Technical Memorandum

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From	Kamesh Vedula, GHD Zach Stinger, GHD	**Project No.**	12658096
Project Name	DOWNTOWN GRASS VALLEY ROUNDABOUT PROJECT		
Subject	Downtown Grass Valley Roundabout Right-In Alternative Analysis Memorandum		

1. Introduction

The Downtown Grass Valley Roundabout Project is currently in the Project Approval Environmental Document phase, and two alternative updates to the control type and access at the intersection of S Auburn Street and Neal Street are proposed. This memorandum has been prepared to present projected 2050 Design Year PM peak hour intersection operations for the roundabout and the intersection of S Auburn Street and Neal Street with the conversion of S Auburn Street to a right-in access from Neal Street. The other proposed alternative is a right-in right-out access at the intersection of S Auburn Street and Neal Street. For intersection operations results for the right-in right-out alternative, refer to the “Downtown Grass Valley Roundabout Right-In Right-Out Alternative Analysis Memorandum”.

2. S Auburn Street / Neal Street Right-In Access

The intersection of S Auburn Street and Neal Street was reanalyzed with a right-in only access from westbound right Neal Street onto S Auburn Street. The southbound right turn movement from S Auburn Street onto Neal Street was closed, resulting in all S Auburn Street approach traffic rerouting to enter the roundabout from Neal Street and Tinloy Street. Westbound through and westbound right-turning traffic along Neal Street were unaffected by the southbound S Auburn Street approach closure.

2.1 Traffic Volumes

2050 Design Year PM peak hour traffic forecasts presented in the 2025 revalidation were used for this updated analysis to remain consistent with previous assumptions. Refer to the “Downtown Grass Valley Roundabout Traffic Operations Memorandum – Revalidation” for 2050 Design Year PM peak hour traffic forecasts. Updated traffic assignments for the right-in alternative analysis were determined based on similar traffic routing assumptions used in the “Downtown Grass Valley Roundabout Right-In Right-Out Alternative Analysis Memorandum”.

2.2 Design Year 2050 Build Conditions

Table 2.1 presents Design Year 2050 Build Conditions intersection operations for all intersections assuming a right-in access at the intersection of S Auburn Street and Neal Street and geometry modifications between S Auburn Street / Neal Street and the roundabout. Refer to the "Downtown Grass Valley Roundabout Right-In Right-Out Alternative Analysis Memorandum" for additional information on proposed geometry modifications between S Auburn Street / Neal Street and the roundabout. All intersections are projected to operate acceptably. All Synchro and SimTraffic reports are provided in Appendix A, and all Sidra reports are provided in Appendix B.

Table 2.1 Design Year 2050 Build Conditions Intersection Operations – Right-In

#	Intersection	Control Type[1]	Target LOS	PM Peak Hour	
				Delay	LOS
1	Auburn Street & EB Off-Ramp	TWSC	D	12.3	B
2	Auburn Street/WB On-Ramp/Tinloy Street/Neal Street/SR 174	RNDBT	D	16.2	B
3	Auburn Street & Neal Street	-	D	3.2	A
4	Hansen Way & Colfax Avenue/SR 174	TWSC	D	10.6	B

Notes:
1. TWSC = Two Way Stop Control, RNDBT = Roundabout
2. LOS = Delay based on worst minor street approach for TWSC intersections, average of all approaches for RNDBT
3. **Bold** = Unacceptable Conditions
4. OVR = Delay over 300 seconds

Due to restricted access, Neal Street no longer has a point of conflict with S Auburn Street, resulting in free movements. However, due to crossing pedestrians, a delay was still calculated.

Table 2.2 presents Design Year 2050 Build Conditions 95th percentile queue results for all intersections in the network.

Table 2.2 Design Year 2050 Build Conditions 95th percentile Queue Results – Right-In

Int. #	Intersection/Approach	Control Type	2050 Design Year 95th Percentile Queue (ft)	
			PM Peak Hour	Available Storage
1	***Auburn Street & EB Off-Ramp***			
	Eastbound Left	TWSC	145	
	Eastbound Right		45	140
	Northbound Thu		195	
	Southbound Thru		5	100
2	***Auburn Street/WB On-Ramp/Tinloy Street/Neal Street/SR 174***			
	Westbound Left/Thru/Right	RNDBT	45	125
	Southwestbound Left/Thru/Right		355	
	Northbound Left/Thru/Right		***145***	100
	Southbound Left/Thru/Right		385	

Table 2.2 Design Year 2050 Build Conditions 95th percentile Queue Results – Right-In (Continued)

Int. #	Intersection/Approach	Control Type	2050 Design Year 95th Percentile Queue (ft) PM Peak Hour	Available Storage
3	***Auburn Street & Neal Street***			
	Eastbound Right	-	85	
	Westbound Thru/Right		80	
4	***Hansen Way & Colfax Avenue/SR 174***			
	Eastbound Left	TWSC	10	40
	Eastbound Thru		5	125
	Westbound Thru/Right		215	

Note: **Bold** text indicates queues that exceed available storage

Similar to the right-in right-out alternative, storage is projected to be exceeded on the northbound approach of the roundabout by approximately two vehicles (assuming 25 ft per vehicle). The approximate 100 ft storage represents the distance from the stop sign next to Grass Valley Charter School to the northbound yield line of the roundabout.

With the right-in alternative, a 95th percentile queue of approximately 16 vehicles is projected for the southbound approach to the roundabout. The previous configuration had limited storage between the roundabout and the Neal Street intersection. With restricted access, Neal Street no longer has a conflict point with S Auburn Street. Therefore, the queue extends continuously from the roundabout along Neal Street, spilling back past the Safeway Driveway.

In the 2025 "Downtown Grass Valley Roundabout Traffic Operations Memorandum – Revalidation", a 75 ft 95th percentile queue was projected for the southbound left/through/right movement of the roundabout. The roundabout configuration presented in the 2025 revalidation included a southbound left/through/right turn and southbound bypass lane. With the right-in alternative and the removal of the southbound bypass, a 385 ft southbound approach queue is projected, which is approximately 13 vehicles longer than the projected queue in the 2025 revalidation. This longer projected queue is primarily due to removing the southbound bypass lane, which causes southbound right-turning traffic at the roundabout (that could previously use the bypass lane) to enter the roundabout with the rest of the through traffic.

In the 2025 revalidation, a 140 ft queue was projected for the southwestbound Tinloy Street approach to the roundabout. With the right-in alternative, a 355 ft queue is projected for the southwestbound approach, and with the right-in/right-out alternative, a 295 ft queue is projected for the southwestbound approach. An increase in queuing at the southwestbound approach is projected for both alternatives due to an increase in volumes from rerouting traffic.

3. Conclusions

With the conversion of the S Auburn Street and Neal Street intersection to a right-in access and modifications to intersection geometries, the network is projected to operate with acceptable LOS and with projected queuing along Neal Street past the Safeway driveway. With the removal of the southbound bypass lane and traffic rerouting, the southbound and southwest bound legs (two of the longest queued legs) of the roundabout are notably worsened.

Appendix A

Synchro and SimTraffic Reports

1: S Auburn St & EB Off Ramp Performance by movement

Movement	EBL	EBR	NBT	SBT	All
Denied Del/Veh (s)	0.5	3.4	0.4	0.3	0.6
Total Del/Veh (s)	14.7	2.5	14.0	0.3	9.7
Vehicles Entered	331	79	432	313	1155
Vehicles Exited	331	79	431	314	1155
Hourly Exit Rate	331	79	431	314	1155
Input Volume	330	80	420	315	1145
% of Volume	100	98	103	100	101

Total Network Performance

Denied Del/Veh (s)	0.6
Total Del/Veh (s)	11.5
Vehicles Entered	1155
Vehicles Exited	1157
Hourly Exit Rate	1157
Input Volume	2290
% of Volume	51

Intersection: 1: S Auburn St & EB Off Ramp

Movement	EB	EB	NB	SB
Directions Served	L	R	T	T
Maximum Queue (ft)	170	56	255	4
Average Queue (ft)	88	12	106	0
95th Queue (ft)	145	46	194	4
Link Distance (ft)	825		757	461
Upstream Blk Time (%)				
Queuing Penalty (veh)				
Storage Bay Dist (ft)		140		
Storage Blk Time (%)	1			
Queuing Penalty (veh)	1			

Network Summary

Network wide Queuing Penalty: 1

3: S Auburn St & Neal St Performance by movement

Movement	EBR	WBT	WBR	All
Denied Del/Veh (s)	0.7	1.0	1.0	0.8
Total Del/Veh (s)	2.8	4.2	2.9	3.2
Vehicles Entered	683	392	466	1541
Vehicles Exited	684	392	465	1541
Hourly Exit Rate	684	392	465	1541
Input Volume	687	390	460	1537
% of Volume	100	101	101	100

Total Network Performance

Denied Del/Veh (s)	0.8
Total Del/Veh (s)	3.7
Vehicles Entered	1541
Vehicles Exited	1540
Hourly Exit Rate	1540
Input Volume	3074
% of Volume	50

Intersection: 3: S Auburn St & Neal St

Movement	EB	WB
Directions Served	R	TR
Maximum Queue (ft)	148	132
Average Queue (ft)	22	18
95th Queue (ft)	87	80
Link Distance (ft)	556	484
Upstream Blk Time (%)		
Queuing Penalty (veh)		
Storage Bay Dist (ft)		
Storage Blk Time (%)		
Queuing Penalty (veh)		

Network Summary

Network wide Queuing Penalty: 0

Intersection	
Int Delay, s/veh	6.3

Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Traffic Vol, veh/h	370	370	300	100	0	0
Future Vol, veh/h	370	370	300	100	0	0
Conflicting Peds, #/hr	2	0	0	2	2	0
Sign Control	Free	Free	Stop	Stop	Free	Free
RT Channelized	-	None	-	None	-	None
Storage Length	40	-	-	-	-	-
Veh in Median Storage, #	-	0	0	-	0	-
Grade, %	-	0	0	-	0	-
Peak Hour Factor	92	92	92	92	92	92
Heavy Vehicles, %	2	2	2	2	2	2
Mvmt Flow	402	402	326	109	0	0

Major/Minor	Major1		Minor2	
Conflicting Flow All	2	0	1208	4
Stage 1	-	-	2	-
Stage 2	-	-	1206	-
Critical Hdwy	4.12	-	6.52	6.22
Critical Hdwy Stg 1	-	-	-	-
Critical Hdwy Stg 2	-	-	5.52	-
Follow-up Hdwy	2.218	-	4.018	3.318
Pot Cap-1 Maneuver	1620	-	~ 183	1080
Stage 1	-	-	-	-
Stage 2	-	-	~ 257	-
Platoon blocked, %		-		
Mov Cap-1 Maneuver	1617	-	0	1076
Mov Cap-2 Maneuver	-	-	0	-
Stage 1	-	-	0	-
Stage 2	-	-	0	-

Approach	EB	WB
HCM Control Delay, s	4	10.6
HCM LOS		B

Minor Lane/Major Mvmt	EBL	EBTWBLn1	
Capacity (veh/h)	1617	-	1076
HCM Lane V/C Ratio	0.249	-	0.404
HCM Control Delay (s)	8	-	10.6
HCM Lane LOS	A	-	B
HCM 95th %tile Q(veh)	1	-	2

Notes			
~: Volume exceeds capacity	$: Delay exceeds 300s	+: Computation Not Defined	*: All major volume in platoon

4: Hansen Way & SR 174 Performance by movement

Movement	EBL	EBT	WBT	WBR	All
Denied Del/Veh (s)	3.3	1.3	0.4	0.4	1.6
Total Del/Veh (s)	1.0	1.6	17.2	14.1	6.6
Vehicles Entered	359	369	292	102	1122
Vehicles Exited	358	369	291	102	1120
Hourly Exit Rate	358	369	291	102	1120
Input Volume	370	370	300	100	1139
% of Volume	97	100	97	102	98

Total Network Performance

Denied Del/Veh (s)	1.6
Total Del/Veh (s)	7.4
Vehicles Entered	1122
Vehicles Exited	1120
Hourly Exit Rate	1120
Input Volume	2278
% of Volume	49

Intersection: 4: Hansen Way & SR 174

Movement	EB	EB	WB
Directions Served	L	T	TR
Maximum Queue (ft)	16	8	280
Average Queue (ft)	1	0	113
95th Queue (ft)	8	6	216
Link Distance (ft)		358	573
Upstream Blk Time (%)			
Queuing Penalty (veh)			
Storage Bay Dist (ft)	40		
Storage Blk Time (%)	0	0	
Queuing Penalty (veh)	0	0	

Network Summary

Network wide Queuing Penalty: 0

Appendix B

Sidra Report

LANE SUMMARY

Site: [2 (4)] RNDBT - Right-In w/ Rerouted Traffic (Network)
Network: [N101 (3)] Network - Right-In w/ Rerouted Traffic (General)
Output produced by SIDRA INTERSECTION Version: 10.0.5.217

New Site
Site Category: (None)
Roundabout
Network Scenario: 1 | Local Volumes **Site Scenario: 1 | Local Volumes**

Lane Use and Performance

	Demand Flows [Total veh/h	HV] %	Arrival Flows [Total veh/h	HV] %	Cap. veh/h	Deg. Satn v/c	Lane Util. %	Aver. Delay sec	Level of Service	95% Back Of Queue [Veh	Dist] ft	Lane Config	Lane Length ft	Cap. Adj. %	Prob. Block. %
South: S Auburn St - NB															
Lane 1[d]	789	2.0	723	2.0	1257	0.575	100	9.5	LOS A	5.8	146.4	Full	100	0.0	17.7
Approach	789	2.0	723	2.0		0.575		9.5	LOS A	5.8	146.4				
East: Hwy 174 - WB															
Lane 1[d]	316	2.0	316	2.0	1244	0.254	100	5.1	LOS A	1.8	44.9	Full	125	0.0	0.0
Approach	316	2.0	316	2.0		0.254		5.1	LOS A	1.8	44.9				
NorthEast: Tinloy St - SWB															
Lane 1[d]	829	2.0	829	2.0	1042	0.796	100	18.9	LOS B	14.0	356.4	Full	1600	0.0	0.0
Approach	829	2.0	829	2.0		0.796		18.9	LOS B	14.0	356.4				
NorthWest: S Auburn St - SB															
Lane 1[d]	723	2.0	723	2.0	864	0.837	100	24.9	LOS C	15.2[N8]	386.0[N8]	Full	80	0.0	49.9
Approach	723	2.0	723	2.0		0.837		24.9	LOS C	15.2	386.0				
All Vehicles	2658	2.0	2591	2.1		0.837		16.2	LOS B	15.2	386.0				

Site Level of Service (LOS) Method: Delay & v/c (HCM 6). Site LOS Method is specified in the Network Data dialog (Override Site Data tab).
Roundabout LOS Method: Same as Signalised Intersections.
Lane LOS values are based on average delay and v/c ratio (degree of saturation) per lane.
LOS F will result if v/c >1 irrespective of lane delay value (does not apply for approaches and intersection).
Intersection and Approach LOS values are based on average delay for all lanes (v/c not used as specified in HCM 6).
Roundabout Capacity Model: SIDRA HCM.
Delay Model: HCM Delay Formula (Stopline Delay: Geometric Delay is not included).
Queue Model: SIDRA queue estimation methods are used for Back of Queue and Queue at Start of Gap.
Gap-Acceptance Capacity Formula: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.
Arrival Flows used in performance calculations are adjusted to include any Initial Queued Demand and Upstream Capacity Constraint effects.

d Dominant lane on roundabout approach
N4 Average Back of Queue has been restricted to the available queue storage space as it extends to lanes at upstream Sites.
N8 The Percentile Back of Queue extends to upstream Site lanes.

Approach Lane Flows (veh/h)

South: S Auburn St - NB

Mov.	L2	T1	R2	Total	%HV	Deg.	Lane	Prob.	Ov.

From S To Exit:	W	N	E			Cap. veh/h	Satn v/c	Util. %	SL Ov. %	Lane No.
Lane 1	34	405	284	723	2.0	1257	0.575	100	NA	NA
Approach	34	405	284	723	2.0		0.575			

East: Hwy 174 - WB

Mov. From E To Exit:	L2 S	T1 W	R2 N	Total	%HV	Cap. veh/h	Deg. Satn v/c	Lane Util. %	Prob. SL Ov. %	Ov. Lane No.
Lane 1	42	84	189	316	2.0	1244	0.254	100	NA	NA
Approach	42	84	189	316	2.0		0.254			

NorthEast: Tinloy St - SWB

Mov. From NE To Exit:	L3 E	L1 S	R1 W	R3 N	Total	%HV	Cap. veh/h	Deg. Satn v/c	Lane Util. %	Prob. SL Ov. %	Ov. Lane No.
Lane 1	168	137	251	274	829	2.0	1042	0.796	100	NA	NA
Approach	168	137	251	274	829	2.0		0.796			

NorthWest: S Auburn St - SB

Mov. From NW To Exit:	L3 N	L1 E	R1 S	R3 W	Total	%HV	Cap. veh/h	Deg. Satn v/c	Lane Util. %	Prob. SL Ov. %	Ov. Lane No.
Lane 1	89	300	153	181	723	2.0	864	0.837	100	NA	NA
Approach	89	300	153	181	723	2.0		0.837			

	Total	%HV	Deg.Satn (v/c)
All Vehicles	2591	2.1	0.837

Arrival Flows used in performance calculations are adjusted to include any Initial Queued Demand and Upstream Capacity Constraint effects.

Merge Analysis

	Exit Lane Number	Short Lane Length ft	Percent Opng in Lane %	Opposing Flow Rate veh/h	Critical Gap pcu/h	Follow-up Headway sec	Lane Flow Rate veh/h	Capacity veh/h	Deg. Satn v/c	Min. Delay sec	Merge Delay sec	Merge Queue [Veh	Dist] ft

There are no Exit Short Lanes for Merge Analysis at this Site.

Variable Demand Analysis

	Initial Queued Demand veh	Residual Queued Demand veh	Time for Residual Demand to Clear sec	Duration of Oversatn sec
South: S Auburn St - NB				
Lane 1	0.0	0.0	0.0	0.0
East: Hwy 174 - WB				
Lane 1	0.0	0.0	0.0	0.0
NorthEast: Tinloy St - SWB				

Lane 1	0.0	0.0	0.0	0.0
NorthWest: S Auburn St - SB				
Lane 1	0.0	0.0	0.0	0.0