City of Omaha

SIGNAL OPERATIONS 72ND STREET

MAPA-5037, CN 22802, OPW 53798

Olsson Project No. C16-24020

April 2021

olsson®

CITY OF OMAHA, NEBRASKA INCORPORATED FEBRUARY 2, 1857

PROFESSIONAL CIVIL ENGINEER
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STATE OF NEBRASKA

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EXECUTIVE SUMMARY

Olsson conducted a signal operations evaluation of multiple corridors as part of the City of Omaha Signal System Master Plan. The objective of this project was to review coordinated signal timing plans for vehicles traveling north/south along 72nd Street and east/west along Pacific Street and also document measures of effectiveness. In addition, short-term and long-term safety and operational improvements were evaluated along the corridors and recommendations were provided. A benefit-cost analysis was completed for the safety and operations evaluation tasks.

The project included 44 signalized intersections along/near 72nd and Pacific Streets. Four signalized intersections along 72nd Street were not re-timed because they are a part of the Dodge Street phase of the Adaptive Signal Control Technology (ASCT) project.

Synchro models were used to compare existing to implemented timing plans for the AM, Midday (MD), PM, and Offpeak (OP) analysis periods. Network performance measures compared (which include ALL movements at all signals) were total delay, total stops, total travel time, and fuel consumed. Total delay and total stops were reduced for all four periods, but total travel time and fuel consumed increased in the PM periods by approximately one percent. AM, MD, and OP periods decreased for total travel time and fuel consumed.

Travel time runs were collected before and after implementation along 72nd Street from Harrison Street to Blondo Street. The average travel time run in both the north and south directions was decreased after implementation during all weekday time periods, except the southbound AM. The average directional travel time runs decreased by 27 to 192 seconds for the other weekday periods. This represented reductions in total delay of 10-45%. Weekend travel times increased in each direction.

A benefit analysis was preformed to evaluate a monetary value of the implemented timing changes. The benefits used to estimate this value included travel time savings, fuel savings, reduction in greenhouse gas emissions, and an estimate in crash reductions. The monetary benefit over the next five years is anticipated to be $17.3 million.

Performance Measure	Project Benefit	Present Value
Delay Reduction	501,737 hours	$ 13,586,564
Fuel Consumption Reduction	576,048 gallons	$ 1,180,898
Emissions Reduction	5,138 tons	$ 401,046
Crash Reduction	58 crashes	$ 2,456,451

1.0 INTRODUCTION & OBJECTIVE

Olsson conducted a signal operations evaluation of multiple corridors as part of the City of Omaha Signal System Master Plan. The objective of this project was to review coordinated signal timing plans for vehicles traveling north/south along 72nd Street and east/west along Pacific Street and also document measures of effectiveness. In addition, short-term and long-term safety and operational improvements were evaluated along the corridors. A benefit-cost analysis was completed for both the signal timing optimization and safety and operations evaluation tasks.

This project updated cycle lengths, clearance intervals, and phasing plans for the area while bringing the project area up to City of Omaha timing standards. Intersections along the corridor were also evaluated for leading pedestrian intervals, bicycle timing accommodations and potential changes to left-turn phasing. These tasks were completed for the AM, Offpeak (OP), Midday (MD), PM, and Weekend Midday (WM) peak hour periods. The time-of-day schedule was also updated to provide more uniformity and increase cross corridor compatibility.

This report documents the methods and procedures taken to evaluate signal operations through a series of sections summarized by major task.

The project included 44 signalized intersections along/near 72nd and Pacific Streets. Four signalized intersections along 72nd Street were not re-timed because they are a part of the Dodge Street phase of the Adaptive Signal Control Technology (ASCT) project. The intersections along 72nd Street include (from south to north with adjacent intersections in parenthesis and signal ID in brackets):

- [699] Harrison Street
- [730] Drexel Street
- [615] Main Street
- [616] Q Street
- [1167] M Plaza
- [449] L Street (South)
- [449] L Street (North)
- [444] F Street
- [44] I-80 Eastbound Ramps
- [43] I-80 Westbound Ramps
- [445] Grover Street
- [455] Spring Street
- [451] Mercy Road
- [868] Cedar Street
- [446] Hickory Street
- [831] Pine Street
- [453] Pacific Street
- [808] Rose Blumkin Drive ([973] Rose Blumkin Drive & NFM Entrance and [939] Rose Blumkin Drive & Harney Street)
- [700] Jones Street
- [448] Jones Circle
- [447] Farnam Street*
- [443] Dodge Street*
- [738] Crossroads Drive*
- [441] Cass Street* ([438] 69th Street & Cass Street)
- [947] Mayfield Drive
- [456] Western Avenue (West)
- [456] Western Avenue (East)
- [454] Seward Street
- [439] Bakers Drive
- [440] Blondo Street
- [450] Maple Street

* Intersection not modified; part of Dodge Street adaptive corridor

The intersections along Pacific Street include (from west to east with adjacent intersections in parenthesis and signal ID in brackets):

- [506] 90th Street ([512] 90th Street & Westover Road/Harney Street)
- [8493] 87th Avenue
- [493] 87th Street
- [485] 84th Street
- [610] 74th Street
- [453] 72nd Street
- [830] 69th Street
- [435] 67th Street

Table 1 illustrates the speed limits, median type, and number of lanes along the corridors.

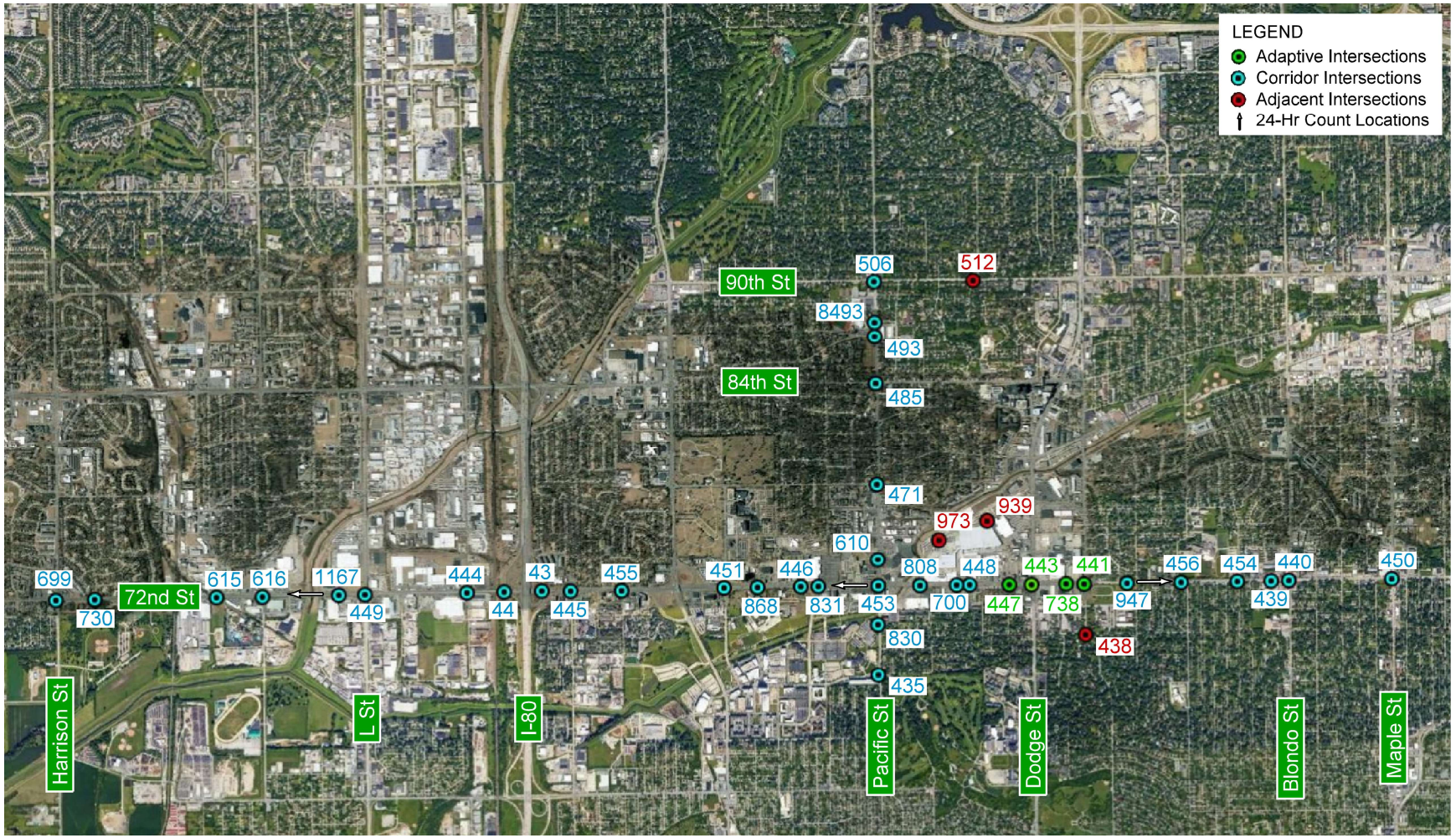
Table 1. Corridor Characteristics

Corridor		Speed Limit	Median	Lanes
72nd St	Harrison St to I-80	40	Divided	4-Lanes
72nd St	I-80 to Pacific St	35	Divided	6-Lanes
72nd St	Pacific St to Cass St	35	Divided	6-Lanes
72nd St	Cass St to Western Ave (West)	35	Undivided	5-Lanes
72nd St	Western Ave (West) to Blondo St	35	Divided	4-Lanes
72nd St	Blondo St to Maple St	40	Divided	4-Lanes
Pacific St	90th St to 67th St	35	Undivided	5-Lanes

Along the corridors, between signalized intersections, there are many side street stop-controlled full access and T-intersections. Pedestrian accommodations are provided at all signalized intersections except at the I-80 ramp intersections. The signalized intersections are a coordinated system for north/south traffic along 72nd Street and for east/west traffic along Pacific Street. Further discussion of the existing time of day schedule and field observations is included in **Section 4**.

A map illustrating the location of the project intersections is shown in **Figure 1**.

NTS



Source: Google Earth Pro

Figure 1. Project Intersections

2.0 PROJECT ADMINISTRATION

2.1 Project Team

The project team encompasses members from the City of Omaha, Nebraska Department of Transportation (NDOT), and Olsson who helped throughout the duration of the project:

- Bryan Guy (City of Omaha, Project Manager)
- Garret Schram (City of Omaha)
- Nick Gordon (City of Omaha)
- John Gloden (City of Omaha)
- Jenna Habegger (NDOT)
- Justin Petersen (Olsson)
- Shane King (Olsson)
- Jeremy Stretz (Olsson)
- Tom Fulton (Olsson)
- Dan Bellizzi (Olsson)
- John Diediker (Olsson)
- Greta Ehrhorn (Olsson)

2.2 Project Meetings

Project meetings are listed below which were held online due to precautions from the ongoing COVID-19 pandemic during the project duration. Meeting Minutes for each are summarized in **Appendix A**.

- Kickoff Meeting – September 15, 2020
- Progress Meeting – October 27, 2020
- Progress Meeting – November 10, 2020
- Progress Meeting – November 25, 2020
- Pre-Implementation Meeting – January 15, 2021
- Implementation – February 10, 2021
- Progress Meeting – March 2, 2021

A project kick-off meeting was held on September 15, 2020, to coordinate project goals, expectations, and data management on the 72nd Street project. Progress meetings were held to outline project developments and coordinate between staff. A pre-implementation meeting was held on January 15, 2021, to review timing plans, patterns, programming, and other pertinent conversations before implementation.

3.0 DATA COLLECTION

3.1 Turning Movement Counts

The City of Omaha provided historical weekday average daily traffic (ADT) volumes and turning movement counts (TMC) from 2015-2019. The intersection turning movement volumes were entered into Synchro (Version 10) traffic signal timing software and used to analyze proposed timing plans for the 72nd and Pacific Streets corridors. TMC were conducted from 7:00 AM – 11:00 AM and 2:00 PM – 6:00 PM.

3.2 24-Hour Segment Counts

Olsson collected roadway segment counts along 72nd Street north of Mayfield Avenue, south of M Plaza, and south of Pacific Street. Volumes were collected from October 19, 2020 through October 24, 2020 (Monday-Saturday). Weekend documentation was cut short on Saturday afternoon due to a snowstorm requiring snowplow operations that forced the in roadway mat counters to be picked up. Raw traffic counts and plots of volumes by time, day, and direction are illustrated in **Appendix B**.

When comparing the ADT volumes collected versus historical data, traffic volumes were noticeably low, likely impacted by the ongoing COVID-19 pandemic. The AM peak hour traffic volumes were approximately 27-37% lower than historical counts and PM peak hour traffic volumes were 16-30% lower than historical counts. ADT volumes were 11-34% lower than 2018 Omaha-Council Bluffs Metropolitan Area Planning Agency (MAPA) counts. Year to year variations are to be expected, but these noted differences are likely attributed to ongoing COVID-19 impacts when counts were conducted. **Table 2** summarizes the differences between MAPA 2018 and 2020 ADT counts. **Figure 2** depicts the weekday 15-minute interval volumes south of Pacific Street. **Figure 3** illustrates the difference in directional volumes south of Pacific Street.

Table 2. Count Comparisons

Location	Averagae Weekday Traffic Counts		% Change
	2018*	2020	
72nd St North of Mayfield Ave	36,300	23,925	-34.1%
72nd St South of M Plz	32,900	29,060	-11.7%
72nd St South of Pacific St	43,800	36,600	-16.4%
** Source: MAPA*			

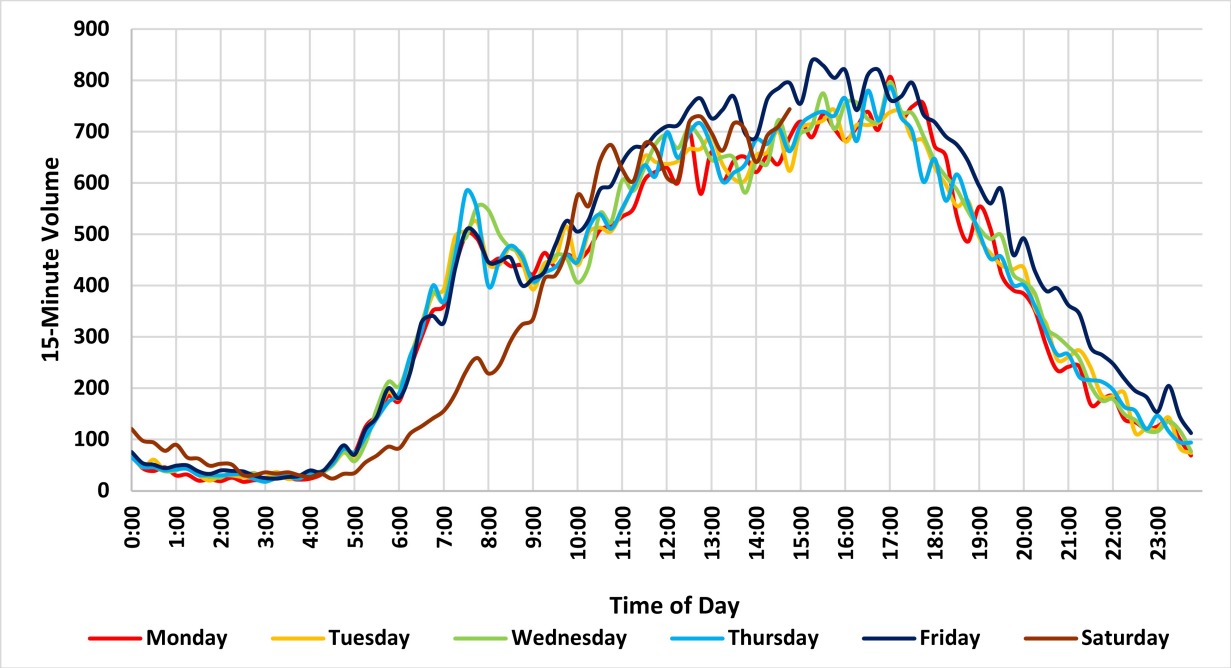


Figure 2. 72nd Street Daily Total Traffic Volumes South of Pacific Street

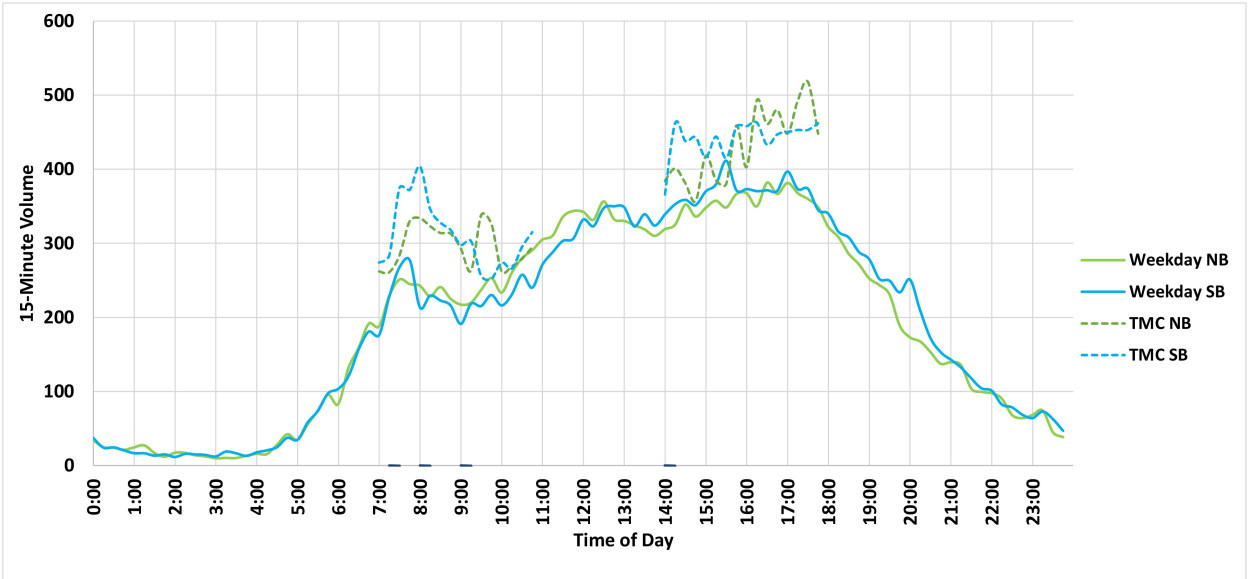


Figure 3. 72nd Street Weekday Traffic Volumes by Direction South of Pacific Street

3.3 Travel Time Runs

Travel time runs were collected for "before" conditions on 72nd Street from October 21, 2020 through October 24, 2020 as a baseline to compare against new. The timing plan periods collected were weekday AM (7:00 AM – 9:00 AM), OP (9:00 AM – 11:00 AM), MD (11:00 AM – 3:00 PM), PM (4:00 PM – 6:00 PM), and WM (11:00 AM – 3:00 PM) time periods. Field measurements were recorded using Tru-Traffic (v10) software and GPS. Some interpolation was required to estimate intersection arrival times due to loss of GPS signal at L Street and I-80 underpasses. These do not affect the total travel times captured but may cause disruptions in where precisely delays occur around these two underpasses. Travel time data and graphs are illustrated in **Appendix C** and summarized in **Section 7.3**.

3.4 Crash Data

The City of Omaha provided crash data at three locations from 2015-2019: 72nd and Blondo Streets, 72nd and Grover Streets, and 90th and Pacific Streets. The City also provided existing signal timings, Synchro models, access to traffic monitoring cameras, warrants for left-turn phasing and leading pedestrian intervals, and comments from staff on concerns related to the existing timing plans.

4.0 EXISTING ROADWAY & TRAFFIC CONDITIONS

4.1 Time of Day Schedule and Special Plans

Intersections along the 72nd Street corridor are currently coordinated for north/south traffic along 72nd Street and east/west traffic along Pacific Street. Most intersections run a 90 second cycle length during the AM, OP, MD, and PM periods. Exceptions include the AM, MD, and PM periods when the intersections of 72nd and L Streets (north and south) and 72nd Street and M Plaza run a 120 second cycle. 72nd and Main Streets, 72nd and Q Streets, and 72nd and F Streets also run a 120 second cycle length in the PM period. **Table 3** depicts the weekday time of day schedule. **Table 4** and **Table 5** depict the Saturday and Sunday time of day schedules, respectively.

Special timing plans that used or had unique patterns were identified to determine whether such plans are still required. Many intersections use the timing pattern 6 through the MD period, but these plans are identical to pattern 1. In the same manner, pattern 4 is run by multiple intersections after pattern 3 in the PM period, but is identical to pattern 3. Pattern 5 is used throughout the day at multiple intersections during the weekend but is identical to pattern 1. **Table 6** summarizes unique timing patterns for the project intersections.

Table 3. Existing Weekday Time of Day Schedule

EXISTING SCHEDULES WEEKDAY		12 am	1 am	2 am	3 am	4 am	5 am	6 am	7 am	8 am	9 am	10 am	11 am	12 pm	1 pm	2 pm	3 pm	4 pm	5 pm	6 pm	7 pm	8 pm	9 pm	10 pm	11 pm
450	72nd St & Maple St	20 [Free]							2 [90]			1 [90]						3 [90]			1 [90]			20 [Free]	
440	72nd St & Blondo St	1 [90]							2[90]			1 [90]						3 [90]			1 [90]				
439	72nd St & Parker St (Bakers Dr)	33 [Flash]							2[90]			1 [90]						3 [90]			1 [90]			33 [Flash]	
454	72nd St & Seward St	33 [Flash]							2[90]			1 [90]						3 [90]			1 [90]			33 [Flash]	
456	72nd St & Western St	20 [Free]						1 [90]	2 [90]		1 [90]		6 [90]*		1 [90]			3 [90]	4 [90]*		1 [90]			20 [Free]	
947	72nd St & Mayfield St	33 [Flash]							2[90]		1 [90]		6 [90]*		1 [90]			3 [90]	4 [90]*		1 [90]			33 [Flash]	
441	72nd St & Cass St	1 [90]							21 [Adaptive]									3 [150]			21 [Adaptive]			1 [90]	
738	72nd St & Crossroads Mall	1 [90]							21 [Adaptive]									3 [150]			21 [Adaptive]			1 [90]	
443	72nd St & Dodge St	1 [90]							21 [Adaptive]									3 [150]			21 [Adaptive]			1 [90]	
447	72nd St & Farnam	1 [90]							21 [Adaptive]									3 [150]			21 [Adaptive]			1 [90]	
448	72nd St & Jones Cir	20 [Free]						1 [90]	2 [90]		1 [90]		6 [90]*		1 [90]			3 [90]	4 [90]*		1 [90]			20 [Free]	
700	72nd St & Jones St	20 [Free]						1 [90]	2 [90]		1 [90]		6 [90]*		1 [90]			3 [90]	4 [90]*		1 [90]			20 [Free]	
808	72nd St & Rose Blumkin	20 [Free]						1 [90]	2 [90]		1 [90]		6 [90]*		1 [90]			3 [90]	4 [90]*		1 [90]			20 [Free]	
453	72nd St & Pacific St	1 [90]							2 [90]		1 [90]		6 [90]**		1 [90]			3 [90]	4 [90]*		1 [90]				
831	72nd St & Pine St	20 [Free]						1 [90]	2 [90]		1 [90]		6 [90]*		1 [90]			3 [90]	4 [90]*		1 [90]			20 [Free]	
446	72nd St & Hickory St	20 [Free]						1 [90]	2 [90]		1 [90]		6 [90]*		1 [90]			3 [90]	4 [90]*		1 [90]			20 [Free]	
868	72nd St & Cedar St	20 [Free]						1 [90]	2 [90]		1 [90]		6 [90]*		1 [90]			3 [90]	4 [90]*		1 [90]			20 [Free]	
451	72nd St & Mercy St	20 [Free]						1 [90]	2 [90]		1 [90]		6 [90]*		1 [90]			3 [90]	4 [90]*		1 [90]			20 [Free]	
455	72nd St & Spring St	10 [Free]							2 [90]			1 [90]						3 [90]		1 [90]		11 [90]		10 [Free]	
445	72nd St & Grover St	10 [Free]							2 [90]			1 [90]						3 [90]		1 [90]		11 [90]		10 [Free]	
43	72nd St & I-80 WB Ramps	20 [Free]							2 [90]			1 [90]						3 [90]			1 [90]			20 [Free]	
44	72nd St & I-80 EB Ramps	20 [Free]							2 [90]			1 [90]						3 [90]			1 [90]			20 [Free]	
444	72nd St & F St	20 [Free]							2 [90]			1 [90]						3 [120]			1 [90]			20 [Free]	
449	72nd St & L St	10 [Free]							2 [120]		4 [90]**			1 [120]				3 [120]		1 [120]		4 [90]**		10 [Free]	
1167	72nd St & M Plz	19 [Flash]							2 [120]		4 [90]**			1 [120]				3 [120]		1 [120]		4 [90]**		19 [Flash]	
616	72nd St & Q St	10 [Free]							2 [90]			1 [90]						3 [120]			1 [90]			10 [Free]	
615	72nd St & Main St	20 [Free]							2 [90]			1 [90]						3 [120]			1 [90]			20 [Free]	
730	72nd St & Drexel St	33 [Flash]					20 [Free]		2[90]			1 [90]						3 [90]			1 [90]			33 [Flash]	
699	72nd St & Harrison St	20 [Free]							2 [90]			1 [90]						3 [90]			1 [90]			20 [Free]	
508	90th St & Shamrock	20 [Free]																							
512	90th St & Harney/Westover St	20 [Free]					1 [90]		2 [90]			1 [90]						3 [90]			1 [90]			20 [Free]	
506	90th St & Pacific St	1 [90]							2 [90]			1 [90]						3 [90]			1 [90]				
8493	87th Ave &Pacific St	20 [Free]					1 [90]		2 [90]			1 [90]						3 [90]			1 [90]				
493	87th St & Pacific St	20 [Free]					1 [90]		2 [90]			1 [90]						3 [90]			1 [90]				
485	84th St & Pacific St	20 [Free]					1 [90]		2 [90]			1 [90]						3 [90]			1 [90]			20 [Free]	
58	Ridgewood St & Pacific St	20 [Free]																							
471	78th St & Pacific St	20 [Free]					1 [90]		2 [90]			1 [90]						3 [90]			1 [90]			20 [Free]	
610	74th St & Pacific St	33 [Flash]							2[90]			1 [90]						3 [90]			1 [90]			33 [Flash]	
453	72nd St & Pacific St	1 [90]							2 [90]		1 [90]		6 [90]**		1 [90]			3 [90]	4 [90]*						
830	69th St & Pacific St	33 [Flash]							2[90]		1 [90]		6 [90]*		1 [90]			3 [90]	4 [90]*		1 [90]			33 [Flash]	
435	67th St & Pacific St	20 [Free]							2 [90]			20 [Free]						3 [90]	4 [90]*		20 [Free]				
939	Rose Blumkin & Harney St	33 [Flash]							2[90]			1 [90]						3 [90]	4 [90]*		1 [90]			33 [Flash]	
973	Rose Blumkin & NFM Ent	33 [Flash]							2[90]			1 [90]						3 [90]	4 [90]*		1 [90]			33 [Flash]	
438	69th St & Cass/Underwood	20 [Free]						1 [90]	2 [90]			1 [90]						3 [90]			1 [90]			20 [Free]	

LEGEND
* Indicates Duplicate Time of Day Plans
**Indicates Unique Time of Day Plan

Table 4. Existing Saturday Time of Day Schedule

	EXISTING SCHEDULES SATURDAY	12 am	1 am	2 am	3 am	4 am	5 am	6 am	7 am	8 am	9 am	10 am	11 am	12 pm	1 pm	2 pm	3 pm	4 pm	5 pm	6 pm	7 pm	8 pm	9 pm	10 pm	11 pm
450	72nd St & Maple St	20 [Free]							1 [90]																
440	72nd St & Blondo St	1 [90]																							
439	72nd St & Parker St (Bakers Dr)	33 [Flash]						1 [90]							1 [90]										
454	72nd St & Seward St	33 [Flash]						1 [90]							1 [90]										
456	72nd St & Western St	20 [Free]						1 [90]							5 [90]*						1 [90]				
947	72nd St & Mayfield St	33 [Flash]						1 [90]							5 [90]*						1 [90]				
441	72nd St & Cass St	1 [90]													21 [Adaptive]										1 [90]
738	72nd St & Crossroads Mall	1 [90]													21 [Adaptive]										1 [90]
443	72nd St & Dodge St	1 [90]													21 [Adaptive]										1 [90]
447	72nd St & Farnam	11 [90]													21 [Adaptive]										11 [90]
448	72nd St & Jones Cir	20 [Free]						1 [90]							5 [90]*						1 [90]				
700	72nd St & Jones St	20 [Free]						1 [90]							5 [90]*						1 [90]				
808	72nd St & Rose Blumkin	20 [Free]						1 [90]							5 [90]**						1 [90]				
453	72nd St & Pacific St	1 [90]													5 [90]**						1 [90]				
831	72nd St & Pine St	20 [Free]						1 [90]							5 [90]*						1 [90]				
446	72nd St & Hickory St	20 [Free]						1 [90]							5 [90]*						1 [90]				
868	72nd St & Cedar St	20 [Free]						1 [90]							5 [90]*						1 [90]				
451	72nd St & Mercy St	20 [Free]						1 [90]							5 [90]*					4 [90]**		1 [90]			
455	72nd St & Spring St	10 [Free]							1 [90]													11 [90]			
445	72nd St & Grover St	10 [Free]							11 [90]						1 [90]						. [9	5 [90]**			
43	72nd St & I-80 WB Ramps	20 [Free]							1 [90]																
44	72nd St & I-80 EB Ramps	20 [Free]							1 [90]																
444	72nd St & F St	20 [Free]							1 [90]																
449	72nd St & L St	10 [Free]							4 [90]**						1 [120]							4 [90]**			
1167	72nd St & M Plz	19 [Flash]							4 [90]**						1 [120]							4 [90]**			
616	72nd St & Q St	10 [Free]							1 [90]																
615	72nd St & Main St	20 [Free]							1 [90]																
730	72nd St & Drexel St	33 [Flash]							1 [90]																
699	72nd St & Harrison St	20 [Free]							1 [90]																
508	90th St & Shamrock	20 [Free]																							
512	90th St & Harney/Westover St	20 [Free]							1 [90]																
506	90th St & Pacific St	1 [90]																							
8493	87th Ave &Pacific St	20 [Free]							1 [90]																
493	87th St & Pacific St	20 [Free]							1 [90]																
485	84th St & Pacific St	20 [Free]							1 [90]																
58	Ridgewood St & Pacific St	20 [Free]																							
471	78th St & Pacific St	20 [Free]							1 [90]																
610	74th St & Pacific St	33 [Flash]							1 [90]												1 [90]				
453	72nd St & Pacific St	1 [90]													5 [90]**						1 [90]				
830	69th St & Pacific St	33 [Flash]						1 [90]							5 [90]*						1 [90]				
435	67th St & Pacific St	20 [Free]						1 [90]							5 [90]*						1 [90]				
939	Rose Blumkin & Harney St	33 [Flash]						1 [90]							5 [90]*						1 [90]				
973	Rose Blumkin & NFM Ent	33 [Flash]						1 [90]							5 [90]*						1 [90]				
438	69th St & Cass/Underwood	20 [Free]							1 [90]																

LEGEND
* Indicates Duplicate Time of Day Plans
**Indicates Unique Time of Day Plan

Table 5. Existing Sunday Time of Day Schedule

	EXISTING SCHEDULES SUNDAY	12 am	1 am	2 am	3 am	4 am	5 am	6 am	7 am	8 am	9 am	10 am	11 am	12 pm	1 pm	2 pm	3 pm	4 pm	5 pm	6 pm	7 pm	8 pm	9 pm	10 pm	11 pm
450	72nd St & Maple St	20 [Free]							1 [90]																20 [Free]
440	72nd St & Blondo St	1 [90]																							
439	72nd St & Parker St (Bakers Dr)	33 [Flash]						1 [90]							1 [90]										33 [Flash]
454	72nd St & Seward St	33 [Flash]						1 [90]							1 [90]										33 [Flash]
456	72nd St & Western St	20 [Free]							1 [90]						5 [90]*						1 [90]				20 [Free]
947	72nd St & Mayfield St	33 [Flash]							1 [90]						5 [90]*						1 [90]				33 [Flash]
441	72nd St & Cass St	1 [90]													21 [Adaptive]								1 [90]		
738	72nd St & Crossroads Mall	1 [90]													21 [Adaptive]								1 [90]		
443	72nd St & Dodge St	1 [90]													21 [Adaptive]								1 [90]		
447	72nd St & Farnam	11 [90]													21 [Adaptive]								11 [90]		
448	72nd St & Jones Cir	20 [Free]							1 [90]						5 [90]*						1 [90]				20 [Free]
700	72nd St & Jones St	20 [Free]							1 [90]						5 [90]*						1 [90]				20 [Free]
808	72nd St & Rose Blumkin	20 [Free]							1 [90]						5 [90]**						1 [90]				20 [Free]
453	72nd St & Pacific St	1 [90]													5 [90]**						1 [90]				
831	72nd St & Pine St	20 [Free]							1 [90]						5 [90]*						1 [90]				20 [Free]
446	72nd St & Hickory St	20 [Free]							1 [90]						5 [90]*						1 [90]				20 [Free]
868	72nd St & Cedar St	20 [Free]							1 [90]						5 [90]*						1 [90]				20 [Free]
451	72nd St & Mercy St	20 [Free]							1 [90]						5 [90]*						1 [90]				20 [Free]
455	72nd St & Spring St	10 [Free]													1 [90]								11 [90]		10 [Free]
445	72nd St & Grover St	10 [Free]							11 [90]						1 [90]								11 [90]		10 [Free]
43	72nd St & I-80 WB Ramps	20 [Free]													1 [90]										20 [Free]
44	72nd St & I-80 EB Ramps	20 [Free]													1 [90]										20 [Free]
444	72nd St & F St	20 [Free]													1 [90]										20 [Free]
449	72nd St & L St	10 [Free]							4 [90]**						1 [120]								4 [90]**		10 [Free]
1167	72nd St & M Plz	19 [Flash]							4 [90]**						1 [120]								4 [90]**		19 [Flash]
616	72nd St & Q St	10 [Free]													1 [90]										10 [Free]
615	72nd St & Main St	20 [Free]													1 [90]										20 [Free]
730	72nd St & Drexel St	33 [Flash]													1 [90]										33 [Flash]
699	72nd St & Harrison St	20 [Free]													1 [90]										20 [Free]
508	90th St & Shamrock	20 [Free]																							
512	90th St & Harney/Westover St	20 [Free]													1 [90]										20 [Free]
506	90th St & Pacific St	1 [90]																							
8493	87th Ave & Pacific St	20 [Free]													1 [90]										
493	87th St & Pacific St	20 [Free]													1 [90]										
485	84th St & Pacific St	20 [Free]													1 [90]										20 [Free]
58	Ridgewood St & Pacific St	20 [Free]																							
471	78th St & Pacific St	20 [Free]													1 [90]										20 [Free]
610	74th St & Pacific St	33 [Flash]													1 [90]										33 [Flash]
453	72nd St & Pacific St	1 [90]													5 [90]**						1 [90]				
830	69th St & Pacific St	33 [Flash]							1 [90]						5 [90]*						1 [90]				33 [Flash]
435	67th St & Pacific St	20 [Free]							1 [90]						5 [90]*						1 [90]				20 [Free]
939	Rose Blumkin & Harney St	33 [Flash]							1 [90]						5 [90]*						1 [90]				33 [Flash]
973	Rose Blumkin & NFM Ent	33 [Flash]							1 [90]						5 [90]*						1 [90]				33 [Flash]
438	69th St & Cass/Underwood	20 [Free]													1 [90]										20 [Free]

LEGEND
* Indicates Duplicate Time of Day Plans
**Indicates Unique Time of Day Plan

Table 6. Unique Timing Plans

Intersection		Plan	Cycle	Description (Action)
445	72nd St & Grover St	5	90	Baxter Arena OB (Remain)
445	72nd St & Grover St	6	90	Baxter Arena OB No FYAs (Remain)
808	72nd St & Rose Blumkin Dr	5	90	NFM (Removed)
616	72nd St & Q St	22	120	Ralston Arena (Remain)
616	72nd St & Q St	23	120	Ralston Arena (Remain)
615	72nd St & Main St	22	120	Ralston Arena (Remain)
615	72nd St & Main St	23	120	Ralston Arena (Remain)
1167	72nd St & M St	22	120	Ralston Arena (Remain)
1167	72nd St & M St	23	120	Ralston Arena (Remain)
449	72nd St & L St	22	120	Ralston Inbound (Remain)
449	72nd St & L St	23	120	Ralston Outbound (Remain)
43,44	72nd St & I-80	37	120	I-80 Incident Management Plan 7,8 (Remain)
43,44	72nd St & I-80	39	120	I-80 Incident Management Plan 9, 10 (Remain)
453	72nd St & Pacific St	5	90	Unknown (Removed)
453	72nd St & Pacific St	6	90	Unknown (Removed)

4.2 Existing Intersection Observations

Overall, previous timing plans provided generally acceptable operations along the 72nd Street corridor based on travel time runs and observations. The impacts of COVID-19 on travel patterns have reduced traffic volumes and likely masked some of the issues that may have occurred prior to March 2020. The following list details concerns at several intersections from City of Omaha and Olsson staff:

- 72nd and Blondo Streets
  - Long NB Queues (reaching Baker's Drive during PM peak)
- 72nd and Pacific Streets
  - Pedestrian volumes influence signal timings and cause the signal to transition and shorten desired green times on NBL/SBL
  - WB queueing during PM peak can reach 67th Street
- 90th and Pacific Streets

- 90th and Pacific Streets
  - WB queueing is particularly high in PM
- 87th and Pacific Streets
  - Pedestrian crossings of Pacific Street during school arrival/dismissal impact operations
  - Outside EB thru lane queues during Omaha Westside arrival/dismissal
- 72nd and Grover Streets
  - WBL has complaints on short green intervals
  - SB/NB rear-end crash pattern
- 72nd and F Streets
  - Heavy truck use
  - EBL is used as I-80 alternative for crashes
- 72nd and Harrison Streets
  - EB/WB does receive operational complaints occasionally
  - Long SB queues were observed during PM peak that reached Drexel Street

4.3 Existing Model Verification

The City of Omaha provided existing Synchro models for the existing AM, MD, and PM timing plans. Since MD volumes were not provided, a comparison was made to the daily counts which led to a five percent increase in 2:00 PM – 3:00 PM volumes to estimate existing MD volumes and input into the Synchro model. Olsson saved a copy of the existing MD file to use for the proposed OP timing plan. The OP volumes were highest in the 9:00 AM – 10:00 AM hour and were therefore used for model development analysis. The existing models were verified with data provided by the City of Omaha, Maxview, and field observations. These models were then used to estimate measures of effectiveness (MOE) reporting from the Synchro models.

5.0 IMPLEMENTED TIMING PLAN DEVELOPMENT

5.1 Clearance Intervals

The City of Omaha previously calculated yellow and red clearance interval time periods and pedestrian walk times for most project intersections. Eight intersections had updated clearance intervals and pedestrian walk times calculated by Olsson using the templates provided by the City of Omaha as part of this project:

- 72nd and Drexel Streets
- 72nd and Parker Streets (Bakers Dr.)
- 72nd and Blondo Streets
- 78th and Pacific Streets
- 87th and Pacific Streets
- 90th Street and Westover Road
- 90th and Harney Streets
- 90th and Pacific Streets

Summaries of the calculation sheets are illustrated in **Appendix D**.

5.2 Cycle Length Evaluation

Based on data collected and existing timing plans, different cycle lengths along the corridors breaks the coordination between signals and makes progression inconsistent. This applies mostly to the intersections around the 72nd and L Streets intersections which run mostly 120 second cycle lengths (plans 1, 2, and 3) compared to 90 seconds for most other study intersections. The cycle lengths implemented for the AM and MD plans were 120 seconds (60 second half-cycle), 90 seconds in the OP plan, and 150 seconds in the PM plan (75 second half-cycle). Preference towards a certain direction was given when bi-directional volumes were significantly different and weighted towards the larger traffic volumes. In the PM plan, 120 second cycle length was used after clear bidirectional progression was not able to be implemented and a significant break in signal spacing provided buffer for transition between cycle lengths. This was used on the west end of Pacific Street corridor and 72nd and Maple Streets. **Table 7** illustrates initial MOE for each potential cycle length analyzed based on Synchro optimization.

Table 7. Preliminary Cycle Length MOE

MOE	Plan 1 MD					Plan 2 AM				
Cycle Length	Existing	60	90	120	150	Existing	60	90	120	150
Performance Index	731	773	635	695	755	990	1,238	851	866	960
Queue Delay (hr)	-	9	5	6	6	-	36	3	4	6
Total Delay (hr)	568	586	493	558	623	814	1,046	695	721	813
Delay / Veh (s)	15	17	15	17	18	21	30	20	21	24
Total Stops	58,821	67,181	51,298	49,463	47,477	63,102	68,815	56,370	52,206	53,017
Stops / Veh	0.44	0.55	0.42	0.41	0.39	0.46	0.55	0.45	0.42	0.43
Fuel (gal)	1,893	1,899	1,691	1,718	1,750	2,147	2,284	1,916	1,899	1,971
Unserved Vehicles	170	172	50	-	-	863	1,679	632	570	541
Dilemma Vehicles	3,923	6,072	3,970	3,087	2,846	4,099	5,606	3,907	2,858	2,404
% Dilemma Vehicles	-	5%	3%	3%	2%	-	5%	3%	2%	2%
Average Speed (mph)	21	19	21	20	19	18	15	18	18	17
MOE	**Plan 3 PM**					**Plan 4 OP**				
Cycle Length	Existing	60	90	120	150	Existing	60	90	120	150
Performance Index	1,391	1,823	1,471	1,315	1,397	726	667	619	660	710
Queue Delay (hr)	-	44	33	12	18	-	3	1	5	6
Total Delay (hr)	1,150	1,554	1,251	1,091	1,182	613	542	521	566	617
Delay / Veh (s)	23	35	28	25	27	21	21	20	22	24
Total Stops	86,588	96,648	79,328	80,390	77,555	40,655	44,853	35,221	34,095	33,498
Stops / Veh	0.49	0.60	0.50	0.50	0.48	0.39	0.48	0.38	0.37	0.36
Fuel (gal)	2,988	3,282	2,905	2,795	2,837	1,561	1,471	1,373	1,393	1,425
Unserved Vehicles	1,039	2,058	1,337	280	301	1,237	953	986	851	850
Dilemma Vehicles	4,463	6,952	4,825	3,823	3,207	2,789	4,367	2,649	2,315	2,106
% Dilemma Vehicles	-	4%	3%	2%	2%	-	5%	3%	2%	2%
Average Speed (mph)	17	14	16	17	17	18	18	18	17	17

5.3 Left-Turn Phasing Evaluation

The City of Omaha provided left-turn phasing templates to evaluate if existing protected/permitted phasing is warranted. Olsson evaluated all left-turn movements currently utilizing permitted/protected phasing in any timing plan to determine which locations and timing plans were appropriate to have such phasing. Calculations for protected/permitted phasing include both capacity and delay warrants. After evaluation, left-turn phasing was omitted where it did not meet any capacity or delay thresholds for the traffic conditions during a particular pattern. **Table 8** summarizes the locations where existing movements previously utilized protected/permitted phasing and whether based on capacity or delay thresholds, protected/permitted phasing was implemented.

Olsson also calculated all left-turn movements currently operating as permitted only to determine any locations that may benefit from protected/permitted phasing. Based on the warrants, consideration should be given to install flashing yellow arrow (FYA) signal heads to allow for protected/permitted phasing at 72nd and Pine Streets westbound left for PM timing plan and 78th and Pacific Streets southbound left for the AM and PM timing plans. These installations would be completed as part of another City of Omaha project.

The City of Omaha directed Olsson to evaluate the left-turn phasing of some protected only movements along 72nd Street. After FYA heads are installed, these locations could be operated with either permitted or protected/permitted phasing. **Table 9** provides a summary of the warrants for evaluating protected/permitted phasing where currently there is protected only phasing enabled and whether protected/permitted phasing or permissive-only phasing should be implemented. All left-turn phasing evaluations are illustrated in **Appendix F**.

Table 8. Left-Turn Phases Implemented

Intersection	Movement	Plan 1 MD	Plan 2 AM	Plan 3 PM	Plan 4 OP
72nd St & Harrison St	EBL	Enable	Enable	Enable	Enable
	WBL	Omit	Enable	Enable	Omit
	NBL	Enable	Enable	Enable	Enable
	SBL	Enable	Enable	Enable	Enable
72nd St & Main St	NBL	Enable	Enable	Enable	Omit
72nd St & Q St	NBL	Enable	Enable	Enable	Enable
	SBL	Enable	Enable	Enable	Enable
72nd St & M Plz	NBL	Enable	Enable	Enable	Enable
72nd St & L (North Ramp)	NBL	Enable (FYA Omitted)	Enable (FYA Omitted)	Enable (FYA Omitted)	Enable (FYA Enabled)
72nd St & F St	EBL	Enable	Enable	Enable	Enable
	NBL	Enable	Enable	Enable	Enable
	SBL	Enable	Enable	Enable	Enable
72nd St & Mercy Rd	WBL	Omit	Omit	Enable	Omit
72nd St & Western Ave (W)	NBL	Enable	Enable	Enable	Enable
72nd St & Western Ave (E)	SBL	Omit	Enable	Enable	Omit
72nd St & Blondo St	EBL	Enable	Enable	Enable	Enable
	WBL	Enable	Enable	Enable	Enable
	NBL	Enable	Enable	Enable	Enable
	SBL	Enable	Enable	Enable	Enable
72nd St & Maple St	WBL	Enable	Enable	Enable	Enable
	NBL	Enable	Enable	Enable	Enable
	SBL	Enable	Enable	Enable	Enable
Rose Blumkin Dr & NFM Ent	SBL	Enable	Omit	Enable	Omit
67th St & Pacific St	EBL	Enable	Enable	Enable	Enable
	WBL	Enable	Enable	Enable	Enable
	NBL	Enable	Enable	Enable	Enable
74th St & Pacific St	WBL	Omit	Enable	Omit	Omit
78th St & Pacific St	WBL	Enable	Enable	Enable	Omit
	NBL	Enable	Enable	Enable	Omit
84th St & Pacific St	EBL	Omit	Enable	Enable	Omit
	SBL	Omit	Enable	Enable	Omit
87th St & Pacific St	WBL	Enable	Enable	Enable	Enable
90th St & Pacific St	NBL	Enable	Enable	Enable	Enable
	SBL	Enable	Enable	Enable	Enable

Table 9. Future Left-Turn Phases

Intersection	Movement	Plan 1 MD	Plan 2 AM	Plan 3 PM	Plan 4 OP
72nd St & Jones Cir	SBL	Enable	Enable	Enable	Omit
72nd St & Jones St	NBL	Omit	Omit	Enable	Omit
	SBL	Omit	Omit	Enable	Enable
72nd St & Rose Blumkin St	SBL	Enable	Omit	Enable	Omit
72nd St & Hickory St	NBL	Enable	Enable	Enable	Enable
	SBL	Omit	Omit	Omit	Omit
72nd St & Cedar St	NBL	Omit	Omit	Omit	Omit
	SBL	Omit	Omit	Omit	Omit
72nd St & Spring St	SBL	Enable	Enable	Enable	Omit
72nd St & Grover St	NBL	Enable	Enable	Enable	Enable
	SBL	Enable	Enable	Enable	Enable

Note: Implementation not possible until after installation of FYA's

5.4 Trails and Bicycle Facilities

There are two trail networks that pass under 72nd Street within the limits of this project: Keystone Trail between Pacific Street and Rose Blumkin Drive and Big Papio Trail between Q Street and M Plaza. Pedestrian access is available from 72nd Street at both trail locations. In addition, the Ralston Trail connects to a multi-use path along the west side of 72nd and Main Streets and continues north where it ties into the Big Papio Trail.

There are no existing or planned on-street bicycle facilities along the corridor. The intersection of 72nd and Main Streets has a channelized southbound right-turn lane which sets the crosswalk further into the west leg. The northbound left-turn phasing implemented is protected/permitted for AM, MD, and PM timing plans, but not the OP timing plan. 72nd and Q Streets has a multi-use crossing on the west leg. No southbound right-turn lane is provided, but northbound left-turn phasing implemented is protected/permitted for all four timing plans. Specific bicycle counts were not provided at intersections and pedestrian volumes are low at both intersections; therefore, no specific timing accommodations were implemented.

5.5 Leading Pedestrian Intervals

Leading pedestrian intervals were considered at all intersections along the corridor. A review of pedestrian volumes, conflicting turning movements, and intersection geometry provided four initial intersections for further review: 87th Avenue & Pacific Street, 87th and Pacific Streets, 69th and Pacific Streets, and 67th and Pacific Streets.

The City of Omaha provided leading pedestrian interval warrants to evaluate each location. Warrants 4, 5, 6, and 7 were evaluated based on volume criteria and Warrant 8 was evaluated based on school crossing locations when applicable. Warrants provide a base level of screening; however, engineering judgement was used to propose the use of all leading pedestrian intervals. The west leg of 87th and Pacific Streets and the east leg of 87th Avenue and Pacific Street should have leading pedestrian intervals for all timing periods related to school operations (AM/PM). The City is unable to implement LPI operation at this location with its existing equipment, however, it should be deployed when the control equipment is upgraded. A seven second leading interval should be sufficient to get pedestrians into the intersection and make conflicting vehicles aware of their presence. The intersection of 69th and Pacific Streets does not require a leading pedestrian interval at this time. The west leg of 67th and Pacific Streets has pedestrian volumes sufficient to meet leading pedestrian interval warrants but does not have sufficient conflicting vehicle volumes. LPI implementation is not possible with existing equipment but should be reconsidered after planned infrastructure improvements in 2021. A summary of the leading pedestrian interval warrants is illustrated in **Appendix E**.

5.6 Day Plan Schedules

The implemented time of day schedule is based on 8-hour and 24-hour counts collected by the City of Omaha and Olsson, respectively. Weekday traffic count data contained volumes for all movements at the intersections along the corridor for a typical weekday from 6:00 AM to 7:00 PM. Time of day plans were simplified by running new plans starting at 6:00 AM and running until 10:00 PM. All other weekday time of day plans run free or flash outside of the adaptive control intersections. **Table 10** depicts the implemented time of day schedule for the weekday periods. **Table 11** and **Table 12** depict the implemented time of day schedule for the Saturday and Sunday periods, respectively.

Table 10. Implemented Weekday Time of Day Schedule

	PROPOSED SCHEDULES WEEKDAY	12 am	1 am	2 am	3 am	4 am	5 am	6 am	7 am	8 am	9 am	10 am	11 am	12 pm	1 pm	2 pm	3 pm	4 pm	5 pm	6 pm	7 pm	8 pm	9 pm	10 pm	11 pm
450	72nd St & Maple St	20 [Free]						4 [90	2 [120]		4 [90]			1 [120]				3 [120]			4 [90]			20 [Free]
440	72nd St & Blondo St	20 [Free]						4 [90	2 [120]		4 [90]			1 [120]				3 [150]			4 [90]			20 [Free]
439	72nd St & Parker St (Bakers Dr)	33 [Flash]						4 [90	2 [120]		4 [90]			1 [120]				3 [150]			4 [90]			33 [Flash]
454	72nd St & Seward St	33 [Flash]						4 [90	2 [120]		4 [90]			1 [120]				3 [150]			4 [90]			33 [Flash]
456	72nd St & Western St	10 [Free]						4 [90	2 [120]		4 [90]			1 [120]				3 [150]			4 [90]			10 [Free]
947	72nd St & Mayfield St	33 [Flash]						4 [90	2 [120]		4 [90]			1 [120]				3 [150]			4 [90]			33 [Flash]
441	72nd St & Cass St	1 [90]						21 [Adaptive]										3 [150]			21 [Adaptive]			1 [90]
738	72nd St & Crossroads Mall	1 [90]						21 [Adaptive]										3 [150]			21 [Adaptive]			1 [90]
443	72nd St & Dodge St	1 [90]						21 [Adaptive]										3 [150]			21 [Adaptive]			1 [90]
447	72nd St & Farnam	1 [90]						21 [Adaptive]										3 [150]			21 [Adaptive]			1 [90]
448	72nd St & Jones Cir	20 [Free]						4 [90	2 [120]		4 [90]			1 [120]				3 [150]			4 [90]			20 [Free]
700	72nd St & Jones St	20 [Free]						4 [90	2 [120]		4 [90]			1 [120]				3 [150]			4 [90]			20 [Free]
808	72nd St & Rose Blumkin	20 [Free]						4 [90	2 [120]		4 [90]			1 [120]				3 [150]			4 [90]			20 [Free]
453	72nd St & Pacific St	20 [Free]						4 [90	2 [120]		4 [90]			1 [120]				3 [150]			4 [90]			20 [Free]
831	72nd St & Pine St	20 [Free]						4 [90	2 [120]		4 [90]			1 [120]				3 [150]			4 [90]			20 [Free]
446	72nd St & Hickory St	20 [Free]						4 [90	2 [120]		4 [90]			1 [120]				3 [150]			4 [90]			20 [Free]
868	72nd St & Cedar St	20 [Free]						4 [90	2 [120]		4 [90]			1 [120]				3 [150]			4 [90]			20 [Free]
451	72nd St & Mercy St	10 [Free]						4 [90	2 [120]		4 [90]			1 [120]				3 [150]			4 [90]			10 [Free]
455	72nd St & Spring St	10 [Free]						4 [90	2 [120]		4 [90]			1 [120]				3 [150]			4 [90]			10 [Free]
445	72nd St & Grover St	10 [Free]						4 [90	2 [120]		4 [90]			1 [120]				3 [150]			4 [90]			10 [Free]
43	72nd St & I-80 WB Ramps	20 [Free]						4 [90	2 [120]		4 [90]			1 [120]				3 [150]			4 [90]			20 [Free]
44	72nd St & I-80 EB Ramps	20 [Free]						4 [90	2 [120]		4 [90]			1 [120]				3 [150]			4 [90]			20 [Free]
444	72nd St & F St	20 [Free]						4 [90	2 [120]		4 [90]			1 [120]				3 [150]			4 [90]			20 [Free]
449	72nd St & L St	10 [Free]						4 [90	2 [120]		4 [90]			1 [120]				3 [150]			4 [90]			10 [Free]
1167	72nd St & M Plz	19 [Flash]						4 [90	2 [120]		4 [90]			1 [120]				3 [150]			4 [90]			19 [Flash]
616	72nd St & Q St	10 [Free]						4 [90	2 [120]		4 [90]			1 [120]				3 [150]			4 [90]			10 [Free]
615	72nd St & Main St	10 [Free]						4 [90	2 [120]		4 [90]			1 [120]				3 [150]			4 [90]			10 [Free]
730	72nd St & Drexel St	33 [Flash]						4 [90	2 [120]		4 [90]			1 [120]				3 [150]			4 [90]			33 [Flash]
699	72nd St & Harrison St	10 [Free]						4 [90	2 [120]		4 [90]			1 [120]				3 [150]			4 [90]			10 [Free]
508	90th St & Shamrock	20 [Free]																						
512	90th St & Harney/Westover St	20 [Free]								2 [60]		20 [Free]		1 [60]				3 [60]			20 [Free]			
506	90th St & Pacific St	20 [Free]						4 [90	2 [120]		4 [90]			1 [120]				3 [120]			4 [90]			20 [Free]
8493	87th Ave &Pacific St	20 [Free]						4 [90	2 [120]		4 [90]			1 [120]				3 [120]			4 [90]			20 [Free]
493	87th St & Pacific St	20 [Free]						4 [90	2 [120]		4 [90]			1 [120]				3 [120]			4 [90]			20 [Free]
485	84th St & Pacific St	10 [Free]						4 [90	2 [120]		4 [90]			1 [120]				3 [120]			4 [90]			10 [Free]
58	Ridgewood St & Pacific St	20 [Free]																						
471	78th St & Pacific St	10 [Free]						4 [90	2 [120]		4 [90]			1 [120]				3 [120]			4 [90]			10 [Free]
610	74th St & Pacific St	33 [Flash]						4 [90	2 [120]		4 [90]			1 [120]				3 [150]			4 [90]			33 [Flash]
453	72nd St & Pacific St	20 [Free]						4 [90	2 [120]		4 [90]			1 [120]				3 [150]			4 [90]			20 [Free]
830	69th St & Pacific St	33 [Flash]						) [Fre	2 [120]		20 [Free]			1 [120]				3 [75]			20 [Free]			33 [Flash]
435	67th St & Pacific St	20 [Free]								2 [120]					20 [Free]									
939	Rose Blumkin & Harney St	33 [Flash]							2 [60]		20 [Free]			1 [60]				3 [75]			20 [Free]			33 [Flash]
973	Rose Blumkin & NFM Ent	33 [Flash]							2 [60]		10 [Free]			1 [60]				3 [75]			10 [Free]			33 [Flash]
438	69th St & Cass/Underwood	20 [Free]																3 [75]			20 [Free]			

Table 11. Implemented Saturday Time of Day Schedule

	PROPOSED SCHEDULES SATURDAY	12 am	1 am	2 am	3 am	4 am	5 am	6 am	7 am	8 am	9 am	10 am	11 am	12 pm	1 pm	2 pm	3 pm	4 pm	5 pm	6 pm	7 pm	8 pm	9 pm	10 pm	11 pm
450	72nd St & Maple St	20 [Free]								4 [90]				1 [120]							4 [90]				
440	72nd St & Blondo St	20 [Free]								4 [90]				1 [120]							4 [90]				
439	72nd St & Parker St (Bakers Dr)	33 [Flash]						20 [Free]		4 [90]				1 [120]							4 [90]				
454	72nd St & Seward St	33 [Flash]						20 [Free]		4 [90]				1 [120]							4 [90]				
456	72nd St & Western St	10 [Free]								4 [90]				1 [120]							4 [90]				
947	72nd St & Mayfield St	33 [Flash]						20 [Free]		4 [90]				1 [120]							4 [90]				
441	72nd St & Cass St	1 [90]								21 [Adaptive]															
738	72nd St & Crossroads Mall	1 [90]								21 [Adaptive]															
443	72nd St & Dodge St	1 [90]								21 [Adaptive]															
447	72nd St & Farnam	11 [90]								21 [Adaptive]															
448	72nd St & Jones Cir	20 [Free]								4 [90]				1 [120]							4 [90]				
700	72nd St & Jones St	20 [Free]								4 [90]				1 [120]							4 [90]				
808	72nd St & Rose Blumkin	20 [Free]								4 [90]				1 [120]							4 [90]				
453	72nd St & Pacific St	20 [Free]								4 [90]				1 [120]							4 [90]				
831	72nd St & Pine St	20 [Free]								4 [90]				1 [120]							4 [90]				
446	72nd St & Hickory St	20 [Free]								4 [90]				1 [120]							4 [90]				
868	72nd St & Cedar St	20 [Free]								4 [90]				1 [120]							4 [90]				
451	72nd St & Mercy St	10 [Free]								4 [90]				1 [120]							4 [90]				
455	72nd St & Spring St	10 [Free]								4 [90]				1 [120]							4 [90]				
445	72nd St & Grover St	10 [Free]								4 [90]				1 [120]							4 [90]				
43	72nd St & I-80 WB Ramps	20 [Free]								4 [90]				1 [120]							4 [90]				
44	72nd St & I-80 EB Ramps	20 [Free]								4 [90]				1 [120]							4 [90]				
444	72nd St & F St	20 [Free]								4 [90]				1 [120]							4 [90]				
449	72nd St & L St	10 [Free]								4 [90]				1 [120]							4 [90]				
1167	72nd St & M Plz	19 [Flash]						20 [Free]		4 [90]				1 [120]							4 [90]				
616	72nd St & Q St	10 [Free]								4 [90]				1 [120]							4 [90]				
615	72nd St & Main St	10 [Free]								4 [90]				1 [120]							4 [90]				
730	72nd St & Drexel St	33 [Flash]						20 [Free]		4 [90]				1 [120]							4 [90]				
699	72nd St & Harrison St	10 [Free]								4 [90]				1 [120]							4 [90]				
508	90th St & Shamrock	20 [Free]																							
512	90th St & Harney/Westover St	20 [Free]												1 [60]							20 [Free]				
506	90th St & Pacific St	20 [Free]								4 [90]				1 [120]							4 [90]				
8493	87th Ave &Pacific St	20 [Free]								4 [90]				1 [120]							4 [90]				
493	87th St & Pacific St	20 [Free]								4 [90]				1 [120]							4 [90]				
485	84th St & Pacific St	10 [Free]								4 [90]				1 [120]							4 [90]				
58	Ridgewood St & Pacific St	20 [Free]																							
471	78th St & Pacific St	10 [Free]								4 [90]				1 [120]							4 [90]				
610	74th St & Pacific St	33 [Flash]						10 [Free]		4 [90]				1 [120]							4 [90]				
453	72nd St & Pacific St	10 [Free]								4 [90]				1 [120]							4 [90]				
830	69th St & Pacific St	33 [Flash]								20 [Free]				1 [120]							20 [Free]				
435	67th St & Pacific St	20 [Free]																							
939	Rose Blumkin & Harney St	33 [Flash]								20 [Free]				1 [60]							20 [Free]				
973	Rose Blumkin & NFM Ent	33 [Flash]								10 [Free]				1 [60]							10 [Free]				
438	69th St & Cass/Underwood	20 [Free]																							

Table 12. Implemented Sunday Time of Day Schedule

	PROPOSED SCHEDULES SUNDAY	12 am	1 am	2 am	3 am	4 am	5 am	6 am	7 am	8 am	9 am	10 am	11 am	12 pm	1 pm	2 pm	3 pm	4 pm	5 pm	6 pm	7 pm	8 pm	9 pm	10 pm	11 pm
450	72nd St & Maple St	20 [Free]								4 [90]			1 [120]						4 [90]					20 [Free]
440	72nd St & Blondo St	20 [Free]								4 [90]			1 [120]						4 [90]					20 [Free]
439	72nd St & Parker St (Bakers Dr)	33 [Flash]						20 [Free]		4 [90]			1 [120]						4 [90]					33 [Flash]
454	72nd St & Seward St	33 [Flash]						20 [Free]		4 [90]			1 [120]						4 [90]					33 [Flash]
456	72nd St & Western St	10 [Free]								4 [90]			1 [120]						4 [90]					10 [Free]
947	72nd St & Mayfield St	33 [Flash]						20 [Free]		4 [90]			1 [120]						4 [90]					33 [Flash]
441	72nd St & Cass St	1 [90]								21 [Adaptive]														1 [90]
738	72nd St & Crossroads Mall	1 [90]								21 [Adaptive]														1 [90]
443	72nd St & Dodge St	1 [90]								21 [Adaptive]														1 [90]
447	72nd St & Farnam	11 [90]								21 [Adaptive]														11 [90]
448	72nd St & Jones Cir	20 [Free]								4 [90]			1 [120]						4 [90]					20 [Free]
700	72nd St & Jones St	20 [Free]								4 [90]			1 [120]						4 [90]					20 [Free]
808	72nd St & Rose Blumkin	20 [Free]								4 [90]			1 [120]						4 [90]					20 [Free]
453	72nd St & Pacific St	20 [Free]								4 [90]			1 [120]						4 [90]					20 [Free]
831	72nd St & Pine St	20 [Free]								4 [90]			1 [120]						4 [90]					20 [Free]
446	72nd St & Hickory St	20 [Free]								4 [90]			1 [120]						4 [90]					20 [Free]
868	72nd St & Cedar St	20 [Free]								4 [90]			1 [120]						4 [90]					20 [Free]
451	72nd St & Mercy St	10 [Free]								4 [90]			1 [120]						4 [90]					10 [Free]
455	72nd St & Spring St	10 [Free]								4 [90]			1 [120]						4 [90]					10 [Free]
445	72nd St & Grover St	10 [Free]								4 [90]			1 [120]						4 [90]					10 [Free]
43	72nd St & I-80 WB Ramps	20 [Free]								4 [90]			1 [120]						4 [90]					20 [Free]
44	72nd St & I-80 EB Ramps	20 [Free]								4 [90]			1 [120]						4 [90]					20 [Free]
444	72nd St & F St	20 [Free]								4 [90]			1 [120]						4 [90]					20 [Free]
449	72nd St & L St	10 [Free]								4 [90]			1 [120]						4 [90]					10 [Free]
1167	72nd St & M Plz	19 [Flash]						20 [Free]		4 [90]			1 [120]						4 [90]					19 [Flash]
616	72nd St & Q St	10 [Free]								4 [90]			1 [120]						4 [90]					20 [Free]
615	72nd St & Main St	10 [Free]								4 [90]			1 [120]						4 [90]					10 [Free]
730	72nd St & Drexel St	33 [Flash]						20 [Free]		4 [90]			1 [120]						4 [90]					33 [Flash]
699	72nd St & Harrison St	10 [Free]								4 [90]			1 [120]						4 [90]					10 [Free]
508	90th St & Shamrock	20 [Free]																						
512	90th St & Harney/Westover St	20 [Free]													1 [60]					20 [Free]				
506	90th St & Pacific St	20 [Free]								4 [90]			1 [120]						4 [90]					20 [Free]
8493	87th Ave &Pacific St	20 [Free]								4 [90]			1 [120]						4 [90]					20 [Free]
493	87th St & Pacific St	20 [Free]								4 [90]			1 [120]						4 [90]					20 [Free]
485	84th St & Pacific St	10 [Free]								4 [90]			1 [120]						4 [90]					10 [Free]
58	Ridgewood St & Pacific St	20 [Free]																						
471	78th St & Pacific St	10 [Free]								4 [90]			1 [120]						4 [90]					10 [Free]
610	74th St & Pacific St	33 [Flash]						10 [Free]		4 [90]			1 [120]						4 [90]					33 [Flash]
453	72nd St & Pacific St	10 [Free]								4 [90]			1 [120]						4 [90]					10 [Free]
830	69th St & Pacific St	33 [Flash]							20 [Free]				1 [120]						20 [Free]					33 [Flash]
435	67th St & Pacific St	20 [Free]																						
939	Rose Blumkin & Harney St	33 [Flash]							20 [Free]						1 [60]					20 [Free]				33 [Flash]
973	Rose Blumkin & NFM Ent	33 [Flash]							10 [Free]						1 [60]					10 [Free]				33 [Flash]
438	69th St & Cass/Underwood	20 [Free]																						

5.7 Phase Sequencing

During the optimization process, different left-turn phase sequencing was evaluated to improve progression along the corridor. **Table 13** summarizes implemented changes to the left-turn phase sequencing of intersection timing plans.

Table 13. Implemented Sequence Changes

72nd Street		Plan 1 MD	Plan 2 AM	Plan 3 PM	Plan 4 OP
72nd & Grover	Existing	Seq 1	Seq 1	Seq 1	Seq 1
	Proposed	Seq 9	Seq 1	Seq 3	Seq 1
72nd & Spring	Existing	Seq 9	Seq 9	Seq 9	Seq 9
	Proposed	Seq 3	Seq 1	Seq 3	Seq 3
72nd & Mercy	Existing	Seq 9	Seq 9	Seq 9	Seq 9
	Proposed	Seq 9	Seq 9	Seq 3	Seq 3
72nd & Cedar	Existing	Seq 1	Seq 1	Seq 1	Seq 1
	Proposed	Seq 3	Seq 9	Seq 3	Seq 9
72nd & Hickory	Existing	Seq 1	Seq 1	Seq 1	Seq 1
	Proposed	Seq 3	Seq 9	Seq 9	Seq 9
72nd & Pine	Existing	Seq 1	Seq 1	Seq 1	Seq 1
	Proposed	Seq 3	Seq 9	Seq 9	Seq 3
72nd & Pacific	Existing	Seq 1	Seq 1	Seq 1	Seq 1
	Proposed	Seq 10	Seq 4	Seq 7	Seq 1
72nd & Rose Blumkin	Existing	Seq 9	Seq 9	Seq 9	Seq 9
	Proposed	Seq 3	Seq 9	Seq 3	Seq 9
72nd & Jones St	Existing	Seq 1	Seq 1	Seq 1	Seq 1
	Proposed	Seq 9	Seq 9	Seq 3	Seq 1

6.0 IMPLEMENTATION

6.1 Controller Programming

Database entry of proposed timing plans were reviewed for both MAXTIME and Wapiti controllers by the City of Omaha before implementation. Olsson utilized the current database at each intersection as a baseline for making edits to proposed timings, sequencing, and time of day schedule. Proposed database programming was approved for implementation by the City of Omaha.

6.2 Implementation

Starting the morning of February 10, 2021, proposed database plans were downloaded to MAXTIME controlled intersections after the AM peak hour finished and general traffic volumes decrease through midday. Intersections timing plans were uploaded intersection by intersection and verified both in the field and in the City of Omaha traffic maintenance shop control center. After all MAXTIME controlled intersections were downloaded, proposed timing plans for Wapiti controlled intersections were downloaded to intersection controllers. These intersections were also downloaded one at a time with verification occur both in the field and in the maintenance shop. All proposed timings were downloaded to each intersection on February 10, 2021.

6.3 Fine Tuning

After proposed timings were downloaded to all intersections, fine tuning began on February 10, 2021 for the PM peak period plan. Fine tuning consisted of checking traffic monitoring cameras, corridor runs, checking pedestrian service calls, and side street observations to evaluate proper operations of proposed timing plans. Changes were made from both the maintenance shop and remotely from the field to improve the overall timing plans. During the process, updates were made to offsets and sequencing and issues related to detection, time of day plans, and database programming were corrected. Fine tuning was completed on February 16, 2021.

6.4 Public Comment

90th and Harney/Westover Streets – Complaints were received regarding long wait times on the eastbound and westbound approaches. Given the relatively low volumes and the ability to maintain platoons from Pacific Street along 90th Street, it was determined that half cycling the intersection for plans 1, 2, and 3 would benefit the times between service on the eastbound and westbound approaches. Plan 4 was changed to running free due to timing constraints and lower volumes overall.

67th and Pacific Streets – During the cold spell in mid-February, rolling blackouts took place throughout Omaha. After the intersection had the power returned after a blackout, old timing plans were running after the signal started up. Olsson redownloaded the new timings to ensure proper timing plans were being run.

69th and Pacific Streets – Sunday Bryan Guy drove through the intersection noticed that the signal was still running in flash. The time of day plan was missing the command to take the signal out of flash on Sundays. Olsson added the command to the time of day schedule to correct the issue.

7.0 PERFORMANCE MEASURES

7.1 Network Performance Measures

To estimate the performance of the implemented timing plans, the existing timing plans were used as a baseline for comparison. Evaluation of the network is based on the Synchro model alone of the existing and implemented timings. No field measured data was used in this process. The metrics analyzed for this summary are total delay, total stops, total travel time, and fuel consumed. **Table 14** summaries the changes in performance measures between the existing and implemented timing plans for each analysis period. Detailed reports are illustrated in **Appendix G**.

Table 14. Network Performance Measures

	Plan 1 MD Peak			Plan 2 AM Peak		
	Existing	Implemented	Difference	Existing	Implemented	Difference
Total Delay (hr)	568	542	-4.6%	814	704	-13.5%
Total Stops (#)	58,821	53,967	-8.3%	63,102	59,326	-6.0%
Total Travel Time (hr)	1,289	1,284	-0.4%	1,566	1,470	-6.1%
Fuel Consumed (gal)	1,893	1,855	-2.0%	2,147	2,047	-4.7%
	Plan 3 PM Peak			Plan 4 OP Peak		
	Existing	Implemented	Difference	Existing	Implemented	Difference
Total Delay (hr)	1,150	1,145	-0.4%	568	498	-12.3%
Total Stops (#)	86,588	85,132	-1.7%	40,655	37,661	-7.4%
Total Travel Time (hr)	2,199	2,224	1.1%	1,178	1,071	-9.1%
Fuel Consumed (gal)	2,988	3,010	0.7%	1,561	1,460	-6.5%

7.2 Intersection Performance Measures

Individual intersections were also analyzed to compare existing and implemented timing plans. The overall intersection delay was compared for each analysis period to determine whether delay had decreased, increased by less than five seconds, or increased by more than five seconds. Changes in delay at individual intersections is based on cycle length, where programmed stops are implemented, coordination of platooned vehicles, phasing, and green time allocated to each movement. **Table 15** summarizes the number of intersections in each of the three categories of delay comparing the existing timing plan to the one that was implemented**. Table 16** details each intersection that saw an increase of greater than five seconds and the corresponding LOS between existing and implementation timing plans.

Table 15. Intersection Delay Summary

Number of Intersections Where:	Plan 1 MD	Plan 2 AM	Plan 3 PM	Plan 4 OP
Delay decreased	23	23	15	27
Delay increased <= 5 sec/veh	14	12	20	12
Delay increased > 5 sec/veh	3	5	5	1

Table 16. Intersection Delay Increase Over Five Seconds

Intersection	Period	Existing Delay (sec/veh) – LOS	Implemented Delay (sec/veh) - LOS
72nd St & L St WB	AM	16 – B	23 – C
72nd St & I-80 EB Ramps	PM	15 – B	21 – C
72nd St & Spring St	PM	5 – A	12 – B
72nd St & Blondo St	AM	26 – C	34 – C
	MD	20 – B	31 – C
	PM	49 – D	58 – E
72nd St & Maple St	AM	34 – C	41 – D
	MD	29 – C	36 – D
90th St & Pacific St	MD	27 – C	35 – D
87th Ave & Pacific St	AM	5 – A	14 – B
	OP	3 – A	9 – A
87th St & Pacific St	AM	9 – A	19 – B
	PM	3 – A	10 – A
78th St & Pacific St	PM	27 – C	38 - D

The following list summarizes the reasons for the increased delay at the intersections and analysis periods listed in **Table 16**:

- 72nd Street and L WB Ramp (AM) – Additional delay is due to increased cycle length and southbound programed stop. Due to previous crash mitigation efforts, the City of Omaha recommends the sequence at this signal not be changed.
- 72nd Street and I-80 EB Ramp (PM) – Additional delay is due to increased cycle length and northbound programed stop.
- 72nd and Spring Streets (PM) – Additional delay is due to increased cycle length which resulted in increased delay for the side street.
- 72nd and Blondo Streets (AM) – Additional delay is due to increased cycle length to cover pedestrian walk times and provide more reliable operations.
- 72nd and Blondo Streets (MD) – Additional delay is due to increased cycle length to cover pedestrian walk times and provide more reliable operations.
- 72nd and Blondo Streets (PM) – Additional delay is due to cycle length changes between adjacent intersections.
- 72nd and Maple Streets (AM) – Additional delay is due to increased cycle length to cover pedestrian walk times and provide more reliable operations.
- 72nd and Maple Streets (MD) – Additional delay is due to increased cycle length to cover pedestrian walk times and provide more reliable operations.
- 90th and Pacific Streets (MD) – Additional delay is due to increased cycle length which resulted in increased delay for most movements.
- 87th Avenue and Pacific Street (AM) – Additional delay is due to increased cycle length which resulted in increased delay for the side street.
- 87th Avenue and Pacific Street (OP) – Additional delay is due to eastbound programed stop.
- 87th and Pacific Streets (AM) – Additional delay is due to increased cycle length which resulted in increased delay for the side street.
- 87th and Pacific Streets (PM) – Additional delay is due to increased cycle length which resulted in increased delay for the side street.
- 78th and Pacific Streets (PM) – Additional delay is due to cycle length changes between adjacent intersections.

7.3 Corridor Performance Measures

Travel time runs were collected after implementation from February 17, 2021 through February 27, 2021 to compare against existing timings and document changes in 72nd Street travel times. Free flow travel time along 72nd Street was calculated at just over nine minutes. The average travel time run in both directions was decreased after implementation during all weekday time periods, except the southbound AM. The average directional travel time runs decreased by 27 to 192 seconds for the other weekday periods. This represented reductions in total delay of 10-45%.

Weekend travel times increased by approximately 110 seconds in each direction. Northbound travel experienced a spike travelling from Cedar Street to Hickory Street then generally parallels previous travel documentation. After weekend travel time runs were collected, reference points for determining offsets in the models were corrected that may have influenced the travel time increases on weekends. During field visits and traffic monitoring, correcting these offsets appeared to benefit progression from Mercy to Pacific Streets.

Table 17 summarizes the average travel time and net changes, and **Figures 4-8** illustrate average travel times for the bi-directional travel during the AM, OP, MD, PM, and WM, respectively.

Table 17. Travel Time Runs

		AM (7-9 AM)		OP (9-11 AM)		MD (11 AM-2 PM)		PM (3:45-6 PM)		WM (11 AM -2 PM)	
		Travel Time(s)	Delay(s)	Travel Time(s)	Delay(s)	Travel Time(s)	Delay(s)	Travel Time(s)	Delay(s)	Travel Time(s)	Delay(s)
Northbound	Old Timing	829	258	835	264	1,003	432	934	363	798	227
	New Timing	802	231	769	198	811	240	802	231	906	335
	Difference	-27		-66		-192		-133		108	
	% Difference	-3.3%	-10.5%	-7.9%	-25.0%	-19.2%	-44.5%	-14.2%	-36.5%	13.6%	47.6%
Southbound	Old Timing	811	240	757	186	835	264	889	318	799	228
	New Timing	848	277	726	155	754	183	822	251	913	342
	Difference	37		-31		-80		-67		114	
	% Difference	4.6%	15.5%	-4.1%	-16.5%	-9.6%	-30.5%	-7.6%	-21.2%	14.2%	49.8%

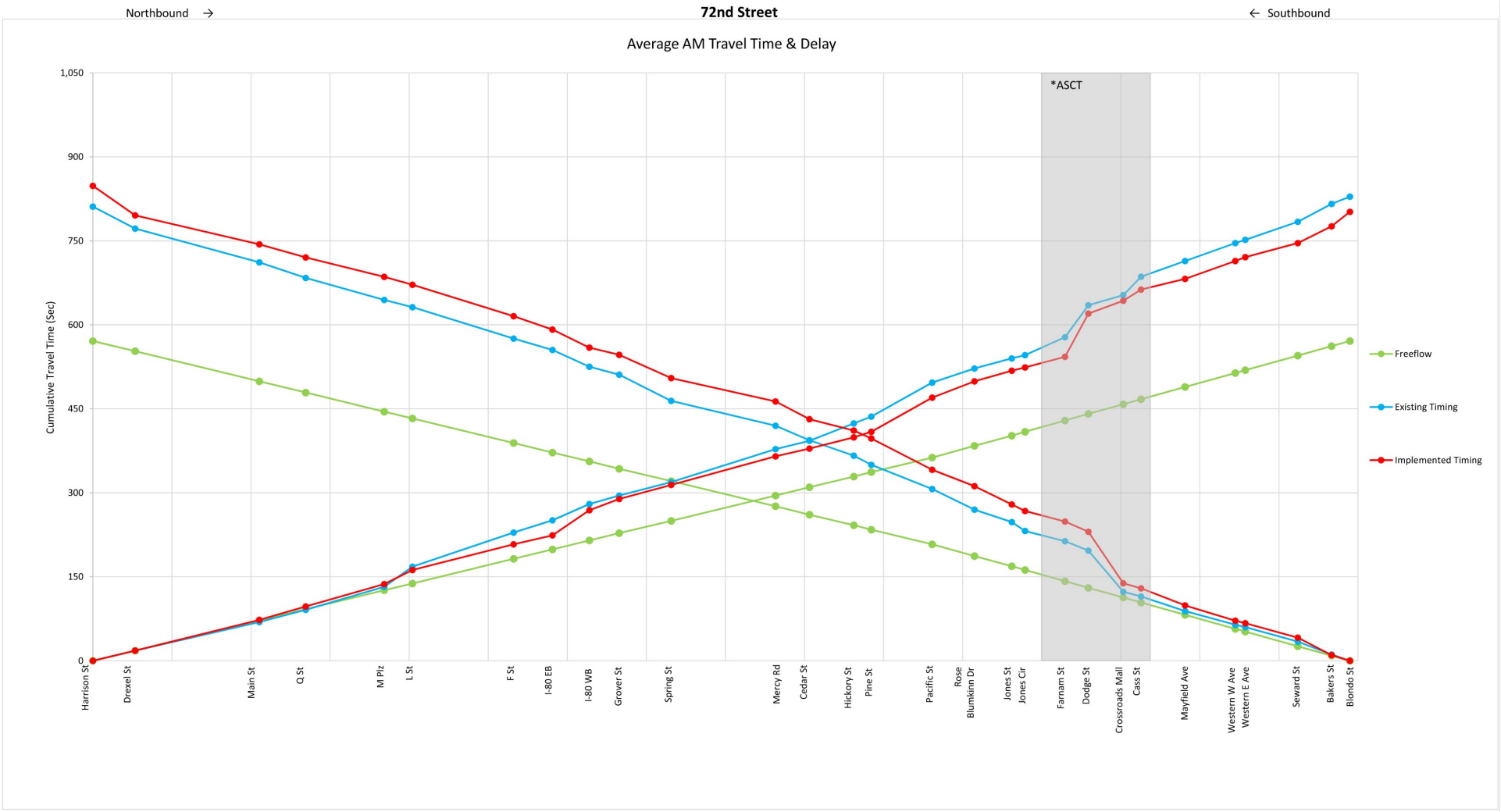


Figure 4. AM Average Travel Time

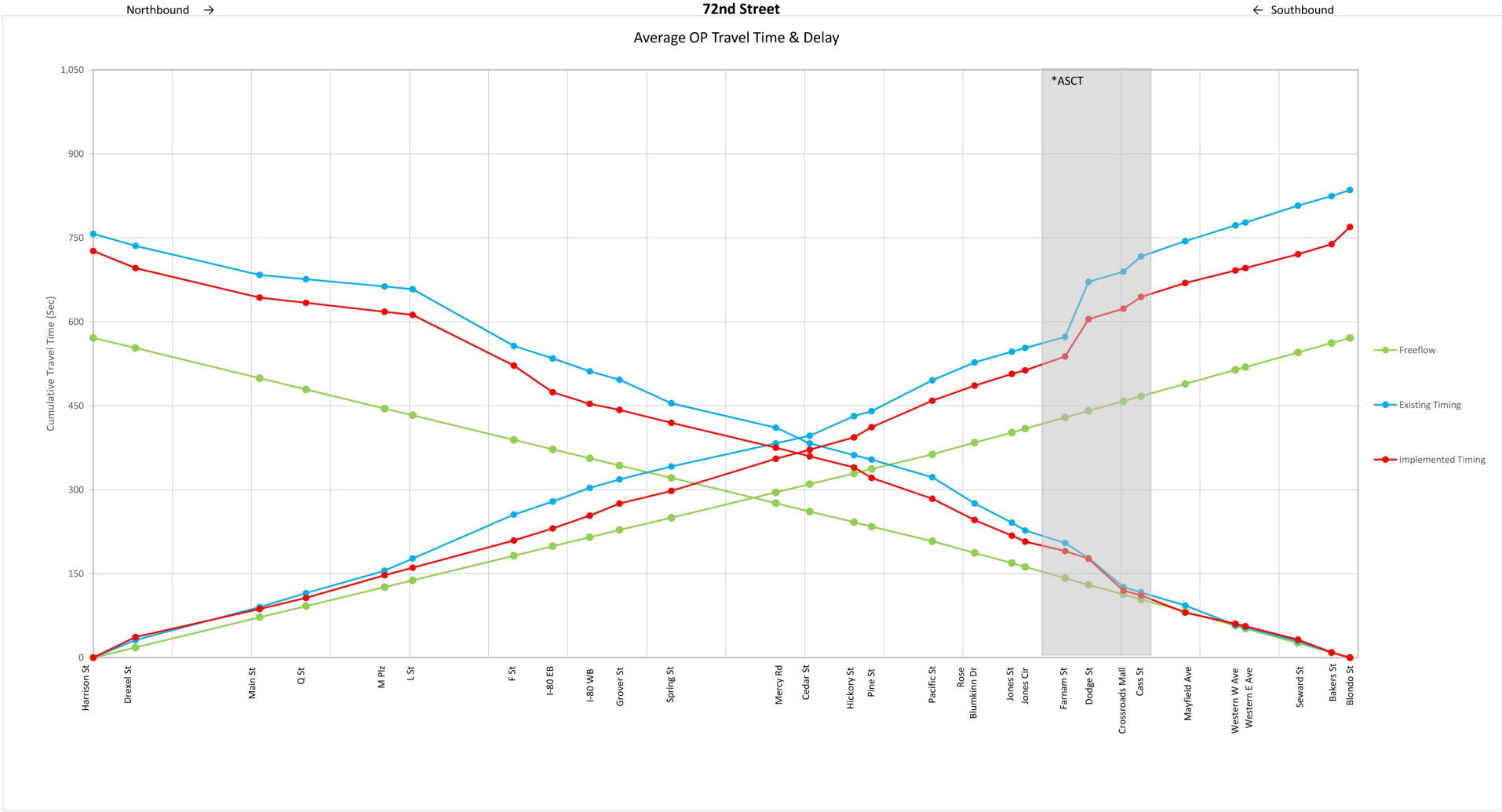


Figure 5. OP Average Travel Time

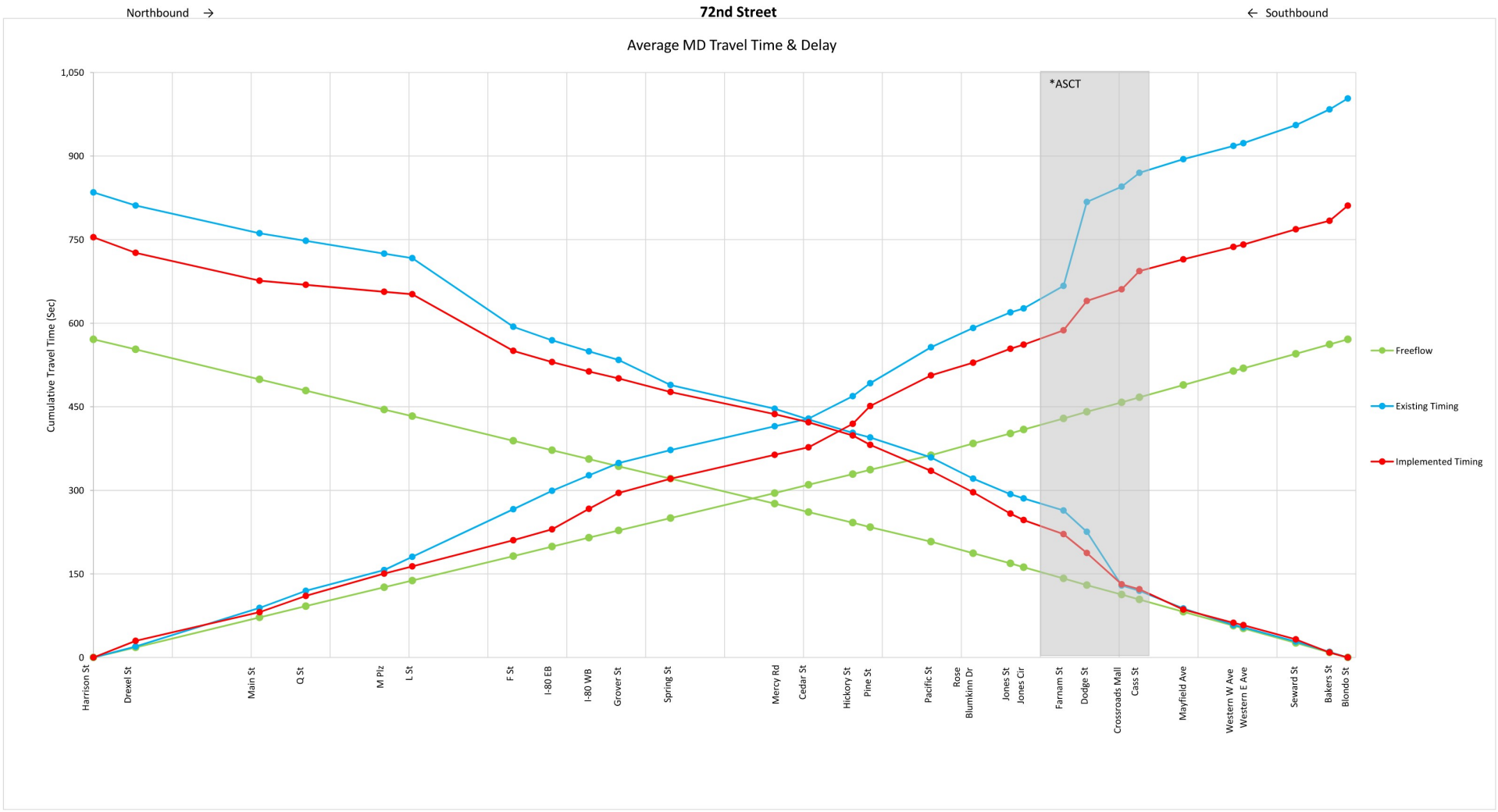


Figure 6. MD Average Travel Time

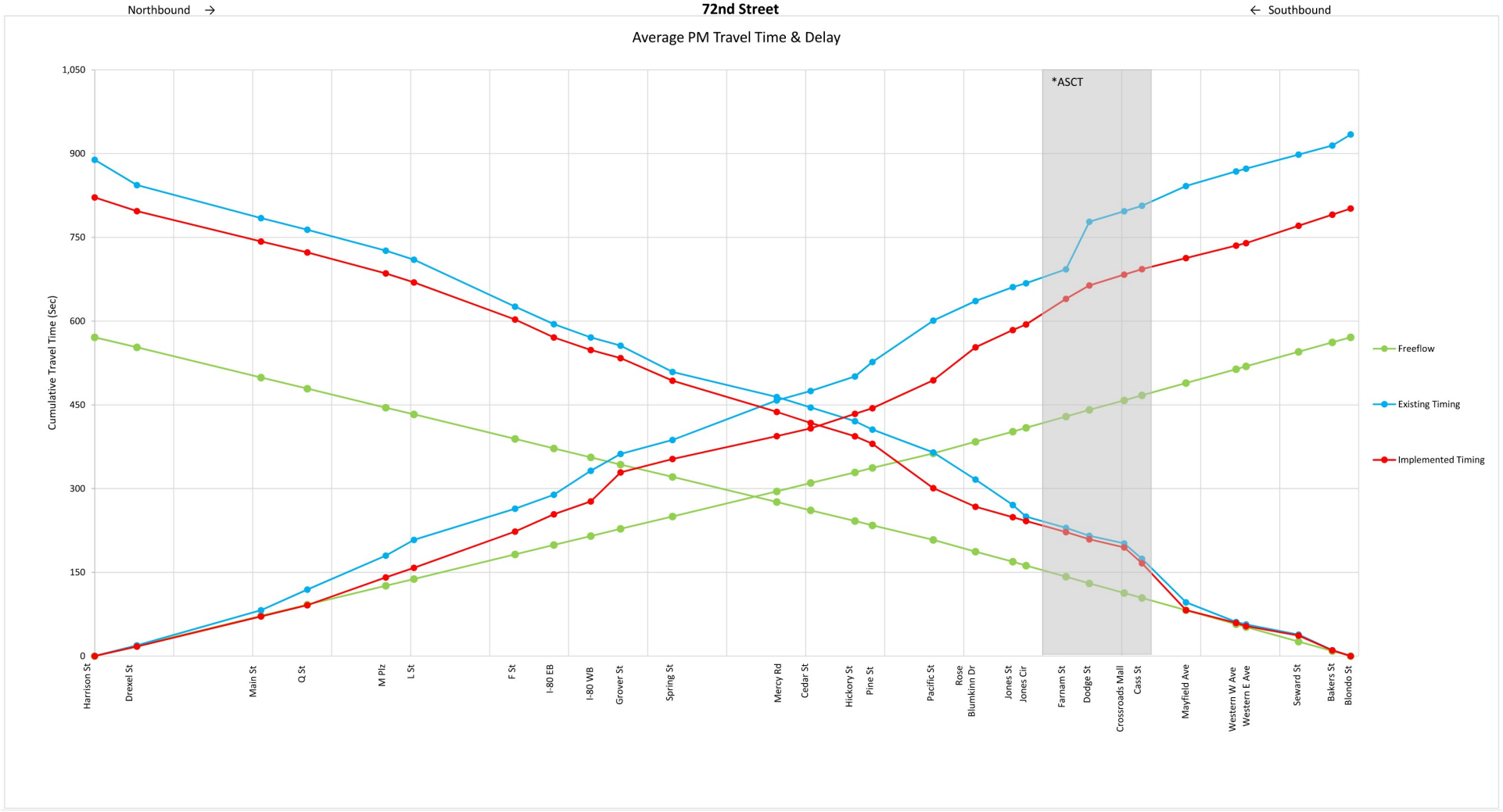


Figure 7. PM Average Travel Time

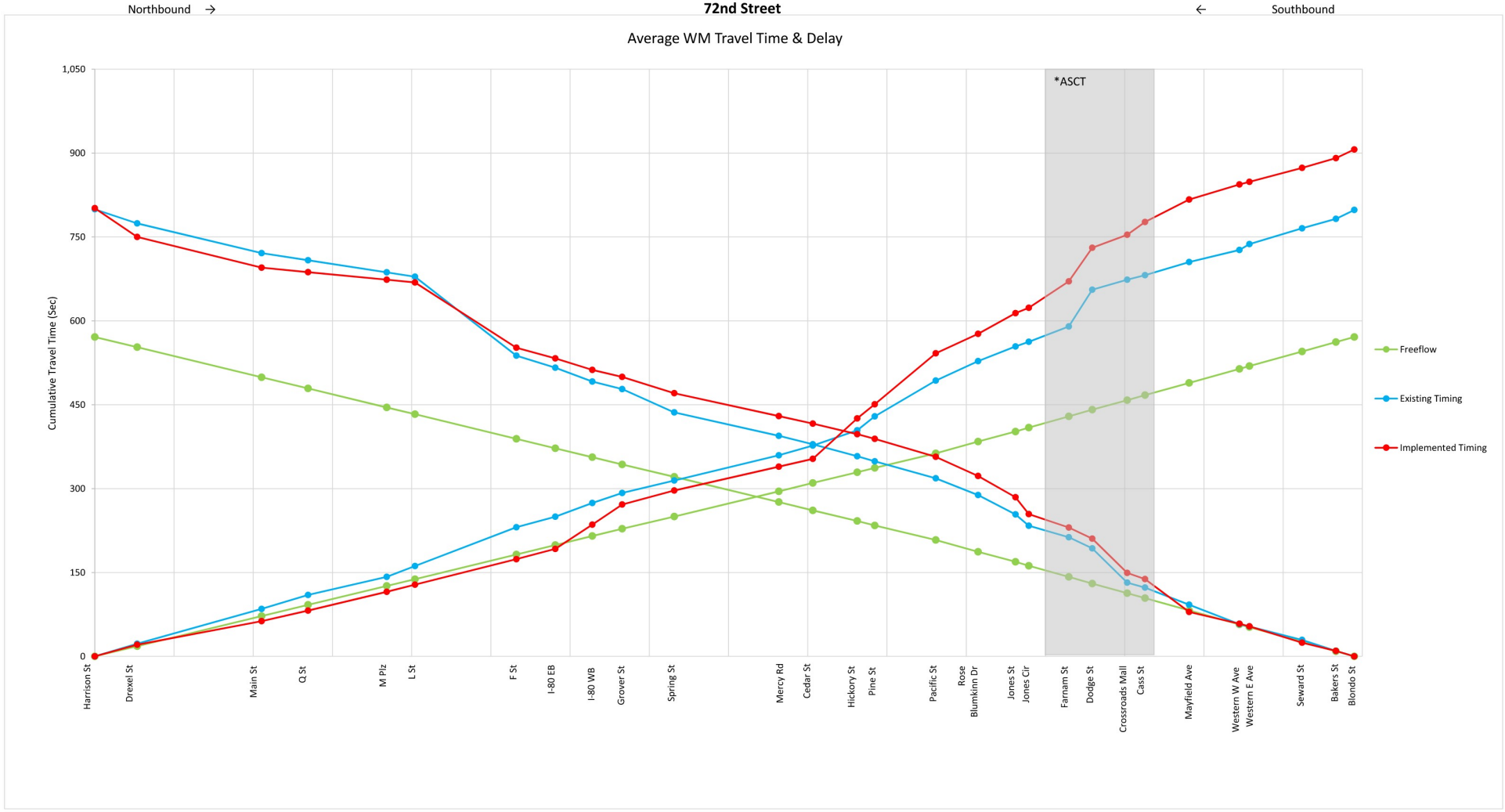


Figure 8. WM Average Travel Time

7.4 Benefit Summary of Implemented Timings

A benefit analysis sheet was provided by the City of Omaha to estimate a monetary value of implemented timing changes. The benefits used to estimate this value included travel time savings, fuel savings, reduction in greenhouse gas emissions, and an estimate in crash reductions. Based on USDOT guidelines and local data, the monetary benefit over the next five years is anticipated to be $17.3 million. **Table 18** summarizes the anticipated five-year benefit of the implemented timings on the analyzed categories. Detailed calculations are provided in **Appendix H**.

Table 18. Anticipated Five Year Benefits of Implemented Timings

Performance Measure	Project Benefit	Present Value
Delay Reduction	501,737 hours	$ 13,586,564
Fuel Consumption Reduction	576,048 gallons	$ 1,180,898
Emissions Reduction	5,138 tons	$ 401,046
Crash Reduction	58 crashes	$ 2,456,451

7.5 Short Term Operational Recommendations

While operational issues typically arise from long term capacity or resource constraints, some short-term operational benefits can be found from less invasive upgrades or resource requirements. The list was determined during data collection, the optimization process, and fine-tuning timing plans.

FYA Upgrades

The ability to progress bidirectional platoons of vehicles more efficiently is hindered by five-section heads utilizing protected/permitted phasing. Implementing FYA would allow lead/lag optimization of left-turn phasing. FYA are planned at many study intersections as part of other infrastructure upgrades and timing plans should be revisited to aid the progression of traffic.

School Queueing

During school arrival/dismissal periods, the outside eastbound thru lane along Pacific Street becomes interrupted with slowing or queued vehicles picking up/dropping off students from Omaha Westside. Consider working with the school to develop a plan to reduce queueing on Pacific Street and consider alternative places or plans for arrival/dismissal.

8.0 SAFETY ANALYSIS

8.1 Short-Term Safety Recommendations

Based on crash reports and field observations, short-term safety recommendations are listed below:

- 72nd and F Streets – Provide additional signing on the southbound approach to warn drivers of slow or stopped vehicles approaching the crest of the bridge "Watch for Stopped Vehicles" (W25-5). The bridge is expected to be reconstructed soon.
- 72nd Street and I-80 EB Ramp – Provide additional signing on the northbound approach to warn drivers of slow or stopped vehicles approaching the crest of the bridge "Watch for Stopped Vehicles" (W25-5). The bridge is expected to be reconstructed soon.
- 72nd and Grover Streets and 72nd and Spring Streets – Monitor crashes at Grover to assess the effectiveness of lane assignment on mast arm poles at 72nd and Spring on rear-end crashes at 72nd and Grover. If rear-end crashes continue to be a concern, determine whether additional static lane assignment/guide signing south of Spring Street is appropriate for southbound traffic.
- 72nd & Blondo Streets – Coordinate with Metro Transit to relocate existing southbound bus stop from the near side (north leg) to the far side (south leg) of the intersection. Consider installing advanced warning sign "Prepare to Stop When Flashing" (W20-8C) with post-mounted flashing beacons north of Blondo Street facing southbound traffic.
- 78th and Pacific Streets – Install FYA for southbound left to implement protected/permitted phasing in the AM and PM peak hours.
- 90th and Pacific Streets – Upgrade eastbound signal heads to LEDs to provide greater visibility and diminish potential evening time sun glare from existing incandescent signal heads. Consider installing advanced warning sign "Prepare to Stop When Flashing" (W20-8C) with post-mounted flashing beacons west of 90th Street facing eastbound traffic. Angle crashes, especially those involving eastbound red-light runners, should be monitored at this intersection after the implementation of these improvements.

8.2 Long-Term Safety Recommendations

A detailed long-term safety and operational evaluation was performed as part of this project to develop recommendations to mitigate crash patterns and improve traffic operations. The City of Omaha provided crash data for the study corridor. The data included crashes for the following intersections (date range):

- 72nd and Blondo Streets (January 2015 to December 2019)
- 72nd and Grover Streets (January 2015 to December 2019)
- 90th and Pacific Streets (January 2017 to December 2019)

This data detailed the date and time of the crash, severity, direction, and crash type. The crash history provided by the City of Omaha is included in **Appendix I**. In addition to the crash data, peak hour turning movement volumes were utilized in the development of the safety recommendations, shown in **Table 19**.

Table 19. Peak Hour Traffic Volumes

Intersection	Peak Time Period	Turning Movement Volumes											
		EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
72nd & Blondo	AM	129	317	239	168	549	88	128	517	67	72	918	160
	MID	148	298	182	114	327	64	167	855	87	98	722	127
	PM	209	583	229	142	455	92	271	1101	143	112	819	162
	OP	146	224	162	141	296	73	103	503	76	72	711	112
72nd & Grover	AM	48	93	181	198	128	247	110	1794	201	103	850	29
	MID	39	86	114	176	81	116	84	1209	142	168	1589	44
	PM	56	121	174	372	187	171	116	1309	227	220	2115	42
	OP	40	61	90	144	53	139	72	1271	156	85	785	42
90th & Pacific	AM	267	1000	87	88	499	168	189	566	177	241	415	53
	MID	75	513	173	102	664	165	163	429	120	183	436	87
	PM	80	701	170	118	1039	191	183	468	79	226	566	203
	OP	78	463	92	62	374	103	106	327	70	164	297	56

A total of 396 crashes were reported. Of the 396 reported crashes, there were no fatalities (FAT), four disabling injuries (INJ-A), 25 visible injuries (INJ-B), 157 possible injuries (INJ-C), and 213 property damage only (PDO) crashes. **Table 20** summarizes the five-year crash history of each intersection by severity.

Table 20. Five-Year Crash Summary by Severity

	FAT	INJ A	INJ B	INJ C	PDO	Total
72nd and Blondo St	0	2	13	54	70	139
72nd and Grover St	0	2	7	82	101	192
90th and Pacific St	0	0	5	21	39	65
					Total Crashes	**396**

At all three intersections, rear-end crashes were the most common, making up 68% of all crashes. At 72nd and Grover streets, 81% of all crashes were rear-end crashes. Left-turn leaving and Angle were the next most, making up 11% and 10% of the total crashes, respectively. **Table 21** summarizes the five-year crash history of each intersection by accident type.

Table 21. Five-Year Crash Summary by Type

	Rear-End	Left-Turn Leaving	Side-swipe (same)	Angle	Bicycle	U-Turn	Pedes-trian	Backing	Ran off Road	Fixed Object in Road	Other	Total
72nd and Blondo St	87	29	5	13	1	1	1	1	1	0	0	139
72nd and Grover St	155	3	17	13	0	0	1	0	1	2	0	192
90th and Pacific St	28	13	5	14	0	0	0	0	1	2	2	65
											Total Crashes	**396**

Of the 155 rear-end crashes at 72nd and Grover streets, 96 were in the southbound direction. Of those 96 southbound rear-end crashes, 69 occurred in the outside curb lane. This crash pattern was likely caused, in part, by excessive queuing in that lane as vehicles positioned themselves upstream of the I-80 ramps. On September 14, 2019, the City of Omaha implemented lane assignments for I-80 westbound (outside curb lane) and I-80 eastbound (middle lane) traffic. This lane assignment included dropping the southbound outside lane at the I-80 North Ramp for I-80 westbound traffic. With only three months of data, we cannot verify the expected reduction in rear-end crashes; however, it is anticipated that the crash pattern will be mitigated with the new lane configuration and assignments. The City of Omaha should continue to monitor this intersection to verify the effectiveness of the countermeasure.

Safety improvements have been identified at the designated intersections based on the crash history, traffic operations, and peak hour volumes.

8.2.1 72nd and Blondo Streets

To assist in the development of improvements, crash types by direction were reviewed. A summary of crash types by direction at 72nd Street & Blondo Street are shown in **Table 22**.

Table 22. 72nd & Blondo Major Crash Types by Direction

Crash Type	Direction	Count	Notes
Rear-end	NB	26	2 NBL
	SB	31	1 SBL
	EB	15	
	WB	15	2 WBL
Left-turn leaving	NBL	12	
	SBL	4	
	EBL	5	
	WBL	8	
Angle	NB	2	
	SB	7	4 red light runners
	EB	2	
	WB	2	

Two options were developed at 72nd & and Blondo streets. Option 1 includes seven improvements:

- Construct eastbound right-turn lane with approximately 100 feet of storage length
  - Adjacent driveway access and building footprint limits available storage for this improvement
- Construct westbound right-turn lane with 100 feet of storage length
  - Adjacent building footprint limits available storage for this improvement
- Construct northbound right-turn lane with 250 feet of storage length
- Construct southbound right-turn lane with 100 feet of storage length
  - Adjacent driveway access limits available storage for this improvement
- Extend eastbound left-turn lane to include a total of 225 feet of storage length
- Extend westbound left-turn lane to include a total of 300 feet of storage length
- Extend southbound left-turn lane to include a total of 225 feet of storage length

Option 2 includes a full intersection reconstruction that includes all improvements listed in Option 1 as well as dual northbound and southbound left-turn lanes. Based on peak volumes, the southbound left is recommended to be striped as a single left with permitted/protected phasing.

The left-turn lane extensions are included to address queue spillback identified in the capacity analysis. Similarly, the right-turn lanes are recommended to help mitigate rear-end, sideswipe, and angle crashes, in addition to improve operations for each approach. It should be noted this intersection has tight right-of-way constraints as well as a retaining wall that would need to be reconstructed with the construction of the northbound right-turn lane.

Due to its proximity to the intersection, with the construction of the eastbound right-turn lane it is proposed to close the existing private driveway located less than 100 feet west of 72nd Street on Blondo Street. The proximity of the driveway to the intersection presents a safety issue and adds friction to vehicles approaching the intersection.

Based on traffic volumes and crash patterns, an evaluation of potential lane reassignments on both Blondo Street approaches was performed. Instead of constructing new eastbound and westbound right-turn lanes, the intersection was analyzed with one through lane and drop right-turn lanes. A comparison of operations for eastbound movements is provided in **Table 23** below. Based on the heavy delay and queueing without the installation of the right-turn lane, lane reassignments were not further considered at this intersection.

Table 23. 72nd and Blondo Street EB Operations Comparison

Movement	Scenario	LOS AM (PM)	Delay, sec/veh AM (PM)	Queue, ft AM (PM)
Eastbound Left	With Right Turn Lane	D (D)	41 (53)	#126 (#289)
	Lane Reassignment	D (D)	40 (52)	#125 (#283)
Eastbound Through	With Right Turn Lane	D (E)	45 (77)	233 (#600)
	Lane Reassignment	E (F)	62 (207)	357 (#1036)
Eastbound Right	With Right Turn Lane	D (D)	54 (52)	123 (121)
	Lane Reassignment	D (D)	54 (51)	131 (163)

A summary of the improvement costs for each individual improvement at this intersection are detailed in **Tables 24-31** below. The concepts for Option 1 and Option 2 are illustrated in **Figure 9** and **Figure 10**, respectively. Option 1 is the preferred concept at this intersection due to its higher overall benefit-cost ratio.

Table 24. 72nd and Blondo Street EBR - Safety and Operations (Option 1)

Item	Quantity	Unit	Unit Price	Construction Cost
Remove Pavement	425.00	SY	$ 12	$ 5,100
Remove Sidewalk	2,000.00	SF	$ 3	$ 6,000
Construct 10-inch Concrete Pavement (Type L65)	345.00	SY	$ 80	$ 27,600
Construct 4" Sidewalk	1,340.00	SF	$ 6	$ 8,040
Construct 9" Driveway	30.00	SY	$ 80	$ 2,400
Signing, Striping, and Signals	1.00	LS	$ 100,000	$ 100,000
Grading	1.00	LS	$ 2,500	$ 2,500
Traffic Control	1.00	LS	$ 10,000	$ 10,000
Erosion Control	1.00	LS	$ 5,000	$ 5,000
Drainage Items	1.00	LS	$ 15,000	$ 15,000
Mobilization	1.00	LS	$ 20,000	$ 20,000
			Subtotal	$ 201,640
			Contingency 30%	$ 60,492
			Construction Total	$ 262,132
			Construction Engineering 10%	$ 26,213
			ROW 35%	$ 91,746
			Utility Relocations 5%	$ 13,107
			Total Project Cost	**$ 393,198**

Table 25. 72nd and Blondo Street WBR - Safety and Operations (Option 1)

Item	Quantity	Unit	Unit Price	Construction Cost
Remove Pavement	375.00	SY	$ 12	$ 4,500
Remove Sidewalk	2,000.00	SF	$ 3	$ 6,000
Construct 10-inch Concrete Pavement (Type L65)	365.00	SY	$ 80	$ 29,200
Construct 4" Sidewalk	1,450.00	SF	$ 6	$ 8,700
Construct 9" Driveway	50.00	SY	$ 80	$ 4,000
Signing, Striping, and Signals	1.00	LS	$ 100,000	$ 100,000
Grading	1.00	LS	$ 2,500	$ 2,500
Traffic Control	1.00	LS	$ 10,000	$ 10,000
Erosion Control	1.00	LS	$ 5,000	$ 5,000
Drainage Items	1.00	LS	$ 10,000	$ 10,000
Mobilization	1.00	LS	$ 20,000	$ 20,000
			Subtotal	$ 199,900
			Contingency 30%	$ 59,970
			Construction Total	$ 259,870
			Construction Engineering 10%	$ 25,987
			ROW 25%	$ 64,968
			Utility Relocations 5%	$ 12,994
			Total Project Cost	**$ 363,818**

Table 26. 72nd and Blondo Street NBR - Safety and Operations (Option 1)

Item	Quantity	Unit	Unit Price	Construction Cost
Remove Pavement	160.00	SY	$ 12	$ 1,920
Remove Retaining Wall	915.00	SF	$ 25	$ 22,875
Remove Sidewalk	3,210.00	SF	$ 3	$ 9,630
Construct 10-inch Concrete Pavement (Type L65)	630.00	SY	$ 80	$ 50,400
Construct 4" Sidewalk	3,110.00	SF	$ 6	$ 18,660
Construct Retaining Wall	1,750.00	SF	$ 50	$ 87,500
Signing, Striping, and Signals	1.00	LS	$ 100,000	$ 100,000
Grading	1.00	LS	$ 25,000	$ 25,000
Traffic Control	1.00	LS	$ 10,000	$ 10,000
Erosion Control	1.00	LS	$ 25,000	$ 25,000
Drainage Items	1.00	LS	$ 15,000	$ 15,000
Mobilization	1.00	LS	$ 50,000	$ 50,000
			Subtotal	$ 415,985
			Contingency 30%	$ 124,796
			Construction Total	$ 540,781
			Construction Engineering 10%	$ 54,078
			ROW 10%	$ 54,078
			Utility Relocations 5%	$ 27,039
			Total Project Cost	**$ 675,976**

Table 27. 72nd and Blondo Street SBR - Safety and Operations (Option 1)

Item	Quantity	Unit	Unit Price	Construction Cost
Remove Pavement	315.00	SY	$ 12	$ 3,780
Remove Sidewalk	1,600.00	SF	$ 3	$ 4,800
Construct 10-inch Concrete Pavement (Type L65)	365.00	SY	$ 80	$ 29,200
Construct 4" Sidewalk	1,480.00	SF	$ 6	$ 8,880
Construct 9" Driveway	35.00	SY	$ 80	$ 2,800
Signing, Striping, and Signals	1.00	LS	$ 100,000	$ 100,000
Grading	1.00	LS	$ 5,000	$ 5,000
Traffic Control	1.00	LS	$ 10,000	$ 10,000
Erosion Control	1.00	LS	$ 10,000	$ 10,000
Drainage Items	1.00	LS	$ 15,000	$ 15,000
Mobilization	1.00	LS	$ 30,000	$ 30,000
			Subtotal	$ 219,460
			Contingency 30%	$ 65,838
			Construction Total	$ 285,298
			Construction Engineering 10%	$ 28,530
			ROW 25%	$ 71,325
			Utility Relocations 5%	$ 14,265
			Total Project Cost	**$ 399,417**

Table 28. 72nd and Blondo Street SBL Extension - Operational (Option 1)

Item	Quantity	Unit	Unit Price	Construction Cost
Remove Pavement	95.00	SY	$ 12	$ 1,140
Remove Median Surfacing	1,720.00	SF	$ 3	$ 5,160
Construct 10-inch Concrete Pavement (Type L65)	150.00	SY	$ 80	$ 12,000
Construct 6-inch Concrete Median Surfacing	1,232.00	SF	$ 10	$ 12,320
Grading	1.00	LS	$ 2,500	$ 2,500
Traffic Control	1.00	LS	$ 10,000	$ 10,000
Erosion Control	1.00	LS	$ 2,500	$ 2,500
Mobilization	1.00	LS	$ 10,000	$ 10,000
		Subtotal		$ 55,620
		Contingency	30%	$ 16,686
		Construction Total		$ 72,306
		Construction Engineering	10%	$ 7,230
		Total Project Cost		**$ 79,536**

Table 29. 72nd and Blondo Street WBL Extension - Operational (Option 1)

Item	Quantity	Unit	Unit Price	Construction Cost
Remove Pavement	175.00	SY	$ 12	$ 2,100
Remove Median Surfacing	3,320.00	SF	$ 3	$ 9,960
Construct 10-inch Concrete Pavement (Type L65)	370.00	SY	$ 80	$ 29,600
Construct 6-inch Concrete Median Surfacing	1,587.00	SF	$ 10	$ 15,870
Grading	1.00	LS	$ 2,500	$ 2,500
Traffic Control	1.00	LS	$ 10,000	$ 10,000
Erosion Control	1.00	LS	$ 2,500	$ 2,500
Mobilization	1.00	LS	$ 12,500	$ 12,500
		Subtotal		$ 85,030
		Contingency	30%	$ 25,509
		Construction Total		$ 110,539
		Construction Engineering	10%	$ 11,053
			Total Project Cost	**$ 121,592**

Table 30. 72nd and Blondo Street EBL Extension - Operational (Option 1)

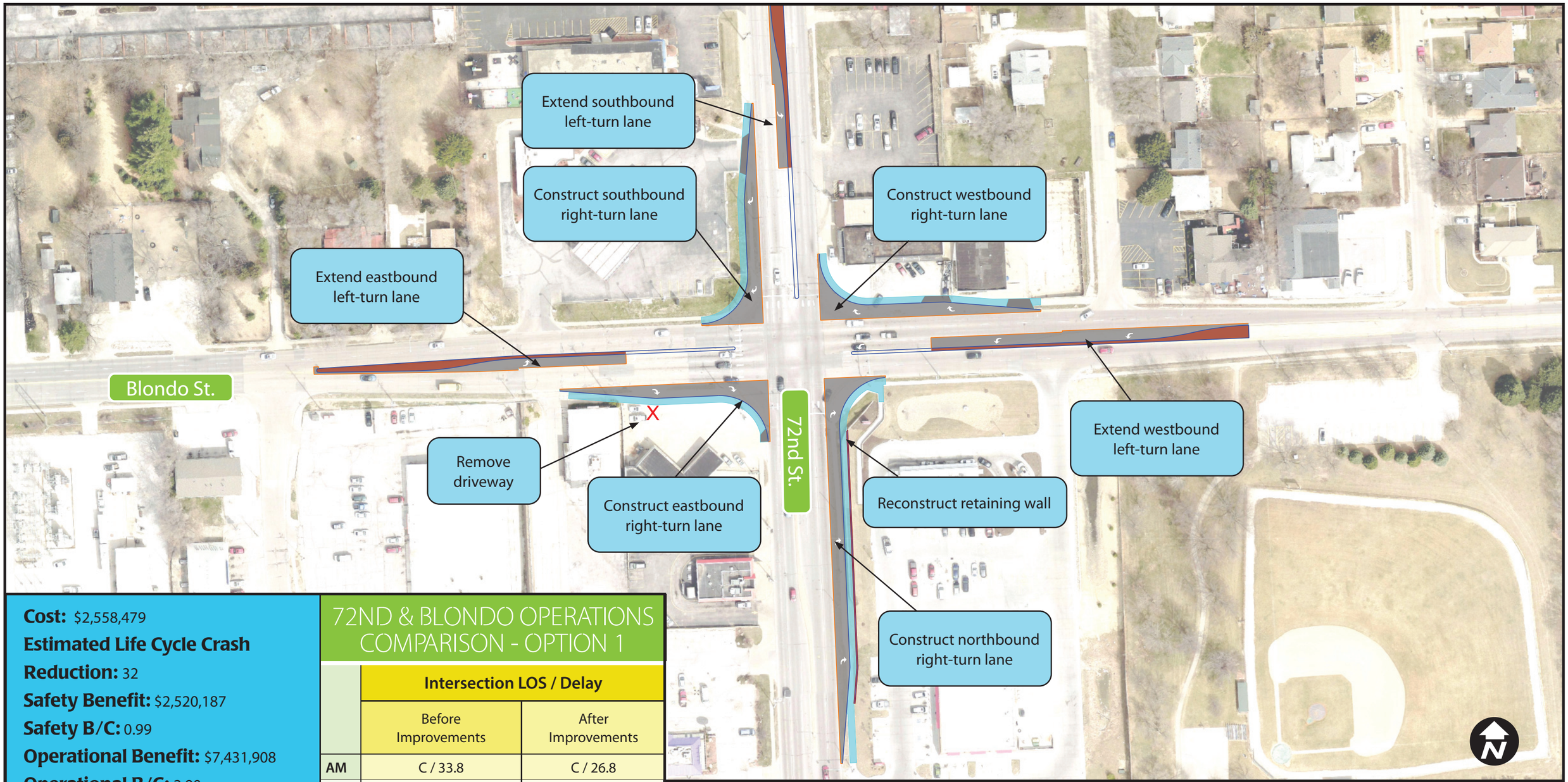
Item	Quantity	Unit	Unit Price	Construction Cost
Remove Pavement	215.00	SY	$ 12	$ 2,580
Remove Median Surfacing	1,890.00	SF	$ 3	$ 5,670
Construct 10-inch Concrete Pavement (Type L65)	235.00	SY	$ 80	$ 18,800
Construct 6-inch Concrete Median Surfacing	1,685.00	SF	$ 10	$ 16,850
Grading	1.00	LS	$ 2,500	$ 2,500
Traffic Control	1.00	LS	$ 10,000	$ 10,000
Erosion Control	1.00	LS	$ 2,500	$ 2,500
Mobilization	1.00	LS	$ 10,000	$ 10,000
		Subtotal		$ 68,900
		Contingency	30%	$ 20,670
		Construction Total		$ 89,570
		Construction Engineering	10%	$ 8,957
			Total Project Cost	**$ 98,527**

Table 31. 72nd and Blondo Street Full Intersection Reconstruction (Option 2)

Item	Quantity	Unit	Unit Price	Construction Cost
Remove Pavement	8,900.00	SY	$ 12	$ 106,800
Remove Median Surfacing	8,475.00	SF	$ 3	$ 25,425
Remove Retaining Wall	1,000.00	SF	$ 25	$ 25,000
Remove Sidewalk	18,725.00	SF	$ 3	$ 56,175
Construct 10-inch Concrete Pavement (Type L65)	10,815.00	SY	$ 80	$ 865,200
Construct 6-inch Concrete Median Surfacing	8,610.00	SF	$ 10	$ 86,100
Construct 4" Sidewalk	12,645.00	SF	$ 6	$ 75,870
Construct 9" Driveway	270.00	SY	$ 80	$ 21,600
Construct Retaining Wall	2,135.00	SF	$ 50	$ 106,750
Signing, Striping, and Signals	1.00	LS	$ 400,000	$ 400,000
Grading	1.00	LS	$ 100,000	$ 100,000
Traffic Control	1.00	LS	$ 75,000	$ 75,000
Erosion Control	1.00	LS	$ 85,000	$ 85,000
Drainage Items	1.00	LS	$ 125,000	$ 125,000
Mobilization	1.00	LS	$ 350,000	$ 350,000
			Subtotal	$ 2,503,920
			Contingency 30%	$ 751,176
			Construction Total	$ 3,255,096
			Construction Engineering 10%	$ 325,510
			ROW 10%	$ 325,510
			Utility Relocations 5%	$ 162,755
			Total Project Cost	**$ 4,068,870**

72ND AND BLONDO STREET INTERSECTION

Safety Recommendations



Cost: $2,558,479
Estimated Life Cycle Crash Reduction: 32
Safety Benefit: $2,520,187
Safety B/C: 0.99
Operational Benefit: $7,431,908
Operational B/C: 2.90
Total Benefit: $9,952,095
Total B/C: 3.89

72ND & BLONDO OPERATIONS COMPARISON - OPTION 1

	Intersection LOS / Delay	
	Before Improvements	After Improvements
AM	C / 33.8	C / 26.8
MD	C / 30.6	C / 25.2
PM	E / 58.2	D / 37.7
OP	C / 22.5	B / 19.7

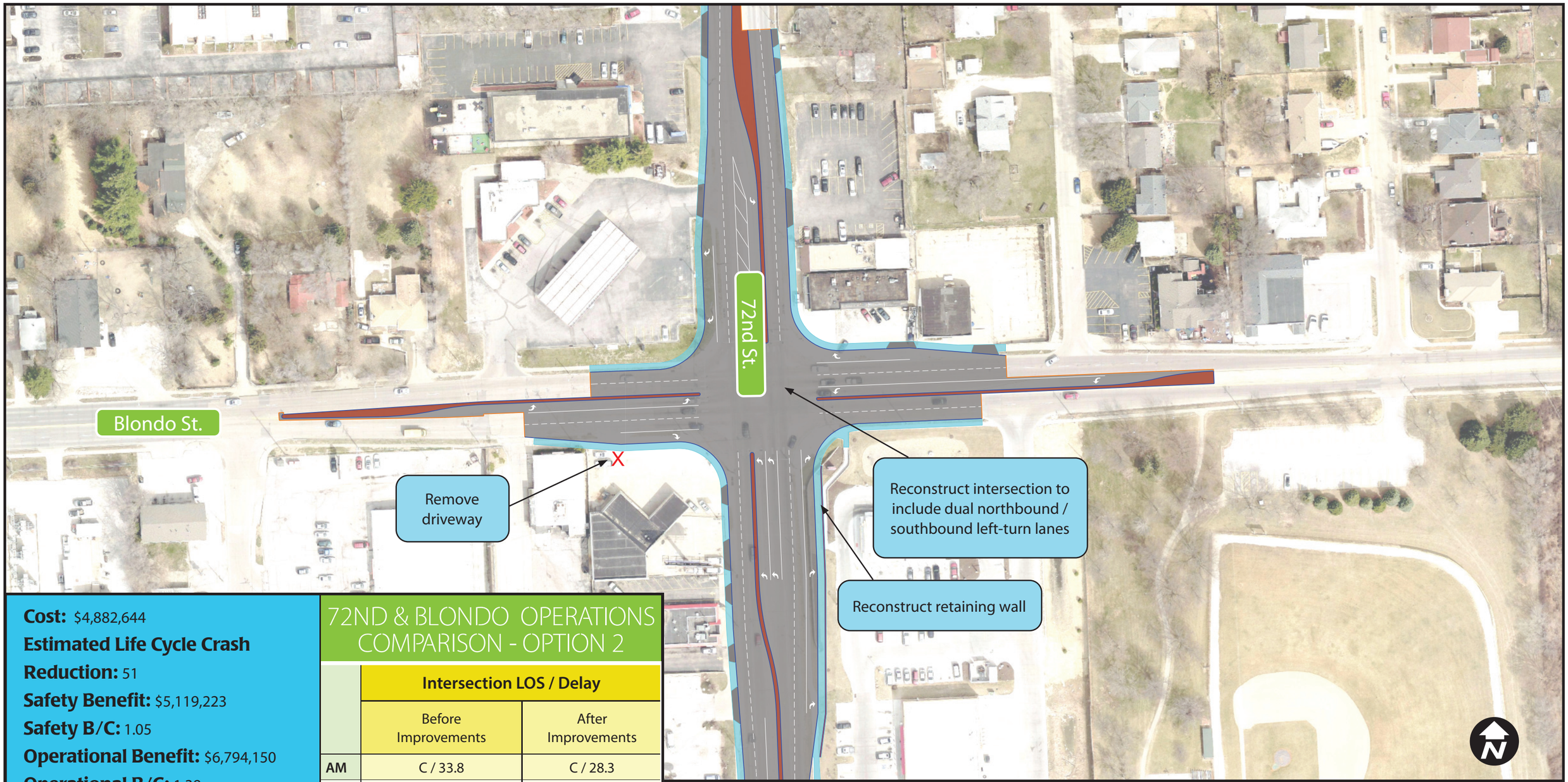
FIGURE 9

olsson | KEEP OMAHA moving

0' 25' 50' 100'
SCALE IN FEET

72ND AND BLONDO STREET INTERSECTION

Safety Recommendations



Cost: $4,882,644
Estimated Life Cycle Crash Reduction: 51
Safety Benefit: $5,119,223
Safety B/C: 1.05
Operational Benefit: $6,794,150
Operational B/C: 1.39
Total Benefit: $11,913,373
Total B/C: 2.44

72ND & BLONDO OPERATIONS COMPARISON - OPTION 2

	Intersection LOS / Delay	
	Before Improvements	After Improvements
AM	C / 33.8	C / 28.3
MD	C / 30.6	C / 28.3
PM	E / 58.2	D / 40.1
OP	C / 22.5	C / 21.2

FIGURE 10

olsson | KEEP OMAHA moving

0' 25' 50' 100'
SCALE IN FEET

8.2.2 72nd and Grover Streets

To assist in the development of improvements, crash types by direction were reviewed. A summary of crash types by direction at 72nd Street & Grover Street are shown in **Table 32**.

Table 32. 72nd and Grover Major Crash Types by Direction

Crash Type	Direction	Count	Notes
Rear-end	NB	50	1 NBL
	SB	96	2 SBL
	EB	3	2 EBL
	WB	6	4 WBL
Angle	NB	3	
	SB	8	7 red light runners
	EB	1	
	WB	1	

As previously discussed, the city has already implemented a lane utilization countermeasure that is anticipated to mitigate the southbound rear-end crash pattern. In addition, the countermeasure may help mitigate the red-light runners in the southbound direction, a cause for most of the reported angle crashes, by improving lane utilization and decreasing delay per vehicle. This intersection should be monitored to determine if additional safety improvements should be implemented.

To address a large northbound right-turning movement and northbound rear-end crash pattern, a northbound right-turn lane is proposed. The dedicated northbound right-turn lane would help mitigate rear-end and sideswipe crashes as well as improve operations. While there were 13 angle crashes at this intersection, seven were red light runners involving southbound through vehicles. These were likely due to the longer queues prior to the lane assignment change implemented by the city. Angle crashes, especially in the southbound direction, should be monitored at this intersection.

A westbound right-turn lane was also included to address excess queueing in the existing shared westbound through-right lane as well as to address heavy westbound right-turning movement to help mitigate queues. A southbound right-turn lane was also considered to help mitigate the rear-end crash pattern but would require significant noise wall reconstruction and encroachment to several residential properties and was ruled out.

A summary of the costs for these improvements are detailed in **Table 33** and **Table 34**. **Figure 11** illustrates the recommended right-turn lanes. Based on the concept, the northbound right-turn lane would avoid major utility relocations and right-of-way acquisitions.

Table 33. 72nd and Grover Street NBR - Safety and Operations

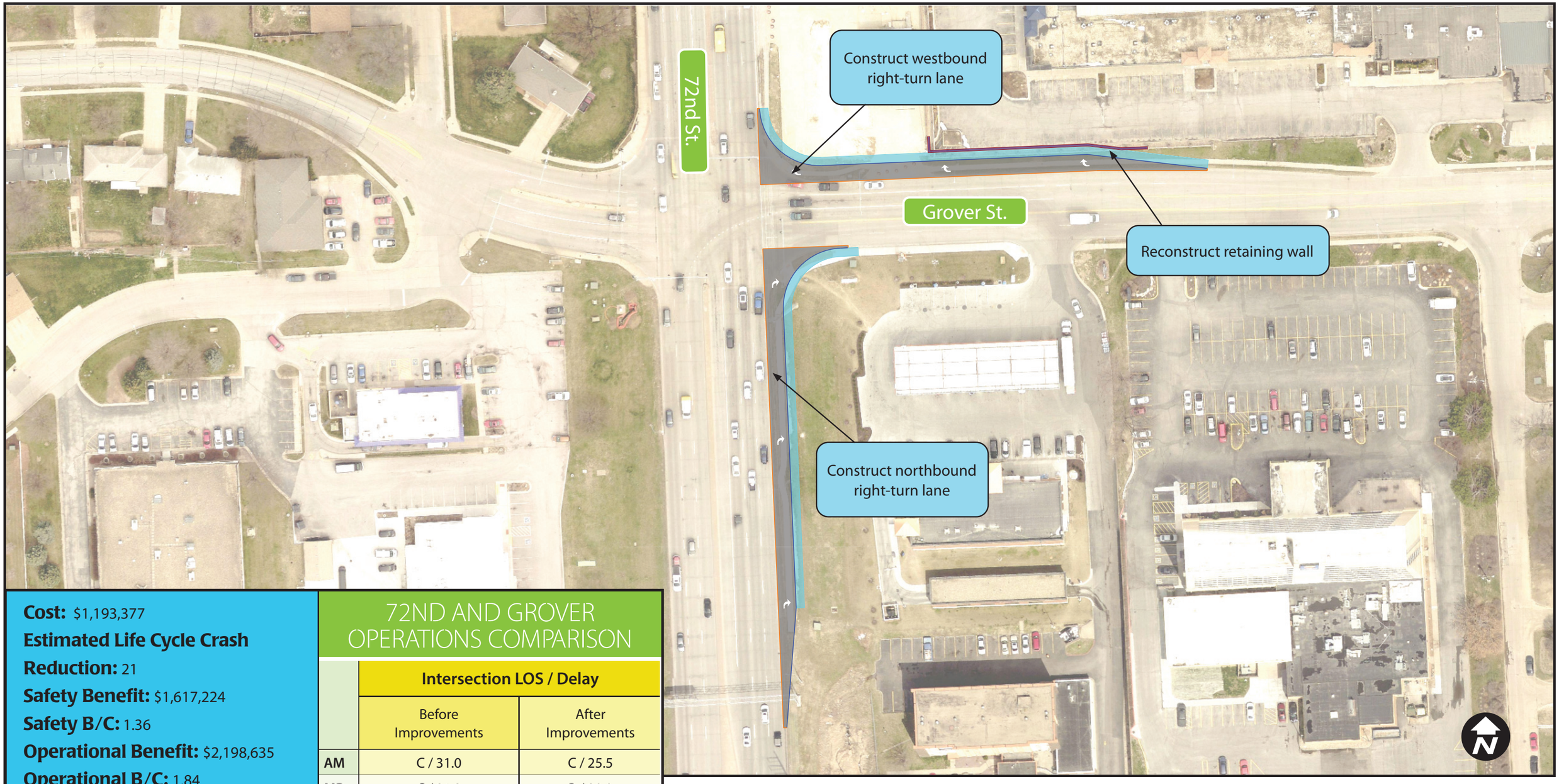
Item	Quantity	Unit	Unit Price	Construction Cost
Remove Pavement	185.00	SY	$ 12	$ 2,220
Remove Sidewalk	2,180.00	SF	$ 3	$ 6,540
Construct 10-inch Concrete Pavement (Type L65)	675.00	SY	$ 80	$ 54,000
Construct 4" Sidewalk	2,366.00	SF	$ 6	$ 14,196
Signing, Striping, and Signals	1.00	LS	$ 100,000	$ 100,000
Grading	1.00	LS	$ 8,000	$ 8,000
Traffic Control	1.00	LS	$ 10,000	$ 10,000
Erosion Control	1.00	LS	$ 10,000	$ 10,000
Drainage Items	1.00	LS	$ 12,500	$ 12,500
Mobilization	1.00	LS	$ 25,000	$ 25,000
			Subtotal	$ 242,456
			Contingency 30%	$ 72,737
			Construction Total	$ 315,193
			Construction Engineering 10%	$ 31,519
			Utility Relocations 5%	$ 15,760
			Total Project Cost	**$ 362,472**

Table 34. 72nd and Grover Street WBR - Safety and Operations

Item	Quantity	Unit	Unit Price	Construction Cost
Remove Pavement	165.00	SY	$ 12	$ 1,980
Remove Retaining Wall	1,000.00	SF	$ 25	$ 25,000
Remove Sidewalk	1,850.00	SF	$ 3	$ 5,550
Construct 10-inch Concrete Pavement (Type L65)	590.00	SY	$ 80	$ 47,200
Construct 4" Sidewalk	2,790.00	SF	$ 6	$ 16,740
Construct Retaining Wall	1,200.00	SF	$ 50	$ 60,000
Signing, Striping, and Signals	1.00	LS	$ 100,000	$ 100,000
Grading	1.00	LS	$ 30,000	$ 30,000
Traffic Control	1.00	LS	$ 10,000	$ 10,000
Erosion Control	1.00	LS	$ 12,500	$ 12,500
Drainage Items	1.00	LS	$ 15,000	$ 15,000
Mobilization	1.00	LS	$ 50,000	$ 50,000
			Subtotal	$ 373,970
			Contingency 30%	$ 112,191
			Construction Total	$ 486,161
			Construction Engineering 10%	$ 48,616
			ROW 15%	$ 72,924
			Utility Relocations 5%	$ 24,308
			Total Project Cost	**$ 632,009**

72ND AND GROVER STREET INTERSECTION

Safety Recommendations



Cost: $1,193,377
Estimated Life Cycle Crash Reduction: 21
Safety Benefit: $1,617,224
Safety B/C: 1.36
Operational Benefit: $2,198,635
Operational B/C: 1.84
Total Benefit: $3,815,859
Total B/C: 3.20

72ND AND GROVER OPERATIONS COMPARISON

	Intersection LOS / Delay	
	Before Improvements	After Improvements
AM	C / 31.0	C / 25.5
MD	C / 21.3	B / 20.0
PM	D / 44.1	D / 39.2
OP	B / 12.6	B / 11.8

FIGURE 11

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8.2.3 90th and Pacific Streets

To assist in the development of improvements, crash types by direction were reviewed. A summary of crash types by direction at 90th Street & Pacific Street are shown in **Table 35**.

Table 35. 90th & Pacific Major Crash Types by Direction

Crash Type	Direction	Count	Notes
Rear-end	NB	5	
	SB	12	1 SBL
	EB	6	
	WB	5	1 WBL
Left-turn leaving	NBL	1	
	SBL	4	
	EBL	7	
	WBL	1	
Angle	NB	1	
	SB	4	2 red light runners (EB)
	EB	6	5 red light runners
	WB	3	2 red light runners

Five potential improvements were identified at the intersection of 90th and Pacific streets:

- Construct eastbound right-turn lane with approximately 150 feet of storage length
  - Adjacent driveway/parking lot access limits available storage for this improvement.
- Construct westbound right-turn lane with approximately 150 feet of storage length.
- Construct southbound right-turn lane with approximately 250 feet of storage length.
- Construct northbound right-turn lane with approximately 250 feet of storage length.
- Reconstruct west leg to flatten vertical curve.

After an investigation into the vertical curve on the west leg, it was determined that a more detailed evaluation of roadway geometry, including the need for survey, would be required to develop a reliable cost estimate to perform a B-C analysis of this improvement. Therefore, this improvement was not evaluated further as part of this study.

All right-turn lane improvements are recommended to help mitigate rear-end and sideswipe crashes, in addition to improve operations at each approach. Due to its proximity to the intersection, it is proposed to close the existing residential circle driveway located directly adjacent to 90th Street with the construction of the westbound right-turn lane. The residential property has an additional access off 90th Street to utilize.

A summary of the improvement costs at this intersection are detailed in **Tables 36** to **39** below. The improvements are illustrated in **Figure 12**.

Table 36. 90th and Pacific Street EBR - Safety and Operations

Item	Quantity	Unit	Unit Price	Construction Cost
Remove Pavement	80.00	SY	$ 12	$ 960
Remove Sidewalk	1,910.00	SF	$ 3	$ 5,730
Construct 10-inch Concrete Pavement (Type L65)	405.00	SY	$ 80	$ 32,400
Construct 4" Sidewalk	2,335.00	SF	$ 6	$ 14,010
Signing, Striping, and Signals	1.00	LS	$ 100,000	$ 100,000
Grading	1.00	LS	$ 12,000	$ 12,000
Traffic Control	1.00	LS	$ 10,000	$ 10,000
Erosion Control	1.00	LS	$ 15,000	$ 15,000
Drainage Items	1.00	LS	$ 7,500	$ 7,500
Mobilization	1.00	LS	$ 25,000	$ 25,000
			Subtotal	$ 222,600
			Contingency 30%	$ 66,780
			Construction Total	$ 289,380
			Construction Engineering 10%	$ 28,938
			ROW 15%	$ 43,407
			Utility Relocations 10%	$ 28,938
			Total Project Cost	**$ 390,663**

Table 37. 90th and Pacific Street WBR - Safety and Operations

Item	Quantity	Unit	Unit Price	Construction Cost
Remove Pavement	440.00	SY	$ 12	$ 5,280
Remove Sidewalk	1,545.00	SF	$ 3	$ 4,635
Construct 10-inch Concrete Pavement (Type L65)	450.00	SY	$ 80	$ 36,000
Construct 4" Sidewalk	2,110.00	SF	$ 6	$ 12,660
Signing, Striping, and Signals	1.00	LS	$ 100,000	$ 100,000
Grading	1.00	LS	$ 20,000	$ 20,000
Traffic Control	1.00	LS	$ 10,000	$ 10,000
Erosion Control	1.00	LS	$ 25,000	$ 25,000
Drainage Items	1.00	LS	$ 20,000	$ 20,000
Mobilization	1.00	LS	$ 27,500	$ 27,500
			Subtotal	$ 261,075
			Contingency 30%	$ 78,323
			Construction Total	$ 339,398
			Construction Engineering 10%	$ 33,940
			ROW 25%	$ 84,849
			Utility Relocations 5%	$ 16,970
			Total Project Cost	**$ 475,157**

Table 38. 90th and Pacific Street NBR - Safety and Operations

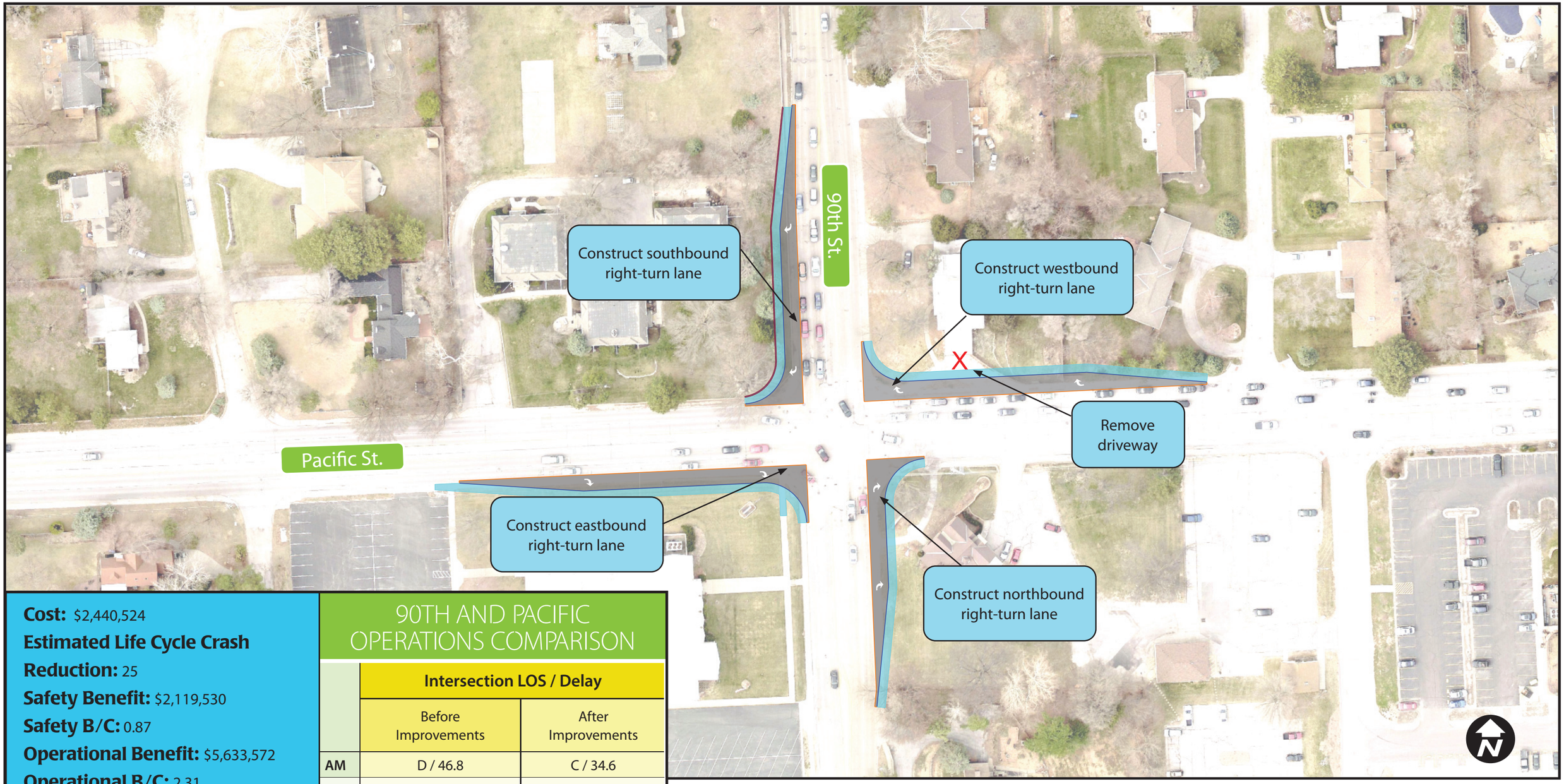
Item	Quantity	Unit	Unit Price	Construction Cost
Remove Pavement	75.00	SY	$ 12	$ 900
Remove Sidewalk	1,725.00	SF	$ 3	$ 5,175
Construct 10-inch Concrete Pavement (Type L65)	285.00	SY	$ 80	$ 22,800
Construct 4" Sidewalk	1,550.00	SF	$ 6	$ 9,300
Signing, Striping, and Signals	1.00	LS	$ 100,000	$ 100,000
Grading	1.00	LS	$ 10,000	$ 10,000
Traffic Control	1.00	LS	$ 10,000	$ 10,000
Erosion Control	1.00	LS	$ 15,000	$ 15,000
Drainage Items	1.00	LS	$ 12,500	$ 12,500
Mobilization	1.00	LS	$ 25,000	$ 25,000
			Subtotal	$ 210,675
			Contingency 30%	$ 63,202
			Construction Total	$ 273,877
			Construction Engineering 10%	$ 27,387
			ROW 35%	$ 95,857
			Utility Relocations 5%	$ 13,694
			Total Project Cost	**$ 410,815**

Table 39. 90th and Pacific Street SBR - Safety and Operations

Item	Quantity	Unit	Unit Price	Construction Cost
Remove Pavement	100.00	SY	$ 12	$ 1,200
Remove Retaining Wall	1,300.00	SF	$ 25	$ 32,500
Remove Sidewalk	1,760.00	SF	$ 3	$ 5,280
Construct 10-inch Concrete Pavement (Type L65)	570.00	SY	$ 80	$ 45,600
Construct 4" Sidewalk	2,415.00	SF	$ 6	$ 14,490
Construct Retaining Wall	2,500.00	SF	$ 50	$ 125,000
Signing, Striping, and Signals	1.00	LS	$ 100,000	$ 100,000
Grading	1.00	LS	$ 25,000	$ 25,000
Traffic Control	1.00	LS	$ 10,000	$ 10,000
Erosion Control	1.00	LS	$ 20,000	$ 20,000
Drainage Items	1.00	LS	$ 17,500	$ 17,500
Mobilization	1.00	LS	$ 60,000	$ 60,000
			Subtotal	$ 456,570
			Contingency 30%	$ 136,971
			Construction Total	$ 593,541
			Construction Engineering 10%	$ 59,354
			ROW 15%	$ 89,031
			Utility Relocations 5%	$ 29,677
			Total Project Cost	**$ 771,603**

90TH & PACIFIC STREET INTERSECTION

Safety Recommendations



Cost: $2,440,524
Estimated Life Cycle Crash Reduction: 25
Safety Benefit: $2,119,530
Safety B/C: 0.87
Operational Benefit: $5,633,572
Operational B/C: 2.31
Total Benefit: $7,753,102
Total B/C: 3.18

90TH AND PACIFIC OPERATIONS COMPARISON

	Intersection LOS / Delay	
	Before Improvements	After Improvements
AM	D / 46.8	C / 34.6
MD	D / 35.8	C / 29.0
PM	D / 51.4	D / 36.8
OP	C / 24.2	C / 21.2

FIGURE 12

olsson | KEEP OMAHA moving

0' 20' 40' 80'
SCALE IN FEET

9.0 BENEFIT COST ANALYSIS

A Benefit-Cost Analysis (BCA) is a method that determines the value of project benefits to mitigate existing hazards and compares those to its costs. A benefit-cost ratio of 1.0 or greater is considered cost effective. Specific to this project, costs include construction and maintenance fees; benefits include safety and operational improvements.

As previously mentioned, historical crash data at three study intersections were provided by the City of Omaha for evaluation. The crash data was reduced and crash patterns and areas for improvement were identified. Potential geometric improvements were identified at each intersection for further evaluation. A crash modification factor (CMF) is used to compute the expected number of crashes after implementing a countermeasure or roadway improvement. CMF Clearinghouse (http://www.cmfclearinghouse.org) is an online database with professionally researched CMFs and were utilized as part of this project.

A BCA was performed for each individual improvement identified in the Safety Analysis section. Each improvement was estimated to have a service life of 20 years. Only crashes that may be directly affected by the proposed improvement were included in the benefit/cost calculations. Right-of-way acquisitions and utility costs were included in the cost estimate. Operational benefits included in each BCA are specific to delay savings with the proposed improvements and does not include fuel/emissions savings.

The Nebraska Department of Transportation (NDOT) provides societal costs of Nebraska traffic crashes by crash type, shown in **Table 40**.

Table 40. Societal Costs of Nebraska Traffic Crashes

Crash Type	Cost (2019)
Right Angle	$ 100,530
Rear-end	$ 79,700
Sideswipe (Same)	$ 54,510
Sideswipe (Opposite)	$ 123,820
Head-On	$ 374,700
Left-Turn	$ 136,480
Other	$ 28,000

9.1 72nd and Blondo Streets

The proposed seven improvements for Option 1 (right-turn lane construction and left-turn lane extensions) are anticipated to cost approximately $2.1 million in construction fees with approximately $426,000 in additional maintenance/construction fees. A CMF of 0.91 was used for the right-turn lanes. Although the three left-turn lane extension improvements are anticipated to have safety benefits, there is a lack of CMF research for these improvements in the clearing house. Therefore, only operational benefits were included for these improvements. B/C calculations resulted in a Total B/C of 3.89 for Option 1.

The reconstruction of the intersection for Option 2 is anticipated to cost approximately $4.1 million in construction fees with approximately $814,000 in additional maintenance/construction costs. A CMF of 0.91 was used for the right-turn lanes added, and a CMF of 0.58 was used for the dual northbound lefts that would change signal phasing from permitted-protected to protected only. B/C calculations resulted in a Total B/C of 2.44 for Option 2.

9.2 72nd and Grover Streets

The two proposed right-turn lanes are anticipated to cost approximately $995,000 in construction fees with approximately $199,000 in additional maintenance/construction costs. A CMF of 0.91 was used for these improvements. B/C calculations resulted in a Total B/C of 3.20.

9.3 90th and Pacific Streets

The four proposed right-turn lanes are anticipated to cost approximately $2.0 million in construction fees with approximately $407,000 in additional maintenance/construction costs. A CMF of 0.91 was used for all four improvements. B/C calculations resulted in a Total B/C of 3.18.

A summary of the results of the B/C calculations at each intersection are included in **Figures 9** to **12**. Detailed benefit-cost calculations are included in **Appendix H**.