Improving Traffic Flow on John Nolen Dr.

Group-5

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CIV ENGR 574 – TRAFFIC CONTROL

Submitted to:

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Overview

A. Base Conditions & Problem Definition

B. No-Build Scenario 1: Future Traffic Demand for 2035

C. Build Scenario 2: Operational Fix by Signal Timing Optimization

D. Build Scenario 3: Physical Fix by Network Geometry Refinement

E. Results and Discussion

A

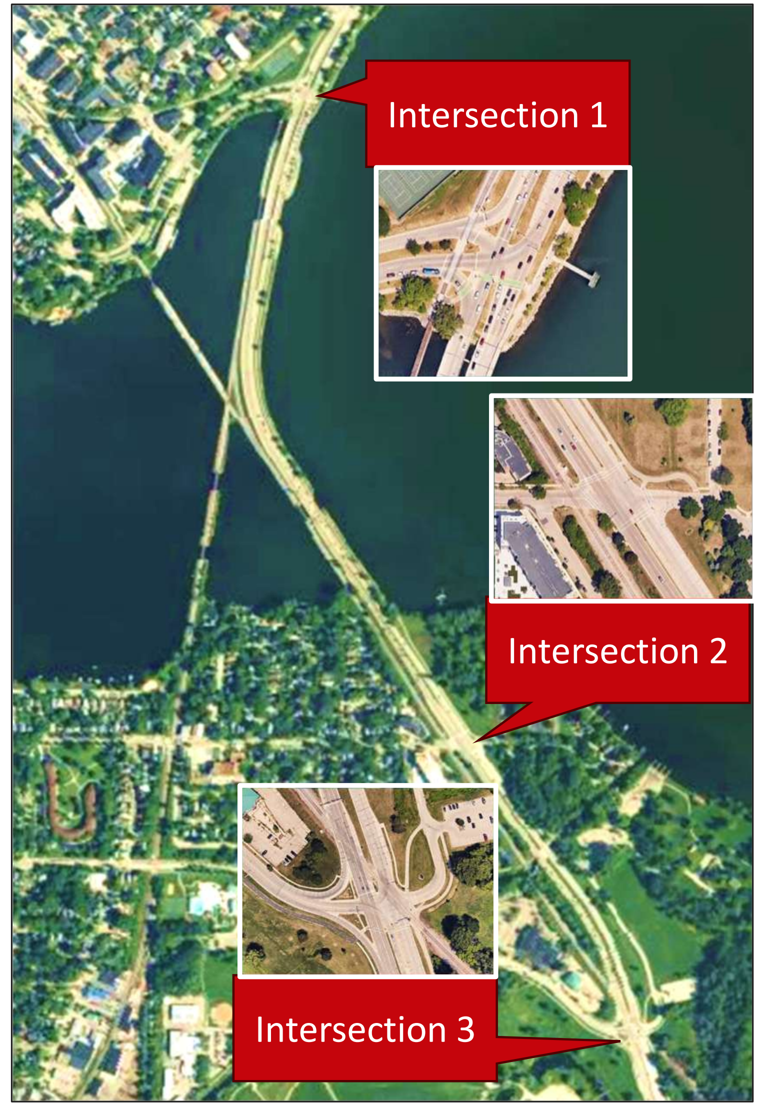
Base Conditions

Project Area

1. John Nolen Dr & North Shore Dr
2. John Nolen Dr & Lakeside St
3. John Nolen Dr & Olin Ave

Simulation parameters in VISSIM

- Wiedemann-74 model
- 15 simulations + random seed + maximum speed
- Period = 7200 s
- 900 s warmup
- Network MOEs: Delay, Speed, Travel Time, Stops
- Node Data MOEs: Movement Delay, Stops, Qlen, LOS, etc.



A

Problem Definition

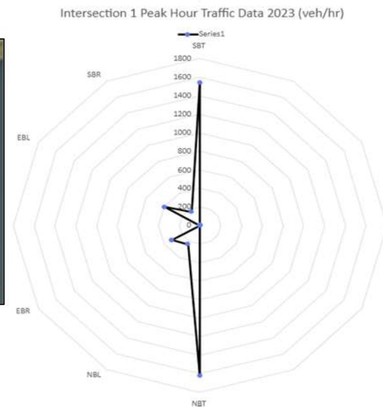
Reduce delay caused by traffic flow in the year 2035

Task	Scenario Name	Scenario Setup				Goal
0	Base Model	Network Geometry (2023 traffic data)	Vehicle Inputs (2023 traffic data)	Routing (2023 traffic data)	Signal Timing (2023 traffic data)	Obtain MOEs from Network and Node Evaluation (15 runs)
1	Scenario 1- (No-Build Scenario)	Network Geometry (2023 traffic data)	Vehicle Inputs (projected 2035 traffic data)	Routing (2023 traffic data)	Signal Timing (2023 traffic data)	Run simulation 5 times and obtain MOEs due to projected traffic
2	Scenario 2	Network Geometry (2023 traffic data)	Vehicle Inputs (projected 2035 traffic data)	Routing (2023 traffic data)	Optimized Signal Timing with HCS as starting point (projected 2035 traffic data)	Run simulation 5 times and obtain MOE_2 improved from MOE_1
3	Scenario 3	Refined Network Geometry (projected 2035 traffic data)	Vehicle Inputs (projected 2035 traffic data)	Routing (2023 traffic data)	Reoptimized Signal Timing (if applicable) with HCS as starting point (projected 2035 traffic data)	Run simulation 5 times and obtain MOE_3 improved from both MOE_1 and MOE_2

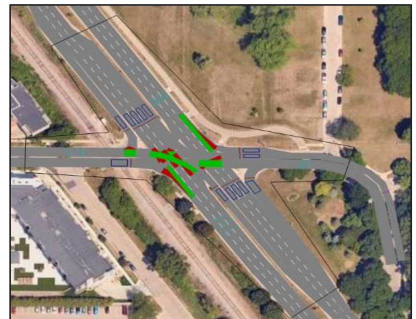
A

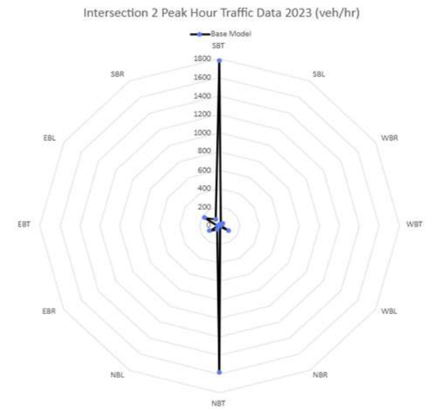
Base Model

1. John Nolen Dr & North Shore Dr

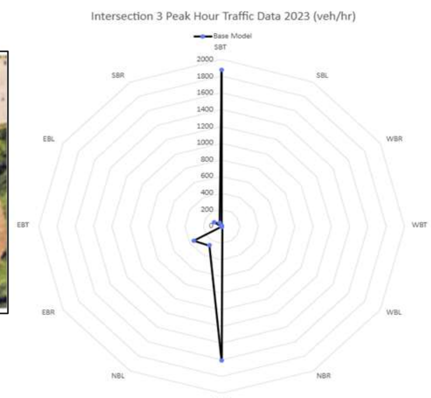


2. John Nolen Dr & Lakeside St





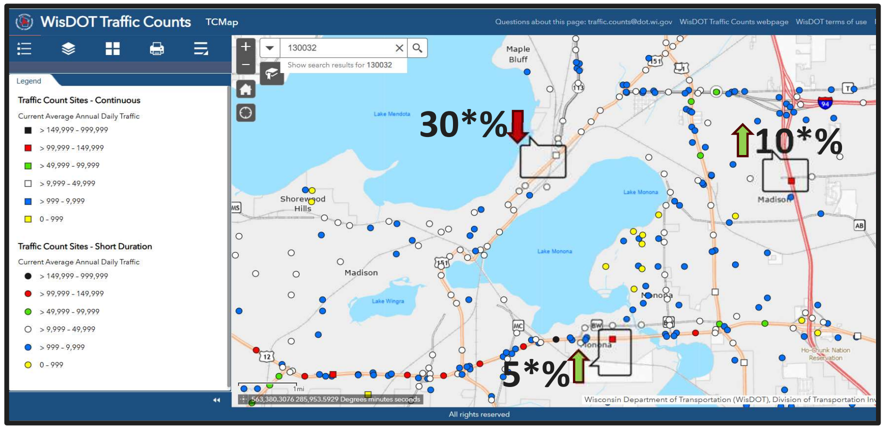
3. John Nolen Dr & Olin Ave

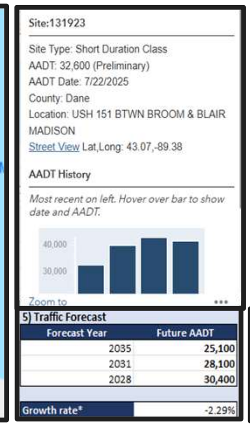


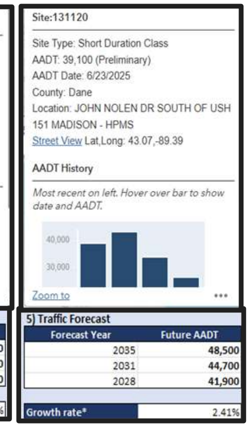
Task	Scenario Name	Scenario Setup				Goal
0	Base Model	Network Geometry (2023 traffic data)	Vehicle Inputs (2023 traffic data)	Routing (2023 traffic data)	Signal Timing (2023 traffic data)	Obtain MOEs from Network and Node

B

No-Build Scenario: Future Traffic Demand for 2035







*Figures based on data provided by R. Lewis, Civil Engineer Transportation Senior at WisDOT

Following are the Calculations Based on site number 131923 and 131120 AADT growth rate as available on WisDOT TCMap:

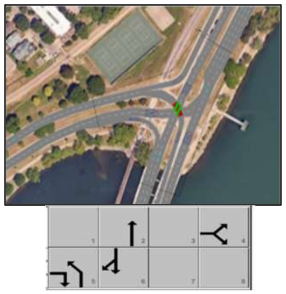
Site Locations	N-S Growth Rate
North 131923	-2.29
South 131120	2.41

Future AADT=Base AADT×(1+g)^n
- **g = annual growth rate**
- **n = number of years= 12**

Task	Scenario Name	Scenario Setup				Goal
1	Scenario 1	Network Geometry (2023 traffic data)	Vehicle Inputs (projected 2035 traffic data)	Routing (2023 traffic data)	Signal Timing (2023 traffic data)	Run simulation 5 times and obtain MOEs due to projected traffic

B

No-Build Scenario: Future Traffic Demand for 2035



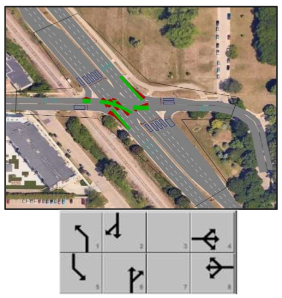
2023

John Nolan Dr. and North Shore Dr.						
Time	From North (SB)		From South (NB)		From West (EB)	
	Thru	Right	Thru	Left	Left	Right
Sum_peakHr	1539	167	1623	235	394	314

2035*

John Nolan Dr. and North Shore Dr.						
Time	From North (SB)		From South (NB)		From West (EB)	
	Thru	Right	Thru	Left	Left	Right
Sum_peakHr	2050	143	2161	201	336	268

v/c ratio: 1.334 0.199 0.849 0.497 0.686 0.391



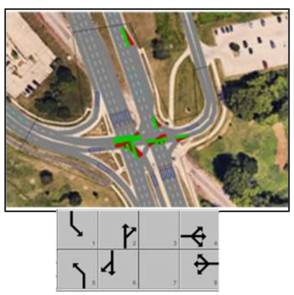
2023

John Nolan Dr. and W. Lakeside Str.												
Time	From North (SB)			From South (NB)			From West (EB)			From East (WB)		
	Thru	Left	Right	Thru	Left	Right	Thru	Left	Right	Thru	Left	Right
Sum_peakHr	1780	21	78	1583	47	10	16	168	116	17	105	43

2035*

John Nolan Dr. and W. Lakeside Str.												
Time	From North (SB)			From South (NB)			From West (EB)			From East (WB)		
	Thru	Left	Right	Thru	Left	Right	Thru	Left	Right	Thru	Left	Right
Sum_peakHr	3112	19	68	2767	41	10	15	295	204	16	184	76

v/c ratio: 0.984 0.768 0.020 1.280 0.541 0.015 0.989 0.875 0.375



2023

John Nolan Dr. and W. Olin Ave.												
Time	From North (SB)			From South (NB)			From West (EB)			From East (WB)		
	Thru	Left	Right	Thru	Left	Right	Thru	Left	Right	Thru	Left	Right
Sum_peakHr	1875	2	42	1614	264	13	0	93	349	0	5	8

2035*

John Nolan Dr. and W. Olin Ave.												
Time	From North (SB)			From South (NB)			From West (EB)			From East (WB)		
	Thru	Left	Right	Thru	Left	Right	Thru	Left	Right	Thru	Left	Right
Sum_peakHr	4476	1	34	3527	214	12	0	197	789	0	26	21

v/c ratio: 3.081 0.334 0.075 1.035 0.812 1.035 0.293 1.309 0.487

*We assumed uniform growth in both directions of each approach without considering future directional imbalances

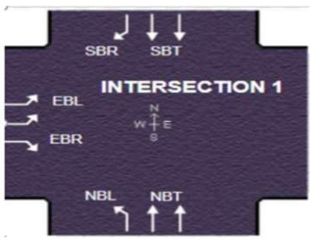
Task	Scenario Name	Scenario Setup				Goal
1	Scenario 1	Network Geometry (2023 traffic data)	Vehicle Inputs (projected 2035 traffic data)	Routing (2023 traffic data)	Signal Timing (2023 traffic data)	Run simulation 5 times and obtain MOEs due to projected traffic

C

Build Scenario 2: Operational Fix by Signal Timing Optimization

Logic: v/c >1.15
=> Overflow Delay [=(T1+T2)/2x(v/c -1), where (T1+T2)= queue time, v/c= vol:capacity ratio]
=>to reduce OD, increase c=s.g/C, where s=sat flow, g= effective green time and C=cycle length
=>to increase c, **increase g/C** ratio where delay is high but also keep **cycle length reasonably low**

Scenario 1 | **Trial 1** | **Trial 2**



Scenario 1:

Green	71.0	16.2	14.0	0.0	0.0	0.0
Yellow	3.5	3.5	3.5	0.0	0.0	0.0
Red	1.5	1.0	2.0	0.0	0.0	0.0

Cycle= 116.2 s (LOS A)

Trial 1:

Green	50.0	10.4	21.0	0.0	0.0	0.0
Yellow	3.5	3.5	3.5	0.0	0.0	0.0
Red	1.5	1.0	2.0	0.0	0.0	0.0

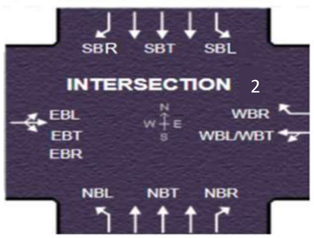
96.4 s (LOS B)

Trial 2:

Green	5.5	32.0	9.7	0.0	0.0	0.0
Yellow	3.5	3.5	3.5	0.0	0.0	0.0
Red	1.0	1.5	2.0	0.0	0.0	0.0

62.2 s (LOS A)

g/C for EB: 0.12 to 0.16



Scenario 1:

Green	1.9	1.3	47.4	9.9	20.0	0.0
Yellow	3.5	0.0	4.0	3.5	3.5	0.0
Red	3.0	0.0	1.5	3.0	3.0	0.0

Cycle= 105.6 s (LOS A)

Trial 1:

Green	3.0	1.0	167.3	126.0	41.0	0.0
Yellow	3.5	3.5	4.0	3.5	3.5	0.0
Red	3.0	2.5	1.5	3.0	3.0	0.0

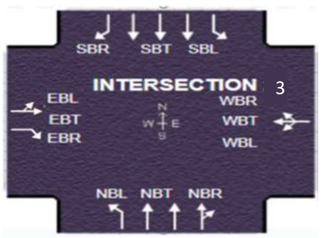
369.4 s (LOS D)

Trial 2:

Green	0.9	0.8	37.6	11.8	9.1	0.0
Yellow	3.5	0.0	4.0	3.5	3.5	0.0
Red	3.0	0.0	1.5	3.0	3.0	0.0

85.2 s (LOS A)

g/C for EB-WB: 0.094 to 0.138



Scenario 1:

Green	0.4	15.2	30.0	32.2	2.6	0.0
Yellow	3.5	3.5	4.0	3.5	3.5	0.0
Red	2.0	2.5	1.0	1.5	1.5	0.0

Cycle= 106.8 s (LOS A)

Trial 1:

Green	34.1	140.1	210.0	10.0	0.0	0.0
Yellow	3.5	4.0	3.5	3.5	0.0	0.0
Red	2.5	1.0	1.5	1.5	0.0	0.0

420.0 s (LOS F)

Trial 2:

Green	5.1	18.7	14.8	2.1	0.0	0.0
Yellow	3.5	4.0	3.5	3.5	0.0	0.0
Red	2.5	1.0	1.5	1.5	0.0	0.0

61.7 s (LOS A)

Task	Scenario Name	Scenario Setup				Goal
2	Scenario 2	Network Geometry (2023 traffic data)	Vehicle Inputs (projected 2035 traffic data)	Routing (2023 traffic data)	Optimized Signal Timing with HCS as starting point (projected 2035 traffic data)	Run simulation 5 times and obtain MOE2 improved from MOE1

D

Scenario 3 –Cost : Benefit Analysis for Adding Turning Lanes

Item	Value	Source
Urban arterial add-a-lane cost	$10M/lane-mi × 1.795 CPI inflation → $17.95M/lane-mi	FHWA "Pricing kit" from 2002 (https://www.fhwa.dot.gov/policy/otps/pricingkit.cfm)
Analysis period	20 years with real discount rate 7%	USDOT BCA guidance (https://www.transportation.gov/sites/dot.gov/files/2025-05/Benefit%20Cost%20Analysis%20Guidance%202025%20Update%20II%20%28Final%29.pdf)
Lanes added	1 turn-lane 250 ft long	250 ft or 0.047 mi is taken as adequate length
Annualized Cost with CRF	$ 79600/year	0.0473 lane-mi × $17.95 M/lane-mi x Capital Recovery Factor (7%, 20) [i.e., 0.0944]
Weekday "congestion days"	250 days/year	https://www.trb.org/publications/nchrp/nchrp_syn_311.pdf
Value of travel time (Personal-General Travel Time)	$19.40 per person-hour	USDOT BCA Guidance, Table A-2
Average vehicle occupancy, weekday peak	1.34 persons/vehicle	USDOT BCA Guidance, Table A-3 (derived from 2022 NHTS)

- Requirement: Cost/ Benefit≤ 1

  C/B=Capital Cost/(Value of travel time x Average Veh Occupancy x Total Reduced delay)= 79600/(19.40 x 1.34 x veh-hr)≥ 1
  Required annual delay savings for B/C=1 is: 3063 veh-hr=11 x 10^6 veh-s
  Highest turn-lane volume from Scenario 2 (Int 3 EBR) =800 vph (approx) =800 vph x 1 peak hour x 250 weekday/year = 200000 veh/yr (Assuming benefit only in 1 peak hr/weekday)
  Minimum required reduction in delay per year per vehicle= 11 x 10^6 veh-s/200000 veh= 55 s]

- For C/B≤ 1, minimum resulting reduction in delay=55 s/veh

  This value is 2 times larger than the highest delay from Scenario 2= 27.73 s/veh for Int-2 SBL making resulting delay after lane addition<=0s/veh, which is impractical

- Given the existing low delays, C/B cannot reach ≤ 1
- Hence no lanes were found feasible to be added in Scenario 3 for the provided traffic data
- Additionally, this can disrupt the rail transit track running parallel to the Drive driving C/B further up

Task	Scenario Name	Scenario Setup				Goal
3	Scenario 3	Refined Network Geometry (projected 2035 traffic data)	Vehicle Inputs (projected 2035 traffic data)	Routing (2023 traffic data)	Reoptimized Signal Timing (if applicable) with HCS as starting point (projected 2035 traffic data)	Run simulation 5 times and obtain MOE3 improved from both MOE1 and MOE2

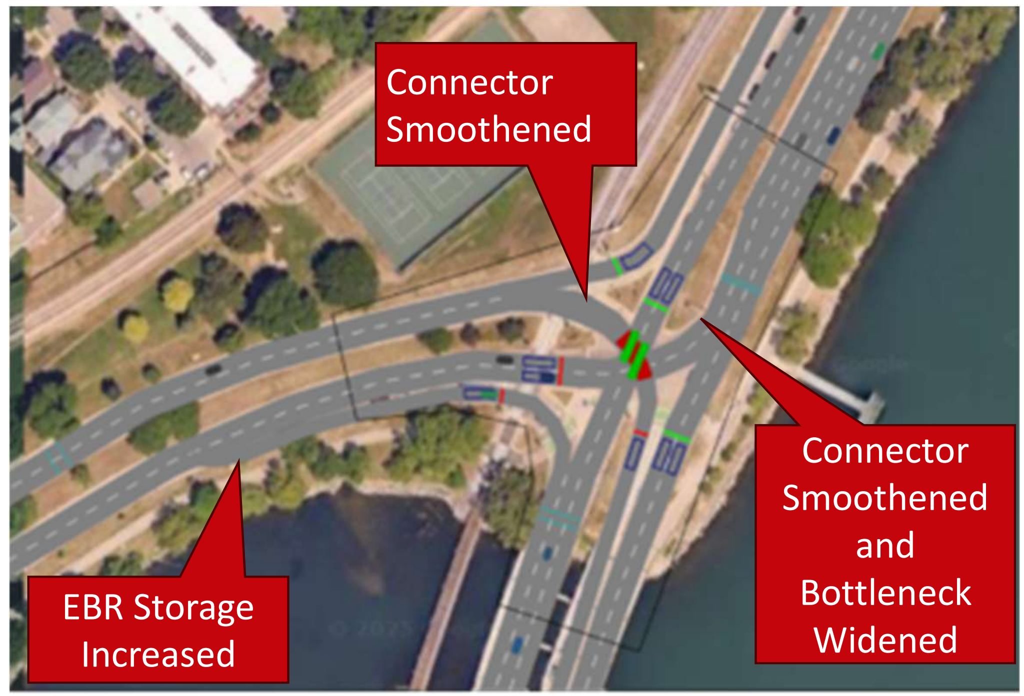
D

Scenario 3 – Intersection 1

Logic: Bottleneck movements with high delay (LOS>A) and/or high queue length => Refine geometry=>Improved MOEs

Base Model/Scenario 1/Scenario 2

Scenario 3



Task	Scenario Name	Scenario Setup				Goal
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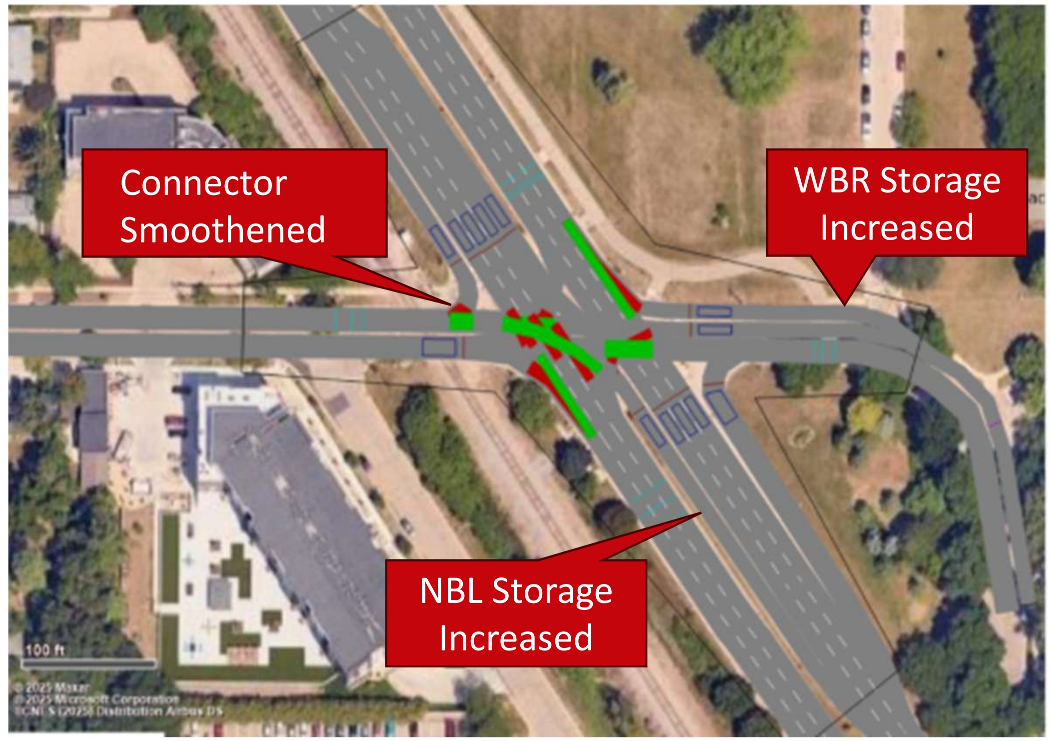
D

Scenario 3 – Intersection 2

Base Model/Scenario 1/Scenario 2

Scenario 3

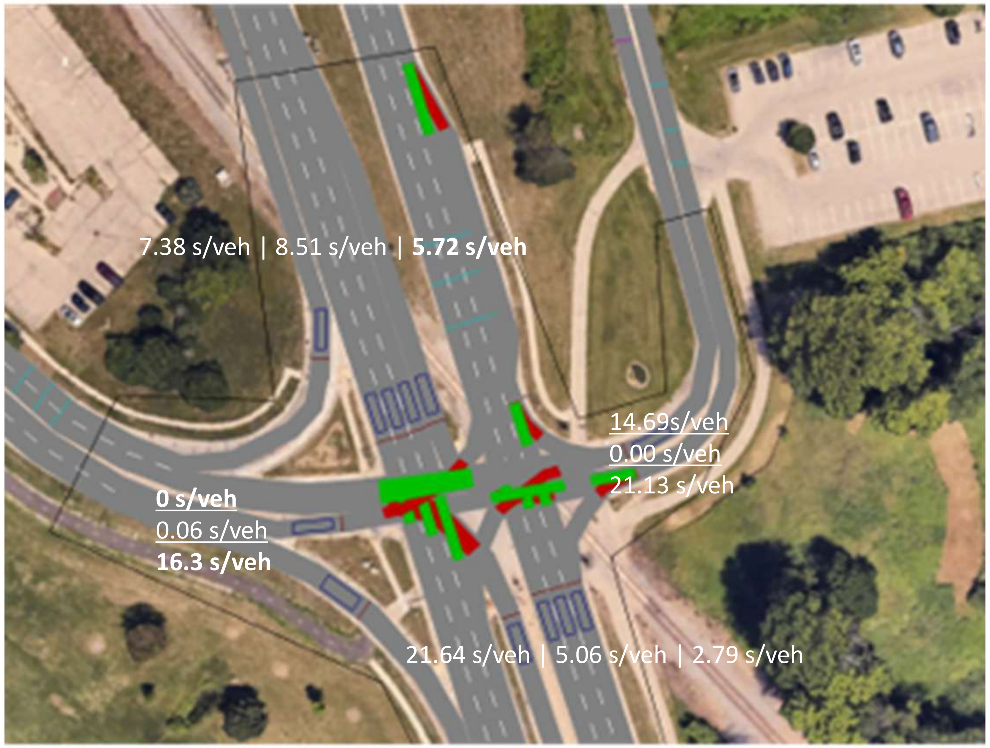


Task	Scenario Name	Scenario Setup				Goal
3	Scenario 3	Refined Network Geometry (projected 2035 traffic data)	Vehicle Inputs (projected 2035 traffic data)	Routing (2023 traffic data)	Reoptimized Signal Timing (if applicable) with HCS as starting point (projected 2035 traffic data)	Run simulation 5 times and obtain MOE3 improved from both MOE1 and MOE2

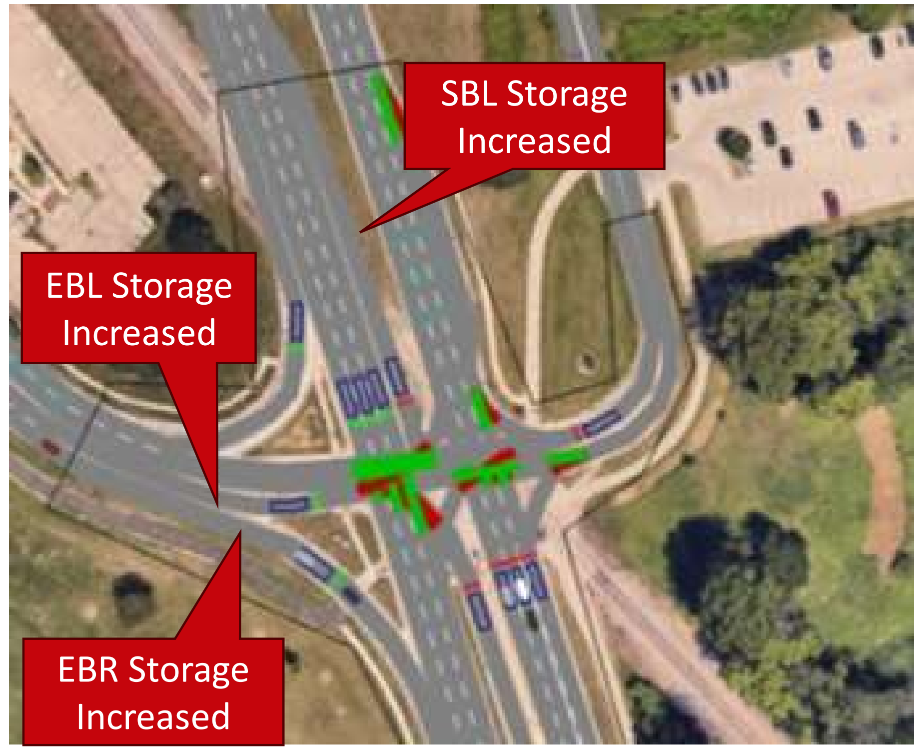
D

Scenario 3 – Intersection 3

Base Model/Scenario 1/Scenario 2



Scenario 3

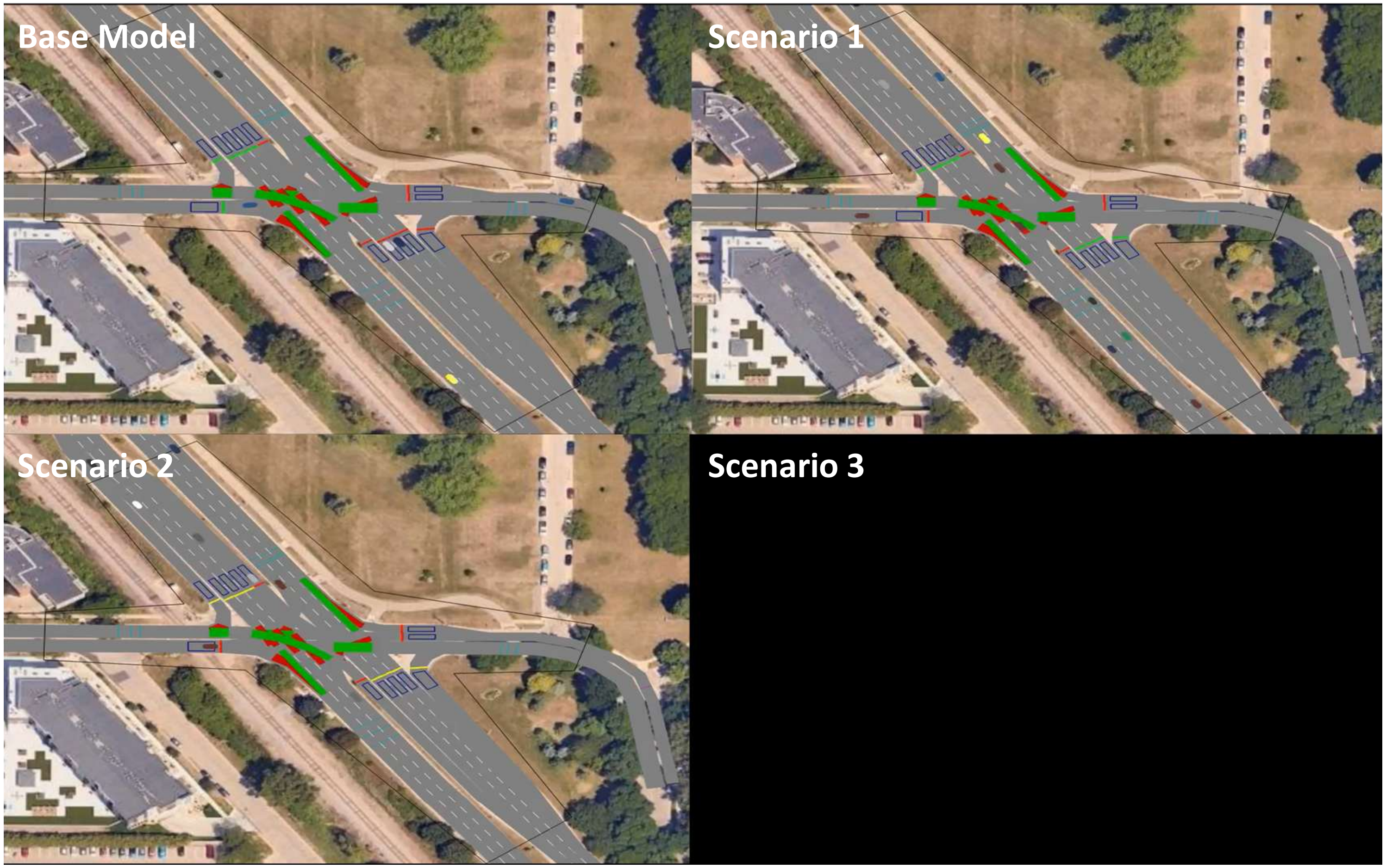


Task	Scenario Name	Scenario Setup				Goal
3	Scenario 3	Refined Network Geometry (projected 2035 traffic data)	Vehicle Inputs (projected 2035 traffic data)	Routing (2023 traffic data)	Reoptimized Signal Timing (if applicable) with HCS as starting point (projected 2035 traffic data)	Run simulation 5 times and obtain MOE3 improved from both MOE1 and MOE2

E

Results and Discussion

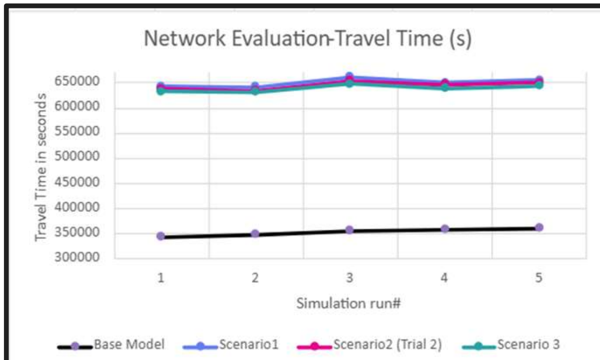
VISSIM Simulation comparison at Intersection 2 for illustration:

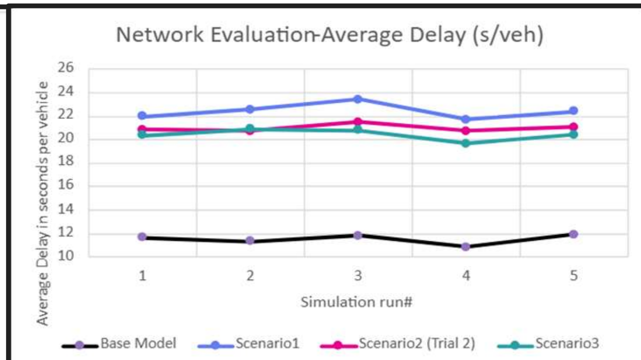


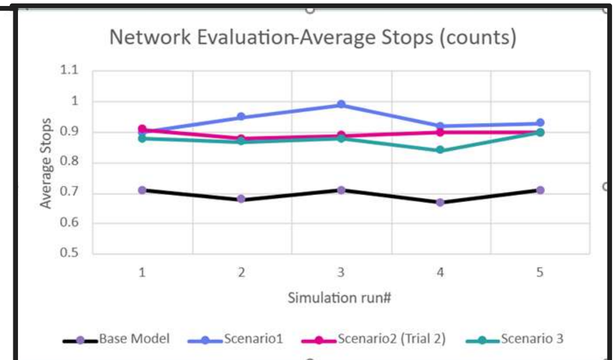
E

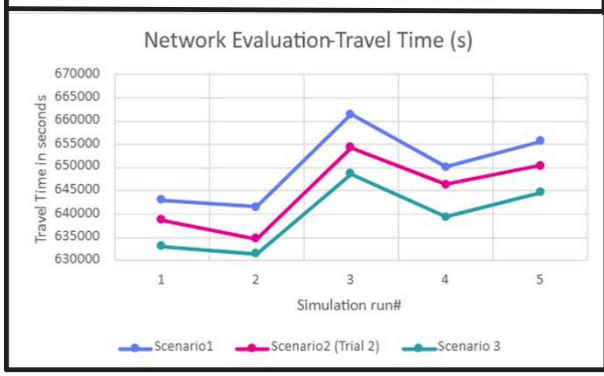
Results and Discussion

Network Evaluation :

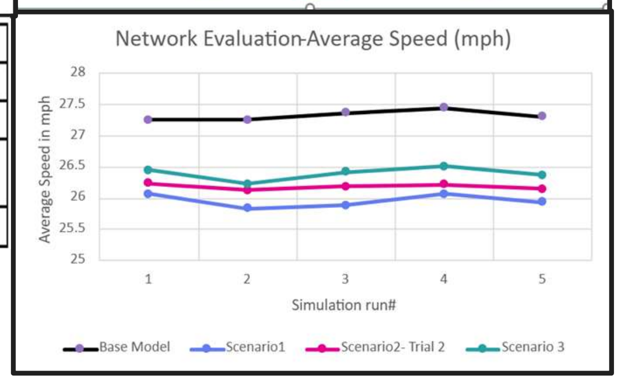








	DELAYAVG(ALL)	SPEEDAVG(ALL)	TRAVTMTOT(ALL)	STOPSAVG(ALL)
Base Model	11.651	27.306	354230.87	0.695
Scenario 1	22.432	25.962	650393.84	0.938
Scenario 2-trial 2	20.996	26.186	644925.52	0.896
Scenario 3	20.436	26.396	639485.88	0.874



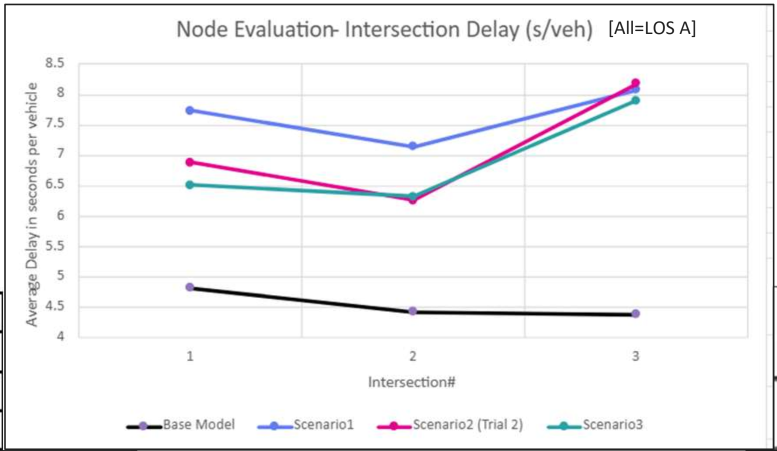
Results: $MOE_1 < MOE_2 < MOE_3$

E

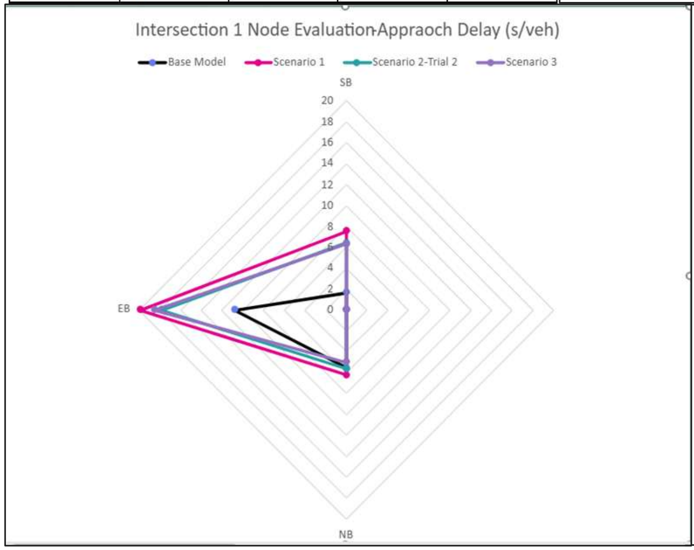
Results and Discussion

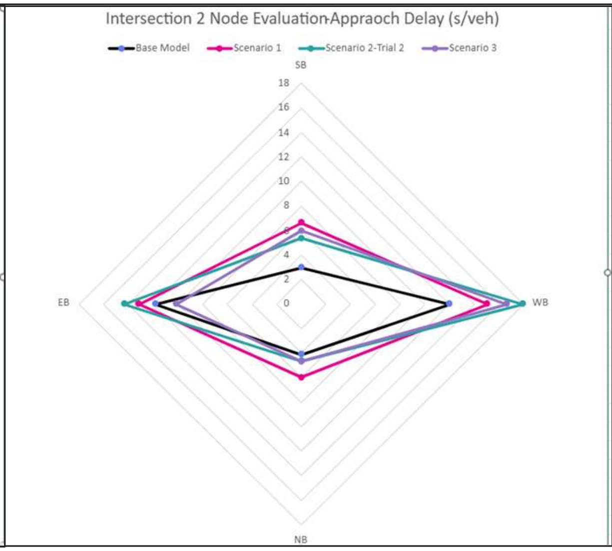
Node Evaluation : Delay (s/veh)

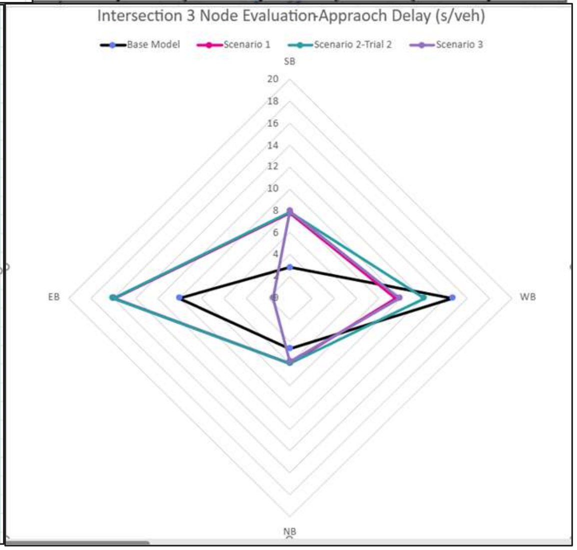
	Original Model	Scenario 1	Scenario 2-trial 2	Scenario 3
Intersection 1	4.82	7.74	6.89	6.51
Intersection 2	4.43	7.14	6.26	6.33
Intersection 3	4.39	8.08	8.18	7.90



Control Delay (s/veh)	<10	10-20	20-35	35-55	55-80	>80
LOS	A	B	C	D	E	F



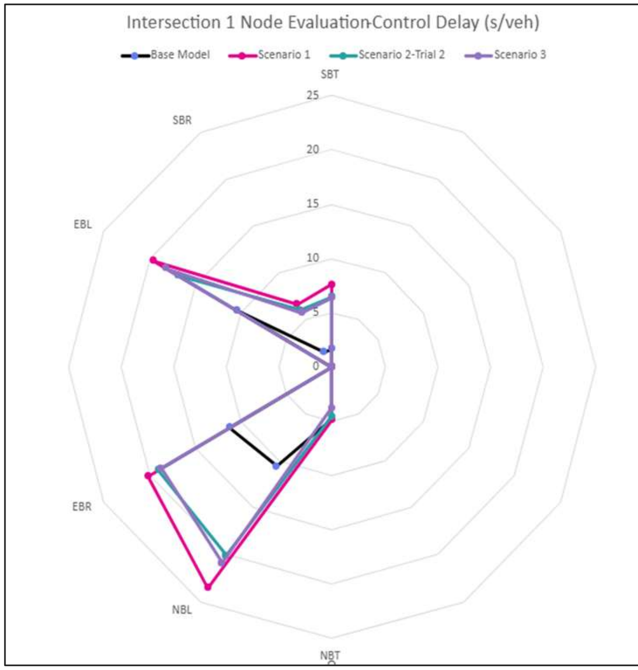


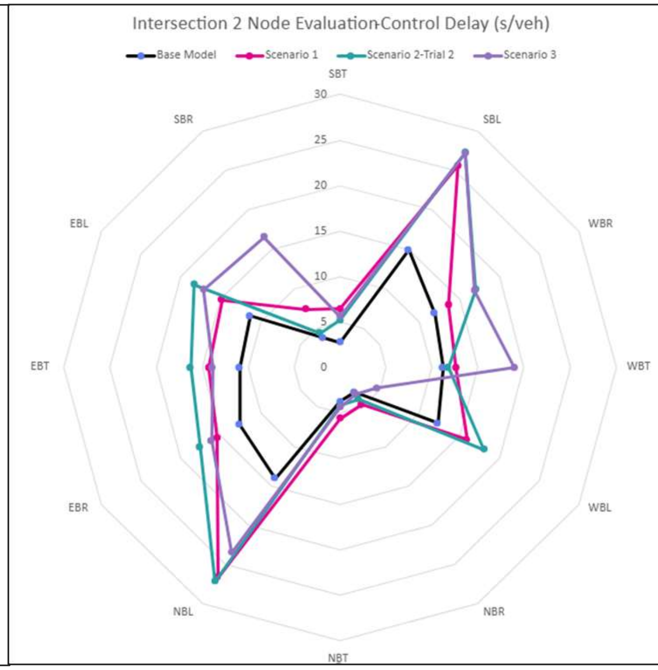


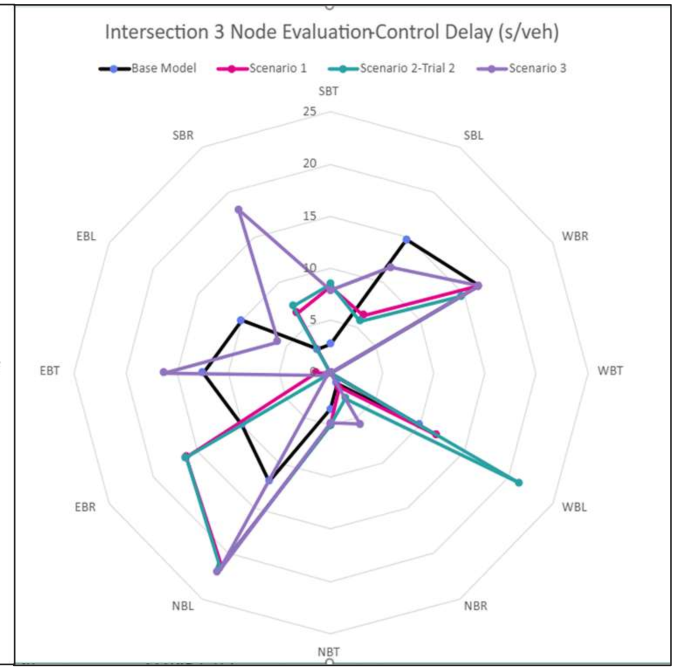
E

Results and Discussion

Node Evaluation [contd.] : Control Delay (s/veh)



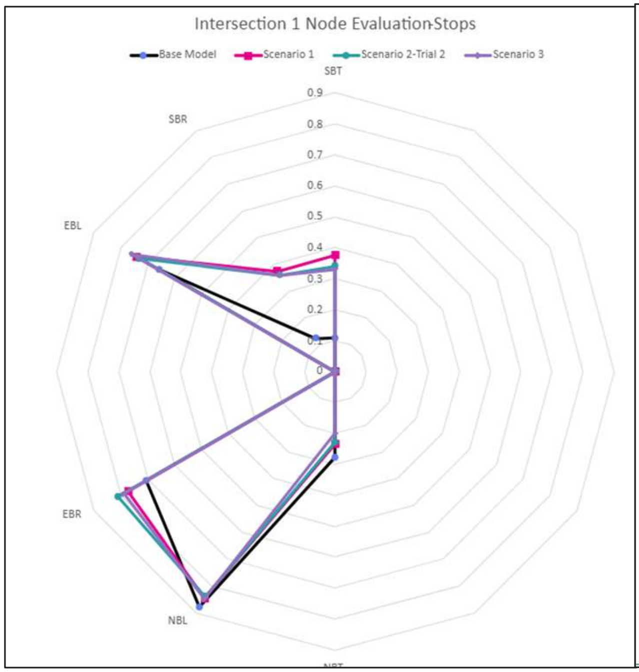


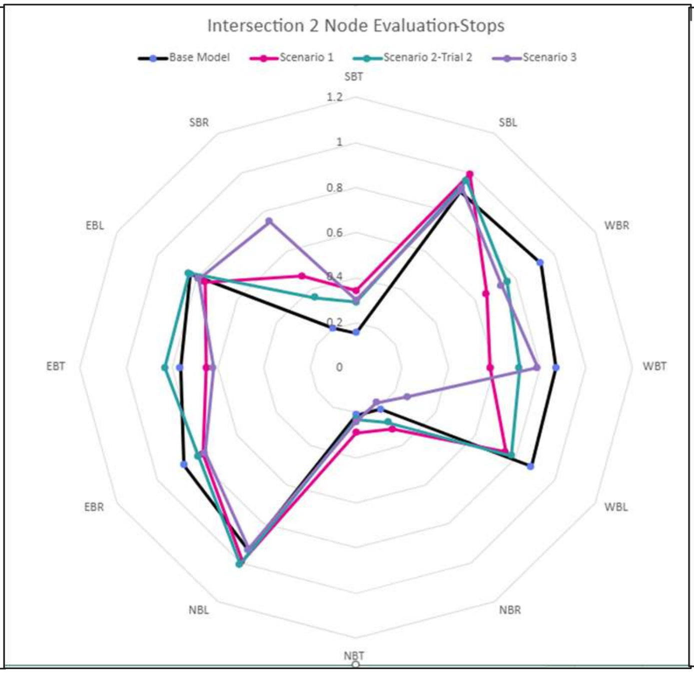


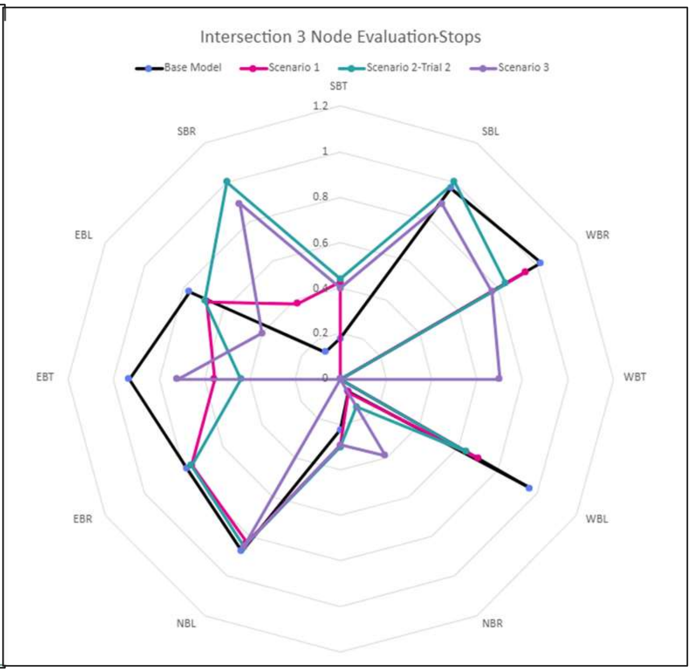
Control Delay (s/veh)	<10	10-20	20-35	35-55	55-80	>80
LOS	A	B	C	D	E	F

Results and Discussion

Node Evaluation [contd.] : Stops

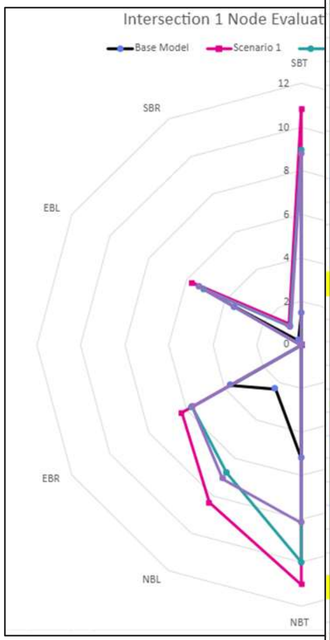




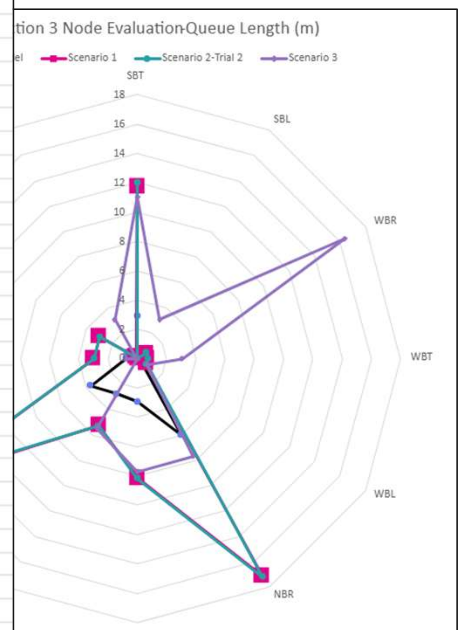


Results and Discussion

Node Evaluation [contd.] : Queue Length



		Model			Scenario 1			Scenario 2-trial 2			Scenario 3		Peak hr vol
	Delay	STOPS(ALI	QLEN	Delay	STOPS(ALI	QLEN	Delay	STOPS(ALI	QLEN	Delay	STOPS(ALI	QLEN	
SBT	1.664	0.108	1.457	7.58	0.38	10.85	6.44	0.34	8.96	6.34	0.33	8.76	2050
	0	0	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0	0	0
NBT	4.83	0.278	5.213	4.91	0.23	11.01	4.55	0.23	9.99	3.8	0.2	8.16	2161
NBL	10.563	0.879	2.331	23.55	0.85	8.36	20.11	0.84	6.78	20.9	0.85	7.1	201
EBR	11.233	0.706	3.689	20.18	0.77	6.26	19.01	0.81	5.71	18.76	0.79	5.7	268
	0	0	0	0	0	0	0	0	0	0	0	0	0
EBL	10.375	0.657	3.483	19.59	0.74	5.71	16.84	0.73	5.09	18.24	0.76	5.33	336
SBR	1.562	0.124	0.235	6.66	0.37	1.12	6.05	0.21	0.15	5.75	0.36	0.96	143
SBT	2.79	0.154	2.893	6.46	0.34	8.39	5.22	0.29	6.62	5.57	0.3	7.05	3112
SBL	14.91	0.903	0.26	25.65	0.99	0.43	27.24	0.96	0.53	27.73	0.92	0.47	19
WBR	11.89	0.927	0.532	13.97	0.65	1.27	17.03	0.76	1.68	16.94	0.73	2.99	76
WBT	11.19	0.869	1.016	12.16	0.58	2.47	12.09	0.71	2.83	18.95	0.79	2.99	16
WBL	12.24	0.879	1.016	16.22	0.75	2.47	18.19	0.78	2.83	4.61	0.26	0.17	184
NBR	3.17	0.215	0.089	4.73	0.32	0.11	4	0.23	0.06	3.36	0.18	0.05	10
NBT	3.77	0.21	3.243	5.6	0.29	9.83	4.22	0.23	7.15	4.35	0.24	7.13	2767
NBL	14.11	0.937	0.731	26.64	0.99	2.07	27.18	1.01	2.05	23.54	0.93	1.67	41
EBR	12.6	0.863	3.589	15.44	0.77	8.7	17.56	0.79	10.64	16.15	0.76	9.88	204
EBT	10.9	0.763	3.589	14.24	0.65	8.7	16.25	0.83	10.64	13.86	0.62	9.88	15
EBL	11.3	0.83	3.589	14.83	0.76	8.7	18.26	0.84	10.64	17.1	0.79	9.88	295
SBR	3.8	0.202	0.211	7.37	0.47	0.35	4.35	0.21	0.15	16.53	0.75	1.6	68
SBT	2.77	0.178	2.939	8.24	0.43	11.71	8.51	0.44	12.01	7.87	0.4	11.04	4476
SBL	14.72	0.97	0.044	6.37	1	0.02	5.72	1	0.02	11.63	0.89	3.07	1
WBR	16.65	1.019	0.197	16.63	0.7	0.69	14.69	0.84	0.76	16.61	0.77	16.41	21
WBT	0	0	0.197	0	0	0.69	0	0	0.76	0	0.7	3.07	0
WBL	9.94	0.962	0.197	11.91	0.66	0.69	21.13	0.64	0.76	0	0	0.79	26
NBR	1.15	0.062	6.003	1.63	0.07	17.12	2.79	0.14	17.19	5.66	0.39	7.7	12
NBT	3.52	0.223	2.937	5.05	0.29	8.14	5.06	0.3	8.16	4.83	0.29	7.7	3527
NBL	12.02	0.874	2.788	21.41	0.83	5.25	21.64	0.85	5.3	22.1	0.85	5.48	214
EBR	9.96	0.783	3.673	16.21	0.76	16.21	16.3	0.76	16.03	0.49	0	0	789
EBT	12.46	0.933	0.763	1.49	0.56	2.98	0.06	0.44	2.95	16.26	0.72	0.79	0
EBL	10.05	0.771	0.763	0	0.68	2.98	0	0.69	2.95	5.99	0.4	0.09	197
SBR	2.63	0.137	0.063	6.63	1	0.02	7.38	1	0.02	18.01	0.89	3.07	34



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Discussions

Methodology summary: AADT → Growth Factor → 2035 Volumes → Scenario 1 VISSIM Base → Scenario 2 reduce starvation → Scenario 3 reduce bottlenecks → MOE changes

Key Takeaways:

- Growth year (Scenario 1) caused the largest systemwide degradation (60-85% increase in intersection delay, 3x queue lengths)
- Signal timing optimization only changes delays by 10-12% but increases it slightly for intersection 3, and queues remain almost the same as arrival tends to exceed capacity due to projected traffic growth
- Geometry changes reduce delay at intersections 1 & 3 but makes it slightly worse in intersection 2 compared to scenario 2 maybe due to mid-corridor pressure- but makes traffic flow smoother (stops reduce)
- Best improvement occurred on high-volume north–south movements at the cost of the minor approaches
- To maximize delay reduction for the intersection we followed the logic that saving 1 second on a movement with 2000 vehicles is better than saving 3 seconds on a movement with 100 vehicles

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Discussions

Future Recommendations & Limitations

- Re-optimize signal timing after Scenario 3 geometry
- Include pedestrians, bicycles, and transit in future models
- Refine calibration assumptions in software
- Perform safety/collision/robustness analyses

Questions?

- Because our project scope excluded safety analysis, infrastructure condition assessment, multimodal needs, etc., and prioritized peak-hour intersection delay -the C/B result obtained is severely limited and heavily dependent on traffic data provided to us
- The City's ongoing plans to fully reconstruct this same corridor is driven by factors our model does not capture, viz. end-of-life bridges and pavement, shoreline and stormwater failures, long-term multimodal safety goals, urban design, etc.
- Thus, while our delay-only analysis finds a turn-lane addition unjustified, it does not contradict the City's broader reconstruction plan, which addresses needs far beyond intersection-level congestion

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NB: The project and the presentation slides were refined using the help of ChatGPT 5.1-Auto model