QUALITY CERTIFICATION STATEMENT

To: Anthony Turowski

From: Andy Shahan
LJB Inc.

Date: December 31, 2020

Project name: FRA/FAI-33 Feasibility Study PID111460

DELIVERABLE:

Submission: Safety Study for US 33 & SR 317 (Hamilton Road) Interchange

Products:

> Task 2.0.B Prepare and Complete Full Safety Study US33/Hamilton Rd.

- Field review and documentation
- Existing conditions diagrams
- Capacity analysis
- Crash diagrams
- Countermeasure summary
- ECAT calculations
- Concept plans/cost estimates

QUALITY CERTIFICATION:

This submission has been developed under my direct supervision, and has been completed in accordance with the project's quality management plan. A specific task checklist has been completed and can be provided upon request.

Andrew J. Shahan, P.E., P.S., PMP, Principal and Project Manager

12/31/2020
Date

FRA-33-FEASIBILITY STUDY
SAFETY STUDY FOR US 33 & SR 317 (HAMILTON ROAD) INTERCHANGE
2018 URBAN NON-FWY RANK #41 & URBAN INT RANK #185

December 30, 2020

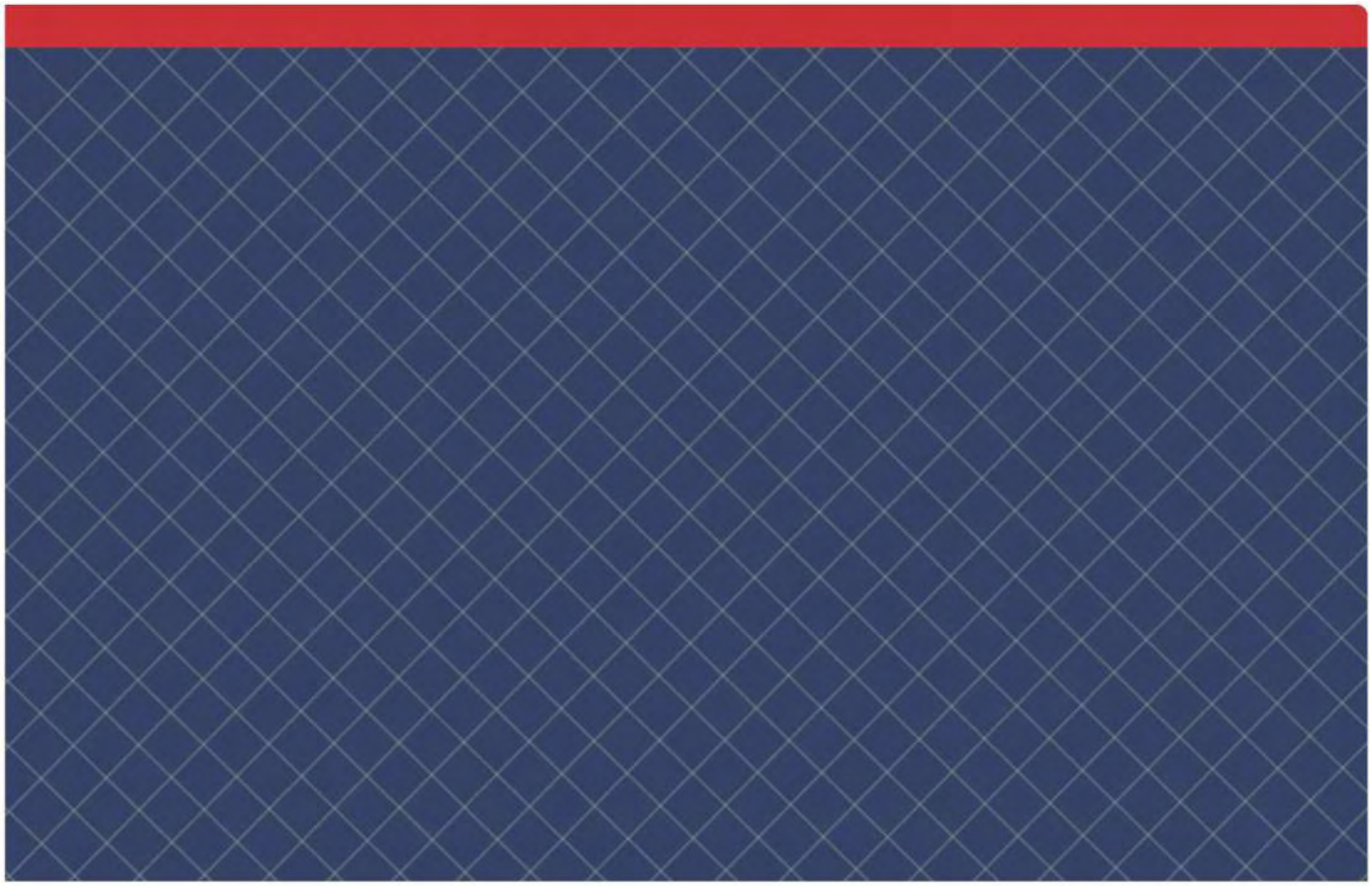

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TABLE OF CONTENTS

TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

LIST OF APPENDICES

EXECUTIVE SUMMARY

The purpose of this study is to evaluate existing safety performance and identify potential countermeasures to reduce traffic crashes and improve capacity at the Hamilton Rd & US 33 interchange in Franklin County, OH. This interchange includes the #185 ranked urban intersection (Hamilton Rd & Williams Rd) and #41 ranked urban non-freeway segment (Hamilton Rd) on ODOT's 2018 HSIP list. This study focuses on countermeasures for the Hamilton Rd and the intersections. A TSMO and Feasibility Study being developed as part of the same ODOT project as this study will evaluate long term improvements for US 33. The safety study project area includes three intersections: Hamilton Rd & Williams Rd, Hamilton Rd & US 33 EB Ramps, and Hamilton Rd & US 33 WB Ramps.

Crash data from 2016-2018 was used because construction on US 33 mainline took place throughout much of 2019. A review of this data showed 204 crashes were reported in the project area, with 29% crashes resulting in injuries. At signalized intersections, 122 crashes were reported. The primary crash types were rear end, sideswipe-passing, and left turn. Fewer crashes occurred at the Hamilton Rd & US 33 EB Ramps intersection than at the other two intersections because most turns are restricted.

Capacity analysis using HCS showed that several movements operate poorly and are over capacity in the 2020 existing condition. These issues are worse in the 2045 No Build condition, which has higher traffic volumes. The Build scenario includes several improvements that improve capacity and safety. The countermeasures include:

SHORT TERM

- Revise clearance intervals to be compliant with the ODOT and the ITE evaluation method.
- Install emergency vehicle preemption.
- Extend the NB left turn lane at Hamilton Rd & US 33 WB Ramps to maximize storage by restriping the existing painted median
- Add emergency vehicle warning signs on US 33 mainline.

MEDIUM TERM

- Upgrade traffic signals to include backplates and radar detection at all intersections.
- Install video surveillance at each intersection.
- Increase storage length of the NB left turn lane at Hamilton Rd & Williams Rd.
- Change the NB left turn phasing to 'protected-only' at Hamilton Rd & Williams Rd.
- Add a SB right turn lane at Hamilton Rd & Williams Rd.
- Widen the EB approach to three lanes (L-R-R) at Hamilton Rd & US 33 EB Ramps.
- Remove the slip ramp for the WB exit to Hamilton Rd NB right movement, and replace with a right turn lane at the signalized intersection at Hamilton Rd & US 33 WB Ramps.
- Add a SB right turn lane at Hamilton Rd & US 33 WB Ramps.
- Change NB left turn signal head to a flashing yellow arrow (FYA) at Hamilton Rd & US 33 WB Ramps.

The ECAT Benefit-Cost ratio for these countermeasures is 1.50.

INTRODUCTION

The Ohio Department of Transportation (ODOT) District 6 has engaged LJB Inc. to conduct multiple studies of the US 33 corridor southeast of Columbus between SR 104 and Pickerington Road (Fairfield County). This safety study is one part of this effort, which also includes a Traffic Systems Management and Operations (TSMO) study and Feasibility Study for the I-270 and US 33 interchange. This Hamilton Rd & US 33 Safety Study focuses on the intersections, ramps, and mainline approaches to the SR 317/Hamilton Rd and US 33 interchange.

BACKGROUND

Figure 1 shows the location of the safety study focus area. US 33 is classified as an "Other Freeway and Expressway" functional class and passes through Columbus and its SE suburbs. In the project area, it is an interstate-style highway with two through lanes in each direction, a 60-mph speed limit, and an AADT of 77,000 vehicles per day. South Hamilton Road (SR 317) is a north-south Urban Principal Arterial that connects Columbus and east side suburbs, including Groveport, Gahanna, and New Albany. The speed limit through the project area is 50 mph with two through lanes in each direction and an AADT of 27,000 vehicles per day.

Just north of the project area is a growing commercial area with restaurants and a grocery store, as well as apartment complexes and neighborhoods of single-family homes. South of the interchange, land-uses include a car dealership, light industrial sites, and multiple educational facilities. South Hamilton Rd transitions to a four-lane divided section with signalized at-grade intersections.

FIGURE 1: REGIONAL MAP

PURPOSE AND NEED

The purpose of this study is to evaluate the existing safety performance of the project area and to identify potential countermeasures to reduce traffic crashes on US 33 and Hamilton Rd, including the ramps at this interchange. The intersection of Hamilton Rd. & Williams Rd is the #185 ranked Urban Intersection on ODOT's 2018 Highway Safety Improvement Program (HSIP) Safety Priority List. The northern approach to the Hamilton & US 33 EB Ramps intersection is the #41 Urban Non-freeway segment. **Figure 2** shows the project area and the HSIP Safety Priority List locations.

FIGURE 2: PROJECT AREA AND HSIP SAFETY PRIORITY LIST LOCATIONS

PREVIOUS STUDIES AND IMPROVEMENTS

Multiple studies of this interchange and various projects in the surrounding area have been completed. These studies are included in **Appendix G**.

- **South Hamilton Road and US-33 Cursory Safety Review and Operational Analysis (2017):** This safety study of South Hamilton Road from Williams Road to Hamilton Square Boulevard was conducted for the City of Columbus. This study reviewed traffic operations and crash history; and recommended improvements include signal coordination, a speed study, emergency vehicle preemption for the corridor. Intersection-specific improvements include emergency vehicle preemption at all signals, protected-only NBL turn phases at all signals, an EBR turn lane at Hamilton Rd & US 33 EB Ramps, and a SBR turn lane at Hamilton Rd & US 33 WB Ramps.
- **Traffic Impact Study (2019):** This traffic impact study evaluated the impacts of development northwest of the interchange, directly north of US 33 and west of Hamilton Road. The development will include mixed-use land uses, including a grocery store, two fast

food restaurants, a car wash, retail space, and apartments. The results showed that there are two areas that will have queuing concerns in the Future No Build scenario. A new traffic signal was recommended at Hamilton & Professional Parkway, with an extension of the existing northbound left turn lane at that intersection with delineators to prevent weaving movements by vehicles merging onto Hamilton Rd from the US 33 WB exit to Hamilton NB. A southbound right turn lane was recommended for the Hamilton & US 33 WB Ramps intersection, but not as a result of the development. This development is currently under construction.

An addendum was added to this study in 2020 to incorporate impacts from a gas station, which would have right-in/right-out (RIRO) access on Hamilton Rd between Professional Parkway and US 33 EB Ramps intersection. The recommended improvements are currently under design. Draft plans are included in **Appendix G**.

- **4500 South Hamilton Road Traffic Impact Study (2019):** This traffic impact study evaluated the impacts of development along Hamilton Rd at Higgins Boulevard. The study found that Hamilton Road operates under congested conditions regardless of the proposed development. In particular, the NB left turn movement at the US 33 WB Ramps intersection is over capacity, but bridge reconstruction is necessary to add capacity. Similar capacity issues exist at the US 33 Eastbound ramps intersection for the NB right and EB right turn movements, and these capacity improvements are more feasible.
- **South Hamilton Road Traffic Signal Timing Study (2019):** This study analyzed corridor timing for six intersections along Hamilton Rd between the US 33 WB ramps and Bixby Rd. The study recommended retiming to support signal coordination and capacity improvements, including long term improvements to install additional turn lanes at the US 33 Ramps intersections.
- **ODOT PID 98111:** This construction project added an auxiliary lane along US 33 in both directions between I-270 and the Hamilton Rd interchange. Construction took place through most of 2019.
- **Hamilton Road at Higgins Boulevard/Directors Boulevard Project:** This project will be completed in 2021. It includes signal and infrastructure improvements along Hamilton Rd south of the study area. The maintenance of traffic for the work zone extends into the study area up to the Hamilton Rd & Williams Rd intersection.

EXISTING CONDITIONS

LAND USE

The area surrounding the project is characterized by retail and restaurants along Hamilton Road; and apartments and single-family homes in neighborhoods off Hamilton Road. Additional commercial centers exist to the north. The larger trip generators include a grocery store just north of the project area, a car dealership in the southwest quadrant of the interchange between Williams Road and the US33 EB ramps intersection, and Eastland Vocational School and Groveport Madison High School just south of Williams Road.

SR 317/Hamilton Road connects the two largest airports in the Columbus Region. To the north, John Glenn Columbus International Airport (CMH) is surrounded by warehouses, light industrial, and residential land uses. To the south, SR 317 provides access to the Rickenbacker International Airport (LCK), which is surrounded by warehouse and light industrial land use to the north and agricultural land use to the south.

EXISTING ROADWAY CONDITIONS

The US 33 & Hamilton Rd interchange is partial cloverleaf with directional ramps for the entrances to eastbound US 33. The existing roadway conditions are shown in **Table 1**.

TABLE 1: EXISTING ROADWAY CONDITIONS

ROADWAY	ODOT FUNCTIONAL CLASSIFICATION	POSTED SPEED LIMIT	ROADWAY SECTION	2019 AADT (vpd)
US 33	Other Freeway and Expressway	60 mph	Interstate-style, two 12-foot through lanes	East of interchange:76,700 West of interchange: 68,600
SR 317 (South Hamilton Road)	Urban Principal Arterial	50 mph	Two 12-foot through lanes	South of Williams Rd: 27,100 North of interchange: 27,100
Williams Rd	Urban Minor Arterial	50 mph	Two 12-foot through lanes	9,000 EB: 5,000 WB: 4,000
US 33 EB Exit Ramp	Ramp	-	15-foot lane with a 6-foot right shoulder	9,000
US 33 EB Entrance Ramp from SB Hamilton	Ramp	-	12-foot lane with 6-foot shoulders	1,500
US 33 EB Entrance Ramp from NB Hamilton	Ramp	-	12-foot lane with 6-foot shoulders	3,000
US 33 WB Exit Ramp	Ramp	-	12-foot lane with 6-foot shoulders	4,000
US 33 WB Entrance Ramp	Ramp	-	12-foot lane with 6-foot shoulders	10,000

Figure 3 and **Figure 4** show INRIX data that present congestion by time of day along the US 33 and Hamilton Road corridors during typical weekdays. The February 2020 data shows that weekday congestion on US 33 is worst from 3-5 pm, especially on eastbound US 33 (labeled SB on the graph). During the PM peak, travel speeds on eastbound US 33 vary between 45 MPH and 10 MPH from south of SR 104 interchange through Hamilton Road interchange.

FIGURE 3: SPEED FOR US 33 BETWEEN REFUGEE RD & EBRIGHT RD USING INRIX DATA

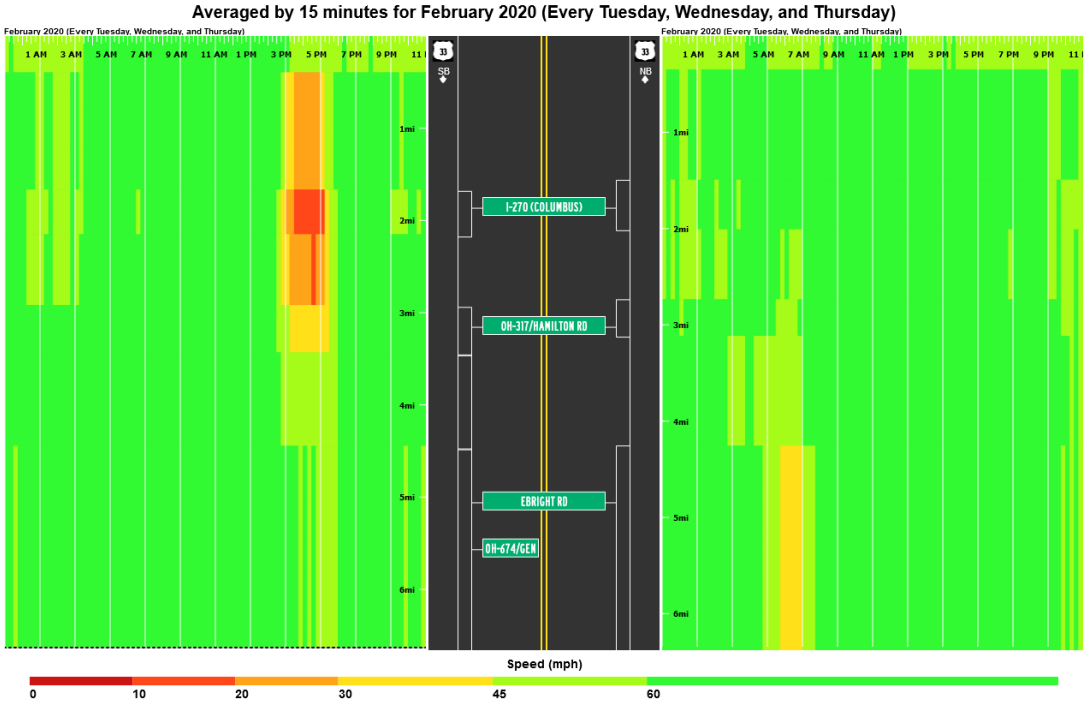
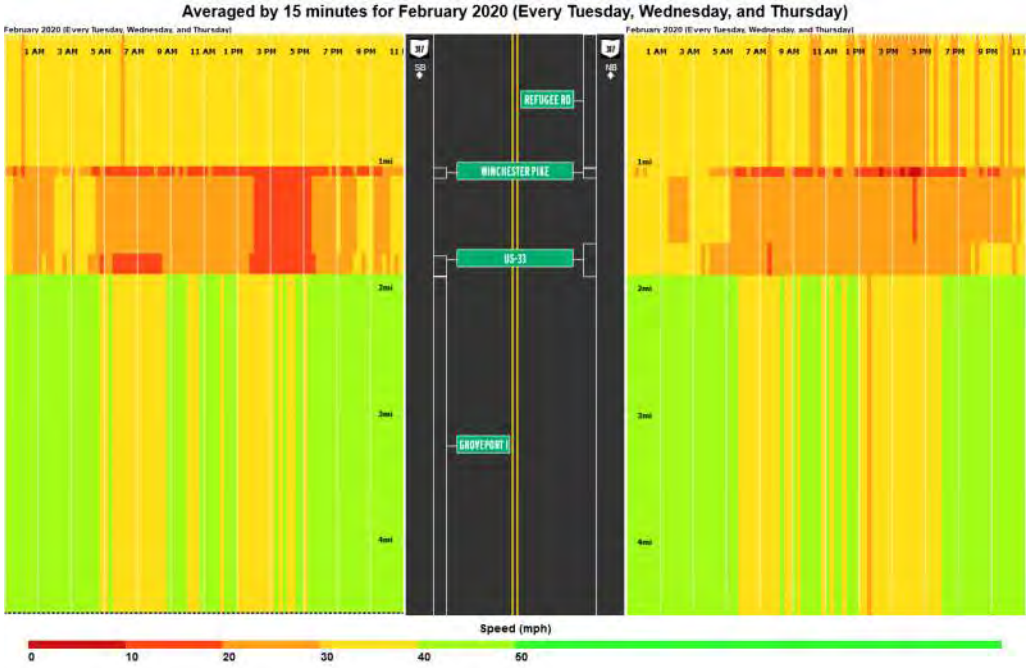


FIGURE 4: SPEED FOR HAMILTON RD BETWEEN GROVEPORT RD & REFUGEE RD USING INRIX DATA



On Hamilton Rd, congestion occurs at the US 33 interchange throughout much of the day, with the worst occurring during the AM and PM peaks of 5-9 am and 2-6 pm, respectively.

Field conditions and observations in the study area are summarized below:

- The Hamilton Rd typical section varies between 4-lane divided and 5-lane section within study limits. The median width on Hamilton Rd varies between 15' and 17' and is used as a left turn lane as necessary from Williams Rd through Professional Parkway. In sections where a left turn lane is provided, the additional median width is either striped for an offset left turn lane or includes a raised concrete median. A raised median is provided on the northbound approach to Williams Rd and on the bridge over US 33.
- Throughout most of the project area, the pavement markings and pavement are in good condition
- Street lighting is not provided on Hamilton Road or Williams Rd, or the US 33 & Hamilton interchange.
- Queues have been observed during peak hours on Hamilton Rd and the exit ramp approaches. During the PM peak, queues on Hamilton Rd were observed on both directions approaching the US 33 interchange. Northbound queues extended to the Higgins Blvd intersection and southbound queues extended past the Professional Parkway intersection.

  Northbound queues were observed in both through lanes, whereas southbound Hamilton Rd queues were primarily in the outside lane. As both US 33 EB and WB entrance ramps are on the right side, traffic destined to US 33 is heavy and contributes to this lane imbalance issue during peak hours. The NB through movement for the US 33 EB ramps intersection queued through the downstream Williams Rd intersection.

HAMILTON RD & WILLIAMS INTERSECTION

The Hamilton Road & Williams Road intersection is the southern boundary of the project area. At this intersection, north, south, and west approaches are under signal control. The east approach is an unsignalized driveway with right-out only access. The traffic signal is a drop-box span wire configuration. Coordination with other intersections is done through spread spectrum radio. Detection is accomplished through loop detectors.

The south approach has two through lanes and one left turn lane with 85 feet of storage space. Left turns are protected-permitted. The north approach has two through lanes and one left turn lane with 140 feet of storage space. The southbound left turn lane stop bar is set back from the intersection. The west approach has a dedicated left turn lane (L) and a shared left, through and right turn (LTR) lane. Curb ramps and push buttons are provided for crossing the south approach, but no sidewalk or pedestrian signal heads exist. Due to adjacent steep grading, the SE, NE, and NW corners are bordered by guardrail.

During the PM peak hour, the eastbound left turn movement and northbound through movements are heavy and result in long queues. The southbound right turn movement is heavy during both AM and PM peaks. Also, the short northbound left turn lane fills quickly during peak hours and spills into adjacent through lane.

HAMILTON RD & US 33 EB RAMPS

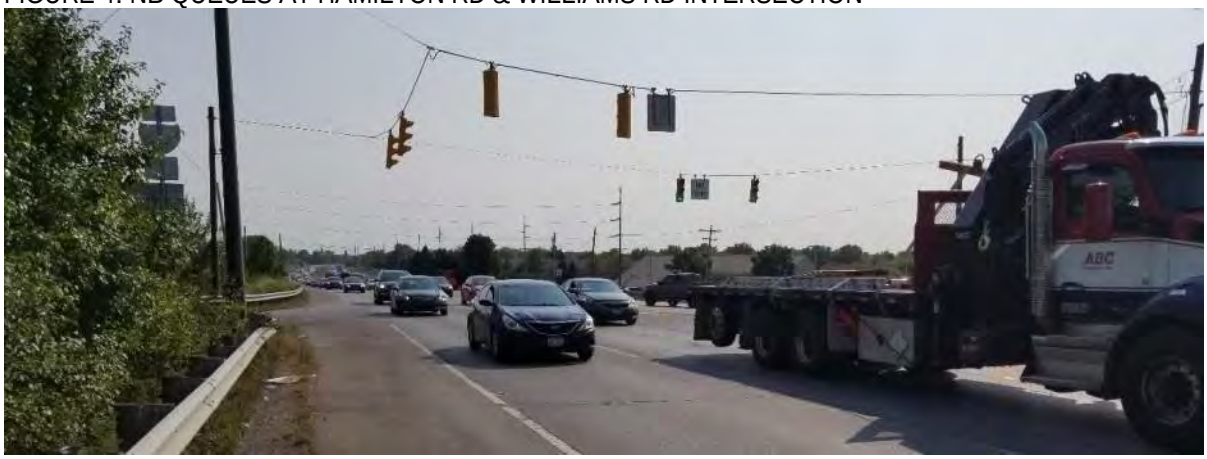
The Hamilton Rd & US 33 EB ramps intersection is a signalized intersection with a partial drop-box span wire configuration. The east approach is an entrance to US 33 EB for right-turning NB vehicles

only. Vehicles that are SB on Hamilton Rd can instead use the directional loop ramp just north of the US 33 EB ramps intersection for uninterrupted access to US 33 EB. Coordination with other intersections is done through spread spectrum radio. Detection is accomplished through loop detectors.

The south approach has two through lanes, and a right turn is completed from the outside through lane. The north approach has two through lanes; and southbound left turns are not permitted. The west approach has a single lane and is one way inbound only. However, pavement markings are worn and the approach is widened at the intersection to accommodate larger vehicles. Motorists on this ramp were observed treating it as a two-lane ramp. The east approach is one-way outbound only. There are no curb ramps, sidewalks, pushbuttons, or pedestrian signal heads.

The US 33 EB exit ramp approach is heaviest during the AM peak with moderate demand during the PM peak, northbound Hamilton Rd experiences significant traffic during both AM and PM peaks. The available storage on the northbound approach is less than 300 feet, and queues quickly spill through the Williams Road signal blocking the intersection, as shown in **Figure 4**.

FIGURE 4: NB QUEUES AT HAMILTON RD & WILLIAMS RD INTERSECTION



HAMILTON RD & US 33 WB RAMPS

The Hamilton Rd & US 33 WB ramps intersection is a signalized intersection with a partial drop-box span wire configuration. The west approach is the WB exit ramp from US 33. The ramp splits upstream of the intersection, allowing motorists going NB on Hamilton Rd to make uninterrupted turns via a slip ramp, where drivers must yield to Hamilton Rd traffic. This slip ramp intersects with Hamilton Road at a skew and results in sight distance restriction. Drivers must turn their necks at an awkward angle to see oncoming traffic before completing the merge safely. Visibility is limited as motorists approach the merge area due to the curvature, vegetation, and grading. Left turns onto Hamilton Rd are made at the signal. Coordination with other intersections is done through spread spectrum radio. Detection is accomplished through loop detectors.

The south approach has two through lanes and one left turn lane that is 525 feet long. Left turns are served by a protected-permitted phase. The north approach has two through lanes. There is a slip ramp 40 feet from the stop line to allow right turns onto the US 33 WB entrance ramp, but no corresponding storage lane. The east approach is one-way inbound and has one lane with no restrictions on turning movements. The west approach is one-way outbound with one lane. There are curb ramps to cross the south approach, but no sidewalk or pedestrian signal heads.

During a field visit, queues for the NBL turn were seen meeting or exceeding storage capacity during peak hours, as shown in **Figure 5**. Similarly, **Figure 6** shows queues for the SBR turn that extend past the Professional Parkway intersection, nearly to Hamilton Square Blvd. Also, the westbound left turn movement experiences significant truck traffic and the short turn lane fills quickly extending queues into the diverge area, blocking northbound right turn vehicles on the exit ramp.

FIGURE 5: NBL QUEUE AT HAMILTON RD & US 33 WB RAMPS INTERSECTION

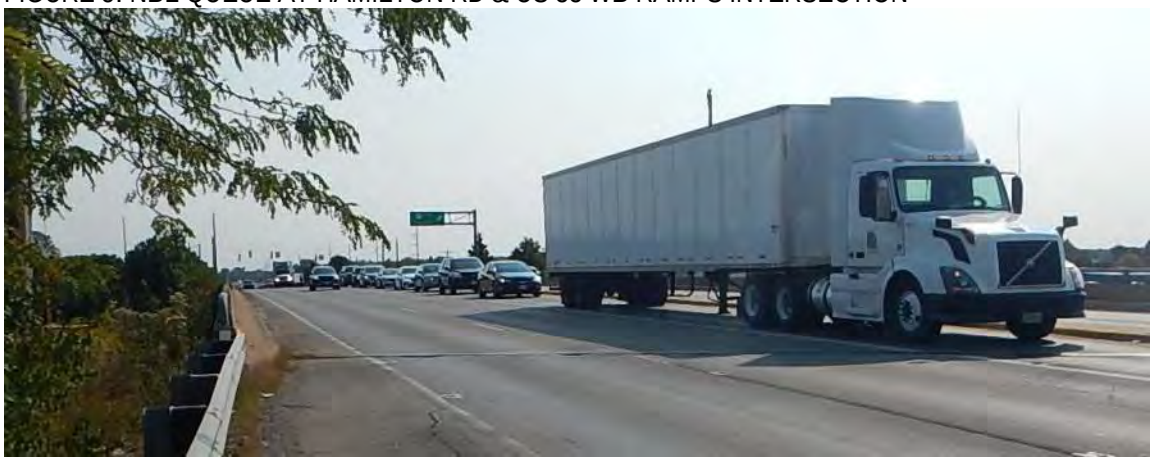


FIGURE 6: SBR QUEUE AT HAMILTON RD & US 33 WB RAMPS INTERSECTION

US 33 MAINLINE

US 33 EB and WB each have 2 through lanes in each direction. On US 33 EB, an auxiliary lane was built in 2019 starting west of the I-270 overpass (prior to I-270 southbound entrance ramp) and ends as an exit-only lane to Hamilton Rd. Similarly, in the westbound direction, an auxiliary lane is provided from Hamilton Road entrance ramp to I-270 northbound exit ramp. There are U-turn locations 3200 feet west and 2200 feet east of Hamilton Rd for emergency vehicles only. In the Hamilton Road interchange vicinity, the typical section includes 10-foot outside shoulders and 4-foot inside shoulders, each with rumble strips.

East of Hamilton Road interchange, US 33 includes at-grade intersections that result in reduced capacity of the corridor. As shown earlier on INRIX speed maps, US 33 EB experiences congestion during the PM peak due to constrained capacity downstream of Hamilton Rd interchange. In the westbound direction, US 33 experiences some congestion from Gender Rd interchange through I-270 interchange in the AM peak. The auxiliary lane between Hamilton Rd and I-270 interchange helped ease congestion in this section, however, capacity constraints east of Hamilton Rd interchange remain unchanged.

CRASH ANALYSIS

CRASH DATA

Crash data was obtained from the ODOT's GIS Crash Analysis Tool (GCAT) for the study limits, encompassing the three-year period from 2016-2018. Data from 2019 was not used due to the construction project that affected traffic conditions throughout much of the year. The OH-1 crash report for each documented crash was reviewed to confirm accuracy and to locate crashes properly within the study limits. Crash diagrams are provided in **Appendix B**. **Table 2** provides a summary of crashes by location.

TABLE 2: CRASH SUMMARY BY LOCATION

LOCATION	REAR END	SIDESWIPE-PASSING	LEFT TURN	FIXED OBJECT	OTHER	INJURY (%)	TOTAL
Hamilton Rd & Williams Rd	25	2	6	0	12	11%	45
Hamilton Rd & US 33 EB Ramps	20	3	1	1	3	4%	28
Hamilton Rd & US 33 WB Ramps	26	2	17	1	3	10%	49
US 33 EB Mainline	12	7	0	1	5	24%	25
US 33 WB Mainline	21	2	0	1	2	12%	26
US 33 EB Entrance from Hamilton NB	0	1	0	0	0	0%	1
US 33 EB Entrance from Hamilton SB	0	1	0	2	0	0%	3
US 33 EB Exit Ramp	1	1	0	2	0	0%	4
US 33 WB Entrance Ramp	2	3	0	1	0	0%	6
US 33 WB Exit Ramp	0	2	0	1	0	0%	3
US 33 WB Exit Merge to Hamilton NB	13	1	0	0	0	21%	14
Total	120	25	24	10	25	11%	204

Excluding animal crashes, a total of 204 crashes were reported within the study limits during the analysis period with 62 (29%) crashes resulting in injuries. A review of documented crash history is provided below:

- Rear end crashes were the most common crash type, followed by left turn, sideswipe-passing, and fixed object crashes. Rear end crashes were the most common crash type at intersections, ramps, and mainline segments.

- Crash frequency was more prevalent on weekdays. As shown on Figure 6, the AM Peak had the highest occurrence, with a second peak during the PM Peak, moderate crash rates were noted in the afternoon as well. Few crashes occurred overnight.
- **Figure 7** shows that crash frequency was higher during weekdays. **Figure 8** shows that crash frequency was highest during the AM Peak, followed by the PM Peak.

FIGURE 7: CRASH OCCURRENCE BY DAY OF WEEK (2016-2018)

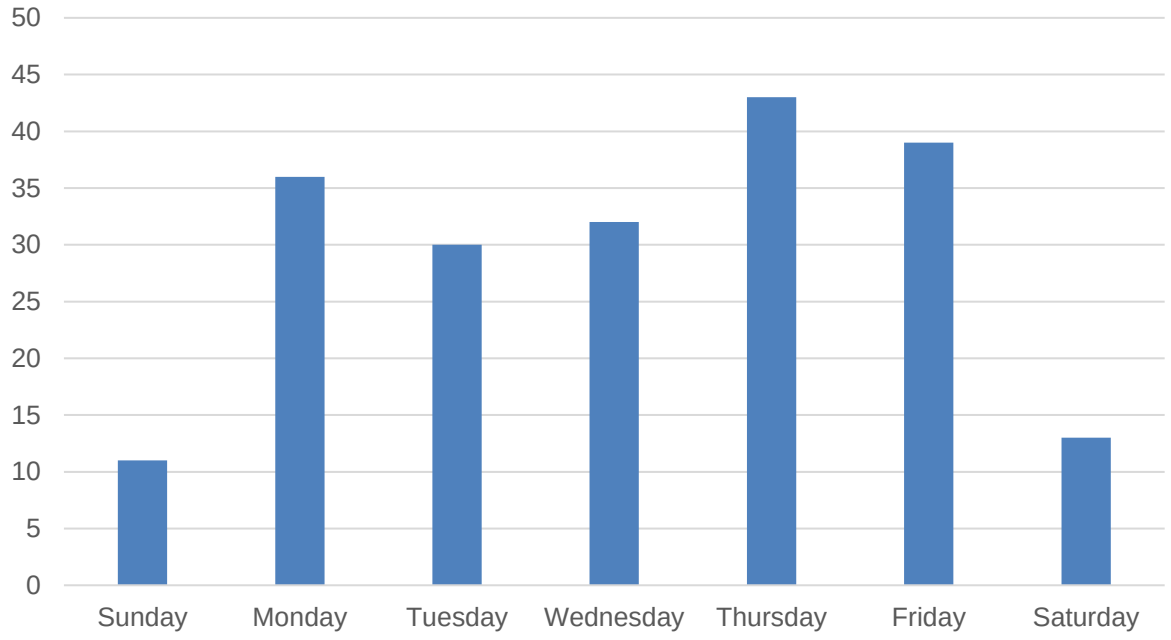
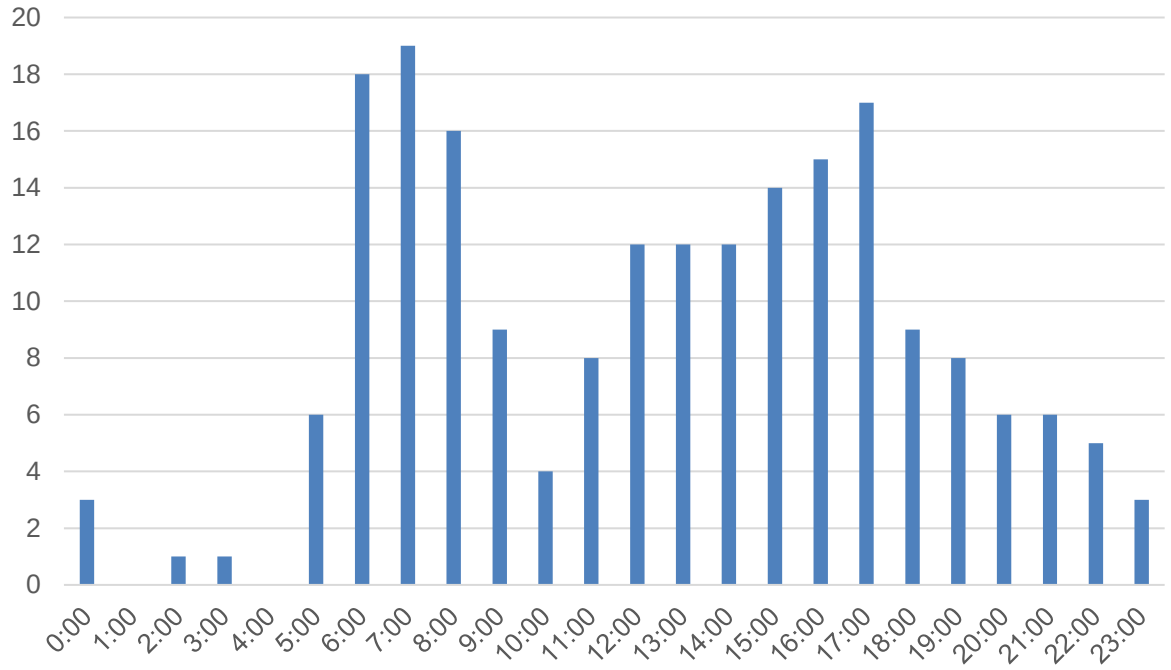


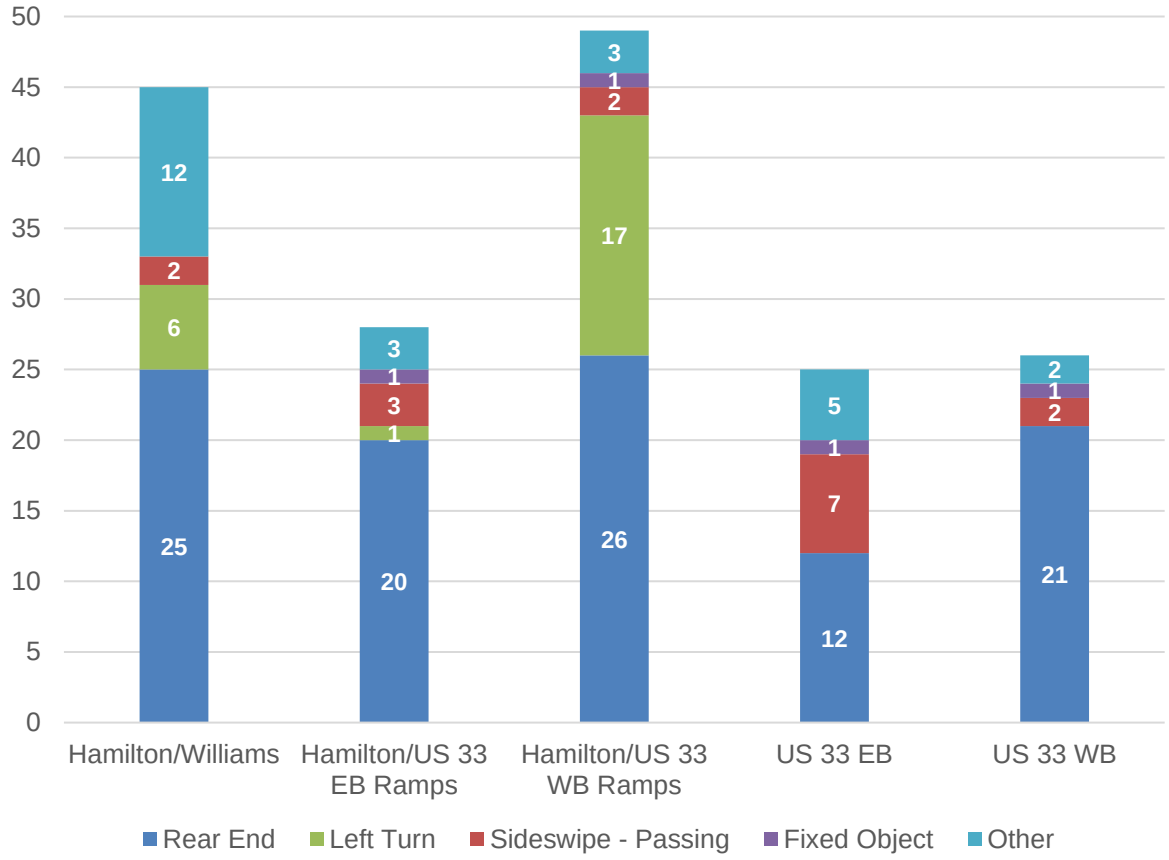
FIGURE 8: CRASH OCCURRENCE BY TIME OF DAY (2016-2018)



- Overall, 35 (17%) of crashes involved hit-and-run vehicles. This includes one incident involving a motorist who fled from one crash and struck another during a police chase. This was recorded as two separate crashes. Hit-and-run incidents occurred mostly on Hamilton Rd and the ramps.
- Five (2%) crashes involved emergency vehicles. These crashes occurred on US 33 mainline, US 33 EB exit ramp, and at the Hamilton Rd & Williams Rd intersection. There is a fire station just south of the project area on Hamilton Rd. Three of the emergency vehicle crashes involved ambulances and two involved police vehicles. The emergency vehicle operators were not found at fault for any crashes.

Figure 9 shows the distribution of crashes at the Hamilton Rd intersections and US 33 mainline.

FIGURE 9: CRASH TYPE BY LOCATION AT INTERSECTIONS AND US 33 MAINLINE (2016-2018)



HAMILTON & WILLIAMS INTERSECTION (44 CRASHES)

Rear end (25) and left turn (12) crashes were the primary crash types at the Hamilton Rd & Williams intersection. In total, 44 crashes occurred at this intersection.

- The left turn crashes mostly involved northbound left turn movement, as drivers failed to yield safely to oncoming traffic.
- Many rear end crashes occurred in the dedicated EB left turn lane, which is uphill as it approaches the traffic signal. Rear end crashes also occurred on the north and south approaches, mostly involving through vehicles. Traffic signals on Hamilton Road are closely spaced. This combined with congestion leads to queueing and stop-and-go conditions.

- Five angle crashes occurred between EB Williams Rd vehicles and southbound Hamilton Rd vehicles. The EB vehicles were at fault in 4 crashes, and fault was unknown in the other.

HAMILTON & EB RAMPS (28 CRASHES)

Rear (20) and sideswipe passing (3) crashes were the most common crash types. In total, 28 crashes occurred at this intersection.

- Rear end crashes occurred on all three inbound approaches. Several on the north approach occurred upstream of the southbound Hamilton Rd. loop ramp to US 33 EB. These crashes occurred in both lanes.
- The sideswipe passing crashes occurred on Hamilton Rd, two in the SB direction and one NB.

HAMILTON & WB RAMPS (49 CRASHES)

Rear end (28) and left turn (17) crashes were the most common crash types. In total, 49 crashes occurred at this intersection, not including the ramp from US 33 WB to Hamilton Rd NB.

- The left turn crashes occurred predominantly when NB left turning vehicles struck SB opposing vehicles. In all but two cases, the NB left turning driver was found at fault for failing to yield.
- Many of the rear end crashes occurred in the NB left storage lane. In the field, conditions contributing to this crash were observed. The lane fills quickly during peak hours, often nearing or reaching capacity. Alongside these stopped vehicles, through traffic in the adjacent lanes moves at up to 50 mph in congested conditions. In order to enter the left turn lane, vehicles must either change lanes into the left turn lane, then rapidly decelerate, or decelerate in the left through lane before shifting lanes. Vehicles in the through lane may not expect others to brake rapidly.
- Additional rear end crashes occurred for southbound vehicles near the right turn slip ramp and further upstream in the right lane.

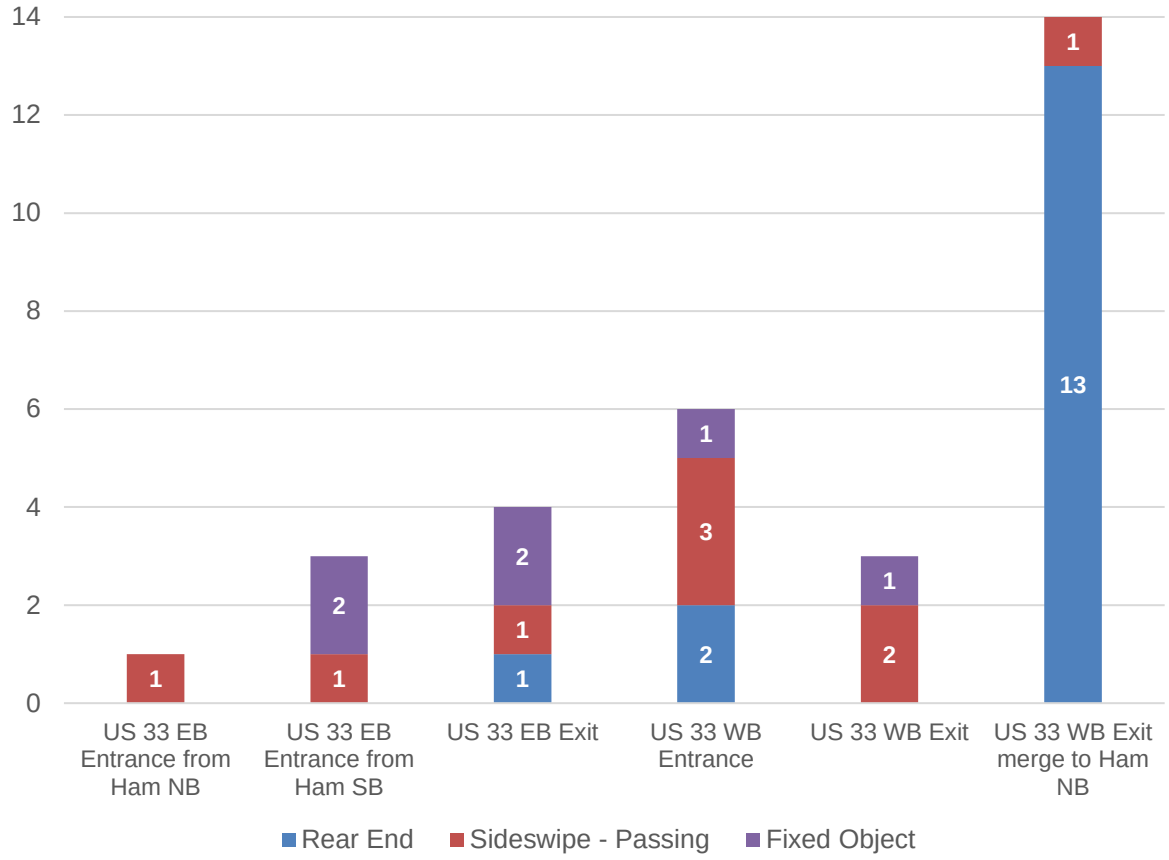
US 33

Mainline

The leading crash types on the US 33 mainline are rear end (33) and sideswipe passing (9) crashes. Crash risk was similar for both directions, with 25 crashes EB and 26 crashes WB. The crash distribution is shown in **Figure 10**.

- The rear end crashes often occurred during congested conditions at lower speeds.
- Crashes were distributed throughout the project area, without evident patterns as to where they occurred, based on the locations recorded in the crash reports.

FIGURE 10: CRASH TYPE BY LOCATION ON US 33 RAMPS (2016-2018)



Ramps

Rear end, sideswipe-passing, and fixed object crashes occurred on the ramps between US 33 and Hamilton Rd. The sideswipe-passing crashes mostly occurred in merge areas onto US 33. The crash rates on the ramps are consistent with statewide averages, except for the US 33 WB exit to Hamilton Rd NB.

The US 33 WB exit to northbound Hamilton Rd ramp splits from the US 33 WB exit ramp, curves to the right, then merges with Hamilton Rd. Due to heavy traffic on Hamilton Rd and the short merge area of about 150 feet, vehicles must stop while waiting for a gap. The sight distance approaching the merge area is limited by skew, vegetation and elevation. Vehicles approach the merge area at freeway speeds intending to merge onto the 50 mph speed limit Hamilton Rd, and are unable to stop safely leading to a rear end crash.

TRAFFIC OPERATIONS

CLEARANCE INTERVALS

Clearance intervals can have a considerable impact on safety performance at signalized intersections. LJB evaluated yellow change and red clearance intervals per current ODOT TEM and ITE guidelines for both intersections. These calculations are shown in **Appendix D**. The existing and LJB recommended clearance intervals compared in **Table 3**. The existing clearance intervals are generally 0.5 to 1.0 second lower than the recommended length, except for the NBL movements at Hamilton Rd & Williams Rd and Hamilton Rd & US 33 WB Ramps. For these phases, the clearance intervals were more than 1.5 seconds shorter than the recommended length. These movements are also the left turns that result in most of the left turn crashes throughout the corridor.

TABLE 3: CLEARANCE INTERVALS

PHASE	EXISTING CLEARANCE (SECONDS)			LJB RECOMMENDED CLEARANCE (SECONDS)		
	YELLOW	ALL-RED	Y+AR	YELLOW	ALL-RED	Y+AR
Hamilton Rd & Williams Rd						
1: NBT/SBT	5	1	6	5.5	1	6.5
2: EBT	3.6	1.6	5.2	4.8	1	5.8
3: NBL	3.6	1.8	5.4	4.1	3.5	7.6
Hamilton Rd & US 33 EB Ramps						
1: NBT/SBT	5	1	6	5.5	1	6.5
2: EBT	3.6	1.6	5.2	4.8	1	5.8
Hamilton Rd & US 33 WB Ramps						
1: NBT/SBT	5	1	6	5.2	1	6.2
2: WBT	3.6	1.3	4.9	4.8	1	5.8
3: NBL	3.6	1.6	5.2	4.3	2.5	6.8

CAPACITY ANALYSIS

LJB conducted capacity analysis on each mainline segment, diverge, merge, and intersection in the project area using Highway Capacity Software (HCS). The volumes shown in **Appendix C** were developed as a part of the overall FRA/FAI-33 study and approved by ODOT's Modeling and Forecasting Section. The results of the HCS analysis are shown in **Appendix D** and summarized in **Table 4**.

US 33 Mainline

US 33 mainline was analyzed in the EB and WB directions between the entrance ramps. The results showed that each direction is within capacity with existing traffic except for US 33 WB east of Hamilton Rd at LOS E. The LOS is lower in the direction of commuters to Columbus from the southeast. Backups were observed during peak hours on field visits. These conditions were influenced by incidents, emergency vehicles, and bottlenecks downstream.

In the 2045 No Build scenario, traffic volumes are projected to grow, which reduced the LOS, particularly on WB US 33 in the AM Peak and EB US 33 in the PM Peak. The LOS fell to LOS F in those cases due to volumes above the capacity for two through lanes. To address these capacity issues, two 2045 Build scenarios are discussed in the TSMO study related to this project. Both include an additional through lane in both directions on US 33.

TABLE 4: FREEWAY SEGMENT AND RAMP HCS ANALYSIS RESULTS

Location		2020 Existing		2045 No Build	
	Time Period	Density (veh/mi)[1]	LOS	Density (veh/mi)[1]	LOS
US 33 EB west of Hamilton Rd (Mainline)	AM Peak	14.4	B	21.7	C
	PM Peak	26.1	D	**23.0**	**F[2]**
US 33 EB exit to Hamilton Rd (Diverge)	AM Peak	13.6 / 13.6	B	21.7 / 21.7	C
	PM Peak	24.8 / 24.8	C	**26.0 / 26.0**	**F[2]**
US 33 EB between ramps (Mainline)	AM Peak	14.3	B	23.3	C
	PM Peak	**35.9**	**E**	**27.6**	**F[2]**
US 33 EB Entrance from SB Hamilton (Merge)	AM Peak	15.5 / 15.2	B	27.4 / 25.4	C
	PM Peak	40.6 / 34.3	D	**34.3 / 30.5**	**F[2]**
US 33 EB Entrance from NB Hamilton (Merge)	AM Peak	16.5 / 15.6	B	29.2 / 26.3	C
	PM Peak	**45.8 / 36.3**	**E**	**40.7 / 33.8**	**F[2]**
US 33 EB east of Hamilton Rd (Mainline)	AM Peak	15.9	B	26.0	C
	PM Peak	**44.7**	**E**	**37.6**	**F[2]**
US 33 WB east of Hamilton Rd (Mainline)	AM Peak	**36.4**	**E**	**38.9**	**F[2]**
	PM Peak	16.9	B	27.4	D
US 33 WB exit to Hamilton Rd (Diverge)	AM Peak	36.0 / 34.1	D	**38.2 / 36.0**	**F[2]**
	PM Peak	18.2 / 16.4	B	30.5 / 28.3	D
US 33 WB between ramps (Mainline)	AM Peak	32.9	D	**32.9**	**F[2]**
	PM Peak	14.2	B	22.7	C
US 33 WB weave from Hamilton Rd	AM Peak	33.8	D	**27.6**	**F[2]**
	PM Peak	17.1	B	28.5	D

[1] Freeway density / Ramp density
[2] Volume exceeds capacity (v/c>1)

Ramps

The entrance and exit ramp merges and diverges were analyzed in HCS. Like mainline US 33, the ramps facilitating movements in the direction of commutes to and from Columbus showed lower LOS, in several cases at LOS E. The US 33 EB merge from Hamilton Rd northbound functions at LOS E during the PM Peak.

In the 2045 No Build scenario, all ramp merges and diverges reach LOS F during peak periods. The EB entrance and exit ramp is above capacity during the PM peak, and the WB entrance and exit ramp is above capacity during the AM peak. Two 2045 Build scenarios are discussed in the TSMO study related to this project. Both include an additional through lane in each direction on US 33.

The US 33 WB exit to Hamilton Rd NB includes a merge onto Hamilton Rd that is not applicable to any HCS analysis type, so no LOS is provided in this study. However, the high crash history, limited sight distance, and substandard merging length suggest that this merge does not operate at an acceptable LOS.

Hamilton Road Intersections

The results for intersections are shown in **Tables 5-8**. Capacity analysis was conducted for the intersections in three scenarios: Existing, 2045 No Build, and 2045 Build. In each scenario, the signals were coordinated with each other. Previous studies have recommended coordination with additional neighboring signals, including the proposed signal at Hamilton Rd & Professional Pkwy.

TABLE 5: HAMILTON RD & WILLIAMS RD HCS RESULTS

Performance Measure	EB			NB			SB		
	EBL	EBT	EBR	NBL	NBT	NBR	SBL	SBT	SBR
AM Existing (2020)									
Movement LOS	C	C		B	A	A	B	C	C
Delay	28.1	30.4		19.5	5.5	5.6	14.1	26.4	30.9
v/c Ratio	0.498	0.597		0.47	0.499	0.499	0.016	0.876	0.89
QSR	0.34	0.3		0.58	0.09	0.09	0.02	**1.41**	**1.53**
95th Percentile Queue	172	209		50	103	98	3	**422**	**441**
Approach LOS	C (29.3)			A (6.9)			C (28.5)		
PM Existing (2020)									
Movement LOS	**E**	D		B	B	B	B	C	C
Delay	**55.2**	54.3		16.1	11.3	11.3	17.6	22.6	21.9
v/c Ratio	0.781	0.765		0.462	0.563	0.563	0.022	0.635	0.64
QSR	0.73	0.5		0.73	0.28	0.28	0.03	**1.65**	**1.49**
95th Percentile Queue	364	347		62	336	324	4	**496**	**425**
Approach LOS	D (54.8)			B (11.7)			C (22.2)		
AM No Build (2045)									
Movement LOS	D	**E**		D	B	B	C	**F**	**F**
Delay	49.4	**58.5**		52.1	13.5	13.5	24.1	**75.8**	**101.8**
v/c Ratio	0.733	0.835		0.586	0.606	0.606	0.033	1.091	1.171
QSR	0.72	0.6		**2.34**	0.33	0.33	0.03	**3.62**	**3.96**
95th Percentile Queue	358	419		**199**	391	370	4	**1085**	**1143**
Approach LOS	D (54.1)			B (17.1)			**F (88.6)**		
PM No Build (2045)									
Movement LOS	**E**	D		**F**	C	C	D	**F**	**F**
Delay	**55.1**	53		**92.3**	31.3	31.4	54.3	**60.5**	**115.7**
v/c Ratio	0.781	0.749		0.921	0.87	0.871	0.068	**1.05**	**1.153**
QSR	**1.05**	0.69		**2.79**	0.78	0.78	0.07	**3.64**	**5.32**
95th Percentile Queue	**525**	484		**237**	940	905	10	**1092**	**1523**
Approach LOS	D (54.1)			D (36.2)			**F (87.9)**		
AM Build (2045)									
Movement LOS	**E**	**E**		**E**	B	B	C	D	B
Delay	**55.6**	**76.4**		**76.7**	11.7	11.7	24.4	42.2	10.6
v/c Ratio	0.832	0.947		0.849	0.602	0.602	0.033	0.98	0.561
QSR	0.71	0.64		**1.06**	0.27	0.27	0.03	**2.5**	0.53
95th Percentile Queue	355	445		**238**	327	309	5	**750**	145
Approach LOS	**E (66.5)**			B (17.9)			D (35.8)		
PM Build (2045)									
Movement LOS	**E**	**E**		**E**	C	C	C	C	C
Delay	**63.9**	**58.2**		**73.2**	22.8	22.9	31.4	33	21.3
v/c Ratio	0.913	0.875		0.84	0.846	0.847	0.056	0.891	0.764
QSR	0.98	0.63		0.43	0.54	0.54	0.05	2	**1.1**
95th Percentile Queue	488	440		259	648	623	7	602	**302**
Approach LOS	**E (61.1)**			C (26.9)			C (29.8)		

TABLE 6: HAMILTON RD & US 33 EB RAMPS HCS RESULTS

Performance Measure	EB			NB			SB		
	EBL	EBT	EBR	NBL	NBT	NBR	SBL	SBT	SBR
AM Existing (2020)									
Movement LOS	B		**F**		C	D		A	
Delay	17.6		**108.5**		34	35.2		6.5	
v/c Ratio	0.254		**1.143**		0.856	0.862		0.515	
QSR	0.06		**23.41**		**2.0**	**2.0**		0.1	
95th Percentile Queue	99		**936**		**549**	**549**		74	
Approach LOS	**F (90.3)**			C (34.6)			A (6.5)		
PM Existing (2020)									
Movement LOS	C		C		D	**E**		B	
Delay	27.1		34.4		50.3	**58.3**		19.3	
v/c Ratio	0.42		0.69		0.957	0.995		0.498	
QSR	0.14		**10.09**		**3.35**	**3.51**		0.32	
95th Percentile Queue	256		**404**		**921**	**966**		229	
Approach LOS	C (31.4)			D (54.2)			B (19.3)		
AM No Build (2045)									
Movement LOS	B		**F**		**F**	**F**		C	
Delay	19.1		**142.7**		**132.7**	**146.9**		23.3	
v/c Ratio	0.311		**1.222**		**1.218**	**1.251**		0.863	
QSR	0.11		**40.28**		**5.19**	**5.45**		0.49	
95th Percentile Queue	198		**1611**		**1426**	**1498**		358	
Approach LOS	**F (115.2)**			**F (139.8)**			C (23.3)		
PM No Build (2045)									
Movement LOS	D		**E**		**F**	**F**		D	
Delay	39.6		**63**		**157.8**	**197.9**		40.9	
v/c Ratio	0.627		0.914		**1.241**	**1.326**		0.764	
QSR	0.26		**18.3**		**8.15**	**9.21**		0.95	
95th Percentile Queue	461		**732**		**2241**	**2533**		689	
Approach LOS	D (52.8)			**F (177.9)**			D (40.9)		
AM Build (2045)									
Movement LOS	C		D		C	C		A	
Delay	26.8		51.2		27.4	31.7		7.1	
v/c Ratio	0.427		0.949		0.944	0.967		0.686	
QSR	0.37		0.81		**1.89**	**2.06**		0.19	
95th Percentile Queue	219		488		**521**	**565**		136	
Approach LOS	D (45.8)			C (29.5)			A (7.1)		
PM Build (2045)									
Movement LOS	**E**		D		**F**	**F**		A	
Delay	**78.6**		47.1		21.7	47.1		1.4	
v/c Ratio	0.973		0.801		**1.003**	**1.072**		0.675	
QSR	0.92		0.5		**1.82**	**2.61**		0.06	
95th Percentile Queue	552		302		**502**	**719**		41	
Approach LOS	**E (60.8)**			C (34.4)			A (1.4)		

TABLE 7: HAMILTON RD & US 33 WB RAMPS HCS RESULTS

Performance Measure	WB			NB			SB		
	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
AM Existing (2020)									
Movement LOS		C		D	A			**F**	**F**
Delay		31		43.1	8.5			**83.2**	**86.8**
v/c Ratio		0.398		0.968	0.361			**1.058**	**1.062**
QSR		0.65		0.65	0.19			0.79	0.73
95th Percentile Queue		107		342	141			691	640
Approach LOS		C (31.0)			C (22.8)			**F (84.9)**	
PM Existing (2020)									
Movement LOS		D		B	A			**F**	**F**
Delay		51.5		12.4	3			**96.8**	**104.8**
v/c Ratio		0.613		0.824	0.418			**1.079**	**1.083**
QSR		**1.35**		0.21	0.11			0.96	0.92
95th Percentile Queue		**222**		111	82			837	805
Approach LOS		D (51.5)			A (6.4)			**F (100.6)**	
AM No Build (2045)									
Movement LOS		**E**		**F**	A			D	D
Delay		**69.1**		**137.2**	7.5			43.7	50.8
v/c Ratio		0.819		**1.24**	0.363			0.907	0.944
QSR		**1.89**		**1.5**	0.2			0.9	0.9
95th Percentile Queue		**312**		**787**	151			785	790
Approach LOS		**E (69.1)**			**E (58.0)**			D (47.1)	
PM No Build (2045)									
Movement LOS		D		**F**	A			**F**	**F**
Delay		54.3		**242.5**	8.2			**92.4**	**106.6**
v/c Ratio		0.656		**1.45**	0.522			**1.062**	**1.1**
QSR		**2.21**		**2.57**	0.25			**1.42**	**1.45**
95th Percentile Queue		**364**		**1351**	188			**1244**	**1273**
Approach LOS		D (54.3)			**F (90.3)**			**F (99.4)**	
AM Build (2045)									
Movement LOS	**E**		**E**	**F**	A			C	D
Delay	**73**		**75.4**	**66.8**	7.1			31.7	50.2
v/c Ratio	0.867		0.866	**1.089**	0.428			0.756	0.91
QSR	0.72		0.9	**1.01**	0.21			0.48	**1.32**
95th Percentile Queue	290		269	**710**	172			422	**560**
Approach LOS		**E (74.1)**			C (30.4)			D (38.1)	
PM Build (2045)									
Movement LOS	**E**		**E**	**F**	A			**E**	D
Delay	**64.5**		**71.7**	**147.8**	8.3			**56.5**	35.6
v/c Ratio	0.856		0.894	**1.268**	0.582			0.982	0.652
QSR	**1.17**		**1.38**	**1.56**	0.28			0	0
95th Percentile Queue	**352**		**346**	**937**	211			660	337
Approach LOS		**E (68.1)**			**E (57.2)**			D (51.7)	

TABLE 8: INTERSECTION HCS ANALYSIS RESULTS

Intersection	Time Period	EB			WB			NB			SB			Overall
		EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR	
Existing (2020)														
Hamilton & Williams	AM Peak	C (28)	C (30)					B (20)	A (6)	A (6)	B (14)	C (27)	C (33)	C (21)
	PM Peak	E (55)	D (54)					B (18)	B (11)	B (11)	B (18)	C (24)	C (23)	C (23)
Hamilton & US 33 EB Ramps	AM Peak	B (18)		F (109)					C (34)	D (35)		B (12)		D (43)
	PM Peak	C (27)		C (34)					D (50)	E (58)		C (29)		D (42)
Hamilton & US 33 WB Ramps	AM Peak				C (31)			D (43)	A (9)			F (83)	F (87)	F (85)
	PM Peak				D (52)			B (12)	A (3)			F (97)	F (105)	F (101)
No Build (2045)														
Hamilton & Williams	AM Peak	D (49)	E (59)					D (52)	B (14)	B (14)	C (24)	F (76)	F (102)	E (56)
	PM Peak	E (55)	D (53)					F (92)	C (31)	C (31)	D (54)	F (61)	F (116)	E (60)
Hamilton & US 33 EB Ramps	AM Peak	B (19)		F (143)					F (133)	F (147)		C (23)		F (99)
	PM Peak	D (40)		E (63)					F (158)	F (198)		D (41)		F (114)
Hamilton & US 33 WB Ramps	AM Peak				E (69)			F (137)	A (8)			D (44)	D (51)	D (54)
	PM Peak				D (54)			F (243)	A (8)			F (92)	F (107)	F (92)
Build (2045)														
Hamilton & Williams	AM Peak	E (56)	E (76)					E (77)	B (12)	B (12)	C (24)	D (42)	B (11)	C (34)
	PM Peak	E (64)	E (58)					E (73)	C (23)	C (23)	C (31)	C (33)	C (21)	C (33)
Hamilton & US 33 EB Ramps	AM Peak	C (27)		D (51)					C (27)	C (32)		A (7)		C (27)
	PM Peak	E (79)		D (47)					F (22)	F (47)		A (1)		C (29)
Hamilton & US 33 WB Ramps	AM Peak				E (73)			F (67)	A (7)			C (32)	D (50)	D (38)
	PM Peak				E (65)			F (148)	A (8)			E (57)	D (36)	D (52)

LOS (Delay in seconds)

Existing (2020) Capacity Analysis

The existing analysis uses the clearance intervals, signal timing, and coordination timing that is currently implemented in the field. Each movement at the Hamilton Rd & Williams Rd intersection performs at LOS D or better, except for the EBL during the PM Peak. Despite a dedicated left turn lane and a shared L-T-R lane, left turn volumes are too high given the split provided. The southbound approach performs at an acceptable LOS, but does not have adequate storage between intersections.

Similarly at the Hamilton Rd & EB Ramps intersection, there is inadequate storage for the northbound approach. The NBR movement, which shares a lane with the through movement, performs at LOS E during the PM Peak. The EBR turn from the US 33 exit ramp performs at LOS F. This also negatively impacts the EBL movement, which shares a single lane with the EBR. Because the approach widens near the intersection, providing a short de-facto area to separate right turning vehicles, and because motorists have been observed using the ramp as a two-lane facility, it was modeled in HCS with a short right turn lane.

The current signal timing at the Hamilton Rd & WB Ramps intersection provides a large split for the NBL phase. This allows the NBL and NBT movements to perform at acceptable LOS throughout the day. However, the SB movements operate at LOS F during both peak periods, and the overall intersection LOS is F. HCS capacity analysis shows that there are no queueing issues, although field investigation has shown that the NBL, SBT, and WB ramps movements both fill their storage space during peak periods. When the WB ramp exceeds its storage space, the ramp from US 33 WB to Hamilton Rd NB is blocked as well. This leads to delays not measured in the intersection capacity analysis, and potentially encourages motorists to pass queued vehicles on the right using the shoulder.

No-build (2045) Capacity Analysis

The No Build analysis uses the same infrastructure conditions as the existing configuration, but with forecasted 2045 volumes. At each intersection, projected increases in traffic exacerbated the issues present in the 2020 analysis. At Williams Rd & Hamilton Rd, the SBT and SBR movements perform at LOS F, each exceeding the available storage space between intersections. The NB movements operate at acceptable LOS in the AM Peak, but the NBL operates at LOS F in the PM Peak and exceeds the available storage space of 85 feet in both the AM and PM peak hours.

At the Hamilton Rd & US 33 EB Ramps intersection, the NB approach exceeds the available storage space between intersections and operates at LOS F. At the same time, the EBR movement performs at LOS F in the AM and LOS E in the PM Peak. Queue spillback issues are anticipated for these movements as well.

At the Hamilton Rd & US 33 WB Ramps intersection, the No Build analysis did not include the SBR turn lane recommended in the TIS addendum because although the study identified it as an improvement necessary to achieve acceptable operations, it was not tied to the development and not included in the project currently under design. Through signal timing adjustments, the overall No Build LOS is improved over the existing. However, the PM peak still operates at LOS F overall, and the SB approach operates at LOS F during the PM Peak. The NBL operates at LOS F in both peak periods. Due to the large split necessary for the NBL, the NBT movement operates at an acceptable LOS. In the PM peak, all movements exceed their storage capacity. This could lead to blocking and increased congestion for upstream intersections, including the future signalized Hamilton Rd & Professional Pkwy and the US 33 WB exit to Hamilton Rd NB.

Build (2045) Capacity Analysis

The Build analysis includes several improvements at each intersection that address safety and capacity issues. At Hamilton Rd & Williams Rd, these improvements include:

- Change NBL turn phasing from permitted-protected to protected only.

- Extend the length of the NBL turn lane from 85 feet to 225 feet.
- Add a SBR turn lane that extends 275 feet back to the Hamilton Rd & US 33 EB Ramps intersection.

The addition of the SBR turn lane improves LOS for the SB approach from F in both peak periods to acceptable levels. Despite losing NBL capacity during the NBT phase, the NBL LOS in the PM Peak improved from F to E. This change also reduces the risk of left turn crashes. The overall LOS for the intersection improved from LOS E to LOS C in both peak periods.

At the Hamilton Rd & US 33 EB Ramps intersection, the EB approach was widened from one lane to three lanes (L-R-R) and provides 500 feet of vehicle storage in each lane. This situation improved the overall performance from LOS F to LOS C in both peak periods. In the AM Peak, all movements were improved to acceptable levels. In the PM Peak, the NB approach was improved in terms of delay. However, the volume-to-capacity (v/c) ratio was still over one, resulting in LOS F. A dedicated right turn lane would add the necessary capacity to lower the v/c ratio below one, improving the LOS. This change was not included in the Build condition due to the limited space between intersections, further reduced by the business driveway present at the Williams Rd intersection. The limited length could make it difficult for EB vehicles on Williams Rd to access the US 33 EB entrance ramp. In addition, the SBR turn lane at Williams Rd is more critical and will require widening on this portion.

At the Hamilton Rd & US 33 WB Ramps intersection, several changes were made:

- Remove the slip ramp from US 33 WB to Hamilton Rd NB.
- Widen the WB approach from one lane to two lanes (L-R).
- Extend the NBL turn lane back to the Hamilton Rd & US 33 EB intersection.
- Add a SBR turn lane that extends 425 feet back to the proposed gas station access point.

These improvements raise the overall performance from LOS F in the PM Peak to LOS D. In the AM Peak, delay is reduced but LOS remains at D. The NBL left operates at LOS F and exceeds storage in both peak periods, but the delay is less than the No Build scenario. To improve safety and reduce left turn crash risk, a change in left turn phasing was considered from permitted-protected to protected only. However, the LOS was too poor even when left turns were permitted during the NBT phase. Further reducing capacity could increase other types of crash risk at this intersection and upstream, so this change was not included. To provide a protected NBL turn with acceptable LOS, a second left turn lane would be necessary. This would not be possible without widening or replacing the bridge over US 33 or taking away a NBT lane. Operating under this lane configuration (L-L-T rather than L-T-T) would improve overall LOS and the NB approach LOS, although not to adequate levels in both peak periods. This would reduce lane continuity and would create a trap situation where motorists expect a lane to continue as a through lane and have limited time to change lanes before reaching the

COUNTERMEASURES

The following sections discuss countermeasures to address congestion and crash risks identified in this document. The focus is on countermeasures for Hamilton Road intersections, and US 33 exit ramp approaches to Hamilton Road. These countermeasures are in addition to improvements under design in relation to nearby development. Long term improvements on US 33 corridor will be covered in the TSMO Study.

The countermeasures are shown in the concept plans that follow this section.

SHORT TERM

Project-Wide

- **Revise clearance intervals to be compliant with the ODOT and the ITE evaluation method.** Note that some countermeasures will alter the clearance intervals calculated in this study. The clearance intervals were found to be about 0.5-1 second too short, which could increase the risk of left turn crashes. (Primary – left turn)
- **Install emergency vehicle preemption.** Hamilton Rd is a common route for emergency vehicles, especially due to the fire station just south of the project. Previous studies have also recommended emergency vehicle preemption. The preemption equipment should be installed at all 3 intersections. *(Secondary – emergency vehicle crashes)*

Hamilton Rd & US 33 WB Ramps Intersection

- **Extend the NB left turn lane.** The northbound left turn lane reaches capacity during peak hours. The lane can be extended by about 200 feet to reach a total length of about 725 feet with restriping the painted median. The calculated storage length is 1,037 feet as shown in **Appendix D**, but this length cannot be built due to the proximity of the Hamilton Rd & US 33 EB Ramps intersection. Further extension is not possible due to the proximity to the upstream Hamilton Rd & US 33 EB Ramps intersection.

US 33 Mainline

- **Add emergency vehicle warning signs.** Multiple crashes occurred on US 33 mainline where emergency vehicles struck vehicles that blocked their paths. One sign on US 33 EB states “Move over for stopped vehicle with flashing lights”, although it is partially obscured by vegetation. These signs should instruct motorists to move over for emergency vehicles. *(Secondary – emergency vehicle crashes)*

MEDIUM TERM

All Intersections

- **Upgrade traffic signals to include backplates and radar detection.** None of the existing traffic signals at the intersections have backplates. Backplates increase signal conspicuity, reducing the risk of crashes. Because backplates create higher wind loads, the existing strain poles will likely need to be replaced. Stop bar detection for minor street/ramp approaches and advance dilemma radar detection for all approaches are recommended. *(Primary – rear end, left turn)*
- **Install video surveillance.** The Columbus Traffic Signal System (CTSS) communications network will expand to include the Hamilton Rd corridor through a separate project. Video surveillance may not directly reduce crash frequency, but would aid enforcement during investigation of hit-and-run crashes.

Hamilton Rd & Williams Rd Intersection

- **Extend the NB left turn lane.** The NB left turn lane is about 85 feet long and fills during peak hours. When turn lanes fill, queues can spill into the adjacent through lanes, increasing rear end crash risk. The grass median upstream from the turn lane could be removed to accommodate a longer left turn lane. Turn lane length calculations are shown in **Appendix D**. Based on turning volumes, the lane needs to be at least 300 feet long. However, in order to prevent queued through traffic from blocking the entrance to the turn lane, the turn lane length should be the maximum recommended turn length of 600 feet. *(Primary – rear end)*

- **Change the NB left turn phasing to protected-only**. To reduce crash risk, the NB left turn phasing should be changed from protected-permissive to protected-only. This countermeasure synergizes with the extension of the NB left turn lane, since capacity will be reduced by removing the permissive portion of the cycle. *(Primary – left turn)*

- **Add SB right turn lane.** This turn lane would reduce congestion due to high turning volumes and limited storage space between intersections. Calculations show that more storage space is needed than available between intersections, so the lane should extend to the Hamilton Rd & US 33 EB Ramps intersection.

Hamilton Rd & US 33 EB Ramps Intersection

- **Widen the EB approach to three lanes.** While this ramp is a standard width, wide paved shoulders cause drivers to treat the ramp as a two-lane approach. This increases risk of sideswipe crashes. The addition of two right turn lanes and maintaining a dedicated left turn lane at the intersection would improve capacity and safety. To avoid being blocked by left turning queued vehicles, the right turn lanes should be 500 feet long.

  The ramp is wide enough to provide two lanes by using much of the existing shoulder space but will require further widening for three lanes. The directional entrance ramp to US 33 EB prevents widening on the left side, but sufficient right-of-way is available on the right side. This improvement will involve roadside grading, as the adjacent car dealership is at a lower elevation. *(Primary– sideswipe-crashes)*

Hamilton Rd & US 33 WB Ramps Intersection

- **Remove the slip ramp for the WB right movement, replacing it with right turn lane at the signalized intersection.** Poor sight distance mixed with heavy traffic and the 50 mph speed limit is causing rear end crashes to occur at the merge at the ramp terminus from US 33 WB to Hamilton Rd NB. This movement can be accommodated at the existing traffic signal, where it is not currently prohibited, by constructing a right-turn lane that can operate during the same phase as the WB left turn. The right turn lane should be 450 feet long, including tapers. *(Primary– rear end crashes)*

- **Add a SB right turn lane.** Traffic analysis and field observations in this study confirmed findings in previous studies that a southbound right turn lane would improve capacity and reduce queueing and crash risk. Traffic currently queues in the right through lane past the Hamilton Rd & Professional Parkway intersection during peak hours. The length of the turn lane will be limited by the RIRO access point proposed for the gas station. The turn lane should be preceded by a buffer space so that vehicles exiting the gas station are able to turn into the through lanes and not forced to turn into the right turn lane during congested periods, which could potentially trap exiting motorists into entering US 33 WB. The calculated turn lane length is 700 feet including the taper. Only 485 feet is available, so that full length should be used, minus the space taken for the buffer.

The shoulder is currently about 8 feet wide, so widening will be necessary to accommodate this lane, plus any additional space desired for a shoulder. The roadside area north of the roadway is steeply graded, but within ODOT right-of-way. The area that holds slip ramp to be removed should be restored to natural drainage conditions.

- **Change NB left turn signal head to a flashing yellow arrow (FYA).** The intersection would not operate at an acceptable LOS if the left turning phasing were changed to protected-only. Flashing yellow arrows have been shown to improve safety, but do not reduce capacity. Flashing Yellow Arrows can provide protected-only, permissive only, or protected-permissive phasing as appropriate for different time periods in a day. *(Primary – left turn crashes)*

LONG TERM

The medium-term recommendations enhance capacity and safety, however, some movements are expected to remain congested. Long term alternatives to address the capacity constraints on Hamilton Road at both ramp intersections are necessary.

Long term countermeasures such as interchange reconstruction or reconfiguration are discussed in the US 33 TSMO study, which looks at this interchange and the regional facilities from a more wholistic perspective.

FRA/FAI-33-FEASIBILITY STUDY

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SHEET 1 / TOTAL 3	PROJECT ID 111460	REVIEWER TVF 12-16-20	DESIGNER JAH	DESIGN AGENCY

DLZ Ohio, Inc.
2500 Newmark Drive
Miamisburg, OH 45342
(937) 235-5100 tel
(937) 235-5105 fax
dlz.com

MEDIUM TERM CONCEPTUAL PLAN 1
SOUTH HAMILTION ROAD

HORIZONTAL SCALE IN FEET
0 30
15 60

FRA/FAI-33-FEASIBILITY STUDY

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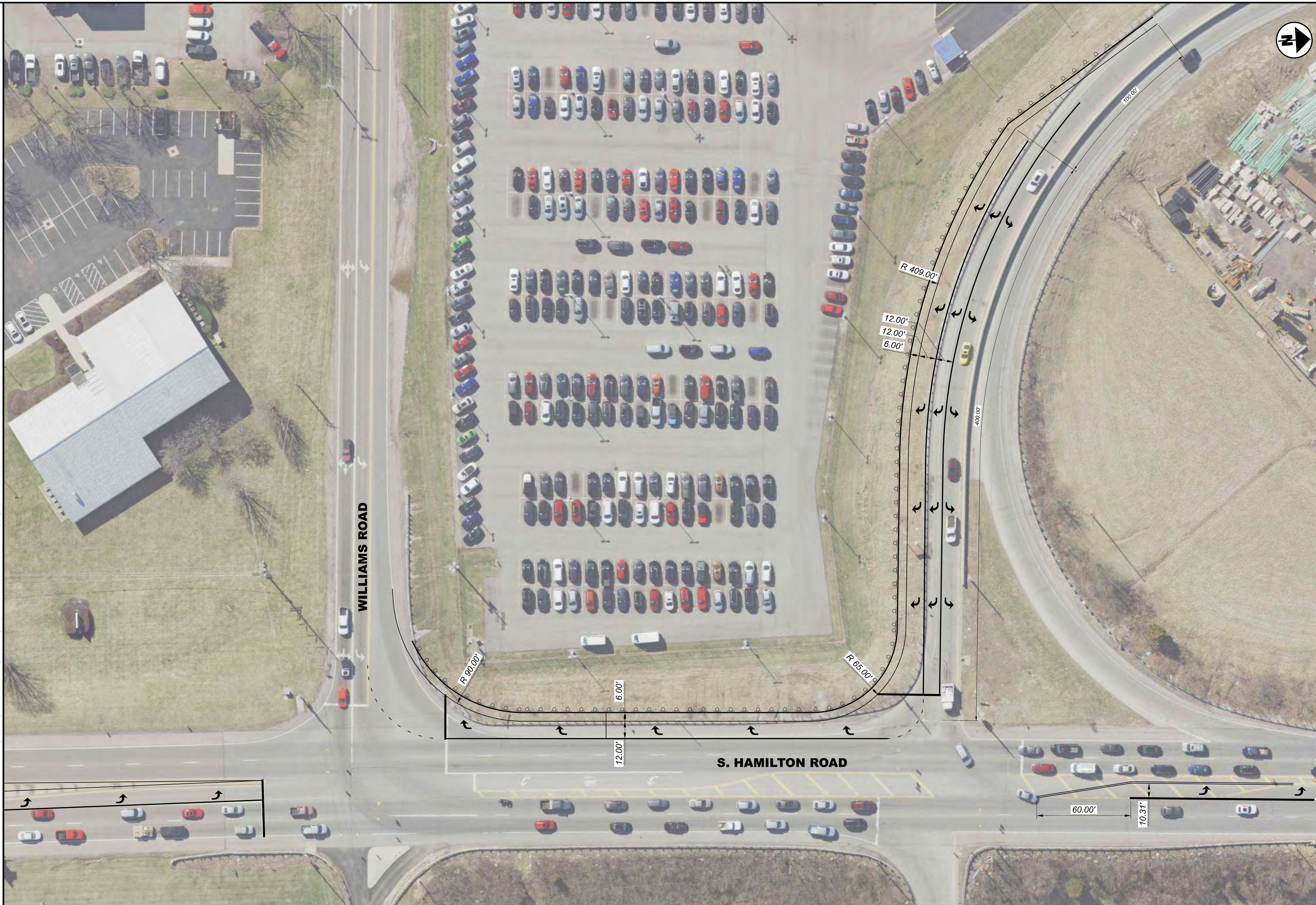

MEDIUM TERM CONCEPTUAL PLAN 2
SOUTH HAMILTON ROAD

DESIGN AGENCY

LJB Inc.
2500 Newmark Drive
Miamisburg, OH 45342
(937) 259-5000 tel
(937) 259-5100 fax
LJBinc.com

DESIGNER: JAH

REVIEWER: TVF 12-16-20

PROJECT ID: 111460

SHEET 2 | TOTAL 3

FRA/FAI-33-FEASIBILITY STUDY

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HORIZONTAL SCALE IN FEET
0 20 40 80

MEDIUM TERM CONCEPTUAL PLAN 3
SOUTH HAMILTON ROAD

DESIGN AGENCY

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Miamisburg, OH 45342
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(937) 259-5100 fax
LJBinc.com

DESIGNER	JAH
REVIEWER	TVF 12-16-20
PROJECT ID	111460
SHEET	3
TOTAL	3

HSM ANALYSIS

The predictive method described in Part C of the Highway Safety Manual (HSM) provides steps to estimate the expected average crash frequency of a site for a given time period, geometric design, traffic control features, and traffic volumes. The expected average crash frequency ($N_{expected}$) is estimated using a predictive model estimate of crash frequency for a specific site type ($N_{predicted}$) together with observed crash frequency.

The difference between the predicted and expected average crash frequencies is termed the "Expected Excess Crashes" for the site. If the expected average crash frequency is greater than the predicted average crash frequency, then the site has potential for safety improvement. If expected frequency is less than predicted frequency, then the site is expected to experience fewer crashes per year on average than its peers.

A predictive analysis was prepared using ODOT's Economic Crash Analysis Tool (ECAT). The HSM predictive method for urban intersections was applied to each intersection to determine the potential for safety improvement. Results are presented in **Table 9**. HSM output reports are provided in **Appendix E**.

TABLE 9: SUMMARY OF ECAT ANALYSIS – HAMILTON RD INTERSECTIONS

INTERSECTION	HAMILTON & WILLIAMS	HAMILTON & US 33 EB RAMPS	HAMILTON & US 33 WB RAMPS
Predicted Average Crash Frequency ($N_{predicted}$)	8.78	1.95	10.53
Expected Average Crash Frequency – Existing Conditions ($N_{expected}$, existing)	10.52	2.88	13.61
Expected Excess Crashes	1.74	0.93	3.09
Potential for Safety Improvement	Yes	Yes	Yes

Benefit cost analysis is a tool used to determine the financial benefits of a project by comparing the net present value (NPV) of a project to NPV of the safety benefit provided by that project. Benefit cost values greater than one indicate a positive return on the original investment. Preferred countermeasures are those having the highest NPV of safety benefits.

A benefit cost analysis was prepared using ODOT's ECAT tool. Crash modification factors (CMF) were applied for the following improvements at the two ramp intersections in the study area. This does not account for all recommended improvements, rather only those countermeasures that have CMF values. In addition, the HSM methodology does not support more than four CMFs being applied to the same intersection or segment, so some CMFs are provided for context only.

CRASH MODIFICATION FACTORS

The following crash modification factors were used in the ECAT analysis of the proposed countermeasures:

- **Add 3-inch yellow retroreflective sheeting to signal backplates (CMF: 0.85)**[1]: This CMF has a 4-star rating on the CMF Clearinghouse and applies to all crash types in urban environments.

[1] http://www.cmfclearinghouse.org/detail.cfm?facid=1410

- **Modify change plus clearance interval to ITE 1985 Proposed Recommended Practice**: This CMF is a Part D CMF in the Highway Safety Manual and applies to 4-leg signalized intersections. This CMF was applied to all 3 intersections.
- **Change from 5-section "doghouse" protected/permissive left turn to flashing yellow arrow protected/permissive left turn (CMF: 0.838)[2]:** This CMF has a 4-star rating on the CMF Clearinghouse and applies to left turn crashes.

Along with above CMFs, the HSM Part C CMFs for the addition of turn lanes has been applied to the in the ECAT tool.

COST ESTIMATE

Cost estimates and the ECAT benefit cost analysis results are summarized in **Table 10**; the Benefit-Cost reports are included in **Appendix F**. The cost estimates include a 30 percent contingency factor and an inflation rate of 13.4 percent for a 2025 design year. Construction costs for all countermeasures are included in the cost estimate.

TABLE 10: SUMMARY OF BENEFIT-COST ANALYSIS

$N_{expected}$ – Existing Conditions	27.02
$N_{expected}$ – Proposed Conditions	19.64
Expected annual crash adjustment	-7.38
Net present value of project	$2,027,481
Net present value of safety benefit	$3,031,486
Benefit / Cost Ratio	1.50

[2] http://www.cmfclearinghouse.org/detail.cfm?facid=7696

APPENDIX A
EXISTING CONDITIONS DIAGRAMS

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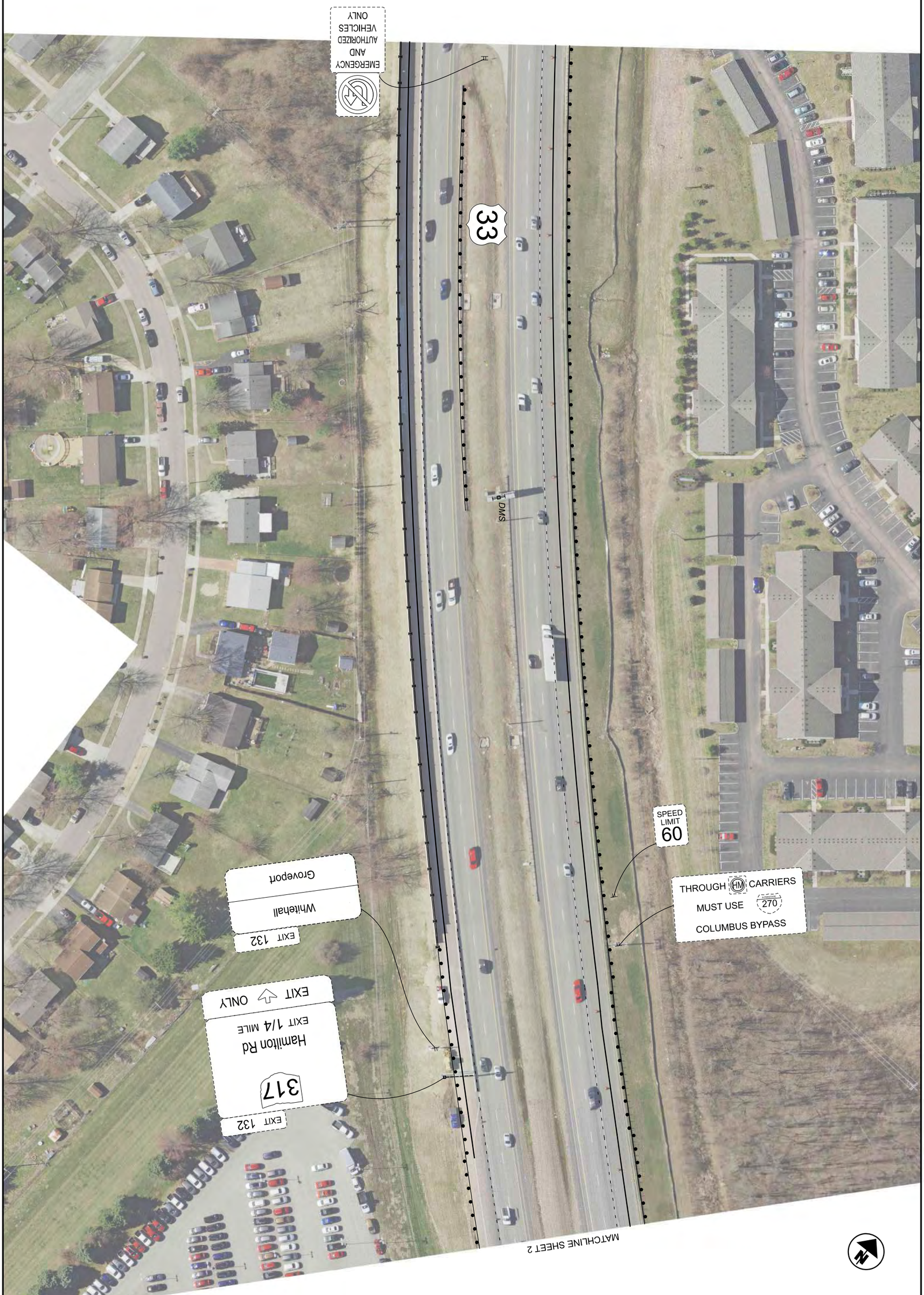

EXISTING CONDITIONS DIAGRAM

HORIZONTAL SCALE IN FEET
0 40
20 80

SHEET	TOTAL	PROJECT ID	REVIEWER	DESIGNER	DESIGN AGENCY
1	7	111460	XXX MM-DD-YY	TVF	

FRA/FAI-033-FEASIBILITY STUDY

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MATCHLINE SHEET 1

MATCHLINE SHEET 3

EXIT 131B

NORTH

HM

ADVISORY 270

3/4 MILE

EXIT ONLY

33

OHIO LOGO SIGN

OHIO LOGO SIGN

SPEED LIMIT 60

WOTS MUTARY MUSEUM THIS EXIT

Eastland Career Ctr

EXIT 132

317

Hamilton Rd

EXIT ONLY

EXIT 132

HORIZONTAL SCALE IN FEET

0 20 40 80

EXISTING CONDITIONS DIAGRAM

DESIGN AGENCY

DESIGNER TVF

REVIEWER XXX MM-DD-YY

PROJECT ID 111460

SHEET 2 TOTAL 7

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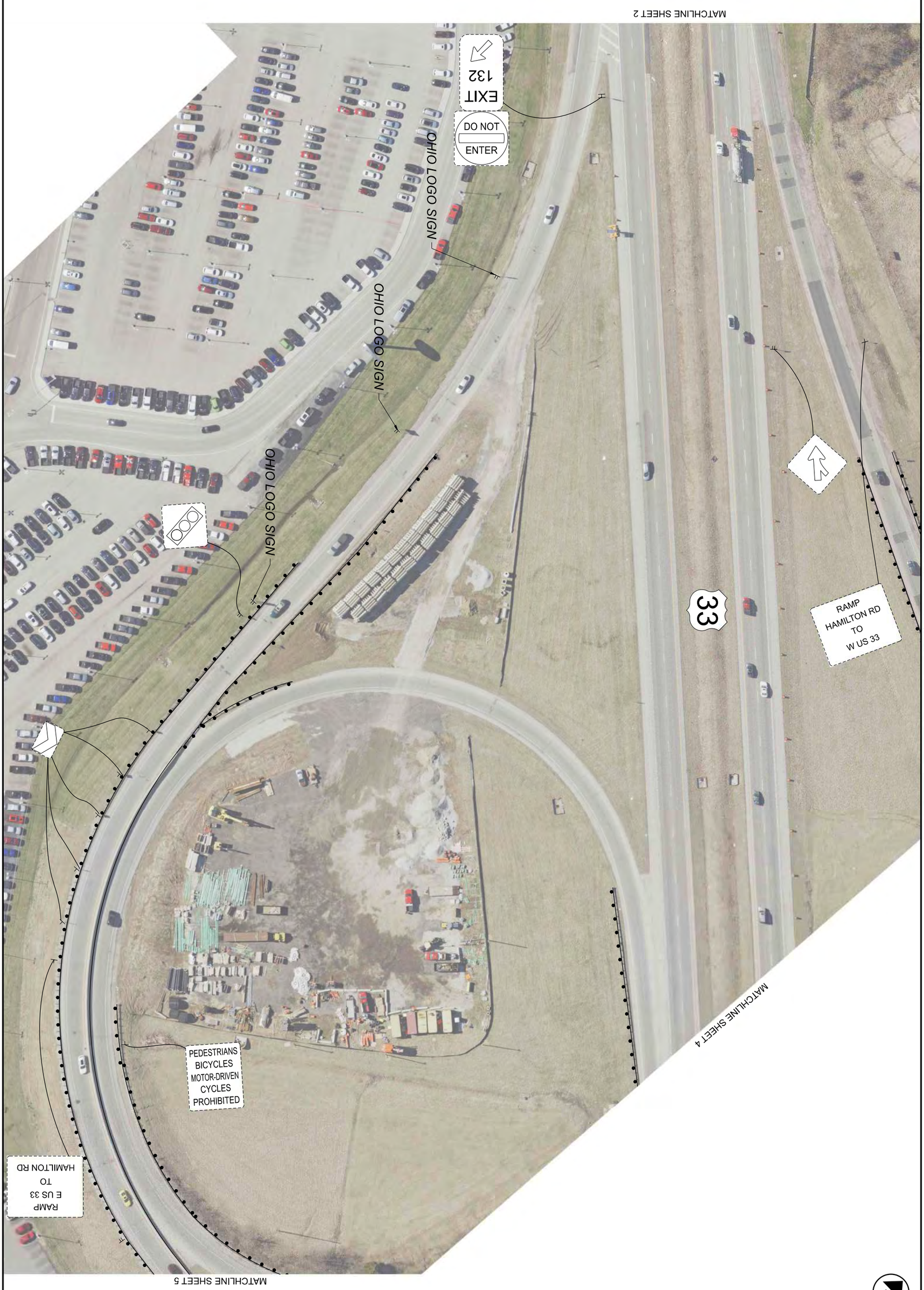

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3	7	111460	XXX MM-DD-YY	TVF	

EXISTING CONDITIONS DIAGRAM

HORIZONTAL SCALE IN FEET
0 40
20 80

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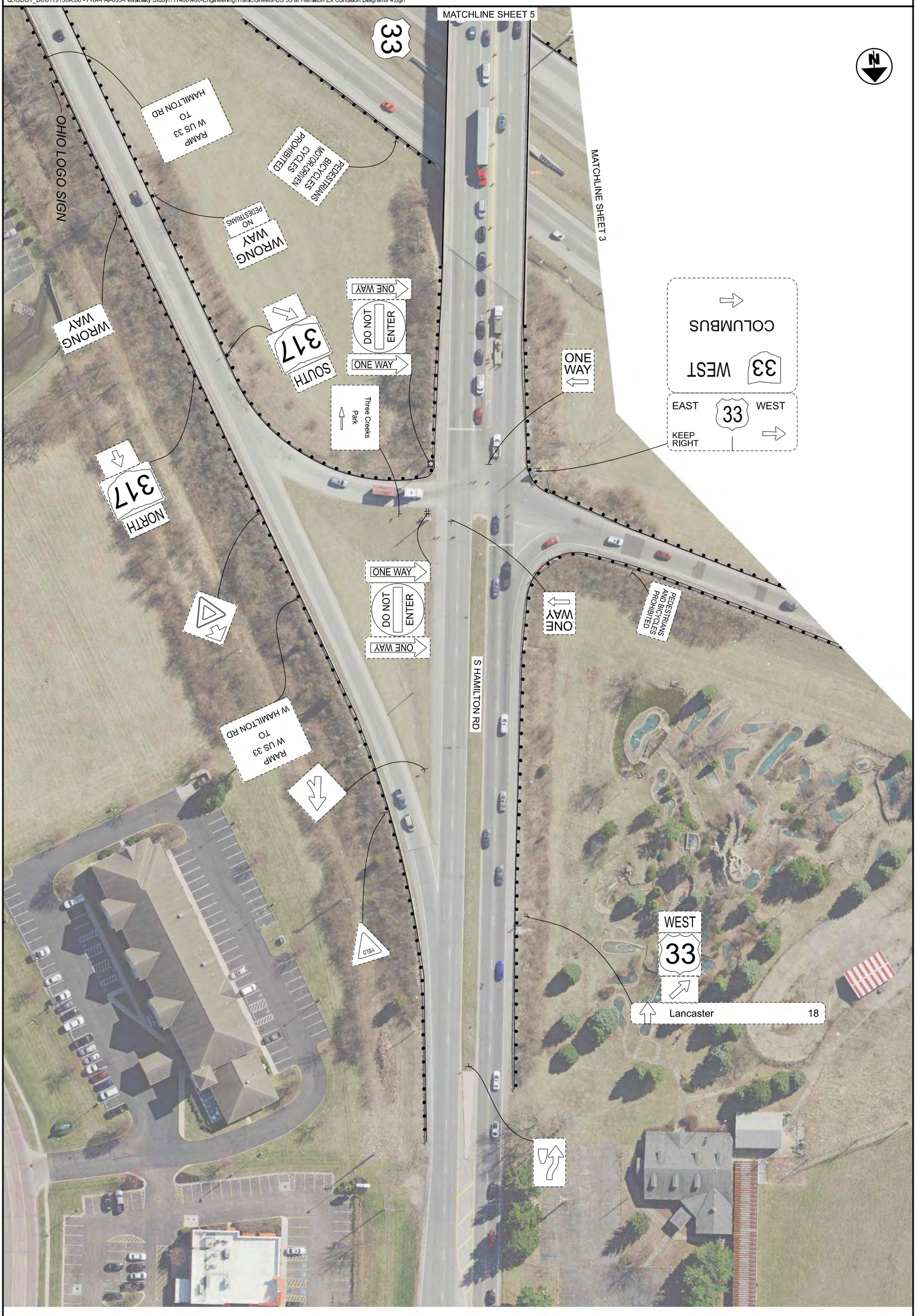

SHEET 4 / TOTAL 7	PROJECT ID 111460	REVIEWER XXX MM-DD-YY	DESIGNER TVF	DESIGN AGENCY	EXISTING CONDITIONS DIAGRAM

HORIZONTAL SCALE IN FEET
0 40
20 80

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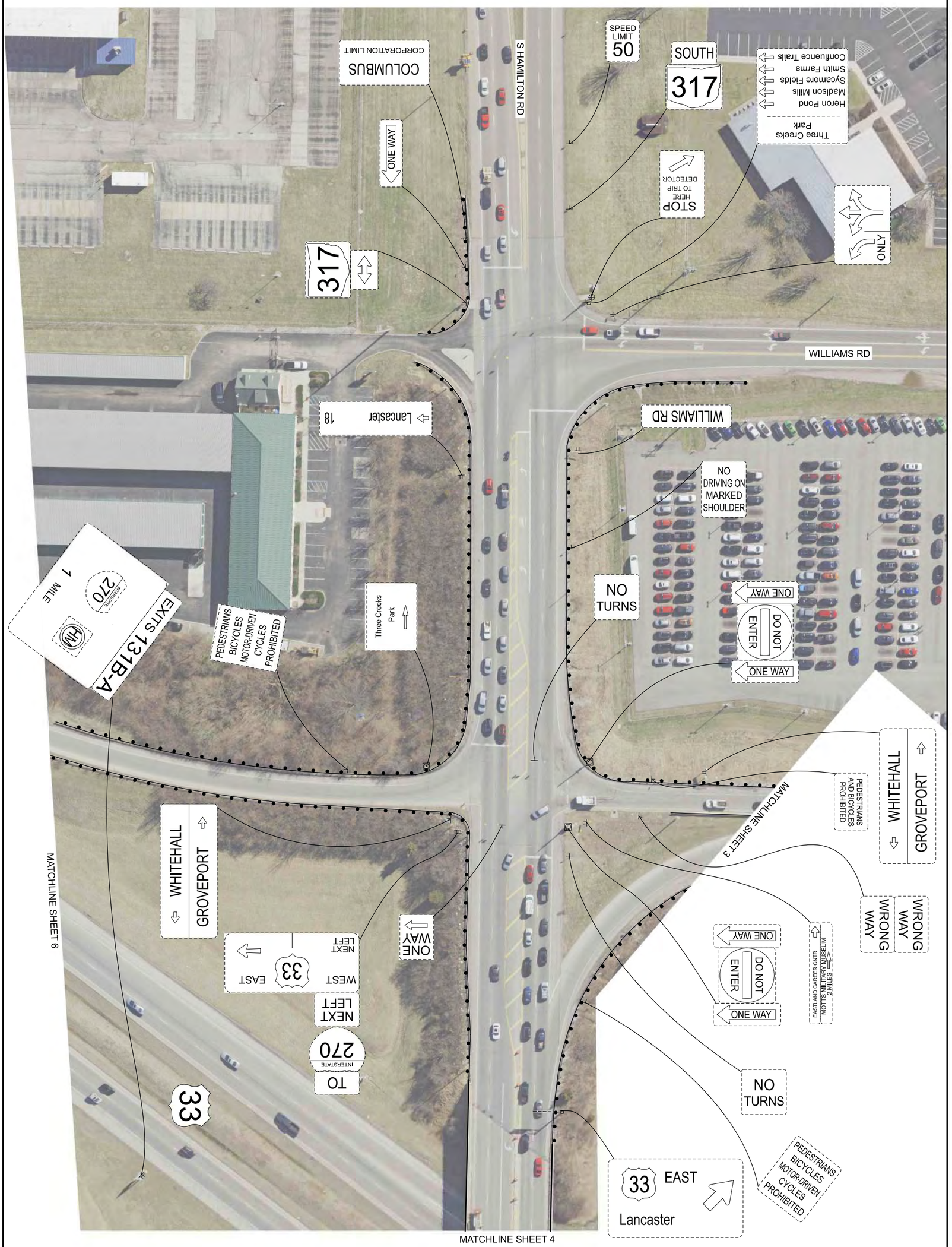

EXISTING CONDITIONS DIAGRAM

HORIZONTAL SCALE IN FEET
0 40
20 80

DESIGNER	REVIEWER	PROJECT ID	SHEET	TOTAL
TVF	XXX MM-DD-YY	111460	5	7

DESIGN AGENCY

FRA/FAI-033-FEASIBILITY STUDY

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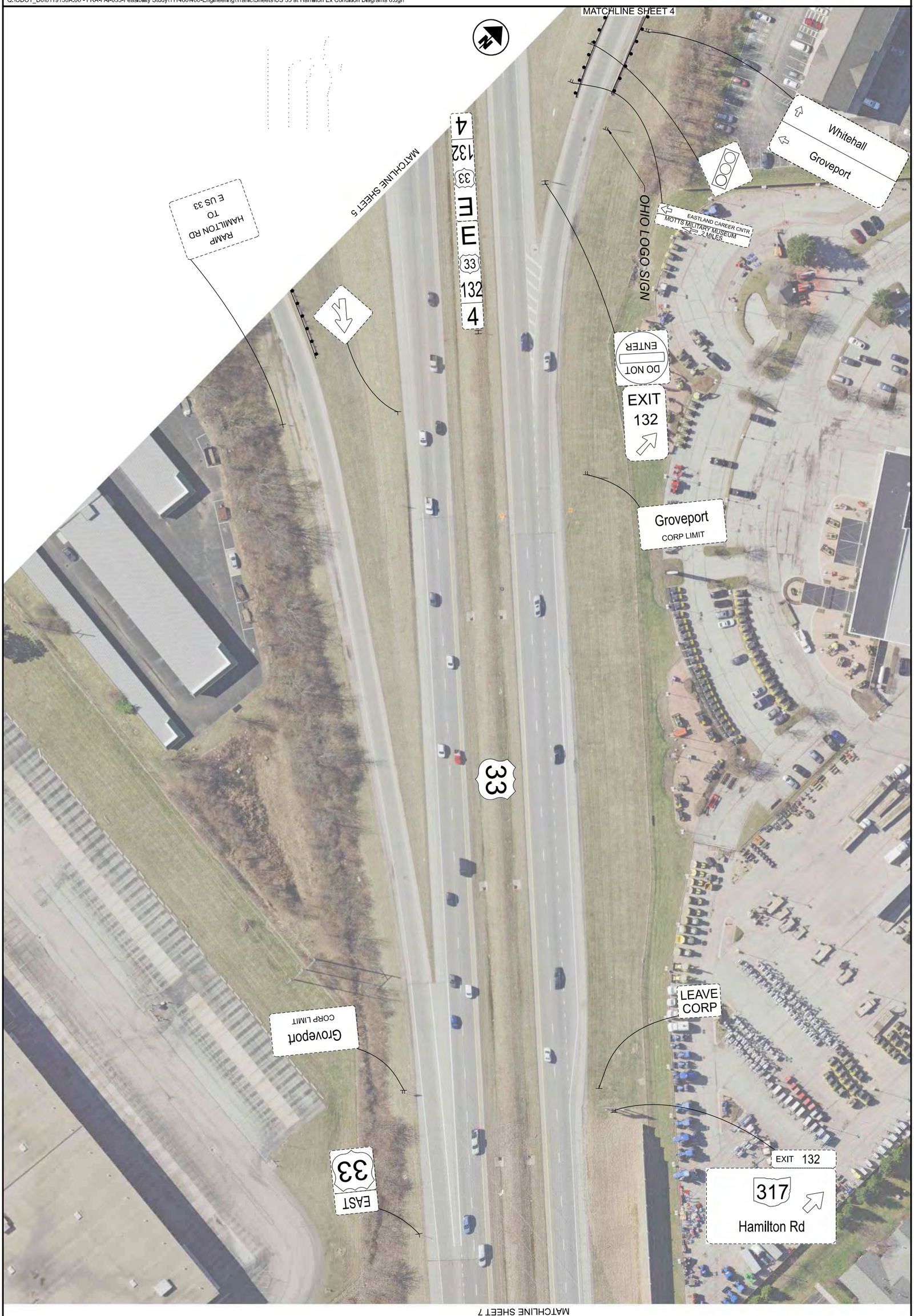

SHEET 6 / TOTAL 7	PROJECT ID 111460	REVIEWER XXX MM-DD-YY	DESIGNER TVF	DESIGN AGENCY	EXISTING CONDITIONS DIAGRAM

HORIZONTAL SCALE IN FEET
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20 80

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EXISTING CONDITIONS DIAGRAM

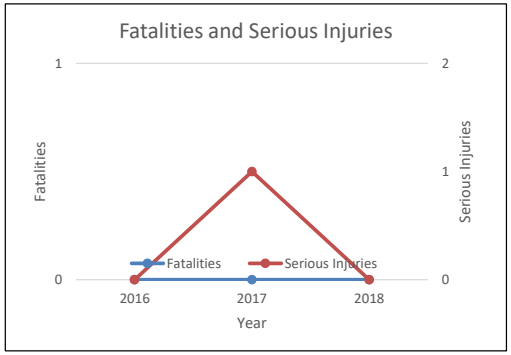
HORIZONTAL SCALE IN FEET
0 40
20 80

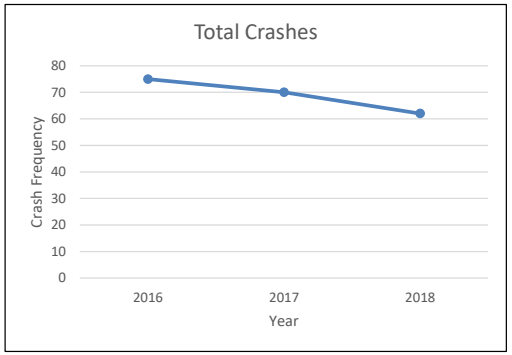
SHEET	TOTAL	PROJECT ID	REVIEWER	DESIGNER	DESIGN AGENCY
7	7	111460	XXX MM-DD-YY	TVF	

APPENDIX B
CRASH DIAGRAMS AND CRASH SUMMARIES

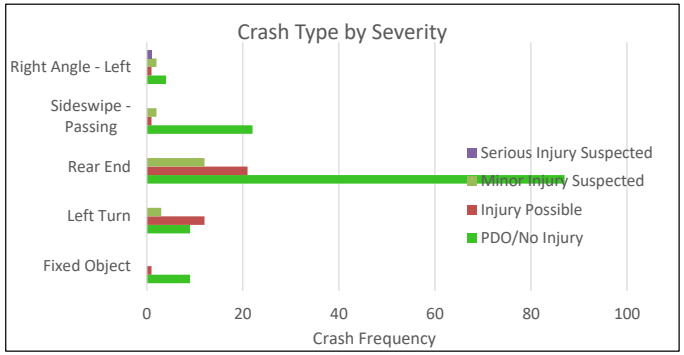
US 33 & Hamilton Interchange
Crash Summary Sheet

Year	Total Crashes	Fatalities	Serious Injuries
2016	75	0	0
2017	70	0	1
2018	62	0	0
Grand Total	207	0	1





Total Crashes	Injury Level				
Crash Type	PDO/No Injury	Injury Possible	Minor Injury Su	Serious Injury S	Grand Total
Rear End	87	21	12	0	120
Sideswipe - Passing	22	1	2	0	25
Left Turn	9	12	3	0	24
Fixed Object	9	1	0	0	10
Right Angle - Left	4	1	2	1	8
Turning Angle	4	1	0	0	5
Angle	2	0	1	0	3
Animal	2	0	0	0	2
Non-Veh. - Lost Load	1	0	1	0	2
Backing	2	0	0	0	2
Animal - Deer	1	0	0	0	1
Out of Control - Left	1	0	0	0	1
Right Angle - Right	0	1	0	0	1
Other Non-Collision	1	0	0	0	1
Head On	0	0	1	0	1
Other Non-Vehicle	1	0	0	0	1
Grand Total	146	38	22	1	207



US 33 & Hamilton Interchange
Crash Summary Sheet

Road Condition	Total Crashes	Fatalities	Serious Injuries
Dry	166	0	1
Ice	1	0	0
Snow	3	0	0
Wet	36	0	0
Other / Unknown	1	0	0
Grand Total	207	0	1

Weather	Total Crashes	Fatalities	Serious Injuries
Data Not Valid or Not Provided	207	0	1
Grand Total	207	0	1

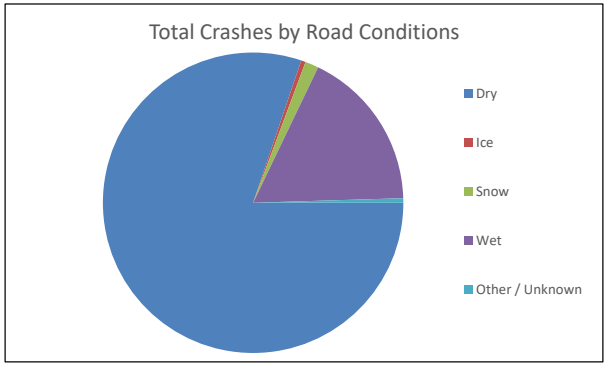
Crash Location	Total Crashes	Fatalities	Serious Injuries
Four-Way Intersection	40	0	1
Not An Intersection	125	0	0
T-Intersection	20	0	0
On Ramp	11	0	0
Off Ramp	10	0	0
Grand Total	206	0	1

Roadway Contour	Total Crashes	Fatalities	Serious Injuries
Curve Grade	8	0	0
Curve Level	10	0	0
Straight Grade	42	0	0
Straight Level	147	0	1
Grand Total	207	0	1

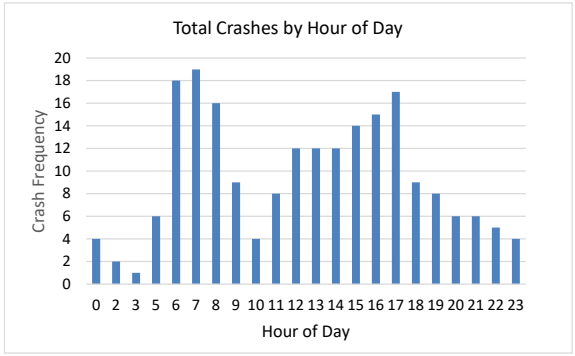
Hour of Day	Total Crashes
0	4
2	2
3	1
5	6
6	18
7	19
8	16
9	9
10	4
11	8
12	12
13	12
14	12
15	14
16	15
17	17
18	9
19	8
20	6
21	6
22	5
23	4
Grand Total	207

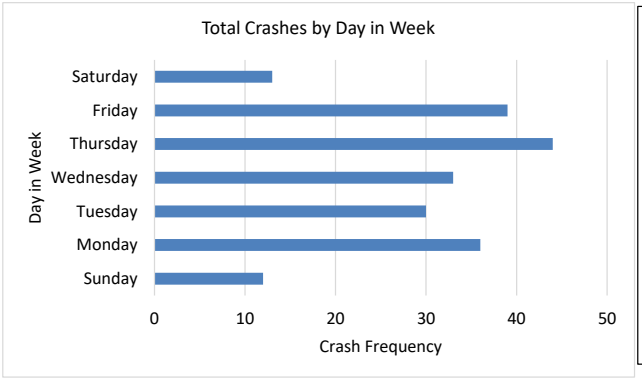
Month	Total Crashes
January	13
February	13
March	16
April	10
May	13
June	16
July	20
August	15
September	29
October	29
November	13
December	20
Grand Total	207

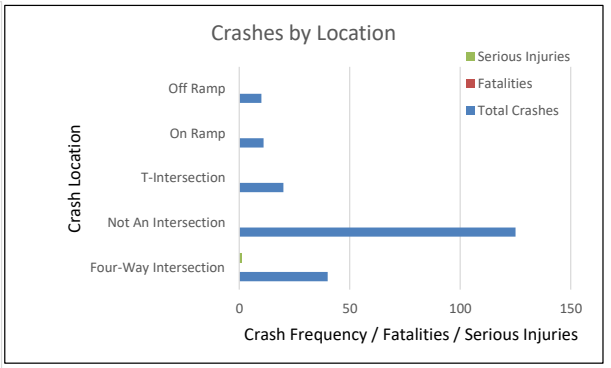
Day in Week	Total Crashes
Sunday	12
Monday	36
Tuesday	30
Wednesday	33
Thursday	44
Friday	39
Saturday	13
Grand Total	207

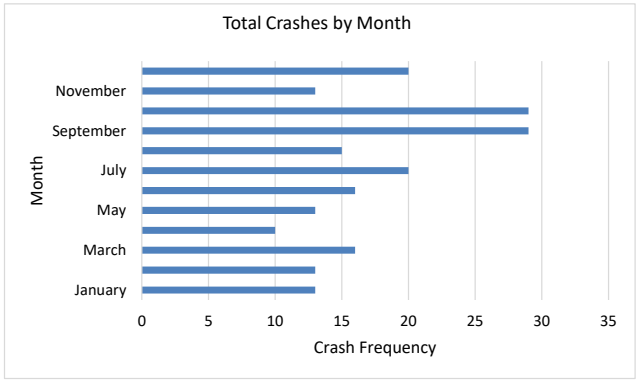


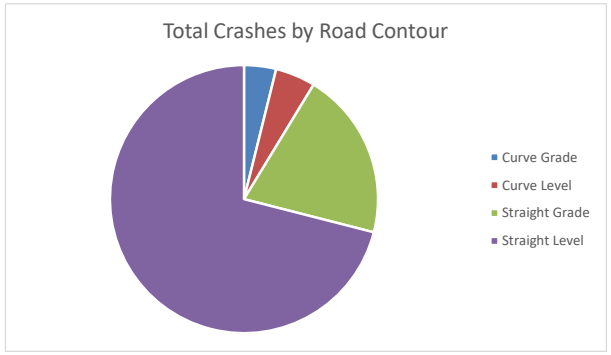
US 33 & Hamilton Interchange
Crash Summary Sheet











US 33 & Hamilton Interchange

Unit 1 Crash Summary

Type of Unit	Total Crashes	Fatalities	Serious Injuries
Sport Utility Vehicle	47	0	0
Unknown or Hit/Skip	1	0	0
Passenger Car	109	0	1
Pick up	24	0	0
Single Unit Truck	6	0	0
Passenger Van (minivan)	9	0	0
Semi-Tractor	5	0	0
Cargo Van	3	0	0
Heavy Equipment	2	0	0
Van (9-15 Seats)	1	0	0
Grand Total	207	0	1

Traffic Control	Total Crashes	Fatalities	Serious Injuries
Yield Sign	5	0	0
No Control	108	0	0
Signal	94	0	1
Grand Total	207	0	1

Object Struck	Total Crashes	Fatalities	Serious Injuries
Embankment	1	0	0
Fence	1	0	0
Guardrail End	1	0	0
Guardrail Face	7	0	0
Other Fixed Object	1	0	0
Traffic Sign Post	1	0	0
Grand Total	12	0	0

Special Function	Total Crashes	Fatalities	Serious Injuries
Construction Equipment	2	0	0
None	205	0	1
Grand Total	207	0	1

Contributing Circumstances	Total Crashes	Fatalities	Serious Injuries
Failure to Yield	15	0	0
Improper Backing	3	0	0
Improper Turn	5	0	0
Load shifting/Falling/Spilling	1	0	0
Other Improper Action	32	0	0
Ran Red Light	9	0	1
Following too Close / ACDA	115	0	0
Improper Lane Change	17	0	0
None	10	0	0
Grand Total	207	0	1

Pre-Crash Action	Total Crashes	Fatalities	Serious Injuries
Backing	4	0	0
Changing Lanes	19	0	0
Entering Traffic Lane	5	0	0
Leaving Traffic Lane	2	0	0
Making Left Turn	20	0	1
Making Right Turn	6	0	0
Negotiating a Curve	4	0	0
Overtaking/Passing	1	0	0
Slowing or Stopped In Traffic	20	0	0
Straight Ahead	124	0	0
Data Not Valid or Not Provided	2	0	0
Grand Total	207	0	1

Alcohol Involved	Total Crashes	Fatalities	Serious Injuries
No	205	0	1
Yes	2	0	0
Grand Total	207	0	1

Distracted By	Total Crashes	Fatalities	Serious Injuries
	2	0	0
Not Distracted	193	0	1
Other distraction inside the vehicle	10	0	0
Other distraction outside the vehicle	2	0	0
Grand Total	207	0	1

US 33 & Hamilton Interchange

Unit 1 Crash Summary

Gender	Total Crashes	Fatalities	Serious Injuries
Female	80	0	0
Male	112	0	1
Unknown	15	0	0
Grand Total	207	0	1

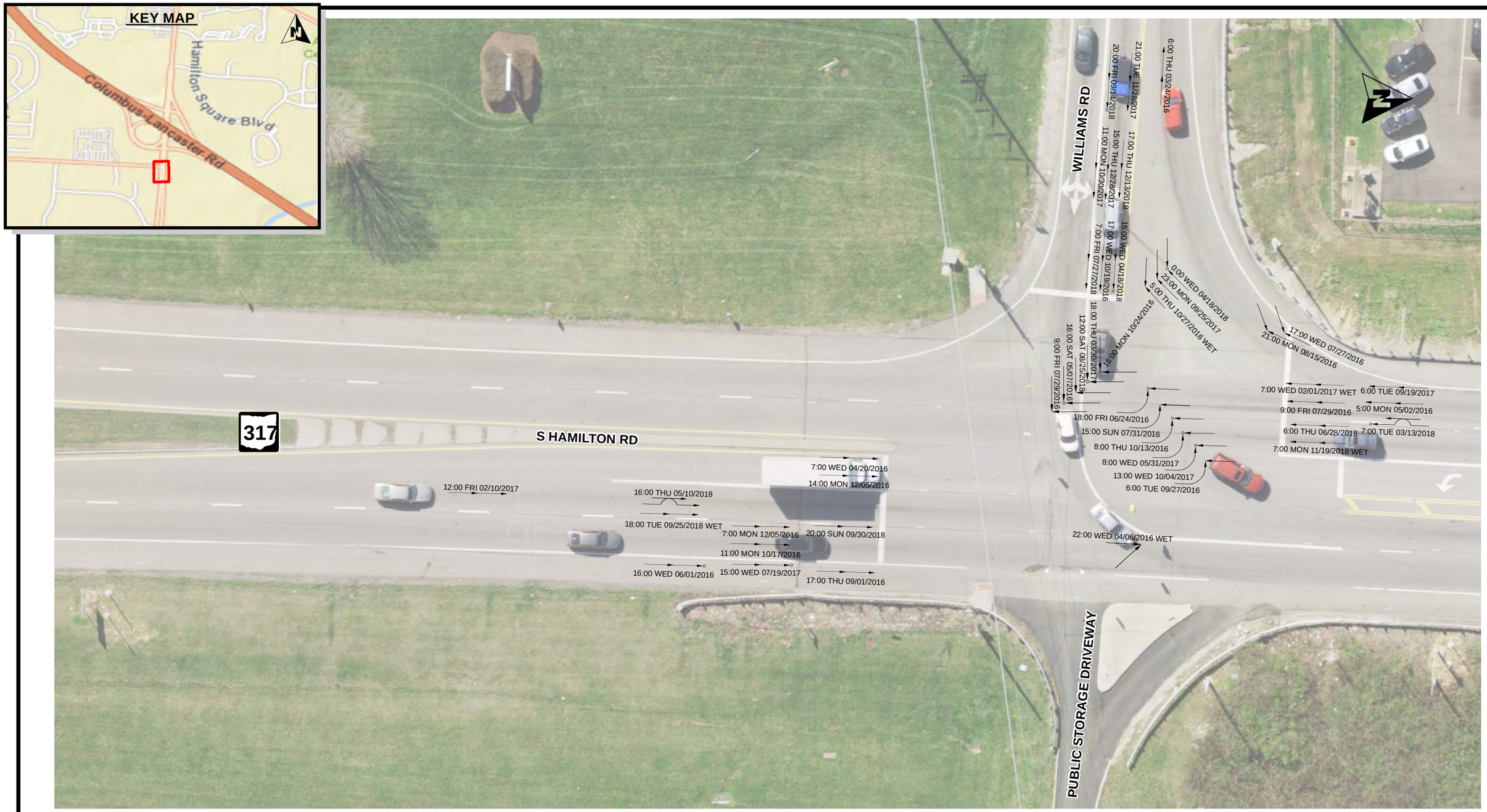
Driver Age	Total Crashes	Fatalities	Serious Injuries
<15	26	0	0
15-19	21	0	0
20-24	28	0	0
25-29	27	0	0
30-34	18	0	0
35-39	17	0	0
40-44	16	0	0
45-49	10	0	1
50-54	12	0	0
55-59	16	0	0
60-64	7	0	0
65-70	8	0	0
>70	1	0	0
Grand Total	207	0	1

Estimated Speed	Total Crashes	Fatalities	Serious Injuries
<15	82	0	0
15-19	14	0	0
20-24	18	0	0
25-29	9	0	0
30-34	12	0	1
35-39	14	0	0
40-44	11	0	0
45-49	17	0	0
50-54	6	0	0
55-59	7	0	0
60-64	10	0	0
65-70	6	0	0
>70	1	0	0
Grand Total	207	0	1

OHIO SHSP
EMPHASIS AREAS (Total Crashes)

Target Group	2018 Serious Injuries	2018 % of Total Serious Injuries	2017 Serious Injuries	2017 % of Total Serious Injuries	2016 Serious Injuries	2016 % of Total Serious Injuries
Total Serious Injuries by Year	**5**		**1**		**3**	
Roadway Departure	1	20%	0	0%	1	33%
Intersection	3	60%	0	0%	0	0%
Railroad Crossing	0	0%	0	0%	0	0%
Alcohol Related Involvement	0	0%	0	0%	0	0%
Restraints Not Used Driver/Occupants	0	0%	0	0%	0	0%
Speed Related Involvement	0	0%	0	0%	1	33%
Young Driver Involvement (15-25)	2	40%	0	0%	2	67%
Older Driver Involvement (65+)	1	20%	0	0%	0	0%
Distracted Drivers	0	0%	0	0%	1	33%
Motorcycle Driver/Passenger	0	0%	0	0%	0	0%
Pedestrian Involvement	0	0%	0	0%	0	0%
Bicycle Involvement	0	0%	0	0%	0	0%
Work Zone Related	0	0%	0	0%	0	0%
Drug Related Involvement	0	0%	0	0%	0	0%
Rear End	2	40%	1	100%	2	67%

*** 2018 Data is Preliminary**



NUMBER OF CRASHES

31	PROPERTY DAMAGE ONLY
13	INJURY OR FATAL
44	TOTAL CRASHES

SYMBOLS	TYPES OF COLLISIONS
MOVING VEHICLE	REAR END
BACKING VEHICLE	RIGHT ANGLE
NON-INVOLVED VEH.	SIDE SWIPE
PEDESTRIAN	OUT OF CONTROL
PARKED VEHICLE	LEFT TURN
FIXED OBJECT	HEAD ON
FATAL CRASH	
INJURY CRASH	

SHOW FOR EACH CRASH

1. TIME, DAY, DATE
2. WEATHER AND ROAD SURFACE IF UNUSUAL CONDITION EXISTED
3. NIGHT - IF BETWEEN DUSK AND DAWN

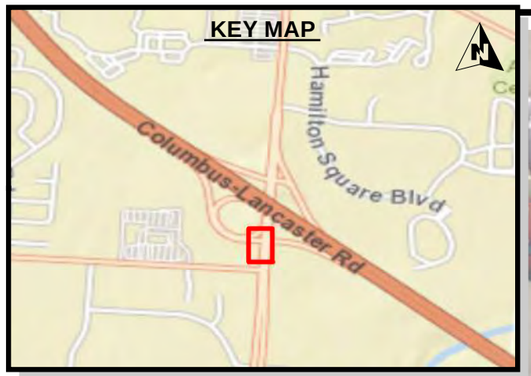
COLLISION DIAGRAM

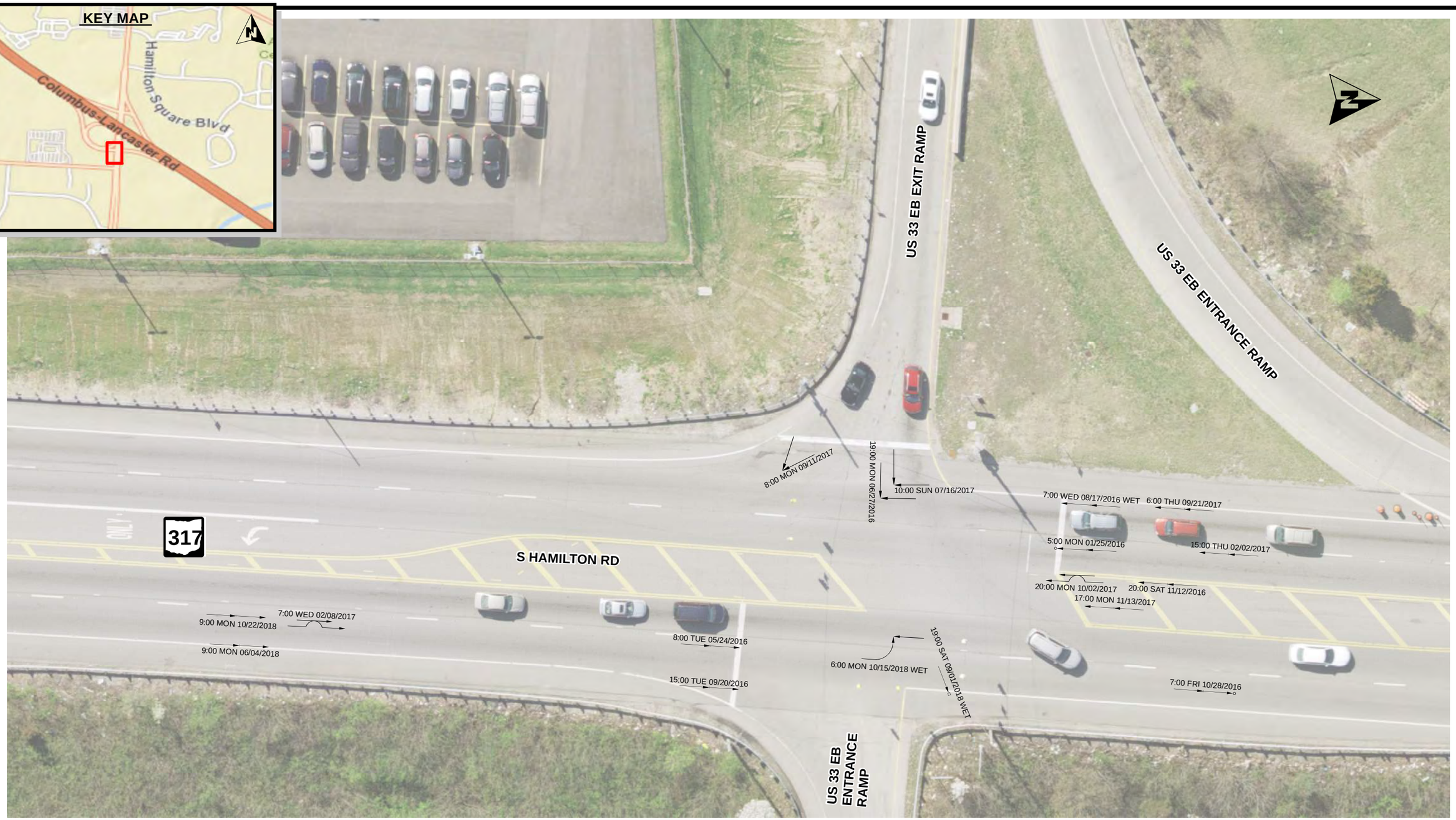
INTERSECTION: HAMILTON RD & WILLIAMS RD

PERIOD: 3 YEARS FROM: 2016 TO: 2018

LOCATION: FRANKLIN CO, DISTRICT 6 ROUTE NUMBER: SR 317/US 33

DATE: 9/23/2020





NUMBER OF CRASHES

16	PROPERTY DAMAGE ONLY
2	INJURY OR FATAL
18	TOTAL CRASHES

SYMBOLS

- MOVING VEHICLE
- BACKING VEHICLE
- NON-INVOLVED VEH.
- PEDESTRIAN
- PARKED VEHICLE
- FIXED OBJECT
- FATAL CRASH
- INJURY CRASH

TYPES OF COLLISIONS

- REAR END
- RIGHT ANGLE
- SIDE SWIPE
- OUT OF CONTROL
- LEFT TURN
- HEAD ON

SHOW FOR EACH CRASH

1. TIME, DAY, DATE
2. WEATHER AND ROAD SURFACE IF UNUSUAL CONDITION EXISTED
3. NIGHT - IF BETWEEN DUSK AND DAWN

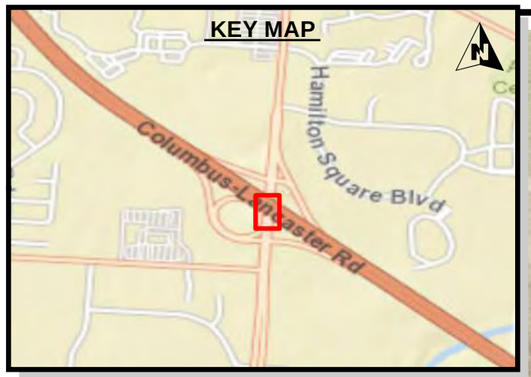
COLLISION DIAGRAM

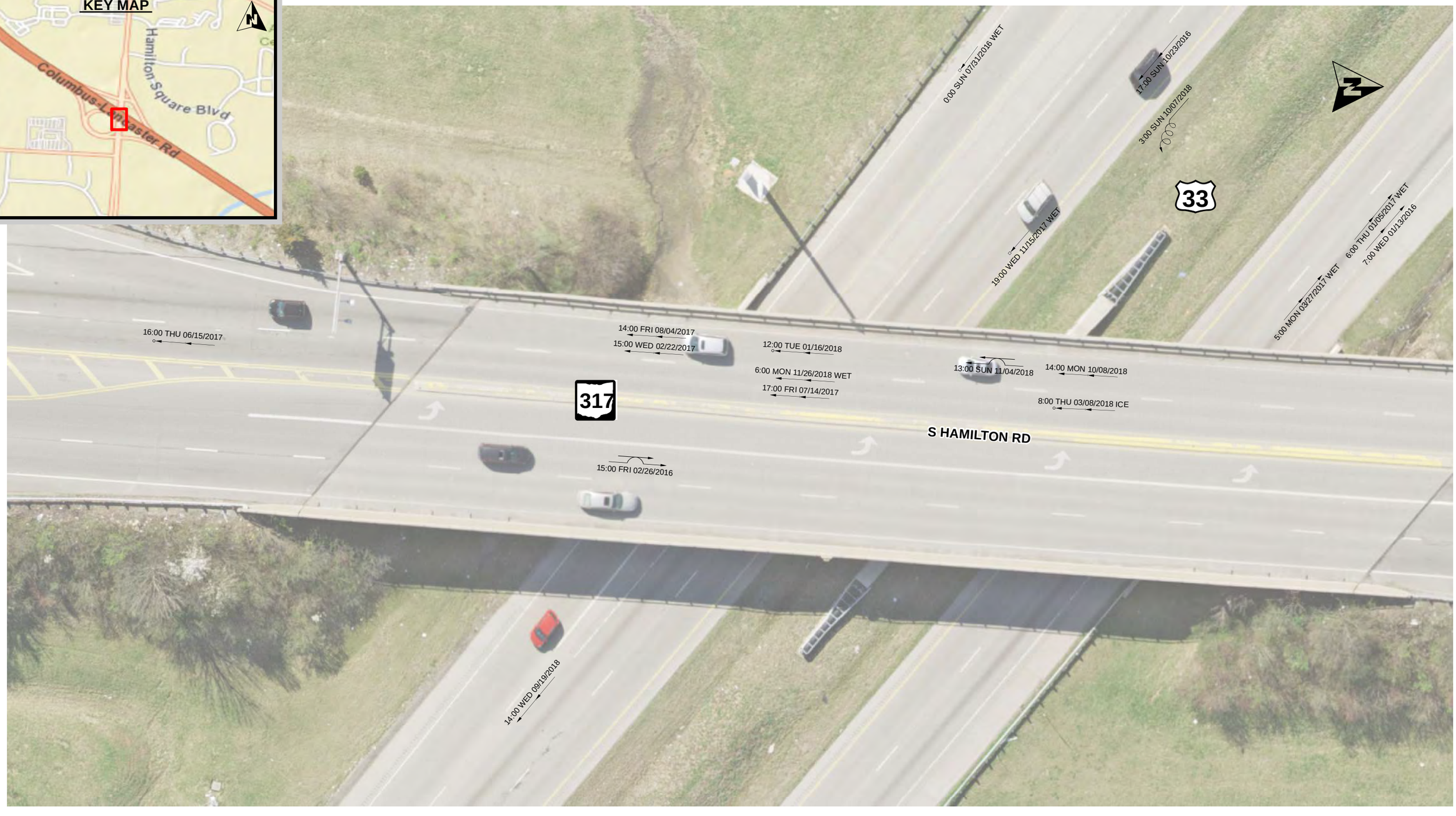
INTERSECTION: HAMILTON RD & US 33 EB RAMPS

PERIOD: 3 YEARS FROM: 2016 TO: 2018

LOCATION: FRANKLIN CO, DISTRICT 6 ROUTE NUMBER: SR 317/US 33

DATE: 9/23/2020





NUMBER OF CRASHES

15	PROPERTY DAMAGE ONLY
3	INJURY OR FATAL
18	TOTAL CRASHES

SYMBOLS

- MOVING VEHICLE
- BACKING VEHICLE
- NON-INVOLVED VEH.
- PEDESTRIAN
- PARKED VEHICLE
- FIXED OBJECT
- FATAL CRASH
- INJURY CRASH

TYPES OF COLLISIONS

- REAR END
- RIGHT ANGLE
- SIDE SWIPE
- OUT OF CONTROL
- LEFT TURN
- HEAD ON

SHOW FOR EACH CRASH

1. TIME, DAY, DATE
2. WEATHER AND ROAD SURFACE IF UNUSUAL CONDITION EXISTED
3. NIGHT - IF BETWEEN DUSK AND DAWN

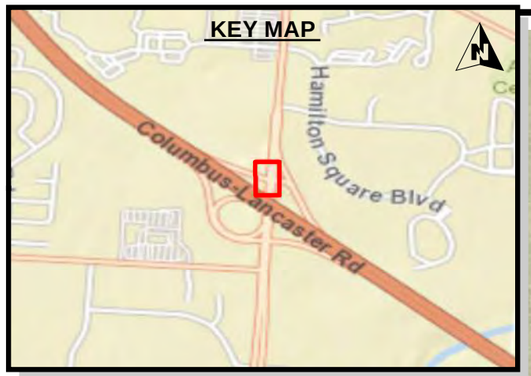
COLLISION DIAGRAM

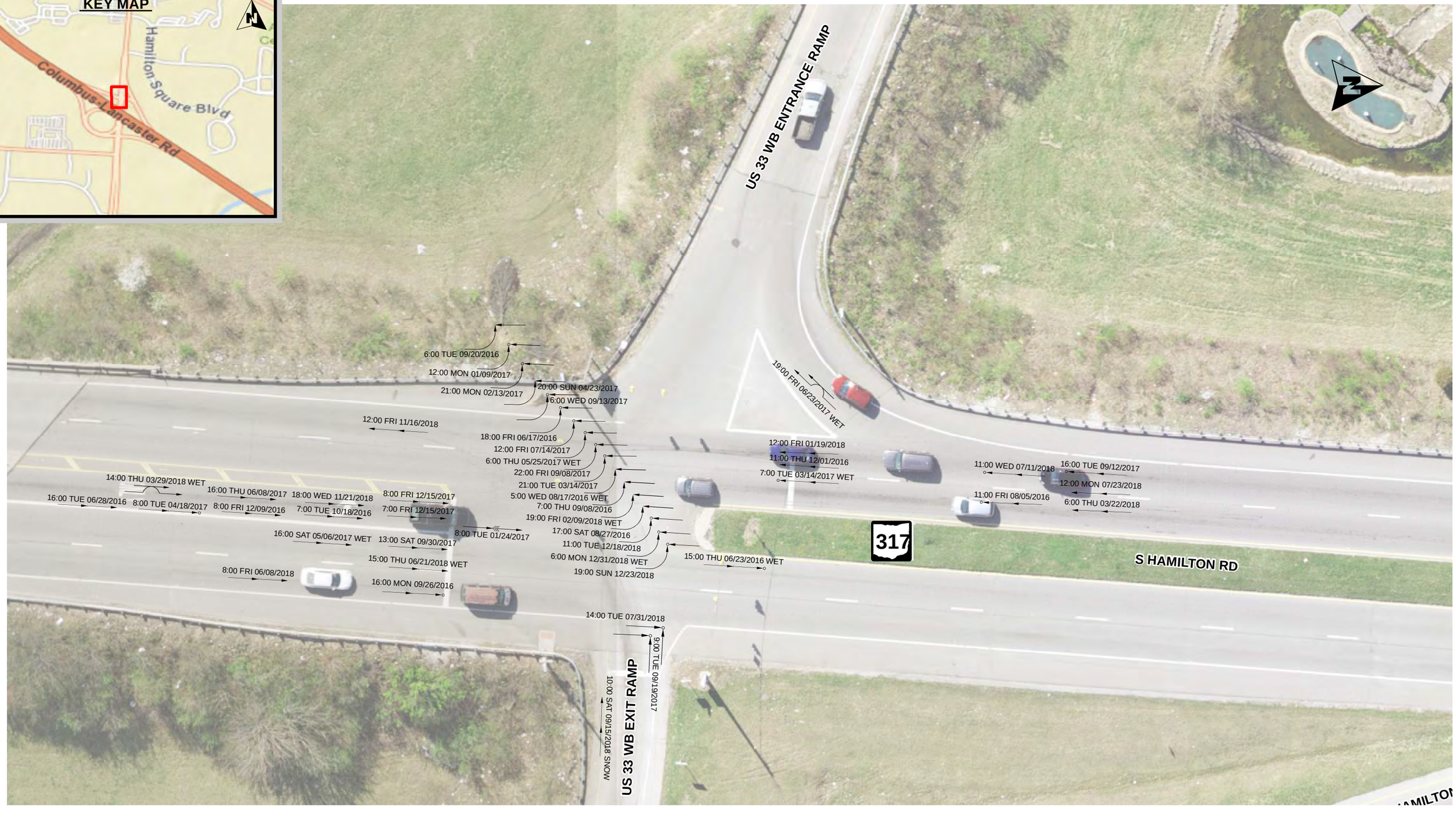
INTERSECTION: HAMILTON RD OVER US 33

PERIOD: 3 YEARS FROM: 2016 TO: 2018

LOCATION: FRANKLIN CO, DISTRICT 6 ROUTE NUMBER: SR 317/US 33

DATE: 9/23/2020





NUMBER OF CRASHES

26	PROPERTY DAMAGE ONLY
20	INJURY OR FATAL
46	TOTAL CRASHES

SYMBOLS

- MOVING VEHICLE
- BACKING VEHICLE
- NON-INVOLVED VEH.
- PEDESTRIAN
- PARKED VEHICLE
- FIXED OBJECT
- FATAL CRASH
- INJURY CRASH

TYPES OF COLLISIONS

- REAR END
- RIGHT ANGLE
- SIDE SWIPE
- OUT OF CONTROL
- LEFT TURN
- HEAD ON

SHOW FOR EACH CRASH

1. TIME, DAY, DATE
2. WEATHER AND ROAD SURFACE IF UNUSUAL CONDITION EXISTED
3. NIGHT - IF BETWEEN DUSK AND DAWN

COLLISION DIAGRAM

INTERSECTION: HAMILTON RD & US 33 WB RAMPS

PERIOD: 3 YEARS FROM 2016 TO 2018

LOCATION: FRANKLIN CO, DISTRICT 6 ROUTE NUMBER: SR 317/US 33

DATE: 9/23/2020

NUMBER OF CRASHES

11	PROPERTY DAMAGE ONLY
5	INJURY OR FATAL
16	TOTAL CRASHES

SYMBOLS

- MOVING VEHICLE
- BACKING VEHICLE
- NON-INVOLVED VEH.
- PEDESTRIAN
- PARKED VEHICLE
- FIXED OBJECT
- FATAL CRASH
- INJURY CRASH

TYPES OF COLLISIONS

- REAR END
- RIGHT ANGLE
- SIDE SWIPE
- OUT OF CONTROL
- LEFT TURN
- HEAD ON

SHOW FOR EACH CRASH

1. TIME, DAY, DATE
2. WEATHER AND ROAD SURFACE IF UNUSUAL CONDITION EXISTED
3. NIGHT - IF BETWEEN DUSK AND DAWN

COLLISION DIAGRAM

INTERSECTION: US 33 WB EXIT RAMP TO NB HAMILTON RD

PERIOD: 3 YEARS FROM: 2016 TO: 2018

LOCATION: FRANKLIN CO, DISTRICT 6 ROUTE NUMBER: SR 317/US 33

DATE: 9/23/2020

NUMBER OF CRASHES

4	PROPERTY DAMAGE ONLY
4	INJURY OR FATAL
8	TOTAL CRASHES

SYMBOLS

- MOVING VEHICLE
- BACKING VEHICLE
- NON-INVOLVED VEH.
- PEDESTRIAN
- PARKED VEHICLE
- FIXED OBJECT
- FATAL CRASH
- INJURY CRASH

TYPES OF COLLISIONS

- REAR END
- RIGHT ANGLE
- SIDE SWIPE
- OUT OF CONTROL
- LEFT TURN
- HEAD ON

SHOW FOR EACH CRASH

1. TIME, DAY, DATE
2. WEATHER AND ROAD SURFACE IF UNUSUAL CONDITION EXISTED
3. NIGHT - IF BETWEEN DUSK AND DAWN

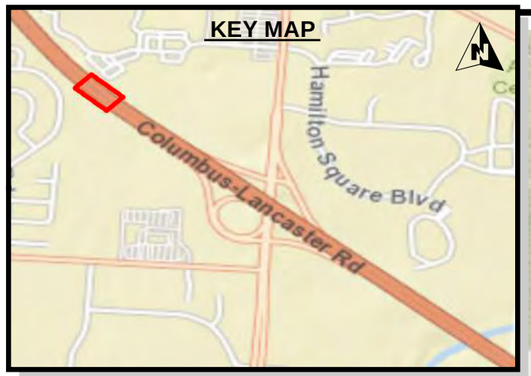
COLLISION DIAGRAM

INTERSECTION: US 33 WEST OF HAMILTON RD

PERIOD: 3 YEARS FROM: 2016 TO: 2018

LOCATION: FRANKLIN CO, DISTRICT 6 ROUTE NUMBER: SR 317/US 33

DATE: 9/23/2020



NUMBER OF CRASHES

3	PROPERTY DAMAGE ONLY
0	INJURY OR FATAL
3	TOTAL CRASHES

SYMBOLS

- MOVING VEHICLE
- BACKING VEHICLE
- NON-INVOLVED VEH.
- PEDESTRIAN
- PARKED VEHICLE
- FIXED OBJECT
- FATAL CRASH
- INJURY CRASH

TYPES OF COLLISIONS

- REAR END
- RIGHT ANGLE
- SIDE SWIPE
- OUT OF CONTROL
- LEFT TURN
- HEAD ON

SHOW FOR EACH CRASH

1. TIME, DAY, DATE
2. WEATHER AND ROAD SURFACE IF UNUSUAL CONDITION EXISTED
3. NIGHT - IF BETWEEN DUSK AND DAWN

COLLISION DIAGRAM

INTERSECTION: US 33 WEST OF HAMILTON RD

PERIOD: 3 YEARS FROM: 2016 TO: 2018

LOCATION: FRANKLIN CO, DISTRICT 6 ROUTE NUMBER: SR 317/US 33

DATE: 9/23/2020

NUMBER OF CRASHES

3	PROPERTY DAMAGE ONLY
0	INJURY OR FATAL
3	TOTAL CRASHES

SYMBOLS

- MOVING VEHICLE
- BACKING VEHICLE
- NON-INVOLVED VEH.
- PEDESTRIAN
- PARKED VEHICLE
- FIXED OBJECT
- FATAL CRASH
- INJURY CRASH

TYPES OF COLLISIONS

- REAR END
- RIGHT ANGLE
- SIDE SWIPE
- OUT OF CONTROL
- LEFT TURN
- HEAD ON

SHOW FOR EACH CRASH

1. TIME, DAY, DATE
2. WEATHER AND ROAD SURFACE IF UNUSUAL CONDITION EXISTED
3. NIGHT - IF BETWEEN DUSK AND DAWN

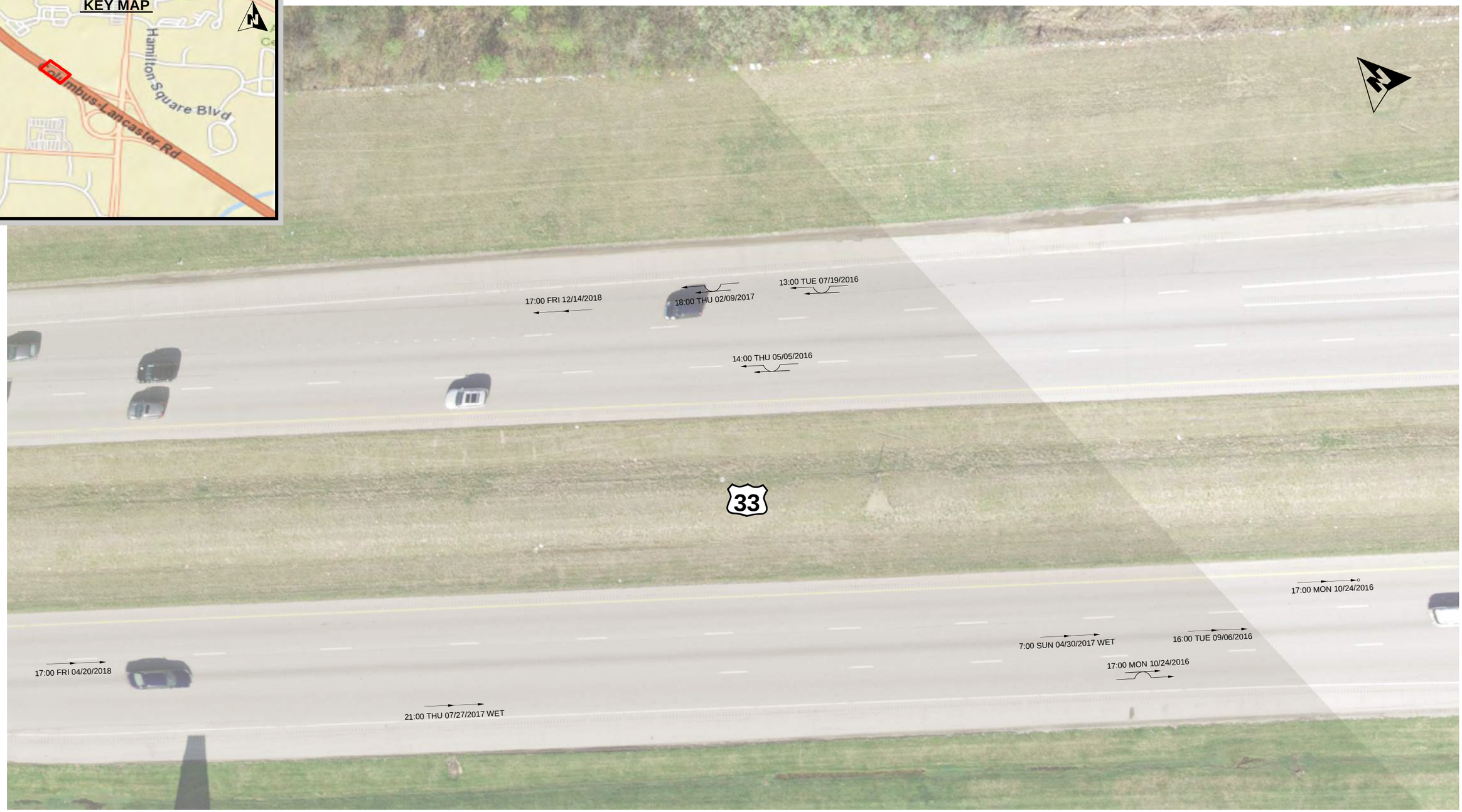
COLLISION DIAGRAM

INTERSECTION: US 33 WEST OF HAMILTON RD

PERIOD: 3 YEARS FROM: 2016 TO: 2018

LOCATION: FRANKLIN CO, DISTRICT 6 ROUTE NUMBER: SR 317/US 33

DATE: 9/23/2020



NUMBER OF CRASHES

9	PROPERTY DAMAGE ONLY
1	INJURY OR FATAL
10	TOTAL CRASHES

SYMBOLS	
	MOVING VEHICLE
	BACKING VEHICLE
	NON-INVOLVED VEH.
	PEDESTRIAN
	PARKED VEHICLE
□	FIXED OBJECT
●	FATAL CRASH
○	INJURY CRASH

TYPES OF COLLISIONS
REAR END
RIGHT ANGLE
SIDE SWIPE
OUT OF CONTROL
LEFT TURN
HEAD ON

SHOW FOR EACH CRASH

1. TIME, DAY, DATE
2. WEATHER AND ROAD SURFACE IF UNUSUAL CONDITION EXISTED
3. NIGHT - IF BETWEEN DUSK AND DAWN

COLLISION DIAGRAM

INTERSECTION: US 33 EB EXIT AND WB ENTRANCE TO/FROM HAMILTON RD

PERIOD: 3 YEARS FROM 2016 TO 2018

LOCATION: FRANKLIN CO, DISTRICT 6 ROUTE NUMBER: SR 317/US 33

DATE: 9/23/2020

NUMBER OF CRASHES

8	PROPERTY DAMAGE ONLY
1	INJURY OR FATAL
9	TOTAL CRASHES

SYMBOLS

- MOVING VEHICLE
- BACKING VEHICLE
- NON-INVOLVED VEH.
- PEDESTRIAN
- PARKED VEHICLE
- FIXED OBJECT
- FATAL CRASH
- INJURY CRASH

TYPES OF COLLISIONS

- REAR END
- RIGHT ANGLE
- SIDE SWIPE
- OUT OF CONTROL
- LEFT TURN
- HEAD ON

SHOW FOR EACH CRASH

1. TIME, DAY, DATE
2. WEATHER AND ROAD SURFACE IF UNUSUAL CONDITION EXISTED
3. NIGHT - IF BETWEEN DUSK AND DAWN

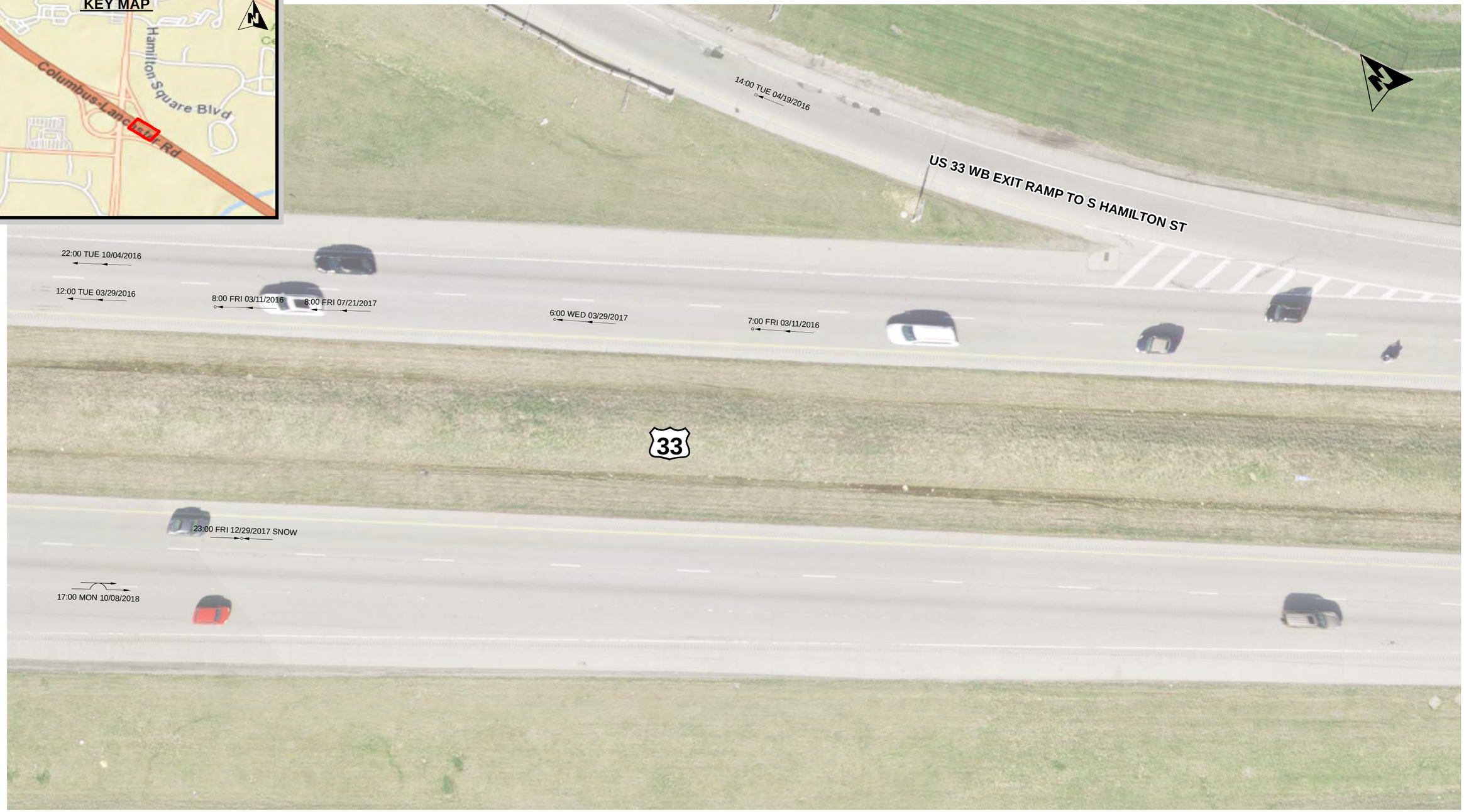
COLLISION DIAGRAM

INTERSECTION: US 33 EB EXIT AND WB ENTRANCE TO/FROM HAMILTON RD

PERIOD: 3 YEARS FROM: 2016 TO: 2018

LOCATION: FRANKLIN CO, DISTRICT 6 ROUTE NUMBER: SR 317/US 33

DATE: 9/23/2020



NUMBER OF CRASHES

5	PROPERTY DAMAGE ONLY
4	INJURY OR FATAL
9	TOTAL CRASHES

SYMBOLS

- MOVING VEHICLE
- BACKING VEHICLE
- NON-INVOLVED VEH.
- PEDESTRIAN
- PARKED VEHICLE
- FIXED OBJECT
- FATAL CRASH
- INJURY CRASH

TYPES OF COLLISIONS

- REAR END
- RIGHT ANGLE
- SIDE SWIPE
- OUT OF CONTROL
- LEFT TURN
- HEAD ON

SHOW FOR EACH CRASH

1. TIME, DAY, DATE
2. WEATHER AND ROAD SURFACE IF UNUSUAL CONDITION EXISTED
3. NIGHT - IF BETWEEN DUSK AND DAWN

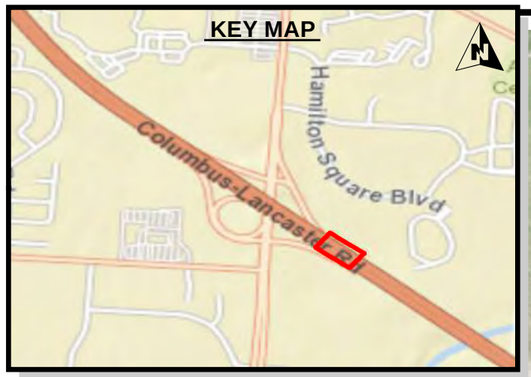
COLLISION DIAGRAM

INTERSECTION: US 33 WB EXIT RAMP DIVERGE TO NB/SB HAMILTON RD

PERIOD: 3 YEARS FROM: 2016 TO: 2018

LOCATION: FRANKLIN CO, DISTRICT 6 ROUTE NUMBER: SR 317/US 33

DATE: 9/23/2020



US 33 WB EXIT RAMP TO S HAMILTON RD

19:00 WED 10/24/2018

8:00 MON 05/21/2018 WET

6:00 SAT 03/24/2018

33

15:00 FRI 07/21/2017

US 33 EB ENTRANCE RAMP FROM S HAMILTON RD

NUMBER OF CRASHES

1	PROPERTY DAMAGE ONLY
3	INJURY OR FATAL
4	TOTAL CRASHES

SYMBOLS	TYPES OF COLLISIONS
MOVING VEHICLE	REAR END
BACKING VEHICLE	RIGHT ANGLE
NON-INVOLVED VEH.	SIDE SWIPE
PEDESTRIAN	OUT OF CONTROL
PARKED VEHICLE	LEFT TURN
FIXED OBJECT	HEAD ON
FATAL CRASH	
INJURY CRASH	

SHOW FOR EACH CRASH

1. TIME, DAY, DATE
2. WEATHER AND ROAD SURFACE IF UNUSUAL CONDITION EXISTED
3. NIGHT - IF BETWEEN DUSK AND DAWN

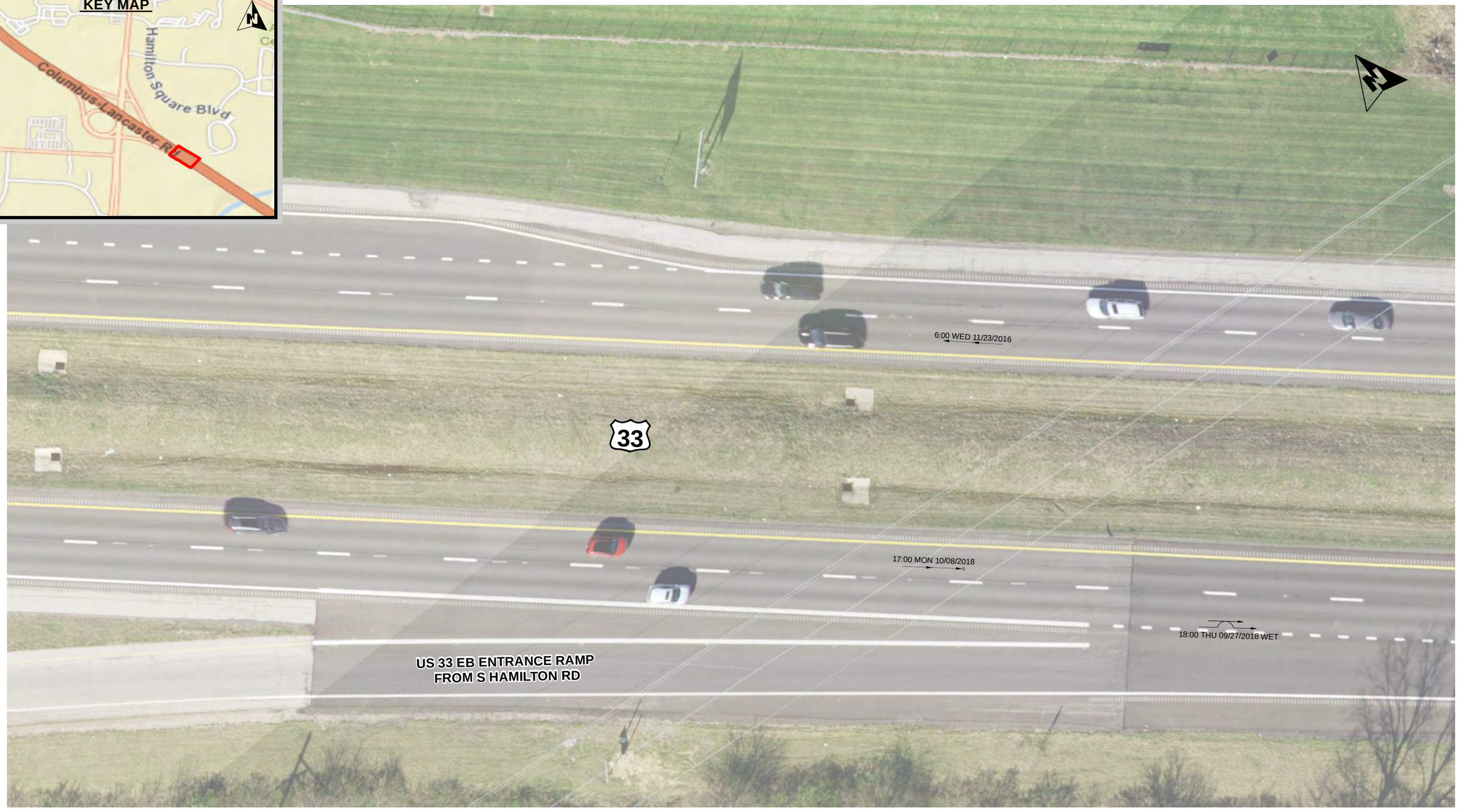
COLLISION DIAGRAM

INTERSECTION: APPROACH TO US 33 WB EXIT TO HAMILTON RD

PERIOD: 3 YEARS FROM: 2016 TO: 2018

LOCATION: FRANKLIN CO, DISTRICT 6 ROUTE NUMBER: SR 317/US 33

DATE: 9/23/2020



NUMBER OF CRASHES

2	PROPERTY DAMAGE ONLY
1	INJURY OR FATAL
3	TOTAL CRASHES

SYMBOLS

- MOVING VEHICLE
- BACKING VEHICLE
- NON-INVOLVED VEH.
- PEDESTRIAN
- PARKED VEHICLE
- FIXED OBJECT
- FATAL CRASH
- INJURY CRASH

TYPES OF COLLISIONS

- REAR END
- RIGHT ANGLE
- SIDE SWIPE
- OUT OF CONTROL
- LEFT TURN
- HEAD ON

SHOW FOR EACH CRASH

1. TIME, DAY, DATE
2. WEATHER AND ROAD SURFACE IF UNUSUAL CONDITION EXISTED
3. NIGHT - IF BETWEEN DUSK AND DAWN

COLLISION DIAGRAM

INTERSECTION: HAMILTON RD ENTRANCE TO EB US 33 MERGE AREA

PERIOD: 3 YEARS FROM: 2016 TO: 2018

LOCATION: FRANKLIN CO, DISTRICT 6 ROUTE NUMBER: SR 317/US 33

DATE: 9/23/2020

NUMBER OF CRASHES

4	PROPERTY DAMAGE ONLY
3	INJURY OR FATAL
7	TOTAL CRASHES

SYMBOLS

- MOVING VEHICLE
- BACKING VEHICLE
- NON-INVOLVED VEH.
- PEDESTRIAN
- PARKED VEHICLE
- FIXED OBJECT
- FATAL CRASH
- INJURY CRASH

TYPES OF COLLISIONS

- REAR END
- RIGHT ANGLE
- SIDE SWIPE
- OUT OF CONTROL
- LEFT TURN
- HEAD ON

SHOW FOR EACH CRASH

1. TIME, DAY, DATE
2. WEATHER AND ROAD SURFACE IF UNUSUAL CONDITION EXISTED
3. NIGHT - IF BETWEEN DUSK AND DAWN

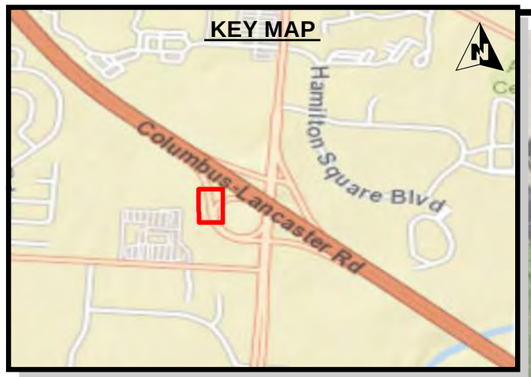
COLLISION DIAGRAM

INTERSECTION: HAMILTON RD ENTRANCE MERGE ONTO US 33 EB

PERIOD: 3 YEARS FROM: 2016 TO: 2018

LOCATION: FRANKLIN CO, DISTRICT 6 ROUTE NUMBER: SR 317/US 33

DATE: 9/23/2020



NUMBER OF CRASHES

2	PROPERTY DAMAGE ONLY
0	INJURY OR FATAL
2	TOTAL CRASHES

SYMBOLS

- MOVING VEHICLE
- BACKING VEHICLE
- NON-INVOLVED VEH.
- PEDESTRIAN
- PARKED VEHICLE
- FIXED OBJECT
- FATAL CRASH
- INJURY CRASH

TYPES OF COLLISIONS

- REAR END
- RIGHT ANGLE
- SIDE SWIPE
- OUT OF CONTROL
- LEFT TURN
- HEAD ON

SHOW FOR EACH CRASH

1. TIME, DAY, DATE
2. WEATHER AND ROAD SURFACE IF UNUSUAL CONDITION EXISTED
3. NIGHT - IF BETWEEN DUSK AND DAWN

COLLISION DIAGRAM

INTERSECTION: US 33 EB RAMPS TO/FROM HAMILTON RD

PERIOD: 3 YEARS FROM: 2016 TO: 2018

LOCATION: FRANKLIN CO, DISTRICT 6 ROUTE NUMBER: SR 317/US 33

DATE: 9/23/2020

NUMBER OF CRASHES

1	PROPERTY DAMAGE ONLY
0	INJURY OR FATAL
1	TOTAL CRASHES

SYMBOLS	
	MOVING VEHICLE
	BACKING VEHICLE
	NON-INVOLVED VEH.
	PEDESTRIAN
	PARKED VEHICLE
□	FIXED OBJECT
●	FATAL CRASH
○	INJURY CRASH

TYPES OF COLLISIONS
REAR END
RIGHT ANGLE
SIDE SWIPE
OUT OF CONTROL
LEFT TURN
HEAD ON

SHOW FOR EACH CRASH

1. TIME, DAY, DATE
2. WEATHER AND ROAD SURFACE IF UNUSUAL CONDITION EXISTED
3. NIGHT - IF BETWEEN DUSK AND DAWN

COLLISION DIAGRAM

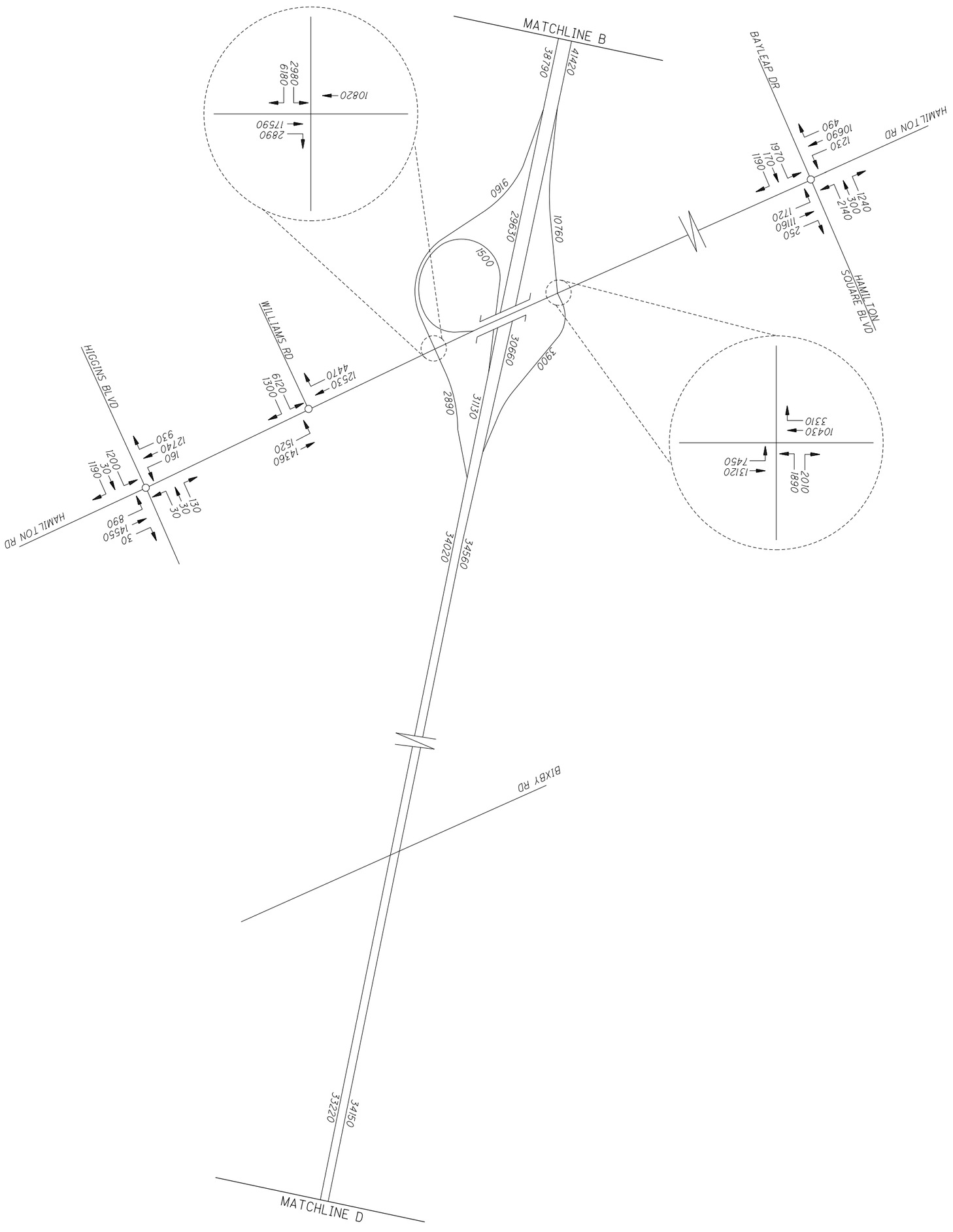
INTERSECTION US 33 WB EXIT RAMP DIVERGE TO NB/SB HAMILTON RD

PERIOD 3 YEARS FROM 2016 TO 2018

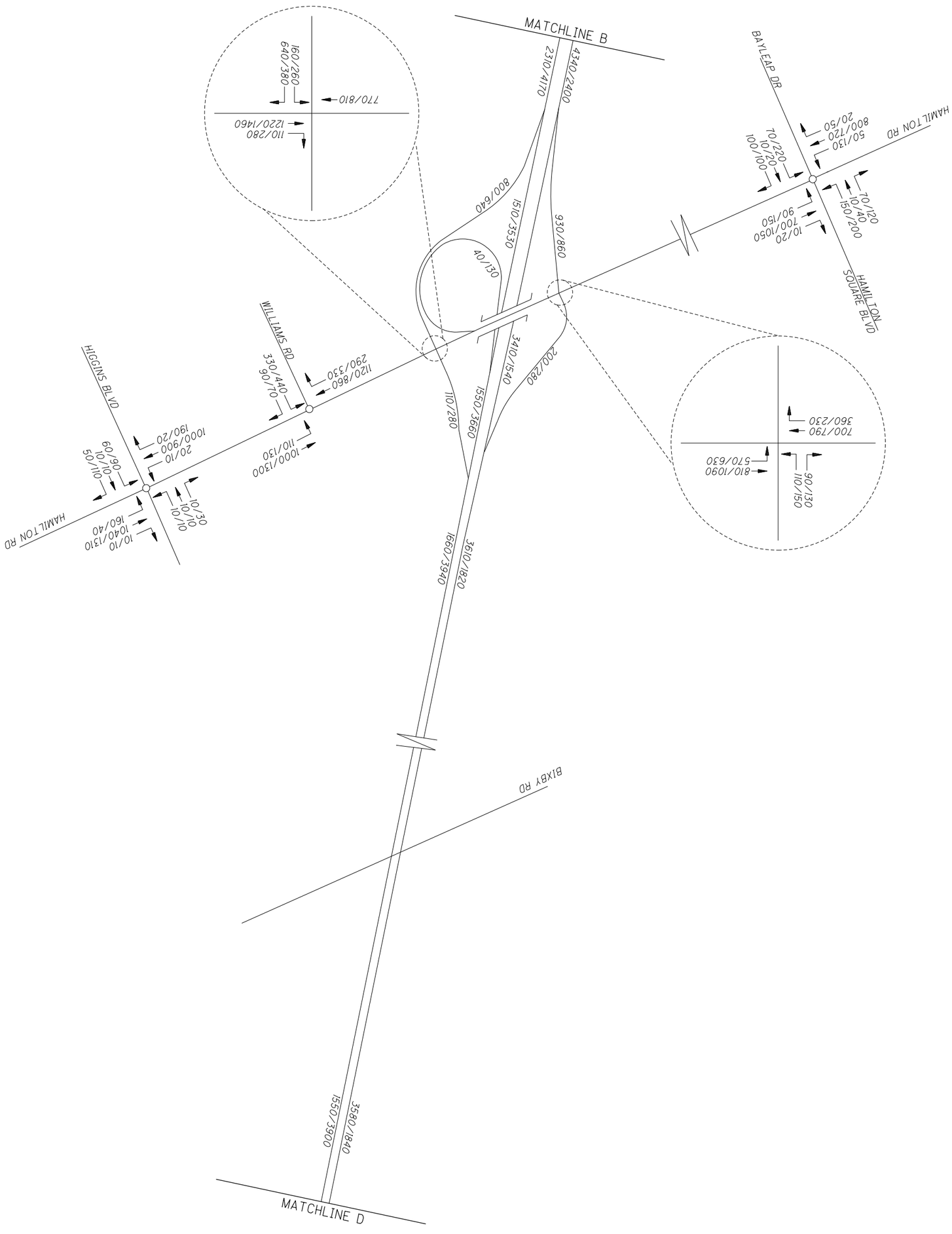
LOCATION FRANKLIN CO, DISTRICT 6 ROUTE NUMBER SR 317/US 33

DATE: 9/23/2020

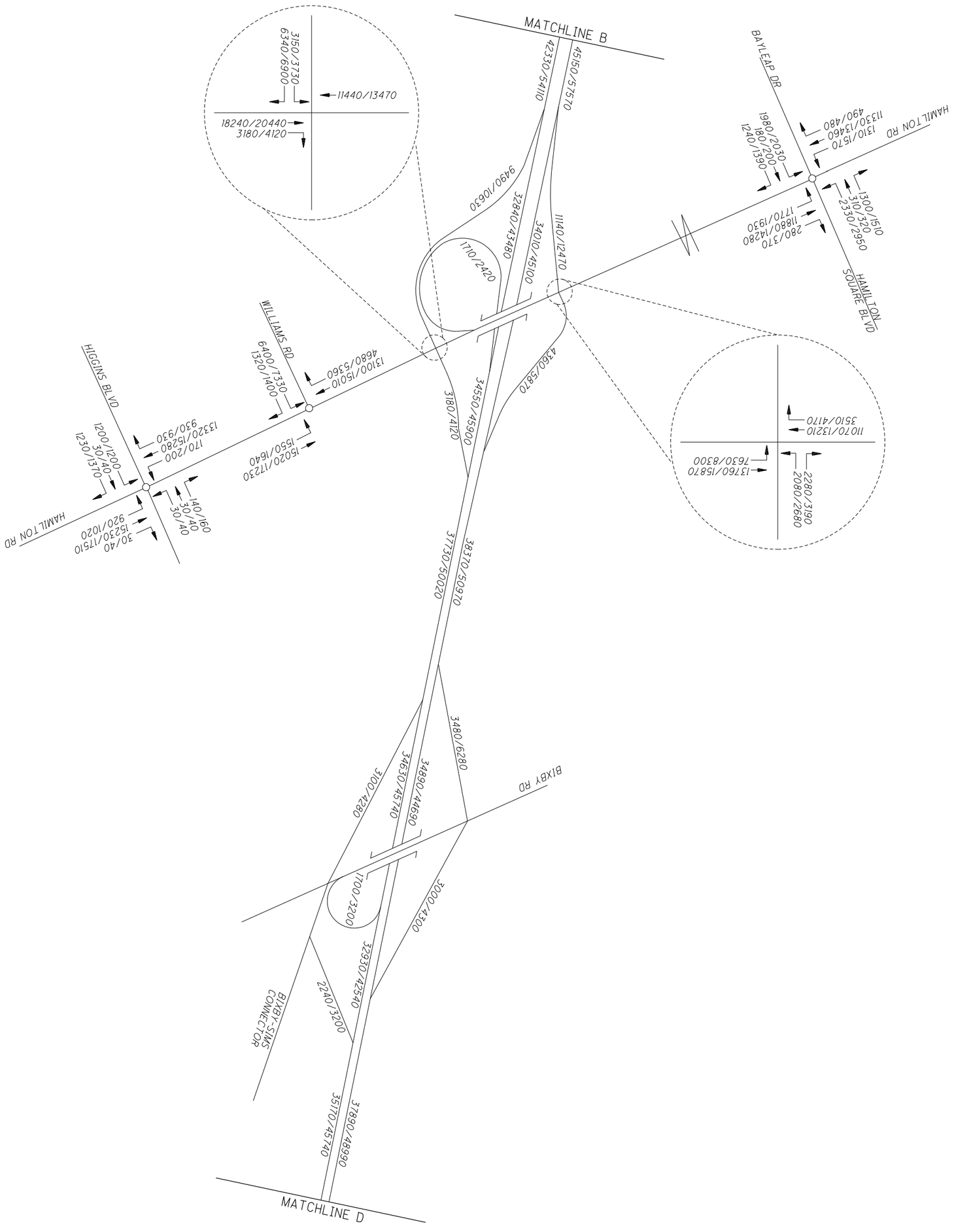
APPENDIX C
CERTIFIED TRAFFIC



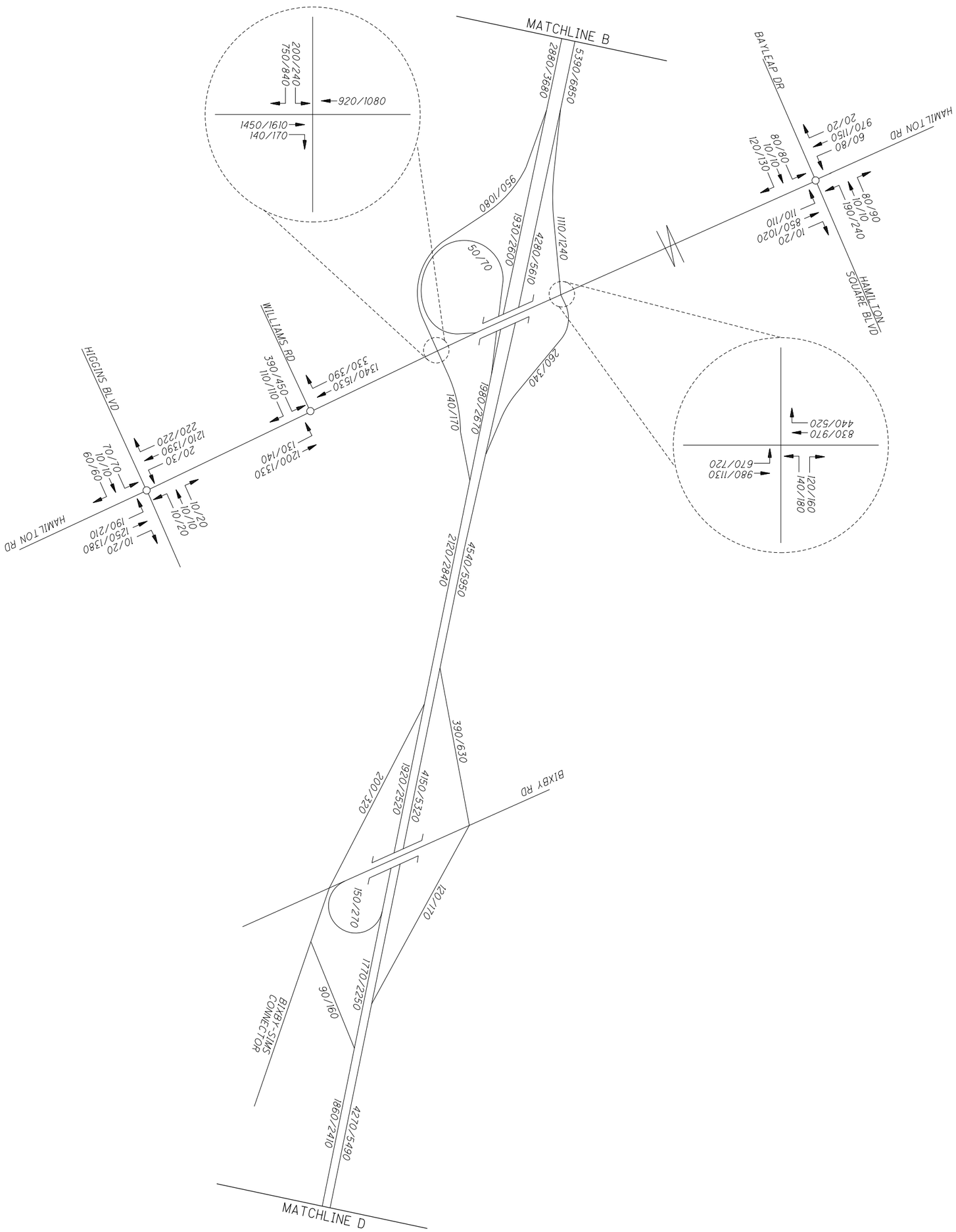
2 / 48	PID 111460	FRA/FAI - US 33 FEASIBILITY STUDY 2019 EXISTING ADT VOLUMES	ANALYST MEL DATE 08/28/20	NOT TO SCALE



6 / 48	PID 111460	FRA/FAI - US 33 FEASIBILITY STUDY 2019 EXISTING AM/PM VOLUMES	ANALYST MEL DATE 08/28/20	NOT TO SCALE



10 / 48	PID 111460	FRA/FAI - US 33 FEASIBILITY STUDY 2025/2045 NO-BUILD ADT VOLUMES	ANALYST MEL DATE 08/28/20	NOT TO SCALE



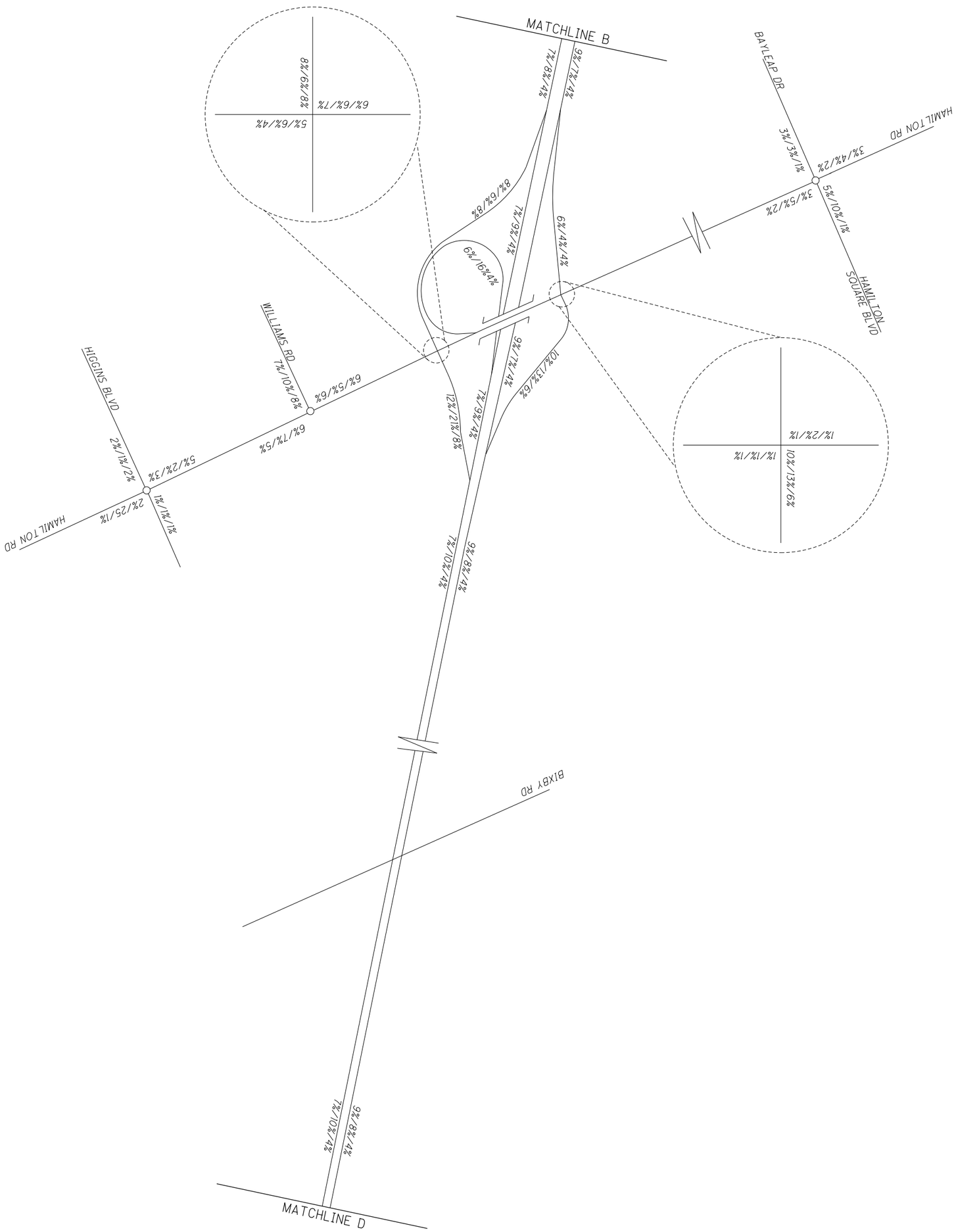
48 / 141	PID 111460	FRA/FAI - US 33 FEASIBILITY STUDY 2025/2045 NO-BUILD AM VOLUMES	ANALYST MEL DATE 08/28/20	NOT TO SCALE

NOT TO SCALE

ANALYST MEL
DATE 08/28/20

FRA / FAI - US 33 FEASIBILITY STUDY
2025 / 2045 NO-BUILD PM VOLUMES

PID 111460



46 / 48	**PID 111460**	**FRA/FAI - US 33 FEASIBILITY STUDY** **T24/AM/PM TRUCK PERCENTAGES**	ANALYST MEL DATE 08/28/20	NOT TO SCALE	

APPENDIX D
CAPACITY ANALYSIS

ASSOCIATED PHASE	DIRECTION	MOVEMENT	TRAFFIC SIGNAL														PEDESTRIAN													
			FACTORS *(TEM 403-2)								CALCULATED (TEM 403-2)			FINAL CLEARANCE											3 fps CHECKS (OMUTCD 4E.06, 01-14)				FINAL PED TIMING	
			POSTED SPEED LIMIT	PERCEPTION/REACTION TIME (1s TYP)	YELLOW CHANGE APPROACH SPEED*	RED APPROACH SPEED*	DECELERATION RATE (10 fps TYP)	WIDTH OF INTERSECTION*	LENGTH OF VEHICLE (20 ft TYP)	APPROACH GRADE	YELLOW	RED	Y + R	YELLOW	RED	Y + R	PED MOVEMENT	ASSOCIATED PHASE	CROSSWALK LENGTH	PUSHBUTTON PROVIDED	DISTANCE TO PUSHBUTTON FROM CURB	OMUTCD 4E.06-12	OMUTCD 4E.06-07		(L+P)/(3 fps) (NOTE: P=6 IF NO PUSHBUTTON)	WALK + PED CHANGE INTERVALS	IS Y>=X?		FINAL WALK INTERVAL	FINAL PED CHANGE INTERVAL (FDW)
				t	V_Y	V_R	a	W	L	g	Y	R	TOTAL	Y (3-6s TYP)	R (1-6s TYP)	TOTAL			L		P	WALK INTERVAL (4-7s TYP)	CALCULATED PED CLEARANCE	PED CHANGE INTERVAL (FDW)	X	Y		ADDITIONAL WALK INTERVAL REQUIRED		
																							= 3.5 fps WALK TIME	= 3.5 fps WALK TIME - 3 sec BUFFER						
			MPH	SEC	MPH	MPH	FPS	FT	FT	%	SEC	SEC	SEC	SEC	SEC	SEC			FT		FT	SEC	SEC	SEC	SEC	SEC		SEC	SEC	SEC
1	NB	THROUGH/RT	50	1	57	57	10	147	20	-2	5.5	1.0	6.5	5.5	1	6.5	-	-	-	-	-	-	-	-	-	-	-	-	-	-
2	EB	THROUGH/RT	50	1	57	57	10	98	20	3	4.8	0.4	5.2	4.8	1	5.8	-	-	-	-	-	-	-	-	-	-	-	-	-	-
3	NB LT	LEFT TURN	50	1	45	25	10	147	20	2	4.1	3.5	7.6	4.1	3.5	7.6	-	-	-	-	-	-	-	-	-	-	-	-	-	-
4	-	-	-	1	-	-	10	-	20	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
5	-	-	-	1	-	-	10	-	20	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
6	-	-	-	1	-	-	10	-	20	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
7	-	-	-	1	-	-	10	-	20	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
8	-	-	-	1	-	-	10	-	20	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

ASSOCIATED PHASE	DIRECTION	MOVEMENT	TRAFFIC SIGNAL														PEDESTRIAN													
			FACTORS *(TEM 403-2)								CALCULATED (TEM 403-2)			FINAL CLEARANCE											3 fps CHECKS (OMUTCD 4E.06, 01-14)				FINAL PED TIMING	
			POSTED SPEED LIMIT	PERCEPTION/REACTION TIME (1s TYP)	YELLOW CHANGE APPROACH SPEED*	RED APPROACH SPEED*	DECELERATION RATE (10 fps TYP)	WIDTH OF INTERSECTION*	LENGTH OF VEHICLE (20 ft TYP)	APPROACH GRADE	YELLOW	RED	Y + R	YELLOW	RED	Y + R	PED MOVEMENT	ASSOCIATED PHASE	CROSSWALK LENGTH	PUSHBUTTON PROVIDED	DISTANCE TO PUSHBUTTON FROM CURB	OMUTCD 4E.06-12 WALK INTERVAL (4-7s TYP)	OMUTCD 4E.06-07 CALCULATED PED CLEARANCE	PED CHANGE INTERVAL (FDW)	(L+P)/(3 fps) (NOTE: P=6 IF NO PUSHBUTTON)	WALK + PED CHANGE INTERVALS	IS Y>=X?	ADDITIONAL WALK INTERVAL REQUIRED	FINAL WALK INTERVAL	FINAL PED CHANGE INTERVAL (FDW)
				t	V_Y	V_R	a	W	L	g	Y	R	TOTAL	Y (3-6s TYP)	R (1-6s TYP)	TOTAL			L		P		= 3.5 fps WALK TIME	= 3.5 fps WALK TIME - 3 sec BUFFER	X	Y				
			MPH	SEC	MPH	MPH	FPS	FT	FT	%	SEC	SEC	SEC	SEC	SEC	SEC			FT		FT	SEC	SEC	SEC	SEC	SEC		SEC	SEC	SEC
1	NB	THROUGH/RT	50	1	57	57	10	147	20	-2	5.5	1.0	6.5	5.5	1	6.5	-	-	-	-	-	-	-	-	-	-	-	-	-	-
2	EB	THROUGH/RT	45	1	52	52	10	54	20	0	4.8	0.0	4.8	4.8	1	5.8	-	-	-	-	-	-	-	-	-	-	-	-	-	-
3	-	-	-	1	-	-	10	-	20	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
4	-	-	-	1	-	-	10	-	20	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
5	-	-	-	1	-	-	10	-	20	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
6	-	-	-	1	-	-	10	-	20	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
7	-	-	-	1	-	-	10	-	20	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
8	-	-	-	1	-	-	10	-	20	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

ASSOCIATED PHASE	DIRECTION	MOVEMENT	TRAFFIC SIGNAL														PEDESTRIAN													
			FACTORS *(TEM 403-2)								CALCULATED (TEM 403-2)			FINAL CLEARANCE											3 fps CHECKS (OMUTCD 4E.06, 01-14)				FINAL PED TIMING	
			POSTED SPEED LIMIT	PERCEPTION/REACTION TIME (1s TYP)	YELLOW CHANGE APPROACH SPEED*	RED APPROACH SPEED*	DECELERATION RATE (10 fps TYP)	WIDTH OF INTERSECTION*	LENGTH OF VEHICLE (20 ft TYP)	APPROACH GRADE	YELLOW	RED	Y + R	YELLOW	RED	Y + R	PED MOVEMENT	ASSOCIATED PHASE	CROSSWALK LENGTH	PUSHBUTTON PROVIDED	DISTANCE TO PUSHBUTTON FROM CURB	WALK INTERVAL (4-7s TYP)	CALCULATED PED CLEARANCE	PED CHANGE INTERVAL (FDW)	(L+P)/(3 fps) (NOTE: P=6 IF NO PUSHBUTTON)	WALK + PED CHANGE INTERVALS	IS Y>=X?	ADDITIONAL WALK INTERVAL REQUIRED	FINAL WALK INTERVAL	FINAL PED CHANGE INTERVAL (FDW)
			t	V_Y	V_R	a	W	L	g	Y	R	TOTAL	Y (3-6s TYP)	R (1-6s TYP)	TOTAL			L		P		= 3.5 fps WALK TIME	= 3.5 fps WALK TIME - 3 sec BUFFER	X	Y				
			MPH	SEC	MPH	MPH	FPS	FT	FT	%	SEC	SEC	SEC	SEC	SEC	SEC			FT		FT	SEC	SEC	SEC	SEC	SEC		SEC	SEC	SEC
1	NB	THROUGH/RT	50	1	57	57	10	107	20	0	5.2	0.5	5.7	5.2	1	6.2	-	-	-	-	-	-	-	-	-	-	-	-	-	-
2	WB	THROUGH/RT	45	1	52	52	10	79	20	0	4.8	0.3	5.1	4.8	1	5.8	-	-	-	-	-	-	-	-	-	-	-	-	-	-
3	NB LT	LEFT TURN	50	1	45	25	10	107	20	0	4.3	2.5	6.8	4.3	2.5	6.8	-	-	-	-	-	-	-	-	-	-	-	-	-	-
4	-	-	-	1	-	-	10	-	20	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
5	-	-	-	1	-	-	10	-	20	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
6	-	-	-	1	-	-	10	-	20	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
7	-	-	-	1	-	-	10	-	20	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
8	-	-	-	1	-	-	10	-	20	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

2020 EXISTING CAPACITY ANALYSIS

HCS7 Freeway Facilities Report

Project Information

Analyst	TVF	Date	12/16/2020
Agency	LJB	Analysis Year	2020
Jurisdiction		Time Period Analyzed	AM 2020 Existing
Project Description	EB US33	Unit	United States Customary

Facility Global Input

Jam Density, pc/mi/ln	190.0	Density at Capacity, pc/mi/ln	45.0
Queue Discharge Capacity Drop, %	7	Total Segments	13
Total Time Periods	1	Time Period Duration, min	15
Facility Length, mi	4.23		

Facility Segment Data

No.	Coded	Analyzed	Name	Length, ft	Lanes
1	Basic	Basic	Eb US33 S of 104	3020	2
2	Diverge	Diverge	Eb US33 to I270 Ramp	1500	2
3	Basic	Basic	Eb US33 2 Lane Segment	710	2
4	Basic	Basic	Eb US33 3 Lane Segment	130	3
5	Weaving	Weaving	Eb US33 (Weave)	1476	4
6	Basic	Basic	Eb US33	410	3
7	Merge	Merge	Nb I270 to Eb US33 (Long Ramp)	1500	3
8	Basic	Basic	Eb US33	990	3
9	Diverge	Basic	Eb US33 to Hamilton (Long Ramp)	1500	3
10	Basic	Basic	Eb US33	1350	2
11	Merge	Merge	Sb Hamilton to Eb US33 Ramp	1400	2
12	Merge	Merge	Nb Hamilton to Eb US33 Ramp	1500	2
13	Basic	Basic	Eb US33 W of Bixby Signal	6850	2

Facility Segment Data

Segment 1: Basic

Time Period	PHF	fHV	Flow Rate (pc/h)	Capacity (pc/h)	d/c Ratio	Speed (mi/h)	Density (pc/mi/ln)	LOS
1	0.94	0.926	1735	4626	0.38	61.3	14.2	B

Segment 2: Diverge

Time Period	PHF		fHV		Flow Rate (pc/h)		Capacity (pc/h)		d/c Ratio		Speed (mi/h)		Density (pc/mi/ln)		LOS
	F	R	F	R	Freeway	Ramp	Freeway	Ramp	F	R	F	R	Freeway	Ramp	
1	0.94	0.94	0.926	0.926	1735	253	4700	2100	0.37	0.12	59.1	59.1	14.7	14.5	B

Segment 3: Basic

Time Period	PHF	fHV	Flow Rate (pc/h)	Capacity (pc/h)	d/c Ratio	Speed (mi/h)	Density (pc/mi/ln)	LOS
1	0.94	0.926	1482	4626	0.32	60.9	12.1	B

Segment 4: Basic

Time Period	PHF	fHV	Flow Rate (pc/h)	Capacity (pc/h)	d/c Ratio	Speed (mi/h)	Density (pc/mi/ln)	LOS
1	0.94	0.926	1482	6939	0.21	61.1	8.1	A

Segment 5: Weaving

Time Period	PHF	fHV	Flow Rate (pc/h)	Capacity (pc/h)	d/c Ratio	Speed (mi/h)	Density (pc/mi/ln)	LOS
1	0.94	0.926	2250	5607	0.40	52.8	10.7	B

Segment 6: Basic

Time Period	PHF	fHV	Flow Rate (pc/h)	Capacity (pc/h)	d/c Ratio	Speed (mi/h)	Density (pc/mi/ln)	LOS
1	0.94	0.926	2056	6939	0.30	59.5	11.2	B

Segment 7: Merge

Time Period	PHF		fHV		Flow Rate (pc/h)		Capacity (pc/h)		d/c Ratio		Speed (mi/h)		Density (pc/mi/ln)		LOS
	F	R	F	R	Freeway	Ramp	Freeway	Ramp	F	R	F	R	Freeway	Ramp	
1	0.94	0.94	0.926	0.893	2675	619	7050	2000	0.38	0.31	60.3	58.9	14.8	13.5	B

Segment 8: Basic

Time Period	PHF	fHV	Flow Rate (pc/h)	Capacity (pc/h)	d/c Ratio	Speed (mi/h)	Density (pc/mi/ln)	LOS
1	0.94	0.926	2654	6939	0.38	61.2	14.4	B

Segment 9: Diverge

Time Period	PHF		fHV		Flow Rate (pc/h)		Capacity (pc/h)		d/c Ratio		Speed (mi/h)		Density (pc/mi/ln)		LOS
	F	R	F	R	Freeway	Ramp	Freeway	Ramp	F	R	F	R	Freeway	Ramp	
1	0.94	0.94	0.926	0.943	2654	903	7050	2000	0.38	0.45	64.5	65.0	13.6	13.6	B

Segment 10: Basic

Time Period	PHF	fHV	Flow Rate (pc/h)	Capacity (pc/h)	d/c Ratio	Speed (mi/h)	Density (pc/mi/ln)	LOS
1	0.94	0.917	1752	4626	0.38	61.3	14.3	B

Segment 11: Merge

Time Period	PHF		fHV		Flow Rate (pc/h)		Capacity (pc/h)		d/c Ratio		Speed (mi/h)		Density (pc/mi/ln)		LOS
	F	R	F	R	Freeway	Ramp	Freeway	Ramp	F	R	F	R	Freeway	Ramp	
1	0.94	0.94	0.917	0.862	1801	49	4700	2000	0.38	0.02	58.2	58.2	15.5	15.2	B

Segment 12: Merge

Time Period	PHF		fHV		Flow Rate (pc/h)		Capacity (pc/h)		d/c Ratio		Speed (mi/h)		Density (pc/mi/ln)		LOS
	F	R	F	R	Freeway	Ramp	Freeway	Ramp	F	R	F	R	Freeway	Ramp	
1	0.94	0.94	0.917	0.826	1940	142	4700	2100	0.41	0.07	58.7	58.7	16.5	15.6	B

Segment 13: Basic

Time Period	PHF	fHV	Flow Rate (pc/h)	Capacity (pc/h)	d/c Ratio	Speed (mi/h)	Density (pc/mi/ln)	LOS
1	0.94	0.909	1943	4626	0.42	61.3	15.9	B

Facility Time Period Results

T	Speed, mi/h	Density, pc/mi/ln	Density, veh/mi/ln	Travel Time, min	LOS
1	60.2	14.3	13.1	4.20	B

Facility Overall Results

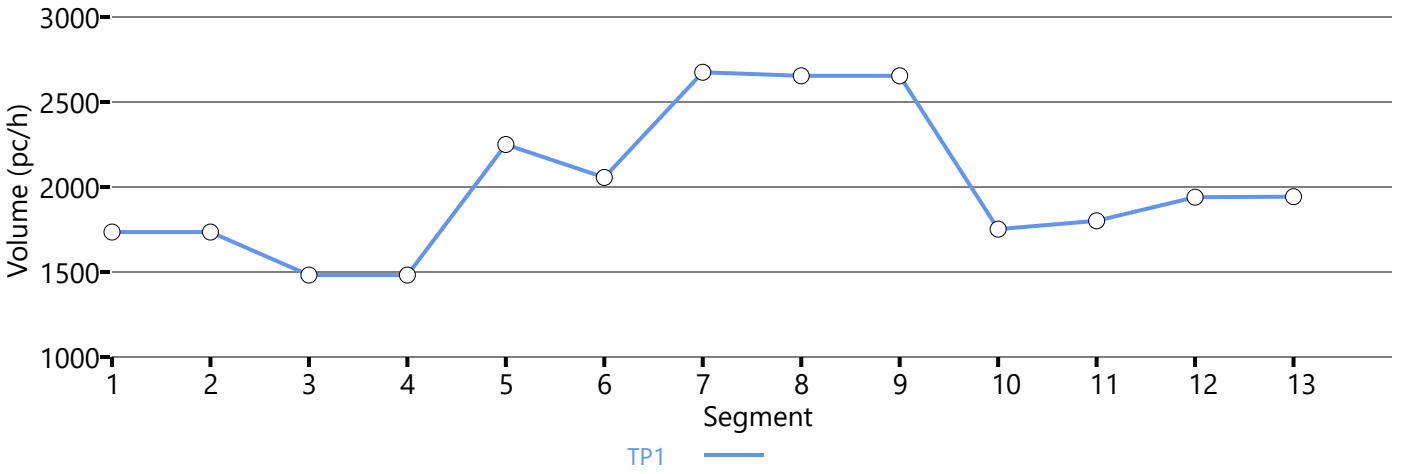
Space Mean Speed, mi/h	60.2	Density, veh/mi/ln	13.1
Average Travel Time, min	4.20	Density, pc/mi/ln	14.3

Messages

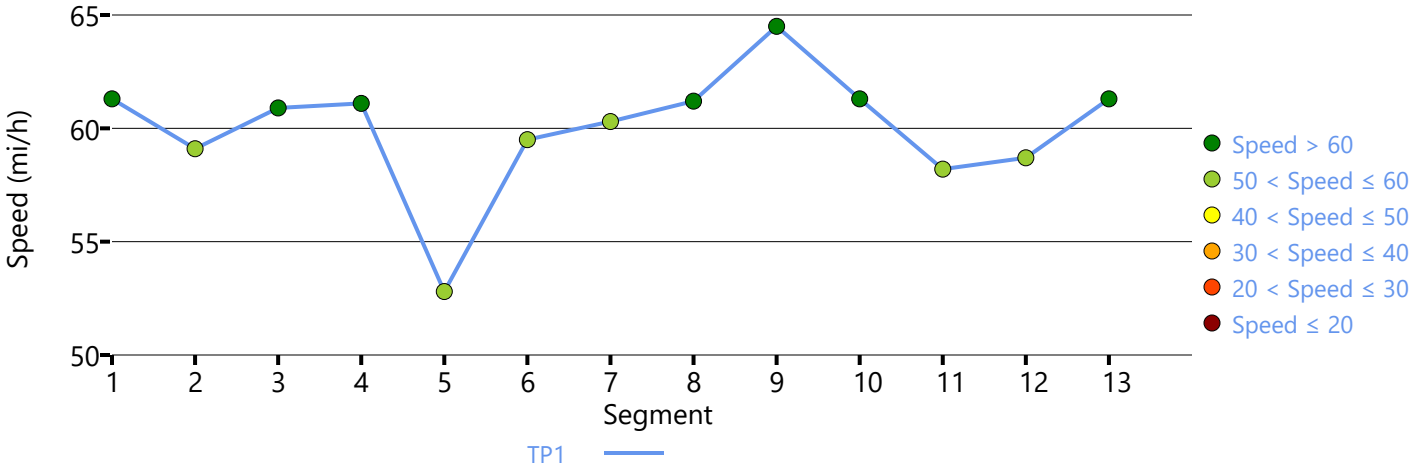
WARNING 1	Weaving Segment (segment 5) is shorter than the segment short length allows. Weaving segments include 500 feet upstream and downstream of gore point. Short length is at a maximum the gore to gore length, and is reduced for any barrier markings (solid white lines) that prohibit or discourage lane changing. Review the values set for Segment length on the Segments page and Short Length on the details page.

Comments

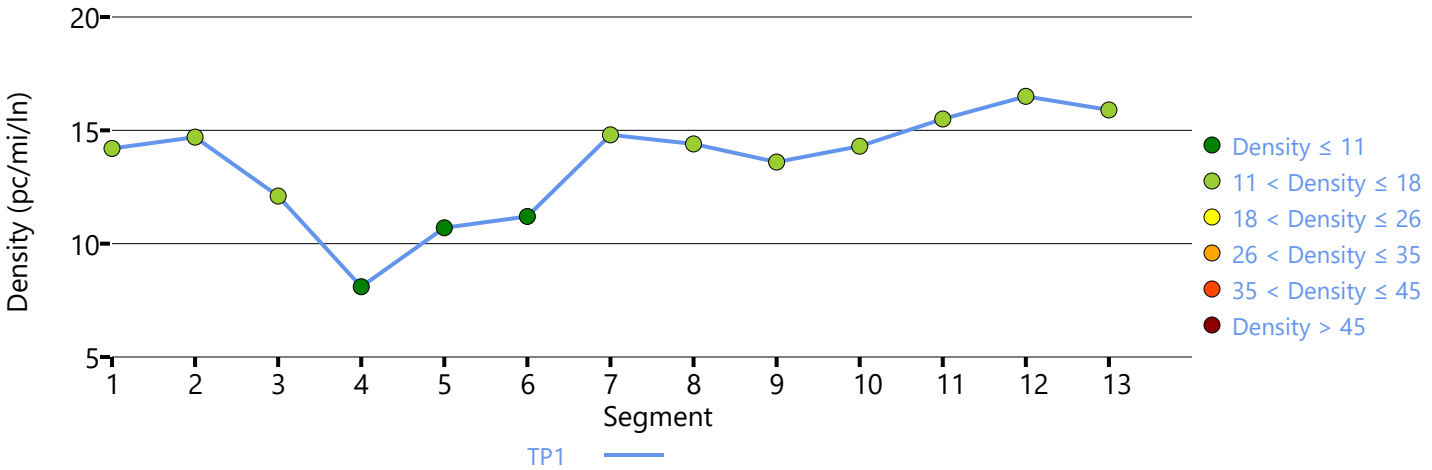
Volume Distribution



Speed Distribution



Density Distribution



HCS7 Freeway Facilities Report

Project Information

Analyst	TVF	Date	12/16/2020
Agency	LJB	Analysis Year	2020
Jurisdiction		Time Period Analyzed	AM 2020 Existing
Project Description	WB US33	Unit	United States Customary

Facility Global Input

Jam Density, pc/mi/ln	190.0	Density at Capacity, pc/mi/ln	45.0
Queue Discharge Capacity Drop, %	7	Total Segments	9
Total Time Periods	1	Time Period Duration, min	15
Facility Length, mi	4.29		

Facility Segment Data

No.	Coded	Analyzed	Name	Length, ft	Lanes
1	Basic	Basic	Wb US33 W of Bixby	7970	2
2	Diverge	Diverge	Wb US33 to Hamilton Ramp	1500	2
3	Basic	Basic	Wb US33	1800	2
4	Weaving	Weaving	Wb US33 (Weave)	4557	3
5	Overlap	Basic	Wb US33 (Overlap)	90	2
6	Weaving	Weaving	Wb US33 (Weave)	1449	3
7	Basic	Basic	Wb US33	830	2
8	Merge	Merge	Sb I270 to Wb US33 Ramp	1500	2
9	Basic	Basic	Wb US33	2960	2

Facility Segment Data

Segment 1: Basic

Time Period	PHF	fHV	Flow Rate (pc/h)	Capacity (pc/h)	d/c Ratio	Speed (mi/h)	Density (pc/mi/ln)	LOS
1	0.94	0.926	4147	4636	0.89	56.9	36.4	E

Segment 2: Diverge

Time Period	PHF		fHV		Flow Rate (pc/h)		Capacity (pc/h)		d/c Ratio		Speed (mi/h)		Density (pc/mi/ln)		LOS
	F	R	F	R	Freeway	Ramp	Freeway	Ramp	F	R	F	R	Freeway	Ramp	
1	0.94	0.94	0.926	0.885	4147	240	4700	2100	0.88	0.11	57.6	57.6	36.0	34.1	D

Segment 3: Basic

Time Period	PHF	fHV	Flow Rate (pc/h)	Capacity (pc/h)	d/c Ratio	Speed (mi/h)	Density (pc/mi/ln)	LOS
1	0.94	0.935	3880	4636	0.84	59.0	32.9	D

Segment 4: Weaving

Time Period	PHF	fHV	Flow Rate (pc/h)	Capacity (pc/h)	d/c Ratio	Speed (mi/h)	Density (pc/mi/ln)	LOS
1	0.94	0.935	4893	6513	0.75	48.2	33.8	D

Segment 5: Overlap

Time Period	PHF	fHV	Flow Rate (pc/h)	Capacity (pc/h)	d/c Ratio	Speed (mi/h)	Density (pc/mi/ln)	LOS
1	0.94	0.935	3550	4636	0.77	60.8	29.2	D

Segment 6: Weaving

Time Period	PHF	fHV	Flow Rate (pc/h)	Capacity (pc/h)	d/c Ratio	Speed (mi/h)	Density (pc/mi/ln)	LOS
1	0.94	0.935	3722	6111	0.61	52.7	23.5	C

Segment 7: Basic

Time Period	PHF	fHV	Flow Rate (pc/h)	Capacity (pc/h)	d/c Ratio	Speed (mi/h)	Density (pc/mi/ln)	LOS
1	0.94	0.935	3129	4636	0.67	60.4	25.3	C

Segment 8: Merge

Time Period	PHF		fHV		Flow Rate (pc/h)		Capacity (pc/h)		d/c Ratio		Speed (mi/h)		Density (pc/mi/ln)		LOS
	F	R	F	R	Freeway	Ramp	Freeway	Ramp	F	R	F	R	Freeway	Ramp	
1	0.94	0.94	0.935	0.935	3391	262	4700	2100	0.72	0.12	56.3	56.3	30.1	27.7	C

Segment 9: Basic

Time Period	PHF	fHV	Flow Rate (pc/h)	Capacity (pc/h)	d/c Ratio	Speed (mi/h)	Density (pc/mi/ln)	LOS
1	0.94	0.935	3391	4636	0.73	61.3	27.7	D

Facility Time Period Results

T	Speed, mi/h	Density, pc/mi/ln	Density, veh/mi/ln	Travel Time, min	LOS
1	54.9	32.6	29.7	4.70	D

Facility Overall Results

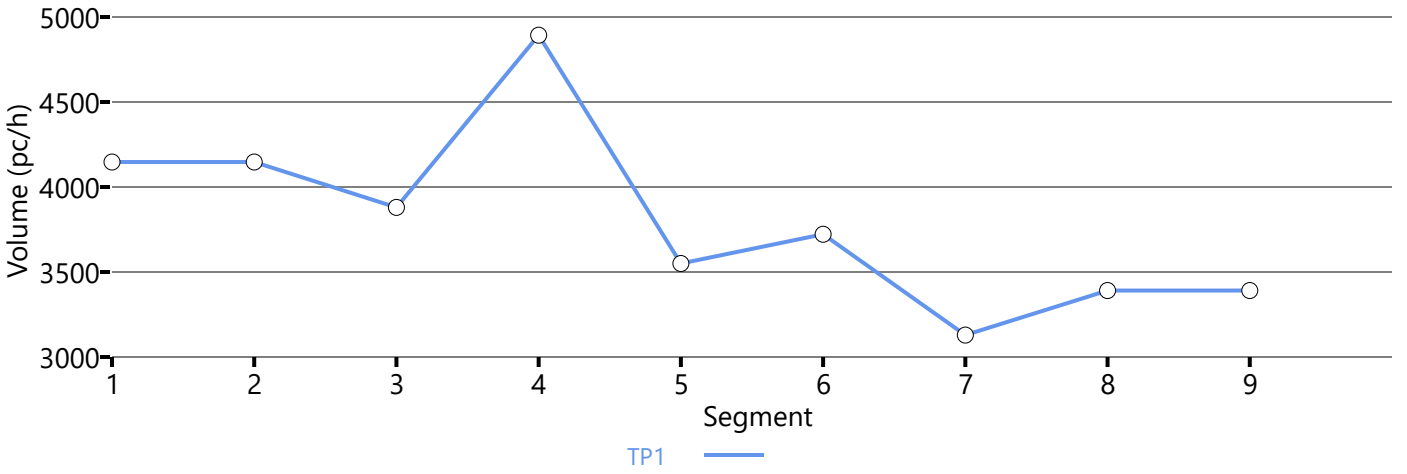
Space Mean Speed, mi/h	54.9	Density, veh/mi/ln	29.7
Average Travel Time, min	4.70	Density, pc/mi/ln	32.6

Messages

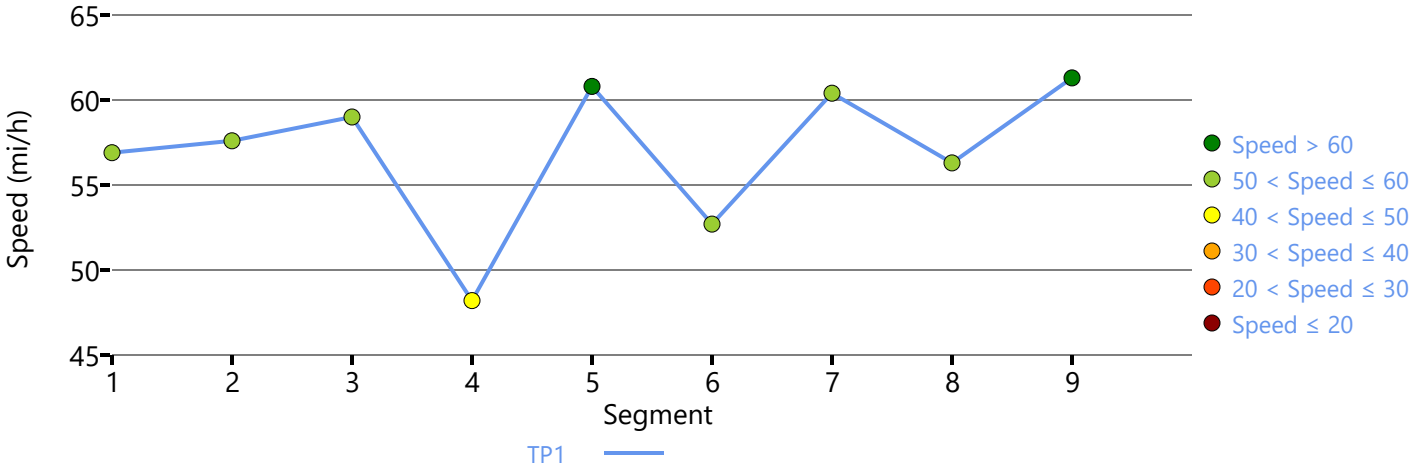
WARNING 1	Sum of lengths of ramp overlap segment (segment 5) and an adjacent ramp segment (segment 4) should be 1500 feet.
WARNING 2	Sum of lengths of ramp overlap segment (segment 5) and an adjacent ramp segment (segment 6) should be 1500 feet.
WARNING 3	Weaving Segment (segment 4) is shorter than the segment short length allows. Weaving segments include 500 feet upstream and downstream of gore point. Short length is at a maximum the gore to gore length, and is reduced for any barrier markings (solid white lines) that prohibit or discourage lane changing. Review the values set for Segment length on the Segments page and Short Length on the details page.
WARNING 4	Weaving Segment (segment 6) is shorter than the segment short length allows. Weaving segments include 500 feet upstream and downstream of gore point. Short length is at a maximum the gore to gore length, and is reduced for any barrier markings (solid white lines) that prohibit or discourage lane changing. Review the values set for Segment length on the Segments page and Short Length on the details page.

Comments

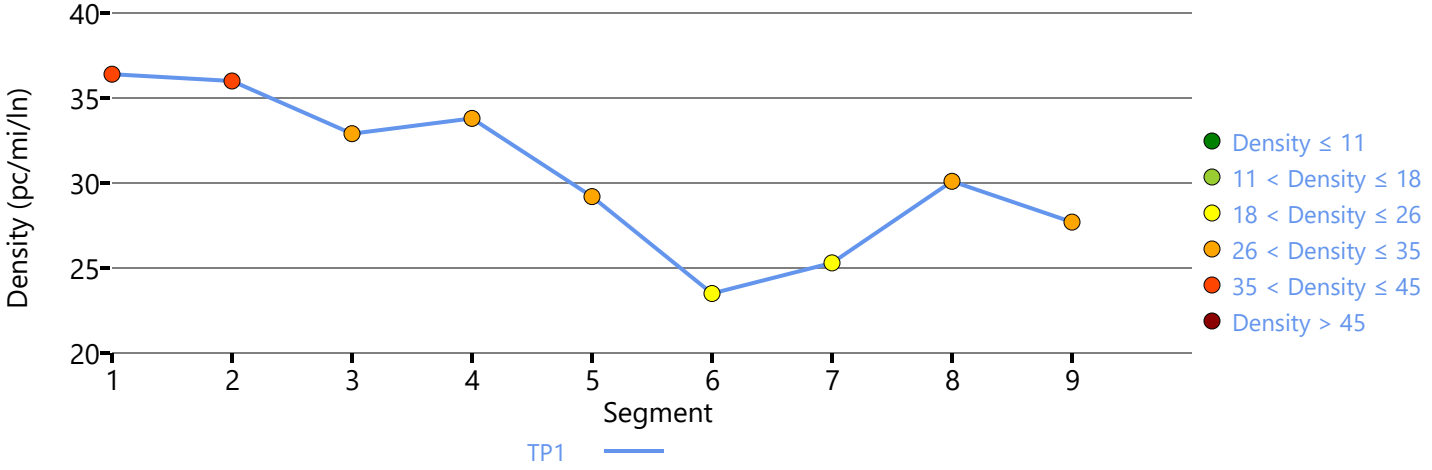
Volume Distribution



Speed Distribution

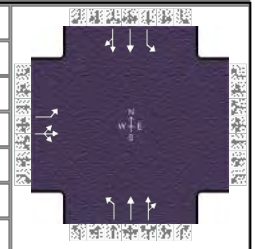


Density Distribution



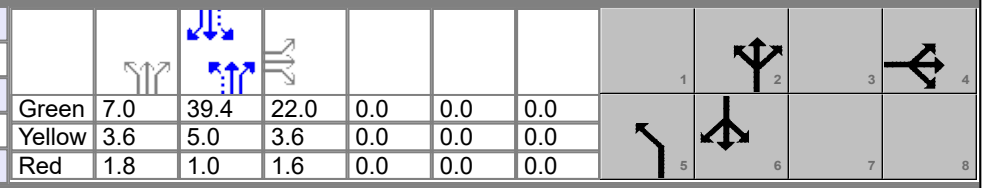
HCS7 Signalized Intersection Input Data

General Information				Intersection Information	
Agency	LJB			Duration, h	0.250
Analyst	TVF	Analysis Date	Oct 8, 2020	Area Type	Other
Jurisdiction	Columbus	Time Period	AM Peak	PHF	0.92
Urban Street	S Hamilton Rd	Analysis Year	2020	Analysis Period	1> 7:00
Intersection	Williams Rd	File Name	S Hamilton Rd Intersections AM Existing.xus		
Project Description	S Hamiilton Rd & US 33 Safety Study				



Demand Information	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Demand (*v*), veh/h	330	5	90				110	1000	5	5	1120	290

Signal Information			
Cycle, s	85.0	Reference Phase	2
Offset, s	51	Reference Point	End
Uncoordinated	No	Simult. Gap E/W	On
Force Mode	Float	Simult. Gap N/S	On



	EB			WB			NB			SB		
Green	7.0	39.4		22.0	0.0	0.0	0.0					
Yellow	3.6	5.0		3.6	0.0	0.0	0.0					
Red	1.8	1.0		1.6	0.0	0.0	0.0					

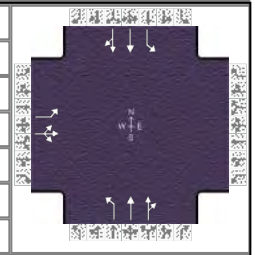
Traffic Information	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Demand (*v*), veh/h	330	5	90				110	1000	5	5	1120	290
Initial Queue (Q_b), veh/h	0	0	0				0	0	0	0	0	0
Base Saturation Flow Rate (s_o), veh/h	1900	1900	1900				1900	1900	1900	1900	1900	1900
Parking (N_m), man/h		None						None			None	
Heavy Vehicles (P_{HV}), %	10	10					7	7		5	5	
Ped / Bike / RTOR, /h	0	0	0	0	0		0	0	0	0	0	0
Buses (N_b), buses/h	0	0	0				0	0	0	0	0	0
Arrival Type (*AT*)	3	3	3				3	4	3	3	4	4
Upstream Filtering (*I*)	1.00	1.00	1.00				1.00	1.00	1.00	0.49	0.49	0.49
Lane Width (*W*), ft	12.0	12.0					12.0	12.0		12.0	12.0	
Turn Bay Length, ft	500	700					85	1200		140	300	
Grade (*Pg*), %		0			0			0			0	
Speed Limit, mi/h	50	50	50				50	50	50	50	50	50

Phase Information	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Maximum Green (G_{max}) or Phase Split, s		27.2			12.4	57.8		45.4
Yellow Change Interval (*Y*), s		3.6			3.6	5.0		5.0
Red Clearance Interval (R_c), s		1.6			1.8	1.0		1.0
Minimum Green (G_{min}), s		7			7	20		20
Start-Up Lost Time (*l1*), s	2.0	2.0			2.0	2.0	2.0	2.0
Extension of Effective Green (*e*), s	2.0	2.0			2.0	2.0	2.0	2.0
Passage (*PT*), s		4.0			3.7	3.0		3.0
Recall Mode		Min			Off	Min		Min
Dual Entry		Yes			No	Yes		Yes
Walk (*Walk*), s		0.0		0.0				0.0
Pedestrian Clearance Time (*PC*), s		0.0		0.0				0.0

Multimodal Information	EB			WB			NB			SB		
85th % Speed / Rest in Walk / Corner Radius	0	No	25	0	No	25				0	No	25
Walkway / Crosswalk Width / Length, ft	9.0	12	0	9.0	12	0				9.0	12	0
Street Width / Island / Curb	0	0	No		0		0		No	0	0	No
Width Outside / Bike Lane / Shoulder, ft	12	5.0	2.0				12	5.0	2.0	12	5.0	2.0
Pedestrian Signal / Occupied Parking	No	0.50		No				0.50		No	0.50	

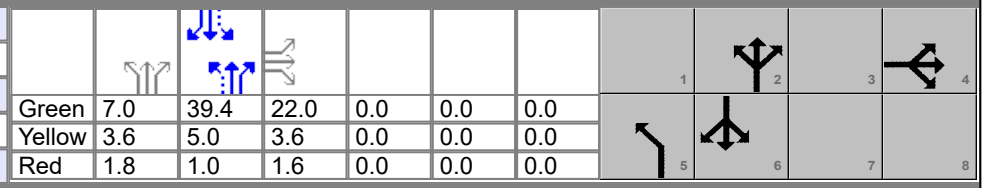
HCS7 Signalized Intersection Results Summary

General Information				Intersection Information	
Agency	LJB			Duration, h	0.250
Analyst	TVF	Analysis Date	Oct 8, 2020	Area Type	Other
Jurisdiction	Columbus	Time Period	AM Peak	PHF	0.92
Urban Street	S Hamilton Rd	Analysis Year	2020	Analysis Period	1> 7:00
Intersection	Williams Rd	File Name	S Hamilton Rd Intersections AM Existing.xus		
Project Description	S Hamiilton Rd & US 33 Safety Study				



Demand Information	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Demand (*v*), veh/h	330	5	90				110	1000	5	5	1120	290

Signal Information			
Cycle, s	85.0	Reference Phase	2
Offset, s	51	Reference Point	End
Uncoordinated	No	Simult. Gap E/W	On
Force Mode	Float	Simult. Gap N/S	On



Green	7.0	39.4	22.0	0.0	0.0	0.0
Yellow	3.6	5.0	3.6	0.0	0.0	0.0
Red	1.8	1.0	1.6	0.0	0.0	0.0

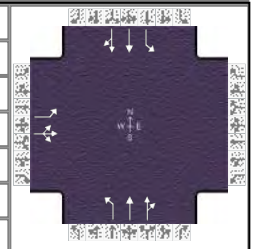
Timer Results	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Assigned Phase		4			5	2		6
Case Number		10.0			1.0	4.0		6.3
Phase Duration, s		27.2			12.4	57.8		45.4
Change Period, ($Y+R_c$), s		5.2			5.4	6.0		6.0
Max Allow Headway (*MAH*), s		5.1			4.7	0.0		0.0
Queue Clearance Time (g_s), s		13.5			4.8			
Green Extension Time (g_e), s		1.7			0.1	0.0		0.0
Phase Call Probability		1.00			1.00			
Max Out Probability		0.37			1.00			

Movement Group Results	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Assigned Movement	7	4	14				5	2	12	1	6	16
Adjusted Flow Rate (*v*), veh/h	215	247					120	547	546	5	762	722
Adjusted Saturation Flow Rate (*s*), veh/h/ln	1668	1596					1711	1796	1793	504	1826	1697
Queue Service Time (g_s), s	9.3	11.5					2.8	8.2	8.2	0.5	32.2	34.1
Cycle Queue Clearance Time (g_c), s	9.3	11.5					2.8	8.2	8.2	0.5	32.2	34.1
Green Ratio (*g/C*)	0.26	0.26					0.57	0.61	0.61	0.46	0.46	0.46
Capacity (*c*), veh/h	432	413					247	1095	1093	318	846	787
Volume-to-Capacity Ratio (*X*)	0.498	0.597					0.484	0.499	0.499	0.017	0.900	0.918
Back of Queue (*Q*), ft/ln (95 th percentile)	171.8	208.6					49.9	102.8	98.1	2.6	433.5	460.8
Back of Queue (*Q*), veh/ln (95 th percentile)	6.4	7.7					1.9	3.9	3.9	0.1	16.7	18.4
Queue Storage Ratio (*RQ*) (95 th percentile)	0.34	0.30					0.59	0.09	0.09	0.02	1.44	1.60
Uniform Delay (d_1), s/veh	26.8	27.6					18.1	3.9	3.9	13.7	19.5	22.9
Incremental Delay (d_2), s/veh	1.3	2.8					1.9	1.6	1.6	0.0	7.9	9.9
Initial Queue Delay (d_3), s/veh	0.0	0.0					0.0	0.0	0.0	0.0	0.0	0.0
Control Delay (*d*), s/veh	28.1	30.4					20.0	5.5	5.6	13.7	27.4	32.7
Level of Service (LOS)	C	C					B	A	A	B	C	C
Approach Delay, s/veh / LOS	29.3	C		0.0			7.0	A		29.9	C	
Intersection Delay, s/veh / LOS	21.0						C					

Multimodal Results	EB		WB		NB		SB	
Pedestrian LOS Score / LOS	2.31	B	2.31	B	1.36	A	1.90	B
Bicycle LOS Score / LOS	1.25	A			1.49	A	1.76	B

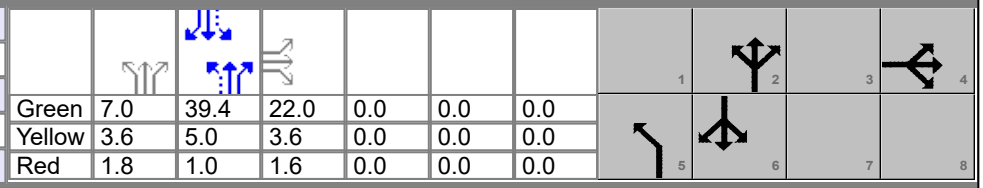
HCS7 Signalized Intersection Intermediate Values

General Information				Intersection Information	
Agency	LJB			Duration, h	0.250
Analyst	TVF	Analysis Date	Oct 8, 2020	Area Type	Other
Jurisdiction	Columbus	Time Period	AM Peak	PHF	0.92
Urban Street	S Hamilton Rd	Analysis Year	2020	Analysis Period	1> 7:00
Intersection	Williams Rd	File Name	S Hamilton Rd Intersections AM Existing.xus		
Project Description	S Hamiilton Rd & US 33 Safety Study				



Demand Information	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Demand (*v*), veh/h	330	5	90				110	1000	5	5	1120	290

Signal Information			
Cycle, s	85.0	Reference Phase	2
Offset, s	51	Reference Point	End
Uncoordinated	No	Simult. Gap E/W	On
Force Mode	Float	Simult. Gap N/S	On



Green	7.0	39.4	22.0	0.0	0.0	0.0						
Yellow	3.6	5.0	3.6	0.0	0.0	0.0						
Red	1.8	1.0	1.6	0.0	0.0	0.0						

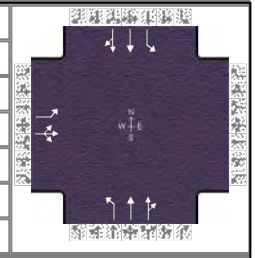
Saturation Flow / Delay	L	T	R	L	T	R	L	T	R	L	T	R
Lane Width Adjustment Factor (f_w)	1.000	1.000	1.000				1.000	1.000	1.000	1.000	1.000	1.000
Heavy Vehicles and Grade Factor (f_{HVg})	0.922	0.922	1.000				0.945	0.945	1.000	0.961	0.961	1.000
Parking Activity Adjustment Factor (f_p)	1.000	1.000	1.000	0.000	0.000	0.000	1.000	1.000	1.000	1.000	1.000	1.000
Bus Blockage Adjustment Factor (f_{bb})	1.000	1.000	1.000	0.000	0.000	0.000	1.000	1.000	1.000	1.000	1.000	1.000
Area Type Adjustment Factor (f_a)	1.000	1.000	1.000				1.000	1.000	1.000	1.000	1.000	1.000
Lane Utilization Adjustment Factor (f_{LU})	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
Left-Turn Adjustment Factor (f_{LT})	0.952	0.000					0.952	0.000		0.265	0.000	
Right-Turn Adjustment Factor (f_{RT})		0.854	0.854					0.998	0.998		0.929	0.929
Left-Turn Pedestrian Adjustment Factor (f_{Lpb})	1.000						1.000			1.000		
Right-Turn Ped-Bike Adjustment Factor (f_{Rpb})			1.000						1.000			1.000
Work Zone Adjustment Factor (f_{wz})	1.000	1.000	1.000				1.000	1.000	1.000	1.000	1.000	1.000
DDI Factor (f_{DDI})	1.000	1.000	1.000				1.000	1.000	1.000	1.000	1.000	1.000
Movement Saturation Flow Rate (s), veh/h	1668	79	1564				1711	3571	18	504	2805	717
Proportion of Vehicles Arriving on Green (P)	0.26	0.26	0.26	0.00	0.00	0.00	0.08	0.81	0.61	0.41	0.50	0.33
Incremental Delay Factor (k)	0.15	0.22					0.14	0.50	0.50	0.50	0.50	0.50

Signal Timing / Movement Groups	EBL	EBT/R	WBL	WBT/R	NBL	NBT/R	SBL	SBT/R
Lost Time (t_L)		4.0			5.4	6.0		6.0
Green Ratio (g/C)		0.26			0.57	0.61		0.46
Permitted Saturation Flow Rate (s_p), veh/h/ln		1668			341	0		504
Shared Saturation Flow Rate (s_{sh}), veh/h/ln								
Permitted Effective Green Time (g_p), s		0.0			41.4	0.0		39.4
Permitted Service Time (g_u), s		0.0			5.3	0.0		39.4
Permitted Queue Service Time (g_{ps}), s					5.3			0.5
Time to First Blockage (g_f), s		0.0			0.0	0.0		0.0
Queue Service Time Before Blockage (g_{fs}), s								
Protected Right Saturation Flow (s_R), veh/h/ln								
Protected Right Effective Green Time (g_R), s								

Multimodal	EB		WB		NB		SB	
Pedestrian F_w / F_v	1.557	0.000	1.557	0.000	0.681	0.000	1.198	0.000
Pedestrian F_s / F_{delay}	0.000	0.156	0.000	0.155	0.000	0.075	0.000	0.100
Pedestrian M_{corner} / M_{cw}								
Bicycle c_b / d_b		48.93		47.65	1218.82	6.48	927.06	12.23
Bicycle F_w / F_v	-3.64	0.76	-3.64		-3.64	1.00	-3.64	1.27

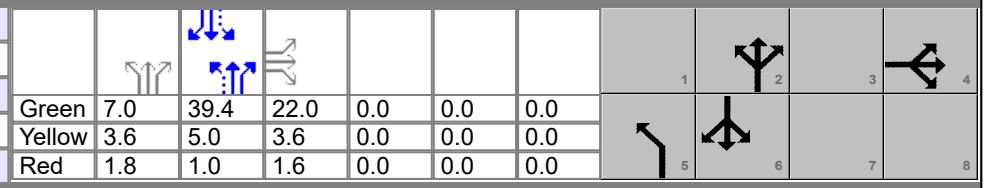
HCS7 Signalized Intersection Results Graphical Summary

General Information				Intersection Information	
Agency	LJB			Duration, h	0.250
Analyst	TVF	Analysis Date	Oct 8, 2020	Area Type	Other
Jurisdiction	Columbus	Time Period	AM Peak	PHF	0.92
Urban Street	S Hamilton Rd	Analysis Year	2020	Analysis Period	1> 7:00
Intersection	Williams Rd	File Name	S Hamilton Rd Intersections AM Existing.xus		
Project Description	S Hamiilton Rd & US 33 Safety Study				



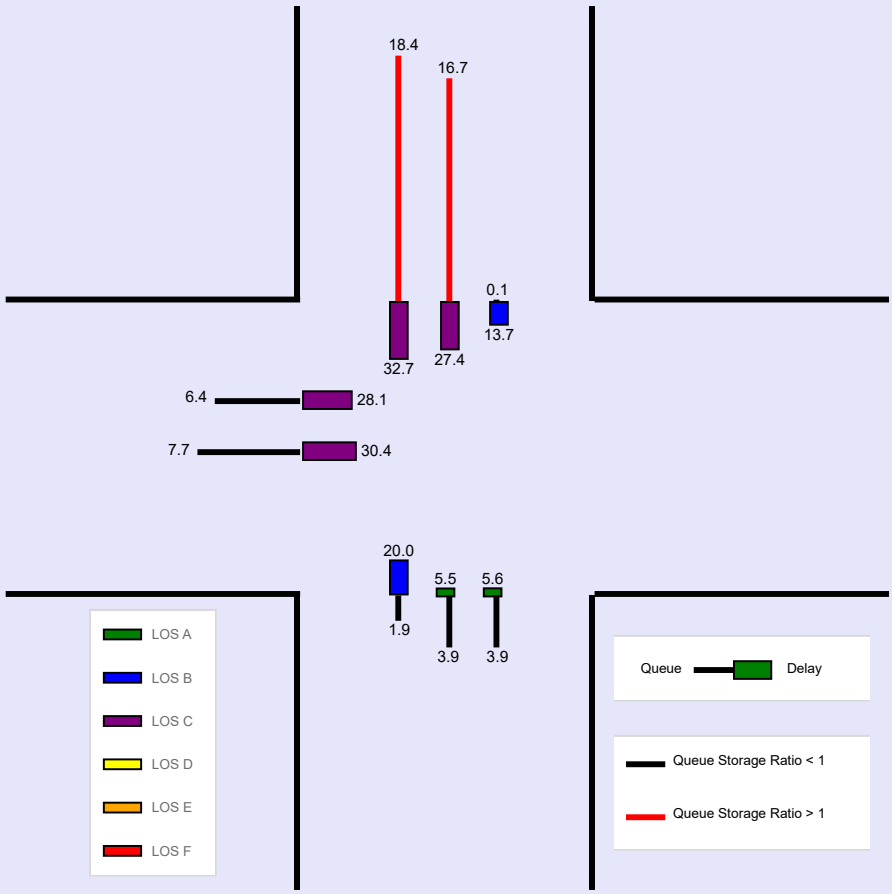
Demand Information	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Demand (*v*), veh/h	330	5	90				110	1000	5	5	1120	290

Signal Information			
Cycle, s	85.0	Reference Phase	2
Offset, s	51	Reference Point	End
Uncoordinated	No	Simult. Gap E/W	On
Force Mode	Float	Simult. Gap N/S	On



Green	7.0	39.4	22.0	0.0	0.0	0.0						
Yellow	3.6	5.0	3.6	0.0	0.0	0.0						
Red	1.8	1.0	1.6	0.0	0.0	0.0						

Movement Group Results	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Back of Queue (*Q*), ft/ln (95 th percentile)	171.8	208.6					49.9	102.8	98.1	2.6	433.5	460.8
Back of Queue (*Q*), veh/ln (95 th percentile)	6.4	7.7					1.9	3.9	3.9	0.1	16.7	18.4
Queue Storage Ratio (*RQ*) (95 th percentile)	0.34	0.30					0.59	0.09	0.09	0.02	1.44	1.60
Control Delay (*d*), s/veh	28.1	30.4					20.0	5.5	5.6	13.7	27.4	32.7
Level of Service (LOS)	C	C					B	A	A	B	C	C
Approach Delay, s/veh / LOS	29.3	C		0.0			7.0	A		29.9	C	
Intersection Delay, s/veh / LOS	21.0						C					



--- Messages ---

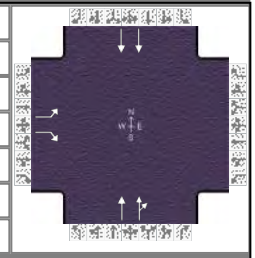
WARNING: Since queue spillover from turn lanes and spillback into upstream intersections is not accounted for in the HCM procedures, use of a simulation tool may be advised in situations where the Queue Storage Ratio exceeds 1.0.

WARNING: The shared-plus-exclusive turn lane solution is an approximation of the HCM method, because more than three lane groups cannot be accommodated. Input data for Percent Turns in Shared Lane are used to specify proportion of turning vehicles in the shared lane.

--- Comments ---

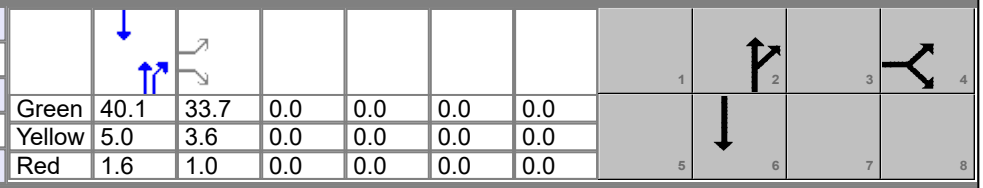
HCS7 Signalized Intersection Input Data

General Information				Intersection Information	
Agency	LJB			Duration, h	0.250
Analyst	TVF	Analysis Date	Oct 8, 2020	Area Type	Other
Jurisdiction	Columbus	Time Period	AM Peak	PHF	0.92
Urban Street	S Hamilton Rd	Analysis Year	2020	Analysis Period	1> 7:00
Intersection	US 33 EB Ramps	File Name	S Hamilton Rd Intersections AM Existing.xus		
Project Description	S Hamiilton Rd & US 33 Safety Study				



Demand Information	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Demand (*v*), veh/h	160		640					1220	110		770	

Signal Information			
Cycle, s	85.0	Reference Phase	2
Offset, s	57	Reference Point	Begin
Uncoordinated	No	Simult. Gap E/W	On
Force Mode	Float	Simult. Gap N/S	On



	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Green	40.1		33.7	0.0	0.0	0.0	0.0					
Yellow	5.0		3.6	0.0	0.0	0.0	0.0					
Red	1.6		1.0	0.0	0.0	0.0	0.0					

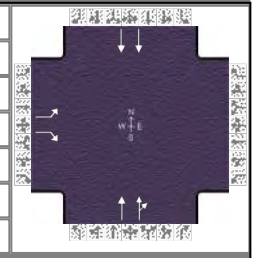
Traffic Information	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Demand (*v*), veh/h	160		640					1220	110		770	
Initial Queue (Q_b), veh/h	0		0					0	0		0	
Base Saturation Flow Rate (s_o), veh/h	1900		1900					1900	1900		1900	
Parking (N_m), man/h		None						None			None	
Heavy Vehicles (P_{HV}), %	6		6					6			6	
Ped / Bike / RTOR, /h	0	0		0	0		0	0	0	0	0	
Buses (N_b), buses/h	0	0	0				0	0	0	0	0	0
Arrival Type (*AT*)	3		3					4	4		4	
Upstream Filtering (*I*)	1.00		1.00					0.79	0.79		0.79	
Lane Width (*W*), ft	12.0		12.0					12.0			12.0	
Turn Bay Length, ft	1800		40					275			725	
Grade (*Pg*), %		0			0			0			0	
Speed Limit, mi/h	50		50					50	50		50	

Phase Information	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Maximum Green (G_{max}) or Phase Split, s		38.3				46.7		46.7
Yellow Change Interval (*Y*), s		3.6				5.0		5.0
Red Clearance Interval (R_c), s		1.0				1.6		1.6
Minimum Green (G_{min}), s		7				20		20
Start-Up Lost Time (*l*t), s	2.0					2.0		2.0
Extension of Effective Green (*e*), s	2.0					2.0		2.0
Passage (*PT*), s		5.0				3.0		3.0
Recall Mode		Min				Min		Min
Dual Entry		Yes				Yes		Yes
Walk (*Walk*), s		0.0		0.0				0.0
Pedestrian Clearance Time (*PC*), s		0.0		0.0				0.0

Multimodal Information	EB			WB			NB			SB		
85th % Speed / Rest in Walk / Corner Radius	0	No	25	0	No	25				0	No	25
Walkway / Crosswalk Width / Length, ft	9.0	12	0	9.0	12	0				9.0	12	0
Street Width / Island / Curb	0	0	No		0		0		No	0	0	No
Width Outside / Bike Lane / Shoulder, ft	12	5.0	2.0				12	5.0	2.0	12	5.0	2.0
Pedestrian Signal / Occupied Parking	No	0.50		No				0.50		No	0.50	

HCS7 Signalized Intersection Results Summary

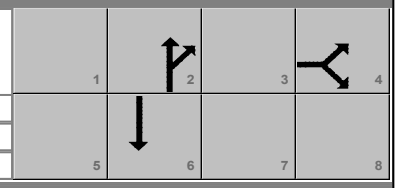
General Information				Intersection Information	
Agency	LJB			Duration, h	0.250
Analyst	TVF	Analysis Date	Oct 8, 2020	Area Type	Other
Jurisdiction	Columbus	Time Period	AM Peak	PHF	0.92
Urban Street	S Hamilton Rd	Analysis Year	2020	Analysis Period	1> 7:00
Intersection	US 33 EB Ramps	File Name	S Hamilton Rd Intersections AM Existing.xus		
Project Description	S Hamiilton Rd & US 33 Safety Study				



Demand Information	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Demand (*v*), veh/h	160		640					1220	110		770	

Signal Information			
Cycle, s	85.0	Reference Phase	2
Offset, s	57	Reference Point	Begin
Uncoordinated	No	Simult. Gap E/W	On
Force Mode	Float	Simult. Gap N/S	On

Green	40.1	33.7	0.0	0.0	0.0	0.0	
Yellow	5.0	3.6	0.0	0.0	0.0	0.0	
Red	1.6	1.0	0.0	0.0	0.0	0.0	



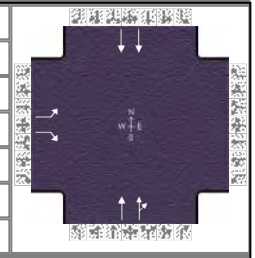
Timer Results	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Assigned Phase		4				2		6
Case Number		9.0				8.0		8.0
Phase Duration, s		38.3				46.7		46.7
Change Period, ($Y+R_c$), s		4.6				6.6		6.6
Max Allow Headway (*MAH*), s		6.1				0.0		0.0
Queue Clearance Time (g_s), s		35.7						
Green Extension Time (g_e), s		0.0				0.0		0.0
Phase Call Probability		1.00						
Max Out Probability		1.00						

Movement Group Results	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Assigned Movement	7		14					2	12		6	
Adjusted Flow Rate (*v*), veh/h	174		696					731	715		880	
Adjusted Saturation Flow Rate (*s*), veh/h/ln	1725		1535					1811	1758		1724	
Queue Service Time (g_s), s	5.8		33.7					30.5	32.4		12.3	
Cycle Queue Clearance Time (g_c), s	5.8		33.7					30.5	32.4		12.3	
Green Ratio (*g/C*)	0.40		0.40					0.47	0.47		0.47	
Capacity (*c*), veh/h	684		609					854	829		1627	
Volume-to-Capacity Ratio (*X*)	0.254		1.143					0.856	0.862		0.541	
Back of Queue (*Q*), ft/ln (95 th percentile)	99.4		936.3					548.9	549.2		164.5	
Back of Queue (*Q*), veh/ln (95 th percentile)	3.8		35.7					21.0	21.0		6.3	
Queue Storage Ratio (*RQ*) (95 th percentile)	0.06		23.41					2.00	2.00		0.23	
Uniform Delay (d_1), s/veh	17.2		25.7					25.3	25.9		10.7	
Incremental Delay (d_2), s/veh	0.4		82.8					8.7	9.3		1.0	
Initial Queue Delay (d_3), s/veh	0.0		0.0					0.0	0.0		0.0	
Control Delay (*d*), s/veh	17.6		108.5					34.0	35.2		11.7	
Level of Service (LOS)	B		F					C	D		B	
Approach Delay, s/veh / LOS	90.3		F	0.0			34.6		C	11.7		B
Intersection Delay, s/veh / LOS	43.4						D					

Multimodal Results	EB		WB		NB		SB	
Pedestrian LOS Score / LOS	2.14	B	2.14	B	0.70	A	1.67	B
Bicycle LOS Score / LOS		F			1.68	B	1.18	A

HCS7 Signalized Intersection Intermediate Values

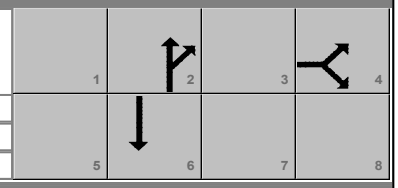
General Information				Intersection Information	
Agency	LJB			Duration, h	0.250
Analyst	TVF	Analysis Date	Oct 8, 2020	Area Type	Other
Jurisdiction	Columbus	Time Period	AM Peak	PHF	0.92
Urban Street	S Hamilton Rd	Analysis Year	2020	Analysis Period	1> 7:00
Intersection	US 33 EB Ramps	File Name	S Hamilton Rd Intersections AM Existing.xus		
Project Description	S Hamiilton Rd & US 33 Safety Study				



Demand Information	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Demand (*v*), veh/h	160		640					1220	110		770	

Signal Information			
Cycle, s	85.0	Reference Phase	2
Offset, s	57	Reference Point	Begin
Uncoordinated	No	Simult. Gap E/W	On
Force Mode	Float	Simult. Gap N/S	On

Green	40.1	33.7	0.0	0.0	0.0	0.0	
Yellow	5.0	3.6	0.0	0.0	0.0	0.0	
Red	1.6	1.0	0.0	0.0	0.0	0.0	



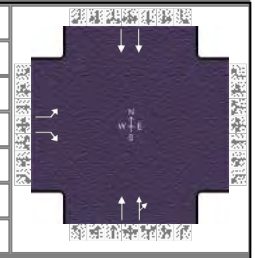
Saturation Flow / Delay	L	T	R	L	T	R	L	T	R	L	T	R
Lane Width Adjustment Factor (f_w)	1.000	1.000	1.000				1.000	1.000	1.000	1.000	1.000	1.000
Heavy Vehicles and Grade Factor (f_{HVg})	0.953	1.000	0.953				1.000	0.953	0.953	1.000	0.953	1.000
Parking Activity Adjustment Factor (f_p)	1.000	1.000	1.000	0.000	0.000	0.000	1.000	1.000	1.000	1.000	1.000	1.000
Bus Blockage Adjustment Factor (f_{bb})	1.000	1.000	1.000	0.000	0.000	0.000	1.000	1.000	1.000	1.000	1.000	1.000
Area Type Adjustment Factor (f_a)	1.000	1.000	1.000				1.000	1.000	1.000	1.000	1.000	1.000
Lane Utilization Adjustment Factor (f_{LU})	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	0.952	1.000
Left-Turn Adjustment Factor (f_{LT})	0.952	0.000					1.000	1.000		1.000	1.000	
Right-Turn Adjustment Factor (f_{RT})		0.000	0.847					0.971	0.971		1.000	1.000
Left-Turn Pedestrian Adjustment Factor (f_{Lpb})	1.000						1.000			1.000		
Right-Turn Ped-Bike Adjustment Factor (f_{Rpb})			1.000						1.000			1.000
Work Zone Adjustment Factor (f_{wz})	1.000	1.000	1.000				1.000	1.000	1.000	1.000	1.000	1.000
DDI Factor (f_{DDI})	1.000	1.000	1.000				1.000	1.000	1.000	1.000	1.000	1.000
Movement Saturation Flow Rate (s), veh/h	1725	0	1535				0	3275	294	0	3622	0
Proportion of Vehicles Arriving on Green (P)	0.40	0.00	0.40	0.00	0.00	0.00	0.00	0.34	0.26	0.00	0.63	0.00
Incremental Delay Factor (k)	0.23		0.50					0.50	0.50		0.50	

Signal Timing / Movement Groups	EBL	EBT/R	WBL	WBT/R	NBL	NBT/R	SBL	SBT/R
Lost Time (t_L)		4.0				6.6		6.6
Green Ratio (g/C)		0.40				0.47		0.47
Permitted Saturation Flow Rate (s_p), veh/h/ln		1725				640		375
Shared Saturation Flow Rate (s_{sh}), veh/h/ln						0		0
Permitted Effective Green Time (g_p), s		0.0				0.0		0.0
Permitted Service Time (g_u), s		0.0				0.0		0.0
Permitted Queue Service Time (g_{ps}), s								
Time to First Blockage (g_f), s		0.0				40.1		40.1
Queue Service Time Before Blockage (g_{fs}), s								
Protected Right Saturation Flow (s_R), veh/h/ln		0						
Protected Right Effective Green Time (g_R), s		0.0						

Multimodal	EB		WB		NB		SB	
Pedestrian F_w / F_v	1.389	0.000	1.389	0.000	0.000	0.000	0.972	0.000
Pedestrian F_s / F_{delay}	0.000	0.155	0.000	0.155	0.000	0.099	0.000	0.099
Pedestrian M_{corner} / M_{cw}								
Bicycle c_b / d_b		48.28		47.65	943.53	11.86	943.53	11.86
Bicycle F_w / F_v	-3.64		-3.64		-3.64	1.19	-3.64	0.69

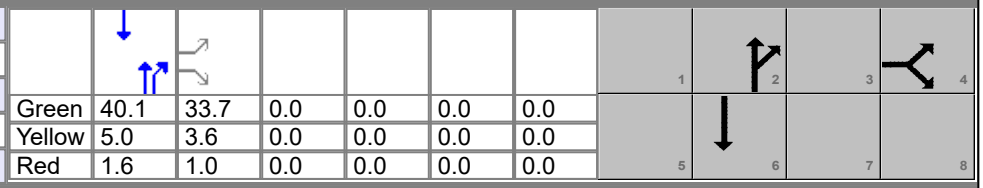
HCS7 Signalized Intersection Results Graphical Summary

General Information				Intersection Information	
Agency	LJB			Duration, h	0.250
Analyst	TVF	Analysis Date	Oct 8, 2020	Area Type	Other
Jurisdiction	Columbus	Time Period	AM Peak	PHF	0.92
Urban Street	S Hamilton Rd	Analysis Year	2020	Analysis Period	1> 7:00
Intersection	US 33 EB Ramps	File Name	S Hamilton Rd Intersections AM Existing.xus		
Project Description	S Hamiilton Rd & US 33 Safety Study				



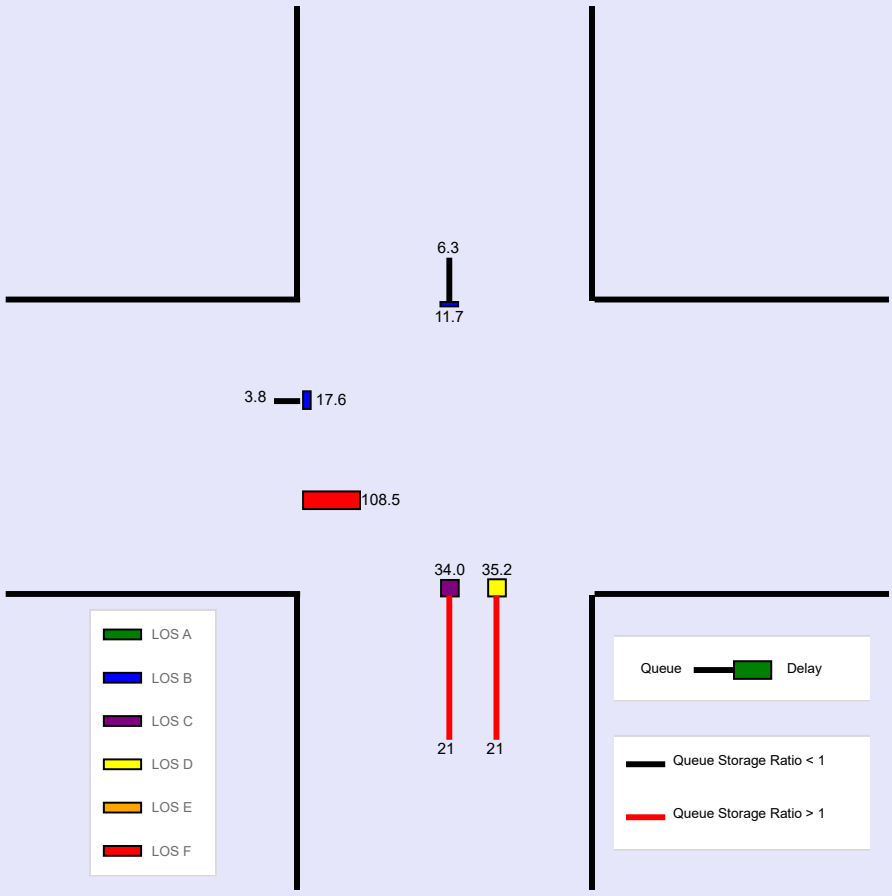
Demand Information	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Demand (*v*), veh/h	160		640					1220	110		770	

Signal Information			
Cycle, s	85.0	Reference Phase	2
Offset, s	57	Reference Point	Begin
Uncoordinated	No	Simult. Gap E/W	On
Force Mode	Float	Simult. Gap N/S	On



Green	40.1	33.7	0.0	0.0	0.0	0.0			
Yellow	5.0	3.6	0.0	0.0	0.0	0.0			
Red	1.6	1.0	0.0	0.0	0.0	0.0			

Movement Group Results	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Back of Queue (*Q*), ft/ln (95 th percentile)	99.4		936.3					548.9	549.2		164.5	
Back of Queue (*Q*), veh/ln (95 th percentile)	3.8		35.7					21.0	21.0		6.3	
Queue Storage Ratio (*RQ*) (95 th percentile)	0.06		23.41					2.00	2.00		0.23	
Control Delay (*d*), s/veh	17.6		108.5					34.0	35.2		11.7	
Level of Service (LOS)	B		F					C	D		B	
Approach Delay, s/veh / LOS	90.3		F	0.0			34.6		C	11.7		B
Intersection Delay, s/veh / LOS	43.4						D					



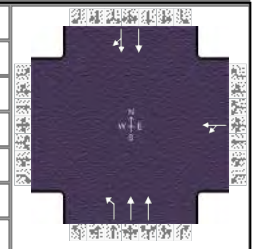
--- Messages ---

WARNING: Since queue spillover from turn lanes and spillback into upstream intersections is not accounted for in the HCM procedures, use of a simulation tool may be advised in situations where the Queue Storage Ratio exceeds 1.0.

--- Comments ---

HCS7 Signalized Intersection Input Data

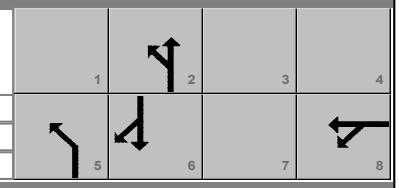
General Information				Intersection Information	
Agency	LJB			Duration, h	0.250
Analyst	TVF	Analysis Date	Oct 8, 2020	Area Type	Other
Jurisdiction	Columbus	Time Period	AM Peak	PHF	0.92
Urban Street	S Hamilton Rd	Analysis Year	2020	Analysis Period	1> 7:00
Intersection	US 33 WB Ramps	File Name	S Hamilton Rd Intersections AM Existing.xus		
Project Description	S Hamiilton Rd & US 33 Safety Study				



Demand Information	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Demand (*v*), veh/h				110	5		570	810			700	360

Signal Information			
Cycle, s	85.0	Reference Phase	2
Offset, s	75	Reference Point	End
Uncoordinated	No	Simult. Gap E/W	On
Force Mode	Fixed	Simult. Gap N/S	On

Green	26.3	26.2	16.4	0.0	0.0	0.0	
Yellow	3.6	5.0	3.6	0.0	0.0	0.0	
Red	1.6	1.0	1.3	0.0	0.0	0.0	



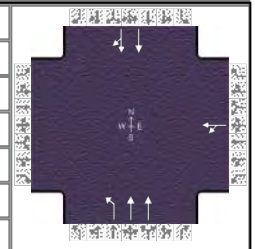
Traffic Information	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Demand (*v*), veh/h				110	5		570	810			700	360
Initial Queue (Q_b), veh/h				0	0		0	0			0	0
Base Saturation Flow Rate (s_o), veh/h				1900	1900		1900	1900			1900	1900
Parking (N_m), man/h					None			None			None	
Heavy Vehicles (P_{HV}), %					13		1	1			2	
Ped / Bike / RTOR, /h	0	0		0	0		0	0		0	0	0
Buses (N_b), buses/h				0	0	0	0	0	0	0	0	0
Arrival Type (*AT*)				3	3		3	3			3	3
Upstream Filtering (*I*)				1.00	1.00		0.52	0.52			1.00	1.00
Lane Width (*W*), ft					12.0		12.0	12.0			12.0	
Turn Bay Length, ft					165		525	750			875	
Grade (*Pg*), %		0			0			0			0	
Speed Limit, mi/h				50	50		50	50			50	50

Phase Information	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Maximum Green (G_{max}) or Phase Split, s				21.3	31.5	63.7		32.2
Yellow Change Interval (*Y*), s				3.6	3.6	5.0		5.0
Red Clearance Interval (R_c), s				1.3	1.6	1.0		1.0
Minimum Green (G_{min}), s				7	7	20		20
Start-Up Lost Time (*l*t), s			2.0	2.0	2.0	2.0		2.0
Extension of Effective Green (*e*), s			2.0	2.0	2.0	2.0		2.0
Passage (*PT*), s				3.7	5.0	3.0		3.0
Recall Mode				Off	Off	Min		Min
Dual Entry				Yes	No	Yes		Yes
Walk (*Walk*), s		0.0		0.0		0.0		
Pedestrian Clearance Time (*PC*), s		0.0		0.0		0.0		

Multimodal Information	EB			WB			NB			SB		
85th % Speed / Rest in Walk / Corner Radius	0	No	25	0	No	25	0	No	25			
Walkway / Crosswalk Width / Length, ft	9.0	12	0	9.0	12	0	9.0	12	0			
Street Width / Island / Curb		0		0	0	No	0	0	No	0		No
Width Outside / Bike Lane / Shoulder, ft				12	5.0	2.0	12	5.0	2.0	12	5.0	2.0
Pedestrian Signal / Occupied Parking	No			No	0.50		No	0.50			0.50	

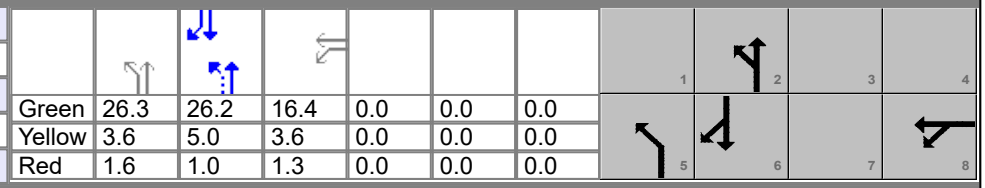
HCS7 Signalized Intersection Results Summary

General Information				Intersection Information	
Agency	LJB			Duration, h	0.250
Analyst	TVF	Analysis Date	Oct 8, 2020	Area Type	Other
Jurisdiction	Columbus	Time Period	AM Peak	PHF	0.92
Urban Street	S Hamilton Rd	Analysis Year	2020	Analysis Period	1> 7:00
Intersection	US 33 WB Ramps	File Name	S Hamilton Rd Intersections AM Existing.xus		
Project Description	S Hamiilton Rd & US 33 Safety Study				



Demand Information	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Demand (*v*), veh/h				110	5		570	810			700	360

Signal Information			
Cycle, s	85.0	Reference Phase	2
Offset, s	75	Reference Point	End
Uncoordinated	No	Simult. Gap E/W	On
Force Mode	Fixed	Simult. Gap N/S	On



Green	26.3	26.2	16.4	0.0	0.0	0.0			
Yellow	3.6	5.0	3.6	0.0	0.0	0.0			
Red	1.6	1.0	1.3	0.0	0.0	0.0			

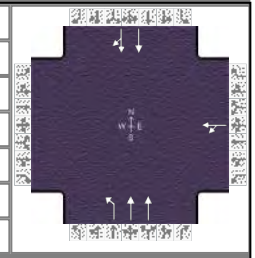
Timer Results	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Assigned Phase				8	5	2		6
Case Number				12.0	1.0	4.0		8.3
Phase Duration, s				21.3	31.5	63.7		32.2
Change Period, (*Y+R c*), s				4.9	5.2	6.0		6.0
Max Allow Headway (*MAH*), s				4.7	6.0	0.0		0.0
Queue Clearance Time (*g s*), s				7.7	26.9			
Green Extension Time (*g e*), s				0.3	0.0	0.0		0.0
Phase Call Probability				1.00	1.00			
Max Out Probability				0.05	1.00			

Movement Group Results	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Assigned Movement				3	8		5	2			6	16
Adjusted Flow Rate (*v*), veh/h					125		620	880			610	542
Adjusted Saturation Flow Rate (*s*), veh/h/ln					1629		1795	1795			1870	1655
Queue Service Time (*g s*), s					5.7		24.9	11.3			27.2	26.2
Cycle Queue Clearance Time (*g c*), s					5.7		24.9	11.3			27.2	26.2
Green Ratio (*g/C*)					0.19		0.64	0.68			0.31	0.31
Capacity (*c*), veh/h					314		640	2437			577	510
Volume-to-Capacity Ratio (*X*)					0.398		0.968	0.361			1.058	1.062
Back of Queue (*Q*), ft/ln (95 th percentile)					107.4		341.7	141			691	639.8
Back of Queue (*Q*), veh/ln (95 th percentile)					3.9		13.6	5.6			27.2	25.2
Queue Storage Ratio (*RQ*) (95 th percentile)					0.65		0.65	0.19			0.79	0.73
Uniform Delay (*d 1*), s/veh					30.0		24.6	8.3			29.4	29.4
Incremental Delay (*d 2*), s/veh					1.0		18.5	0.2			53.8	57.4
Initial Queue Delay (*d 3*), s/veh					0.0		0.0	0.0			0.0	0.0
Control Delay (*d*), s/veh					31.0		43.1	8.5			83.2	86.8
Level of Service (LOS)					C		D	A			F	F
Approach Delay, s/veh / LOS	0.0			31.0		C	22.8		C	84.9		F
Intersection Delay, s/veh / LOS	48.9						D					

Multimodal Results	EB		WB		NB		SB	
Pedestrian LOS Score / LOS	2.31	B	2.14	B	1.34	A	1.40	A
Bicycle LOS Score / LOS			0.69	A	1.73	B	1.44	A

HCS7 Signalized Intersection Intermediate Values

General Information				Intersection Information	
Agency	LJB			Duration, h	0.250
Analyst	TVF	Analysis Date	Oct 8, 2020	Area Type	Other
Jurisdiction	Columbus	Time Period	AM Peak	PHF	0.92
Urban Street	S Hamilton Rd	Analysis Year	2020	Analysis Period	1> 7:00
Intersection	US 33 WB Ramps	File Name	S Hamilton Rd Intersections AM Existing.xus		
Project Description	S Hamiilton Rd & US 33 Safety Study				



Demand Information	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Demand (*v*), veh/h				110	5		570	810			700	360

Signal Information			
Cycle, s	85.0	Reference Phase	2
Offset, s	75	Reference Point	End
Uncoordinated	No	Simult. Gap E/W	On
Force Mode	Fixed	Simult. Gap N/S	On

							1	2	3	4		
Green	26.3	26.2	16.4	0.0	0.0	0.0	5	6	7	8		
Yellow	3.6	5.0	3.6	0.0	0.0	0.0						
Red	1.6	1.0	1.3	0.0	0.0	0.0						

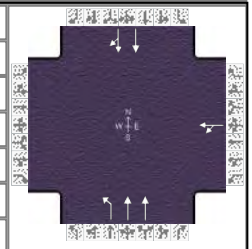
Saturation Flow / Delay	L	T	R	L	T	R	L	T	R	L	T	R
Lane Width Adjustment Factor (f_w)				1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
Heavy Vehicles and Grade Factor (f_{HVg})				1.000	0.899	1.000	0.992	0.992	1.000	1.000	0.984	0.984
Parking Activity Adjustment Factor (f_p)	0.000	0.000	0.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
Bus Blockage Adjustment Factor (f_{bb})	0.000	0.000	0.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
Area Type Adjustment Factor (f_a)				1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
Lane Utilization Adjustment Factor (f_{LU})	1.000	1.000	1.000	1.000	1.000	1.000	1.000	0.952	1.000	1.000	1.000	1.000
Left-Turn Adjustment Factor (f_{LT})				0.954	0.954		0.952	0.000		1.000	1.000	
Right-Turn Adjustment Factor (f_{RT})					0.000	0.000		1.000	1.000		0.885	0.885
Left-Turn Pedestrian Adjustment Factor (f_{Lpb})				1.000			1.000			1.000		
Right-Turn Ped-Bike Adjustment Factor (f_{Rpb})						1.000			1.000			1.000
Work Zone Adjustment Factor (f_{wz})				1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
DDI Factor (f_{DDI})				1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
Movement Saturation Flow Rate (s), veh/h				1559	71	0	1795	3680	0	0	2331	1195
Proportion of Vehicles Arriving on Green (P)	0.00	0.00	0.00	0.19	0.19	0.00	0.27	0.57	0.00	0.00	0.31	0.31
Incremental Delay Factor (k)					0.14		0.48	0.50			0.50	0.50

Signal Timing / Movement Groups	EBL	EBT/R	WBL	WBT/R	NBL	NBT/R	SBL	SBT/R
Lost Time (t_L)				4.0	5.2	6.0		6.0
Green Ratio (g/C)				0.19	0.64	0.68		0.31
Permitted Saturation Flow Rate (s_p), veh/h/ln				0	492	0		640
Shared Saturation Flow Rate (s_{sh}), veh/h/ln								0
Permitted Effective Green Time (g_p), s				0.0	28.2	0.0		0.0
Permitted Service Time (g_u), s				0.0	0.0	0.0		0.0
Permitted Queue Service Time (g_{ps}), s					0.0			
Time to First Blockage (g_f), s				0.0	0.0	0.0		26.2
Queue Service Time Before Blockage (g_{fs}), s								
Protected Right Saturation Flow (s_R), veh/h/ln								
Protected Right Effective Green Time (g_R), s								

Multimodal	EB		WB		NB		SB	
Pedestrian F_w / F_v	1.557	0.000	1.389	0.000	0.681	0.000	0.681	0.000
Pedestrian F_s / F_{delay}	0.000	0.155	0.000	0.156	0.000	0.059	0.000	0.121
Pedestrian M_{corner} / M_{cw}								
Bicycle c_b / d_b		47.65		48.60	1357.65	4.38	616.47	20.34
Bicycle F_w / F_v	-3.64		-3.64	0.21	-3.64	1.24	-3.64	0.95

HCS7 Signalized Intersection Results Graphical Summary

General Information				Intersection Information	
Agency	LJB			Duration, h	0.250
Analyst	TVF	Analysis Date	Oct 8, 2020	Area Type	Other
Jurisdiction	Columbus	Time Period	AM Peak	PHF	0.92
Urban Street		Analysis Year	2020	Analysis Period	
Intersection		File Name			
Project Description					



Demand Information	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Demand (*v*), veh/h				110	5		570	810			700	360

Signal Information			
Cycle, s	85.0	Reference Phase	2
Offset, s	75	Reference Point	End
Uncoordinated	No	Simult. Gap E/W	On
Force Mode	Fixed	Simult. Gap N/S	On

Movement Group Results	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Back of Queue (*Q*), ft/ln (95 th percentile)					107.4		341.7	141			691	639.8
Back of Queue (*Q*), veh/ln (95 th percentile)					3.9		13.6	5.6			27.2	25.2
Queue Storage Ratio (*RQ*) (95 th percentile)					0.65		0.65	0.19			0.79	0.73
Control Delay (*d*), s/veh					31.0		43.1	8.5			83.2	86.8
Level of Service (LOS)					C		D	A			F	F
Approach Delay, s/veh / LOS	0.0			31.0		C	22.8		C	84.9		F
Intersection Delay, s/veh / LOS	48.9						D					

--- Messages ---

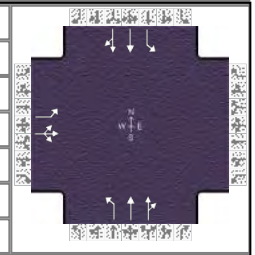
WARNING: Since queue spillover from turn lanes and spillback into upstream intersections is not accounted for in the HCM procedures, use of a simulation tool may be advised in situations where the Queue Storage Ratio exceeds 1.0.

WARNING: The shared-plus-exclusive turn lane solution is an approximation of the HCM method, because more than three lane groups cannot be accommodated. Input data for Percent Turns in Shared Lane are used to specify proportion of turning vehicles in the shared lane.

--- Comments ---

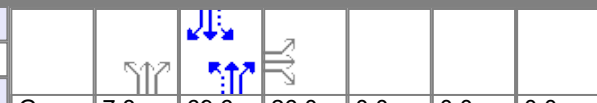
HCS7 Signalized Intersection Input Data

General Information				Intersection Information	
Agency	LJB			Duration, h	0.250
Analyst	TVF	Analysis Date	Oct 8, 2020	Area Type	Other
Jurisdiction	Columbus	Time Period	PM Peak	PHF	0.92
Urban Street	S Hamilton Rd	Analysis Year	2020	Analysis Period	1> 7:00
Intersection	Williams Rd	File Name	S Hamilton Rd Intersections PM Existing.xus		
Project Description	S Hamiilton Rd & US 33 Safety Study				

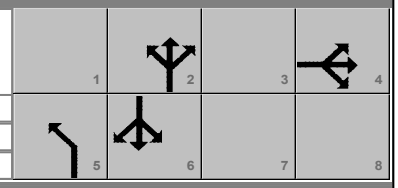


Demand Information	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Demand (*v*), veh/h	440	5	70				130	1300	5	5	860	330

Signal Information			
Cycle, s	120.0	Reference Phase	2
Offset, s	5	Reference Point	End
Uncoordinated	No	Simult. Gap E/W	On
Force Mode	Float	Simult. Gap N/S	On



	EB			WB			NB			SB		
Green	7.8	69.6		26.0	0.0		0.0					
Yellow	3.6	5.0		3.6	0.0		0.0					
Red	1.8	1.0		1.6	0.0		0.0					



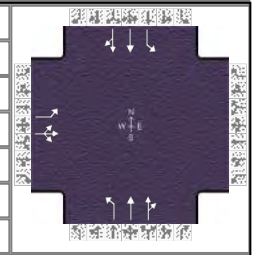
Traffic Information	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Demand (*v*), veh/h	440	5	70				130	1300	5	5	860	330
Initial Queue (Q_b), veh/h	0	0	0				0	0	0	0	0	0
Base Saturation Flow Rate (s_o), veh/h	1900	1900	1900				1900	1900	1900	1900	1900	1900
Parking (N_m), man/h		None						None			None	
Heavy Vehicles (P_{HV}), %	8	8					5	5		6	6	
Ped / Bike / RTOR, /h	0	0	0	0	0		0	0	0	0	0	0
Buses (N_b), buses/h	0	0	0				0	0	0	0	0	0
Arrival Type (*AT*)	3	3	3				3	3	3	3	3	3
Upstream Filtering (*I*)	1.00	1.00	1.00				1.00	1.00	1.00	0.81	0.81	0.81
Lane Width (*W*), ft	12.0	12.0					12.0	12.0		12.0	12.0	
Turn Bay Length, ft	500	700					85	1200		140	300	
Grade (*Pg*), %		0			0			0			0	
Speed Limit, mi/h	50	50	50				50	50	50	50	50	50

Phase Information	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Maximum Green (G_{max}) or Phase Split, s		31.2			13.2	88.8		75.6
Yellow Change Interval (*Y*), s		3.6			3.6	5.0		5.0
Red Clearance Interval (R_c), s		1.6			1.8	1.0		1.0
Minimum Green (G_{min}), s		7			7	20		20
Start-Up Lost Time (*l1*), s	2.0	2.0			2.0	2.0	2.0	2.0
Extension of Effective Green (*e*), s	2.0	2.0			2.0	2.0	2.0	2.0
Passage (*PT*), s		4.0			3.7	3.0		3.0
Recall Mode		Min			Off	Min		Min
Dual Entry		Yes			No	Yes		Yes
Walk (*Walk*), s		0.0		0.0				0.0
Pedestrian Clearance Time (*PC*), s		0.0		0.0				0.0

Multimodal Information	EB			WB			NB			SB		
85th % Speed / Rest in Walk / Corner Radius	0	No	25	0	No	25				0	No	25
Walkway / Crosswalk Width / Length, ft	9.0	12	0	9.0	12	0				9.0	12	0
Street Width / Island / Curb	0	0	No		0		0		No	0	0	No
Width Outside / Bike Lane / Shoulder, ft	12	5.0	2.0				12	5.0	2.0	12	5.0	2.0
Pedestrian Signal / Occupied Parking	No	0.50		No				0.50		No	0.50	

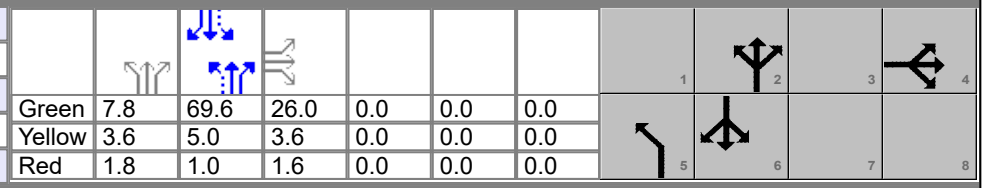
HCS7 Signalized Intersection Results Summary

General Information				Intersection Information	
Agency	LJB			Duration, h	0.250
Analyst	TVF	Analysis Date	Oct 8, 2020	Area Type	Other
Jurisdiction	Columbus	Time Period	PM Peak	PHF	0.92
Urban Street	S Hamilton Rd	Analysis Year	2020	Analysis Period	1> 7:00
Intersection	Williams Rd	File Name	S Hamilton Rd Intersections PM Existing.xus		
Project Description	S Hamiilton Rd & US 33 Safety Study				



Demand Information	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Demand (*v*), veh/h	440	5	70				130	1300	5	5	860	330

Signal Information			
Cycle, s	120.0	Reference Phase	2
Offset, s	5	Reference Point	End
Uncoordinated	No	Simult. Gap E/W	On
Force Mode	Float	Simult. Gap N/S	On



Green	7.8	69.6	26.0	0.0	0.0	0.0
Yellow	3.6	5.0	3.6	0.0	0.0	0.0
Red	1.8	1.0	1.6	0.0	0.0	0.0

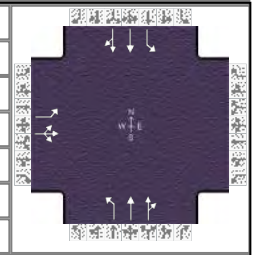
Timer Results	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Assigned Phase		4			5	2		6
Case Number		10.0			1.0	4.0		6.3
Phase Duration, s		31.2			13.2	88.8		75.6
Change Period, (*Y+R c*), s		5.2			5.4	6.0		6.0
Max Allow Headway (*MAH*), s		5.1			4.7	0.0		0.0
Queue Clearance Time (*g s*), s		21.1			5.6			
Green Extension Time (*g e*), s		1.4			0.1	0.0		0.0
Phase Call Probability		1.00			1.00			
Max Out Probability		1.00			1.00			

Movement Group Results	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Assigned Movement	7	4	14				5	2	12	1	6	16
Adjusted Flow Rate (*v*), veh/h	287	273					141	710	709	5	667	609
Adjusted Saturation Flow Rate (*s*), veh/h/ln	1697	1645					1739	1826	1823	366	1811	1640
Queue Service Time (*g s*), s	19.1	18.7					3.6	23.6	23.7	1.0	32.0	31.7
Cycle Queue Clearance Time (*g c*), s	19.1	18.7					3.6	23.6	23.7	11.4	32.0	31.7
Green Ratio (*g/C*)	0.22	0.22					0.66	0.69	0.69	0.58	0.58	0.58
Capacity (*c*), veh/h	368	357					306	1260	1258	241	1050	951
Volume-to-Capacity Ratio (*X*)	0.781	0.765					0.462	0.563	0.563	0.022	0.635	0.640
Back of Queue (*Q*), ft/ln (95 th percentile)	364.3	346.5					62	336.2	323.7	4.2	496.2	425.1
Back of Queue (*Q*), veh/ln (95 th percentile)	13.7	13.0					2.4	12.9	12.9	0.2	18.9	17.0
Queue Storage Ratio (*RQ*) (95 th percentile)	0.73	0.50					0.73	0.28	0.28	0.03	1.65	1.49
Uniform Delay (*d 1*), s/veh	44.3	44.1					14.7	9.4	9.4	17.5	20.2	19.3
Incremental Delay (*d 2*), s/veh	10.9	10.1					1.4	1.8	1.8	0.1	2.4	2.7
Initial Queue Delay (*d 3*), s/veh	0.0	0.0					0.0	0.0	0.0	0.0	0.0	0.0
Control Delay (*d*), s/veh	55.2	54.3					16.1	11.3	11.3	17.6	22.6	21.9
Level of Service (LOS)	E	D					B	B	B	B	C	C
Approach Delay, s/veh / LOS	54.8	D		0.0			11.7	B		22.2	C	
Intersection Delay, s/veh / LOS	22.8						C					

Multimodal Results	EB		WB		NB		SB	
Pedestrian LOS Score / LOS	2.33	B	2.32	B	1.35	A	1.89	B
Bicycle LOS Score / LOS	1.41	A			1.77	B	1.56	B

HCS7 Signalized Intersection Intermediate Values

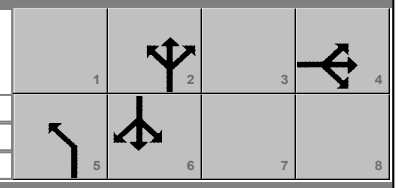
General Information				Intersection Information	
Agency	LJB			Duration, h	0.250
Analyst	TVF	Analysis Date	Oct 8, 2020	Area Type	Other
Jurisdiction	Columbus	Time Period	PM Peak	PHF	0.92
Urban Street	S Hamilton Rd	Analysis Year	2020	Analysis Period	1> 7:00
Intersection	Williams Rd	File Name	S Hamilton Rd Intersections PM Existing.xus		
Project Description	S Hamiilton Rd & US 33 Safety Study				



Demand Information	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Demand (*v*), veh/h	440	5	70				130	1300	5	5	860	330

Signal Information			
Cycle, s	120.0	Reference Phase	2
Offset, s	5	Reference Point	End
Uncoordinated	No	Simult. Gap E/W	On
Force Mode	Float	Simult. Gap N/S	On

Green	7.8	69.6	26.0	0.0	0.0	0.0	
Yellow	3.6	5.0	3.6	0.0	0.0	0.0	
Red	1.8	1.0	1.6	0.0	0.0	0.0	



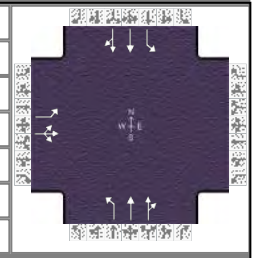
Saturation Flow / Delay	L	T	R	L	T	R	L	T	R	L	T	R
Lane Width Adjustment Factor (f_w)	1.000	1.000	1.000				1.000	1.000	1.000	1.000	1.000	1.000
Heavy Vehicles and Grade Factor (f_{HVg})	0.938	0.938	1.000				0.961	0.961	1.000	0.953	0.953	1.000
Parking Activity Adjustment Factor (f_p)	1.000	1.000	1.000	0.000	0.000	0.000	1.000	1.000	1.000	1.000	1.000	1.000
Bus Blockage Adjustment Factor (f_{bb})	1.000	1.000	1.000	0.000	0.000	0.000	1.000	1.000	1.000	1.000	1.000	1.000
Area Type Adjustment Factor (f_a)	1.000	1.000	1.000				1.000	1.000	1.000	1.000	1.000	1.000
Lane Utilization Adjustment Factor (f_{LU})	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
Left-Turn Adjustment Factor (f_{LT})	0.952	0.000					0.952	0.000		0.193	0.000	
Right-Turn Adjustment Factor (f_{RT})		0.856	0.856					0.999	0.999		0.905	0.905
Left-Turn Pedestrian Adjustment Factor (f_{Lpb})	1.000						1.000			1.000		
Right-Turn Ped-Bike Adjustment Factor (f_{Rpb})			1.000						1.000			1.000
Work Zone Adjustment Factor (f_{wz})	1.000	1.000	1.000				1.000	1.000	1.000	1.000	1.000	1.000
DDI Factor (f_{DDI})	1.000	1.000	1.000				1.000	1.000	1.000	1.000	1.000	1.000
Movement Saturation Flow Rate (s), veh/h	1697	102	1615				1739	3635	14	366	2498	952
Proportion of Vehicles Arriving on Green (P)	0.22	0.22	0.22	0.00	0.00	0.00	0.07	0.69	0.69	0.53	0.51	0.55
Incremental Delay Factor (k)	0.35	0.34					0.14	0.50	0.50	0.50	0.50	0.50

Signal Timing / Movement Groups	EBL	EBT/R	WBL	WBT/R	NBL	NBT/R	SBL	SBT/R
Lost Time (t_L)		4.0			5.4	6.0		6.0
Green Ratio (g/C)		0.22			0.66	0.69		0.58
Permitted Saturation Flow Rate (s_p), veh/h/ln		1697			424	0		366
Shared Saturation Flow Rate (s_{sh}), veh/h/ln								
Permitted Effective Green Time (g_p), s		0.0			71.6	0.0		69.6
Permitted Service Time (g_u), s		0.0			37.6	0.0		59.1
Permitted Queue Service Time (g_{ps}), s					17.0			1.0
Time to First Blockage (g_f), s		0.0			0.0	0.0		0.0
Queue Service Time Before Blockage (g_{fs}), s								
Protected Right Saturation Flow (s_R), veh/h/ln								
Protected Right Effective Green Time (g_R), s								

Multimodal	EB		WB		NB		SB	
Pedestrian F_w / F_v	1.557	0.000	1.557	0.000	0.681	0.000	1.198	0.000
Pedestrian F_s / F_{delay}	0.000	0.168	0.000	0.167	0.000	0.070	0.000	0.095
Pedestrian M_{corner} / M_{cw}								
Bicycle c_b / d_b		66.36	-83.33	65.10	1380.00	5.77	1160.00	10.58
Bicycle F_w / F_v	-3.64	0.92	-3.64		-3.64	1.29	-3.64	1.07

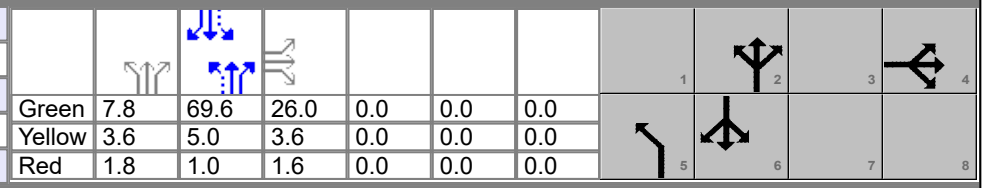
HCS7 Signalized Intersection Results Graphical Summary

General Information				Intersection Information	
Agency	LJB			Duration, h	0.250
Analyst	TVF	Analysis Date	Oct 8, 2020	Area Type	Other
Jurisdiction	Columbus	Time Period	PM Peak	PHF	0.92
Urban Street	S Hamilton Rd	Analysis Year	2020	Analysis Period	1> 7:00
Intersection	Williams Rd	File Name	S Hamilton Rd Intersections PM Existing.xus		
Project Description	S Hamiilton Rd & US 33 Safety Study				



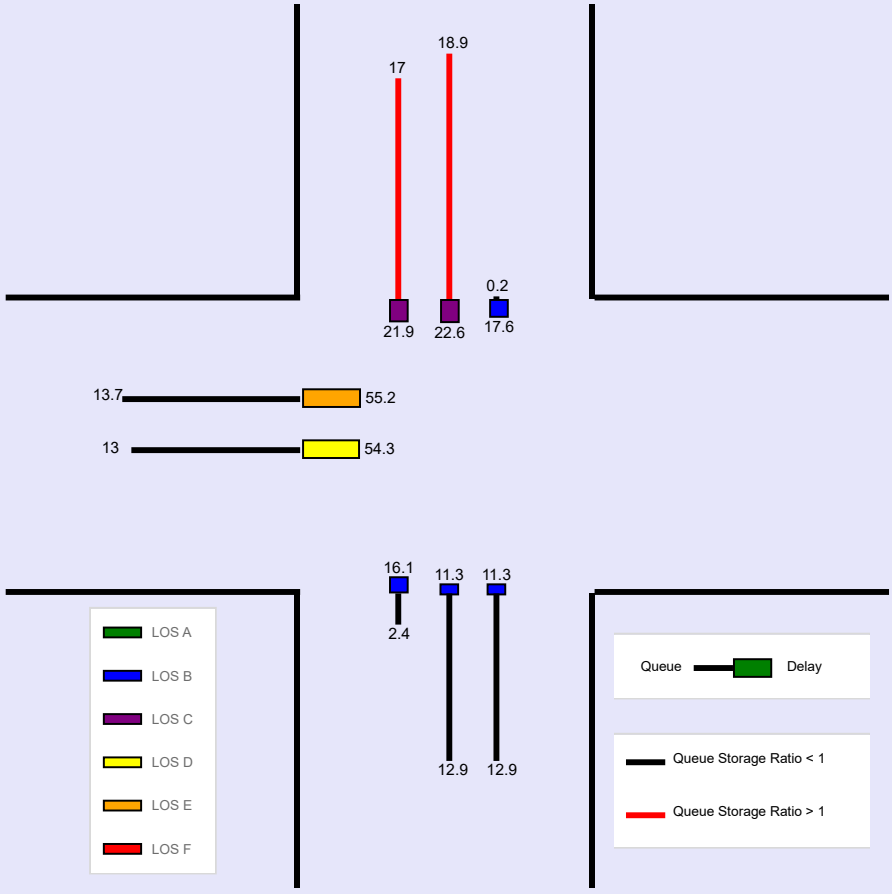
Demand Information	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Demand (*v*), veh/h	440	5	70				130	1300	5	5	860	330

Signal Information			
Cycle, s	120.0	Reference Phase	2
Offset, s	5	Reference Point	End
Uncoordinated	No	Simult. Gap E/W	On
Force Mode	Float	Simult. Gap N/S	On



Green	7.8	69.6	26.0	0.0	0.0	0.0						
Yellow	3.6	5.0	3.6	0.0	0.0	0.0						
Red	1.8	1.0	1.6	0.0	0.0	0.0						

Movement Group Results	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Back of Queue (*Q*), ft/ln (95 th percentile)	364.3	346.5					62	336.2	323.7	4.2	496.2	425.1
Back of Queue (*Q*), veh/ln (95 th percentile)	13.7	13.0					2.4	12.9	12.9	0.2	18.9	17.0
Queue Storage Ratio (*RQ*) (95 th percentile)	0.73	0.50					0.73	0.28	0.28	0.03	1.65	1.49
Control Delay (*d*), s/veh	55.2	54.3					16.1	11.3	11.3	17.6	22.6	21.9
Level of Service (LOS)	E	D					B	B	B	B	C	C
Approach Delay, s/veh / LOS	54.8	D		0.0			11.7	B		22.2	C	
Intersection Delay, s/veh / LOS	22.8						C					



--- Messages ---

WARNING: Since queue spillover from turn lanes and spillback into upstream intersections is not accounted for in the HCM procedures, use of a simulation tool may be advised in situations where the Queue Storage Ratio exceeds 1.0.

WARNING: The shared-plus-exclusive turn lane solution is an approximation of the HCM method, because more than three lane groups cannot be accommodated. Input data for Percent Turns in Shared Lane are used to specify proportion of turning vehicles in the shared lane.

--- Comments ---

HCS7 Freeway Facilities Report

Project Information

Analyst	TVF	Date	12/16/2020
Agency	LJB	Analysis Year	2020
Jurisdiction		Time Period Analyzed	PM 2020 Existing
Project Description	EB US33	Unit	United States Customary

Facility Global Input

Jam Density, pc/mi/ln	190.0	Density at Capacity, pc/mi/ln	45.0
Queue Discharge Capacity Drop, %	7	Total Segments	13
Total Time Periods	1	Time Period Duration, min	15
Facility Length, mi	4.23		

Facility Segment Data

No.	Coded	Analyzed	Name	Length, ft	Lanes
1	Basic	Basic	Eb US33 S of 104	3020	2
2	Diverge	Diverge	Eb US33 to I270 Ramp	1500	2
3	Basic	Basic	Eb US33 2 Lane Segment	710	2
4	Basic	Basic	Eb US33 3 Lane Segment	130	3
5	Weaving	Weaving	Eb US33 (Weave)	1476	4
6	Basic	Basic	Eb US33	410	3
7	Merge	Merge	Nb I270 to Eb US33 (Long Ramp)	1500	3
8	Basic	Basic	Eb US33	990	3
9	Diverge	Basic	Eb US33 to Hamilton (Long Ramp)	1500	3
10	Basic	Basic	Eb US33	1350	2
11	Merge	Merge	Sb Hamilton to Eb US33 Ramp	1400	2
12	Merge	Merge	Nb Hamilton to Eb US33 Ramp	1500	2
13	Basic	Basic	Eb US33 W of Bixby Signal	6850	2

Facility Segment Data

Segment 1: Basic

Time Period	PHF	fHV	Flow Rate (pc/h)	Capacity (pc/h)	d/c Ratio	Speed (mi/h)	Density (pc/mi/ln)	LOS
1	0.94	0.926	2953	4626	0.64	61.3	24.1	C

Segment 2: Diverge

Time Period	PHF		fHV		Flow Rate (pc/h)		Capacity (pc/h)		d/c Ratio		Speed (mi/h)		Density (pc/mi/ln)		LOS
	F	R	F	R	Freeway	Ramp	Freeway	Ramp	F	R	F	R	Freeway	Ramp	
1	0.94	0.94	0.926	0.926	2953	195	4700	2100	0.63	0.09	59.2	59.2	24.9	25.0	C

Segment 3: Basic

Time Period	PHF	fHV	Flow Rate (pc/h)	Capacity (pc/h)	d/c Ratio	Speed (mi/h)	Density (pc/mi/ln)	LOS
1	0.94	0.926	2757	4626	0.60	60.9	22.5	C

Segment 4: Basic

Time Period	PHF	fHV	Flow Rate (pc/h)	Capacity (pc/h)	d/c Ratio	Speed (mi/h)	Density (pc/mi/ln)	LOS
1	0.94	0.926	2757	6939	0.40	61.1	15.0	B

Segment 5: Weaving

Time Period	PHF	fHV	Flow Rate (pc/h)	Capacity (pc/h)	d/c Ratio	Speed (mi/h)	Density (pc/mi/ln)	LOS
1	0.94	0.926	3897	6779	0.57	49.1	19.8	B

Segment 6: Basic

Time Period	PHF	fHV	Flow Rate (pc/h)	Capacity (pc/h)	d/c Ratio	Speed (mi/h)	Density (pc/mi/ln)	LOS
1	0.94	0.926	3665	6939	0.53	58.7	19.9	C

Segment 7: Merge

Time Period	PHF		fHV		Flow Rate (pc/h)		Capacity (pc/h)		d/c Ratio		Speed (mi/h)		Density (pc/mi/ln)		LOS
	F	R	F	R	Freeway	Ramp	Freeway	Ramp	F	R	F	R	Freeway	Ramp	
1	0.94	0.94	0.926	0.893	4832	1167	7050	2000	0.69	0.58	58.2	56.8	27.7	25.1	C

Segment 8: Basic

Time Period	PHF	fHV	Flow Rate (pc/h)	Capacity (pc/h)	d/c Ratio	Speed (mi/h)	Density (pc/mi/ln)	LOS
1	0.94	0.926	4791	6939	0.69	60.9	26.1	D

Segment 9: Diverge

Time Period	PHF		fHV		Flow Rate (pc/h)		Capacity (pc/h)		d/c Ratio		Speed (mi/h)		Density (pc/mi/ln)		LOS
	F	R	F	R	Freeway	Ramp	Freeway	Ramp	F	R	F	R	Freeway	Ramp	
1	0.94	0.94	0.926	0.943	4791	722	7050	2000	0.68	0.36	64.5	64.5	24.8	24.8	C

Segment 10: Basic

Time Period	PHF	fHV	Flow Rate (pc/h)	Capacity (pc/h)	d/c Ratio	Speed (mi/h)	Density (pc/mi/ln)	LOS
1	0.94	0.917	4095	4626	0.89	57.1	35.9	E

Segment 11: Merge

Time Period	PHF		fHV		Flow Rate (pc/h)		Capacity (pc/h)		d/c Ratio		Speed (mi/h)		Density (pc/mi/ln)		LOS
	F	R	F	R	Freeway	Ramp	Freeway	Ramp	F	R	F	R	Freeway	Ramp	
1	0.94	0.94	0.917	0.862	4255	160	4700	2000	0.91	0.08	52.4	52.4	40.6	34.3	D

Segment 12: Merge

Time Period	PHF		fHV		Flow Rate (pc/h)		Capacity (pc/h)		d/c Ratio		Speed (mi/h)		Density (pc/mi/ln)		LOS
	F	R	F	R	Freeway	Ramp	Freeway	Ramp	F	R	F	R	Freeway	Ramp	
1	0.94	0.94	0.917	0.826	4607	361	4700	2100	0.98	0.17	50.3	50.3	45.8	36.3	E

Segment 13: Basic

Time Period	PHF	fHV	Flow Rate (pc/h)	Capacity (pc/h)	d/c Ratio	Speed (mi/h)	Density (pc/mi/ln)	LOS
1	0.94	0.909	4611	4626	1.00	51.6	44.7	E

Facility Time Period Results

T	Speed, mi/h	Density, pc/mi/ln	Density, veh/mi/ln	Travel Time, min	LOS
1	55.0	32.1	29.3	4.60	D

Facility Overall Results

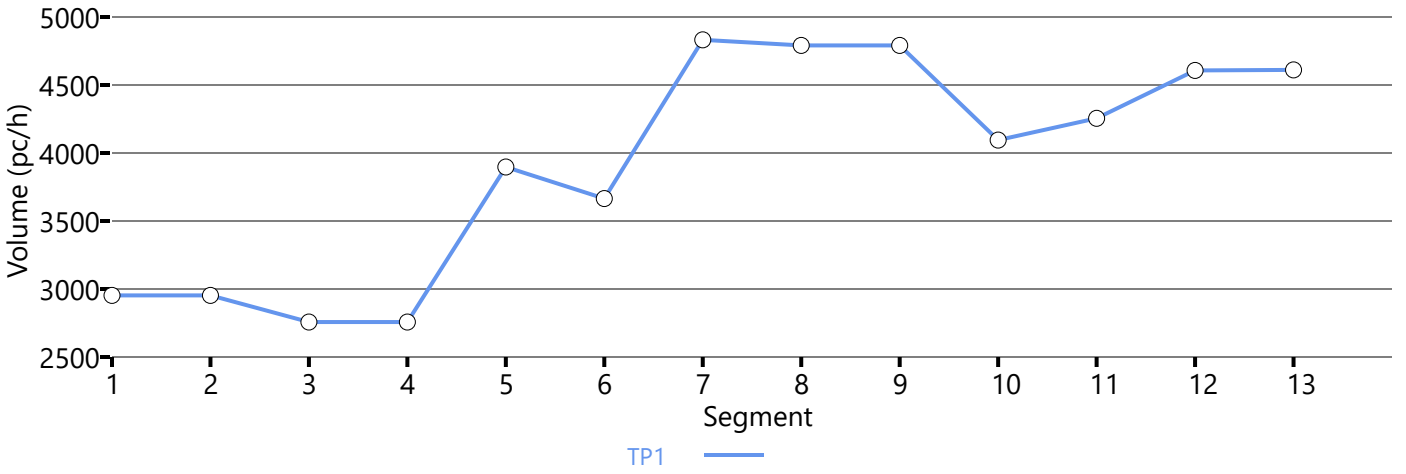
Space Mean Speed, mi/h	55.0	Density, veh/mi/ln	29.3
Average Travel Time, min	4.60	Density, pc/mi/ln	32.1

Messages

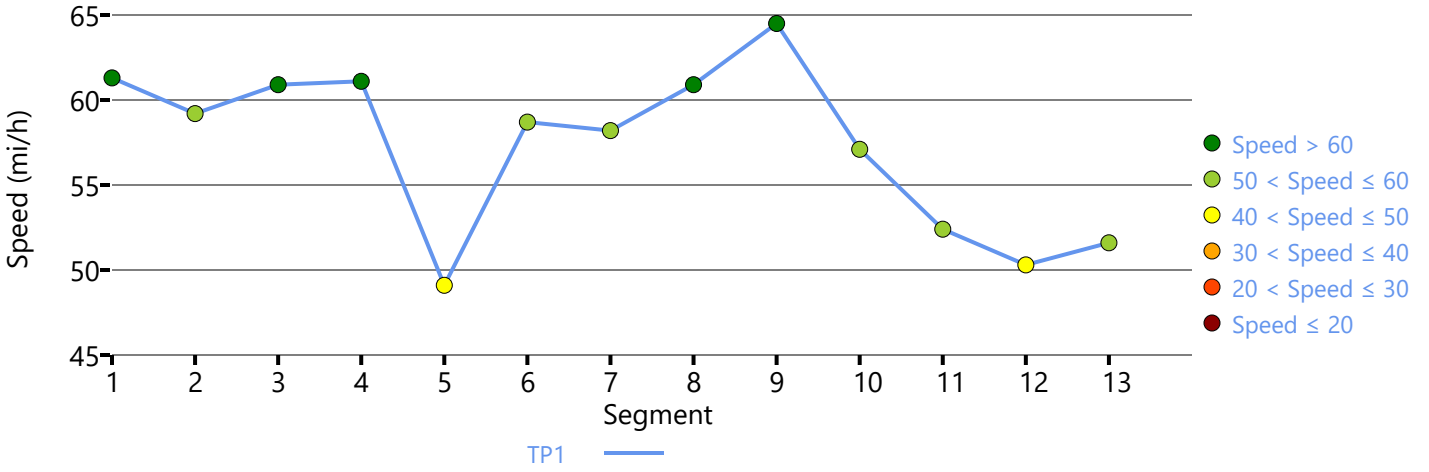
WARNING 1	Weaving Segment (segment 5) is shorter than the segment short length allows. Weaving segments include 500 feet upstream and downstream of gore point. Short length is at a maximum the gore to gore length, and is reduced for any barrier markings (solid white lines) that prohibit or discourage lane changing. Review the values set for Segment length on the Segments page and Short Length on the details page.

Comments

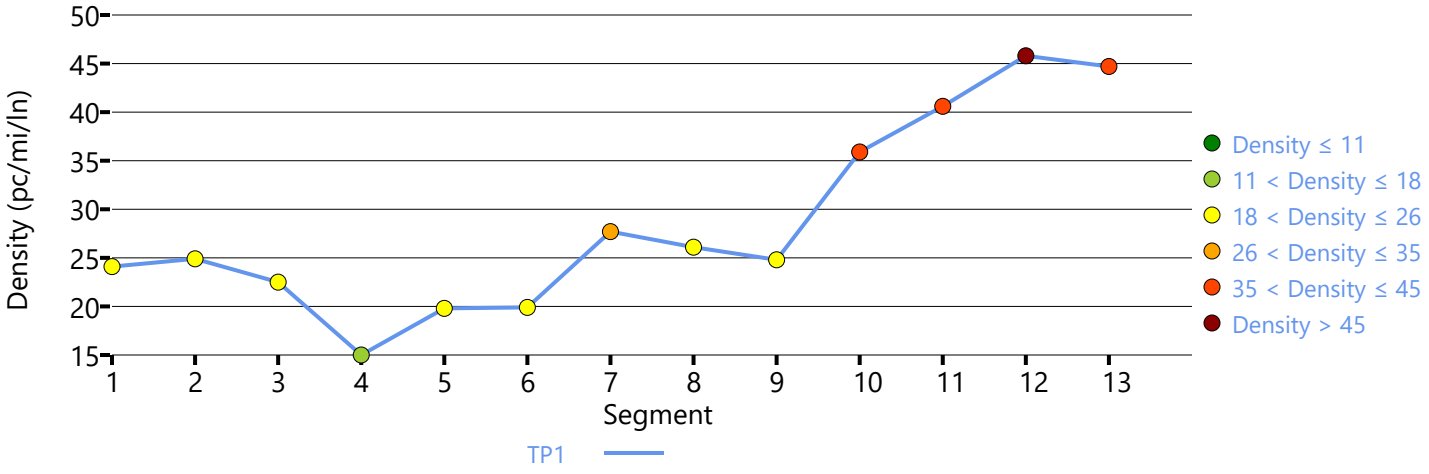
Volume Distribution



Speed Distribution



Density Distribution



HCS7 Freeway Facilities Report

Project Information

Analyst	TVF	Date	12/16/2020
Agency	LJB	Analysis Year	2020
Jurisdiction		Time Period Analyzed	PM 2020 Existing
Project Description	WB US33	Unit	United States Customary

Facility Global Input

Jam Density, pc/mi/ln	190.0	Density at Capacity, pc/mi/ln	45.0
Queue Discharge Capacity Drop, %	7	Total Segments	9
Total Time Periods	1	Time Period Duration, min	15
Facility Length, mi	4.29		

Facility Segment Data

No.	Coded	Analyzed	Name	Length, ft	Lanes
1	Basic	Basic	Wb US33 W of Bixby	7970	2
2	Diverge	Diverge	Wb US33 to Hamilton Ramp	1500	2
3	Basic	Basic	Wb US33	1800	2
4	Weaving	Weaving	Wb US33 (Weave)	4557	3
5	Overlap	Basic	Wb US33 (Overlap)	90	2
6	Weaving	Weaving	Wb US33 (Weave)	1449	3
7	Basic	Basic	Wb US33	830	2
8	Merge	Merge	Sb I270 to Wb US33 Ramp	1500	2
9	Basic	Basic	Wb US33	2960	2

Facility Segment Data

Segment 1: Basic

Time Period	PHF	fHV	Flow Rate (pc/h)	Capacity (pc/h)	d/c Ratio	Speed (mi/h)	Density (pc/mi/ln)	LOS
1	0.94	0.926	2091	4636	0.45	61.8	16.9	B

Segment 2: Diverge

Time Period	PHF		fHV		Flow Rate (pc/h)		Capacity (pc/h)		d/c Ratio		Speed (mi/h)		Density (pc/mi/ln)		LOS
	F	R	F	R	Freeway	Ramp	Freeway	Ramp	F	R	F	R	Freeway	Ramp	
1	0.94	0.94	0.926	0.885	2091	337	4700	2100	0.44	0.16	57.5	57.5	18.2	16.4	B

Segment 3: Basic

Time Period	PHF	fHV	Flow Rate (pc/h)	Capacity (pc/h)	d/c Ratio	Speed (mi/h)	Density (pc/mi/ln)	LOS
1	0.94	0.935	1752	4636	0.38	61.5	14.2	B

Segment 4: Weaving

Time Period	PHF	fHV	Flow Rate (pc/h)	Capacity (pc/h)	d/c Ratio	Speed (mi/h)	Density (pc/mi/ln)	LOS
1	0.94	0.935	2703	3042	0.89	52.8	17.1	B

Segment 5: Overlap

Time Period	PHF	fHV	Flow Rate (pc/h)	Capacity (pc/h)	d/c Ratio	Speed (mi/h)	Density (pc/mi/ln)	LOS
1	0.94	0.935	1547	4636	0.33	61.6	12.5	B

Segment 6: Weaving

Time Period	PHF	fHV	Flow Rate (pc/h)	Capacity (pc/h)	d/c Ratio	Speed (mi/h)	Density (pc/mi/ln)	LOS
1	0.94	0.935	1843	5052	0.36	53.4	11.5	B

Segment 7: Basic

Time Period	PHF	fHV	Flow Rate (pc/h)	Capacity (pc/h)	d/c Ratio	Speed (mi/h)	Density (pc/mi/ln)	LOS
1	0.94	0.935	1252	4636	0.27	60.5	10.1	A

Segment 8: Merge

Time Period	PHF		fHV		Flow Rate (pc/h)		Capacity (pc/h)		d/c Ratio		Speed (mi/h)		Density (pc/mi/ln)		LOS
	F	R	F	R	Freeway	Ramp	Freeway	Ramp	F	R	F	R	Freeway	Ramp	
1	0.94	0.94	0.935	0.935	1411	159	4700	2100	0.30	0.08	58.6	58.6	12.0	12.3	B

Segment 9: Basic

Time Period	PHF	fHV	Flow Rate (pc/h)	Capacity (pc/h)	d/c Ratio	Speed (mi/h)	Density (pc/mi/ln)	LOS
1	0.94	0.935	1411	4636	0.30	61.7	11.4	B

Facility Time Period Results

T	Speed, mi/h	Density, pc/mi/ln	Density, veh/mi/ln	Travel Time, min	LOS
1	58.1	15.2	13.9	4.40	B

Facility Overall Results

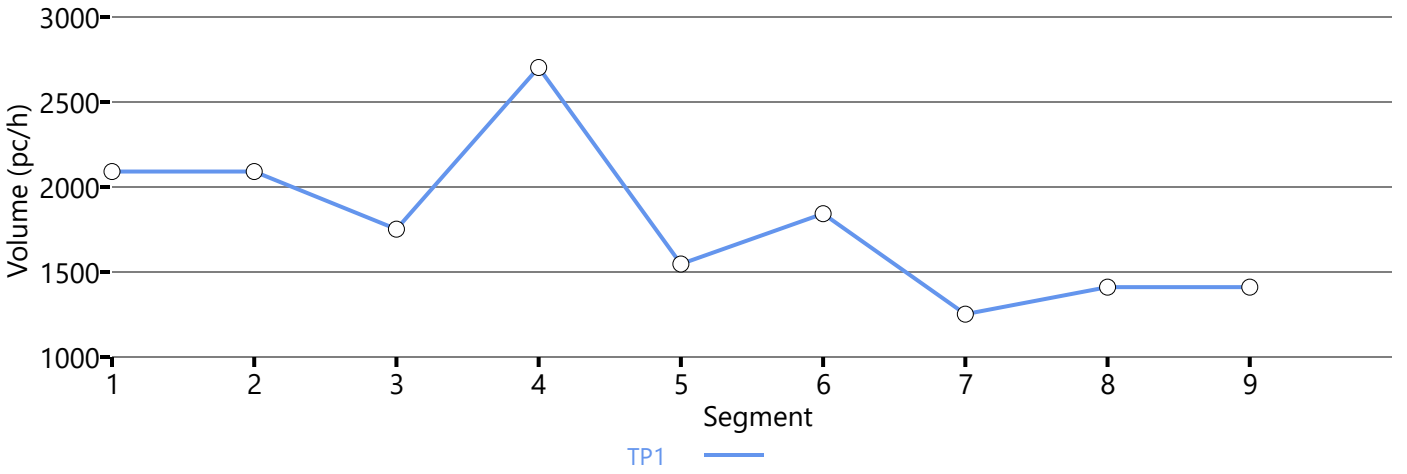
Space Mean Speed, mi/h	58.1	Density, veh/mi/ln	13.9
Average Travel Time, min	4.40	Density, pc/mi/ln	15.2

Messages

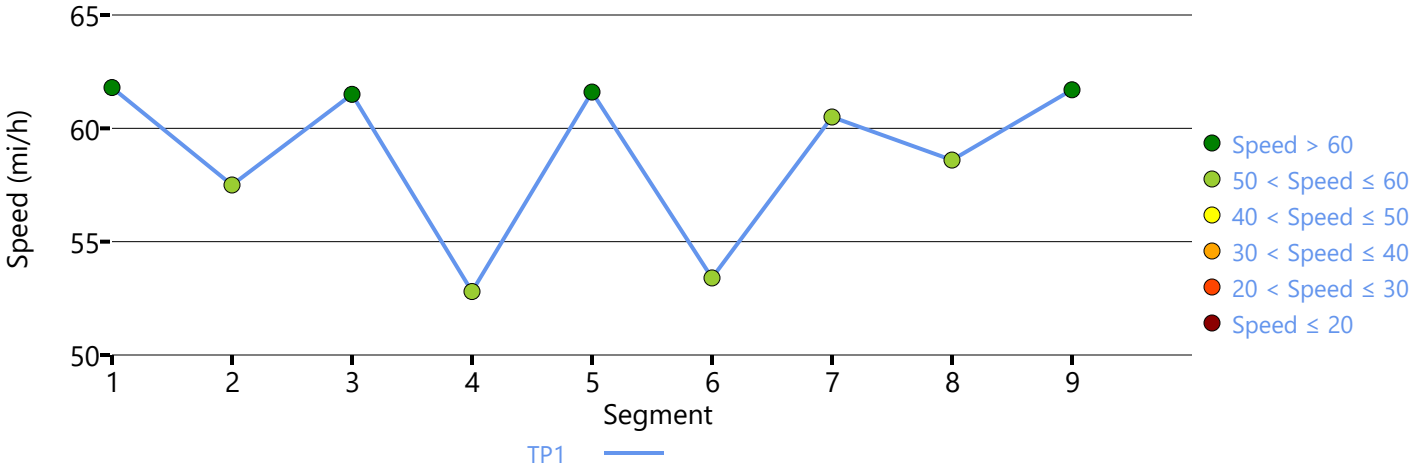
WARNING 1	Sum of lengths of ramp overlap segment (segment 5) and an adjacent ramp segment (segment 4) should be 1500 feet.
WARNING 2	Sum of lengths of ramp overlap segment (segment 5) and an adjacent ramp segment (segment 6) should be 1500 feet.
WARNING 3	Weaving Segment (segment 4) is shorter than the segment short length allows. Weaving segments include 500 feet upstream and downstream of gore point. Short length is at a maximum the gore to gore length, and is reduced for any barrier markings (solid white lines) that prohibit or discourage lane changing. Review the values set for Segment length on the Segments page and Short Length on the details page.
WARNING 4	Weaving Segment (segment 6) is shorter than the segment short length allows. Weaving segments include 500 feet upstream and downstream of gore point. Short length is at a maximum the gore to gore length, and is reduced for any barrier markings (solid white lines) that prohibit or discourage lane changing. Review the values set for Segment length on the Segments page and Short Length on the details page.

Comments

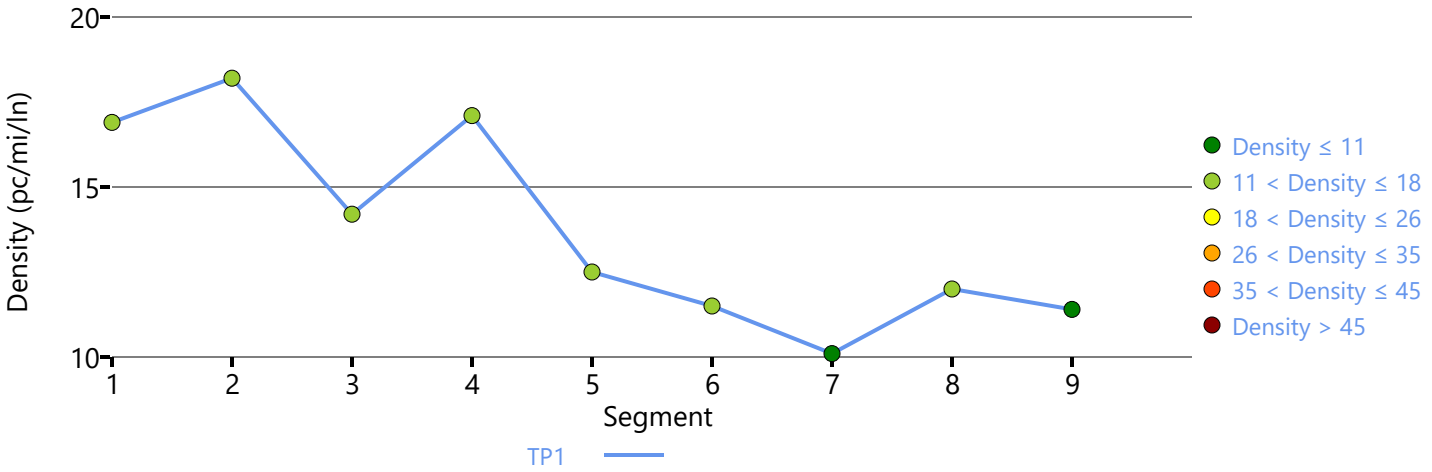
Volume Distribution



Speed Distribution

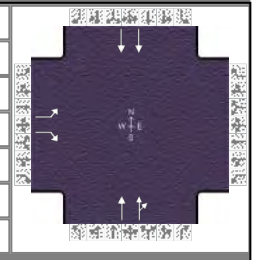


Density Distribution



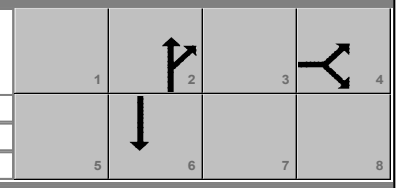
HCS7 Signalized Intersection Input Data

General Information				Intersection Information	
Agency	LJB			Duration, h	0.250
Analyst	TVF	Analysis Date	Oct 8, 2020	Area Type	Other
Jurisdiction	Columbus	Time Period	PM Peak	PHF	0.92
Urban Street	S Hamilton Rd	Analysis Year	2020	Analysis Period	1> 7:00
Intersection	US 33 EB Ramps	File Name	S Hamilton Rd Intersections PM Existing.xus		
Project Description	S Hamiilton Rd & US 33 Safety Study				



Demand Information	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Demand (*v*), veh/h	260		380					1460	280		810	

Signal Information					EB		WB		NB		SB		
Cycle, s	120.0	Reference Phase	2										
Offset, s	22	Reference Point	End	Green	61.2	47.6	0.0	0.0	0.0	0.0			
Uncoordinated	No	Simult. Gap E/W	On	Yellow	5.0	3.6	0.0	0.0	0.0	0.0			
Force Mode	Fixed	Simult. Gap N/S	On	Red	1.0	1.6	0.0	0.0	0.0	0.0			



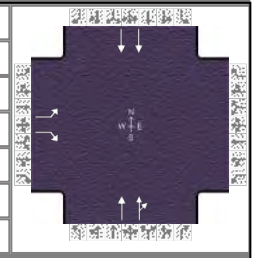
Traffic Information	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Demand (*v*), veh/h	260		380					1460	280		810	
Initial Queue (Q_b), veh/h	0		0					0	0		0	
Base Saturation Flow Rate (s_o), veh/h	1900		1900					1900	1900		1900	
Parking (N_m), man/h		None						None			None	
Heavy Vehicles (P_{HV}), %	8		8					4			7	
Ped / Bike / RTOR, /h	0	0		0	0		0	0	0	0	0	
Buses (N_b), buses/h	0	0	0				0	0	0	0	0	0
Arrival Type (*AT*)	3		3					4	3		4	
Upstream Filtering (*I*)	1.00		1.00					0.58	0.58		0.10	
Lane Width (*W*), ft	12.0		12.0					12.0			12.0	
Turn Bay Length, ft	1800		40					275			725	
Grade (*Pg*), %		0			0			0			0	
Speed Limit, mi/h	50		50					50	50		50	

Phase Information	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Maximum Green (G_{max}) or Phase Split, s		52.8				67.2		67.2
Yellow Change Interval (*Y*), s		3.6				5.0		5.0
Red Clearance Interval (R_c), s		1.6				1.0		1.0
Minimum Green (G_{min}), s		7				20		20
Start-Up Lost Time (*l*t), s	2.0					2.0		2.0
Extension of Effective Green (*e*), s	2.0					2.0		2.0
Passage (*PT*), s		5.0				3.0		3.0
Recall Mode		Min				Min		Min
Dual Entry		Yes				Yes		Yes
Walk (*Walk*), s		0.0		0.0				0.0
Pedestrian Clearance Time (*PC*), s		0.0		0.0				0.0

Multimodal Information	EB			WB			NB			SB		
85th % Speed / Rest in Walk / Corner Radius	0	No	25	0	No	25				0	No	25
Walkway / Crosswalk Width / Length, ft	9.0	12	0	9.0	12	0				9.0	12	0
Street Width / Island / Curb	0	0	No		0		0		No	0	0	No
Width Outside / Bike Lane / Shoulder, ft	12	5.0	2.0				12	5.0	2.0	12	5.0	2.0
Pedestrian Signal / Occupied Parking	No	0.50		No				0.50		No	0.50	

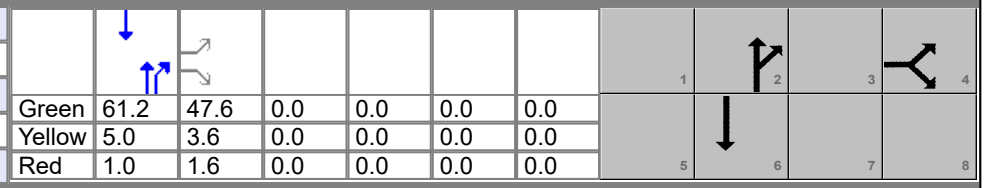
HCS7 Signalized Intersection Results Summary

General Information				Intersection Information	
Agency	LJB			Duration, h	0.250
Analyst	TVF	Analysis Date	Oct 8, 2020	Area Type	Other
Jurisdiction	Columbus	Time Period	PM Peak	PHF	0.92
Urban Street	S Hamilton Rd	Analysis Year	2020	Analysis Period	1> 7:00
Intersection	US 33 EB Ramps	File Name	S Hamilton Rd Intersections PM Existing.xus		
Project Description	S Hamiilton Rd & US 33 Safety Study				



Demand Information	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Demand (*v*), veh/h	260		380					1460	280		810	

Signal Information			
Cycle, s	120.0	Reference Phase	2
Offset, s	22	Reference Point	End
Uncoordinated	No	Simult. Gap E/W	On
Force Mode	Fixed	Simult. Gap N/S	On



Green	61.2	47.6	0.0	0.0	0.0	0.0		
Yellow	5.0	3.6	0.0	0.0	0.0	0.0		
Red	1.0	1.6	0.0	0.0	0.0	0.0		

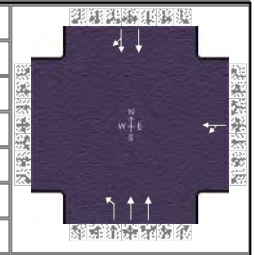
Timer Results	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Assigned Phase		4				2		6
Case Number		9.0				8.0		8.0
Phase Duration, s		52.8				67.2		67.2
Change Period, ($Y+R_c$), s		5.2				6.0		6.0
Max Allow Headway (*MAH*), s		6.1				0.0		0.0
Queue Clearance Time (g_s), s		29.3						
Green Extension Time (g_e), s		5.5				0.0		0.0
Phase Call Probability		1.00						
Max Out Probability		0.21						

Movement Group Results	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Assigned Movement	7		14					2	12		6	
Adjusted Flow Rate (*v*), veh/h	283		413					898	882		868	
Adjusted Saturation Flow Rate (*s*), veh/h/ln	1697		1510					1841	1739		1710	
Queue Service Time (g_s), s	14.5		27.3					65.1	60.7		19.9	
Cycle Queue Clearance Time (g_c), s	14.5		27.3					65.1	60.7		19.9	
Green Ratio (*g/C*)	0.40		0.40					0.51	0.51		0.51	
Capacity (*c*), veh/h	673		599					939	887		1744	
Volume-to-Capacity Ratio (*X*)	0.420		0.690					0.957	0.995		0.498	
Back of Queue (*Q*), ft/ln (95 th percentile)	255.8		403.6					920.8	966.2		228.9	
Back of Queue (*Q*), veh/ln (95 th percentile)	9.6		15.2					35.7	37.4		8.7	
Queue Storage Ratio (*RQ*) (95 th percentile)	0.14		10.09					3.35	3.51		0.32	
Uniform Delay (d_1), s/veh	26.2		30.1					36.0	36.5		19.2	
Incremental Delay (d_2), s/veh	0.9		4.3					14.2	21.8		0.1	
Initial Queue Delay (d_3), s/veh	0.0		0.0					0.0	0.0		0.0	
Control Delay (*d*), s/veh	27.1		34.4					50.3	58.3		19.3	
Level of Service (LOS)	C		C					D	E		B	
Approach Delay, s/veh / LOS	31.4	C		0.0			54.2	D		19.3	B	
Intersection Delay, s/veh / LOS	40.4						D					

Multimodal Results	EB		WB		NB		SB	
Pedestrian LOS Score / LOS	2.16	B	2.16	B	0.71	A	1.68	B
Bicycle LOS Score / LOS		F			2.05	B	1.21	A

HCS7 Signalized Intersection Intermediate Values

General Information				Intersection Information	
Agency	LJB			Duration, h	0.250
Analyst	TVF	Analysis Date	Oct 8, 2020	Area Type	Other
Jurisdiction	Columbus	Time Period	PM Peak	PHF	0.92
Urban Street	S Hamilton Rd	Analysis Year	2020	Analysis Period	1> 7:00
Intersection	US 33 WB Ramps	File Name	S Hamilton Rd Intersections PM Existing.xus		
Project Description	S Hamiilton Rd & US 33 Safety Study				



Demand Information	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Demand (*v*), veh/h				150	5		630	1090			700	360

Signal Information			
Cycle, s	120.0	Reference Phase	2
Offset, s	75	Reference Point	End
Uncoordinated	No	Simult. Gap E/W	On
Force Mode	Fixed	Simult. Gap N/S	On

							1	2	3	4		
Green	48.8	36.0	19.1	0.0	0.0	0.0	5	6	7	8		
Yellow	3.6	5.0	3.6	0.0	0.0	0.0						
Red	1.6	1.0	1.3	0.0	0.0	0.0						

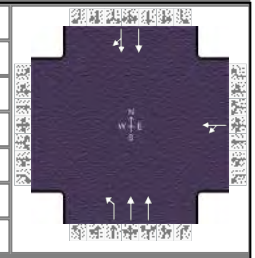
Saturation Flow / Delay	L	T	R	L	T	R	L	T	R	L	T	R
Lane Width Adjustment Factor (f_w)				1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
Heavy Vehicles and Grade Factor (f_{HVg})				1.000	0.953	1.000	0.992	0.992	1.000	1.000	0.992	0.992
Parking Activity Adjustment Factor (f_p)	0.000	0.000	0.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
Bus Blockage Adjustment Factor (f_{bb})	0.000	0.000	0.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
Area Type Adjustment Factor (f_a)				1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
Lane Utilization Adjustment Factor (f_{LU})	1.000	1.000	1.000	1.000	1.000	1.000	1.000	0.952	1.000	1.000	1.000	1.000
Left-Turn Adjustment Factor (f_{LT})				0.954	0.954		0.952	0.000		1.000	1.000	
Right-Turn Adjustment Factor (f_{RT})					0.000	0.000		1.000	1.000		0.885	0.885
Left-Turn Pedestrian Adjustment Factor (f_{Lpb})				1.000			1.000			1.000		
Right-Turn Ped-Bike Adjustment Factor (f_{Rpb})						1.000			1.000			1.000
Work Zone Adjustment Factor (f_{wz})				1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
DDI Factor (f_{DDI})				1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
Movement Saturation Flow Rate (s), veh/h				1672	56	0	1795	3680	0	0	2349	1204
Proportion of Vehicles Arriving on Green (P)	0.00	0.00	0.00	0.16	0.16	0.00	0.71	0.85	0.00	0.00	0.40	0.30
Incremental Delay Factor (k)					0.22		0.41	0.50			0.50	0.50

Signal Timing / Movement Groups	EBL	EBT/R	WBL	WBT/R	NBL	NBT/R	SBL	SBT/R
Lost Time (t_L)				4.0	5.2	6.0		6.0
Green Ratio (g/C)				0.16	0.72	0.75		0.30
Permitted Saturation Flow Rate (s_p), veh/h/ln				0	492	0		508
Shared Saturation Flow Rate (s_{sh}), veh/h/ln								0
Permitted Effective Green Time (g_p), s				0.0	38.0	0.0		0.0
Permitted Service Time (g_u), s				0.0	0.0	0.0		0.0
Permitted Queue Service Time (g_{ps}), s					0.0			
Time to First Blockage (g_f), s				0.0	0.0	0.0		36.0
Queue Service Time Before Blockage (g_{fs}), s								
Protected Right Saturation Flow (s_R), veh/h/ln								
Protected Right Effective Green Time (g_R), s								

Multimodal	EB		WB		NB		SB	
Pedestrian F_w / F_v	1.557	0.000	1.389	0.000	0.681	0.000	0.681	0.000
Pedestrian F_s / F_{delay}	0.000	0.167	0.000	0.168	0.000	0.053	0.000	0.136
Pedestrian M_{corner} / M_{cw}								
Bicycle c_b / d_b	-83.33	65.10	-98.33	66.05	1500.00	3.75	600.00	29.40
Bicycle F_w / F_v	-3.64		-3.64	0.28	-3.64	1.54	-3.64	0.95

HCS7 Signalized Intersection Results Graphical Summary

General Information				Intersection Information	
Agency	LJB			Duration, h	0.250
Analyst	TVF	Analysis Date	Oct 8, 2020	Area Type	Other
Jurisdiction	Columbus	Time Period	PM Peak	PHF	0.92
Urban Street	S Hamilton Rd	Analysis Year	2020	Analysis Period	1> 7:00
Intersection	US 33 WB Ramps	File Name	S Hamilton Rd Intersections PM Existing.xus		
Project Description	S Hamiilton Rd & US 33 Safety Study				

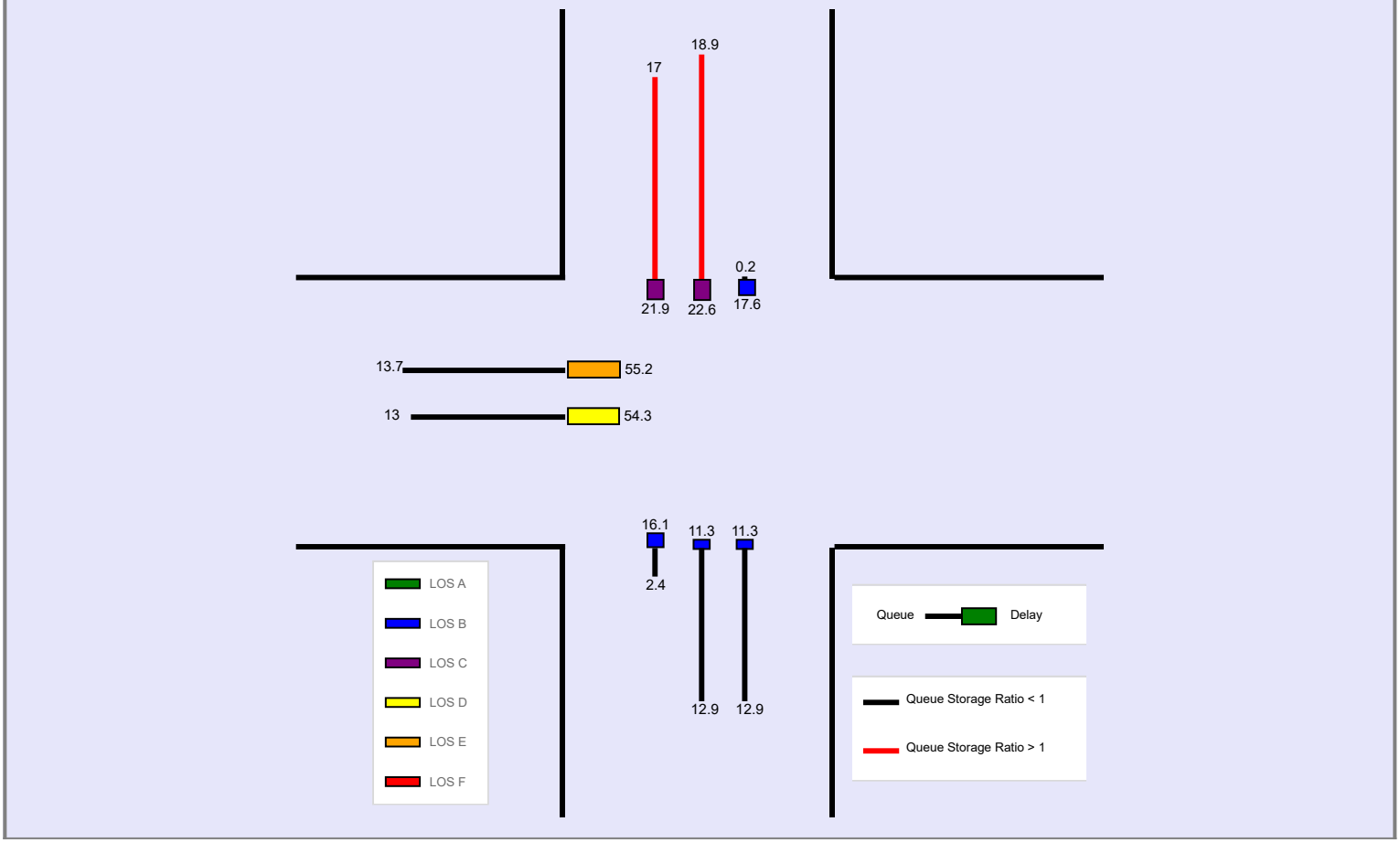


Demand Information	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Demand (*v*), veh/h				150	5		630	1090			700	360

Signal Information			
Cycle, s	120.0	Reference Phase	2
Offset, s	75	Reference Point	End
Uncoordinated	No	Simult. Gap E/W	On
Force Mode	Fixed	Simult. Gap N/S	On

							1	2	3	4		
Green	48.8	36.0	19.1	0.0	0.0	0.0	5	6	7	8		
Yellow	3.6	5.0	3.6	0.0	0.0	0.0						
Red	1.6	1.0	1.3	0.0	0.0	0.0						

Movement Group Results	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Back of Queue (*Q*), ft/ln (95 th percentile)					222.3		110.6	81.5			836.6	805.1
Back of Queue (*Q*), veh/ln (95 th percentile)					8.5		4.4	3.2			33.2	31.9
Queue Storage Ratio (*RQ*) (95 th percentile)					1.35		0.21	0.11			0.96	0.92
Control Delay (*d*), s/veh					51.5		12.4	3.0			96.8	104.8
Level of Service (LOS)					D		B	A			F	F
Approach Delay, s/veh / LOS	0.0			51.5		D	6.4		A	100.6		F
Intersection Delay, s/veh / LOS	43.9						D					



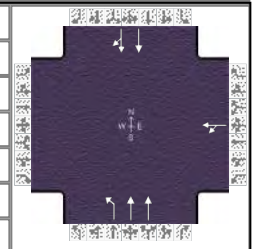
--- Messages ---

WARNING: Since queue spillover from turn lanes and spillback into upstream intersections is not accounted for in the HCM procedures, use of a simulation tool may be advised in situations where the Queue Storage Ratio exceeds 1.0.

--- Comments ---

HCS7 Signalized Intersection Input Data

General Information				Intersection Information	
Agency	LJB			Duration, h	0.250
Analyst	TVF	Analysis Date	Oct 8, 2020	Area Type	Other
Jurisdiction	Columbus	Time Period	PM Peak	PHF	0.92
Urban Street	S Hamilton Rd	Analysis Year	2020	Analysis Period	1> 7:00
Intersection	US 33 WB Ramps	File Name	S Hamilton Rd Intersections PM Existing.xus		
Project Description	S Hamiilton Rd & US 33 Safety Study				



Demand Information	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Demand (*v*), veh/h				150	5		630	1090			700	360

Signal Information												
Cycle, s	120.0	Reference Phase	2									
Offset, s	75	Reference Point	End									
Uncoordinated	No	Simult. Gap E/W	On									
Force Mode	Fixed	Simult. Gap N/S	On									
				Green	48.8	36.0	19.1	0.0	0.0	0.0		
				Yellow	3.6	5.0	3.6	0.0	0.0	0.0		
				Red	1.6	1.0	1.3	0.0	0.0	0.0		

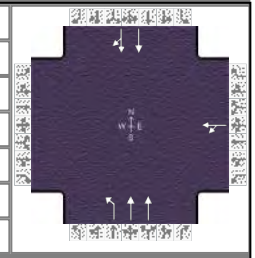
Traffic Information	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Demand (*v*), veh/h				150	5		630	1090			700	360
Initial Queue (Q_b), veh/h				0	0		0	0			0	0
Base Saturation Flow Rate (s_o), veh/h				1900	1900		1900	1900			1900	1900
Parking (N_m), man/h					None		0	L			None	
Heavy Vehicles (P_{HV}), %					6		1	1			1	
Ped / Bike / RTOR, /h	0	0		0	0		0	0		0	0	0
Buses (N_b), buses/h				0	0	0	0	0	0	0	0	0
Arrival Type (*AT*)				3	3		3	4			4	3
Upstream Filtering (*I*)				1.00	1.00		0.35	0.35			1.00	1.00
Lane Width (*W*), ft					12.0		12.0	12.0			12.0	
Turn Bay Length, ft					165		525	750			875	
Grade (*Pg*), %		0			0			0			0	
Speed Limit, mi/h				50	50		50	50			50	50

Phase Information	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Maximum Green (G_{max}) or Phase Split, s				24.0	54.0	96.0		42.0
Yellow Change Interval (*Y*), s				3.6	3.6	5.0		5.0
Red Clearance Interval (R_c), s				1.3	1.6	1.0		1.0
Minimum Green (G_{min}), s				7	10	20		20
Start-Up Lost Time (*l*t), s			2.0	2.0	2.0	2.0		2.0
Extension of Effective Green (*e*), s			2.0	2.0	2.0	2.0		2.0
Passage (*PT*), s				3.7	5.0	3.0		3.0
Recall Mode				Off	Off	Min		Min
Dual Entry				Yes	No	Yes		Yes
Walk (*Walk*), s		0.0		0.0		0.0		
Pedestrian Clearance Time (*PC*), s		0.0		0.0		0.0		

Multimodal Information	EB			WB			NB			SB		
85th % Speed / Rest in Walk / Corner Radius	0	No	25	0	No	25	0	No	25			
Walkway / Crosswalk Width / Length, ft	9.0	12	0	9.0	12	0	9.0	12	0			
Street Width / Island / Curb		0		0	0	No	0	0	No	0		No
Width Outside / Bike Lane / Shoulder, ft				12	5.0	2.0	12	5.0	2.0	12	5.0	2.0
Pedestrian Signal / Occupied Parking	No			No	0.50		No	0.50			0.50	

HCS7 Signalized Intersection Results Summary

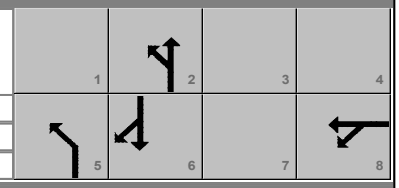
General Information				Intersection Information	
Agency	LJB			Duration, h	0.250
Analyst	TVF	Analysis Date	Oct 8, 2020	Area Type	Other
Jurisdiction	Columbus	Time Period	PM Peak	PHF	0.92
Urban Street	S Hamilton Rd	Analysis Year	2020	Analysis Period	1> 7:00
Intersection	US 33 WB Ramps	File Name	S Hamilton Rd Intersections PM Existing.xus		
Project Description	S Hamiilton Rd & US 33 Safety Study				



Demand Information	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Demand (*v*), veh/h				150	5		630	1090			700	360

Signal Information			
Cycle, s	120.0	Reference Phase	2
Offset, s	75	Reference Point	End
Uncoordinated	No	Simult. Gap E/W	On
Force Mode	Fixed	Simult. Gap N/S	On

Green	48.8	36.0	19.1	0.0	0.0	0.0	
Yellow	3.6	5.0	3.6	0.0	0.0	0.0	
Red	1.6	1.0	1.3	0.0	0.0	0.0	



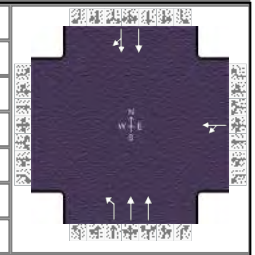
Timer Results	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Assigned Phase				8	5	2		6
Case Number				12.0	1.0	4.0		8.3
Phase Duration, s				24.0	54.0	96.0		42.0
Change Period, (*Y+R c*), s				4.9	5.2	6.0		6.0
Max Allow Headway (*MAH*), s				4.7	6.0	0.0		0.0
Queue Clearance Time (*g s*), s				12.9	25.4			
Green Extension Time (*g e*), s				0.3	6.1	0.0		0.0
Phase Call Probability				1.00	1.00			
Max Out Probability				0.37	0.09			

Movement Group Results	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Assigned Movement				3	8		5	2			6	16
Adjusted Flow Rate (*v*), veh/h					168		651	1126			610	542
Adjusted Saturation Flow Rate (*s*), veh/h/ln					1727		1795	1795			1885	1668
Queue Service Time (*g s*), s					10.9		23.4	8.6			38.4	36.0
Cycle Queue Clearance Time (*g c*), s					10.9		23.4	8.6			38.4	36.0
Green Ratio (*g/C*)					0.16		0.72	0.75			0.30	0.30
Capacity (*c*), veh/h					275		790	2692			566	501
Volume-to-Capacity Ratio (*X*)					0.613		0.824	0.418			1.079	1.083
Back of Queue (*Q*), ft/ln (95 th percentile)					222.3		110.6	81.5			836.6	805.1
Back of Queue (*Q*), veh/ln (95 th percentile)					8.5		4.4	3.2			33.2	31.9
Queue Storage Ratio (*RQ*) (95 th percentile)					1.35		0.21	0.11			0.96	0.92
Uniform Delay (*d 1*), s/veh					47.0		9.5	2.8			36.0	40.3
Incremental Delay (*d 2*), s/veh					4.5		2.9	0.2			60.8	64.5
Initial Queue Delay (*d 3*), s/veh					0.0		0.0	0.0			0.0	0.0
Control Delay (*d*), s/veh					51.5		12.4	3.0			96.8	104.8
Level of Service (LOS)					D		B	A			F	F
Approach Delay, s/veh / LOS	0.0			51.5		D	6.4		A	100.6		F
Intersection Delay, s/veh / LOS	43.9						D					

Multimodal Results	EB		WB		NB		SB	
Pedestrian LOS Score / LOS	2.32	B	2.16	B	1.33	A	1.42	A
Bicycle LOS Score / LOS			0.77	A	2.03	B	1.44	A

HCS7 Signalized Intersection Intermediate Values

General Information				Intersection Information	
Agency	LJB			Duration, h	0.250
Analyst	TVF	Analysis Date	Oct 8, 2020	Area Type	Other
Jurisdiction	Columbus	Time Period	PM Peak	PHF	0.92
Urban Street	S Hamilton Rd	Analysis Year	2020	Analysis Period	1> 7:00
Intersection	US 33 WB Ramps	File Name	S Hamilton Rd Intersections PM Existing.xus		
Project Description	S Hamiilton Rd & US 33 Safety Study				



Demand Information	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Demand (*v*), veh/h				150	5		630	1090			700	360

Signal Information			
Cycle, s	120.0	Reference Phase	2
Offset, s	75	Reference Point	End
Uncoordinated	No	Simult. Gap E/W	On
Force Mode	Fixed	Simult. Gap N/S	On

							1	2	3	4		
Green	48.8	36.0	19.1	0.0	0.0	0.0	5	6	7	8		
Yellow	3.6	5.0	3.6	0.0	0.0	0.0						
Red	1.6	1.0	1.3	0.0	0.0	0.0						

Saturation Flow / Delay	L	T	R	L	T	R	L	T	R	L	T	R
Lane Width Adjustment Factor (f_w)				1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
Heavy Vehicles and Grade Factor (f_{HVg})				1.000	0.953	1.000	0.992	0.992	1.000	1.000	0.992	0.992
Parking Activity Adjustment Factor (f_p)	0.000	0.000	0.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
Bus Blockage Adjustment Factor (f_{bb})	0.000	0.000	0.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
Area Type Adjustment Factor (f_a)				1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
Lane Utilization Adjustment Factor (f_{LU})	1.000	1.000	1.000	1.000	1.000	1.000	1.000	0.952	1.000	1.000	1.000	1.000
Left-Turn Adjustment Factor (f_{LT})				0.954	0.954		0.952	0.000		1.000	1.000	
Right-Turn Adjustment Factor (f_{RT})					0.000	0.000		1.000	1.000		0.885	0.885
Left-Turn Pedestrian Adjustment Factor (f_{Lpb})				1.000			1.000			1.000		
Right-Turn Ped-Bike Adjustment Factor (f_{Rpb})						1.000			1.000			1.000
Work Zone Adjustment Factor (f_{wz})				1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
DDI Factor (f_{DDI})				1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
Movement Saturation Flow Rate (s), veh/h				1672	56	0	1795	3680	0	0	2349	1204
Proportion of Vehicles Arriving on Green (P)	0.00	0.00	0.00	0.16	0.16	0.00	0.71	0.85	0.00	0.00	0.40	0.30
Incremental Delay Factor (k)					0.22		0.41	0.50			0.50	0.50

Signal Timing / Movement Groups	EBL	EBT/R	WBL	WBT/R	NBL	NBT/R	SBL	SBT/R
Lost Time (t_L)				4.0	5.2	6.0		6.0
Green Ratio (g/C)				0.16	0.72	0.75		0.30
Permitted Saturation Flow Rate (s_p), veh/h/ln				0	492	0		508
Shared Saturation Flow Rate (s_{sh}), veh/h/ln								0
Permitted Effective Green Time (g_p), s				0.0	38.0	0.0		0.0
Permitted Service Time (g_u), s				0.0	0.0	0.0		0.0
Permitted Queue Service Time (g_{ps}), s					0.0			
Time to First Blockage (g_f), s				0.0	0.0	0.0		36.0
Queue Service Time Before Blockage (g_{fs}), s								
Protected Right Saturation Flow (s_R), veh/h/ln								
Protected Right Effective Green Time (g_R), s								

Multimodal	EB		WB		NB		SB	
Pedestrian F_w / F_v	1.557	0.000	1.389	0.000	0.681	0.000	0.681	0.000
Pedestrian F_s / F_{delay}	0.000	0.167	0.000	0.168	0.000	0.053	0.000	0.136
Pedestrian M_{corner} / M_{cw}								
Bicycle c_b / d_b	-83.33	65.10	-98.33	66.05	1500.00	3.75	600.00	29.40
Bicycle F_w / F_v	-3.64		-3.64	0.28	-3.64	1.54	-3.64	0.95

HCS7 Signalized Intersection Results Graphical Summary

General Information				Intersection Information	
Agency	LJB			Duration, h	0.250
Analyst	TVF	Analysis Date	Oct 8, 2020	Area Type	Other
Jurisdiction	Columbus	Time Period	PM Peak	PHF	0.92
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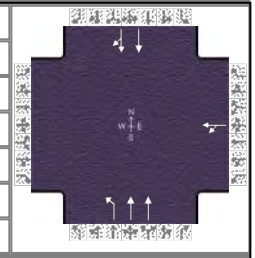
Project Description	S Hamiilton Rd & US 33 Safety Study				

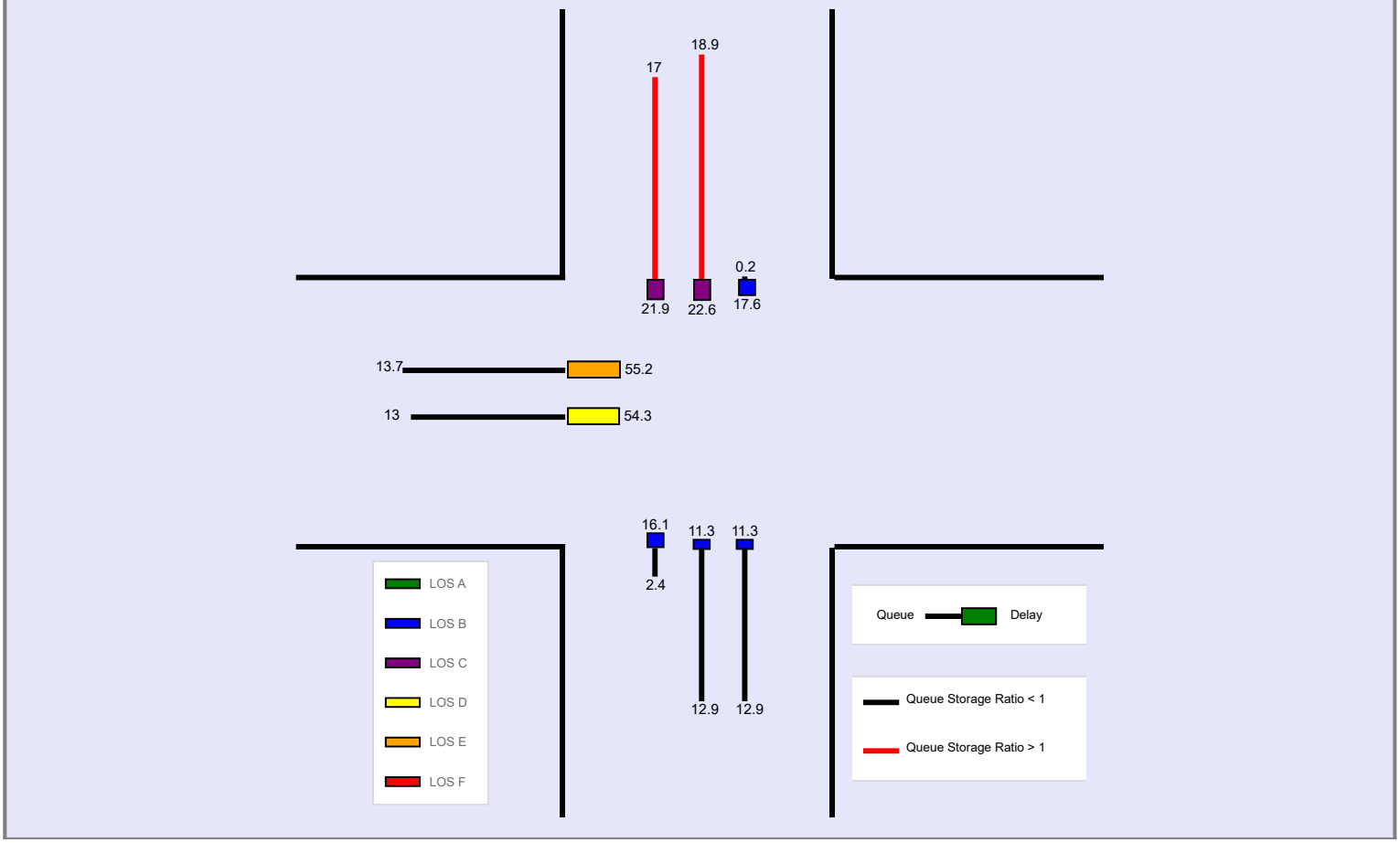


Demand Information	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Demand (*v*), veh/h				150	5		630	1090			700	360

Signal Information			
Cycle, s	120.0	Reference Phase	2
Offset, s	75	Reference Point	End
Uncoordinated	No	Simult. Gap E/W	On
Force Mode	Fixed	Simult. Gap N/S	On

							1	2	3	4		
Green	48.8	36.0	19.1	0.0	0.0	0.0	5	6	7	8		
Yellow	3.6	5.0	3.6	0.0	0.0	0.0						
Red	1.6	1.0	1.3	0.0	0.0	0.0						

Movement Group Results	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Back of Queue (*Q*), ft/ln (95 th percentile)					222.3		110.6	81.5			836.6	805.1
Back of Queue (*Q*), veh/ln (95 th percentile)					8.5		4.4	3.2			33.2	31.9
Queue Storage Ratio (*RQ*) (95 th percentile)					1.35		0.21	0.11			0.96	0.92
Control Delay (*d*), s/veh					51.5		12.4	3.0			96.8	104.8
Level of Service (LOS)					D		B	A			F	F
Approach Delay, s/veh / LOS	0.0			51.5		D	6.4		A	100.6		F
Intersection Delay, s/veh / LOS	43.9						D					



--- Messages ---

WARNING: Since queue spillover from turn lanes and spillback into upstream intersections is not accounted for in the HCM procedures, use of a simulation tool may be advised in situations where the Queue Storage Ratio exceeds 1.0.

--- Comments ---

2045 NO BUILD CAPACITY ANALYSIS

HCS7 Freeway Facilities Report

Project Information

Analyst	LJB/JDO	Date	11/20/2020
Agency		Analysis Year	2045
Jurisdiction		Time Period Analyzed	AM 2045 NB
Project Description	EB US33	Unit	United States Customary

Facility Global Input

Jam Density, pc/mi/ln	190.0	Density at Capacity, pc/mi/ln	45.0
Queue Discharge Capacity Drop, %	7	Total Segments	30
Total Time Periods	1	Time Period Duration, min	15
Facility Length, mi	11.50		

Facility Segment Data

No.	Coded	Analyzed	Name	Length, ft	Lanes
1	Basic	Basic	Eb US33 S of 104	3020	2
2	Diverge	Diverge	Eb US33 to I270 SB Off-Ramp	1500	2
3	Basic	Basic	Eb US33 2 Lane Segment	710	2
4	Basic	Basic	Eb US33 3 Lane Segment	130	3
5	Weaving	Weaving	Eb US33 (Weave)	1476	4
6	Basic	Basic	Eb US33	410	3
7	Merge	Merge	Nb I270 to Eb US33 On Ramp (Long Ramp)	1500	3
8	Basic	Basic	Eb US33-Bet I-270 & Hamilton	990	3
9	Diverge	Basic	Eb US33 to Hamilton off-ramp (Long Ramp)	1500	3
10	Basic	Basic	Eb US33	1350	2
11	Merge	Merge	Sb Hamilton to Eb US33 On-Ramp	1400	2
12	Merge	Merge	Nb Hamilton to Eb US33 On-Ramp	1500	2
13	Basic	Basic	Eb US33 (Hamilton to Bixby)	4680	2
14	Diverge	Diverge	EB US 33 to Bixby SB Off-ramp	1500	2
15	Diverge	Diverge	EB US 33 to Bixby NB Off-ramp	1500	2
16	Basic	Basic	EB US 33	650	2
17	Merge	Merge	Bixby to EB US33 On Ramp	1500	2
18	Basic	Basic	EB US 33 - Bixby to Gender	4070	2
19	Diverge	Diverge	Eb US33 to Gender Off Ramp	1500	2
20	Basic	Basic	EB US 33-Bet Gender Ramps	2350	2
21	Merge	Merge	Gender to EB US33 On Ramp	1500	2
22	Basic	Basic	Eb US33 -Gender to Diley	3730	2
23	Diverge	Diverge	EB US 33 to Diley - Off ramp	1500	2
24	Basic	Basic	Between Diley Ramps	4090	2
25	Merge	Merge	Diley to EB US33 On-Ramp	1500	2

26	Basic	Basic	EB US33-Diley to Pickerington	4860	2
27	Diverge	Diverge	EB US 33 to Pickerington Off-ramp	1500	2
28	Basic	Basic	EB US33-Bet Pickerington Ramps	2000	2
29	Merge	Merge	EB US33-Pickerington On Ramp	1500	2
30	Basic	Basic	EB US 33-East of Pickerington	5280	2

Facility Segment Data

Segment 1: Basic

Time Period	PHF	fHV	Flow Rate (pc/h)	Capacity (pc/h)	d/c Ratio	Speed (mi/h)	Density (pc/mi/ln)	LOS
1	0.94	0.926	2711	4700	0.58	65.0	20.9	C

Segment 2: Diverge

Time Period	PHF		fHV		Flow Rate (pc/h)		Capacity (pc/h)		d/c Ratio		Speed (mi/h)		Density (pc/mi/ln)		LOS
	F	R	F	R	Freeway	Ramp	Freeway	Ramp	F	R	F	R	Freeway	Ramp	
1	0.94	0.94	0.926	0.926	2711	379	4700	2100	0.58	0.18	58.9	58.9	23.0	22.9	C

Segment 3: Basic

Time Period	PHF	fHV	Flow Rate (pc/h)	Capacity (pc/h)	d/c Ratio	Speed (mi/h)	Density (pc/mi/ln)	LOS
1	0.94	0.926	2332	4700	0.50	64.0	17.9	B

Segment 4: Basic

Time Period	PHF	fHV	Flow Rate (pc/h)	Capacity (pc/h)	d/c Ratio	Speed (mi/h)	Density (pc/mi/ln)	LOS
1	0.94	0.926	2332	7050	0.33	64.5	12.0	B

Segment 5: Weaving

Time Period	PHF	fHV	Flow Rate (pc/h)	Capacity (pc/h)	d/c Ratio	Speed (mi/h)	Density (pc/mi/ln)	LOS
1	0.94	0.926	3461	6015	0.58	49.2	17.6	B

Segment 6: Basic

Time Period	PHF	fHV	Flow Rate (pc/h)	Capacity (pc/h)	d/c Ratio	Speed (mi/h)	Density (pc/mi/ln)	LOS
1	0.94	0.926	3217	7050	0.46	61.6	16.5	B

Segment 7: Merge

Time Period	PHF		fHV		Flow Rate (pc/h)		Capacity (pc/h)		d/c Ratio		Speed (mi/h)		Density (pc/mi/ln)		LOS
	F	R	F	R	Freeway	Ramp	Freeway	Ramp	F	R	F	R	Freeway	Ramp	
1	0.94	0.94	0.926	0.893	4265	1048	7050	2000	0.60	0.52	59.0	57.7	24.1	22.1	C

Segment 8: Basic

Time Period	PHF	fHV	Flow Rate (pc/h)	Capacity (pc/h)	d/c Ratio	Speed (mi/h)	Density (pc/mi/ln)	LOS
1	0.94	0.926	4228	7050	0.60	64.2	21.7	C

Segment 9: Diverge

Time Period	PHF	fHV	Flow Rate (pc/h)	Capacity (pc/h)	d/c Ratio	Speed (mi/h)	Density (pc/mi/ln)	LOS

	F	R	F	R	Freeway	Ramp	Freeway	Ramp	F	R	F	R	Freeway	Ramp	
1	0.94	0.94	0.926	0.943	4228	1218	7050	2000	0.60	0.61	64.9	65.0	21.7	21.7	C

Segment 10: Basic

Time Period	PHF	fHV	Flow Rate (pc/h)	Capacity (pc/h)	d/c Ratio	Speed (mi/h)	Density (pc/mi/ln)	LOS
1	0.94	0.917	3016	4700	0.64	64.8	23.3	C

Segment 11: Merge

Time Period	PHF		fHV		Flow Rate (pc/h)		Capacity (pc/h)		d/c Ratio		Speed (mi/h)		Density (pc/mi/ln)		LOS
	F	R	F	R	Freeway	Ramp	Freeway	Ramp	F	R	F	R	Freeway	Ramp	
1	0.94	0.94	0.917	0.862	3102	86	4700	2000	0.66	0.04	56.7	56.7	27.4	25.4	C

Segment 12: Merge

Time Period	PHF		fHV		Flow Rate (pc/h)		Capacity (pc/h)		d/c Ratio		Speed (mi/h)		Density (pc/mi/ln)		LOS
	F	R	F	R	Freeway	Ramp	Freeway	Ramp	F	R	F	R	Freeway	Ramp	
1	0.94	0.94	0.917	0.826	3317	219	4700	2100	0.71	0.10	56.8	56.8	29.2	26.3	C

Segment 13: Basic

Time Period	PHF	fHV	Flow Rate (pc/h)	Capacity (pc/h)	d/c Ratio	Speed (mi/h)	Density (pc/mi/ln)	LOS
1	0.94	0.909	3324	4700	0.71	64.0	26.0	C

Segment 14: Diverge

Time Period	PHF		fHV		Flow Rate (pc/h)		Capacity (pc/h)		d/c Ratio		Speed (mi/h)		Density (pc/mi/ln)		LOS
	F	R	F	R	Freeway	Ramp	Freeway	Ramp	F	R	F	R	Freeway	Ramp	
1	0.94	0.94	0.909	0.962	3324	354	4700	2000	0.71	0.18	54.4	54.4	30.6	27.4	C

Segment 15: Diverge

Time Period	PHF		fHV		Flow Rate (pc/h)		Capacity (pc/h)		d/c Ratio		Speed (mi/h)		Density (pc/mi/ln)		LOS
	F	R	F	R	Freeway	Ramp	Freeway	Ramp	F	R	F	R	Freeway	Ramp	
1	0.94	0.94	0.909	0.962	2949	299	4700	2000	0.63	0.15	54.5	54.5	27.1	22.4	C

Segment 16: Basic

Time Period	PHF	fHV	Flow Rate (pc/h)	Capacity (pc/h)	d/c Ratio	Speed (mi/h)	Density (pc/mi/ln)	LOS
1	0.94	0.909	2633	4700	0.56	63.2	20.2	C

Segment 17: Merge

Time Period	PHF		fHV		Flow Rate (pc/h)		Capacity (pc/h)		d/c Ratio		Speed (mi/h)		Density (pc/mi/ln)		LOS
	F	R	F	R	Freeway	Ramp	Freeway	Ramp	F	R	F	R	Freeway	Ramp	
1	0.94	0.94	0.909	0.962	2810	177	4700	2000	0.60	0.09	57.4	57.4	24.5	22.4	C

Segment 18: Basic

Time Period	PHF	fHV	Flow Rate (pc/h)	Capacity (pc/h)	d/c Ratio	Speed (mi/h)	Density (pc/mi/ln)	LOS
1	0.94	0.909	2820	4700	0.60	64.9	21.7	C

Segment 19: Diverge

Time Period	PHF		fHV		Flow Rate (pc/h)		Capacity (pc/h)		d/c Ratio		Speed (mi/h)		Density (pc/mi/ln)		LOS
	F	R	F	R	Freeway	Ramp	Freeway	Ramp	F	R	F	R	Freeway	Ramp	
1	0.94	0.94	0.909	0.901	2820	744	4700	2000	0.60	0.37	53.6	53.6	26.3	23.2	C

Segment 20: Basic

Time Period	PHF	fHV	Flow Rate (pc/h)	Capacity (pc/h)	d/c Ratio	Speed (mi/h)	Density (pc/mi/ln)	LOS
1	0.94	0.909	2083	4700	0.44	64.5	16.0	B

Segment 21: Merge

Time Period	PHF		fHV		Flow Rate (pc/h)		Capacity (pc/h)		d/c Ratio		Speed (mi/h)		Density (pc/mi/ln)		LOS
	F	R	F	R	Freeway	Ramp	Freeway	Ramp	F	R	F	R	Freeway	Ramp	
1	0.94	0.94	0.909	0.962	2492	409	4700	2000	0.53	0.20	57.8	57.8	21.6	19.8	B

Segment 22: Basic

Time Period	PHF	fHV	Flow Rate (pc/h)	Capacity (pc/h)	d/c Ratio	Speed (mi/h)	Density (pc/mi/ln)	LOS
1	0.94	0.917	2494	4700	0.53	64.9	19.2	C

Segment 23: Diverge

Time Period	PHF		fHV		Flow Rate (pc/h)		Capacity (pc/h)		d/c Ratio		Speed (mi/h)		Density (pc/mi/ln)		LOS
	F	R	F	R	Freeway	Ramp	Freeway	Ramp	F	R	F	R	Freeway	Ramp	
1	0.94	0.94	0.917	0.943	2494	609	4700	2000	0.53	0.30	53.9	53.9	23.1	22.3	C

Segment 24: Basic

Time Period	PHF	fHV	Flow Rate (pc/h)	Capacity (pc/h)	d/c Ratio	Speed (mi/h)	Density (pc/mi/ln)	LOS
1	0.94	0.917	1868	4700	0.40	64.9	14.4	B

Segment 25: Merge

Time Period	PHF		fHV		Flow Rate (pc/h)		Capacity (pc/h)		d/c Ratio		Speed (mi/h)		Density (pc/mi/ln)		LOS
	F	R	F	R	Freeway	Ramp	Freeway	Ramp	F	R	F	R	Freeway	Ramp	
1	0.94	0.94	0.917	0.952	2337	469	4700	2000	0.50	0.23	57.6	57.6	20.3	20.0	B

Segment 26: Basic

Time Period	PHF	fHV	Flow Rate (pc/h)	Capacity (pc/h)	d/c Ratio	Speed (mi/h)	Density (pc/mi/ln)	LOS
1	0.94	0.917	2355	4700	0.50	65.0	18.1	C

Segment 27: Diverge

Time Period	PHF		fHV		Flow Rate (pc/h)		Capacity (pc/h)		d/c Ratio		Speed (mi/h)		Density (pc/mi/ln)		LOS
	F	R	F	R	Freeway	Ramp	Freeway	Ramp	F	R	F	R	Freeway	Ramp	
1	0.94	0.94	0.917	0.943	2355	79	4700	2000	0.50	0.04	55.0	55.0	21.4	19.1	B

Segment 28: Basic

Time Period	PHF	fHV	Flow Rate (pc/h)	Capacity (pc/h)	d/c Ratio	Speed (mi/h)	Density (pc/mi/ln)	LOS

1	0.94		0.917		2274		4700		0.48		64.4		17.5		B

Segment 29: Merge

Time Period	PHF		fHV		Flow Rate (pc/h)		Capacity (pc/h)		d/c Ratio		Speed (mi/h)		Density (pc/mi/ln)		LOS
	F	R	F	R	Freeway	Ramp	Freeway	Ramp	F	R	F	R	Freeway	Ramp	
1	0.94	0.94	0.917	0.943	2455	181	4700	2000	0.52	0.09	57.9	57.9	21.2	19.6	B

Segment 30: Basic

Time Period	PHF	fHV	Flow Rate (pc/h)	Capacity (pc/h)	d/c Ratio	Speed (mi/h)	Density (pc/mi/ln)	LOS
1	0.94	0.917	2459	4700	0.52	65.0	18.9	C

Facility Time Period Results

T	Speed, mi/h	Density, pc/mi/ln	Density, veh/mi/ln	Travel Time, min	LOS
1	61.1	21.1	19.3	11.30	C

Facility Overall Results

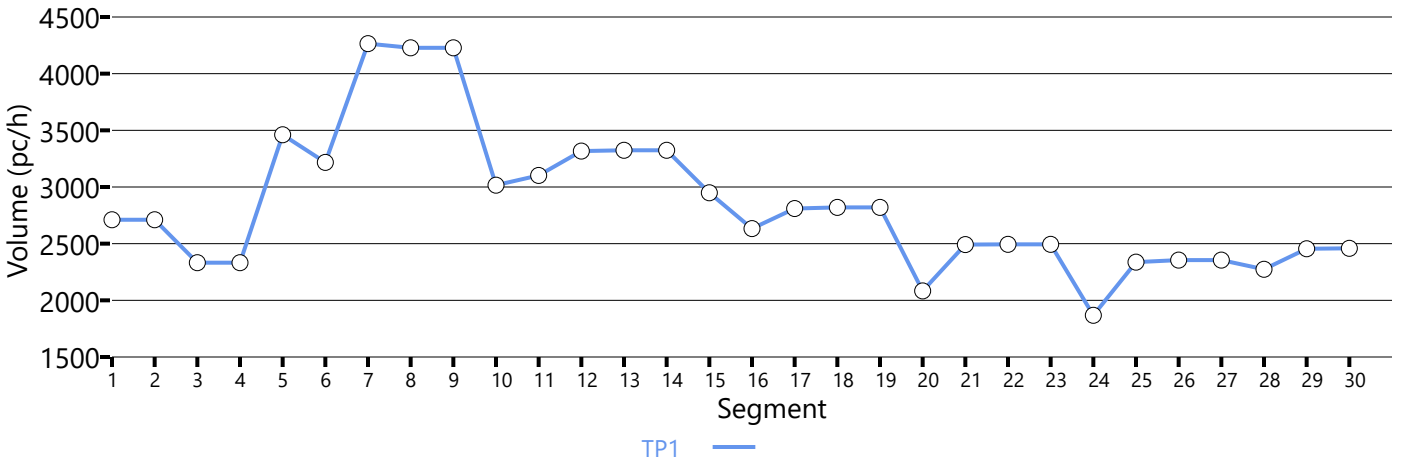
Space Mean Speed, mi/h	61.1	Density, veh/mi/ln	19.3
Average Travel Time, min	11.30	Density, pc/mi/ln	21.1

Messages

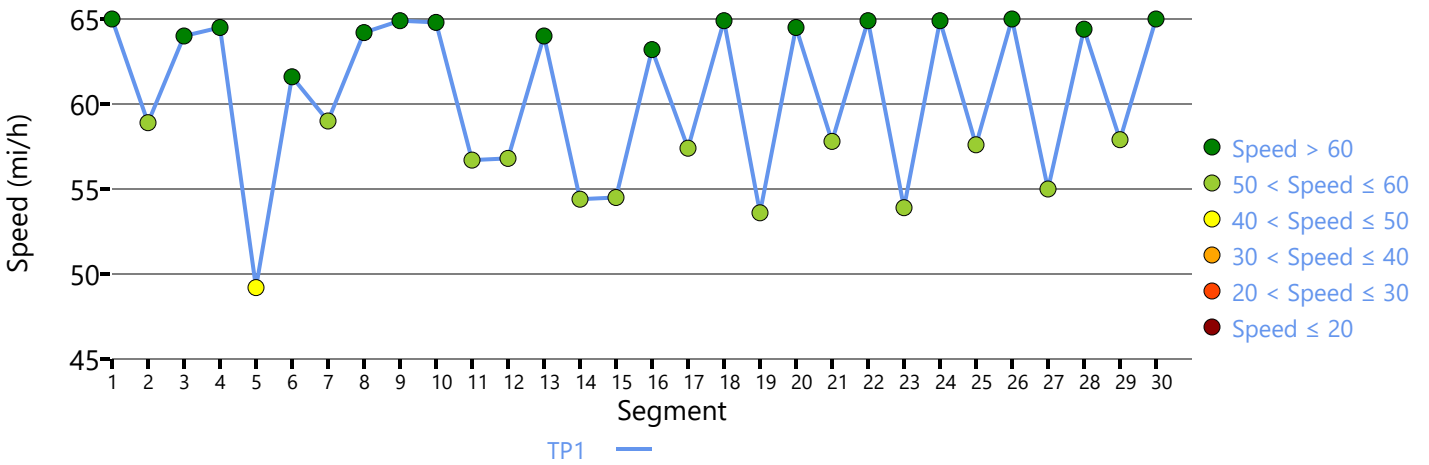
WARNING 1	Weaving Segment (segment 5) is shorter than the segment short length allows. Weaving segments include 500 feet upstream and downstream of gore point. Short length is at a maximum the gore to gore length, and is reduced for any barrier markings (solid white lines) that prohibit or discourage lane changing. Review the values set for Segment length on the Segments page and Short Length on the details page.

Comments

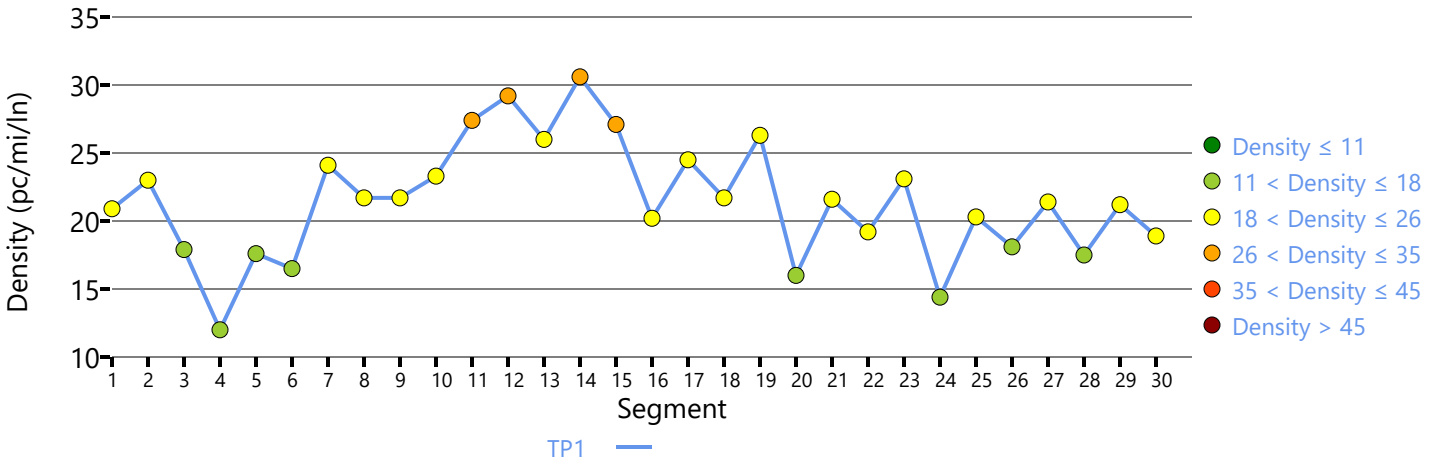
Volume Distribution



Speed Distribution



Density Distribution



HCS7 Freeway Facilities Report

Project Information

Analyst	LJB/JDO	Date	11/20/2020
Agency		Analysis Year	2045
Jurisdiction		Time Period Analyzed	AM 2045 NB
Project Description	WB US33	Unit	United States Customary

Facility Global Input

Jam Density, pc/mi/ln	190.0	Density at Capacity, pc/mi/ln	45.0
Queue Discharge Capacity Drop, %	7	Total Segments	27
Total Time Periods	1	Time Period Duration, min	15
Facility Length, mi	12.22		

Facility Segment Data

No.	Coded	Analyzed	Name	Length, ft	Lanes
1	Basic	Basic	WB US 33-East of Pickerington	5280	2
2	Diverge	Diverge	WB US 33-Pickerington Off Ramp	1500	2
3	Basic	Basic	WB US 33-Bet Pickerington Ramps	1000	2
4	Merge	Merge	WB US33-NB Pickerington On Ramp	1000	2
5	Merge	Merge	WB US33-Pickerington On Ramp	1500	2
6	Basic	Basic	WB US33- Bet Pickerington and Diley	7140	2
7	Diverge	Diverge	WB US33-Diley Off ramp	1500	2
8	Basic	Basic	WB US33-Bet Diley Ramps	2040	2
9	Merge	Merge	WB US33-Diley On-Ramp	1500	2
10	Basic	Basic	WB US33-Diley to Gender	7560	2
11	Diverge	Diverge	WB US33-Gender Off Ramp	1500	2
12	Basic	Basic	WB US33	1460	2
13	Merge	Merge	WB US33-NB Gender On Ramp	1200	2
14	Merge	Merge	WB US33-SB Gender On Ramp	1500	2
15	Basic	Basic	WB US33-Gender to Bixby	3960	2
16	Diverge	Diverge	WB US33-Bixby Off Ramp	1500	2
17	Basic	Basic	WB US33-Bet Bixby Ramps	1020	2
18	Merge	Merge	WB US33-Bixby On-Ramp	1500	2
19	Basic	Basic	Wb US33 -Bixby to Hamilton	6090	2
20	Diverge	Diverge	Wb US33 to Hamilton Off Ramp	1500	2
21	Basic	Basic	Wb US33	1800	2
22	Weaving	Weaving	Wb US33 (Weave)-Ham to I-270 NB	4660	3
23	Overlap	Basic	Wb US33 (Overlap)	50	2
24	Weaving	Weaving	Wb US33 (Weave) - Betw 270 ramps	1450	3
25	Basic	Basic	Wb US33	830	2
26	Merge	Merge	Sb I270 to Wb US33 On Ramp	1500	2
27	Basic	Basic	Wb US33	2960	2

Facility Segment Data

Segment 1: Basic

Time Period	PHF	fHV	Flow Rate (pc/h)	Capacity (pc/h)	d/c Ratio	Speed (mi/h)	Density (pc/mi/ln)	LOS
1	0.94	0.909	3909	4700	0.83	60.6	32.3	D

Segment 2: Diverge

Time Period	PHF		fHV		Flow Rate (pc/h)		Capacity (pc/h)		d/c Ratio		Speed (mi/h)		Density (pc/mi/ln)		LOS
	F	R	F	R	Freeway	Ramp	Freeway	Ramp	F	R	F	R	Freeway	Ramp	
1	0.94	0.94	0.909	0.943	3909	226	4700	2000	0.83	0.11	54.7	54.7	35.7	30.7	D

Segment 3: Basic

Time Period	PHF	fHV	Flow Rate (pc/h)	Capacity (pc/h)	d/c Ratio	Speed (mi/h)	Density (pc/mi/ln)	LOS
1	0.94	0.909	3683	4700	0.78	62.2	29.6	D

Segment 4: Merge

Time Period	PHF		fHV		Flow Rate (pc/h)		Capacity (pc/h)		d/c Ratio		Speed (mi/h)		Density (pc/mi/ln)		LOS
	F	R	F	R	Freeway	Ramp	Freeway	Ramp	F	R	F	R	Freeway	Ramp	
1	0.94	0.94	0.909	0.943	3796	113	4700	2000	0.81	0.06	54.9	54.9	34.6	30.1	D

Segment 5: Merge

Time Period	PHF		fHV		Flow Rate (pc/h)		Capacity (pc/h)		d/c Ratio		Speed (mi/h)		Density (pc/mi/ln)		LOS
	F	R	F	R	Freeway	Ramp	Freeway	Ramp	F	R	F	R	Freeway	Ramp	
1	0.94	0.94	0.909	0.943	3931	135	4700	2000	0.84	0.07	54.3	54.3	36.2	31.1	D

Segment 6: Basic

Time Period	PHF	fHV	Flow Rate (pc/h)	Capacity (pc/h)	d/c Ratio	Speed (mi/h)	Density (pc/mi/ln)	LOS
1	0.94	0.909	3931	4700	0.84	60.5	32.5	D

Segment 7: Diverge

Time Period	PHF		fHV		Flow Rate (pc/h)		Capacity (pc/h)		d/c Ratio		Speed (mi/h)		Density (pc/mi/ln)		LOS
	F	R	F	R	Freeway	Ramp	Freeway	Ramp	F	R	F	R	Freeway	Ramp	
1	0.94	0.94	0.909	0.962	3931	387	4700	2000	0.84	0.19	54.4	54.4	36.1	26.1	C

Segment 8: Basic

Time Period	PHF	fHV	Flow Rate (pc/h)	Capacity (pc/h)	d/c Ratio	Speed (mi/h)	Density (pc/mi/ln)	LOS
1	0.94	0.901	3544	4700	0.76	63.0	28.1	D

Segment 9: Merge

Time Period	PHF		fHV		Flow Rate (pc/h)		Capacity (pc/h)		d/c Ratio		Speed (mi/h)		Density (pc/mi/ln)		LOS
	F	R	F	R	Freeway	Ramp	Freeway	Ramp	F	R	F	R	Freeway	Ramp	
1	0.94	0.94	0.901	0.962	4052	962	4700	2000	0.96	0.48	53.3	53.3	38.0	33.5	D

Segment 10: Basic

Time Period	PHF		fHV		Flow Rate (pc/h)		Capacity (pc/h)		d/c Ratio		Speed (mi/h)		Density (pc/mi/ln)		LOS
1	0.94		0.917		4052		4700		0.96		59.5		34.1		D
Segment 11: Diverge															
Time Period	**PHF**		**fHV**		**Flow Rate (pc/h)**		**Capacity (pc/h)**		**d/c Ratio**		**Speed (mi/h)**		**Density (pc/mi/ln)**		**LOS**
	F	**R**	**F**	**R**	**Freeway**	**Ramp**	**Freeway**	**Ramp**	**F**	**R**	**F**	**R**	**Freeway**	**Ramp**	
1	0.94	0.94	0.917	0.962	4052	597	4700	2000	0.96	0.30	53.9	53.9	37.6	34.7	D
Segment 12: Basic															
Time Period	**PHF**		**fHV**		**Flow Rate (pc/h)**		**Capacity (pc/h)**		**d/c Ratio**		**Speed (mi/h)**		**Density (pc/mi/ln)**		**LOS**
1	0.94		0.917		3354		4700		0.82		63.9		26.2		D
Segment 13: Merge															
Time Period	**PHF**		**fHV**		**Flow Rate (pc/h)**		**Capacity (pc/h)**		**d/c Ratio**		**Speed (mi/h)**		**Density (pc/mi/ln)**		**LOS**
	F	**R**	**F**	**R**	**Freeway**	**Ramp**	**Freeway**	**Ramp**	**F**	**R**	**F**	**R**	**Freeway**	**Ramp**	
1	0.94	0.94	0.917	0.952	3807	1464	4700	2000	1.14	0.73	27.0	39.5	70.4	44.3	F
Segment 14: Merge															
Time Period	**PHF**		**fHV**		**Flow Rate (pc/h)**		**Capacity (pc/h)**		**d/c Ratio**		**Speed (mi/h)**		**Density (pc/mi/ln)**		**LOS**
	F	**R**	**F**	**R**	**Freeway**	**Ramp**	**Freeway**	**Ramp**	**F**	**R**	**F**	**R**	**Freeway**	**Ramp**	
1	0.94	0.94	0.917	0.971	4269	920	4700	2000	1.34	0.46	41.6	8.7	51.3	51.7	F
Segment 15: Basic															
Time Period	**PHF**		**fHV**		**Flow Rate (pc/h)**		**Capacity (pc/h)**		**d/c Ratio**		**Speed (mi/h)**		**Density (pc/mi/ln)**		**LOS**
1	0.94		0.926		4152		4700		1.34		37.2		55.8		F
Segment 16: Diverge															
Time Period	**PHF**		**fHV**		**Flow Rate (pc/h)**		**Capacity (pc/h)**		**d/c Ratio**		**Speed (mi/h)**		**Density (pc/mi/ln)**		**LOS**
	F	**R**	**F**	**R**	**Freeway**	**Ramp**	**Freeway**	**Ramp**	**F**	**R**	**F**	**R**	**Freeway**	**Ramp**	
1	0.94	0.94	0.926	0.926	4107	195	4700	2000	1.34	0.10	33.7	54.7	61.0	53.1	F
Segment 17: Basic															
Time Period	**PHF**		**fHV**		**Flow Rate (pc/h)**		**Capacity (pc/h)**		**d/c Ratio**		**Speed (mi/h)**		**Density (pc/mi/ln)**		**LOS**
1	0.94		0.926		3873		4700		1.30		27.9		69.4		F
Segment 18: Merge															
Time Period	**PHF**		**fHV**		**Flow Rate (pc/h)**		**Capacity (pc/h)**		**d/c Ratio**		**Speed (mi/h)**		**Density (pc/mi/ln)**		**LOS**
	F	**R**	**F**	**R**	**Freeway**	**Ramp**	**Freeway**	**Ramp**	**F**	**R**	**F**	**R**	**Freeway**	**Ramp**	
1	0.94	0.94	0.926	0.926	4376	724	4700	2000	1.45	0.36	51.8	51.8	42.2	34.3	F
Segment 19: Basic															
Time Period	**PHF**		**fHV**		**Flow Rate (pc/h)**		**Capacity (pc/h)**		**d/c Ratio**		**Speed (mi/h)**		**Density (pc/mi/ln)**		**LOS**
1	0.94		0.926		4376		4700		1.45		56.2		38.9		F

Segment 20: Diverge

Time Period	PHF		fHV		Flow Rate (pc/h)		Capacity (pc/h)		d/c Ratio		Speed (mi/h)		Density (pc/mi/ln)		LOS
	F	R	F	R	Freeway	Ramp	Freeway	Ramp	F	R	F	R	Freeway	Ramp	
1	0.94	0.94	0.926	0.885	4376	409	4700	2100	1.45	0.19	57.3	57.3	38.2	36.0	F

Segment 21: Basic

Time Period	PHF	fHV	Flow Rate (pc/h)	Capacity (pc/h)	d/c Ratio	Speed (mi/h)	Density (pc/mi/ln)	LOS
1	0.94	0.935	3967	4700	1.36	60.2	32.9	F

Segment 22: Weaving

Time Period	PHF	fHV	Flow Rate (pc/h)	Capacity (pc/h)	d/c Ratio	Speed (mi/h)	Density (pc/mi/ln)	LOS
1	0.94	0.935	4319	6561	1.18	52.2	27.6	F

Segment 23: Overlap

Time Period	PHF	fHV	Flow Rate (pc/h)	Capacity (pc/h)	d/c Ratio	Speed (mi/h)	Density (pc/mi/ln)	LOS
1	0.94	0.935	2271	4700	1.22	52.2	45.0	F

Segment 24: Weaving

Time Period	PHF	fHV	Flow Rate (pc/h)	Capacity (pc/h)	d/c Ratio	Speed (mi/h)	Density (pc/mi/ln)	LOS
1	0.94	0.935	2521	6090	0.98	55.2	15.2	B

Segment 25: Basic

Time Period	PHF	fHV	Flow Rate (pc/h)	Capacity (pc/h)	d/c Ratio	Speed (mi/h)	Density (pc/mi/ln)	LOS
1	0.94	0.935	1497	4700	1.06	63.5	11.5	F

Segment 26: Merge

Time Period	PHF		fHV		Flow Rate (pc/h)		Capacity (pc/h)		d/c Ratio		Speed (mi/h)		Density (pc/mi/ln)		LOS
	F	R	F	R	Freeway	Ramp	Freeway	Ramp	F	R	F	R	Freeway	Ramp	
1	0.94	0.94	0.935	0.935	1827	330	4700	2100	1.13	0.16	58.4	58.4	15.6	15.5	F

Segment 27: Basic

Time Period	PHF	fHV	Flow Rate (pc/h)	Capacity (pc/h)	d/c Ratio	Speed (mi/h)	Density (pc/mi/ln)	LOS
1	0.94	0.935	1827	4700	1.13	64.8	14.1	F

Facility Time Period Results

T	Speed, mi/h	Density, pc/mi/ln	Density, veh/mi/ln	Travel Time, min	LOS
1	52.2	34.9	32.1	14.00	F

Facility Overall Results

Space Mean Speed, mi/h	52.2	Density, veh/mi/ln	32.1
Average Travel Time, min	14.00	Density, pc/mi/ln	34.9

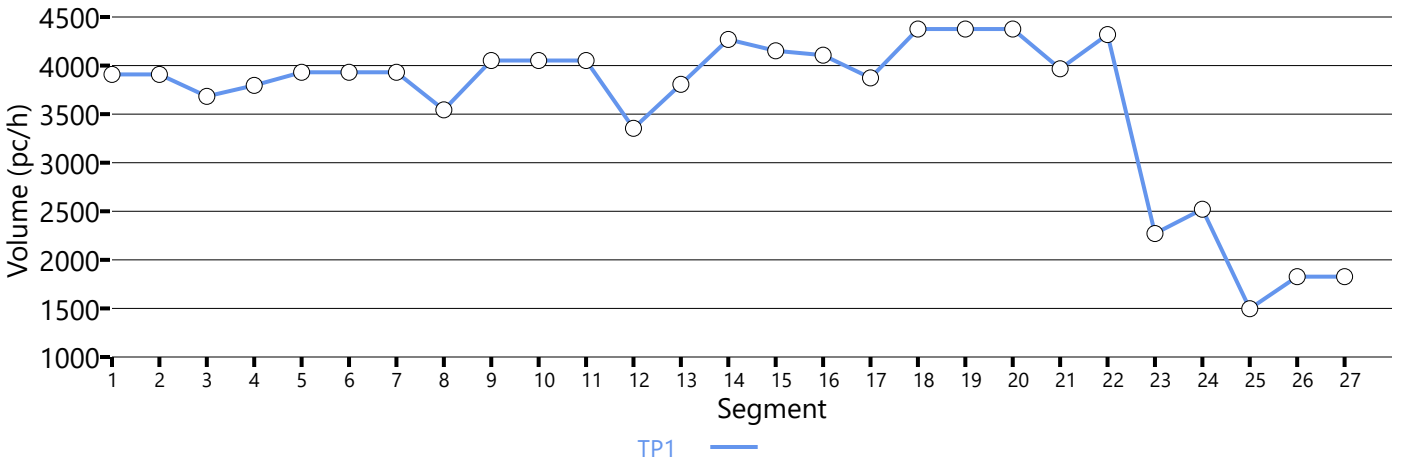
Messages

WARNING 1	Oversaturated conditions currently exist in boundary segment 27. Results may not be reliable.

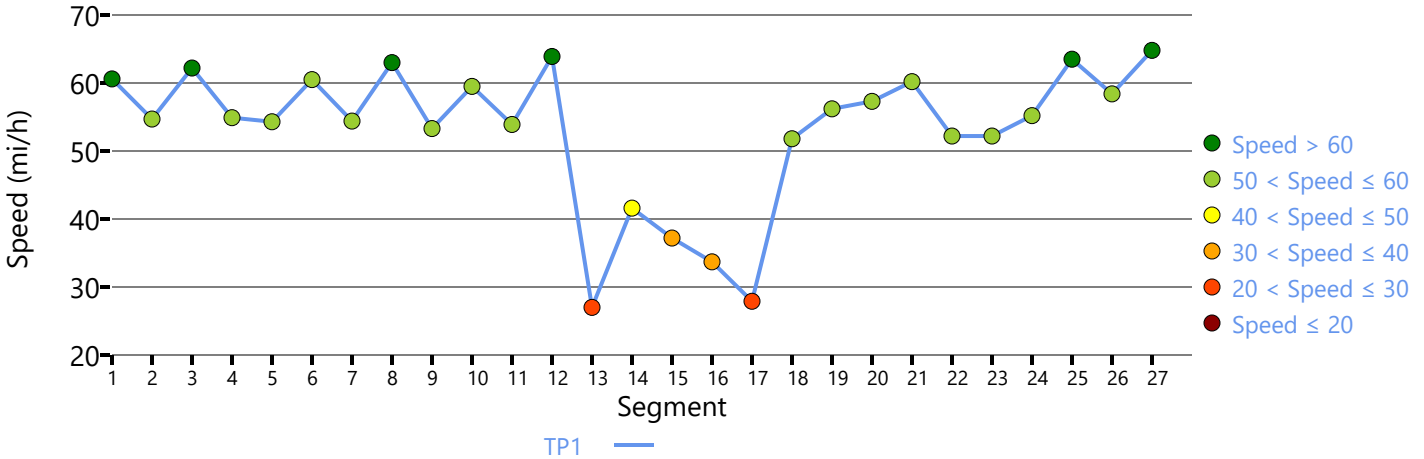
	Consider expanding analysis in time and/or space to resolve this warning.
WARNING 2	Oversaturated conditions currently exist in boundary time period 1. Results may not be reliable. Consider expanding analysis in time and/or space to resolve this warning.
WARNING 3	Oversaturated conditions currently exist on segment 23, which is less than 300 feet. Due to time step size, these segments may produce unreliable results. Consider reviewing facility segmentation to resolve this warning.
WARNING 4	Sum of lengths of ramp overlap segment (segment 23) and an adjacent ramp segment (segment 22) should be 1500 feet.
WARNING 5	Diverge capacity is less than diverge demand on segment 22. This may result in an off-ramp queue affecting the mainline flow. This is not currently modeled in HCM methodologies. Use caution when reviewing results.
WARNING 6	Weaving Segment (segment 24) is shorter than the segment short length allows. Weaving segments include 500 feet upstream and downstream of gore point. Short length is at a maximum the gore to gore length, and is reduced for any barrier markings (solid white lines) that prohibit or discourage lane changing. Review the values set for Segment length on the Segments page and Short Length on the details page.

Comments

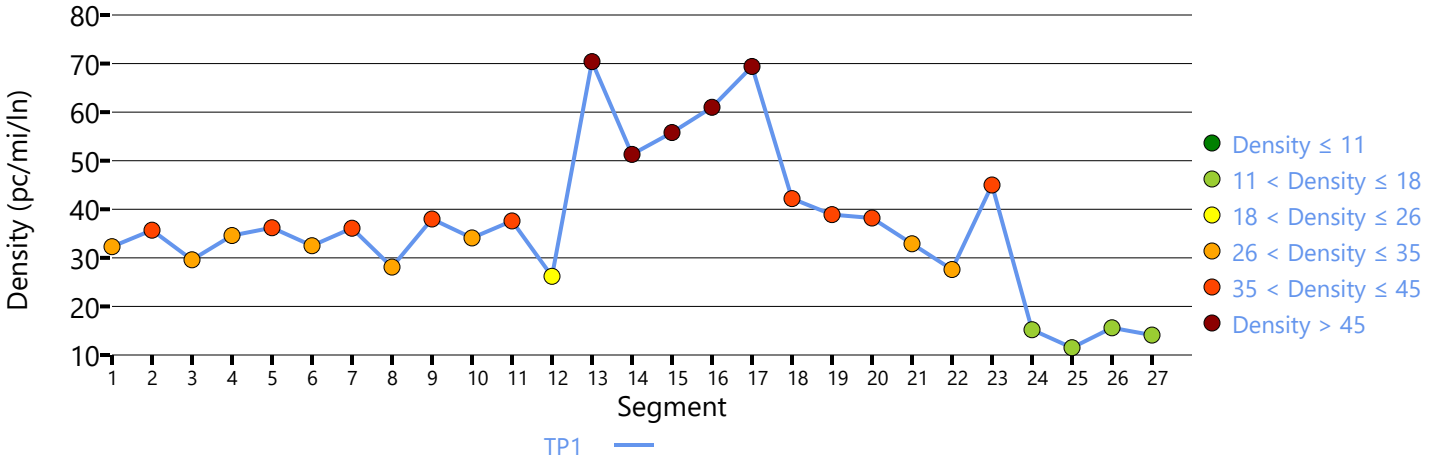
Volume Distribution



Speed Distribution

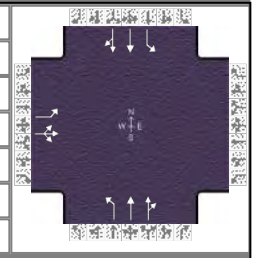


Density Distribution



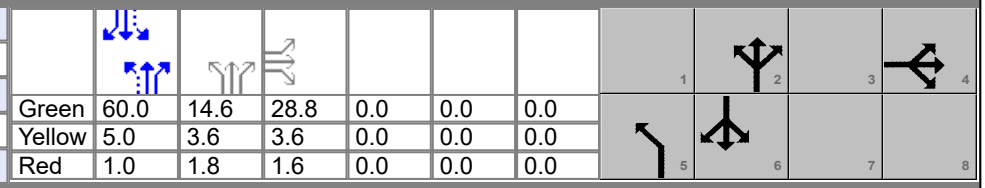
HCS7 Signalized Intersection Input Data

General Information				Intersection Information	
Agency	LJB			Duration, h	0.250
Analyst	TVF	Analysis Date	Dec 8, 2020	Area Type	Other
Jurisdiction	Columbus	Time Period	AM Peak	PHF	0.92
Urban Street	S Hamilton Rd	Analysis Year	2045	Analysis Period	1> 7:00
Intersection	Williams Rd	File Name	S Hamilton Rd Intersections AM NB.xus		
Project Description	S Hamiilton Rd & US 33 Safety Study				



Demand Information	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Demand (*v*), veh/h	450	5	110				140	1330	5	5	1530	390

Signal Information			
Cycle, s	120.0	Reference Phase	2
Offset, s	22	Reference Point	End
Uncoordinated	No	Simult. Gap E/W	On
Force Mode	Float	Simult. Gap N/S	On



Green	60.0	14.6	28.8	0.0	0.0	0.0
Yellow	5.0	3.6	3.6	0.0	0.0	0.0
Red	1.0	1.8	1.6	0.0	0.0	0.0

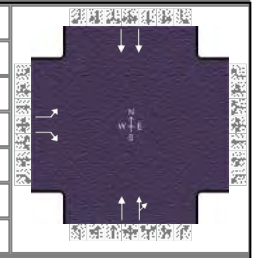
Traffic Information	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Demand (*v*), veh/h	450	5	110				140	1330	5	5	1530	390
Initial Queue (Q_b), veh/h	0	0	0				0	0	0	0	0	0
Base Saturation Flow Rate (s_o), veh/h	1900	1900	1900				1900	1900	1900	1900	1900	1900
Parking (N_m), man/h		None						None			None	
Heavy Vehicles (P_{HV}), %	10	10					7	7		5	5	
Ped / Bike / RTOR, /h	0	0	0	0	0		0	0	0	0	0	0
Buses (N_b), buses/h	0	0	0				0	0	0	0	0	0
Arrival Type (*AT*)	3	3	3				3	3	3	3	3	3
Upstream Filtering (*I*)	1.00	1.00	1.00				1.00	1.00	1.00	1.00	1.00	1.00
Lane Width (*W*), ft	12.0	12.0					12.0	12.0		12.0	12.0	
Turn Bay Length, ft	500	700					85	1200		140	300	
Grade (*Pg*), %		0			0			0			0	
Speed Limit, mi/h	50	50	50				50	50	50	50	50	50

Phase Information	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Maximum Green (G_{max}) or Phase Split, s		34.0			20.0	86.0		66.0
Yellow Change Interval (*Y*), s		3.6			3.6	5.0		5.0
Red Clearance Interval (R_c), s		1.6			1.8	1.0		1.0
Minimum Green (G_{min}), s		7			7	20		20
Start-Up Lost Time (*l1*), s	2.0	2.0			2.0	2.0	2.0	2.0
Extension of Effective Green (*e*), s	2.0	2.0			2.0	2.0	2.0	2.0
Passage (*PT*), s		4.0			3.7	3.0		3.0
Recall Mode		Min			Off	Min		Min
Dual Entry		Yes			No	Yes		Yes
Walk (*Walk*), s		0.0		0.0				0.0
Pedestrian Clearance Time (*PC*), s		0.0		0.0				0.0

Multimodal Information	EB			WB			NB			SB		
85th % Speed / Rest in Walk / Corner Radius	0	No	25	0	No	25				0	No	25
Walkway / Crosswalk Width / Length, ft	9.0	12	0	9.0	12	0				9.0	12	0
Street Width / Island / Curb	0	0	No		0		0		No	0	0	No
Width Outside / Bike Lane / Shoulder, ft	12	5.0	2.0				12	5.0	2.0	12	5.0	2.0
Pedestrian Signal / Occupied Parking	No	0.50		No				0.50		No	0.50	

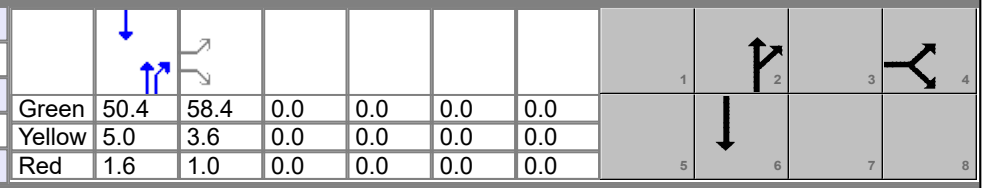
HCS7 Signalized Intersection Intermediate Values

General Information				Intersection Information	
Agency	LJB			Duration, h	0.250
Analyst	TVF	Analysis Date	Dec 8, 2020	Area Type	Other
Jurisdiction	Columbus	Time Period	AM Peak	PHF	0.92
Urban Street	S Hamilton Rd	Analysis Year	2045	Analysis Period	1> 7:00
Intersection	US 33 EB Ramps	File Name	S Hamilton Rd Intersections AM NB.xus		
Project Description	S Hamiilton Rd & US 33 Safety Study				



Demand Information	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Demand (*v*), veh/h	240		840					1610	170		1080	

Signal Information			
Cycle, s	120.0	Reference Phase	2
Offset, s	54	Reference Point	Begin
Uncoordinated	No	Simult. Gap E/W	On
Force Mode	Fixed	Simult. Gap N/S	On



Green	50.4	58.4	0.0	0.0	0.0	0.0						
Yellow	5.0	3.6	0.0	0.0	0.0	0.0						
Red	1.6	1.0	0.0	0.0	0.0	0.0						

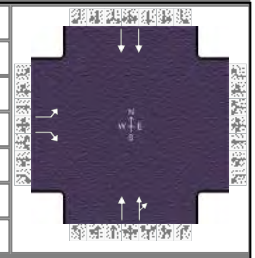
Saturation Flow / Delay	L	T	R	L	T	R	L	T	R	L	T	R
Lane Width Adjustment Factor (f_w)	1.000	1.000	1.000				1.000	1.000	1.000	1.000	1.000	1.000
Heavy Vehicles and Grade Factor (f_{HVg})	0.953	1.000	0.953				1.000	0.953	0.953	1.000	0.953	1.000
Parking Activity Adjustment Factor (f_p)	1.000	1.000	1.000	0.000	0.000	0.000	1.000	1.000	1.000	1.000	1.000	1.000
Bus Blockage Adjustment Factor (f_{bb})	1.000	1.000	1.000	0.000	0.000	0.000	1.000	1.000	1.000	1.000	1.000	1.000
Area Type Adjustment Factor (f_a)	1.000	1.000	1.000				1.000	1.000	1.000	1.000	1.000	1.000
Lane Utilization Adjustment Factor (f_{LU})	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	0.952	1.000
Left-Turn Adjustment Factor (f_{LT})	0.952	0.000					1.000	1.000		1.000	1.000	
Right-Turn Adjustment Factor (f_{RT})		0.000	0.847					0.967	0.967		1.000	1.000
Left-Turn Pedestrian Adjustment Factor (f_{Lpb})	1.000						1.000			1.000		
Right-Turn Ped-Bike Adjustment Factor (f_{Rpb})			1.000						1.000			1.000
Work Zone Adjustment Factor (f_{wz})	1.000	1.000	1.000				1.000	1.000	1.000	1.000	1.000	1.000
DDI Factor (f_{DDI})	1.000	1.000	1.000				1.000	1.000	1.000	1.000	1.000	1.000
Movement Saturation Flow Rate (s), veh/h	1725	0	1535				0	3226	336	0	3622	0
Proportion of Vehicles Arriving on Green (P)	0.49	0.00	0.49	0.00	0.00	0.00	0.00	0.54	0.57	0.00	0.60	0.00
Incremental Delay Factor (k)	0.23		0.50					0.50	0.50		0.50	

Signal Timing / Movement Groups	EBL	EBT/R	WBL	WBT/R	NBL	NBT/R	SBL	SBT/R
Lost Time (t_L)		4.0				6.6		6.6
Green Ratio (g/C)		0.49				0.42		0.42
Permitted Saturation Flow Rate (s_p), veh/h/ln		1725				452		254
Shared Saturation Flow Rate (s_{sh}), veh/h/ln						0		0
Permitted Effective Green Time (g_p), s		0.0				0.0		0.0
Permitted Service Time (g_u), s		0.0				0.0		0.0
Permitted Queue Service Time (g_{ps}), s								
Time to First Blockage (g_f), s		0.0				50.4		50.4
Queue Service Time Before Blockage (g_{fs}), s								
Protected Right Saturation Flow (s_R), veh/h/ln		0						
Protected Right Effective Green Time (g_R), s		0.0						

Multimodal	EB		WB		NB		SB	
Pedestrian F_w / F_v	1.389	0.000	1.389	0.000	0.000	0.000	0.972	0.000
Pedestrian F_s / F_{delay}	0.000	0.168	0.000	0.167	0.000	0.120	0.000	0.120
Pedestrian M_{corner} / M_{cw}								
Bicycle c_b / d_b	-93.33	65.73	-83.33	65.10	840.00	20.18	840.00	20.18
Bicycle F_w / F_v	-3.64		-3.64		-3.64	1.60	-3.64	0.97

HCS7 Signalized Intersection Results Graphical Summary

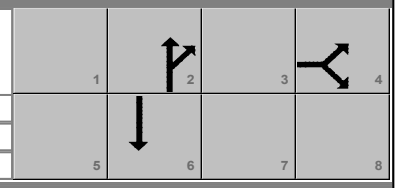
General Information				Intersection Information	
Agency	LJB			Duration, h	0.250
Analyst	TVF	Analysis Date	Dec 8, 2020	Area Type	Other
Jurisdiction	Columbus	Time Period	AM Peak	PHF	0.92
Urban Street	S Hamilton Rd	Analysis Year	2045	Analysis Period	1> 7:00
Intersection	US 33 EB Ramps	File Name	S Hamilton Rd Intersections AM NB.xus		
Project Description	S Hamiilton Rd & US 33 Safety Study				



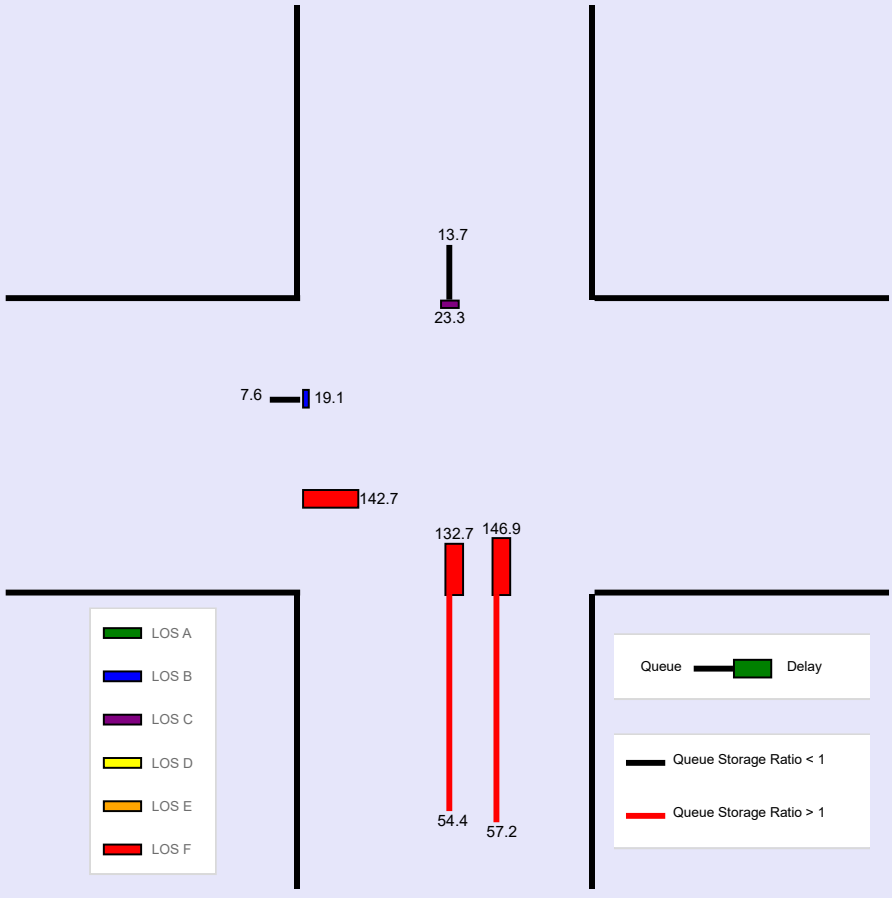
Demand Information	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Demand (*v*), veh/h	240		840					1610	170		1080	

Signal Information			
Cycle, s	120.0	Reference Phase	2
Offset, s	54	Reference Point	Begin
Uncoordinated	No	Simult. Gap E/W	On
Force Mode	Fixed	Simult. Gap N/S	On

	EB			WB			NB			SB		
Green	50.4		58.4	0.0		0.0	0.0		0.0	0.0		0.0
Yellow	5.0		3.6	0.0		0.0	0.0		0.0	0.0		0.0
Red	1.6		1.0	0.0		0.0	0.0		0.0	0.0		0.0



Movement Group Results	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Back of Queue (*Q*), ft/ln (95 th percentile)	198		1611.4					1426.1	1498.2		358.1	
Back of Queue (*Q*), veh/ln (95 th percentile)	7.6		61.5					54.4	57.2		13.7	
Queue Storage Ratio (*RQ*) (95 th percentile)	0.11		40.28					5.19	5.45		0.49	
Control Delay (*d*), s/veh	19.1		142.7					132.7	146.9		23.3	
Level of Service (LOS)	B		F					F	F		C	
Approach Delay, s/veh / LOS	115.2		F	0.0			139.8		F	23.3		C
Intersection Delay, s/veh / LOS	99.0						F					



--- Messages ---

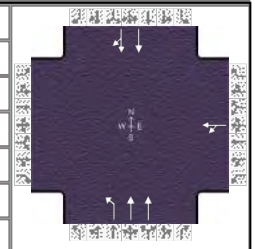
WARNING: Since queue spillover from turn lanes and spillback into upstream intersections is not accounted for in the HCM procedures, use of a simulation tool may be advised in situations where the Queue Storage Ratio exceeds 1.0.

WARNING: If demand exceeds capacity, a multiple-period analysis should be conducted.

--- Comments ---

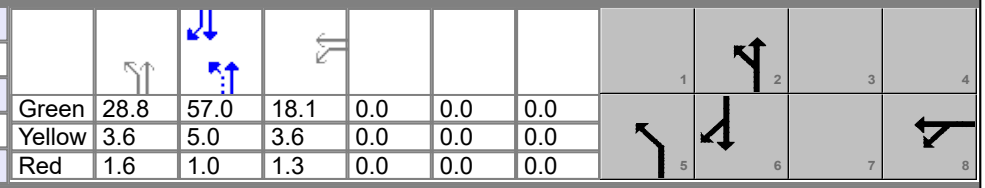
HCS7 Signalized Intersection Input Data

General Information				Intersection Information	
Agency	LJB			Duration, h	0.250
Analyst	TVF	Analysis Date	Dec 8, 2020	Area Type	Other
Jurisdiction	Columbus	Time Period	AM Peak	PHF	0.92
Urban Street	S Hamilton Rd	Analysis Year	2045	Analysis Period	1> 7:00
Intersection	US 33 WB Ramps	File Name	S Hamilton Rd Intersections AM NB.xus		
Project Description	S Hamiilton Rd & US 33 Safety Study				



Demand Information	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Demand (*v*), veh/h				180	5		720	1130			970	520

Signal Information			
Cycle, s	120.0	Reference Phase	2
Offset, s	66	Reference Point	End
Uncoordinated	No	Simult. Gap E/W	On
Force Mode	Fixed	Simult. Gap N/S	On



Green	28.8	57.0	18.1	0.0	0.0	0.0						
Yellow	3.6	5.0	3.6	0.0	0.0	0.0						
Red	1.6	1.0	1.3	0.0	0.0	0.0						

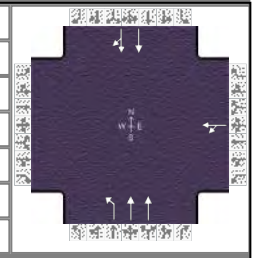
Traffic Information	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Demand (*v*), veh/h				180	5		720	1130			970	520
Initial Queue (Q_b), veh/h				0	0		0	0			0	0
Base Saturation Flow Rate (s_o), veh/h				1900	1900		1900	1900			1900	1900
Parking (N_m), man/h					None			None			None	
Heavy Vehicles (P_{HV}), %					13		1	1			2	
Ped / Bike / RTOR, /h	0	0		0	0		0	0		0	0	60
Buses (N_b), buses/h				0	0	0	0	0	0	0	0	0
Arrival Type (*AT*)				3	3		3	3			3	3
Upstream Filtering (*I*)				1.00	1.00		0.09	0.09			1.00	1.00
Lane Width (*W*), ft					12.0		12.0	12.0			12.0	
Turn Bay Length, ft					165		525	750			875	
Grade (*Pg*), %		0			0			0			0	
Speed Limit, mi/h				50	50		50	50			50	50

Phase Information	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Maximum Green (G_{max}) or Phase Split, s				23.0	34.0	97.0		63.0
Yellow Change Interval (*Y*), s				3.6	3.6	5.0		5.0
Red Clearance Interval (R_c), s				1.3	1.6	1.0		1.0
Minimum Green (G_{min}), s				7	7	20		20
Start-Up Lost Time (*lt*), s			2.0	2.0	2.0	2.0		2.0
Extension of Effective Green (*e*), s			2.0	2.0	2.0	2.0		2.0
Passage (*PT*), s				3.7	5.0	3.0		3.0
Recall Mode				Off	Off	Min		Min
Dual Entry				Yes	No	Yes		Yes
Walk (*Walk*), s		0.0		0.0		0.0		
Pedestrian Clearance Time (*PC*), s		0.0		0.0		0.0		

Multimodal Information	EB			WB			NB			SB		
85th % Speed / Rest in Walk / Corner Radius	0	No	25	0	No	25	0	No	25			
Walkway / Crosswalk Width / Length, ft	9.0	12	0	9.0	12	0	9.0	12	0			
Street Width / Island / Curb		0		0	0	No	0	0	No	0		No
Width Outside / Bike Lane / Shoulder, ft				12	5.0	2.0	12	5.0	2.0	12	5.0	2.0
Pedestrian Signal / Occupied Parking	No			No	0.50		No	0.50			0.50	

HCS7 Signalized Intersection Results Summary

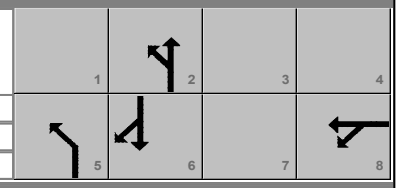
General Information				Intersection Information	
Agency	LJB			Duration, h	0.250
Analyst	TVF	Analysis Date	Dec 8, 2020	Area Type	Other
Jurisdiction	Columbus	Time Period	AM Peak	PHF	0.92
Urban Street	S Hamilton Rd	Analysis Year	2045	Analysis Period	1> 7:00
Intersection	US 33 WB Ramps	File Name	S Hamilton Rd Intersections AM NB.xus		
Project Description	S Hamiilton Rd & US 33 Safety Study				



Demand Information	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Demand (*v*), veh/h				180	5		720	1130			970	520

Signal Information			
Cycle, s	120.0	Reference Phase	2
Offset, s	66	Reference Point	End
Uncoordinated	No	Simult. Gap E/W	On
Force Mode	Fixed	Simult. Gap N/S	On

Green	28.8	57.0	18.1	0.0	0.0	0.0	
Yellow	3.6	5.0	3.6	0.0	0.0	0.0	
Red	1.6	1.0	1.3	0.0	0.0	0.0	



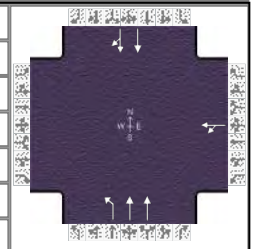
Timer Results	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Assigned Phase				8	5	2		6
Case Number				12.0	1.0	4.0		8.3
Phase Duration, s				23.0	34.0	97.0		63.0
Change Period, ($Y+R_c$), s				4.9	5.2	6.0		6.0
Max Allow Headway (*MAH*), s				4.7	6.0	0.0		0.0
Queue Clearance Time (g_s), s				16.4	30.8			
Green Extension Time (g_e), s				0.1	0.0	0.0		0.0
Phase Call Probability				1.00	1.00			
Max Out Probability				1.00	1.00			

Movement Group Results	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Assigned Movement				3	8		5	2			6	16
Adjusted Flow Rate (*v*), veh/h					201		629	987			806	748
Adjusted Saturation Flow Rate (*s*), veh/h/ln					1628		1795	1795			1870	1670
Queue Service Time (g_s), s					14.4		28.8	14.8			47.0	51.2
Cycle Queue Clearance Time (g_c), s					14.4		28.8	14.8			47.0	51.2
Green Ratio (*g/C*)					0.15		0.73	0.76			0.48	0.48
Capacity (*c*), veh/h					246		507	2722			888	793
Volume-to-Capacity Ratio (*X*)					0.819		1.240	0.363			0.907	0.944
Back of Queue (*Q*), ft/ln (95 th percentile)					311.6		786.5	151.1			785	789.7
Back of Queue (*Q*), veh/ln (95 th percentile)					11.3		31.2	6.0			30.9	31.1
Queue Storage Ratio (*RQ*) (95 th percentile)					1.89		1.50	0.20			0.90	0.90
Uniform Delay (d_1), s/veh					49.4		27.5	7.5			29.1	30.0
Incremental Delay (d_2), s/veh					19.7		109.6	0.0			14.7	20.8
Initial Queue Delay (d_3), s/veh					0.0		0.0	0.0			0.0	0.0
Control Delay (*d*), s/veh					69.1		137.2	7.5			43.7	50.8
Level of Service (LOS)					E		F	A			D	D
Approach Delay, s/veh / LOS	0.0			69.1		E	58.0		E	47.1		D
Intersection Delay, s/veh / LOS	53.6						D					

Multimodal Results	EB		WB		NB		SB	
Pedestrian LOS Score / LOS	2.32	B	2.24	B	1.33	A	1.39	A
Bicycle LOS Score / LOS			0.82	A	2.15	B	1.77	B

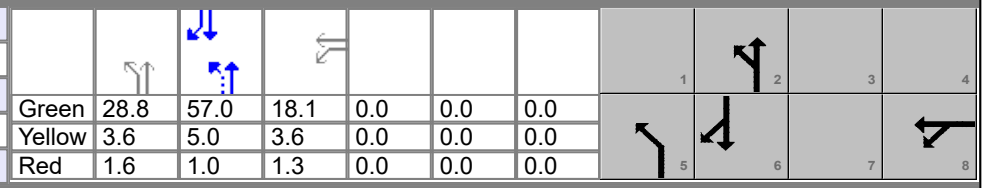
HCS7 Signalized Intersection Intermediate Values

General Information				Intersection Information	
Agency	LJB			Duration, h	0.250
Analyst	TVF	Analysis Date	Dec 8, 2020	Area Type	Other
Jurisdiction	Columbus	Time Period	AM Peak	PHF	0.92
Urban Street	S Hamilton Rd	Analysis Year	2045	Analysis Period	1> 7:00
Intersection	US 33 WB Ramps	File Name	S Hamilton Rd Intersections AM NB.xus		
Project Description	S Hamiilton Rd & US 33 Safety Study				



Demand Information	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Demand (*v*), veh/h				180	5		720	1130			970	520

Signal Information			
Cycle, s	120.0	Reference Phase	2
Offset, s	66	Reference Point	End
Uncoordinated	No	Simult. Gap E/W	On
Force Mode	Fixed	Simult. Gap N/S	On



Green	28.8	57.0	18.1	0.0	0.0	0.0						
Yellow	3.6	5.0	3.6	0.0	0.0	0.0						
Red	1.6	1.0	1.3	0.0	0.0	0.0						

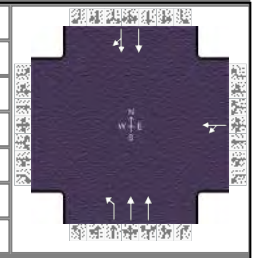
Saturation Flow / Delay	L	T	R	L	T	R	L	T	R	L	T	R
Lane Width Adjustment Factor (f_w)				1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
Heavy Vehicles and Grade Factor (f_{HVg})				1.000	0.899	1.000	0.992	0.992	1.000	1.000	0.984	0.984
Parking Activity Adjustment Factor (f_p)	0.000	0.000	0.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
Bus Blockage Adjustment Factor (f_{bb})	0.000	0.000	0.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
Area Type Adjustment Factor (f_a)				1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
Lane Utilization Adjustment Factor (f_{LU})	1.000	1.000	1.000	1.000	1.000	1.000	1.000	0.952	1.000	1.000	1.000	1.000
Left-Turn Adjustment Factor (f_{LT})				0.954	0.954		0.952	0.000		1.000	1.000	
Right-Turn Adjustment Factor (f_{RT})					0.000	0.000		1.000	1.000		0.893	0.893
Left-Turn Pedestrian Adjustment Factor (f_{Lpb})				1.000			1.000			1.000		
Right-Turn Ped-Bike Adjustment Factor (f_{Rpb})						1.000			1.000			1.000
Work Zone Adjustment Factor (f_{wz})				1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
DDI Factor (f_{DDI})				1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
Movement Saturation Flow Rate (s), veh/h				1584	44	0	1795	3680	0	0	2424	1116
Proportion of Vehicles Arriving on Green (P)	0.00	0.00	0.00	0.15	0.15	0.00	0.42	0.66	0.00	0.00	0.48	0.48
Incremental Delay Factor (k)					0.37		0.50	0.50			0.50	0.50

Signal Timing / Movement Groups	EBL	EBT/R	WBL	WBT/R	NBL	NBT/R	SBL	SBT/R
Lost Time (t_L)				4.0	5.2	6.0		6.0
Green Ratio (g/C)				0.15	0.73	0.76		0.48
Permitted Saturation Flow Rate (s_p), veh/h/ln				0	335	0		579
Shared Saturation Flow Rate (s_{sh}), veh/h/ln								0
Permitted Effective Green Time (g_p), s				0.0	59.0	0.0		0.0
Permitted Service Time (g_u), s				0.0	5.8	0.0		0.0
Permitted Queue Service Time (g_{ps}), s					5.8			
Time to First Blockage (g_f), s				0.0	0.0	0.0		57.0
Queue Service Time Before Blockage (g_{fs}), s								
Protected Right Saturation Flow (s_R), veh/h/ln								
Protected Right Effective Green Time (g_R), s								

Multimodal	EB		WB		NB		SB	
Pedestrian F_w / F_v	1.557	0.000	1.389	0.085	0.681	0.000	0.681	0.000
Pedestrian F_s / F_{delay}	0.000	0.167	0.000	0.168	0.000	0.050	0.000	0.113
Pedestrian M_{corner} / M_{cw}								
Bicycle c_b / d_b	-83.33	65.10	-98.33	66.05	1516.67	3.50	950.00	16.54
Bicycle F_w / F_v	-3.64		-3.64	0.33	-3.64	1.66	-3.64	1.28

HCS7 Signalized Intersection Results Graphical Summary

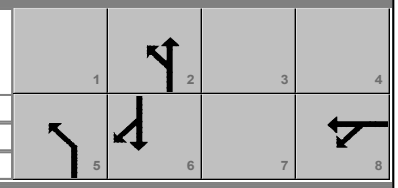
General Information				Intersection Information	
Agency	LJB			Duration, h	0.250
Analyst	TVF	Analysis Date	Dec 8, 2020	Area Type	Other
Jurisdiction	Columbus	Time Period	AM Peak	PHF	0.92
Urban Street	S Hamilton Rd	Analysis Year	2045	Analysis Period	1> 7:00
Intersection	US 33 WB Ramps	File Name	S Hamilton Rd Intersections AM NB.xus		
Project Description	S Hamiilton Rd & US 33 Safety Study				



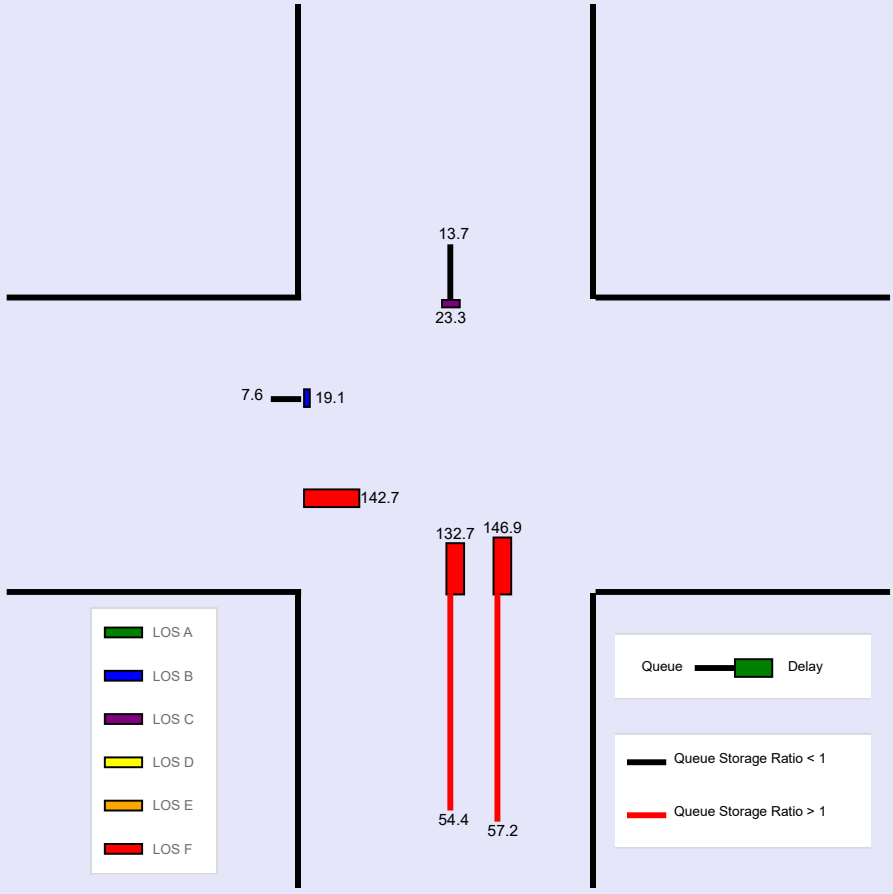
Demand Information	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Demand (*v*), veh/h				180	5		720	1130			970	520

Signal Information			
Cycle, s	120.0	Reference Phase	2
Offset, s	66	Reference Point	End
Uncoordinated	No	Simult. Gap E/W	On
Force Mode	Fixed	Simult. Gap N/S	On

Green	28.8	57.0	18.1	0.0	0.0	0.0	
Yellow	3.6	5.0	3.6	0.0	0.0	0.0	
Red	1.6	1.0	1.3	0.0	0.0	0.0	



Movement Group Results	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Back of Queue (*Q*), ft/ln (95 th percentile)					311.6		786.5	151.1			785	789.7
Back of Queue (*Q*), veh/ln (95 th percentile)					11.3		31.2	6.0			30.9	31.1
Queue Storage Ratio (*RQ*) (95 th percentile)					1.89		1.50	0.20			0.90	0.90
Control Delay (*d*), s/veh					69.1		137.2	7.5			43.7	50.8
Level of Service (LOS)					E		F	A			D	D
Approach Delay, s/veh / LOS	0.0			69.1		E	58.0		E	47.1		D
Intersection Delay, s/veh / LOS	53.6						D					



--- Messages ---

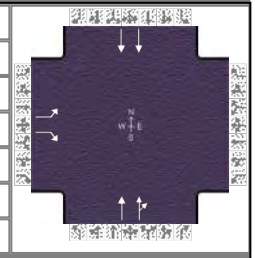
WARNING: Since queue spillover from turn lanes and spillback into upstream intersections is not accounted for in the HCM procedures, use of a simulation tool may be advised in situations where the Queue Storage Ratio exceeds 1.0.

WARNING: If demand exceeds capacity, a multiple-period analysis should be conducted.

--- Comments ---

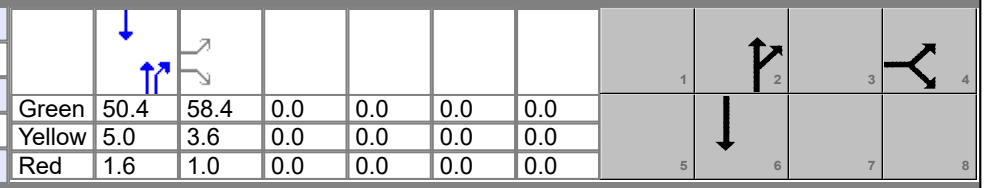
HCS7 Signalized Intersection Input Data

General Information				Intersection Information	
Agency	LJB			Duration, h	0.250
Analyst	TVF	Analysis Date	Dec 8, 2020	Area Type	Other
Jurisdiction	Columbus	Time Period	AM Peak	PHF	0.92
Urban Street	S Hamilton Rd	Analysis Year	2045	Analysis Period	1> 7:00
Intersection	US 33 EB Ramps	File Name	S Hamilton Rd Intersections AM NB.xus		
Project Description	S Hamiilton Rd & US 33 Safety Study				



Demand Information	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Demand (*v*), veh/h	240		840					1610	170		1080	

Signal Information			
Cycle, s	120.0	Reference Phase	2
Offset, s	54	Reference Point	Begin
Uncoordinated	No	Simult. Gap E/W	On
Force Mode	Fixed	Simult. Gap N/S	On



Green	50.4	58.4	0.0	0.0	0.0	0.0						
Yellow	5.0	3.6	0.0	0.0	0.0	0.0						
Red	1.6	1.0	0.0	0.0	0.0	0.0						

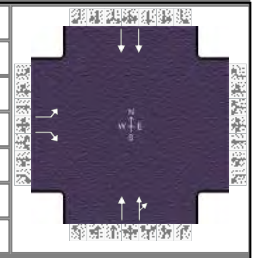
Traffic Information	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Demand (*v*), veh/h	240		840					1610	170		1080	
Initial Queue (Q_b), veh/h	0		0					0	0		0	
Base Saturation Flow Rate (s_o), veh/h	1900		1900					1900	1900		1900	
Parking (N_m), man/h		None						None			None	
Heavy Vehicles (P_{HV}), %	6		6					6			6	
Ped / Bike / RTOR, /h	0	0		0	0		0	0	0	0	0	
Buses (N_b), buses/h	0	0	0				0	0	0	0	0	0
Arrival Type (*AT*)	3		3					3	3		3	
Upstream Filtering (*I*)	1.00		1.00					0.56	0.56		0.31	
Lane Width (*W*), ft	12.0		12.0					12.0			12.0	
Turn Bay Length, ft	1800		40					275			725	
Grade (*Pg*), %		0			0			0			0	
Speed Limit, mi/h	50		50					50	50		50	

Phase Information	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Maximum Green (G_{max}) or Phase Split, s		63.0				57.0		57.0
Yellow Change Interval (*Y*), s		3.6				5.0		5.0
Red Clearance Interval (R_c), s		1.0				1.6		1.6
Minimum Green (G_{min}), s		7				20		20
Start-Up Lost Time (*l1*), s	2.0					2.0		2.0
Extension of Effective Green (*e*), s	2.0					2.0		2.0
Passage (*PT*), s		5.0				3.0		3.0
Recall Mode		Min				Min		Min
Dual Entry		Yes				Yes		Yes
Walk (*Walk*), s		0.0		0.0				0.0
Pedestrian Clearance Time (*PC*), s		0.0		0.0				0.0

Multimodal Information	EB			WB			NB			SB		
85th % Speed / Rest in Walk / Corner Radius	0	No	25	0	No	25				0	No	25
Walkway / Crosswalk Width / Length, ft	9.0	12	0	9.0	12	0				9.0	12	0
Street Width / Island / Curb	0	0	No		0		0		No	0	0	No
Width Outside / Bike Lane / Shoulder, ft	12	5.0	2.0				12	5.0	2.0	12	5.0	2.0
Pedestrian Signal / Occupied Parking	No	0.50		No				0.50		No	0.50	

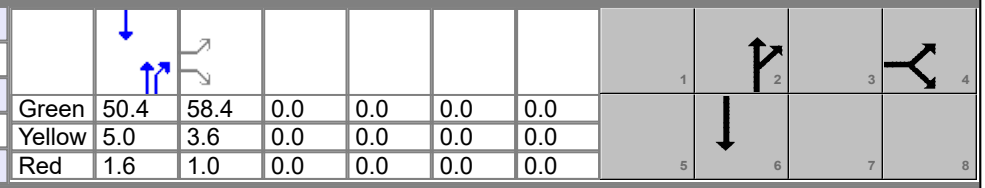
HCS7 Signalized Intersection Results Summary

General Information				Intersection Information	
Agency	LJB			Duration, h	0.250
Analyst	TVF	Analysis Date	Dec 8, 2020	Area Type	Other
Jurisdiction	Columbus	Time Period	AM Peak	PHF	0.92
Urban Street	S Hamilton Rd	Analysis Year	2045	Analysis Period	1> 7:00
Intersection	US 33 EB Ramps	File Name	S Hamilton Rd Intersections AM NB.xus		
Project Description	S Hamiilton Rd & US 33 Safety Study				



Demand Information	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Demand (*v*), veh/h	240		840					1610	170		1080	

Signal Information			
Cycle, s	120.0	Reference Phase	2
Offset, s	54	Reference Point	Begin
Uncoordinated	No	Simult. Gap E/W	On
Force Mode	Fixed	Simult. Gap N/S	On



Green	50.4	58.4	0.0	0.0	0.0	0.0		
Yellow	5.0	3.6	0.0	0.0	0.0	0.0		
Red	1.6	1.0	0.0	0.0	0.0	0.0		

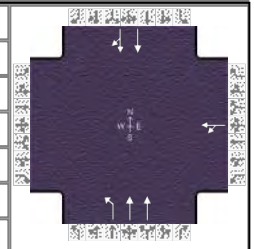
Timer Results	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Assigned Phase		4				2		6
Case Number		9.0				8.0		8.0
Phase Duration, s		63.0				57.0		57.0
Change Period, ($Y+R_c$), s		4.6				6.6		6.6
Max Allow Headway (*MAH*), s		6.2				0.0		0.0
Queue Clearance Time (g_s), s		60.4						
Green Extension Time (g_e), s		0.0				0.0		0.0
Phase Call Probability		1.00						
Max Out Probability		1.00						

Movement Group Results	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Assigned Movement	7		14					2	12		6	
Adjusted Flow Rate (*v*), veh/h	261		913					926	920		1250	
Adjusted Saturation Flow Rate (*s*), veh/h/ln	1725		1535					1811	1751		1724	
Queue Service Time (g_s), s	11.0		58.4					82.4	50.4		36.0	
Cycle Queue Clearance Time (g_c), s	11.0		58.4					82.4	50.4		36.0	
Green Ratio (*g/C*)	0.49		0.49					0.42	0.42		0.42	
Capacity (*c*), veh/h	839		747					761	735		1448	
Volume-to-Capacity Ratio (*X*)	0.311		1.222					1.218	1.251		0.863	
Back of Queue (*Q*), ft/ln (95 th percentile)	198		1611.4					1426.1	1498.2		358.1	
Back of Queue (*Q*), veh/ln (95 th percentile)	7.6		61.5					54.4	57.2		13.7	
Queue Storage Ratio (*RQ*) (95 th percentile)	0.11		40.28					5.19	5.45		0.49	
Uniform Delay (d_1), s/veh	18.6		30.8					27.9	27.5		21.0	
Incremental Delay (d_2), s/veh	0.4		111.9					104.8	119.5		2.4	
Initial Queue Delay (d_3), s/veh	0.0		0.0					0.0	0.0		0.0	
Control Delay (*d*), s/veh	19.1		142.7					132.7	146.9		23.3	
Level of Service (LOS)	B		F					F	F		C	
Approach Delay, s/veh / LOS	115.2	F		0.0			139.8	F		23.3	C	
Intersection Delay, s/veh / LOS	99.0						F					

Multimodal Results	EB		WB		NB		SB	
Pedestrian LOS Score / LOS	2.16	B	2.16	B	0.72	A	1.69	B
Bicycle LOS Score / LOS		F			2.08	B	1.46	A

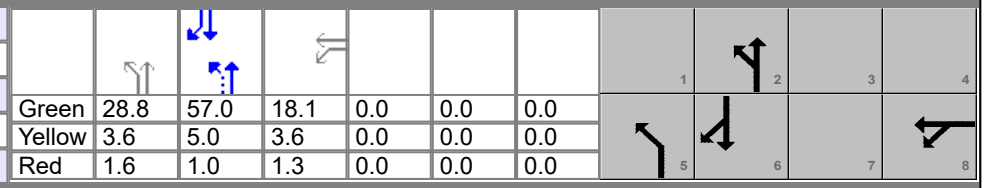
HCS7 Signalized Intersection Intermediate Values

General Information				Intersection Information	
Agency	LJB			Duration, h	0.250
Analyst	TVF	Analysis Date	Dec 8, 2020	Area Type	Other
Jurisdiction	Columbus	Time Period	AM Peak	PHF	0.92
Urban Street	S Hamilton Rd	Analysis Year	2045	Analysis Period	1> 7:00
Intersection	US 33 WB Ramps	File Name	S Hamilton Rd Intersections AM NB.xus		
Project Description	S Hamiilton Rd & US 33 Safety Study				



Demand Information	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Demand (*v*), veh/h				180	5		720	1130			970	520

Signal Information			
Cycle, s	120.0	Reference Phase	2
Offset, s	66	Reference Point	End
Uncoordinated	No	Simult. Gap E/W	On
Force Mode	Fixed	Simult. Gap N/S	On



Green	28.8	57.0	18.1	0.0	0.0	0.0						
Yellow	3.6	5.0	3.6	0.0	0.0	0.0						
Red	1.6	1.0	1.3	0.0	0.0	0.0						

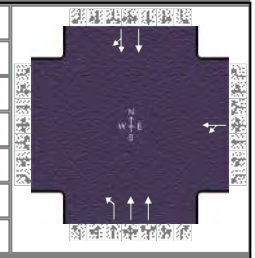
Saturation Flow / Delay	L	T	R	L	T	R	L	T	R	L	T	R
Lane Width Adjustment Factor (f_w)				1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
Heavy Vehicles and Grade Factor (f_{HVg})				1.000	0.899	1.000	0.992	0.992	1.000	1.000	0.984	0.984
Parking Activity Adjustment Factor (f_p)	0.000	0.000	0.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
Bus Blockage Adjustment Factor (f_{bb})	0.000	0.000	0.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
Area Type Adjustment Factor (f_a)				1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
Lane Utilization Adjustment Factor (f_{LU})	1.000	1.000	1.000	1.000	1.000	1.000	1.000	0.952	1.000	1.000	1.000	1.000
Left-Turn Adjustment Factor (f_{LT})				0.954	0.954		0.952	0.000		1.000	1.000	
Right-Turn Adjustment Factor (f_{RT})					0.000	0.000		1.000	1.000		0.893	0.893
Left-Turn Pedestrian Adjustment Factor (f_{Lpb})				1.000			1.000			1.000		
Right-Turn Ped-Bike Adjustment Factor (f_{Rpb})						1.000			1.000			1.000
Work Zone Adjustment Factor (f_{wz})				1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
DDI Factor (f_{DDI})				1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
Movement Saturation Flow Rate (s), veh/h				1584	44	0	1795	3680	0	0	2424	1116
Proportion of Vehicles Arriving on Green (P)	0.00	0.00	0.00	0.15	0.15	0.00	0.42	0.66	0.00	0.00	0.48	0.48
Incremental Delay Factor (k)					0.37		0.50	0.50			0.50	0.50

Signal Timing / Movement Groups	EBL	EBT/R	WBL	WBT/R	NBL	NBT/R	SBL	SBT/R
Lost Time (t_L)				4.0	5.2	6.0		6.0
Green Ratio (g/C)				0.15	0.73	0.76		0.48
Permitted Saturation Flow Rate (s_p), veh/h/ln				0	335	0		579
Shared Saturation Flow Rate (s_{sh}), veh/h/ln								0
Permitted Effective Green Time (g_p), s				0.0	59.0	0.0		0.0
Permitted Service Time (g_u), s				0.0	5.8	0.0		0.0
Permitted Queue Service Time (g_{ps}), s					5.8			
Time to First Blockage (g_f), s				0.0	0.0	0.0		57.0
Queue Service Time Before Blockage (g_{fs}), s								
Protected Right Saturation Flow (s_R), veh/h/ln								
Protected Right Effective Green Time (g_R), s								

Multimodal	EB		WB		NB		SB	
Pedestrian F_w / F_v	1.557	0.000	1.389	0.085	0.681	0.000	0.681	0.000
Pedestrian F_s / F_{delay}	0.000	0.167	0.000	0.168	0.000	0.050	0.000	0.113
Pedestrian M_{corner} / M_{cw}								
Bicycle c_b / d_b	-83.33	65.10	-98.33	66.05	1516.67	3.50	950.00	16.54
Bicycle F_w / F_v	-3.64		-3.64	0.33	-3.64	1.66	-3.64	1.28

HCS7 Signalized Intersection Results Graphical Summary

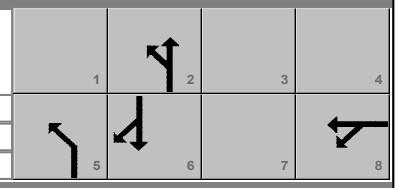
General Information				Intersection Information	
Agency	LJB			Duration, h	0.250
Analyst	TVF	Analysis Date	Dec 8, 2020	Area Type	Other
Jurisdiction	Columbus	Time Period	AM Peak	PHF	0.92
Urban Street	S Hamilton Rd	Analysis Year	2045	Analysis Period	1> 7:00
Intersection	US 33 WB Ramps	File Name	S Hamilton Rd Intersections AM NB.xus		
Project Description	S Hamiilton Rd & US 33 Safety Study				



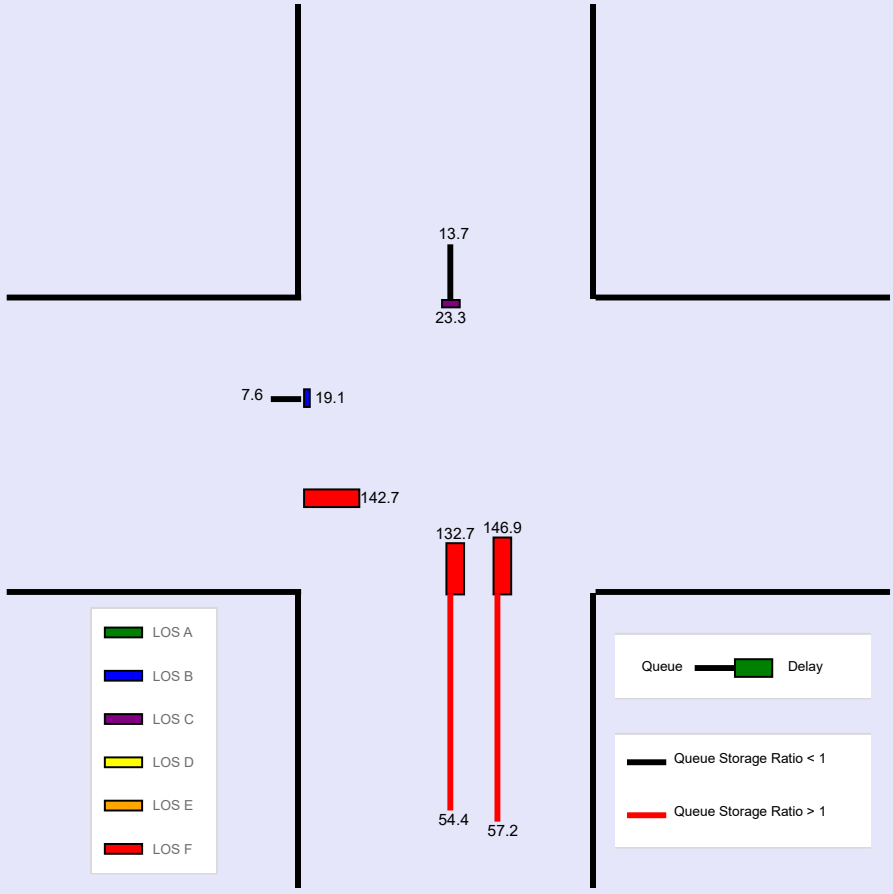
Demand Information	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Demand (*v*), veh/h				180	5		720	1130			970	520

Signal Information			
Cycle, s	120.0	Reference Phase	2
Offset, s	66	Reference Point	End
Uncoordinated	No	Simult. Gap E/W	On
Force Mode	Fixed	Simult. Gap N/S	On

Green	28.8	57.0	18.1	0.0	0.0	0.0	
Yellow	3.6	5.0	3.6	0.0	0.0	0.0	
Red	1.6	1.0	1.3	0.0	0.0	0.0	



Movement Group Results	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Back of Queue (*Q*), ft/ln (95 th percentile)					311.6		786.5	151.1			785	789.7
Back of Queue (*Q*), veh/ln (95 th percentile)					11.3		31.2	6.0			30.9	31.1
Queue Storage Ratio (*RQ*) (95 th percentile)					1.89		1.50	0.20			0.90	0.90
Control Delay (*d*), s/veh					69.1		137.2	7.5			43.7	50.8
Level of Service (LOS)					E		F	A			D	D
Approach Delay, s/veh / LOS	0.0			69.1		E	58.0		E	47.1		D
Intersection Delay, s/veh / LOS	53.6						D					



--- Messages ---

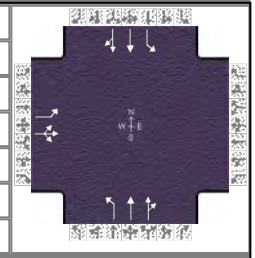
WARNING: Since queue spillover from turn lanes and spillback into upstream intersections is not accounted for in the HCM procedures, use of a simulation tool may be advised in situations where the Queue Storage Ratio exceeds 1.0.

WARNING: If demand exceeds capacity, a multiple-period analysis should be conducted.

--- Comments ---

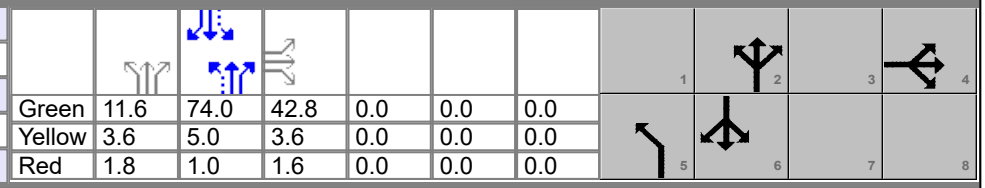
HCS7 Signalized Intersection Input Data

General Information				Intersection Information	
Agency	LJB			Duration, h	0.250
Analyst	TVF	Analysis Date	Dec 8, 2020	Area Type	Other
Jurisdiction	Columbus	Time Period	PM Peak	PHF	0.92
Urban Street	S Hamilton Rd	Analysis Year	2045	Analysis Period	1> 7:00
Intersection	Williams Rd	File Name	S Hamilton Rd Intersections PM NB.xus		
Project Description	S Hamiilton Rd & US 33 Safety Study				



Demand Information	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Demand (*v*), veh/h	600	5	90				160	1830	5	5	1180	450

Signal Information			
Cycle, s	145.0	Reference Phase	2
Offset, s	5	Reference Point	End
Uncoordinated	No	Simult. Gap E/W	On
Force Mode	Float	Simult. Gap N/S	On



	EB			WB			NB			SB		
Green	11.6	74.0		42.8	0.0	0.0	0.0					
Yellow	3.6	5.0		3.6	0.0	0.0	0.0					
Red	1.8	1.0		1.6	0.0	0.0	0.0					

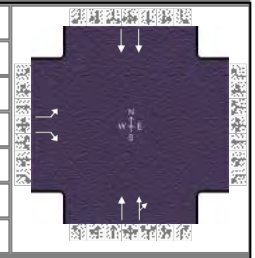
Traffic Information	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Demand (*v*), veh/h	600	5	90				160	1830	5	5	1180	450
Initial Queue (Q_b), veh/h	0	0	0				0	0	0	0	0	0
Base Saturation Flow Rate (s_o), veh/h	1900	1900	1900				1900	1900	1900	1900	1900	1900
Parking (N_m), man/h		None						None			None	
Heavy Vehicles (P_{HV}), %	8	8					5	5		6	6	
Ped / Bike / RTOR, /h	0	0	0	0	0		0	0	0	0	0	0
Buses (N_b), buses/h	0	0	0				0	0	0	0	0	0
Arrival Type (*AT*)	3	3	3				3	3	3	3	3	3
Upstream Filtering (*I*)	1.00	1.00	1.00				1.00	1.00	1.00	0.49	0.49	0.49
Lane Width (*W*), ft	12.0	12.0					12.0	12.0		12.0	12.0	
Turn Bay Length, ft	500	700					85	1200		140	300	
Grade (*Pg*), %		0			0			0			0	
Speed Limit, mi/h	50	50	50				50	50	50	50	50	50

Phase Information	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Maximum Green (G_{max}) or Phase Split, s		48.0			17.0	97.0		80.0
Yellow Change Interval (*Y*), s		3.6			3.6	5.0		5.0
Red Clearance Interval (R_c), s		1.6			1.8	1.0		1.0
Minimum Green (G_{min}), s		7			7	20		20
Start-Up Lost Time (*l1*), s	2.0	2.0			2.0	2.0	2.0	2.0
Extension of Effective Green (*e*), s	2.0	2.0			2.0	2.0	2.0	2.0
Passage (*PT*), s		4.0			3.7	3.0		3.0
Recall Mode		Min			Off	Min		Min
Dual Entry		Yes			No	Yes		Yes
Walk (*Walk*), s		0.0		0.0				0.0
Pedestrian Clearance Time (*PC*), s		0.0		0.0				0.0

Multimodal Information	EB			WB			NB			SB		
85th % Speed / Rest in Walk / Corner Radius	0	No	25	0	No	25				0	No	25
Walkway / Crosswalk Width / Length, ft	9.0	12	0	9.0	12	0				9.0	12	0
Street Width / Island / Curb	0	0	No		0		0		No	0	0	No
Width Outside / Bike Lane / Shoulder, ft	12	5.0	2.0				12	5.0	2.0	12	5.0	2.0
Pedestrian Signal / Occupied Parking	No	0.50		No				0.50		No	0.50	

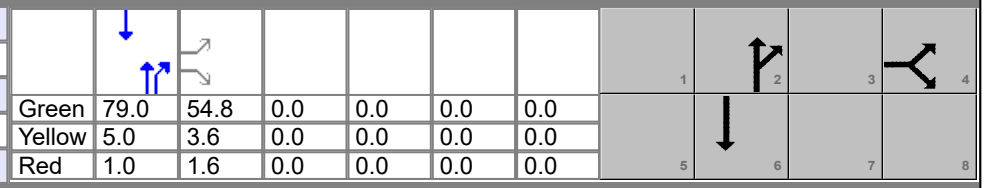
HCS7 Signalized Intersection Results Summary

General Information				Intersection Information	
Agency	LJB			Duration, h	0.250
Analyst	TVF	Analysis Date	Dec 8, 2020	Area Type	Other
Jurisdiction	Columbus	Time Period	PM Peak	PHF	0.92
Urban Street	S Hamilton Rd	Analysis Year	2045	Analysis Period	1> 7:00
Intersection	US 33 EB Ramps	File Name	S Hamilton Rd Intersections PM NB.xus		
Project Description	S Hamiilton Rd & US 33 Safety Study				



Demand Information	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Demand (*v*), veh/h	370		480					1970	460		1150	

Signal Information			
Cycle, s	145.0	Reference Phase	2
Offset, s	70	Reference Point	End
Uncoordinated	No	Simult. Gap E/W	On
Force Mode	Fixed	Simult. Gap N/S	On



Green	79.0	54.8	0.0	0.0	0.0	0.0		
Yellow	5.0	3.6	0.0	0.0	0.0	0.0		
Red	1.0	1.6	0.0	0.0	0.0	0.0		

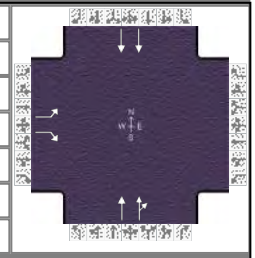
Timer Results	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Assigned Phase		4				2		6
Case Number		9.0				8.0		8.0
Phase Duration, s		60.0				85.0		85.0
Change Period, ($Y+R_c$), s		5.2				6.0		6.0
Max Allow Headway (*MAH*), s		6.1				0.0		0.0
Queue Clearance Time (g_s), s		49.6						
Green Extension Time (g_e), s		3.1				0.0		0.0
Phase Call Probability		1.00						
Max Out Probability		1.00						

Movement Group Results	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Assigned Movement	7		14					2	12		6	
Adjusted Flow Rate (*v*), veh/h	402		522					1245	1245		1424	
Adjusted Saturation Flow Rate (*s*), veh/h/ln	1697		1510					1841	1723		1710	
Queue Service Time (g_s), s	28.0		47.6					145.0	79.0		54.2	
Cycle Queue Clearance Time (g_c), s	28.0		47.6					145.0	79.0		54.2	
Green Ratio (*g/C*)	0.38		0.38					0.54	0.54		0.54	
Capacity (*c*), veh/h	641		571					1003	939		1863	
Volume-to-Capacity Ratio (*X*)	0.627		0.914					1.241	1.326		0.764	
Back of Queue (*Q*), ft/ln (95 th percentile)	461.2		732.1					2240.6	2533.3		688.7	
Back of Queue (*Q*), veh/ln (95 th percentile)	17.3		27.5					86.8	98.2		26.1	
Queue Storage Ratio (*RQ*) (95 th percentile)	0.26		18.30					8.15	9.21		0.95	
Uniform Delay (d_1), s/veh	36.8		42.9					47.9	50.1		40.6	
Incremental Delay (d_2), s/veh	2.8		20.1					109.9	147.8		0.3	
Initial Queue Delay (d_3), s/veh	0.0		0.0					0.0	0.0		0.0	
Control Delay (*d*), s/veh	39.6		63.0					157.8	197.9		40.9	
Level of Service (LOS)	D		E					F	F		D	
Approach Delay, s/veh / LOS	52.8	D		0.0			177.9	F		40.9	D	
Intersection Delay, s/veh / LOS	113.6						F					

Multimodal Results	EB		WB		NB		SB	
Pedestrian LOS Score / LOS	2.16	B	2.16	B	0.71	A	1.68	B
Bicycle LOS Score / LOS		F			2.67	C	1.52	B

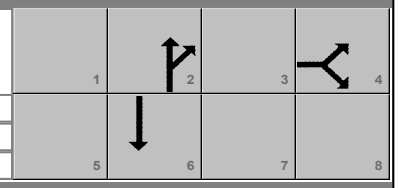
HCS7 Signalized Intersection Intermediate Values

General Information				Intersection Information	
Agency	LJB			Duration, h	0.250
Analyst	TVF	Analysis Date	Dec 8, 2020	Area Type	Other
Jurisdiction	Columbus	Time Period	PM Peak	PHF	0.92
Urban Street	S Hamilton Rd	Analysis Year	2045	Analysis Period	1> 7:00
Intersection	US 33 EB Ramps	File Name	S Hamilton Rd Intersections PM NB.xus		
Project Description	S Hamiilton Rd & US 33 Safety Study				



Demand Information	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Demand (*v*), veh/h	370		480					1970	460		1150	

Signal Information			
Cycle, s	145.0	Reference Phase	2
Offset, s	70	Reference Point	End
Uncoordinated	No	Simult. Gap E/W	On
Force Mode	Fixed	Simult. Gap N/S	On



Green	79.0	54.8	0.0	0.0	0.0	0.0						
Yellow	5.0	3.6	0.0	0.0	0.0	0.0						
Red	1.0	1.6	0.0	0.0	0.0	0.0						

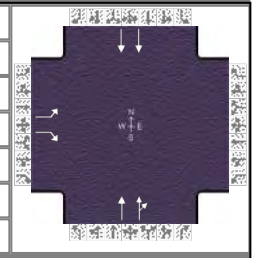
Saturation Flow / Delay	L	T	R	L	T	R	L	T	R	L	T	R
Lane Width Adjustment Factor (f_w)	1.000	1.000	1.000				1.000	1.000	1.000	1.000	1.000	1.000
Heavy Vehicles and Grade Factor (f_{HVg})	0.938	1.000	0.938				1.000	0.969	0.969	1.000	0.945	1.000
Parking Activity Adjustment Factor (f_p)	1.000	1.000	1.000	0.000	0.000	0.000	1.000	1.000	1.000	1.000	1.000	1.000
Bus Blockage Adjustment Factor (f_{bb})	1.000	1.000	1.000	0.000	0.000	0.000	1.000	1.000	1.000	1.000	1.000	1.000
Area Type Adjustment Factor (f_a)	1.000	1.000	1.000				1.000	1.000	1.000	1.000	1.000	1.000
Lane Utilization Adjustment Factor (f_{LU})	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	0.952	1.000
Left-Turn Adjustment Factor (f_{LT})	0.952	0.000					1.000	1.000		1.000	1.000	
Right-Turn Adjustment Factor (f_{RT})		0.000	0.847					0.936	0.936		1.000	1.000
Left-Turn Pedestrian Adjustment Factor (f_{Lpb})	1.000						1.000			1.000		
Right-Turn Ped-Bike Adjustment Factor (f_{Rpb})			1.000						1.000			1.000
Work Zone Adjustment Factor (f_{wz})	1.000	1.000	1.000				1.000	1.000	1.000	1.000	1.000	1.000
DDI Factor (f_{DDI})	1.000	1.000	1.000				1.000	1.000	1.000	1.000	1.000	1.000
Movement Saturation Flow Rate (s), veh/h	1697	0	1510				0	2912	652	0	3593	0
Proportion of Vehicles Arriving on Green (P)	0.38	0.00	0.38	0.00	0.00	0.00	0.00	0.34	0.26	0.00	0.33	0.00
Incremental Delay Factor (k)	0.30		0.45					0.50	0.50		0.50	

Signal Timing / Movement Groups	EBL	EBT/R	WBL	WBT/R	NBL	NBT/R	SBL	SBT/R
Lost Time (t_L)		4.0				6.0		6.0
Green Ratio (g/C)		0.38				0.54		0.54
Permitted Saturation Flow Rate (s_p), veh/h/ln		1697				382		135
Shared Saturation Flow Rate (s_{sh}), veh/h/ln						0		0
Permitted Effective Green Time (g_p), s		0.0				0.0		0.0
Permitted Service Time (g_u), s		0.0				0.0		0.0
Permitted Queue Service Time (g_{ps}), s								
Time to First Blockage (g_f), s		0.0				79.0		79.0
Queue Service Time Before Blockage (g_{fs}), s								
Protected Right Saturation Flow (s_R), veh/h/ln		0						
Protected Right Effective Green Time (g_R), s		0.0						

Multimodal	EB		WB		NB		SB	
Pedestrian F_w / F_v	1.389	0.000	1.389	0.000	0.000	0.000	0.972	0.000
Pedestrian F_s / F_{delay}	0.000	0.175	0.000	0.174	0.000	0.109	0.000	0.109
Pedestrian M_{corner} / M_{cw}								
Bicycle c_b / d_b	-85.52	78.83	-68.97	77.59	1089.66	15.02	1089.66	15.02
Bicycle F_w / F_v	-3.64		-3.64		-3.64	2.18	-3.64	1.03

HCS7 Signalized Intersection Results Graphical Summary

General Information				Intersection Information	
Agency	LJB			Duration, h	0.250
Analyst	TVF	Analysis Date	Dec 8, 2020	Area Type	Other
Jurisdiction	Columbus	Time Period	PM Peak	PHF	0.92
Urban Street	S Hamilton Rd	Analysis Year	2045	Analysis Period	1> 7:00
Intersection	US 33 EB Ramps	File Name	S Hamilton Rd Intersections PM NB.xus		
Project Description	S Hamiilton Rd & US 33 Safety Study				

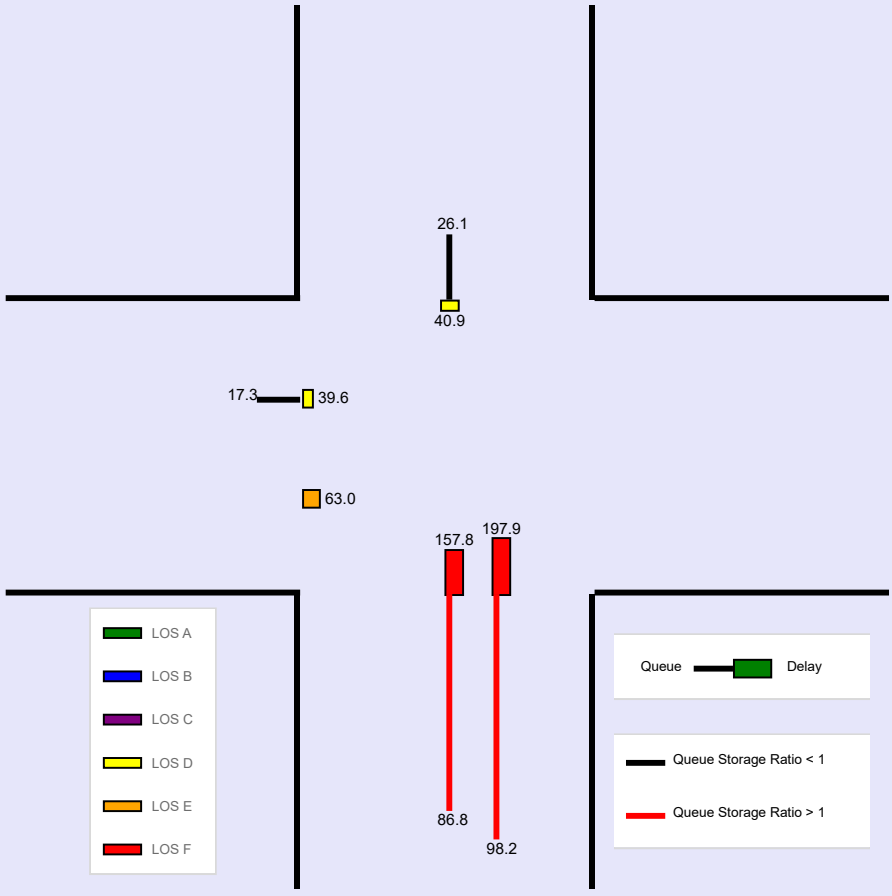


Demand Information	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Demand (*v*), veh/h	370		480					1970	460		1150	

Signal Information			
Cycle, s	145.0	Reference Phase	2
Offset, s	70	Reference Point	End
Uncoordinated	No	Simult. Gap E/W	On
Force Mode	Fixed	Simult. Gap N/S	On

Green	79.0	54.8	0.0	0.0	0.0	0.0						
Yellow	5.0	3.6	0.0	0.0	0.0	0.0						
Red	1.0	1.6	0.0	0.0	0.0	0.0						

Movement Group Results	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Back of Queue (*Q*), ft/ln (95 th percentile)	461.2		732.1					2240.6	2533.3		688.7	
Back of Queue (*Q*), veh/ln (95 th percentile)	17.3		27.5					86.8	98.2		26.1	
Queue Storage Ratio (*RQ*) (95 th percentile)	0.26		18.30					8.15	9.21		0.95	
Control Delay (*d*), s/veh	39.6		63.0					157.8	197.9		40.9	
Level of Service (LOS)	D		E					F	F		D	
Approach Delay, s/veh / LOS	52.8	D		0.0			177.9	F		40.9	D	
Intersection Delay, s/veh / LOS	113.6	F										



--- Messages ---

WARNING: Since queue spillover from turn lanes and spillback into upstream intersections is not accounted for in the HCM procedures, use of a simulation tool may be advised in situations where the Queue Storage Ratio exceeds 1.0.

WARNING: If demand exceeds capacity, a multiple-period analysis should be conducted.

WARNING: According to input data, upstream feeding volume is equal to 121% of downstream exit volume during time period #1, for thru movement #6.

--- Comments ---

HCS7 Freeway Facilities Report

Project Information

Analyst	LJB/JDO	Date	11/20/2020
Agency		Analysis Year	2045
Jurisdiction		Time Period Analyzed	PM 2045 NB
Project Description	EB US33	Unit	United States Customary

Facility Global Input

Jam Density, pc/mi/ln	190.0	Density at Capacity, pc/mi/ln	45.0
Queue Discharge Capacity Drop, %	7	Total Segments	30
Total Time Periods	1	Time Period Duration, min	15
Facility Length, mi	11.50		

Facility Segment Data

No.	Coded	Analyzed	Name	Length, ft	Lanes
1	Basic	Basic	Eb US33 S of 104	3020	2
2	Diverge	Diverge	Eb US33 to I270 SB Off-Ramp	1500	2
3	Basic	Basic	Eb US33 2 Lane Segment	710	2
4	Basic	Basic	Eb US33 3 Lane Segment	130	3
5	Weaving	Weaving	Eb US33 (Weave)	1480	4
6	Basic	Basic	Eb US33	410	3
7	Merge	Merge	Nb I270 to Eb US33 On Ramp (Long Ramp)	1500	3
8	Basic	Basic	Eb US33-Bet I-270 & Hamilton	990	3
9	Diverge	Basic	Eb US33 to Hamilton off-ramp (Long Ramp)	1500	3
10	Basic	Basic	Eb US33	1350	2
11	Merge	Merge	Sb Hamilton to Eb US33 On-Ramp	1400	2
12	Merge	Merge	Nb Hamilton to Eb US33 On-Ramp	1500	2
13	Basic	Basic	Eb US33 (Hamilton to Bixby)	4680	2
14	Diverge	Diverge	EB US 33 to Bixby SB Off-ramp	1500	2
15	Diverge	Diverge	EB US 33 to Bixby NB Off-ramp	1500	2
16	Basic	Basic	EB US 33	650	2
17	Merge	Merge	Bixby to EB US33 On Ramp	1500	2
18	Basic	Basic	EB US 33 - Bixby to Gender	4070	2
19	Diverge	Diverge	Eb US33 to Gender Off Ramp	1500	2
20	Basic	Basic	EB US 33-Bet Gender Ramps	2350	2
21	Merge	Merge	Gender to EB US33 On Ramp	1500	2
22	Basic	Basic	Eb US33 -Gender to Diley	3730	2
23	Diverge	Diverge	EB US 33 to Diley - Off ramp	1500	2
24	Basic	Basic	Between Diley Ramps	4090	2
25	Merge	Merge	Diley to EB US33 On-Ramp	1500	2

26	Basic	Basic	EB US33-Diley to Pickerington	4860	2
27	Diverge	Diverge	EB US 33 to Pickerington Off-ramp	1500	2
28	Basic	Basic	EB US33-Bet Pickerington Ramps	2000	2
29	Merge	Merge	EB US33- Pickerington On Ramp	1500	2
30	Basic	Basic	EB US 33 -East of Pickerington	5280	2

Facility Segment Data

Segment 1: Basic

Time Period	PHF	fHV	Flow Rate (pc/h)	Capacity (pc/h)	d/c Ratio	Speed (mi/h)	Density (pc/mi/ln)	LOS
1	0.94	0.971	4426	4700	0.94	55.6	39.8	E

Segment 2: Diverge

Time Period	PHF		fHV		Flow Rate (pc/h)		Capacity (pc/h)		d/c Ratio		Speed (mi/h)		Density (pc/mi/ln)		LOS
	F	R	F	R	Freeway	Ramp	Freeway	Ramp	F	R	F	R	Freeway	Ramp	
1	0.94	0.94	0.971	0.935	4426	284	4700	2100	0.94	0.14	59.0	59.0	37.5	37.6	E

Segment 3: Basic

Time Period	PHF	fHV	Flow Rate (pc/h)	Capacity (pc/h)	d/c Ratio	Speed (mi/h)	Density (pc/mi/ln)	LOS
1	0.94	0.971	4142	4700	0.88	58.6	35.3	E

Segment 4: Basic

Time Period	PHF	fHV	Flow Rate (pc/h)	Capacity (pc/h)	d/c Ratio	Speed (mi/h)	Density (pc/mi/ln)	LOS
1	0.94	0.971	4142	7050	0.59	61.8	21.2	C

Segment 5: Weaving

Time Period	PHF	fHV	Flow Rate (pc/h)	Capacity (pc/h)	d/c Ratio	Speed (mi/h)	Density (pc/mi/ln)	LOS
1	0.94	0.971	4415	6997	0.84	54.8	20.1	C

Segment 6: Basic

Time Period	PHF	fHV	Flow Rate (pc/h)	Capacity (pc/h)	d/c Ratio	Speed (mi/h)	Density (pc/mi/ln)	LOS
1	0.94	0.962	4119	7050	0.79	62.8	21.1	C

Segment 7: Merge

Time Period	PHF		fHV		Flow Rate (pc/h)		Capacity (pc/h)		d/c Ratio		Speed (mi/h)		Density (pc/mi/ln)		LOS
	F	R	F	R	Freeway	Ramp	Freeway	Ramp	F	R	F	R	Freeway	Ramp	
1	0.94	0.94	0.962	0.962	4477	1803	7050	2000	1.04	0.90	58.1	56.7	25.7	25.1	F

Segment 8: Basic

Time Period	PHF	fHV	Flow Rate (pc/h)	Capacity (pc/h)	d/c Ratio	Speed (mi/h)	Density (pc/mi/ln)	LOS
1	0.94	0.962	4477	7050	1.04	64.1	23.0	F

Segment 9: Diverge

Time Period	PHF	fHV	Flow Rate (pc/h)	Capacity (pc/h)	d/c Ratio	Speed (mi/h)	Density (pc/mi/ln)	LOS

	F	R	F	R	Freeway	Ramp	Freeway	Ramp	F	R	F	R	Freeway	Ramp	
1	0.94	0.94	0.962	0.926	4477	977	7050	2000	1.04	0.49	57.4	57.4	26.0	26.0	F

Segment 10: Basic

Time Period	PHF	fHV	Flow Rate (pc/h)	Capacity (pc/h)	d/c Ratio	Speed (mi/h)	Density (pc/mi/ln)	LOS
1	0.94	0.962	3500	4700	1.36	63.3	27.6	F

Segment 11: Merge

Time Period	PHF		fHV		Flow Rate (pc/h)		Capacity (pc/h)		d/c Ratio		Speed (mi/h)		Density (pc/mi/ln)		LOS
	F	R	F	R	Freeway	Ramp	Freeway	Ramp	F	R	F	R	Freeway	Ramp	
1	0.94	0.94	0.962	0.962	3765	265	4700	2000	1.42	0.13	54.9	54.9	34.3	30.5	F

Segment 12: Merge

Time Period	PHF		fHV		Flow Rate (pc/h)		Capacity (pc/h)		d/c Ratio		Speed (mi/h)		Density (pc/mi/ln)		LOS
	F	R	F	R	Freeway	Ramp	Freeway	Ramp	F	R	F	R	Freeway	Ramp	
1	0.94	0.94	0.962	0.926	4290	528	4700	2100	1.53	0.25	52.7	52.7	40.7	33.8	F

Segment 13: Basic

Time Period	PHF	fHV	Flow Rate (pc/h)	Capacity (pc/h)	d/c Ratio	Speed (mi/h)	Density (pc/mi/ln)	LOS
1	0.94	0.962	4290	4700	1.53	57.1	37.6	F

Segment 14: Diverge

Time Period	PHF		fHV		Flow Rate (pc/h)		Capacity (pc/h)		d/c Ratio		Speed (mi/h)		Density (pc/mi/ln)		LOS
	F	R	F	R	Freeway	Ramp	Freeway	Ramp	F	R	F	R	Freeway	Ramp	
1	0.94	0.94	0.962	0.962	4290	487	4700	2000	1.53	0.24	54.1	54.1	39.6	35.7	F

Segment 15: Diverge

Time Period	PHF		fHV		Flow Rate (pc/h)		Capacity (pc/h)		d/c Ratio		Speed (mi/h)		Density (pc/mi/ln)		LOS
	F	R	F	R	Freeway	Ramp	Freeway	Ramp	F	R	F	R	Freeway	Ramp	
1	0.94	0.94	0.962	0.962	3803	299	4700	2000	1.42	0.15	54.5	54.5	34.9	29.8	F

Segment 16: Basic

Time Period	PHF	fHV	Flow Rate (pc/h)	Capacity (pc/h)	d/c Ratio	Speed (mi/h)	Density (pc/mi/ln)	LOS
1	0.94	0.962	3504	4700	1.36	63.2	27.7	F

Segment 17: Merge

Time Period	PHF		fHV		Flow Rate (pc/h)		Capacity (pc/h)		d/c Ratio		Speed (mi/h)		Density (pc/mi/ln)		LOS
	F	R	F	R	Freeway	Ramp	Freeway	Ramp	F	R	F	R	Freeway	Ramp	
1	0.94	0.94	0.962	0.962	3769	265	4700	2000	1.42	0.13	55.0	55.0	34.3	29.8	F

Segment 18: Basic

Time Period	PHF	fHV	Flow Rate (pc/h)	Capacity (pc/h)	d/c Ratio	Speed (mi/h)	Density (pc/mi/ln)	LOS
1	0.94	0.962	3769	4700	1.42	61.7	30.5	F

Segment 19: Diverge

Time Period	PHF		fHV		Flow Rate (pc/h)		Capacity (pc/h)		d/c Ratio		Speed (mi/h)		Density (pc/mi/ln)		LOS
	F	R	F	R	Freeway	Ramp	Freeway	Ramp	F	R	F	R	Freeway	Ramp	
1	0.94	0.94	0.962	0.962	3769	1747	4700	2000	1.42	0.87	51.5	51.5	36.6	31.4	F

Segment 20: Basic

Time Period	PHF	fHV	Flow Rate (pc/h)	Capacity (pc/h)	d/c Ratio	Speed (mi/h)	Density (pc/mi/ln)	LOS
1	0.94	0.962	2022	4700	1.04	64.4	15.6	F

Segment 21: Merge

Time Period	PHF		fHV		Flow Rate (pc/h)		Capacity (pc/h)		d/c Ratio		Speed (mi/h)		Density (pc/mi/ln)		LOS
	F	R	F	R	Freeway	Ramp	Freeway	Ramp	F	R	F	R	Freeway	Ramp	
1	0.94	0.94	0.962	0.962	2527	774	4700	2000	1.21	0.39	57.8	57.8	21.9	19.9	F

Segment 22: Basic

Time Period	PHF	fHV	Flow Rate (pc/h)	Capacity (pc/h)	d/c Ratio	Speed (mi/h)	Density (pc/mi/ln)	LOS
1	0.94	0.962	2527	4700	1.21	64.9	19.4	F

Segment 23: Diverge

Time Period	PHF		fHV		Flow Rate (pc/h)		Capacity (pc/h)		d/c Ratio		Speed (mi/h)		Density (pc/mi/ln)		LOS
	F	R	F	R	Freeway	Ramp	Freeway	Ramp	F	R	F	R	Freeway	Ramp	
1	0.94	0.94	0.962	0.980	2527	1194	4700	2000	1.21	0.60	52.7	52.7	24.0	22.6	F

Segment 24: Basic

Time Period	PHF	fHV	Flow Rate (pc/h)	Capacity (pc/h)	d/c Ratio	Speed (mi/h)	Density (pc/mi/ln)	LOS
1	0.94	0.962	1333	4700	0.95	64.9	10.3	A

Segment 25: Merge

Time Period	PHF		fHV		Flow Rate (pc/h)		Capacity (pc/h)		d/c Ratio		Speed (mi/h)		Density (pc/mi/ln)		LOS
	F	R	F	R	Freeway	Ramp	Freeway	Ramp	F	R	F	R	Freeway	Ramp	
1	0.94	0.94	0.962	0.980	1952	619	4700	2000	1.08	0.31	57.9	57.9	16.9	17.0	F

Segment 26: Basic

Time Period	PHF	fHV	Flow Rate (pc/h)	Capacity (pc/h)	d/c Ratio	Speed (mi/h)	Density (pc/mi/ln)	LOS
1	0.94	0.962	1952	4700	1.08	65.0	15.0	F

Segment 27: Diverge

Time Period	PHF		fHV		Flow Rate (pc/h)		Capacity (pc/h)		d/c Ratio		Speed (mi/h)		Density (pc/mi/ln)		LOS
	F	R	F	R	Freeway	Ramp	Freeway	Ramp	F	R	F	R	Freeway	Ramp	
1	0.94	0.94	0.962	0.980	1952	271	4700	2000	1.08	0.14	54.6	54.6	17.9	15.6	F

Segment 28: Basic

Time Period	PHF	fHV	Flow Rate (pc/h)	Capacity (pc/h)	d/c Ratio	Speed (mi/h)	Density (pc/mi/ln)	LOS

1	0.94	0.962	1681	4700	1.03	64.4	12.9	F

Segment 29: Merge

Time Period	PHF		fHV		Flow Rate (pc/h)		Capacity (pc/h)		d/c Ratio		Speed (mi/h)		Density (pc/mi/ln)		LOS
	F	R	F	R	Freeway	Ramp	Freeway	Ramp	F	R	F	R	Freeway	Ramp	
1	0.94	0.94	0.962	0.980	1952	271	4700	2000	1.08	0.14	58.3	58.3	16.7	15.6	F

Segment 30: Basic

Time Period	PHF	fHV	Flow Rate (pc/h)	Capacity (pc/h)	d/c Ratio	Speed (mi/h)	Density (pc/mi/ln)	LOS
1	0.94	0.962	1952	4700	1.08	65.0	15.0	F

Facility Time Period Results

T	Speed, mi/h	Density, pc/mi/ln	Density, veh/mi/ln	Travel Time, min	LOS
1	58.6	24.6	23.7	11.80	F

Facility Overall Results

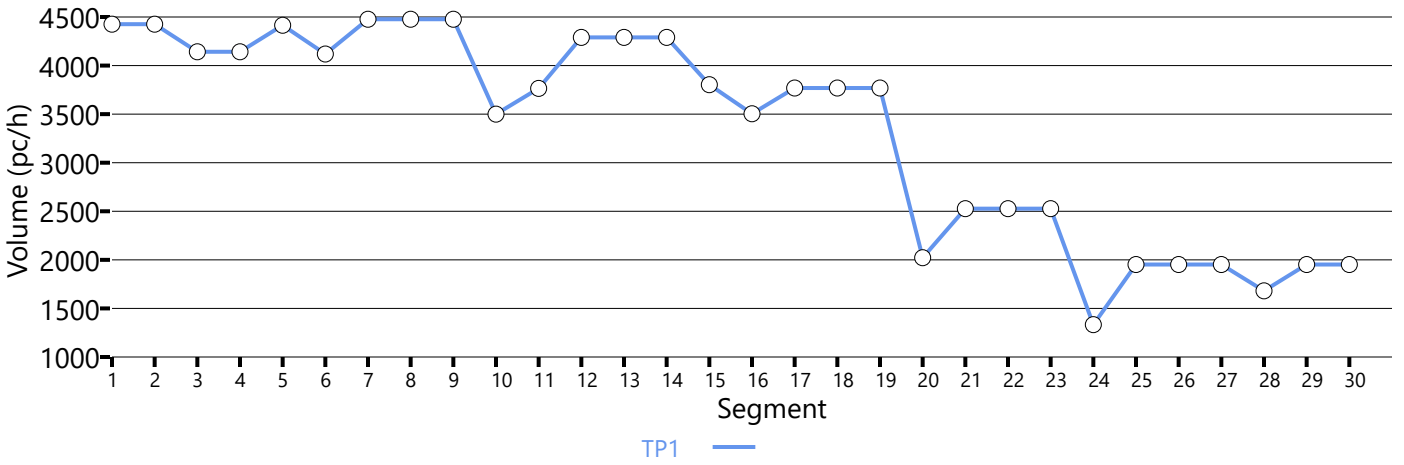
Space Mean Speed, mi/h	58.6	Density, veh/mi/ln	23.7
Average Travel Time, min	11.80	Density, pc/mi/ln	24.6

Messages

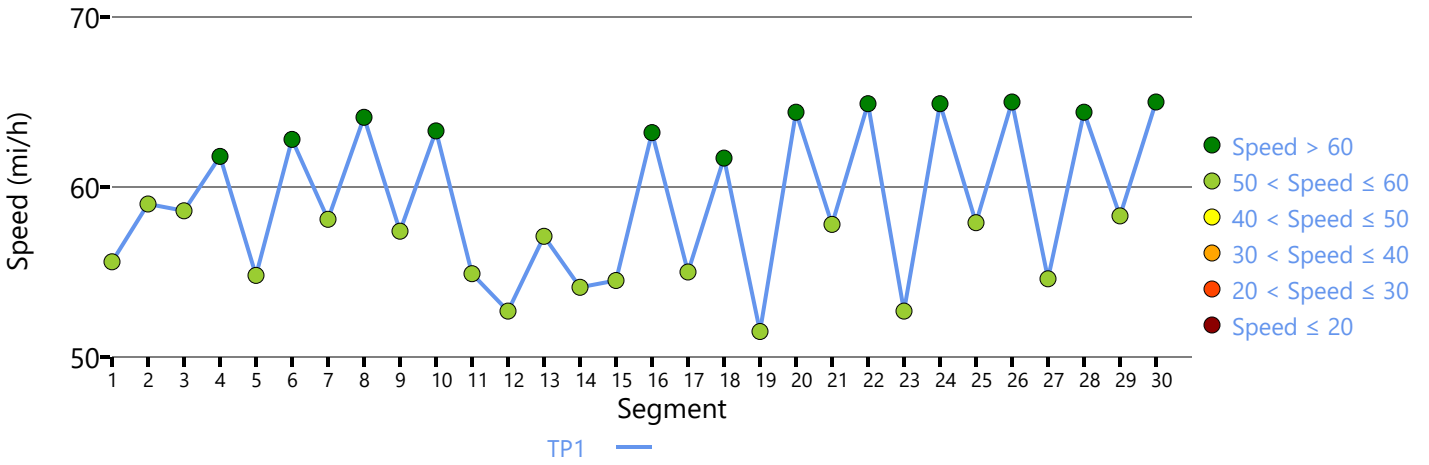
WARNING 1	Oversaturated conditions currently exist in boundary segment 30. Results may not be reliable. Consider expanding analysis in time and/or space to resolve this warning.
WARNING 2	Oversaturated conditions currently exist in boundary time period 1. Results may not be reliable. Consider expanding analysis in time and/or space to resolve this warning.
WARNING 3	Oversaturated conditions currently exist on segment 4, which is less than 300 feet. Due to time step size, these segments may produce unreliable results. Consider reviewing facility segmentation to resolve this warning.

Comments

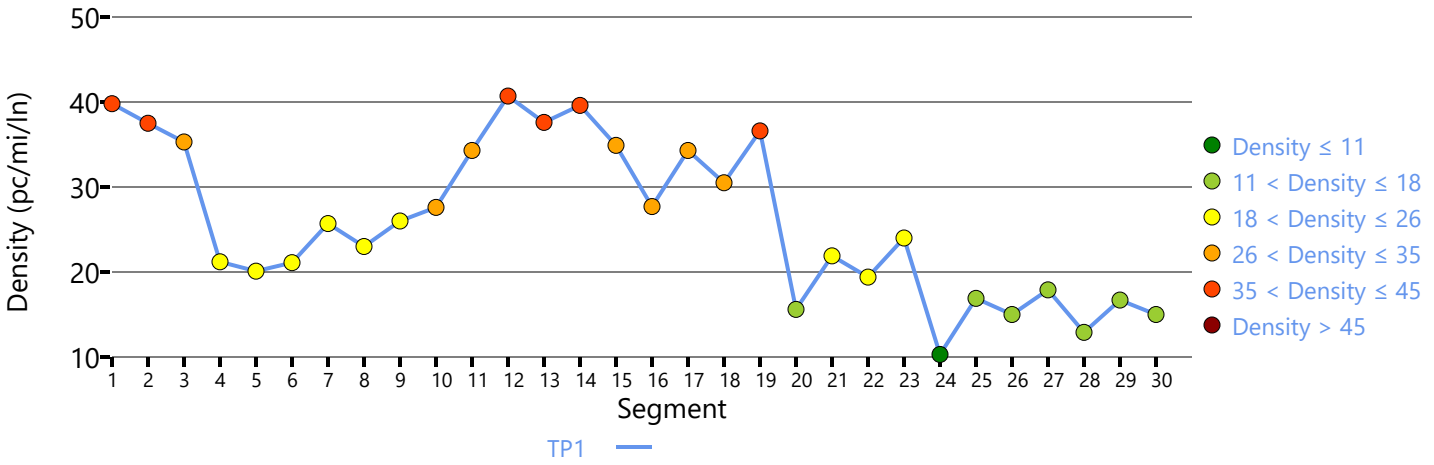
Volume Distribution



Speed Distribution



Density Distribution



HCS7 Freeway Facilities Report

Project Information

Analyst	LJB/JDO	Date	11/20/2020
Agency		Analysis Year	2045
Jurisdiction		Time Period Analyzed	PM 2045 NB
Project Description	WB US33	Unit	United States Customary

Facility Global Input

Jam Density, pc/mi/ln	190.0	Density at Capacity, pc/mi/ln	45.0
Queue Discharge Capacity Drop, %	7	Total Segments	27
Total Time Periods	1	Time Period Duration, min	15
Facility Length, mi	12.22		

Facility Segment Data

No.	Coded	Analyzed	Name	Length, ft	Lanes
1	Basic	Basic	WB US 33-East of Pickerington	5280	2
2	Diverge	Diverge	WB US 33- Pickerington Off ramp	1500	2
3	Basic	Basic	WB US33-Bet Pickerington Ramps	1000	2
4	Merge	Merge	WB US33- NB Pickerington On Ramp	1000	2
5	Merge	Merge	WB US33-SB Pickerington On Ramp	1500	2
6	Basic	Basic	WB US33- Bet Pickerington and Diley	7140	2
7	Diverge	Diverge	WB US33-Diley Off ramp	1500	2
8	Basic	Basic	WB US33-Bet Diley Ramps	2040	2
9	Merge	Merge	WB US33-Diley On-Ramp	1500	2
10	Basic	Basic	WB US33-Diley to Gender	7560	2
11	Diverge	Diverge	WB US33-Gender Off Ramp	1500	2
12	Basic	Basic	WB US33	1460	2
13	Merge	Merge	WB US33-NB Gender On Ramp	1200	2
14	Merge	Merge	WB US33-SB Gender On Ramp	1500	2
15	Basic	Basic	WB US33-Gender to Bixby	3960	2
16	Diverge	Diverge	WB US33-Bixby Off Ramp	1500	2
17	Basic	Basic	WB US33-Bet Bixby Ramps	1020	2
18	Merge	Merge	WB US33-Bixby On-Ramp	1500	2
19	Basic	Basic	Wb US33 -Bixby to Hamilton	6090	2
20	Diverge	Diverge	Wb US33 to Hamilton Off Ramp	1500	2
21	Basic	Basic	Wb US33	1800	2
22	Weaving	Weaving	Wb US33 (Weave)-Ham to I-270 NB	4660	3
23	Overlap	Basic	Wb US33 (Overlap)	50	2
24	Weaving	Weaving	Wb US33 (Weave) - Betw 270 ramps	1450	3
25	Basic	Basic	Wb US33	830	2
26	Merge	Merge	Sb I270 to Wb US33 On Ramp	1500	2
27	Basic	Basic	Wb US33	2960	2

Facility Segment Data

Segment 1: Basic

Time Period	PHF	fHV	Flow Rate (pc/h)	Capacity (pc/h)	d/c Ratio	Speed (mi/h)	Density (pc/mi/ln)	LOS
1	0.94	0.971	2542	4700	0.54	65.0	19.6	C

Segment 2: Diverge

Time Period	PHF		fHV		Flow Rate (pc/h)		Capacity (pc/h)		d/c Ratio		Speed (mi/h)		Density (pc/mi/ln)		LOS
	F	R	F	R	Freeway	Ramp	Freeway	Ramp	F	R	F	R	Freeway	Ramp	
1	0.94	0.94	0.971	0.980	2542	261	4700	2000	0.54	0.13	54.6	54.6	23.3	18.9	B

Segment 3: Basic

Time Period	PHF	fHV	Flow Rate (pc/h)	Capacity (pc/h)	d/c Ratio	Speed (mi/h)	Density (pc/mi/ln)	LOS
1	0.94	0.971	2279	4700	0.48	63.6	17.5	B

Segment 4: Merge

Time Period	PHF		fHV		Flow Rate (pc/h)		Capacity (pc/h)		d/c Ratio		Speed (mi/h)		Density (pc/mi/ln)		LOS
	F	R	F	R	Freeway	Ramp	Freeway	Ramp	F	R	F	R	Freeway	Ramp	
1	0.94	0.94	1.000	1.000	2287	74	4700	2000	0.49	0.04	58.0	58.0	19.7	18.3	B

Segment 5: Merge

Time Period	PHF		fHV		Flow Rate (pc/h)		Capacity (pc/h)		d/c Ratio		Speed (mi/h)		Density (pc/mi/ln)		LOS
	F	R	F	R	Freeway	Ramp	Freeway	Ramp	F	R	F	R	Freeway	Ramp	
1	0.94	0.94	0.971	0.980	2421	65	4700	2000	0.52	0.03	57.9	57.9	20.9	19.4	B

Segment 6: Basic

Time Period	PHF	fHV	Flow Rate (pc/h)	Capacity (pc/h)	d/c Ratio	Speed (mi/h)	Density (pc/mi/ln)	LOS
1	0.94	0.971	2421	4700	0.52	65.0	18.6	C

Segment 7: Diverge

Time Period	PHF		fHV		Flow Rate (pc/h)		Capacity (pc/h)		d/c Ratio		Speed (mi/h)		Density (pc/mi/ln)		LOS
	F	R	F	R	Freeway	Ramp	Freeway	Ramp	F	R	F	R	Freeway	Ramp	
1	0.94	0.94	0.971	0.980	2421	315	4700	2000	0.52	0.16	54.5	54.5	22.2	13.1	B

Segment 8: Basic

Time Period	PHF	fHV	Flow Rate (pc/h)	Capacity (pc/h)	d/c Ratio	Speed (mi/h)	Density (pc/mi/ln)	LOS
1	0.94	0.971	2104	4700	0.45	64.4	16.2	B

Segment 9: Merge

Time Period	PHF		fHV		Flow Rate (pc/h)		Capacity (pc/h)		d/c Ratio		Speed (mi/h)		Density (pc/mi/ln)		LOS
	F	R	F	R	Freeway	Ramp	Freeway	Ramp	F	R	F	R	Freeway	Ramp	
1	0.94	0.94	0.971	0.952	2842	738	4700	2000	0.60	0.37	56.9	56.9	25.0	24.1	C

Segment 10: Basic

Time Period	PHF		fHV		Flow Rate (pc/h)		Capacity (pc/h)		d/c Ratio		Speed (mi/h)		Density (pc/mi/ln)		LOS
1	0.94		0.962		2853		4700		0.61		65.0		21.9		C
Segment 11: Diverge															
Time Period	PHF		fHV		Flow Rate (pc/h)		Capacity (pc/h)		d/c Ratio		Speed (mi/h)		Density (pc/mi/ln)		LOS
	F	R	F	R	Freeway	Ramp	Freeway	Ramp	F	R	F	R	Freeway	Ramp	
1	0.94	0.94	0.962	0.962	2853	575	4700	2000	0.61	0.29	54.0	54.0	26.4	24.4	C
Segment 12: Basic															
Time Period	PHF		fHV		Flow Rate (pc/h)		Capacity (pc/h)		d/c Ratio		Speed (mi/h)		Density (pc/mi/ln)		LOS
1	0.94		0.962		2278		4700		0.48		64.0		17.5		B
Segment 13: Merge															
Time Period	PHF		fHV		Flow Rate (pc/h)		Capacity (pc/h)		d/c Ratio		Speed (mi/h)		Density (pc/mi/ln)		LOS
	F	R	F	R	Freeway	Ramp	Freeway	Ramp	F	R	F	R	Freeway	Ramp	
1	0.94	0.94	0.962	0.952	3049	771	4700	2000	0.65	0.39	56.3	56.3	27.1	26.8	C
Segment 14: Merge															
Time Period	PHF		fHV		Flow Rate (pc/h)		Capacity (pc/h)		d/c Ratio		Speed (mi/h)		Density (pc/mi/ln)		LOS
	F	R	F	R	Freeway	Ramp	Freeway	Ramp	F	R	F	R	Freeway	Ramp	
1	0.94	0.94	0.962	0.971	3315	274	4700	2000	0.71	0.14	55.8	55.8	29.7	28.6	D
Segment 15: Basic															
Time Period	PHF		fHV		Flow Rate (pc/h)		Capacity (pc/h)		d/c Ratio		Speed (mi/h)		Density (pc/mi/ln)		LOS
1	0.94		0.962		3318		4700		0.71		64.1		25.9		C
Segment 16: Diverge															
Time Period	PHF		fHV		Flow Rate (pc/h)		Capacity (pc/h)		d/c Ratio		Speed (mi/h)		Density (pc/mi/ln)		LOS
	F	R	F	R	Freeway	Ramp	Freeway	Ramp	F	R	F	R	Freeway	Ramp	
1	0.94	0.94	0.962	0.962	3318	431	4700	2000	0.71	0.22	54.3	54.3	30.6	27.4	C
Segment 17: Basic															
Time Period	PHF		fHV		Flow Rate (pc/h)		Capacity (pc/h)		d/c Ratio		Speed (mi/h)		Density (pc/mi/ln)		LOS
1	0.94		0.962		2886		4700		0.61		63.6		22.2		C
Segment 18: Merge															
Time Period	PHF		fHV		Flow Rate (pc/h)		Capacity (pc/h)		d/c Ratio		Speed (mi/h)		Density (pc/mi/ln)		LOS
	F	R	F	R	Freeway	Ramp	Freeway	Ramp	F	R	F	R	Freeway	Ramp	
1	0.94	0.94	0.962	0.962	3472	586	4700	2000	0.74	0.29	56.0	56.0	31.0	27.3	C
Segment 19: Basic															
Time Period	PHF		fHV		Flow Rate (pc/h)		Capacity (pc/h)		d/c Ratio		Speed (mi/h)		Density (pc/mi/ln)		LOS
1	0.94		0.962		3472		4700		0.74		63.4		27.4		D

Segment 20: Diverge

Time Period	PHF		fHV		Flow Rate (pc/h)		Capacity (pc/h)		d/c Ratio		Speed (mi/h)		Density (pc/mi/ln)		LOS
	F	R	F	R	Freeway	Ramp	Freeway	Ramp	F	R	F	R	Freeway	Ramp	
1	0.94	0.94	0.962	0.943	3472	542	4700	2100	0.74	0.26	57.0	57.0	30.5	28.3	D

Segment 21: Basic

Time Period	PHF	fHV	Flow Rate (pc/h)	Capacity (pc/h)	d/c Ratio	Speed (mi/h)	Density (pc/mi/ln)	LOS
1	0.94	0.962	2942	4700	0.63	64.4	22.7	C

Segment 22: Weaving

Time Period	PHF	fHV	Flow Rate (pc/h)	Capacity (pc/h)	d/c Ratio	Speed (mi/h)	Density (pc/mi/ln)	LOS
1	0.94	0.980	4220	6030	0.70	49.4	28.5	D

Segment 23: Overlap

Time Period	PHF	fHV	Flow Rate (pc/h)	Capacity (pc/h)	d/c Ratio	Speed (mi/h)	Density (pc/mi/ln)	LOS
1	0.94	0.980	2442	4700	0.52	64.7	18.8	C

Segment 24: Weaving

Time Period	PHF	fHV	Flow Rate (pc/h)	Capacity (pc/h)	d/c Ratio	Speed (mi/h)	Density (pc/mi/ln)	LOS
1	0.94	0.980	2885	5031	0.57	49.0	19.6	B

Segment 25: Basic

Time Period	PHF	fHV	Flow Rate (pc/h)	Capacity (pc/h)	d/c Ratio	Speed (mi/h)	Density (pc/mi/ln)	LOS
1	0.94	0.980	1900	4700	0.40	62.5	14.6	B

Segment 26: Merge

Time Period	PHF		fHV		Flow Rate (pc/h)		Capacity (pc/h)		d/c Ratio		Speed (mi/h)		Density (pc/mi/ln)		LOS
	F	R	F	R	Freeway	Ramp	Freeway	Ramp	F	R	F	R	Freeway	Ramp	
1	0.94	0.94	0.980	0.917	2109	209	4700	2100	0.45	0.10	58.2	58.2	18.1	17.8	B

Segment 27: Basic

Time Period	PHF	fHV	Flow Rate (pc/h)	Capacity (pc/h)	d/c Ratio	Speed (mi/h)	Density (pc/mi/ln)	LOS
1	0.94	0.980	2095	4700	0.45	64.8	16.1	B

Facility Time Period Results

T	Speed, mi/h	Density, pc/mi/ln	Density, veh/mi/ln	Travel Time, min	LOS
1	59.7	23.0	22.1	12.30	C

Facility Overall Results

Space Mean Speed, mi/h	59.7	Density, veh/mi/ln	22.1
Average Travel Time, min	12.30	Density, pc/mi/ln	23.0

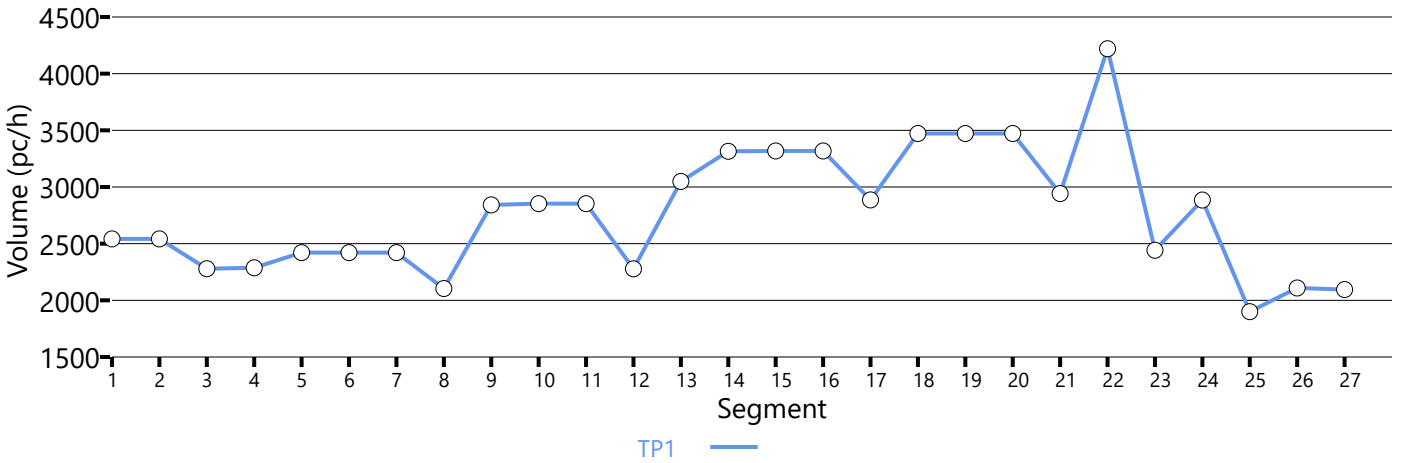
Messages

WARNING 1	Sum of lengths of ramp overlap segment (segment 23) and an adjacent ramp segment (segment 22)

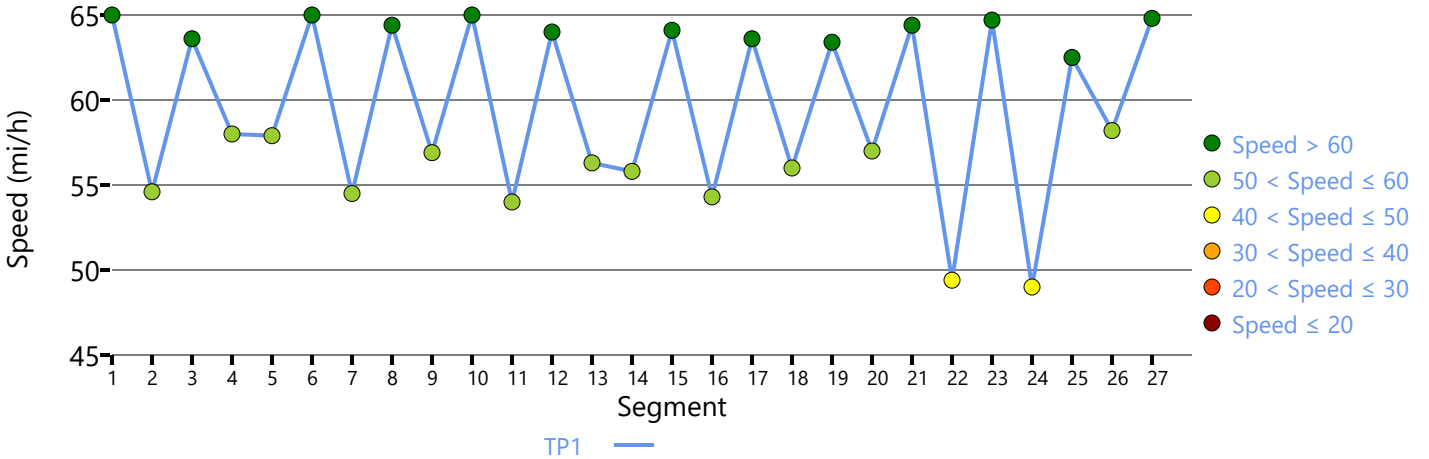
	should be 1500 feet.
WARNING 2	Weaving Segment (segment 24) is shorter than the segment short length allows. Weaving segments include 500 feet upstream and downstream of gore point. Short length is at a maximum the gore to gore length, and is reduced for any barrier markings (solid white lines) that prohibit or discourage lane changing. Review the values set for Segment length on the Segments page and Short Length on the details page.

Comments

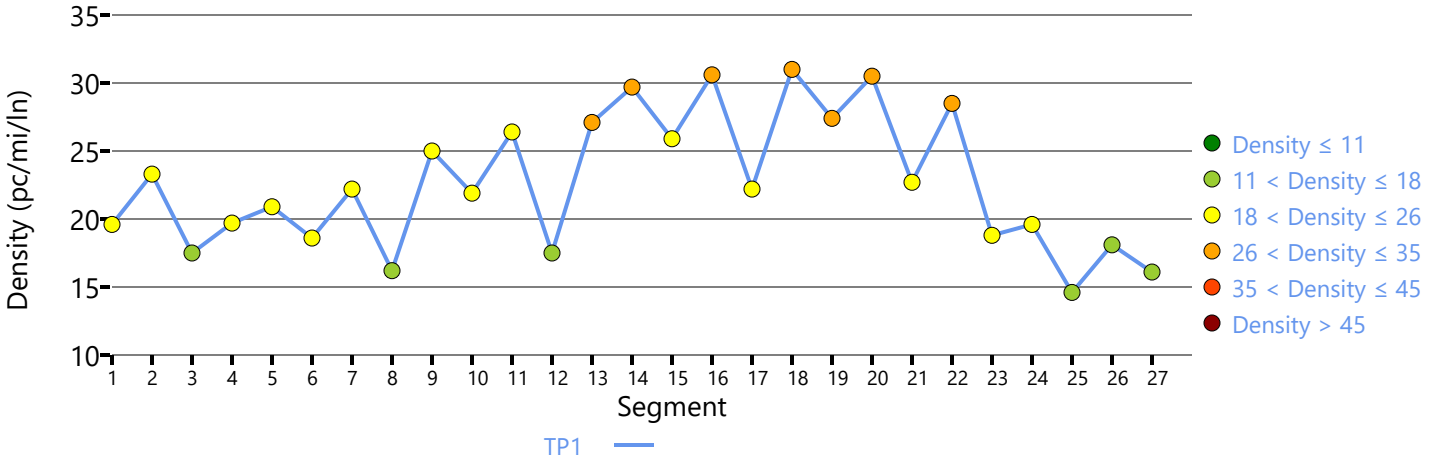
Volume Distribution



Speed Distribution

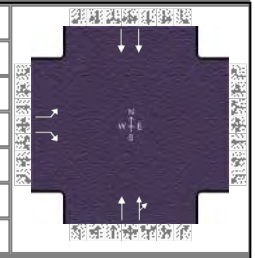


Density Distribution



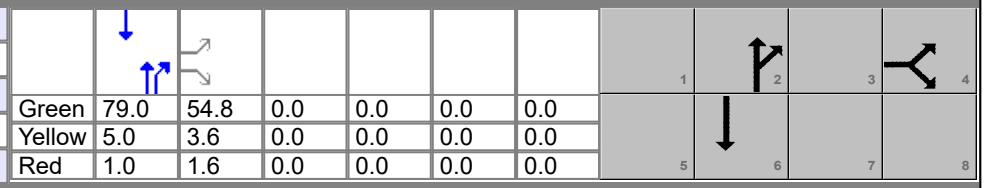
HCS7 Signalized Intersection Input Data

General Information				Intersection Information	
Agency	LJB			Duration, h	0.250
Analyst	TVF	Analysis Date	Dec 8, 2020	Area Type	Other
Jurisdiction	Columbus	Time Period	PM Peak	PHF	0.92
Urban Street	S Hamilton Rd	Analysis Year	2045	Analysis Period	1> 7:00
Intersection	US 33 EB Ramps	File Name	S Hamilton Rd Intersections PM NB.xus		
Project Description	S Hamiilton Rd & US 33 Safety Study				



Demand Information	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Demand (*v*), veh/h	370		480					1970	460		1150	

Signal Information			
Cycle, s	145.0	Reference Phase	2
Offset, s	70	Reference Point	End
Uncoordinated	No	Simult. Gap E/W	On
Force Mode	Fixed	Simult. Gap N/S	On



Green	79.0	54.8	0.0	0.0	0.0	0.0						
Yellow	5.0	3.6	0.0	0.0	0.0	0.0						
Red	1.0	1.6	0.0	0.0	0.0	0.0						

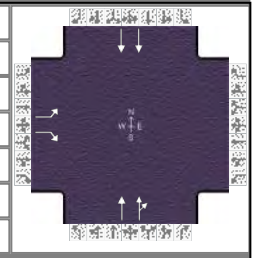
Traffic Information	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Demand (*v*), veh/h	370		480					1970	460		1150	
Initial Queue (Q_b), veh/h	0		0					0	0		0	
Base Saturation Flow Rate (s_o), veh/h	1900		1900					1900	1900		1900	
Parking (N_m), man/h		None						None			None	
Heavy Vehicles (P_{HV}), %	8		8					4			7	
Ped / Bike / RTOR, /h	0	0		0	0		0	0	0	0	0	
Buses (N_b), buses/h	0	0	0				0	0	0	0	0	0
Arrival Type (*AT*)	3		3					3	3		3	
Upstream Filtering (*I*)	1.00		1.00					0.14	0.14		0.09	
Lane Width (*W*), ft	12.0		12.0					12.0			12.0	
Turn Bay Length, ft	1800		40					275			725	
Grade (*Pg*), %		0			0			0			0	
Speed Limit, mi/h	50		50					50	50		50	

Phase Information	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Maximum Green (G_{max}) or Phase Split, s		60.0				85.0		85.0
Yellow Change Interval (*Y*), s		3.6				5.0		5.0
Red Clearance Interval (R_c), s		1.6				1.0		1.0
Minimum Green (G_{min}), s		7				20		20
Start-Up Lost Time (*l1*), s	2.0					2.0		2.0
Extension of Effective Green (*e*), s	2.0					2.0		2.0
Passage (*PT*), s		5.0				3.0		3.0
Recall Mode		Min				Min		Min
Dual Entry		Yes				Yes		Yes
Walk (*Walk*), s		0.0		0.0				0.0
Pedestrian Clearance Time (*PC*), s		0.0		0.0				0.0

Multimodal Information	EB			WB			NB			SB		
85th % Speed / Rest in Walk / Corner Radius	0	No	25	0	No	25				0	No	25
Walkway / Crosswalk Width / Length, ft	9.0	12	0	9.0	12	0				9.0	12	0
Street Width / Island / Curb	0	0	No		0		0		No	0	0	No
Width Outside / Bike Lane / Shoulder, ft	12	5.0	2.0				12	5.0	2.0	12	5.0	2.0
Pedestrian Signal / Occupied Parking	No	0.50		No				0.50		No	0.50	

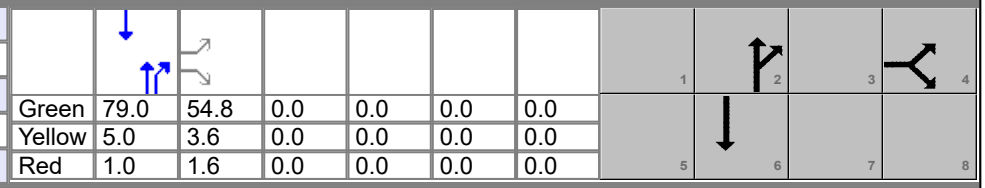
HCS7 Signalized Intersection Results Summary

General Information				Intersection Information	
Agency	LJB			Duration, h	0.250
Analyst	TVF	Analysis Date	Dec 8, 2020	Area Type	Other
Jurisdiction	Columbus	Time Period	PM Peak	PHF	0.92
Urban Street	S Hamilton Rd	Analysis Year	2045	Analysis Period	1> 7:00
Intersection	US 33 EB Ramps	File Name	S Hamilton Rd Intersections PM NB.xus		
Project Description	S Hamiilton Rd & US 33 Safety Study				



Demand Information	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Demand (*v*), veh/h	370		480					1970	460		1150	

Signal Information			
Cycle, s	145.0	Reference Phase	2
Offset, s	70	Reference Point	End
Uncoordinated	No	Simult. Gap E/W	On
Force Mode	Fixed	Simult. Gap N/S	On



Green	79.0	54.8	0.0	0.0	0.0	0.0		
Yellow	5.0	3.6	0.0	0.0	0.0	0.0		
Red	1.0	1.6	0.0	0.0	0.0	0.0		

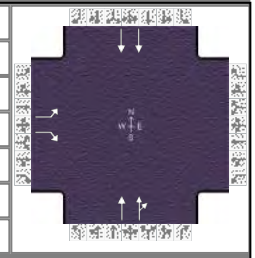
Timer Results	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Assigned Phase		4				2		6
Case Number		9.0				8.0		8.0
Phase Duration, s		60.0				85.0		85.0
Change Period, ($Y+R_c$), s		5.2				6.0		6.0
Max Allow Headway (*MAH*), s		6.1				0.0		0.0
Queue Clearance Time (g_s), s		49.6						
Green Extension Time (g_e), s		3.1				0.0		0.0
Phase Call Probability		1.00						
Max Out Probability		1.00						

Movement Group Results	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Assigned Movement	7		14					2	12		6	
Adjusted Flow Rate (*v*), veh/h	402		522					1245	1245		1424	
Adjusted Saturation Flow Rate (*s*), veh/h/ln	1697		1510					1841	1723		1710	
Queue Service Time (g_s), s	28.0		47.6					145.0	79.0		54.2	
Cycle Queue Clearance Time (g_c), s	28.0		47.6					145.0	79.0		54.2	
Green Ratio (*g/C*)	0.38		0.38					0.54	0.54		0.54	
Capacity (*c*), veh/h	641		571					1003	939		1863	
Volume-to-Capacity Ratio (*X*)	0.627		0.914					1.241	1.326		0.764	
Back of Queue (*Q*), ft/ln (95 th percentile)	461.2		732.1					2240.6	2533.3		688.7	
Back of Queue (*Q*), veh/ln (95 th percentile)	17.3		27.5					86.8	98.2		26.1	
Queue Storage Ratio (*RQ*) (95 th percentile)	0.26		18.30					8.15	9.21		0.95	
Uniform Delay (d_1), s/veh	36.8		42.9					47.9	50.1		40.6	
Incremental Delay (d_2), s/veh	2.8		20.1					109.9	147.8		0.3	
Initial Queue Delay (d_3), s/veh	0.0		0.0					0.0	0.0		0.0	
Control Delay (*d*), s/veh	39.6		63.0					157.8	197.9		40.9	
Level of Service (LOS)	D		E					F	F		D	
Approach Delay, s/veh / LOS	52.8	D		0.0			177.9	F		40.9	D	
Intersection Delay, s/veh / LOS	113.6						F					

Multimodal Results	EB		WB		NB		SB	
Pedestrian LOS Score / LOS	2.16	B	2.16	B	0.71	A	1.68	B
Bicycle LOS Score / LOS		F			2.67	C	1.52	B

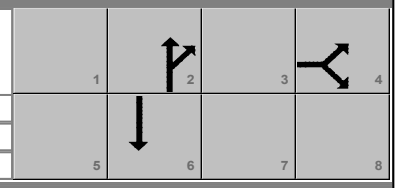
HCS7 Signalized Intersection Intermediate Values

General Information				Intersection Information	
Agency	LJB			Duration, h	0.250
Analyst	TVF	Analysis Date	Dec 8, 2020	Area Type	Other
Jurisdiction	Columbus	Time Period	PM Peak	PHF	0.92
Urban Street	S Hamilton Rd	Analysis Year	2045	Analysis Period	1> 7:00
Intersection	US 33 EB Ramps	File Name	S Hamilton Rd Intersections PM NB.xus		
Project Description	S Hamiilton Rd & US 33 Safety Study				



Demand Information	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Demand (*v*), veh/h	370		480					1970	460		1150	

Signal Information			
Cycle, s	145.0	Reference Phase	2
Offset, s	70	Reference Point	End
Uncoordinated	No	Simult. Gap E/W	On
Force Mode	Fixed	Simult. Gap N/S	On



Green	79.0	54.8	0.0	0.0	0.0	0.0						
Yellow	5.0	3.6	0.0	0.0	0.0	0.0						
Red	1.0	1.6	0.0	0.0	0.0	0.0						

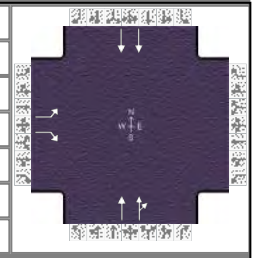
Saturation Flow / Delay	L	T	R	L	T	R	L	T	R	L	T	R
Lane Width Adjustment Factor (f_w)	1.000	1.000	1.000				1.000	1.000	1.000	1.000	1.000	1.000
Heavy Vehicles and Grade Factor (f_{HVg})	0.938	1.000	0.938				1.000	0.969	0.969	1.000	0.945	1.000
Parking Activity Adjustment Factor (f_p)	1.000	1.000	1.000	0.000	0.000	0.000	1.000	1.000	1.000	1.000	1.000	1.000
Bus Blockage Adjustment Factor (f_{bb})	1.000	1.000	1.000	0.000	0.000	0.000	1.000	1.000	1.000	1.000	1.000	1.000
Area Type Adjustment Factor (f_a)	1.000	1.000	1.000				1.000	1.000	1.000	1.000	1.000	1.000
Lane Utilization Adjustment Factor (f_{LU})	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	0.952	1.000
Left-Turn Adjustment Factor (f_{LT})	0.952	0.000					1.000	1.000		1.000	1.000	
Right-Turn Adjustment Factor (f_{RT})		0.000	0.847					0.936	0.936		1.000	1.000
Left-Turn Pedestrian Adjustment Factor (f_{Lpb})	1.000						1.000			1.000		
Right-Turn Ped-Bike Adjustment Factor (f_{Rpb})			1.000						1.000			1.000
Work Zone Adjustment Factor (f_{wz})	1.000	1.000	1.000				1.000	1.000	1.000	1.000	1.000	1.000
DDI Factor (f_{DDI})	1.000	1.000	1.000				1.000	1.000	1.000	1.000	1.000	1.000
Movement Saturation Flow Rate (s), veh/h	1697	0	1510				0	2912	652	0	3593	0
Proportion of Vehicles Arriving on Green (P)	0.38	0.00	0.38	0.00	0.00	0.00	0.00	0.34	0.26	0.00	0.33	0.00
Incremental Delay Factor (k)	0.30		0.45					0.50	0.50		0.50	

Signal Timing / Movement Groups	EBL	EBT/R	WBL	WBT/R	NBL	NBT/R	SBL	SBT/R
Lost Time (t_L)		4.0				6.0		6.0
Green Ratio (g/C)		0.38				0.54		0.54
Permitted Saturation Flow Rate (s_p), veh/h/ln		1697				382		135
Shared Saturation Flow Rate (s_{sh}), veh/h/ln						0		0
Permitted Effective Green Time (g_p), s		0.0				0.0		0.0
Permitted Service Time (g_u), s		0.0				0.0		0.0
Permitted Queue Service Time (g_{ps}), s								
Time to First Blockage (g_f), s		0.0				79.0		79.0
Queue Service Time Before Blockage (g_{fs}), s								
Protected Right Saturation Flow (s_R), veh/h/ln		0						
Protected Right Effective Green Time (g_R), s		0.0						

Multimodal	EB		WB		NB		SB	
Pedestrian F_w / F_v	1.389	0.000	1.389	0.000	0.000	0.000	0.972	0.000
Pedestrian F_s / F_{delay}	0.000	0.175	0.000	0.174	0.000	0.109	0.000	0.109
Pedestrian M_{corner} / M_{cw}								
Bicycle c_b / d_b	-85.52	78.83	-68.97	77.59	1089.66	15.02	1089.66	15.02
Bicycle F_w / F_v	-3.64		-3.64		-3.64	2.18	-3.64	1.03

HCS7 Signalized Intersection Results Graphical Summary

General Information				Intersection Information	
Agency	LJB			Duration, h	0.250
Analyst	TVF	Analysis Date	Dec 8, 2020	Area Type	Other
Jurisdiction	Columbus	Time Period	PM Peak	PHF	0.92
Urban Street	S Hamilton Rd	Analysis Year	2045	Analysis Period	1> 7:00
Intersection	US 33 EB Ramps	File Name	S Hamilton Rd Intersections PM NB.xus		
Project Description	S Hamiilton Rd & US 33 Safety Study				

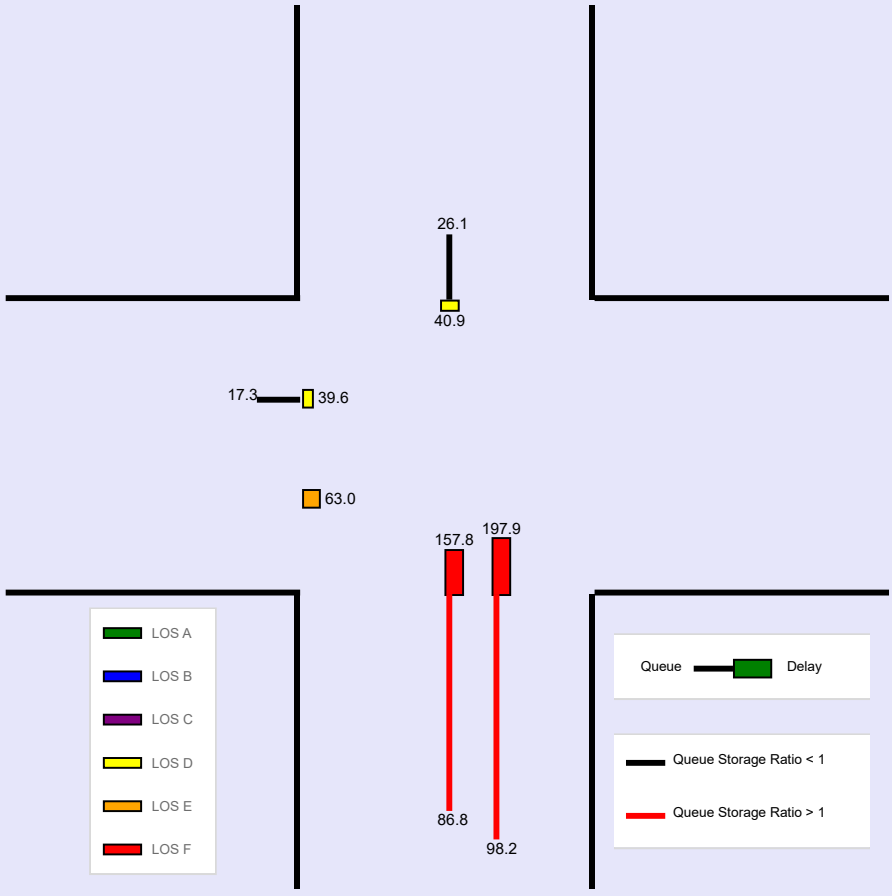


Demand Information	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Demand (*v*), veh/h	370		480					1970	460		1150	

Signal Information			
Cycle, s	145.0	Reference Phase	2
Offset, s	70	Reference Point	End
Uncoordinated	No	Simult. Gap E/W	On
Force Mode	Fixed	Simult. Gap N/S	On

Green	79.0	54.8	0.0	0.0	0.0	0.0						
Yellow	5.0	3.6	0.0	0.0	0.0	0.0						
Red	1.0	1.6	0.0	0.0	0.0	0.0						

Movement Group Results	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Back of Queue (*Q*), ft/ln (95 th percentile)	461.2		732.1					2240.6	2533.3		688.7	
Back of Queue (*Q*), veh/ln (95 th percentile)	17.3		27.5					86.8	98.2		26.1	
Queue Storage Ratio (*RQ*) (95 th percentile)	0.26		18.30					8.15	9.21		0.95	
Control Delay (*d*), s/veh	39.6		63.0					157.8	197.9		40.9	
Level of Service (LOS)	D		E					F	F		D	
Approach Delay, s/veh / LOS	52.8	D		0.0			177.9	F		40.9	D	
Intersection Delay, s/veh / LOS	113.6	F										



--- Messages ---

WARNING: Since queue spillover from turn lanes and spillback into upstream intersections is not accounted for in the HCM procedures, use of a simulation tool may be advised in situations where the Queue Storage Ratio exceeds 1.0.

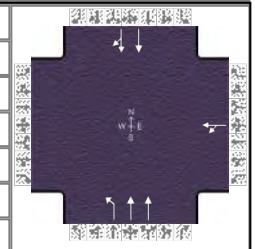
WARNING: If demand exceeds capacity, a multiple-period analysis should be conducted.

WARNING: According to input data, upstream feeding volume is equal to 121% of downstream exit volume during time period #1, for thru movement #6.

--- Comments ---

HCS7 Signalized Intersection Input Data

General Information				Intersection Information	
Agency	LJB			Duration, h	0.250
Analyst	TVF	Analysis Date	Dec 8, 2020	Area Type	Other
Jurisdiction	Columbus	Time Period	PM Peak	PHF	0.92
Urban Street	S Hamilton Rd	Analysis Year	2045	Analysis Period	1> 7:00
Intersection	US 33 WB Ramps	File Name	S Hamilton Rd Intersections PM NB.xus		
Project Description	S Hamiilton Rd & US 33 Safety Study				



Demand Information	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Demand (*v*), veh/h				240	5		820	1520			1150	340

Signal Information					EB			WB			NB			SB		
Cycle, s	145.0	Reference Phase	2													
Offset, s	111	Reference Point	End	Green	34.8	60.0		34.1	0.0	0.0	0.0					
Uncoordinated	No	Simult. Gap E/W	On	Yellow	3.6	5.0		3.6	0.0	0.0	0.0					
Force Mode	Fixed	Simult. Gap N/S	On	Red	1.6	1.0		1.3	0.0	0.0	0.0					

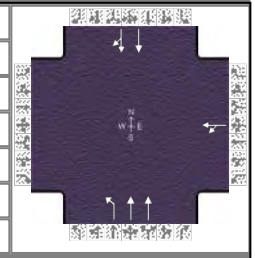
Traffic Information	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Demand (*v*), veh/h				240	5		820	1520			1150	340
Initial Queue (Q_b), veh/h				0	0		0	0			0	0
Base Saturation Flow Rate (s_o), veh/h				1900	1900		1900	1900			1900	1900
Parking (N_m), man/h					None			None			None	
Heavy Vehicles (P_{HV}), %					6		1	1			1	
Ped / Bike / RTOR, /h	0	0		0	0		0	0		0	0	0
Buses (N_b), buses/h				0	0	0	0	0	0	0	0	0
Arrival Type (*AT*)				3	3		3	3			3	3
Upstream Filtering (*I*)				1.00	1.00		0.09	0.09			1.00	1.00
Lane Width (*W*), ft					12.0		12.0	12.0			12.0	
Turn Bay Length, ft					165		525	750			875	
Grade (*Pg*), %		0			0			0			0	
Speed Limit, mi/h				50	50		50	50			50	50

Phase Information	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Maximum Green (G_{max}) or Phase Split, s				39.0	40.0	106.0		66.0
Yellow Change Interval (*Y*), s				3.6	3.6	5.0		5.0
Red Clearance Interval (R_c), s				1.3	1.6	1.0		1.0
Minimum Green (G_{min}), s				7	10	20		20
Start-Up Lost Time (*lt*), s			2.0	2.0	2.0	2.0		2.0
Extension of Effective Green (*e*), s			2.0	2.0	2.0	2.0		2.0
Passage (*PT*), s				3.7	5.0	3.0		3.0
Recall Mode				Off	Off	Min		Min
Dual Entry				Yes	No	Yes		Yes
Walk (*Walk*), s		0.0		0.0		0.0		
Pedestrian Clearance Time (*PC*), s		0.0		0.0		0.0		

Multimodal Information	EB			WB			NB			SB		
85th % Speed / Rest in Walk / Corner Radius	0	No	25	0	No	25	0	No	25			
Walkway / Crosswalk Width / Length, ft	9.0	12	0	9.0	12	0	9.0	12	0			
Street Width / Island / Curb		0		0	0	No	0	0	No	0		No
Width Outside / Bike Lane / Shoulder, ft				12	5.0	2.0	12	5.0	2.0	12	5.0	2.0
Pedestrian Signal / Occupied Parking	No			No	0.50		No	0.50			0.50	

HCS7 Signalized Intersection Results Summary

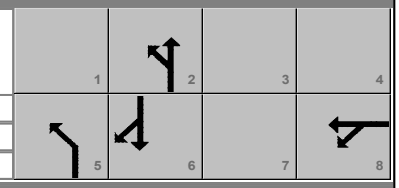
General Information				Intersection Information	
Agency	LJB			Duration, h	0.250
Analyst	TVF	Analysis Date	Dec 8, 2020	Area Type	Other
Jurisdiction	Columbus	Time Period	PM Peak	PHF	0.92
Urban Street	S Hamilton Rd	Analysis Year	2045	Analysis Period	1> 7:00
Intersection	US 33 WB Ramps	File Name	S Hamilton Rd Intersections PM NB.xus		
Project Description	S Hamiilton Rd & US 33 Safety Study				



Demand Information	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Demand (*v*), veh/h				240	5		820	1520			1150	340

Signal Information			
Cycle, s	145.0	Reference Phase	2
Offset, s	111	Reference Point	End
Uncoordinated	No	Simult. Gap E/W	On
Force Mode	Fixed	Simult. Gap N/S	On

Green	34.8	60.0	34.1	0.0	0.0	0.0	
Yellow	3.6	5.0	3.6	0.0	0.0	0.0	
Red	1.6	1.0	1.3	0.0	0.0	0.0	



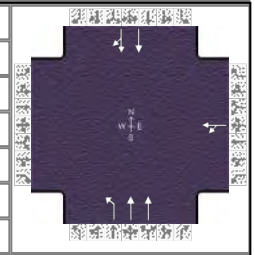
Timer Results	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Assigned Phase				8	5	2		6
Case Number				12.0	1.0	4.0		8.3
Phase Duration, s				39.0	40.0	106.0		66.0
Change Period, ($Y+R_c$), s				4.9	5.2	6.0		6.0
Max Allow Headway (*MAH*), s				4.7	6.0	0.0		0.0
Queue Clearance Time (g_s), s				22.2	36.8			
Green Extension Time (g_e), s				0.9	0.0	0.0		0.0
Phase Call Probability				1.00	1.00			
Max Out Probability				0.03	1.00			

Movement Group Results	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Assigned Movement				3	8		5	2			6	16
Adjusted Flow Rate (*v*), veh/h					266		697	1292			828	791
Adjusted Saturation Flow Rate (*s*), veh/h/ln					1727		1795	1795			1885	1739
Queue Service Time (g_s), s					20.2		34.8	21.1			67.2	60.0
Cycle Queue Clearance Time (g_c), s					20.2		34.8	21.1			67.2	60.0
Green Ratio (*g/C*)					0.24		0.67	0.69			0.41	0.41
Capacity (*c*), veh/h					406		481	2475			780	720
Volume-to-Capacity Ratio (*X*)					0.656		1.450	0.522			1.062	1.100
Back of Queue (*Q*), ft/ln (95 th percentile)					363.8		1350.6	187.9			1244.3	1273.1
Back of Queue (*Q*), veh/ln (95 th percentile)					13.9		53.6	7.5			49.4	50.5
Queue Storage Ratio (*RQ*) (95 th percentile)					2.21		2.57	0.25			1.42	1.45
Uniform Delay (d_1), s/veh					50.1		38.9	8.1			42.5	42.5
Incremental Delay (d_2), s/veh					4.1		203.6	0.1			49.9	64.1
Initial Queue Delay (d_3), s/veh					0.0		0.0	0.0			0.0	0.0
Control Delay (*d*), s/veh					54.3		242.5	8.2			92.4	106.6
Level of Service (LOS)					D		F	A			F	F
Approach Delay, s/veh / LOS	0.0			54.3		D	90.3		F	99.4		F
Intersection Delay, s/veh / LOS	91.6						F					

Multimodal Results	EB		WB		NB		SB	
Pedestrian LOS Score / LOS	2.33	B	2.16	B	1.36	A	1.41	A
Bicycle LOS Score / LOS			0.93	A	2.59	C	1.82	B

HCS7 Signalized Intersection Intermediate Values

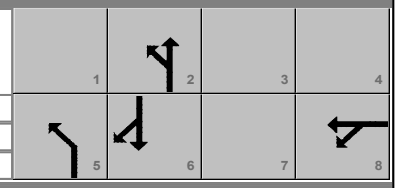
General Information				Intersection Information	
Agency	LJB			Duration, h	0.250
Analyst	TVF	Analysis Date	Dec 8, 2020	Area Type	Other
Jurisdiction	Columbus	Time Period	PM Peak	PHF	0.92
Urban Street	S Hamilton Rd	Analysis Year	2045	Analysis Period	1> 7:00
Intersection	US 33 WB Ramps	File Name	S Hamilton Rd Intersections PM NB.xus		
Project Description	S Hamiilton Rd & US 33 Safety Study				



Demand Information	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Demand (*v*), veh/h				240	5		820	1520			1150	340

Signal Information			
Cycle, s	145.0	Reference Phase	2
Offset, s	111	Reference Point	End
Uncoordinated	No	Simult. Gap E/W	On
Force Mode	Fixed	Simult. Gap N/S	On

Green	34.8	60.0	34.1	0.0	0.0	0.0						
Yellow	3.6	5.0	3.6	0.0	0.0	0.0						
Red	1.6	1.0	1.3	0.0	0.0	0.0						



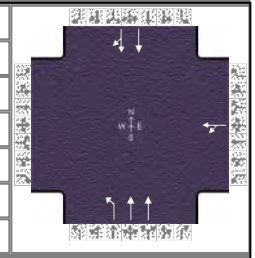
Saturation Flow / Delay	L	T	R	L	T	R	L	T	R	L	T	R
Lane Width Adjustment Factor (f_w)				1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
Heavy Vehicles and Grade Factor (f_{HVg})				1.000	0.953	1.000	0.992	0.992	1.000	1.000	0.992	0.992
Parking Activity Adjustment Factor (f_p)	0.000	0.000	0.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
Bus Blockage Adjustment Factor (f_{bb})	0.000	0.000	0.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
Area Type Adjustment Factor (f_a)				1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
Lane Utilization Adjustment Factor (f_{LU})	1.000	1.000	1.000	1.000	1.000	1.000	1.000	0.952	1.000	1.000	1.000	1.000
Left-Turn Adjustment Factor (f_{LT})				0.953	0.953		0.952	0.000		1.000	1.000	
Right-Turn Adjustment Factor (f_{RT})					0.000	0.000		1.000	1.000		0.922	0.922
Left-Turn Pedestrian Adjustment Factor (f_{Lpb})				1.000			1.000			1.000		
Right-Turn Ped-Bike Adjustment Factor (f_{Rpb})						1.000			1.000			1.000
Work Zone Adjustment Factor (f_{wz})				1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
DDI Factor (f_{DDI})				1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
Movement Saturation Flow Rate (s), veh/h				1691	35	0	1795	3680	0	0	2812	812
Proportion of Vehicles Arriving on Green (P)	0.00	0.00	0.00	0.24	0.24	0.00	0.37	0.75	0.00	0.00	0.41	0.41
Incremental Delay Factor (k)					0.25		0.50	0.50			0.50	0.50

Signal Timing / Movement Groups	EBL	EBT/R	WBL	WBT/R	NBL	NBT/R	SBL	SBT/R
Lost Time (t_L)				4.0	5.2	6.0		6.0
Green Ratio (g/C)				0.24	0.67	0.69		0.41
Permitted Saturation Flow Rate (s_p), veh/h/ln				0	314	0		434
Shared Saturation Flow Rate (s_{sh}), veh/h/ln								0
Permitted Effective Green Time (g_p), s				0.0	62.0	0.0		0.0
Permitted Service Time (g_u), s				0.0	0.0	0.0		0.0
Permitted Queue Service Time (g_{ps}), s					0.0			
Time to First Blockage (g_f), s				0.0	0.0	0.0		60.0
Queue Service Time Before Blockage (g_{fs}), s								
Protected Right Saturation Flow (s_R), veh/h/ln								
Protected Right Effective Green Time (g_R), s								

Multimodal	EB		WB		NB		SB	
Pedestrian F_w / F_v	1.557	0.000	1.389	0.000	0.681	0.000	0.681	0.000
Pedestrian F_s / F_{delay}	0.000	0.174	0.000	0.175	0.000	0.078	0.000	0.129
Pedestrian M_{corner} / M_{cw}								
Bicycle c_b / d_b	-68.97	77.59	-81.38	78.52	1379.31	6.98	827.59	24.91
Bicycle F_w / F_v	-3.64		-3.64	0.44	-3.64	2.10	-3.64	1.34

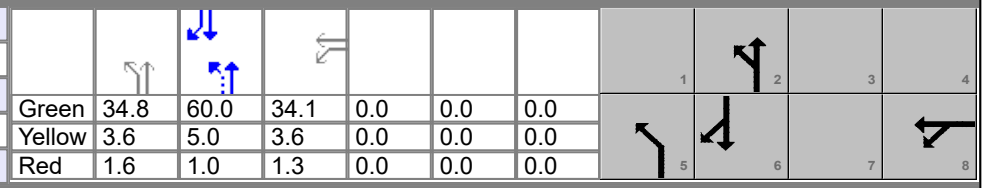
HCS7 Signalized Intersection Results Graphical Summary

General Information				Intersection Information	
Agency	LJB			Duration, h	0.250
Analyst	TVF	Analysis Date	Dec 8, 2020	Area Type	Other
Jurisdiction	Columbus	Time Period	PM Peak	PHF	0.92
Urban Street	S Hamilton Rd	Analysis Year	2045	Analysis Period	1> 7:00
Intersection	US 33 WB Ramps	File Name	S Hamilton Rd Intersections PM NB.xus		
Project Description	S Hamiilton Rd & US 33 Safety Study				



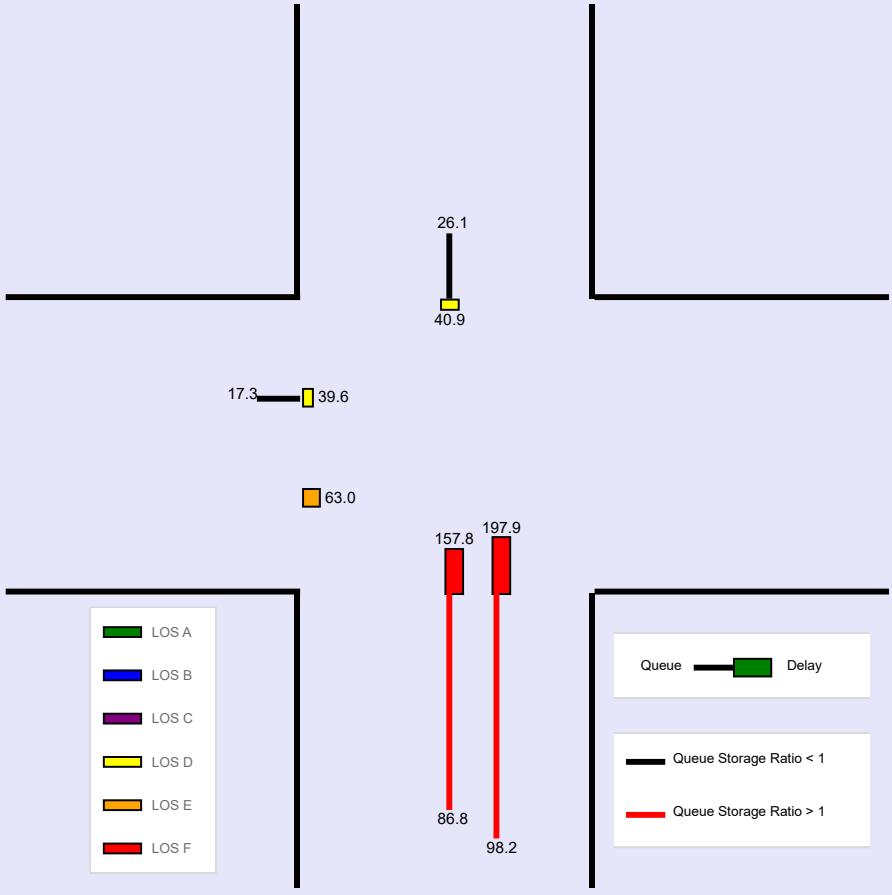
Demand Information	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Demand (*v*), veh/h				240	5		820	1520			1150	340

Signal Information			
Cycle, s	145.0	Reference Phase	2
Offset, s	111	Reference Point	End
Uncoordinated	No	Simult. Gap E/W	On
Force Mode	Fixed	Simult. Gap N/S	On



	EB			WB			NB			SB		
Green	34.8	60.0		34.1	0.0	0.0	0.0					
Yellow	3.6	5.0		3.6	0.0	0.0	0.0					
Red	1.6	1.0		1.3	0.0	0.0	0.0					

Movement Group Results	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Back of Queue (*Q*), ft/ln (95 th percentile)					363.8		1350.6	187.9			1244.3	1273.1
Back of Queue (*Q*), veh/ln (95 th percentile)					13.9		53.6	7.5			49.4	50.5
Queue Storage Ratio (*RQ*) (95 th percentile)					2.21		2.57	0.25			1.42	1.45
Control Delay (*d*), s/veh					54.3		242.5	8.2			92.4	106.6
Level of Service (LOS)					D		F	A			F	F
Approach Delay, s/veh / LOS	0.0			54.3		D	90.3		F	99.4		F
Intersection Delay, s/veh / LOS	91.6						F					



--- Messages ---

WARNING: Since queue spillover from turn lanes and spillback into upstream intersections is not accounted for in the HCM procedures, use of a simulation tool may be advised in situations where the Queue Storage Ratio exceeds 1.0.

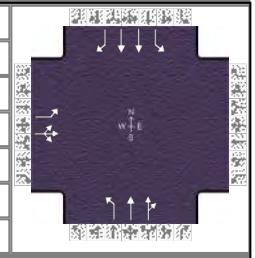
WARNING: If demand exceeds capacity, a multiple-period analysis should be conducted.

--- Comments ---

2045 BUILD CAPACITY ANALYSIS

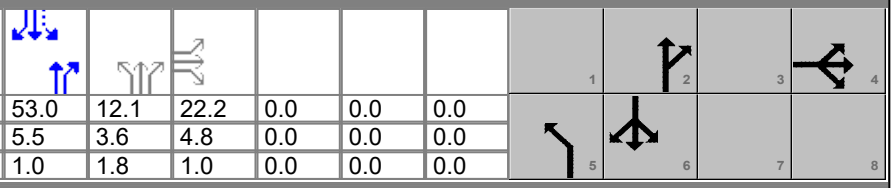
HCS7 Signalized Intersection Input Data

General Information				Intersection Information	
Agency	LJB			Duration, h	0.250
Analyst	TVF	Analysis Date	Dec 8, 2020	Area Type	Other
Jurisdiction	Columbus	Time Period	AM Peak	PHF	0.92
Urban Street	S Hamilton Rd	Analysis Year	2045 Build	Analysis Period	1> 7:00
Intersection	Williams Rd	File Name	S Hamilton Rd Intersections AM Build.xus		
Project Description	S Hamiilton Rd & US 33 Safety Study				



Demand Information	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Demand (*v*), veh/h	450	5	110				140	1330	5	5	1530	390

Signal Information			
Cycle, s	105.0	Reference Phase	2
Offset, s	51	Reference Point	End
Uncoordinated	No	Simult. Gap E/W	On
Force Mode	Float	Simult. Gap N/S	On



Green	53.0	12.1	22.2	0.0	0.0	0.0
Yellow	5.5	3.6	4.8	0.0	0.0	0.0
Red	1.0	1.8	1.0	0.0	0.0	0.0

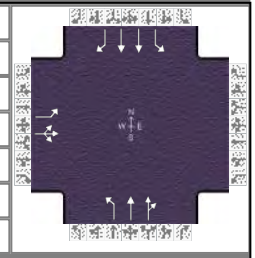
Traffic Information	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Demand (*v*), veh/h	450	5	110				140	1330	5	5	1530	390
Initial Queue (Q_b), veh/h	0	0	0				0	0	0	0	0	0
Base Saturation Flow Rate (s_o), veh/h	1900	1900	1900				1900	1900	1900	1900	1900	1900
Parking (N_m), man/h		None						None			None	
Heavy Vehicles (P_{HV}), %	10	10					7	7		5	5	5
Ped / Bike / RTOR, /h	0	0	0	0	0		0	0	0	0	0	0
Buses (N_b), buses/h	0	0	0				0	0	0	0	0	0
Arrival Type (*AT*)	3	3	3				3	3	3	3	3	3
Upstream Filtering (*I*)	1.00	1.00	1.00				1.00	1.00	1.00	1.00	1.00	1.00
Lane Width (*W*), ft	12.0	12.0					12.0	12.0		12.0	12.0	12.0
Turn Bay Length, ft	500	700					225	1200		140	300	275
Grade (*Pg*), %		0			0			0			0	
Speed Limit, mi/h	50	50	50				50	50	50	50	50	50

Phase Information	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Maximum Green (G_{max}) or Phase Split, s		28.0			17.5	77.0		59.5
Yellow Change Interval (*Y*), s		4.8			3.6	5.5		5.5
Red Clearance Interval (R_c), s		1.0			1.8	1.0		1.0
Minimum Green (G_{min}), s		7			7	20		20
Start-Up Lost Time (*l1*), s	2.0	2.0			2.0	2.0	2.0	2.0
Extension of Effective Green (*e*), s	2.0	2.0			2.0	2.0	2.0	2.0
Passage (*PT*), s		4.0			3.7	3.0		3.0
Recall Mode		Min			Off	Min		Min
Dual Entry		Yes			No	Yes		Yes
Walk (*Walk*), s		0.0		0.0				0.0
Pedestrian Clearance Time (*PC*), s		0.0		0.0				0.0

Multimodal Information	EB			WB			NB			SB		
85th % Speed / Rest in Walk / Corner Radius	0	No	25	0	No	25				0	No	25
Walkway / Crosswalk Width / Length, ft	9.0	12	0	9.0	12	0				9.0	12	0
Street Width / Island / Curb	0	0	No		0		0		No	0	0	No
Width Outside / Bike Lane / Shoulder, ft	12	5.0	2.0				12	5.0	2.0	12	5.0	2.0
Pedestrian Signal / Occupied Parking	No	0.50		No				0.50		No	0.50	

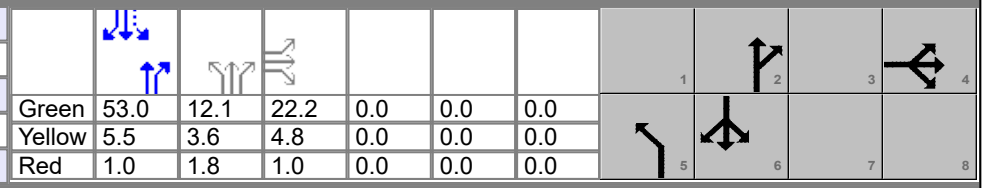
HCS7 Signalized Intersection Results Summary

General Information				Intersection Information	
Agency	LJB			Duration, h	0.250
Analyst	TVF	Analysis Date	Dec 8, 2020	Area Type	Other
Jurisdiction	Columbus	Time Period	AM Peak	PHF	0.92
Urban Street	S Hamilton Rd	Analysis Year	2045 Build	Analysis Period	1> 7:00
Intersection	Williams Rd	File Name	S Hamilton Rd Intersections AM Build.xus		
Project Description	S Hamiilton Rd & US 33 Safety Study				



Demand Information	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Demand (*v*), veh/h	450	5	110				140	1330	5	5	1530	390

Signal Information			
Cycle, s	105.0	Reference Phase	2
Offset, s	51	Reference Point	End
Uncoordinated	No	Simult. Gap E/W	On
Force Mode	Float	Simult. Gap N/S	On



Green	53.0	12.1	22.2	0.0	0.0	0.0
Yellow	5.5	3.6	4.8	0.0	0.0	0.0
Red	1.0	1.8	1.0	0.0	0.0	0.0

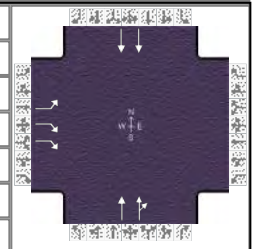
Timer Results	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Assigned Phase		4			5	2		6
Case Number		10.0			2.0	4.0		5.4
Phase Duration, s		28.0			17.5	77.0		59.5
Change Period, ($Y+R_c$), s		5.8			6.5	6.5		6.5
Max Allow Headway (*MAH*), s		5.1			4.7	0.0		0.0
Queue Clearance Time (g_s), s		22.7			11.2			
Green Extension Time (g_e), s		0.0			0.0	0.0		0.0
Phase Call Probability		1.00			1.00			
Max Out Probability		1.00			1.00			

Movement Group Results	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Assigned Movement	7	4	14				5	2	12	1	6	16
Adjusted Flow Rate (*v*), veh/h	293	321					152	726	725	6	1719	438
Adjusted Saturation Flow Rate (*s*), veh/h/ln	1668	1601					1711	1796	1794	358	1738	1547
Queue Service Time (g_s), s	17.7	20.7					9.2	23.4	23.4	1.0	51.2	13.9
Cycle Queue Clearance Time (g_c), s	17.7	20.7					9.2	23.4	23.4	24.5	51.2	13.9
Green Ratio (*g/C*)	0.21	0.21					0.10	0.67	0.67	0.50	0.50	0.50
Capacity (*c*), veh/h	353	338					179	1206	1204	169	1755	781
Volume-to-Capacity Ratio (*X*)	0.832	0.947					0.849	0.602	0.602	0.033	0.980	0.561
Back of Queue (*Q*), ft/ln (95 th percentile)	355.4	445.1					237.5	327	308.8	4.5	750.2	144.9
Back of Queue (*Q*), veh/ln (95 th percentile)	13.2	16.5					9.0	12.4	12.4	0.2	28.9	5.6
Queue Storage Ratio (*RQ*) (95 th percentile)	0.71	0.64					1.06	0.27	0.27	0.03	2.50	0.53
Uniform Delay (d_1), s/veh	39.6	40.8					46.2	9.5	9.5	24.2	31.0	9.1
Incremental Delay (d_2), s/veh	16.0	35.5					30.5	2.2	2.2	0.2	11.2	1.5
Initial Queue Delay (d_3), s/veh	0.0	0.0					0.0	0.0	0.0	0.0	0.0	0.0
Control Delay (*d*), s/veh	55.6	76.4					76.7	11.7	11.7	24.4	42.2	10.6
Level of Service (LOS)	E	E					E	B	B	C	D	B
Approach Delay, s/veh / LOS	66.5	E		0.0			17.9	B		35.8	D	
Intersection Delay, s/veh / LOS	33.5						C					

Multimodal Results	EB		WB		NB		SB	
Pedestrian LOS Score / LOS	2.32	B	2.47	B	1.35	A	1.95	B
Bicycle LOS Score / LOS	1.50	B			1.81	B	2.21	B

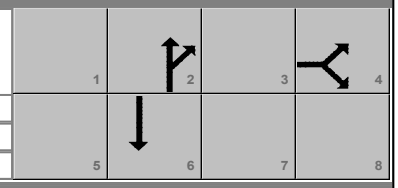
HCS7 Signalized Intersection Intermediate Values

General Information				Intersection Information	
Agency	LJB			Duration, h	0.250
Analyst	TVF	Analysis Date	Dec 8, 2020	Area Type	Other
Jurisdiction	Columbus	Time Period	AM Peak	PHF	0.92
Urban Street	S Hamilton Rd	Analysis Year	2045 Build	Analysis Period	1> 7:00
Intersection	US 33 EB Ramps	File Name	S Hamilton Rd Intersections AM Build.xus		
Project Description	S Hamiilton Rd & US 33 Safety Study				



Demand Information	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Demand (*v*), veh/h	240		840					1610	170		1080	

Signal Information			
Cycle, s	105.0	Reference Phase	2
Offset, s	69	Reference Point	Begin
Uncoordinated	No	Simult. Gap E/W	On
Force Mode	Fixed	Simult. Gap N/S	On



Green	55.5	37.2	0.0	0.0	0.0	0.0						
Yellow	5.5	4.8	0.0	0.0	0.0	0.0						
Red	1.0	1.0	0.0	0.0	0.0	0.0						

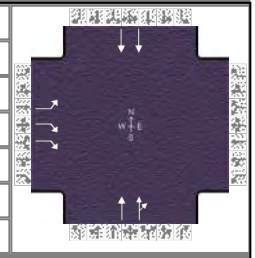
Saturation Flow / Delay	L	T	R	L	T	R	L	T	R	L	T	R
Lane Width Adjustment Factor (f_w)	1.000	1.000	1.000				1.000	1.000	1.000	1.000	1.000	1.000
Heavy Vehicles and Grade Factor (f_{HVg})	0.953	1.000	0.953				1.000	0.953	0.953	1.000	0.953	1.000
Parking Activity Adjustment Factor (f_p)	1.000	1.000	1.000	0.000	0.000	0.000	1.000	1.000	1.000	1.000	1.000	1.000
Bus Blockage Adjustment Factor (f_{bb})	1.000	1.000	1.000	0.000	0.000	0.000	1.000	1.000	1.000	1.000	1.000	1.000
Area Type Adjustment Factor (f_a)	1.000	1.000	1.000				1.000	1.000	1.000	1.000	1.000	1.000
Lane Utilization Adjustment Factor (f_{LU})	1.000	1.000	0.885	1.000	1.000	1.000	1.000	1.000	1.000	1.000	0.952	1.000
Left-Turn Adjustment Factor (f_{LT})	0.952	0.000					1.000	1.000		1.000	1.000	
Right-Turn Adjustment Factor (f_{RT})		0.000	0.847					0.967	0.967		1.000	1.000
Left-Turn Pedestrian Adjustment Factor (f_{Lpb})	1.000						1.000			1.000		
Right-Turn Ped-Bike Adjustment Factor (f_{Rpb})			1.000						1.000			1.000
Work Zone Adjustment Factor (f_{wz})	1.000	1.000	1.000				1.000	1.000	1.000	1.000	1.000	1.000
DDI Factor (f_{DDI})	1.000	1.000	1.000				1.000	1.000	1.000	1.000	1.000	1.000
Movement Saturation Flow Rate (s), veh/h	1725	0	2717				0	3226	336	0	3622	0
Proportion of Vehicles Arriving on Green (P)	0.35	0.00	0.35	0.00	0.00	0.00	0.00	0.66	0.63	0.00	0.82	0.00
Incremental Delay Factor (k)	0.23		0.47					0.50	0.50		0.50	

Signal Timing / Movement Groups	EBL	EBT/R	WBL	WBT/R	NBL	NBT/R	SBL	SBT/R
Lost Time (t_L)		4.0				6.5		6.5
Green Ratio (g/C)		0.35				0.53		0.53
Permitted Saturation Flow Rate (s_p), veh/h/ln		1725				452		266
Shared Saturation Flow Rate (s_{sh}), veh/h/ln						0		0
Permitted Effective Green Time (g_p), s		0.0				0.0		0.0
Permitted Service Time (g_u), s		0.0				0.0		0.0
Permitted Queue Service Time (g_{ps}), s								
Time to First Blockage (g_f), s		0.0				55.5		55.5
Queue Service Time Before Blockage (g_{fs}), s								
Protected Right Saturation Flow (s_R), veh/h/ln		0						
Protected Right Effective Green Time (g_R), s		0.0						

Multimodal	EB		WB		NB		SB	
Pedestrian F_w / F_v	1.389	0.000	1.389	0.000	0.000	0.000	1.198	0.000
Pedestrian F_s / F_{delay}	0.000	0.164	0.000	0.163	0.000	0.099	0.000	0.099
Pedestrian M_{corner} / M_{cw}								
Bicycle c_b / d_b		59.52	-95.24	57.62	1057.14	11.67	1057.14	11.67
Bicycle F_w / F_v	-3.64		-3.64		-3.64	1.60	-3.64	0.97

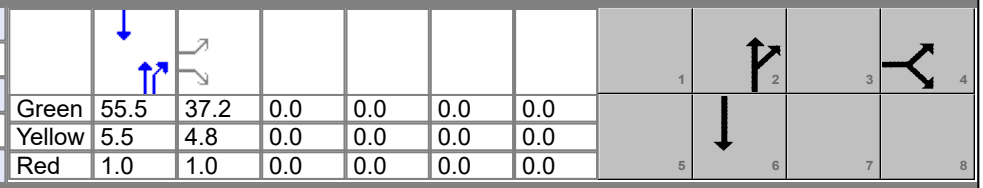
HCS7 Signalized Intersection Results Graphical Summary

General Information				Intersection Information	
Agency	LJB			Duration, h	0.250
Analyst	TVF	Analysis Date	Dec 8, 2020	Area Type	Other
Jurisdiction	Columbus	Time Period	AM Peak	PHF	0.92
Urban Street	S Hamilton Rd	Analysis Year	2045 Build	Analysis Period	1> 7:00
Intersection	US 33 EB Ramps	File Name	S Hamilton Rd Intersections AM Build.xus		
Project Description	S Hamiilton Rd & US 33 Safety Study				



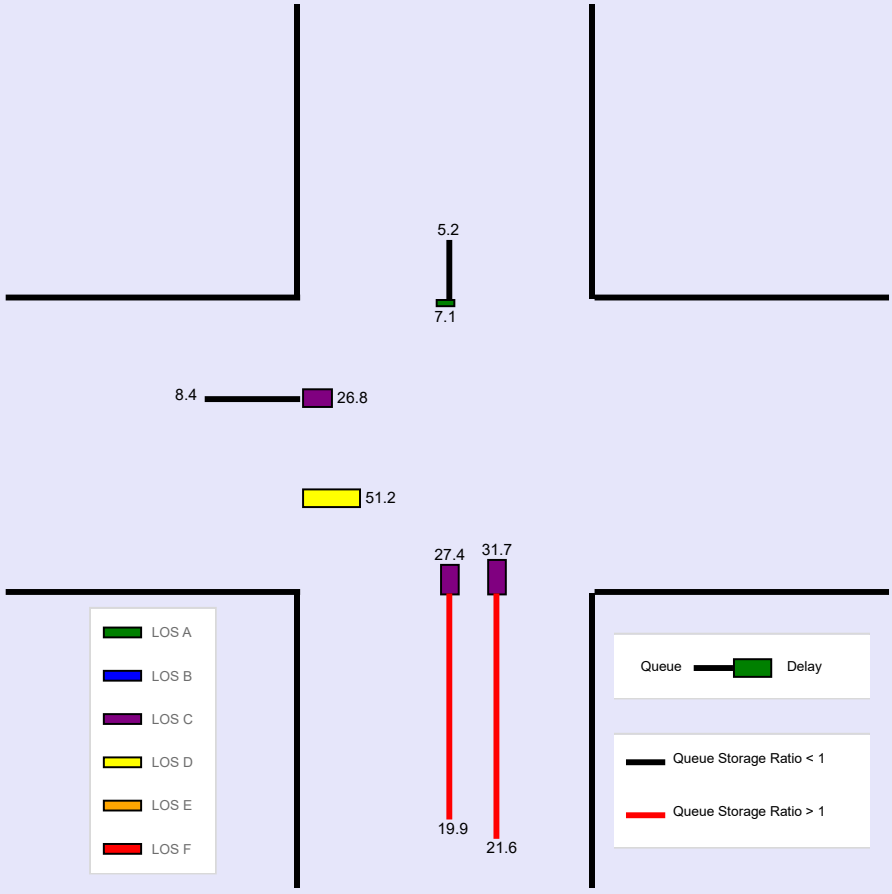
Demand Information	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Demand (*v*), veh/h	240		840					1610	170		1080	

Signal Information			
Cycle, s	105.0	Reference Phase	2
Offset, s	69	Reference Point	Begin
Uncoordinated	No	Simult. Gap E/W	On
Force Mode	Fixed	Simult. Gap N/S	On



	EB			WB			NB			SB		
Green	55.5		37.2	0.0		0.0	0.0		0.0			
Yellow	5.5		4.8	0.0		0.0	0.0		0.0			
Red	1.0		1.0	0.0		0.0	0.0		0.0			

Movement Group Results	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Back of Queue (*Q*), ft/ln (95 th percentile)	219.4		488.2					520.7	565.3		135.6	
Back of Queue (*Q*), veh/ln (95 th percentile)	8.4		18.6					19.9	21.6		5.2	
Queue Storage Ratio (*RQ*) (95 th percentile)	0.37		0.81					1.89	2.06		0.19	
Control Delay (*d*), s/veh	26.8		51.2					27.4	31.7		7.1	
Level of Service (LOS)	C		D					C	C		A	
Approach Delay, s/veh / LOS	45.8		D	0.0			29.5		C	7.1		A
Intersection Delay, s/veh / LOS	27.4						C					



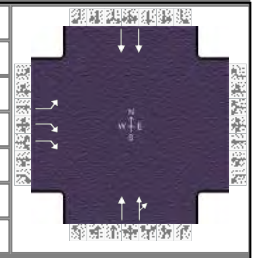
--- Messages ---

WARNING: Since queue spillover from turn lanes and spillback into upstream intersections is not accounted for in the HCM procedures, use of a simulation tool may be advised in situations where the Queue Storage Ratio exceeds 1.0.

--- Comments ---

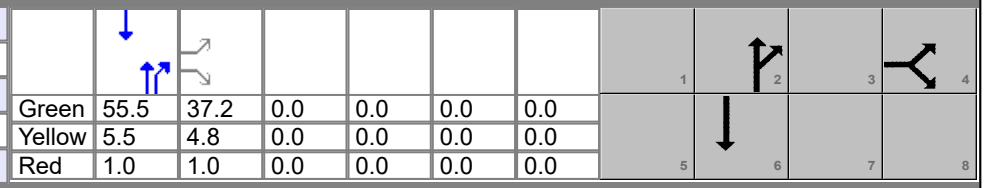
HCS7 Signalized Intersection Input Data

General Information				Intersection Information	
Agency	LJB			Duration, h	0.250
Analyst	TVF	Analysis Date	Dec 8, 2020	Area Type	Other
Jurisdiction	Columbus	Time Period	AM Peak	PHF	0.92
Urban Street	S Hamilton Rd	Analysis Year	2045 Build	Analysis Period	1> 7:00
Intersection	US 33 EB Ramps	File Name	S Hamilton Rd Intersections AM Build.xus		
Project Description	S Hamiilton Rd & US 33 Safety Study				



Demand Information	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Demand (*v*), veh/h	240		840					1610	170		1080	

Signal Information			
Cycle, s	105.0	Reference Phase	2
Offset, s	69	Reference Point	Begin
Uncoordinated	No	Simult. Gap E/W	On
Force Mode	Fixed	Simult. Gap N/S	On



	EB			WB			NB			SB		
Green	55.5	37.2		0.0	0.0	0.0	0.0					
Yellow	5.5	4.8		0.0	0.0	0.0	0.0					
Red	1.0	1.0		0.0	0.0	0.0	0.0					

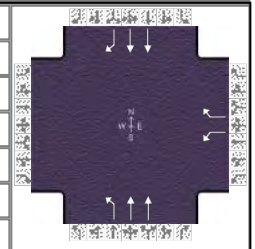
Traffic Information	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Demand (*v*), veh/h	240		840					1610	170		1080	
Initial Queue (Q_b), veh/h	0		0					0	0		0	
Base Saturation Flow Rate (s_o), veh/h	1900		1900					1900	1900		1900	
Parking (N_m), man/h		None						None			None	
Heavy Vehicles (P_{HV}), %	6		6					6			6	
Ped / Bike / RTOR, /h	0	0		0	0		0	0	0	0	0	
Buses (N_b), buses/h	0	0	0				0	0	0	0	0	0
Arrival Type (*AT*)	3		3					3	3		3	
Upstream Filtering (*I*)	1.00		1.00					0.50	0.50		0.54	
Lane Width (*W*), ft	12.0		12.0					12.0			12.0	
Turn Bay Length, ft	600		600					275			725	
Grade (*Pg*), %		0			0			0			0	
Speed Limit, mi/h	50		50					50	50		50	

Phase Information	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Maximum Green (G_{max}) or Phase Split, s		43.0				62.0		62.0
Yellow Change Interval (*Y*), s		4.8				5.5		5.5
Red Clearance Interval (R_c), s		1.0				1.0		1.0
Minimum Green (G_{min}), s		7				20		20
Start-Up Lost Time (*l1*), s	2.0					2.0		2.0
Extension of Effective Green (*e*), s	2.0					2.0		2.0
Passage (*PT*), s		5.0				3.0		3.0
Recall Mode		Min				Min		Min
Dual Entry		Yes				Yes		Yes
Walk (*Walk*), s		0.0		0.0				0.0
Pedestrian Clearance Time (*PC*), s		0.0		0.0				0.0

Multimodal Information	EB			WB			NB			SB		
85th % Speed / Rest in Walk / Corner Radius	0	No	25	0	No	25				0	No	25
Walkway / Crosswalk Width / Length, ft	9.0	12	0	9.0	12	0				9.0	12	0
Street Width / Island / Curb	0	0	No		0		0		No	0	0	No
Width Outside / Bike Lane / Shoulder, ft	12	5.0	2.0				12	5.0	2.0	12	5.0	2.0
Pedestrian Signal / Occupied Parking	No	0.50		No				0.50		No	0.50	

HCS7 Signalized Intersection Intermediate Values

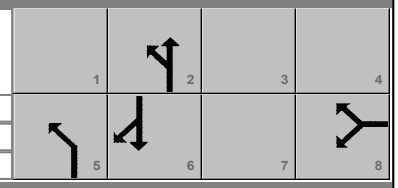
General Information				Intersection Information	
Agency	LJB			Duration, h	0.250
Analyst	TVF	Analysis Date	Dec 8, 2020	Area Type	Other
Jurisdiction	Columbus	Time Period	AM Peak	PHF	0.92
Urban Street	S Hamilton Rd	Analysis Year	2045 Build	Analysis Period	1> 7:00
Intersection	US 33 WB Ramps	File Name	S Hamilton Rd Intersections AM Build.xus		
Project Description	S Hamiilton Rd & US 33 Safety Study				



Demand Information	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Demand (*v*), veh/h				180		160	720	1130			970	520

Signal Information			
Cycle, s	105.0	Reference Phase	2
Offset, s	85	Reference Point	End
Uncoordinated	No	Simult. Gap E/W	On
Force Mode	Fixed	Simult. Gap N/S	On

Green	31.2	40.8	14.2	0.0	0.0	0.0	
Yellow	4.3	5.2	4.8	0.0	0.0	0.0	
Red	2.5	1.0	1.0	0.0	0.0	0.0	



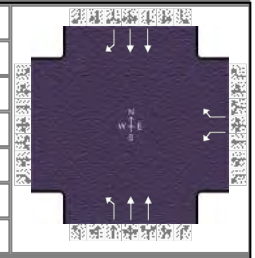
Saturation Flow / Delay	L	T	R	L	T	R	L	T	R	L	T	R
Lane Width Adjustment Factor (f_w)				1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
Heavy Vehicles and Grade Factor (f_{HVg})				0.922	0.899	0.922	0.992	0.992	1.000	1.000	0.992	0.992
Parking Activity Adjustment Factor (f_p)	0.000	0.000	0.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
Bus Blockage Adjustment Factor (f_{bb})	0.000	0.000	0.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
Area Type Adjustment Factor (f_a)				1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
Lane Utilization Adjustment Factor (f_{LU})	1.000	1.000	1.000	1.000	1.000	1.000	1.000	0.952	1.000	1.000	0.952	1.000
Left-Turn Adjustment Factor (f_{LT})				0.952	0.000		0.952	0.000		1.000	1.000	
Right-Turn Adjustment Factor (f_{RT})					0.000	0.847		1.000	1.000		0.000	0.847
Left-Turn Pedestrian Adjustment Factor (f_{Lpb})				1.000			1.000			1.000		
Right-Turn Ped-Bike Adjustment Factor (f_{Rpb})						1.000			1.000			1.000
Work Zone Adjustment Factor (f_{wz})				1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
DDI Factor (f_{DDI})				1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
Movement Saturation Flow Rate (s), veh/h				1668	0	1485	1795	3680	0	0	3680	1598
Proportion of Vehicles Arriving on Green (P)	0.00	0.00	0.00	0.14	0.00	0.14	0.47	0.67	0.00	0.00	0.39	0.39
Incremental Delay Factor (k)				0.40		0.40	0.50	0.50			0.50	0.50

Signal Timing / Movement Groups	EBL	EBT/R	WBL	WBT/R	NBL	NBT/R	SBL	SBT/R
Lost Time (t_L)				4.0	6.8	6.2		6.2
Green Ratio (g/C)				0.14	0.70	0.75		0.39
Permitted Saturation Flow Rate (s_p), veh/h/ln				1668	539	0		495
Shared Saturation Flow Rate (s_{sh}), veh/h/ln								0
Permitted Effective Green Time (g_p), s				0.0	42.8	0.0		0.0
Permitted Service Time (g_u), s				0.0	14.1	0.0		0.0
Permitted Queue Service Time (g_{ps}), s					14.1			
Time to First Blockage (g_f), s				0.0	0.0	0.0		40.8
Queue Service Time Before Blockage (g_{fs}), s								
Protected Right Saturation Flow (s_R), veh/h/ln				0				0
Protected Right Effective Green Time (g_R), s				0.0				0.0

Multimodal	EB		WB		NB		SB	
Pedestrian F_w / F_v	1.557	0.000	1.557	0.000	0.972	0.000	0.681	0.000
Pedestrian F_s / F_{delay}	0.000	0.163	0.000	0.164	0.000	0.047	0.000	0.119
Pedestrian M_{corner} / M_{cw}								
Bicycle c_b / d_b	-95.24	57.62		59.52	1500.95	3.27	777.14	19.63
Bicycle F_w / F_v	-3.64		-3.64		-3.64	1.66	-3.64	1.34

HCS7 Signalized Intersection Results Graphical Summary

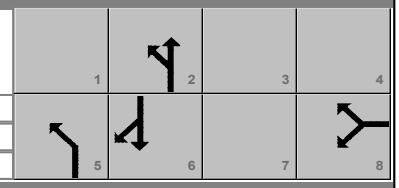
General Information				Intersection Information	
Agency	LJB			Duration, h	0.250
Analyst	TVF	Analysis Date	Dec 8, 2020	Area Type	Other
Jurisdiction	Columbus	Time Period	AM Peak	PHF	0.92
Urban Street	S Hamilton Rd	Analysis Year	2045 Build	Analysis Period	1> 7:00
Intersection	US 33 WB Ramps	File Name	S Hamilton Rd Intersections AM Build.xus		
Project Description	S Hamiilton Rd & US 33 Safety Study				



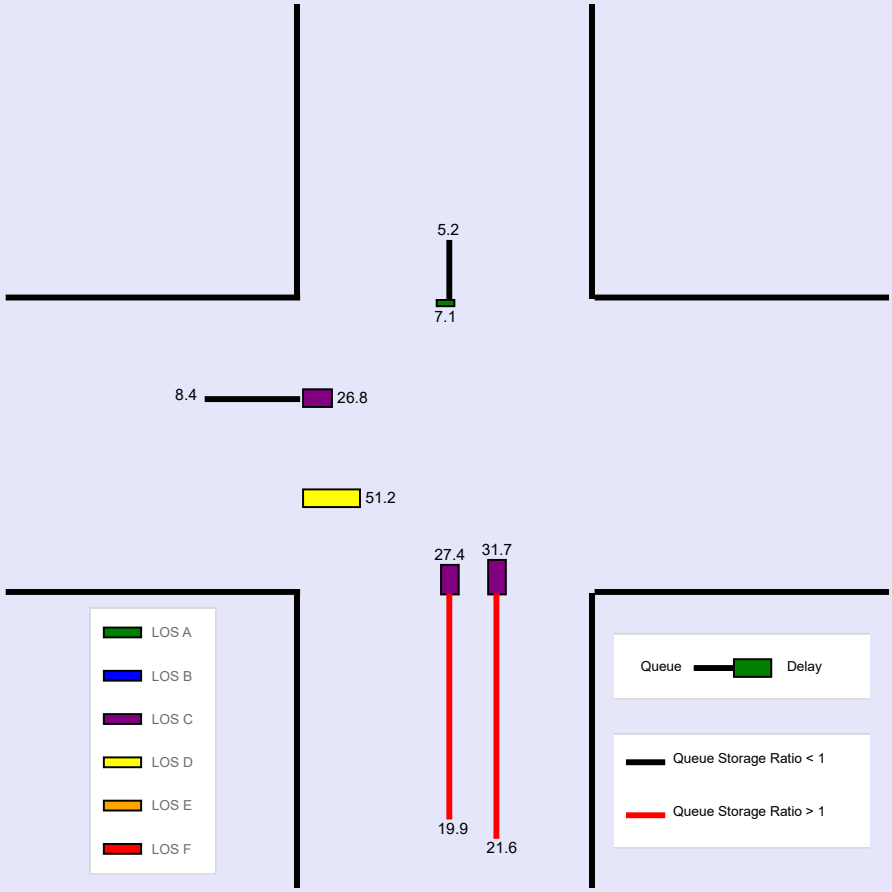
Demand Information	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Demand (*v*), veh/h				180		160	720	1130			970	520

Signal Information			
Cycle, s	105.0	Reference Phase	2
Offset, s	85	Reference Point	End
Uncoordinated	No	Simult. Gap E/W	On
Force Mode	Fixed	Simult. Gap N/S	On

Green	31.2	40.8	14.2	0.0	0.0	0.0	
Yellow	4.3	5.2	4.8	0.0	0.0	0.0	
Red	2.5	1.0	1.0	0.0	0.0	0.0	



Movement Group Results	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Back of Queue (*Q*), ft/ln (95 th percentile)				289.5		268.6	709.8	171.8			421.6	560
Back of Queue (*Q*), veh/ln (95 th percentile)				10.7		9.9	28.2	6.8			16.7	22.2
Queue Storage Ratio (*RQ*) (95 th percentile)				0.72		0.90	1.01	0.21			0.48	1.32
Control Delay (*d*), s/veh				73.0		75.4	66.8	7.1			31.7	50.2
Level of Service (LOS)				E		E	F	A			C	D
Approach Delay, s/veh / LOS	0.0			74.1		E	30.4		C	38.1		D
Intersection Delay, s/veh / LOS	37.8						D					



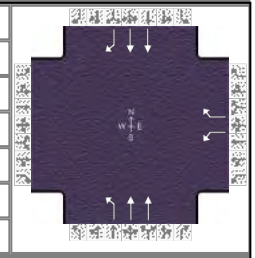
--- Messages ---

WARNING: Since queue spillover from turn lanes and spillback into upstream intersections is not accounted for in the HCM procedures, use of a simulation tool may be advised in situations where the Queue Storage Ratio exceeds 1.0.

--- Comments ---

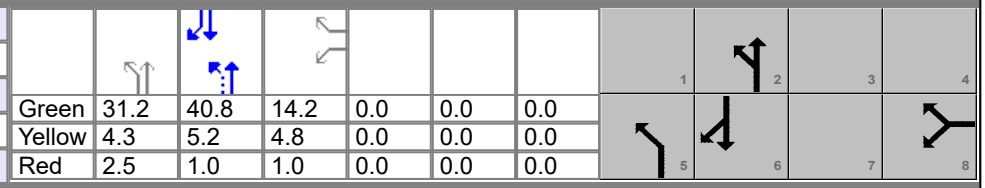
HCS7 Signalized Intersection Input Data

General Information				Intersection Information	
Agency	LJB			Duration, h	0.250
Analyst	TVF	Analysis Date	Dec 8, 2020	Area Type	Other
Jurisdiction	Columbus	Time Period	AM Peak	PHF	0.92
Urban Street	S Hamilton Rd	Analysis Year	2045 Build	Analysis Period	1> 7:00
Intersection	US 33 WB Ramps	File Name	S Hamilton Rd Intersections AM Build.xus		
Project Description	S Hamiilton Rd & US 33 Safety Study				



Demand Information	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Demand (*v*), veh/h				180		160	720	1130			970	520

Signal Information			
Cycle, s	105.0	Reference Phase	2
Offset, s	85	Reference Point	End
Uncoordinated	No	Simult. Gap E/W	On
Force Mode	Fixed	Simult. Gap N/S	On



	EB			WB			NB			SB		
Green	31.2	40.8		14.2	0.0	0.0	0.0					
Yellow	4.3	5.2		4.8	0.0	0.0	0.0					
Red	2.5	1.0		1.0	0.0	0.0	0.0					

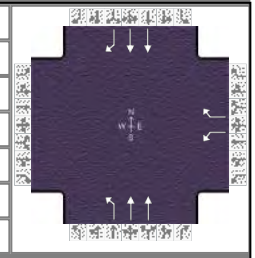
Traffic Information	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Demand (*v*), veh/h				180		160	720	1130			970	520
Initial Queue (Q_b), veh/h				0		0	0	0			0	0
Base Saturation Flow Rate (s_o), veh/h				1900		1900	1900	1900			1900	1900
Parking (N_m), man/h					None			None			None	
Heavy Vehicles (P_{HV}), %				10		10	1	1			1	1
Ped / Bike / RTOR, /h	0	0		0	0		0	0		0	0	0
Buses (N_b), buses/h				0	0	0	0	0	0	0	0	0
Arrival Type (*AT*)				3		3	3	3			3	3
Upstream Filtering (*I*)				1.00		1.00	0.35	0.35			1.00	1.00
Lane Width (*W*), ft				12.0		12.0	12.0	12.0			12.0	12.0
Turn Bay Length, ft				400		300	700	800			875	425
Grade (*Pg*), %		0			0			0			0	
Speed Limit, mi/h				50		50	50	50			50	50

Phase Information	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Maximum Green (G_{max}) or Phase Split, s				20.0	38.0	85.0		47.0
Yellow Change Interval (*Y*), s				4.8	4.3	5.2		5.2
Red Clearance Interval (R_c), s				1.0	2.5	1.0		1.0
Minimum Green (G_{min}), s				7	7	20		20
Start-Up Lost Time (*l*t), s			2.0		2.0	2.0		2.0
Extension of Effective Green (*e*), s			2.0		2.0	2.0		2.0
Passage (*PT*), s				3.7	5.0	3.0		3.0
Recall Mode				Off	Off	Min		Min
Dual Entry				Yes	No	Yes		Yes
Walk (*Walk*), s		0.0		0.0		0.0		
Pedestrian Clearance Time (*PC*), s		0.0		0.0		0.0		

Multimodal Information	EB			WB			NB			SB		
85th % Speed / Rest in Walk / Corner Radius	0	No	25	0	No	25	0	No	25			
Walkway / Crosswalk Width / Length, ft	9.0	12	0	9.0	12	0	9.0	12	0			
Street Width / Island / Curb		0		0	0	No	0	0	No	0		No
Width Outside / Bike Lane / Shoulder, ft				12	5.0	2.0	12	5.0	2.0	12	5.0	2.0
Pedestrian Signal / Occupied Parking	No			No	0.50		No	0.50			0.50	

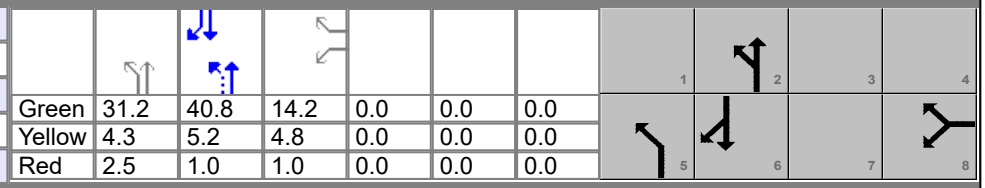
HCS7 Signalized Intersection Results Summary

General Information				Intersection Information	
Agency	LJB			Duration, h	0.250
Analyst	TVF	Analysis Date	Dec 8, 2020	Area Type	Other
Jurisdiction	Columbus	Time Period	AM Peak	PHF	0.92
Urban Street	S Hamilton Rd	Analysis Year	2045 Build	Analysis Period	1> 7:00
Intersection	US 33 WB Ramps	File Name	S Hamilton Rd Intersections AM Build.xus		
Project Description	S Hamiilton Rd & US 33 Safety Study				



Demand Information	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Demand (*v*), veh/h				180		160	720	1130			970	520

Signal Information			
Cycle, s	105.0	Reference Phase	2
Offset, s	85	Reference Point	End
Uncoordinated	No	Simult. Gap E/W	On
Force Mode	Fixed	Simult. Gap N/S	On



Green	31.2	40.8	14.2	0.0	0.0	0.0
Yellow	4.3	5.2	4.8	0.0	0.0	0.0
Red	2.5	1.0	1.0	0.0	0.0	0.0

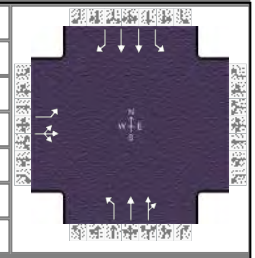
Timer Results	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Assigned Phase				8	5	2		6
Case Number				9.0	1.0	4.0		7.3
Phase Duration, s				20.0	38.0	85.0		47.0
Change Period, (*Y+R c*), s				5.8	6.8	6.2		6.2
Max Allow Headway (*MAH*), s				4.8	6.0	0.0		0.0
Queue Clearance Time (*g s*), s				14.1	33.2			
Green Extension Time (*g e*), s				0.0	0.0	0.0		0.0
Phase Call Probability				1.00	1.00			
Max Out Probability				1.00	1.00			

Movement Group Results	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Assigned Movement				3		18	5	2			6	16
Adjusted Flow Rate (*v*), veh/h				196		174	735	1153			1054	565
Adjusted Saturation Flow Rate (*s*), veh/h/ln				1668		1485	1795	1795			1795	1598
Queue Service Time (*g s*), s				12.1		12.0	31.2	15.7			26.7	35.1
Cycle Queue Clearance Time (*g c*), s				12.1		12.0	31.2	15.7			26.7	35.1
Green Ratio (*g/C*)				0.14		0.14	0.70	0.75			0.39	0.39
Capacity (*c*), veh/h				226		201	674	2694			1395	621
Volume-to-Capacity Ratio (*X*)				0.867		0.866	1.089	0.428			0.756	0.910
Back of Queue (*Q*), ft/ln (95 th percentile)				289.5		268.6	709.8	171.8			421.6	560
Back of Queue (*Q*), veh/ln (95 th percentile)				10.7		9.9	28.2	6.8			16.7	22.2
Queue Storage Ratio (*RQ*) (95 th percentile)				0.72		0.90	1.01	0.21			0.48	1.32
Uniform Delay (*d 1*), s/veh				44.5		44.5	17.4	6.9			27.8	30.4
Incremental Delay (*d 2*), s/veh				28.5		30.9	49.4	0.2			3.9	19.8
Initial Queue Delay (*d 3*), s/veh				0.0		0.0	0.0	0.0			0.0	0.0
Control Delay (*d*), s/veh				73.0		75.4	66.8	7.1			31.7	50.2
Level of Service (LOS)				E		E	F	A			C	D
Approach Delay, s/veh / LOS	0.0			74.1		E	30.4		C	38.1		D
Intersection Delay, s/veh / LOS	37.8						D					

Multimodal Results	EB		WB		NB		SB	
Pedestrian LOS Score / LOS	2.32	B	2.32	B	1.62	B	1.40	A
Bicycle LOS Score / LOS				F	2.15	B	1.82	B

HCS7 Signalized Intersection Intermediate Values

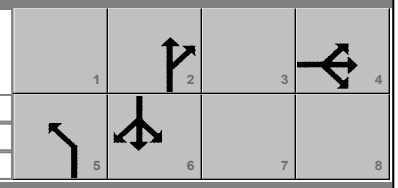
General Information				Intersection Information	
Agency	LJB			Duration, h	0.250
Analyst	TVF	Analysis Date	Dec 8, 2020	Area Type	Other
Jurisdiction	Columbus	Time Period	AM Peak	PHF	0.92
Urban Street	S Hamilton Rd	Analysis Year	2045 Build	Analysis Period	1> 7:00
Intersection	Williams Rd	File Name	S Hamilton Rd Intersections AM Build.xus		
Project Description	S Hamiilton Rd & US 33 Safety Study				



Demand Information	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Demand (*v*), veh/h	450	5	110				140	1330	5	5	1530	390

Signal Information			
Cycle, s	105.0	Reference Phase	2
Offset, s	51	Reference Point	End
Uncoordinated	No	Simult. Gap E/W	On
Force Mode	Float	Simult. Gap N/S	On

Green	53.0	12.1	22.2	0.0	0.0	0.0
Yellow	5.5	3.6	4.8	0.0	0.0	0.0
Red	1.0	1.8	1.0	0.0	0.0	0.0



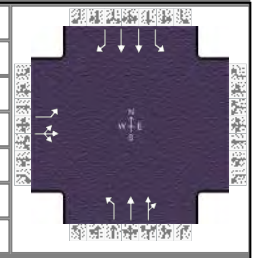
Saturation Flow / Delay	L	T	R	L	T	R	L	T	R	L	T	R
Lane Width Adjustment Factor (f_w)	1.000	1.000	1.000				1.000	1.000	1.000	1.000	1.000	1.000
Heavy Vehicles and Grade Factor (f_{HVg})	0.922	0.922	1.000				0.945	0.945	1.000	0.961	0.961	0.961
Parking Activity Adjustment Factor (f_p)	1.000	1.000	1.000	0.000	0.000	0.000	1.000	1.000	1.000	1.000	1.000	1.000
Bus Blockage Adjustment Factor (f_{bb})	1.000	1.000	1.000	0.000	0.000	0.000	1.000	1.000	1.000	1.000	1.000	1.000
Area Type Adjustment Factor (f_a)	1.000	1.000	1.000				1.000	1.000	1.000	1.000	1.000	1.000
Lane Utilization Adjustment Factor (f_{LU})	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	0.952	1.000
Left-Turn Adjustment Factor (f_{LT})	0.952	0.000					0.952	0.000		0.188	0.000	
Right-Turn Adjustment Factor (f_{RT})		0.853	0.853					0.999	0.999		0.000	0.847
Left-Turn Pedestrian Adjustment Factor (f_{Lpb})	1.000						1.000			1.000		
Right-Turn Ped-Bike Adjustment Factor (f_{Rpb})			1.000						1.000			1.000
Work Zone Adjustment Factor (f_{wz})	1.000	1.000	1.000				1.000	1.000	1.000	1.000	1.000	1.000
DDI Factor (f_{DDI})	1.000	1.000	1.000				1.000	1.000	1.000	1.000	1.000	1.000
Movement Saturation Flow Rate (s), veh/h	1668	65	1575				1711	3577	13	358	3477	1547
Proportion of Vehicles Arriving on Green (P)	0.21	0.21	0.21	0.00	0.00	0.00	0.10	0.67	0.67	0.58	0.40	0.72
Incremental Delay Factor (k)	0.38	0.46					0.39	0.50	0.50	0.50	0.50	0.50

Signal Timing / Movement Groups	EBL	EBT/R	WBL	WBT/R	NBL	NBT/R	SBL	SBT/R
Lost Time (t_L)		4.0			5.4	6.5		6.5
Green Ratio (g/C)		0.21			0.10	0.67		0.50
Permitted Saturation Flow Rate (s_p), veh/h/ln		1668			0	0		358
Shared Saturation Flow Rate (s_{sh}), veh/h/ln								
Permitted Effective Green Time (g_p), s		0.0			0.0	0.0		53.0
Permitted Service Time (g_u), s		0.0			0.0	0.0		29.6
Permitted Queue Service Time (g_{ps}), s								1.1
Time to First Blockage (g_f), s		0.0			0.0	0.0		0.0
Queue Service Time Before Blockage (g_{fs}), s								
Protected Right Saturation Flow (s_R), veh/h/ln								0
Protected Right Effective Green Time (g_R), s								0.0

Multimodal	EB		WB		NB		SB	
Pedestrian F_w / F_v	1.557	0.000	1.710	0.000	0.681	0.000	1.198	0.000
Pedestrian F_s / F_{delay}	0.000	0.164	0.000	0.163	0.000	0.070	0.000	0.150
Pedestrian M_{corner} / M_{cw}								
Bicycle c_b / d_b		59.52	-95.24	57.62	1342.86	5.67	209.52	42.08
Bicycle F_w / F_v	-3.64	1.01	-3.64		-3.64	1.32	-3.64	1.73

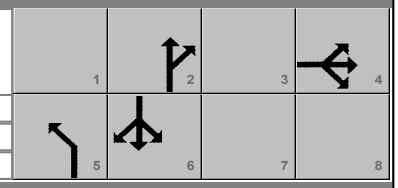
HCS7 Signalized Intersection Results Graphical Summary

General Information				Intersection Information	
Agency	LJB			Duration, h	0.250
Analyst	TVF	Analysis Date	Dec 8, 2020	Area Type	Other
Jurisdiction	Columbus	Time Period	AM Peak	PHF	0.92
Urban Street	S Hamilton Rd	Analysis Year	2045 Build	Analysis Period	1> 7:00
Intersection	Williams Rd	File Name	S Hamilton Rd Intersections AM Build.xus		
Project Description	S Hamiilton Rd & US 33 Safety Study				

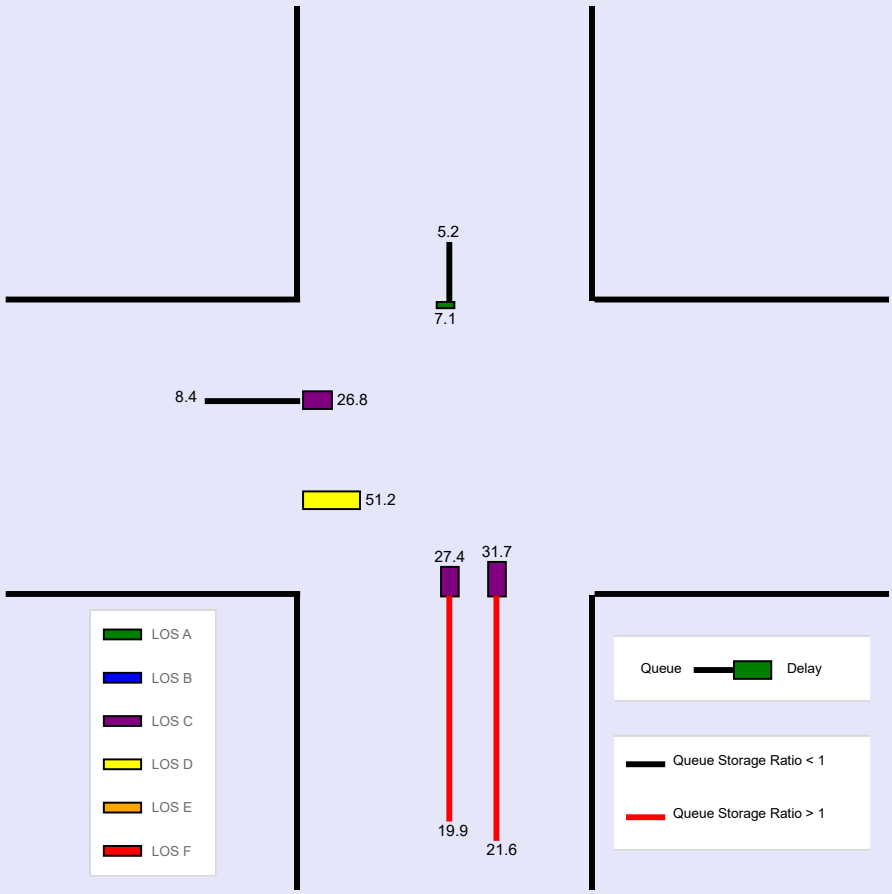


Demand Information	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Demand (*v*), veh/h	450	5	110				140	1330	5	5	1530	390

Signal Information					EB			WB			NB			SB		
Cycle, s	105.0	Reference Phase	2		L	T	R	L	T	R	L	T	R	L	T	R
Offset, s	51	Reference Point	End	Green	53.0	12.1	22.2	0.0	0.0	0.0						
Uncoordinated	No	Simult. Gap E/W	On	Yellow	5.5	3.6	4.8	0.0	0.0	0.0						
Force Mode	Float	Simult. Gap N/S	On	Red	1.0	1.8	1.0	0.0	0.0	0.0						



Movement Group Results	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Back of Queue (*Q*), ft/ln (95 th percentile)	355.4	445.1					237.5	327	308.8	4.5	750.2	144.9
Back of Queue (*Q*), veh/ln (95 th percentile)	13.2	16.5					9.0	12.4	12.4	0.2	28.9	5.6
Queue Storage Ratio (*RQ*) (95 th percentile)	0.71	0.64					1.06	0.27	0.27	0.03	2.50	0.53
Control Delay (*d*), s/veh	55.6	76.4					76.7	11.7	11.7	24.4	42.2	10.6
Level of Service (LOS)	E	E					E	B	B	C	D	B
Approach Delay, s/veh / LOS	66.5	E		0.0			17.9	B		35.8	D	
Intersection Delay, s/veh / LOS	33.5						C					



--- Messages ---

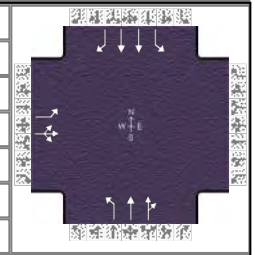
WARNING: Since queue spillover from turn lanes and spillback into upstream intersections is not accounted for in the HCM procedures, use of a simulation tool may be advised in situations where the Queue Storage Ratio exceeds 1.0.

WARNING: The shared-plus-exclusive turn lane solution is an approximation of the HCM method, because more than three lane groups cannot be accommodated. Input data for Percent Turns in Shared Lane are used to specify proportion of turning vehicles in the shared lane.

--- Comments ---

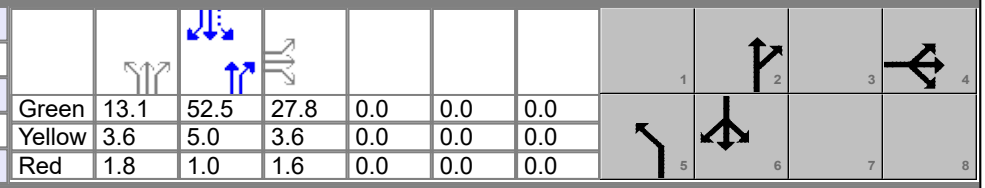
HCS7 Signalized Intersection Input Data

General Information				Intersection Information	
Agency	LJB			Duration, h	0.250
Analyst	TVF	Analysis Date	Dec 8, 2020	Area Type	Other
Jurisdiction	Columbus	Time Period	PM Peak	PHF	0.92
Urban Street	S Hamilton Rd	Analysis Year	2045 Build	Analysis Period	1> 7:00
Intersection	Williams Rd	File Name	S Hamilton Rd Intersections PM Build.xus		
Project Description	S Hamiilton Rd & US 33 Safety Study				



Demand Information	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Demand (*v*), veh/h	600	5	90				160	1830	5	5	1180	450

Signal Information			
Cycle, s	110.0	Reference Phase	2
Offset, s	5	Reference Point	End
Uncoordinated	No	Simult. Gap E/W	On
Force Mode	Float	Simult. Gap N/S	On



	EB			WB			NB			SB		
Green	13.1	52.5		27.8	0.0	0.0	0.0					
Yellow	3.6	5.0		3.6	0.0	0.0	0.0					
Red	1.8	1.0		1.6	0.0	0.0	0.0					

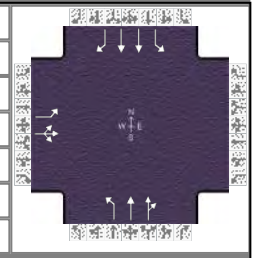
Traffic Information	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Demand (*v*), veh/h	600	5	90				160	1830	5	5	1180	450
Initial Queue (Q_b), veh/h	0	0	0				0	0	0	0	0	0
Base Saturation Flow Rate (s_o), veh/h	1900	1900	1900				1900	1900	1900	1900	1900	1900
Parking (N_m), man/h		None						None			None	
Heavy Vehicles (P_{HV}), %	8	8					5	5		6	6	6
Ped / Bike / RTOR, /h	0	0	0	0	0		0	0	0	0	0	0
Buses (N_b), buses/h	0	0	0				0	0	0	0	0	0
Arrival Type (*AT*)	3	3	3				3	3	3	3	3	3
Upstream Filtering (*I*)	1.00	1.00	1.00				1.00	1.00	1.00	0.64	0.64	0.64
Lane Width (*W*), ft	12.0	12.0					12.0	12.0		12.0	12.0	12.0
Turn Bay Length, ft	500	700					600	1200		140	300	275
Grade (*Pg*), %		0			0			0			0	
Speed Limit, mi/h	50	50	50				50	50	50	50	50	50

Phase Information	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Maximum Green (G_{max}) or Phase Split, s		33.0			18.5	77.0		58.5
Yellow Change Interval (*Y*), s		3.6			3.6	5.0		5.0
Red Clearance Interval (R_c), s		1.6			1.8	1.0		1.0
Minimum Green (G_{min}), s		7			7	20		20
Start-Up Lost Time (*l*t), s	2.0	2.0			2.0	2.0	2.0	2.0
Extension of Effective Green (*e*), s	2.0	2.0			2.0	2.0	2.0	2.0
Passage (*PT*), s		4.0			3.7	3.0		3.0
Recall Mode		Min			Off	Min		Min
Dual Entry		Yes			No	Yes		Yes
Walk (*Walk*), s		0.0		0.0				0.0
Pedestrian Clearance Time (*PC*), s		0.0		0.0				0.0

Multimodal Information	EB			WB			NB			SB		
85th % Speed / Rest in Walk / Corner Radius	0	No	25	0	No	25				0	No	25
Walkway / Crosswalk Width / Length, ft	9.0	12	0	9.0	12	0				9.0	12	0
Street Width / Island / Curb	0	0	No		0		0		No	0	0	No
Width Outside / Bike Lane / Shoulder, ft	12	5.0	2.0				12	5.0	2.0	12	5.0	2.0
Pedestrian Signal / Occupied Parking	No	0.50		No				0.50		No	0.50	

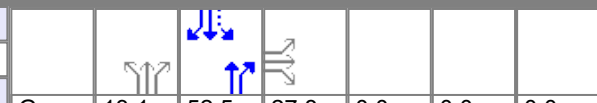
HCS7 Signalized Intersection Results Summary

General Information				Intersection Information	
Agency	LJB			Duration, h	0.250
Analyst	TVF	Analysis Date	Dec 8, 2020	Area Type	Other
Jurisdiction	Columbus	Time Period	PM Peak	PHF	0.92
Urban Street	S Hamilton Rd	Analysis Year	2045 Build	Analysis Period	1> 7:00
Intersection	Williams Rd	File Name	S Hamilton Rd Intersections PM Build.xus		
Project Description	S Hamiilton Rd & US 33 Safety Study				

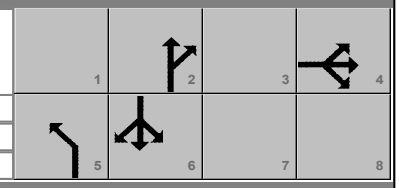


Demand Information	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Demand (*v*), veh/h	600	5	90				160	1830	5	5	1180	450

Signal Information			
Cycle, s	110.0	Reference Phase	2
Offset, s	5	Reference Point	End
Uncoordinated	No	Simult. Gap E/W	On
Force Mode	Float	Simult. Gap N/S	On



Green	13.1	52.5	27.8	0.0	0.0	0.0
Yellow	3.6	5.0	3.6	0.0	0.0	0.0
Red	1.8	1.0	1.6	0.0	0.0	0.0



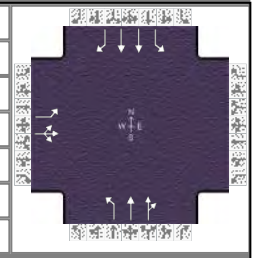
Timer Results	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Assigned Phase		4			5	2		6
Case Number		10.0			2.0	4.0		5.3
Phase Duration, s		33.0			18.5	77.0		58.5
Change Period, ($Y+R_c$), s		5.2			5.4	6.0		6.0
Max Allow Headway (*MAH*), s		5.1			4.7	0.0		0.0
Queue Clearance Time (g_s), s		26.6			12.8			
Green Extension Time (g_e), s		0.5			0.0	0.0		0.0
Phase Call Probability		1.00			1.00			
Max Out Probability		1.00			1.00			

Movement Group Results	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Assigned Movement	7	4	14				5	2	12	1	6	16
Adjusted Flow Rate (*v*), veh/h	391	364					174	997	997	6	1467	559
Adjusted Saturation Flow Rate (*s*), veh/h/ln	1697	1647					1739	1826	1824	210	1724	1535
Queue Service Time (g_s), s	24.6	23.3					10.8	46.9	47.0	2.3	43.0	28.9
Cycle Queue Clearance Time (g_c), s	24.6	23.3					10.8	46.9	47.0	31.1	43.0	28.9
Green Ratio (*g/C*)	0.25	0.25					0.12	0.65	0.65	0.48	0.48	0.48
Capacity (*c*), veh/h	429	416					207	1179	1177	111	1646	733
Volume-to-Capacity Ratio (*X*)	0.913	0.875					0.840	0.846	0.847	0.056	0.891	0.764
Back of Queue (*Q*), ft/ln (95 th percentile)	488	439.9					258.8	647.8	623.3	6.5	601.5	302.2
Back of Queue (*Q*), veh/ln (95 th percentile)	18.3	16.5					10.0	24.9	24.9	0.2	23.0	11.5
Queue Storage Ratio (*RQ*) (95 th percentile)	0.98	0.63					0.43	0.54	0.54	0.05	2.00	1.10
Uniform Delay (d_1), s/veh	39.9	39.4					47.4	15.2	15.3	30.8	27.8	16.4
Incremental Delay (d_2), s/veh	23.9	18.7					25.8	7.6	7.6	0.6	5.2	4.9
Initial Queue Delay (d_3), s/veh	0.0	0.0					0.0	0.0	0.0	0.0	0.0	0.0
Control Delay (*d*), s/veh	63.9	58.2					73.2	22.8	22.9	31.4	33.0	21.3
Level of Service (LOS)	E	E					E	C	C	C	C	C
Approach Delay, s/veh / LOS	61.1	E		0.0			26.9	C		29.8	C	
Intersection Delay, s/veh / LOS	33.3						C					

Multimodal Results	EB		WB		NB		SB	
Pedestrian LOS Score / LOS	2.32	B	2.47	B	1.36	A	1.91	B
Bicycle LOS Score / LOS	1.73	B			2.28	B	1.95	B

HCS7 Signalized Intersection Intermediate Values

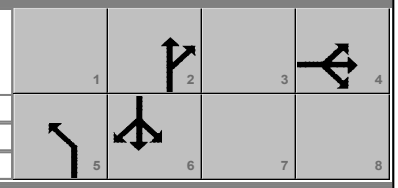
General Information				Intersection Information	
Agency	LJB			Duration, h	0.250
Analyst	TVF	Analysis Date	Dec 8, 2020	Area Type	Other
Jurisdiction	Columbus	Time Period	PM Peak	PHF	0.92
Urban Street	S Hamilton Rd	Analysis Year	2045 Build	Analysis Period	1> 7:00
Intersection	Williams Rd	File Name	S Hamilton Rd Intersections PM Build.xus		
Project Description	S Hamiilton Rd & US 33 Safety Study				



Demand Information	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Demand (*v*), veh/h	600	5	90				160	1830	5	5	1180	450

Signal Information			
Cycle, s	110.0	Reference Phase	2
Offset, s	5	Reference Point	End
Uncoordinated	No	Simult. Gap E/W	On
Force Mode	Float	Simult. Gap N/S	On

Green	13.1	52.5	27.8	0.0	0.0	0.0	
Yellow	3.6	5.0	3.6	0.0	0.0	0.0	
Red	1.8	1.0	1.6	0.0	0.0	0.0	



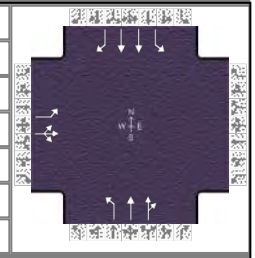
Saturation Flow / Delay	L	T	R	L	T	R	L	T	R	L	T	R
Lane Width Adjustment Factor (f_w)	1.000	1.000	1.000				1.000	1.000	1.000	1.000	1.000	1.000
Heavy Vehicles and Grade Factor (f_{HVg})	0.938	0.938	1.000				0.961	0.961	1.000	0.953	0.953	0.953
Parking Activity Adjustment Factor (f_p)	1.000	1.000	1.000	0.000	0.000	0.000	1.000	1.000	1.000	1.000	1.000	1.000
Bus Blockage Adjustment Factor (f_{bb})	1.000	1.000	1.000	0.000	0.000	0.000	1.000	1.000	1.000	1.000	1.000	1.000
Area Type Adjustment Factor (f_a)	1.000	1.000	1.000				1.000	1.000	1.000	1.000	1.000	1.000
Lane Utilization Adjustment Factor (f_{LU})	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	0.952	1.000
Left-Turn Adjustment Factor (f_{LT})	0.952	0.000					0.952	0.000		0.110	0.000	
Right-Turn Adjustment Factor (f_{RT})		0.854	0.854					0.999	0.999		0.000	0.847
Left-Turn Pedestrian Adjustment Factor (f_{Lpb})	1.000						1.000			1.000		
Right-Turn Ped-Bike Adjustment Factor (f_{Rpb})			1.000						1.000			1.000
Work Zone Adjustment Factor (f_{wz})	1.000	1.000	1.000				1.000	1.000	1.000	1.000	1.000	1.000
DDI Factor (f_{DDI})	1.000	1.000	1.000				1.000	1.000	1.000	1.000	1.000	1.000
Movement Saturation Flow Rate (s), veh/h	1697	80	1624				1739	3640	10	210	3448	1535
Proportion of Vehicles Arriving on Green (P)	0.25	0.25	0.25	0.00	0.00	0.00	0.12	0.65	0.65	0.55	0.45	0.62
Incremental Delay Factor (k)	0.44	0.41					0.38	0.50	0.50	0.50	0.50	0.50

Signal Timing / Movement Groups	EBL	EBT/R	WBL	WBT/R	NBL	NBT/R	SBL	SBT/R
Lost Time (t_L)		4.0			5.4	6.0		6.0
Green Ratio (g/C)		0.25			0.12	0.65		0.48
Permitted Saturation Flow Rate (s_p), veh/h/ln		1697			0	0		210
Shared Saturation Flow Rate (s_{sh}), veh/h/ln								
Permitted Effective Green Time (g_p), s		0.0			0.0	0.0		52.5
Permitted Service Time (g_u), s		0.0			0.0	0.0		24.0
Permitted Queue Service Time (g_{ps}), s								2.5
Time to First Blockage (g_f), s		0.0			0.0	0.0		0.0
Queue Service Time Before Blockage (g_{fs}), s								
Protected Right Saturation Flow (s_R), veh/h/ln								0
Protected Right Effective Green Time (g_R), s								0.0

Multimodal	EB		WB		NB		SB	
Pedestrian F_w / F_v	1.557	0.000	1.710	0.000	0.681	0.000	1.198	0.000
Pedestrian F_s / F_{delay}	0.000	0.165	0.000	0.164	0.000	0.078	0.000	0.109
Pedestrian M_{corner} / M_{cw}								
Bicycle c_b / d_b		61.37	-90.91	60.11	1290.91	6.91	954.55	15.03
Bicycle F_w / F_v	-3.64	1.25	-3.64		-3.64	1.79	-3.64	1.47

HCS7 Signalized Intersection Results Graphical Summary

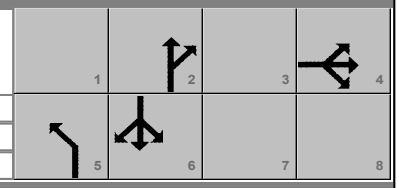
General Information				Intersection Information	
Agency	LJB			Duration, h	0.250
Analyst	TVF	Analysis Date	Dec 8, 2020	Area Type	Other
Jurisdiction	Columbus	Time Period	PM Peak	PHF	0.92
Urban Street	S Hamilton Rd	Analysis Year	2045 Build	Analysis Period	1> 7:00
Intersection	Williams Rd	File Name	S Hamilton Rd Intersections PM Build.xus		
Project Description	S Hamiilton Rd & US 33 Safety Study				



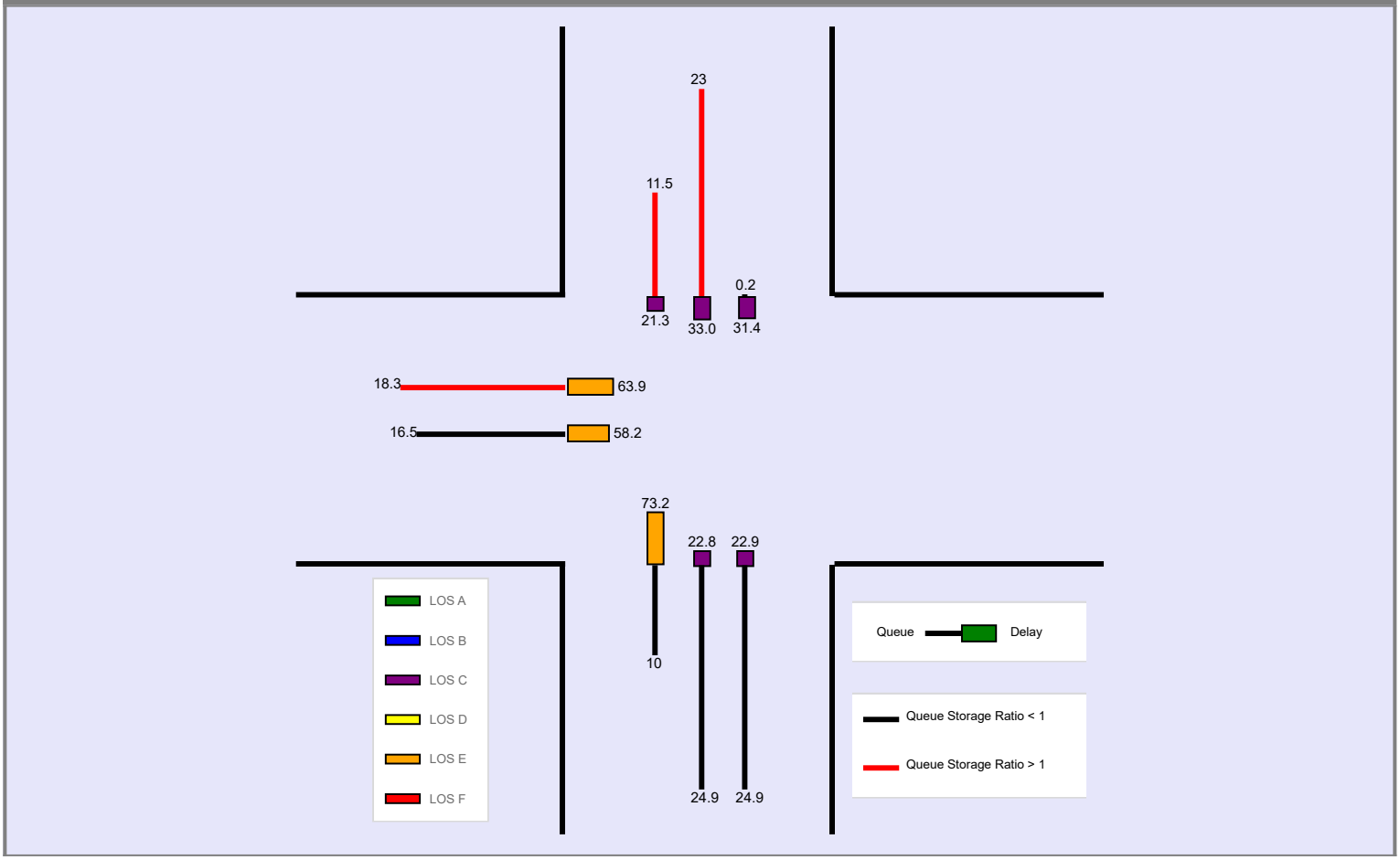
Demand Information	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Demand (*v*), veh/h	600	5	90				160	1830	5	5	1180	450

Signal Information			
Cycle, s	110.0	Reference Phase	2
Offset, s	5	Reference Point	End
Uncoordinated	No	Simult. Gap E/W	On
Force Mode	Float	Simult. Gap N/S	On

Green	13.1	52.5	27.8	0.0	0.0	0.0	
Yellow	3.6	5.0	3.6	0.0	0.0	0.0	
Red	1.8	1.0	1.6	0.0	0.0	0.0	



Movement Group Results	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Back of Queue (*Q*), ft/ln (95 th percentile)	488	439.9					258.8	647.8	623.3	6.5	601.5	302.2
Back of Queue (*Q*), veh/ln (95 th percentile)	18.3	16.5					10.0	24.9	24.9	0.2	23.0	11.5
Queue Storage Ratio (*RQ*) (95 th percentile)	0.98	0.63					0.43	0.54	0.54	0.05	2.00	1.10
Control Delay (*d*), s/veh	63.9	58.2					73.2	22.8	22.9	31.4	33.0	21.3
Level of Service (LOS)	E	E					E	C	C	C	C	C
Approach Delay, s/veh / LOS	61.1	E		0.0			26.9	C		29.8	C	
Intersection Delay, s/veh / LOS	33.3						C					



--- Messages ---

WARNING: Since queue spillover from turn lanes and spillback into upstream intersections is not accounted for in the HCM procedures, use of a simulation tool may be advised in situations where the Queue Storage Ratio exceeds 1.0.

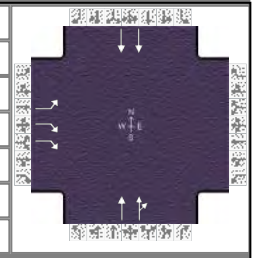
WARNING: According to input data, upstream feeding volume is equal to 114% of downstream exit volume during time period #1, for thru movement #6.

WARNING: The shared-plus-exclusive turn lane solution is an approximation of the HCM method, because more than three lane groups cannot be accommodated. Input data for Percent Turns in Shared Lane are used to specify proportion of turning vehicles in the shared lane.

--- Comments ---

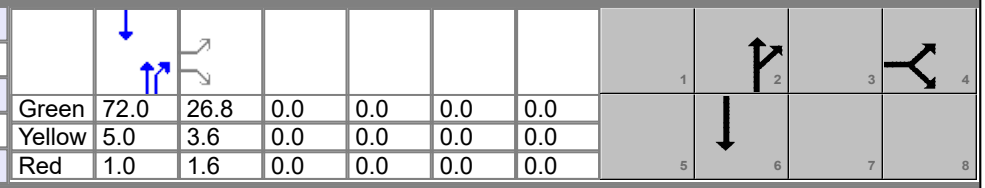
HCS7 Signalized Intersection Input Data

General Information				Intersection Information	
Agency	LJB			Duration, h	0.250
Analyst	TVF	Analysis Date	Dec 8, 2020	Area Type	Other
Jurisdiction	Columbus	Time Period	PM Peak	PHF	0.92
Urban Street	S Hamilton Rd	Analysis Year	2045 Build	Analysis Period	1> 7:00
Intersection	US 33 EB Ramps	File Name	S Hamilton Rd Intersections PM Build.xus		
Project Description	S Hamiilton Rd & US 33 Safety Study				



Demand Information	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Demand (*v*), veh/h	370		480					1970	460		1150	

Signal Information			
Cycle, s	110.0	Reference Phase	2
Offset, s	102	Reference Point	End
Uncoordinated	No	Simult. Gap E/W	On
Force Mode	Fixed	Simult. Gap N/S	On



	EB			WB			NB			SB		
Green	72.0	26.8		0.0	0.0	0.0	0.0					
Yellow	5.0	3.6		0.0	0.0	0.0	0.0					
Red	1.0	1.6		0.0	0.0	0.0	0.0					

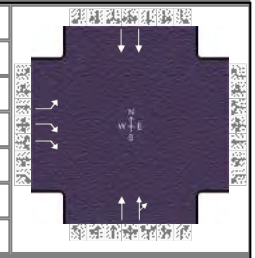
Traffic Information	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Demand (*v*), veh/h	370		480					1970	460		1150	
Initial Queue (Q_b), veh/h	0		0					0	0		0	
Base Saturation Flow Rate (s_o), veh/h	1900		1900					1900	1900		1900	
Parking (N_m), man/h		None						None			None	
Heavy Vehicles (P_{HV}), %	8		8					4			7	
Ped / Bike / RTOR, /h	0	0		0	0		0	0	0	0	0	
Buses (N_b), buses/h	0	0	0				0	0	0	0	0	0
Arrival Type (*AT*)	3		3					3	3		3	
Upstream Filtering (*I*)	1.00		1.00					0.09	0.09		0.18	
Lane Width (*W*), ft	12.0		12.0					12.0			12.0	
Turn Bay Length, ft	600		600					275			725	
Grade (*Pg*), %		0			0			0			0	
Speed Limit, mi/h	50		50					50	50		50	

Phase Information	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Maximum Green (G_{max}) or Phase Split, s		32.0				78.0		78.0
Yellow Change Interval (*Y*), s		3.6				5.0		5.0
Red Clearance Interval (R_c), s		1.6				1.0		1.0
Minimum Green (G_{min}), s		7				20		20
Start-Up Lost Time (*l1*), s	2.0					2.0		2.0
Extension of Effective Green (*e*), s	2.0					2.0		2.0
Passage (*PT*), s		5.0				3.0		3.0
Recall Mode		Min				Min		Min
Dual Entry		Yes				Yes		Yes
Walk (*Walk*), s		0.0		0.0				0.0
Pedestrian Clearance Time (*PC*), s		0.0		0.0				0.0

Multimodal Information	EB			WB			NB			SB		
85th % Speed / Rest in Walk / Corner Radius	0	No	25	0	No	25				0	No	25
Walkway / Crosswalk Width / Length, ft	9.0	12	0	9.0	12	0				9.0	12	0
Street Width / Island / Curb	0	0	No		0		0		No	0	0	No
Width Outside / Bike Lane / Shoulder, ft	12	5.0	2.0				12	5.0	2.0	12	5.0	2.0
Pedestrian Signal / Occupied Parking	No	0.50		No				0.50		No	0.50	

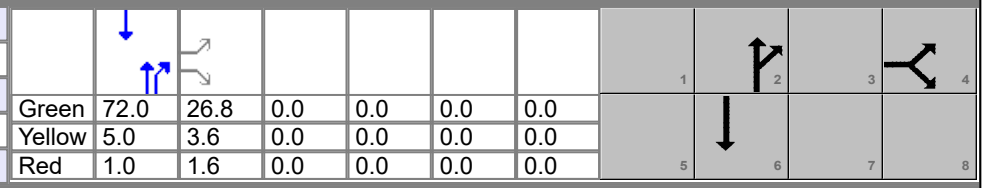
HCS7 Signalized Intersection Results Summary

General Information				Intersection Information	
Agency	LJB			Duration, h	0.250
Analyst	TVF	Analysis Date	Dec 8, 2020	Area Type	Other
Jurisdiction	Columbus	Time Period	PM Peak	PHF	0.92
Urban Street	S Hamilton Rd	Analysis Year	2045 Build	Analysis Period	1> 7:00
Intersection	US 33 EB Ramps	File Name	S Hamilton Rd Intersections PM Build.xus		
Project Description	S Hamiilton Rd & US 33 Safety Study				



Demand Information	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Demand (*v*), veh/h	370		480					1970	460		1150	

Signal Information			
Cycle, s	110.0	Reference Phase	2
Offset, s	102	Reference Point	End
Uncoordinated	No	Simult. Gap E/W	On
Force Mode	Fixed	Simult. Gap N/S	On



Green	72.0	26.8	0.0	0.0	0.0	0.0		
Yellow	5.0	3.6	0.0	0.0	0.0	0.0		
Red	1.0	1.6	0.0	0.0	0.0	0.0		

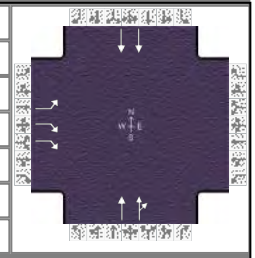
Timer Results	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Assigned Phase		4				2		6
Case Number		9.0				8.0		8.0
Phase Duration, s		32.0				78.0		78.0
Change Period, ($Y+R_c$), s		5.2				6.0		6.0
Max Allow Headway (*MAH*), s		6.1				0.0		0.0
Queue Clearance Time (g_s), s		27.8						
Green Extension Time (g_e), s		0.0				0.0		0.0
Phase Call Probability		1.00						
Max Out Probability		1.00						

Movement Group Results	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Assigned Movement	7		14					2	12		6	
Adjusted Flow Rate (*v*), veh/h	402		522					1209	1209		1511	
Adjusted Saturation Flow Rate (*s*), veh/h/ln	1697		1336					1841	1723		1710	
Queue Service Time (g_s), s	25.8		20.2					105.6	72.0		6.8	
Cycle Queue Clearance Time (g_c), s	25.8		20.2					105.6	72.0		6.8	
Green Ratio (*g/C*)	0.24		0.24					0.65	0.65		0.65	
Capacity (*c*), veh/h	413		651					1205	1128		2239	
Volume-to-Capacity Ratio (*X*)	0.973		0.801					1.003	1.072		0.675	
Back of Queue (*Q*), ft/ln (95 th percentile)	551.5		301.5					501.7	718.8		40.9	
Back of Queue (*Q*), veh/ln (95 th percentile)	20.7		11.3					19.4	27.9		1.6	
Queue Storage Ratio (*RQ*) (95 th percentile)	0.92		0.50					1.82	2.61		0.06	
Uniform Delay (d_1), s/veh	41.2		39.1					13.1	12.8		1.1	
Incremental Delay (d_2), s/veh	37.4		8.0					8.6	34.3		0.3	
Initial Queue Delay (d_3), s/veh	0.0		0.0					0.0	0.0		0.0	
Control Delay (*d*), s/veh	78.6		47.1					21.7	47.1		1.4	
Level of Service (LOS)	E		D					F	F		A	
Approach Delay, s/veh / LOS	60.8	E		0.0			34.4	C		1.4	A	
Intersection Delay, s/veh / LOS	29.2						C					

Multimodal Results	EB		WB		NB		SB	
Pedestrian LOS Score / LOS	2.15	B	2.15	B	0.68	A	1.87	B
Bicycle LOS Score / LOS		F			2.67	C	1.52	B

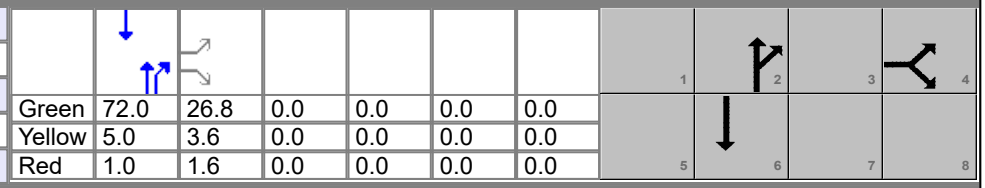
HCS7 Signalized Intersection Intermediate Values

General Information				Intersection Information	
Agency	LJB			Duration, h	0.250
Analyst	TVF	Analysis Date	Dec 8, 2020	Area Type	Other
Jurisdiction	Columbus	Time Period	PM Peak	PHF	0.92
Urban Street	S Hamilton Rd	Analysis Year	2045 Build	Analysis Period	1> 7:00
Intersection	US 33 EB Ramps	File Name	S Hamilton Rd Intersections PM Build.xus		
Project Description	S Hamiilton Rd & US 33 Safety Study				



Demand Information	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Demand (*v*), veh/h	370		480					1970	460		1150	

Signal Information			
Cycle, s	110.0	Reference Phase	2
Offset, s	102	Reference Point	End
Uncoordinated	No	Simult. Gap E/W	On
Force Mode	Fixed	Simult. Gap N/S	On



Green	72.0	26.8	0.0	0.0	0.0	0.0						
Yellow	5.0	3.6	0.0	0.0	0.0	0.0						
Red	1.0	1.6	0.0	0.0	0.0	0.0						

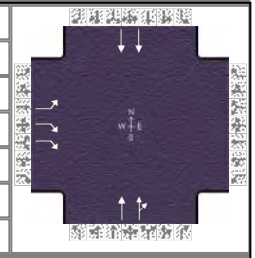
Saturation Flow / Delay	L	T	R	L	T	R	L	T	R	L	T	R
Lane Width Adjustment Factor (f_w)	1.000	1.000	1.000				1.000	1.000	1.000	1.000	1.000	1.000
Heavy Vehicles and Grade Factor (f_{HVg})	0.938	1.000	0.938				1.000	0.969	0.969	1.000	0.945	1.000
Parking Activity Adjustment Factor (f_p)	1.000	1.000	1.000	0.000	0.000	0.000	1.000	1.000	1.000	1.000	1.000	1.000
Bus Blockage Adjustment Factor (f_{bb})	1.000	1.000	1.000	0.000	0.000	0.000	1.000	1.000	1.000	1.000	1.000	1.000
Area Type Adjustment Factor (f_a)	1.000	1.000	1.000				1.000	1.000	1.000	1.000	1.000	1.000
Lane Utilization Adjustment Factor (f_{LU})	1.000	1.000	0.885	1.000	1.000	1.000	1.000	1.000	1.000	1.000	0.952	1.000
Left-Turn Adjustment Factor (f_{LT})	0.952	0.000					1.000	1.000		1.000	1.000	
Right-Turn Adjustment Factor (f_{RT})		0.000	0.847					0.936	0.936		1.000	1.000
Left-Turn Pedestrian Adjustment Factor (f_{Lpb})	1.000						1.000			1.000		
Right-Turn Ped-Bike Adjustment Factor (f_{Rpb})			1.000						1.000			1.000
Work Zone Adjustment Factor (f_{wz})	1.000	1.000	1.000				1.000	1.000	1.000	1.000	1.000	1.000
DDI Factor (f_{DDI})	1.000	1.000	1.000				1.000	1.000	1.000	1.000	1.000	1.000
Movement Saturation Flow Rate (s), veh/h	1697	0	2672				0	2912	652	0	3593	0
Proportion of Vehicles Arriving on Green (P)	0.24	0.00	0.24	0.00	0.00	0.00	0.00	0.76	0.78	0.00	0.95	0.00
Incremental Delay Factor (k)	0.49		0.39					0.50	0.50		0.50	

Signal Timing / Movement Groups	EBL	EBT/R	WBL	WBT/R	NBL	NBT/R	SBL	SBT/R
Lost Time (t_L)		4.0				6.0		6.0
Green Ratio (g/C)		0.24				0.65		0.65
Permitted Saturation Flow Rate (s_p), veh/h/ln		1697				352		145
Shared Saturation Flow Rate (s_{sh}), veh/h/ln						0		0
Permitted Effective Green Time (g_p), s		0.0				0.0		0.0
Permitted Service Time (g_u), s		0.0				0.0		0.0
Permitted Queue Service Time (g_{ps}), s								
Time to First Blockage (g_f), s		0.0				72.0		72.0
Queue Service Time Before Blockage (g_{fs}), s								
Protected Right Saturation Flow (s_R), veh/h/ln		0						
Protected Right Effective Green Time (g_R), s		0.0						

Multimodal	EB		WB		NB		SB	
Pedestrian F_w / F_v	1.389	0.000	1.389	0.000	0.000	0.000	1.198	0.000
Pedestrian F_s / F_{delay}	0.000	0.165	0.000	0.164	0.000	0.075	0.000	0.075
Pedestrian M_{corner} / M_{cw}								
Bicycle c_b / d_b		61.37	-90.91	60.11	1309.09	6.56	1309.09	6.56
Bicycle F_w / F_v	-3.64		-3.64		-3.64	2.18	-3.64	1.03

HCS7 Signalized Intersection Results Graphical Summary

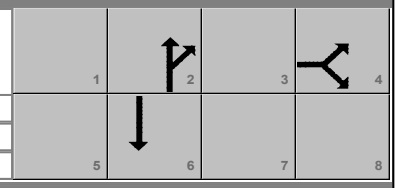
General Information				Intersection Information	
Agency	LJB			Duration, h	0.250
Analyst	TVF	Analysis Date	Dec 8, 2020	Area Type	Other
Jurisdiction	Columbus	Time Period	PM Peak	PHF	0.92
Urban Street	S Hamilton Rd	Analysis Year	2045 Build	Analysis Period	1> 7:00
Intersection	US 33 EB Ramps	File Name	S Hamilton Rd Intersections PM Build.xus		
Project Description	S Hamiilton Rd & US 33 Safety Study				



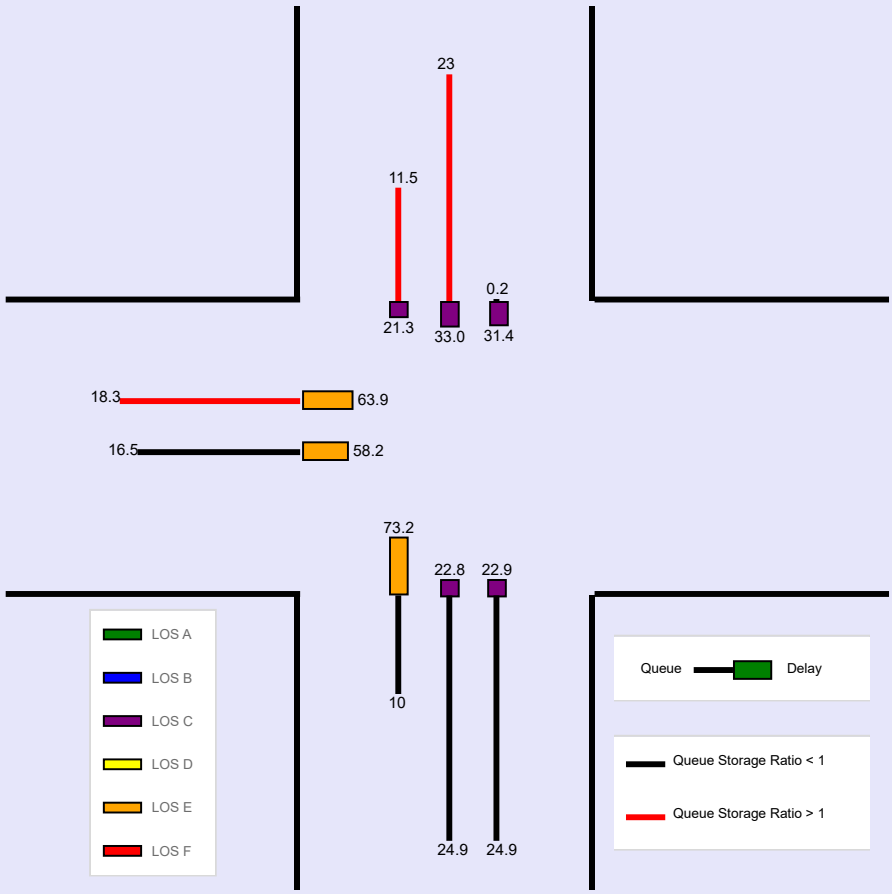
Demand Information	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Demand (*v*), veh/h	370		480					1970	460		1150	

Signal Information			
Cycle, s	110.0	Reference Phase	2
Offset, s	102	Reference Point	End
Uncoordinated	No	Simult. Gap E/W	On
Force Mode	Fixed	Simult. Gap N/S	On

Green	72.0	26.8	0.0	0.0	0.0	0.0	
Yellow	5.0	3.6	0.0	0.0	0.0	0.0	
Red	1.0	1.6	0.0	0.0	0.0	0.0	



Movement Group Results	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Back of Queue (*Q*), ft/ln (95 th percentile)	551.5		301.5					501.7	718.8		40.9	
Back of Queue (*Q*), veh/ln (95 th percentile)	20.7		11.3					19.4	27.9		1.6	
Queue Storage Ratio (*RQ*) (95 th percentile)	0.92		0.50					1.82	2.61		0.06	
Control Delay (*d*), s/veh	78.6		47.1					21.7	47.1		1.4	
Level of Service (LOS)	E		D					F	F		A	
Approach Delay, s/veh / LOS	60.8		E	0.0			34.4		C	1.4		A
Intersection Delay, s/veh / LOS	29.2						C					



--- Messages ---

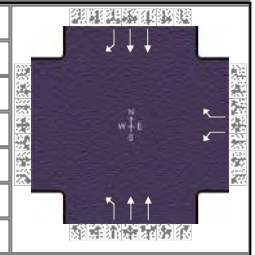
WARNING: Since queue spillover from turn lanes and spillback into upstream intersections is not accounted for in the HCM procedures, use of a simulation tool may be advised in situations where the Queue Storage Ratio exceeds 1.0.

WARNING: According to input data, upstream feeding volume is equal to 121% of downstream exit volume during time period #1, for thru movement #6.

--- Comments ---

HCS7 Signalized Intersection Input Data

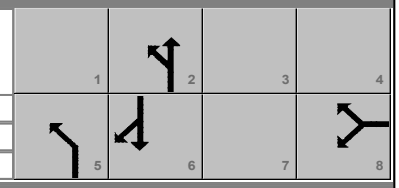
General Information				Intersection Information	
Agency	LJB			Duration, h	0.250
Analyst	TVF	Analysis Date	Dec 8, 2020	Area Type	Other
Jurisdiction	Columbus	Time Period	PM Peak	PHF	0.92
Urban Street	S Hamilton Rd	Analysis Year	2045 Build	Analysis Period	1> 7:00
Intersection	US 33 WB Ramps	File Name	S Hamilton Rd Intersections PM Build.xus		
Project Description	S Hamiilton Rd & US 33 Safety Study				



Demand Information	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Demand (*v*), veh/h				240		240	820	1520			1150	340

Signal Information			
Cycle, s	110.0	Reference Phase	2
Offset, s	52	Reference Point	End
Uncoordinated	No	Simult. Gap E/W	On
Force Mode	Fixed	Simult. Gap N/S	On

Green	34.8	39.0	20.1	0.0	0.0	0.0	
Yellow	3.6	5.0	3.6	0.0	0.0	0.0	
Red	1.6	1.0	1.3	0.0	0.0	0.0	



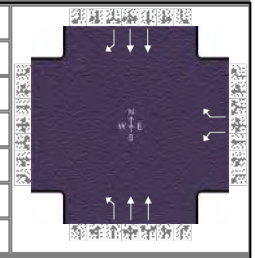
Traffic Information	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Demand (*v*), veh/h				240		240	820	1520			1150	340
Initial Queue (Q_b), veh/h				0		0	0	0			0	0
Base Saturation Flow Rate (s_o), veh/h				1900		1900	1900	1900			1900	1900
Parking (N_m), man/h					None			None			None	
Heavy Vehicles (P_{HV}), %				10		1	1	1			1	1
Ped / Bike / RTOR, /h	0	0		0	0		0	0		0	0	0
Buses (N_b), buses/h				0	0	0	0	0	0	0	0	0
Arrival Type (*AT*)				3		3	3	3			3	3
Upstream Filtering (*I*)				1.00		1.00	0.09	0.09			1.00	1.00
Lane Width (*W*), ft				12.0		12.0	12.0	12.0			12.0	12.0
Turn Bay Length, ft				300		250	600	750			0	0
Grade (*Pg*), %		0			0			0			0	
Speed Limit, mi/h				50		50	50	50			50	50

Phase Information	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Maximum Green (G_{max}) or Phase Split, s				25.0	40.0	85.0		45.0
Yellow Change Interval (*Y*), s				3.6	3.6	5.0		5.0
Red Clearance Interval (R_c), s				1.3	1.6	1.0		1.0
Minimum Green (G_{min}), s				7	10	20		20
Start-Up Lost Time (*l*t), s			2.0		2.0	2.0		2.0
Extension of Effective Green (*e*), s			2.0		2.0	2.0		2.0
Passage (*PT*), s				3.7	5.0	3.0		3.0
Recall Mode				Off	Off	Min		Min
Dual Entry				Yes	No	Yes		Yes
Walk (*Walk*), s		0.0		0.0		0.0		
Pedestrian Clearance Time (*PC*), s		0.0		0.0		0.0		

Multimodal Information	EB			WB			NB			SB		
85th % Speed / Rest in Walk / Corner Radius	0	No	25	0	No	25	0	No	25			
Walkway / Crosswalk Width / Length, ft	9.0	12	0	9.0	12	0	9.0	12	0			
Street Width / Island / Curb		0		0	0	No	0	0	No	0		No
Width Outside / Bike Lane / Shoulder, ft				12	5.0	2.0	12	5.0	2.0	12	5.0	2.0
Pedestrian Signal / Occupied Parking	No			No	0.50		No	0.50			0.50	

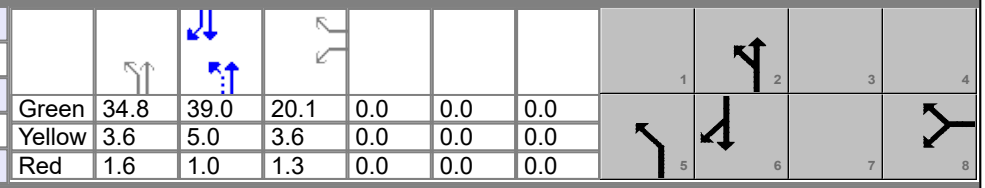
HCS7 Signalized Intersection Results Summary

General Information				Intersection Information	
Agency	LJB			Duration, h	0.250
Analyst	TVF	Analysis Date	Dec 8, 2020	Area Type	Other
Jurisdiction	Columbus	Time Period	PM Peak	PHF	0.92
Urban Street	S Hamilton Rd	Analysis Year	2045 Build	Analysis Period	1> 7:00
Intersection	US 33 WB Ramps	File Name	S Hamilton Rd Intersections PM Build.xus		
Project Description	S Hamiilton Rd & US 33 Safety Study				



Demand Information	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Demand (*v*), veh/h				240		240	820	1520			1150	340

Signal Information			
Cycle, s	110.0	Reference Phase	2
Offset, s	52	Reference Point	End
Uncoordinated	No	Simult. Gap E/W	On
Force Mode	Fixed	Simult. Gap N/S	On



Green	34.8	39.0	20.1	0.0	0.0	0.0						
Yellow	3.6	5.0	3.6	0.0	0.0	0.0						
Red	1.6	1.0	1.3	0.0	0.0	0.0						

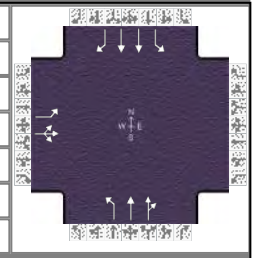
Timer Results	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Assigned Phase				8	5	2		6
Case Number				9.0	1.0	4.0		7.3
Phase Duration, s				25.0	40.0	85.0		45.0
Change Period, (*Y+R c*), s				4.9	5.2	6.0		6.0
Max Allow Headway (*MAH*), s				4.8	6.0	0.0		0.0
Queue Clearance Time (*g s*), s				19.5	36.8			
Green Extension Time (*g e*), s				0.2	0.0	0.0		0.0
Phase Call Probability				1.00	1.00			
Max Out Probability				1.00	1.00			

Movement Group Results	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Assigned Movement				3		18	5	2			6	16
Adjusted Flow Rate (*v*), veh/h				261		261	809	1499			1250	370
Adjusted Saturation Flow Rate (*s*), veh/h/ln				1668		1598	1795	1795			1795	1598
Queue Service Time (*g s*), s				16.7		17.5	34.8	23.4			37.9	21.4
Cycle Queue Clearance Time (*g c*), s				16.7		17.5	34.8	23.4			37.9	21.4
Green Ratio (*g/C*)				0.18		0.18	0.69	0.72			0.35	0.35
Capacity (*c*), veh/h				305		292	638	2578			1273	566
Volume-to-Capacity Ratio (*X*)				0.856		0.894	1.268	0.582			0.982	0.652
Back of Queue (*Q*), ft/ln (95 th percentile)				352.3		345.8	936.8	211.3			659.8	336.7
Back of Queue (*Q*), veh/ln (95 th percentile)				13.0		13.7	37.2	8.4			26.2	13.4
Queue Storage Ratio (*RQ*) (95 th percentile)				1.17		1.38	1.56	0.28			0.00	0.00
Uniform Delay (*d 1*), s/veh				43.5		43.9	26.0	8.3			35.2	29.8
Incremental Delay (*d 2*), s/veh				21.0		27.8	121.8	0.1			21.3	5.8
Initial Queue Delay (*d 3*), s/veh				0.0		0.0	0.0	0.0			0.0	0.0
Control Delay (*d*), s/veh				64.5		71.7	147.8	8.3			56.5	35.6
Level of Service (LOS)				E		E	F	A			E	D
Approach Delay, s/veh / LOS	0.0			68.1		E	57.2		E	51.7		D
Intersection Delay, s/veh / LOS	56.5						E					

Multimodal Results	EB		WB		NB		SB	
Pedestrian LOS Score / LOS	2.32	B	2.32	B	1.63	B	1.41	A
Bicycle LOS Score / LOS				F	2.59	C	1.82	B

HCS7 Signalized Intersection Results Graphical Summary

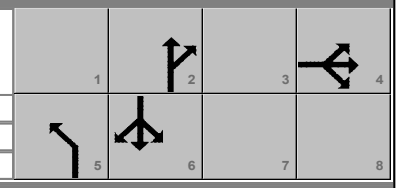
General Information				Intersection Information	
Agency	LJB			Duration, h	0.250
Analyst	TVF	Analysis Date	Dec 8, 2020	Area Type	Other
Jurisdiction	Columbus	Time Period	PM Peak	PHF	0.92
Urban Street	S Hamilton Rd	Analysis Year	2045 Build	Analysis Period	1> 7:00
Intersection	Williams Rd	File Name	S Hamilton Rd Intersections PM Build.xus		
Project Description	S Hamiilton Rd & US 33 Safety Study				



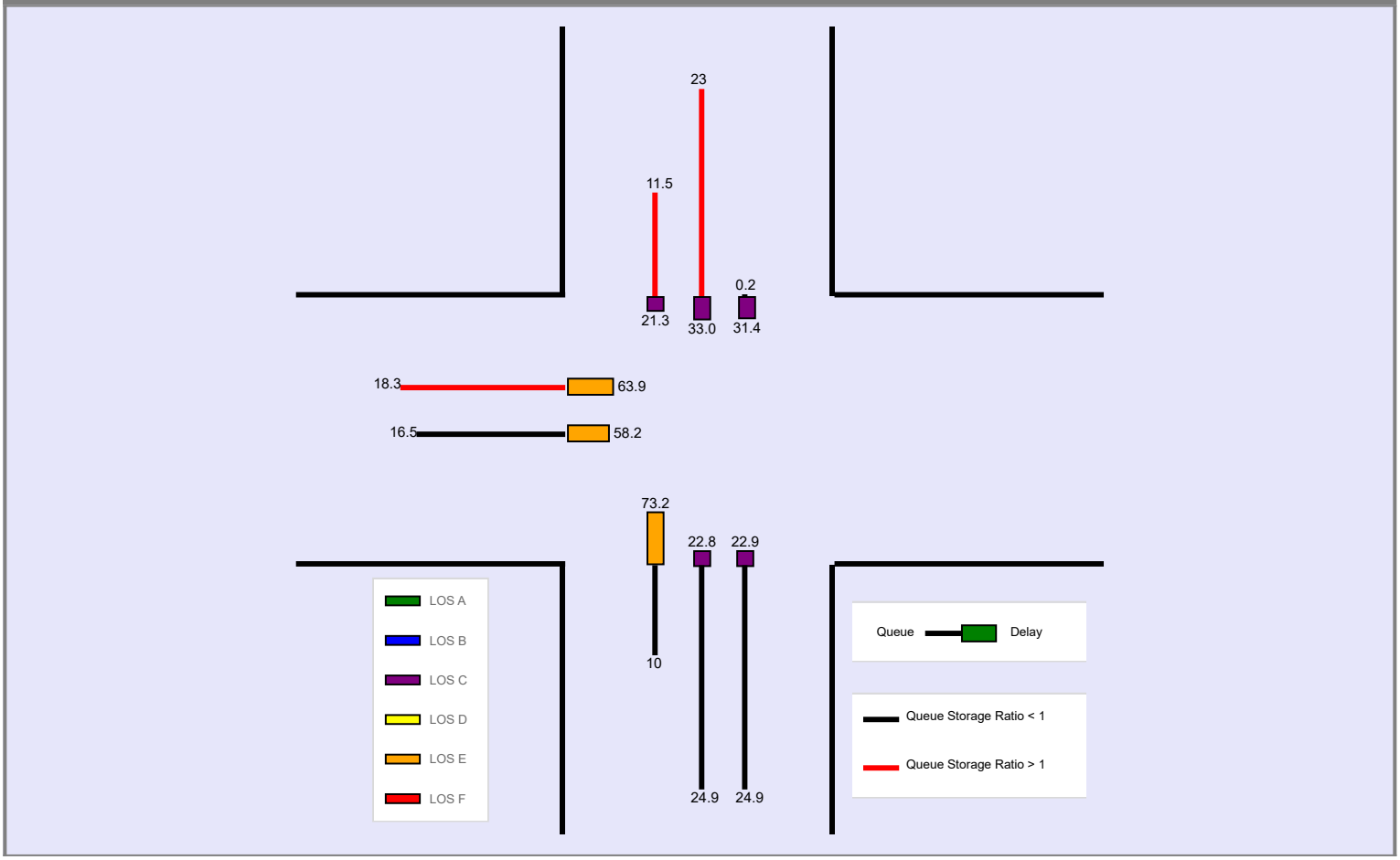
Demand Information	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Demand (*v*), veh/h	600	5	90				160	1830	5	5	1180	450

Signal Information			
Cycle, s	110.0	Reference Phase	2
Offset, s	5	Reference Point	End
Uncoordinated	No	Simult. Gap E/W	On
Force Mode	Float	Simult. Gap N/S	On

Green	13.1	52.5	27.8	0.0	0.0	0.0	
Yellow	3.6	5.0	3.6	0.0	0.0	0.0	
Red	1.8	1.0	1.6	0.0	0.0	0.0	



Movement Group Results	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Back of Queue (*Q*), ft/ln (95 th percentile)	488	439.9					258.8	647.8	623.3	6.5	601.5	302.2
Back of Queue (*Q*), veh/ln (95 th percentile)	18.3	16.5					10.0	24.9	24.9	0.2	23.0	11.5
Queue Storage Ratio (*RQ*) (95 th percentile)	0.98	0.63					0.43	0.54	0.54	0.05	2.00	1.10
Control Delay (*d*), s/veh	63.9	58.2					73.2	22.8	22.9	31.4	33.0	21.3
Level of Service (LOS)	E	E					E	C	C	C	C	C
Approach Delay, s/veh / LOS	61.1	E		0.0			26.9	C		29.8	C	
Intersection Delay, s/veh / LOS	33.3						C					



--- Messages ---

WARNING: Since queue spillover from turn lanes and spillback into upstream intersections is not accounted for in the HCM procedures, use of a simulation tool may be advised in situations where the Queue Storage Ratio exceeds 1.0.

WARNING: According to input data, upstream feeding volume is equal to 114% of downstream exit volume during time period #1, for thru movement #6.

WARNING: The shared-plus-exclusive turn lane solution is an approximation of the HCM method, because more than three lane groups cannot be accommodated. Input data for Percent Turns in Shared Lane are used to specify proportion of turning vehicles in the shared lane.

--- Comments ---

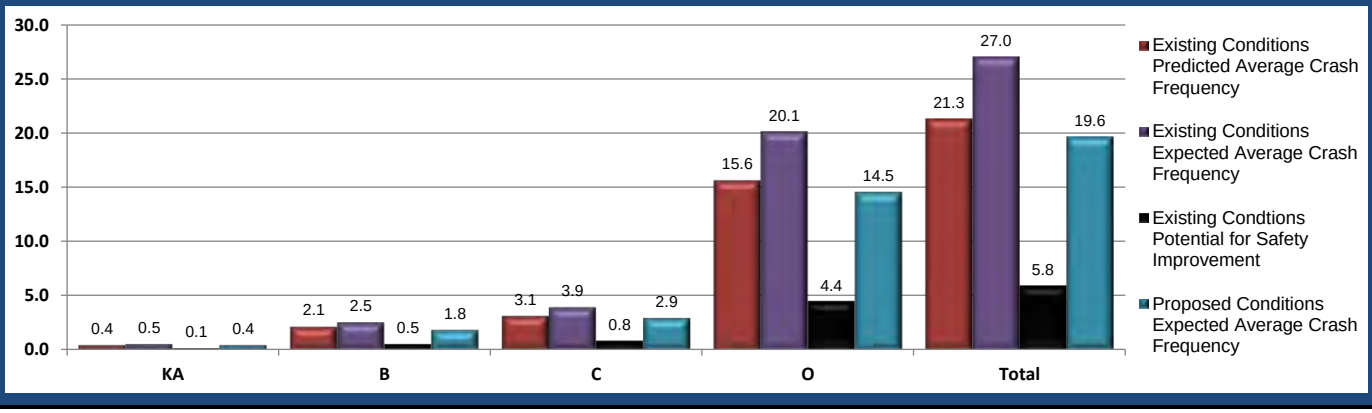
APPENDIX E
ECAT ANALYSIS

Project Safety Performance Report

General Information

Project Name	FRA/FAI-33	Contact Email	tflask@ljbinc.com
Project Description	S Hamilton Rd & US 33 Interchange Safety Study	Contact Phone	216-303-6055
Reference Number	#185 Urban Intersection (Hamilton &	Date Performed	12/22/2020
Analyst	TVF	Analysis Year	2020
Agency/Company	LJB		

Summary of Anticipated Safety Performance of the Project (average crashes/year)



Project Summary Results (Without Animal Crashes)

	KA	B	C	O	Total
$N_{predicted}$ - Existing Conditions	0.4386	2.0697	3.1105	15.6383	21.2571
$N_{expected}$ - Existing Conditions	0.5423	2.5391	3.8698	20.0642	27.0154
$N_{potential\ for\ improvement}$ - Existing Conditions	**0.1037**	**0.4694**	**0.7593**	**4.4259**	**5.7583**
$N_{expected}$ - Proposed Conditions	0.3723	1.8360	2.9335	14.4957	19.6375

Existing Conditions Project Element Predicted Crash Summary (Without Animal Crashes)

Project Element ID	Common Name	Crash Severity Level				
		KA	B	C	O	Total
SR317N; 9.03	Hamilton & Williams	0.1754	0.7928	1.0948	6.7156	8.7786
SR317N; 9.11	Hamilton & EB Ramps	0.0626	0.4505	0.7385	0.7013	1.9529
SR317N; 9.27	Hamilton & WB Ramps	0.2006	0.8264	1.2772	8.2214	10.5256

Existing Conditions Project Element Expected Crash Summary (Without Animal Crashes)

Project Element ID	Common Name	Crash Severity Level				
		KA	B	C	O	Total
SR317N; 9.03	Hamilton & Williams	0.1985	0.9224	1.3277	8.0706	10.5192
SR317N; 9.11	Hamilton & EB Ramps	0.0652	0.4691	0.7691	1.5815	2.8849
SR317N; 9.27	Hamilton & WB Ramps	0.2786	1.1476	1.773	10.4121	13.6113

Existing Conditions Project Element Potential for Safety Improvement Summary (Without Animal Crashes)

Project Element ID	Common Name	Crash Severity Level				
		KA	B	C	O	Total
SR317N; 9.03	Hamilton & Williams	**0.0231**	**0.1296**	**0.2329**	**1.355**	**1.7406**
SR317N; 9.11	Hamilton & EB Ramps	**0.0026**	**0.0186**	**0.0306**	**0.8802**	**0.932**
SR317N; 9.27	Hamilton & WB Ramps	**0.078**	**0.3212**	**0.4958**	**2.1907**	**3.0857**

Proposed Conditions Project Element Expected Crash Summary (Without Animal Crashes)

Project Element ID	Common Name	Crash Severity Level				
		KA	B	C	O	Total
SR317N; 9.03	Hamilton & Williams	0.144	0.6892	1.0396	6.4816	8.3544
SR317N; 9.11	Hamilton & EB Ramps	0.0541	0.4026	0.6866	1.4233	2.5666
SR317N; 9.27	Hamilton & WB Ramps	0.1742	0.7442	1.2073	6.5908	8.7165

Project Safety Performance Report

General Information

Project Name	FRA/FAI-33	Contact Email	tflask@ljbinc.com
Project Description	S Hamilton Rd & US 33 Interchange Safety Study	Contact Phone	216-303-6055
Reference Number	#185 Urban Intersection (Hamilton &	Date Performed	12/22/2020
Analyst	TVF	Analysis Year	2020
Agency/Company	LJB		

Summary by Crash Type

Crash Type	Existing			Proposed
	Predicted Crash Frequency	Expected Crash Frequency	PSI	Expected Crash Frequency
Unknown	0.0131	0.0160	**0.0028**	0.0104
Head On	0.0889	0.1109	**0.0220**	0.0757
Rear End	10.6396	12.6814	**2.0418**	10.2086
Backing	0.3803	0.4462	**0.0659**	0.2993
Sideswipe - Meeting	0.2155	0.2569	**0.0414**	0.1806
Sideswipe - Passing	2.4370	2.8360	**0.3990**	1.9166
Angle	3.8484	4.5517	**0.7034**	3.0335
Parked Vehicle	0.2864	0.3251	**0.0386**	0.2106
Pedestrian	0.0531	0.0665	**0.0134**	0.0303
Animal	0.0000	0.0000	0.0000	0.0000
Train	0.0003	0.0003	0.0000	0.0002
Pedalcycles	0.3343	0.2973	-0.0370	0.1400
Other Non-Vehicle	0.0000	0.0000	0.0000	0.0000
Fixed Object	0.7896	0.8901	**0.1005**	0.5587
Other Object	0.0324	0.0390	**0.0066**	0.0249
Overturning	0.0744	0.0828	**0.0084**	0.0524
Other Non-Collision	0.0990	0.1084	**0.0094**	0.0668
Left Turn	1.9647	2.3644	**0.3996**	1.5942
Right Turn	0.0000	0.0000	0.0000	0.0000

APPENDIX F
BENEFIT-COST ANALYSIS

CY 2020-2024 Business Plan Inflation Calculator:

Not sure if you have the latest calculator? Click here.

Last Modified: 1/29/2020

Today's Date:
December 30, 2020

Please Enter Values in the Yellow Areas Only:

Estimation Start Date:
Less than or Equal to Today's Date
(mm/dd/yyyy)

12/17/2020
Start Date:

Enter Construction Mid-Point Date:
(cannot exceed 12/30/2045)
(mm/dd/yyyy)

5/1/2025
Construction Mid-Point Date:

Present-Day Estimated Cost:

$1,202,361.00
Estimated Dollar Amount:

Estimate Start Date to Construction Mid-Point Date: 53 Months

Inflation - Start to Mid-Point of Construction:

	(compounded growth rate)	Inflated Dollar Amount:
Business Plan	13.4%	$1,363,387.39

Estimator's Name:

County - Route - Section: FRA/FAI-33-Feasibility Study

PID: 111460

Estimator's Notes:
Hamilton & US 33 Interchange Safety Study

HAMILTON RD & US 33 SAFETY STUDY

CITIES OF COLUMBUS AND GROVEPORT, FRANKLIN COUNTY, OHIO

PRELIMINARY CONSTRUCTION COST ESTIMATE

LINE NO.	ODOT ITEM	EXT	DESCRIPTION	ESTIMATED QUANTITY	UNIT	UNIT COST	TOTAL COST
UPGRADE TRAFFIC SIGNALS TO INCLUDE BACKPLATES AND RADAR DETECTION							**$ 218,014**
1	632	E05006	Vehicular signal head, (LED), 3-section- 12" lens, 1-way, polycarbonate	14	EA	$ 800.00	$ 11,200
2	632	E86130	Strain pole, Type TC-81.11, Design 10	12	EA	$ 5,000.00	$ 60,000
3	632	E64000	Strain pole foundation	12	EA	$ 4,188.00	$ 50,256
4	809	E69000	Advance radar detection	9	EA	$ 6,688.00	$ 60,192
5	809	E69100	Stop line radar detection	6	EA	$ 6,061.00	$ 36,366
REVISE CLEARANCE INTERVALS TO BE COMPLIANT WITH THE ODOT AND THE ITE EVALUATION METHOD							
6	No construction required						
INSTALL EMERGENCY VEHICLE PREEMPTION							**$ 18,750**
7	809	E69200	Emergency vehicle preemption	3	EA	$ 800.00	$ 2,400
8	809	E69210	Preempt receiving unit	9	EA	$ 650.00	$ 5,850
9	809	E69230	Preempt phase selector	3	EA	$ 2,000.00	$ 6,000
10	809	E69240	Preempt confirmation light	9	EA	$ 500.00	$ 4,500
EXTEND THE NBL TURN LANE AT HAMILTON & US 33 WB RAMPS							**$ 2,685**
8	646	E10200	Center line	0.03	MI	$ 53,212.00	$ 1,794
9	646	E10300	Channelizing line, 8"	126	FT	$ 3.50	$ 441
10	646	E20300	Lane arrow	2	EA	$ 225.00	$ 450
ADD EMERGENCY VEHICLE WARNING SIGNS ON US 33 MAINLINE							**$ 720**
11	630	E80100	Sign, flat sheet	40	SF	$ 18.00	$ 720

HAMILTON RD & US 33 SAFETY STUDY

CITIES OF COLUMBUS AND GROVEPORT, FRANKLIN COUNTY, OHIO

PRELIMINARY CONSTRUCTION COST ESTIMATE

LINE NO.	ODOT ITEM	EXT	DESCRIPTION	ESTIMATED QUANTITY	UNIT	UNIT COST	TOTAL COST
ADD VIDEO SURVEILLANCE AT EACH INTERSECTION							**$ 31,995**
12	809	E60000	CCTV IP-camera system, dome-type	3	EA	$ 10,665.00	$ 31,995
EXTEND THE NBL TURN LANE AT HAMILTON & WILLIAMS							**$ 73,539**
13	202	E30600	Concrete median removed	113	SY	$ 22.50	$ 2,545
14	202	E32000	Curb removed	190	FT	$ 11.50	$ 2,185
15	203	E10000	Excavation	256	CY	$ 14.00	$ 3,578
16	203	E20000	Embankment	26	CY	$ 11.00	$ 281
17	204	E10000	Subgrade compaction	767	SY	$ 2.00	$ 1,533
18	301	E46000	Asphalt concrete base, PG64-22	128	CY	$ 142.00	$ 18,144
19	304	E20000	Aggregate base	170	CY	$ 62.00	$ 10,563
20	441	E50000	Asphalt concrete surface course, type 1, (448), PG64-22	27	CY	$ 202.00	$ 5,377
21	441	E50300	Asphalt concrete intermediate course, type 2, (448)	37	CY	$ 161.00	$ 6,000
22	609	E26000	Curb, Type 6	300	FT	$ 22.00	$ 6,600
23	609	E72000	Concrete median	120	SY	$ 69.00	$ 8,280
24	646	E10000	Edge line, 4"	0.16	MI	$ 24,000.00	$ 3,823
25	646	E10300	Channelizing line, 8"	600	FT	$ 3.50	$ 2,100
26	646	E20300	Lane arrow	9	EA	$ 225.00	$ 2,025
27	646	E10400	Stop line	36	FT	$ 14.00	$ 504
CHANGE THE NBL TURN PHASING TO PROTECTED ONLY AT HAMILTON & WILLIAMS							**$ 1,600**
28	632	E05006	Vehicular signal head, (LED), 3-section- 12" lens, 1-way, polycarbonate	2	EA	$ 800.00	$ 1,600

HAMILTON RD & US 33 SAFETY STUDY

CITIES OF COLUMBUS AND GROVEPORT, FRANKLIN COUNTY, OHIO

PRELIMINARY CONSTRUCTION COST ESTIMATE

LINE NO.	ODOT ITEM	EXT	DESCRIPTION	ESTIMATED QUANTITY	UNIT	UNIT COST	TOTAL COST
ADD A SBR TURN LANE AT HAMILTON & WILLIAMS							**$ 100,756**
29	202	E38000	Guardrail removed	330	FT	$ 2.00	$ 660
30	203	E10000	Excavation	95	CY	$ 14.00	$ 1,327
31	203	E20000	Embankment	1,519	CY	$ 11.00	$ 16,709
32	204	E10000	Subgrade compaction	642	SY	$ 2.00	$ 1,284
33	301	E46000	Asphalt concrete base, PG64-22	107	CY	$ 142.00	$ 15,186
34	304	E20000	Aggregate base	143	CY	$ 62.00	$ 8,841
35	441	E50000	Asphalt concrete surface course, type 1, (448), PG64-22	22	CY	$ 202.00	$ 4,501
36	441	E50300	Asphalt concrete intermediate course, type 2, (448)	31	CY	$ 161.00	$ 5,022
37	606	E13000	Guardrail, Type 5	330	FT	$ 16.00	$ 5,280
38	611	E07600	18" conduit, Type C	400	FT	$ 65.00	$ 26,000
39	611	E98510	Catch basin, No. 2-3	3	EA	$ 2,200.00	$ 6,600
40	611	E99154	Inlet reconstructed to grade	1	EA	$ 2,800.00	$ 2,800
41	630	E80100	Sign, flat sheet	50	SF	$ 18.00	$ 900
42	632	E05086	Vehicular signal head, (LED), 5-section- 12" lens, 1-way, polycarbonate	1	EA	$ 1,250.00	$ 1,250
43	646	E10000	Edge line, 4"	0.07	MI	$ 24,000.00	$ 1,782
44	646	E10300	Channelizing line, 8"	305	FT	$ 3.50	$ 1,068
45	646	E20300	Lane arrow	5	EA	$ 225.00	$ 1,125
46	646	E10400	Stop line	30	FT	$ 14.00	$ 420
WIDEN THE EB APPROACH TO 3 LANES AT HAMILTON & US 33 EB RAMPS							**$ 177,493**
47	202	E38000	Guardrail removed	533	FT	$ 2.00	$ 1,066
48	202	E58100	Catch basin removed	1	EA	$ 500.00	$ 500
49	203	E10000	Excavation	158	CY	$ 14.00	$ 2,211
50	203	E20000	Embankment	6,017	CY	$ 11.00	$ 66,187
51	204	E10000	Subgrade compaction	1,599	SY	$ 2.00	$ 3,198
52	301	E46000	Asphalt concrete base, PG64-22	267	CY	$ 142.00	$ 37,843
53	304	E20000	Aggregate base	355	CY	$ 62.00	$ 22,031
54	441	E50000	Asphalt concrete surface course, type 1, (448), PG64-22	56	CY	$ 202.00	$ 11,216

HAMILTON RD & US 33 SAFETY STUDY

CITIES OF COLUMBUS AND GROVEPORT, FRANKLIN COUNTY, OHIO

PRELIMINARY CONSTRUCTION COST ESTIMATE

LINE NO.	ODOT ITEM	EXT	DESCRIPTION	ESTIMATED QUANTITY	UNIT	UNIT COST	TOTAL COST
55	441	E50300	Asphalt concrete intermediate course, type 2, (448)	78	CY	$ 161.00	$ 12,515
56	606	E13000	Guardrail, Type 5	533	FT	$ 16.00	$ 8,528
57	630	E80100	Sign, flat sheet	23	SF	$ 18.00	$ 405
58	630	E87500	Removal of pole mounted sign and disposal	3	EA	$ 27.00	$ 81
59	632	E05006	Vehicular signal head, (LED), 3-section- 12" lens, 1-way, polycarbonate	3	EA	$ 800.00	$ 2,400
60	646	E10000	Edge line, 4"	0.10	MI	$ 24,000.00	$ 2,423
61	646	E10300	Channelizing line, 8"	832	FT	$ 3.50	$ 2,912
62	646	E20300	Lane arrow	15	EA	$ 225.00	$ 3,375
63	646	E10400	Stop line	43	FT	$ 14.00	$ 602
REMOVE THE SLIP RAMP FOR THE WBR MOVEMENT, REPLACING IT WITH WBR TURN LANE AT HAMILTON & US 33 RAMPS INTERSECTION							**$ 144,069**
64	201	E11000	Clearing and grubbing	1	LS	$ 5,000.00	$ 5,000
65	202	E38000	Guardrail removed	920	FT	$ 2.00	$ 1,840
66	202	E23000	Pavement removed	1,167	SY	$ 11.00	$ 12,835
67	203	E10000	Excavation	4,816	CY	$ 14.00	$ 67,418
68	203	E20000	Embankment	685	CY	$ 11.00	$ 7,539
69	204	E10000	Subgrade compaction	711	SY	$ 2.00	$ 1,423
70	301	E46000	Asphalt concrete base, PG64-22	119	CY	$ 142.00	$ 16,830
71	304	E20000	Aggregate base	158	CY	$ 62.00	$ 9,798
72	441	E50000	Asphalt concrete surface course, type 1, (448), PG64-22	25	CY	$ 202.00	$ 4,988
73	441	E50300	Asphalt concrete intermediate course, type 2, (448)	35	CY	$ 161.00	$ 5,566
74	606	E13000	Guardrail, Type 5	240	FT	$ 16.00	$ 3,840
75	630	E80100	Sign, flat sheet	50	SF	$ 18.00	$ 900
76	646	E10000	Edge line, 4"	0.05	MI	$ 24,000.00	$ 1,091
77	646	E10300	Channelizing line, 8"	393	FT	$ 3.50	$ 1,376
78	646	E20300	Lane arrow	14	EA	$ 225.00	$ 3,150
79	646	E10400	Stop line	34	FT	$ 14.00	$ 476

HAMILTON RD & US 33 SAFETY STUDY

CITIES OF COLUMBUS AND GROVEPORT, FRANKLIN COUNTY, OHIO

PRELIMINARY CONSTRUCTION COST ESTIMATE

LINE NO.	ODOT ITEM	EXT	DESCRIPTION	ESTIMATED QUANTITY	UNIT	UNIT COST	TOTAL COST
ADD A SBR TURN LANE AT HAMILTON & US 33 WB RAMPS							**$ 119,769**
80	201	E11000	Clearing and grubbing	1	LS	$ 5,000.00	$ 5,000
81	202	E38000	Guardrail removed	590	FT	$ 2.00	$ 1,180
82	203	E10000	Excavation	170	CY	$ 14.00	$ 2,385
83	203	E20000	Embankment	2,700	CY	$ 11.00	$ 29,705
84	204	E10000	Subgrade compaction	1,182	SY	$ 2.00	$ 2,364
85	301	E46000	Asphalt concrete base, PG64-22	197	CY	$ 142.00	$ 27,973
85	304	E20000	Aggregate base	263	CY	$ 62.00	$ 16,285
86	441	E50000	Asphalt concrete surface course, type 1, (448), PG64-22	41	CY	$ 202.00	$ 8,291
87	441	E50300	Asphalt concrete intermediate course, type 2, (448)	57	CY	$ 161.00	$ 9,251
88	606	E13000	Guardrail, Type 5	590	FT	$ 16.00	$ 9,440
89	630	E80100	Sign, flat sheet	50	SF	$ 18.00	$ 900
90	632	E05006	Vehicular signal head, (LED), 3-section- 12" lens, 1-way, polycarbonate	1	EA	$ 800.00	$ 800
91	646	E10000	Edge line, 4"	0.11	MI	$ 24,000.00	$ 2,682
92	646	E10300	Channelizing line, 8"	570	FT	$ 3.50	$ 1,995
93	646	E20300	Lane arrow	6	EA	$ 225.00	$ 1,350
94	646	E10400	Stop line	12	FT	$ 14.00	$ 168
CHANGE NBL TURN SIGNAL HEAD TO A FLASHING YELLOW ARROW							**$ 1,250**
95	632	E05086	Vehicular signal head, (LED), 5-section- 12" lens, 1-way, polycarbonate	1	EA	$ 1,250.00	$ 1,250

CONSTRUCTION COST	$	890,640
MAINTENANCE OF TRAFFIC	$	44,532
CONTINGENCY (30%)	$	267,192
CONSTRUCTION COST SUBTOTAL	$	1,202,364
INFLATION (13.4%)	$	161,117
TOTAL CONSTRUCTION COST	**$**	**1,363,480**
PRELIMINARY ENGINEERING (20%)	**$**	**272,696**
RIGHT OF WAY	**$**	**-**
CONSTRUCTION ENGINEERING (7%)	**$**	**95,444**
TOTAL	**$**	**1,731,620**

Safety Benefit - Cost Analysis

General Information

Project Name	FRA/FAI-33	Contact Email	tflask@ljbinc.com
Project Description	S Hamilton Rd & US 33 Interchange Safety Study	Contact Phone	216-303-6055
Reference Number	#185 Urban Intersection (Hamilton & Williams), #41 Urban Non-freeway (Hamilton)	Date Performed	12/22/2020
Analyst	TVF	Analysis Year	2020
Agency/Company	LJB		

Select Site Types to be used in Benefit-Cost Analysis:

All Sites

Comments:

Countermeasure Service Lives, Costs, and Safety Benefits

Countermeasures	Service Life (Years)	Initial Cost of Countermeasure	Annual Maintenance & Energy Costs	Salvage Value	Net Present Cost of Countermeasure	Total Cost of Countermeasures	Summary of Annual Crash Modifications	Net Present Value of Safety Benefits
Add a SBR turn lane at Hamilton & Williams	20	$151,134.00			$151,134.00	$151,134.00	-4.224	$1,436,722
Widen the EB approach to 3 lanes at Hamilton & US 33 EB Ramps	20	$266,239.50			$266,239.50	$266,239.50		
Remove the slip ramp for the WBR movement, replacing it with WBR turn lane at Hamilton & US 33 Ramps	20	$216,103.50			$216,103.50	$216,103.50		
Add a SBR turn lane at Hamilton & US 33 WB Ramps	20	$299,653.50			$299,653.50	$299,653.50		
CMF 1 - Add 3-inch yellow retroreflective sheeting to signal backplates	10	$327,021.00			$654,042.00	$811,091.97	-3.419	$1,405,991
Extend the NBL turn lane at Hamilton & Williams	20	$110,308.50			$110,308.50	$110,308.50	0.000	$0
ITS equipment, signage, pavement markings, and other project costs.	10	$161,625.00			$323,250.00	$400,869.48	0.000	$0
		$0.00			$0.00	$0.00	0.000	$0
CMF 5 - Modify change plus clearance interval to ITE 1985 Proposed Recommended Practice (4-leg signalized)	10	$1,500.00			$3,000.00	$3,720.37	0.571	$2,123
CMF 6 - Change from 5-section "doghouse" protected/permissive left turn to flashing yellow arrow protected/permitted left turn	10	$1,875.00			$3,750.00	$4,650.46	-0.306	$186,650
		$0.00			$0.00	$0.00	0.000	$0
		$0.00			$0.00	$0.00	0.000	$0
		$0.00			$0.00	$0.00	0.000	$0
		$0.00			$0.00	$0.00	0.000	$0
Totals		**$1,535,460.00**	**$0.00**	**$0.00**	**$2,027,481.00**	**$2,263,771.27**	**-7.378**	**$3,031,486**

Safety Benefit - Cost Analysis

General Information

Project Name	FRA/FAI-33	Contact Email	tflask@ljbinc.com
Project Description	S Hamilton Rd & US 33 Interchange Safety Study	Contact Phone	216-303-6055
Reference Number	#185 Urban Intersection (Hamilton & Williams), #41 Urban Non-freeway (Hamilton)	Date Performed	12/22/2020
Analyst	TVF	Analysis Year	2020
Agency/Company	LJB		

Benefit - Cost Calculator

Net Present Value of Project	$2,027,481.00
Net Present Value of Safety Benefits	$3,031,486.03
Net Benefit	$1,004,005.03
Benefit / Cost Ratio	1.50

Expected Annual Crash Adjustment

Number of Fatal & Incapacitating Injury Crashes	-0.170
Number of Injury Crashes	-1.809
Number of Total Crashes	-7.378

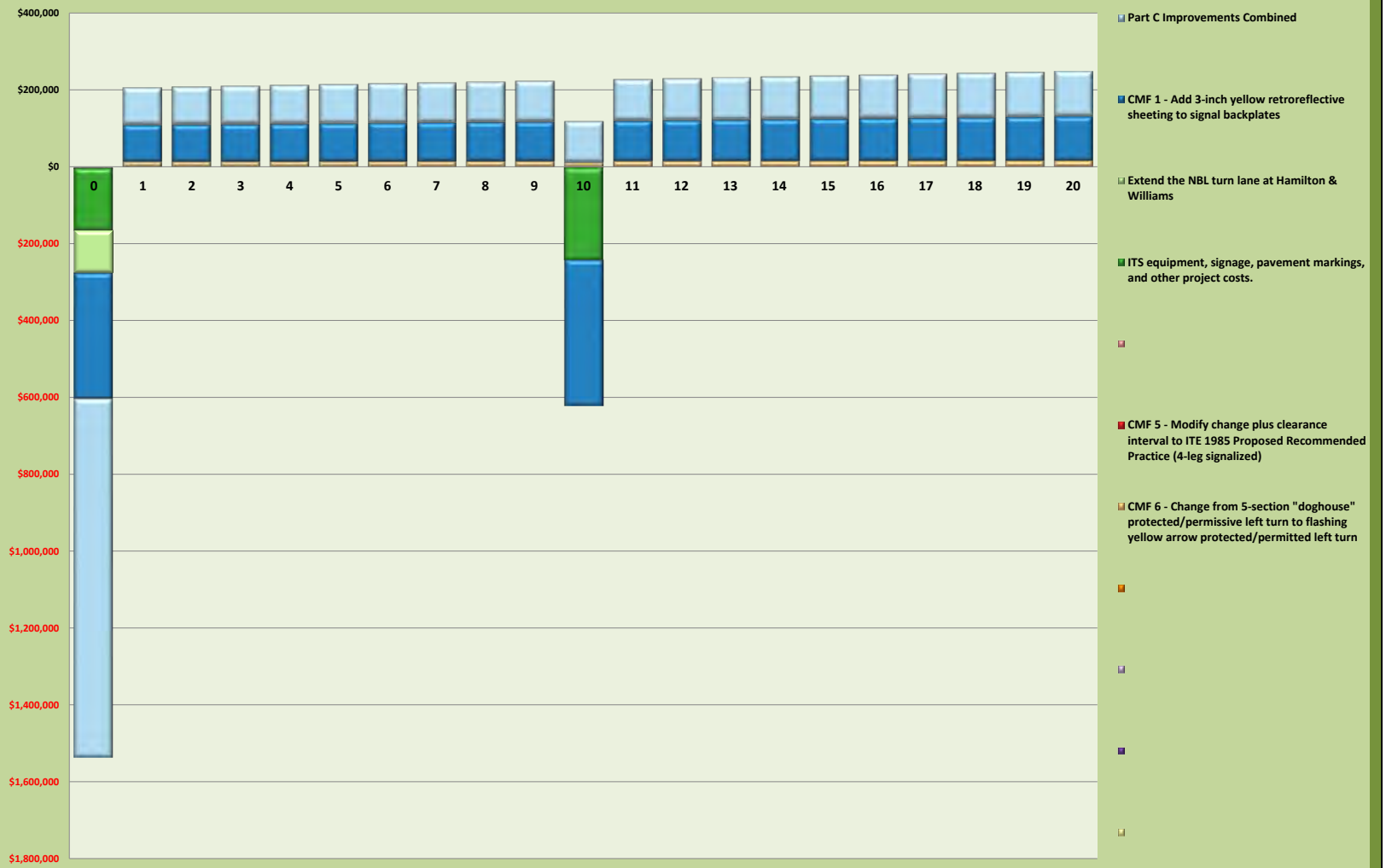
Comments:

Safety Benefit - Cost Analysis

General Information

Project Name	FRA/FAI-33	Contact Email	tflask@ljbinc.com
Project Description	S Hamilton Rd & US 33 Interchange Safety Study	Contact Phone	216-303-6055
Reference Number	#185 Urban Intersection (Hamilton & Williams), #41 Urban Non-freeway (Hamilton)	Date Performed	12/22/2020
Analyst	TVF	Analysis Year	2020
Agency/Company	LJB		

Safety Benefits and Project Costs Combined Cash Flows By Countermeasure Per Year

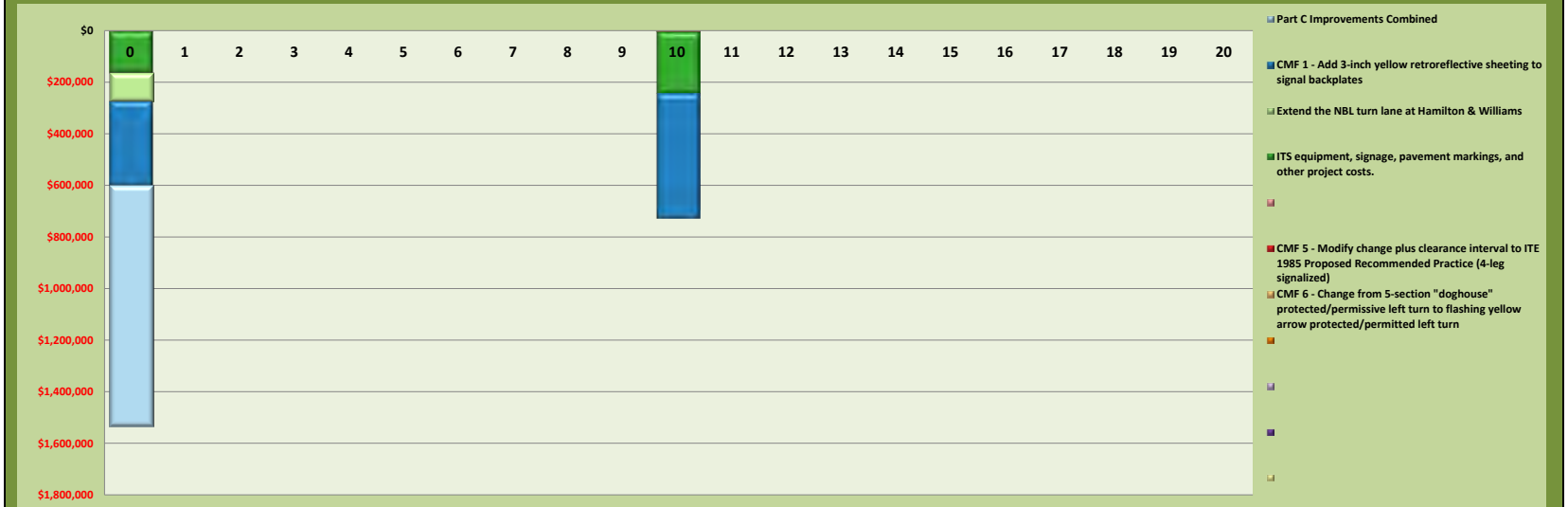


Safety Benefit - Cost Analysis

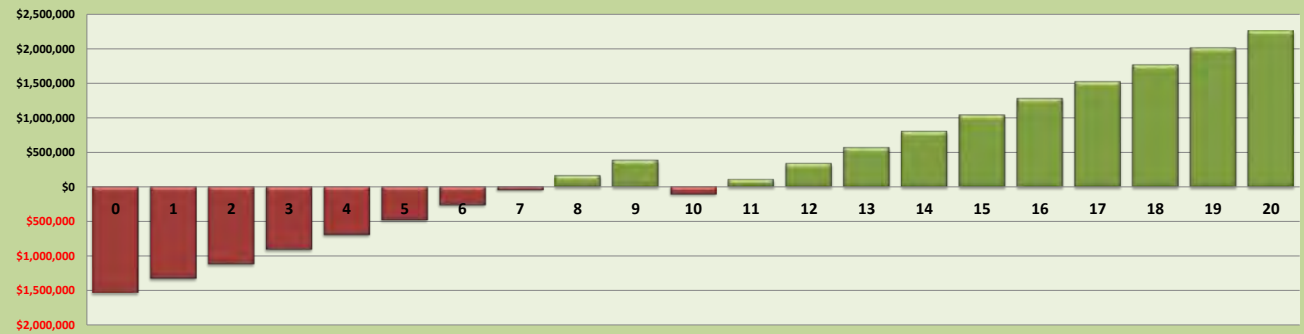
General Information

Project Name	FRA/FAI-33	Contact Email	tflask@ljbinc.com
Project Description	S Hamilton Rd & US 33 Interchange Safety Study	Contact Phone	216-303-6055
Reference Number	#185 Urban Intersection (Hamilton & Williams), #41 Urban Non-freeway (Hamilton)	Date Performed	12/22/2020
Analyst	TVF	Analysis Year	2020
Agency/Company	LJB		

Project Costs Only Cash Flows By Countermeasure Per Year



Return on Investment (Safety Benefits and Project Investments)



First year to observe a positive return on investiment: 2031 (11 years)

Percentage of Service Life to observe a continuous Positive Return on Investment: 50.00%