



LSC TRANSPORTATION CONSULTANTS, INC.

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March 6, 2018

Mr. Jeff Mark  
The Landhuis Company  
212 N. Wahsatch Avenue, Suite 301  
Colorado Springs, CO 80903

Re: Lorson Ranch East  
Roundabout Report  
El Paso County, CO  
LSC #164360

Dear Mr. Mark:

We are pleased to submit this roundabout design report for the intersection of Fontaine Boulevard and Lamprey Drive in El Paso County, Colorado.

### **Roundabout Layout**

Figure 1 shows the conceptual roundabout design parameters. The overall diameter is 150 feet and the entry phi angles are between 20.5 and 21.5 degrees on each of the approaches.

### **Design Vehicle**

Figures 2 through 5 show WB-50 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.

Figure 6a shows the WB-67 truck paths through the proposed roundabout. Many movements will likely traverse over the outside curb or into the center or splitter islands. Figure 6b shows the proposed roundabout can accommodate a WB-67 truck passing east-west through the intersection.

### **Design Speeds**

Figures 7 through 10 show the estimated fastest path radii for each of the approaches to the proposed roundabout. These paths are drawn in accordance with the methodology outlined in the *Roundabout Informational Guide* (NCHRP 672). 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 four approaches meets this criteria.

### **Pedestrian Safety and Accessibility**

Pedestrian crossings with pedestrian refuge areas on the splitter islands have been provided on all four approaches. The *Roundabout Informational Guide* (NCHRP 672) gives recommendations for placement and design of pedestrian crossings. The recommendations given in the *Roundabout Informational Guide* (NCHRP 672) were followed in the proposed design including the following:

- Pedestrian refuge widths are a minimum of 6 feet;
- Pedestrian refuge widths that will accommodate bicycles should be increased to a minimum of ten feet;
- 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. The following recommendations are given when designing the vertical aspects of the proposed roundabout:

- Pedestrian refuge areas should be designed at street level rather than elevated to the height of the splitter island;
- Ramps should be provided and designed in accordance with ADA standards on each end of the crosswalk;
- Detectable warning surfaces in accordance with ADA standards should be provided at ramps and the pedestrian refuge area of the splitter islands.
- The truck apron should be textured and raised above the circulating roadway. The specific design will be determined as part of the construction plans.

### **Sight Distance**

Figure 11 shows the areas that should remain free of obstacles that would limit sight distance for vehicles, bicycles, and pedestrians. The sight lines were drawn in accordance with WisDOT standards which are consistent with NCHRP 672.

### **Bike Lanes**

There are on-street bike lanes proposed along Fontaine Boulevard. As on-street cyclists approach the roundabout, they will enter the vehicle lane and traverse the roundabout as a vehicle or use the bike lane ramps to exit the bike lane onto the adjacent multi-use path and traverse the roundabout as a pedestrian.

### **CAPACITY ANALYSIS**

The 2040 total traffic volumes were evaluated using Rodel. The results show acceptable operations are expected through 2040. The Rodel reports are attached for reference.

\* \* \* \* \*

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

3-6-18

Enclosures: Figures 1 - 11  
Rodel Reports



Approximate Scale  
Scale: 1" = 60'

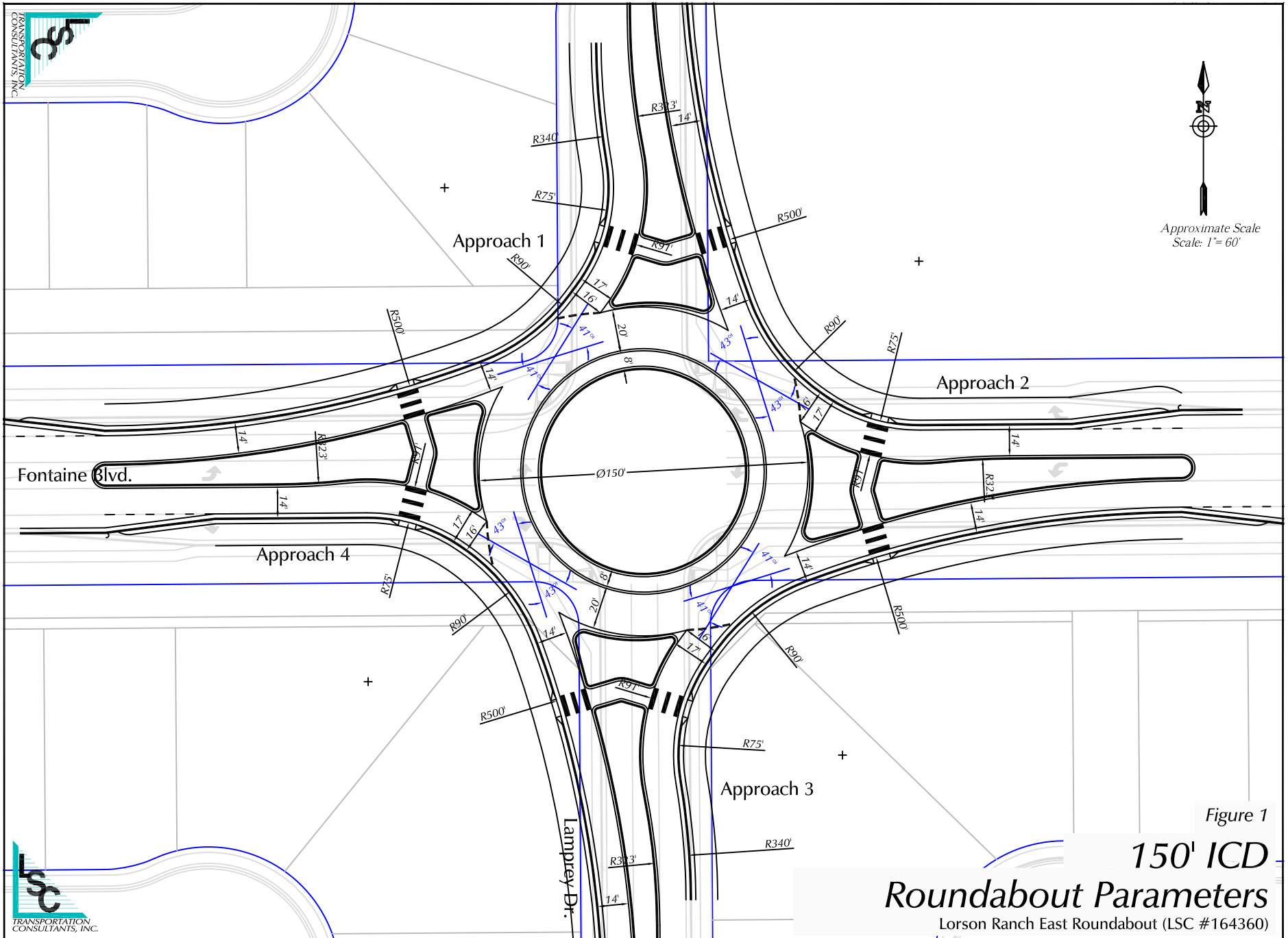


Figure 1

# 150' ICD Roundabout Parameters

Lorson Ranch East Roundabout (LSC #164360)

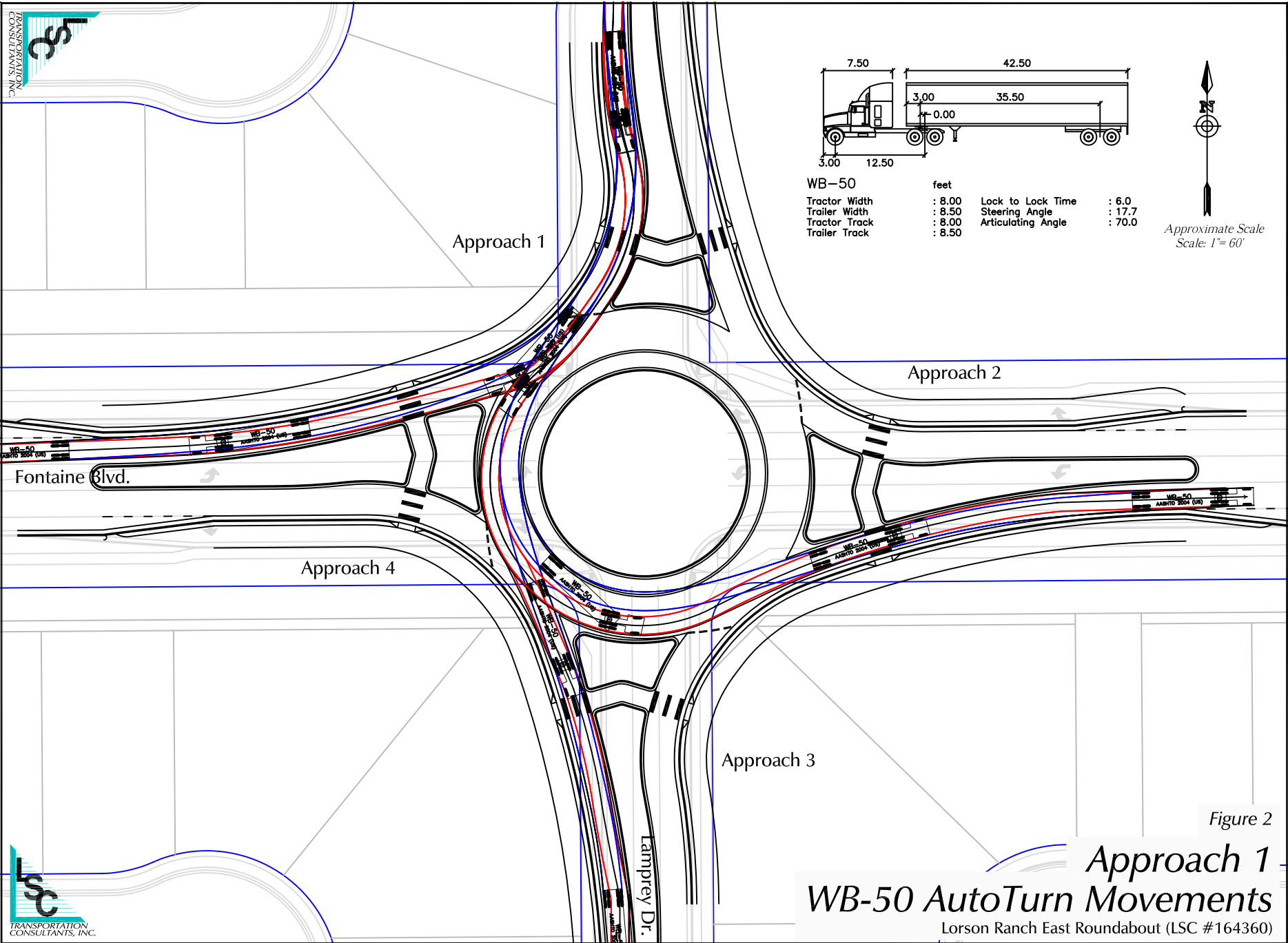
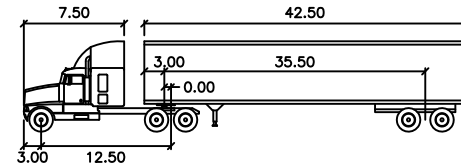


Figure 2

**Approach 1**  
**WB-50 AutoTurn Movements**  
Lorson Ranch East Roundabout (LSC #164360)



WB-50		feet	
Tractor Width	: 8.00	Lock to Lock Time	: 6.0
Trailer Width	: 8.50	Steering Angle	: 17.7
Tractor Track	: 8.00	Articulating Angle	: 70.0
Trailer Track	: 8.50		



Approximate Scale  
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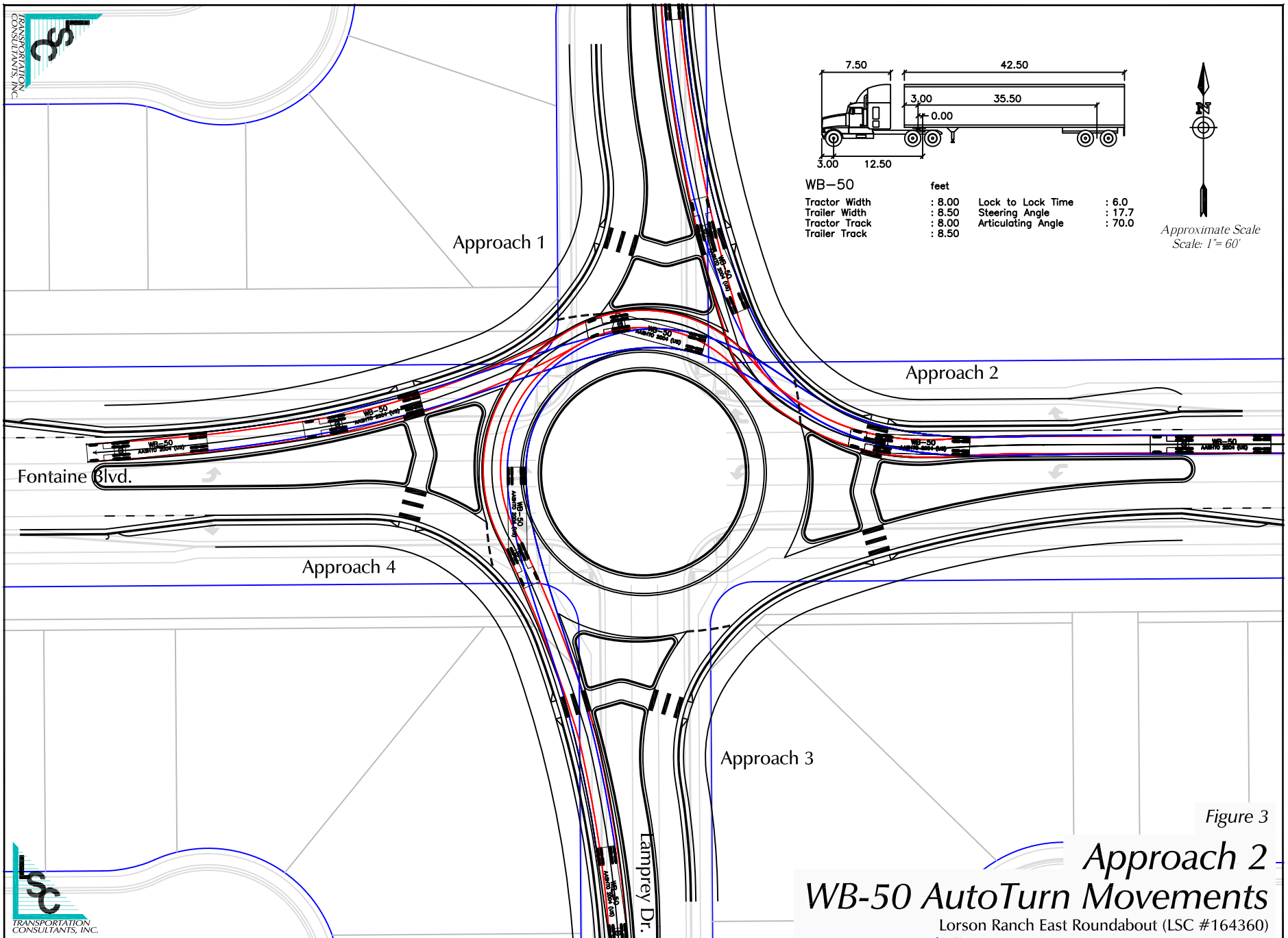


Figure 3

**Approach 2**  
**WB-50 AutoTurn Movements**  
Lorson Ranch East Roundabout (LSC #164360)

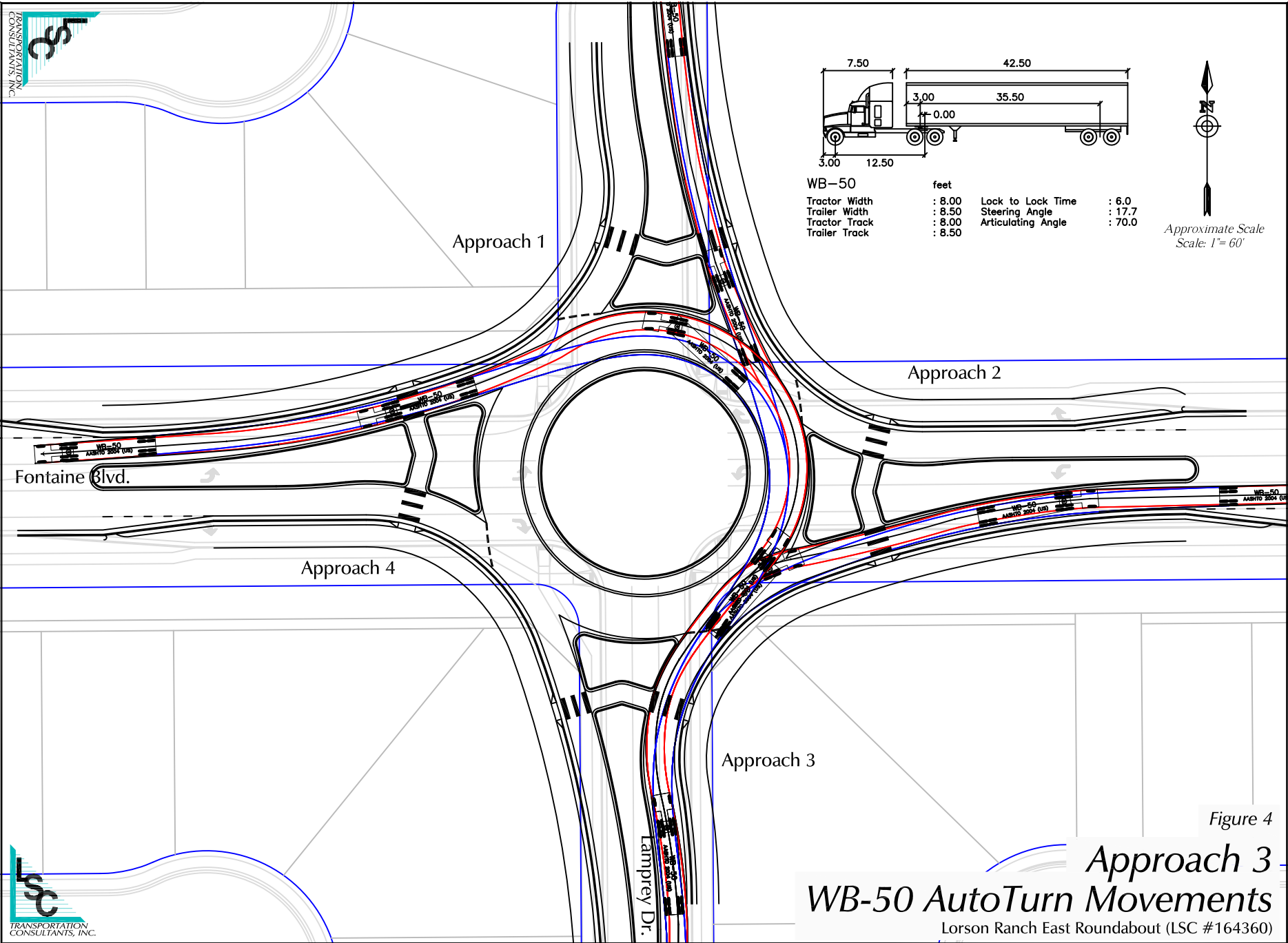


Figure 4

**Approach 3**  
**WB-50 AutoTurn Movements**  
Lorson Ranch East Roundabout (LSC #164360)

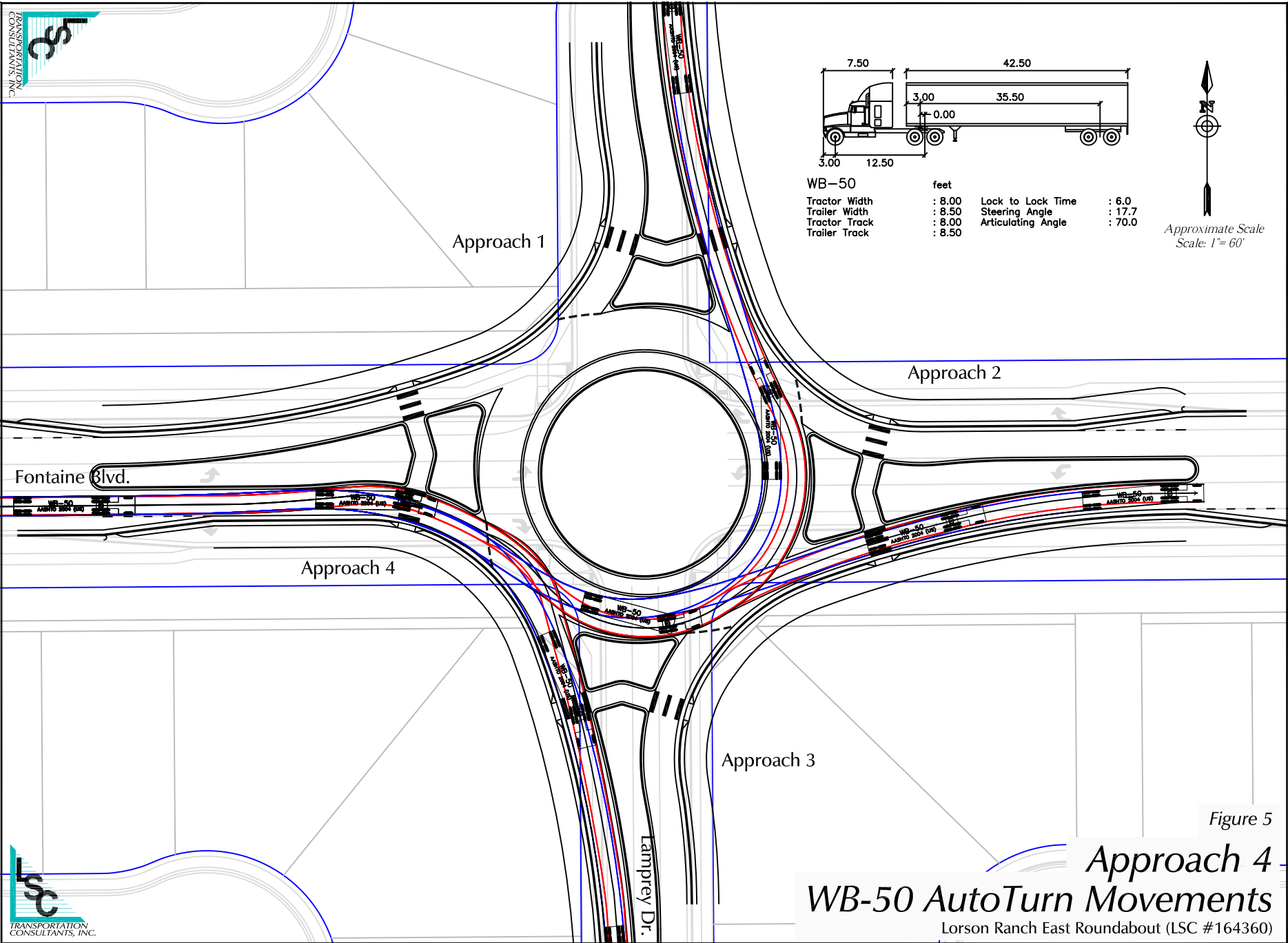
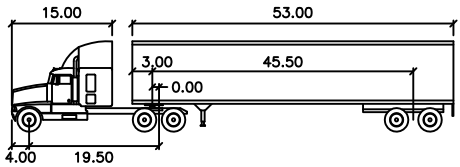
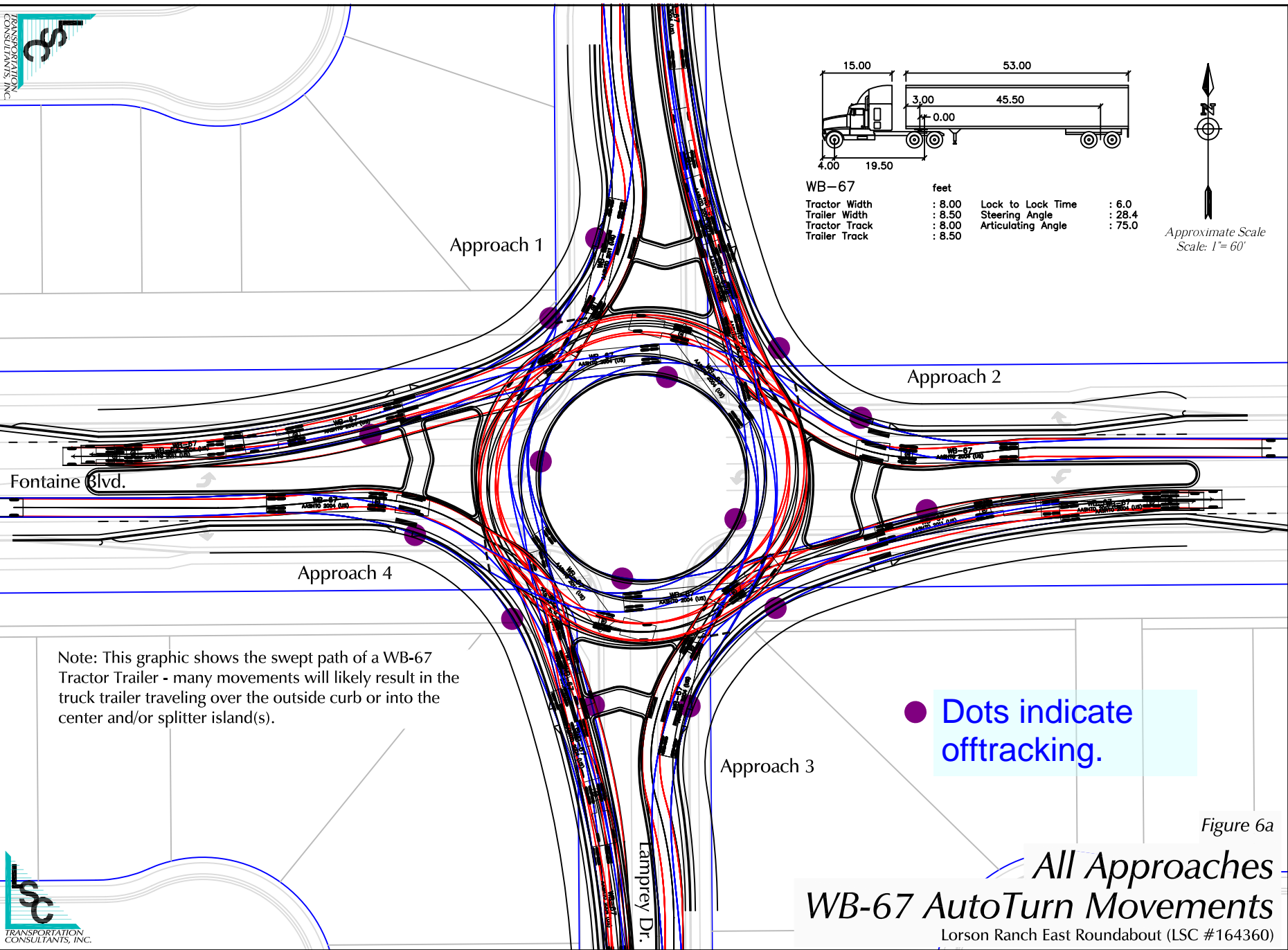


Figure 5

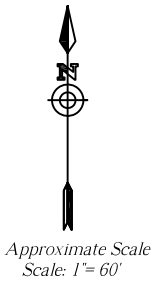
**Approach 4**  
**WB-50 AutoTurn Movements**  
Lorson Ranch East Roundabout (LSC #164360)





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		



Fontaine Blvd.

Approach 4

Approach 1

Approach 2

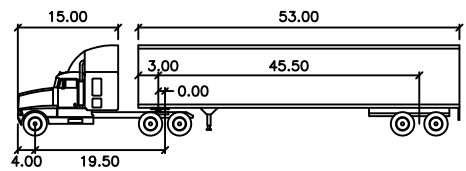
Approach 3

Lamprey Dr.

Note: This graphic shows the swept path of a WB-67 Tractor Trailer - many movements will likely result in the truck trailer traveling over the outside curb or into the center and/or splitter island(s).

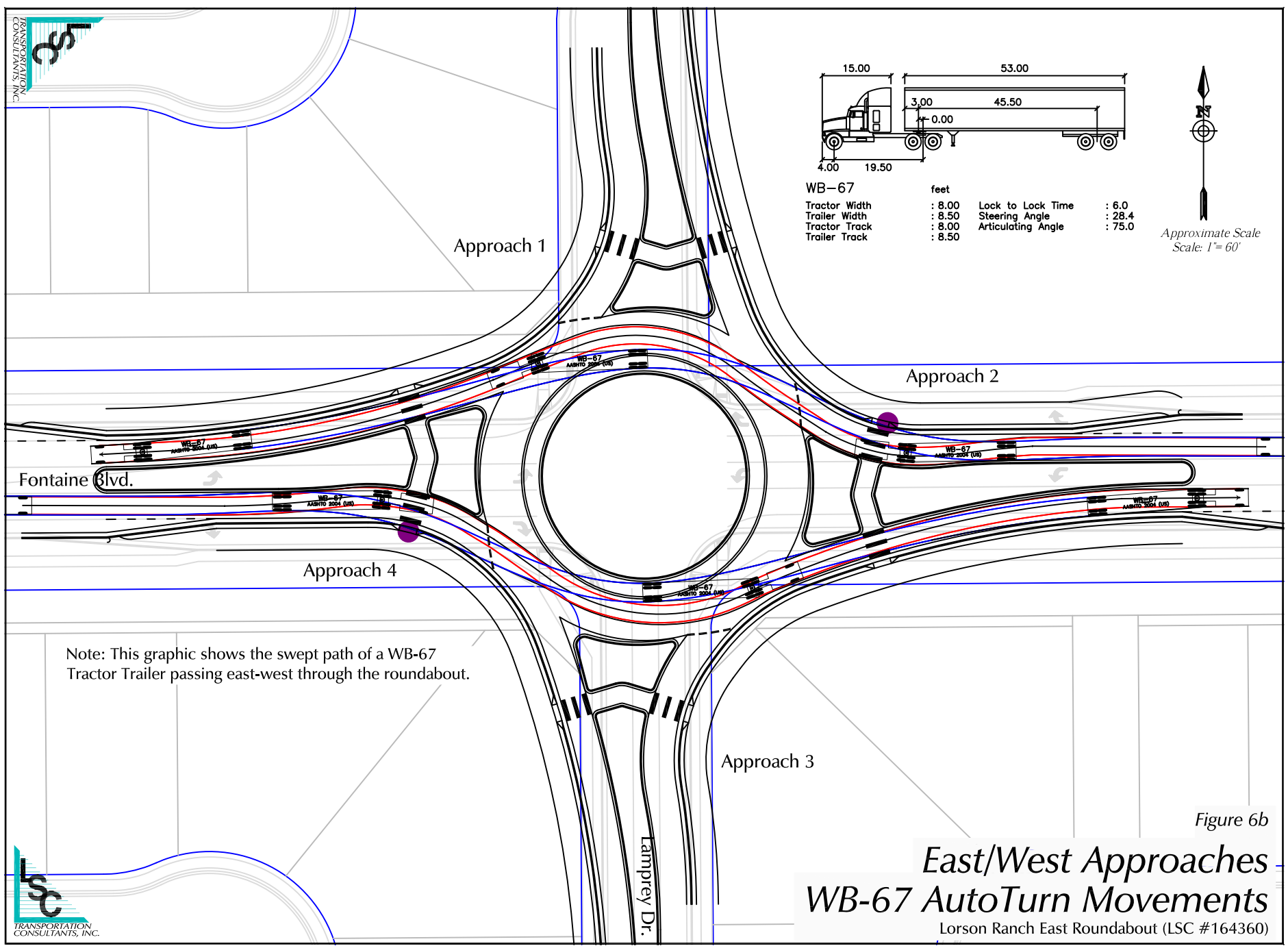
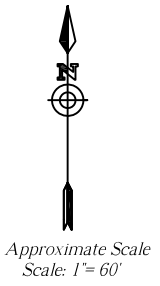
● Dots indicate offtracking.

Figure 6a  
**All Approaches  
WB-67 AutoTurn Movements**  
Lorson Ranch East Roundabout (LSC #164360)



WB-67

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



Note: This graphic shows the swept path of a WB-67 Tractor Trailer passing east-west through the roundabout.

Figure 6b  
**East/West Approaches  
WB-67 AutoTurn Movements**  
Lorson Ranch East Roundabout (LSC #164360)



Approximate Scale  
Scale: 1" = 60'

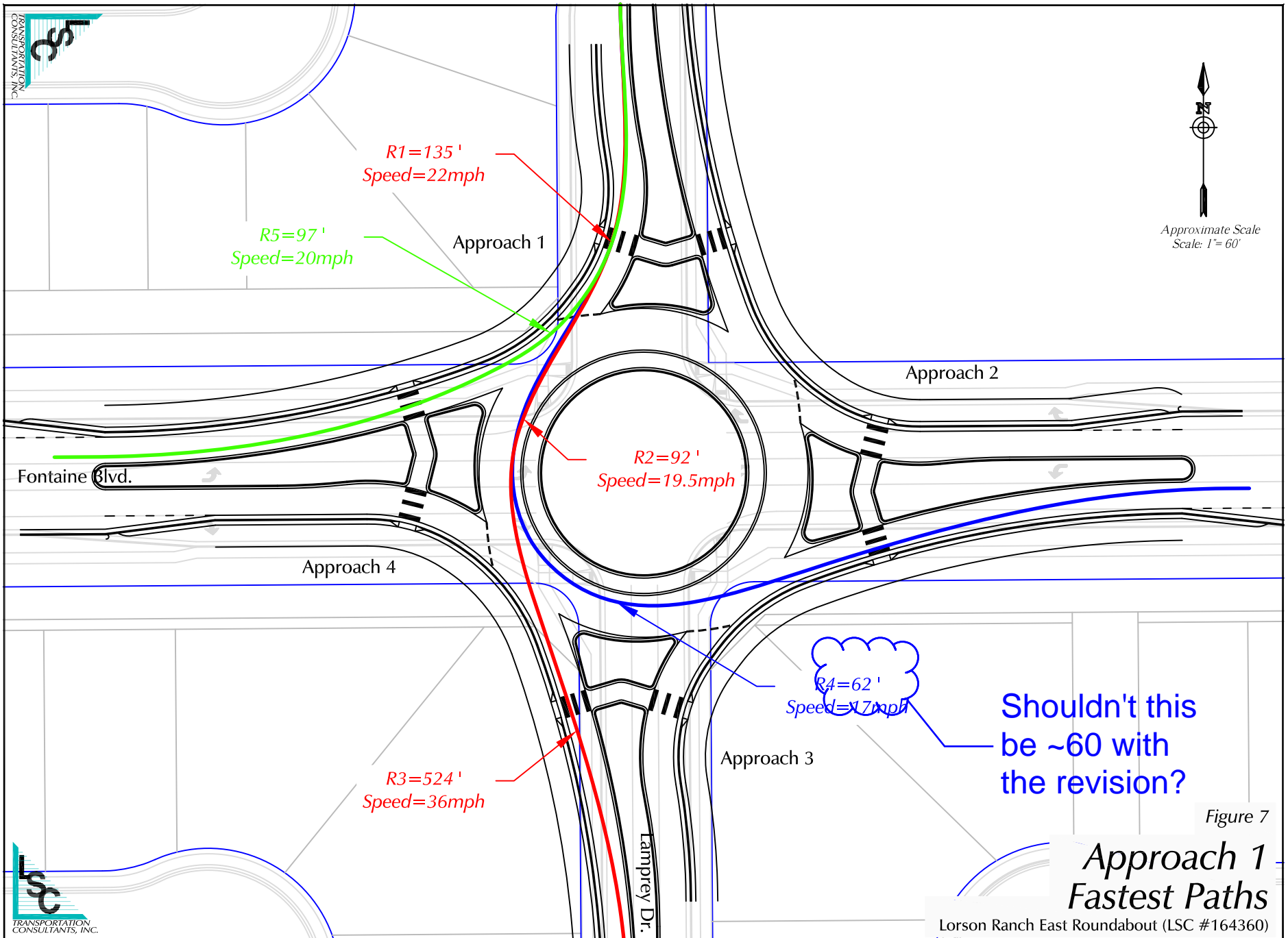


Figure 7

### Approach 1 Fastest Paths

Lorson Ranch East Roundabout (LSC #164360)



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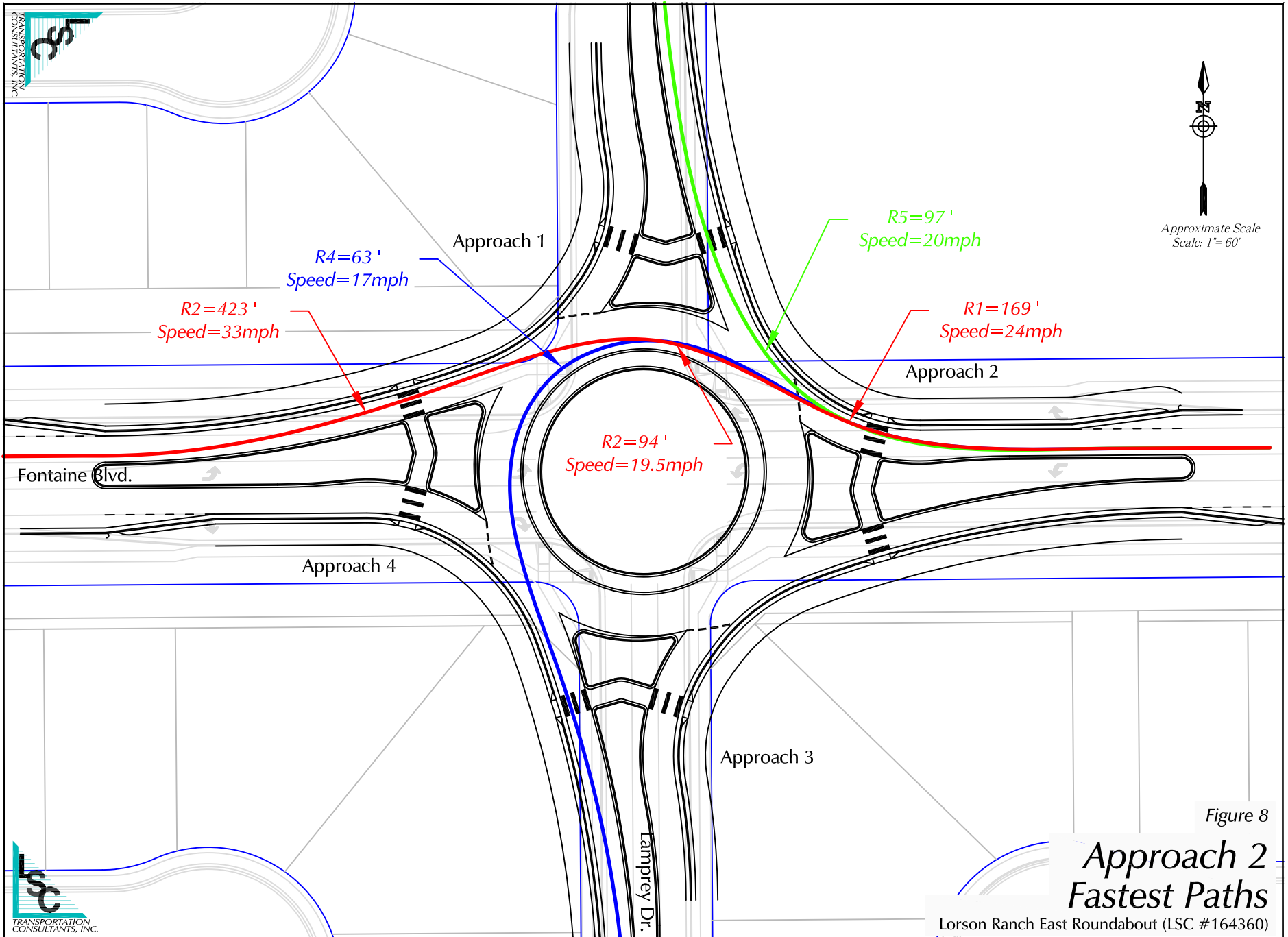
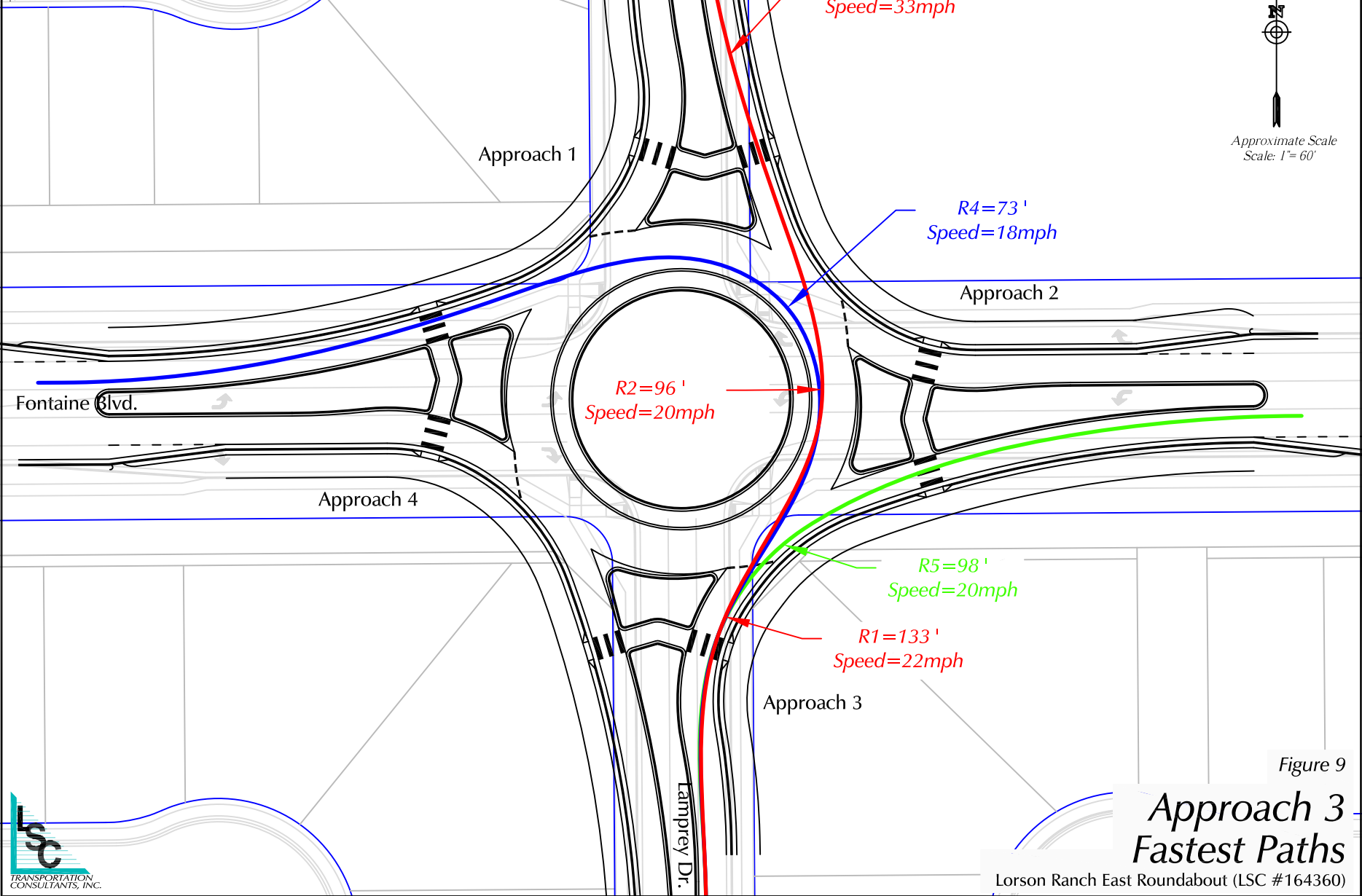


Figure 8

## Approach 2 Fastest Paths

Lorson Ranch East Roundabout (LSC #164360)



Approximate Scale  
Scale: 1" = 60'

Figure 9

# Approach 3 Fastest Paths

Lorson Ranch East Roundabout (LSC #164360)





Approximate Scale  
Scale: 1" = 60'

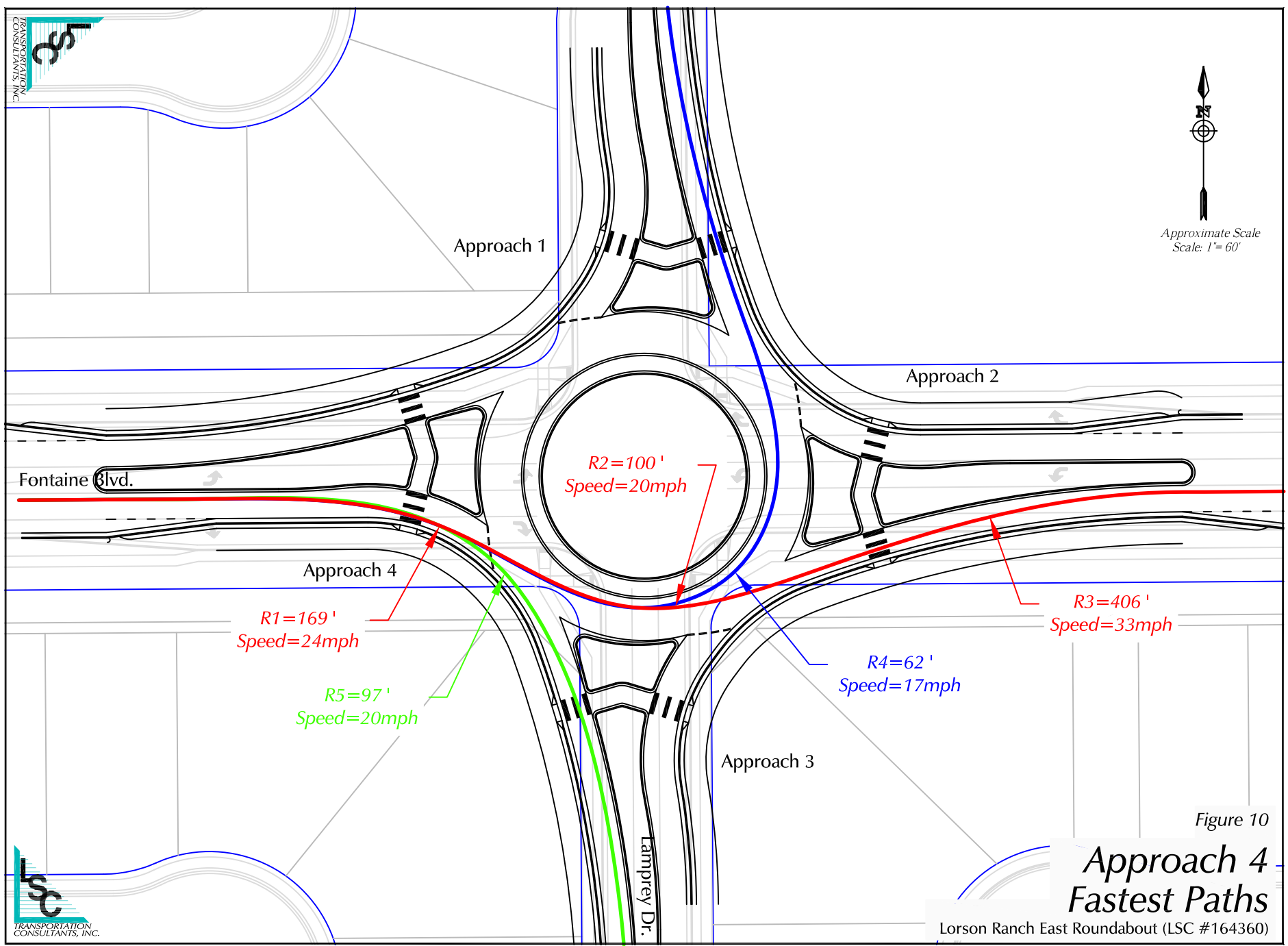
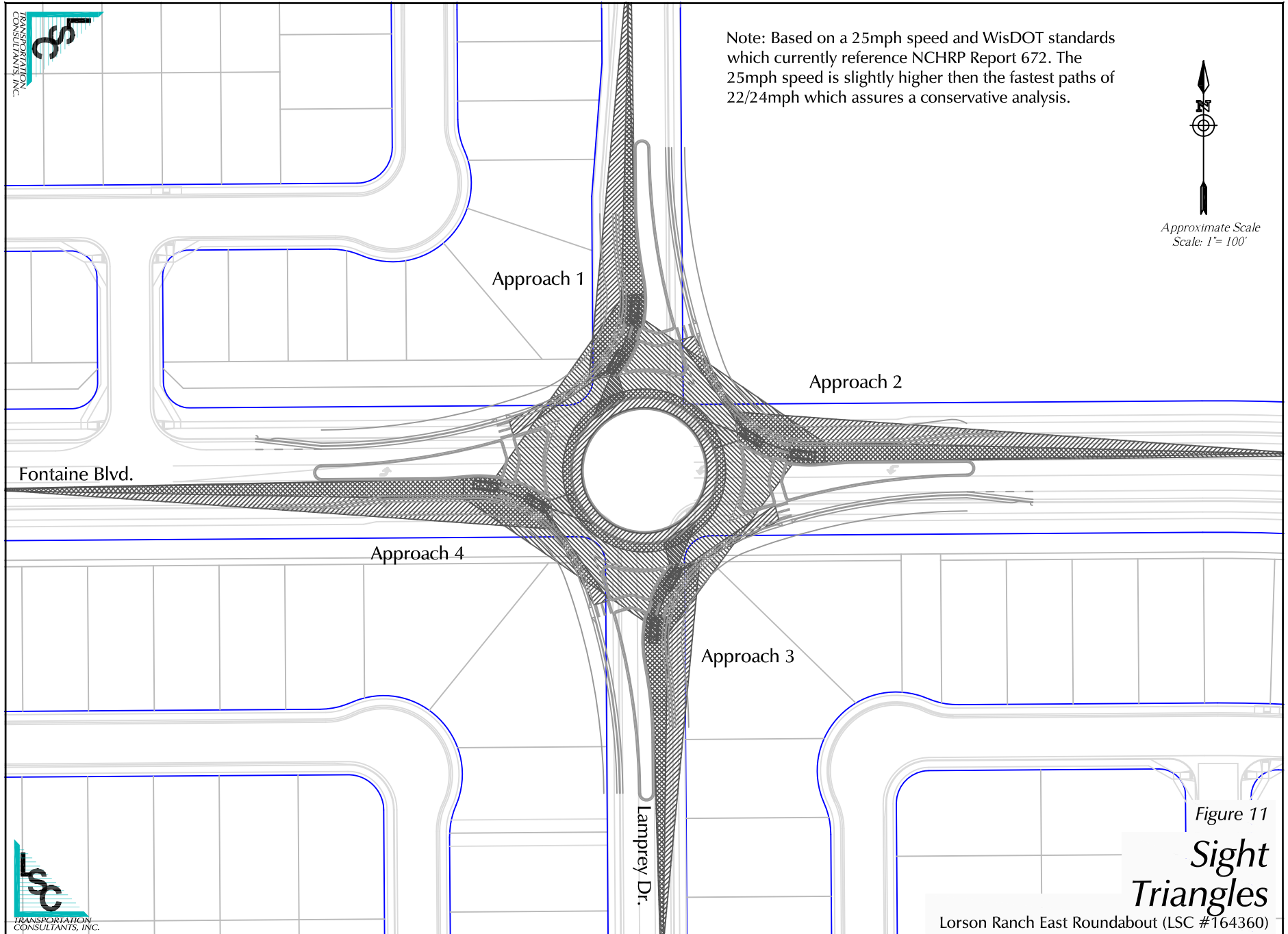


Figure 10

# Approach 4 Fastest Paths

Lorson Ranch East Roundabout (LSC #164360)



Note: Based on a 25mph speed and WisDOT standards which currently reference NCHRP Report 672. The 25mph speed is slightly higher than the fastest paths of 22/24mph which assures a conservative analysis.



Approximate Scale  
Scale: 1" = 100'

Fontaine Blvd.

Approach 1

Approach 2

Approach 4

Approach 3

Lamprey Dr.

Figure 11

# Sight Triangles

Lorson Ranch East Roundabout (LSC #164360)



## Operational Data

### Main Geometry (ft)

#### Approach and Entry Geometry

Leg	Leg Names	Approach Bearing (deg)	Grade Separation G	Half Width V	Approach Lanes n	Entry Width E	Entry Lanes n	Flare Length L'	Entry Radius R	Entry Angle ?
1	Lamprey Drive	0	0	14.00	1	17.00	1	120.00	90.00	20.50
2	Fontaine Blvd.	90	0	14.00	1	17.00	1	75.00	90.00	21.50
3	Lamprey Drive	180	0	14.00	1	17.00	1	120.00	90.00	20.50
4	Fountain Blvd.	270	0	14.00	1	17.00	1	75.00	90.00	21.50

#### Circulating and Exit Geometry

Leg	Leg Names	Inscribed Diameter D	Circulating Width C	Circulating Lanes nc	Exit Width Ex	Exit Lanes nex	Exit Half Width Vx	Exit Half Width Lanes nvx
1	Lamprey Drive	150.00	20.00	1	14.00	1	14.00	1
2	Fontaine Blvd.	150.00	20.00	1	14.00	1	14.00	1
3	Lamprey Drive	150.00	20.00	1	14.00	1	14.00	1
4	Fountain Blvd.	150.00	20.00	1	14.00	1	14.00	1

#### Capacity Modifiers and Capacity Calibration (veh/hr)

Leg	Leg Names	Entry Capacity		Entry Calibration		Approach Road			Exit Road		
		Capacity + or -	XWalk Factor	Intercept + or -	Slope Factor	V (ft)	Default Capacity	Calib Capacity	V (ft)	Default Capacity	Calib Capacity
1	Lamprey Drive	0	1.000	0	1.000	20.00	2091	0	14.00	2091	0
2	Fontaine Blvd.	0	1.000	0	1.000	20.00	2091	0	14.00	2091	0
3	Lamprey Drive	0	1.000	0	1.000	20.00	2091	0	14.00	2091	0
4	Fountain Blvd.	0	1.000	0	1.000	20.00	2091	0	14.00	2091	0



## 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	Lamprey Drive	0	5	29	254	0	2.0	1.00	0.9
2	Fontaine Blvd.	0	129	229	54	0	2.0	1.00	0.9
3	Lamprey Drive	0	176	62	5	0	2.0	1.00	0.9
4	Fountain Blvd.	0	2	557	10	0	2.0	1.00	0.9

## Operational Results

### 2040 AM Peak - 60 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	Lamprey Drive	None	288		735		201	759		0.3876
2	Fontaine Blvd.	None	412		36		987	1147		0.3639
3	Lamprey Drive	None	243		363		85	968		0.2547
4	Fountain Blvd.	None	569		367		239	962		0.6049

#### 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	Lamprey Drive	None	10.18		10.18	1.88		B		B
2	Fontaine Blvd.	None	7.46		7.46	1.60		A		A
3	Lamprey Drive	None	7.02		7.02	0.97		A		A
4	Fountain Blvd.	None	12.52		12.52	4.38		B		B

## 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	Lamprey Drive	None	313		798		218	724		0.4393
2	Fontaine Blvd.	None	448		39		1071	1145		0.3950
3	Lamprey Drive	None	264		394		92	950		0.2808
4	Fountain Blvd.	None	618		399		260	944		0.6675

### 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	Lamprey Drive	None	8.76		8.76	1.88		A		A
2	Fontaine Blvd.	None	5.74		5.74	1.60		A		A
3	Lamprey Drive	None	5.84		5.84	0.97		A		A
4	Fountain Blvd.	None	10.31		10.31	4.38		B		B

## Global Results

### Performance and Accidents

#### 2040 AM Peak Global Performance

Parameter	Units	Entries	Bypasses	Total
Arrive Flows	veh/hr	1512		1512
Capacity	veh/hr	3836		3836
Average Delay	sec/veh	8.81		8.81
L.O.S. (Signal)	A – F	A		A
L.O.S. (Unsig)	A – F	A		A
Total Delay	veh.hrs	3.70		3.70

## Operational Data

### Main Geometry (ft)

#### Approach and Entry Geometry

Leg	Leg Names	Approach Bearing (deg)	Grade Separation G	Half Width V	Approach Lanes n	Entry Width E	Entry Lanes n	Flare Length L'	Entry Radius R	Entry Angle ?
1	Lamprey Drive	0	0	14.00	1	17.00	1	120.00	90.00	20.50
2	Fontaine Blvd.	90	0	14.00	1	17.00	1	75.00	90.00	21.50
3	Lamprey Drive	180	0	14.00	1	17.00	1	120.00	90.00	20.50
4	Fountain Blvd.	270	0	14.00	1	17.00	1	75.00	90.00	21.50

#### Circulating and Exit Geometry

Leg	Leg Names	Inscribed Diameter D	Circulating Width C	Circulating Lanes nc	Exit Width Ex	Exit Lanes nex	Exit Half Width Vx	Exit Half Width Lanes nvx
1	Lamprey Drive	150.00	20.00	1	14.00	1	14.00	1
2	Fontaine Blvd.	150.00	20.00	1	14.00	1	14.00	1
3	Lamprey Drive	150.00	20.00	1	14.00	1	14.00	1
4	Fountain Blvd.	150.00	20.00	1	14.00	1	14.00	1

#### Capacity Modifiers and Capacity Calibration (veh/hr)

Leg	Leg Names	Entry Capacity		Entry Calibration		Approach Road			Exit Road		
		Capacity + or -	XWalk Factor	Intercept + or -	Slope Factor	V (ft)	Default Capacity	Calib Capacity	V (ft)	Default Capacity	Calib Capacity
1	Lamprey Drive	0	1.000	0	1.000	20.00	2091	0	14.00	2091	0
2	Fontaine Blvd.	0	1.000	0	1.000	20.00	2091	0	14.00	2091	0
3	Lamprey Drive	0	1.000	0	1.000	20.00	2091	0	14.00	2091	0
4	Fountain Blvd.	0	1.000	0	1.000	20.00	2091	0	14.00	2091	0

## 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	Lamprey Drive	0	3	19	146	0	2.0	1.00	0.9
2	Fontaine Blvd.	0	238	586	203	0	2.0	1.00	0.9
3	Lamprey Drive	0	125	10	1	0	2.0	1.00	0.9
4	Fountain Blvd.	0	1	359	1	0	2.0	1.00	0.9

## Operational Results

### 2040 PM Peak - 60 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	Lamprey Drive	None	168		485		249	900		0.1895
2	Fontaine Blvd.	None	1027		23		630	1154		0.9361
3	Lamprey Drive	None	136		826		223	709		0.1958
4	Fountain Blvd.	None	361		373		589	959		0.3827

#### 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	Lamprey Drive	None	6.60		6.60	0.67		A		A
2	Fontaine Blvd.	None	28.15		28.15	23.41		D		D
3	Lamprey Drive	None	7.96		7.96	0.72		A		A
4	Fountain Blvd.	None	8.61		8.61	1.77		A		A

## 2040 PM 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	Lamprey Drive	None	183		527		268	876		0.2106
2	Fontaine Blvd.	None	1116		25		684	1153		1.0176
3	Lamprey Drive	None	148		889		240	673		0.2226
4	Fountain Blvd.	None	392		403		635	942		0.4217

### 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	Lamprey Drive	None	5.81		5.81	0.67		A		A
2	Fontaine Blvd.	None	28.75		28.75	23.41		D		D
3	Lamprey Drive	None	7.26		7.26	0.72		A		A
4	Fountain Blvd.	None	6.92		6.92	1.77		A		A



## Global Results

### Performance and Accidents

#### 2040 PM Peak Global Performance

Parameter	Units	Entries	Bypasses	Total
Arrive Flows	veh/hr	1692		1692
Capacity	veh/hr	3721		3721
Average Delay	sec/veh	19.23		19.23
L.O.S. (Signal)	A – F	B		B
L.O.S. (Unsig)	A – F	C		C
Total Delay	veh.hrs	9.04		9.04

# Markup Summary

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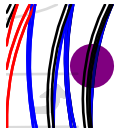
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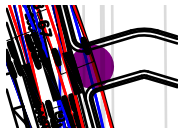
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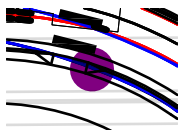
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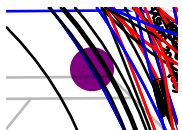
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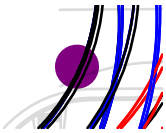


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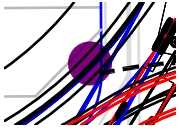


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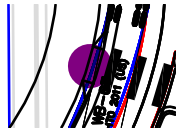
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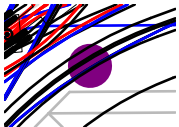
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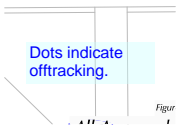
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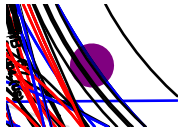
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Dots indicate offtracking.



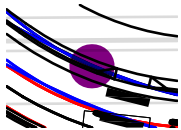
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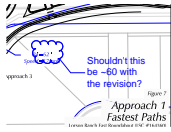
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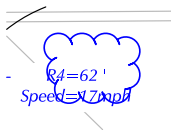
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Shouldn't this be ~60 with the revision?



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