91	2019 PM Signal	Avg
Start Time	4:20	4:20	4:20	4:20	4:20	4:20	4:20	4:20
End Time	5:30	5:30	5:30	5:30	5:30	5:30	5:30	5:30
Total Time (min)	70	70	70	70	70	70	70	70
Time Recorded (min)	60	60	60	60	60	60	60	60
# of Intervals	5	5	5	5	5	5	5	5
# of Recorded Intervals	4	4	4	4	4	4	4	4
Vehs Entered	1914	1909	1939	1808	1887	1975	1905	1905
Vehs Exited	1917	1910	1927	1793	1898	1984	1905	1905
Starting Vehs	39	37	35	30	35	40	34	34
Ending Vehs	36	36	47	45	24	31	35	35
Denied Entry Before	0	0	0	0	0	0	0	0
Denied Entry After	0	0	0	0	0	0	0	0
Travel Distance (mi)	1357	1348	1360	1277	1333	1397	1345	1345
Travel Time (hr)	37.9	37.3	38.0	35.5	36.8	38.7	37.4	37.4
Total Delay (hr)	6.8	6.4	6.9	6.3	6.3	6.8	6.6	6.6
Total Stops	695	648	700	658	635	687	669	669
Fuel Used (gal)	42.4	41.7	42.3	39.6	41.7	43.3	41.8	41.8

Interval #0 Information Seeding

Start Time	4:20
End Time	4:30
Total Time (min)	10
Volumes adjusted by Growth Factors, Anti PHF.	
No data recorded this interval.	

Interval #1 Information Recording

Start Time	4:30
End Time	4:45
Total Time (min)	15
Volumes adjusted by Growth Factors, Anti PHF.	

Run Number	Hwy 91 STEP	Design	Traffic	Synchro	Synchro	Hwy 91	2019 PM Signal	Avg
Vehs Entered	439	424	483	428	430	482	447	447
Vehs Exited	452	426	478	430	424	485	449	449
Starting Vehs	39	37	35	30	35	40	34	34
Ending Vehs	26	35	40	28	41	37	33	33
Denied Entry Before	0	0	0	0	0	0	0	0
Denied Entry After	0	0	0	0	0	0	0	0
Travel Distance (mi)	313	304	338	305	301	345	318	318
Travel Time (hr)	8.8	8.3	9.9	8.5	8.2	9.3	8.8	8.8
Total Delay (hr)	1.7	1.3	2.1	1.5	1.3	1.5	1.6	1.6
Total Stops	170	151	200	162	141	149	165	165
Fuel Used (gal)	10.1	9.5	10.6	9.6	9.5	10.8	10.0	10.0

Interval #2 Information Recording

Start Time	4:45
End Time	5:00
Total Time (min)	15

Volumes adjusted by PHF, Growth Factors.

Run Number	Hwy 91 STEP	Design	Traffic	Synchro	Synchro	Hwy 91_2019 PM Signal	Avg
Vehs Entered	556	554	509	485	584	540	538
Vehs Exited	523	547	511	474	580	537	529
Starting Vehs	26	35	40	28	41	37	33
Ending Vehs	59	42	38	39	45	40	42
Denied Entry Before	0	0	0	0	0	0	0
Denied Entry After	0	0	0	0	0	0	0
Travel Distance (mi)	375	383	359	339	407	380	374
Travel Time (hr)	10.5	10.7	9.8	9.6	11.5	10.9	10.5
Total Delay (hr)	1.9	2.0	1.6	1.9	2.2	2.2	2.0
Total Stops	196	195	165	189	207	208	194
Fuel Used (gal)	11.6	11.9	11.0	10.6	12.8	11.8	11.6

Interval #3 Information Recording

Start Time	5:00
End Time	5:15
Total Time (min)	15

Volumes adjusted by Growth Factors, Anti PHF.

Run Number	Hwy 91 STEP	Design	Traffic	Synchro	Synchro	Hwy 91_2019 PM Signal	Avg
Vehs Entered	455	459	457	436	422	463	447
Vehs Exited	479	467	454	442	437	468	458
Starting Vehs	59	42	38	39	45	40	42
Ending Vehs	35	34	41	33	30	35	33
Denied Entry Before	0	0	0	0	0	0	0
Denied Entry After	0	0	2	0	0	0	0
Travel Distance (mi)	338	329	321	309	305	328	322
Travel Time (hr)	9.3	8.8	8.7	8.4	8.3	8.9	8.7
Total Delay (hr)	1.5	1.2	1.4	1.4	1.3	1.4	1.4
Total Stops	137	121	152	146	137	155	141
Fuel Used (gal)	10.2	9.9	9.9	9.5	9.6	10.0	9.9

Interval #4 Information Recording

Start Time	5:15
End Time	5:30
Total Time (min)	15

Volumes adjusted by Growth Factors, Anti PHF.

Run Number	Hwy 91 STEP	Design	Traffic	Synchro	Synchro	Hwy 91_2019 PM Signal	Avg
Vehs Entered	464	472	490	459	451	490	472
Vehs Exited	463	470	484	447	457	494	469
Starting Vehs	35	34	41	33	30	35	33
Ending Vehs	36	36	47	45	24	31	35
Denied Entry Before	0	0	2	0	0	0	0
Denied Entry After	0	0	0	0	0	0	0
Travel Distance (mi)	331	332	342	323	320	345	332
Travel Time (hr)	9.3	9.5	9.5	8.9	8.8	9.6	9.3
Total Delay (hr)	1.8	1.9	1.8	1.5	1.4	1.6	1.7
Total Stops	192	181	183	161	150	175	174
Fuel Used (gal)	10.4	10.4	10.8	10.0	9.9	10.6	10.4

2: Performance by movement

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Denied Delay (hr)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Denied Del/Veh (s)	1.0	0.2	0.1	2.7	0.2	0.3	0.1	0.1	0.1	0.1	0.1	0.2
Total Delay (hr)	0.2	2.1	0.0	0.1	2.1	0.0	0.0	0.0	0.0	0.1	0.0	0.0
Total Del/Veh (s)	13.5	8.6	5.6	13.1	9.1	4.5	10.9	12.4	5.3	11.5	9.7	5.0
Stop Delay (hr)	0.1	0.7	0.0	0.0	0.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Stop Del/Veh (s)	8.4	3.0	3.0	9.4	3.7	2.6	9.1	10.6	4.8	9.8	7.9	4.5
Total Stops	38	253	8	18	271	9	5	8	20	13	5	21
Stop/Veh	0.84	0.29	0.44	0.95	0.32	0.38	0.62	0.67	0.69	0.76	0.56	0.66
Travel Dist (mi)	23.6	462.9	9.7	3.7	161.9	4.7	0.5	0.7	1.9	1.1	0.6	2.1
Travel Time (hr)	0.8	12.5	0.3	0.2	5.8	0.2	0.0	0.1	0.1	0.1	0.0	0.1
Avg Speed (mph)	32	37	36	22	28	29	11	10	14	11	12	14
Fuel Used (gal)	0.6	11.9	0.2	0.1	4.9	0.1	0.0	0.0	0.1	0.0	0.0	0.1
Fuel Eff. (mpg)	40.1	38.8	41.4	34.6	33.3	34.7	26.1	25.3	31.8	27.0	26.7	32.0
HC Emissions (g)	6	138	1	1	65	2	0	0	1	0	0	0
CO Emissions (g)	177	4021	53	45	2766	88	3	4	16	6	3	13
NOx Emissions (g)	29	630	8	3	231	7	0	0	2	1	0	2
Vehicles Entered	44	864	18	19	830	24	8	11	29	17	9	32
Vehicles Exited	44	866	18	19	832	24	8	12	29	17	9	32
Hourly Exit Rate	44	866	18	19	832	24	8	12	29	17	9	32
Input Volume	44	860	20	19	843	24	8	10	26	16	9	32
% of Volume	101	101	91	101	99	100	97	117	112	108	97	99
Denied Entry Before	0	0	0	0	0	0	0	0	0	0	0	0
Denied Entry After	0	0	0	0	0	0	0	0	0	0	0	0
Density (ft/veh)												
Occupancy (veh)	1	12	0	0	6	0	0	0	0	0	0	0

2: Performance by movement

Movement	All
Denied Delay (hr)	0.1
Denied Del/Veh (s)	0.2
Total Delay (hr)	4.7
Total Del/Veh (s)	8.9
Stop Delay (hr)	2.0
Stop Del/Veh (s)	3.7
Total Stops	669
Stop/Veh	0.35
Travel Dist (mi)	673.4
Travel Time (hr)	20.2
Avg Speed (mph)	33
Fuel Used (gal)	18.1
Fuel Eff. (mpg)	37.2
HC Emissions (g)	215
CO Emissions (g)	7196
NOx Emissions (g)	912
Vehicles Entered	1905
Vehicles Exited	1910
Hourly Exit Rate	1910
Input Volume	1911
% of Volume	100
Denied Entry Before	0
Denied Entry After	0
Density (ft/veh)	609
Occupancy (veh)	20

Total Network Performance

Denied Delay (hr)	0.1
Denied Del/Veh (s)	0.2
Total Delay (hr)	6.5
Total Del/Veh (s)	12.0
Stop Delay (hr)	2.0
Stop Del/Veh (s)	3.8
Total Stops	669
Stop/Veh	0.34
Travel Dist (mi)	1345.4
Travel Time (hr)	37.4
Avg Speed (mph)	36
Fuel Used (gal)	41.8
Fuel Eff. (mpg)	32.2
HC Emissions (g)	556
CO Emissions (g)	20492
NOx Emissions (g)	2283
Vehicles Entered	1905
Vehicles Exited	1905
Hourly Exit Rate	1905
Input Volume	3822
% of Volume	50
Denied Entry Before	0
Denied Entry After	0
Density (ft/veh)	329
Occupancy (veh)	37

Intersection: 2:

Movement	EB	EB	EB	WB	WB	WB	NB	SB
Directions Served	L	T	TR	L	T	TR	LTR	LTR
Maximum Queue (ft)	82	151	158	65	176	148	60	68
Average Queue (ft)	26	64	73	14	87	61	24	26
95th Queue (ft)	55	119	130	46	157	121	55	56
Link Distance (ft)		2826	2826		1028	1028	338	348
Upstream Blk Time (%)								
Queuing Penalty (veh)								
Storage Bay Dist (ft)	100			100				
Storage Blk Time (%)	0	2			5			
Queuing Penalty (veh)	0	1			1			

Network Summary

Network wide Queuing Penalty: 2

Appendix C – Signal Warrants

HCS7 Warrants Report

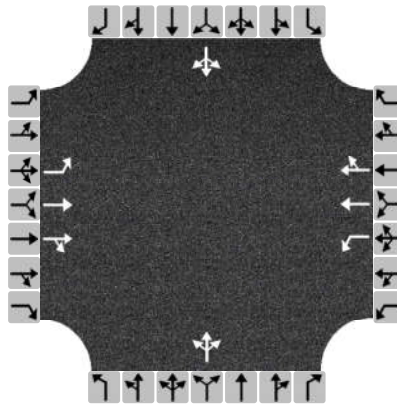
Project Information

Analyst	PEC	Date	3/23/2020
Agency	Garver	Analysis Year	2019
Jurisdiction	ARDOT	Time Period Analyzed	7 am to 7 pm
Project Description	Hwy 91 STEP - Hwy 91 and State St Intersection		

General

Major Street Direction	East-West	Population < 10,000	No
Starting Time Interval	7	Coordinated Signal System	No
Median Type	Undivided	Crashes (crashes/year)	5
Major Street Speed (mi/h)	45	Adequate Trials of Crash Exp. Alt.	Yes
Nearest Signal (ft)	1050		

Geometry and Traffic



Approach	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Movement												
Number of Lanes, N	1	2	0	1	2	0	0	1	0	0	1	0
Lane Usage	L	TR		L	TR			LTR			LTR	
Vehicle Volumes Averages (veh/h)	25	627	18	19	665	11	10	7	19	8	9	27
Pedestrian Averages (peds/h)	13			0			2			4		
Gap Averages (gaps/h)	0			0			0			0		
Delay (s/veh)	0.0			0.0			0.0			0.0		
Delay (veh-hrs)	0.0			0.0			0.0			0.0		

School Crossing and Roadway Network

Number of Students in Highest Hour	0	Two or More Major Routes	No
Number of Adequate Gaps in Period	0	Weekend Counts	No
Number of Minutes in Period	0	5-year Growth Factor (%)	0

Railroad Crossing

Grade Crossing Approach	None	Rail Traffic (trains/day)	4
Highest Volume Hour with Trains	Unknown	High Occupancy Buses (%)	0
Distance to Stop Line (ft)		Tractor-Trailer Trucks (%)	10

HCS7 Warrants Report

Volume Summary

Hour	Major Volume	Minor Volume	Total Volume	Peds/h	Gaps/h	1A (70%)	1A (56%)	1B (70%)	1B (56%)	2 (70%)	3A (70%)	3B (70%)	4A (70%)	4B (70%)
07 - 08	1542	33	1592	11	0	No	No	No	No	No	No	No	No	No
08 - 09	1270	37	1329	10	0	No	No	No	No	No	No	No	No	No
09 - 10	1026	33	1087	21	0	No	No	No	No	No	No	No	No	No
10 - 11	1066	46	1146	17	0	No	No	No	Yes	No	No	No	No	No
11 - 12	1222	44	1305	16	0	No	No	No	Yes	No	No	No	No	No
12 - 13	1392	52	1481	16	0	No	No	No	Yes	No	No	No	No	No
13 - 14	1244	37	1312	32	0	No	No	No	No	No	No	No	No	No
14 - 15	1363	56	1458	12	0	No	No	Yes	Yes	No	No	No	No	No
15 - 16	1624	65	1727	20	0	No	No	Yes	Yes	Yes	No	No	No	No
16 - 17	1673	61	1771	37	0	No	No	Yes	Yes	Yes	No	No	No	No
17 - 18	1760	55	1866	22	0	No	No	Yes	Yes	No	No	No	No	No
18 - 19	1227	57	1332	39	0	No	No	Yes	Yes	No	No	No	No	No
Total	16409	576	17406	253	0	0	0	5	8	2	0	0	0	0

Warrants

Warrant 1: Eight-Hour Vehicular Volume

- A. Minimum Vehicular Volumes (Both major approaches --and-- higher minor approach) --or--
- B. Interruption of Continuous Traffic (Both major approaches --and-- higher minor approach) --or--
- 56% Vehicular --and-- Interruption Volumes (Both major approaches --and-- higher minor approach)

Warrant 2: Four-Hour Vehicular Volume

- Four-Hour Vehicular Volume (Both major approaches --and-- higher minor approach)

Warrant 3: Peak Hour

- A. Peak-Hour Conditions (Minor delay -- and-- minor volume --and-- total volume) --or--
- B. Peak-Hour Vehicular Volumes (Both major approaches --and-- higher minor approach)

Warrant 4: Pedestrian Volume

- A. Four Hour Volumes --or--
- B. One-Hour Volumes

Warrant 5: School Crossing

- Gaps Same Period --and--
- Student Volumes
- Nearest Traffic Control Signal (optional) ✓

Warrant 6: Coordinated Signal System

- Degree of Platooning (Predominant direction or both directions)

Warrant 7: Crash Experience

- A. Adequate trials of alternatives, observance and enforcement failed --and-- ✓
- B. Reported crashes susceptible to correction by signal (12-month period) --and-- ✓
- C. 56% Volumes for Warrants 1A, 1B, --or-- 4 are satisfied ✓

Warrant 8: Roadway Network

- A. Weekday Volume (Peak hour total --and-- projected warrants 1, 2, or 3) --or--
- B. Weekend Volume (Five hours total)

Warrant 9: Grade Crossing

- A. Grade Crossing within 140 ft --and--
- B. Peak-Hour Vehicular Volumes



FINAL REPORT APPENDICES

Job 100977

CRAIGHEAD COUNTY



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