

Appendix Volume 2

Technical Analysis Summary

Active Transportation Prioritization

Right-in/Right-out Analysis

Technical Analysis Summary

US 97 Parkway Plan Phase 2

Technical Memorandum #7 – Second Level Screening: Appendix

September 20, 2019

Final

Prepared for:



Prepared by:





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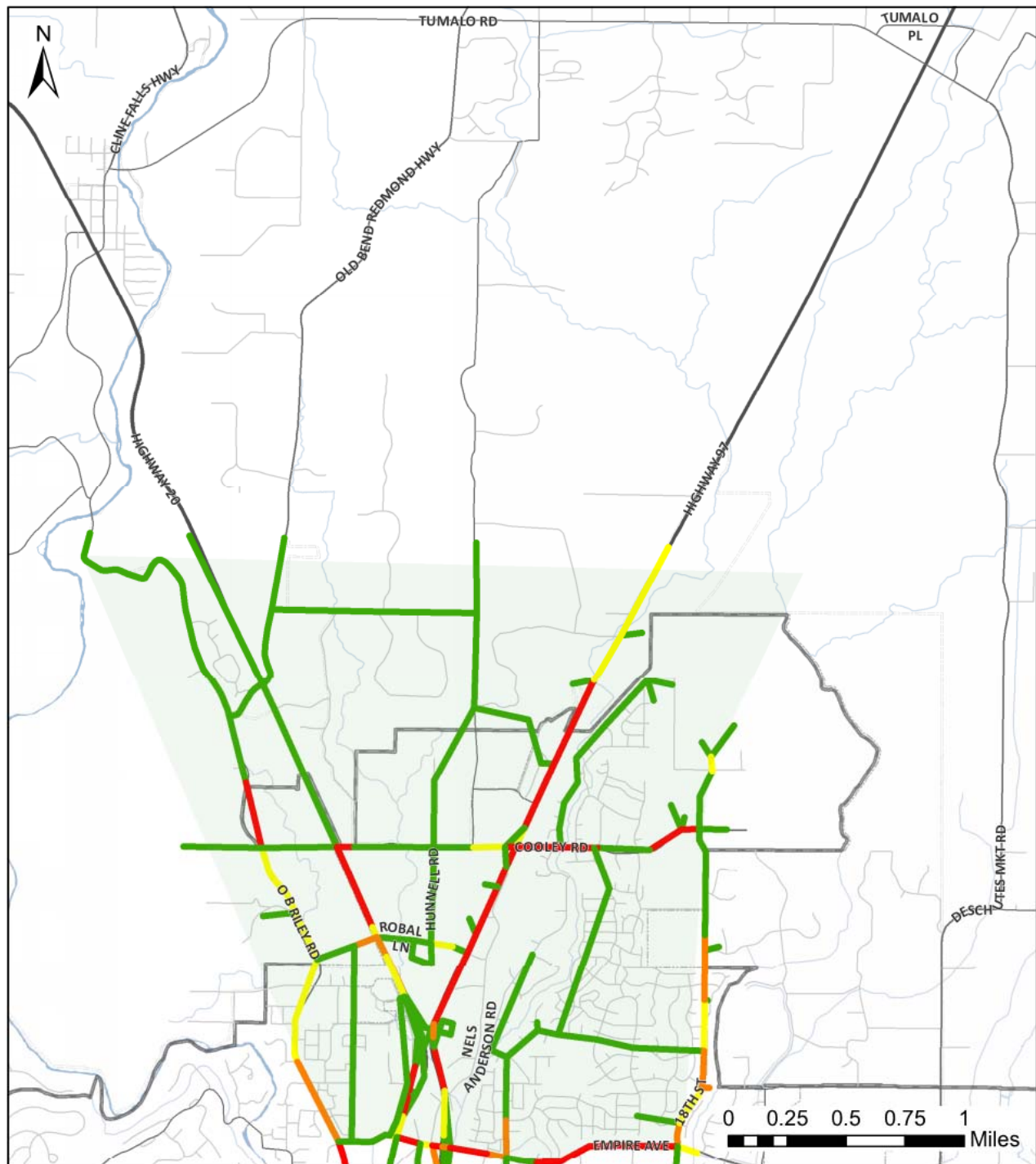


1.0 DEMAND COMPARISON

A high-level regional demand analysis was performed using the Bend-Redmond Model (BRM). The analysis included peak hour demand to capacity ratios for 2040 No Build and Build Bundles (Figures A1-A12)



Figure A1

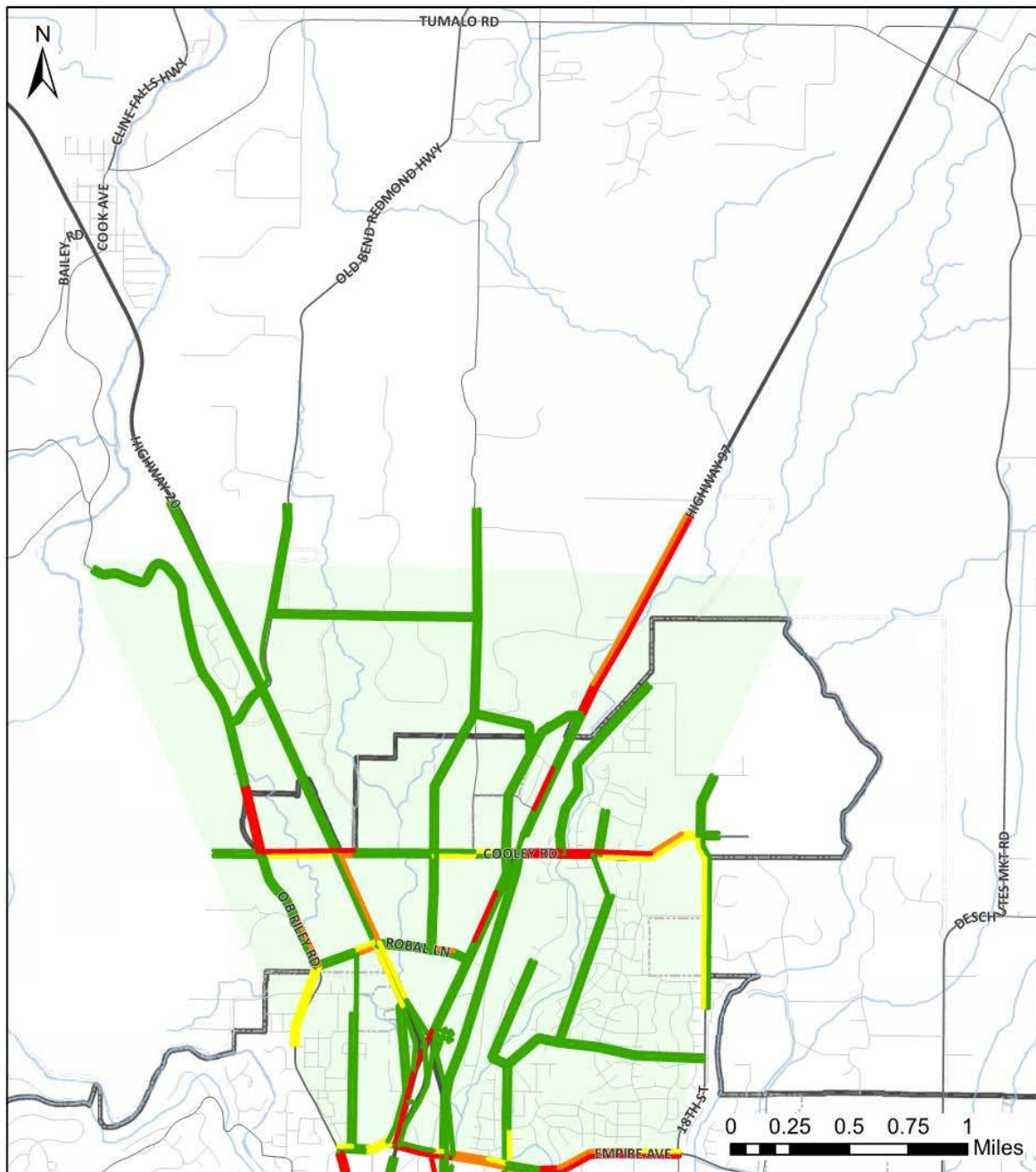


2040 PM Peak Hour Demand-to-Capacity - North Study Area

Demand/Capacity	Parkway Study Area	Boundaries & Misc.
0.00 - 0.70	North Study Area	Bend City Limits
0.71 - 0.80		Bend MPO Boundary
0.81 - 0.90		UGB - Urban Growth Boundary
0.91 - >1.0		Waterways



Figure A2



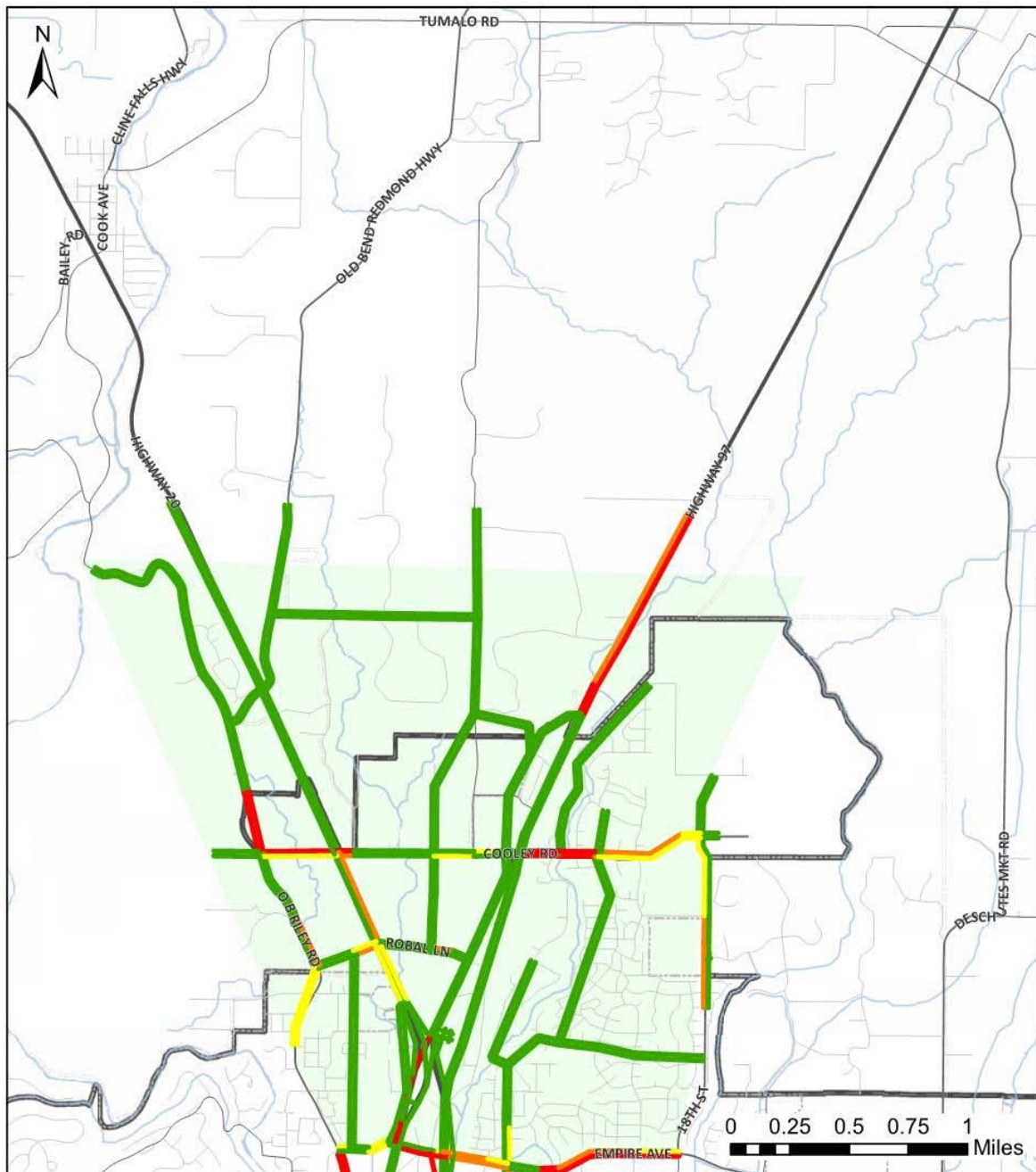
2040 PM Peak Hour Volume-to-Capacity - Bundle A - North Study Area

Demand/Capacity Parkway Study Area Boundaries & Misc.





Figure A3



2040 PM Peak Hour Volume-to-Capacity - Bundle B - North Study Area

Demand/Capacity Parkway Study Area Boundaries & Misc.

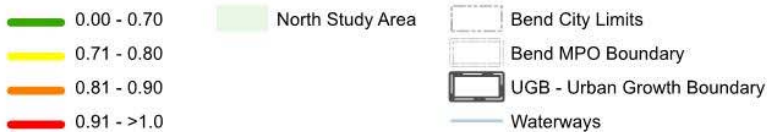
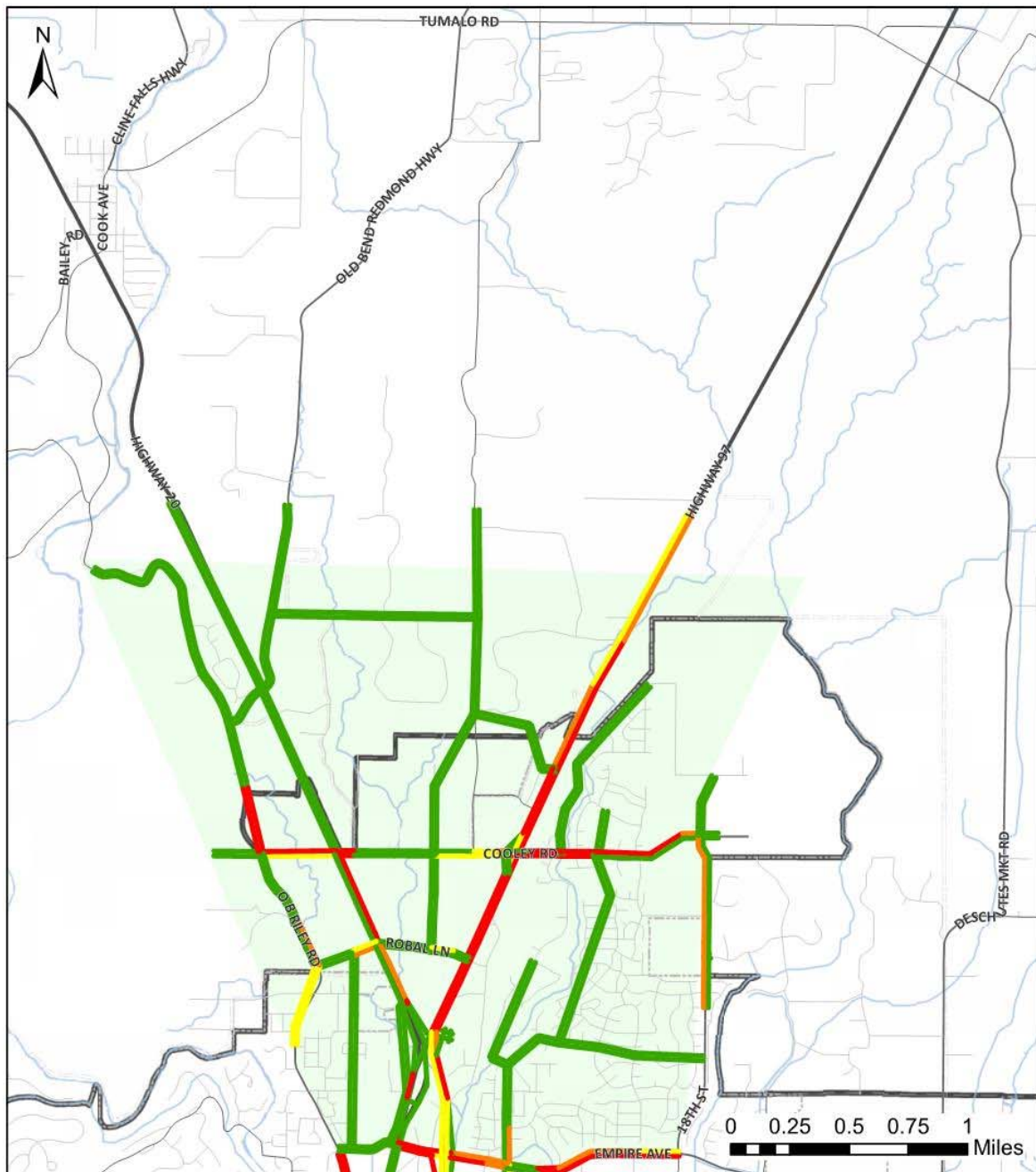




Figure A4



2040 PM Peak Hour Volume-to-Capacity - Bundle C - North Study Area

Demand/Capacity Parkway Study Area Phase 2 Boundaries & Misc.





Figure A5

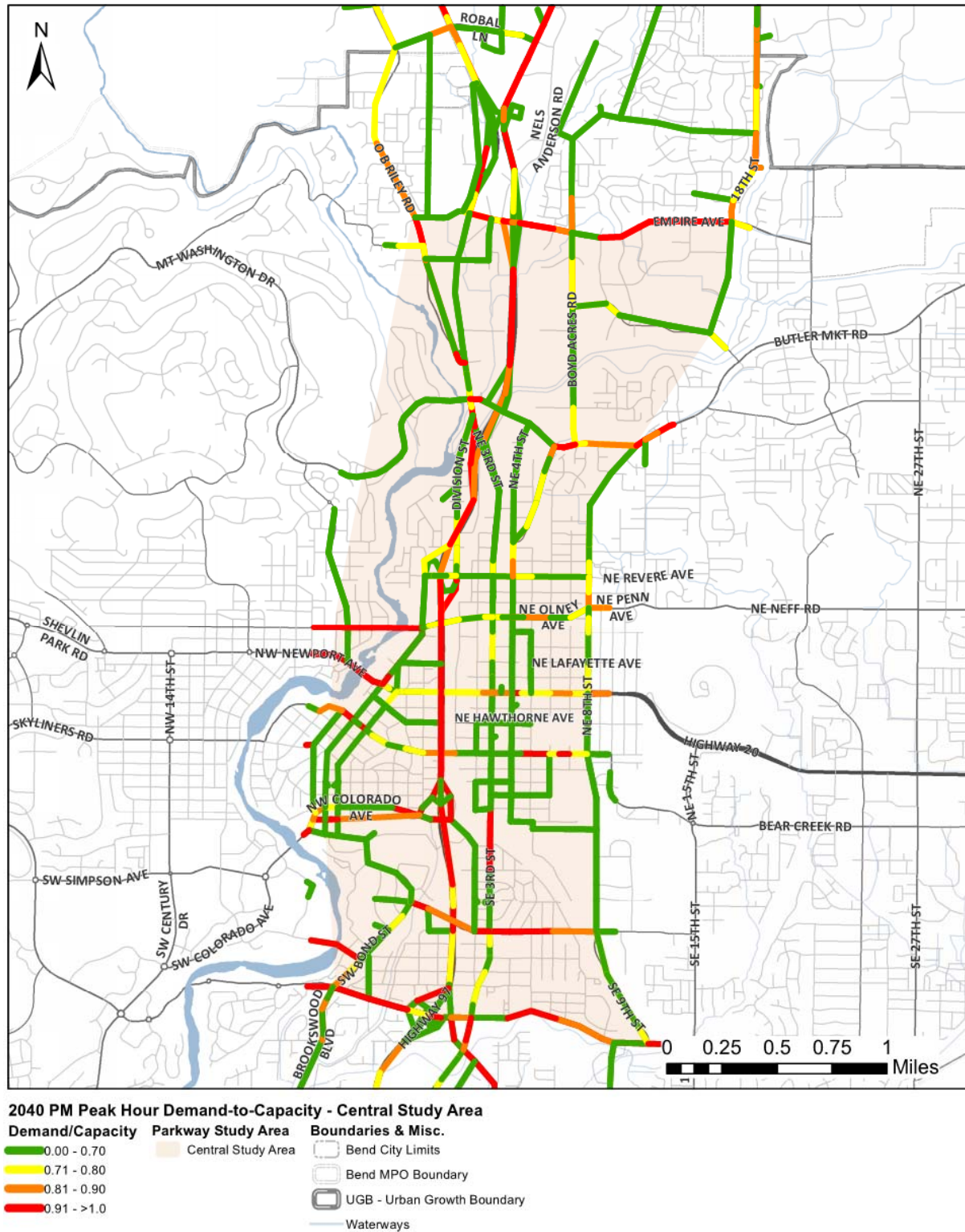
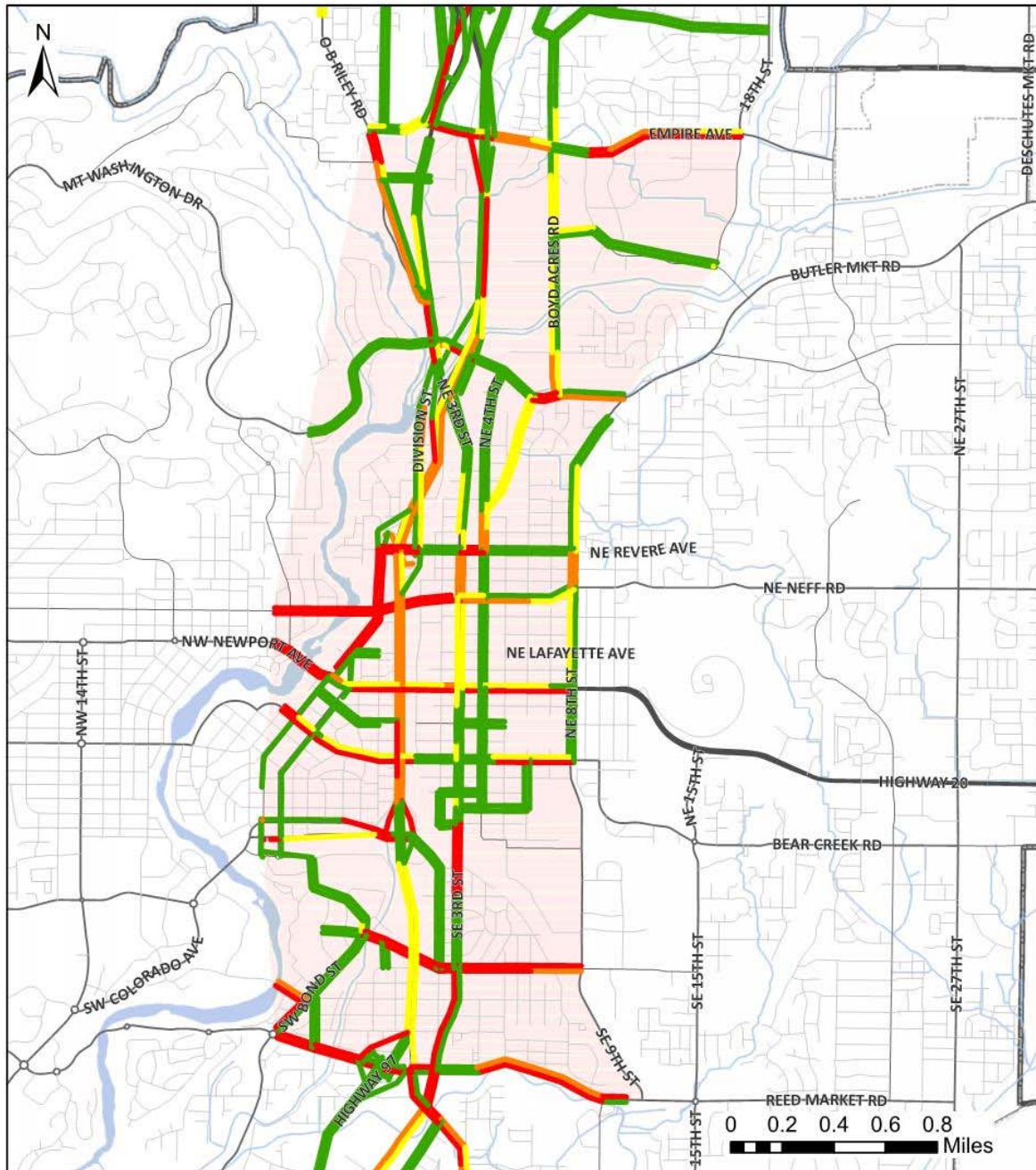




Figure A6



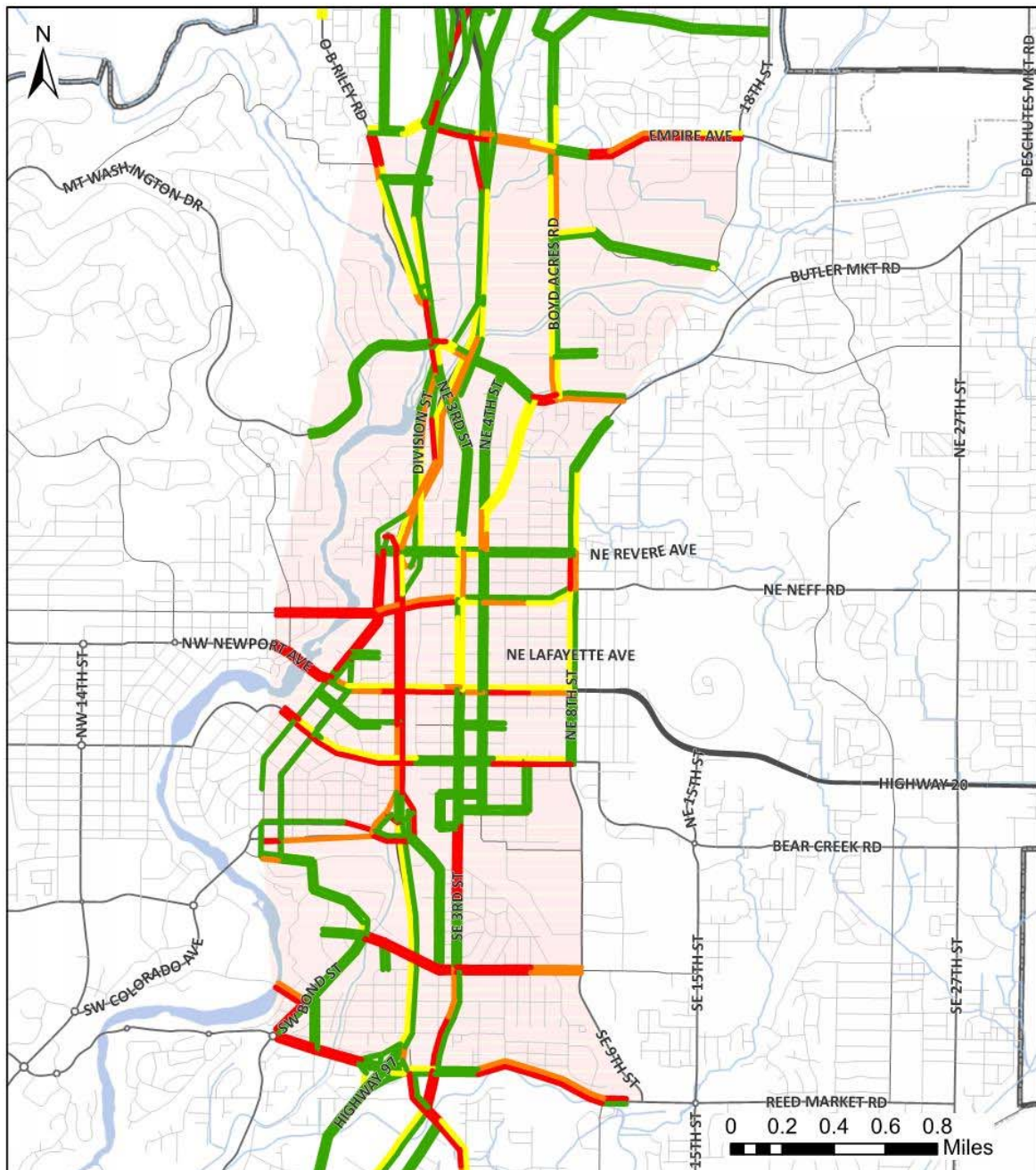
2040 PM Peak Hour Volume-to-Capacity - Bundle A - Central Study Area

Parkway Study Area Phase 2 Boundaries & Misc.

- Central Study Area
- Bend City Limits
- Bend MPO Boundary
- UGB - Urban Growth Boundary
- Waterways



Figure A7



2040 PM Peak Hour Volume-to-Capacity - Bundle B - Central Study Area

Demand/Capacity Parkway Study Area Boundaries & Misc.



Demand/Capacity Parkway Study Area Boundaries & Misc.





Figure A9

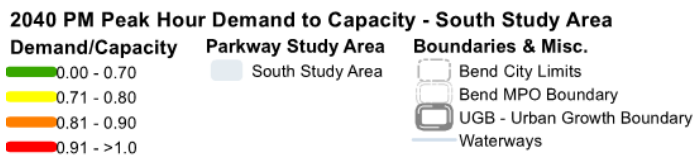
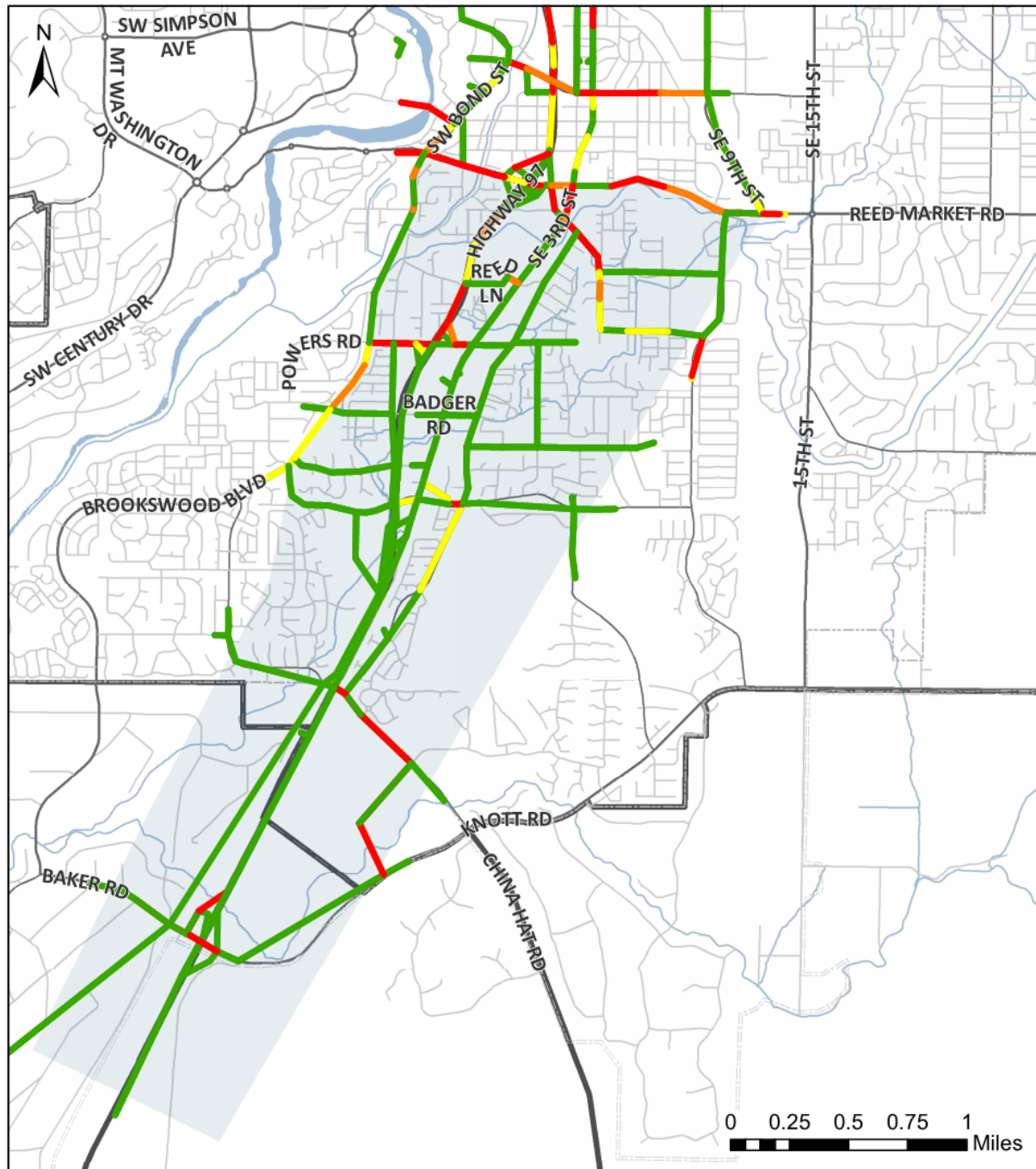
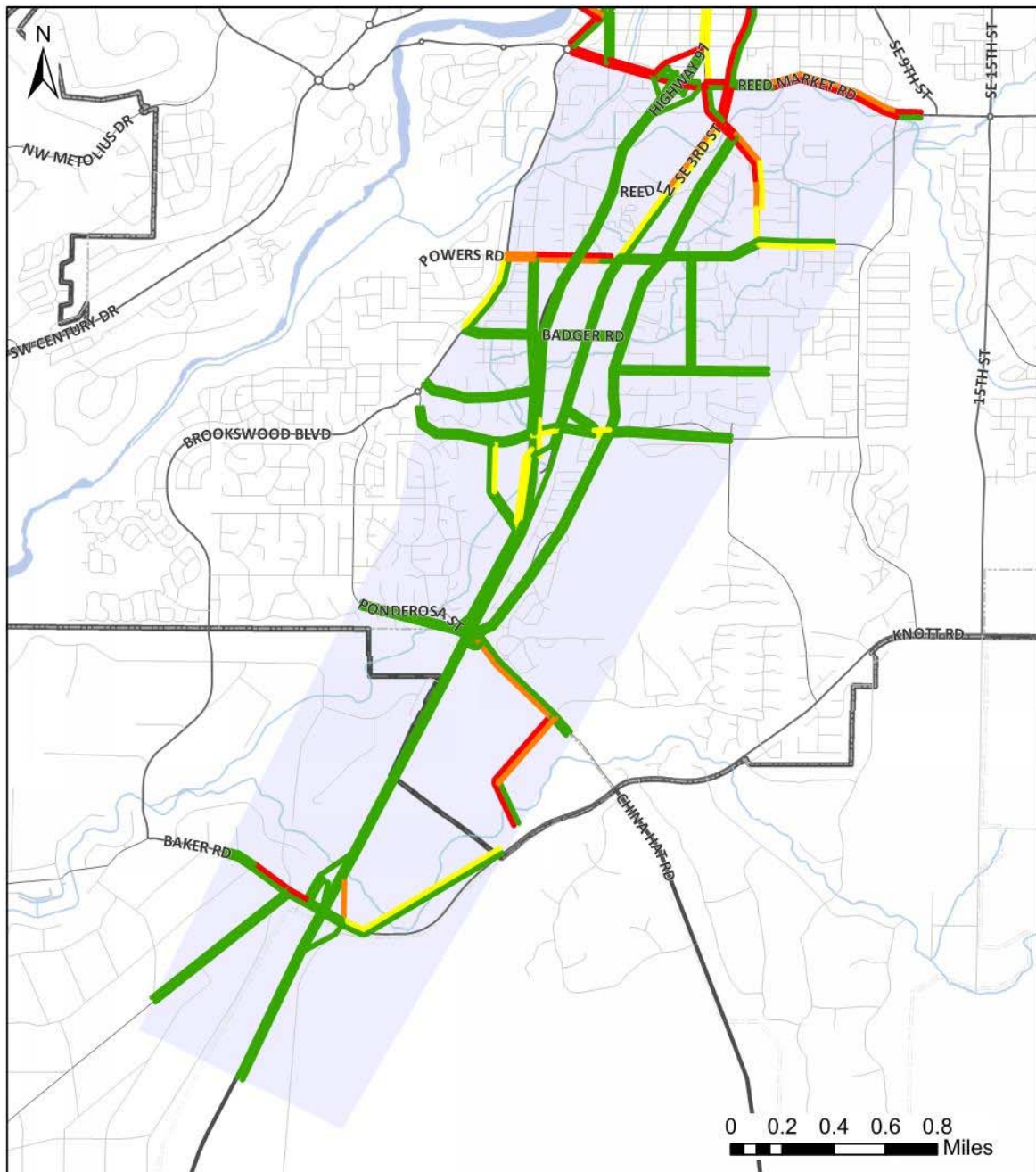




Figure A10



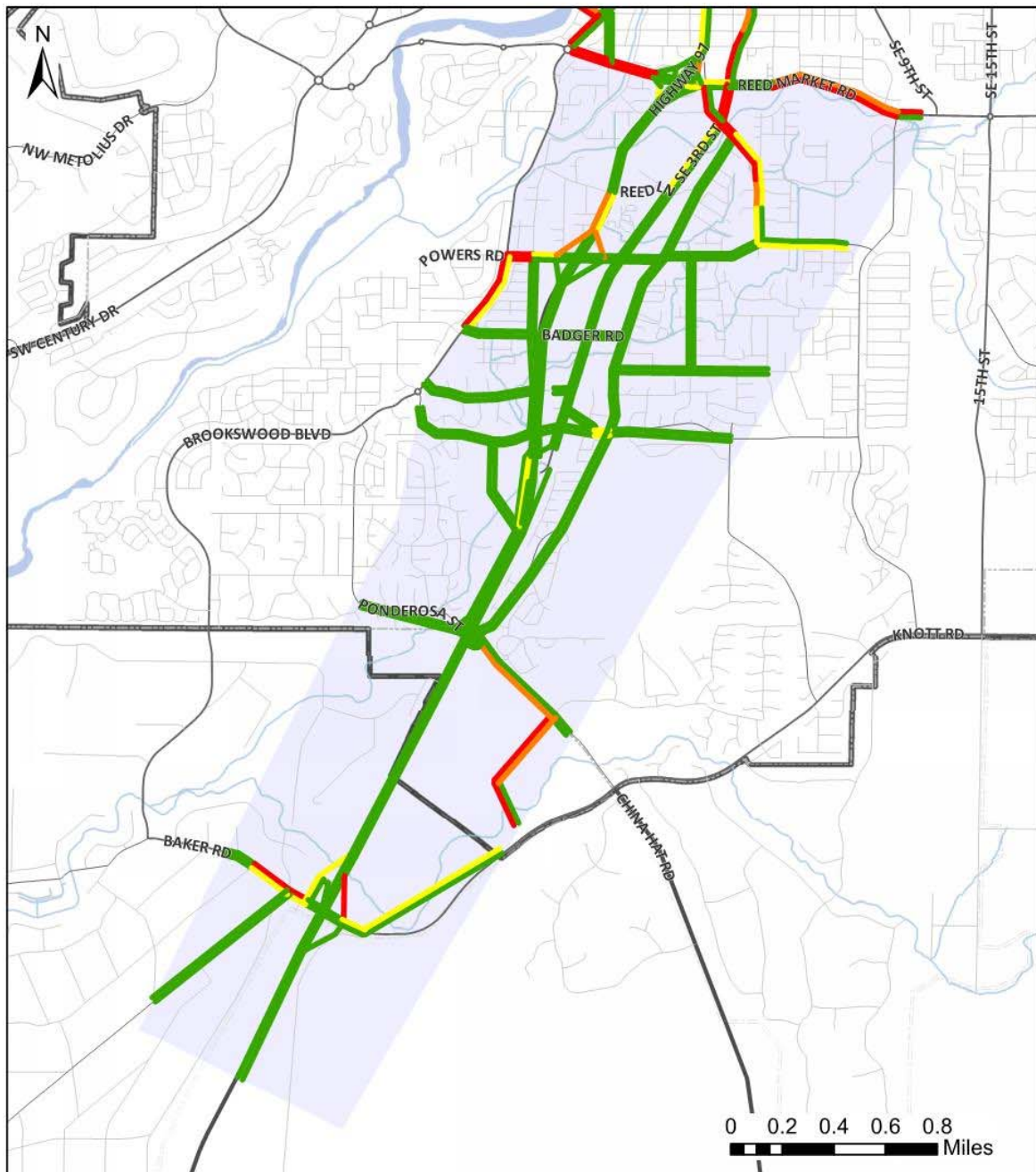
2040 PM Peak Hour Volume-to-Capacity - Bundle A - South Study Area

Demand/Capacity Parkway Study Area Boundaries & Misc.





Figure A11



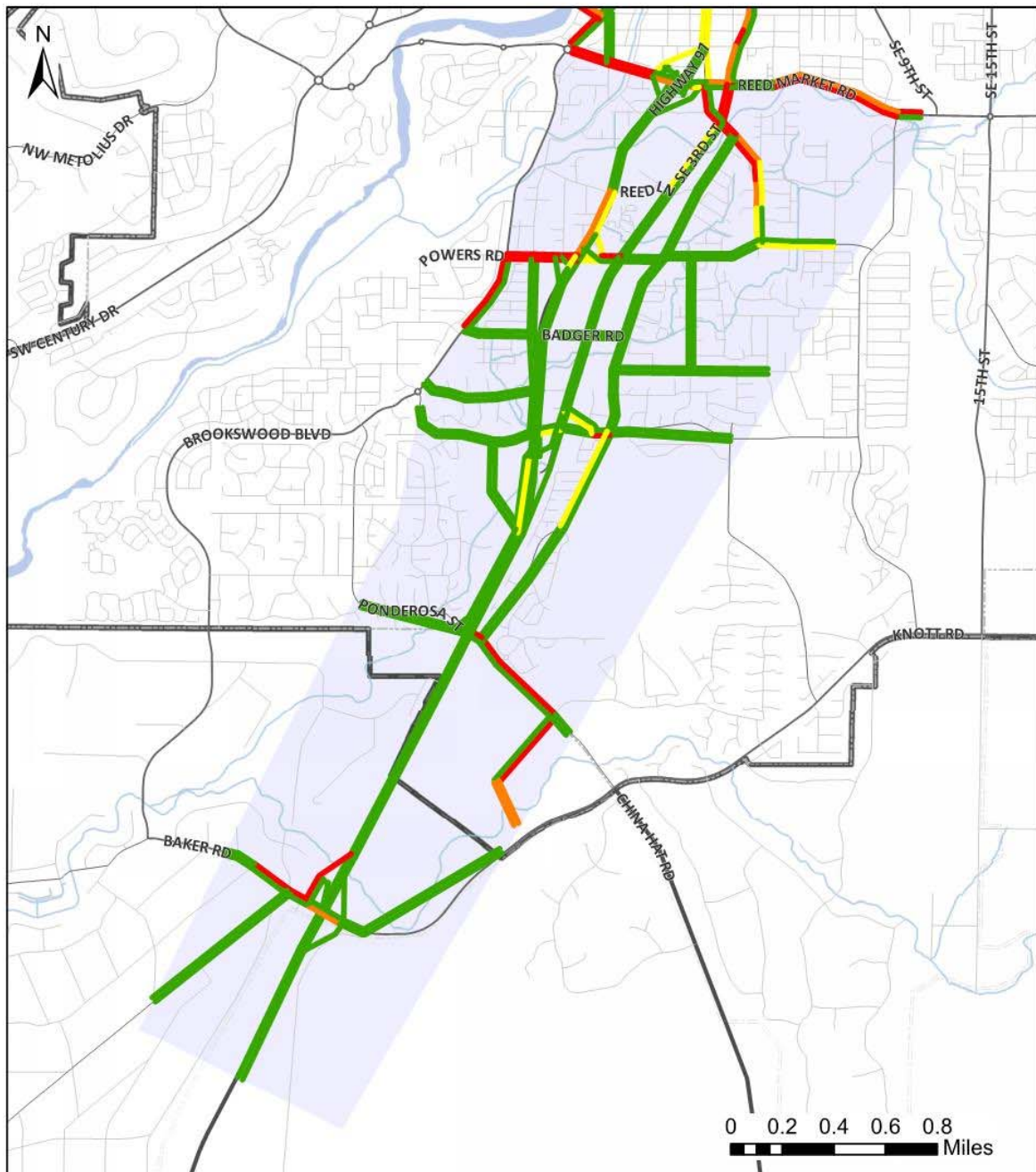
2040 PM Peak Hour Volume-to-Capacity - Bundle B - South Study Area

Demand/Capacity Parkway Study Area Boundaries & Misc.





Figure A12



2040 PM Peak Hour Volume-to-Capacity - Bundle C - South Study Area

Demand/Capacity Parkway Study Area Boundaries & Misc.





1.1 REGIONAL TRAVEL PATTERNS

Table A1a: US 97 Corridor Travel Patterns Comparing 2040 Bundle A to 2040 No Build Conditions

Location	Begin and End in Bend 2040 Bundle A / (2040 No Build)	Begin or End in Bend 2040 Bundle A / (2040 No Build)	Begin and End Outside Bend 2040 A / (2040 No Build)
US 97/Bend Parkway Southbound			
South of US 20 interchange	19% / (41%)	69% / (48%)	12% / (11%)
South of Revere Ave interchange	47% / (56%)	43% / (35%)	10% / (9%)
South of Truman Ave	44% / (58%)	44% / (33%)	12% / (9%)
South of Badger Rd	31% / (42%)	52% / (41%)	16% / (17%)
US 97/Bend Parkway Northbound			
South of US 20 interchange	33% / (34%)	59% / (59%)	9% / (7%)
South of Revere Ave interchange	48% / (54%)	43% / (38%)	9% / (8%)
South of Truman Ave	54% / (57%)	35% / (32%)	11% / (11%)
South of Badger Rd	39% / (41%)	43% / (41%)	18% / (18%)

Table A1b: US 97 Corridor Travel Patterns Comparing 2040 Bundle B Conditions to 2040 No Build Conditions

Location	Begin and End in Bend 2040 / (2010)	Begin or End in Bend 2040 / (2010)	Begin and End Outside Bend 2040 / (2010)
US 97/Bend Parkway Southbound			
South of US 20 interchange	19% / (41%)	69% / (48%)	12% / (11%)
South of Revere Ave interchange	50% / (56%)	40% / (35%)	10% / (9%)
South of Truman Ave	49% / (58%)	40% / (33%)	11% / (9%)
South of Badger Rd	27% / (42%)	55% / (41%)	18% / (17%)
US 97/Bend Parkway Northbound			
South of US 20 interchange	32% / (34%)	59% / (59%)	9% / (7%)
South of Revere Ave interchange	49% / (54%)	42% / (38%)	9% / (8%)
South of Truman Ave	54% / (57%)	35% / (32%)	12% / (11%)
South of Badger Rd	36% / (41%)	45% / (41%)	19% / (18%)

Table A1c: US 97 Corridor Travel Patterns Comparing 2040 Bundle C Conditions to 2040 No Build Conditions

Location	Begin and End in Bend 2040 / (2010)	Begin or End in Bend 2040 / (2010)	Begin and End Outside Bend 2040 / (2010)
US 97/Bend Parkway Southbound			
South of US 20 interchange	44% / (41%)	46% / (48%)	10% / (11%)
South of Revere Ave interchange	54% / (56%)	37% / (35%)	9% / (9%)
South of Truman Ave	50% / (58%)	38% / (33%)	11% / (9%)
South of Badger Rd	24% / (42%)	57% / (41%)	19% / (17%)
US 97/Bend Parkway Northbound			
South of US 20 interchange	34% / (34%)	58% / (59%)	8% / (7%)
South of Revere Ave interchange	51% / (54%)	40% / (38%)	9% / (8%)
South of Truman Ave	55% / (57%)	33% / (32%)	11% / (11%)
South of Badger Rd	43% / (41%)	40% / (41%)	17% / (18%)



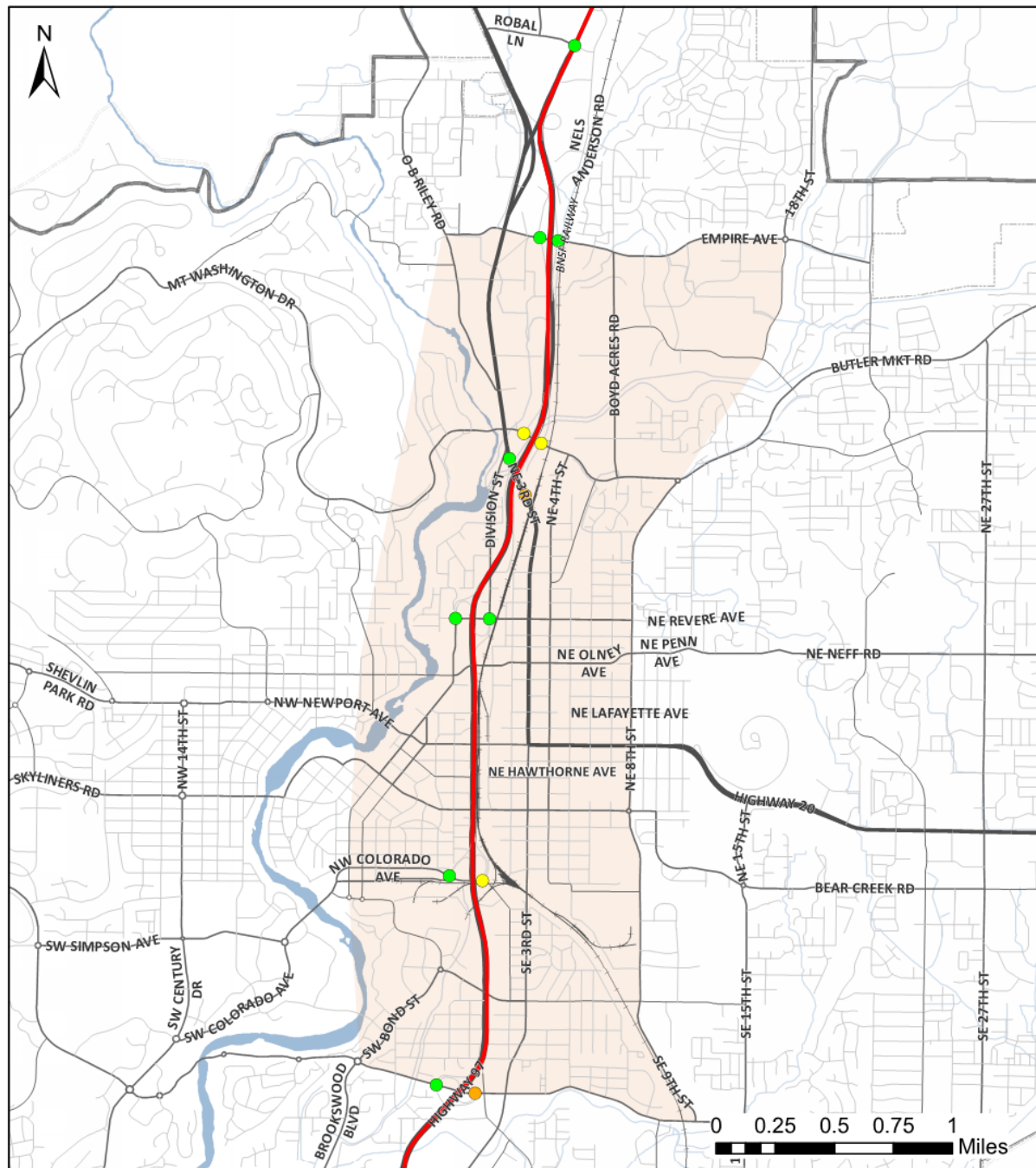
2.0 MULTIMODAL ANALYSIS

2.1 BICYCLE LEVEL OF TRAFFIC STRESS ASSESSMENT

Figures A13-20 show the Bicycle LTS projected for the US 97 mainline and key crossing locations under 2040 Build Bundle conditions.



Figure A13 – Future No-Build Bicycle Level of Stress – Central Study Area

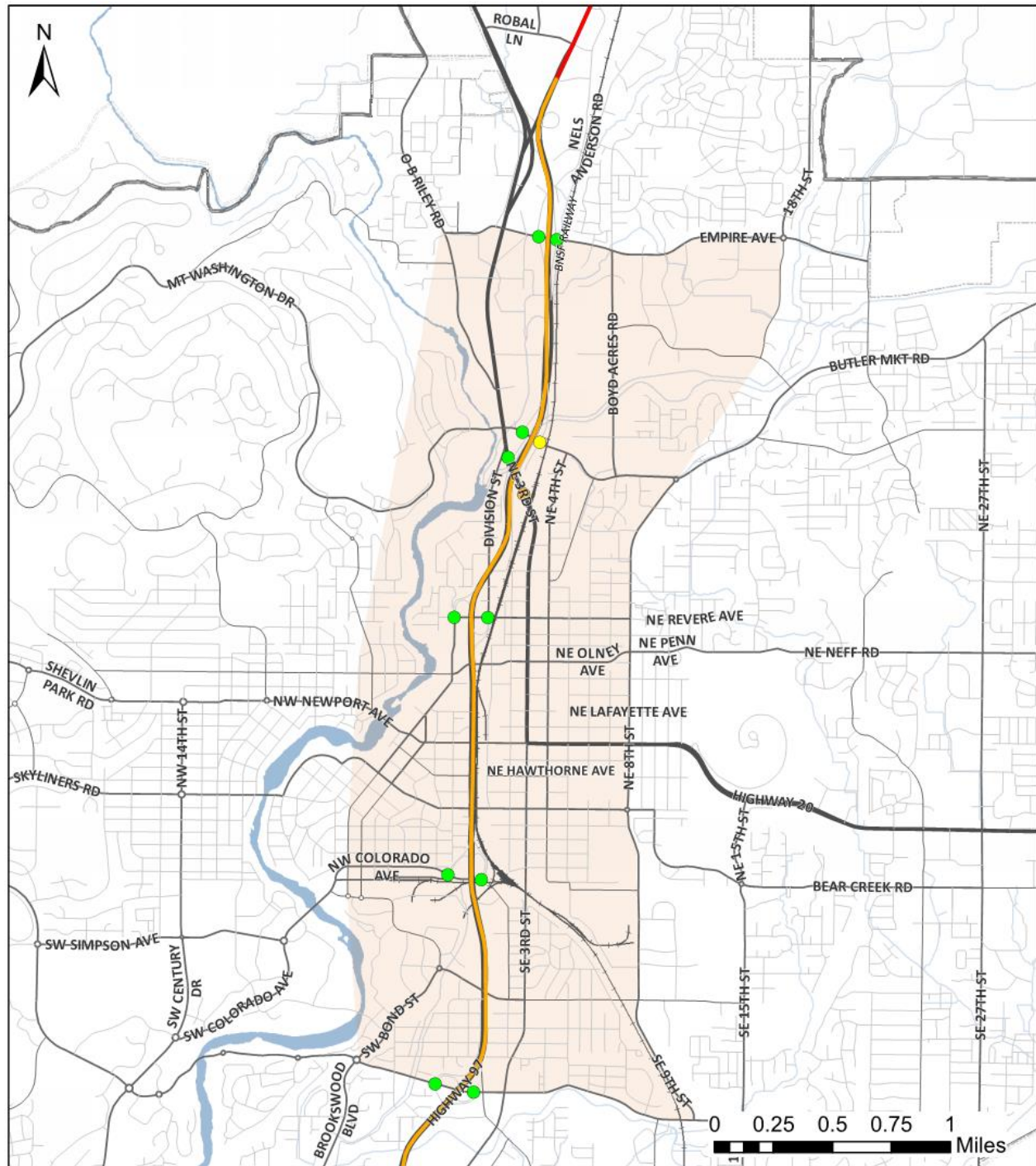


2040 No-Build Bicycle Level of Traffic Stress - Central Study Area

Roads	Infrastructure	Bicycle Level of Traffic Stress	Parkway Study Area	Boundaries & Misc.
Highway	Railroads	Segment Stress	Central Study Area	Bend City Limits
Arterial		High		Bend MPO Boundary
Collector		Intersection Stress		UGB - Urban Growth Boundary
Local		Lowest		Waterways
		Low		
		Medium		



Figure A14 – 2040 Bundle A Bicycle Level of Stress – Central Study Area



2040 Build Bundle A Bicycle Level of Traffic Stress - Central Study Area

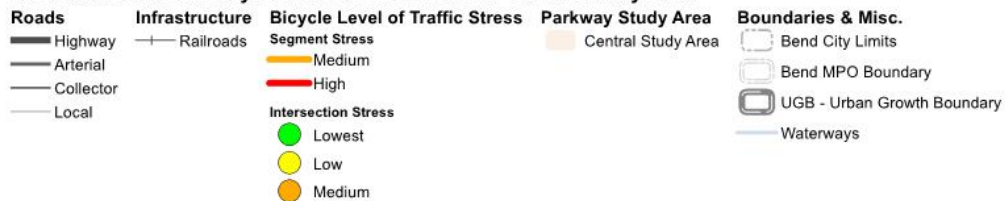
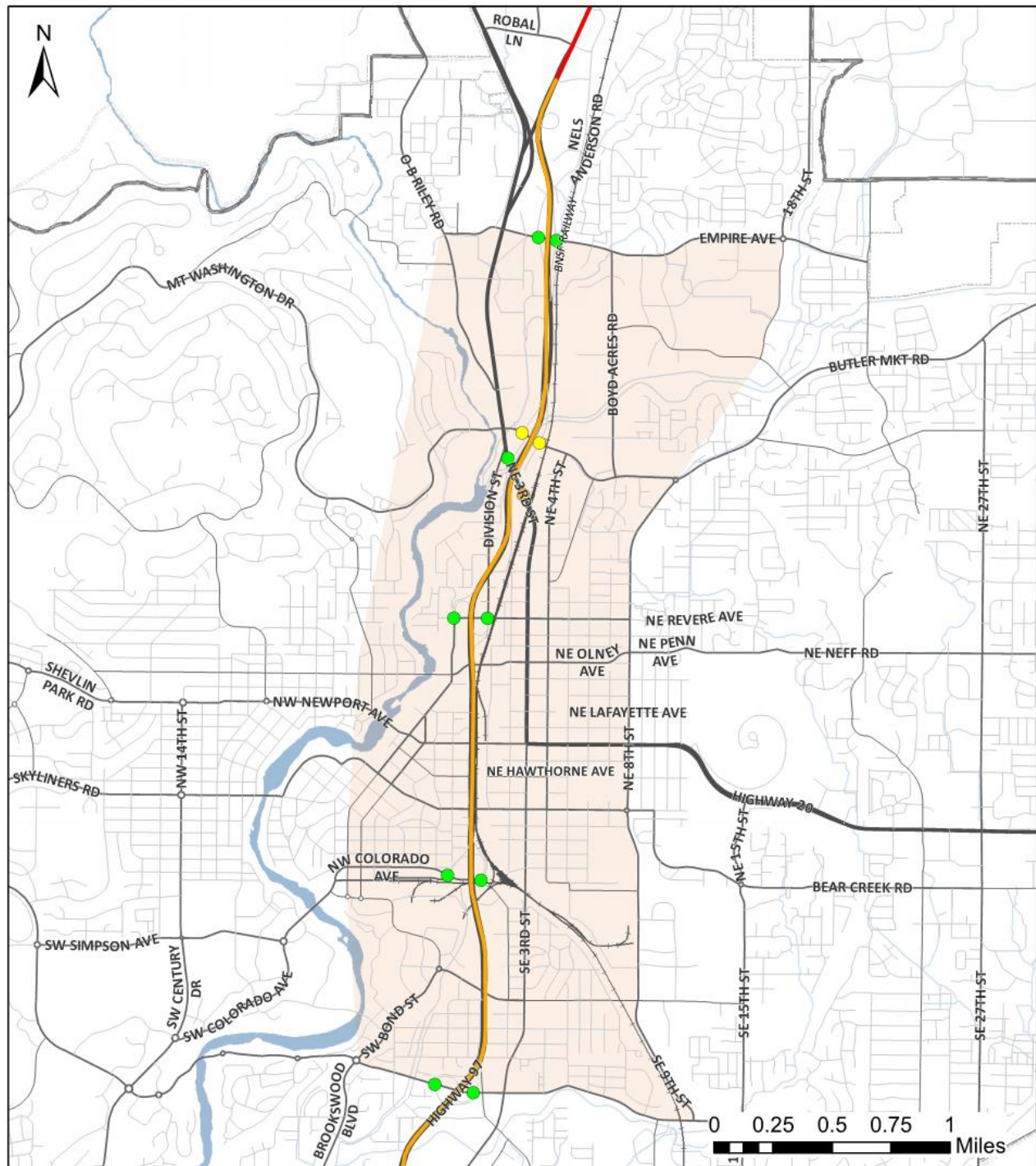




Figure A15 – 2040 Bundle B Bicycle Level of Stress – Central Study Area



2040 Build Bundle B Bicycle Level of Traffic Stress - Central Study Area

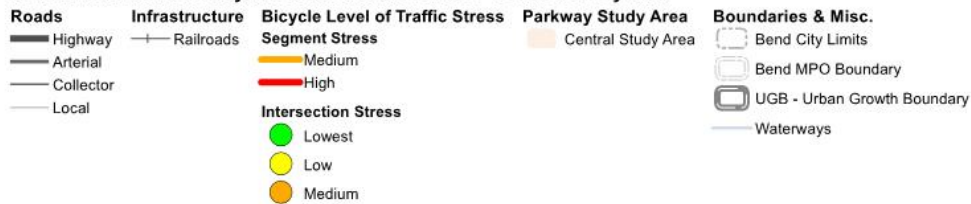
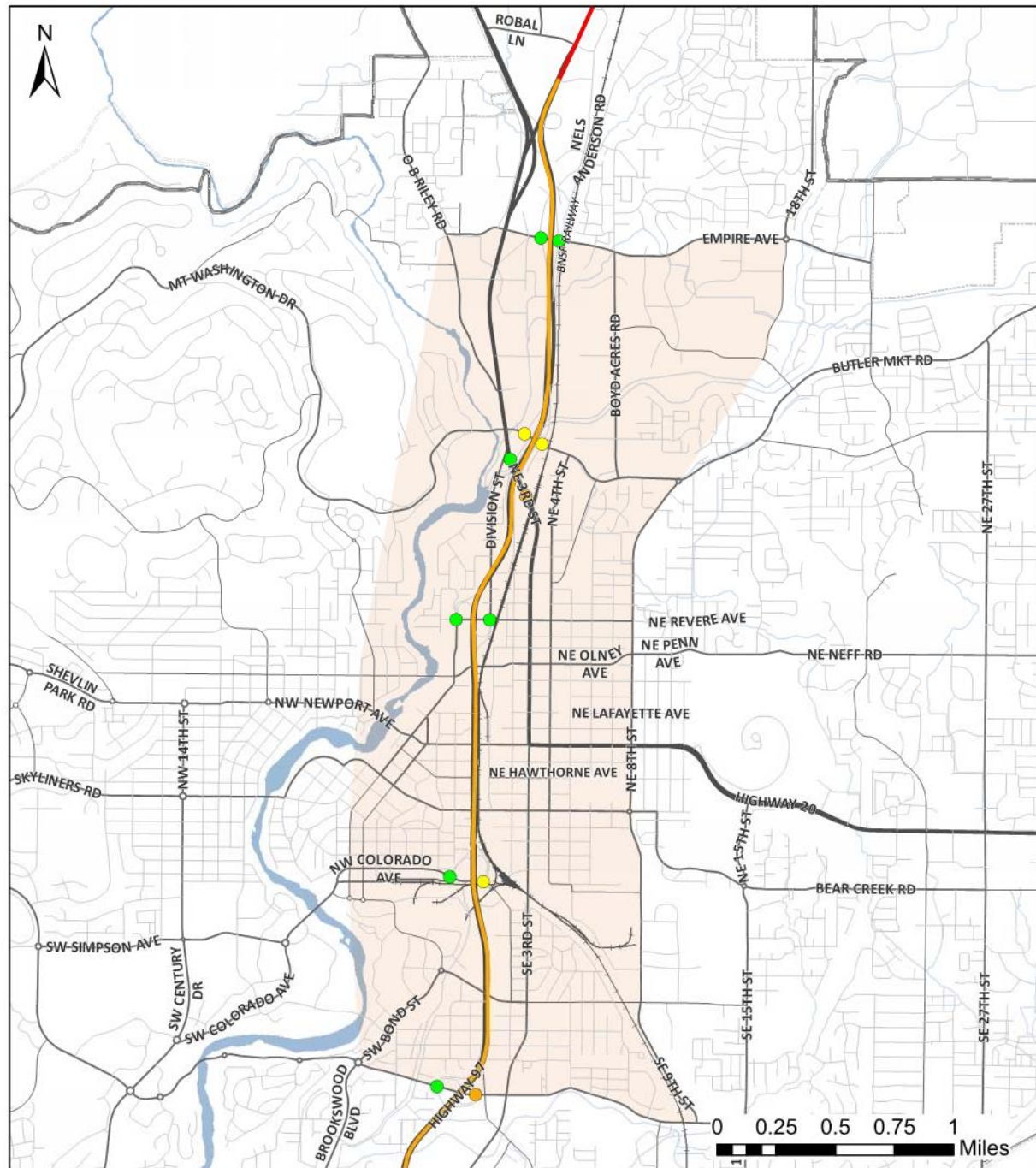




Figure A16 – 2040 Bundle C Bicycle Level of Stress – Central Study Area



2040 Build Bundle C Bicycle Level of Traffic Stress - Central Study Area

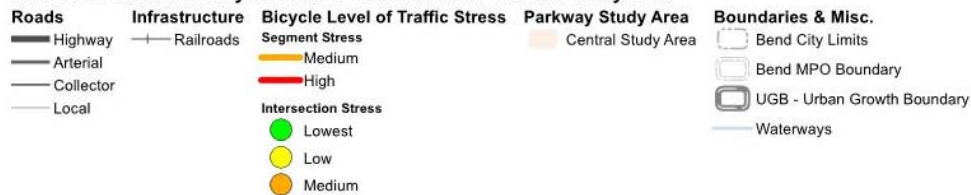
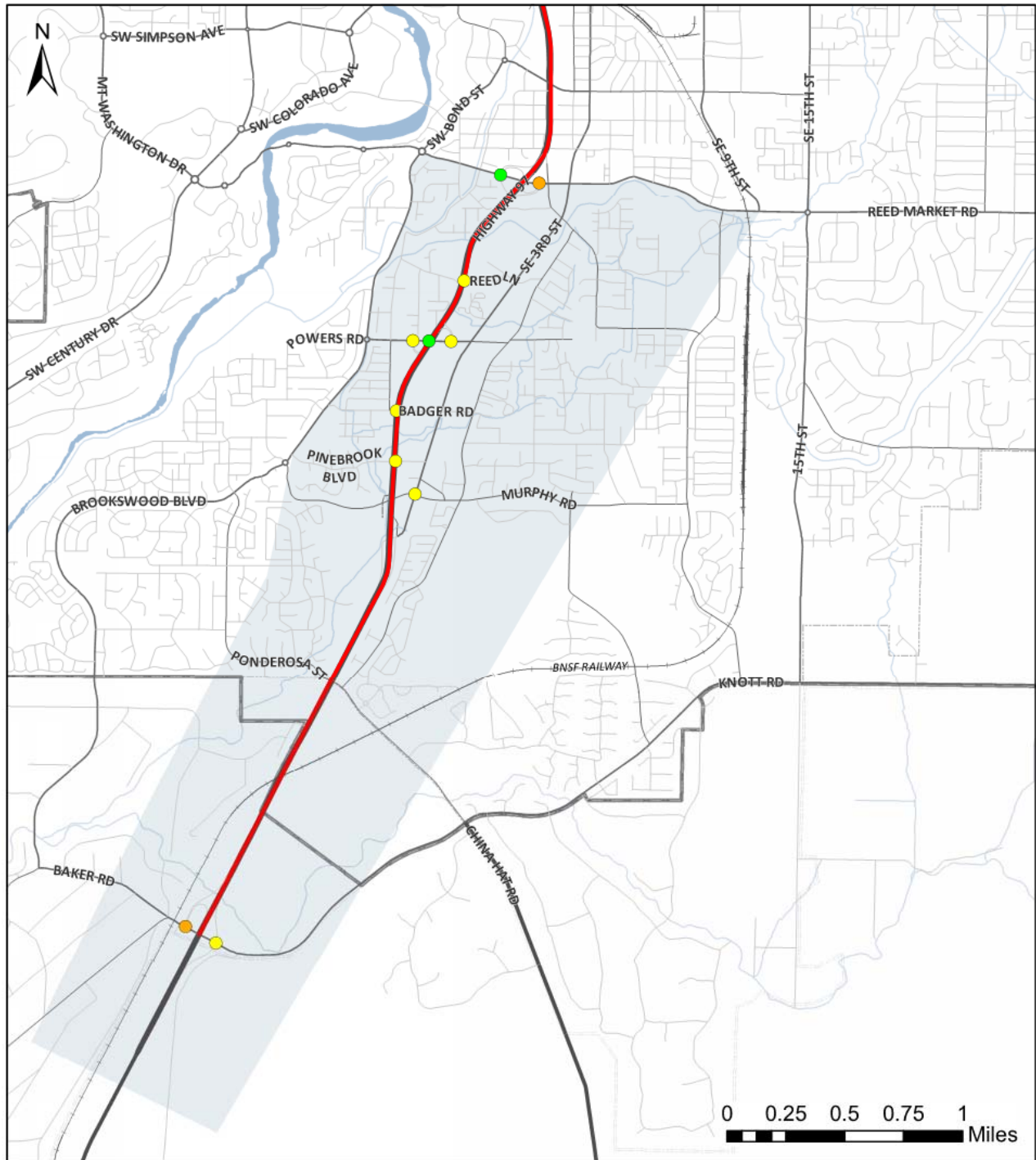




Figure A17 – Future No-Build Bicycle Level of Stress – South Study Area



2040 No-Build Bicycle Level of Traffic Stress - South Study Area

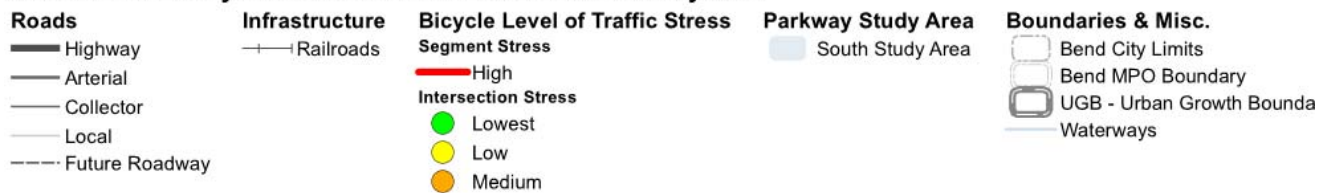
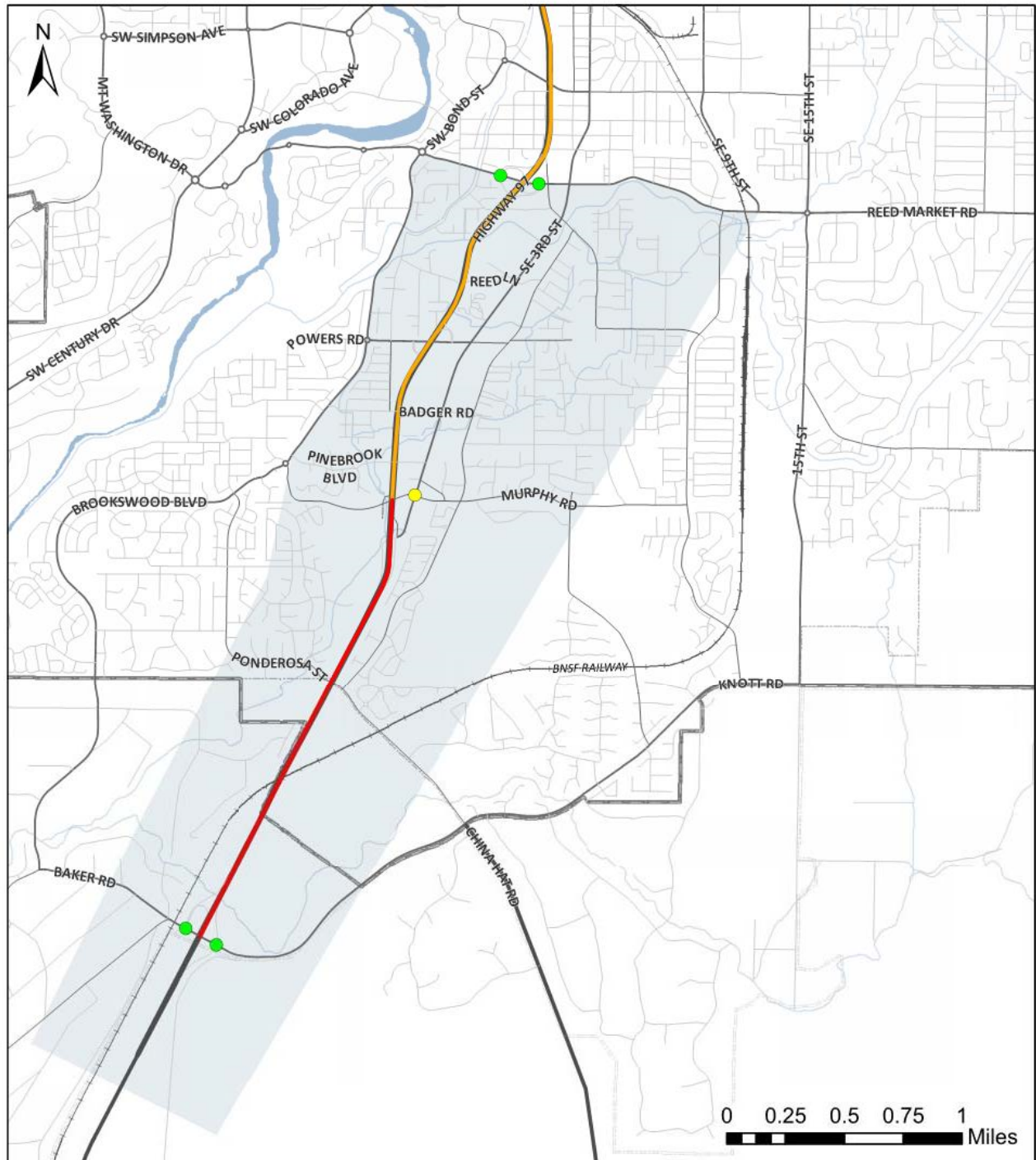




Figure A18 – Future Bundle A Bicycle Level of Stress – South Study Area

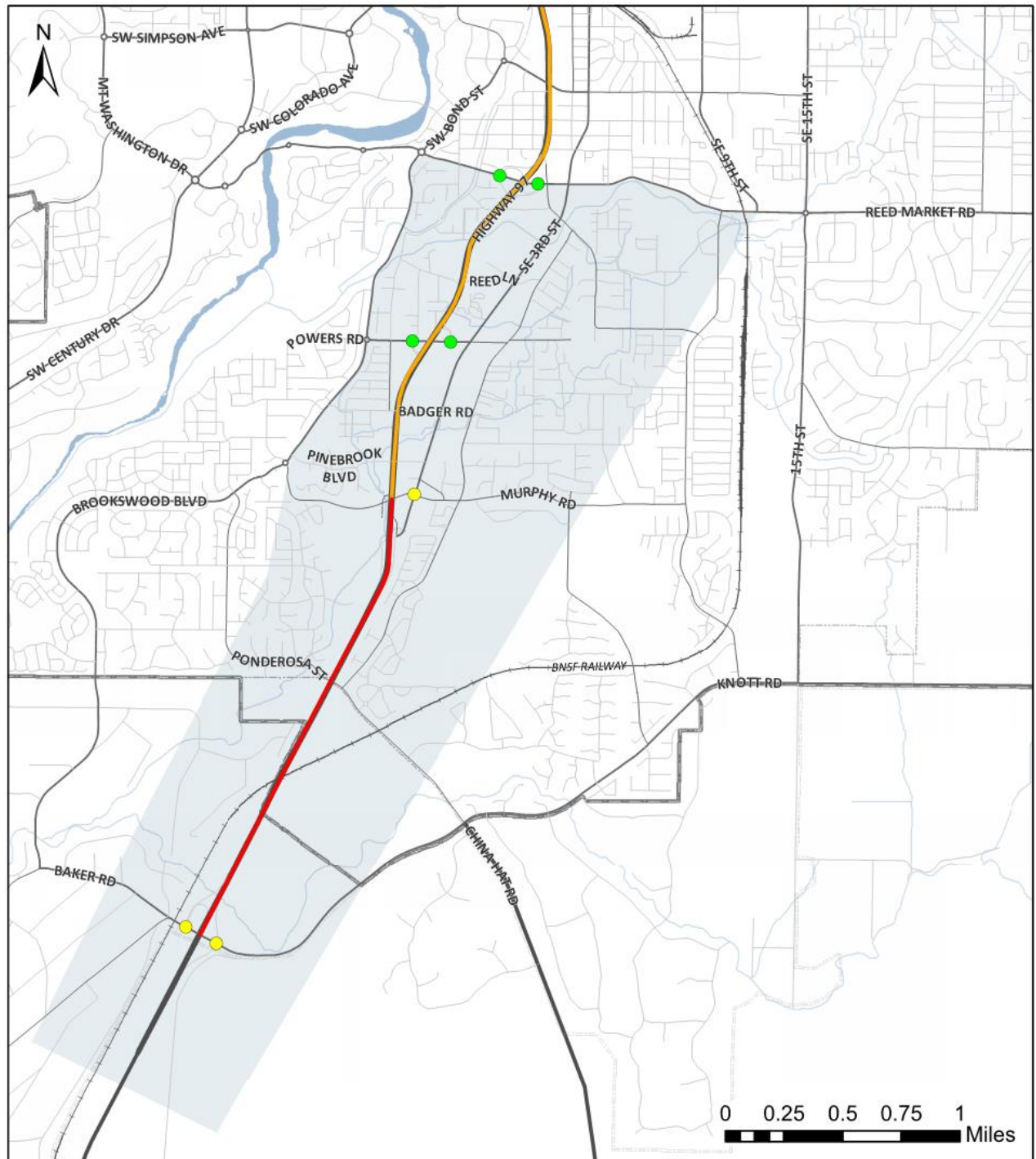


2040 Build Bundle A Bicycle Level of Traffic Stress - South Study Area





Figure A19 – Future Bundle B Bicycle Level of Stress – Study Area

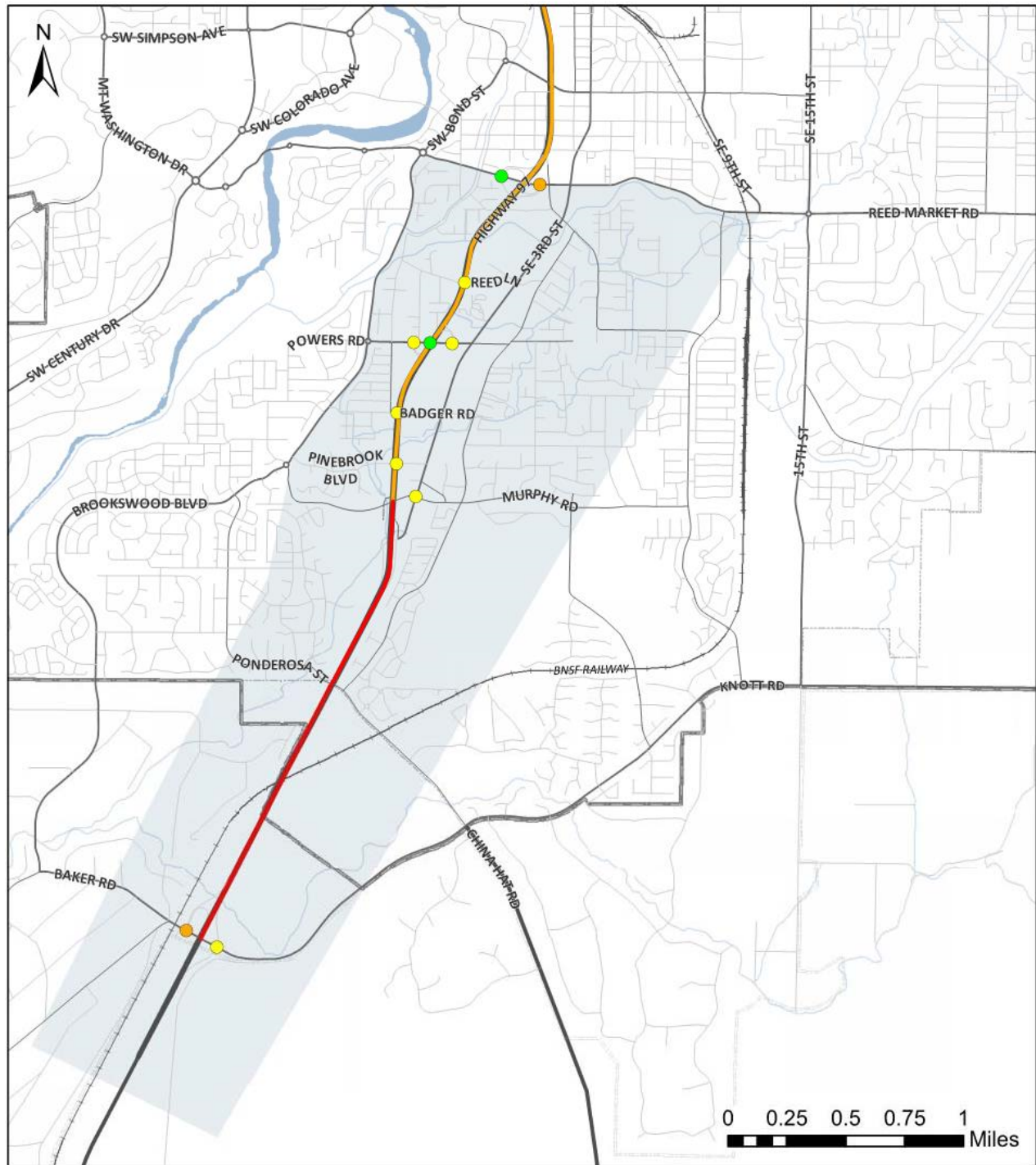


2040 Build Bundle B Bicycle Level of Traffic Stress - South Study Area

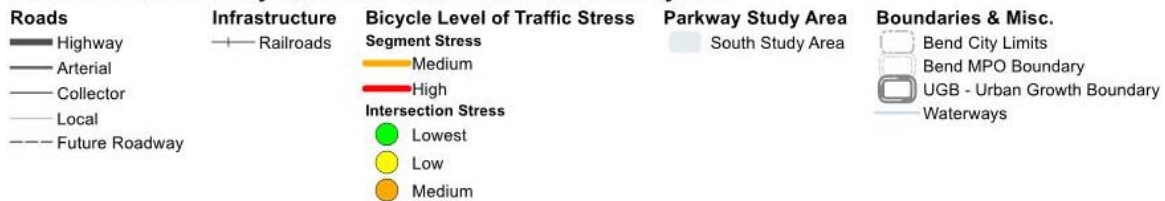
Roads	Infrastructure	Bicycle Level of Traffic Stress	Parkway Study Area	Boundaries & Misc.
- Highway - Arterial - Collector - Local - Future Roadway	Railroads	- Segment Stress - Medium - High - Intersection Stress - Lowest - Low	South Study Area	- Bend City Limits - Bend MPO Boundary - UGB - Urban Growth Boundary - Waterways



Figure A20 – Future Bundle C Bicycle Level of Stress – South Study Area



2040 Build Bundle C Bicycle Level of Traffic Stress - South Study Area





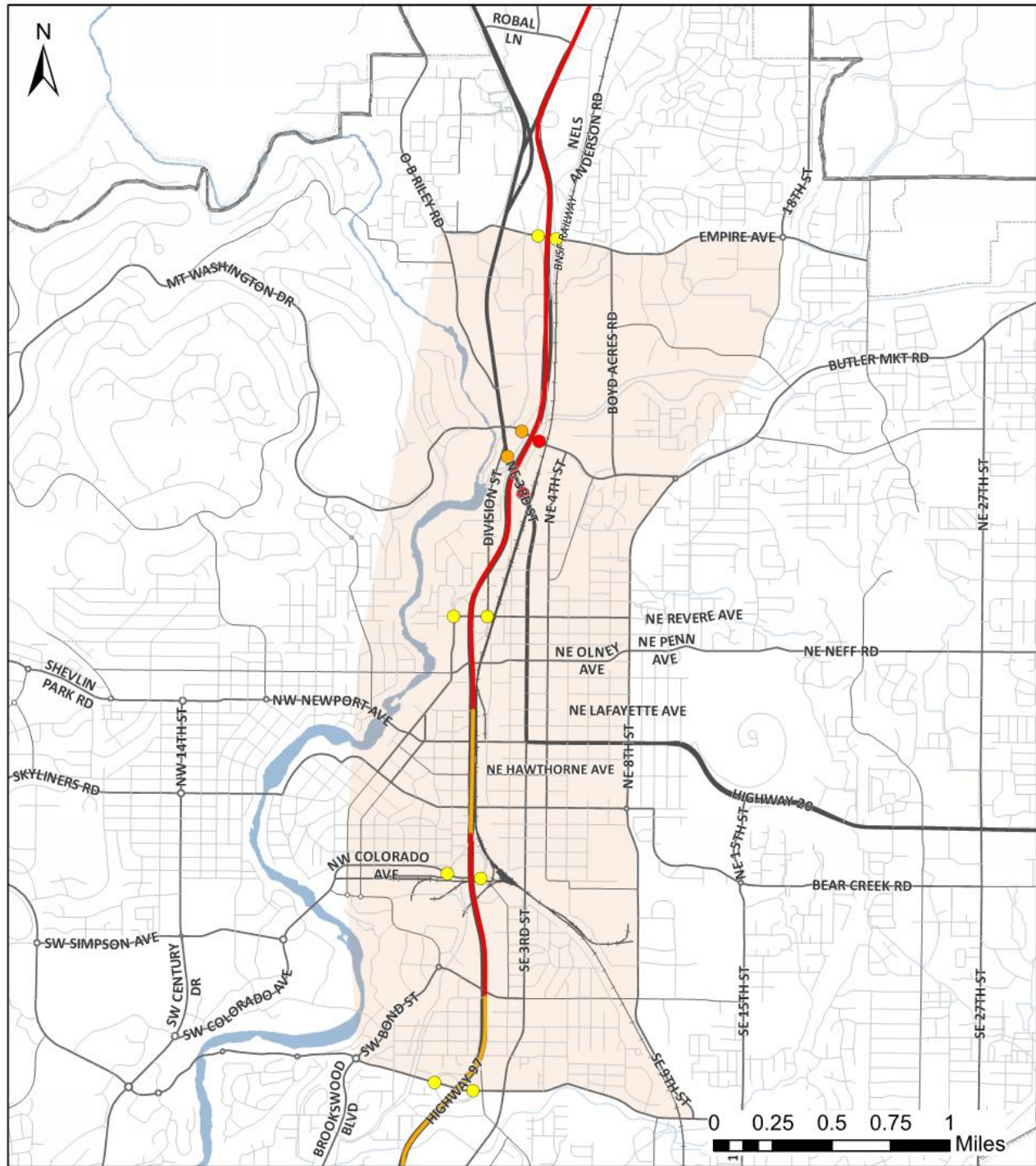
2.2 PEDESTRIAN LEVEL OF TRAFFIC STRESS ASSESSMENT

Figures A21-28 show the Pedestrian LTS projected for the US 97 mainline and key crossing locations under the 2040 Build Bundle conditions.

The map displays the proposed rail alignment through the Denver area. The alignment is shown as a red line with yellow dots indicating station locations. The map includes major roads like I-70, I-25, and I-76, as well as local streets. The proposed alignment is shown as a red line with yellow dots indicating station locations. A scale bar at the bottom indicates distances from 0 to 1 mile. A north arrow is located in the top left corner.



Figure A22 – Future Bundle A Pedestrian Level of Stress – Central Study Area



2040 Build Bundle A Pedestrian Level of Traffic Stress - Central Study Area

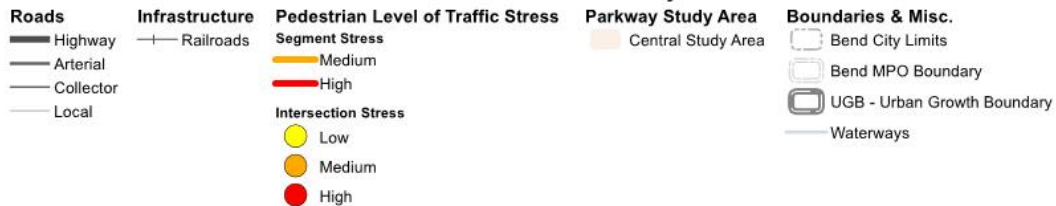
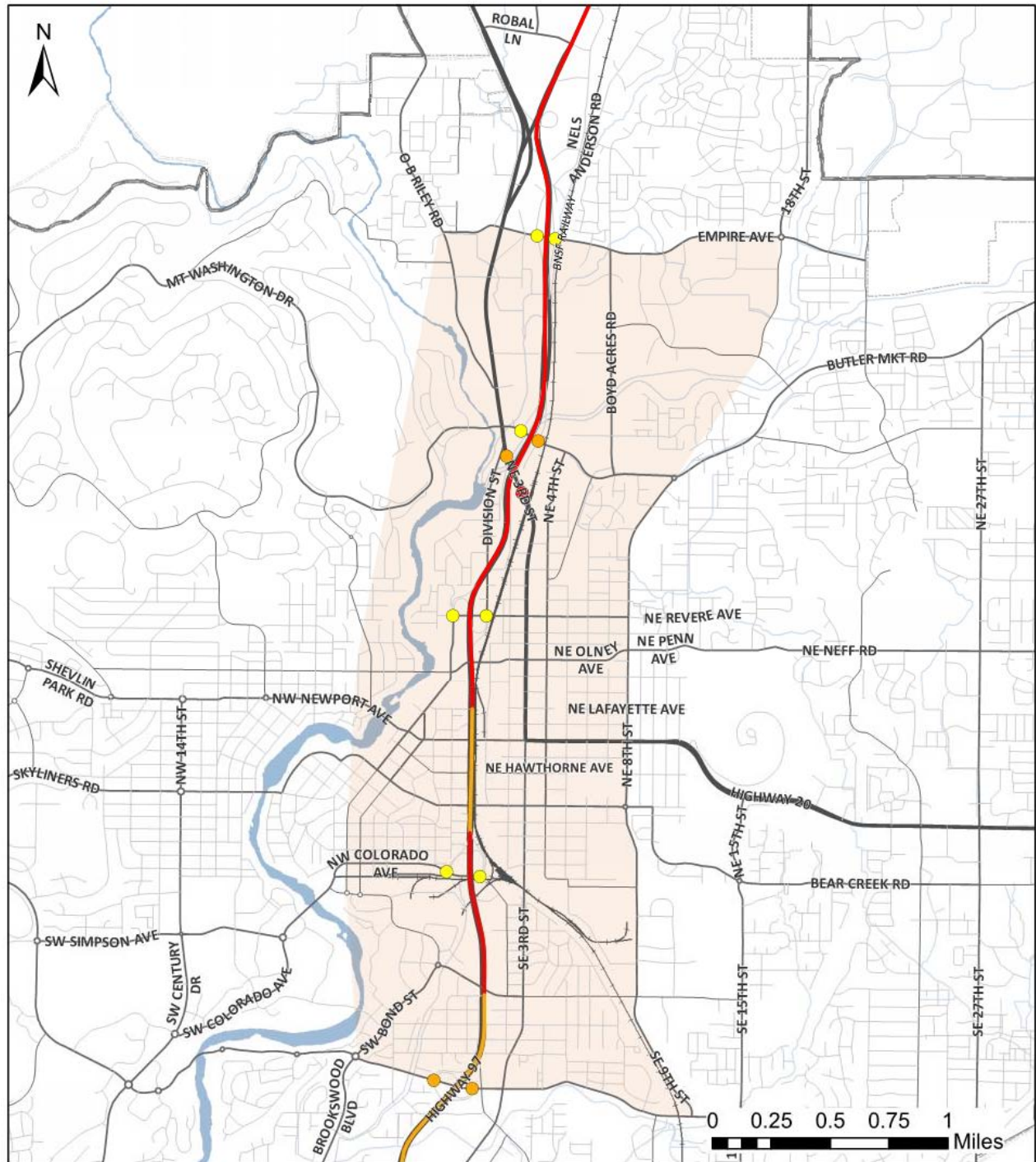




Figure A23 – Future Bundle B Pedestrian Level of Stress – Central Study Area



2040 Build Bundle B Pedestrian Level of Traffic Stress - Central Study Area

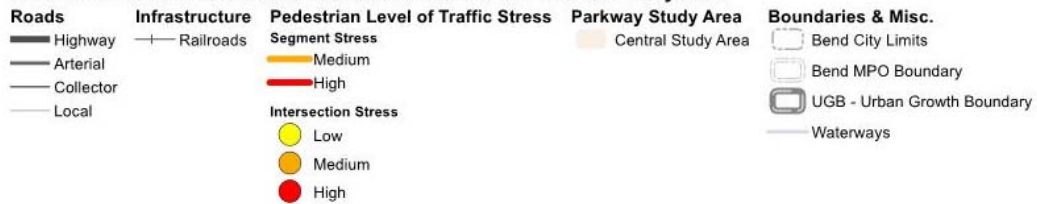
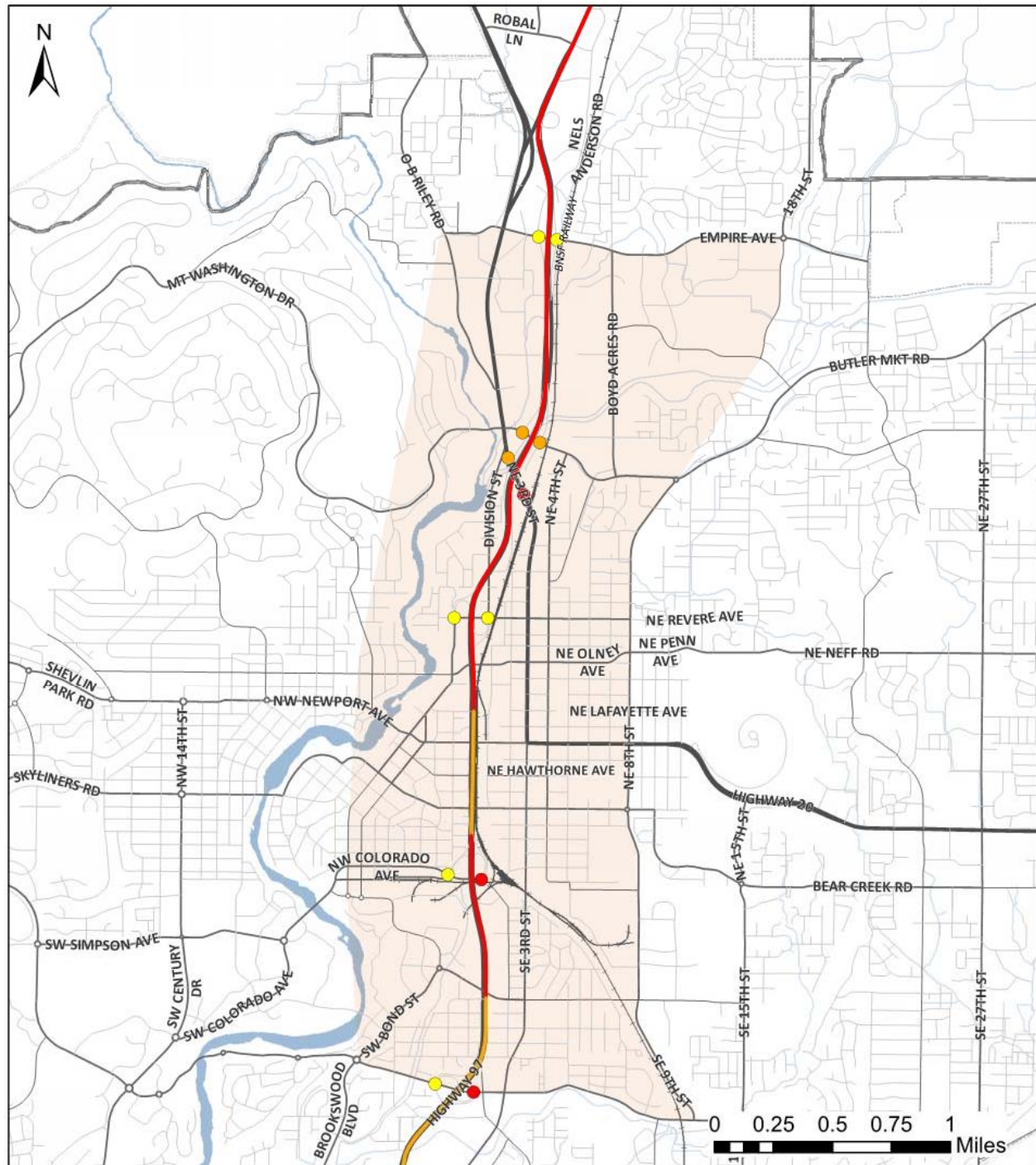




Figure A24 – Future Bundle C Pedestrian Level of Stress – Central Study Area



2040 Build Bundle C Pedestrian Level of Traffic Stress - Central Study Area

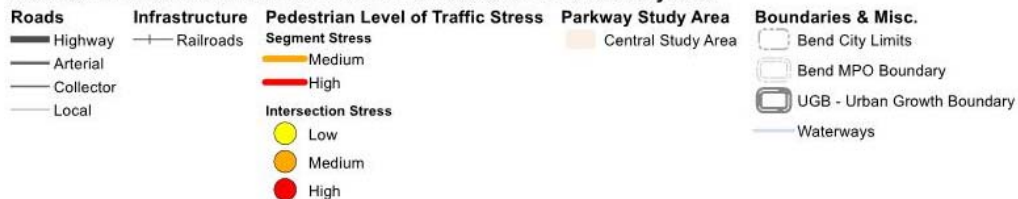
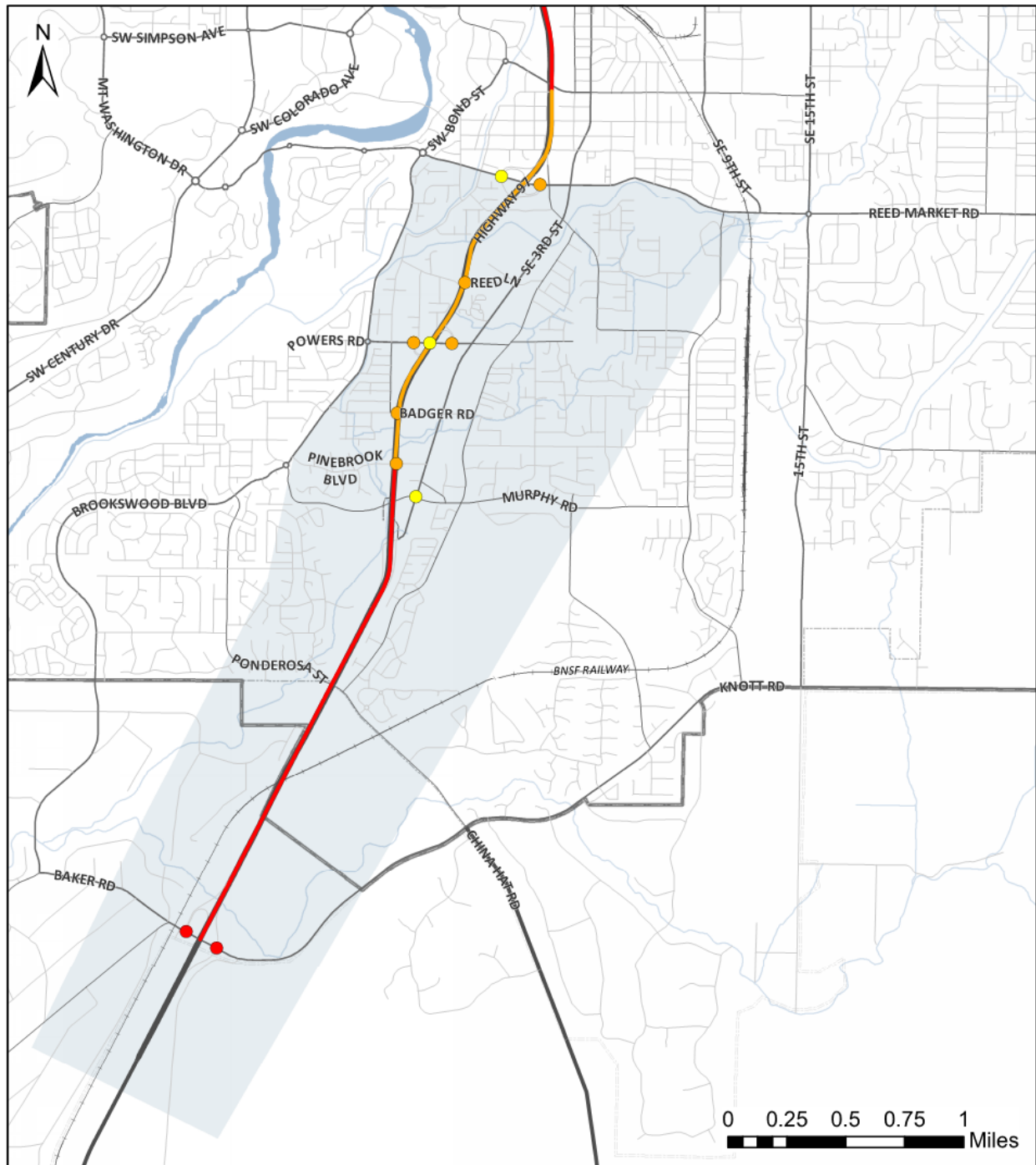




Figure A25 – Future No-Build Pedestrian Level of Stress – South Study Area



2040 No-Build Pedestrian Level of Traffic Stress - South Study Area

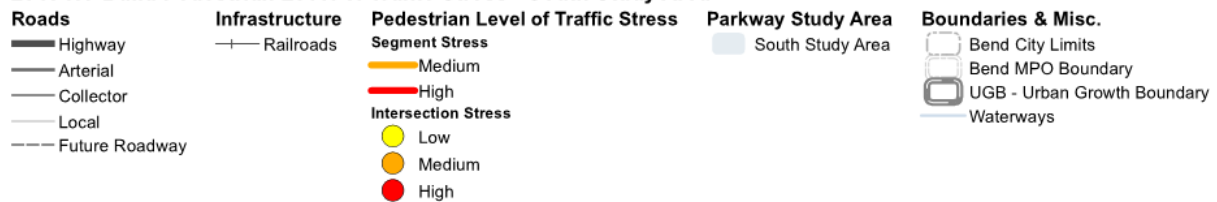
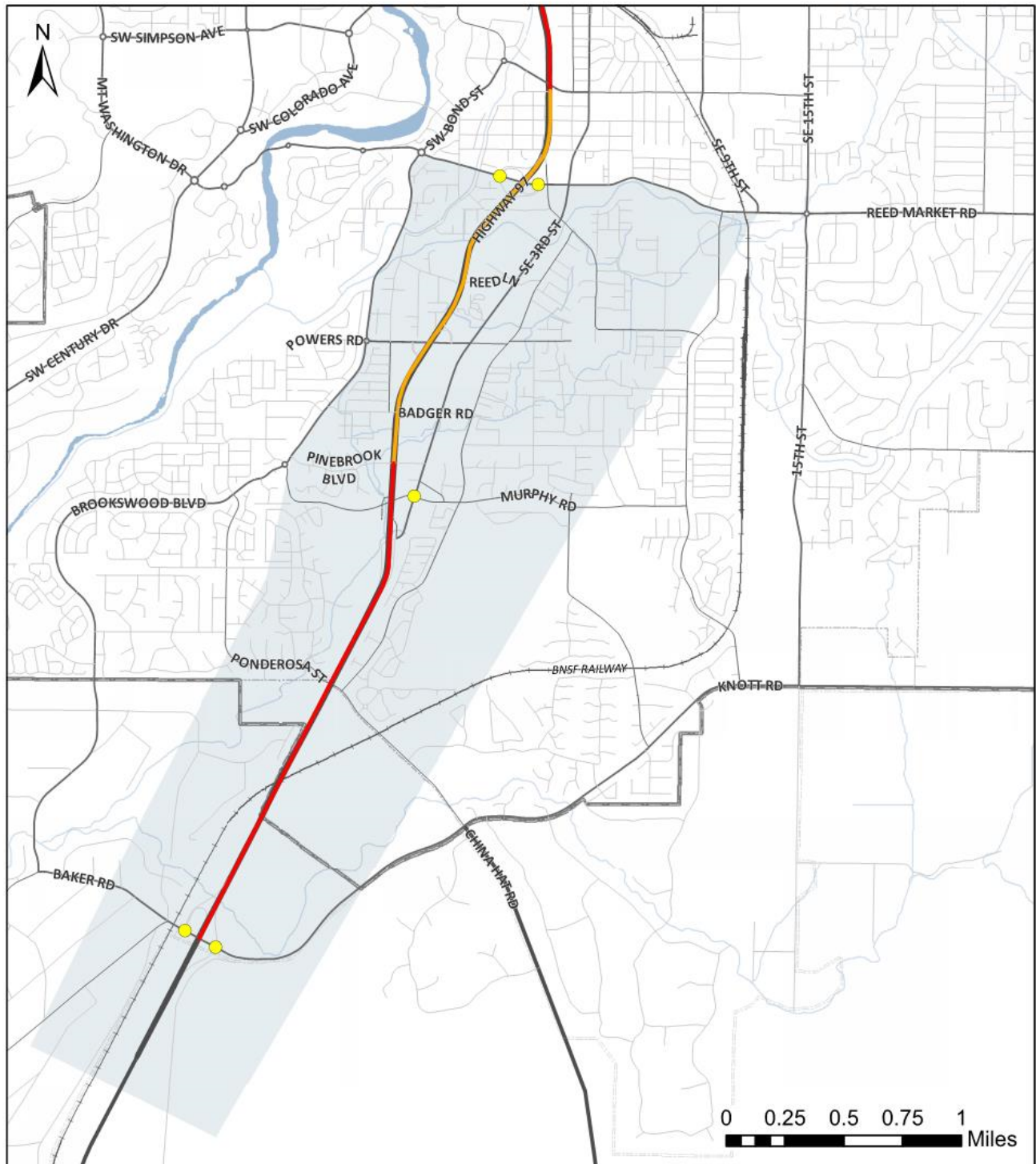




Figure A26 – Future Bundle A Pedestrian Level of Stress – South Study Area



2040 Build Bundle A Pedestrian Level of Traffic Stress - South Study Area

Roads
 — Highway
 — Arterial
 — Collector
 — Local
 - - Future Roadway

Infrastructure
 — Railroads

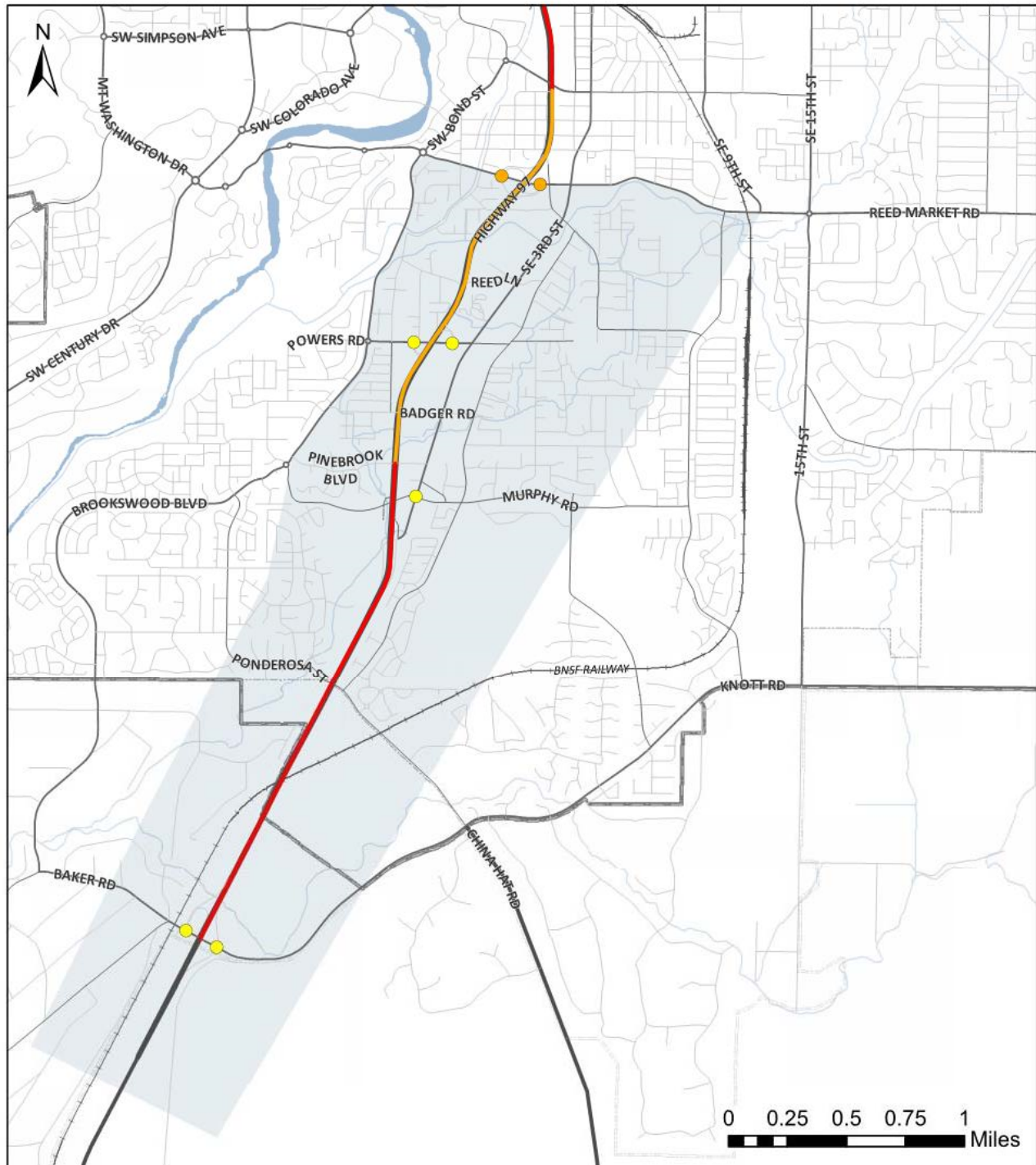
Pedestrian Level of Traffic Stress
 Segment Stress
 — Medium
 — High
 Intersection Stress
 ● Low

Parkway Study Area
 — South Study Area

Boundaries & Misc.
 — Bend City Limits
 — Bend MPO Boundary
 — UGB - Urban Growth Boundary
 — Waterways



Figure A27 – Future Bundle B Pedestrian Level of Stress – South Study Area



2040 Build Bundle B Pedestrian Level of Traffic Stress - South Study Area

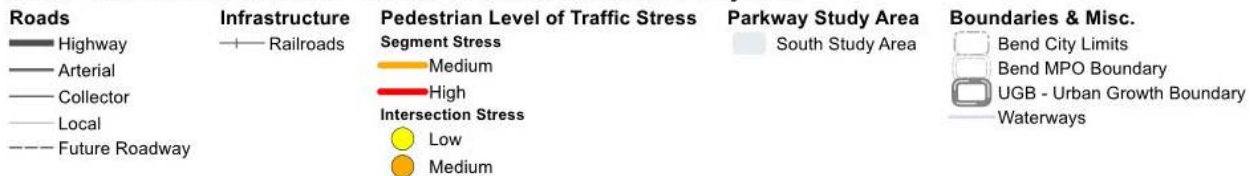
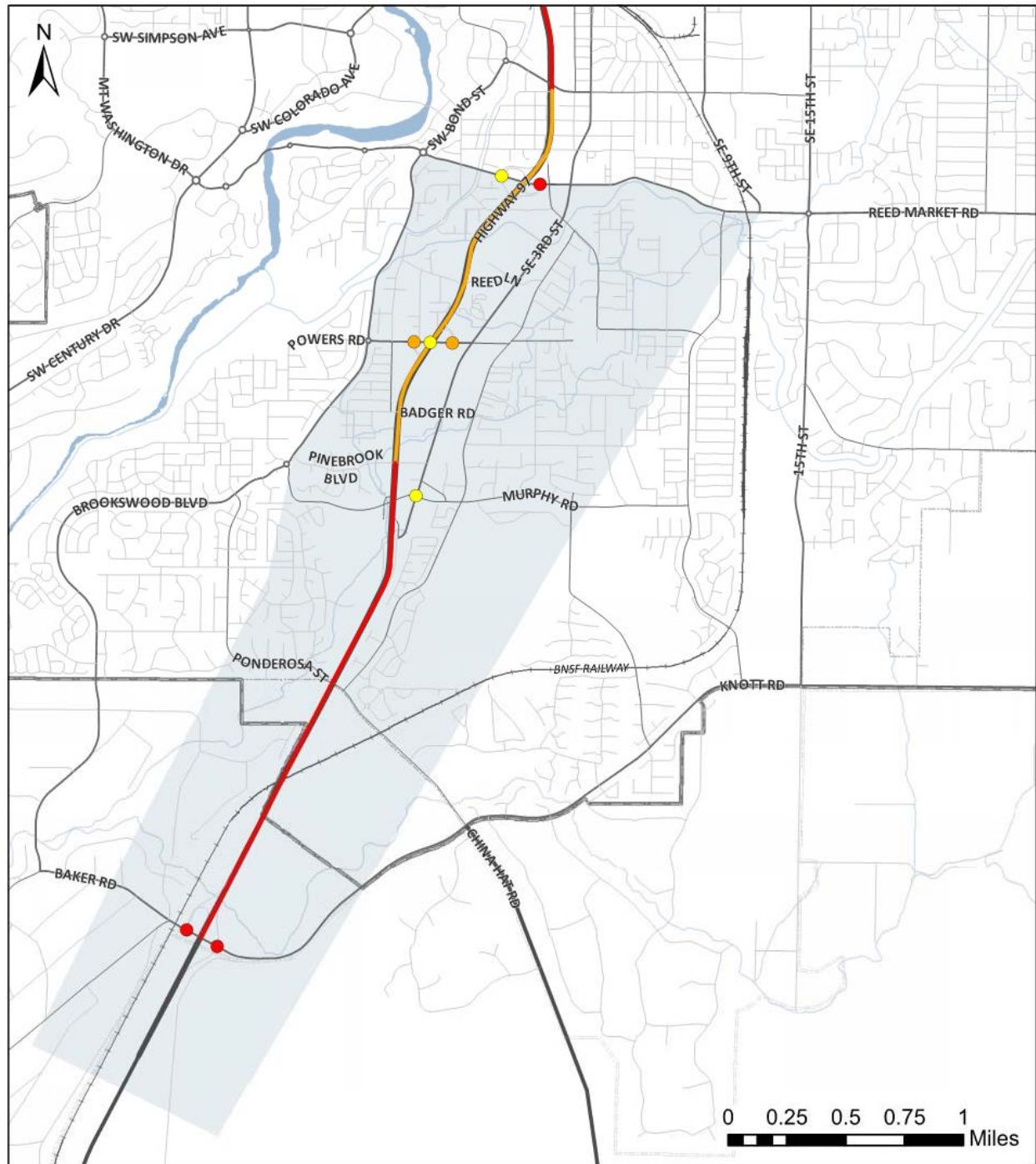
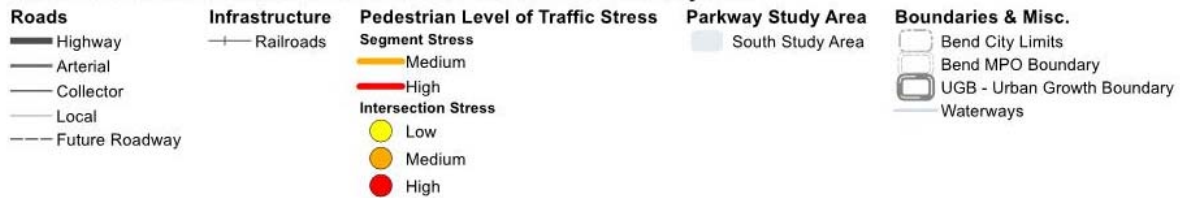




Figure A28 – Future Bundle C Pedestrian Level of Stress – South Study Area



2040 Build Bundle C Pedestrian Level of Traffic Stress - South Study Area





3.0 SAFETY ANALYSIS

3.1 ANALYSIS RESULTS



Table A2: 2040 No Build Predicted Crashes on US 97 – Segments

Study Site	Segment MP	Predicted Crashes per Year		
		Fatal and Injury	Property Damage Only	Total
Clausen Rd to South Cooley Rd Intersection	133.9-134.35	0.7	2.1	2.8
South Cooley Rd Intersection to Robal Rd	134.35-134.6	0.6	1.8	2.4
Robal Rd to Nels Anderson Pl	134.6-134.75	0.4	1.3	1.7
Nels Anderson Pl to US 20 off ramp	134.75-134.92	0.4	1.3	1.7
Empire Blvd ramp to Butler Market Rd ramp	35.77-135.92	0.4	1.2	1.6
Butler Market Rd ramp to Revere Blvd ramp	136.81-136.96	0.4	1.2	1.6
Revere Ave ramp to Lafayette Ave	137.32-137.53	0.6	1.8	2.4
Lafayette Ave to Hawthorne Ave	137.53-137.8	0.8	2.2	3
Hawthorne Ave to Colorado Ave ramp	137.8-137.97	0.5	1.4	1.9
Colorado Ave ramp to Truman Ave	138.4-138.75	0.9	2.8	3.7
Truman Ave to Reed Market Rd ramp	138.75-138.85	0.4	1.1	1.5
Reed Market Rd ramp to Reed Ln	139.43-139.68	0.5	1.3	1.8
Reed Ln to Powers Rd	139.68-139.97	0.6	1.7	2.3
Powers Rd to Badger Rd	139.97-140.3	0.5	1.3	1.8
Badger Rd to Pinebrook Blvd	140.3-140.52	0.3	0.9	1.2
Pinebrook Blvd to Murphy Rd ramp	140.52-140.72	0.6	1.6	2.2
Murphy Rd ramp to Ponderosa St/China Hat Rd	142.02-142.24	0.6	1.4	2
Ponderosa St/China Hat Rd to MP 142.52	142.24-142.52	0.5	1.3	1.8
MP 142.52 to Baker Rd/Knott Rd ramp	142.52-143.1	1.1	2.9	4
Totals		10.8	30.6	41.4



Table A2a: 2040 Bundle A Predicted Crashes on US 97 – Segments

Study Site	Segment MP	Predicted Crashes per Year		
		Fatal and Injury	Property Damage Only	Total
Clausen Rd to South Cooley Rd Intersection	133.9-134.35	1.1	3.1	4.2
South Cooley Rd Intersection to Robal Rd	134.35-134.6	¹		
Robal Rd to Nels Anderson Pl	134.6-134.75	1.1	3.2	4.3
Nels Anderson Pl to US 20 off ramp	134.75-134.92	²		
Empire Blvd ramp to Butler Market Rd ramp	35.77-135.92	0.4	1.1	1.5
Butler Market Rd ramp to Revere Blvd ramp	136.81-136.96	0.4	1.1	1.5
Revere Ave ramp to Lafayette Ave	137.32-137.53	0.6	1.7	2.3
Lafayette Ave to Hawthorne Ave	137.53-137.8	0.8	2.2	3
Hawthorne Ave to Colorado Ave ramp	137.8-137.97	0.5	1.4	1.9
Colorado Ave ramp to Truman Ave	138.4-138.75	0.8	2.4	3.2
Truman Ave to Reed Market Rd ramp	138.75-138.85	0.3	0.9	1.2
Reed Market Rd ramp to Reed Ln	139.43-139.68	0.3	0.9	1.2
Reed Ln to Powers Rd	139.68-139.97	0.4	1.2	1.6
Powers Rd to Badger Rd	139.97-140.3	0.5	1.4	1.9
Badger Rd to Pinebrook Blvd	140.3-140.52	0.3	0.9	1.2
Pinebrook Blvd to Murphy Rd ramp	140.52-140.72	0.6	1.7	2.3
Murphy Rd ramp to Ponderosa St/China Hat Rd	142.02-142.24	0.6	1.4	2
Ponderosa St/China Hat Rd to MP 142.52	142.24-142.52	0.6	1.6	2.2
MP 142.52 to Baker Rd/Knott Rd ramp	142.52-143.1	1.3	3.4	4.7
Totals		10.6	29.6	40.2

¹ Combined with above segment from Clausen Rd to South Cooley Rd

² Combined with above segment from Robal Rd to Nels Anderson



Table A2b: 2040 Bundle B Predicted Crashes on US 97 – Segments

Study Site	Segment MP	Predicted Crashes per Year		
		Fatal and Injury	Property Damage Only	Total
Clausen Rd to South Cooley Rd Intersection	133.9-134.35	0.9	2.7	3.6
South Cooley Rd Intersection to Robal Rd	134.35-134.6	³		
Robal Rd to Nels Anderson Pl	134.6-134.75	0.9	2.7	3.6
Nels Anderson Pl to US 20 off ramp	134.75-134.92	⁴		
Empire Blvd ramp to Butler Market Rd ramp	35.77-135.92	0.5	1.5	2
Butler Market Rd ramp to Revere Blvd ramp	136.81-136.96	0.4	1.1	1.5
Revere Ave ramp to Lafayette Ave	137.32-137.53	0.6	1.7	2.3
Lafayette Ave to Hawthorne Ave	137.53-137.8	0.8	2.2	3
Hawthorne Ave to Colorado Ave ramp	137.8-137.97	0.5	1.4	1.9
Colorado Ave ramp to Truman Ave	138.4-138.75	0.8	2.5	3.3
Truman Ave to Reed Market Rd ramp	138.75-138.85	0.3	1	1.3
Reed Market Rd ramp to Reed Ln	139.43-139.68	0.4	1	1.4
Reed Ln to Powers Rd	139.68-139.97	0.5	1.4	1.9
Powers Rd to Badger Rd	139.97-140.3	0.5	1.6	2.1
Badger Rd to Pinebrook Blvd	140.3-140.52	0.4	1	1.4
Pinebrook Blvd to Murphy Rd ramp	140.52-140.72	0.7	1.9	2.6
Murphy Rd ramp to Ponderosa St/China Hat Rd	142.02-142.24	0.5	1.3	1.8
Ponderosa St/China Hat Rd to MP 142.52	142.24-142.52	0.6	1.6	2.2
MP 142.52 to Baker Rd/Knott Rd ramp	142.52-143.1	1.3	3.4	4.7
Totals		10.8	10.6	30

³ Combined with above segment from Clausen Rd to South Cooley Rd

⁴ Combined with above segment from Robal Rd to Nels Anderson



Table A2c: 2040 Bundle C Predicted Crashes on US 97 – Segments

Study Site	Segment MP	Predicted Crashes per Year		
		Fatal and Injury	Property Damage Only	Total
Clausen Rd to South Cooley Rd Intersection	133.9-134.35	0.9	2.6	3.5
South Cooley Rd Intersection to Robal Rd	134.35-134.6	0.6	1.7	2.3
Robal Rd to Nels Anderson Pl	134.6-134.75	0.4	1.2	1.6
Nels Anderson Pl to US 20 off ramp	134.75-134.92	0.4	1.2	1.6
Empire Blvd ramp to Butler Market Rd ramp	35.77-135.92	0.4	1.1	1.5
Butler Market Rd ramp to Revere Blvd ramp	136.81-136.96	0.4	1.1	1.5
Revere Ave ramp to Lafayette Ave	137.32-137.53	0.6	1.7	2.3
Lafayette Ave to Hawthorne Ave	137.53-137.8	0.8	2.2	3
Hawthorne Ave to Colorado Ave ramp	137.8-137.97	0.5	1.4	1.9
Colorado Ave ramp to Truman Ave	138.4-138.75	0.9	2.5	3.4
Truman Ave to Reed Market Rd ramp	138.75-138.85	0.3	1	1.3
Reed Market Rd ramp to Reed Ln	139.43-139.68	0.4	1.2	1.6
Reed Ln to Powers Rd	139.68-139.97	0.5	1.6	2.1
Powers Rd to Badger Rd	139.97-140.3	0.5	1.3	1.8
Badger Rd to Pinebrook Blvd	140.3-140.52	0.3	0.9	1.2
Pinebrook Blvd to Murphy Rd ramp	140.52-140.72	0.6	1.6	2.2
Murphy Rd ramp to Ponderosa St/China Hat Rd	142.02-142.24	0.5	1.4	1.9
Ponderosa St/China Hat Rd to MP 142.52	142.24-142.52	0.5	1.4	1.9
MP 142.52 to Baker Rd/Knott Rd ramp	142.52-143.1	1.1	3	4.1
Totals		10.6	30.1	40.7

Table A3: 2040 No Build Predicted Crashes on US 97 – Intersections

Study Site	Location	Predicted Crashes per Year		
		Fatal and Injury	Property Damage Only	Total
US 97/North Cooley Rd Intersection	MP 133.95	2.2	5.2	7.4
US 97/South Cooley Rd Intersection	MP 134.35	1.8	3.8	5.6
US 97/Robal Rd	MP 134.6	3.4	6.1	9.5
US 97/Nels Anderson Pl	MP 134.75	1	1.4	2.4
US 97/Lafayette Ave	MP 137.53	0.4	0.8	1.2
US 97/Hawthorne Ave	MP 137.8	0.7	1.8	2.5
US 97/Truman Ave	MP 138.75	0.8	1.8	2.6
US 97/Reed Ln	MP 139.68	0.7	1.4	2.1
US 97/Powers Rd	MP 139.97	5.6	10.5	16.1
US 97/Ponderosa St/China Hat Rd	MP 142.24	1.2	1.6	2.8
Totals		17.8	34.4	52.2



Table A3a: 2040 Bundle A Predicted Crashes on US 97 – Intersections

Study Site	Location	Predicted Crashes per Year		
		Fatal and Injury	Property Damage Only	Total
US 97/North Cooley Rd Intersection	MP 133.95	1.8	4.3	6.1
US 97/South Cooley Rd Intersection	MP 134.35	0	0	0
US 97/Robal Rd	MP 134.6	0	0	0
US 97/Nels Anderson Pl	MP 134.75	0	0	0
US 97/Lafayette Ave	MP 137.53	0	0	0
US 97/Hawthorne Ave	MP 137.8	0.7	1.8	2.5
US 97/Truman Ave	MP 138.75	0	0	0
US 97/Reed Ln	MP 139.68	0	0	0
US 97/Powers Rd	MP 139.97	0	0	0
US 97/Ponderosa St/China Hat Rd	MP 142.24	0	0	0
Totals		2.5	6.1	8.6

Table A3b: 2040 Bundle B Predicted Crashes on US 97 – Intersections

Study Site	Location	Predicted Crashes per Year		
		Fatal and Injury	Property Damage Only	Total
US 97/North Cooley Rd Intersection	MP 133.95	1.7	4	5.7
US 97/South Cooley Rd Intersection	MP 134.35	0	0	0
US 97/Robal Rd	MP 134.6	0	0	0
US 97/Nels Anderson Pl	MP 134.75	0	0	0
US 97/Lafayette Ave	MP 137.53	0	0	0
US 97/Hawthorne Ave	MP 137.8	0.7	1.8	2.5
US 97/Truman Ave	MP 138.75	0	0	0
US 97/Reed Ln	MP 139.68	0	0	0
US 97/Powers Rd	MP 139.97	0 ⁵	0	0
US 97/Ponderosa St/China Hat Rd	MP 142.24	0	0	0
Totals		2.4	5.8	8.2

⁵ Modeled as an interchange. See Table A4b



Table A3c: 2040 Bundle C Predicted Crashes on US 97 – Intersections

Study Site	Location	Predicted Crashes per Year		
		Fatal and Injury	Property Damage Only	Total
US 97/North Cooley Rd Intersection	MP 133.95	1.8	4	5.8
US 97/South Cooley Rd Intersection	MP 134.35	2	4.6	6.6
US 97/Robal Rd	MP 134.6	3.6	6.4	10
US 97/Nels Anderson Pl	MP 134.75	1.1	1.4	2.5
US 97/Lafayette Ave	MP 137.53	0	0	0
US 97/Hawthorne Ave	MP 137.8	0.6	1.2	1.8
US 97/Truman Ave	MP 138.75	0	0	0
US 97/Reed Ln	MP 139.68	0	0	0
US 97/Powers Rd	MP 139.97	4.6	8.7	13.3
US 97/Ponderosa St/China Hat Rd	MP 142.24	1	1.4	2.4
Totals		14.7	27.7	42.4

Table A4: 2040 No Build Predicted Crashes on US 97 – Interchanges

Study Site	Segment MP	Predicted Crashes per Year		
		Fatal and Injury	Property Damage Only	Total
US 20 Interchange	134.92-135.13	4.1	6.4	10.5
Empire Blvd Interchange	135.13-135.77	11.5	16.4	27.9
Butler Market Rd/US 20 Interchange	135.92-136.81	7.5	14.1	21.6
Revere Ave Interchange	136.96-137.32	13.5	19	32.5
Colorado Ave Interchange	137.97-138.4	9.3	14.4	23.7
Reed Market Rd Interchange	138.85-139.43	7.6	12.7	20.3
Murphy Rd Interchange	140.72-142.02	2	3.1	5.1
Baker Rd/Knott Rd Interchange	143.1-143.7	4.1	7.3	11.4
Totals		59.6	93.4	153

Table A4a: 2040 Bundle A Predicted Crashes on US 97 – Interchanges

Study Site	Segment MP	Predicted Crashes per Year		
		Fatal and Injury	Property Damage Only	Total
US 20 Interchange	134.92-135.13	0	0	0
Empire Blvd Interchange	135.13-135.77	10.1	14.9	25
Butler Market Rd/US 20 Interchange	135.92-136.81	7.1	13.5	20.6
Revere Ave Interchange	136.96-137.32	11.4	16.1	27.5
Colorado Ave Interchange ⁶	137.97-138.4	NA	NA	NA
Reed Market Rd Interchange	138.85-139.43	6.7	10.5	17.2
Murphy Rd Interchange	140.72-142.02	2.1	3.2	5.3
Baker Rd/Knott Rd Interchange	143.1-143.7	5.6	8.8	14.4
Totals		43.0	67.0	110.0

⁶ ISATe does not have the capability to properly model this specific interchange improvement



Table A4b: 2040 Bundle B Predicted Crashes on US 97 – Interchanges

Study Site	Segment MP	Predicted Crashes per Year		
		Fatal and Injury	Property Damage Only	Total
US 20 Interchange	134.92-135.13	0	0	0
Empire Blvd Interchange	135.13-135.77	9.8	14.2	24
Butler Market Rd/US 20 Interchange	135.92-136.81	6.7	12.6	19.3
Revere Ave Interchange	136.96-137.32	11.4	16.3	27.7
Colorado Ave Interchange	137.97-138.4	10.1	14.3	24.4
Reed Market Rd Interchange ⁷	138.85-139.43	NA	NA	NA
Powers Rd Interchange ⁸	TBD	NA	NA	NA
Murphy Rd Interchange	140.72-142.02	2	3	5
Baker Rd/Knott Rd Interchange	143.1-143.7	4.2	7.8	12
Totals		44.2	68.2	112.4

Table A4c: 2040 Bundle C Predicted Crashes on US 97 – Interchanges

Study Site	Segment MP	Predicted Crashes per Year		
		Fatal and Injury	Property Damage Only	Total
US 20 Interchange	134.92-135.13	4.2	6.5	10.7
Empire Blvd Interchange	135.13-135.77	9.9	14.7	24.6
Butler Market Rd/US 20 Interchange	135.92-136.81	6.9	13.1	20
Revere Ave Interchange	136.96-137.32	12	16.8	28.8
Colorado Ave Interchange	137.97-138.4	8.6	13	21.6
Reed Market Rd Interchange	138.85-139.43	6.7	11.3	18
Murphy Rd Interchange	140.72-142.02	2.2	3.4	5.6
Baker Rd/Knott Rd Interchange	143.1-143.7	4.2	7.4	11.6
Totals		54.7	86.2	140.9

⁷ ISATe does not have the capability to properly model this specific interchange improvement

⁸ ISATe does not have the capability to properly model this specific interchange improvement



4.0 CORRIDOR OPERATIONS ANALYSIS

4.1 INTERSECTION OPERATIONS ANALYSIS

Table A5 summarizes the operations analysis results of the 2040 No Build, Build Bundle A, Build Bundle B, and Build C analysis for the Parkway intersections (including ramp terminals) and for intersections on parallel routes near the Parkway, comparing each intersection's performance against the adopted mobility target.⁹ Locations where a performance measure exceeds the mobility target are bolded for ease of reference. The intersection operations analysis results are included in the "Synchro HCM reports" (signalized and stop-controlled intersections) and the "Vistro HCM reports" Appendices.

⁹ Mobility targets for ODOT facilities obtained from the 1999 Oregon Highway Plan.



Table A5: 2040 No Build, Build Bundle A, Build Bundle B, Build Bundle C Design Hour¹⁰ Traffic Operations at Study Intersections

US 97/Bend Parkway Study Intersections					No Build			Bundle A			Bundle B			Bundle C		
Int. No.	Intersection	Jurisdiction	Control D	Mobility Target	Performance			Performance			Performance			Performance		
				V/C	V/C ^A	LOS ^B	Delay (sec) ^C	V/C ^A	LOS ^B	Delay (sec) ^C	V/C ^A	LOS ^B	Delay (sec) ^C	V/C ^A	LOS ^B	Delay (sec) ^C
1	US 97 & Tumalo Pl	(removed from study area after existing conditions analysis was completed)														
2A	US 97 & Cooley Rd (north)	ODOT/ City	Signalized	< 0.85	1.07	D	41.3	(removed from study area)			(removed from study area)			(removed from study area)		
2B	US 97 & Cooley Rd	ODOT/ City	Signalized	< 0.85	0.61	D	39.9	(removed from study area)			(removed from study area)			(removed from study area)		
2C	US 97 & Cooley Rd (south)	ODOT/ City	Signalized	< 0.85	0.90	B	15.3	(removed from study area)			(removed from study area)			(removed from study area)		
3	US 97 & Robal Rd	ODOT/ City	Signalized	< 0.85	1.41	F	>100	(removed from study area)			(removed from study area)			(removed from study area)		
4	US 97 & Nels Anderson Pl/Cascade Village	ODOT/ City	TWSC	< 0.85 (major) < 0.95 (minor)	>2.00/ >2.00	F/F	>100/ >100	(removed from study area)			(removed from study area)			(removed from study area)		
5	Bend Pkwy SB On-Ramp & Empire Blvd	ODOT/ City	Signalized E	< 0.85	1.28	F	>100	1.12	F	89.5	1.14	F	90.2	1.18	F	>100
6	Bend Pkwy NB Ramps & Empire Blvd	ODOT/ City	Signalized	< 0.85	1.33	F	91.2	1.11	D	43.4	1.14	D	48.0	1.17	D	53.7
7	US 20 & Empire Blvd	ODOT/ City	Signalized	< 0.85	1.32	F	>100	1.19	F	>100	1.19	F	>100	1.24	F	>100
8	US 20 & Butler Market Rd	ODOT/ City	Signalized	< 0.85	1.27	F	>100	1.40	F	>100	1.49	F	>100	1.24	F	>100
9	Bend Pkwy SB Off-Ramp & Butler Market Rd	ODOT/ City	TWSC	< 0.85 (ramp) < 0.95 (Butler Market Rd)	NA/ 1.30	NA/F	NA/>100	0.75	B	18.1	0.69	B	11.2	NA/ 1.09	NA/F	NA/>100
10	Bend Pkwy NB On-Ramp & Butler Market Rd	ODOT/ City	TWSC	< 0.85 (ramp) < 0.95 (Butler Market Rd)	0.11/0.04	B/B	9.5/14.9	0.14/0.06	B/C	10.8/15.9	0.14/0.05	B/C	9.6/15.4	0.13/0.04	B/B	10.7/14.9
11	Bend Pkwy SB On-Ramp/Division St & 3rd St	ODOT/ City	Signalized	< 0.85	1.37	F	>100	0.88	C	25.8	1.48	F	>100	1.34	F	>100
12	Bend Pkwy SB Ramps & Revere Ave	ODOT/ City	Signalized	< 0.85	0.99	D	51.7	1.00	C	32.6	1.06	E	56.2	1.01	E	56.5
13	Bend Pkwy NB Ramps & Revere Ave	ODOT/ City	Signalized	< 0.85	0.94	C	25.5	0.96	D	39.1	0.83	B	18.6	0.87	C	20.3
14	Bend Pkwy & Lafayette Ave	ODOT/ City	TWSC	< 0.85 (major) < 0.95 (minor)	NA/ >2.00	NA/F	NA/>100	(RIRO closed)			(RIRO closed)			(RIRO closed)		
15	Bend Pkwy & Hawthorne Ave	ODOT/ City	TWSC	< 0.85 (major) < 0.95 (minor)	NA/ >2.00	NA/F	NA/>100	(right out closed)			(right out closed)			(right out closed)		
16	Bend Pkwy SB Ramps & Colorado Ave	ODOT/ City	Signalized	< 0.85	1.17	E	73.3	0.78	C	28.3	1.05	D	53.8	1.06	E	60.6
17	Bend Pkwy NB Ramps & Colorado Ave	ODOT/ City	TWSC	< 0.85 (ramp) < 0.95 (Colorado Ave)	0.52/ 1.29	C/F	16.6/>100	0.74	D	36.7	0.84	C	27.1	0.94/ >2.00	E/F	36.6/>100
18	Bend Pkwy & Truman Ave	ODOT/ City	TWSC	< 0.85 (major) < 0.95 (minor)	NA/ >2.00	NA/F	NA/>100	(RIRO closed)			(RIRO closed)			(RIRO closed)		
19	Bend Pkwy SB Ramps & Reed Market Rd	ODOT/ City	Signalized	< 0.85	1.29	F	93.2	1.22	F	95.6	0.76	C	28.6	1.15	E	61.0
20	Bend Pkwy NB Ramps & Reed Market Rd	ODOT/ City	TWSC	< 0.85 (ramp)	NA/ >2.00	NA/F	NA/>100	0.89	A	9.1				NA/ >2.00	NA/F	NA/>100

¹⁰ The “design hour” is the future equivalent of the 30th highest annual hour (30 HV), which was used for existing conditions analysis.



US 97/Bend Parkway Study Intersections					No Build			Bundle A			Bundle B			Bundle C		
Int. No.	Intersection	Jurisdiction	Control D	Mobility Target	Performance			Performance			Performance			Performance		
				V/C	V/C ^A	LOS ^B	Delay (sec) ^C	V/C ^A	LOS ^B	Delay (sec) ^C	V/C ^A	LOS ^B	Delay (sec) ^C	V/C ^A	LOS ^B	Delay (sec) ^C
				< 0.95 (Reed Market Rd)												
21	Bend Pkwy & Reed Ln	ODOT/ City	TWSC	< 0.85 (major) < 0.95 (minor)	NA/ 1.05	NA/F	NA/>100	(RIRO closed)			(RIRO closed)			(RIRO closed)		
22	Bend Pkwy SB Ramps & Powers Rd	ODOT/ City	TWSC	< 0.85 (ramp) < 0.95 (Powers Rd)	0.08/ 1.24	A/F	9.5/>100	(no longer an intersection)			0.84	C	26.0	0.08/ 0.95	A/F	9.4/63.4
23	Bend Pkwy & Powers Rd	ODOT/ City	Signalized	< 0.85	1.45	F	>100	(no longer an intersection)			(no longer an intersection)			1.33	F	133.7
24	Bend Pkwy NB Ramps & Powers Rd	ODOT/ City	TWSC	< 0.85 (ramp) < 0.95 (Powers Rd)	0.28/0.09	A/B	10/11.4	(no longer an intersection)			0.57	B	18.7	0.21/0.09	A/B	9.2/11.3
25	Bend Pkwy & Badger Rd	ODOT/ City	Free F	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
26	Bend Pkwy & Pinebrook Blvd	ODOT/ City	Free F	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
27	US 97 & Ponderosa St	ODOT/ City	TWSC	< 0.85 (major) < 0.95 (minor)	NA/ >2.00	NA/F	NA/>100	(RIRO closed)			(RIRO closed)			NA/ >2.00	NA/F	NA/>100
28	US 97 SB Ramps & Baker Rd	ODOT/ City	TWSC	< 0.85 (ramp) < 0.95 (Knott Rd)	0.02/ 1.26	A/F	8.6/>100	0.63	C	21.5	0.79	B	13.5	0.02/ 1.08	A/F	8.6/>100
29	US 97 NB Ramps & Knott Rd	ODOT/ County	TWSC	< 0.85 (ramp) < 0.95 (Knott Rd)	0.41/ >2.00	B/F	12.5/>100	0.80	C	28.9	0.80	B	13.1	0.38/ >2.00	B/F	12.0/>100
Study Intersections Paralleling US 97																
40	US 20 & O.B. Riley Rd	ODOT	Signalized	< 0.85	0.91	D	35.5	1.09	E	64.9	1.10	E	68.4	0.90	D	35.8
42	Butler Market Rd & 4th St	City	AWSC	(< 50 s)	1.72	F	>100	0.89	C	23.8	0.76	C	15.5	1.64	F	>100
46	Revere Ave & 3rd St	ODOT	Signalized	< 0.85	1.17	F	>100	1.19	F	>100	1.12	F	95	1.18	F	>100
47	Revere Ave & 4th St	City	AWSC	(< 50 s)	>2.00	F	>100	1.92	F	>100	>2.00	F	>100	>2.00	F	>100
49	Reed Market Rd & Brookwood Blvd	City	Roundabout	< 1.00	>2.00	F	>100	>2.00	F	>100	>2.00	F	>100	>2.00	F	>100
50	Reed Market Rd & Silver Lake Blvd	City	TWSC	(< 50 s)	0.25/ >2.00	B/F	13.3/ >100	0.22/>2.00	B/F	13.5/ >100	0.22/>2.00	B/F	13.3/ >100	0.24/>2.00	B/F	13.6/ >100
51	Reed Market Rd & Division St	City	TWSC	(< 50 s)	0.23/0.17	C/D	15.6/25.4	0.31/0.27	C/D	20/25.9	0.02/0.20	C/C	16.4/22.5	0.25/0.20	C/C	16.2/22.2
52	Reed Market Rd & 3rd St	City	Signalized	< 1.00	1.52	F	>100	1.53	F	>100	1.31	F	83.0	1.53	F	>100
53	Powers Rd & Brookwood Blvd	City	Roundabout	< 1.00	1.30	F	90.7	1.24	F	81.5	1.43	F	>100	1.36	F	92.3
54	Powers Rd & 3rd St	City	Signalized	< 1.00	0.98	D	46.2	0.98	D	46.7	0.94	D	40.5	0.89	C	33.5
55	Powers Rd & Parrell Rd	City	TWSC	(< 50 s)	0.03/0.43	A/C	8.6/21.7	0.09/0.80	A/F	9.1/ 72.4	0.09/0.79	A/F	9.1/ 64.1	0.07/0.72	A/E	9.2/48.2
57	Badger Rd & 3rd St	City	Signalized	< 1.00	0.55	B	12.0	0.55	B	12.5	0.55	B	11.8	0.61	B	13.1
58	Pinebrook Blvd & 3rd St	City	TWSC	(< 50 s)	0.17/0.40	B/E	11.6/44.2	0.16/0.42	B/E	11.6/48.3	0.17/0.39	B/E	16.0/42.6	0.18/0.46	B/F	12.5/ 55.3



US 97/Bend Parkway Study Intersections					No Build			Bundle A			Bundle B			Bundle C		
Int. No.	Intersection	Jurisdiction	Control D	Mobility Target	Performance			Performance			Performance			Performance		
				V/C	V/C ^A	LOS ^B	Delay (sec) ^C	V/C ^A	LOS ^B	Delay (sec) ^C	V/C ^A	LOS ^B	Delay (sec) ^C	V/C ^A	LOS ^B	Delay (sec) ^C
59	Murphy Rd & 3rd St	City	Roundabout	< 1.00	1.48	F	88.2	>2.00	F	>100	>2.00	F	>100	1.87	F	>100
60	China Hat Rd and Parrell Rd	City	TWSC	(< 50 s)	0.08/1.42	B/F	10.5/ >100	0.29/0.89	A/F	9.9/ 77.4	0.29/0.40	A/C	9.5/17.8	0.24/1.86	B/F	11.5/ >100
62	Powers Rd & Blakely Rd	City	TWSC	(< 50 s)	0.20/1.31	B/F	10.7/ >100	0.13/1.18	A/F	9.4/ >100	0.19/1.14	B/F	10.3/ >100	0.17/0.84	A/F	9.8/ >100

A Overall intersection V/C ratio at signalized intersections, worst case approach V/C at roundabouts and all-way stop-controlled intersections, and V/C ratio for Major Street/Minor Street at two-way stop-controlled. Major Street NB(SB)/Minor Street at two-way stop-controlled intersections where HCS Multilane Highway Analysis was used.

B Major street LOS/minor street LOS for two-way stop-controlled intersections. Worst case approach LOS at roundabout and all-way stop-controlled intersections. Overall intersection LOS for signalized intersections.

C Control delay for Major Street/Minor Street for two-way stop-controlled intersections. Worst case approach delay at roundabout and all-way stop-controlled intersections. Overall intersection delay for signalized intersections.

D TWSC stands for Two-Way Stop-Controlled. AWSC stands for All-Way Stop-Controlled.

E The delay mobility target for the City of Bend only applies to critical lane groups with 100+ vehicles per hour.

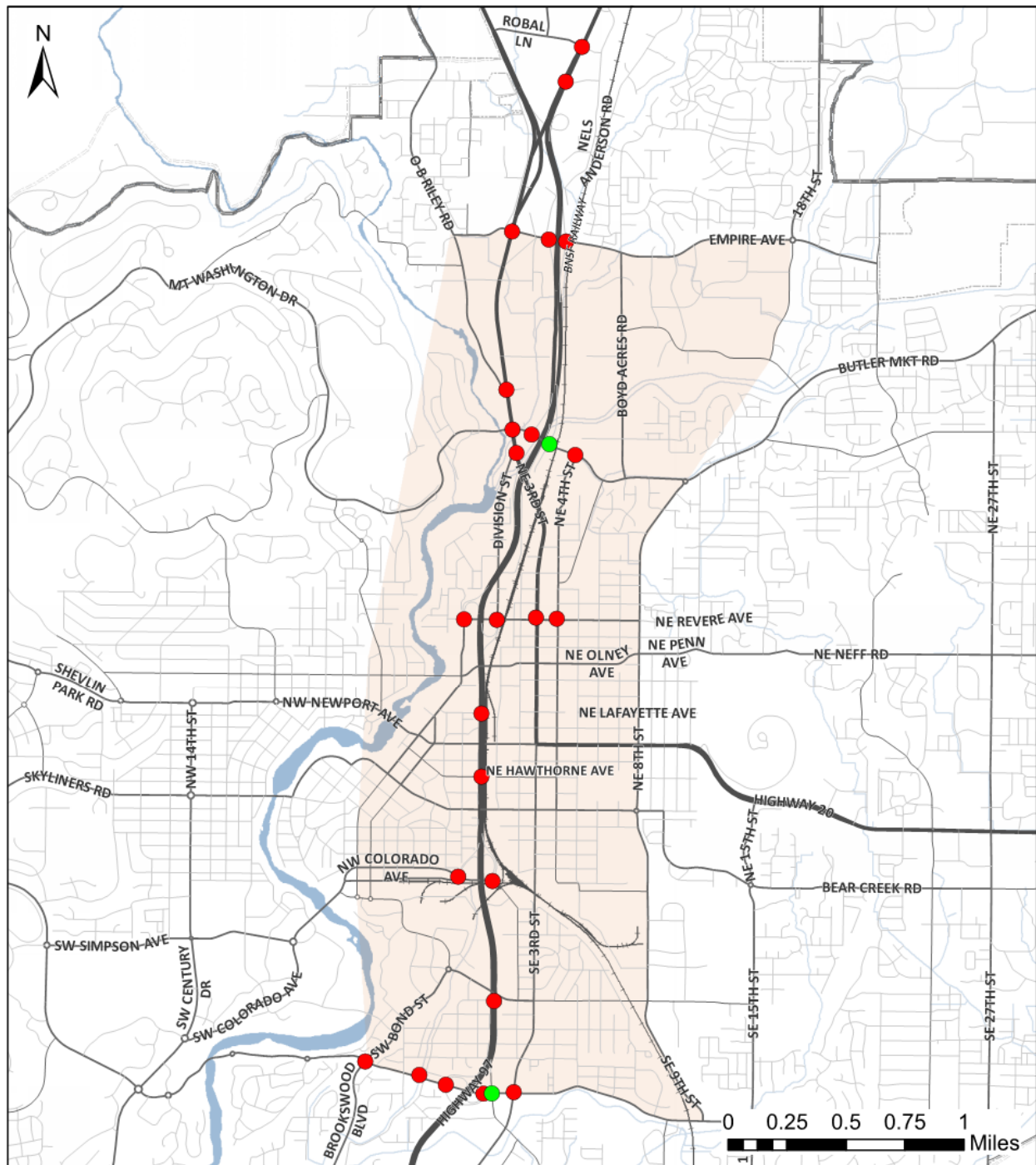
F Control change due to Financially Constrained Project

Bold values indicate performance measures failing to meet adopted mobility targets.

Highlighted values indicate locations where the control type has changed to a signal or roundabout due to a Build project.



Figure A29 – Future No-Build Intersection Operations Analysis – Central Study Area



2040 No-Build Intersection Operations Analysis - Central Study Area

Intersection Operations

- V/C Meets Target
- V/C Fails to Meet Target

Roads

- Highway
- Arterial
- Collector
- Local

Infrastructure

- + Railroads

Parkway Study Area

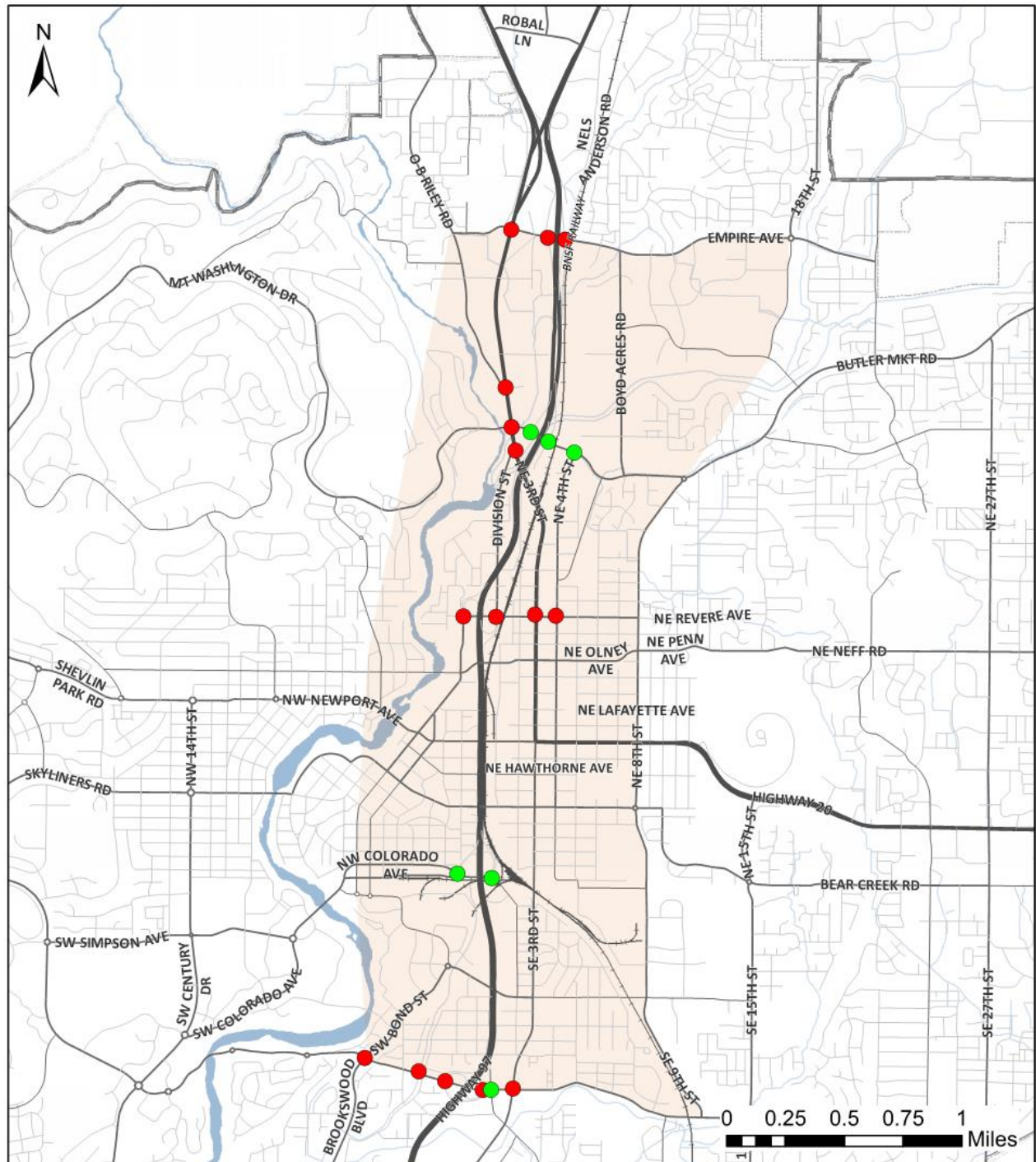
- Central Study Area

Boundaries & Misc.

- Bend City Limits
- Bend MPO Boundary
- UGB - Urban Growth Boundary
- Waterways



Figure A30 – Future Bundle A Intersection Operations Analysis – Central Study Area



2040 Build Bundle A Intersection Operations Analysis - Central Study Area

Intersection Operations	Roads	Infrastructure	Parkway Study Area	Boundaries & Misc.
● V/C Meets Target	 Highway	+ Railroads	 Central Study Area	 Bend City Limits
● V/C Fails to Meet Target	 Arterial			 Bend MPO Boundary
	 Collector			 UGB - Urban Growth Boundary
	 Local			 Waterways

The map displays the proposed rail alignment through the Denver area. The alignment is shown as a thick black line, with stations marked by red dots and potential stations by green dots. The map includes major roads such as I-70, I-25, and US-10, and various streets including NW Newpark Ave, NW Colorado Ave, NW 14th St, NW 15th St, NW 16th St, NW 17th St, NW 18th St, NW 19th St, NW 20th St, NW 21st St, NW 22nd St, NW 23rd St, NW 24th St, NW 25th St, NW 26th St, NW 27th St, NW 28th St, NW 29th St, NW 30th St, NW 31st St, NW 32nd St, NW 33rd St, NW 34th St, NW 35th St, NW 36th St, NW 37th St, NW 38th St, NW 39th St, NW 40th St, NW 41st St, NW 42nd St, NW 43rd St, NW 44th St, NW 45th St, NW 46th St, NW 47th St, NW 48th St, NW 49th St, NW 50th St, NW 51st St, NW 52nd St, NW 53rd St, NW 54th St, NW 55th St, NW 56th St, NW 57th St, NW 58th St, NW 59th St, NW 60th St, NW 61st St, NW 62nd St, NW 63rd St, NW 64th St, NW 65th St, NW 66th St, NW 67th St, NW 68th St, NW 69th St, NW 70th St, NW 71st St, NW 72nd St, NW 73rd St, NW 74th St, NW 75th St, NW 76th St, NW 77th St, NW 78th St, NW 79th St, NW 80th St, NW 81st St, NW 82nd St, NW 83rd St, NW 84th St, NW 85th St, NW 86th St, NW 87th St, NW 88th St, NW 89th St, NW 90th St, NW 91st St, NW 92nd St, NW 93rd St, NW 94th St, NW 95th St, NW 96th St, NW 97th St, NW 98th St, NW 99th St, NW 100th St, NW 101st St, NW 102nd St, NW 103rd St, NW 104th St, NW 105th St, NW 106th St, NW 107th St, NW 108th St, NW 109th St, NW 110th St, NW 111th St, NW 112th St, NW 113th St, NW 114th St, NW 115th St, NW 116th St, NW 117th St, NW 118th St, NW 119th St, NW 120th St, NW 121st St, NW 122nd St, NW 123rd St, NW 124th St, NW 125th St, NW 126th St, NW 127th St, NW 128th St, NW 129th St, NW 130th St, NW 131st St, NW 132nd St, NW 133rd St, NW 134th St, NW 135th St, NW 136th St, NW 137th St, NW 138th St, NW 139th St, NW 140th St, NW 141st St, NW 142nd St, NW 143rd St, NW 144th St, NW 145th St, NW 146th St, NW 147th St, NW 148th St, NW 149th St, NW 150th St, NW 151st St, NW 152nd St, NW 153rd St, NW 154th St, NW 155th St, NW 156th St, NW 157th St, NW 158th St, NW 159th St, NW 160th St, NW 161st St, NW 162nd St, NW 163rd St, NW 164th St, 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Intersection Operations

- V/C Meets Target
- V/C Fails to Meet Target

Roads

- Highway
- Arterial
- Collector
- Local

Infrastructure

- Railroads

Parkway Study Area

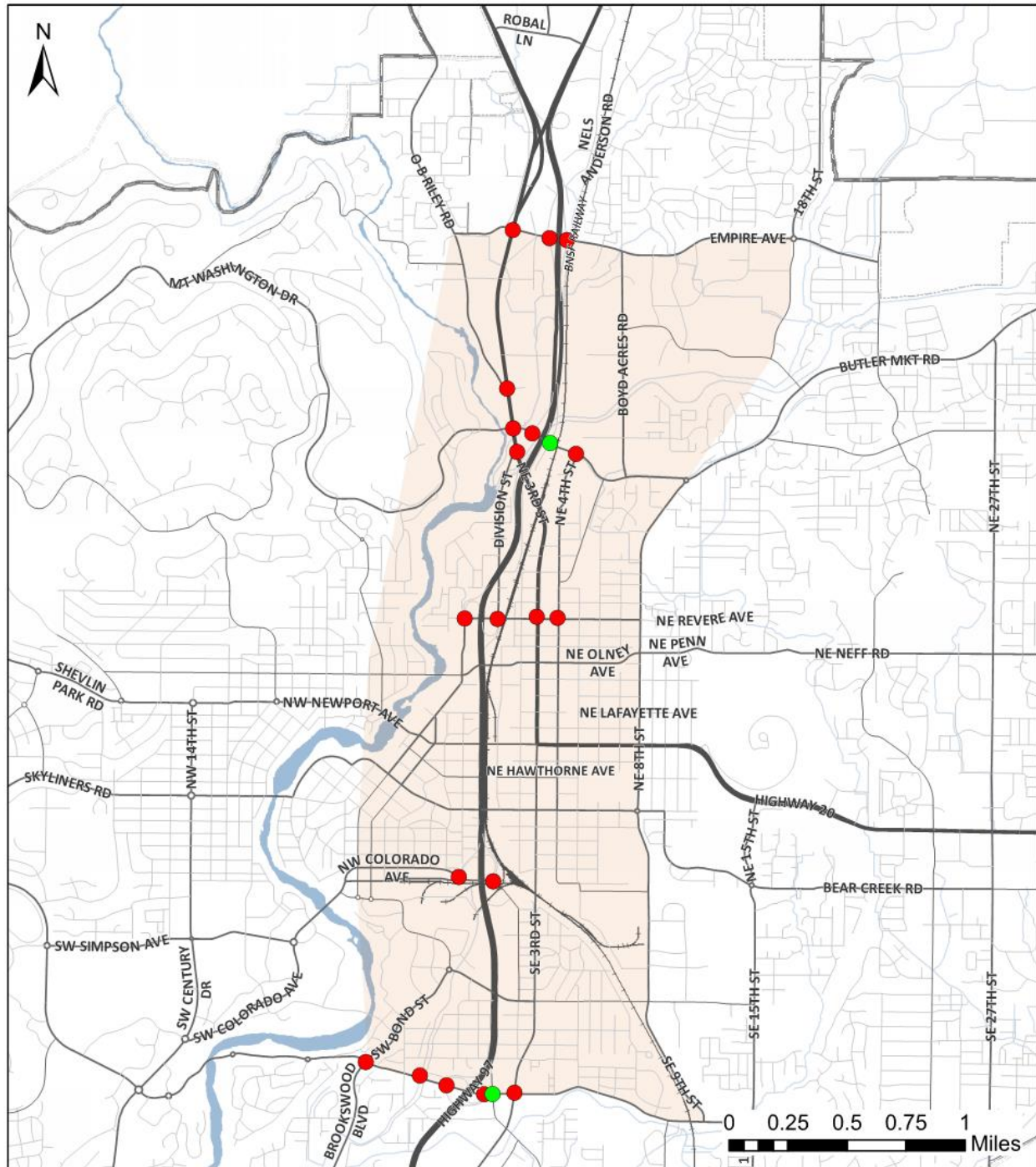
- Central Study Area

Boundaries & Misc.

- Bend City Limits
- Bend MPO Boundary
- UGB - Urban Growth Boundary
- Waterways



Figure A32 – Future Bundle C Intersection Operations Analysis – Central Study Area

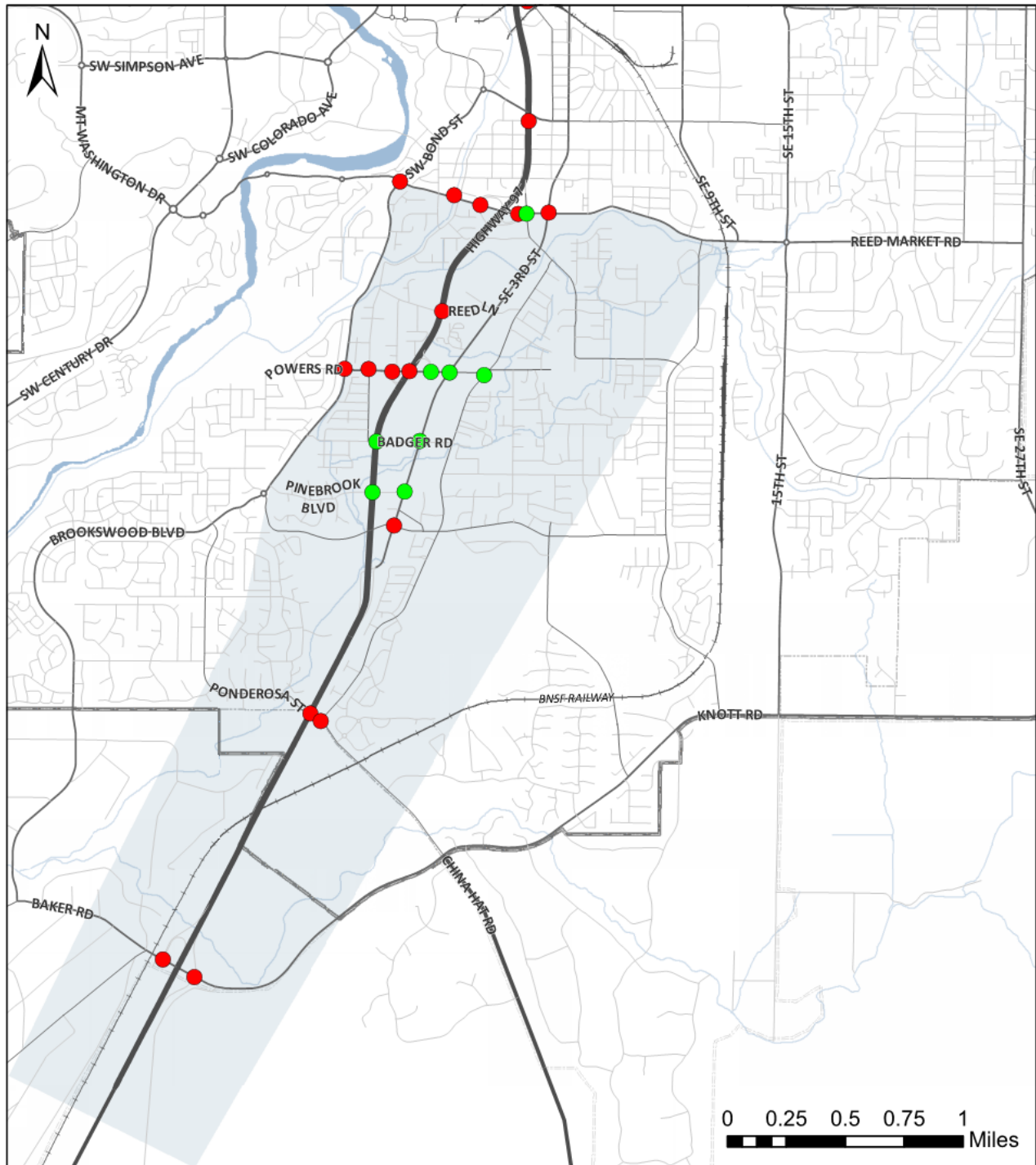


2040 Build Bundle C Intersection Operations Analysis - Central Study Area

Intersection Operations	Roads	Infrastructure	Parkway Study Area	Boundaries & Misc.
● V/C Meets Target	— Highway	—+— Railroads	 Central Study Area	 Bend City Limits
● V/C Fails to Meet Target	— Arterial			 Bend MPO Boundary
	— Collector			 UGB - Urban Growth Boundary
	— Local			— Waterways



Figure A33 – Future No-Build Intersection Operations Analysis – South Study Area



2040 No-Build Intersection Operations Analysis - South Study Area

Intersection Operations

- V/C Meets Target
- V/C Fails to Meet Target

Roads

- Highway
- Arterial
- Collector
- Local

Infrastructure

- Railroads

Parkway Study Area

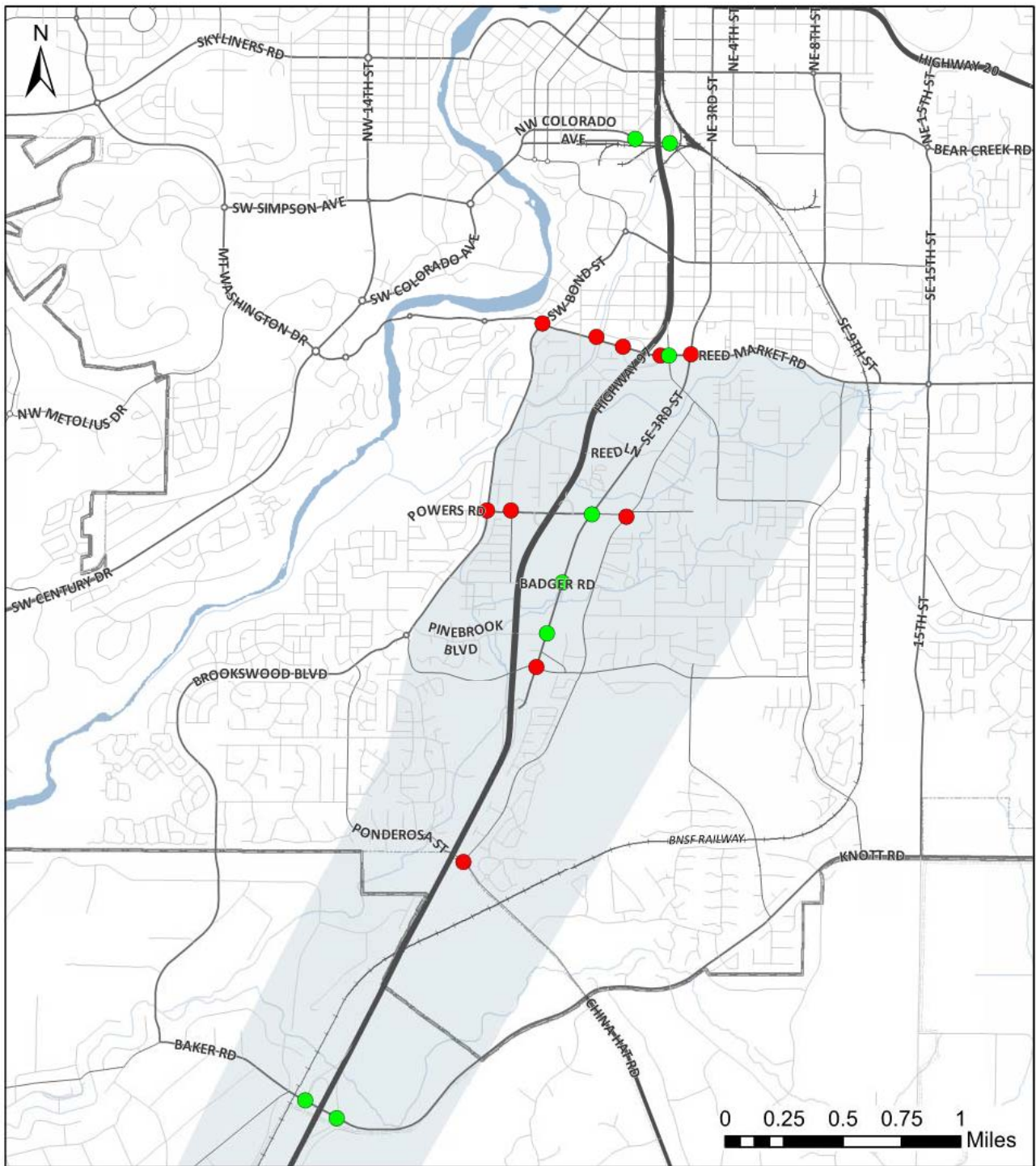
- South Study Area

Boundaries & Misc.

- Bend City Limits
- Bend MPO Boundary
- UGB - Urban Growth Boundary
- Waterways



Figure A34 – Future Bundle A Intersection Operations Analysis – South Study Area

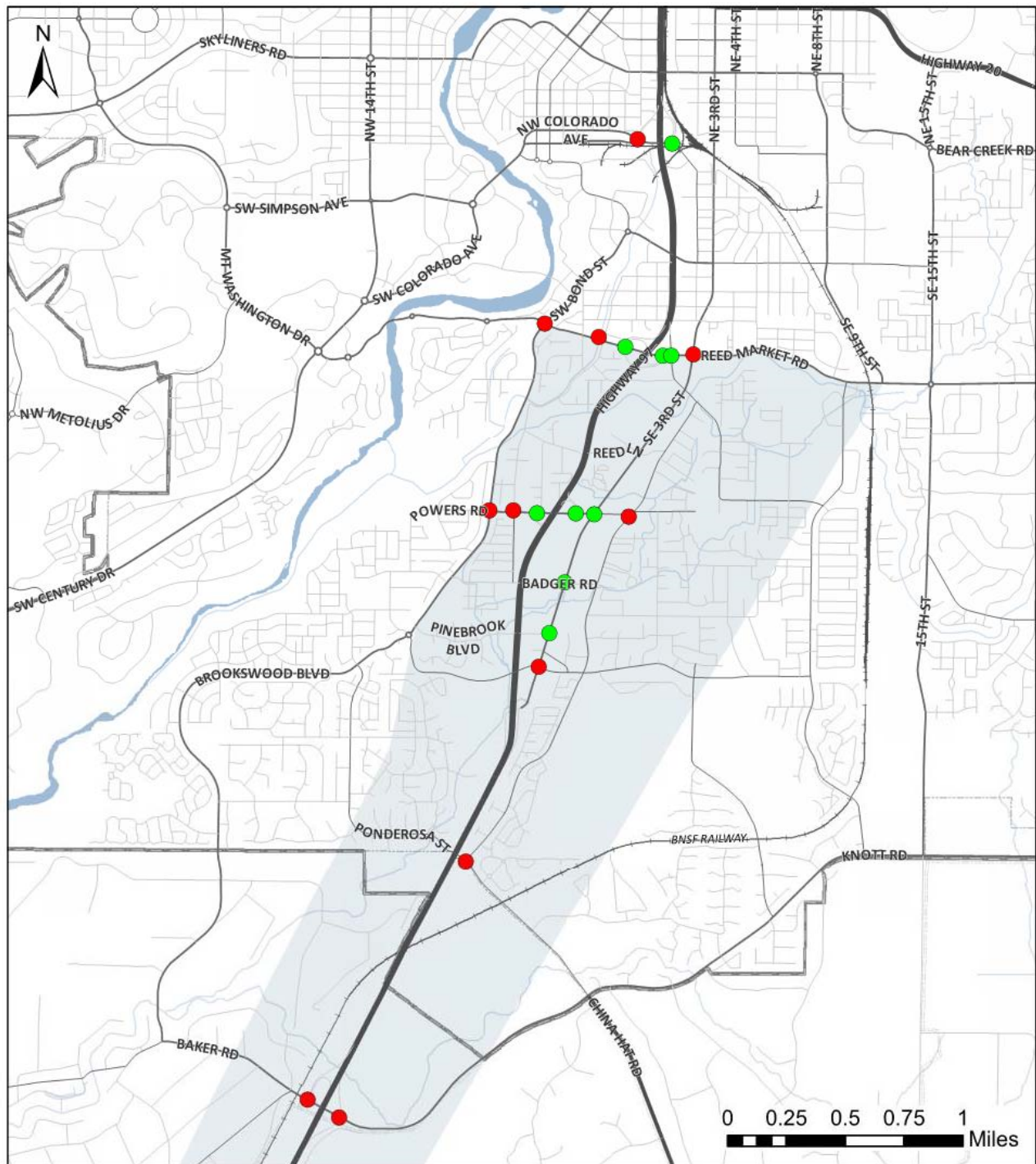


2040 Build Bundle A Intersection Operations Analysis - South Study Area

Intersection Operations	Roads	Infrastructure	Parkway Study Area	Boundaries & Misc.
● V/C Meets Target	— Highway	—+— Railroads	 South Study Area	 Bend City Limits
● V/C Fails to Meet Target	— Arterial			 Bend MPO Boundary
	— Collector			 UGB - Urban Growth Boundary
	— Local			— Waterways



Figure A35 – Future Bundle B Intersection Operations Analysis – South Study Area

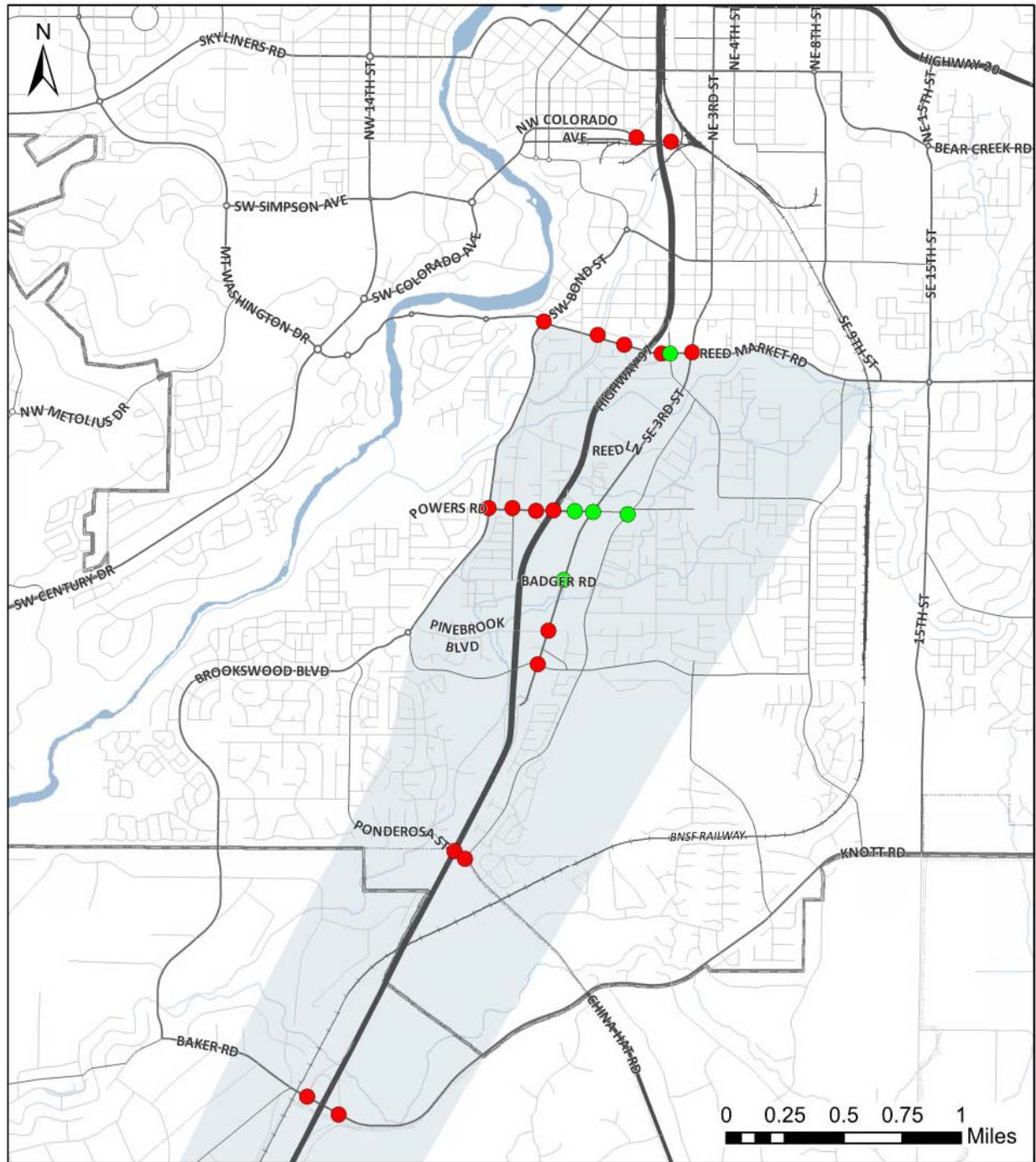


2040 Build Bundle B Intersection Operations Analysis - South Study Area

Intersection Operations	Roads	Infrastructure	Parkway Study Area	Boundaries & Misc.
● V/C Meets Target	— Highway	—+— Railroads	 South Study Area	 Bend City Limits
● V/C Fails to Meet Target	— Arterial			 Bend MPO Boundary
	— Collector			 UGB - Urban Growth Boundary
	— Local			— Waterways



Figure A36 – Future Bundle C Intersection Operations Analysis – South Study Area



2040 Build Bundle C Intersection Operations Analysis - South Study Area

Intersection Operations	Roads	Infrastructure	Parkway Study Area	Boundaries & Misc.
● V/C Meets Target	— Highway	—+— Railroads	 South Study Area	 Bend City Limits
● V/C Fails to Meet Target	— Arterial			 Bend MPO Boundary
	— Collector			 UGB - Urban Growth Boundary
	— Local			— Waterways



4.2 PARKWAY MERGING/DIVERGING RAMP OPERATIONS ANALYSIS

Table A6 summarizes the results of this analysis for the 2040 design hour¹¹ under No Build conditions compared to those reported under future Build Bundle conditions.

Table A6: 2040 No Build and Build Bundles Merging/Diverging/Weaving Operations

Location	Segment Type	Existing (2017) V/C	2040 No Build V/C	2040 Bundle A V/C	2040 Bundle B V/C	2040 Bundle C V/C
US 97/Bend Parkway Southbound						
SB Division Street Ramp	Merge	0.94	1.24	1.04	1.04	1.11
SB Revere Avenue Ramp	Diverge	0.94	1.24	1.04	1.04	1.11
SB Revere Avenue Ramp	Merge	0.94	1.20	1.09	1.11	1.16
SB Colorado Avenue Ramp	Diverge	0.94	1.21	1.00	1.02	1.07
SB Colorado Avenue Ramp	Merge	0.90	1.13	0.45	0.97	0.99
US 97/Bend Parkway Northbound						
NB Reed Market Road Ramp	Merge	0.42	0.66	0.52	0.32	0.64
NB Division Street Ramp (Reed Market)	Merge	0.54	0.82	0.78	NA	0.81
NB Colorado Avenue Ramp	Diverge	0.54	0.73	0.45	0.78	0.81
NB Colorado Avenue Ramp	Merge	0.84	1.09	0.40	1.08	1.09
NB Revere Avenue Ramp	Diverge	0.83	1.10	1.08	1.09	1.10
NB Revere Avenue Ramp	Merge	0.72	0.98	1.03	1.04	1.00
NB 3rd Street Ramp	Merge	0.88	1.20	0.57	0.57	1.12
NB Butler Market Road Ramp	Merge	0.97	1.27	0.49	0.50	1.19
NB Empire Boulevard Ramp	Diverge	0.95	1.27	0.82	0.71	1.19
NB Empire Boulevard Ramp - Sisters Loop	Weaving	0.61	0.56	NA	NA	0.61

Bold values indicate performance fails to meet adopted mobility target requiring operation at a V/C ratio no greater than 0.85.

Results for Existing (2017) represent the 30th highest annual hour of traffic, while results for 2040 No Build and Build Bundles represent the future design hour. Both are generally assumed to be the weekday PM peak hour during the summer.

¹¹ The “design hour” is the future equivalent of the 30th highest annual hour (30 HV), which was used for existing conditions analysis.



5.0 TRAVEL TIME RELIABILITY ANALYSIS

Tables A7a-A7c summarizes the results of the travel time reliability analysis as relative change in average daily conditions for the 2040 No Build conditions and Build Bundle conditions, for each segment of the corridor.



Table A7a: Change in Average Daily Travel Time Reliability for Bundle A

From	To	2040 Bundle A – 2040 No Build		
		Change in Average Speed (mph)	Change in Average Travel Time (sec)	Change in Planning Time Index
Clausen Rd	Cooley Rd	10	-19	-0.66
Cooley Rd	Robal Rd	13	-10	-0.59
Robal Rd	US 20 Interchange	26	-22	-2.38
US 20 Interchange	Empire Blvd	0	0	-0.03
Empire Blvd	Butler Market Rd Interchange	0	0	0.00
Butler Market Rd Interchange	Revere Blvd	0	0	-0.02
Revere Blvd	Lafayette Ave	0	0	-0.02
Lafayette Ave	Hawthorne Ave	1	0	-0.06
Hawthorne Ave	Colorado Ave Interchange	4	-1	-0.30
Colorado Ave Interchange	Truman Rd	2	-2	-0.12
Truman Rd	Reed Market Rd Interchange	2	-1	-0.11
Reed Market Rd Interchange	Reed Ln	1	0	-0.04
Reed Ln	Powers Rd	1	0	-0.04
Powers Rd	Badger Rd	14	-8	-1.04
Badger Rd	Pinebrook Blvd	0	0	-0.01
Pinebrook Blvd	Murphy Rd	0	0	-0.01
Murphy Rd	Murphy Interchange	0	0	-0.01
Murphy Interchange	Ponderosa St/China Hat Rd	6	-3	-0.02
Ponderosa St/China Hat Rd	Baker Rd/Knott Rd Interchange	6	-5	-0.01



Table A7b: Change in Average Daily Travel Time Reliability for Bundle B

From	To	2040 Bundle B – 2040 2040 No Build		
		Change in Average Speed (mph)	Change in Average Travel Time (sec)	Change in Planning Time Index
Clausen Rd	Cooley Rd	11	-19	-0.68
Cooley Rd	Robal Rd	13	-10	-0.60
Robal Rd	US 20 Interchange	26	-22	-2.38
US 20 Interchange	Empire Blvd	1	0	-0.04
Empire Blvd	Butler Market Rd Interchange	1	0	-0.04
Butler Market Rd Interchange	Revere Blvd	1	-1	-0.05
Revere Blvd	Lafayette Ave	0	0	-0.02
Lafayette Ave	Hawthorne Ave	1	0	-0.05
Hawthorne Ave	Colorado Ave Interchange	4	-1	-0.30
Colorado Ave Interchange	Truman Rd	2	-2	-0.12
Truman Rd	Reed Market Rd Interchange	2	-1	-0.11
Reed Market Rd Interchange	Reed Ln	1	0	-0.04
Reed Ln	Powers Rd	1	0	-0.04
Powers Rd	Badger Rd	14	-8	-1.04
Badger Rd	Pinebrook Blvd	0	0	-0.01
Pinebrook Blvd	Murphy Rd	0	0	-0.01
Murphy Rd	Murphy Interchange	0	0	-0.01
Murphy Interchange	Ponderosa St/China Hat Rd	6	-3	-0.02
Ponderosa St/China Hat Rd	Baker Rd/Knott Rd Interchange	6	-6	-0.01



Table A7c: Change in Average Daily Travel Time Reliability for Bundle C

From	To	2040 Bundle C – 2040 2040 No Build		
		Change in Average Speed (mph)	Change in Average Travel Time (sec)	Change in Planning Time Index
Clausen Rd	Cooley Rd	0	0	0.00
Cooley Rd	Robal Rd	0	0	0.00
Robal Rd	US 20 Interchange	1	-2	-0.26
US 20 Interchange	Empire Blvd	0	0	0.01
Empire Blvd	Butler Market Rd Interchange	0	0	-0.03
Butler Market Rd Interchange	Revere Blvd	1	-1	-0.04
Revere Blvd	Lafayette Ave	0	0	-0.02
Lafayette Ave	Hawthorne Ave	1	0	-0.04
Hawthorne Ave	Colorado Ave Interchange	1	-1	-0.13
Colorado Ave Interchange	Truman Rd	1	-1	-0.04
Truman Rd	Reed Market Rd Interchange	0	0	-0.03
Reed Market Rd Interchange	Reed Ln	0	0	-0.01
Reed Ln	Powers Rd	0	0	-0.01
Powers Rd	Badger Rd	0	0	0.02
Badger Rd	Pinebrook Blvd	0	0	0.00
Pinebrook Blvd	Murphy Rd	0	0	0.00
Murphy Rd	Murphy Interchange	0	0	0.00
Murphy Interchange	Ponderosa St/China Hat Rd	0	0	0.00
Ponderosa St/China Hat Rd	Baker Rd/Knott Rd Interchange	0	0	0.00

Active Transportation Prioritization

US 97 Bend Parkway Active Transportation Crossing Enhancement Prioritization (Preliminary Rankings)

Location	Prioritization Score	Prioritization Rank	Existing Crossing?	Tier 1	Tier 2
NE Butler Market Rd	267.4	1	Yes	X	
China Hat Rd	255.8	2	No	X	
SW Reed Market Rd	243.9	3	Yes	X	
Baker/Knott Rd	242.4	4	Yes	X	
Murphy Rd	241.4	5	Yes	X	
NE Revere Ave	235.4	6	Yes	X	
Pinebrook Blvd	234.3	7	Yes	X	
Powers Rd	223.8	8	Yes		X
Badger Rd	220.2	9	Yes	X	
NE Empire Ave	217.5	10	Yes		X
Canal/SW Garfield Ave	217.3	11	Yes		X
Cooley Rd	212.8	12	No		X
SE Wilson Ave	211.5	13	Yes		X
NW Franklin Ave	209.0	14	Yes		X
Loco Rd/Clausen Dr	203.8	15	No		X
NE Olney Ave	203.5	16	Yes		X
3rd Street Overpass	199.0	17	Yes		X
SE Aune Rd	196.0	18	Yes		X
NW Greenwood Ave	195.7	19	Yes		X
NW Kearney Ave	190.5	20	No		
Nels Anderson Pl	184.8	21	Yes		
NW Hawthorne Ave	181.3	22	No		
NW Lafayette Ave	177.2	23	No		
Robal Rd	174.1	24	Yes		
Chavre Rd	173.5	25	No		
NE Underwood Ave	171.5	26	Yes		
SW Roosevelt Ave	170.2	27	No		
NW Colorado Ave	168.0	28	Yes		
SW Cleveland Ave	167.2	29	No		
NE Norwood Rd/NE Mervin Sampels Rd	162.3	30	No		
Reed Ln	158.9	31	Yes		
NW Irving Ave	157.2	32	No		
NW Greeley Ave	157.2	32	No		
SW McKinley Ave	157.2	32	No		
SW Taft Ave	156.5	35	No		
NE Emerson Ave/NW Park Pl	150.5	36	No		
SW Hayes Rd	148.8	37	No		
NE Dekalb Ave/ NW Lake Pl	145.5	38	No		
NW Norton Ave	143.8	39	No		
Romain Village Way	0.0	40	No		

Right-in/Right-out Analysis

US 97 Parkway Plan Phase 2

Draft Technical Memorandum – RIRO Closure/Modification Alternatives
Analysis

April 16, 2019

Prepared for:



Prepared by:





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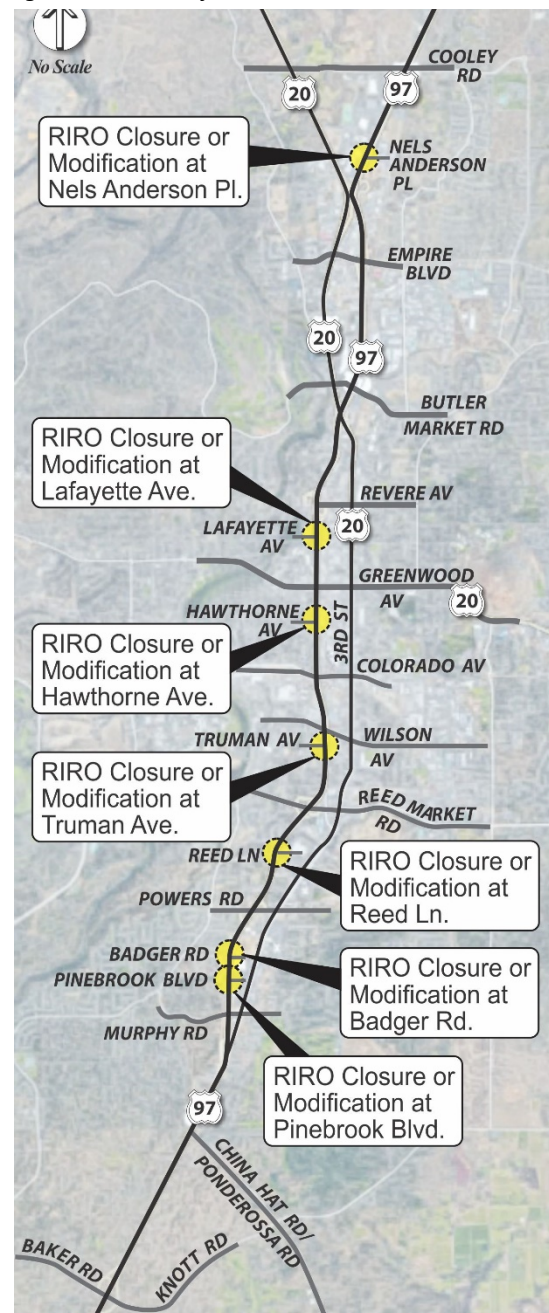
INTRODUCTION

In the Preliminary Alternatives memorandum¹, potential projects were identified to address the deficiencies in operations and safety flagged in the Existing Conditions² and Future Conditions³ Memoranda. These projects were initially screened and qualitatively evaluated in the First Level Alternatives Evaluation memorandum⁴ (Level 1 Evaluation). The outcome of the Level 1 Evaluation consisted of two bundles of projects (Bundle A and Bundle B) advanced for further analysis in the Level 2 Evaluation.

One of the projects recommended for inclusion in both project bundles in the Level 2 Evaluation consisted of either closing or modifying right-in/right-outs (RIROs) intersections along US 97. A right-in/right-out (RIRO) refers to a type of intersection where the turning movements are restricted to right turns only. On US 97, this refers to minor street stop-controlled intersections of a local road with US 97, where only right turns to and from the local road are allowed. The locations where either partial or full closure was recommended for further analysis in the Level 2 Evaluation (see Figure 1) were based on deficiencies in operations and safety identified by Existing and Future Conditions analysis.

The Level 1 Evaluation did not provide the detailed analysis to determine the impacts of each individual RIRO closure or modification. Ramp metering was identified both by the Level 1 Evaluation and by the ongoing Bend TSP/MTP Update as corridor solution with likely benefits to travel time reliability and system management. Unsignalized right turns onto the Parkway would provide alternate access to metered ramps, potentially decreasing the effectiveness of ramp meters as a traffic management tool. In addition, RIRO closures or modifications have significant impacts to traffic routing throughout the project study area, particularly at interchanges. To analyze the two bundles of projects identified by the Level 1 Evaluation, a reasonable RIRO closure scenario must be identified as a baseline assumption across both project bundles to ensure an

Figure 1: RIRO Projects



¹ US 97 Parkway Plan Phase 2: Technical Memorandum #5 Preliminary Alternatives, Draft, 2019

² US 97 Parkway Plan Phase 2: Revised Technical Memorandum #2 Existing Conditions, August 14, 2018

³ US 97 Parkway Plan Phase 2: Technical Memorandum #4 Future Conditions, November 9, 2018

⁴ US 97 Parkway Plan Phase 2: Technical Memorandum #6 First Level Alternatives Evaluation, Draft, 2019



even comparison between other projects throughout the study area. In addition, other projects identified in the ongoing Bend TSP/MTP Update may also conflict with keeping open certain RIRO access locations on US 97.

The purpose of this analysis was to learn and understand the traffic diversion impacts of RIRO closures to the local street system. To do so, six RIRO closure scenarios were selected (described in the methodology below) to help form an understanding of the impacts through a variety of RIRO closure combinations. The RIRO access points likely have significant influence on each other, where closing one might significantly increase traffic either at an adjacent RIRO, interchange, or on the local system. Based on this analysis and discussion of the results with project stakeholders, a reasonable RIRO scenario will be advanced within both project bundles. This scenario may be further refined based on the findings Level 2 Evaluation, but for analysis purposes should capture the maximum traffic impacts of likely RIRO closures or modifications.

METHODOLOGY

The following methodology was used to help identify impacts of RIRO closures/modifications along the Parkway.

SCENARIO DESCRIPTIONS

While closing the RIROs will likely improve the operations and safety on US 97, the access provided by each intersection must also be addressed. Closing all RIRO intersections without mitigation could be detrimental to local business and downtown access. Therefore, several modifications and configurations were explored, and particular attention was given to access to key destinations, such as the downtown Central Business District (CBD). Based on this assessment and consultation with study advisory committees, the following RIRO closure and modification scenarios were tested to capture the range of impacts and to identify the appropriate mitigations and/or phasing strategies to manage these access points:

- Scenario 1: Closure of Lafayette Avenue
- Scenario 2: Closure of Hawthorne Avenue
- Scenario 3: Conversion of Lafayette Avenue to right-in only
- Scenario 4: Conversion of Hawthorne Avenue to right-in only
- Scenario 5: Closure of Nels Anderson Place, Truman Avenue and Reed Lane
- Scenario 6: Closure of all intersections listed above

Note that the closure of the Pinebrook Boulevard and Badger Road RIRO access to US 97 was assumed as part of the No-Build analysis due to assumed improvements to the Murphy Road interchange area, including a northbound on-ramp and southbound off-ramp at Murphy Road and north-south frontage road between Powers Road and Murphy Road.

Findings and results from each of the six scenarios, are presented in the following sections for each RIRO to explain the impact that different RIRO modifications would have on intersection operations both on the state and local system, along with the daily volume diversions caused by changes in network routing options.



Results from the following scenarios are included under each RIRO to guide the discussion of the impacts of RIRO modifications at that location to the surrounding transportation network:

- RIRO Modifications at Lafayette Avenue:
 - Scenario 1: Closure of Lafayette Avenue
 - Scenario 3: Conversion of Lafayette Avenue to right-in only
 - Scenario 6: Closure of all analyzed RIRO intersections
- RIRO Modifications at Hawthorne Avenue:
 - Scenario 2: Closure of Hawthorne Avenue
 - Scenario 4: Conversion of Hawthorne Avenue to right-in only
 - Scenario 6: Closure of all analyzed RIRO intersections
- RIRO Modifications at Truman Avenue:
 - Scenario 5: Closure of Nels Anderson Place, Truman Avenue and Reed Lane
 - Scenario 6: Closure of all analyzed RIRO intersections
- RIRO Modifications at Reed Lane:
 - Scenario 5: Closure of Nels Anderson Place, Truman Avenue and Reed Lane
 - Scenario 6: Closure of all analyzed RIRO intersections
- RIRO Modifications at Nels Anderson Place:
 - Scenario 5: Closure of Nels Anderson Place, Truman Avenue and Reed Lane
 - Scenario 6: Closure of all analyzed RIRO intersections

ANALYSIS TOOLS

The future “No-Build” (ongoing Bend TSP/MTP “Baseline” scenario) network was modified to test each RIRO scenario using the Bend-Redmond Travel Demand Model. The year 2040 daily traffic volumes were then reassigned to the network and used to determine the changes in traffic patterns. The pm peak hour volumes were also re-assigned and forecasted for the year 2040 to determine changes in traffic operations. The future forecasting methodology can be found in the Future Traffic Forecast Technical Memorandum.⁵ In the Existing Conditions Memorandum⁶, the peak hour of traffic was identified to occur from about 4:30 PM to 5:30 PM.

Intersection traffic operations were analyzed using the same tools and methodology applied for existing and future conditions. Intersection traffic operations were analyzed at any study intersection that received an additional 50 PM peak hour trips or more. The analysis was conducted at all the impacted study intersections⁷ using the forecasted seasonally factored 30 HV traffic volumes for the year 2040.

PERFORMANCE MEASURES

Two main measures of impacts are reported for each RIRO closure: changes in average daily traffic and intersection operations.

The change in average daily traffic is a measure of the scale of diversion expected from the RIRO closure. These measures indicate where daily traffic is likely to re-route after RIRO closures or modifications and

⁵ US 97 Parkway Plan Phase 2 Technical Memorandum #3 – Future Traffic Forecast, September 2018.

⁶ US 97 Parkway Plan Phase 2: Revised Technical Memorandum #2 Existing Conditions, August 14, 2018

⁷ Additional intersections beyond the US 97 Parkway Study area were included in the analysis to capture the extent of changes to traffic operations on the local system caused by the RIRO closures or modifications.



indicate the level of magnitude of access change between US 97 and key destinations, such as the downtown CBD.

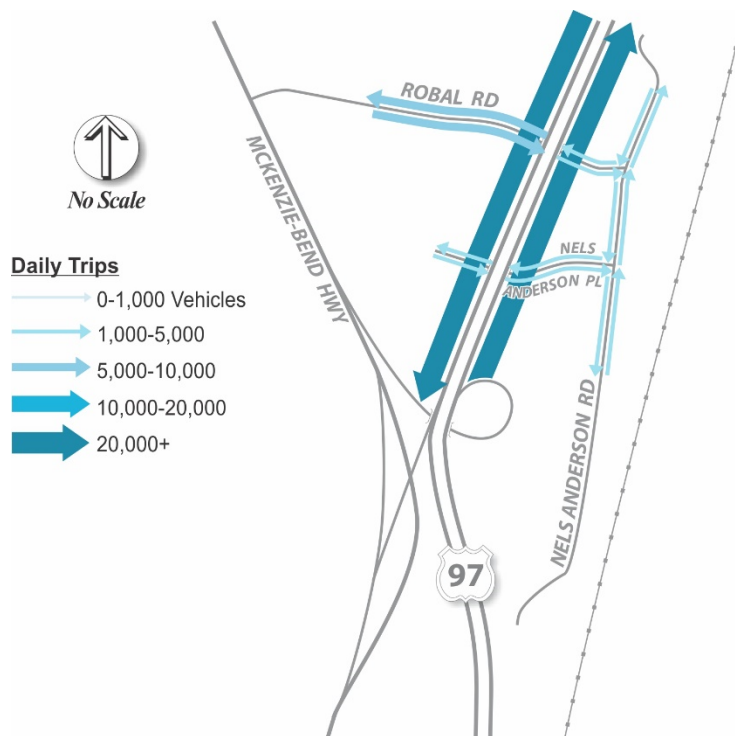
Intersection operation results are reported for each RIRO, under each tested modification. Intersection operations are reported as volume-to-capacity (V/C) ratios or seconds of control delay (for City two-way stop-controlled intersections), based on existing adopted mobility targets.⁸ These measures are intended to capture the peak hour operations impacts to the local system caused by limiting access to US 97 through RIRO closures or modifications. Intersection operations reports are included in Appendix A.

RESULTS

NO-BUILD DAILY TRAFFIC

To provide context to the magnitude of daily traffic re-routing for each RIRO closure or modification, 2040 No-Build daily traffic volumes are shown in Figures 2a-2c.

Figure 2a: No-Build 2040 Daily Volumes (near Nels Anderson Place)



⁸ Mobility targets for ODOT facilities obtained from the 1999 Oregon Highway Plan. Mobility targets for City of Bend facilities obtained from the 2016 City of Bend Development Code.



Figure 2b: No-Build 2040 Daily Volumes (near downtown)

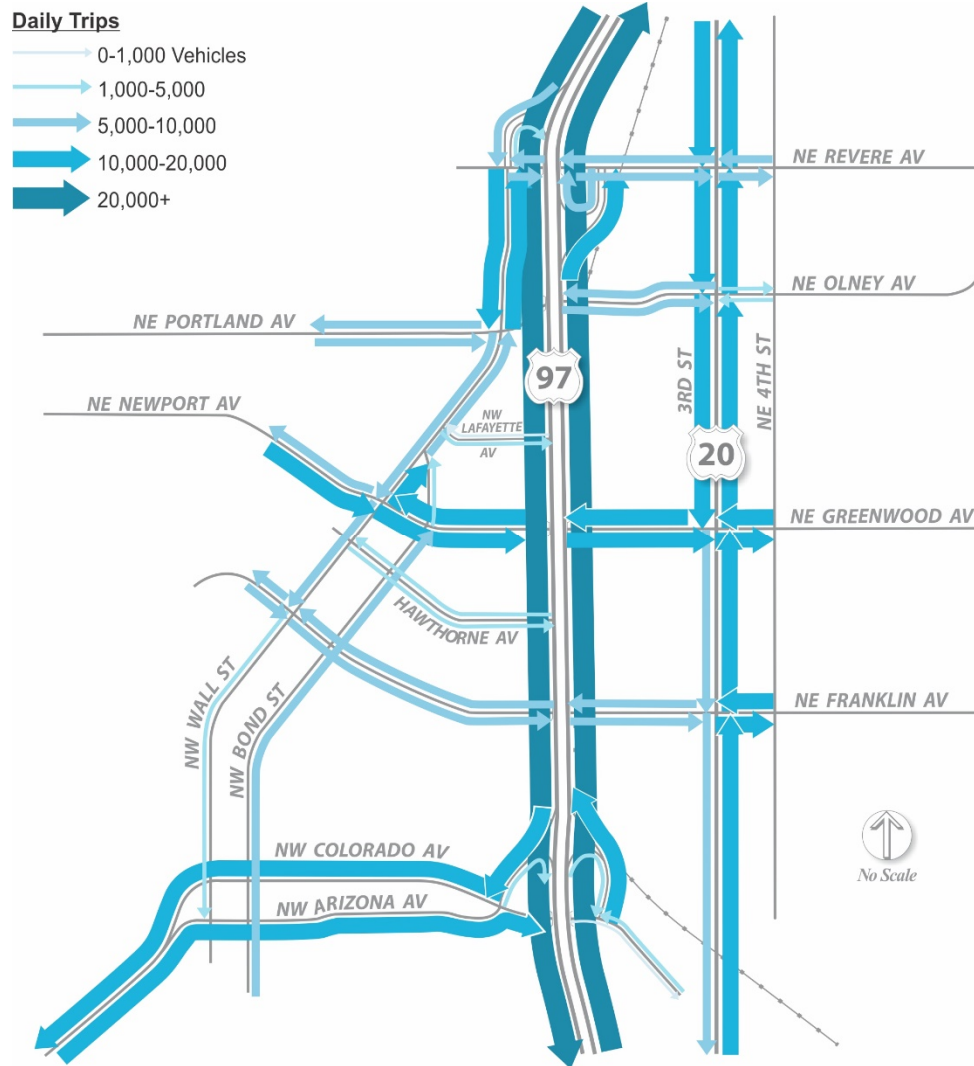
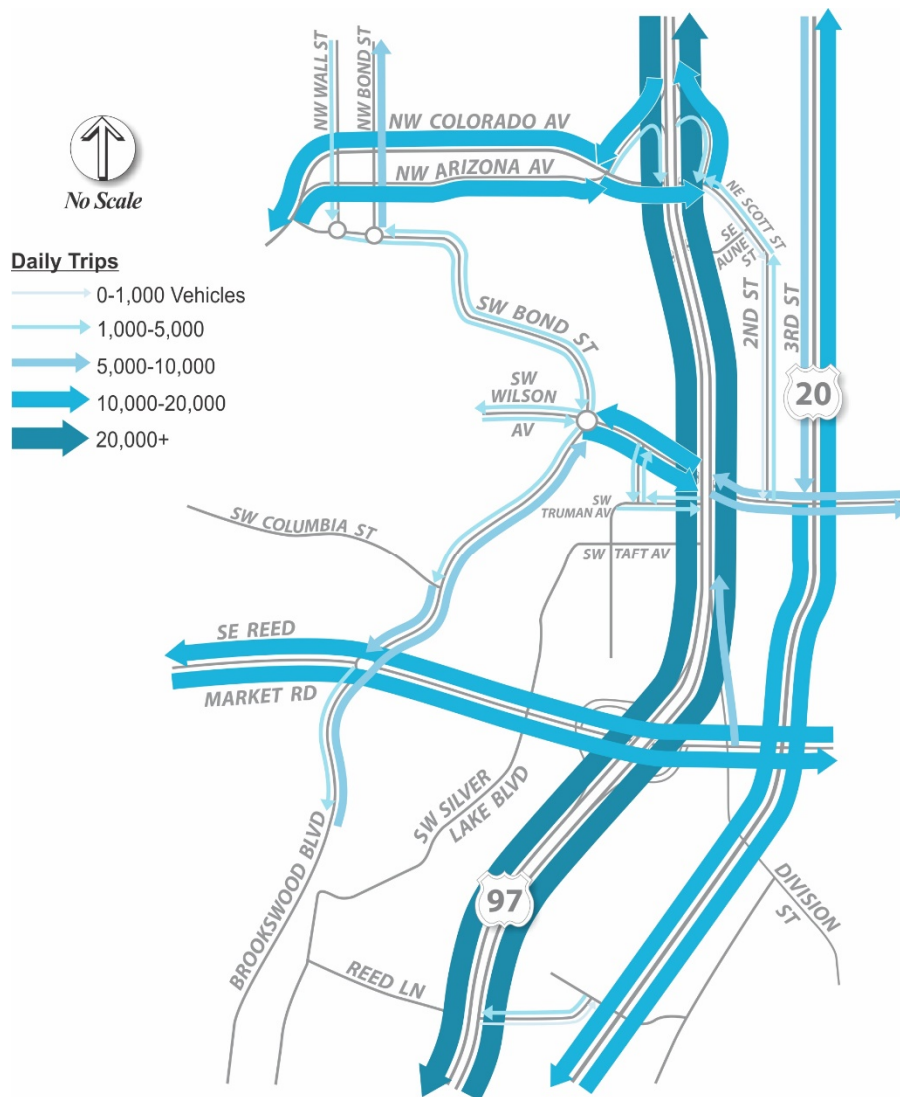




Figure 2c: No-Build 2040 Daily Volumes (near Reed Market Road)



RIRO MODIFICATIONS AT LAFAYETTE AVENUE

Under existing conditions, the Lafayette Avenue RIRO access was flagged as a safety focus due to a high proportion of rear-end crashes. As noted during field observations, drivers also demonstrate aggressive gap selection behavior at this location, which is also a sign of accepting a greater crash risk. As traffic volumes increase in the future, the crash frequency at US 97 and Lafayette is expected to be higher than comparable sites, as described in the Future Conditions Memorandum.

Both the Existing Conditions and Future No-Build analysis indicated over-capacity conditions and extensive eastbound queuing on Lafayette Avenue. By 2040, eastbound pm peak hour queues were expected to extend at least to Wall Street. In addition, Lafayette Avenue was flagged as a location with both deficient acceleration and deceleration lanes. While the deceleration lane at this location could be extended without incurring large ROW costs, building a new acceleration lane would impact the US 97 overcrossing at Greenwood Avenue, leading to structural impacts and high costs.



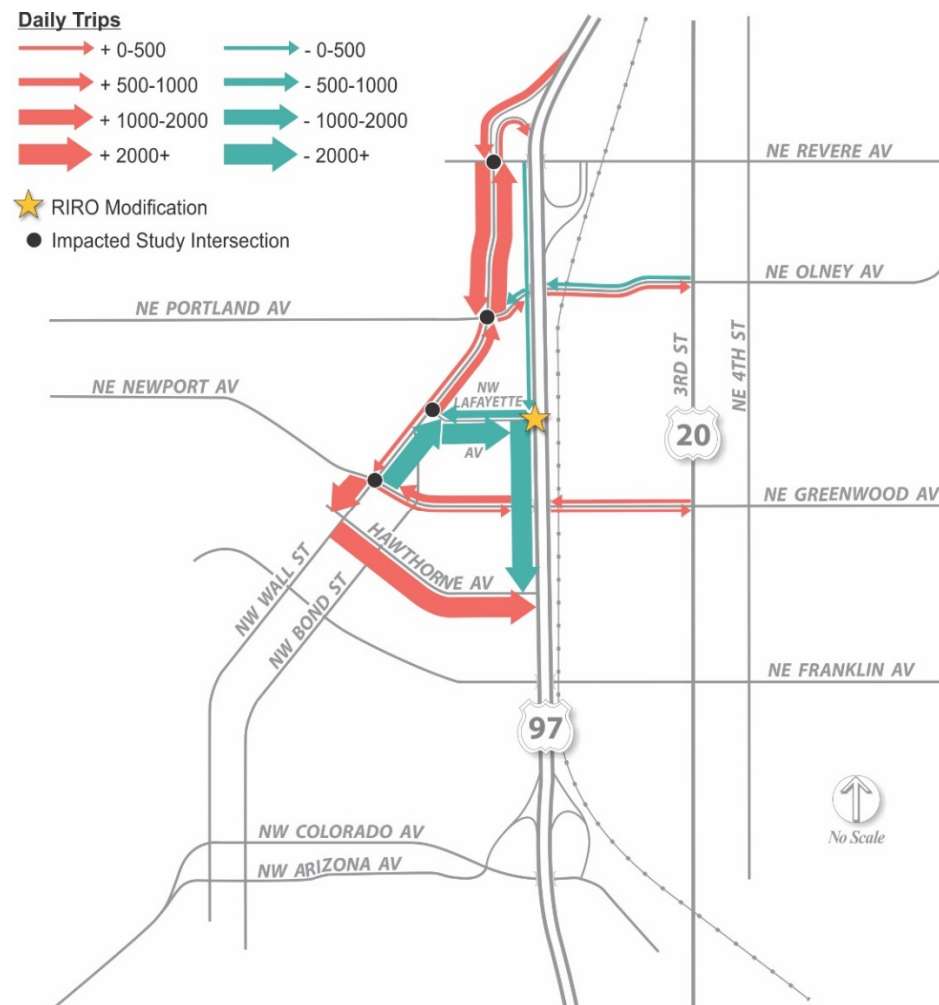
Lafayette Avenue provides direct access to businesses including social and governmental services in downtown Bend for southbound drivers on US 97. This location also provides a southbound US 97 alternative to the Revere Avenue interchange.

An alternative to closing the RIRO at Lafayette Avenue would be to convert the intersection to right-in only. This means that drivers would be able to make a right-turn from US 97 onto Lafayette Avenue, but the right-turn onto US 97 would be prohibited. As part of this conversion, the southbound deceleration lane on US 97 could be reconstructed to meet ODOT standards to help decrease the risk of rear-end collisions. Restricting only the right-turn onto US 97 would eliminate the eastbound queueing issues projected at Lafayette Avenue and US 97 in the future.

Traffic Volume Impacts

With a full closure of the Lafayette Avenue RIRO (Scenario 1), most former Lafayette Avenue trips exiting downtown use Hawthorne Avenue instead, with some trips shifting to the Revere Avenue interchange, as shown in Figure 5. Daily trips traveling to the downtown area are not significantly impacted, as the overall daily demand forecasted to use the Lafayette Avenue right-off movement is less than 1,000 vehicles per day, and this volume mainly shifts to a combination of Hawthorne Avenue (if open) and the Revere Avenue interchange. The pm peak hour impacts are relatively localized, with only a handful of study intersections impacted.

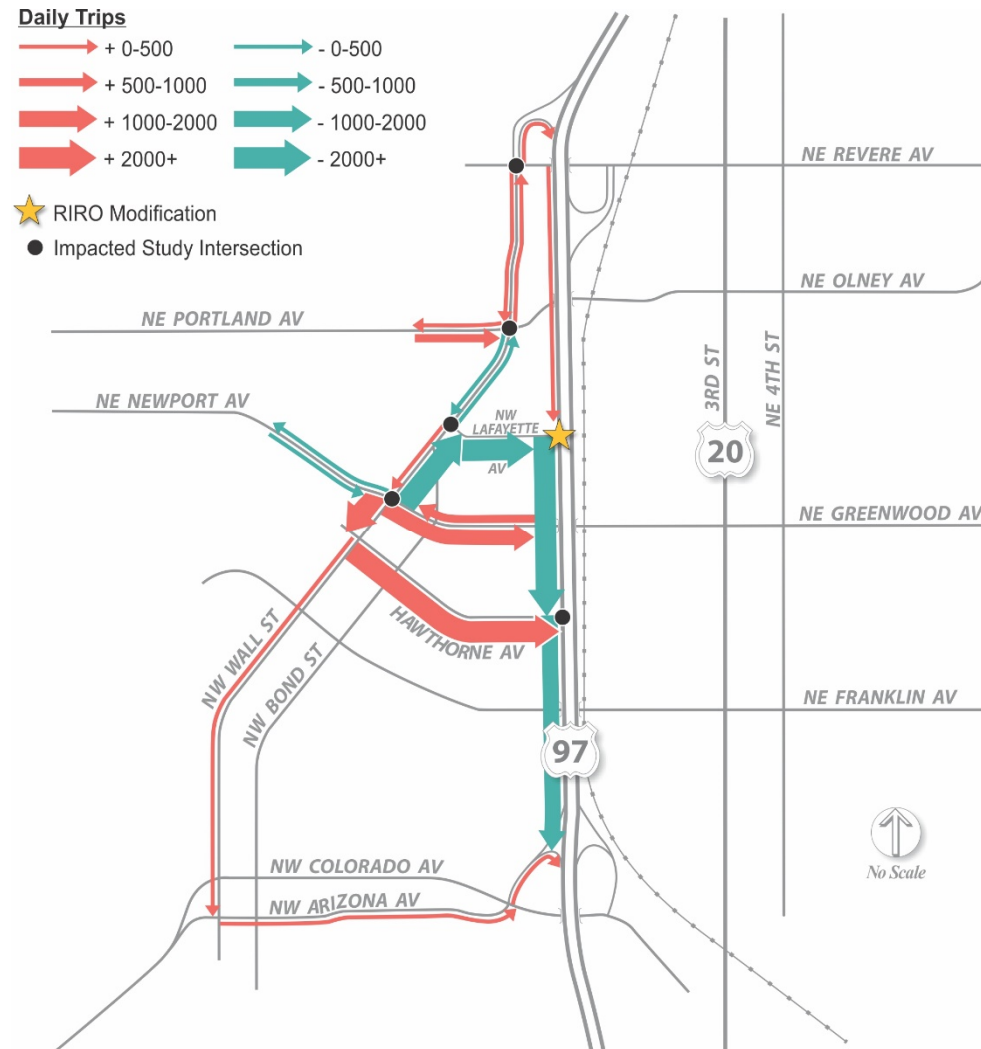
Figure 3: Lafayette Avenue RIRO Full Closure Daily Volume Shifts





With a partial closure of Lafayette Avenue to right-in only (Scenario 3), southbound US 97 trips traveling to downtown still use the US 97 right-in access at Lafayette Avenue. However, trips accessing southbound US 97 again shift to Hawthorne Avenue, as shown in Figure 6. Some southbound trips also shift north to the Revere Avenue interchange to access US 97.

Figure 4: Lafayette Right-In Only Daily Volume Shifts



With all RIRO access closed along the Parkway (Scenario 6), more trips exit and access US 97 at the Revere Avenue interchange due to the combined diversion impacts from closing the Lafayette and Hawthorne RIROs, increasing the daily volumes by nearly 15 percent over 2040 No Build conditions. These combined impacts increase traffic in both directions of travel on Wall Street, as shown in Figure 7. Additional traffic shifts south to the Colorado Avenue interchange, although this traffic likely originated from the Hawthorne access. Some trips remain on the local system, traveling along 3rd Street instead of accessing US 97.

Daily Trips

- + 0-500
- + 500-1000
- + 1000-2000
- + 2000+
- 0-500
- 500-1000
- 1000-2000
- 2000+

★ RIRO Modification
● Impacted Study Intersection

NE REVERE AV
NE OLNEY AV
NE PORTLAND AV
NE NEWPORT AV
NE GREENWOOD AV
NE FRANKLIN AV
NW WALL ST
NW BOND ST
NW COLORADO AV
NW ARIZONA AV
NW LAFAYETTE AV
HAWTHORNE AV
3RD ST
NE 4TH ST
20
97
No Scale

Table 1 lists the operations at intersections impacted by RIRO modifications at Lafayette Avenue.

Int. No.	Intersection	Control	Mobility Target V/C ^A	Intersection Performance			
				2040 No-Build	Lafayette Ave RIRO Full Closure	Lafayette Ave Right-In Only	All RIRO Closures
US 97/Bend Parkway Study Intersections							
12	Bend Pkwy SB Ramps & Revere Ave	Signalized	< 0.85	0.99	1.01	1.02	1.04
14	Bend Pkwy & Lafayette Ave	TWSC ^D	< 0.85 (major) < 0.95 (minor)	NA/>2.00	NA ^C	NA ^C	NA ^C
15	Bend Pkwy & Hawthorne Ave	TWSC	< 0.85 (major) < 0.95 (minor)	NA/>2.00	NA/>2.00	NA/>2.00	NA ^C
Study Intersections Paralleling US 97							



Int. No.	Intersection	Control	Mobility Target V/C ^A	Intersection Performance			
				2040 No-Build	Lafayette Ave RIRO Full Closure	Lafayette Ave Right-In Only	All RIRO Closures
-	US 20 (NE 3rd St) & Olney Ave	Signalized	< 0.85	0.82	-	-	0.85
-	Wall St & NW Lafayette Ave	TWSC	≤ 50 s (Delay) ^B	9.8/48.4	9.4/29.3	9.4/28.7	9.8/37.6
-	Wall St & Portland Ave	Signalized	< 1.00	1.09	1.09	1.10	1.18
-	Wall St & Greenwood Ave	Signalized	< 1.00	0.90	0.89	0.90	0.91
-	US 20 (NE 3 rd St) & Greenwood Ave	Signalized	< 0.85	1.29	1.37	-	1.37

A Overall intersection V/C ratio at signalized intersections, worst case approach V/C at roundabouts and all-way stop-controlled intersections, and V/C ratio for Major Street/Minor Street at two-way stop-controlled.

B The delay mobility target for the City of Bend only applies to critical lane groups with 100+ vehicles per hour.

C Intersection performance is not applicable when the RIRO access is closed or modified to right-in only.

D Two-way stop-controlled (TWSC).

Bold values indicate performance measures failing to meet adopted mobility targets.

The operational impacts to each intersection impacted by 50 additional peak hour vehicles or more are summarized below:

- Bend Pkwy SB Ramps & Revere Ave: Closing both Lafayette Avenue and Hawthorne Avenue access to US 97 southbound has the largest combined impacts at the Revere Avenue interchange and the intersection of Wall Street/Portland Avenue. Any modification of Lafayette Avenue access would cause the Revere Avenue southbound ramp to US 97 exceed capacity and would likely trigger some long term (possibly by year 2035) mitigation at this location.
- Bend Pkwy & Lafayette Ave: Any access modification at Lafayette Avenue would improve operations at the intersection, where the demand is more than twice the capacity under 2040 No-Build conditions.
- Bend Pkwy & Hawthorne Ave: Closing or modifying access Lafayette Avenue would send more traffic to the Hawthorne Avenue access. Without closing or modifying access at Hawthorne Avenue, significant mitigation would be required to limit queue spillback on the local system and allow for safe operation of the intersection.
- US 20 (NE 3rd St) & Olney Ave: Although peak hour volumes are forecasted to increase, no significant impacts to intersection operations are expected at this intersection with any modifications of RIRO access to the Parkway.
- Wall St & NW Lafayette Ave: Although peak hour volumes are forecasted to increase on Wall Street, the overall operations at this intersection improve under all closure scenarios as the minor street (Lafayette Avenue) volumes decreases significantly with any modifications of the RIRO access to the Parkway.
- Wall St & Portland Ave: This intersection is expected to operate over capacity in 2040 No Build conditions. More traffic will travel through this intersection with a closure of all RIRO access on the Parkway, increasing the v/c from 1.09 to 1.18, and could potentially trigger mitigation at this location earlier (possibly by year 2030) than under No Build conditions.
- Wall St & Greenwood Ave: Although peak hour volumes are forecasted to increase, no significant impacts to intersection operations are expected at this intersection with any modifications of RIRO access to the Parkway.



- US 20 (NE 3rd St) & Greenwood Ave: This intersection is over capacity under 2040 No Build conditions. However, with a full closure of Lafayette Avenue, the intersection v/c will increase to 1.37 from 1.29. Any mitigation identified at this location through the ongoing Bend TSP/MTP Update process would likely be triggered earlier, possibly as soon as the year 2025.

Overall, intersections that fail to meet mobility standards under the 2040 No-Build conditions continue to fail with any RIRO modification at Lafayette Avenue. One location (Bend Pkwy SB Ramps & Revere Ave) that was under capacity in the 2040 No-Build is expected to exceed capacity with any RIRO modifications at Lafayette Avenue. The volume shifts caused by a modification of the RIRO access at Lafayette Avenue are not expected to cause any intersections beyond those already failing under Future No-Build conditions to exceed adopted mobility targets.

Findings

Any RIRO modification at Lafayette Avenue is expected to shift 5-15 percent more daily traffic volume to the Revere Avenue interchange. This impact may conflict with the lane reallocation project on Revere Avenue (to be analyzed as part of Project Bundle A), which is expected to support low-stress pedestrian and bicycle crossings of US 97 and simplify traffic operations on between northbound and southbound ramp terminals. Ramp meters at the Revere Avenue and Colorado Avenue interchanges could increase the popularity of Lafayette Avenue right-out movement to US 97 (if left open) due to increased delay at the interchanges. The ongoing Bend TSP/MTP Update does not as yet include any capacity enhancements to the Wall Street/Portland Avenue intersection, which is expected to already operate over capacity under No-Build conditions. Any improvements identified for this location through TSP process will likely be triggered sooner under a full closure condition at the Lafayette Avenue RIRO Access. Closing RIRO access at Lafayette Avenue would improve safety at a location that was flagged as a safety focus area, particularly for rear-end collisions as the main conflict (southbound right turns) leading to these collisions would be removed. Given the low ADT for the right-in movement and potential benefits to US 97 both for safety and operations (travel time reliability and throughput) a full closure of the Lafayette Avenue RIRO is recommended for inclusion in the Level 2 Evaluation.

RIRO MODIFICATIONS AT HAWTHORNE AVENUE

Similar to Lafayette Avenue at US 97, the Hawthorne Avenue RIRO access was flagged as a safety focus due to a high proportion of rear-end crashes. As noted during field observations, drivers also demonstrate aggressive gap selection behavior at this location, which is also a sign of accepting a greater crash risk. As traffic volumes increase in the future, the crash frequency at US 97 and Hawthorne is expected to be higher than comparable sites, as described in the Future Conditions Memorandum. In addition, Hawthorne Avenue was flagged as a location with both deficient acceleration and deceleration lanes. While the deceleration lane at this location could be extended without incurring large ROW costs, building an acceleration lane would impact the US 97 overcrossing at Franklin Avenue. Both the Existing Conditions and Future No-Build analysis indicated over-capacity conditions and extensive eastbound queuing. By 2040, eastbound queues were expected to extend back up Hawthorn Avenue and Oregon Avenue to at least to Bond Street.

Similar to Lafayette Avenue, Hawthorne Avenue provides direct access to businesses including social and governmental services in downtown Bend for southbound drivers on US 97, especially businesses located along Oregon Avenue and Minnesota Avenue. This location also provides a southbound US 97 alternative to both the Revere Avenue and Colorado Avenue interchanges.

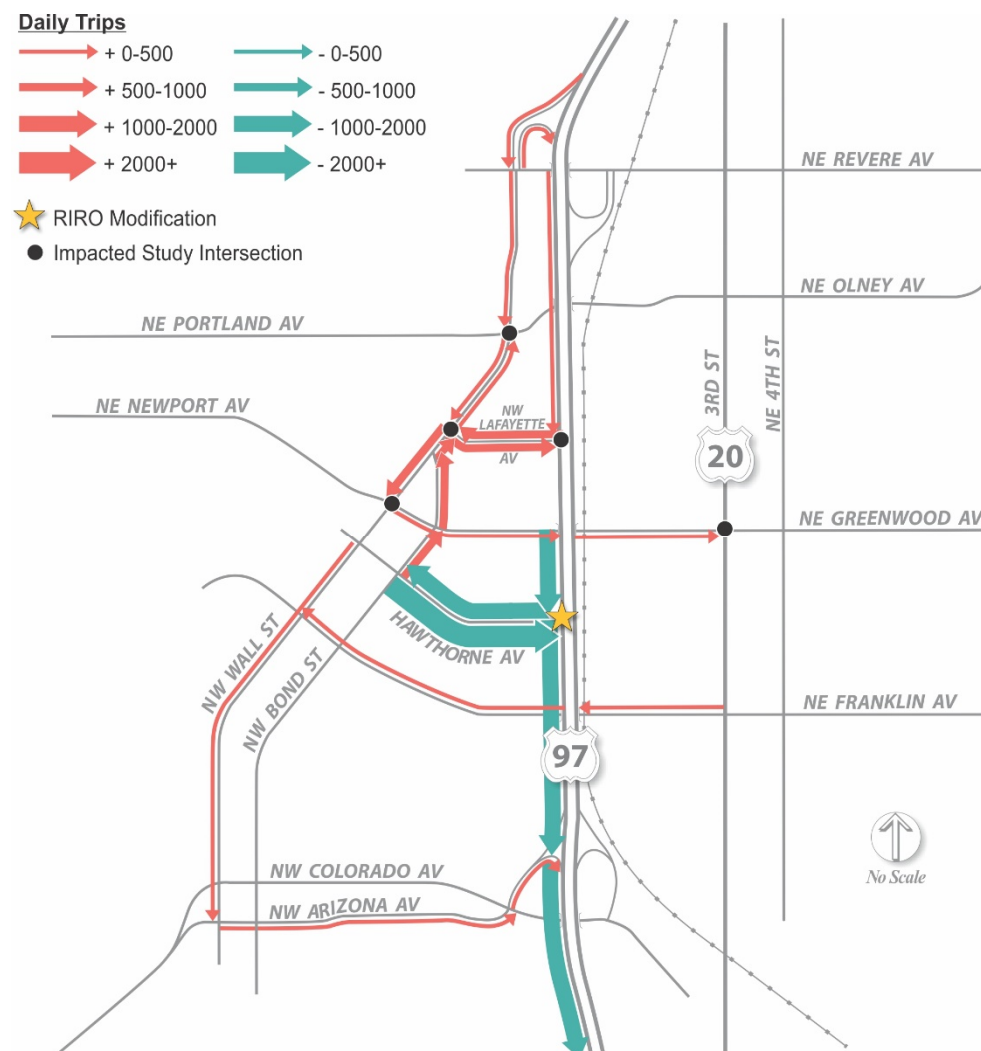


An alternative to closing the RIRO at Hawthorne Avenue would be to convert the intersection to right-in only. This means that drivers would be able to make a right-turn from US 97 onto Hawthorne Avenue but the right-turn onto US 97 would be prohibited. As part of this conversion, the southbound deceleration lane on US 97 could be reconstructed to meet ODOT standards to help decrease the risk of rear-end collisions. Restricting only the right-turn onto US 97 would eliminate the queueing issues projected at Hawthorne Avenue and US 97 in the future but would still allow drivers to exit US 97.

Traffic Volume Impacts

With a full closure of Hawthorne Avenue RIRO, most trips accessing downtown use Lafayette Avenue instead, with some trips shifting to the Colorado Avenue interchange, as shown in Figure 8. Daily trips traveling to the downtown area do shift significantly away from the Hawthorne Avenue/Oregon Avenue corridor, as the overall daily demand forecasted to use the Hawthorne Avenue right-in movement is less than 2,000 vehicles per day, and this volume mainly shifts to a combination of Lafayette Avenue (if open), the Revere Avenue interchange, and other local routes. The traffic impacts are relatively localized, but one more study intersection is impacted than by the Lafayette Avenue RIRO full closure due to approximately five percent more traffic volume shifting the Greenwood Avenue corridor.

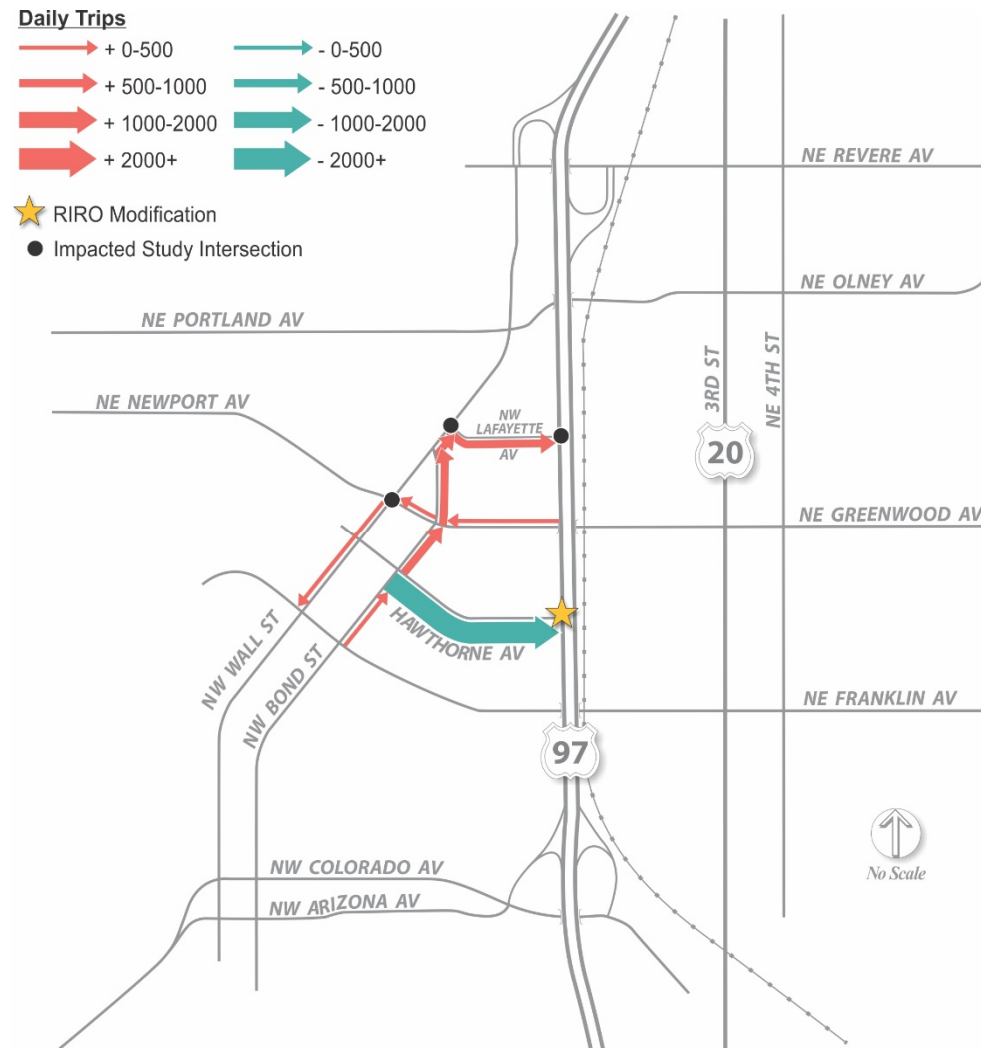
Figure 6: Hawthorne Avenue RIRO Full Closure Daily Volume Shifts





With a partial closure of Hawthorne Avenue (right-In only), trips traveling to downtown still use the US 97 right-in access at Hawthorne Avenue. However, trips entering US 97 instead shift to Lafayette Avenue, as shown in Figure 9. This nearly 15 percent increase in daily volume would exacerbate existing safety concerns at Lafayette Avenue if access was not modified at Lafayette Avenue. Hawthorne Avenue/Oregon Avenue east of Bond Street would experience significant daily traffic decreases, but the remainder of the downtown area would either experience minimal change or slight increases.

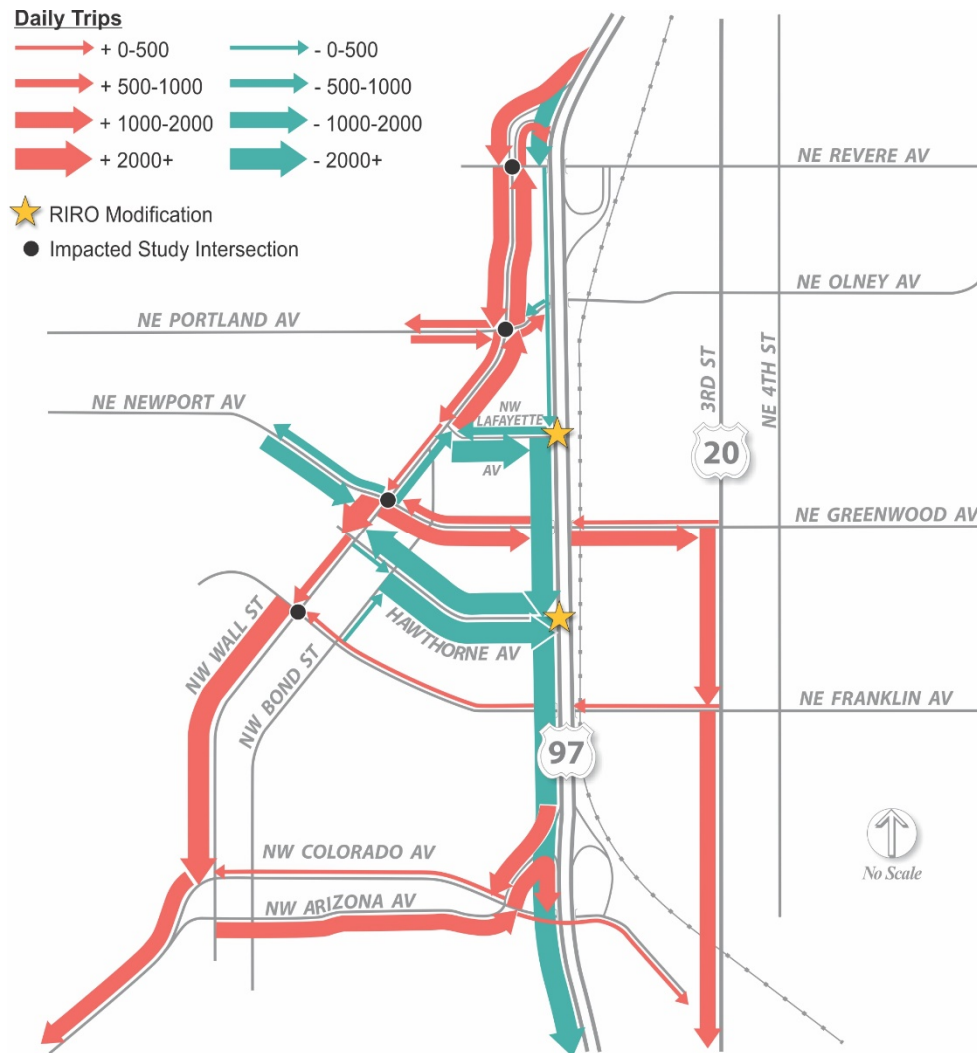
Figure 7: Hawthorne Avenue Right-In Only Daily Volume Shifts



With all RIRO access closed, 10-15 percent more daily trips access US 97 via the Colorado Avenue and Revere Avenue interchanges, as shown in Figure 10. Ten percent more daily traffic volume travels down Wall Street and an additional five percent uses Franklin Avenue to access 3rd street, instead of traveling along US 97. Note that Franklin Avenue is part of the City of Bend Low Stress Network (LSN) for bicycles and pedestrians. The daily volume on Greenwood Avenue also increases by nearly 10 percent.



Figure 8: Hawthorne Avenue - All RIRO Closures Daily Volume Shifts



Intersection Operations

Table 2 lists the operations at intersections impacted by RIRO modifications at Hawthorne Avenue.

Table 2: 2040 PM Peak Hour Intersection Operations - Hawthorne Avenue RIRO Modifications

Int. No.	Intersection	Control	Mobility Target V/C ^A	Intersection Performance			
				2040 No-Build	Hawthorne Ave RIRO Full Closure	Hawthorne Ave Right-In Only	All RIRO Full Closures
US 97/Bend Parkway Study Intersections							
14	Bend Pkwy & Lafayette Ave	TWSC ^D	< 0.85 (major) < 0.95 (minor)	NA/>2.00	NA/>2.00	NA/>2.00	NA ^C
15	Bend Pkwy & Hawthorne Ave	TWSC	< 0.85 (major) < 0.95 (minor)	NA/>2.00	NA ^C	NA ^C	NA ^C
Study Intersections Paralleling US 97							
-	Wall St & NW Lafayette Ave	TWSC	≤ 50 s (Delay) ^B	9.8/48.4	10.2/>100	10.2/>100	9.8/37.6



Int. No.	Intersection	Control	Mobility Target V/C ^A	Intersection Performance			
				2040 No-Build	Hawthorne Ave RIRO Full Closure	Hawthorne Ave Right-In Only	All RIRO Full Closures
-	Wall St & Portland Ave	Signalized	< 1.00	1.09	1.08	-	1.18
-	Wall St & Greenwood Ave	Signalized	< 1.00	0.90	0.91	0.91	0.91
-	Wall St & Franklin Ave	Signalized	< 1.00	0.98	-	-	1.04
-	Bond St & Franklin Ave	Signalized	< 1.00	1.03	-	-	1.10
-	NE 3rd St & Franklin Ave	Signalized	< 1.00	1.21	-	-	1.32
-	US 20 (NE 3 rd St) & Greenwood Ave	Signalized	< 0.85	1.29	1.36	-	1.37

A Overall intersection V/C ratio at signalized intersections, worst case approach V/C at roundabouts and all-way stop-controlled intersections, and V/C ratio (or delay at City intersections) for Major Street/Minor Street at two-way stop-controlled.

B The delay mobility target for the City of Bend only applies to critical lane groups with 100+ vehicles per hour.

C Intersection performance is not applicable when the RIRO access is closed or modified to right-in only.

D Two-way stop-controlled (TWSC).

Bold values indicate performance measures failing to meet adopted mobility targets.

The operational impacts to each intersection are summarized below:

- Bend Pkwy & Lafayette Ave: Closing or modifying access Hawthorne Avenue would send more traffic to the Lafayette Avenue access. Without closing or modifying access at Hawthorne Avenue, significant mitigation would be required to limit queue spillback on the local system and allow for safe operation of the intersection.
- Bend Pkwy & Hawthorne Ave: Any access modification at Hawthorne Avenue would improve operations at the intersection, where the demand is more than twice the capacity under 2040 No-Build conditions.
- Wall St & NW Lafayette Ave: Modifying or removing RIRO access at Hawthorne Avenue without modifying or removing RIRO access at Lafayette Avenue would cause this intersection to exceed mobility standards as a two-way stop-controlled intersection due to pm peak hour traffic diversion, triggering a need for short term mitigation at this location. Again, note that this mitigation would only be triggered by a closure or modification to the Hawthorne Avenue RIRO access coupled with no changes to the Lafayette Avenue RIRO access.
- Wall St & Portland Ave: No significant impacts to intersection operations are expected at this intersection with a closure or modification of just the Hawthorne Avenue RIRO. Closing all RIRO access along the Parkway would increase the v/c ratio from 1.09 under 2040 No Build conditions to 1.18, and could potentially trigger mitigation at this location earlier (possibly by year 2030) than under No Build conditions..
- Wall St & Greenwood Ave: Although peak hour volumes are forecasted to increase, no significant impacts to intersection operations are expected at this intersection with any modifications of RIRO access to the Parkway.
- Wall St & Franklin Ave: With the combined effects of a closure at Hawthorne Avenue and Lafayette Avenue (under the all RIRO closure scenario), more trips travel through the intersection of Wall Street/Franklin Avenue, causing the intersection to slightly exceed mobility standards, possibly triggering some mitigation by the year 2040.



- Bond St & Franklin Ave: This intersection exceeds mobility standards under 2040 No Build conditions. Impacts to intersection operations at this location with a closure of all RIRO access to the Parkway are expected to increase the intersection v/c from 1.03 to 1.10, triggering mitigation at this location possibly by the year 2030.
- NE 3rd St & Franklin Ave: This intersection exceeds mobility standards under 2040 No Build conditions. With additional volume from all RIRO closures along the Parkway, the v/c at this location is expected to increase to 1.32 from 1.21, triggering mitigation on a shorter timeframe, possibly as early as the year 2025.
- US 20 (NE 3rd St) & Greenwood Ave: This intersection is over capacity under 2040 No Build conditions. However, with a full closure of Hawthorne Avenue, the intersection v/c will increase to 1.36 from 1.29. Any mitigation identified at this location through the ongoing Bend TSP/MTP Update process would likely be triggered earlier, possibly as soon as the year 2025..

Overall, intersections that fail to meet mobility standards under the 2040 No-Build continue to fail with any RIRO modification at Hawthorne Avenue. One intersection (Wall St & Franklin Ave) which meets mobility standards under 2040 No-Build conditions would exceed mobility standards with a closure of all RIRO access along the Parkway due to traffic re-routing impacts from the Hawthorne Avenue RIRO closure.

Findings

A bicyclist and pedestrian overcrossing of US 97 at Hawthorne Avenue is proposed as part of the City of Bend's Low Stress Bicycle Network (LSN). The overcrossing would likely require at a minimum a partial closure of access at US 97 and Hawthorne Avenue, to support low-stress pedestrian and bicyclist crossings of US 97. As with the Lafayette Avenue RIRO access, ramp meters at the Revere Avenue and Colorado Avenue interchanges could increase the popularity of Hawthorne Avenue right-out movement to US 97 (if left open) due to increased delay at the interchanges. Closing Right-out access at Hawthorne Avenue would improve safety at a location that was flagged as a safety focus area. Given the higher ADT (compared to Lafayette Avenue) and more direct access provided to downtown businesses, a partial closure (conversions to right-in only) of the Hawthorne Avenue RIRO is recommended for inclusion in the Level 2 Evaluation.

RIRO MODIFICATIONS AT TRUMAN AVENUE

Under existing conditions, drivers demonstrate behavior of aggressive gap selection at US 97/Truman Avenue. By 2040, queues on Truman Avenue are expected to spill back all the way to Wilson Avenue as conflicting volumes increase on US 97, decreasing right turn capacity onto the Parkway. In addition, there are no deceleration or acceleration lanes at Truman Avenue, leading to a higher crash risks at this location. Building a deceleration lane to current standards is infeasible without significant capital cost, as widening the Wilson Avenue bridge and/or constructing a pedestrian/bicyclist tunnel under the existing overcrossing would be required. Building an acceleration lane to current standards is also costly with significant capital ROW cost and likely impacts to adjacent homes.

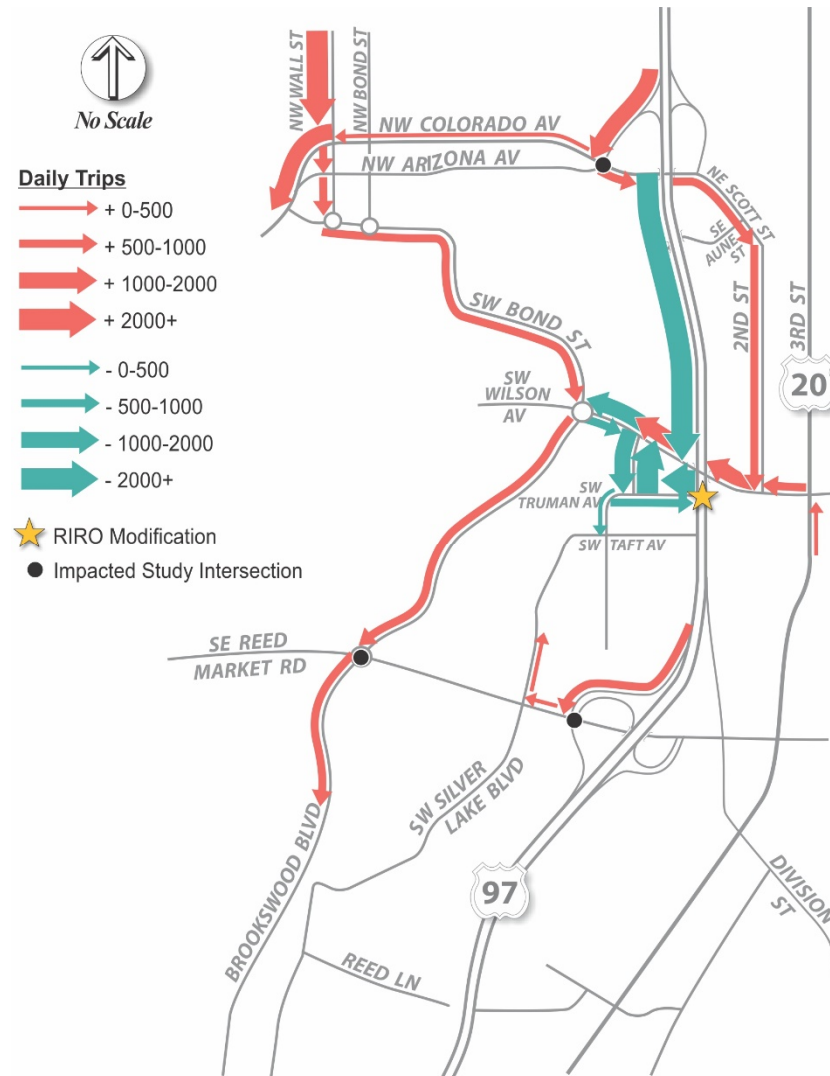
The Truman Avenue RIRO access combined with the Wilson Avenue overcrossing acts as a de-facto half interchange, serving southbound US 97 traffic both east and west of the Parkway. This de-facto interchange provides some southbound traffic relief to both the Colorado Avenue and Reed Market Road interchanges under Future No-Build Conditions.



Traffic Volume Impacts

With a full closure of the Truman Avenue RIRO, most trips shift to the Colorado Avenue or the Reed Market Road interchanges, as shown in Figure 11. Nearly twice the daily trips would travel through Aune Road/NE Scott Street intersections to exit the Colorado Avenue interchange.

Figure 9: Truman Avenue RIRO Full Closure Daily Volume Shifts



With all RIRO access closed, including Lafayette Avenue, Hawthorne Avenue and Truman Avenue, nearly 15 percent more daily trips access US 97 at the Colorado Avenue interchange, as shown in Figure 12. The closure of all the RIROs, including Truman Avenue and Reed Lane, cause nearly 15-20 percent more daily trips to remain on the local system, traveling along 3rd Street instead of accessing US 97. This impacts more non-US 97 study intersections.

Daily Trips

- + 0-500
- + 500-1000
- + 1000-2000
- + 2000+
- 0-500
- 500-1000
- 1000-2000
- 2000+

RIRO Modification

- Impacted Study Intersection

Table 3 lists the operations at intersections impacted by RIRO modifications at Truman Avenue.

Int. No.	Intersection	Control	Mobility Target V/C ^A	Intersection Performance		
				2040 No-Build	Truman Ave RIRO Full Closure	All RIRO Closures
US 97/Bend Parkway Study Intersections						
16	Bend Pkwy SB Ramps & Colorado Ave	Signalized	< 0.85	1.17	1.23	1.29
18	Bend Pkwy & Truman Ave	TWSC ^D	< 0.85 (major) < 0.95 (minor)	NA/>2.00	NA ^C	NA ^C
19	Bend Pkwy SB Ramps & Reed Market Rd	Signalized	< 0.85	1.29	1.32	1.26
Study Intersections Paralleling US 97						

Int. No.	Intersection	Control	Mobility Target V/C ^A	Intersection Performance		
				2040 No-Build	Truman Ave RIRO Full Closure	All RIRO Closures
US 97/Bend Parkway Study Intersections						
16	Bend Pkwy SB Ramps & Colorado Ave	Signalized	< 0.85	1.17	1.23	1.29
18	Bend Pkwy & Truman Ave	TWSC ^D	< 0.85 (major) < 0.95 (minor)	NA/>2.00	NA ^C	NA ^C
19	Bend Pkwy SB Ramps & Reed Market Rd	Signalized	< 0.85	1.29	1.32	1.26
Study Intersections Paralleling US 97						



Int. No.	Intersection	Control	Mobility Target V/C ^A	Intersection Performance		
				2040 No-Build	Truman Ave RIRO Full Closure	All RIRO Closures
49	Reed Market Rd & Brookwood Blvd	Roundabout	< 1.00	>2.00	>2.00	>2.00
-	Wall St & Colorado Ave	Signalized	< 1.00	0.73	-	0.81
-	Bond St & Arizona Ave	Signalized	< 1.00	1.00	-	1.10
-	NE 3rd St & Wilson Ave	Signalized	< 1.00	1.32	-	1.43
-	Aune St & NE Scott St	TWSC	≤ 50 s (Delay) ^B	7.8/16.3	-	7.8/17.1

A Overall intersection V/C ratio at signalized intersections, worst case approach V/C at roundabouts and all-way stop-controlled intersections, and V/C ratio for Major Street/Minor Street at two-way stop-controlled.

B The delay mobility target for the City of Bend only applies to critical lane groups with 100+ vehicles per hour.

C Intersection performance is not applicable when the RIRO access is closed.

D Two-way stop-controlled (TWSC).

Bold values indicate performance measures failing to meet adopted mobility targets.

The operational impacts to each intersection are summarized below:

- Bend Pkwy SB Ramps & Colorado Ave: This intersection significantly exceeds capacity under 2040 No-Build conditions. The increased pm peak hour traffic volume due to closure of Truman Avenue RIRO access (and other RIRO access such as Hawthorne Avenue and Lafayette Avenue) would slightly worsen intersection operations over No-Build. Note that mitigations at this location will be analyzed as part of the Level 2 evaluation.
- Bend Pkwy & Truman Ave: Any access modification at Truman Avenue would improve operations at the intersection which is more than two times over capacity under 2040 No-Build conditions. Note that while this RIRO access location does not experience the traffic operations issues that exist today at the Hawthorne Avenue and Lafayette Avenue RIROs, under forecasted future conditions this location would see significant increases in demand due to congestions at the Reed Market and Colorado Avenue interchanges, leading to increased eastbound queuing.
- Bend Pkwy SB Ramps & Reed Market Rd: This intersection is significantly over capacity under 2040 No Build conditions. No significant impacts to intersection operations are expected at this intersection with any modifications of RIRO access to the Parkway.
- Reed Market Rd & Brookwood Blvd: This roundabout intersection is significantly over capacity under 2040 No Build conditions with a worst case approach v/c over 2.00. No significant impacts to intersection operations are expected at this intersection with any modifications of RIRO access to the Parkway. The ongoing Bend TSP/MTP Update process is investigating a capacity improvement to this roundabout.
- Wall St & Colorado Ave: Although peak hour volumes are forecasted to increase, no significant impacts to intersection operations are expected at this intersection with any modifications of RIRO access to the Parkway.
- Bond St & Arizona Ave: This intersection is just at capacity under 2040 No-Build conditions. Closing all RIRO access to the Parkway would increase the v/c at this location to 1.10. The ongoing Bend TSP/MTP Update has identified the Colorado/Arizona Avenue as part of a key east-west corridor likely to need capacity enhancements, allowing traffic capacity mitigations at this location to match with TSP goals..



- NE 3rd St & Wilson Ave: While this location would see an increase in v/c with all RIRO access to the Parkway closed, it is near capacity today, and significantly over capacity under 2040 No Build conditions and would likely need short-term (prior to 2025) intersection capacity improvements prior to RIRO access closures on the Parkway.
- Aune St & NE Scott St: Although peak hour volumes are forecasted to increase, no significant impacts to intersection operations are expected at this intersection with any modifications of RIRO access to the Parkway.

Overall, intersections that fail to meet mobility standards under 2040 No-Build conditions continue to fail with any RIRO modification at Truman Avenue. The Colorado Avenue interchange is significantly impacted by a closure at Truman, particularly if the US 97/Lafayette Avenue and the US 97/Hawthorne Avenue accesses are also closed, diverting more traffic to the Colorado Avenue interchange via Scott Street/Colorado Avenue/Arizona Avenue. In addition, when all RIRO access along US 97 is closed, more 10 to 15 percent more daily traffic diverts to 3rd Street instead of using US 97. This accounts for the degraded intersection performance at 3rd Street and Wilson Avenue (1.32 v/c to 1.43 v/c), as well as slightly improved intersection performance at the US 97 SB ramps at Reed Market Road (1.29 v/c to 1.26 v/c).

Findings

The ongoing Bend TSP/MTP Update is studying the potential benefits of a Wilson Avenue extension (to either Pettigrew Road or 27th Avenue), particularly on the Reed Market corridor. The potential traffic diversion benefits to the Reed Market Road corridor of this roadway extension would likely be reduced by closure of the RIRO access at Truman Avenue since vehicles would not be able to exit the Parkway at Truman Avenue to access the Wilson Avenue extension.

One of the project bundles advancing to the Level 2 Evaluation includes major capacity enhancements to the Colorado Avenue and Reed Market Road interchange. The interchange improvements being evaluated would have the flexibility to serve multiple future demand scenarios, including increased demand due to the Truman Avenue RIRO access closure. With the forecasted increased demand combined with the lack of (and feasibility to construct) a southbound deceleration lane at this location, the risk of crashes at this location increases in the future. Given the potential benefits to US 97 both for safety and operations (travel time reliability and throughput), the lack of feasibility to modify this RIRO with standard deceleration and acceleration lanes, and need for full demand sensitivity testing at the Colorado Avenue and Reed Market Road interchanges, a full closure of the Truman Avenue RIRO is recommended for inclusion in the Level 2 Evaluation.

RIRO MODIFICATIONS AT REED LANE

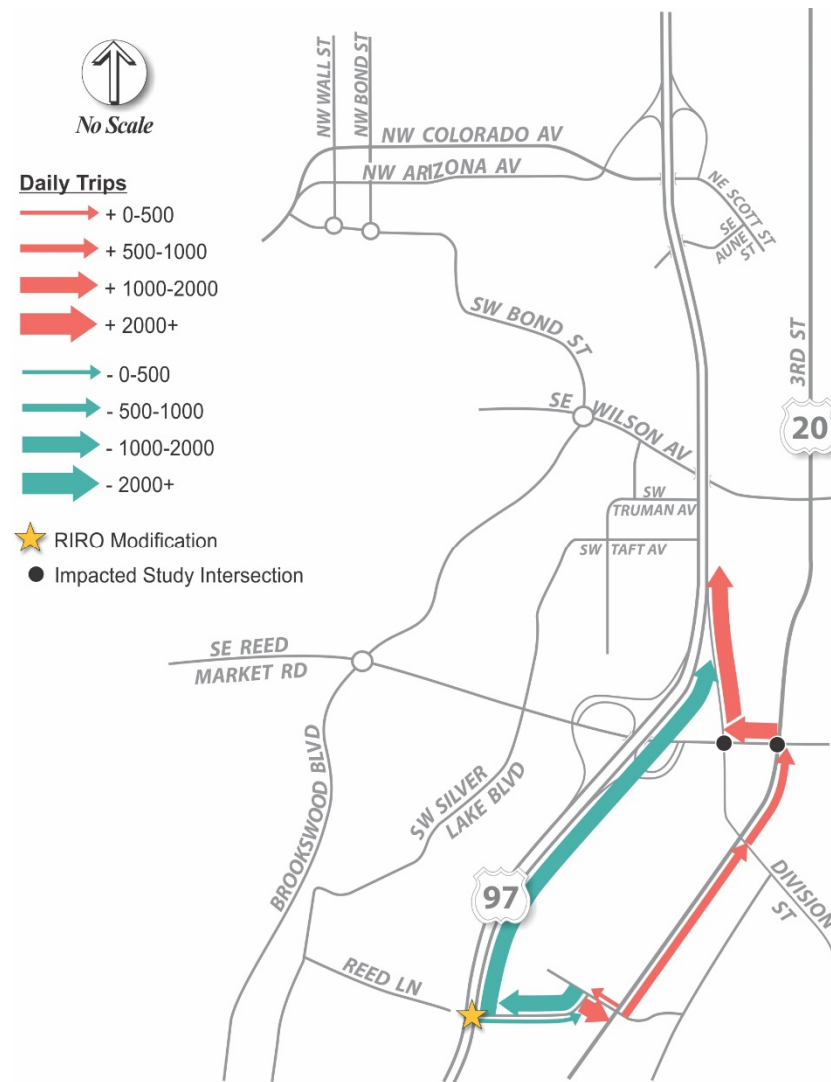
By 2040, the intersection of US 97/Reed Lane is expected to exceed mobility standards, with queues spilling back along Reed Lane to the Fred Meyer and 3rd Street as volumes increase on US 97. There are no deceleration or acceleration lanes at Reed Lane, leading to a higher risk of crashes at this location.

Traffic Volume Impacts

The impact of traffic volumes shifts is relatively localized with a full closure of the Reed Lane, as shown in Figure 13. Instead of using the Reed Lane RIRO, drivers continue to the Reed Market interchange via 3rd Street. This adds trips to the intersection of Reed Market Road/SE 3rd Street and Reed Market Road/Division Street. This trend does not significantly change when all the RIRO accesses are closed, as shown in Figure 12 (above in the Truman Avenue discussion).



Figure 11: Reed Lane RIRO Full Closure Daily Volume Shifts



Intersection Operations

Table 4 lists the operations at intersections impacted by RIRO modifications at Reed Lane.

Table 4: 2040 PM Peak Hour Intersection Operations - Reed Lane RIRO Modifications

Int. No.	Intersection	Control	Mobility Target V/C ^A	Intersection Performance		
				2040 No-Build	Reed Lane RIRO Full Closure	All RIRO Closures
US 97/Bend Parkway Study Intersections						
21	Bend Pkwy & Reed Ln	TWSC ^D	< 0.85 (major) < 0.95 (minor)	NA/1.05	NA ^C	NA ^C
Study Intersections Paralleling US 97						
52	Reed Market Rd & SE 3rd St	Signalized	< 1.00	1.53	1.59	1.57
51	Reed Market Rd & Division St	TWSC	< 1.00	0.23/0.31	0.27/0.43	0.27/0.38



- A** Overall intersection V/C ratio at signalized intersections, worst case approach V/C at roundabouts and all-way stop-controlled intersections, and V/C ratio for Major Street/Minor Street at two-way stop-controlled.
- B** The delay mobility target for the City of Bend only applies to critical lane groups with 100+ vehicles per hour.
- C** Intersection performance is not applicable when the RIRO access is closed.
- D** Two-way stop-controlled (TWSC).

Bold values indicate performance measures failing to meet adopted mobility targets.

With a closure at Reed Lane, the intersection operation impacts to the local system are minimal. The operational impacts to each intersection are summarized below:

- Bend Pkwy & Reed Ln: Any access modification at Reed Lane would improve operations at the intersection which is slightly over capacity under 2040 No-Build conditions.
- Reed Market Rd & SE 3rd St: This intersection is significantly over capacity under 2040 No Build conditions with a v/c of 1.53. A capacity improvement to this intersection is already included in the Level 2 Evaluation. No significant impacts to intersection operations are expected at this intersection with any modifications of RIRO access to the Parkway.
- Reed Market Rd & Division St: No significant impacts to intersection operations are expected at this intersection with any modifications of RIRO access to the Parkway.

Findings

Building deceleration lanes to standard at Reed Lane would likely conflict with any interchange at Powers Road (evaluated in Project Bundle B). Any access modification would also significantly improve the safety at this location by reducing conflicts. Grade separation of pedestrian crossings at Reed Lane was recommended under existing conditions, particularly as at-grade intersections are progressively phased off the Parkway in the future. This is consistent with work to date by the City in the ongoing Bend TSP/MTP update. While closure of Reed Lane would add trips to the intersection of Reed Market Road/SE 3rd Street, both the Level 1 Evaluation and the ongoing Bend TSP/MTP Update process have already identified this location for improvements. Due to the likely safety and traffic operations benefits, a full closure of the Reed Lane RIRO is recommended for inclusion in the Level 2 Evaluation.

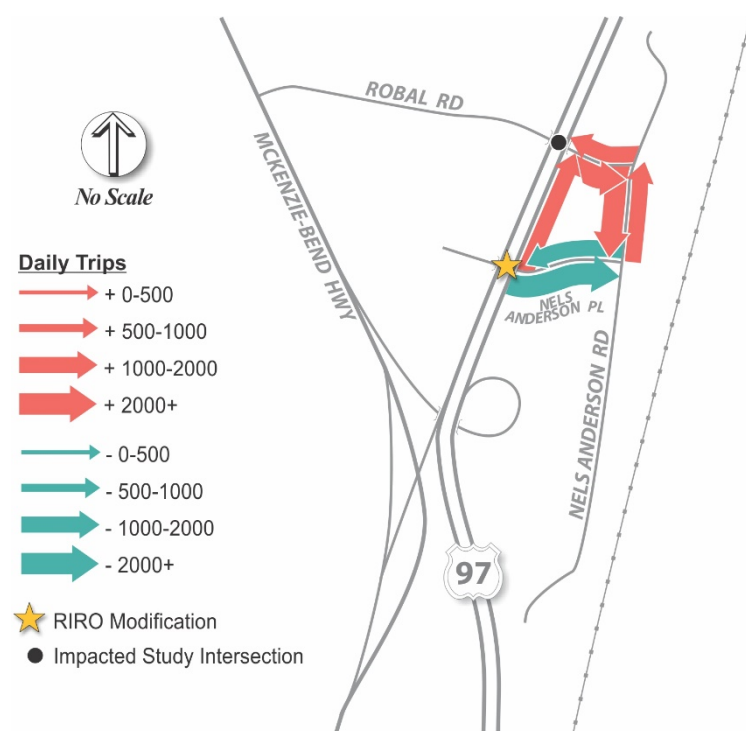
RIRO MODIFICATIONS AT NELS ANDERSON PLACE

US 97/Nels Anderson Place is over capacity under existing conditions and remains over capacity in the future No-Build conditions.

Traffic Volume Impacts

The impact of traffic volumes shifts is relatively localized with a full closure of Nels Anderson Place, as shown in Figure 14. Instead of using the Nels Anderson Place RIRO, trips shift to US 97/Robal Road.

Figure 12: Nels Anderson Place RIRO Full Closure Daily Volume Shifts



Intersection Operations

Table 5 lists the operations at intersections impacted by RIRO modifications at Nels Anderson Place. The only study intersection impacted by the closure of the Nels Anderson Place RIRO is US 97/Robal Road, which was significantly over capacity under the No-Build conditions.

Table 5: 2040 PM Peak Hour Intersection Operations for Intersections Impacted by Reed Lane RIRO Modifications

Int. No.	Intersection	Control	Mobility Target V/C ^A	Intersection Performance	
				2040 No-Build	Nels Anderson PI RIRO Full Closure
US 97/Bend Parkway Study Intersections					
3	US 97 & Robal Rd	Signalized	< 0.85	1.41	1.45
4	US 97 & Nels Anderson PI/Cascade Village	TWSC ^D	< 0.85 (major) < 0.95 (minor)	>2.00/ >2.00	NA ^C

A Overall intersection V/C ratio at signalized intersections, worst case approach V/C at roundabouts and all-way stop-controlled intersections, and V/C ratio for Major Street/Minor Street at two-way stop-controlled.

B The delay mobility target for the City of Bend only applies to critical lane groups with 100+ vehicles per hour.

C Intersection performance is not applicable when the RIRO access is closed.

D Two-way stop-controlled (TWSC).

Bold values indicate performance measures failing to meet adopted mobility targets.

With a closure at Nels Anderson Place, the intersection operation impacts to the local system are minimal. The operational impacts to each intersection are summarized below:

- US 97 & Robal Rd: This intersection is significantly over capacity under 2040 No Build conditions with a v/c of 1.41. No significant impacts to intersection operations are expected at this intersection with any modifications of RIRO access to the Parkway.



- Any access modification at Reed Lane would improve operations at the intersection which is more than two times over capacity under 2040 No-Build conditions. Any access modification would also significantly improve safety at this location with reduced conflicts.

Findings

The planned improvements in the US 97 Bend North Corridor Project (FEIS) include a reconfiguration of US 97 to a more local route at Nels Anderson Place/Cascade Village. Under the FEIS, Nels Anderson Place/Cascade Village would not access the new US 97 alignment and would instead access the new local route that is an extension of 3rd Street. Analysis and potential short-term improvements for this intersection will be reviewed in the US 97 North Corridor Study. Due to the likely safety and traffic operations benefits, a full closure of the Nels Anderson Place RIRO is recommended for inclusion in the Level 2 Evaluation.

RECOMMENDATIONS

Based on the results of this analysis, the following combinations of RIRO closures and modifications are recommended as the reasonable scenario for inclusion in both Project Bundle A and Bundle B for Level 2 Evaluation. Note that these recommended RIRO closures and modifications are subject to change based on the findings of the Level 2 Evaluation and could differ from the final preferred solution for the US 97 Parkway Study.

1. Nels Anderson Place – full closure
2. Reed Lane – full closure
3. Truman Road – full closure
4. Hawthorne Avenue – close right-out (onto US 97) only, build deceleration lane to standard
5. Lafayette Avenue – full closure

As stated earlier, allowing stop-controlled right-out movements to US 97 would hinder the effectiveness of ramp metering as a traffic management tool. Therefore, all right-outs at RIRO access locations are recommended for closure on a simultaneous timeline with ramp meter implementation, if ramp meters become part of the final project recommendations. The analysis showed significant impacts to both the Revere Avenue and Colorado Avenue interchanges caused by full closure of both the Lafayette Avenue and Hawthorne Avenue RIRO accesses and especially at Revere Avenue, these impacts may not be easily mitigated. Hawthorne Avenue provides the most direct business access to downtown Bend, serves the highest daily demand, and is therefore recommended to remain open for southbound traffic exiting US 97.

Based on the recommended closures above, Table 6 summarizes the study intersections impacted by each RIRO closure and whether mitigations would likely be triggered at that location. Each “X” indicates where a mitigation would likely be triggered to meet mobility standards due to the impacts of the closures while each “O” indicates an intersection that will be impacted (more than 50 pm peak hour trips) but will likely not trigger any additional mitigation beyond the mitigation needed for 2040 No-Build conditions.



Table 6: Summary of Impacted Study Intersections

Int. No.	Intersection	RIRO Closure/Modification Location				
		Lafayette	Hawthorne	Truman	Reed Lane	Nels Anderson Place
US 97/Bend Parkway Study Intersections						
3	US 97 & Robal Rd	-	-	-	-	O
4	US 97 & Nels Anderson Pl/Cascade Village	-	-	-	-	O
12	Bend Pkwy SB Ramps & Revere Ave	X	-	-	-	-
14	Bend Pkwy & Lafayette Ave	O	O	-	-	-
15	Bend Pkwy & Hawthorne Ave	O	O	-	-	-
16	Bend Pkwy SB Ramps & Colorado Ave	-	-	X	-	-
18	Bend Pkwy & Truman Ave	-	-	O	-	-
19	Bend Pkwy SB Ramps & Reed Market Rd	-	-	O	-	-
21	Bend Pkwy & Reed Ln	-	-	-	O	-
Study Intersections Paralleling US 97						
-	US 20 (NE 3rd St) & Olney Ave	O	-	-	-	-
-	Wall St & NW Lafayette Ave	O	O	-	-	-
-	Wall St & Portland Ave	X	X	-	-	-
-	Wall St & Greenwood Ave	O	O	-	-	-
-	Wall St & Franklin Ave	-	X	-	-	-
-	Bond St & Franklin Ave	-	X	-	-	-
-	NE 3rd St & Franklin Ave	-	X	-	-	-
-	US 20 (NE 3 rd St) & Greenwood Ave	X	X	-	-	-
49	Reed Market Rd & Brookwood Blvd	-	-	O	-	-
-	Wall St & Colorado Ave	-	-	O	-	-
-	Bond St & Arizona Ave	-	-	X	-	-
-	NE 3rd St & Wilson Ave	-	-	O	-	-
-	Aune St & NE Scott St	-	-	O	-	-
52	Reed Market Rd & SE 3rd St	-	-	-	O	-
51	Reed Market Rd & Division St	-	-	-	O	-

X indicates an impacted intersection where a mitigation would likely be triggered earlier than under No-Build conditions.

O indicates an impacted intersection where no additional mitigations beyond mitigating 2040 No-Build conditions would likely be needed.

Appendix - RIRO Analysis

HCM reports (Synchro and Vistro)

Lafayette Ave Full Closure HCM Reports

HCM Signalized Intersection Capacity Analysis

12: NW Wall St & NE Revere Ave

04/16/2019

												
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		↔		↔	↔		↔	↔	↔	↔	↔	↔
Traffic Volume (vph)	10	140	30	740	135	235	65	200	900	215	405	5
Future Volume (vph)	10	140	30	740	135	235	65	200	900	215	405	5
Ideal Flow (vphpl)	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750
Total Lost time (s)		4.0		4.0	4.0		4.0	4.0	4.0	4.0	4.0	
Lane Util. Factor		1.00		1.00	1.00		1.00	1.00	1.00	1.00	1.00	
Frpb, ped/bikes		0.99		1.00	0.99		1.00	1.00	0.99	1.00	1.00	
Flpb, ped/bikes		1.00		1.00	1.00		1.00	1.00	1.00	1.00	1.00	
Frt		0.98		1.00	0.90		1.00	1.00	0.85	1.00	1.00	
Flt Protected		1.00		0.95	1.00		0.95	1.00	1.00	0.95	1.00	
Satd. Flow (prot)		1697		1662	1552		1662	1750	1465	1612	1747	
Flt Permitted		1.00		0.95	1.00		0.15	1.00	1.00	0.48	1.00	
Satd. Flow (perm)		1697		1662	1552		262	1750	1465	821	1747	
Peak-hour factor, PHF	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90
Adj. Flow (vph)	11	156	33	822	150	261	72	222	1000	239	450	6
RTOR Reduction (vph)	0	6	0	0	52	0	0	0	91	0	1	0
Lane Group Flow (vph)	0	194	0	822	359	0	72	222	909	239	455	0
Confl. Peds. (#/hr)			5	5					1	1		
Confl. Bikes (#/hr)						2			1			
Heavy Vehicles (%)	0%	0%	0%	0%	0%	1%	0%	0%	1%	3%	0%	0%
Turn Type	Split	NA		Split	NA		Perm	NA	pm+ov	Perm	NA	
Protected Phases	8	8		4	4			6			2	
Permitted Phases							6		6		2	
Actuated Green, G (s)		16.8		49.1	49.1		32.0	32.0	81.1	32.0	32.0	
Effective Green, g (s)		17.8		50.1	50.1		33.0	33.0	83.1	33.0	33.0	
Actuated g/C Ratio		0.16		0.44	0.44		0.29	0.29	0.74	0.29	0.29	
Clearance Time (s)		5.0		5.0	5.0		5.0	5.0	5.0	5.0	5.0	
Vehicle Extension (s)		2.5		4.0	4.0		5.2	5.2	4.0	5.2	5.2	
Lane Grp Cap (vph)		267		737	688		76	511	1130	239	510	
v/s Ratio Prot		c0.11		c0.49	0.23			0.13	0.36		0.26	
v/s Ratio Perm							0.27		0.26	c0.29		
v/c Ratio		0.73		1.12	0.52		0.95	0.43	0.80	1.00	0.89	
Uniform Delay, d1		45.2		31.4	22.7		39.1	32.4	9.6	40.0	38.3	
Progression Factor		1.00		1.00	1.00		1.00	1.00	1.00	1.00	1.00	
Incremental Delay, d2		8.9		69.5	0.9		86.5	1.3	4.5	58.2	18.9	
Delay (s)		54.1		100.9	23.7		125.6	33.7	14.1	98.2	57.2	
Level of Service		D		F	C		F	C	B	F	E	
Approach Delay (s)		54.1			75.2			23.7			71.3	
Approach LOS		D			E			C			E	
Intersection Summary												
HCM 2000 Control Delay			53.7			HCM 2000 Level of Service			D			
HCM 2000 Volume to Capacity ratio			1.01									
Actuated Cycle Length (s)			112.9			Sum of lost time (s)			12.0			
Intersection Capacity Utilization			101.4%			ICU Level of Service			G			
Analysis Period (min)			15									
c Critical Lane Group												

Intersection

Int Delay, s/veh 155.7

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations		↗		↗↗	↗↗	↗
Traffic Vol, veh/h	0	415	0	3815	3470	320
Future Vol, veh/h	0	415	0	3815	3470	320
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Stop	Stop	Free	Free	Free	Free
RT Channelized	-	None	-	None	-	None
Storage Length	-	0	-	-	-	100
Veh in Median Storage, #	0	-	-	0	0	-
Grade, %	0	-	-	0	0	-
Peak Hour Factor	92	92	92	92	92	92
Heavy Vehicles, %	0	1	0	3	3	1
Mvmt Flow	0	451	0	4147	3772	348

Major/Minor	Minor2	Major1	Major2
Conflicting Flow All	- 1886	-	0 - 0
Stage 1	-	-	- - -
Stage 2	-	-	- - -
Critical Hdwy	- 6.92	-	- - -
Critical Hdwy Stg 1	-	-	- - -
Critical Hdwy Stg 2	-	-	- - -
Follow-up Hdwy	- 3.31	-	- - -
Pot Cap-1 Maneuver	0 ~ 61	0	- - -
Stage 1	0	0	- - -
Stage 2	0	0	- - -
Platoon blocked, %			- - -
Mov Cap-1 Maneuver	- ~ 61	-	- - -
Mov Cap-2 Maneuver	-	-	- - -
Stage 1	-	-	- - -
Stage 2	-	-	- - -

Approach	EB	NB	SB
HCM Control Delay, \$ 3008.4		0	0
HCM LOS	F		

Minor Lane/Major Mvmt	NBT EBLn1	SBT	SBR
Capacity (veh/h)	- 61	-	-
HCM Lane V/C Ratio	- 7.395	-	-
HCM Control Delay (s)	\$ 3008.4	-	-
HCM Lane LOS	- F	-	-
HCM 95th %tile Q(veh)	- 52	-	-

Notes

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

HCM Signalized Intersection Capacity Analysis

111: Wall St & Portland Ave

04/16/2019

												
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	380	225	95	65	215	160	70	760	75	40	490	485
Future Volume (vph)	380	225	95	65	215	160	70	760	75	40	490	485
Ideal Flow (vphpl)	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750
Total Lost time (s)	4.0	4.0		4.0	4.0	4.0	4.0	4.0		4.0	4.0	4.0
Lane Util. Factor	1.00	1.00		1.00	1.00	1.00	1.00	1.00		1.00	1.00	1.00
Frpb, ped/bikes	1.00	0.99		1.00	1.00	0.97	1.00	1.00		1.00	1.00	0.96
Flpb, ped/bikes	1.00	1.00		1.00	1.00	1.00	1.00	1.00		1.00	1.00	1.00
Frt	1.00	0.96		1.00	1.00	0.85	1.00	0.99		1.00	1.00	0.85
Flt Protected	0.95	1.00		0.95	1.00	1.00	0.95	1.00		0.95	1.00	1.00
Satd. Flow (prot)	1646	1647		1662	1750	1432	1662	1718		1599	1733	1418
Flt Permitted	0.95	1.00		0.95	1.00	1.00	0.23	1.00		0.09	1.00	1.00
Satd. Flow (perm)	1646	1647		1662	1750	1432	406	1718		152	1733	1418
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	413	245	103	71	234	174	76	826	82	43	533	527
RTOR Reduction (vph)	0	14	0	0	0	0	0	3	0	0	0	286
Lane Group Flow (vph)	413	334	0	71	234	174	76	905	0	43	533	241
Confl. Peds. (#/hr)	3					3	5		4	4		5
Confl. Bikes (#/hr)			7			16			7			6
Heavy Vehicles (%)	1%	1%	0%	0%	0%	1%	0%	0%	2%	4%	1%	1%
Turn Type	Prot	NA		Prot	NA	Free	pm+pt	NA		pm+pt	NA	Perm
Protected Phases	1	6		5	2		3	8		7	4	
Permitted Phases						Free	8			4		4
Actuated Green, G (s)	19.2	32.6		5.5	18.9	105.2	48.2	44.3		46.0	43.2	43.2
Effective Green, g (s)	20.2	33.6		6.5	19.9	105.2	50.2	45.3		48.0	44.2	44.2
Actuated g/C Ratio	0.19	0.32		0.06	0.19	1.00	0.48	0.43		0.46	0.42	0.42
Clearance Time (s)	5.0	5.0		5.0	5.0		5.0	5.0		5.0	5.0	5.0
Vehicle Extension (s)	3.0	3.0		3.0	3.0		3.0	3.0		3.0	3.0	3.0
Lane Grp Cap (vph)	316	526		102	331	1432	252	739		121	728	595
v/s Ratio Prot	c0.25	c0.20		0.04	0.13		c0.01	c0.53		0.01	0.31	
v/s Ratio Perm						c0.12	0.13			0.15		0.17
v/c Ratio	1.31	0.64		0.70	0.71	0.12	0.30	1.22		0.36	0.73	0.41
Uniform Delay, d1	42.5	30.6		48.4	39.9	0.0	17.8	30.0		23.9	25.5	21.3
Progression Factor	1.00	1.00		1.00	1.00	1.00	1.00	1.00		1.00	1.00	1.00
Incremental Delay, d2	159.2	2.5		18.6	6.7	0.2	0.7	113.1		1.8	3.8	0.5
Delay (s)	201.7	33.1		67.0	46.7	0.2	18.5	143.0		25.7	29.4	21.8
Level of Service	F	C		E	D	A	B	F		C	C	C
Approach Delay (s)		124.6			32.8			133.4			25.6	
Approach LOS		F			C			F			C	
Intersection Summary												
HCM 2000 Control Delay			81.1			HCM 2000 Level of Service			F			
HCM 2000 Volume to Capacity ratio			1.09									
Actuated Cycle Length (s)			105.2			Sum of lost time (s)			16.0			
Intersection Capacity Utilization			101.5%			ICU Level of Service			G			
Analysis Period (min)			15									
c Critical Lane Group												

Intersection

Int Delay, s/veh 2.3

Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Traffic Vol, veh/h	20	95	620	35	25	740
Future Vol, veh/h	20	95	620	35	25	740
Conflicting Peds, #/hr	1	0	0	28	28	0
Sign Control	Stop	Stop	Free	Free	Free	Free
RT Channelized	-	None	-	None	-	None
Storage Length	0	-	-	-	0	-
Veh in Median Storage, #	0	-	0	-	-	0
Grade, %	0	-	0	-	-	0
Peak Hour Factor	89	89	89	89	89	89
Heavy Vehicles, %	0	0	1	0	0	1
Mvmt Flow	22	107	697	39	28	831

Major/Minor	Minor1	Major1	Major2
Conflicting Flow All	1633	745	0
Stage 1	745	-	-
Stage 2	888	-	-
Critical Hdwy	6.4	6.2	-
Critical Hdwy Stg 1	5.4	-	-
Critical Hdwy Stg 2	5.4	-	-
Follow-up Hdwy	3.5	3.3	-
Pot Cap-1 Maneuver	113	417	-
Stage 1	473	-	-
Stage 2	405	-	-
Platoon blocked, %		-	-
Mov Cap-1 Maneuver	107	407	-
Mov Cap-2 Maneuver	107	-	-
Stage 1	447	-	-
Stage 2	405	-	-

Approach	WB	NB	SB
HCM Control Delay, s	29.3	0	0.3
HCM LOS	D		

Minor Lane/Major Mvmt	NBT	NBRWBLn1	SBL	SBT
Capacity (veh/h)	-	-	274	838
HCM Lane V/C Ratio	-	-	0.472	0.034
HCM Control Delay (s)	-	-	29.3	9.4
HCM Lane LOS	-	-	D	A
HCM 95th %tile Q(veh)	-	-	2.4	0.1

HCM Signalized Intersection Capacity Analysis

113: Greenwood Ave & Wall St

04/16/2019

												
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	85	435	210	440	695	15	0	0	0	120	540	200
Future Volume (vph)	85	435	210	440	695	15	0	0	0	120	540	200
Ideal Flow (vphpl)	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750
Total Lost time (s)	4.0	4.0		4.0	4.0						4.0	4.0
Lane Util. Factor	1.00	0.95		1.00	1.00						0.95	1.00
Frpb, ped/bikes	1.00	0.98		1.00	1.00						1.00	0.88
Flpb, ped/bikes	1.00	1.00		1.00	1.00						1.00	1.00
Frt	1.00	0.95		1.00	1.00						1.00	0.85
Flt Protected	0.95	1.00		0.95	1.00						0.99	1.00
Satd. Flow (prot)	1646	3057		1646	1726						3257	1296
Flt Permitted	0.95	1.00		0.95	1.00						0.99	1.00
Satd. Flow (perm)	1646	3057		1646	1726						3257	1296
Peak-hour factor, PHF	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95
Adj. Flow (vph)	89	458	221	463	732	16	0	0	0	126	568	211
RTOR Reduction (vph)	0	66	0	0	1	0	0	0	0	0	0	156
Lane Group Flow (vph)	89	613	0	463	747	0	0	0	0	0	694	55
Confl. Peds. (#/hr)	12		47	47		12	38		18	18		38
Confl. Bikes (#/hr)			1			11			1			24
Heavy Vehicles (%)	1%	2%	0%	1%	1%	0%	0%	0%	0%	0%	1%	1%
Turn Type	Prot	NA		Prot	NA					Perm	NA	Perm
Protected Phases	5	2		1	6						4	
Permitted Phases										4		4
Actuated Green, G (s)	5.9	22.9		24.4	41.4						20.7	20.7
Effective Green, g (s)	5.9	22.9		24.4	41.4						20.7	20.7
Actuated g/C Ratio	0.07	0.29		0.30	0.52						0.26	0.26
Clearance Time (s)	4.0	4.0		4.0	4.0						4.0	4.0
Vehicle Extension (s)	3.0	3.0		3.0	3.0						3.0	3.0
Lane Grp Cap (vph)	121	875		502	893						842	335
v/s Ratio Prot	0.05	0.20		c0.28	c0.43							
v/s Ratio Perm											0.21	0.04
v/c Ratio	0.74	0.70		0.92	0.84						0.82	0.16
Uniform Delay, d1	36.3	25.5		26.9	16.4						27.9	22.9
Progression Factor	1.00	1.00		1.00	1.00						1.00	1.00
Incremental Delay, d2	20.5	4.7		22.6	9.2						6.6	0.2
Delay (s)	56.8	30.2		49.4	25.6						34.5	23.2
Level of Service	E	C		D	C						C	C
Approach Delay (s)		33.2			34.7			0.0			31.9	
Approach LOS		C			C			A			C	
Intersection Summary												
HCM 2000 Control Delay			33.4			HCM 2000 Level of Service				C		
HCM 2000 Volume to Capacity ratio			0.89									
Actuated Cycle Length (s)			80.0			Sum of lost time (s)			12.0			
Intersection Capacity Utilization			81.3%			ICU Level of Service			D			
Analysis Period (min)			15									
c Critical Lane Group												

HCM Signalized Intersection Capacity Analysis

204: 3rd Street & US 20

04/16/2019

												
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	285	870	245	360	695	295	235	975	265	375	1010	125
Future Volume (vph)	285	870	245	360	695	295	235	975	265	375	1010	125
Ideal Flow (vphpl)	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750
Total Lost time (s)	4.0	4.0		4.0	4.0		4.0	4.0		4.0	4.0	
Lane Util. Factor	1.00	0.95		1.00	0.95		1.00	0.95		1.00	0.95	
Frpb, ped/bikes	1.00	1.00		1.00	0.99		1.00	0.99		1.00	1.00	
Flpb, ped/bikes	1.00	1.00		1.00	1.00		1.00	1.00		1.00	1.00	
Frt	1.00	0.97		1.00	0.96		1.00	0.97		1.00	0.98	
Flt Protected	0.95	1.00		0.95	1.00		0.95	1.00		0.95	1.00	
Satd. Flow (prot)	1599	3172		1646	3101		1646	3167		1583	3228	
Flt Permitted	0.95	1.00		0.95	1.00		0.95	1.00		0.95	1.00	
Satd. Flow (perm)	1599	3172		1646	3101		1646	3167		1583	3228	
Peak-hour factor, PHF	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96
Adj. Flow (vph)	297	906	255	375	724	307	245	1016	276	391	1052	130
RTOR Reduction (vph)	0	16	0	0	29	0	0	16	0	0	6	0
Lane Group Flow (vph)	297	1145	0	375	1002	0	245	1276	0	391	1176	0
Confl. Peds. (#/hr)	2		1	1		2	6		7	7		6
Confl. Bikes (#/hr)			2			1						
Heavy Vehicles (%)	4%	1%	1%	1%	1%	4%	1%	1%	1%	5%	1%	1%
Turn Type	Prot	NA		Prot	NA		Prot	NA		Prot	NA	
Protected Phases	7	4		3	8		1	6		5	2	
Permitted Phases												
Actuated Green, G (s)	21.0	41.0		23.0	43.0		16.0	50.0		26.0	60.0	
Effective Green, g (s)	22.0	42.0		24.0	44.0		17.0	51.0		27.0	61.0	
Actuated g/C Ratio	0.14	0.26		0.15	0.28		0.11	0.32		0.17	0.38	
Clearance Time (s)	5.0	5.0		5.0	5.0		5.0	5.0		5.0	5.0	
Vehicle Extension (s)	2.5	4.3		2.5	4.3		2.5	4.3		2.5	4.3	
Lane Grp Cap (vph)	219	832		246	852		174	1009		267	1230	
v/s Ratio Prot	0.19	c0.36		c0.23	0.32		0.15	c0.40		c0.25	0.36	
v/s Ratio Perm												
v/c Ratio	1.36	1.38		1.52	1.18		1.41	1.26		1.46	0.96	
Uniform Delay, d1	69.0	59.0		68.0	58.0		71.5	54.5		66.5	48.2	
Progression Factor	1.00	1.00		1.00	1.00		1.00	1.00		1.00	1.00	
Incremental Delay, d2	187.1	176.7		255.6	91.5		214.2	127.2		228.4	16.3	
Delay (s)	256.1	235.7		323.6	149.5		285.7	181.7		294.9	64.5	
Level of Service	F	F		F	F		F	F		F	E	
Approach Delay (s)		239.9			195.9			198.3			121.8	
Approach LOS		F			F			F			F	
Intersection Summary												
HCM 2000 Control Delay			187.7			HCM 2000 Level of Service				F		
HCM 2000 Volume to Capacity ratio			1.37									
Actuated Cycle Length (s)			160.0			Sum of lost time (s)				16.0		
Intersection Capacity Utilization			130.8%			ICU Level of Service				H		
Analysis Period (min)			15									
c Critical Lane Group												

Lafayette Ave Right In Only HCM Reports

HCM Signalized Intersection Capacity Analysis

12: NW Wall St & NE Revere Ave

04/16/2019

												
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		↔		↔	↔		↔	↑	↔	↔	↔	↔
Traffic Volume (vph)	10	140	30	735	135	255	65	210	905	215	395	5
Future Volume (vph)	10	140	30	735	135	255	65	210	905	215	395	5
Ideal Flow (vphpl)	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750
Total Lost time (s)		4.0		4.0	4.0		4.0	4.0	4.0	4.0	4.0	
Lane Util. Factor		1.00		1.00	1.00		1.00	1.00	1.00	1.00	1.00	
Frpb, ped/bikes		0.99		1.00	0.99		1.00	1.00	0.99	1.00	1.00	
Flpb, ped/bikes		1.00		1.00	1.00		1.00	1.00	1.00	1.00	1.00	
Frt		0.98		1.00	0.90		1.00	1.00	0.85	1.00	1.00	
Flt Protected		1.00		0.95	1.00		0.95	1.00	1.00	0.95	1.00	
Satd. Flow (prot)		1697		1662	1546		1662	1750	1465	1613	1746	
Flt Permitted		1.00		0.95	1.00		0.16	1.00	1.00	0.47	1.00	
Satd. Flow (perm)		1697		1662	1546		288	1750	1465	793	1746	
Peak-hour factor, PHF	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90
Adj. Flow (vph)	11	156	33	817	150	283	72	233	1006	239	439	6
RTOR Reduction (vph)	0	6	0	0	56	0	0	0	91	0	1	0
Lane Group Flow (vph)	0	194	0	817	377	0	72	233	915	239	444	0
Confl. Peds. (#/hr)			5	5					1	1		
Confl. Bikes (#/hr)						2			1			
Heavy Vehicles (%)	0%	0%	0%	0%	0%	1%	0%	0%	1%	3%	0%	0%
Turn Type	Split	NA		Split	NA		Perm	NA	pm+ov	Perm	NA	
Protected Phases	8	8		4	4			6			2	
Permitted Phases							6		6		2	
Actuated Green, G (s)		16.8		49.1	49.1		32.0	32.0	81.1	32.0	32.0	
Effective Green, g (s)		17.8		50.1	50.1		33.0	33.0	83.1	33.0	33.0	
Actuated g/C Ratio		0.16		0.44	0.44		0.29	0.29	0.74	0.29	0.29	
Clearance Time (s)		5.0		5.0	5.0		5.0	5.0	5.0	5.0	5.0	
Vehicle Extension (s)		2.5		4.0	4.0		5.2	5.2	4.0	5.2	5.2	
Lane Grp Cap (vph)		267		737	686		84	511	1130	231	510	
v/s Ratio Prot		c0.11		c0.49	0.24			0.13	0.36		0.25	
v/s Ratio Perm							0.25		0.27	c0.30		
v/c Ratio		0.73		1.11	0.55		0.86	0.46	0.81	1.03	0.87	
Uniform Delay, d1		45.2		31.4	23.1		37.7	32.6	9.7	40.0	37.9	
Progression Factor		1.00		1.00	1.00		1.00	1.00	1.00	1.00	1.00	
Incremental Delay, d2		8.9		67.0	1.1		57.5	1.4	4.6	68.5	16.3	
Delay (s)		54.1		98.4	24.2		95.3	34.1	14.4	108.5	54.2	
Level of Service		D		F	C		F	C	B	F	D	
Approach Delay (s)		54.1			72.7			22.3			73.2	
Approach LOS		D			E			C			E	
Intersection Summary												
HCM 2000 Control Delay			52.5			HCM 2000 Level of Service			D			
HCM 2000 Volume to Capacity ratio			1.02									
Actuated Cycle Length (s)			112.9			Sum of lost time (s)			12.0			
Intersection Capacity Utilization			100.5%			ICU Level of Service			G			
Analysis Period (min)			15									
c Critical Lane Group												

Intersection

Int Delay, s/veh 168.7

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations		↗		↗↗	↗↗	↗
Traffic Vol, veh/h	0	435	0	3810	3460	315
Future Vol, veh/h	0	435	0	3810	3460	315
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Stop	Stop	Free	Free	Free	Free
RT Channelized	-	None	-	None	-	None
Storage Length	-	0	-	-	-	100
Veh in Median Storage, #	0	-	-	0	0	-
Grade, %	0	-	-	0	0	-
Peak Hour Factor	92	92	92	92	92	92
Heavy Vehicles, %	0	1	0	3	3	1
Mvmt Flow	0	473	0	4141	3761	342

Major/Minor	Minor2	Major1	Major2
Conflicting Flow All	- 1881	-	0 -
Stage 1	-	-	-
Stage 2	-	-	-
Critical Hdwy	- 6.92	-	-
Critical Hdwy Stg 1	-	-	-
Critical Hdwy Stg 2	-	-	-
Follow-up Hdwy	- 3.31	-	-
Pot Cap-1 Maneuver	0 ~ 62	0	-
Stage 1	0	0	-
Stage 2	0	0	-
Platoon blocked, %			-
Mov Cap-1 Maneuver	- ~ 62	-	-
Mov Cap-2 Maneuver	-	-	-
Stage 1	-	-	-
Stage 2	-	-	-

Approach	EB	NB	SB
HCM Control Delay, \$	3110.3	0	0
HCM LOS	F		

Minor Lane/Major Mvmt	NBT EBLn1	SBT	SBR
Capacity (veh/h)	- 62	-	-
HCM Lane V/C Ratio	- 7.626	-	-
HCM Control Delay (s)	\$ 3110.3	-	-
HCM Lane LOS	- F	-	-
HCM 95th %tile Q(veh)	- 54.6	-	-

Notes

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

HCM Signalized Intersection Capacity Analysis

111: Wall St & Portland Ave

04/16/2019

												
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	385	225	90	65	210	160	70	770	75	40	475	485
Future Volume (vph)	385	225	90	65	210	160	70	770	75	40	475	485
Ideal Flow (vphpl)	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750
Total Lost time (s)	4.0	4.0		4.0	4.0	4.0	4.0	4.0		4.0	4.0	4.0
Lane Util. Factor	1.00	1.00		1.00	1.00	1.00	1.00	1.00		1.00	1.00	1.00
Frpb, ped/bikes	1.00	0.99		1.00	1.00	0.97	1.00	1.00		1.00	1.00	0.96
Flpb, ped/bikes	1.00	1.00		1.00	1.00	1.00	1.00	1.00		1.00	1.00	1.00
Frt	1.00	0.96		1.00	1.00	0.85	1.00	0.99		1.00	1.00	0.85
Flt Protected	0.95	1.00		0.95	1.00	1.00	0.95	1.00		0.95	1.00	1.00
Satd. Flow (prot)	1646	1650		1662	1750	1432	1662	1718		1599	1733	1417
Flt Permitted	0.95	1.00		0.95	1.00	1.00	0.24	1.00		0.09	1.00	1.00
Satd. Flow (perm)	1646	1650		1662	1750	1432	418	1718		156	1733	1417
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	418	245	98	71	228	174	76	837	82	43	516	527
RTOR Reduction (vph)	0	13	0	0	0	0	0	3	0	0	0	295
Lane Group Flow (vph)	418	330	0	71	228	174	76	916	0	43	516	232
Confl. Peds. (#/hr)	3					3	5		4	4		5
Confl. Bikes (#/hr)			7			16			7			6
Heavy Vehicles (%)	1%	1%	0%	0%	0%	1%	0%	0%	2%	4%	1%	1%
Turn Type	Prot	NA		Prot	NA	Free	pm+pt	NA		pm+pt	NA	Perm
Protected Phases	1	6		5	2		3	8		7	4	
Permitted Phases						Free	8			4		4
Actuated Green, G (s)	20.2	33.4		5.5	18.7	105.0	47.2	43.3		45.0	42.2	42.2
Effective Green, g (s)	21.2	34.4		6.5	19.7	105.0	49.2	44.3		47.0	43.2	43.2
Actuated g/C Ratio	0.20	0.33		0.06	0.19	1.00	0.47	0.42		0.45	0.41	0.41
Clearance Time (s)	5.0	5.0		5.0	5.0		5.0	5.0		5.0	5.0	5.0
Vehicle Extension (s)	3.0	3.0		3.0	3.0		3.0	3.0		3.0	3.0	3.0
Lane Grp Cap (vph)	332	540		102	328	1432	253	724		122	713	582
v/s Ratio Prot	c0.25	0.20		0.04	c0.13		c0.01	c0.53		0.01	0.30	
v/s Ratio Perm						c0.12	0.13			0.15		0.16
v/c Ratio	1.26	0.61		0.70	0.70	0.12	0.30	1.27		0.35	0.72	0.40
Uniform Delay, d1	41.9	29.7		48.3	39.8	0.0	18.1	30.4		24.0	25.9	21.8
Progression Factor	1.00	1.00		1.00	1.00	1.00	1.00	1.00		1.00	1.00	1.00
Incremental Delay, d2	138.7	2.1		18.6	6.3	0.2	0.7	130.3		1.8	3.6	0.5
Delay (s)	180.6	31.7		66.9	46.1	0.2	18.7	160.6		25.7	29.5	22.2
Level of Service	F	C		E	D	A	B	F		C	C	C
Approach Delay (s)		113.5			32.3			149.8			25.8	
Approach LOS		F			C			F			C	
Intersection Summary												
HCM 2000 Control Delay			84.1			HCM 2000 Level of Service			F			
HCM 2000 Volume to Capacity ratio			1.10									
Actuated Cycle Length (s)			105.0			Sum of lost time (s)			16.0			
Intersection Capacity Utilization			102.2%			ICU Level of Service			G			
Analysis Period (min)			15									
c Critical Lane Group												

Intersection

Int Delay, s/veh 2.2

Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Traffic Vol, veh/h	20	95	625	35	10	745
Future Vol, veh/h	20	95	625	35	10	745
Conflicting Peds, #/hr	1	0	0	28	28	0
Sign Control	Stop	Stop	Free	Free	Free	Free
RT Channelized	-	None	-	None	-	None
Storage Length	0	-	-	-	0	-
Veh in Median Storage, #	0	-	0	-	-	0
Grade, %	0	-	0	-	-	0
Peak Hour Factor	89	89	89	89	89	89
Heavy Vehicles, %	0	0	1	0	0	1
Mvmt Flow	22	107	702	39	11	837

Major/Minor	Minor1	Major1	Major2
Conflicting Flow All	1610	750	0
Stage 1	750	-	-
Stage 2	860	-	-
Critical Hdwy	6.4	6.2	-
Critical Hdwy Stg 1	5.4	-	-
Critical Hdwy Stg 2	5.4	-	-
Follow-up Hdwy	3.5	3.3	-
Pot Cap-1 Maneuver	116	415	-
Stage 1	470	-	-
Stage 2	418	-	-
Platoon blocked, %		-	-
Mov Cap-1 Maneuver	112	405	-
Mov Cap-2 Maneuver	112	-	-
Stage 1	453	-	-
Stage 2	418	-	-

Approach	WB	NB	SB
HCM Control Delay, s	28.7	0	0.1
HCM LOS	D		

Minor Lane/Major Mvmt	NBT	NBRWBLn1	SBL	SBT
Capacity (veh/h)	-	-	278	834
HCM Lane V/C Ratio	-	-	0.465	0.013
HCM Control Delay (s)	-	-	28.7	9.4
HCM Lane LOS	-	-	D	A
HCM 95th %tile Q(veh)	-	-	2.3	0

HCM Signalized Intersection Capacity Analysis

113: Greenwood Ave & Wall St

04/16/2019

												
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	80	430	215	445	695	15	0	0	0	120	555	200
Future Volume (vph)	80	430	215	445	695	15	0	0	0	120	555	200
Ideal Flow (vphpl)	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750
Total Lost time (s)	4.0	4.0		4.0	4.0						4.0	4.0
Lane Util. Factor	1.00	0.95		1.00	1.00						0.95	1.00
Frpb, ped/bikes	1.00	0.98		1.00	1.00						1.00	0.88
Flpb, ped/bikes	1.00	1.00		1.00	1.00						1.00	1.00
Frt	1.00	0.95		1.00	1.00						1.00	0.85
Flt Protected	0.95	1.00		0.95	1.00						0.99	1.00
Satd. Flow (prot)	1646	3052		1646	1726						3257	1297
Flt Permitted	0.95	1.00		0.95	1.00						0.99	1.00
Satd. Flow (perm)	1646	3052		1646	1726						3257	1297
Peak-hour factor, PHF	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95
Adj. Flow (vph)	84	453	226	468	732	16	0	0	0	126	584	211
RTOR Reduction (vph)	0	64	0	0	1	0	0	0	0	0	0	156
Lane Group Flow (vph)	84	615	0	468	747	0	0	0	0	0	710	55
Confl. Peds. (#/hr)	12		47	47		12	38		18	18		38
Confl. Bikes (#/hr)			1			11			1			24
Heavy Vehicles (%)	1%	2%	0%	1%	1%	0%	0%	0%	0%	0%	1%	1%
Turn Type	Prot	NA		Prot	NA					Perm	NA	Perm
Protected Phases	5	2		1	6						4	
Permitted Phases										4		4
Actuated Green, G (s)	5.8	22.4		24.7	41.3						20.9	20.9
Effective Green, g (s)	5.8	22.4		24.7	41.3						20.9	20.9
Actuated g/C Ratio	0.07	0.28		0.31	0.52						0.26	0.26
Clearance Time (s)	4.0	4.0		4.0	4.0						4.0	4.0
Vehicle Extension (s)	3.0	3.0		3.0	3.0						3.0	3.0
Lane Grp Cap (vph)	119	854		508	891						850	338
v/s Ratio Prot	0.05	0.20		c0.28	c0.43							
v/s Ratio Perm											0.22	0.04
v/c Ratio	0.71	0.72		0.92	0.84						0.84	0.16
Uniform Delay, d1	36.3	26.0		26.7	16.5						27.9	22.8
Progression Factor	1.00	1.00		1.00	1.00						1.00	1.00
Incremental Delay, d2	17.3	5.2		22.2	9.3						7.1	0.2
Delay (s)	53.6	31.2		48.9	25.8						35.1	23.0
Level of Service	D	C		D	C						D	C
Approach Delay (s)		33.6			34.7			0.0			32.3	
Approach LOS		C			C			A			C	
Intersection Summary												
HCM 2000 Control Delay			33.7			HCM 2000 Level of Service				C		
HCM 2000 Volume to Capacity ratio			0.90									
Actuated Cycle Length (s)			80.0			Sum of lost time (s)			12.0			
Intersection Capacity Utilization			82.2%			ICU Level of Service			E			
Analysis Period (min)			15									
c Critical Lane Group												

Hawthorne Ave Full Closure HCM Reports

Intersection

Int Delay, s/veh 26.1

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations		↗		↗↗	↗↗	↗
Traffic Vol, veh/h	0	150	0	3815	3845	55
Future Vol, veh/h	0	150	0	3815	3845	55
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Stop	Stop	Free	Free	Free	Free
RT Channelized	-	None	-	None	-	None
Storage Length	-	0	-	-	-	115
Veh in Median Storage, #	0	-	-	0	0	-
Grade, %	0	-	-	0	0	-
Peak Hour Factor	92	92	92	92	92	92
Heavy Vehicles, %	0	0	0	3	3	0
Mvmt Flow	0	163	0	4147	4179	60

Major/Minor	Minor2	Major1	Major2
Conflicting Flow All	- 2090	-	0 - 0
Stage 1	-	-	- - -
Stage 2	-	-	- - -
Critical Hdwy	- 6.9	-	- - -
Critical Hdwy Stg 1	-	-	- - -
Critical Hdwy Stg 2	-	-	- - -
Follow-up Hdwy	- 3.3	-	- - -
Pot Cap-1 Maneuver	0 ~ 45	0	- - -
Stage 1	0	0	- - -
Stage 2	0	0	- - -
Platoon blocked, %			- - -
Mov Cap-1 Maneuver	- ~ 45	-	- - -
Mov Cap-2 Maneuver	-	-	- - -
Stage 1	-	-	- - -
Stage 2	-	-	- - -

Approach	EB	NB	SB
HCM Control Delay, \$ 1367.2		0	0
HCM LOS	F		

Minor Lane/Major Mvmt	NBT EBLn1	SBT	SBR
Capacity (veh/h)	- 45	-	-
HCM Lane V/C Ratio	- 3.623	-	-
HCM Control Delay (s)	\$ 1367.2	-	-
HCM Lane LOS	- F	-	-
HCM 95th %tile Q(veh)	- 18.1	-	-

Notes

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

HCM Signalized Intersection Capacity Analysis

111: Wall St & Portland Ave

04/16/2019

												
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	390	225	100	70	215	160	70	735	70	35	505	480
Future Volume (vph)	390	225	100	70	215	160	70	735	70	35	505	480
Ideal Flow (vphpl)	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750
Total Lost time (s)	4.0	4.0		4.0	4.0	4.0	4.0	4.0		4.0	4.0	4.0
Lane Util. Factor	1.00	1.00		1.00	1.00	1.00	1.00	1.00		1.00	1.00	1.00
Frpb, ped/bikes	1.00	0.99		1.00	1.00	0.97	1.00	1.00		1.00	1.00	0.96
Flpb, ped/bikes	1.00	1.00		1.00	1.00	1.00	1.00	1.00		1.00	1.00	1.00
Frt	1.00	0.95		1.00	1.00	0.85	1.00	0.99		1.00	1.00	0.85
Flt Protected	0.95	1.00		0.95	1.00	1.00	0.95	1.00		0.95	1.00	1.00
Satd. Flow (prot)	1646	1643		1662	1750	1432	1662	1719		1599	1733	1417
Flt Permitted	0.95	1.00		0.95	1.00	1.00	0.21	1.00		0.09	1.00	1.00
Satd. Flow (perm)	1646	1643		1662	1750	1432	362	1719		156	1733	1417
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	424	245	109	76	234	174	76	799	76	38	549	522
RTOR Reduction (vph)	0	15	0	0	0	0	0	3	0	0	0	275
Lane Group Flow (vph)	424	339	0	76	234	174	76	872	0	38	549	247
Confl. Peds. (#/hr)	3					3	5		4	4		5
Confl. Bikes (#/hr)			7			16			7			6
Heavy Vehicles (%)	1%	1%	0%	0%	0%	1%	0%	0%	2%	4%	1%	1%
Turn Type	Prot	NA		Prot	NA	Free	pm+pt	NA		pm+pt	NA	Perm
Protected Phases	1	6		5	2		3	8		7	4	
Permitted Phases						Free	8			4		4
Actuated Green, G (s)	20.2	33.7		5.5	19.0	105.3	47.2	43.3		45.0	42.2	42.2
Effective Green, g (s)	21.2	34.7		6.5	20.0	105.3	49.2	44.3		47.0	43.2	43.2
Actuated g/C Ratio	0.20	0.33		0.06	0.19	1.00	0.47	0.42		0.45	0.41	0.41
Clearance Time (s)	5.0	5.0		5.0	5.0		5.0	5.0		5.0	5.0	5.0
Vehicle Extension (s)	3.0	3.0		3.0	3.0		3.0	3.0		3.0	3.0	3.0
Lane Grp Cap (vph)	331	541		102	332	1432	229	723		121	710	581
v/s Ratio Prot	c0.26	c0.21		0.05	0.13		c0.02	c0.51		0.01	0.32	
v/s Ratio Perm						c0.12	0.14			0.13		0.17
v/c Ratio	1.28	0.63		0.75	0.70	0.12	0.33	1.21		0.31	0.77	0.42
Uniform Delay, d1	42.0	29.8		48.6	39.9	0.0	18.8	30.5		24.0	26.8	22.2
Progression Factor	1.00	1.00		1.00	1.00	1.00	1.00	1.00		1.00	1.00	1.00
Incremental Delay, d2	147.7	2.3		25.2	6.7	0.2	0.9	105.6		1.5	5.2	0.5
Delay (s)	189.7	32.1		73.8	46.5	0.2	19.6	136.1		25.5	32.1	22.7
Level of Service	F	C		E	D	A	B	F		C	C	C
Approach Delay (s)		118.0			34.2			126.8			27.4	
Approach LOS		F			C			F			C	
Intersection Summary												
HCM 2000 Control Delay			78.1			HCM 2000 Level of Service			E			
HCM 2000 Volume to Capacity ratio			1.08									
Actuated Cycle Length (s)			105.3			Sum of lost time (s)			16.0			
Intersection Capacity Utilization			100.4%			ICU Level of Service			G			
Analysis Period (min)			15									
c Critical Lane Group												

Intersection

Int Delay, s/veh 13.6

Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Traffic Vol, veh/h	65	50	710	55	60	740
Future Vol, veh/h	65	50	710	55	60	740
Conflicting Peds, #/hr	1	0	0	28	28	0
Sign Control	Stop	Stop	Free	Free	Free	Free
RT Channelized	-	None	-	None	-	None
Storage Length	0	-	-	-	0	-
Veh in Median Storage, #	0	-	0	-	-	0
Grade, %	0	-	0	-	-	0
Peak Hour Factor	89	89	89	89	89	89
Heavy Vehicles, %	0	0	1	0	0	1
Mvmt Flow	73	56	798	62	67	831

Major/Minor	Minor1	Major1	Major2
Conflicting Flow All	1823	857	0
Stage 1	857	-	-
Stage 2	966	-	-
Critical Hdwy	6.4	6.2	-
Critical Hdwy Stg 1	5.4	-	-
Critical Hdwy Stg 2	5.4	-	-
Follow-up Hdwy	3.5	3.3	-
Pot Cap-1 Maneuver	86	360	-
Stage 1	419	-	-
Stage 2	372	-	-
Platoon blocked, %		-	-
Mov Cap-1 Maneuver	76	352	-
Mov Cap-2 Maneuver	76	-	-
Stage 1	373	-	-
Stage 2	372	-	-

Approach	WB	NB	SB
HCM Control Delay, s	193	0	0.8
HCM LOS	F		

Minor Lane/Major Mvmt	NBT	NBRWBLn1	SBL	SBT
Capacity (veh/h)	-	-	115	753
HCM Lane V/C Ratio	-	-	1.124	0.09
HCM Control Delay (s)	-	-	193	10.2
HCM Lane LOS	-	-	F	B
HCM 95th %tile Q(veh)	-	-	7.9	0.3

HCM Signalized Intersection Capacity Analysis

113: Greenwood Ave & Wall St

04/16/2019

												
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	135	405	180	380	705	25	0	0	0	125	525	225
Future Volume (vph)	135	405	180	380	705	25	0	0	0	125	525	225
Ideal Flow (vphpl)	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750
Total Lost time (s)	4.0	4.0		4.0	4.0						4.0	4.0
Lane Util. Factor	1.00	0.95		1.00	1.00						0.95	1.00
Frpb, ped/bikes	1.00	0.98		1.00	1.00						1.00	0.88
Flpb, ped/bikes	1.00	1.00		1.00	1.00						1.00	1.00
Frt	1.00	0.95		1.00	0.99						1.00	0.85
Flt Protected	0.95	1.00		0.95	1.00						0.99	1.00
Satd. Flow (prot)	1646	3068		1646	1722						3255	1296
Flt Permitted	0.95	1.00		0.95	1.00						0.99	1.00
Satd. Flow (perm)	1646	3068		1646	1722						3255	1296
Peak-hour factor, PHF	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95
Adj. Flow (vph)	142	426	189	400	742	26	0	0	0	132	553	237
RTOR Reduction (vph)	0	60	0	0	2	0	0	0	0	0	0	176
Lane Group Flow (vph)	142	555	0	400	766	0	0	0	0	0	685	61
Confl. Peds. (#/hr)	12		47	47		12	38		18	18		38
Confl. Bikes (#/hr)			1			11			1			24
Heavy Vehicles (%)	1%	2%	0%	1%	1%	0%	0%	0%	0%	0%	1%	1%
Turn Type	Prot	NA		Prot	NA					Perm	NA	Perm
Protected Phases	5	2		1	6						4	
Permitted Phases										4		4
Actuated Green, G (s)	8.5	25.5		21.9	38.9						20.6	20.6
Effective Green, g (s)	8.5	25.5		21.9	38.9						20.6	20.6
Actuated g/C Ratio	0.11	0.32		0.27	0.49						0.26	0.26
Clearance Time (s)	4.0	4.0		4.0	4.0						4.0	4.0
Vehicle Extension (s)	3.0	3.0		3.0	3.0						3.0	3.0
Lane Grp Cap (vph)	174	977		450	837						838	333
v/s Ratio Prot	0.09	0.18		c0.24	c0.45							
v/s Ratio Perm											0.21	0.05
v/c Ratio	0.82	0.57		0.89	0.92						0.82	0.18
Uniform Delay, d1	35.0	22.7		27.9	19.0						27.9	23.1
Progression Factor	1.00	1.00		1.00	1.00						1.00	1.00
Incremental Delay, d2	24.6	2.4		18.8	16.3						6.2	0.3
Delay (s)	59.6	25.1		46.7	35.4						34.2	23.4
Level of Service	E	C		D	D						C	C
Approach Delay (s)		31.5			39.2			0.0			31.4	
Approach LOS		C			D			A			C	
Intersection Summary												
HCM 2000 Control Delay			34.7			HCM 2000 Level of Service				C		
HCM 2000 Volume to Capacity ratio			0.91									
Actuated Cycle Length (s)			80.0			Sum of lost time (s)			12.0			
Intersection Capacity Utilization			83.1%			ICU Level of Service			E			
Analysis Period (min)			15									
c Critical Lane Group												

HCM Signalized Intersection Capacity Analysis

204: 3rd Street & US 20

04/16/2019

												
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	285	870	250	350	705	285	245	970	260	370	1010	125
Future Volume (vph)	285	870	250	350	705	285	245	970	260	370	1010	125
Ideal Flow (vphpl)	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750
Total Lost time (s)	4.0	4.0		4.0	4.0		4.0	4.0		4.0	4.0	
Lane Util. Factor	1.00	0.95		1.00	0.95		1.00	0.95		1.00	0.95	
Frpb, ped/bikes	1.00	1.00		1.00	0.99		1.00	0.99		1.00	1.00	
Flpb, ped/bikes	1.00	1.00		1.00	1.00		1.00	1.00		1.00	1.00	
Frt	1.00	0.97		1.00	0.96		1.00	0.97		1.00	0.98	
Flt Protected	0.95	1.00		0.95	1.00		0.95	1.00		0.95	1.00	
Satd. Flow (prot)	1599	3171		1646	3107		1646	3168		1583	3228	
Flt Permitted	0.95	1.00		0.95	1.00		0.95	1.00		0.95	1.00	
Satd. Flow (perm)	1599	3171		1646	3107		1646	3168		1583	3228	
Peak-hour factor, PHF	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96
Adj. Flow (vph)	297	906	260	365	734	297	255	1010	271	385	1052	130
RTOR Reduction (vph)	0	17	0	0	27	0	0	15	0	0	6	0
Lane Group Flow (vph)	297	1149	0	365	1004	0	255	1266	0	385	1176	0
Confl. Peds. (#/hr)	2		1	1		2	6		7	7		6
Confl. Bikes (#/hr)			2			1						
Heavy Vehicles (%)	4%	1%	1%	1%	1%	4%	1%	1%	1%	5%	1%	1%
Turn Type	Prot	NA		Prot	NA		Prot	NA		Prot	NA	
Protected Phases	7	4		3	8		1	6		5	2	
Permitted Phases												
Actuated Green, G (s)	22.0	42.0		23.0	43.0		17.0	49.0		26.0	58.0	
Effective Green, g (s)	23.0	43.0		24.0	44.0		18.0	50.0		27.0	59.0	
Actuated g/C Ratio	0.14	0.27		0.15	0.28		0.11	0.31		0.17	0.37	
Clearance Time (s)	5.0	5.0		5.0	5.0		5.0	5.0		5.0	5.0	
Vehicle Extension (s)	2.5	4.3		2.5	4.3		2.5	4.3		2.5	4.3	
Lane Grp Cap (vph)	229	852		246	854		185	990		267	1190	
v/s Ratio Prot	0.19	c0.36		c0.22	0.32		0.15	c0.40		c0.24	0.36	
v/s Ratio Perm												
v/c Ratio	1.30	1.35		1.48	1.18		1.38	1.28		1.44	0.99	
Uniform Delay, d1	68.5	58.5		68.0	58.0		71.0	55.0		66.5	50.2	
Progression Factor	1.00	1.00		1.00	1.00		1.00	1.00		1.00	1.00	
Incremental Delay, d2	162.0	164.7		238.2	91.3		200.4	133.2		218.9	23.1	
Delay (s)	230.5	223.2		306.2	149.3		271.4	188.2		285.4	73.3	
Level of Service	F	F		F	F		F	F		F	E	
Approach Delay (s)		224.7			190.4			202.1			125.4	
Approach LOS		F			F			F			F	
Intersection Summary												
HCM 2000 Control Delay			184.7			HCM 2000 Level of Service			F			
HCM 2000 Volume to Capacity ratio			1.36									
Actuated Cycle Length (s)			160.0			Sum of lost time (s)			16.0			
Intersection Capacity Utilization			129.7%			ICU Level of Service			H			
Analysis Period (min)			15									
c Critical Lane Group												

Hawthorne Ave Right In Only HCM Reports

Intersection

Int Delay, s/veh 24.4

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations		↗		↗↗	↗↗	↗
Traffic Vol, veh/h	0	140	0	3825	3905	45
Future Vol, veh/h	0	140	0	3825	3905	45
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Stop	Stop	Free	Free	Free	Free
RT Channelized	-	None	-	None	-	None
Storage Length	-	0	-	-	-	115
Veh in Median Storage, #	0	-	-	0	0	-
Grade, %	0	-	-	0	0	-
Peak Hour Factor	92	92	92	92	92	92
Heavy Vehicles, %	0	0	0	3	3	0
Mvmt Flow	0	152	0	4158	4245	49

Major/Minor	Minor2	Major1	Major2
Conflicting Flow All	- 2123	- 0	- 0
Stage 1	-	-	-
Stage 2	-	-	-
Critical Hdwy	- 6.9	-	-
Critical Hdwy Stg 1	-	-	-
Critical Hdwy Stg 2	-	-	-
Follow-up Hdwy	- 3.3	-	-
Pot Cap-1 Maneuver	0 ~ 42	0	-
Stage 1	0	0	-
Stage 2	0	0	-
Platoon blocked, %		-	-
Mov Cap-1 Maneuver	- ~ 42	-	-
Mov Cap-2 Maneuver	-	-	-
Stage 1	-	-	-
Stage 2	-	-	-

Approach	EB	NB	SB
HCM Control Delay, \$ 1379.6		0	0
HCM LOS	F		

Minor Lane/Major Mvmt	NBT EBLn1	SBT	SBR
Capacity (veh/h)	- 42	-	-
HCM Lane V/C Ratio	- 3.623	-	-
HCM Control Delay (s)	\$ 1379.6	-	-
HCM Lane LOS	- F	-	-
HCM 95th %tile Q(veh)	- 17.1	-	-

Notes

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

HCM Signalized Intersection Capacity Analysis

16: Arizona Ave & NW Colorado Ave

04/12/2019

												
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		↑			↑			↑	↑	↑		↑
Traffic Volume (vph)	0	0	0	0	435	40	10	455	1195	140	0	585
Future Volume (vph)	0	0	0	0	435	40	10	455	1195	140	0	585
Ideal Flow (vphpl)	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750
Total Lost time (s)					4.0			4.0	4.0	4.0		4.0
Lane Util. Factor					1.00			1.00	1.00	1.00		1.00
Frpb, ped/bikes					1.00			1.00	0.99	1.00		0.99
Flpb, ped/bikes					1.00			1.00	1.00	1.00		1.00
Frt					0.99			1.00	0.85	1.00		0.85
Flt Protected					1.00			1.00	1.00	0.95		1.00
Satd. Flow (prot)					1711			1731	1458	1630		1468
Flt Permitted					1.00			1.00	1.00	0.95		1.00
Satd. Flow (perm)					1711			1731	1458	1630		1468
Peak-hour factor, PHF	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90
Adj. Flow (vph)	0	0	0	0	483	44	11	506	1328	156	0	650
RTOR Reduction (vph)	0	0	0	0	7	0	0	0	314	0	0	218
Lane Group Flow (vph)	0	0	0	0	520	0	0	517	1014	156	0	432
Confl. Peds. (#/hr)	2					2	1		1	1		1
Confl. Bikes (#/hr)						2						
Heavy Vehicles (%)	0%	0%	0%	0%	1%	0%	0%	1%	1%	2%	0%	0%
Turn Type					NA		Split	NA	custom	Prot		Perm
Protected Phases		2			6		8	8	1	4		
Permitted Phases									2 8			4
Actuated Green, G (s)					33.0			27.0	60.0	27.0		27.0
Effective Green, g (s)					34.0			28.0	62.0	28.0		28.0
Actuated g/C Ratio					0.33			0.27	0.61	0.27		0.27
Clearance Time (s)					5.0			5.0	5.0	5.0		5.0
Vehicle Extension (s)					3.0			3.0	3.0	3.0		3.0
Lane Grp Cap (vph)					570			475	943	447		402
v/s Ratio Prot					0.30			0.30	c0.36	0.10		
v/s Ratio Perm									0.34			c0.29
v/c Ratio					0.91			1.09	1.08	0.35		1.08
Uniform Delay, d1					32.6			37.0	20.0	29.7		37.0
Progression Factor					1.00			1.00	1.00	1.00		1.00
Incremental Delay, d2					21.4			67.3	51.8	0.5		66.5
Delay (s)					54.0			104.3	71.8	30.2		103.5
Level of Service					D			F	E	C		F
Approach Delay (s)		0.0			54.0			80.9			89.3	
Approach LOS		A			D			F			F	
Intersection Summary												
HCM 2000 Control Delay			78.6									
HCM 2000 Volume to Capacity ratio			1.17									
Actuated Cycle Length (s)			102.0							16.0		
Intersection Capacity Utilization			103.5%									
Analysis Period (min)			15									
c Critical Lane Group												

HCM Signalized Intersection Capacity Analysis

17: Wall St & Franklin Ave

04/12/2019

												
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	0	715	35	225	535	0	0	0	0	185	595	305
Future Volume (vph)	0	715	35	225	535	0	0	0	0	185	595	305
Ideal Flow (vphpl)	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750
Total Lost time (s)		4.0		4.0	4.0						4.0	4.0
Lane Util. Factor		1.00		1.00	1.00						0.95	1.00
Frpb, ped/bikes		0.99		1.00	1.00						1.00	0.85
Flpb, ped/bikes		1.00		1.00	1.00						0.99	1.00
Frt		0.99		1.00	1.00						1.00	0.85
Flt Protected		1.00		0.95	1.00						0.99	1.00
Satd. Flow (prot)		1712		1614	1733						3220	1267
Flt Permitted		1.00		0.11	1.00						0.99	1.00
Satd. Flow (perm)		1712		189	1733						3220	1267
Peak-hour factor, PHF	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90
Adj. Flow (vph)	0	794	39	250	594	0	0	0	0	206	661	339
RTOR Reduction (vph)	0	2	0	0	0	0	0	0	0	0	0	175
Lane Group Flow (vph)	0	831	0	250	594	0	0	0	0	0	867	164
Confl. Peds. (#/hr)	30		138	138		30	71		53	53		71
Confl. Bikes (#/hr)			3			14						12
Heavy Vehicles (%)	0%	1%	0%	3%	1%	0%	0%	0%	0%	0%	1%	0%
Turn Type		NA		pm+pt	NA					Perm	NA	Perm
Protected Phases		8		7	4						2	
Permitted Phases				4						2		2
Actuated Green, G (s)		31.0		46.0	46.0						24.0	24.0
Effective Green, g (s)		32.0		47.0	47.0						25.0	25.0
Actuated g/C Ratio		0.40		0.59	0.59						0.31	0.31
Clearance Time (s)		5.0		5.0	5.0						5.0	5.0
Vehicle Extension (s)		0.2		0.2	0.2						0.2	0.2
Lane Grp Cap (vph)		684		306	1018						1006	395
v/s Ratio Prot		c0.49		c0.11	0.34							
v/s Ratio Perm				0.37							0.27	0.13
v/c Ratio		1.21		0.82	0.58						0.86	0.41
Uniform Delay, d1		24.0		30.1	10.4						25.9	21.7
Progression Factor		1.00		0.51	0.14						1.00	1.00
Incremental Delay, d2		109.6		1.5	0.0						9.7	3.2
Delay (s)		133.6		16.8	1.5						35.5	24.9
Level of Service		F		B	A						D	C
Approach Delay (s)		133.6			6.0			0.0			32.5	
Approach LOS		F			A			A			C	
Intersection Summary												
HCM 2000 Control Delay			54.0			HCM 2000 Level of Service				D		
HCM 2000 Volume to Capacity ratio			1.02									
Actuated Cycle Length (s)			80.0			Sum of lost time (s)			12.0			
Intersection Capacity Utilization			99.3%			ICU Level of Service			F			
Analysis Period (min)			15									
c Critical Lane Group												

HCM Signalized Intersection Capacity Analysis

18: Bond St & Franklin Ave

04/12/2019

												
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	430	590	0	0	695	160	110	675	205	0	0	0
Future Volume (vph)	430	590	0	0	695	160	110	675	205	0	0	0
Ideal Flow (vphpl)	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750
Total Lost time (s)	4.0	4.0			4.0	4.0		4.0	4.0			
Lane Util. Factor	1.00	1.00			1.00	1.00		0.95	1.00			
Frpb, ped/bikes	1.00	1.00			1.00	0.96		1.00	0.92			
Flpb, ped/bikes	1.00	1.00			1.00	1.00		0.98	1.00			
Frt	1.00	1.00			1.00	0.85		1.00	0.85			
Flt Protected	0.95	1.00			1.00	1.00		0.99	1.00			
Satd. Flow (prot)	1662	1716			1733	1434		3247	1362			
Flt Permitted	0.12	1.00			1.00	1.00		0.99	1.00			
Satd. Flow (perm)	212	1716			1733	1434		3247	1362			
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	467	641	0	0	755	174	120	734	223	0	0	0
RTOR Reduction (vph)	0	0	0	0	0	61	0	0	162	0	0	0
Lane Group Flow (vph)	467	641	0	0	755	113	0	854	61	0	0	0
Confl. Peds. (#/hr)	23		47	47		23	103		27	27		103
Confl. Bikes (#/hr)			3			7			4			
Heavy Vehicles (%)	0%	2%	0%	0%	1%	0%	0%	0%	1%	0%	0%	0%
Turn Type	pm+pt	NA			NA	Perm	Perm	NA	Perm			
Protected Phases	3	8			4			6				
Permitted Phases	8					4	6		6			
Actuated Green, G (s)	49.0	49.0			28.0	28.0		21.0	21.0			
Effective Green, g (s)	50.0	50.0			29.0	29.0		22.0	22.0			
Actuated g/C Ratio	0.62	0.62			0.36	0.36		0.28	0.28			
Clearance Time (s)	5.0	5.0			5.0	5.0		5.0	5.0			
Vehicle Extension (s)	0.2	0.2			0.2	0.2		0.2	0.2			
Lane Grp Cap (vph)	440	1072			628	519		892	374			
v/s Ratio Prot	c0.23	0.37			c0.44							
v/s Ratio Perm	0.44					0.08		0.26	0.05			
v/c Ratio	1.06	0.60			1.20	0.22		0.96	0.16			
Uniform Delay, d1	28.2	9.0			25.5	17.7		28.5	22.0			
Progression Factor	0.50	0.20			1.00	1.00		1.00	1.00			
Incremental Delay, d2	33.0	0.1			105.7	0.1		21.4	0.9			
Delay (s)	47.1	1.8			131.2	17.7		50.0	23.0			
Level of Service	D	A			F	B		D	C			
Approach Delay (s)		20.9			109.9			44.4			0.0	
Approach LOS		C			F			D			A	
Intersection Summary												
HCM 2000 Control Delay			55.6				HCM 2000 Level of Service		E			
HCM 2000 Volume to Capacity ratio			1.09									
Actuated Cycle Length (s)			80.0				Sum of lost time (s)		12.0			
Intersection Capacity Utilization			99.3%				ICU Level of Service		F			
Analysis Period (min)			15									
c Critical Lane Group												

HCM Signalized Intersection Capacity Analysis

27: Bond St & Arizona Ave

04/12/2019

												
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	365	1445	0	0	0	0	0	510	265	0	0	0
Future Volume (vph)	365	1445	0	0	0	0	0	510	265	0	0	0
Ideal Flow (vphpl)	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750
Total Lost time (s)		4.0						4.0				
Lane Util. Factor		0.95						0.95				
Frpb, ped/bikes		1.00						0.99				
Flpb, ped/bikes		1.00						1.00				
Frt		1.00						0.95				
Flt Protected		0.99						1.00				
Satd. Flow (prot)		3230						3106				
Flt Permitted		0.99						1.00				
Satd. Flow (perm)		3230						3106				
Peak-hour factor, PHF	0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.88
Adj. Flow (vph)	415	1642	0	0	0	0	0	580	301	0	0	0
RTOR Reduction (vph)	0	39	0	0	0	0	0	9	0	0	0	0
Lane Group Flow (vph)	0	2018	0	0	0	0	0	872	0	0	0	0
Confl. Peds. (#/hr)	5		7	7		5	10		4	4		10
Confl. Bikes (#/hr)			3						1			
Heavy Vehicles (%)	1%	2%	0%	0%	0%	0%	0%	1%	1%	0%	0%	0%
Turn Type	Perm	NA						NA				
Protected Phases		2						8				
Permitted Phases	2											
Actuated Green, G (s)		29.2						17.8				
Effective Green, g (s)		29.7						18.3				
Actuated g/C Ratio		0.53						0.33				
Clearance Time (s)		4.5						4.5				
Vehicle Extension (s)		2.6						2.0				
Lane Grp Cap (vph)		1713						1014				
v/s Ratio Prot								c0.28				
v/s Ratio Perm		0.62										
v/c Ratio		1.18						0.86				
Uniform Delay, d1		13.2						17.6				
Progression Factor		1.00						1.00				
Incremental Delay, d2		86.6						7.1				
Delay (s)		99.7						24.8				
Level of Service		F						C				
Approach Delay (s)		99.7			0.0			24.8			0.0	
Approach LOS		F			A			C			A	
Intersection Summary												
HCM 2000 Control Delay			77.2					HCM 2000 Level of Service			E	
HCM 2000 Volume to Capacity ratio			1.06									
Actuated Cycle Length (s)			56.0					Sum of lost time (s)		8.0		
Intersection Capacity Utilization			89.5%					ICU Level of Service		E		
Analysis Period (min)			15									
c Critical Lane Group												

Intersection						
Int Delay, s/veh	9.8					
Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Traffic Vol, veh/h	60	45	715	50	60	710
Future Vol, veh/h	60	45	715	50	60	710
Conflicting Peds, #/hr	1	0	0	28	28	0
Sign Control	Stop	Stop	Free	Free	Free	Free
RT Channelized	-	None	-	None	-	None
Storage Length	0	-	-	-	0	-
Veh in Median Storage, #	0	-	0	-	-	0
Grade, %	0	-	0	-	-	0
Peak Hour Factor	89	89	89	89	89	89
Heavy Vehicles, %	0	0	1	0	0	1
Mvmt Flow	67	51	803	56	67	798
Major/Minor	Minor1	Major1	Major2			
Conflicting Flow All	1792	859	0	0	887	0
Stage 1	859	-	-	-	-	-
Stage 2	933	-	-	-	-	-
Critical Hdwy	6.4	6.2	-	-	4.1	-
Critical Hdwy Stg 1	5.4	-	-	-	-	-
Critical Hdwy Stg 2	5.4	-	-	-	-	-
Follow-up Hdwy	3.5	3.3	-	-	2.2	-
Pot Cap-1 Maneuver	90	359	-	-	772	-
Stage 1	418	-	-	-	-	-
Stage 2	386	-	-	-	-	-
Platoon blocked, %			-	-		-
Mov Cap-1 Maneuver	80	351	-	-	754	-
Mov Cap-2 Maneuver	80	-	-	-	-	-
Stage 1	372	-	-	-	-	-
Stage 2	386	-	-	-	-	-
Approach	WB	NB	SB			
HCM Control Delay, s	146.5	0	0.8			
HCM LOS	F					
Minor Lane/Major Mvmt	NBT	NBRWBLn1	SBL	SBT		
Capacity (veh/h)	-	-	120	754	-	
HCM Lane V/C Ratio	-	-	0.983	0.089	-	
HCM Control Delay (s)	-	-	146.5	10.2	-	
HCM Lane LOS	-	-	F	B	-	
HCM 95th %tile Q(veh)	-	-	6.5	0.3	-	

HCM Signalized Intersection Capacity Analysis

113: Greenwood Ave & Wall St

04/12/2019

												
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	145	410	185	380	705	25	0	0	0	115	500	215
Future Volume (vph)	145	410	185	380	705	25	0	0	0	115	500	215
Ideal Flow (vphpl)	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750
Total Lost time (s)	4.0	4.0		4.0	4.0						4.0	4.0
Lane Util. Factor	1.00	0.95		1.00	1.00						0.95	1.00
Frpb, ped/bikes	1.00	0.98		1.00	1.00						1.00	0.88
Flpb, ped/bikes	1.00	1.00		1.00	1.00						1.00	1.00
Frt	1.00	0.95		1.00	0.99						1.00	0.85
Flt Protected	0.95	1.00		0.95	1.00						0.99	1.00
Satd. Flow (prot)	1646	3066		1646	1722						3256	1295
Flt Permitted	0.95	1.00		0.95	1.00						0.99	1.00
Satd. Flow (perm)	1646	3066		1646	1722						3256	1295
Peak-hour factor, PHF	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95
Adj. Flow (vph)	153	432	195	400	742	26	0	0	0	121	526	226
RTOR Reduction (vph)	0	64	0	0	2	0	0	0	0	0	0	169
Lane Group Flow (vph)	153	563	0	400	766	0	0	0	0	0	647	57
Confl. Peds. (#/hr)	12		47	47		12	38		18	18		38
Confl. Bikes (#/hr)			1			11			1			24
Heavy Vehicles (%)	1%	2%	0%	1%	1%	0%	0%	0%	0%	0%	1%	1%
Turn Type	Prot	NA		Prot	NA					Perm	NA	Perm
Protected Phases	5	2		1	6						4	
Permitted Phases										4		4
Actuated Green, G (s)	9.1	26.5		21.3	38.7						20.2	20.2
Effective Green, g (s)	9.1	26.5		21.3	38.7						20.2	20.2
Actuated g/C Ratio	0.11	0.33		0.27	0.48						0.25	0.25
Clearance Time (s)	4.0	4.0		4.0	4.0						4.0	4.0
Vehicle Extension (s)	3.0	3.0		3.0	3.0						3.0	3.0
Lane Grp Cap (vph)	187	1015		438	833						822	326
v/s Ratio Prot	0.09	0.18		c0.24	c0.45							
v/s Ratio Perm											0.20	0.04
v/c Ratio	0.82	0.56		0.91	0.92						0.79	0.18
Uniform Delay, d1	34.6	21.9		28.5	19.2						27.9	23.4
Progression Factor	1.00	1.00		1.00	1.00						1.00	1.00
Incremental Delay, d2	23.4	2.2		23.2	16.9						5.0	0.3
Delay (s)	58.1	24.1		51.7	36.1						32.9	23.6
Level of Service	E	C		D	D						C	C
Approach Delay (s)		30.8			41.5			0.0			30.5	
Approach LOS		C			D			A			C	
Intersection Summary												
HCM 2000 Control Delay			35.1			HCM 2000 Level of Service				D		
HCM 2000 Volume to Capacity ratio			0.91									
Actuated Cycle Length (s)			80.0			Sum of lost time (s)			12.0			
Intersection Capacity Utilization			82.6%			ICU Level of Service			E			
Analysis Period (min)			15									
c Critical Lane Group												

Truman Ave, Reed Ln, Nels Anderson Pl Closure HCM Reports

HCM Signalized Intersection Capacity Analysis

3: US 97 & Robal Rd

04/12/2019

												
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	235	70	95	290	95	45	370	2285	60	90	2380	50
Future Volume (vph)	235	70	95	290	95	45	370	2285	60	90	2380	50
Ideal Flow (vphpl)	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750
Total Lost time (s)	4.0	4.0	4.0	4.0	4.0		4.0	4.0		4.0	4.0	
Lane Util. Factor	0.95	0.95	1.00	1.00	1.00		0.97	0.95		1.00	0.95	
Frpb, ped/bikes	1.00	1.00	1.00	1.00	1.00		1.00	1.00		1.00	1.00	
Flpb, ped/bikes	1.00	1.00	1.00	1.00	1.00		1.00	1.00		1.00	1.00	
Frt	1.00	1.00	0.85	1.00	0.95		1.00	1.00		1.00	1.00	
Flt Protected	0.95	0.97	1.00	0.95	1.00		0.95	1.00		0.95	1.00	
Satd. Flow (prot)	1548	1597	1488	1646	1512		3225	3210		1511	3131	
Flt Permitted	0.95	0.97	1.00	0.95	1.00		0.95	1.00		0.95	1.00	
Satd. Flow (perm)	1548	1597	1488	1646	1512		3225	3210		1511	3131	
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	255	76	103	315	103	49	402	2484	65	98	2587	54
RTOR Reduction (vph)	0	0	87	0	11	0	0	1	0	0	1	0
Lane Group Flow (vph)	150	181	16	315	141	0	402	2548	0	98	2640	0
Confl. Peds. (#/hr)	1					1			4	4		
Heavy Vehicles (%)	2%	0%	0%	1%	9%	11%	0%	3%	7%	10%	6%	0%
Turn Type	Split	NA	Prot	Split	NA		Prot	NA		Prot	NA	
Protected Phases	4	4	4	8	8		5	2		1	6	
Permitted Phases												
Actuated Green, G (s)	21.8	21.8	21.8	28.0	28.0		9.0	61.2		16.0	68.2	
Effective Green, g (s)	22.8	22.8	22.8	29.0	29.0		10.0	63.2		17.0	70.2	
Actuated g/C Ratio	0.15	0.15	0.15	0.20	0.20		0.07	0.43		0.11	0.47	
Clearance Time (s)	5.0	5.0	5.0	5.0	5.0		5.0	6.0		5.0	6.0	
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0		3.0	3.0		3.0	3.0	
Lane Grp Cap (vph)	238	246	229	322	296		217	1370		173	1485	
v/s Ratio Prot	0.10	c0.11	0.01	c0.19	0.09		c0.12	c0.79		0.06	c0.84	
v/s Ratio Perm												
v/c Ratio	0.63	0.74	0.07	0.98	0.48		1.85	1.86		0.57	1.78	
Uniform Delay, d1	58.7	59.7	53.5	59.2	52.8		69.0	42.4		62.0	38.9	
Progression Factor	1.00	1.00	1.00	1.00	1.00		1.00	1.00		1.00	1.00	
Incremental Delay, d2	5.3	10.9	0.1	43.8	1.2		400.9	389.7		4.2	352.7	
Delay (s)	64.0	70.6	53.7	102.9	54.0		469.9	432.1		66.2	391.6	
Level of Service	E	E	D	F	D		F	F		E	F	
Approach Delay (s)		64.3			87.0			437.3			380.0	
Approach LOS		E			F			F			F	
Intersection Summary												
HCM 2000 Control Delay			364.1			HCM 2000 Level of Service				F		
HCM 2000 Volume to Capacity ratio			1.45									
Actuated Cycle Length (s)			148.0			Sum of lost time (s)				16.0		
Intersection Capacity Utilization			124.6%			ICU Level of Service				H		
Analysis Period (min)			15									

c Critical Lane Group

HCM Signalized Intersection Capacity Analysis

16: Arizona Ave & NW Colorado Ave

04/12/2019

												
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	0	0	0	0	415	35	10	425	1195	150	0	645
Future Volume (vph)	0	0	0	0	415	35	10	425	1195	150	0	645
Ideal Flow (vphpl)	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750
Total Lost time (s)					4.0			4.0	4.0	4.0		4.0
Lane Util. Factor					1.00			1.00	1.00	1.00		1.00
Frpb, ped/bikes					1.00			1.00	0.99	1.00		0.99
Flpb, ped/bikes					1.00			1.00	1.00	1.00		1.00
Frt					0.99			1.00	0.85	1.00		0.85
Flt Protected					1.00			1.00	1.00	0.95		1.00
Satd. Flow (prot)					1712			1731	1458	1630		1468
Flt Permitted					1.00			1.00	1.00	0.95		1.00
Satd. Flow (perm)					1712			1731	1458	1630		1468
Peak-hour factor, PHF	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90
Adj. Flow (vph)	0	0	0	0	461	39	11	472	1328	167	0	717
RTOR Reduction (vph)	0	0	0	0	7	0	0	0	314	0	0	218
Lane Group Flow (vph)	0	0	0	0	493	0	0	483	1014	167	0	499
Confl. Peds. (#/hr)	2					2	1		1	1		1
Confl. Bikes (#/hr)						2						
Heavy Vehicles (%)	0%	0%	0%	0%	1%	0%	0%	1%	1%	2%	0%	0%
Turn Type					NA		Split	NA	custom	Prot		Perm
Protected Phases		2			6		8	8	1	4		
Permitted Phases									2 8			4
Actuated Green, G (s)					33.0			27.0	60.0	27.0		27.0
Effective Green, g (s)					34.0			28.0	62.0	28.0		28.0
Actuated g/C Ratio					0.33			0.27	0.61	0.27		0.27
Clearance Time (s)					5.0			5.0	5.0	5.0		5.0
Vehicle Extension (s)					3.0			3.0	3.0	3.0		3.0
Lane Grp Cap (vph)					570			475	943	447		402
v/s Ratio Prot					0.29			0.28	c0.36	0.10		
v/s Ratio Perm									0.34			c0.34
v/c Ratio					0.87			1.02	1.08	0.37		1.24
Uniform Delay, d1					31.9			37.0	20.0	29.9		37.0
Progression Factor					1.00			1.00	1.00	1.00		1.00
Incremental Delay, d2					16.1			45.6	51.8	0.5		128.5
Delay (s)					47.9			82.6	71.8	30.4		165.5
Level of Service					D			F	E	C		F
Approach Delay (s)		0.0			47.9			74.7			140.0	
Approach LOS		A			D			E			F	
Intersection Summary												
HCM 2000 Control Delay			88.6		HCM 2000 Level of Service					F		
HCM 2000 Volume to Capacity ratio			1.23									
Actuated Cycle Length (s)			102.0		Sum of lost time (s)					16.0		
Intersection Capacity Utilization			104.4%		ICU Level of Service					G		
Analysis Period (min)			15									
c Critical Lane Group												

HCM Signalized Intersection Capacity Analysis

19: SW Reed Market Rd & US 97

04/12/2019

												
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		↑↑			↑	↗				↖	↑	
Traffic Volume (vph)	0	1125	100	0	775	360	0	0	0	980	0	245
Future Volume (vph)	0	1125	100	0	775	360	0	0	0	980	0	245
Ideal Flow (vphpl)	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750
Total Lost time (s)		4.0			4.0	4.0				4.0	4.0	
Lane Util. Factor		0.95			1.00	1.00				1.00	1.00	
Frpb, ped/bikes		1.00			1.00	0.99				1.00	1.00	
Flpb, ped/bikes		1.00			1.00	1.00				1.00	1.00	
Frt		0.99			1.00	0.85				1.00	0.85	
Flt Protected		1.00			1.00	1.00				0.95	1.00	
Satd. Flow (prot)		3214			1716	1441				1630	1458	
Flt Permitted		1.00			1.00	1.00				0.95	1.00	
Satd. Flow (perm)		3214			1716	1441				1630	1458	
Peak-hour factor, PHF	0.91	0.91	0.91	0.91	0.91	0.91	0.91	0.91	0.91	0.91	0.91	0.91
Adj. Flow (vph)	0	1236	110	0	852	396	0	0	0	1077	0	269
RTOR Reduction (vph)	0	56	0	0	0	24	0	0	0	0	46	0
Lane Group Flow (vph)	0	1290	0	0	852	372	0	0	0	1077	223	0
Confl. Peds. (#/hr)	2		1	1		2						
Confl. Bikes (#/hr)						1						
Heavy Vehicles (%)	0%	2%	2%	0%	2%	2%	0%	0%	0%	2%	0%	2%
Turn Type		NA			NA	custom				Perm	NA	
Protected Phases		2			6	4					4	
Permitted Phases						6				4		
Actuated Green, G (s)		28.0			28.0	56.0				28.0	28.0	
Effective Green, g (s)		29.0			29.0	58.0				29.0	29.0	
Actuated g/C Ratio		0.44			0.44	0.88				0.44	0.44	
Clearance Time (s)		5.0			5.0	5.0				5.0	5.0	
Vehicle Extension (s)		5.2			5.2	3.0				3.0	3.0	
Lane Grp Cap (vph)		1412			754	1441				716	640	
v/s Ratio Prot		0.40			c0.50	0.11					0.15	
v/s Ratio Perm						0.14				c0.66		
v/c Ratio		0.91			1.13	0.26				1.50	0.35	
Uniform Delay, d1		17.3			18.5	0.6				18.5	12.2	
Progression Factor		1.00			1.00	1.00				1.00	1.00	
Incremental Delay, d2		9.9			74.7	0.1				234.2	0.3	
Delay (s)		27.2			93.2	0.7				252.7	12.6	
Level of Service		C			F	A				F	B	
Approach Delay (s)		27.2			63.9			0.0			204.7	
Approach LOS		C			E			A			F	
Intersection Summary												
HCM 2000 Control Delay			99.4				HCM 2000 Level of Service			F		
HCM 2000 Volume to Capacity ratio			1.32									
Actuated Cycle Length (s)			66.0				Sum of lost time (s)			8.0		
Intersection Capacity Utilization			109.9%				ICU Level of Service			H		
Analysis Period (min)			15									
c Critical Lane Group												

Intersection												
Int Delay, s/veh	2.4											
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		↔↔			↔↔				↔		↔↔	
Traffic Vol, veh/h	105	1255	775	5	1030	490	0	0	40	5	0	15
Future Vol, veh/h	105	1255	775	5	1030	490	0	0	40	5	0	15
Conflicting Peds, #/hr	1	0	0	0	0	1	0	0	0	0	0	0
Sign Control	Free	Free	Free	Free	Free	Free	Stop	Stop	Stop	Stop	Stop	Stop
RT Channelized	-	-	None	-	-	None	-	-	Stop	-	-	None
Storage Length	-	-	-	-	-	-	-	-	0	-	-	-
Veh in Median Storage, #	-	0	-	-	0	-	-	0	-	-	0	-
Grade, %	-	0	-	-	0	-	-	0	-	-	0	-
Peak Hour Factor	95	95	95	95	95	95	95	95	95	95	95	95
Heavy Vehicles, %	2	2	2	0	1	4	0	0	5	0	0	6
Mvmt Flow	111	1321	816	5	1084	516	0	0	42	5	0	16

Major/Minor	Major1			Major2			Minor1			Minor2		
Conflicting Flow All	1601	0	0	2137	0	0	-	-	1069	2236	3712	801
Stage 1	-	-	-	-	-	-	-	-	-	1353	1353	-
Stage 2	-	-	-	-	-	-	-	-	-	883	2359	-
Critical Hdwy	4.14	-	-	4.1	-	-	-	-	7	7.5	6.5	7.02
Critical Hdwy Stg 1	-	-	-	-	-	-	-	-	-	6.5	5.5	-
Critical Hdwy Stg 2	-	-	-	-	-	-	-	-	-	6.5	5.5	-
Follow-up Hdwy	2.22	-	-	2.2	-	-	-	-	3.35	3.5	4	3.36
Pot Cap-1 Maneuver	405	-	-	257	-	-	0	0	212	24	5	319
Stage 1	-	-	-	-	-	-	0	0	-	161	220	-
Stage 2	-	-	-	-	-	-	0	0	-	311	69	-
Platoon blocked, %	-	-	-	-	-	-	-	-	-	-	-	-
Mov Cap-1 Maneuver	405	-	-	257	-	-	-	-	212	14	3	319
Mov Cap-2 Maneuver	-	-	-	-	-	-	-	-	-	14	3	-
Stage 1	-	-	-	-	-	-	-	-	-	161	140	-
Stage 2	-	-	-	-	-	-	-	-	-	249	69	-

Approach	EB			WB			NB			SB		
HCM Control Delay, s	0.8			2.4			26.1			125.3		
HCM LOS							D			F		

Minor Lane/Major Mvmt	NBLn1	EBL	EBT	EBR	WBL	WBT	WBR	SBLn1
Capacity (veh/h)	212	405	-	-	257	-	-	49
HCM Lane V/C Ratio	0.199	0.273	-	-	0.02	-	-	0.43
HCM Control Delay (s)	26.1	17.2	0	-	19.3	3.5	-	125.3
HCM Lane LOS	D	C	A	-	C	A	-	F
HCM 95th %tile Q(veh)	0.7	1.1	-	-	0.1	-	-	1.6

HCM Signalized Intersection Capacity Analysis

52: SW Reed Market Rd & SE 3rd St

04/12/2019

												
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	190	895	175	170	485	80	555	760	250	110	945	310
Future Volume (vph)	190	895	175	170	485	80	555	760	250	110	945	310
Ideal Flow (vphpl)	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750
Total Lost time (s)		4.0			4.0		4.0	4.0		4.0	4.0	
Lane Util. Factor		0.95			0.95		1.00	0.95		1.00	0.95	
Frpb, ped/bikes		1.00			1.00		1.00	0.99		1.00	1.00	
Flpb, ped/bikes		1.00			1.00		1.00	1.00		1.00	1.00	
Frt		0.98			0.98		1.00	0.96		1.00	0.96	
Flt Protected		0.99			0.99		0.95	1.00		0.95	1.00	
Satd. Flow (prot)		3123			3162		1646	3101		1630	3128	
Flt Permitted		0.99			0.99		0.95	1.00		0.95	1.00	
Satd. Flow (perm)		3123			3162		1646	3101		1630	3128	
Peak-hour factor, PHF	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96
Adj. Flow (vph)	198	932	182	177	505	83	578	792	260	115	984	323
RTOR Reduction (vph)	0	9	0	0	6	0	0	21	0	0	21	0
Lane Group Flow (vph)	0	1303	0	0	759	0	578	1031	0	115	1286	0
Confl. Peds. (#/hr)	2		1	1		2	1		9	9		1
Confl. Bikes (#/hr)									1			
Heavy Vehicles (%)	3%	3%	5%	2%	2%	3%	1%	3%	1%	2%	2%	2%
Turn Type	Split	NA		Split	NA		Prot	NA		Prot	NA	
Protected Phases	3	3		4	4		1	6		5	2	
Permitted Phases												
Actuated Green, G (s)		42.5			29.5		20.5	51.3		8.7	39.5	
Effective Green, g (s)		43.0			30.0		21.0	51.8		9.2	40.0	
Actuated g/C Ratio		0.29			0.20		0.14	0.35		0.06	0.27	
Clearance Time (s)		4.5			4.5		4.5	4.5		4.5	4.5	
Vehicle Extension (s)		2.5			2.5		2.5	4.3		2.5	4.3	
Lane Grp Cap (vph)		895			632		230	1070		99	834	
v/s Ratio Prot		c0.42			c0.24		c0.35	0.33		0.07	c0.41	
v/s Ratio Perm												
v/c Ratio		1.46			1.20		2.51	0.96		1.16	1.54	
Uniform Delay, d1		53.5			60.0		64.5	48.2		70.4	55.0	
Progression Factor		1.00			1.00		1.00	1.00		1.00	1.00	
Incremental Delay, d2		211.6			104.8		693.6	20.0		140.4	249.7	
Delay (s)		265.1			164.8		758.1	68.2		210.8	304.7	
Level of Service		F			F		F	E		F	F	
Approach Delay (s)		265.1			164.8			312.9			297.1	
Approach LOS		F			F			F			F	
Intersection Summary												
HCM 2000 Control Delay		274.2					HCM 2000 Level of Service			F		
HCM 2000 Volume to Capacity ratio		1.59										
Actuated Cycle Length (s)		150.0					Sum of lost time (s)			16.0		
Intersection Capacity Utilization		147.6%					ICU Level of Service			H		
Analysis Period (min)		15										
c Critical Lane Group												

US 97 Bend Parkway Future No Build

Vistro File:

Scenario: Base Scenario

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Closure.vistro

Report File:

3/27/2019

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sure.pdf**Intersection Analysis Summary**

ID	Intersection Name	Control Type	Method	Worst Mvmt	V/C	Delay (s/veh)	LOS
1	Reed Market and Brookwood	Roundabout	HCM 6th Edition	SEB Thru		439.3	F

V/C, Delay, LOS: For two-way stop, these values are taken from the movement with the worst (highest) delay value. For all other control types, they are taken for the whole intersection.

Intersection Level Of Service Report

Intersection 1: Reed Market and Brookwood

Control Type: Roundabout
 Analysis Method: HCM 6th Edition
 Analysis Period: 15 minutes

Delay (sec / veh): 439.3
 Level Of Service: F

Intersection Setup

Name												
Approach	Northeastbound			Southwestbound			Northwestbound			Southeastbound		
Lane Configuration												
Turning Movement	Left	Thru	Right	Left	Thru	Right	Left	Thru	Right	Left	Thru	Right
Lane Width [ft]	12.00	12.00	12.00	12.00	12.00	12.00	12.00	12.00	12.00	12.00	12.00	12.00
No. of Lanes in Pocket	0	0	0	0	0	0	0	0	0	0	0	0
Pocket Length [ft]	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00
Speed [mph]	25.00			25.00			25.00			25.00		
Grade [%]	0.00			0.00			0.00			0.00		
Crosswalk	Yes			Yes			Yes			Yes		

Volumes

Name												
Base Volume Input [veh/h]	255	300	150	450	550	70	155	390	295	90	585	330
Base Volume Adjustment Factor	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000
Heavy Vehicles Percentage [%]	0.00	1.00	5.00	1.00	1.00	0.00	2.00	1.00	3.00	0.00	1.00	1.00
Growth Rate	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
In-Process Volume [veh/h]	0	0	0	0	0	0	0	0	0	0	0	0
Site-Generated Trips [veh/h]	0	0	0	0	0	0	0	0	0	0	0	0
Diverted Trips [veh/h]	0	0	0	0	0	0	0	0	0	0	0	0
Pass-by Trips [veh/h]	0	0	0	0	0	0	0	0	0	0	0	0
Existing Site Adjustment Volume [veh/h]	0	0	0	0	0	0	0	0	0	0	0	0
Other Volume [veh/h]	0	0	0	0	0	0	0	0	0	0	0	0
Total Hourly Volume [veh/h]	255	300	150	450	550	70	155	390	295	90	585	330
Peak Hour Factor	0.9700	0.9700	0.9700	0.9700	0.9700	0.9700	0.9700	0.9700	0.9700	0.9700	0.9700	0.9700
Other Adjustment Factor	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000
Total 15-Minute Volume [veh/h]	66	77	39	116	142	18	40	101	76	23	151	85
Total Analysis Volume [veh/h]	263	309	155	464	567	72	160	402	304	93	603	340
Pedestrian Volume [ped/h]	0			0			0			0		

Intersection Settings

Number of Conflicting Circulating Lanes	1			1			1			1		
Circulating Flow Rate [veh/h]	1171			832			668			1205		
Exiting Flow Rate [veh/h]	1079			718			1240			741		
Demand Flow Rate [veh/h]	255	300	150	450	550	70	155	390	295	90	585	330
Adjusted Demand Flow Rate [veh/h]	263	309	155	464	567	72	160	402	304	93	603	340

Lanes

Overwrite Calculated Critical Headway	No			No			No			No		
User-Defined Critical Headway [s]	4.00			4.00			4.00			4.00		
Overwrite Calculated Follow-Up Time	No			No			No			No		
User-Defined Follow-Up Time [s]	3.00			3.00			3.00			3.00		
A (intercept)	1380.00			1380.00			1380.00			1380.00		
B (coefficient)	0.00102			0.00102			0.00102			0.00102		
HV Adjustment Factor	0.99			0.99			0.98			0.99		
Entry Flow Rate [veh/h]	738			1114			883			1046		
Capacity of Entry and Bypass Lanes [veh/h]	419			591			699			404		
Pedestrian Impedance	1.00			1.00			1.00			1.00		
Capacity per Entry Lane [veh/h]	413			586			686			401		
X, volume / capacity	1.76			1.89			1.26			2.59		

Movement, Approach, & Intersection Results

Lane LOS	F	F	F	F
95th-Percentile Queue Length [veh]	45.37	70.60	32.57	84.08
95th-Percentile Queue Length [ft]	1134.24	1765.09	814.17	2102.11
Approach Delay [s/veh]	376.67	422.26	150.29	743.02
Approach LOS	F	F	F	F
Intersection Delay [s/veh]	439.31			
Intersection LOS	F			

All Closure HCM Reports

HCM Signalized Intersection Capacity Analysis

3: US 97 & Robal Rd

04/16/2019

												
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	235	70	95	290	100	45	375	2280	60	90	2385	50
Future Volume (vph)	235	70	95	290	100	45	375	2280	60	90	2385	50
Ideal Flow (vphpl)	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750
Total Lost time (s)	4.0	4.0	4.0	4.0	4.0		4.0	4.0		4.0	4.0	
Lane Util. Factor	0.95	0.95	1.00	1.00	1.00		0.97	0.95		1.00	0.95	
Frpb, ped/bikes	1.00	1.00	1.00	1.00	1.00		1.00	1.00		1.00	1.00	
Flpb, ped/bikes	1.00	1.00	1.00	1.00	1.00		1.00	1.00		1.00	1.00	
Frt	1.00	1.00	0.85	1.00	0.95		1.00	1.00		1.00	1.00	
Flt Protected	0.95	0.97	1.00	0.95	1.00		0.95	1.00		0.95	1.00	
Satd. Flow (prot)	1548	1597	1488	1646	1516		3225	3210		1511	3131	
Flt Permitted	0.95	0.97	1.00	0.95	1.00		0.95	1.00		0.95	1.00	
Satd. Flow (perm)	1548	1597	1488	1646	1516		3225	3210		1511	3131	
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	255	76	103	315	109	49	408	2478	65	98	2592	54
RTOR Reduction (vph)	0	0	87	0	11	0	0	1	0	0	1	0
Lane Group Flow (vph)	150	181	16	315	147	0	408	2542	0	98	2645	0
Confl. Peds. (#/hr)	1					1			4	4		
Heavy Vehicles (%)	2%	0%	0%	1%	9%	11%	0%	3%	7%	10%	6%	0%
Turn Type	Split	NA	Prot	Split	NA		Prot	NA		Prot	NA	
Protected Phases	4	4	4	8	8		5	2		1	6	
Permitted Phases												
Actuated Green, G (s)	21.8	21.8	21.8	28.0	28.0		9.0	61.2		16.0	68.2	
Effective Green, g (s)	22.8	22.8	22.8	29.0	29.0		10.0	63.2		17.0	70.2	
Actuated g/C Ratio	0.15	0.15	0.15	0.20	0.20		0.07	0.43		0.11	0.47	
Clearance Time (s)	5.0	5.0	5.0	5.0	5.0		5.0	6.0		5.0	6.0	
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0		3.0	3.0		3.0	3.0	
Lane Grp Cap (vph)	238	246	229	322	297		217	1370		173	1485	
v/s Ratio Prot	0.10	c0.11	0.01	c0.19	0.10		c0.13	c0.79		0.06	c0.84	
v/s Ratio Perm												
v/c Ratio	0.63	0.74	0.07	0.98	0.49		1.88	1.86		0.57	1.78	
Uniform Delay, d1	58.7	59.7	53.5	59.2	53.0		69.0	42.4		62.0	38.9	
Progression Factor	1.00	1.00	1.00	1.00	1.00		1.00	1.00		1.00	1.00	
Incremental Delay, d2	5.3	10.9	0.1	43.8	1.3		413.1	387.7		4.2	354.2	
Delay (s)	64.0	70.6	53.7	102.9	54.3		482.1	430.1		66.2	393.1	
Level of Service	E	E	D	F	D		F	F		E	F	
Approach Delay (s)		64.3			86.7			437.3			381.5	
Approach LOS		E			F			F			F	
Intersection Summary												
HCM 2000 Control Delay			364.5			HCM 2000 Level of Service				F		
HCM 2000 Volume to Capacity ratio			1.45									
Actuated Cycle Length (s)			148.0			Sum of lost time (s)				16.0		
Intersection Capacity Utilization			124.9%			ICU Level of Service				H		
Analysis Period (min)			15									

c Critical Lane Group

HCM Signalized Intersection Capacity Analysis

12: NW Wall St & NE Revere Ave

04/16/2019

												
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		↔		↔	↔		↔	↑	↔	↔	↔	↔
Traffic Volume (vph)	10	135	30	700	130	280	70	280	905	215	460	5
Future Volume (vph)	10	135	30	700	130	280	70	280	905	215	460	5
Ideal Flow (vphpl)	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750
Total Lost time (s)		4.0		4.0	4.0		4.0	4.0	4.0	4.0	4.0	
Lane Util. Factor		1.00		1.00	1.00		1.00	1.00	1.00	1.00	1.00	
Frpb, ped/bikes		0.99		1.00	0.99		1.00	1.00	0.99	1.00	1.00	
Flpb, ped/bikes		1.00		1.00	1.00		1.00	1.00	1.00	1.00	1.00	
Frt		0.98		1.00	0.90		1.00	1.00	0.85	1.00	1.00	
Flt Protected		1.00		0.95	1.00		0.95	1.00	1.00	0.95	1.00	
Satd. Flow (prot)		1695		1662	1537		1662	1750	1463	1613	1747	
Flt Permitted		1.00		0.95	1.00		0.15	1.00	1.00	0.40	1.00	
Satd. Flow (perm)		1695		1662	1537		260	1750	1463	674	1747	
Peak-hour factor, PHF	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90
Adj. Flow (vph)	11	150	33	778	144	311	78	311	1006	239	511	6
RTOR Reduction (vph)	0	7	0	0	65	0	0	0	94	0	1	0
Lane Group Flow (vph)	0	187	0	778	390	0	78	311	912	239	516	0
Confl. Peds. (#/hr)			5	5					1	1		
Confl. Bikes (#/hr)						2			1			
Heavy Vehicles (%)	0%	0%	0%	0%	0%	1%	0%	0%	1%	3%	0%	0%
Turn Type	Split	NA		Split	NA		Perm	NA	pm+ov	Perm	NA	
Protected Phases	8	8		4	4			6			2	
Permitted Phases							6		6		2	
Actuated Green, G (s)		16.5		44.1	44.1		37.0	37.0	81.1	37.0	37.0	
Effective Green, g (s)		17.5		45.1	45.1		38.0	38.0	83.1	38.0	38.0	
Actuated g/C Ratio		0.16		0.40	0.40		0.34	0.34	0.74	0.34	0.34	
Clearance Time (s)		5.0		5.0	5.0		5.0	5.0	5.0	5.0	5.0	
Vehicle Extension (s)		2.5		4.0	4.0		5.2	5.2	4.0	5.2	5.2	
Lane Grp Cap (vph)		263		665	615		87	590	1131	227	589	
v/s Ratio Prot		c0.11		c0.47	0.25			0.18	0.32		0.30	
v/s Ratio Perm							0.30		0.30	c0.35		
v/c Ratio		0.71		1.17	0.63		0.90	0.53	0.81	1.05	0.88	
Uniform Delay, d1		45.2		33.8	27.1		35.4	30.1	9.5	37.3	35.1	
Progression Factor		1.00		1.00	1.00		1.00	1.00	1.00	1.00	1.00	
Incremental Delay, d2		8.2		92.0	2.4		66.3	1.7	4.5	74.3	14.9	
Delay (s)		53.4		125.7	29.5		101.7	31.8	14.1	111.6	50.0	
Level of Service		D		F	C		F	C	B	F	D	
Approach Delay (s)		53.4			90.2			22.9			69.5	
Approach LOS		D			F			C			E	
Intersection Summary												
HCM 2000 Control Delay			57.6			HCM 2000 Level of Service			E			
HCM 2000 Volume to Capacity ratio			1.04									
Actuated Cycle Length (s)			112.6			Sum of lost time (s)			12.0			
Intersection Capacity Utilization			101.9%			ICU Level of Service			G			
Analysis Period (min)			15									
c Critical Lane Group												

HCM Signalized Intersection Capacity Analysis

13: US 20 & Olney Ave

04/16/2019

												
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	160	300	100	170	300	85	100	1300	105	120	1195	40
Future Volume (vph)	160	300	100	170	300	85	100	1300	105	120	1195	40
Ideal Flow (vphpl)	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750
Total Lost time (s)	4.0	4.0		4.0	4.0		4.0	4.0		4.0	4.0	
Lane Util. Factor	1.00	1.00		1.00	1.00		1.00	0.95		1.00	0.95	
Frpb, ped/bikes	1.00	1.00		1.00	1.00		1.00	1.00		1.00	1.00	
Flpb, ped/bikes	1.00	1.00		1.00	1.00		1.00	1.00		1.00	1.00	
Frt	1.00	0.96		1.00	0.97		1.00	0.99		1.00	1.00	
Flt Protected	0.95	1.00		0.95	1.00		0.95	1.00		0.95	1.00	
Satd. Flow (prot)	1644	1677		1659	1686		1662	3189		1662	3210	
Flt Permitted	0.44	1.00		0.42	1.00		0.25	1.00		0.25	1.00	
Satd. Flow (perm)	762	1677		740	1686		437	3189		437	3210	
Peak-hour factor, PHF	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98
Adj. Flow (vph)	163	306	102	173	306	87	102	1327	107	122	1219	41
RTOR Reduction (vph)	0	10	0	0	7	0	0	15	0	0	6	0
Lane Group Flow (vph)	163	398	0	173	386	0	102	1419	0	122	1254	0
Confl. Peds. (#/hr)	3		5	5		3	4		1	1		4
Confl. Bikes (#/hr)			2			4						2
Heavy Vehicles (%)	1%	0%	0%	0%	0%	0%	0%	3%	2%	0%	3%	3%
Turn Type	Perm	NA		Perm	NA		Perm	NA		Perm	NA	
Protected Phases		4			8			2			6	
Permitted Phases	4			8			2			6		
Actuated Green, G (s)	16.0	16.0		16.0	16.0		16.0	16.0		16.0	16.0	
Effective Green, g (s)	16.0	16.0		16.0	16.0		16.0	16.0		16.0	16.0	
Actuated g/C Ratio	0.40	0.40		0.40	0.40		0.40	0.40		0.40	0.40	
Clearance Time (s)	4.0	4.0		4.0	4.0		4.0	4.0		4.0	4.0	
Lane Grp Cap (vph)	304	670		296	674		174	1275		174	1284	
v/s Ratio Prot		c0.24			0.23			c0.44			0.39	
v/s Ratio Perm	0.21			0.23			0.23			0.28		
v/c Ratio	0.54	0.59		0.58	0.57		0.59	1.11		0.70	0.98	
Uniform Delay, d1	9.2	9.4		9.4	9.3		9.4	12.0		10.0	11.8	
Progression Factor	1.00	1.00		1.00	1.00		1.00	1.00		1.00	1.00	
Incremental Delay, d2	6.6	3.8		8.2	3.5		13.7	62.2		21.0	20.1	
Delay (s)	15.8	13.3		17.6	12.9		23.1	74.2		31.0	31.9	
Level of Service	B	B		B	B		C	E		C	C	
Approach Delay (s)		14.0			14.3			70.8			31.8	
Approach LOS		B			B			E			C	
Intersection Summary												
HCM 2000 Control Delay			41.6			HCM 2000 Level of Service				D		
HCM 2000 Volume to Capacity ratio			0.85									
Actuated Cycle Length (s)			40.0			Sum of lost time (s)				8.0		
Intersection Capacity Utilization			97.3%			ICU Level of Service				F		
Analysis Period (min)			15									
c Critical Lane Group												

HCM Signalized Intersection Capacity Analysis

16: Arizona Ave & NW Colorado Ave

04/16/2019

												
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	0	0	0	0	400	45	10	555	1200	150	0	660
Future Volume (vph)	0	0	0	0	400	45	10	555	1200	150	0	660
Ideal Flow (vphpl)	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750
Total Lost time (s)					4.0			4.0	4.0	4.0		4.0
Lane Util. Factor					1.00			1.00	1.00	1.00		1.00
Frpb, ped/bikes					1.00			1.00	0.99	1.00		0.99
Flpb, ped/bikes					1.00			1.00	1.00	1.00		1.00
Frt					0.99			1.00	0.85	1.00		0.85
Flt Protected					1.00			1.00	1.00	0.95		1.00
Satd. Flow (prot)					1706			1731	1457	1630		1468
Flt Permitted					1.00			1.00	1.00	0.95		1.00
Satd. Flow (perm)					1706			1731	1457	1630		1468
Peak-hour factor, PHF	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90
Adj. Flow (vph)	0	0	0	0	444	50	11	617	1333	167	0	733
RTOR Reduction (vph)	0	0	0	0	7	0	0	0	314	0	0	218
Lane Group Flow (vph)	0	0	0	0	487	0	0	628	1019	167	0	515
Confl. Peds. (#/hr)	2						2	1		1		1
Confl. Bikes (#/hr)							2					
Heavy Vehicles (%)	0%	0%	0%	0%	1%	0%	0%	1%	1%	2%	0%	0%
Turn Type					NA		Split	NA	custom	Prot		Perm
Protected Phases		2			6		8	8	1	4		
Permitted Phases									2 8			4
Actuated Green, G (s)					32.0			28.0	60.0	27.0		27.0
Effective Green, g (s)					33.0			29.0	62.0	28.0		28.0
Actuated g/C Ratio					0.32			0.28	0.61	0.27		0.27
Clearance Time (s)					5.0			5.0	5.0	5.0		5.0
Vehicle Extension (s)					3.0			3.0	3.0	3.0		3.0
Lane Grp Cap (vph)					551			492	942	447		402
v/s Ratio Prot					0.29			c0.36	c0.35	0.10		
v/s Ratio Perm									0.35			c0.35
v/c Ratio					0.88			1.28	1.08	0.37		1.28
Uniform Delay, d1					32.7			36.5	20.0	29.9		37.0
Progression Factor					1.00			1.00	1.00	1.00		1.00
Incremental Delay, d2					18.4			139.5	54.1	0.5		144.7
Delay (s)					51.1			176.0	74.1	30.4		181.7
Level of Service					D			F	E	C		F
Approach Delay (s)		0.0			51.1			106.7			153.7	
Approach LOS		A			D			F			F	
Intersection Summary												
HCM 2000 Control Delay			111.1		HCM 2000 Level of Service					F		
HCM 2000 Volume to Capacity ratio			1.29									
Actuated Cycle Length (s)			102.0		Sum of lost time (s)					16.0		
Intersection Capacity Utilization			112.6%		ICU Level of Service					H		
Analysis Period (min)			15									
c Critical Lane Group												

HCM Signalized Intersection Capacity Analysis

17: Wall St & Franklin Ave

04/16/2019

												
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		↻		↻	↻						↻↻	↻
Traffic Volume (vph)	0	705	40	250	555	0	0	0	0	180	615	295
Future Volume (vph)	0	705	40	250	555	0	0	0	0	180	615	295
Ideal Flow (vphpl)	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750
Total Lost time (s)		4.0		4.0	4.0						4.0	4.0
Lane Util. Factor		1.00		1.00	1.00						0.95	1.00
Frpb, ped/bikes		0.99		1.00	1.00						1.00	0.85
Flpb, ped/bikes		1.00		1.00	1.00						0.99	1.00
Frt		0.99		1.00	1.00						1.00	0.85
Flt Protected		1.00		0.95	1.00						0.99	1.00
Satd. Flow (prot)		1709		1614	1733						3223	1267
Flt Permitted		1.00		0.11	1.00						0.99	1.00
Satd. Flow (perm)		1709		189	1733						3223	1267
Peak-hour factor, PHF	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90
Adj. Flow (vph)	0	783	44	278	617	0	0	0	0	200	683	328
RTOR Reduction (vph)	0	2	0	0	0	0	0	0	0	0	0	166
Lane Group Flow (vph)	0	825	0	278	617	0	0	0	0	0	883	162
Confl. Peds. (#/hr)	30		138	138		30	71			53	53	71
Confl. Bikes (#/hr)			3			14						12
Heavy Vehicles (%)	0%	1%	0%	3%	1%	0%	0%	0%	0%	0%	1%	0%
Turn Type		NA		pm+pt	NA					Perm	NA	Perm
Protected Phases		8		7	4						2	
Permitted Phases				4						2		2
Actuated Green, G (s)		31.0		46.0	46.0						24.0	24.0
Effective Green, g (s)		32.0		47.0	47.0						25.0	25.0
Actuated g/C Ratio		0.40		0.59	0.59						0.31	0.31
Clearance Time (s)		5.0		5.0	5.0						5.0	5.0
Vehicle Extension (s)		0.2		0.2	0.2						0.2	0.2
Lane Grp Cap (vph)		683		306	1018						1007	395
v/s Ratio Prot		c0.48		c0.12	0.36							
v/s Ratio Perm				0.41							0.27	0.13
v/c Ratio		1.21		0.91	0.61						0.88	0.41
Uniform Delay, d1		24.0		30.6	10.6						26.0	21.7
Progression Factor		1.00		0.51	0.15						1.00	1.00
Incremental Delay, d2		106.7		3.9	0.1						10.7	3.1
Delay (s)		130.7		19.6	1.6						36.7	24.8
Level of Service		F		B	A						D	C
Approach Delay (s)		130.7			7.2			0.0			33.5	
Approach LOS		F			A			A			C	
Intersection Summary												
HCM 2000 Control Delay			52.9			HCM 2000 Level of Service				D		
HCM 2000 Volume to Capacity ratio			1.04									
Actuated Cycle Length (s)			80.0			Sum of lost time (s)				12.0		
Intersection Capacity Utilization			99.5%			ICU Level of Service				F		
Analysis Period (min)			15									
c Critical Lane Group												

HCM Signalized Intersection Capacity Analysis

18: Bond St & Franklin Ave

04/16/2019

												
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	415	595	0	0	725	160	110	655	215	0	0	0
Future Volume (vph)	415	595	0	0	725	160	110	655	215	0	0	0
Ideal Flow (vphpl)	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750
Total Lost time (s)	4.0	4.0			4.0	4.0		4.0	4.0			
Lane Util. Factor	1.00	1.00			1.00	1.00		0.95	1.00			
Frpb, ped/bikes	1.00	1.00			1.00	0.96		1.00	0.92			
Flpb, ped/bikes	1.00	1.00			1.00	1.00		0.98	1.00			
Frt	1.00	1.00			1.00	0.85		1.00	0.85			
Flt Protected	0.95	1.00			1.00	1.00		0.99	1.00			
Satd. Flow (prot)	1662	1716			1733	1434		3245	1362			
Flt Permitted	0.12	1.00			1.00	1.00		0.99	1.00			
Satd. Flow (perm)	212	1716			1733	1434		3245	1362			
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	451	647	0	0	788	174	120	712	234	0	0	0
RTOR Reduction (vph)	0	0	0	0	0	61	0	0	167	0	0	0
Lane Group Flow (vph)	451	647	0	0	788	113	0	832	67	0	0	0
Confl. Peds. (#/hr)	23		47	47		23	103		27	27		103
Confl. Bikes (#/hr)			3			7			4			
Heavy Vehicles (%)	0%	2%	0%	0%	1%	0%	0%	0%	1%	0%	0%	0%
Turn Type	pm+pt	NA			NA	Perm	Perm	NA	Perm			
Protected Phases	3	8			4			6				
Permitted Phases	8					4	6		6			
Actuated Green, G (s)	49.0	49.0			28.0	28.0		21.0	21.0			
Effective Green, g (s)	50.0	50.0			29.0	29.0		22.0	22.0			
Actuated g/C Ratio	0.62	0.62			0.36	0.36		0.28	0.28			
Clearance Time (s)	5.0	5.0			5.0	5.0		5.0	5.0			
Vehicle Extension (s)	0.2	0.2			0.2	0.2		0.2	0.2			
Lane Grp Cap (vph)	440	1072			628	519		892	374			
v/s Ratio Prot	c0.22	0.38			c0.45							
v/s Ratio Perm	0.42					0.08		0.26	0.05			
v/c Ratio	1.02	0.60			1.25	0.22		0.93	0.18			
Uniform Delay, d1	28.2	9.0			25.5	17.7		28.3	22.1			
Progression Factor	0.50	0.20			1.00	1.00		1.00	1.00			
Incremental Delay, d2	19.8	0.1			127.4	0.1		17.7	1.0			
Delay (s)	33.9	1.9			152.9	17.7		45.9	23.1			
Level of Service	C	A			F	B		D	C			
Approach Delay (s)		15.0			128.4			40.9			0.0	
Approach LOS		B			F			D			A	
Intersection Summary												
HCM 2000 Control Delay			58.8				HCM 2000 Level of Service		E			
HCM 2000 Volume to Capacity ratio			1.10									
Actuated Cycle Length (s)			80.0				Sum of lost time (s)		12.0			
Intersection Capacity Utilization			99.5%				ICU Level of Service		F			
Analysis Period (min)			15									
c Critical Lane Group												

HCM Signalized Intersection Capacity Analysis

19: SW Reed Market Rd & US 97 SB

04/16/2019

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		↑↑			↑	↑				↑	↑	
Traffic Volume (vph)	0	1125	100	0	775	370	0	0	0	910	0	235
Future Volume (vph)	0	1125	100	0	775	370	0	0	0	910	0	235
Ideal Flow (vphpl)	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750
Total Lost time (s)		4.0			4.0	4.0				4.0	4.0	
Lane Util. Factor		0.95			1.00	1.00				1.00	1.00	
Frpb, ped/bikes		1.00			1.00	0.99				1.00	1.00	
Flpb, ped/bikes		1.00			1.00	1.00				1.00	1.00	
Frt		0.99			1.00	0.85				1.00	0.85	
Flt Protected		1.00			1.00	1.00				0.95	1.00	
Satd. Flow (prot)		3214			1716	1440				1630	1458	
Flt Permitted		1.00			1.00	1.00				0.95	1.00	
Satd. Flow (perm)		3214			1716	1440				1630	1458	
Peak-hour factor, PHF	0.91	0.91	0.91	0.91	0.91	0.91	0.91	0.91	0.91	0.91	0.91	0.91
Adj. Flow (vph)	0	1236	110	0	852	407	0	0	0	1000	0	258
RTOR Reduction (vph)	0	55	0	0	0	24	0	0	0	0	51	0
Lane Group Flow (vph)	0	1291	0	0	852	383	0	0	0	1000	207	0
Confl. Peds. (#/hr)	2		1	1		2						
Confl. Bikes (#/hr)						1						
Heavy Vehicles (%)	0%	2%	2%	0%	2%	2%	0%	0%	0%	2%	0%	2%
Turn Type		NA			NA	custom				Perm	NA	
Protected Phases		2			6	4					4	
Permitted Phases						6				4		
Actuated Green, G (s)		29.0			29.0	56.0				27.0	27.0	
Effective Green, g (s)		30.0			30.0	58.0				28.0	28.0	
Actuated g/C Ratio		0.45			0.45	0.88				0.42	0.42	
Clearance Time (s)		5.0			5.0	5.0				5.0	5.0	
Vehicle Extension (s)		5.2			5.2	3.0				3.0	3.0	
Lane Grp Cap (vph)		1460			780	1440				691	618	
v/s Ratio Prot		0.40			c0.50	0.11					0.14	
v/s Ratio Perm						0.15				c0.61		
v/c Ratio		0.88			1.09	0.27				1.45	0.33	
Uniform Delay, d1		16.4			18.0	0.6				19.0	12.7	
Progression Factor		1.00			1.00	1.00				1.00	1.00	
Incremental Delay, d2		7.3			60.3	0.1				209.3	0.3	
Delay (s)		23.7			78.3	0.7				228.3	13.1	
Level of Service		C			E	A				F	B	
Approach Delay (s)		23.7			53.3			0.0			184.2	
Approach LOS		C			D			A			F	
Intersection Summary												
HCM 2000 Control Delay			85.6				HCM 2000 Level of Service			F		
HCM 2000 Volume to Capacity ratio			1.26									
Actuated Cycle Length (s)			66.0				Sum of lost time (s)			8.0		
Intersection Capacity Utilization			105.7%				ICU Level of Service			G		
Analysis Period (min)			15									
c Critical Lane Group												

HCM Signalized Intersection Capacity Analysis

21: 3rd Street & Franklin Ave

04/16/2019

												
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	355	630	195	265	610	100	215	905	195	150	1145	180
Future Volume (vph)	355	630	195	265	610	100	215	905	195	150	1145	180
Ideal Flow (vphpl)	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750
Total Lost time (s)	4.0	4.0	4.0	4.0	4.0		4.0	4.0		4.0	4.0	
Lane Util. Factor	1.00	1.00	1.00	1.00	0.95		1.00	0.95		1.00	0.95	
Frpb, ped/bikes	1.00	1.00	0.97	1.00	1.00		1.00	0.99		1.00	1.00	
Flpb, ped/bikes	1.00	1.00	1.00	1.00	1.00		1.00	1.00		1.00	1.00	
Frt	1.00	1.00	0.85	1.00	0.98		1.00	0.97		1.00	0.98	
Flt Protected	0.95	1.00	1.00	0.95	1.00		0.95	1.00		0.95	1.00	
Satd. Flow (prot)	1630	1733	1408	1614	3176		1646	3148		1630	3219	
Flt Permitted	0.95	1.00	1.00	0.95	1.00		0.95	1.00		0.95	1.00	
Satd. Flow (perm)	1630	1733	1408	1614	3176		1646	3148		1630	3219	
Peak-hour factor, PHF	0.94	0.94	0.94	0.94	0.94	0.94	0.94	0.94	0.94	0.94	0.94	0.94
Adj. Flow (vph)	378	670	207	282	649	106	229	963	207	160	1218	191
RTOR Reduction (vph)	0	0	102	0	11	0	0	15	0	0	10	0
Lane Group Flow (vph)	378	670	105	282	744	0	229	1155	0	160	1399	0
Confl. Peds. (#/hr)	7		13	13		7	8		14	14		8
Confl. Bikes (#/hr)			5			1			1			
Heavy Vehicles (%)	2%	1%	2%	3%	2%	3%	1%	2%	1%	2%	1%	0%
Turn Type	Prot	NA	Perm	Prot	NA		Prot	NA		Prot	NA	
Protected Phases	7	4		3	8		1	6		5	2	
Permitted Phases			4									
Actuated Green, G (s)	17.5	35.5	35.5	13.5	31.5		11.5	44.5		8.5	41.5	
Effective Green, g (s)	18.0	36.0	36.0	14.0	32.0		12.0	45.0		9.0	42.0	
Actuated g/C Ratio	0.15	0.30	0.30	0.12	0.27		0.10	0.38		0.08	0.35	
Clearance Time (s)	4.5	4.5	4.5	4.5	4.5		4.5	4.5		4.5	4.5	
Vehicle Extension (s)	2.5	2.5	2.5	2.5	2.5		2.5	2.5		2.5	2.5	
Lane Grp Cap (vph)	244	519	422	188	846		164	1180		122	1126	
v/s Ratio Prot	c0.23	c0.39		0.17	0.23		c0.14	c0.37		0.10	c0.43	
v/s Ratio Perm			0.07									
v/c Ratio	1.55	1.29	0.25	1.50	0.88		1.40	0.98		1.31	1.24	
Uniform Delay, d1	51.0	42.0	31.8	53.0	42.2		54.0	37.0		55.5	39.0	
Progression Factor	1.00	1.00	1.00	1.00	1.00		1.00	1.00		1.00	1.00	
Incremental Delay, d2	266.4	144.8	0.2	250.8	10.3		211.0	21.6		186.8	116.6	
Delay (s)	317.4	186.8	32.0	303.8	52.4		265.0	58.6		242.3	155.6	
Level of Service	F	F	C	F	D		F	E		F	F	
Approach Delay (s)		200.6			120.8			92.4			164.4	
Approach LOS		F			F			F			F	
Intersection Summary												
HCM 2000 Control Delay			145.3			HCM 2000 Level of Service				F		
HCM 2000 Volume to Capacity ratio			1.32									
Actuated Cycle Length (s)			120.0			Sum of lost time (s)				16.0		
Intersection Capacity Utilization			118.9%			ICU Level of Service				H		
Analysis Period (min)			15									
c Critical Lane Group												

HCM Signalized Intersection Capacity Analysis

26: NW Colorado Ave & Wall St

04/16/2019

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations					↑↑						↑↑	
Traffic Volume (vph)	0	0	0	175	1050	0	0	0	0	0	685	250
Future Volume (vph)	0	0	0	175	1050	0	0	0	0	0	685	250
Ideal Flow (vphpl)	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750
Total Lost time (s)					4.0						4.0	
Lane Util. Factor					0.95						0.95	
Frpb, ped/bikes					1.00						1.00	
Flpb, ped/bikes					1.00						1.00	
Frt					1.00						0.96	
Flt Protected					0.99						1.00	
Satd. Flow (prot)					3273						3170	
Flt Permitted					0.99						1.00	
Satd. Flow (perm)					3273						3170	
Peak-hour factor, PHF	0.94	0.94	0.94	0.94	0.94	0.94	0.94	0.94	0.94	0.94	0.94	0.94
Adj. Flow (vph)	0	0	0	186	1117	0	0	0	0	0	729	266
RTOR Reduction (vph)	0	0	0	0	23	0	0	0	0	0	35	0
Lane Group Flow (vph)	0	0	0	0	1280	0	0	0	0	0	960	0
Confl. Peds. (#/hr)	3		2	2		3	2		11	11		2
Confl. Bikes (#/hr)						1						3
Heavy Vehicles (%)	0%	0%	0%	0%	1%	0%	0%	0%	0%	0%	0%	1%
Turn Type				Perm	NA						NA	
Protected Phases					6						4	
Permitted Phases				6								
Actuated Green, G (s)					28.2						18.8	
Effective Green, g (s)					28.7						19.3	
Actuated g/C Ratio					0.51						0.34	
Clearance Time (s)					4.5						4.5	
Vehicle Extension (s)					2.6						2.0	
Lane Grp Cap (vph)					1677						1092	
v/s Ratio Prot											c0.30	
v/s Ratio Perm					0.39							
v/c Ratio					0.76						0.88	
Uniform Delay, d1					10.9						17.3	
Progression Factor					1.00						1.00	
Incremental Delay, d2					3.4						8.0	
Delay (s)					14.3						25.2	
Level of Service					B						C	
Approach Delay (s)		0.0			14.3			0.0			25.2	
Approach LOS		A			B			A			C	
Intersection Summary												
HCM 2000 Control Delay			19.0		HCM 2000 Level of Service				B			
HCM 2000 Volume to Capacity ratio			0.81									
Actuated Cycle Length (s)			56.0		Sum of lost time (s)				8.0			
Intersection Capacity Utilization			76.3%		ICU Level of Service				D			
Analysis Period (min)			15									
c Critical Lane Group												

HCM Signalized Intersection Capacity Analysis

27: Bond St & Arizona Ave

04/16/2019

												
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	370	1515	0	0	0	0	0	515	280	0	0	0
Future Volume (vph)	370	1515	0	0	0	0	0	515	280	0	0	0
Ideal Flow (vphpl)	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750
Total Lost time (s)		4.0						4.0				
Lane Util. Factor		0.95						0.95				
Frpb, ped/bikes		1.00						0.99				
Flpb, ped/bikes		1.00						1.00				
Frt		1.00						0.95				
Flt Protected		0.99						1.00				
Satd. Flow (prot)		3231						3100				
Flt Permitted		0.99						1.00				
Satd. Flow (perm)		3231						3100				
Peak-hour factor, PHF	0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.88
Adj. Flow (vph)	420	1722	0	0	0	0	0	585	318	0	0	0
RTOR Reduction (vph)	0	37	0	0	0	0	0	7	0	0	0	0
Lane Group Flow (vph)	0	2105	0	0	0	0	0	896	0	0	0	0
Confl. Peds. (#/hr)	5		7	7		5	10		4	4		10
Confl. Bikes (#/hr)			3						1			
Heavy Vehicles (%)	1%	2%	0%	0%	0%	0%	0%	1%	1%	0%	0%	0%
Turn Type	Perm	NA						NA				
Protected Phases		2						8				
Permitted Phases	2											
Actuated Green, G (s)		29.1						17.9				
Effective Green, g (s)		29.6						18.4				
Actuated g/C Ratio		0.53						0.33				
Clearance Time (s)		4.5						4.5				
Vehicle Extension (s)		2.6						2.0				
Lane Grp Cap (vph)		1707						1018				
v/s Ratio Prot								c0.29				
v/s Ratio Perm		0.65										
v/c Ratio		1.23						0.88				
Uniform Delay, d1		13.2						17.8				
Progression Factor		1.00						1.00				
Incremental Delay, d2		110.2						8.6				
Delay (s)		123.4						26.3				
Level of Service		F						C				
Approach Delay (s)		123.4			0.0			26.3			0.0	
Approach LOS		F			A			C			A	
Intersection Summary												
HCM 2000 Control Delay			94.6				HCM 2000 Level of Service			F		
HCM 2000 Volume to Capacity ratio			1.10									
Actuated Cycle Length (s)			56.0				Sum of lost time (s)		8.0			
Intersection Capacity Utilization			92.4%				ICU Level of Service		F			
Analysis Period (min)			15									
c Critical Lane Group												

HCM Signalized Intersection Capacity Analysis

31: 3rd St & Wilson Ave

04/16/2019

												
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	285	380	95	155	375	65	210	830	70	180	1195	190
Future Volume (vph)	285	380	95	155	375	65	210	830	70	180	1195	190
Ideal Flow (vphpl)	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750
Total Lost time (s)	4.0	4.0		4.0	4.0		4.3	4.0		4.0	4.0	
Lane Util. Factor	1.00	1.00		1.00	1.00		1.00	0.95		1.00	0.95	
Frpb, ped/bikes	1.00	1.00		1.00	1.00		1.00	1.00		1.00	0.99	
Flpb, ped/bikes	1.00	1.00		1.00	1.00		1.00	1.00		1.00	1.00	
Frt	1.00	0.97		1.00	0.98		1.00	0.99		1.00	0.98	
Flt Protected	0.95	1.00		0.95	1.00		0.95	1.00		0.95	1.00	
Satd. Flow (prot)	1646	1646		1614	1678		1646	3240		1630	3202	
Flt Permitted	0.95	1.00		0.95	1.00		0.95	1.00		0.95	1.00	
Satd. Flow (perm)	1646	1646		1614	1678		1646	3240		1630	3202	
Peak-hour factor, PHF	0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.88
Adj. Flow (vph)	324	432	108	176	426	74	239	943	80	205	1358	216
RTOR Reduction (vph)	0	7	0	0	5	0	0	5	0	0	10	0
Lane Group Flow (vph)	324	533	0	176	495	0	239	1018	0	205	1564	0
Confl. Peds. (#/hr)	3		1	1		3	10		1	1		10
Confl. Bikes (#/hr)			3									1
Heavy Vehicles (%)	1%	3%	2%	3%	2%	0%	1%	1%	4%	2%	1%	1%
Turn Type	Split	NA		Split	NA		Prot	NA		Prot	NA	
Protected Phases	4	4		8	8		1	6		5	2	
Permitted Phases												
Actuated Green, G (s)	30.0	30.0		28.0	28.0		11.5	41.5		10.5	40.5	
Effective Green, g (s)	31.0	31.0		29.0	29.0		11.7	42.5		11.0	41.5	
Actuated g/C Ratio	0.24	0.24		0.22	0.22		0.09	0.33		0.08	0.32	
Clearance Time (s)	5.0	5.0		5.0	5.0		4.5	5.0		4.5	5.0	
Vehicle Extension (s)	2.5	2.5		2.5	2.5		2.5	2.5		2.5	2.5	
Lane Grp Cap (vph)	394	394		361	375		148	1063		138	1026	
v/s Ratio Prot	0.20	c0.32		0.11	c0.30		c0.15	0.31		0.13	c0.49	
v/s Ratio Perm												
v/c Ratio	0.82	1.35		0.49	1.32		1.61	0.96		1.49	1.52	
Uniform Delay, d1	46.6	49.2		43.8	50.2		58.9	42.6		59.2	44.0	
Progression Factor	1.00	1.00		1.00	1.00		1.00	1.00		1.00	1.00	
Incremental Delay, d2	12.7	174.8		0.8	162.0		305.6	18.1		252.9	241.2	
Delay (s)	59.3	224.1		44.5	212.3		364.5	60.8		312.2	285.2	
Level of Service	E	F		D	F		F	E		F	F	
Approach Delay (s)		162.3			168.6			118.3			288.3	
Approach LOS		F			F			F			F	
Intersection Summary												
HCM 2000 Control Delay			200.0			HCM 2000 Level of Service				F		
HCM 2000 Volume to Capacity ratio			1.43									
Actuated Cycle Length (s)			129.5			Sum of lost time (s)				16.3		
Intersection Capacity Utilization			111.7%			ICU Level of Service				H		
Analysis Period (min)			15									
c Critical Lane Group												

Intersection

Int Delay, s/veh 1.3

Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations						
Traffic Vol, veh/h	215	15	20	550	35	20
Future Vol, veh/h	215	15	20	550	35	20
Conflicting Peds, #/hr	0	1	1	0	0	0
Sign Control	Free	Free	Free	Free	Stop	Stop
RT Channelized	-	None	-	None	-	None
Storage Length	-	-	-	-	0	-
Veh in Median Storage, #	0	-	-	0	0	-
Grade, %	0	-	-	0	0	-
Peak Hour Factor	86	86	86	86	86	86
Heavy Vehicles, %	1	8	0	0	7	0
Mvmt Flow	250	17	23	640	41	23

Major/Minor	Major1	Major2	Minor1
Conflicting Flow All	0	0	268
Stage 1	-	-	-
Stage 2	-	-	-
Critical Hdwy	-	-	4.1
Critical Hdwy Stg 1	-	-	-
Critical Hdwy Stg 2	-	-	-
Follow-up Hdwy	-	-	2.2
Pot Cap-1 Maneuver	-	-	1307
Stage 1	-	-	-
Stage 2	-	-	-
Platoon blocked, %	-	-	-
Mov Cap-1 Maneuver	-	-	1306
Mov Cap-2 Maneuver	-	-	-
Stage 1	-	-	-
Stage 2	-	-	-

Approach	EB	WB	NB
HCM Control Delay, s	0	0.3	17.1
HCM LOS			C

Minor Lane/Major Mvmt	NBLn1	EBT	EBR	WBL	WBT
Capacity (veh/h)	361	-	-	1306	-
HCM Lane V/C Ratio	0.177	-	-	0.018	-
HCM Control Delay (s)	17.1	-	-	7.8	0
HCM Lane LOS	C	-	-	A	A
HCM 95th %tile Q(veh)	0.6	-	-	0.1	-

HCM 2010 TWSC
51: SW Division St & SW Reed Market Rd

04/16/2019

Intersection												
Int Delay, s/veh	2.2											
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		↔↔			↔↔				↗		↕↕	
Traffic Vol, veh/h	105	1170	795	5	1025	490	0	0	35	5	0	15
Future Vol, veh/h	105	1170	795	5	1025	490	0	0	35	5	0	15
Conflicting Peds, #/hr	1	0	0	0	0	1	0	0	0	0	0	0
Sign Control	Free	Free	Free	Free	Free	Free	Stop	Stop	Stop	Stop	Stop	Stop
RT Channelized	-	-	None	-	-	None	-	-	Stop	-	-	None
Storage Length	-	-	-	-	-	-	-	-	0	-	-	-
Veh in Median Storage, #	-	0	-	-	0	-	-	0	-	-	0	-
Grade, %	-	0	-	-	0	-	-	0	-	-	0	-
Peak Hour Factor	95	95	95	95	95	95	95	95	95	95	95	95
Heavy Vehicles, %	2	2	2	0	1	4	0	0	5	0	0	6
Mvmt Flow	111	1232	837	5	1079	516	0	0	37	5	0	16
Major/Minor	Major1			Major2			Minor1			Minor2		
Conflicting Flow All	1596	0	0	2069	0	0	-	-	1035	2186	3639	799
Stage 1	-	-	-	-	-	-	-	-	-	1348	1348	-
Stage 2	-	-	-	-	-	-	-	-	-	838	2291	-
Critical Hdwy	4.14	-	-	4.1	-	-	-	-	7	7.5	6.5	7.02
Critical Hdwy Stg 1	-	-	-	-	-	-	-	-	-	6.5	5.5	-
Critical Hdwy Stg 2	-	-	-	-	-	-	-	-	-	6.5	5.5	-
Follow-up Hdwy	2.22	-	-	2.2	-	-	-	-	3.35	3.5	4	3.36
Pot Cap-1 Maneuver	407	-	-	273	-	-	0	0	224	26	5	320
Stage 1	-	-	-	-	-	-	0	0	-	162	221	-
Stage 2	-	-	-	-	-	-	0	0	-	331	75	-
Platoon blocked, %		-	-		-	-						
Mov Cap-1 Maneuver	407	-	-	273	-	-	-	-	224	16	3	320
Mov Cap-2 Maneuver	-	-	-	-	-	-	-	-	-	16	3	-
Stage 1	-	-	-	-	-	-	-	-	-	162	149	-
Stage 2	-	-	-	-	-	-	-	-	-	277	75	-
Approach	EB			WB			NB			SB		
HCM Control Delay, s	0.9			2.1			24.2			103.8		
HCM LOS							C			F		
Minor Lane/Major Mvmt	NBLn1	EBL	EBT	EBR	WBL	WBT	WBR	SBLn1				
Capacity (veh/h)	224	407	-	-	273	-	-	56				
HCM Lane V/C Ratio	0.164	0.272	-	-	0.019	-	-	0.376				
HCM Control Delay (s)	24.2	17.1	0	-	18.4	3	-	103.8				
HCM Lane LOS	C	C	A	-	C	A	-	F				
HCM 95th %tile Q(veh)	0.6	1.1	-	-	0.1	-	-	1.4				

HCM Signalized Intersection Capacity Analysis

52: SW Reed Market Rd & SE 3rd St

04/16/2019

												
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		↕↕			↕↕		↗	↕↕		↗	↕↕	
Traffic Volume (vph)	180	850	155	165	485	85	535	780	265	135	980	330
Future Volume (vph)	180	850	155	165	485	85	535	780	265	135	980	330
Ideal Flow (vphpl)	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750
Total Lost time (s)		4.0			4.0		4.0	4.0		4.0	4.0	
Lane Util. Factor		0.95			0.95		1.00	0.95		1.00	0.95	
Frpb, ped/bikes		1.00			1.00		1.00	0.99		1.00	1.00	
Flpb, ped/bikes		1.00			1.00		1.00	1.00		1.00	1.00	
Frt		0.98			0.98		1.00	0.96		1.00	0.96	
Flt Protected		0.99			0.99		0.95	1.00		0.95	1.00	
Satd. Flow (prot)		3128			3158		1646	3098		1630	3126	
Flt Permitted		0.99			0.99		0.95	1.00		0.95	1.00	
Satd. Flow (perm)		3128			3158		1646	3098		1630	3126	
Peak-hour factor, PHF	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96
Adj. Flow (vph)	188	885	161	172	505	89	557	812	276	141	1021	344
RTOR Reduction (vph)	0	8	0	0	7	0	0	22	0	0	22	0
Lane Group Flow (vph)	0	1226	0	0	759	0	557	1067	0	141	1343	0
Confl. Peds. (#/hr)	2		1	1		2	1		9	9		1
Confl. Bikes (#/hr)									1			
Heavy Vehicles (%)	3%	3%	5%	2%	2%	3%	1%	3%	1%	2%	2%	2%
Turn Type	Split	NA		Split	NA		Prot	NA		Prot	NA	
Protected Phases	3	3		4	4		1	6		5	2	
Permitted Phases												
Actuated Green, G (s)		41.5			29.5		19.5	53.5		7.5	41.5	
Effective Green, g (s)		42.0			30.0		20.0	54.0		8.0	42.0	
Actuated g/C Ratio		0.28			0.20		0.13	0.36		0.05	0.28	
Clearance Time (s)		4.5			4.5		4.5	4.5		4.5	4.5	
Vehicle Extension (s)		2.5			2.5		2.5	4.3		2.5	4.3	
Lane Grp Cap (vph)		875			631		219	1115		86	875	
v/s Ratio Prot		c0.39			c0.24		c0.34	0.34		0.09	c0.43	
v/s Ratio Perm												
v/c Ratio		1.40			1.20		2.54	0.96		1.64	1.53	
Uniform Delay, d1		54.0			60.0		65.0	46.9		71.0	54.0	
Progression Factor		1.00			1.00		1.00	1.00		1.00	1.00	
Incremental Delay, d2		187.5			105.7		707.8	18.3		334.0	246.3	
Delay (s)		241.5			165.7		772.8	65.2		405.0	300.3	
Level of Service		F			F		F	E		F	F	
Approach Delay (s)		241.5			165.7			304.7			310.1	
Approach LOS		F			F			F			F	
Intersection Summary												
HCM 2000 Control Delay			270.5			HCM 2000 Level of Service				F		
HCM 2000 Volume to Capacity ratio			1.57									
Actuated Cycle Length (s)			150.0			Sum of lost time (s)				16.0		
Intersection Capacity Utilization			145.8%			ICU Level of Service				H		
Analysis Period (min)			15									
c Critical Lane Group												

HCM Signalized Intersection Capacity Analysis

111: Wall St & Portland Ave

04/16/2019

												
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	385	225	95	70	210	170	75	850	85	40	520	490
Future Volume (vph)	385	225	95	70	210	170	75	850	85	40	520	490
Ideal Flow (vphpl)	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750
Total Lost time (s)	4.0	4.0		4.0	4.0	4.0	4.0	4.0		4.0	4.0	4.0
Lane Util. Factor	1.00	1.00		1.00	1.00	1.00	1.00	1.00		1.00	1.00	1.00
Frpb, ped/bikes	1.00	0.99		1.00	1.00	0.97	1.00	1.00		1.00	1.00	0.96
Flpb, ped/bikes	1.00	1.00		1.00	1.00	1.00	1.00	1.00		1.00	1.00	1.00
Frt	1.00	0.96		1.00	1.00	0.85	1.00	0.99		1.00	1.00	0.85
Flt Protected	0.95	1.00		0.95	1.00	1.00	0.95	1.00		0.95	1.00	1.00
Satd. Flow (prot)	1646	1647		1662	1750	1432	1662	1718		1599	1733	1418
Flt Permitted	0.95	1.00		0.95	1.00	1.00	0.21	1.00		0.09	1.00	1.00
Satd. Flow (perm)	1646	1647		1662	1750	1432	374	1718		149	1733	1418
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	418	245	103	76	228	185	82	924	92	43	565	533
RTOR Reduction (vph)	0	14	0	0	0	0	0	3	0	0	0	272
Lane Group Flow (vph)	418	334	0	76	228	185	82	1013	0	43	565	261
Confl. Peds. (#/hr)	3					3	5		4	4		5
Confl. Bikes (#/hr)			7			16			7			6
Heavy Vehicles (%)	1%	1%	0%	0%	0%	1%	0%	0%	2%	4%	1%	1%
Turn Type	Prot	NA		Prot	NA	Free	pm+pt	NA		pm+pt	NA	Perm
Protected Phases	1	6		5	2		3	8		7	4	
Permitted Phases						Free	8			4		4
Actuated Green, G (s)	18.1	31.4		5.5	18.8	105.1	49.3	45.4		47.1	44.3	44.3
Effective Green, g (s)	19.1	32.4		6.5	19.8	105.1	51.3	46.4		49.1	45.3	45.3
Actuated g/C Ratio	0.18	0.31		0.06	0.19	1.00	0.49	0.44		0.47	0.43	0.43
Clearance Time (s)	5.0	5.0		5.0	5.0		5.0	5.0		5.0	5.0	5.0
Vehicle Extension (s)	3.0	3.0		3.0	3.0		3.0	3.0		3.0	3.0	3.0
Lane Grp Cap (vph)	299	507		102	329	1432	242	758		122	746	611
v/s Ratio Prot	c0.25	c0.20		0.05	0.13		c0.02	c0.59		0.01	0.33	
v/s Ratio Perm						c0.13	0.15			0.15		0.18
v/c Ratio	1.40	0.66		0.75	0.69	0.13	0.34	1.34		0.35	0.76	0.43
Uniform Delay, d1	43.0	31.6		48.5	39.8	0.0	17.7	29.3		23.7	25.3	20.9
Progression Factor	1.00	1.00		1.00	1.00	1.00	1.00	1.00		1.00	1.00	1.00
Incremental Delay, d2	198.2	3.1		25.2	6.2	0.2	0.8	160.1		1.8	4.4	0.5
Delay (s)	241.2	34.7		73.7	46.0	0.2	18.5	189.4		25.4	29.7	21.3
Level of Service	F	C		E	D	A	B	F		C	C	C
Approach Delay (s)		147.4			33.0			176.7			25.6	
Approach LOS		F			C			F			C	
Intersection Summary												
HCM 2000 Control Delay			100.8			HCM 2000 Level of Service			F			
HCM 2000 Volume to Capacity ratio			1.18									
Actuated Cycle Length (s)			105.1			Sum of lost time (s)			16.0			
Intersection Capacity Utilization			107.4%			ICU Level of Service			G			
Analysis Period (min)			15									
c Critical Lane Group												

Intersection

Int Delay, s/veh 2.8

Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Traffic Vol, veh/h	20	95	700	35	25	775
Future Vol, veh/h	20	95	700	35	25	775
Conflicting Peds, #/hr	1	0	0	28	28	0
Sign Control	Stop	Stop	Free	Free	Free	Free
RT Channelized	-	None	-	None	-	None
Storage Length	0	-	-	-	0	-
Veh in Median Storage, #	0	-	0	-	-	0
Grade, %	0	-	0	-	-	0
Peak Hour Factor	89	89	89	89	89	89
Heavy Vehicles, %	0	0	1	0	0	1
Mvmt Flow	22	107	787	39	28	871

Major/Minor	Minor1	Major1	Major2
Conflicting Flow All	1763	835	0
Stage 1	835	-	-
Stage 2	928	-	-
Critical Hdwy	6.4	6.2	-
Critical Hdwy Stg 1	5.4	-	-
Critical Hdwy Stg 2	5.4	-	-
Follow-up Hdwy	3.5	3.3	-
Pot Cap-1 Maneuver	94	371	-
Stage 1	429	-	-
Stage 2	388	-	-
Platoon blocked, %		-	-
Mov Cap-1 Maneuver	88	362	-
Mov Cap-2 Maneuver	88	-	-
Stage 1	404	-	-
Stage 2	388	-	-

Approach	WB	NB	SB
HCM Control Delay, s	37.6	0	0.3
HCM LOS	E		

Minor Lane/Major Mvmt	NBT	NBRWBLn1	SBL	SBT
Capacity (veh/h)	-	-	235	775
HCM Lane V/C Ratio	-	-	0.55	0.036
HCM Control Delay (s)	-	-	37.6	9.8
HCM Lane LOS	-	-	E	A
HCM 95th %tile Q(veh)	-	-	3	0.1

HCM Signalized Intersection Capacity Analysis

113: Greenwood Ave & Wall St

04/16/2019

												
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	100	465	165	420	705	20	0	0	0	150	515	200
Future Volume (vph)	100	465	165	420	705	20	0	0	0	150	515	200
Ideal Flow (vphpl)	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750
Total Lost time (s)	3.5	3.5		3.5	3.5						3.5	3.5
Lane Util. Factor	1.00	0.95		1.00	1.00						0.95	1.00
Frpb, ped/bikes	1.00	0.98		1.00	1.00						1.00	0.88
Flpb, ped/bikes	1.00	1.00		1.00	1.00						1.00	1.00
Frt	1.00	0.96		1.00	1.00						1.00	0.85
Flt Protected	0.95	1.00		0.95	1.00						0.99	1.00
Satd. Flow (prot)	1646	3096		1646	1724						3248	1298
Flt Permitted	0.95	1.00		0.95	1.00						0.99	1.00
Satd. Flow (perm)	1646	3096		1646	1724						3248	1298
Peak-hour factor, PHF	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95
Adj. Flow (vph)	105	489	174	442	742	21	0	0	0	158	542	211
RTOR Reduction (vph)	0	43	0	0	1	0	0	0	0	0	0	155
Lane Group Flow (vph)	105	620	0	442	762	0	0	0	0	0	700	56
Confl. Peds. (#/hr)	12		47	47		12	38		18	18		38
Confl. Bikes (#/hr)			1			11			1			24
Heavy Vehicles (%)	1%	2%	0%	1%	1%	0%	0%	0%	0%	0%	1%	1%
Turn Type	Prot	NA		Prot	NA					Perm	NA	Perm
Protected Phases	5	2		1	6						4	
Permitted Phases										4		4
Actuated Green, G (s)	7.0	24.0		23.3	40.3						20.7	20.7
Effective Green, g (s)	7.5	24.5		23.8	40.8						21.2	21.2
Actuated g/C Ratio	0.09	0.31		0.30	0.51						0.26	0.26
Clearance Time (s)	4.0	4.0		4.0	4.0						4.0	4.0
Vehicle Extension (s)	3.0	3.0		3.0	3.0						3.0	3.0
Lane Grp Cap (vph)	154	948		489	879						860	343
v/s Ratio Prot	0.06	0.20		c0.27	c0.44							
v/s Ratio Perm											0.22	0.04
v/c Ratio	0.68	0.65		0.90	0.87						0.81	0.16
Uniform Delay, d1	35.1	24.1		27.0	17.2						27.6	22.6
Progression Factor	1.00	1.00		1.00	1.00						1.00	1.00
Incremental Delay, d2	11.8	3.5		19.9	11.2						6.0	0.2
Delay (s)	46.9	27.6		46.9	28.4						33.5	22.8
Level of Service	D	C		D	C						C	C
Approach Delay (s)		30.2			35.2			0.0			31.0	
Approach LOS		C			D			A			C	
Intersection Summary												
HCM 2000 Control Delay			32.6			HCM 2000 Level of Service				C		
HCM 2000 Volume to Capacity ratio			0.89									
Actuated Cycle Length (s)			80.0			Sum of lost time (s)			10.5			
Intersection Capacity Utilization			81.1%			ICU Level of Service			D			
Analysis Period (min)			15									
c Critical Lane Group												

HCM Signalized Intersection Capacity Analysis

204: 3rd Street & US 20

04/16/2019

												
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	295	900	280	360	705	270	250	960	255	345	1030	125
Future Volume (vph)	295	900	280	360	705	270	250	960	255	345	1030	125
Ideal Flow (vphpl)	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750
Total Lost time (s)	4.0	4.0		4.0	4.0		4.0	4.0		4.0	4.0	
Lane Util. Factor	1.00	0.95		1.00	0.95		1.00	0.95		1.00	0.95	
Frpb, ped/bikes	1.00	1.00		1.00	1.00		1.00	0.99		1.00	1.00	
Flpb, ped/bikes	1.00	1.00		1.00	1.00		1.00	1.00		1.00	1.00	
Frt	1.00	0.96		1.00	0.96		1.00	0.97		1.00	0.98	
Flt Protected	0.95	1.00		0.95	1.00		0.95	1.00		0.95	1.00	
Satd. Flow (prot)	1599	3163		1646	3114		1646	3169		1583	3230	
Flt Permitted	0.95	1.00		0.95	1.00		0.95	1.00		0.95	1.00	
Satd. Flow (perm)	1599	3163		1646	3114		1646	3169		1583	3230	
Peak-hour factor, PHF	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96
Adj. Flow (vph)	307	938	292	375	734	281	260	1000	266	359	1073	130
RTOR Reduction (vph)	0	19	0	0	25	0	0	15	0	0	6	0
Lane Group Flow (vph)	307	1211	0	375	990	0	260	1251	0	359	1197	0
Confl. Peds. (#/hr)	2		1	1		2	6		7	7		6
Confl. Bikes (#/hr)			2			1						
Heavy Vehicles (%)	4%	1%	1%	1%	1%	4%	1%	1%	1%	5%	1%	1%
Turn Type	Prot	NA		Prot	NA		Prot	NA		Prot	NA	
Protected Phases	7	4		3	8		1	6		5	2	
Permitted Phases												
Actuated Green, G (s)	22.0	44.0		23.0	45.0		17.0	48.0		25.0	56.0	
Effective Green, g (s)	23.0	45.0		24.0	46.0		18.0	49.0		26.0	57.0	
Actuated g/C Ratio	0.14	0.28		0.15	0.29		0.11	0.31		0.16	0.36	
Clearance Time (s)	5.0	5.0		5.0	5.0		5.0	5.0		5.0	5.0	
Vehicle Extension (s)	2.5	4.3		2.5	4.3		2.5	4.3		2.5	4.3	
Lane Grp Cap (vph)	229	889		246	895		185	970		257	1150	
v/s Ratio Prot	0.19	c0.38		c0.23	0.32		0.16	c0.39		c0.23	0.37	
v/s Ratio Perm												
v/c Ratio	1.34	1.36		1.52	1.11		1.41	1.29		1.40	1.04	
Uniform Delay, d1	68.5	57.5		68.0	57.0		71.0	55.5		67.0	51.5	
Progression Factor	1.00	1.00		1.00	1.00		1.00	1.00		1.00	1.00	
Incremental Delay, d2	179.7	170.4		255.6	63.6		211.5	138.0		200.6	37.8	
Delay (s)	248.2	227.9		323.6	120.6		282.5	193.5		267.6	89.3	
Level of Service	F	F		F	F		F	F		F	F	
Approach Delay (s)		232.0			175.3			208.7			130.3	
Approach LOS		F			F			F			F	
Intersection Summary												
HCM 2000 Control Delay			186.6			HCM 2000 Level of Service			F			
HCM 2000 Volume to Capacity ratio			1.37									
Actuated Cycle Length (s)			160.0			Sum of lost time (s)			16.0			
Intersection Capacity Utilization			130.3%			ICU Level of Service			H			
Analysis Period (min)			15									
c Critical Lane Group												

US 97 Bend Parkway Future No Build

Vistro File:

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Scenario: Base Scenario

Report File: X:\...\Roundabouts_RIRO_6006_All_Closure.pdf

3/27/2019

Intersection Analysis Summary

ID	Intersection Name	Control Type	Method	Worst Mvmt	V/C	Delay (s/veh)	LOS
1	Reed Market and Brookwood	Roundabout	HCM 6th Edition	SEB Thru		438.9	F

V/C, Delay, LOS: For two-way stop, these values are taken from the movement with the worst (highest) delay value. For all other control types, they are taken for the whole intersection.

Intersection Level Of Service Report

Intersection 1: Reed Market and Brookwood

Control Type: Roundabout
 Analysis Method: HCM 6th Edition
 Analysis Period: 15 minutes

Delay (sec / veh): 438.9
 Level Of Service: F

Intersection Setup

Name												
Approach	Northeastbound			Southwestbound			Northwestbound			Southeastbound		
Lane Configuration												
Turning Movement	Left	Thru	Right	Left	Thru	Right	Left	Thru	Right	Left	Thru	Right
Lane Width [ft]	12.00	12.00	12.00	12.00	12.00	12.00	12.00	12.00	12.00	12.00	12.00	12.00
No. of Lanes in Pocket	0	0	0	0	0	0	0	0	0	0	0	0
Pocket Length [ft]	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00
Speed [mph]	25.00			25.00			25.00			25.00		
Grade [%]	0.00			0.00			0.00			0.00		
Crosswalk	Yes			Yes			Yes			Yes		

Volumes

Name												
Base Volume Input [veh/h]	255	295	150	440	550	70	155	395	290	90	590	340
Base Volume Adjustment Factor	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000
Heavy Vehicles Percentage [%]	0.00	1.00	5.00	1.00	1.00	0.00	2.00	1.00	3.00	0.00	1.00	1.00
Growth Rate	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
In-Process Volume [veh/h]	0	0	0	0	0	0	0	0	0	0	0	0
Site-Generated Trips [veh/h]	0	0	0	0	0	0	0	0	0	0	0	0
Diverted Trips [veh/h]	0	0	0	0	0	0	0	0	0	0	0	0
Pass-by Trips [veh/h]	0	0	0	0	0	0	0	0	0	0	0	0
Existing Site Adjustment Volume [veh/h]	0	0	0	0	0	0	0	0	0	0	0	0
Other Volume [veh/h]	0	0	0	0	0	0	0	0	0	0	0	0
Total Hourly Volume [veh/h]	255	295	150	440	550	70	155	395	290	90	590	340
Peak Hour Factor	0.9700	0.9700	0.9700	0.9700	0.9700	0.9700	0.9700	0.9700	0.9700	0.9700	0.9700	0.9700
Other Adjustment Factor	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000
Total 15-Minute Volume [veh/h]	66	76	39	113	142	18	40	102	75	23	152	88
Total Analysis Volume [veh/h]	263	304	155	454	567	72	160	407	299	93	608	351
Pedestrian Volume [ped/h]	0			0			0			0		

Intersection Settings

Number of Conflicting Circulating Lanes	1			1			1			1		
Circulating Flow Rate [veh/h]	1166			837			663			1194		
Exiting Flow Rate [veh/h]	1090			708			1235			746		
Demand Flow Rate [veh/h]	255	295	150	440	550	70	155	395	290	90	590	340
Adjusted Demand Flow Rate [veh/h]	263	304	155	454	567	72	160	407	299	93	608	351

Lanes

Overwrite Calculated Critical Headway	No			No			No			No		
User-Defined Critical Headway [s]	4.00			4.00			4.00			4.00		
Overwrite Calculated Follow-Up Time	No			No			No			No		
User-Defined Follow-Up Time [s]	3.00			3.00			3.00			3.00		
A (intercept)	1380.00			1380.00			1380.00			1380.00		
B (coefficient)	0.00102			0.00102			0.00102			0.00102		
HV Adjustment Factor	0.99			0.99			0.98			0.99		
Entry Flow Rate [veh/h]	733			1104			883			1062		
Capacity of Entry and Bypass Lanes [veh/h]	421			588			702			409		
Pedestrian Impedance	1.00			1.00			1.00			1.00		
Capacity per Entry Lane [veh/h]	415			583			689			405		
X, volume / capacity	1.74			1.88			1.26			2.60		

Movement, Approach, & Intersection Results

Lane LOS	F	F	F	F
95th-Percentile Queue Length [veh]	44.55	69.75	32.22	85.56
95th-Percentile Queue Length [ft]	1113.72	1743.68	805.53	2138.94
Approach Delay [s/veh]	367.31	419.05	147.48	748.63
Approach LOS	F	F	F	F
Intersection Delay [s/veh]	438.92			
Intersection LOS	F			

2040 Future No-Build HCM Reports

HCM Signalized Intersection Capacity Analysis

3: US 97 & Robal Rd

04/16/2019

												
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	250	45	100	285	100	45	375	2255	35	50	2410	50
Future Volume (vph)	250	45	100	285	100	45	375	2255	35	50	2410	50
Ideal Flow (vphpl)	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750
Total Lost time (s)	4.0	4.0	4.0	4.0	4.0		4.0	4.0		4.0	4.0	
Lane Util. Factor	0.95	0.95	1.00	1.00	1.00		0.97	0.95		1.00	0.95	
Frpb, ped/bikes	1.00	1.00	1.00	1.00	1.00		1.00	1.00		1.00	1.00	
Flpb, ped/bikes	1.00	1.00	1.00	1.00	1.00		1.00	1.00		1.00	1.00	
Frt	1.00	1.00	0.85	1.00	0.95		1.00	1.00		1.00	1.00	
Flt Protected	0.95	0.97	1.00	0.95	1.00		0.95	1.00		0.95	1.00	
Satd. Flow (prot)	1548	1585	1488	1646	1516		3225	3217		1511	3131	
Flt Permitted	0.95	0.97	1.00	0.95	1.00		0.95	1.00		0.95	1.00	
Satd. Flow (perm)	1548	1585	1488	1646	1516		3225	3217		1511	3131	
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	272	49	109	310	109	49	408	2451	38	54	2620	54
RTOR Reduction (vph)	0	0	93	0	11	0	0	1	0	0	1	0
Lane Group Flow (vph)	160	161	16	310	147	0	408	2488	0	54	2673	0
Confl. Peds. (#/hr)	1					1			4	4		
Heavy Vehicles (%)	2%	0%	0%	1%	9%	11%	0%	3%	7%	10%	6%	0%
Turn Type	Split	NA	Prot	Split	NA		Prot	NA		Prot	NA	
Protected Phases	4	4	4	8	8		5	2		1	6	
Permitted Phases												
Actuated Green, G (s)	20.7	20.7	20.7	28.0	28.0		10.0	65.5		12.8	68.3	
Effective Green, g (s)	21.7	21.7	21.7	29.0	29.0		11.0	67.5		13.8	70.3	
Actuated g/C Ratio	0.15	0.15	0.15	0.20	0.20		0.07	0.46		0.09	0.47	
Clearance Time (s)	5.0	5.0	5.0	5.0	5.0		5.0	6.0		5.0	6.0	
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0		3.0	3.0		3.0	3.0	
Lane Grp Cap (vph)	226	232	218	322	297		239	1467		140	1487	
v/s Ratio Prot	c0.10	0.10	0.01	c0.19	0.10		c0.13	0.77		c0.04	c0.85	
v/s Ratio Perm												
v/c Ratio	0.71	0.69	0.07	0.96	0.49		1.71	1.70		0.39	1.80	
Uniform Delay, d1	60.1	60.0	54.5	59.0	53.0		68.5	40.2		63.1	38.9	
Progression Factor	1.00	1.00	1.00	1.00	1.00		1.00	1.00		1.00	1.00	
Incremental Delay, d2	9.7	8.7	0.1	40.0	1.3		335.4	316.3		1.8	361.6	
Delay (s)	69.8	68.7	54.6	98.9	54.3		403.9	356.5		64.9	400.5	
Level of Service	E	E	D	F	D		F	F		E	F	
Approach Delay (s)		65.5			83.8			363.2			393.8	
Approach LOS		E			F			F			F	
Intersection Summary												
HCM 2000 Control Delay			336.3			HCM 2000 Level of Service				F		
HCM 2000 Volume to Capacity ratio			1.41									
Actuated Cycle Length (s)			148.0			Sum of lost time (s)				16.0		
Intersection Capacity Utilization			125.1%			ICU Level of Service				H		
Analysis Period (min)			15									
c Critical Lane Group												

HCM Signalized Intersection Capacity Analysis

12: NW Wall St & NE Revere Ave

04/16/2019

												
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		↔		↔	↔		↔	↑	↔	↔	↔	
Traffic Volume (vph)	10	140	30	735	135	230	65	190	900	215	400	5
Future Volume (vph)	10	140	30	735	135	230	65	190	900	215	400	5
Ideal Flow (vphpl)	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750
Total Lost time (s)		4.0		4.0	4.0		4.0	4.0	4.0	4.0	4.0	
Lane Util. Factor		1.00		1.00	1.00		1.00	1.00	1.00	1.00	1.00	
Frpb, ped/bikes		0.99		1.00	0.99		1.00	1.00	0.99	1.00	1.00	
Flpb, ped/bikes		1.00		1.00	1.00		1.00	1.00	1.00	1.00	1.00	
Frt		0.98		1.00	0.91		1.00	1.00	0.85	1.00	1.00	
Flt Protected		1.00		0.95	1.00		0.95	1.00	1.00	0.95	1.00	
Satd. Flow (prot)		1697		1662	1553		1662	1750	1465	1612	1746	
Flt Permitted		1.00		0.95	1.00		0.16	1.00	1.00	0.50	1.00	
Satd. Flow (perm)		1697		1662	1553		276	1750	1465	850	1746	
Peak-hour factor, PHF	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90
Adj. Flow (vph)	11	156	33	817	150	256	72	211	1000	239	444	6
RTOR Reduction (vph)	0	6	0	0	51	0	0	0	91	0	1	0
Lane Group Flow (vph)	0	194	0	817	355	0	72	211	909	239	449	0
Confl. Peds. (#/hr)			5	5					1	1		
Confl. Bikes (#/hr)						2			1			
Heavy Vehicles (%)	0%	0%	0%	0%	0%	1%	0%	0%	1%	3%	0%	0%
Turn Type	Split	NA		Split	NA		Perm	NA	pm+ov	Perm	NA	
Protected Phases	8	8		4	4			6			2	
Permitted Phases							6		6		2	
Actuated Green, G (s)		16.8		49.1	49.1		32.0	32.0	81.1	32.0	32.0	
Effective Green, g (s)		17.8		50.1	50.1		33.0	33.0	83.1	33.0	33.0	
Actuated g/C Ratio		0.16		0.44	0.44		0.29	0.29	0.74	0.29	0.29	
Clearance Time (s)		5.0		5.0	5.0		5.0	5.0	5.0	5.0	5.0	
Vehicle Extension (s)		2.5		4.0	4.0		5.2	5.2	4.0	5.2	5.2	
Lane Grp Cap (vph)		267		737	689		80	511	1130	248	510	
v/s Ratio Prot		c0.11		c0.49	0.23			0.12	0.36		0.26	
v/s Ratio Perm							0.26		0.26	c0.28		
v/c Ratio		0.73		1.11	0.51		0.90	0.41	0.80	0.96	0.88	
Uniform Delay, d1		45.2		31.4	22.6		38.4	32.2	9.6	39.4	38.1	
Progression Factor		1.00		1.00	1.00		1.00	1.00	1.00	1.00	1.00	
Incremental Delay, d2		8.9		67.0	0.9		71.2	1.2	4.5	47.5	17.4	
Delay (s)		54.1		98.4	23.5		109.6	33.4	14.1	86.9	55.5	
Level of Service		D		F	C		F	C	B	F	E	
Approach Delay (s)		54.1			73.6			22.6			66.4	
Approach LOS		D			E			C			E	
Intersection Summary												
HCM 2000 Control Delay			51.7			HCM 2000 Level of Service			D			
HCM 2000 Volume to Capacity ratio			0.99									
Actuated Cycle Length (s)			112.9			Sum of lost time (s)			12.0			
Intersection Capacity Utilization			100.8%			ICU Level of Service			G			
Analysis Period (min)			15									
c Critical Lane Group												

HCM Signalized Intersection Capacity Analysis

13: US 20 & Olney Ave

04/16/2019

												
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	135	285	100	175	270	75	95	1235	115	105	1120	35
Future Volume (vph)	135	285	100	175	270	75	95	1235	115	105	1120	35
Ideal Flow (vphpl)	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750
Total Lost time (s)	4.0	4.0		4.0	4.0		4.0	4.0		4.0	4.0	
Lane Util. Factor	1.00	1.00		1.00	1.00		1.00	0.95		1.00	0.95	
Frpb, ped/bikes	1.00	1.00		1.00	1.00		1.00	1.00		1.00	1.00	
Flpb, ped/bikes	1.00	1.00		1.00	1.00		1.00	1.00		1.00	1.00	
Frt	1.00	0.96		1.00	0.97		1.00	0.99		1.00	1.00	
Flt Protected	0.95	1.00		0.95	1.00		0.95	1.00		0.95	1.00	
Satd. Flow (prot)	1644	1675		1659	1687		1661	3184		1662	3211	
Flt Permitted	0.49	1.00		0.44	1.00		0.25	1.00		0.25	1.00	
Satd. Flow (perm)	841	1675		769	1687		437	3184		437	3211	
Peak-hour factor, PHF	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98
Adj. Flow (vph)	138	291	102	179	276	77	97	1260	117	107	1143	36
RTOR Reduction (vph)	0	13	0	0	9	0	0	17	0	0	5	0
Lane Group Flow (vph)	138	380	0	179	344	0	97	1360	0	107	1174	0
Confl. Peds. (#/hr)	3		5	5		3	4		1	1		4
Confl. Bikes (#/hr)			2			4						2
Heavy Vehicles (%)	1%	0%	0%	0%	0%	0%	0%	3%	2%	0%	3%	3%
Turn Type	Perm	NA		Perm	NA		Perm	NA		Perm	NA	
Protected Phases		4			8			2			6	
Permitted Phases	4			8			2			6		
Actuated Green, G (s)	16.0	16.0		16.0	16.0		16.0	16.0		16.0	16.0	
Effective Green, g (s)	16.0	16.0		16.0	16.0		16.0	16.0		16.0	16.0	
Actuated g/C Ratio	0.40	0.40		0.40	0.40		0.40	0.40		0.40	0.40	
Clearance Time (s)	4.0	4.0		4.0	4.0		4.0	4.0		4.0	4.0	
Lane Grp Cap (vph)	336	670		307	674		174	1273		174	1284	
v/s Ratio Prot		0.23			0.20			c0.43			0.37	
v/s Ratio Perm	0.16			c0.23			0.22			0.24		
v/c Ratio	0.41	0.57		0.58	0.51		0.56	1.07		0.61	0.91	
Uniform Delay, d1	8.6	9.3		9.4	9.0		9.3	12.0		9.5	11.3	
Progression Factor	1.00	1.00		1.00	1.00		1.00	1.00		1.00	1.00	
Incremental Delay, d2	3.7	3.5		7.9	2.7		12.3	45.5		15.2	11.5	
Delay (s)	12.3	12.8		17.3	11.8		21.5	57.5		24.7	22.8	
Level of Service	B	B		B	B		C	E		C	C	
Approach Delay (s)		12.6			13.6			55.2			23.0	
Approach LOS		B			B			E			C	
Intersection Summary												
HCM 2000 Control Delay			32.7				HCM 2000 Level of Service			C		
HCM 2000 Volume to Capacity ratio			0.82									
Actuated Cycle Length (s)			40.0				Sum of lost time (s)			8.0		
Intersection Capacity Utilization			94.3%				ICU Level of Service			F		
Analysis Period (min)			15									
c Critical Lane Group												

Intersection

Int Delay, s/veh 7.4

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations		↗		↗↗	↗↗	↗
Traffic Vol, veh/h	0	85	0	3820	3840	45
Future Vol, veh/h	0	85	0	3820	3840	45
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Stop	Stop	Free	Free	Free	Free
RT Channelized	-	None	-	None	-	None
Storage Length	-	0	-	-	-	115
Veh in Median Storage, #	0	-	-	0	0	-
Grade, %	0	-	-	0	0	-
Peak Hour Factor	92	92	92	92	92	92
Heavy Vehicles, %	0	0	0	3	3	0
Mvmt Flow	0	92	0	4152	4174	49

Major/Minor	Minor2	Major1	Major2
Conflicting Flow All	- 2087	-	0 - 0
Stage 1	-	-	- - -
Stage 2	-	-	- - -
Critical Hdwy	- 6.9	-	- - -
Critical Hdwy Stg 1	-	-	- - -
Critical Hdwy Stg 2	-	-	- - -
Follow-up Hdwy	- 3.3	-	- - -
Pot Cap-1 Maneuver	0 ~ 45	0	- - -
Stage 1	0	0	- - -
Stage 2	0	0	- - -
Platoon blocked, %			- - -
Mov Cap-1 Maneuver	- ~ 45	-	- - -
Mov Cap-2 Maneuver	-	-	- - -
Stage 1	-	-	- - -
Stage 2	-	-	- - -

Approach	EB	NB	SB
HCM Control Delay, s\$	682.6	0	0
HCM LOS	F		

Minor Lane/Major Mvmt	NBT EBLn1	SBT	SBR
Capacity (veh/h)	- 45	-	-
HCM Lane V/C Ratio	- 2.053	-	-
HCM Control Delay (s)	- \$ 682.6	-	-
HCM Lane LOS	- F	-	-
HCM 95th %tile Q(veh)	- 9.6	-	-

Notes

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

Intersection

Int Delay, s/veh 116.8

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations		↗		↗↗	↗↗	↗
Traffic Vol, veh/h	0	340	0	3820	3605	320
Future Vol, veh/h	0	340	0	3820	3605	320
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Stop	Stop	Free	Free	Free	Free
RT Channelized	-	None	-	None	-	None
Storage Length	-	0	-	-	-	100
Veh in Median Storage, #	0	-	-	0	0	-
Grade, %	0	-	-	0	0	-
Peak Hour Factor	92	92	92	92	92	92
Heavy Vehicles, %	0	1	0	3	3	1
Mvmt Flow	0	370	0	4152	3918	348

Major/Minor	Minor2	Major1	Major2
Conflicting Flow All	- 1959	-	0 - 0
Stage 1	-	-	- - -
Stage 2	-	-	- - -
Critical Hdwy	- 6.92	-	- - -
Critical Hdwy Stg 1	-	-	- - -
Critical Hdwy Stg 2	-	-	- - -
Follow-up Hdwy	- 3.31	-	- - -
Pot Cap-1 Maneuver	0 ~ 54	0	- - -
Stage 1	0	0	- - -
Stage 2	0	0	- - -
Platoon blocked, %			- - -
Mov Cap-1 Maneuver	- ~ 54	-	- - -
Mov Cap-2 Maneuver	-	-	- - -
Stage 1	-	-	- - -
Stage 2	-	-	- - -

Approach	EB	NB	SB
HCM Control Delay, \$ 2777.3		0	0
HCM LOS	F		

Minor Lane/Major Mvmt	NBT EBLn1	SBT	SBR
Capacity (veh/h)	- 54	-	-
HCM Lane V/C Ratio	- 6.844	-	-
HCM Control Delay (s)	\$ 2777.3	-	-
HCM Lane LOS	- F	-	-
HCM 95th %tile Q(veh)	- 42.7	-	-

Notes

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

HCM Signalized Intersection Capacity Analysis

16: Arizona Ave & NW Colorado Ave

04/16/2019

												
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	0	0	0	0	435	40	10	405	1190	140	0	590
Future Volume (vph)	0	0	0	0	435	40	10	405	1190	140	0	590
Ideal Flow (vphpl)	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750
Total Lost time (s)					4.0			4.0	4.0	4.0		4.0
Lane Util. Factor					1.00			1.00	1.00	1.00		1.00
Frpb, ped/bikes					1.00			1.00	0.99	1.00		0.99
Flpb, ped/bikes					1.00			1.00	1.00	1.00		1.00
Frt					0.99			1.00	0.85	1.00		0.85
Flt Protected					1.00			1.00	1.00	0.95		1.00
Satd. Flow (prot)					1711			1731	1458	1630		1468
Flt Permitted					1.00			1.00	1.00	0.95		1.00
Satd. Flow (perm)					1711			1731	1458	1630		1468
Peak-hour factor, PHF	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90
Adj. Flow (vph)	0	0	0	0	483	44	11	450	1322	156	0	656
RTOR Reduction (vph)	0	0	0	0	7	0	0	0	314	0	0	218
Lane Group Flow (vph)	0	0	0	0	520	0	0	461	1008	156	0	438
Confl. Peds. (#/hr)	2					2	1		1	1		1
Confl. Bikes (#/hr)						2						
Heavy Vehicles (%)	0%	0%	0%	0%	1%	0%	0%	1%	1%	2%	0%	0%
Turn Type					NA		Split	NA	custom	Prot		Perm
Protected Phases		2			6		8	8	1	4		
Permitted Phases									2 8			4
Actuated Green, G (s)					33.0			27.0	60.0	27.0		27.0
Effective Green, g (s)					34.0			28.0	62.0	28.0		28.0
Actuated g/C Ratio					0.33			0.27	0.61	0.27		0.27
Clearance Time (s)					5.0			5.0	5.0	5.0		5.0
Vehicle Extension (s)					3.0			3.0	3.0	3.0		3.0
Lane Grp Cap (vph)					570			475	943	447		402
v/s Ratio Prot					0.30			0.27	c0.36	0.10		
v/s Ratio Perm									0.34			c0.30
v/c Ratio					0.91			0.97	1.07	0.35		1.09
Uniform Delay, d1					32.6			36.6	20.0	29.7		37.0
Progression Factor					1.00			1.00	1.00	1.00		1.00
Incremental Delay, d2					21.4			33.6	49.6	0.5		71.4
Delay (s)					54.0			70.2	69.6	30.2		108.4
Level of Service					D			E	E	C		F
Approach Delay (s)		0.0			54.0			69.8			93.4	
Approach LOS		A			D			E			F	
Intersection Summary												
HCM 2000 Control Delay			73.3		HCM 2000 Level of Service				E			
HCM 2000 Volume to Capacity ratio			1.17									
Actuated Cycle Length (s)			102.0		Sum of lost time (s)				16.0			
Intersection Capacity Utilization			101.0%		ICU Level of Service				G			
Analysis Period (min)			15									
c Critical Lane Group												

HCM Signalized Intersection Capacity Analysis

17: Wall St & Franklin Ave

04/16/2019

												
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		↶		↶	↶						↶↶	↶
Traffic Volume (vph)	0	690	35	205	505	0	0	0	0	180	560	295
Future Volume (vph)	0	690	35	205	505	0	0	0	0	180	560	295
Ideal Flow (vphpl)	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750
Total Lost time (s)		4.0		4.0	4.0						4.0	4.0
Lane Util. Factor		1.00		1.00	1.00						0.95	1.00
Frpb, ped/bikes		0.99		1.00	1.00						1.00	0.85
Flpb, ped/bikes		1.00		1.00	1.00						0.99	1.00
Frt		0.99		1.00	1.00						1.00	0.85
Flt Protected		1.00		0.95	1.00						0.99	1.00
Satd. Flow (prot)		1711		1614	1733						3218	1267
Flt Permitted		1.00		0.11	1.00						0.99	1.00
Satd. Flow (perm)		1711		189	1733						3218	1267
Peak-hour factor, PHF	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90
Adj. Flow (vph)	0	767	39	228	561	0	0	0	0	200	622	328
RTOR Reduction (vph)	0	2	0	0	0	0	0	0	0	0	0	189
Lane Group Flow (vph)	0	804	0	228	561	0	0	0	0	0	822	139
Confl. Peds. (#/hr)	30		138	138		30	71		53	53		71
Confl. Bikes (#/hr)			3			14						12
Heavy Vehicles (%)	0%	1%	0%	3%	1%	0%	0%	0%	0%	0%	1%	0%
Turn Type		NA		pm+pt	NA					Perm	NA	Perm
Protected Phases		8		7	4						2	
Permitted Phases				4						2		2
Actuated Green, G (s)		31.0		46.0	46.0						24.0	24.0
Effective Green, g (s)		32.0		47.0	47.0						25.0	25.0
Actuated g/C Ratio		0.40		0.59	0.59						0.31	0.31
Clearance Time (s)		5.0		5.0	5.0						5.0	5.0
Vehicle Extension (s)		0.2		0.2	0.2						0.2	0.2
Lane Grp Cap (vph)		684		306	1018						1005	395
v/s Ratio Prot		c0.47		c0.10	0.32							
v/s Ratio Perm				0.33							0.26	0.11
v/c Ratio		1.17		0.75	0.55						0.82	0.35
Uniform Delay, d1		24.0		29.6	10.1						25.4	21.2
Progression Factor		1.00		0.50	0.12						1.00	1.00
Incremental Delay, d2		93.6		0.8	0.0						7.4	2.5
Delay (s)		117.6		15.7	1.3						32.8	23.7
Level of Service		F		B	A						C	C
Approach Delay (s)		117.6			5.4			0.0			30.2	
Approach LOS		F			A			A			C	
Intersection Summary												
HCM 2000 Control Delay			48.7			HCM 2000 Level of Service				D		
HCM 2000 Volume to Capacity ratio			0.98									
Actuated Cycle Length (s)			80.0			Sum of lost time (s)				12.0		
Intersection Capacity Utilization			94.3%			ICU Level of Service				F		
Analysis Period (min)			15									
c Critical Lane Group												

HCM Signalized Intersection Capacity Analysis

18: Bond St & Franklin Ave

04/16/2019

												
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	385	545	0	0	640	160	105	710	230	0	0	0
Future Volume (vph)	385	545	0	0	640	160	105	710	230	0	0	0
Ideal Flow (vphpl)	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750
Total Lost time (s)	4.0	4.0			4.0	4.0		4.0	4.0			
Lane Util. Factor	1.00	1.00			1.00	1.00		0.95	1.00			
Frpb, ped/bikes	1.00	1.00			1.00	0.96		1.00	0.92			
Flpb, ped/bikes	1.00	1.00			1.00	1.00		0.98	1.00			
Frt	1.00	1.00			1.00	0.85		1.00	0.85			
Flt Protected	0.95	1.00			1.00	1.00		0.99	1.00			
Satd. Flow (prot)	1662	1716			1733	1434		3254	1362			
Flt Permitted	0.12	1.00			1.00	1.00		0.99	1.00			
Satd. Flow (perm)	212	1716			1733	1434		3254	1362			
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	418	592	0	0	696	174	114	772	250	0	0	0
RTOR Reduction (vph)	0	0	0	0	0	61	0	0	181	0	0	0
Lane Group Flow (vph)	418	592	0	0	696	113	0	886	69	0	0	0
Confl. Peds. (#/hr)	23		47	47		23	103		27	27		103
Confl. Bikes (#/hr)			3			7			4			
Heavy Vehicles (%)	0%	2%	0%	0%	1%	0%	0%	0%	1%	0%	0%	0%
Turn Type	pm+pt	NA			NA	Perm	Perm	NA	Perm			
Protected Phases	3	8			4			6				
Permitted Phases	8					4	6		6			
Actuated Green, G (s)	49.0	49.0			28.0	28.0		21.0	21.0			
Effective Green, g (s)	50.0	50.0			29.0	29.0		22.0	22.0			
Actuated g/C Ratio	0.62	0.62			0.36	0.36		0.28	0.28			
Clearance Time (s)	5.0	5.0			5.0	5.0		5.0	5.0			
Vehicle Extension (s)	0.2	0.2			0.2	0.2		0.2	0.2			
Lane Grp Cap (vph)	440	1072			628	519		894	374			
v/s Ratio Prot	c0.20	0.35			c0.40							
v/s Ratio Perm	0.39					0.08		0.27	0.05			
v/c Ratio	0.95	0.55			1.11	0.22		0.99	0.18			
Uniform Delay, d1	27.4	8.6			25.5	17.7		28.9	22.1			
Progression Factor	0.46	0.17			1.00	1.00		1.00	1.00			
Incremental Delay, d2	5.1	0.0			69.3	0.1		28.0	1.1			
Delay (s)	17.8	1.5			94.8	17.7		56.9	23.2			
Level of Service	B	A			F	B		E	C			
Approach Delay (s)		8.3			79.4			49.5			0.0	
Approach LOS		A			E			D			A	
Intersection Summary												
HCM 2000 Control Delay			44.3				HCM 2000 Level of Service			D		
HCM 2000 Volume to Capacity ratio			1.03									
Actuated Cycle Length (s)			80.0				Sum of lost time (s)			12.0		
Intersection Capacity Utilization			94.3%				ICU Level of Service			F		
Analysis Period (min)			15									
c Critical Lane Group												

HCM Signalized Intersection Capacity Analysis

19: SW Reed Market Rd & US 97 SB

04/16/2019

												
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		↑↑			↑	↑				↑	↑	
Traffic Volume (vph)	0	1130	90	0	770	370	0	0	0	945	0	215
Future Volume (vph)	0	1130	90	0	770	370	0	0	0	945	0	215
Ideal Flow (vphpl)	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750
Total Lost time (s)		4.0			4.0	4.0				4.0	4.0	
Lane Util. Factor		0.95			1.00	1.00				1.00	1.00	
Frpb, ped/bikes		1.00			1.00	0.99				1.00	1.00	
Flpb, ped/bikes		1.00			1.00	1.00				1.00	1.00	
Frt		0.99			1.00	0.85				1.00	0.85	
Flt Protected		1.00			1.00	1.00				0.95	1.00	
Satd. Flow (prot)		3219			1716	1440				1630	1458	
Flt Permitted		1.00			1.00	1.00				0.95	1.00	
Satd. Flow (perm)		3219			1716	1440				1630	1458	
Peak-hour factor, PHF	0.91	0.91	0.91	0.91	0.91	0.91	0.91	0.91	0.91	0.91	0.91	0.91
Adj. Flow (vph)	0	1242	99	0	846	407	0	0	0	1038	0	236
RTOR Reduction (vph)	0	55	0	0	0	24	0	0	0	0	52	0
Lane Group Flow (vph)	0	1286	0	0	846	383	0	0	0	1038	184	0
Confl. Peds. (#/hr)	2		1	1		2						
Confl. Bikes (#/hr)						1						
Heavy Vehicles (%)	0%	2%	2%	0%	2%	2%	0%	0%	0%	2%	0%	2%
Turn Type		NA			NA	custom				Perm	NA	
Protected Phases		2			6	4					4	
Permitted Phases						6				4		
Actuated Green, G (s)		29.0			29.0	56.0				27.0	27.0	
Effective Green, g (s)		30.0			30.0	58.0				28.0	28.0	
Actuated g/C Ratio		0.45			0.45	0.88				0.42	0.42	
Clearance Time (s)		5.0			5.0	5.0				5.0	5.0	
Vehicle Extension (s)		5.2			5.2	3.0				3.0	3.0	
Lane Grp Cap (vph)		1463			780	1440				691	618	
v/s Ratio Prot		0.40			c0.49	0.11					0.13	
v/s Ratio Perm						0.15				c0.64		
v/c Ratio		0.88			1.08	0.27				1.50	0.30	
Uniform Delay, d1		16.4			18.0	0.6				19.0	12.5	
Progression Factor		1.00			1.00	1.00				1.00	1.00	
Incremental Delay, d2		6.9			57.6	0.1				233.5	0.3	
Delay (s)		23.3			75.6	0.7				252.5	12.8	
Level of Service		C			E	A				F	B	
Approach Delay (s)		23.3			51.3			0.0			208.1	
Approach LOS		C			D			A			F	
Intersection Summary												
HCM 2000 Control Delay			93.2				HCM 2000 Level of Service			F		
HCM 2000 Volume to Capacity ratio			1.29									
Actuated Cycle Length (s)			66.0				Sum of lost time (s)			8.0		
Intersection Capacity Utilization			107.5%				ICU Level of Service			G		
Analysis Period (min)			15									
c Critical Lane Group												

HCM Signalized Intersection Capacity Analysis

21: 3rd Street & Franklin Ave

04/16/2019

												
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	335	585	160	235	580	100	195	860	185	155	1030	175
Future Volume (vph)	335	585	160	235	580	100	195	860	185	155	1030	175
Ideal Flow (vphpl)	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750
Total Lost time (s)	4.0	4.0	4.0	4.0	4.0		4.0	4.0		4.0	4.0	
Lane Util. Factor	1.00	1.00	1.00	1.00	0.95		1.00	0.95		1.00	0.95	
Frpb, ped/bikes	1.00	1.00	0.97	1.00	1.00		1.00	0.99		1.00	1.00	
Flpb, ped/bikes	1.00	1.00	1.00	1.00	1.00		1.00	1.00		1.00	1.00	
Frt	1.00	1.00	0.85	1.00	0.98		1.00	0.97		1.00	0.98	
Flt Protected	0.95	1.00	1.00	0.95	1.00		0.95	1.00		0.95	1.00	
Satd. Flow (prot)	1630	1733	1408	1614	3173		1646	3148		1630	3214	
Flt Permitted	0.95	1.00	1.00	0.95	1.00		0.95	1.00		0.95	1.00	
Satd. Flow (perm)	1630	1733	1408	1614	3173		1646	3148		1630	3214	
Peak-hour factor, PHF	0.94	0.94	0.94	0.94	0.94	0.94	0.94	0.94	0.94	0.94	0.94	0.94
Adj. Flow (vph)	356	622	170	250	617	106	207	915	197	165	1096	186
RTOR Reduction (vph)	0	0	90	0	12	0	0	15	0	0	12	0
Lane Group Flow (vph)	356	622	80	250	712	0	207	1097	0	165	1270	0
Confl. Peds. (#/hr)	7		13	13		7	8		14	14		8
Confl. Bikes (#/hr)			5			1			1			
Heavy Vehicles (%)	2%	1%	2%	3%	2%	3%	1%	2%	1%	2%	1%	0%
Turn Type	Prot	NA	Perm	Prot	NA		Prot	NA		Prot	NA	
Protected Phases	7	4		3	8		1	6		5	2	
Permitted Phases			4									
Actuated Green, G (s)	21.5	35.5	35.5	13.5	27.5		11.5	42.5		10.5	41.5	
Effective Green, g (s)	22.0	36.0	36.0	14.0	28.0		12.0	43.0		11.0	42.0	
Actuated g/C Ratio	0.18	0.30	0.30	0.12	0.23		0.10	0.36		0.09	0.35	
Clearance Time (s)	4.5	4.5	4.5	4.5	4.5		4.5	4.5		4.5	4.5	
Vehicle Extension (s)	2.5	2.5	2.5	2.5	2.5		2.5	2.5		2.5	2.5	
Lane Grp Cap (vph)	298	519	422	188	740		164	1128		149	1124	
v/s Ratio Prot	c0.22	c0.36		c0.15	0.22		c0.13	0.35		0.10	c0.40	
v/s Ratio Perm			0.06									
v/c Ratio	1.19	1.20	0.19	1.33	0.96		1.26	0.97		1.11	1.13	
Uniform Delay, d1	49.0	42.0	31.2	53.0	45.5		54.0	37.9		54.5	39.0	
Progression Factor	1.00	1.00	1.00	1.00	1.00		1.00	1.00		1.00	1.00	
Incremental Delay, d2	115.7	106.8	0.2	180.2	23.9		157.6	20.9		105.4	70.2	
Delay (s)	164.7	148.8	31.3	233.2	69.4		211.6	58.8		159.9	109.2	
Level of Service	F	F	C	F	E		F	E		F	F	
Approach Delay (s)		136.3			111.5			82.8			115.0	
Approach LOS		F			F			F			F	
Intersection Summary												
HCM 2000 Control Delay			110.6			HCM 2000 Level of Service				F		
HCM 2000 Volume to Capacity ratio			1.21									
Actuated Cycle Length (s)			120.0			Sum of lost time (s)				16.0		
Intersection Capacity Utilization			109.7%			ICU Level of Service				H		
Analysis Period (min)			15									
c Critical Lane Group												

HCM Signalized Intersection Capacity Analysis

26: NW Colorado Ave & Wall St

04/16/2019

												
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations					↑↑						↑↑	
Traffic Volume (vph)	0	0	0	135	995	0	0	0	0	0	565	260
Future Volume (vph)	0	0	0	135	995	0	0	0	0	0	565	260
Ideal Flow (vphpl)	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750
Total Lost time (s)					4.0						4.0	
Lane Util. Factor					0.95						0.95	
Frpb, ped/bikes					1.00						1.00	
Flpb, ped/bikes					1.00						1.00	
Frt					1.00						0.95	
Flt Protected					0.99						1.00	
Satd. Flow (prot)					3276						3142	
Flt Permitted					0.99						1.00	
Satd. Flow (perm)					3276						3142	
Peak-hour factor, PHF	0.94	0.94	0.94	0.94	0.94	0.94	0.94	0.94	0.94	0.94	0.94	0.94
Adj. Flow (vph)	0	0	0	144	1059	0	0	0	0	0	601	277
RTOR Reduction (vph)	0	0	0	0	18	0	0	0	0	0	42	0
Lane Group Flow (vph)	0	0	0	0	1185	0	0	0	0	0	836	0
Confl. Peds. (#/hr)	3		2	2		3	2		11	11		2
Confl. Bikes (#/hr)						1						3
Heavy Vehicles (%)	0%	0%	0%	0%	1%	0%	0%	0%	0%	0%	0%	1%
Turn Type				Perm	NA						NA	
Protected Phases					6						4	
Permitted Phases				6								
Actuated Green, G (s)					29.0						18.0	
Effective Green, g (s)					29.5						18.5	
Actuated g/C Ratio					0.53						0.33	
Clearance Time (s)					4.5						4.5	
Vehicle Extension (s)					2.6						2.0	
Lane Grp Cap (vph)					1725						1037	
v/s Ratio Prot											c0.27	
v/s Ratio Perm					0.36							
v/c Ratio					0.69						0.81	
Uniform Delay, d1					9.8						17.1	
Progression Factor					1.00						1.00	
Incremental Delay, d2					2.3						4.4	
Delay (s)					12.1						21.5	
Level of Service					B						C	
Approach Delay (s)		0.0			12.1			0.0			21.5	
Approach LOS		A			B			A			C	
Intersection Summary												
HCM 2000 Control Delay			16.1		HCM 2000 Level of Service				B			
HCM 2000 Volume to Capacity ratio			0.73									
Actuated Cycle Length (s)			56.0		Sum of lost time (s)			8.0				
Intersection Capacity Utilization			70.2%		ICU Level of Service				C			
Analysis Period (min)			15									
c Critical Lane Group												

HCM Signalized Intersection Capacity Analysis

27: Bond St & Arizona Ave

04/16/2019

												
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	360	1340	0	0	0	0	0	500	250	0	0	0
Future Volume (vph)	360	1340	0	0	0	0	0	500	250	0	0	0
Ideal Flow (vphpl)	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750
Total Lost time (s)		4.0						4.0				
Lane Util. Factor		0.95						0.95				
Frpb, ped/bikes		1.00						0.99				
Flpb, ped/bikes		1.00						1.00				
Frt		1.00						0.95				
Flt Protected		0.99						1.00				
Satd. Flow (prot)		3229						3110				
Flt Permitted		0.99						1.00				
Satd. Flow (perm)		3229						3110				
Peak-hour factor, PHF	0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.88
Adj. Flow (vph)	409	1523	0	0	0	0	0	568	284	0	0	0
RTOR Reduction (vph)	0	42	0	0	0	0	0	13	0	0	0	0
Lane Group Flow (vph)	0	1890	0	0	0	0	0	839	0	0	0	0
Confl. Peds. (#/hr)	5		7	7		5	10		4	4		10
Confl. Bikes (#/hr)			3						1			
Heavy Vehicles (%)	1%	2%	0%	0%	0%	0%	0%	1%	1%	0%	0%	0%
Turn Type	Perm	NA						NA				
Protected Phases		2						8				
Permitted Phases	2											
Actuated Green, G (s)		29.5						17.5				
Effective Green, g (s)		30.0						18.0				
Actuated g/C Ratio		0.54						0.32				
Clearance Time (s)		4.5						4.5				
Vehicle Extension (s)		2.6						2.0				
Lane Grp Cap (vph)		1729						999				
v/s Ratio Prot								c0.27				
v/s Ratio Perm		0.59										
v/c Ratio		1.09						0.84				
Uniform Delay, d1		13.0						17.7				
Progression Factor		1.00						1.00				
Incremental Delay, d2		51.8						6.1				
Delay (s)		64.8						23.7				
Level of Service		E						C				
Approach Delay (s)		64.8			0.0			23.7			0.0	
Approach LOS		E			A			C			A	
Intersection Summary												
HCM 2000 Control Delay		52.3						HCM 2000 Level of Service		D		
HCM 2000 Volume to Capacity ratio		1.00										
Actuated Cycle Length (s)		56.0						Sum of lost time (s)		8.0		
Intersection Capacity Utilization		85.4%						ICU Level of Service		E		
Analysis Period (min)		15										
c Critical Lane Group												

HCM Signalized Intersection Capacity Analysis

31: 3rd St & Wilson Ave

04/16/2019

												
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	270	365	90	150	355	60	195	785	70	160	1065	165
Future Volume (vph)	270	365	90	150	355	60	195	785	70	160	1065	165
Ideal Flow (vphpl)	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750
Total Lost time (s)	4.0	4.0		4.0	4.0		4.3	4.0		4.0	4.0	
Lane Util. Factor	1.00	1.00		1.00	1.00		1.00	0.95		1.00	0.95	
Frpb, ped/bikes	1.00	1.00		1.00	1.00		1.00	1.00		1.00	0.99	
Flpb, ped/bikes	1.00	1.00		1.00	1.00		1.00	1.00		1.00	1.00	
Frt	1.00	0.97		1.00	0.98		1.00	0.99		1.00	0.98	
Flt Protected	0.95	1.00		0.95	1.00		0.95	1.00		0.95	1.00	
Satd. Flow (prot)	1646	1647		1614	1679		1646	3237		1630	3203	
Flt Permitted	0.95	1.00		0.95	1.00		0.95	1.00		0.95	1.00	
Satd. Flow (perm)	1646	1647		1614	1679		1646	3237		1630	3203	
Peak-hour factor, PHF	0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.88
Adj. Flow (vph)	307	415	102	170	403	68	222	892	80	182	1210	188
RTOR Reduction (vph)	0	7	0	0	5	0	0	5	0	0	9	0
Lane Group Flow (vph)	307	510	0	170	466	0	222	967	0	182	1389	0
Confl. Peds. (#/hr)	3		1	1		3	10		1	1		10
Confl. Bikes (#/hr)			3									1
Heavy Vehicles (%)	1%	3%	2%	3%	2%	0%	1%	1%	4%	2%	1%	1%
Turn Type	Split	NA		Split	NA		Prot	NA		Prot	NA	
Protected Phases	4	4		8	8		1	6		5	2	
Permitted Phases												
Actuated Green, G (s)	30.0	30.0		27.0	27.0		11.5	39.5		13.5	41.5	
Effective Green, g (s)	31.0	31.0		28.0	28.0		11.7	40.5		14.0	42.5	
Actuated g/C Ratio	0.24	0.24		0.22	0.22		0.09	0.31		0.11	0.33	
Clearance Time (s)	5.0	5.0		5.0	5.0		4.5	5.0		4.5	5.0	
Vehicle Extension (s)	2.5	2.5		2.5	2.5		2.5	2.5		2.5	2.5	
Lane Grp Cap (vph)	394	394		348	363		148	1012		176	1051	
v/s Ratio Prot	0.19	c0.31		0.11	c0.28		c0.13	0.30		0.11	c0.43	
v/s Ratio Perm												
v/c Ratio	0.78	1.29		0.49	1.28		1.50	0.96		1.03	1.32	
Uniform Delay, d1	46.0	49.2		44.5	50.8		58.9	43.6		57.8	43.5	
Progression Factor	1.00	1.00		1.00	1.00		1.00	1.00		1.00	1.00	
Incremental Delay, d2	9.0	150.4		0.8	147.5		256.9	18.4		77.1	151.3	
Delay (s)	55.1	199.6		45.3	198.2		315.8	62.0		134.8	194.8	
Level of Service	E	F		D	F		F	E		F	F	
Approach Delay (s)		145.8			157.7			109.2			187.9	
Approach LOS		F			F			F			F	
Intersection Summary												
HCM 2000 Control Delay			153.0			HCM 2000 Level of Service			F			
HCM 2000 Volume to Capacity ratio			1.32									
Actuated Cycle Length (s)			129.5			Sum of lost time (s)			16.3			
Intersection Capacity Utilization			103.7%			ICU Level of Service			G			
Analysis Period (min)			15									
c Critical Lane Group												

Intersection						
Int Delay, s/veh	1.3					
Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations						
Traffic Vol, veh/h	210	15	20	515	35	20
Future Vol, veh/h	210	15	20	515	35	20
Conflicting Peds, #/hr	0	1	1	0	0	0
Sign Control	Free	Free	Free	Free	Stop	Stop
RT Channelized	-	None	-	None	-	None
Storage Length	-	-	-	-	0	-
Veh in Median Storage, #	0	-	-	0	0	-
Grade, %	0	-	-	0	0	-
Peak Hour Factor	86	86	86	86	86	86
Heavy Vehicles, %	1	8	0	0	7	0
Mvmt Flow	244	17	23	599	41	23
Major/Minor	Major1	Major2		Minor1		
Conflicting Flow All	0	0	262	0	899	254
Stage 1	-	-	-	-	254	-
Stage 2	-	-	-	-	645	-
Critical Hdwy	-	-	4.1	-	6.47	6.2
Critical Hdwy Stg 1	-	-	-	-	5.47	-
Critical Hdwy Stg 2	-	-	-	-	5.47	-
Follow-up Hdwy	-	-	2.2	-	3.563	3.3
Pot Cap-1 Maneuver	-	-	1314	-	303	790
Stage 1	-	-	-	-	777	-
Stage 2	-	-	-	-	513	-
Platoon blocked, %	-	-		-		
Mov Cap-1 Maneuver	-	-	1313	-	295	789
Mov Cap-2 Maneuver	-	-	-	-	295	-
Stage 1	-	-	-	-	756	-
Stage 2	-	-	-	-	513	-
Approach	EB	WB		NB		
HCM Control Delay, s	0	0.3		16.3		
HCM LOS	C					
Minor Lane/Major Mvmt	NBLn1	EBT	EBR	WBL	WBT	
Capacity (veh/h)	382	-	-	1313	-	
HCM Lane V/C Ratio	0.167	-	-	0.018	-	
HCM Control Delay (s)	16.3	-	-	7.8	0	
HCM Lane LOS	C	-	-	A	A	
HCM 95th %tile Q(veh)	0.6	-	-	0.1	-	

HCM 2010 TWSC
51: SW Division St & SW Reed Market Rd

04/16/2019

Intersection												
Int Delay, s/veh	1.6											
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		↔↔			↔↔				↗		↔↔	
Traffic Vol, veh/h	95	1215	810	5	1015	430	0	0	35	5	0	15
Future Vol, veh/h	95	1215	810	5	1015	430	0	0	35	5	0	15
Conflicting Peds, #/hr	1	0	0	0	0	1	0	0	0	0	0	0
Sign Control	Free	Free	Free	Free	Free	Free	Stop	Stop	Stop	Stop	Stop	Stop
RT Channelized	-	-	None	-	-	None	-	-	Stop	-	-	None
Storage Length	-	-	-	-	-	-	-	-	0	-	-	-
Veh in Median Storage, #	-	0	-	-	0	-	-	0	-	-	0	-
Grade, %	-	0	-	-	0	-	-	0	-	-	0	-
Peak Hour Factor	95	95	95	95	95	95	95	95	95	95	95	95
Heavy Vehicles, %	2	2	2	0	1	4	0	0	5	0	0	6
Mvmt Flow	100	1279	853	5	1068	453	0	0	37	5	0	16
Major/Minor	Major1			Major2			Minor1			Minor2		
Conflicting Flow All	1522	0	0	2132	0	0	-	-	1066	2146	3638	762
Stage 1	-	-	-	-	-	-	-	-	-	1306	1306	-
Stage 2	-	-	-	-	-	-	-	-	-	840	2332	-
Critical Hdwy	4.14	-	-	4.1	-	-	-	-	7	7.5	6.5	7.02
Critical Hdwy Stg 1	-	-	-	-	-	-	-	-	-	6.5	5.5	-
Critical Hdwy Stg 2	-	-	-	-	-	-	-	-	-	6.5	5.5	-
Follow-up Hdwy	2.22	-	-	2.2	-	-	-	-	3.35	3.5	4	3.36
Pot Cap-1 Maneuver	434	-	-	258	-	-	0	0	213	28	5	339
Stage 1	-	-	-	-	-	-	0	0	-	172	232	-
Stage 2	-	-	-	-	-	-	0	0	-	330	71	-
Platoon blocked, %		-	-		-	-						
Mov Cap-1 Maneuver	434	-	-	258	-	-	-	-	213	20	4	339
Mov Cap-2 Maneuver	-	-	-	-	-	-	-	-	-	20	4	-
Stage 1	-	-	-	-	-	-	-	-	-	172	189	-
Stage 2	-	-	-	-	-	-	-	-	-	273	71	-
Approach	EB			WB			NB			SB		
HCM Control Delay, s	0.7			1.3			25.4			80.1		
HCM LOS							D			F		
Minor Lane/Major Mvmt	NBLn1	EBL	EBT	EBR	WBL	WBT	WBR	SBLn1				
Capacity (veh/h)	213	434	-	-	258	-	-	68				
HCM Lane V/C Ratio	0.173	0.23	-	-	0.02	-	-	0.31				
HCM Control Delay (s)	25.4	15.8	0	-	19.2	1.8	-	80.1				
HCM Lane LOS	D	C	A	-	C	A	-	F				
HCM 95th %tile Q(veh)	0.6	0.9	-	-	0.1	-	-	1.1				

HCM Signalized Intersection Capacity Analysis

52: SW Reed Market Rd & SE 3rd St

04/16/2019

												
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	190	875	155	170	480	90	490	770	250	120	940	305
Future Volume (vph)	190	875	155	170	480	90	490	770	250	120	940	305
Ideal Flow (vphpl)	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750
Total Lost time (s)		4.0			4.0		4.0	4.0		4.0	4.0	
Lane Util. Factor		0.95			0.95		1.00	0.95		1.00	0.95	
Frpb, ped/bikes		1.00			1.00		1.00	0.99		1.00	1.00	
Flpb, ped/bikes		1.00			1.00		1.00	1.00		1.00	1.00	
Frt		0.98			0.98		1.00	0.96		1.00	0.96	
Flt Protected		0.99			0.99		0.95	1.00		0.95	1.00	
Satd. Flow (prot)		3129			3154		1646	3102		1630	3129	
Flt Permitted		0.99			0.99		0.95	1.00		0.95	1.00	
Satd. Flow (perm)		3129			3154		1646	3102		1630	3129	
Peak-hour factor, PHF	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96
Adj. Flow (vph)	198	911	161	177	500	94	510	802	260	125	979	318
RTOR Reduction (vph)	0	8	0	0	7	0	0	21	0	0	21	0
Lane Group Flow (vph)	0	1262	0	0	764	0	510	1041	0	125	1276	0
Confl. Peds. (#/hr)	2		1	1		2	1		9	9		1
Confl. Bikes (#/hr)									1			
Heavy Vehicles (%)	3%	3%	5%	2%	2%	3%	1%	3%	1%	2%	2%	2%
Turn Type	Split	NA		Split	NA		Prot	NA		Prot	NA	
Protected Phases	3	3		4	4		1	6		5	2	
Permitted Phases												
Actuated Green, G (s)		41.5			29.5		19.5	52.3		8.7	41.5	
Effective Green, g (s)		42.0			30.0		20.0	52.8		9.2	42.0	
Actuated g/C Ratio		0.28			0.20		0.13	0.35		0.06	0.28	
Clearance Time (s)		4.5			4.5		4.5	4.5		4.5	4.5	
Vehicle Extension (s)		2.5			2.5		2.5	4.3		2.5	4.3	
Lane Grp Cap (vph)		876			630		219	1091		99	876	
v/s Ratio Prot		c0.40			c0.24		c0.31	0.34		0.08	c0.41	
v/s Ratio Perm												
v/c Ratio		1.44			1.21		2.33	0.95		1.26	1.46	
Uniform Delay, d1		54.0			60.0		65.0	47.4		70.4	54.0	
Progression Factor		1.00			1.00		1.00	1.00		1.00	1.00	
Incremental Delay, d2		204.8			109.8		612.0	18.3		176.7	211.9	
Delay (s)		258.8			169.8		677.0	65.7		247.1	265.9	
Level of Service		F			F		F	E		F	F	
Approach Delay (s)		258.8			169.8			264.0			264.2	
Approach LOS		F			F			F			F	
Intersection Summary												
HCM 2000 Control Delay		248.3					HCM 2000 Level of Service			F		
HCM 2000 Volume to Capacity ratio		1.53										
Actuated Cycle Length (s)		150.0					Sum of lost time (s)			16.0		
Intersection Capacity Utilization		142.2%					ICU Level of Service			H		
Analysis Period (min)		15										
c Critical Lane Group												

HCM Signalized Intersection Capacity Analysis

111: Wall St & Portland Ave

04/16/2019

												
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	380	225	100	70	215	155	70	755	75	35	490	480
Future Volume (vph)	380	225	100	70	215	155	70	755	75	35	490	480
Ideal Flow (vphpl)	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750
Total Lost time (s)	4.0	4.0		4.0	4.0	4.0	4.0	4.0		4.0	4.0	4.0
Lane Util. Factor	1.00	1.00		1.00	1.00	1.00	1.00	1.00		1.00	1.00	1.00
Frpb, ped/bikes	1.00	0.99		1.00	1.00	0.97	1.00	1.00		1.00	1.00	0.96
Flpb, ped/bikes	1.00	1.00		1.00	1.00	1.00	1.00	1.00		1.00	1.00	1.00
Frt	1.00	0.95		1.00	1.00	0.85	1.00	0.99		1.00	1.00	0.85
Flt Protected	0.95	1.00		0.95	1.00	1.00	0.95	1.00		0.95	1.00	1.00
Satd. Flow (prot)	1646	1643		1662	1750	1432	1662	1717		1599	1733	1417
Flt Permitted	0.95	1.00		0.95	1.00	1.00	0.22	1.00		0.09	1.00	1.00
Satd. Flow (perm)	1646	1643		1662	1750	1432	389	1717		156	1733	1417
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	413	245	109	76	234	168	76	821	82	38	533	522
RTOR Reduction (vph)	0	15	0	0	0	0	0	3	0	0	0	283
Lane Group Flow (vph)	413	339	0	76	234	168	76	900	0	38	533	239
Confl. Peds. (#/hr)	3					3	5		4	4		5
Confl. Bikes (#/hr)			7			16			7			6
Heavy Vehicles (%)	1%	1%	0%	0%	0%	1%	0%	0%	2%	4%	1%	1%
Turn Type	Prot	NA		Prot	NA	Free	pm+pt	NA		pm+pt	NA	Perm
Protected Phases	1	6		5	2		3	8		7	4	
Permitted Phases						Free	8			4		4
Actuated Green, G (s)	20.2	33.6		5.5	18.9	105.2	47.2	43.3		45.0	42.2	42.2
Effective Green, g (s)	21.2	34.6		6.5	19.9	105.2	49.2	44.3		47.0	43.2	43.2
Actuated g/C Ratio	0.20	0.33		0.06	0.19	1.00	0.47	0.42		0.45	0.41	0.41
Clearance Time (s)	5.0	5.0		5.0	5.0		5.0	5.0		5.0	5.0	5.0
Vehicle Extension (s)	3.0	3.0		3.0	3.0		3.0	3.0		3.0	3.0	3.0
Lane Grp Cap (vph)	331	540		102	331	1432	241	723		121	711	581
v/s Ratio Prot	c0.25	0.21		0.05	c0.13		c0.01	c0.52		0.01	0.31	
v/s Ratio Perm						c0.12	0.13			0.13		0.17
v/c Ratio	1.25	0.63		0.75	0.71	0.12	0.32	1.24		0.31	0.75	0.41
Uniform Delay, d1	42.0	29.9		48.5	39.9	0.0	18.4	30.5		24.0	26.4	22.0
Progression Factor	1.00	1.00		1.00	1.00	1.00	1.00	1.00		1.00	1.00	1.00
Incremental Delay, d2	134.2	2.3		25.2	6.7	0.2	0.8	121.7		1.5	4.4	0.5
Delay (s)	176.2	32.1		73.7	46.7	0.2	19.2	152.1		25.5	30.7	22.4
Level of Service	F	C		E	D	A	B	F		C	C	C
Approach Delay (s)		109.7			34.6			141.8			26.6	
Approach LOS		F			C			F			C	
Intersection Summary												
HCM 2000 Control Delay			81.0			HCM 2000 Level of Service			F			
HCM 2000 Volume to Capacity ratio			1.09									
Actuated Cycle Length (s)			105.2			Sum of lost time (s)			16.0			
Intersection Capacity Utilization			101.3%			ICU Level of Service			G			
Analysis Period (min)			15									
c Critical Lane Group												

Intersection						
Int Delay, s/veh	3.7					
Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Traffic Vol, veh/h	30	80	675	5	55	730
Future Vol, veh/h	30	80	675	5	55	730
Conflicting Peds, #/hr	1	0	0	28	28	0
Sign Control	Stop	Stop	Free	Free	Free	Free
RT Channelized	-	None	-	None	-	None
Storage Length	0	-	-	-	0	-
Veh in Median Storage, #	0	-	0	-	-	0
Grade, %	0	-	0	-	-	0
Peak Hour Factor	89	89	89	89	89	89
Heavy Vehicles, %	0	0	1	0	0	1
Mvmt Flow	34	90	758	6	62	820
Major/Minor	Minor1	Major1		Major2		
Conflicting Flow All	1734	789	0	0	792	0
Stage 1	789	-	-	-	-	-
Stage 2	945	-	-	-	-	-
Critical Hdwy	6.4	6.2	-	-	4.1	-
Critical Hdwy Stg 1	5.4	-	-	-	-	-
Critical Hdwy Stg 2	5.4	-	-	-	-	-
Follow-up Hdwy	3.5	3.3	-	-	2.2	-
Pot Cap-1 Maneuver	98	394	-	-	838	-
Stage 1	451	-	-	-	-	-
Stage 2	381	-	-	-	-	-
Platoon blocked, %			-	-		-
Mov Cap-1 Maneuver	88	385	-	-	818	-
Mov Cap-2 Maneuver	88	-	-	-	-	-
Stage 1	407	-	-	-	-	-
Stage 2	381	-	-	-	-	-
Approach	WB	NB		SB		
HCM Control Delay, s	48.4	0		0.7		
HCM LOS	E					
Minor Lane/Major Mvmt	NBT	NBRWBLn1		SBL	SBT	
Capacity (veh/h)	-	200		818	-	
HCM Lane V/C Ratio	-	0.618		0.076	-	
HCM Control Delay (s)	-	48.4		9.8	-	
HCM Lane LOS	-	E		A	-	
HCM 95th %tile Q(veh)	-	3.5		0.2	-	

HCM Signalized Intersection Capacity Analysis

113: Greenwood Ave & Wall St

04/16/2019

												
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	105	430	205	410	700	20	0	0	0	115	520	205
Future Volume (vph)	105	430	205	410	700	20	0	0	0	115	520	205
Ideal Flow (vphpl)	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750
Total Lost time (s)	4.0	4.0		4.0	4.0						4.0	4.0
Lane Util. Factor	1.00	0.95		1.00	1.00						0.95	1.00
Frpb, ped/bikes	1.00	0.98		1.00	1.00						1.00	0.88
Flpb, ped/bikes	1.00	1.00		1.00	1.00						1.00	1.00
Frt	1.00	0.95		1.00	1.00						1.00	0.85
Flt Protected	0.95	1.00		0.95	1.00						0.99	1.00
Satd. Flow (prot)	1646	3058		1646	1724						3257	1296
Flt Permitted	0.95	1.00		0.95	1.00						0.99	1.00
Satd. Flow (perm)	1646	3058		1646	1724						3257	1296
Peak-hour factor, PHF	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95
Adj. Flow (vph)	111	453	216	432	737	21	0	0	0	121	547	216
RTOR Reduction (vph)	0	69	0	0	1	0	0	0	0	0	0	161
Lane Group Flow (vph)	111	600	0	432	757	0	0	0	0	0	668	55
Confl. Peds. (#/hr)	12		47	47		12	38		18	18		38
Confl. Bikes (#/hr)			1			11			1			24
Heavy Vehicles (%)	1%	2%	0%	1%	1%	0%	0%	0%	0%	0%	1%	1%
Turn Type	Prot	NA		Prot	NA					Perm	NA	Perm
Protected Phases	5	2		1	6						4	
Permitted Phases										4		4
Actuated Green, G (s)	7.4	24.4		23.2	40.2						20.4	20.4
Effective Green, g (s)	7.4	24.4		23.2	40.2						20.4	20.4
Actuated g/C Ratio	0.09	0.30		0.29	0.50						0.25	0.25
Clearance Time (s)	4.0	4.0		4.0	4.0						4.0	4.0
Vehicle Extension (s)	3.0	3.0		3.0	3.0						3.0	3.0
Lane Grp Cap (vph)	152	932		477	866						830	330
v/s Ratio Prot	0.07	0.20		c0.26	c0.44							
v/s Ratio Perm											0.21	0.04
v/c Ratio	0.73	0.64		0.91	0.87						0.80	0.17
Uniform Delay, d1	35.3	24.0		27.3	17.6						27.9	23.2
Progression Factor	1.00	1.00		1.00	1.00						1.00	1.00
Incremental Delay, d2	16.4	3.4		20.5	11.9						5.7	0.2
Delay (s)	51.8	27.5		47.9	29.5						33.6	23.4
Level of Service	D	C		D	C						C	C
Approach Delay (s)		30.9			36.2			0.0			31.1	
Approach LOS		C			D			A			C	
Intersection Summary												
HCM 2000 Control Delay			33.2			HCM 2000 Level of Service				C		
HCM 2000 Volume to Capacity ratio			0.90									
Actuated Cycle Length (s)			80.0			Sum of lost time (s)			12.0			
Intersection Capacity Utilization			80.2%			ICU Level of Service			D			
Analysis Period (min)			15									
c Critical Lane Group												

HCM Signalized Intersection Capacity Analysis

204: 3rd Street & US 20

04/16/2019

												
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	270	815	235	345	675	280	225	915	250	355	960	120
Future Volume (vph)	270	815	235	345	675	280	225	915	250	355	960	120
Ideal Flow (vphpl)	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750
Total Lost time (s)	4.0	4.0		4.0	4.0		4.0	4.0		4.0	4.0	
Lane Util. Factor	1.00	0.95		1.00	0.95		1.00	0.95		1.00	0.95	
Frpb, ped/bikes	1.00	1.00		1.00	0.99		1.00	0.99		1.00	1.00	
Flpb, ped/bikes	1.00	1.00		1.00	1.00		1.00	1.00		1.00	1.00	
Frt	1.00	0.97		1.00	0.96		1.00	0.97		1.00	0.98	
Flt Protected	0.95	1.00		0.95	1.00		0.95	1.00		0.95	1.00	
Satd. Flow (prot)	1599	3170		1646	3104		1646	3167		1583	3228	
Flt Permitted	0.95	1.00		0.95	1.00		0.95	1.00		0.95	1.00	
Satd. Flow (perm)	1599	3170		1646	3104		1646	3167		1583	3228	
Peak-hour factor, PHF	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96
Adj. Flow (vph)	281	849	245	359	703	292	234	953	260	370	1000	125
RTOR Reduction (vph)	0	17	0	0	29	0	0	15	0	0	6	0
Lane Group Flow (vph)	281	1077	0	359	967	0	234	1198	0	370	1119	0
Confl. Peds. (#/hr)	2		1	1		2	6		7	7		6
Confl. Bikes (#/hr)			2			1						
Heavy Vehicles (%)	4%	1%	1%	1%	1%	4%	1%	1%	1%	5%	1%	1%
Turn Type	Prot	NA		Prot	NA		Prot	NA		Prot	NA	
Protected Phases	7	4		3	8		1	6		5	2	
Permitted Phases												
Actuated Green, G (s)	21.0	41.0		25.0	45.0		22.0	47.0		27.0	52.0	
Effective Green, g (s)	22.0	42.0		26.0	46.0		23.0	48.0		28.0	53.0	
Actuated g/C Ratio	0.14	0.26		0.16	0.29		0.14	0.30		0.18	0.33	
Clearance Time (s)	5.0	5.0		5.0	5.0		5.0	5.0		5.0	5.0	
Vehicle Extension (s)	2.5	4.3		2.5	4.3		2.5	4.3		2.5	4.3	
Lane Grp Cap (vph)	219	832		267	892		236	950		277	1069	
v/s Ratio Prot	0.18	c0.34		c0.22	c0.31		0.14	c0.38		c0.23	0.35	
v/s Ratio Perm												
v/c Ratio	1.28	1.29		1.34	1.08		0.99	1.26		1.34	1.05	
Uniform Delay, d1	69.0	59.0		67.0	57.0		68.4	56.0		66.0	53.5	
Progression Factor	1.00	1.00		1.00	1.00		1.00	1.00		1.00	1.00	
Incremental Delay, d2	157.5	141.4		178.0	55.4		56.0	125.8		173.6	40.6	
Delay (s)	226.5	200.4		245.0	112.4		124.4	181.8		239.6	94.1	
Level of Service	F	F		F	F		F	F		F	F	
Approach Delay (s)		205.8			147.5			172.5			130.1	
Approach LOS		F			F			F			F	
Intersection Summary												
HCM 2000 Control Delay			163.4			HCM 2000 Level of Service			F			
HCM 2000 Volume to Capacity ratio			1.29									
Actuated Cycle Length (s)			160.0			Sum of lost time (s)			16.0			
Intersection Capacity Utilization			124.4%			ICU Level of Service			H			
Analysis Period (min)			15									
c Critical Lane Group												

US 97 Bend Parkway Future No Build

Vistro File: X:\...\Future_NoBuild_RIRO_Baseline.vistro

Scenario: Base Scenario

Report File: X:\...\Roundabouts_RIRO_Baseline.pdf

3/27/2019

Intersection Analysis Summary

ID	Intersection Name	Control Type	Method	Worst Mvmt	V/C	Delay (s/veh)	LOS
1	Reed Market and Brookwood	Roundabout	HCM 6th Edition	SEB Thru		423.5	F

V/C, Delay, LOS: For two-way stop, these values are taken from the movement with the worst (highest) delay value. For all other control types, they are taken for the whole intersection.

Intersection Level Of Service Report

Intersection 1: Reed Market and Brookwood

Control Type: Roundabout
 Analysis Method: HCM 6th Edition
 Analysis Period: 15 minutes

Delay (sec / veh): 423.5
 Level Of Service: F

Intersection Setup

Name												
Approach	Northeastbound			Southwestbound			Northwestbound			Southeastbound		
Lane Configuration												
Turning Movement	Left	Thru	Right	Left	Thru	Right	Left	Thru	Right	Left	Thru	Right
Lane Width [ft]	12.00	12.00	12.00	12.00	12.00	12.00	12.00	12.00	12.00	12.00	12.00	12.00
No. of Lanes in Pocket	0	0	0	0	0	0	0	0	0	0	0	0
Pocket Length [ft]	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00
Speed [mph]	25.00			25.00			25.00			25.00		
Grade [%]	0.00			0.00			0.00			0.00		
Crosswalk	Yes			Yes			Yes			Yes		

Volumes

Name												
Base Volume Input [veh/h]	250	290	145	450	535	75	155	400	295	90	580	325
Base Volume Adjustment Factor	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000
Heavy Vehicles Percentage [%]	0.00	1.00	5.00	1.00	1.00	0.00	2.00	1.00	3.00	0.00	1.00	1.00
Growth Rate	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
In-Process Volume [veh/h]	0	0	0	0	0	0	0	0	0	0	0	0
Site-Generated Trips [veh/h]	0	0	0	0	0	0	0	0	0	0	0	0
Diverted Trips [veh/h]	0	0	0	0	0	0	0	0	0	0	0	0
Pass-by Trips [veh/h]	0	0	0	0	0	0	0	0	0	0	0	0
Existing Site Adjustment Volume [veh/h]	0	0	0	0	0	0	0	0	0	0	0	0
Other Volume [veh/h]	0	0	0	0	0	0	0	0	0	0	0	0
Total Hourly Volume [veh/h]	250	290	145	450	535	75	155	400	295	90	580	325
Peak Hour Factor	0.9700	0.9700	0.9700	0.9700	0.9700	0.9700	0.9700	0.9700	0.9700	0.9700	0.9700	0.9700
Other Adjustment Factor	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000
Total 15-Minute Volume [veh/h]	64	75	37	116	138	19	40	103	76	23	149	84
Total Analysis Volume [veh/h]	258	299	149	464	552	77	160	412	304	93	598	335
Pedestrian Volume [ped/h]	0			0			0			0		

Intersection Settings

Number of Conflicting Circulating Lanes	1			1			1			1		
Circulating Flow Rate [veh/h]	1166			837			653			1189		
Exiting Flow Rate [veh/h]	1059			708			1229			751		
Demand Flow Rate [veh/h]	250	290	145	450	535	75	155	400	295	90	580	325
Adjusted Demand Flow Rate [veh/h]	258	299	149	464	552	77	160	412	304	93	598	335

Lanes

Overwrite Calculated Critical Headway	No			No			No			No		
User-Defined Critical Headway [s]	4.00			4.00			4.00			4.00		
Overwrite Calculated Follow-Up Time	No			No			No			No		
User-Defined Follow-Up Time [s]	3.00			3.00			3.00			3.00		
A (intercept)	1380.00			1380.00			1380.00			1380.00		
B (coefficient)	0.00102			0.00102			0.00102			0.00102		
HV Adjustment Factor	0.99			0.99			0.98			0.99		
Entry Flow Rate [veh/h]	717			1104			893			1036		
Capacity of Entry and Bypass Lanes [veh/h]	421			588			709			411		
Pedestrian Impedance	1.00			1.00			1.00			1.00		
Capacity per Entry Lane [veh/h]	415			583			696			407		
X, volume / capacity	1.70			1.88			1.26			2.52		

Movement, Approach, & Intersection Results

Lane LOS	F	F	F	F
95th-Percentile Queue Length [veh]	42.67	69.75	32.59	82.12
95th-Percentile Queue Length [ft]	1066.75	1743.68	814.68	2052.99
Approach Delay [s/veh]	350.36	419.05	147.87	713.95
Approach LOS	F	F	F	F
Intersection Delay [s/veh]	423.51			
Intersection LOS	F			