



LSC TRANSPORTATION CONSULTANTS, INC.

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December 2, 2019

Mr. Steve C. Meier
Hummel Investments, LLC
8117 Preston Road, Suite 120
Dallas, TX 75225

Re: Falcon Marketplace South-
west Roundabout Report
El Paso County, CO
LSC #164350

Dear Mr. Meier:

We are pleased to submit this design report for the proposed southwest roundabout in the Falcon Marketplace development in El Paso County, Colorado.

Roundabout Layout

Figure 1 and the Roundabout Critical Design Parameters form show the proposed design parameters. The inscribed diameter is 150 feet with a 20-foot wide circulatory roadway.

Design Vehicle

Figures 2, 4 and 5 show WB-62 truck paths through the proposed roundabout for three of the four approaches. Figure 3 shows the SU-30 box truck paths for the fourth approach. A minimum of one foot of clearance is maintained between all wheel paths and vertical curbs. Figures 6 through 8 show WB-67 trucks can be accommodated with minimal impact on three of the four approaches.

Design Speeds

Figures 9 through 12 show the estimated fastest path radii for each of the approaches to the proposed roundabout. The fastest entry path should generally be no more than about 25 mph for single-lane approaches and 30 mph for two-lane approaches. The fastest entry path for each of the three approaches meets this criteria.

Sight Distance

Figure 13 shows the sight triangles for the proposed roundabout.

Level of Service

The attached Rodel capacity analysis reports show the proposed roundabout is expected to operate at LOS "A" during both weekday morning and afternoon peak-hours through 2040.

Pedestrian Safety and Accessibility

Pedestrian crossings with pedestrian refuge areas within the splitter islands have been provided on the north approach. Pedestrian crossings are generally set back 25 feet from the yield line. In addition, detached sidewalks should be provided on the corners of the roundabout that provide pedestrian crossings.

Vertical Design Guidance

The following recommendations are given when designing the vertical aspects of the proposed roundabout:

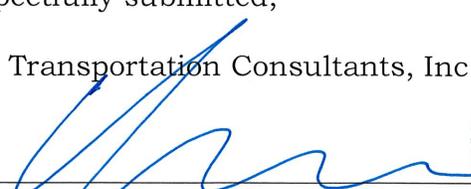
1. Pedestrian refuge areas should be designed at street level rather than elevated to the height of the splitter island;
2. Ramps should be provided and designed in accordance with ADA standards on each end of the crosswalk;
3. Detectable warning surfaces in accordance with ADA standards should be provided at ramps and the pedestrian refuge area of the splitter islands.
4. The truck apron should be textured and raised above the circulating roadway. The specific design will be determined as part of the construction plans.
5. The cross slope of the proposed circulating roadway should generally be two percent or less.

* * * * *

We trust that our findings and recommendations will assist in the planning and design of the proposed roundabout. Please call if we can be of further assistance.

Respectfully submitted,

LSC Transportation Consultants, Inc.

By: 
Christopher S. McGranahan, P.E., PTOE
Principal



CSM/wc

Enclosures: Roundabout Control Design Parameters
Figures 1 - 13
Rodel Capacity Analysis Worksheets

**Southwest Roundabout
Falcon Marketplace
El Paso County, CO**

ROUNDABOUT CRITICAL DESIGN PARAMETERS

DESIGN PARAMETERS	LEG 1	LEG 2	LEG 3	LEG 4	LEG 5	LEG 6
Approach Width, FT	16.0	18.0	16.0	18.0		
Entry Width, FT	16.0	18.0	16.0	18.0		
Entry Angle, PHI Φ , DEG	16.0	37.0	17.0	16.0		
Inscribed Circle Diameter, FT	150.0	150.0	150.0	150.0		
Exit Width, FT	20.0		20.0			
Circulating Roadway Width Upstream of Entry, FT	20.0	20.0	20.0	20.0		

FASTEST SPEED PATH

R_1 , Radius/Speed, FT/MPH	132	22	184	25	120	22	90	20		
R_2 , Radius/Speed, FT/MPH	115	21			65	17				
R_3 , Radius/Speed, FT/MPH	155	24	70	18	70	18	160	24		
R_4 , Radius/Speed, FT/MPH			60	17			63	17		
R_5 , Radius/Speed, FT/MPH			100	20			96	20		
Bypass R_5 , Radius/Speed, FT/MPH										

MINIMUM SIGHT PARAMETERS

Approach Design Speed, MPH								
Horizontal Stopping Sight Distance, FT								
Circulating Intersection Sight Distance, FT/MPH								
Entering Intersection Sight Distance, FT/MPH								

Design Vehicle: WB-62 for Approaches 1, 3, & 4; SU-30 for Approach 2

Truck Apron Width: 15'

OSOW Accommodations: A WB-67 vehicle can be accommodated with minimal impacts on three of the four approaches.

Circulating Roadway Cross-Slope: 2% or less

Access Control:

Parking Control: No parking on any of the approaches

Bicycle & Pedestrian Accommodations: East/West Bicycle & Pedestrian movements are accommodated on the North Approach

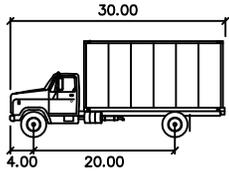
Designer: SMR
Reviewer: CSM

SIGNATURE: _____

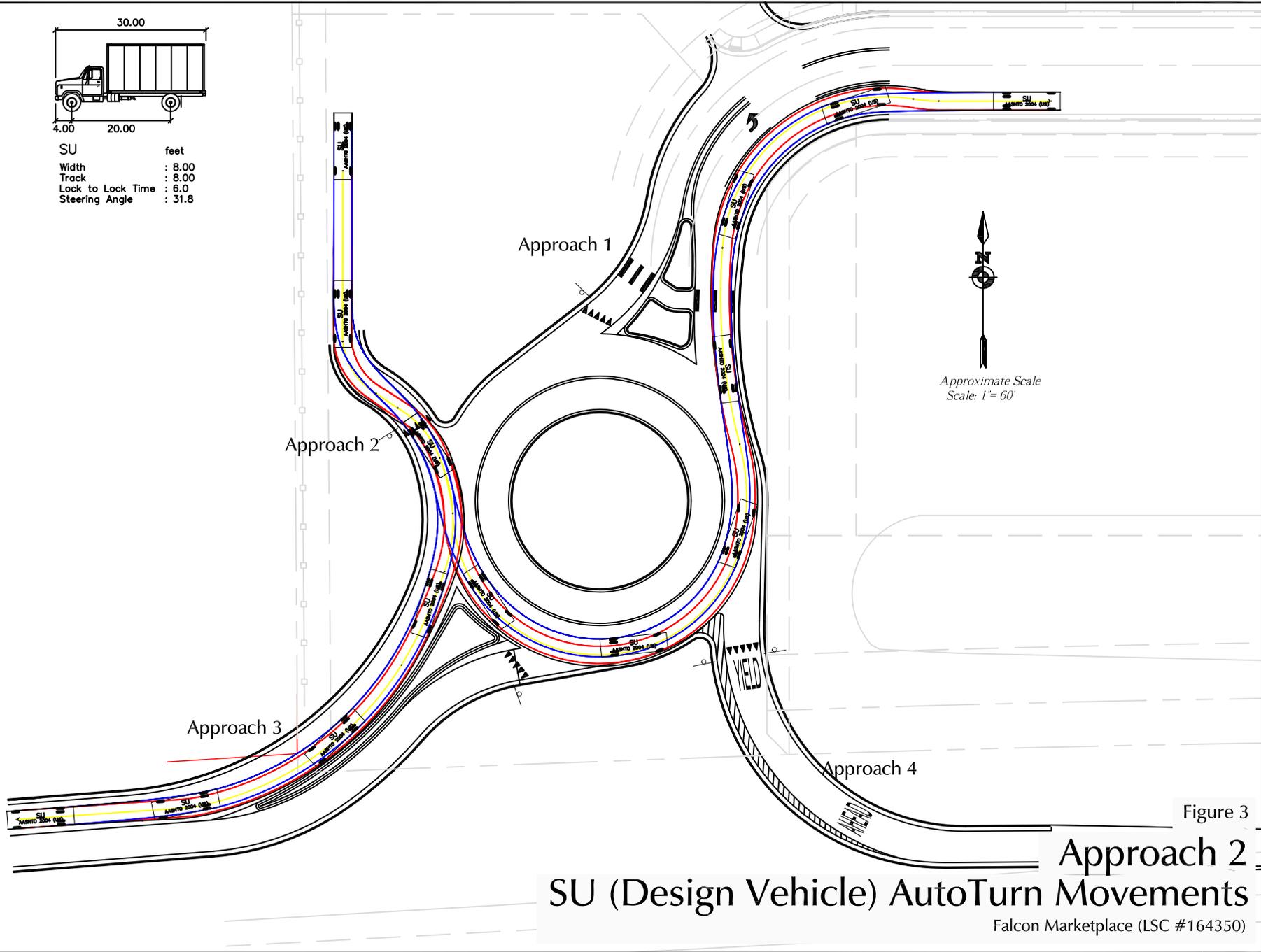
DATE: 12/2/2019

NAME: Christopher S. McGranahan, PE, PTOE

The reviewer's signature on this document indicates that the design has been reviewed and is in general compliance with good roundabout principals. The critical design elements have been addressed. The project design engineer in responsible charge of final plan development will stamp the plans when applicable.

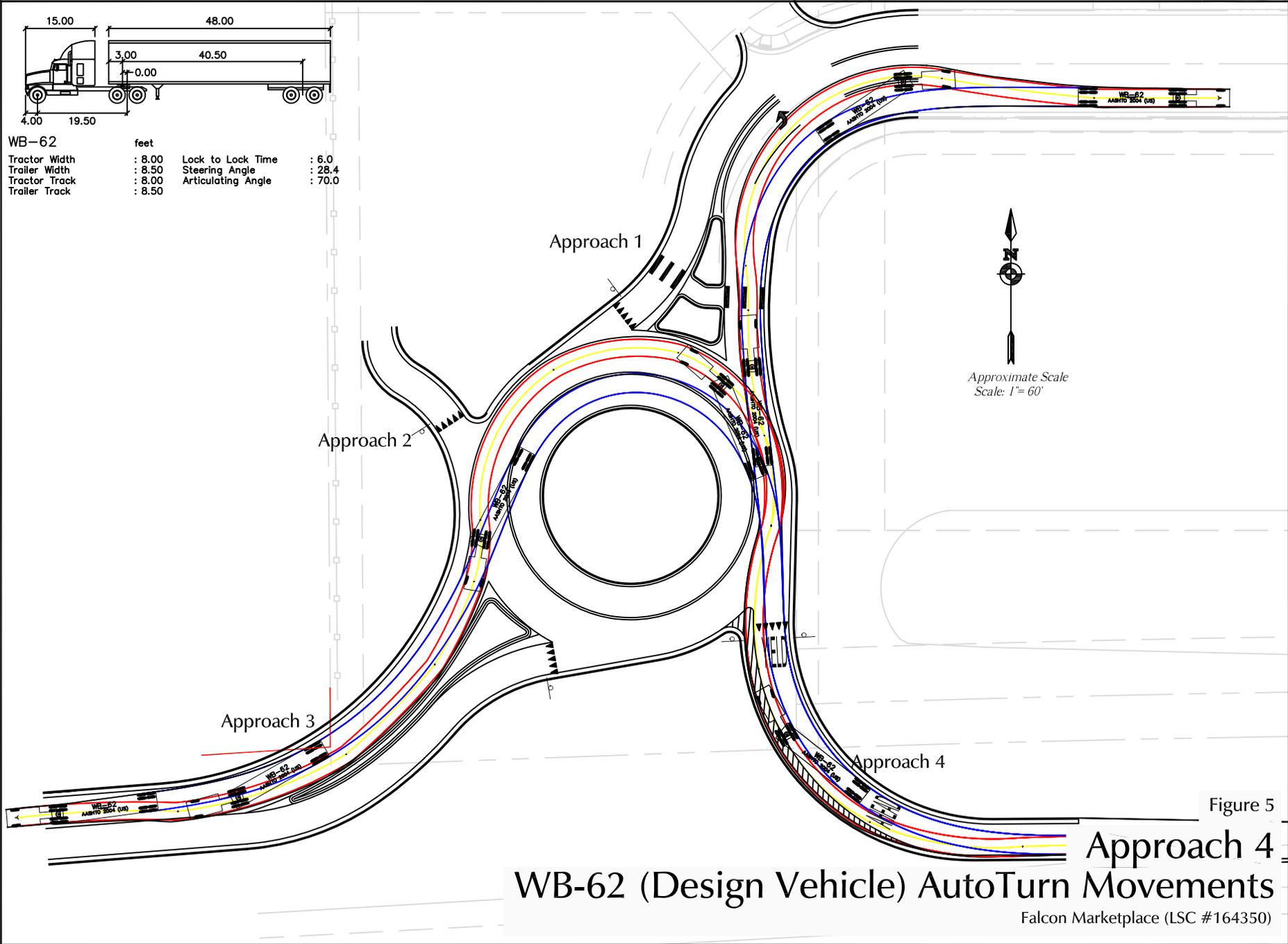


SU feet
 Width : 8.00
 Track : 8.00
 Lock to Lock Time : 6.0
 Steering Angle : 31.8



Approximate Scale
 Scale: 1" = 60'

Figure 3
Approach 2
 SU (Design Vehicle) AutoTurn Movements
 Falcon Marketplace (LSC #164350)



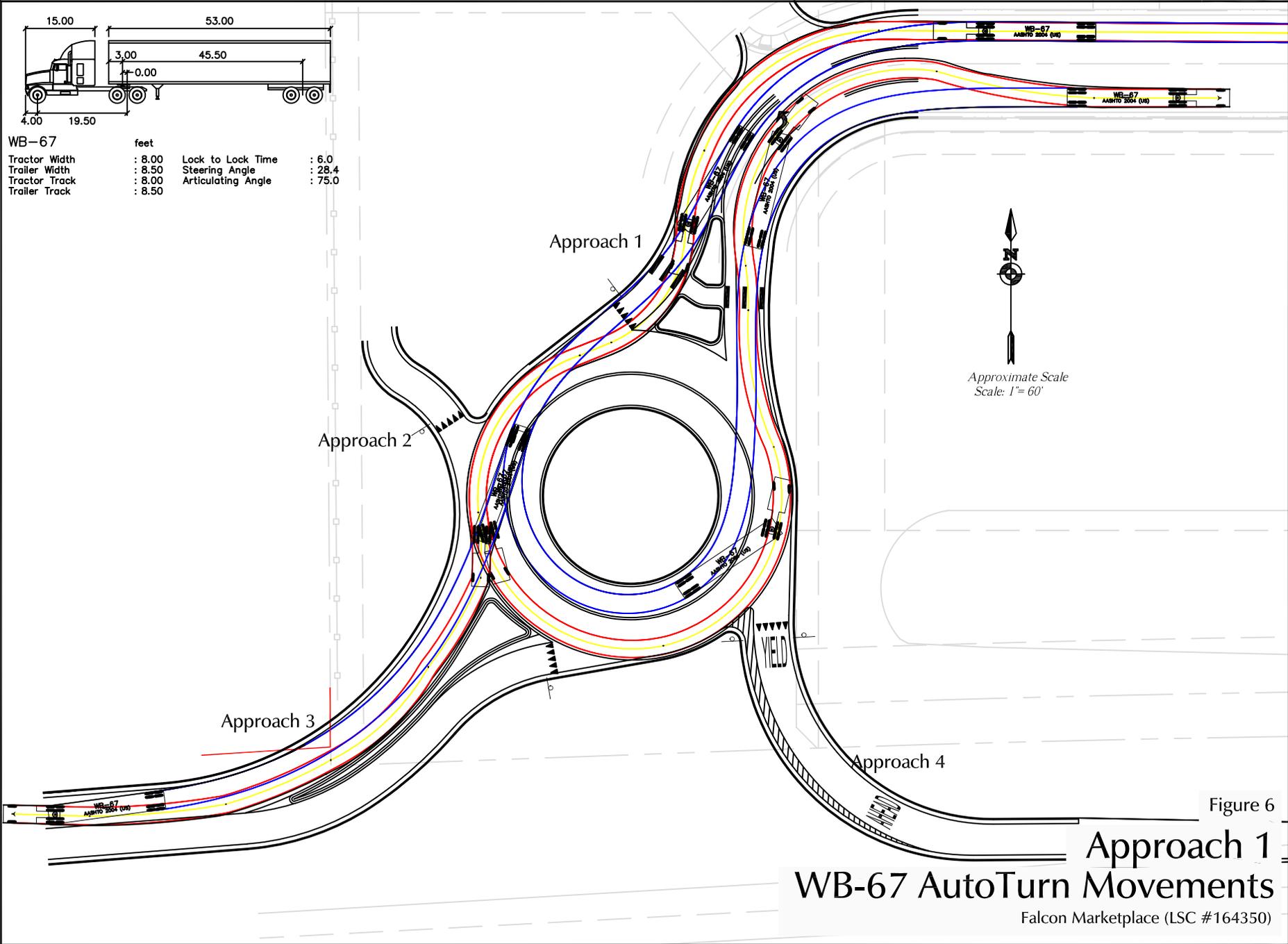


Figure 6
Approach 1
WB-67 AutoTurn Movements
 Falcon Marketplace (LSC #164350)

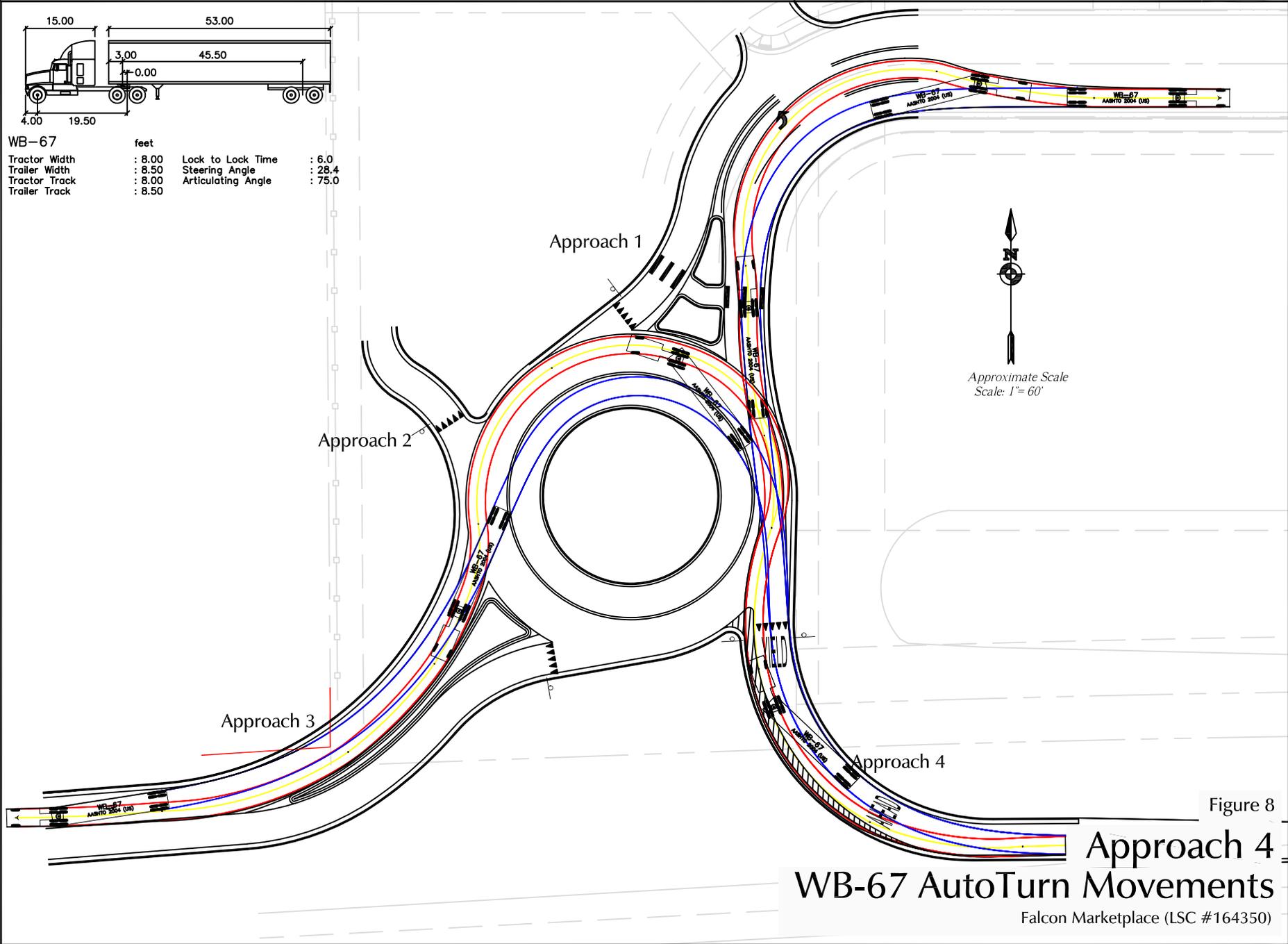
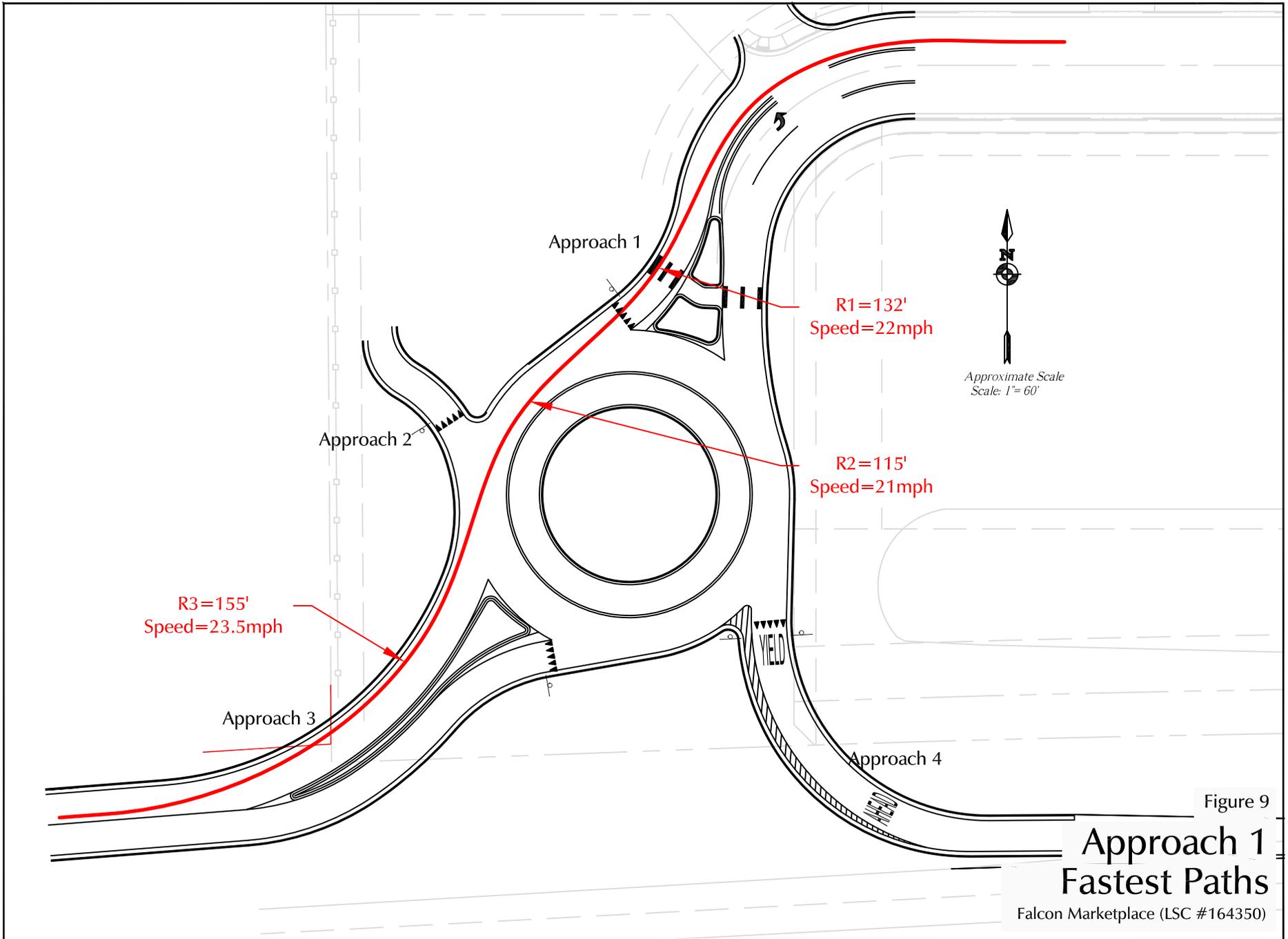
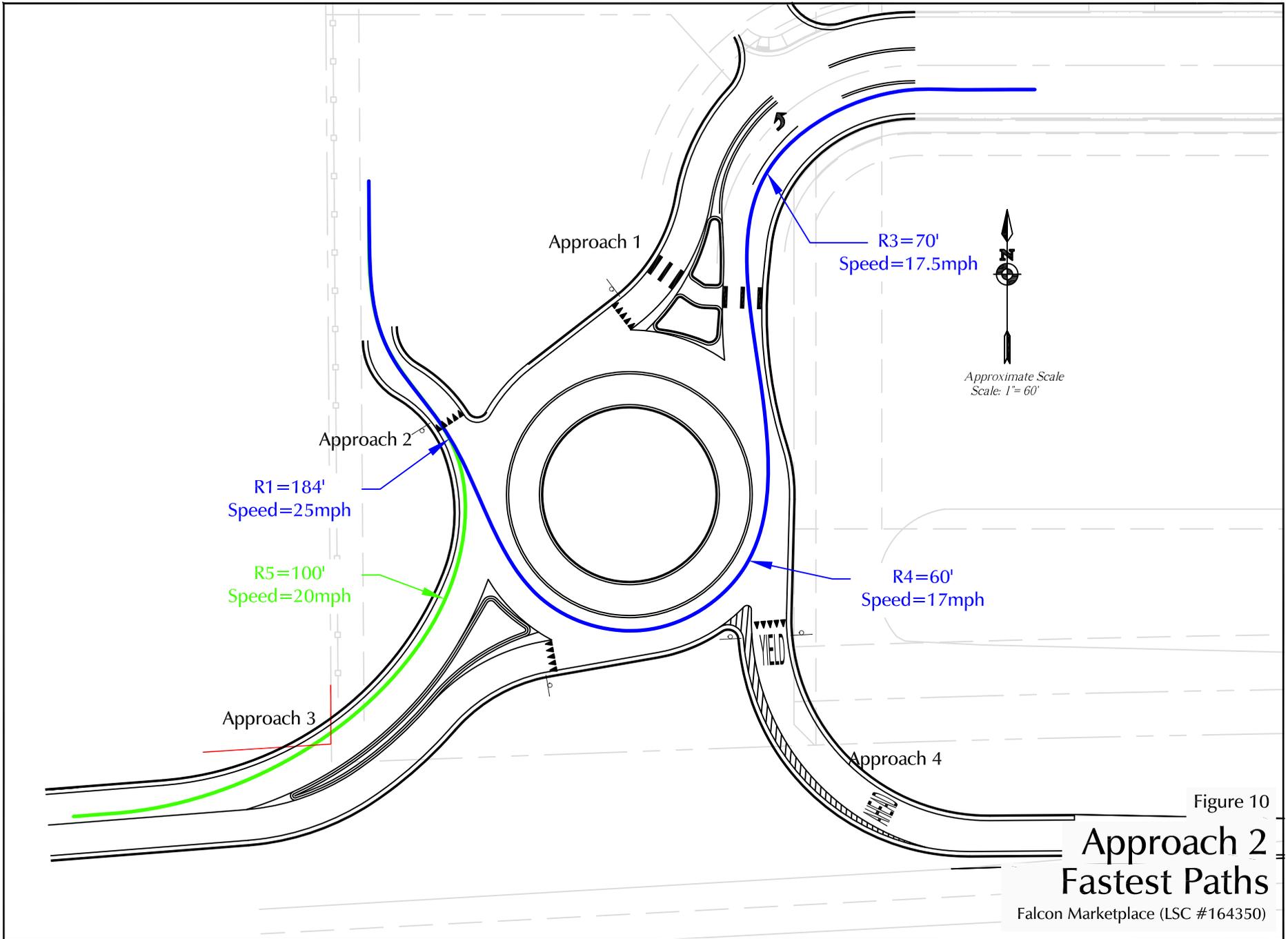


Figure 8

Approach 4 WB-67 AutoTurn Movements

Falcon Marketplace (LSC #164350)





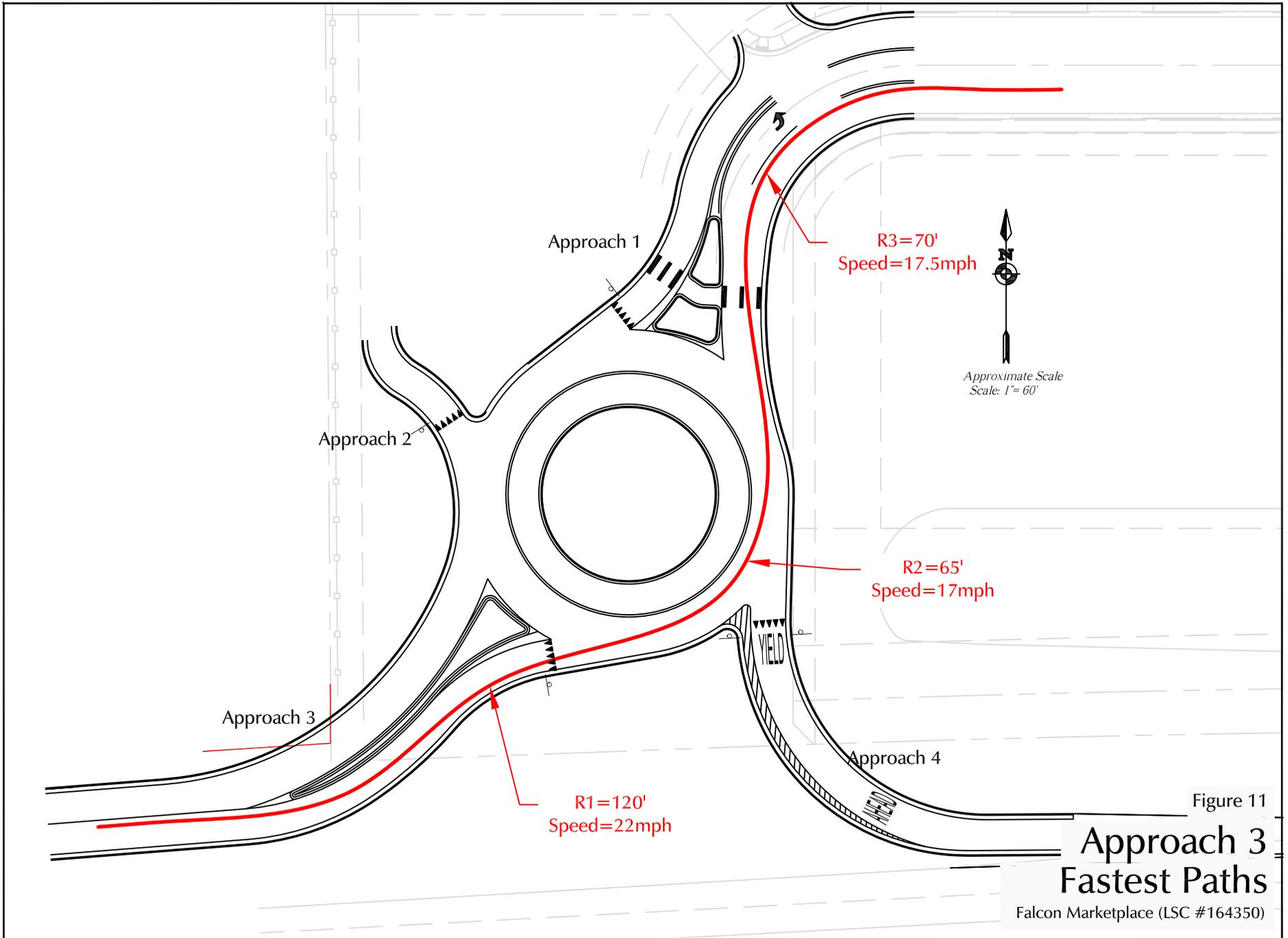


Figure 11

Approach 3 Fastest Paths

Falcon Marketplace (LSC #164350)

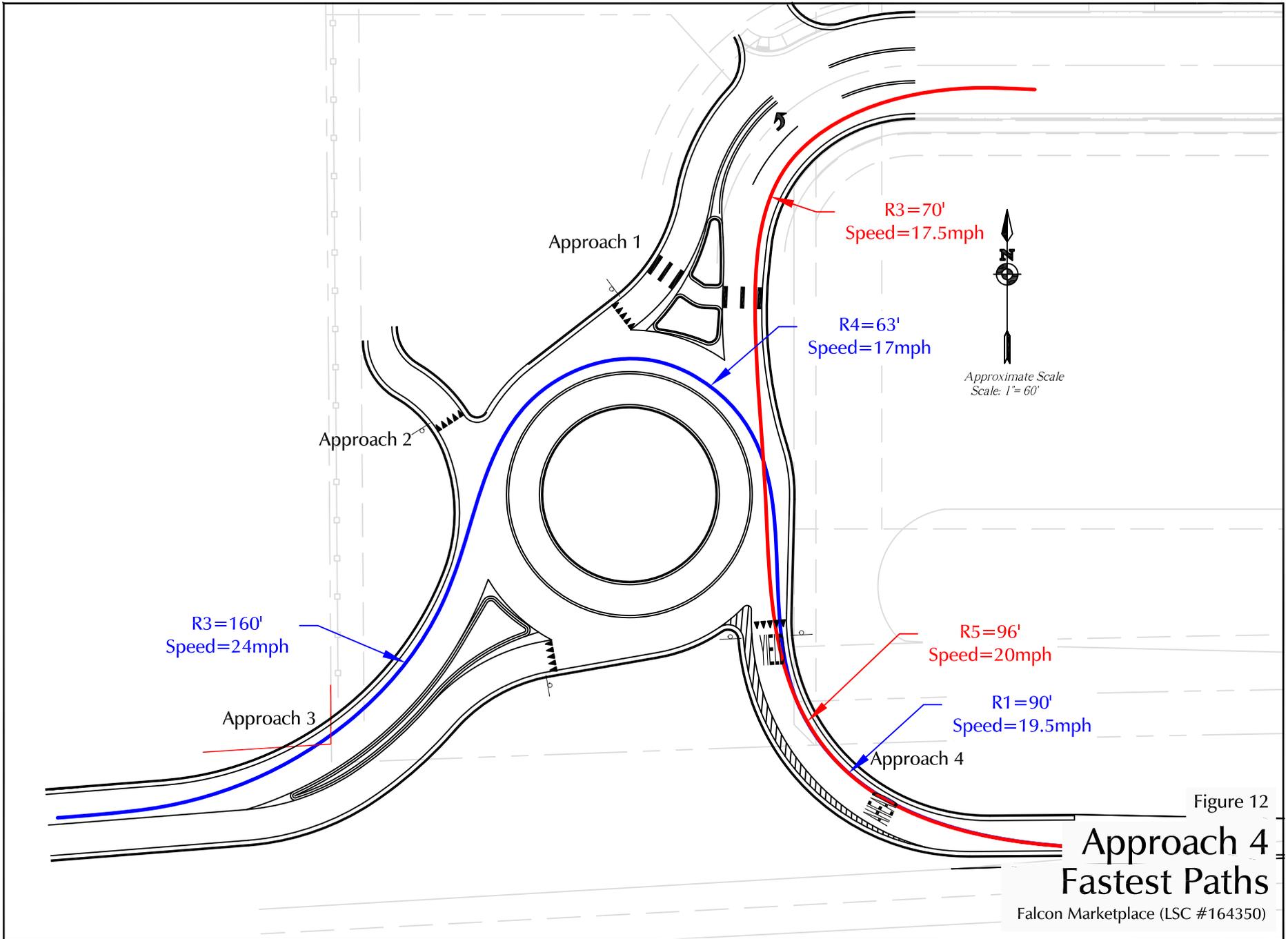


Figure 12

Approach 4 Fastest Paths

Falcon Marketplace (LSC #164350)

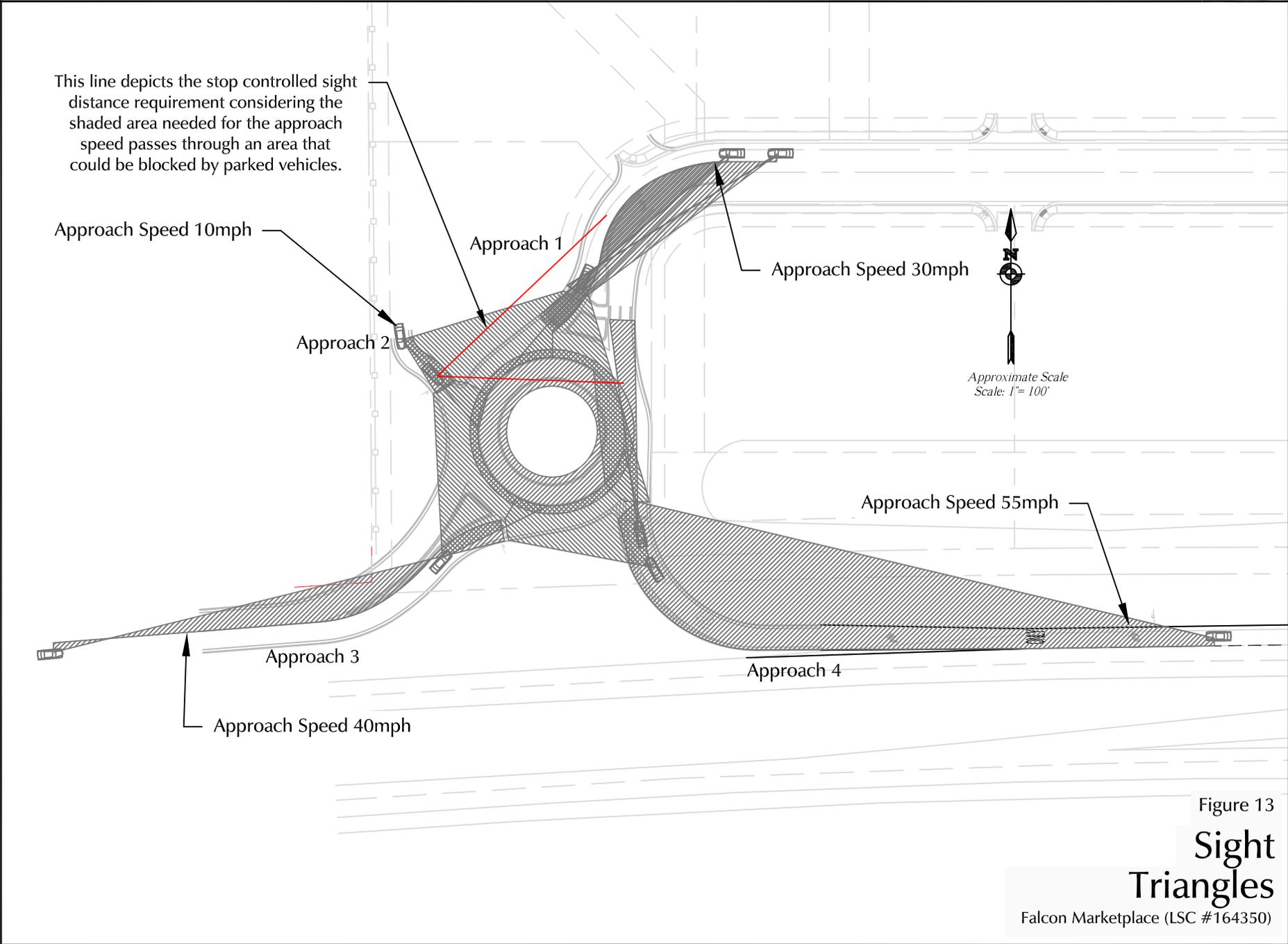


Figure 13

Sight Triangles

Falcon Marketplace (LSC #164350)

Operational Data

Traffic Flow Data (veh/hr)

2040 AM Peak Peak Hour Flows

Leg	Leg Names	Turning Flows					Flow Modifiers		
		U-Turn	Exit-3	Exit-2	Exit-1	Bypass	Trucks %	Flow Factor	Peak Hour Factor
1	Approach 1	0	0	60	0	0	2.0	1.00	0.9
2	Approach 4	0	199	0	151	0	2.0	1.00	0.9
3	Approach 3	0	0	151	0	0	2.0	1.00	0.9
4	Approach 2	0	16	0	21	0	2.0	1.00	0.9

Operational Results

2040 AM Peak - 15 minutes

Flows and Capacity

Leg	Leg Names	Bypass Type	Flows (veh/hr)				Capacity (veh/hr)			
			Arrival Flow		Opposing Flow		Capacity		Average VCR	
			Entry	Bypass	Entry	Bypass	Entry	Bypass	Entry	Bypass
1	Approach 1	None	65		17		403	1242		0.0528
2	Approach 4	None	380		83		0	1399		0.2739
3	Approach 3	None	164		216		247	1118		0.1479
4	Approach 2	None	40		380		0	936		0.0433

Delays, Queues and Level of Service

Leg	Leg Names	Bypass Type	Average Delay (sec)			95% Queue (veh)		Level of Service		
			Entry	Bypass	Leg	Entry	Bypass	Entry	Bypass	Leg
1	Approach 1	None	3.16		3.16	0.14		A		A
2	Approach 4	None	4.29		4.29	0.95		A		A
3	Approach 3	None	4.28		4.28	0.44		A		A
4	Approach 2	None	4.00		4.00	0.12		A		A

Global Results

Performance and Accidents

2040 AM Peak Global Performance

Parameter	Units	Entries	Bypasses	Total
Arrive Flows	veh/hr	598		598
Capacity	veh/hr	4728		4728
Average Delay	sec/veh	4.28		4.28
L.O.S. (Signal)	A – F	A		A
L.O.S. (Unsig)	A – F	A		A
Total Delay	veh.hrs	0.71		0.71

Operational Data

Traffic Flow Data (veh/hr)

2040 PM Peak Peak Hour Flows

Leg	Leg Names	Turning Flows					Flow Modifiers		
		U-Turn	Exit-3	Exit-2	Exit-1	Bypass	Trucks %	Flow Factor	Peak Hour Factor
1	Approach 1	0	0	65	0	0	2.0	1.00	0.9
2	Approach 4	0	157	0	179	0	2.0	1.00	0.9
3	Approach 3	0	0	251	0	0	2.0	1.00	0.9
4	Approach 2	0	5	0	4	0	2.0	1.00	0.9

Operational Results

2040 PM Peak - 15 minutes

Flows and Capacity

Leg	Leg Names	Bypass Type	Flows (veh/hr)					Capacity (veh/hr)			
			Arrival Flow		Opposing Flow		Exit Flow	Capacity		Average VCR	
			Entry	Bypass	Entry	Bypass		Entry	Bypass	Entry	Bypass
1	Approach 1	None	71		5		448	1250			0.0569
2	Approach 4	None	365		76		0	1403			0.2622
3	Approach 3	None	273		171		271	1146			0.2401
4	Approach 2	None	10		443		0	901			0.0109

Delays, Queues and Level of Service

Leg	Leg Names	Bypass Type	Average Delay (sec)			95% Queue (veh)		Level of Service		
			Entry	Bypass	Leg	Entry	Bypass	Entry	Bypass	Leg
1	Approach 1	None	3.18		3.18	0.15		A		A
2	Approach 4	None	4.24		4.24	0.89		A		A
3	Approach 3	None	4.84		4.84	0.79		A		A
4	Approach 2	None	3.00		3.00	0.03		A		A

Global Results

Performance and Accidents

2040 PM Peak Global Performance

Parameter	Units	Entries	Bypasses	Total
Arrive Flows	veh/hr	661		661
Capacity	veh/hr	4731		4731
Average Delay	sec/veh	4.44		4.44
L.O.S. (Signal)	A – F	A		A
L.O.S. (Unsig)	A – F	A		A
Total Delay	veh.hrs	0.82		0.82

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December 2, 2019

Mr. Steve C. Meier
Hummel Investments, LLC
8117 Preston Road, Suite 120
Dallas, TX 75225

Re: Falcon Marketplace North-
east Roundabout Report
El Paso County, CO
LSC #164350

Dear Mr. Meier:

We are pleased to submit this design report for the proposed northeast roundabout in the Falcon Marketplace development in El Paso County, Colorado.

Roundabout Layout

Figures 1a and 1b and the Roundabout Critical Design Parameters form show the proposed design parameters. The inscribed diameter is 135 feet with a 20-foot wide circulatory roadway.

Design Vehicle

Figures 2a through 4 show WB-62 truck paths through the proposed roundabout for the various approaches. A minimum of one foot of clearance is maintained between all wheel paths and vertical curbs. Figures 5a through 7 show WB-67 trucks can be accommodated with minimal impact on each of the approaches.

Design Speeds

Figures 8 through 10 show the estimated fastest path radii for each of the approaches to the proposed roundabout. The fastest entry path should generally be no more than about 25 mph for single-lane approaches and 30 mph for two-lane approaches. The fastest entry path for each of the three approaches meets this criteria with the following exception: The Approach 1 fastest path in the interim condition is expected to be about 27 mph prior to construction of the north leg. The entry phi angle is proposed to be 21 degrees and the conflicting volumes for this movement are minimal, so the 27 mph fastest path is considered acceptable.

Sight Distance

Figure 13 shows the sight triangles for the proposed roundabout.

Level of Service

The attached Rodel capacity analysis reports show the proposed roundabout is expected to operate at LOS "A" during both weekday morning and afternoon peak-hours through 2040.

Pedestrian Safety and Accessibility

Pedestrian crossings with pedestrian refuge areas within the splitter islands have been provided on the north and south approaches. Pedestrian crossings are generally set back 25 feet from the yield line. In addition, detached sidewalks should be provided on the corners of the roundabout that provide pedestrian crossings.

Vertical Design Guidance

The following recommendations are given when designing the vertical aspects of the proposed roundabout:

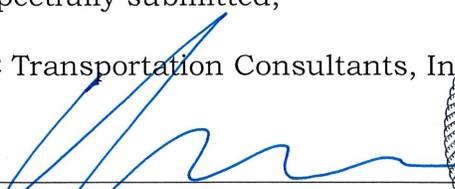
1. Pedestrian refuge areas should be designed at street level rather than elevated to the height of the splitter island;
2. Ramps should be provided and designed in accordance with ADA standards on each end of the crosswalk;
3. Detectable warning surfaces in accordance with ADA standards should be provided at ramps and the pedestrian refuge area of the splitter islands.
4. The truck apron should be textured and raised above the circulating roadway. The specific design will be determined as part of the construction plans.
5. The cross slope of the proposed circulating roadway should generally be two percent or less.

* * * * *

We trust that our findings and recommendations will assist in the planning and design of the proposed roundabout. Please call if we can be of further assistance.

Respectfully submitted,

LSC Transportation Consultants, Inc.

By: 
Christopher S. McGranahan, P.E.
Principal



12-2-19

CSM/wc

Enclosures: Roundabout Control Design Parameters
Figures 1 - 13
Rodel Capacity Analysis Worksheets

**Northeast Roundabout
Falcon Marketplace
El Paso County**

ROUNABOUT CRITICAL DESIGN PARAMETERS

DESIGN PARAMETERS	LEG 1	LEG 2	LEG 3	LEG 4	LEG 5	LEG 6
Approach Width, FT	17.0	21.0	21.0			
Entry Width, FT	18.0	16.0	16.0			
Entry Angle, PHI ϕ , DEG	21.0	24.0	21.0			
Inscribed Circle Diameter, FT	135.0	135.0	135.0			
Exit Width, FT	35.0	20.0	20.0			
Circulating Roadway Width Upstream of Entry, FT	20.0	20.0	20.0			

FASTEST SPEED PATH

R_1 , Radius/Speed, FT/MPH	225	27	165	24	165	24			
R_2 , Radius/Speed, FT/MPH			85	19	85	19			
R_3 , Radius/Speed, FT/MPH	834	46	620	39	620	39			
R_4 , Radius/Speed, FT/MPH	57	17			57	17			
R_5 , Radius/Speed, FT/MPH			160	24					
Bypass R_5 , Radius/Speed, FT/MPH									

MINIMUM SIGHT PARAMETERS

Approach Design Speed, MPH						
Horizontal Stopping Sight Distance, FT						
Circulating Intersection Sight Distance, FT/MPH						
Entering Intersection Sight Distance, FT/MPH						

Design Vehicle: WB-62

Truck Apron Width: 18'

OSOW Accommodations: WB-67 can be accommodated with minimal impacts

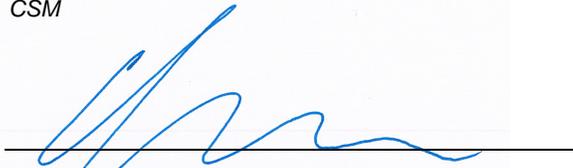
Circulating Roadway Cross-Slope: 2% or less

Access Control:

Parking Control: No parking on any of the three approaches

Bicycle & Pedestrian Accommodations: East/West Bicycle and Pedestrians movements are accommodated on the North and South Approaches

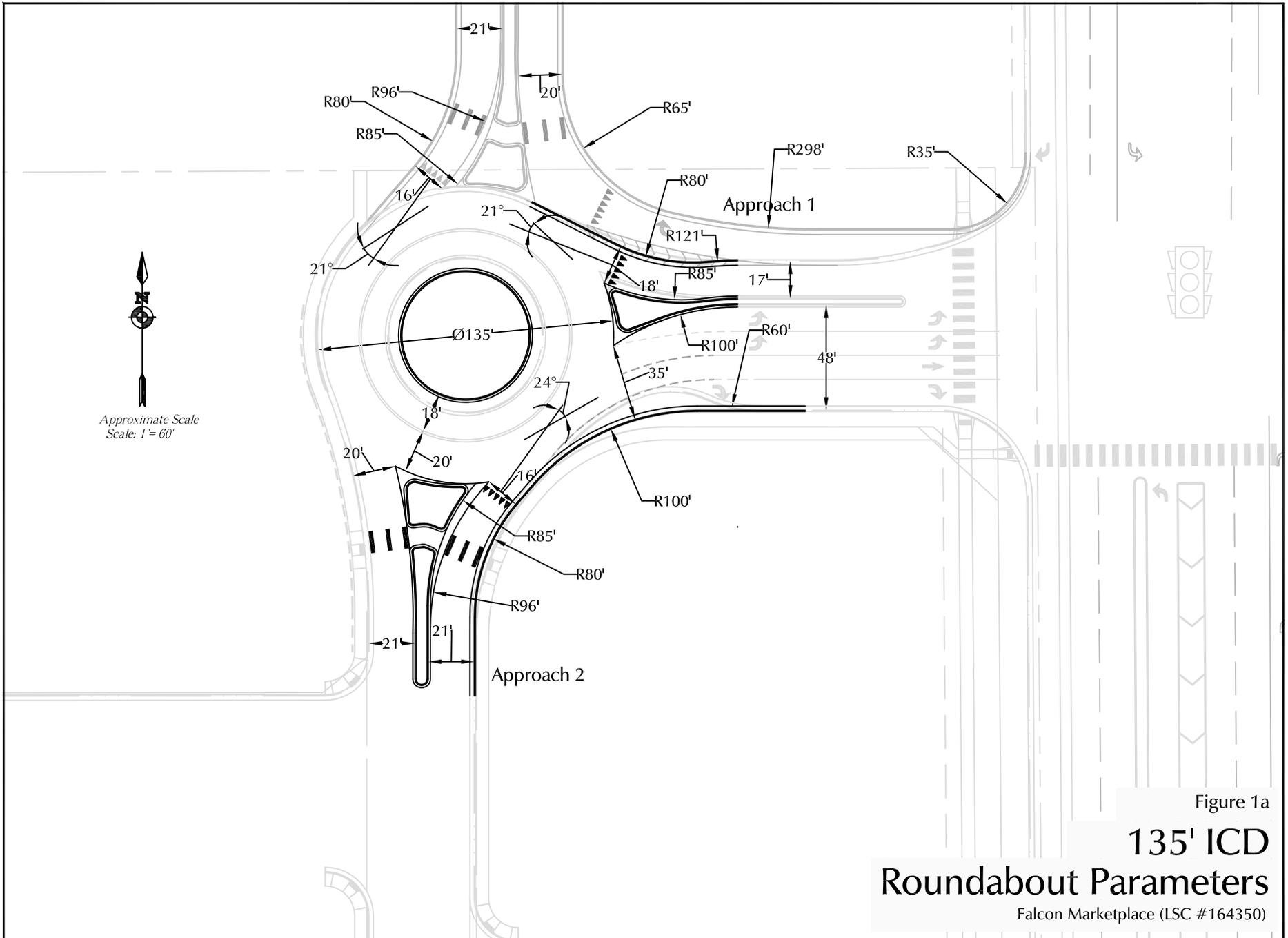
Designer: SMR
Reviewer: CSM

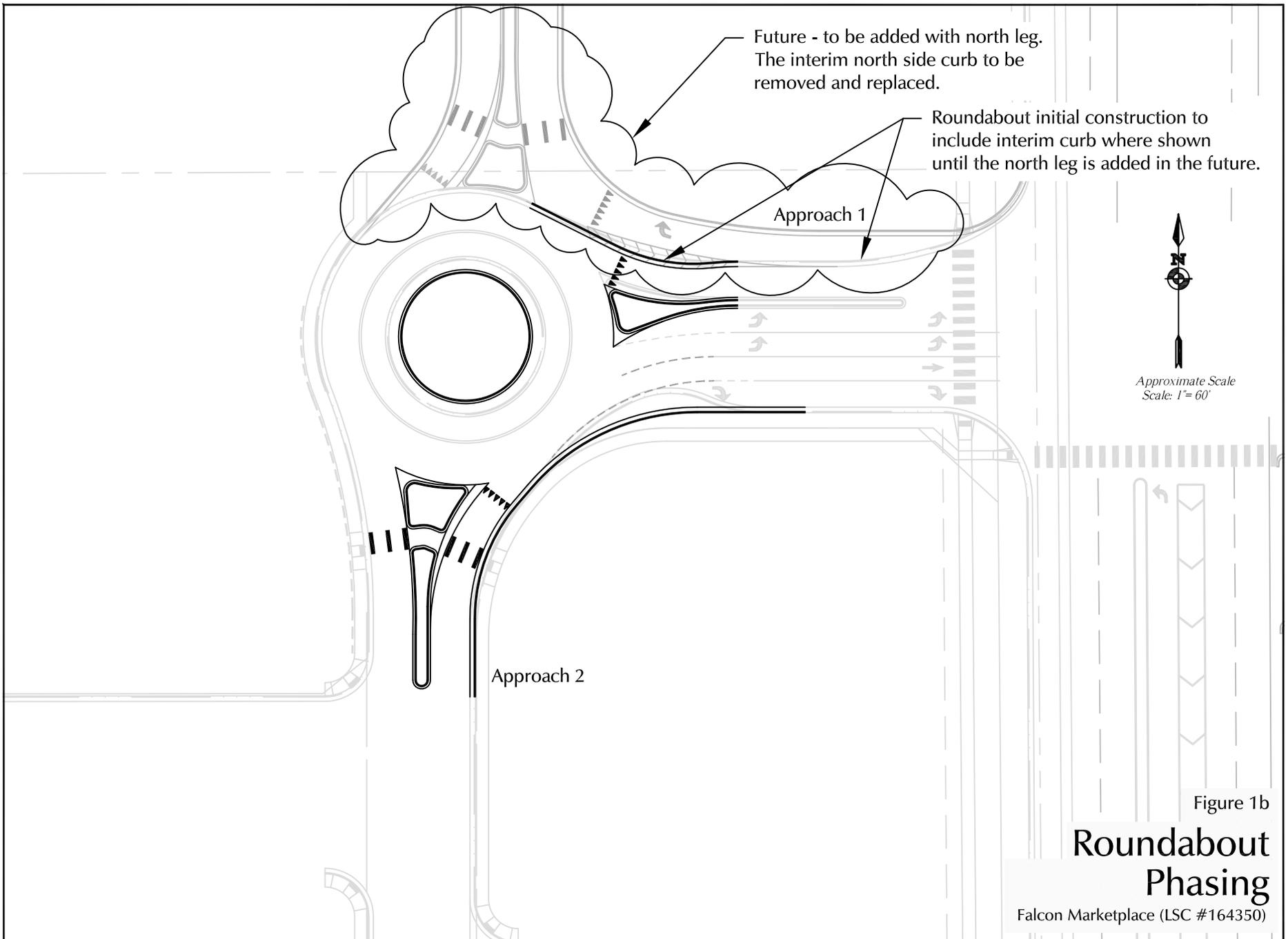
SIGNATURE: 

DATE: 12/2/2019

NAME: Christopher S. McGranahan

The reviewer's signature on this document indicates that the design has been reviewed and is in general compliance with good roundabout principals. The critical design elements have been addressed. The project design engineer in responsible charge of final plan development will stamp the plans when applicable.





Future - to be added with north leg.
The interim north side curb to be removed and replaced.

Roundabout initial construction to include interim curb where shown until the north leg is added in the future.

Approach 1

Approach 2



Approximate Scale
Scale: 1"= 60'

Figure 1b

Roundabout Phasing

Falcon Marketplace (LSC #164350)

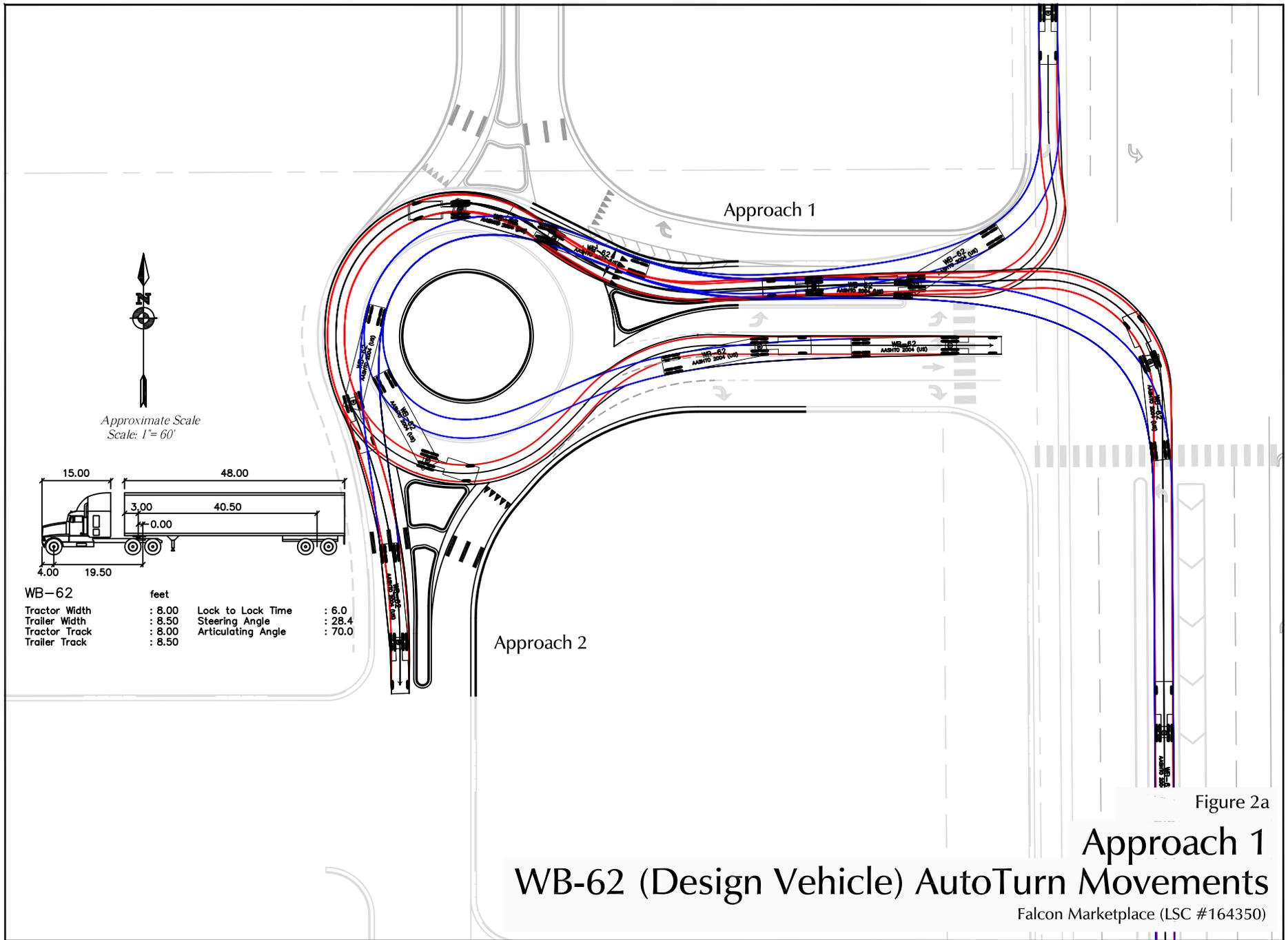
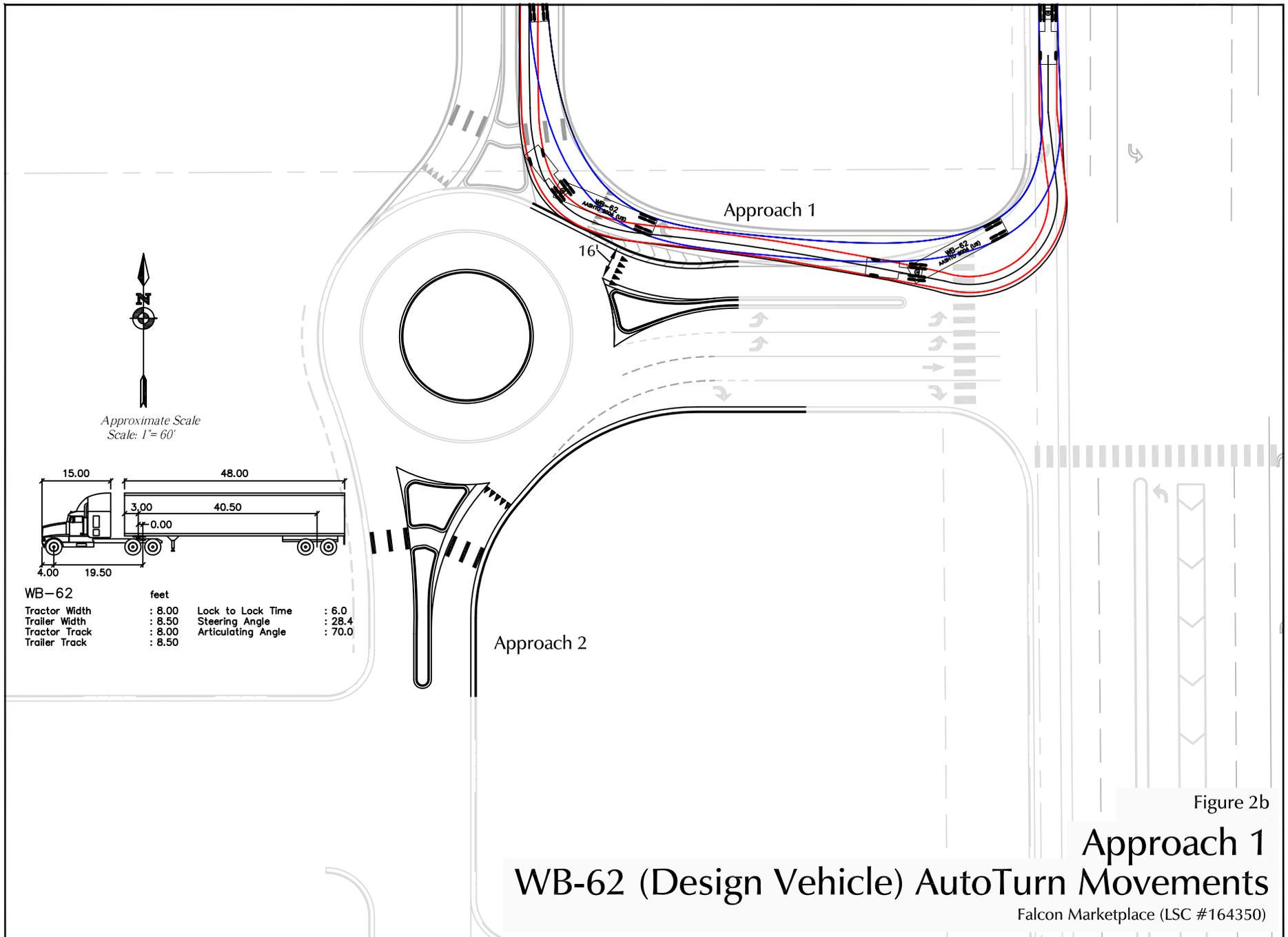


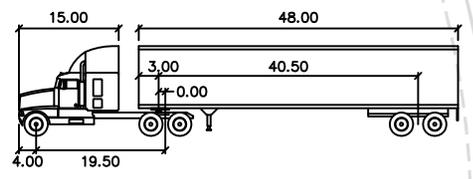
Figure 2a

Approach 1 WB-62 (Design Vehicle) AutoTurn Movements

Falcon Marketplace (LSC #164350)




 Approximate Scale
 Scale: 1" = 60'



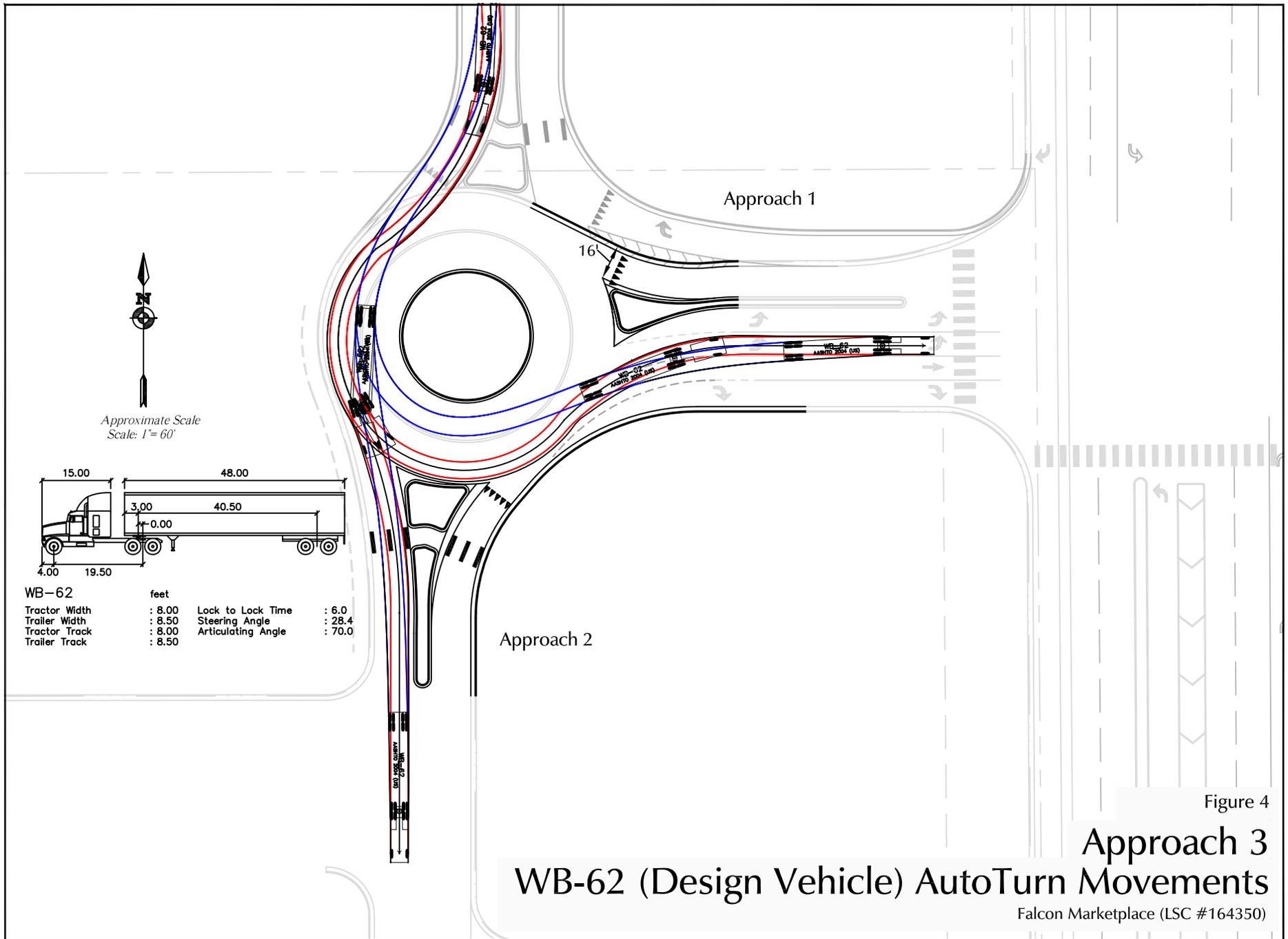
WB-62	feet		
Tractor Width	: 8.00	Lock to Lock Time	: 6.0
Trailer Width	: 8.50	Steering Angle	: 28.4
Tractor Track	: 8.00	Articulating Angle	: 70.0
Trailer Track	: 8.50		

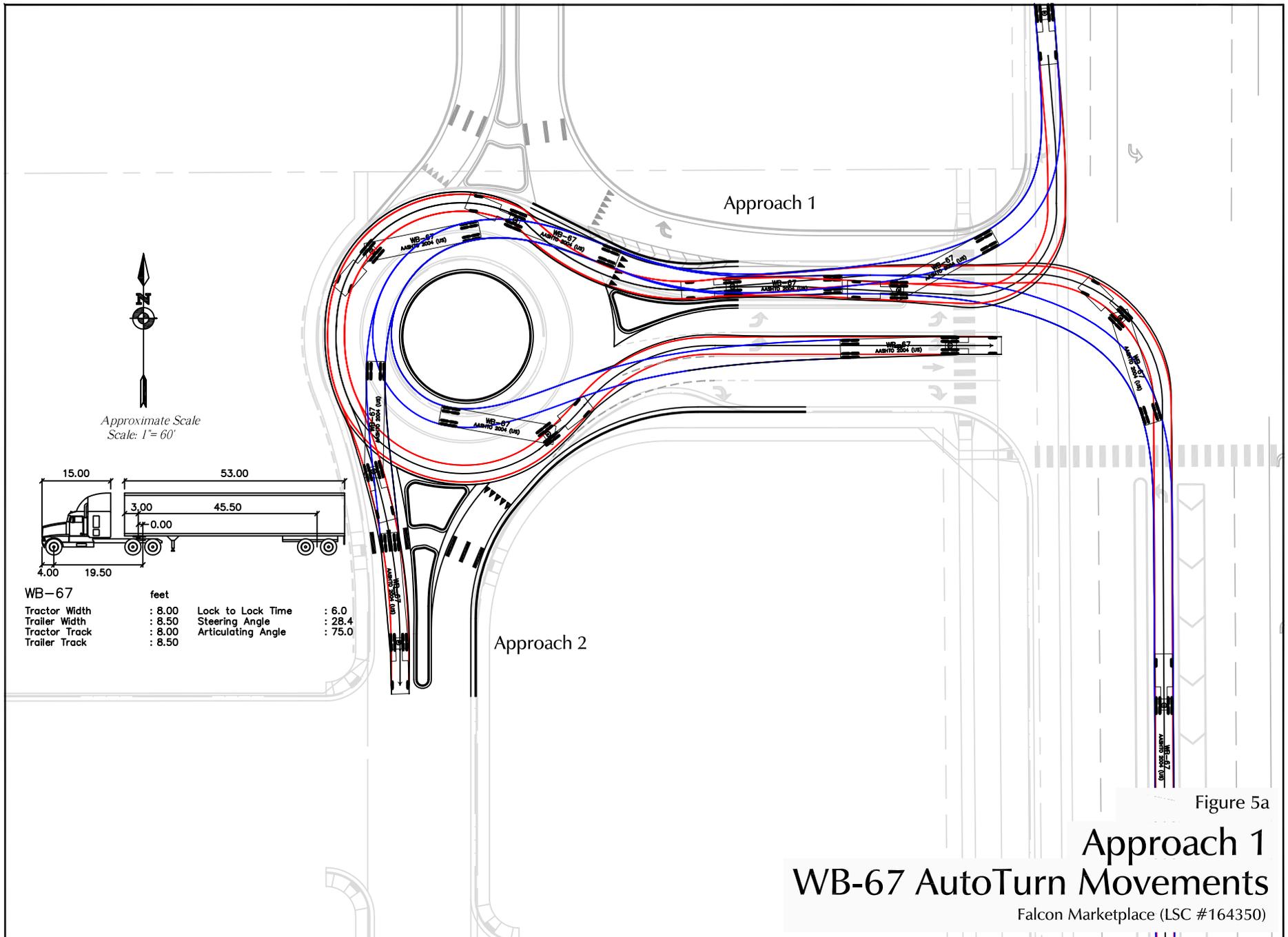
Approach 2

Approach 1

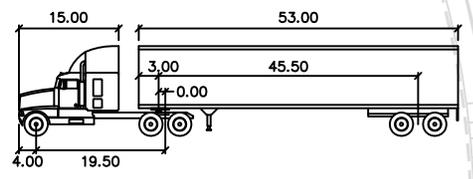
Figure 2b
Approach 1
WB-62 (Design Vehicle) AutoTurn Movements

Falcon Marketplace (LSC #164350)






 Approximate Scale
 Scale: 1" = 60'



WB-67

Tractor Width	: 8.00	Lock to Lock Time	: 6.0
Trailer Width	: 8.50	Steering Angle	: 28.4
Tractor Track	: 8.00	Articulating Angle	: 75.0
Trailer Track	: 8.50		

Figure 5a

Approach 1

WB-67 AutoTurn Movements

Falcon Marketplace (LSC #164350)

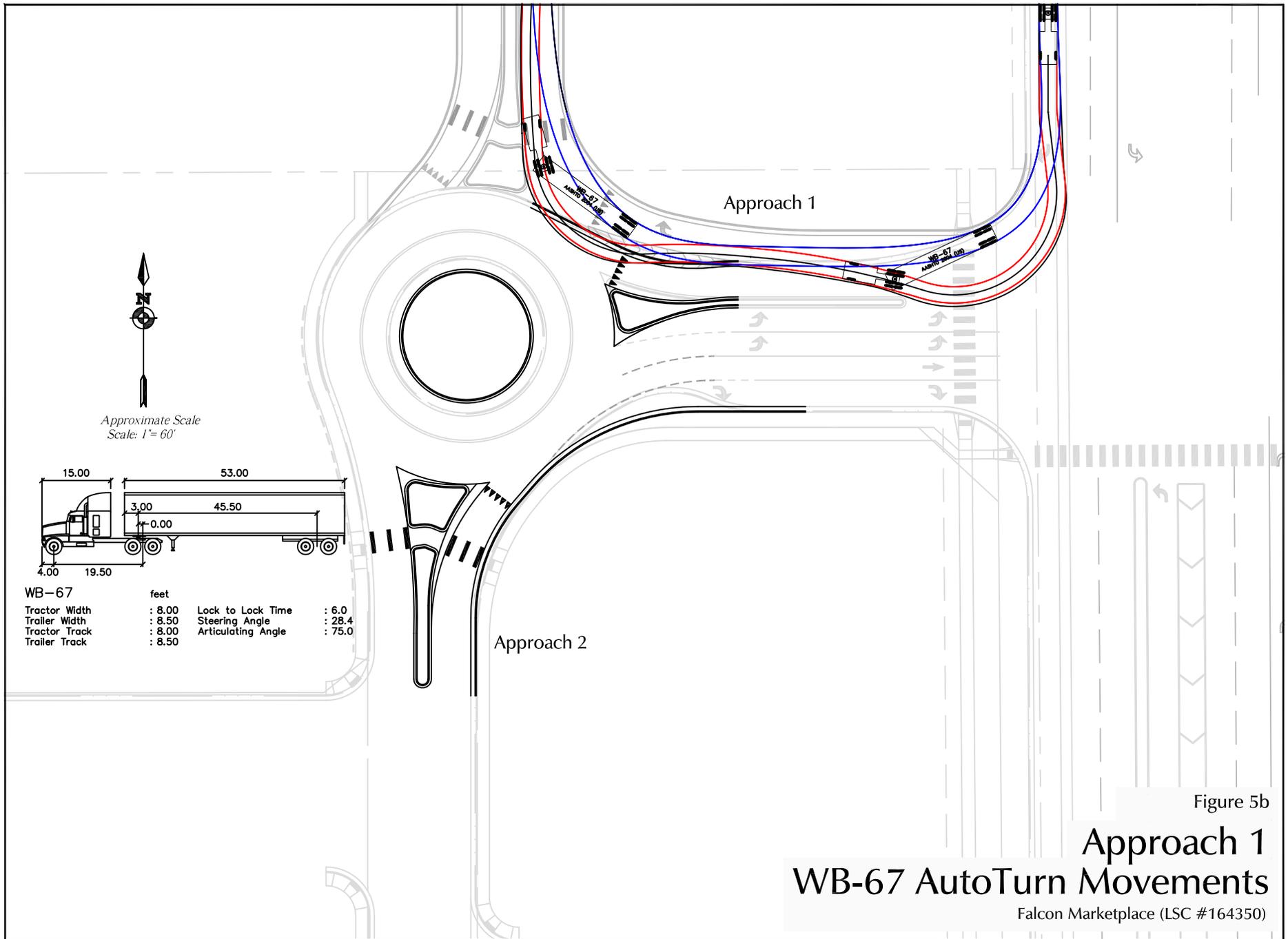
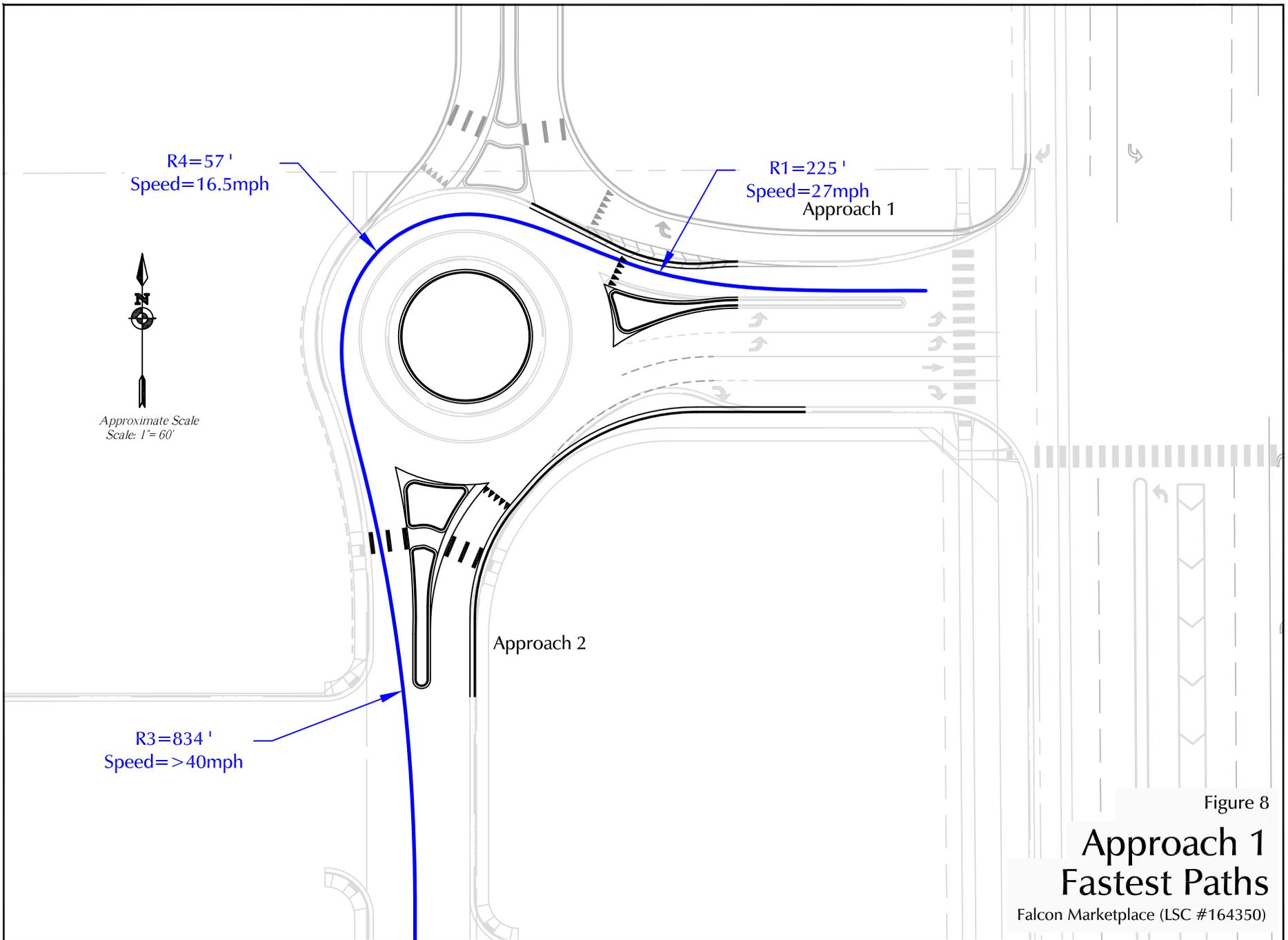


Figure 5b

Approach 1 WB-67 AutoTurn Movements

Falcon Marketplace (LSC #164350)



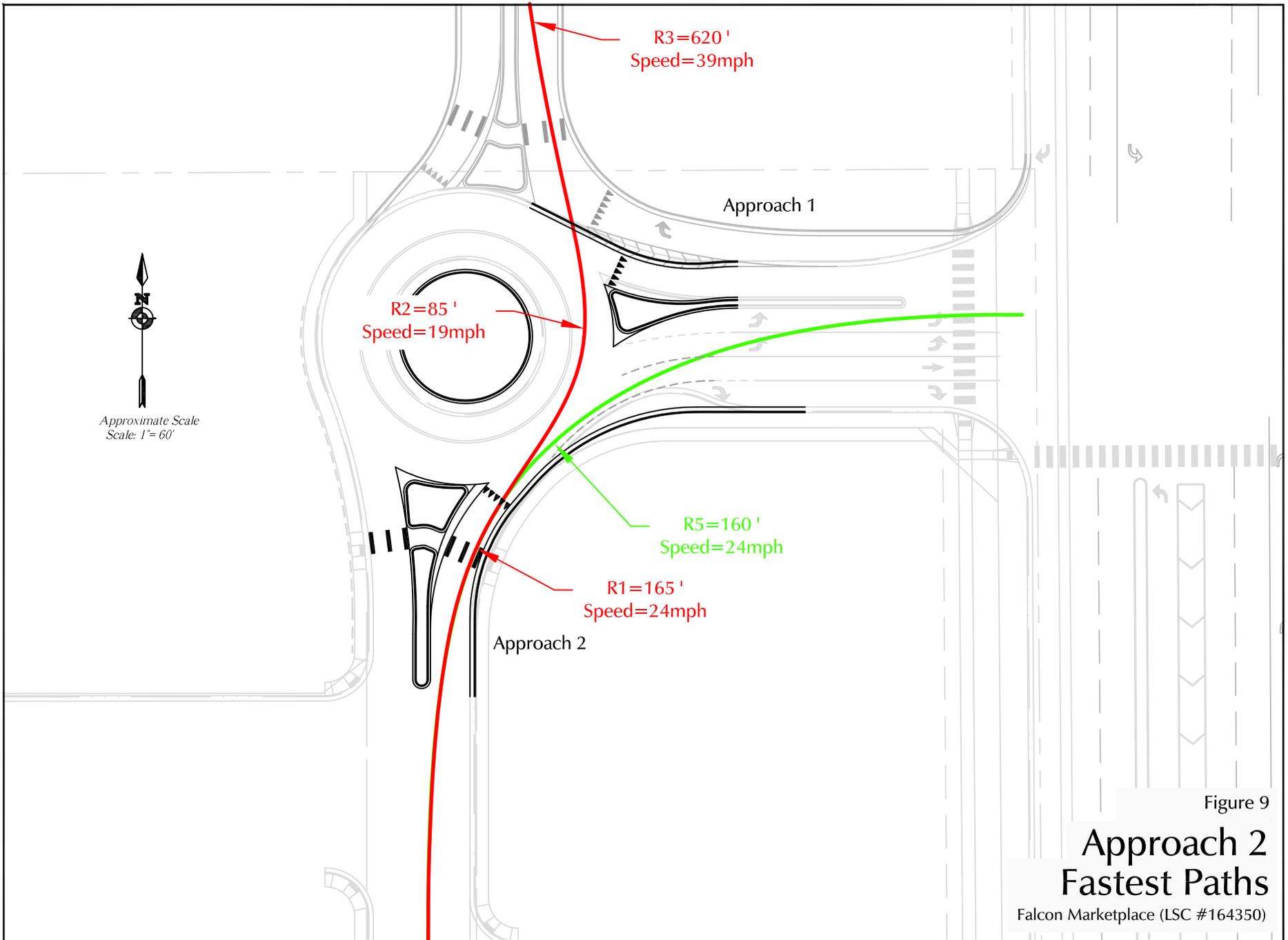


Figure 9

Approach 2 Fastest Paths

Falcon Marketplace (LSC #164350)

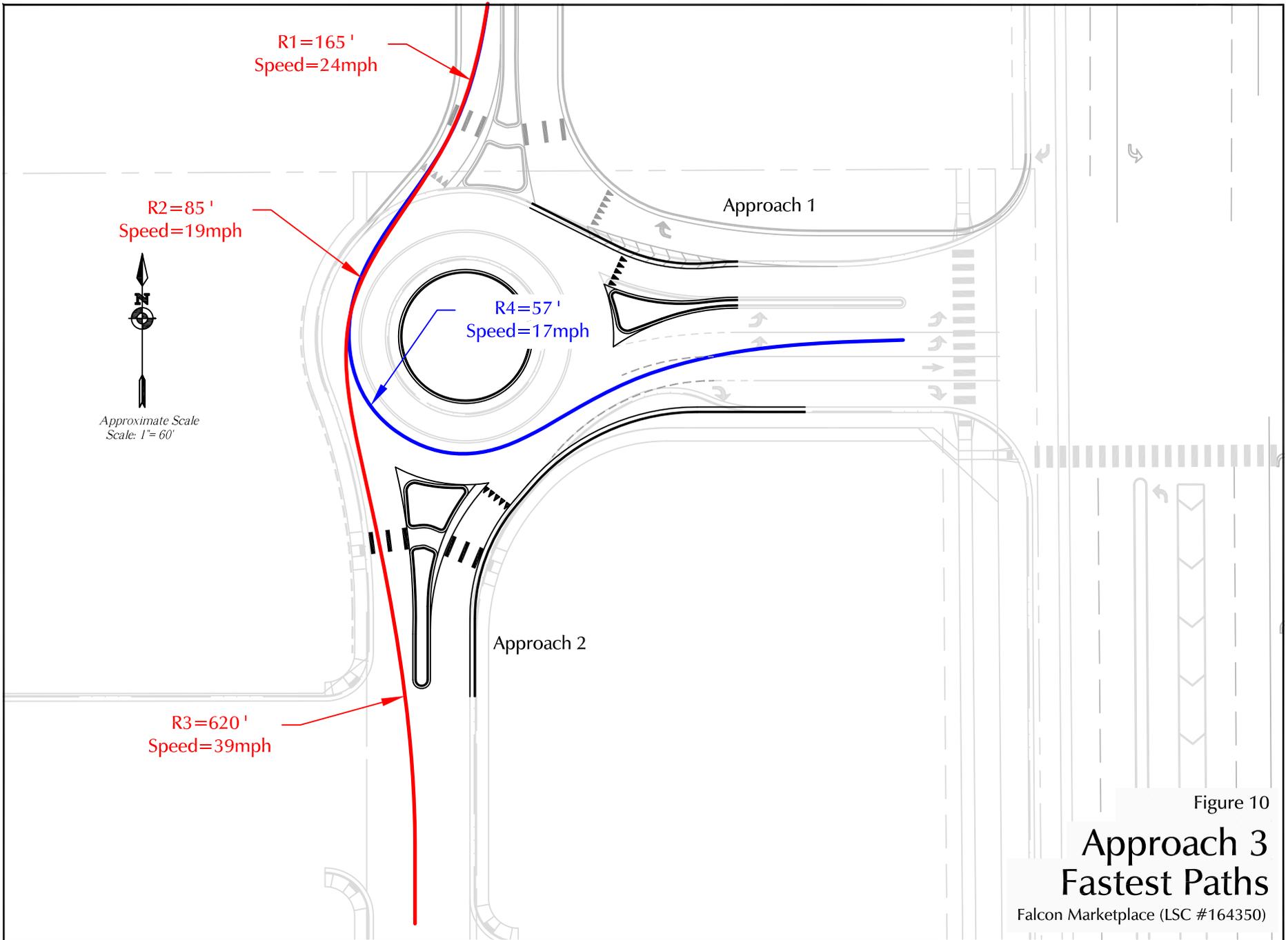
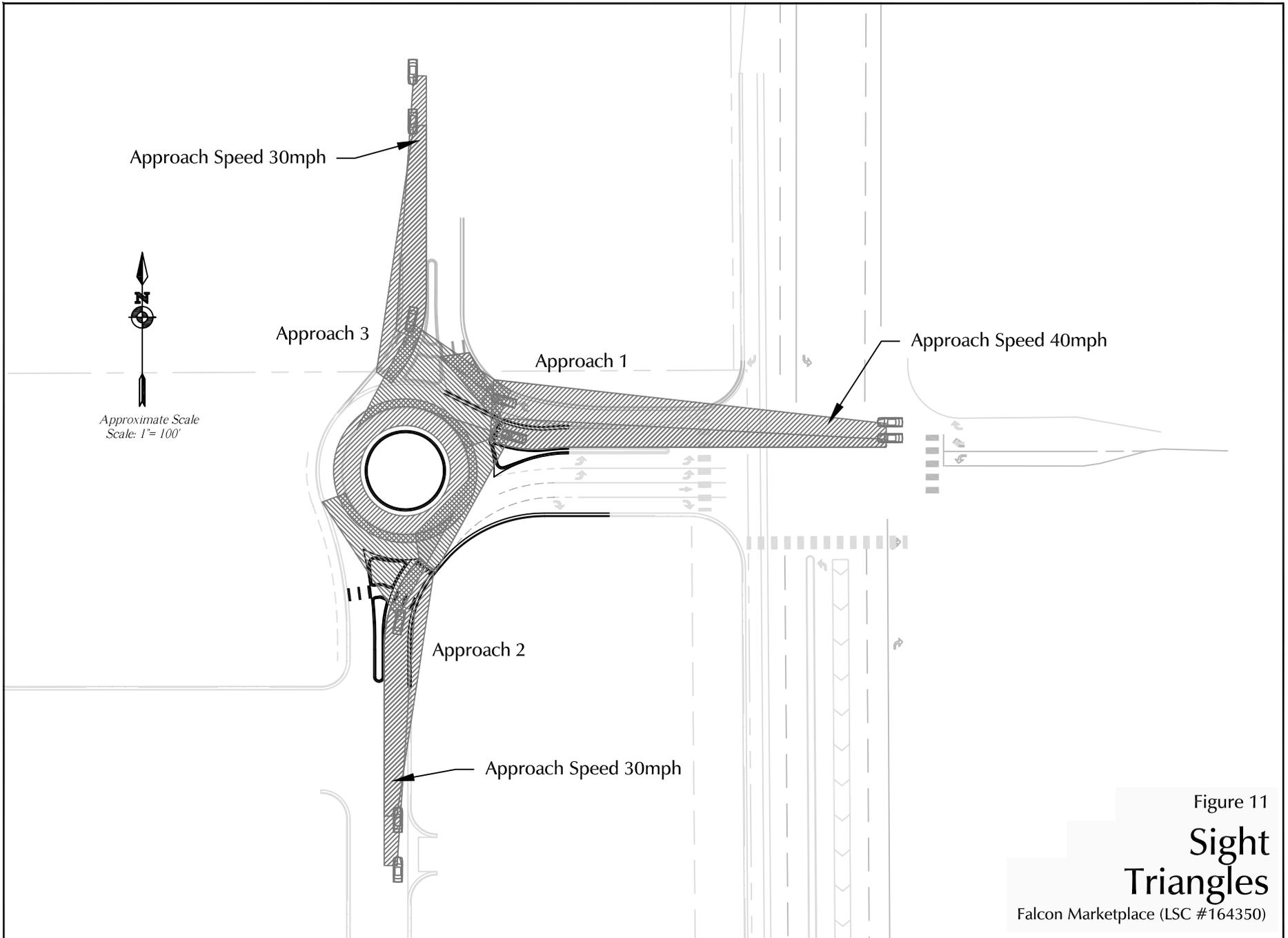


Figure 10

Approach 3 Fastest Paths

Falcon Marketplace (LSC #164350)



Operational Data

Traffic Flow Data (veh/hr)

2040 AM Peak Peak Hour Flows

Leg	Leg Names	Turning Flows				Flow Modifiers		
		U-Turn	Exit-2	Exit-1	Bypass	Trucks %	Flow Factor	Peak Hour Factor
1	Approach 3	0	246	0	0	2.0	1.00	0.9
2	Approach 1	0	3	261	176	2.0	1.00	0.9
3	Approach 2	0	73	5	0	2.0	1.00	0.9

Operational Results

2040 AM Peak - 15 minutes

Flows and Capacity

Leg	Leg Names	Bypass Type	Flows (veh/hr)					Capacity (veh/hr)			
			Arrival Flow		Opposing Flow		Exit Flow	Capacity		Average VCR	
			Entry	Bypass	Entry	Bypass		Entry	Bypass	Entry	Bypass
1	Approach 3	None	267		79		9	1500		0.1793	
2	Approach 1	Yield	287	191	267	551	79	807	1161	0.3603	0.1660
3	Approach 2	None	85		3		742	1551		0.0549	

Delays, Queues and Level of Service

Leg	Leg Names	Bypass Type	Average Delay (sec)			95% Queue (veh)		Level of Service		
			Entry	Bypass	Leg	Entry	Bypass	Entry	Bypass	Leg
1	Approach 3	None	2.74		2.74	0.56		A		A
2	Approach 1	Yield	6.32	3.54	5.21	1.38	0.52	A	A	A
3	Approach 2	None	2.33		2.33	0.15		A		A

Global Results

Performance and Accidents

2040 AM Peak Global Performance

Parameter	Units	Entries	Bypasses	Total
Arrive Flows	veh/hr	588	176	764
Capacity	veh/hr	3874	1192	5066
Average Delay	sec/veh	4.27	3.51	4.10
L.O.S. (Signal)	A – F	A	A	A
L.O.S. (Unsig)	A – F	A	A	A
Total Delay	veh.hrs	0.70	0.17	0.87

Operational Data

Traffic Flow Data (veh/hr)

2040 PM Peak Peak Hour Flows

Leg	Leg Names	Turning Flows				Flow Modifiers		
		U-Turn	Exit-2	Exit-1	Bypass	Trucks %	Flow Factor	Peak Hour Factor
1	Approach 3	0	206	9	0	2.0	1.00	0.9
2	Approach 1	0	371	0	314	2.0	1.00	0.9
3	Approach 2	0	8	558	0	2.0	1.00	0.9

Operational Results

2040 PM Peak - 15 minutes

Flows and Capacity

Leg	Leg Names	Bypass Type	Flows (veh/hr)					Capacity (veh/hr)			
			Arrival Flow		Opposing Flow		Exit Flow	Capacity		Average VCR	
			Entry	Bypass	Entry	Bypass		Entry	Bypass	Entry	Bypass
1	Approach 3	None	234		9		1009	1793		0.1309	
2	Approach 1	Yield	403	341	224	224	18	1077	1640	0.3783	0.2093
3	Approach 2	None	615		403		565	1528		0.4056	

Delays, Queues and Level of Service

Leg	Leg Names	Bypass Type	Average Delay (sec)			95% Queue (veh)		Level of Service		
			Entry	Bypass	Leg	Entry	Bypass	Entry	Bypass	Leg
1	Approach 3	None	2.18		2.18	0.39		A		A
2	Approach 1	Yield	4.89	2.66	3.87	1.50	0.69	A	A	A
3	Approach 2	None	3.60		3.60	1.68		A		A

Global Results

Performance and Accidents

2040 PM Peak Global Performance

Parameter	Units	Entries	Bypasses	Total
Arrive Flows	veh/hr	1152	314	1466
Capacity	veh/hr	4430	1652	6082
Average Delay	sec/veh	3.69	2.67	3.47
L.O.S. (Signal)	A – F	A	A	A
L.O.S. (Unsig)	A – F	A	A	A
Total Delay	veh.hrs	1.18	0.23	1.41