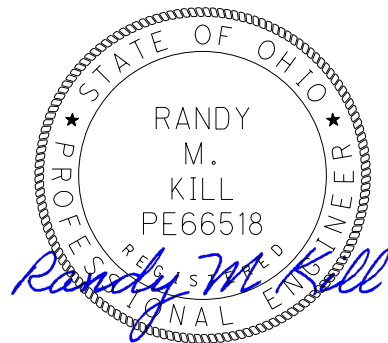


Interchange Modification Study Addendum #1

November 2021



11-19-2021

**Interchange Modification Study Addendum #1
MAD-70-10.27
I-70 & SR 29 Interchange
PID 93605**

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I. Introduction

This addendum to the I-70 & SR 29 Interchange Modification Study (IMS) documents a request to approve a revision to the previously approved Build alternative at the I-70 & SR 29 interchange. The revisions include adding a northbound right turn bypass lane at the EB ramp intersection, adding a westbound left turn lane at the WB ramp intersection, changing the northbound lane use from a left and left/through to a left/through and through at the WB ramp intersection, and converting to a “raindrop” geometry at both roundabouts.

II. Background

Improvements at the I-70 & SR 29 interchange in Madison County, Ohio have been in development for over 10 years. The original IMS was approved in January 2012. An Interchange Operations Study (IOS) was approved in November 2018. Some elements of the Build alternative have also been constructed. The history of the IMS document and construction activities to date are documented below.

IMS Document History

Original IMS Document

The original IMS document for the I-70 & SR 29 interchange was submitted on January 6, 2012 and received FHWA approval January 18, 2012. The preferred alternative selected for the interchange included a diamond design for the interchange and two-lane roundabouts at the ramp terminal intersections. The preferred alternative also relocated the Snyder Lane intersection farther away from the interchange and removed the access to Byerly Road at SR 29. Construction for the preferred alternative was broken into two phases. The Opening Day Build condition constructed a single lane roundabout at the westbound ramps intersection, added a southbound left turn lane at the eastbound ramp intersection and relocated the Snyder Lane intersection. The Design Year Build condition constructs two-lane roundabouts at both ramp intersections, widens the bridge over I-70 to accommodate four lanes and removes the access to Byerly Road at SR 29. The original IMS document is included in **Appendix A**.

2018 Interchange Operations Study (IOS) Document

In 2018, an IOS was prepared and approved by ODOT on November 30, 2018. This IOS evaluated if an interim Design Year Build at the SR 29 & I-70 Eastbound ramps intersection would provide a benefit over the Opening Day Build condition that had already been constructed. The IOS determined that the interim Design Year Build condition did provide a benefit to the intersection, didn't preclude construction of the ultimate Design Year Build condition and was building toward the ultimate Design Year Build condition. The IOS also determined that the ultimate Design Year Build condition from the original IMS was still required in the future and is still expected to provide acceptable operations. The following improvements at the SR 29 & I-70 Eastbound ramps intersection were included in the interim Design Year Build condition:

- Converting the intersection from stop-control to signal control
- Adding a northbound right turn lane

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- Adding a southbound left turn lane (this originally part of the Opening Day condition from the original IMS, but was not constructed)

The 2018 IOS document is included in **Appendix B**.

Construction to Date

Some elements of the preferred alternative from the original IMS have been constructed. Below is a list of construction activities to date.

- Fall 2014 – Opening Day Build condition was constructed. The SR 29/I-70 WB Ramps intersection was converted from stop-control at off-ramp to 1-lane roundabout, with the ability to expand to a 2-lane roundabout in the future. Snyder Lane was relocated to meet the recommended drive spacing of ODOT’s Location and Design Manual, Volume 1, Section 801.2.
- Spring 2019 – Interim Design Year Build condition was constructed. The SR 29/I-70 EB Ramps intersection was converted from stop-control at off-ramp to signal control. In addition, northbound right and southbound left turn lanes were added at the intersection.

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Detailed design of the final Design Year Build condition is ready to begin. It has been 10 years since the original IMS was approved. In addition, ODOT has changed from *Sidra* to *HCS* as their preferred software for roundabout capacity analysis. Therefore, ODOT decided to verify the design of the intersections. This verification resulted in a few tweaks to the configuration of the ramp terminal intersections. The preferred alternative from the original IMS included two-lane roundabouts at each ramp intersection. The revised configuration in this IMS Addendum will also include two-lane roundabouts at each intersection. The proposed changes are related to the exclusive turn lanes at the intersections. Also, the roundabouts will be changed from a traditional roundabout to a raindrop configuration. No changes to the I-70 mainline or the ramp merges and diverges are proposed. The following changes are proposed at the ramp intersections:

Westbound Ramp Intersection Changes

- Two-lane northbound approach lane use changed from Left, shared Through/Left lane use to shared Through/Left, Through lane use
- Westbound right turn lane changed from free-flow bypass lane to yielding right turn
- Add westbound left turn lane
- Conversion to a raindrop shape

Eastbound Ramp Intersection Changes

- Add northbound free-flow right turn bypass lane
- Eastbound right turn lane changed from yielding right turn to free-flow bypass lane
- Conversion to a raindrop shape

The Original IMS Build configuration for the I-70 & SR 29 interchange is shown on **Figure 1** and the Revised Build configuration for the interchange is shown on **Figure 2**.

Figure 1: Original IMS Build Lane Use

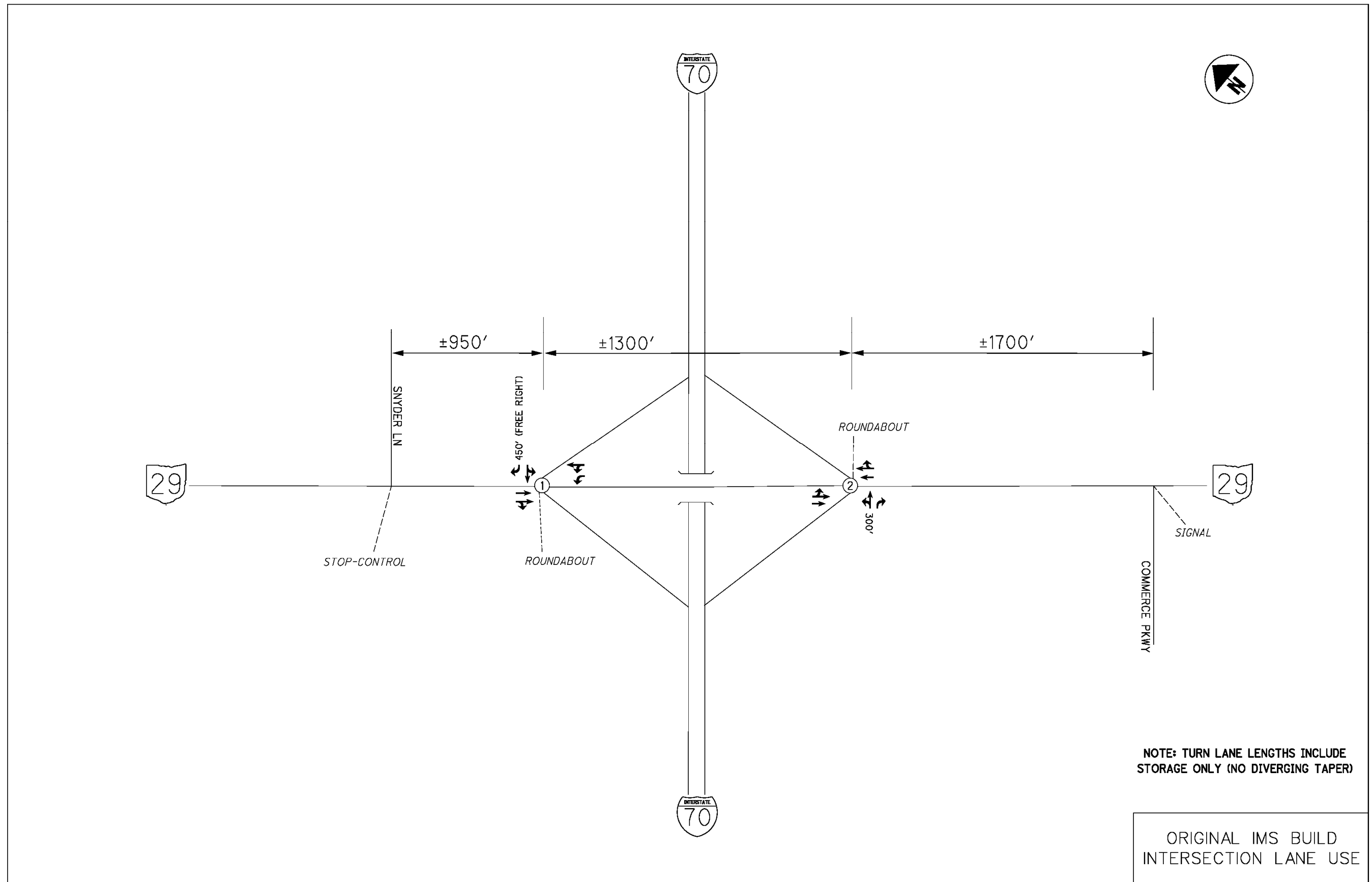
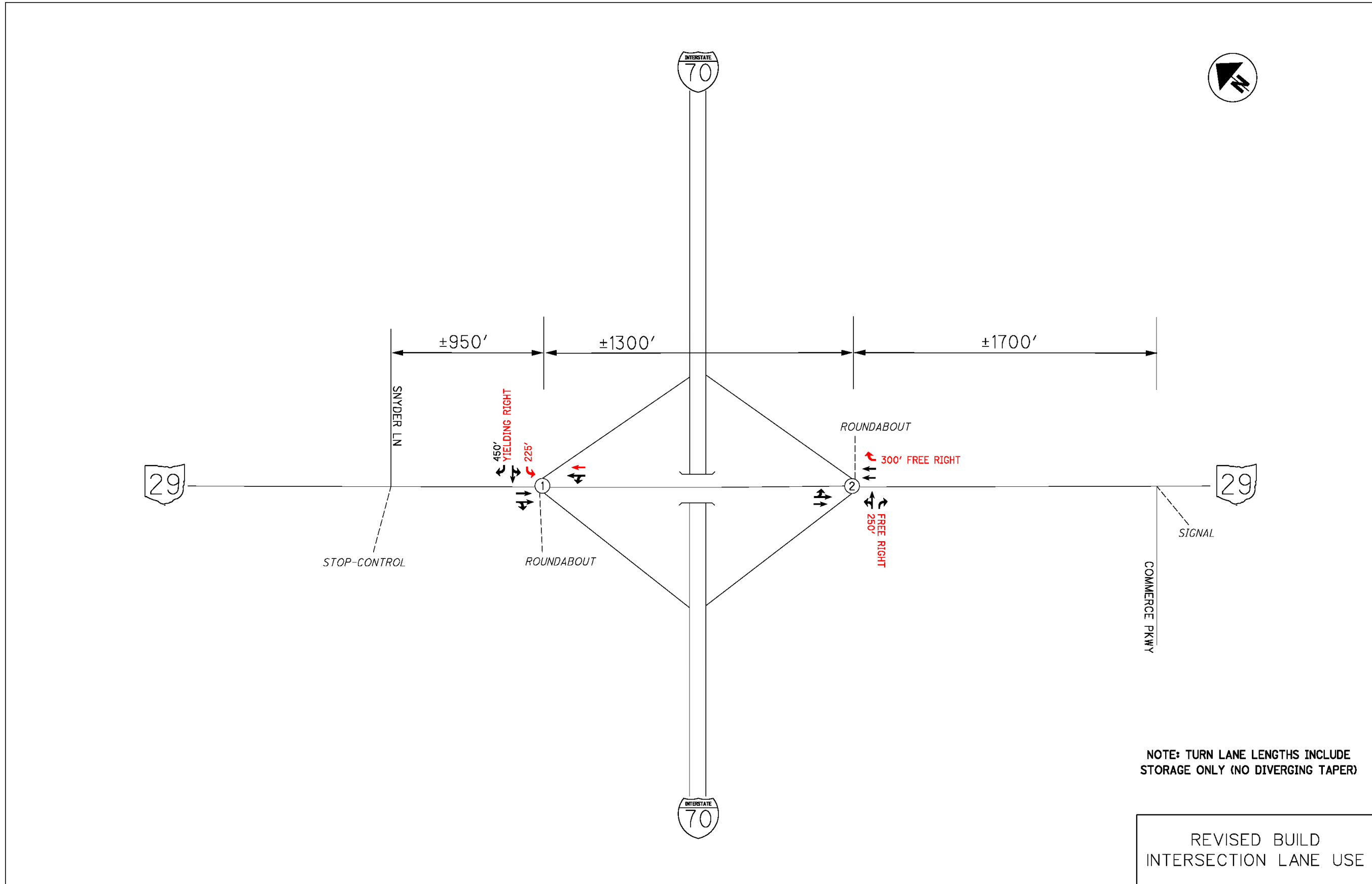


Figure 2: Revised Build Lane Use



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III. Certified Traffic Volumes

The certified traffic from the original IMS was developed in 2007 with an opening year of 2010 and a design year of 2030. Due to age of the certified traffic, the 2018 IOS performed some checks to see how 2017 traffic counts compared to the IMS certified traffic. This comparison showed that for the mainline, the 2017 traffic counts were trending lower than the certified traffic volumes, indicating that the certified traffic was still valid. For the ramp intersections, the 2018 IOS used the trip generation from a 2018 traffic impact study for an Amazon fulfillment center at the interchange to develop new turning movements for the ramp intersections. The new turning movements compared relatively well with the certified traffic with some of the movement volumes being a little higher and some a little lower. See **Appendix B** for additional information regarding the 2018 IOS volume comparison.

For this IMS Addendum, the original certified traffic volumes were once again compared to the current (2020) traffic volumes to determine if they are still valid. Current 2020 traffic counts were obtained from the ODOT MS2 site for the ramps, I-70 mainline and SR 29. For all 2020 counts in the study area, the 2020 counted volume are higher than the 2017 and 2014 historic counts. Also, most of the 2020 AADT, AM and PM peak volumes were lower than the 2010 opening year certified traffic assignments. The following locations had a 2020 count higher than the 2010 opening year certified traffic:

- EB I-70, East of SR 29
 - 2020 AM count – 2101; 2010 certified traffic – 2040
- WB I-70, East of SR 29
 - 2020 AM count – 1947; 2010 certified traffic – 1710
- WB I-70 on-ramp from SR 29
 - 2020 AM count – 106; 2010 certified traffic – 90
- NB SR 29, North of I-70
 - 2020 AM count – 141; 2010 certified traffic – 130
 - 2020 PM count – 318; 2010 certified traffic – 300
- NB SR 29, South of WB I-70 ramps
 - 2020 AM count – 189; 2010 certified traffic - 140

As shown above for the locations where the 2020 counts were higher than the 2010 opening year certified traffic, the difference in volumes was very low. From this comparison, the current traffic volumes in the corridor are trending at or below the original certified traffic volumes. Because the link volumes in the corridor are trending lower than the certified traffic, it is assumed that the turning movement volumes at the ramp intersections are also trending lower than the certified traffic. The original certified traffic volumes are still valid for this IMS Addendum. The original certified traffic volumes and the 2020 count comparison can be found in **Appendix C**.

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IV. Traffic Analysis

Peak Hour Factors and Heavy Vehicle Percentages

Per the ODOT OATS Manual, peak hour factors (PHF) and heavy vehicle percentages for intersection analysis should be calculated using traffic counts. The PHF is calculated for the intersection as a whole and heavy vehicle percentages are typically calculated for each approach to the intersection. For this project, the predominant truck movement is between I-70 and SR 29, south of I-70. Therefore, heavy vehicle percentages were calculated for each turning movement rather than averaging over the entire approach. This results in a more conservative capacity analysis for the intersections. For the Westbound I-70 ramp intersection, 2020 link counts were used to calculate the PHF and approach heavy vehicle percentages. StreetLight data was then used to convert the approach heavy vehicle percentages to individual turning movement heavy vehicle percentages. For the Eastbound I-70 ramp intersection, a turning movement count from 2018 was used to calculate the PHF and heavy vehicle percentages for the turning movements. **Table 1** shows the calculated PHF and heavy vehicle percentages at the ramp intersections.

Table 1: Intersection Peak Hour Factors and Heavy Vehicle Percentages

SR 29 & Westbound I-70				
	AM Peak		PM Peak	
	PHF	HV %	PHF	HV %
Westbound Approach	0.76	8% LT / 10% RT	0.79	38% LT / 14% RT
Northbound Approach		13% LT / 10% TH		12% LT / 14% TH
Southbound Approach		2% RT / 12% TH		9% RT / 23% TH
SR 29 & Eastbound I-70				
	AM Peak		PM Peak	
	PHF	HV %	PHF	HV %
Eastbound Approach	0.89	0% LT / 24% RT	0.78	0% LT / 22% RT
Northbound Approach		31% TH / 22% RT		16% TH / 15% RT
Southbound Approach		5% LT / 15% TH		8% LT / 34% TH

Intersection Capacity Analysis

Roundabout capacity analysis was conducted for the 2030 Original IMS Build and Revised Build conditions using HCS, version 7.9.5. **Table 2** shows the results of the capacity analysis for the ramp intersections during the AM peak hour and **Table 3** shows the intersection capacity results during the PM peak hour. The operational goals for the traffic analysis are that the overall intersection operates with a Level of Service (LOS) of D or better, each movement at LOS E or better, and V/C ratios of 0.93 or less. Capacity results are discussed below, and detailed capacity analysis outputs are contained in **Appendix D**.

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Table 2: AM Peak Hour Intersection Operational Results

INTERSECTION	APPROACH	2030 Original Build				2030 Revised Build			
		LOS	V/C	DELAY	QUEUE	LOS	V/C	DELAY	QUEUE
Intersection 1: SR 29 & Westbound I-70 Ramps (Roundabout)	WB Left	D	0.87	26.2	298'	A	0.50	9.9	70'
	WB Left/Through					A	0.41	8.0	50'
	WB Right	A	-	-	-	A	0.08	3.9	8'
	Westbound	C		23.8		A		8.5	
	NB Left	A	0.11	3.7	10'				
	NB LT/TH	A	0.10	3.6	8'	A	0.10	3.6	8'
	NB Through					A	0.11	3.7	10'
	Northbound	A		3.7		A		3.7	
	SB Through	C	0.48	17.3	65'	C	0.48	17.3	65'
	SB Through/Right	C	0.48	15.4	65'	C	0.48	15.4	65'
	Southbound	C		16.3		C		16.3	
Intersection Total	C		18.7		A		9.9		
Intersection 2: SR 29 & Eastbound I-70 Ramps (Roundabout)	EB Left/Through	B	0.05	11.8	5'	A	0.05	8.3	3'
	EB Right	F	1.22	152.7	488'	A	-	-	-
	Eastbound	F		147.5		A		0.4	
	NB Through	A	0.26	6.6	25'	A	0.11	5.2	10'
	NB Through/Right	A	0.29	7.1	30'	A	0.12	5.4	10'
	NB Right					A	-	-	-
	Northbound	A		6.9		A		2.2	
	SB Left/Through	A	0.43	7.2	55'	A	0.43	7.2	55'
	SB Through	A	0.49	8.0	70'	A	0.49	8.0	70'
	Southbound	A		7.6		A		7.6	
Intersection Total	E		39.1		A		4.7		

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Table 3: PM Peak Hour Intersection Operational Results

INTERSECTION	APPROACH	2030 Original Build				2030 Revised Build			
		LOS	V/C	DELAY	QUEUE	LOS	V/C	DELAY	QUEUE
Intersection 1: SR 29 & Westbound I-70 Ramps (Roundabout)	WB Left	F	1.44	233.1	870'	E	0.85	44.8	213'
	WB Left/Through					C	0.68	24.8	125'
	WB Right	A	-	-	-	A	0.43	9.2	55'
	Westbound	F		151.8		D		26.2	
	NB Left	A	0.32	5.8	35'				
	NB LT/TH	A	0.29	5.4	30'	A	0.29	5.4	30'
	NB Through					A	0.32	5.8	35'
	Northbound	A		5.7		A		5.7	
	SB Through	D	0.54	28.4	75'	D	0.54	28.4	75'
	SB Through/Right	C	0.52	23.8	73'	C	0.52	23.8	73'
	Southbound	D		25.9		D		25.9	
Intersection Total	F		81.0		C		19.0		
Intersection 2: SR 29 & Eastbound I-70 Ramps (Roundabout)	EB Left/Through	B	0.07	12.2	5'	A	0.06	8.7	5'
	EB Right	F	1.28	173.4	535'	A	-	-	-
	Eastbound	F		166.4		A		0.5	
	NB Through	D	0.87	26.0	288'	A	0.36	7.5	40'
	NB Through/Right	E	0.98	43.5	443'	A	0.41	8.1	50'
	NB Right					A	-	-	-
	Northbound	E		35.3		A		3.2	
	SB Left/Through	A	0.44	8.1	58'	A	0.44	8.1	58'
	SB Through	A	0.50	9.0	73'	A	0.50	9.0	73'
	Southbound	A		8.6		A		8.6	
Intersection Total	E		46.5		A		4.5		

Westbound I-70 & SR 29

The roundabout in the Original IMS Build is expected to operate at with an overall intersection LOS C during the AM peak and an overall intersection LOS F and a v/c ratio of 1.44 for the westbound left turn movement during the PM peak. The Revised Build condition adds an additional westbound left turn lane to the roundabout which will reduce the westbound left v/c ratio. In the Revised Build condition, the intersection is expected to operate at LOS A in the AM peak and LOS C in the PM peak. All movements are expected to operate at LOS E or better and all v/c ratios will be 0.85 or less.

Eastbound I-70 & SR 29

This roundabout is expected to operate at LOS E during the AM and PM peaks in the Original IMS Build condition. In addition, the eastbound approach will be LOS F with v/c ratios greater than 1.22 in both the AM and PM peaks. In the Revised Build condition, the free-flow right turn movements for the eastbound and northbound approaches provide a great benefit to the

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intersection. The overall LOS has improved to LOS A during the AM and PM peaks, all movements operate at LOS A and all v/c ratios are 0.50 or less.

I-70 Mainline Analysis

As noted in Section III – Certified Traffic Volumes, current I-70 volumes are lower than projected in the original IMS. This means that I-70 should operate at the same or better LOS as predicted in the original IMS. Therefore, updated analyses for the I-70 mainline were not prepared.

Per the 2020 MS2 volume data, the highest volume on I-70 within the project area was 2,714 for I-70 WB during the PM peak. Using the highest truck percentage from the certified traffic (31%), **Table 4** shows the minimum demand volumes required for LOS D, LOS E and LOS F. Based on these results, I-70 is predicted to have adequate capacity well beyond the 2030 design year.

Table 4: I-70 Volume Thresholds for LOS D-F

LOS	D	E	F
Minimum Demand Volume	3830	4590	5160

Turn Lane Storage

Queue storage lengths were calculated for ramp intersections based on the procedures described in Section 401.2.3 of the ODOT Location and Design Manual (L&D). The storage lengths are based on the highest of the AM and PM Peak hour storage requirements. Per the L&D, turn lanes storage lengths at roundabouts are determined using the 95% queue lengths from the HCS analysis. The turn lane storage requirements are summarized in **Table 5**. All storage lengths at the intersections meet or exceed the L&D requirements.

Table 5: Turn Lane Storage Length Calculations

Intersection/ Turn Lane	2030 Design Volume				95% Queue from HCS Analysis	Potential Through Backup	Proposed Turn Lane Length#
	AM veh/hr		PM veh/hr				
	Turn	Through	Turn	Through			
SR 29 & WB I-70 Off-Ramp							
WB LT	680	70	560	300	213'	125'	275'
WB RT	70	680	300	560	125'	213'	500'
SR 29 & EB I-70 Off-Ramp							
NB RT	260	180	840	590	0'	50'	300'
EB LT	20	410	20	370	5'	0'	300'

- Includes diverging taper

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V. Recommendations

The Revised Build alternative for the I-70 & SR 29 interchange consists of two-lane roundabouts for the eastbound and westbound I-70 ramp intersections. Based on the analysis presented in this report, the Revised Build alternative presented is a betterment compared to the Original IMS Build condition and does not degrade freeway operation within the study area. It is recommended that this Addendum to the Interchange Modification Study be approved.