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Transit Signal Priority Project – Phase II
Fargo-Moorhead Metro Area Transit

Final Report

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Prepared for:
Fargo-Moorhead Council of Governments

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Background/Project Description

To continually improve the service of Metro Area Transit (MAT), the Fargo-Moorhead Council of Governments (F-M COG) contacted the Advanced Traffic Analysis Center (ATAC) to analyze some critical intersections that impact current and possibly future transit operations. This is the second phase of the Transit Signal Priority (TSP) Demonstration project. The first phase implemented TSP on Route 11. Originally phase 2 was going to evaluate system-wide TSP implementation. However, due to the signal impacts of using TSP (which were discovered during phase 1), that option was abandoned. Therefore, phase 2 will focus on improving operations at three Fargo intersections, which include Main Ave. & 2nd St., Albrecht Blvd. & 12th Ave. N., and University Dr. & 13th Ave. N.

Objectives

This project involved the study of three signalized intersections to potentially improve performance for transit vehicles without adversely impacting other vehicles. The intersection of Main Ave. and 2nd St. will be analyzed to determine if modifying signal timing and approach geometry can improve transit operations. The intersection of 12th Ave. N. and Albrecht Blvd. and the intersection of 13th Ave. and University Dr. will be analyzed to determine the transit benefits and signal operations if TSP is implemented at those locations. TSP strategies will be applied to the AM, Midday, and PM signal plans at both locations.

Methodology

The analysis process was initiated by obtaining various types of intersection data. The current signal timing information for the three intersections were obtained from the city of Fargo. In addition, traffic counts for the AM and PM peak periods were conducted at the intersection of Main Ave. and 2nd St. on November 13, 2008. Roadway geometry was obtained using F-M COG's orthorectified aerial photos.

The analysis of Main Ave. & 2nd St. was conducted using Synchro, which is a software program used for analyzing/optimizing traffic signal timing and performing capacity analyses. Synchro has the capability to optimize phase splits, offsets, and cycle lengths for intersections, corridors, and networks. The intersection geometry at Main Ave. & 2nd St. was evaluated with Autoturn, which was run within MicroStation to determine the minimum turning path of a design vehicle based on existing intersection geometry.

The analyses of 12th Ave. N. & Albrecht Blvd and 13th Ave. N. & University Dr. consisted of controller testing the TSP strategies at both locations. During the TSP analyses, the timings were entered into an Eagle EPAC 300 signal controller, and the low priority preemption (used for TSP) was tested using ATAC's Controller Interface Device (ATACid) to determine whether the TSP implementation would be feasible.

Main Ave. & 2nd St. – Intersection Analysis

Main Ave. & 2nd St. is located on the west side of the Main Ave. Bridge between Fargo and Moorhead (Figure 1). Interest was expressed about the possibility of adding a second southbound-left turn lane to accommodate traffic (including city busses) making that movement, and to improve the overall intersection performance. The analysis of this intersection involves three main steps:

1. Evaluate existing conditions using level of service (LOS) and delay as measures of effectiveness (MOE).
2. Optimize the intersection timings (phase splits, and offset), and compare the optimized LOS and delay with the existing conditions.
3. Evaluate the feasibility of adding a second southbound left-turn lane to improve intersection performance.

The geometric analysis of adding a second southbound left-turn lane will be done using Autoturn. If a second southbound left-turn lane is feasible, the intersection will be evaluated using the updated geometry to determine the LOS and delay time. If a second left-turn lane is not allowed, the intersection will also be evaluated using split-phasing for the northbound and southbound left-turn phases.

Figure 1. Intersection of Main Ave. & 2nd St.

Main Ave. & 2nd St. – Existing Conditions

The main traffic operations issue at this intersection is a result of insufficient storage spact for the southbound left-turn movement. The insufficient capacity is due to the railroad bridge structure, which only allows 150 ft. for the southbound left-turn movement.

Traffic counts for the AM and PM peak periods were conducted at the intersection on November 13, 2008. The AM peak hour at this location occurred between 7:30 – 8:30 AM, and had volumes of 358 (NB), 498 (EB), 546 (SB), and 974 (WB). The PM peak hour occurred between 4:45 – 5:45 PM, and had volumes of 354 (NB), 1,048 (EB), 795 (SB), and 861 (WB). Truck percentages at this intersection ranged from 1% during the PM peak to 2% during the AM peak. The current intersection timing plans and traffic counts for the MID peak were provided by the city of Fargo. It was noted that the intersection of Main Ave. and 2nd St. is running free (actuated-uncoordinated) with the exception of a half-hour time period (7:00 – 7:30 AM) during which it runs under a coordinated plan. For this study, both the midday (MID) and PM peak hours utilize the current off-peak (free) plan. However, the volumes are different between the two time periods resulting in differing delays and LOS.

The current delays and LOS were obtained using Synchro (Table 1). The performance of all approaches was either LOS B or LOS C, with the southbound approach experiencing the highest delay for both the MID and PM peak hours. The southbound left-turn and northbound through movements are currently experiencing the highest delays for all time periods, which range from LOS C to LOS D.

Table 1: Main Ave & 2nd St. Existing Conditions

Existing Conditions										
Intersection	Main & 2nd	AM Peak			MID Peak			PM Peak		
		Vol.	Delay	LOS	Vol.	Delay	LOS	Vol.	Delay	LOS
		2376	16.5	B	2131	21.3	C	3058	22.6	C
Approach	EB	498	16.9	B	636	22.3	C	1048	22.9	C
	WB	974	14.2	B	793	17.7	B	861	19.0	B
	NB	358	21.8	C	218	22.8	C	354	21.7	C
	SB	546	17.0	B	484	24.4	C	795	26.1	C
Movement	EBL	171	15.2	B	113	15.8	B	251	15.0	B
	EBT	325	18.0	B	504	25.2	C	784	25.9	C
	EBR	2	11.0	B	19	10.5	B	13	13.5	B
	WBL	154	11.5	B	130	20.8	C	194	30.4	C
	WBT	460	21.0	C	416	24.1	C	388	23.6	C
	WBR	360	6.4	A	247	7.7	A	279	4.5	A
	NBL	0	-	-	3	22.7	C	1	24.0	C
	NBT	219	31.2	C	78	36.8	D	142	38.4	D
	NBR	139	7.1	A	137	8.7	A	211	9.7	A
	SBL	201	28.7	C	231	35.4	D	378	38.0	D
	SBT	147	19.4	B	149	23.1	C	260	25.3	C
	SBR	198	4.1	A	104	4.8	A	157	5.2	A

Note: Highlighted cells have a LOS D or lower

Main Ave. & 2nd St. Existing Conditions (Optimized)

The first modification to the intersection consisted of optimizing the phase splits. The AM coordinated plan has a cycle length of 85 seconds and remained unchanged for the analysis to keep it in coordination with other signals in the network (note Appendix A for timing plans). The optimized results will be the basis of comparison for further modifications (i.e., changes in intersection geometry and changes to intersection phase configuration). The results of the optimization (Table 2) are summarized as follows:

- Intersection: minor decrease in intersection delay, but the LOS remains the same for all time periods

- Southbound approach: slight decrease for the SB approach delay, but the LOS remains the same for all time periods
- EB and WB approaches: delay increases slightly, and the LOS decreases for the WB PM peak as well as the EB AM peak
- SBL: LOS increases from a "D" to a "C" for MID and PM peaks
- SBT: delay decreases slightly, but LOS remains the same
- SBR: delay decreases slightly, but LOS remains the same

It should be noted that although optimizing the signal timings improves the LOS for the southbound left-turn movement by providing more green (8 sec. AM, 5 sec. MID, and 9 sec. PM), the decrease in LOS for other movements is not significant.

Table 2. Main Ave & 2nd St. Optimized Existing Conditions

Existing Geometry (Optimized Splits)										
Intersection	Main & 2nd	AM Peak			MID Peak			PM Peak		
		Vol.	Delay	LOS	Vol.	Delay	LOS	Vol.	Delay	LOS
		2,376	17.5	B	2,131	21.8	C	3,058	24.2	C
Approach	EB	498	21.8	C	636	24.4	C	1,048	28.8	C
	WB	974	16.3	B	793	19.2	B	861	22.2	C
	NB	358	22.0	C	218	23.4	C	354	22.3	C
	SB	546	13.2	B	484	21.8	C	795	21.2	C
Movement	EBL	171	23.8	C	113	18.8	B	251	19.8	B
	EBT	325	20.9	C	504	27.3	C	784	32.2	C
	EBR	2	12.0	B	19	11.1	B	13	16.8	B
	WBL	154	15.8	B	130	24.6	C	194	34.5	C
	WBT	460	24.4	C	416	25.5	C	388	28.1	C
	WBR	360	5.9	A	247	8.1	A	279	5.4	A
	NBL	0	-	-	3	21.3	C	1	22.0	C
	NBT	219	31.4	C	78	38.1	D	142	39.8	D
	NBR	139	7.2	A	137	8.8	A	211	9.9	A
	SBL	201	22.1	C	231	31.2	C	378	30.0	C
	SBT	147	15.6	B	149	21.3	C	260	21.6	C
	SBR	198	3.1	A	104	4.2	A	157	4.2	A

Notes: Blue shaded areas represent an improvement in the LOS
Orange shaded areas represent a decrease in the LOS

2nd St. Dual Southbound Left-Turn

The intersection was evaluated to determine the feasibility of having a dual southbound left turn lane. The information was entered into Autoturn and the design vehicle paths were fitted to the geometry of the existing intersection (Figure 2). The design vehicles used for this intersection were a city bus (40 ft.), and a single-unit truck (WB-40), which follows North Dakota Department of Transportation (NDDOT) specifications. The design vehicle paths fit, but there is minimal clearance between adjacent lanes. In addition, there is only one foot of clearance between the northbound left-turn lane and the second southbound left-turn lane. Without making geometric modifications to the intersection or operating under split-phase operation, having two southbound left-turn lanes is not feasible at this time.

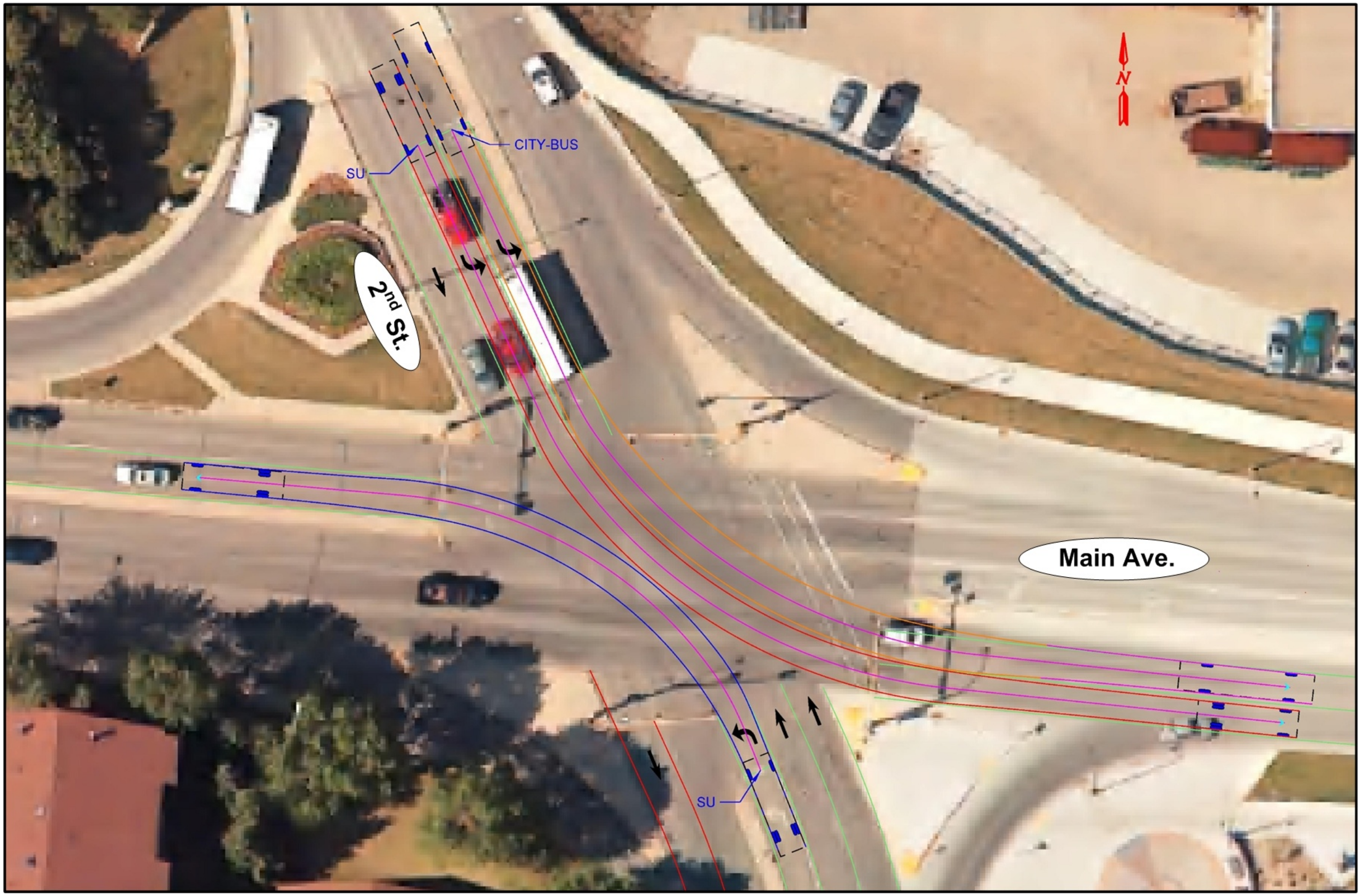


Figure 2. Design Vehicle Paths With Double Left-Turn (Autoturn)

2nd St. Dual Southbound Left-Turn Split-Phase

As an alternative to the existing phasing structure, a split-phase timing configuration also was evaluated to account for overlapping NB and SB turning lanes. A split-phase configuration, specifically for this intersection, would allow the northbound movements to be separated from the southbound movements (each movement would have its own phase). One of the main drawbacks to this type of phasing configuration is the inherent increase in delay at the intersection due to the separation of phases.

As a result of modifying the intersection to a split-phase configuration, the cycle lengths were changed. The AM coordination plan cycle length was changed from 85 seconds to 102 seconds to accommodate the updated phase configuration. The cycle length for the off-peak (free) timing plan was also changed as a result of the split-phase configuration, which required a cycle length of 116 seconds. A summary of the evaluation results (Table 3) for this scenario is detailed as follows:

- Intersection delay: increases for all time periods, and LOS decreases for the AM peak
- Intersection approach delay: slight increase for all time periods, and LOS decreases for the WB, EB (AM and MID peaks), and SB (AM peak) approaches
- SBL: LOS improves for MID and PM peaks
- SBT: LOS decreases for all time periods
- SBR: LOS remains the same for all time periods

Table 3. Main Ave & 2nd St. Dual Southbound Left-Turn Lane (Split-Phase Timings)

Dual SBL - Split Phase Timings										
Intersection	Main & 2nd	AM Peak			MID Peak			PM Peak		
		Vol.	Delay	LOS	Vol.	Delay	LOS	Vol.	Delay	LOS
		2,376	23.6	C	2,131	29.8	C	3,058	29.8	C
Approach	EB	498	29.5	C	636	35.5	D	1,048	34.7	C
	WB	974	21.7	C	793	27.5	C	861	24.8	C
	NB	358	23.5	C	218	25.4	C	354	23.8	C
	SB	546	22.4	C	484	28.9	C	795	30.9	C
Movement	EBL	171	33.7	C	113	27.1	C	251	26.5	C
	EBT	325	27.5	C	504	39.5	D	784	37.9	D
	EBR	2	15.5	B	19	18.3	B	13	18.8	B
	WBL	154	21.0	C	130	36.8	D	194	40.3	D
	WBT	460	33.3	C	416	34.2	C	388	30.9	C
	WBR	360	6.7	A	247	13.9	B	279	5.6	A
	NBL	0	-	-	3	38.0	D	1	40.0	D
	NBT	219	33.5	C	78	40.9	D	142	42.4	D
	NBR	139	7.8	A	137	9.3	A	211	10.3	B
	SBL	201	30.5	C	231	32.0	C	378	33.6	C
	SBT	147	33.6	C	149	38.8	D	260	42.0	D
	SBR	198	6.9	A	104	7.1	A	157	8.5	A

Notes: Blue shaded areas represent an improvement in the LOS compared to existing case
Orange shaded areas represent a decrease in the LOS compared to existing case

Main Ave. & 2nd St. Recommendations

Due to the current geometry at the intersection of Main Ave. and 2nd St., it is not feasible to have a second southbound left-turn lane. However, optimizing the current signal timings would improve the efficiency of vehicles moving through the intersection, including city busses making a southbound left-turn. By optimizing the intersection timings, the level of service for the southbound left-turn movement can be improved from a LOS D to a LOS C for the MID and PM peak periods. Further improvements to the intersection are possible, but will require geometric changes, such as increasing the width of the lanes and re-aligning the southbound through movement.

Transit Signal Priority (TSP) Strategies

Two types of TSP strategies are typically used: early green and green extension. Green extension operates by extending the green signal indication for the phase serving the transit vehicle. This strategy occurs only when the transit vehicle arrives at the signal while it is displaying a green indication, and holds the green indication until the transit vehicle clears the intersection. The early green strategy operates in a similar fashion, but it shortens the duration of the green time on the opposing phases. To prevent TSP from extending the green indefinitely, a max call parameter of 10 sec. was implemented similar to the methodology from the TSP Phase I study. Although both strategies can be used for TSP, only one can be activated during a signal cycle.

TSP Signal Modifications

This study includes the analysis of two intersections adjacent to the campus of North Dakota State University (NDSU), which include 12th Ave. N. & Albrecht Blvd. and 13th Ave. N. & University Dr. Both intersections are used for one of the bus routes accessing NDSU. These intersections will be analyzed to determine if TSP will adversely affect the signal operations.

12th Ave. N. & Albrecht Blvd. – TSP Analysis

The intersection of 12th Ave. N. and Albrecht Blvd. is located on the south side of NDSU (Figure 3). This intersection operates three actuated-coordinated timing plans, which include AM, MID, and PM peak periods. In addition, the east-west movement (phases 2 and 6) is in coordination with adjacent signals. Details of the TSP signal modifications can be seen in Appendix B.

Figure 3. Intersection of 12th Ave. N. & Albrecht Blvd.

AM Timing Plan

The AM plan for this intersection has a cycle length of 85 seconds, and phase splits of 50 seconds (sec.) for phase 2 & 6 and 35 sec. for phase 4 & 8. It should be noted that a phase split includes the green, change interval, and clearance interval time. All phases have a minimum green time of 12 sec. and pedestrian walk times of 7 sec. Pedestrian clearance times are 10 sec. for phase 2 & 6, and 14 sec. for phase 4 & 8 (minimum green and pedestrian timings are the same for all timing plans).

An early green strategy will allow a transit vehicle to receive a green indication up to 27.7 sec. earlier compared to normal signal operations. The early green strategy will give 12 sec. of green time (which is the vehicle minimum green time) to phase 4 & 8 if there is a TSP call. If there is a concurrent pedestrian call for either phase 4 or 8 when the TSP call is placed, a green time of 21 sec. will be provided (7 sec. of walk time and 14 sec. of pedestrian clearance). The green time provided for the early green strategy will be the same for all timing plans. After phase 4 & 8 are provided the early green by the signal, the green indication is then given to phase 2 & 6 for the duration of the cycle. When the green extension strategy is implemented, phase 4 & 8 receive a 10 sec. extension, providing a max green time of 39.7 sec.

MID (Offpeak) Timing Plan

The MID (Offpeak) plan for this intersection has a cycle length of 60 seconds, and phase splits of 35 sec. for phase 2 & 6 and 25 sec. for phase 4 & 8. The early green strategy for this intersection will provide a green indication up to 12.7 sec. earlier for phase 4 & 8. The green extension strategy for phase 4 & 8 will provide an additional 10 sec. of green time, resulting in a maximum green time of 31 sec.

PM Timing Plan

The cycle length for the PM plan is 90 seconds, with phase splits of 60 sec. for phase 2 & 6 and 30 sec. for phase 4 & 8. An early green strategy for this timing plan will provide transit vehicles with a green indication of up to 37.8 sec. earlier for phase 4 & 8. When the green extension strategy is implemented, phase 4 & 8 receive a 10 sec. extension, resulting in a maximum green time of 34.7 sec.

12th Ave. N. & Albrecht Blvd. Findings/Recommendations

During the testing for the early green strategy, it was noticed that the coordination for phase 2 & 6 were affected because the coordinated split does not account for the pedestrian walk and clearance times. However, the maximum difference for the coordination time correction was 2 seconds, so the early green strategy should not have any significant effect on traffic. Since the TSP call is made on a non-coordinated phase, the early green strategy provides an early green but it will only provide the vehicle or pedestrian minimum time, then it will go back to the coordinated phases. Implementing TSP into the signal controller would benefit transit vehicles at this location by advancing the green indication for the AM, MID, and PM peak plans up to 22.4, 12.7, and 32.6 sec., respectively.

13th Ave. N. & University Dr. – TSP Analysis

The intersection of 13th Ave. N. and University Dr. is located on the east side of NDSU (Figure 4). This is a T-intersection, with the major approach (University Dr.) consisting of a one-way southbound movement. This intersection operates three actuated-coordinated timing plans, which are AM, MID (offpeak), and PM peak periods. In addition, the southbound movement (phase 6) is in coordination with adjacent signals. Details of the TSP signal modifications can be seen in Appendix C.

Figure 4. Intersection of University Dr. & 13th Ave. N.

AM Timing Plan

The AM plan for this intersection has a cycle length of 85 seconds, and phase splits of 65 sec. for phase 6 and 20 sec. for phase 8. Both phases have a minimum green time of 12 sec. and pedestrian walk times of 5 sec. Pedestrian clearance times are 11 sec. for both phases (the minimum green and pedestrian timings are the same for all timing plans).

An early green strategy will allow a bus to receive a green indication up to 45 sec. earlier than normal signal operations. The TSP call will provide a 12 sec. early green time (vehicle minimum green time) to phase 8 if there is a TSP call. If there is a concurrent pedestrian call for phase 8 when the TSP call is placed, 16 sec. will be provided (5 sec. of walk time and 11 sec. of pedestrian clearance). The early green time remains the same for all timing plans. After phase 8 is provided the early green by the signal, the green indication is then given to phase 6 for the remainder of the cycle. When the green extension strategy is implemented, phase 8 receives a 10 sec. extension, which provides a maximum green time of 26 sec.

MID (Offpeak) Timing Plan

The MID (Offpeak) plan for this intersection has a cycle length of 70 seconds, and phase splits of 42 seconds (sec.) for phase 6 and 28 sec. for phase 8. If an early green strategy is applied to this timing plan, transit vehicles will be provided a green indication up to 19.8 sec. earlier than normal signal operations. With the green extension strategy, phase 8 receives a 10 sec. extension, which provides a maximum green time of 32 sec.

PM Timing Plan
The PM plan for this intersection has a cycle length of 90 seconds, and phase splits of 66 sec. for phase 6 and 20 sec. for phase 8. An early green strategy will provide phase 8 with a green indication 50 sec. earlier than normal signal operations. When the green extension strategy is implemented, phase 8 receives a 10 sec. extension, which provides a maximum green time of 26 sec.

13th Ave. N. & University Dr. Findings/Recommendations
Since a majority of the green time for each plan is allocated to phase 6, there is sufficient time to serve a TSP call on phase 8. The early green strategy can advance the green indication for AM, MID, and PM peak plans of up to 45 sec., 19.8 sec, and 50 sec., respectively. In addition, the green extension strategy can provide the maximum time of 10 seconds for each signal plan. Implementing TSP into the signal controller should result in an overall benefit for transit vehicles at this location.

Summary/Recommendations
This study evaluated three intersections in the Fargo area, with the objective of improving transit efficiency. The study performed analyses of Main Ave. & 2nd St. E., 12th St. N. & Albrecht Blvd., and 13th Ave. N. & University Dr.

Due to the current geometry at the intersection of Main Ave. and 2nd St., it is not feasible to have a second southbound left-turn lane. The most beneficial modification to the intersection can be achieved by adjusting the current signal timings. Timing modifications will improve vehicle efficiency moving through the intersection, especially city busses making a southbound left-turn. Timing enhancements provide 8 sec. of additional green time for the AM plan (from 12 sec. to 20 sec), 5 sec. for the MID plan (from 20 sec. to 25 sec.), and 9 sec. for the PM plan (from 20 sec. to 29 sec.). The additional green time reduces the delay time for this movement without adversely affecting the other movements. Further improvements to the intersection are possible, but will require geometric changes, such as increasing the width of the lanes and re-aligning the southbound through movement.

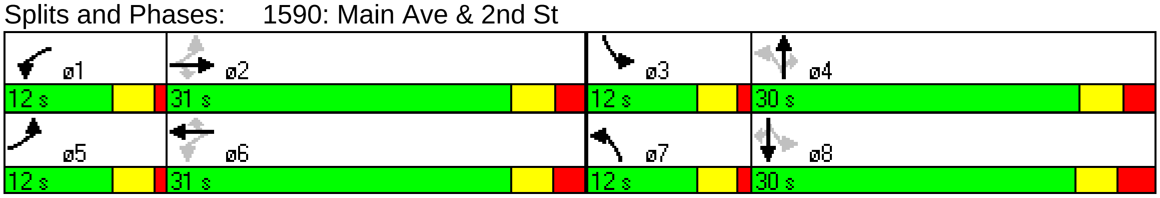
Implementing TSP will benefit transit vehicles at both intersections adjacent to NDSU. The intersection of 12th Ave. N. and Albrecht Blvd. can potentially see improvements for each time period using early green and green extension strategies. Implementing TSP would advance the green indication for the AM, MID, and PM peak plans up to 22.4, 12.7, and 32.6 sec., respectively. Transit vehicles with TSP should also receive a benefit at 13th Ave. & University Dr. during all time periods. Implementing TSP at this location would advance the green indication for the AM, MID, and PM peak plans up to 45 sec., 19.8 sec, and 50 sec., respectively. It should be pointed out that the TSP function may adversely affect the coordinated movements during portions of the AM and PM peak periods. If congestion is observed for these movements, additional signal timing adjustments may be required.

Appendix A: Signal Timing Data

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Total Lost Time (s)	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
Satd. Flow (prot)	1787	3574	1615	1805	3539	1583	1900	3574	1615	1770	3574	1599
Flt Permitted	0.237			0.461						0.548		
Satd. Flow (perm)	446	3574	1615	876	3539	1583	1900	3574	1615	1021	3574	1599
Satd. Flow (RTOR)			8			460			181			264
Volume (vph)	171	325	2	154	460	360	0	219	139	201	147	198
Lane Group Flow (vph)	209	382	8	188	687	522	0	284	181	254	179	264
Turn Type	pm+pt		Perm	pm+pt		Perm	pm+pt		Perm	pm+pt		Perm
Protected Phases	5	2		1	6		7	4		3	8	
Permitted Phases	2		2	6		6	4		4	8		8
Total Split (s)	12.0	31.0	31.0	12.0	31.0	31.0	12.0	30.0	30.0	12.0	30.0	30.0
Act Effct Green (s)	45.1	35.5	35.5	43.7	34.8	34.8		16.6	16.6	28.6	28.6	28.6
Actuated g/C Ratio	0.53	0.42	0.42	0.51	0.41	0.41		0.20	0.20	0.34	0.34	0.34
v/c Ratio	0.54	0.26	0.01	0.34	0.47	0.57		0.41	0.39	0.61	0.15	0.37
Control Delay	15.2	18.0	11.0	11.5	21.0	6.4		31.2	7.1	28.7	19.4	4.1
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0		0.0	0.0	0.0	0.0	0.0
Total Delay	15.2	18.0	11.0	11.5	21.0	6.4		31.2	7.1	28.7	19.4	4.1
LOS	B	B	B	B	C	A		C	A	C	B	A
Approach Delay		16.9			14.2			21.8			17.0	
Approach LOS		B			B			C			B	

Intersection Summary	
Cycle Length: 85	
Actuated Cycle Length: 85	
Offset: 28 (33%), Referenced to phase 2:EBTL and 6:WBTL, Start of Green	
Control Type: Actuated-Coordinated	
Maximum v/c Ratio: 0.61	
Intersection Signal Delay: 16.5	Intersection LOS: B
Intersection Capacity Utilization 56.7%	ICU Level of Service B
Analysis Period (min) 15	

Splits and Phases: 1590: Main Ave & 2nd St

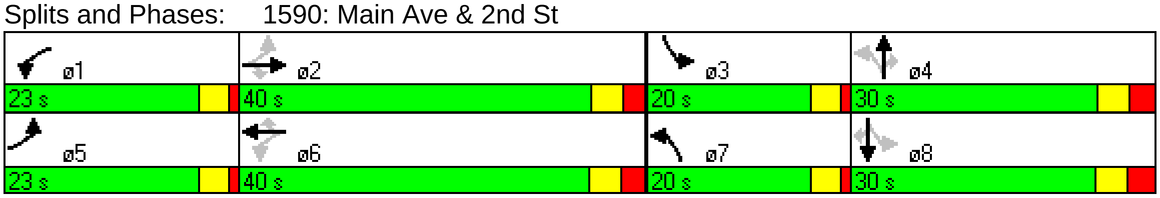


Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Total Lost Time (s)	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
Satd. Flow (prot)	1805	3574	1583	1805	3574	1583	1656	3574	1615	1770	3574	1615
Flt Permitted	0.288			0.192			0.447			0.571		
Satd. Flow (perm)	547	3574	1583	365	3574	1583	779	3574	1615	1064	3574	1615
Satd. Flow (RTOR)			49			355			217			204
Volume (vph)	113	504	19	130	416	247	3	78	137	231	149	104
Lane Group Flow (vph)	192	741	76	203	586	433	12	217	217	398	324	204
Turn Type	pm+pt		Perm	pm+pt		Perm	pm+pt		Perm	pm+pt		Perm
Protected Phases	5	2		1	6		7	4		3	8	
Permitted Phases	2		2	6		6	4		4	8		8
Total Split (s)	23.0	40.0	40.0	23.0	40.0	40.0	20.0	30.0	30.0	20.0	30.0	30.0
Act Effct Green (s)	47.7	36.8	36.8	46.3	36.1	36.1	21.4	16.4	16.4	36.2	34.3	34.3
Actuated g/C Ratio	0.50	0.39	0.39	0.49	0.38	0.38	0.21	0.17	0.17	0.38	0.36	0.36
v/c Ratio	0.46	0.54	0.12	0.61	0.43	0.53	0.06	0.35	0.47	0.76	0.25	0.29
Control Delay	15.8	25.2	10.5	20.8	24.1	7.7	22.7	36.8	8.7	35.4	23.1	4.8
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	15.8	25.2	10.5	20.8	24.1	7.7	22.7	36.8	8.7	35.4	23.1	4.8
LOS	B	C	B	C	C	A	C	D	A	D	C	A
Approach Delay		22.3			17.7			22.8			24.4	
Approach LOS		C			B			C			C	

Intersection Summary

Cycle Length: 113
Actuated Cycle Length: 95.2
Control Type: Actuated-Uncoordinated
Maximum v/c Ratio: 0.76
Intersection Signal Delay: 21.3 Intersection LOS: C
Intersection Capacity Utilization 50.6% ICU Level of Service A
Analysis Period (min) 15

Splits and Phases: 1590: Main Ave & 2nd St

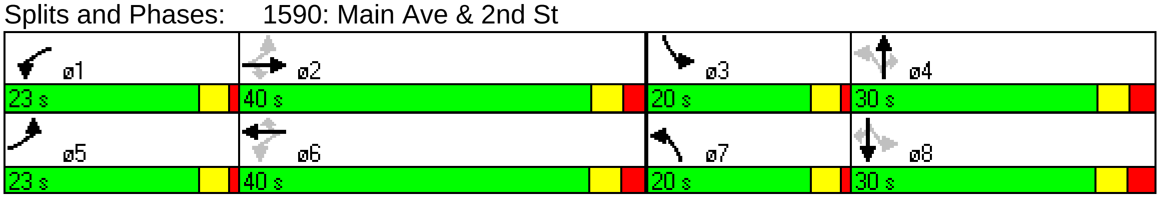


Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Total Lost Time (s)	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
Satd. Flow (prot)	1805	3574	1583	1805	3574	1583	1656	3574	1615	1770	3574	1615
Flt Permitted	0.409			0.124			0.431			0.653		
Satd. Flow (perm)	777	3574	1583	236	3574	1583	751	3574	1615	1216	3574	1615
Satd. Flow (RTOR)			13			297			215			215
Volume (vph)	251	784	13	194	388	279	1	142	211	378	260	157
Lane Group Flow (vph)	299	871	24	204	422	297	4	153	215	402	338	215
Turn Type	pm+pt		Perm	pm+pt		Perm	pm+pt		Perm	pm+pt		Perm
Protected Phases	5	2		1	6		7	4		3	8	
Permitted Phases	2		2	6		6	4		4	8		8
Total Split (s)	23.0	40.0	40.0	23.0	40.0	40.0	20.0	30.0	30.0	20.0	30.0	30.0
Act Effct Green (s)	53.9	39.5	39.5	47.2	36.1	36.1	19.8	15.1	15.1	34.9	33.2	33.2
Actuated g/C Ratio	0.55	0.41	0.41	0.48	0.37	0.37	0.19	0.15	0.15	0.36	0.34	0.34
v/c Ratio	0.51	0.60	0.04	0.70	0.32	0.38	0.02	0.28	0.50	0.77	0.28	0.31
Control Delay	15.0	25.9	13.5	30.4	23.6	4.5	24.0	38.4	9.7	38.0	25.3	5.2
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	15.0	25.9	13.5	30.4	23.6	4.5	24.0	38.4	9.7	38.0	25.3	5.2
LOS	B	C	B	C	C	A	C	D	A	D	C	A
Approach Delay		22.9			19.0			21.7			26.1	
Approach LOS		C			B			C			C	

Intersection Summary

Cycle Length: 113
Actuated Cycle Length: 97.5
Control Type: Actuated-Uncoordinated
Maximum v/c Ratio: 0.77
Intersection Signal Delay: 22.6 Intersection LOS: C
Intersection Capacity Utilization 76.7% ICU Level of Service D
Analysis Period (min) 15

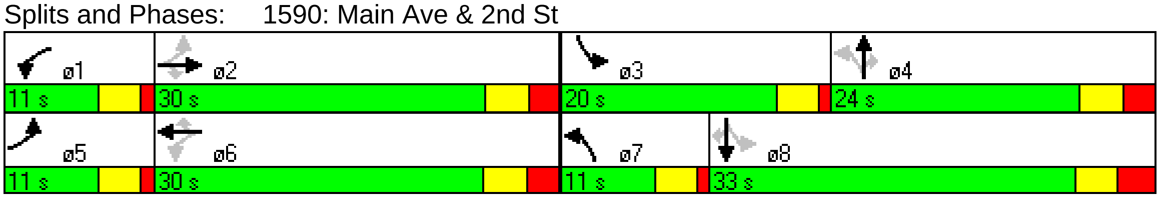
Splits and Phases: 1590: Main Ave & 2nd St



Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Total Lost Time (s)	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
Satd. Flow (prot)	1787	3574	1615	1805	3539	1583	1900	3574	1615	1770	3574	1599
Flt Permitted	0.228			0.456						0.436		
Satd. Flow (perm)	429	3574	1615	866	3539	1583	1900	3574	1615	812	3574	1599
Satd. Flow (RTOR)			8			499			181			264
Volume (vph)	171	325	2	154	460	360	0	219	139	201	147	198
Lane Group Flow (vph)	209	382	8	188	687	522	0	284	181	254	179	264
Turn Type	pm+pt		Perm	pm+pt		Perm	pm+pt		Perm	pm+pt		Perm
Protected Phases	5	2		1	6		7	4		3	8	
Permitted Phases	2		2	6		6	4		4	8		8
Total Split (s)	11.0	30.0	30.0	11.0	30.0	30.0	11.0	24.0	24.0	20.0	33.0	33.0
Act Effct Green (s)	40.3	31.7	31.7	38.9	31.0	31.0		16.5	16.5	33.4	33.4	33.4
Actuated g/C Ratio	0.47	0.37	0.37	0.46	0.36	0.36		0.19	0.19	0.39	0.39	0.39
v/c Ratio	0.61	0.29	0.01	0.39	0.53	0.58		0.41	0.39	0.55	0.13	0.34
Control Delay	23.8	20.9	12.0	15.8	24.4	5.9		31.4	7.2	22.1	15.6	3.1
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0		0.0	0.0	0.0	0.0	0.0
Total Delay	23.8	20.9	12.0	15.8	24.4	5.9		31.4	7.2	22.1	15.6	3.1
LOS	C	C	B	B	C	A		C	A	C	B	A
Approach Delay		21.8			16.3			22.0			13.2	
Approach LOS		C			B			C			B	

Intersection Summary	
Cycle Length: 85	
Actuated Cycle Length: 85	
Offset: 28 (33%), Referenced to phase 2:EBTL and 6:WBTL, Start of Green	
Control Type: Actuated-Coordinated	
Maximum v/c Ratio: 0.61	
Intersection Signal Delay: 17.5	Intersection LOS: B
Intersection Capacity Utilization 56.7%	ICU Level of Service B
Analysis Period (min) 15	

Splits and Phases: 1590: Main Ave & 2nd St



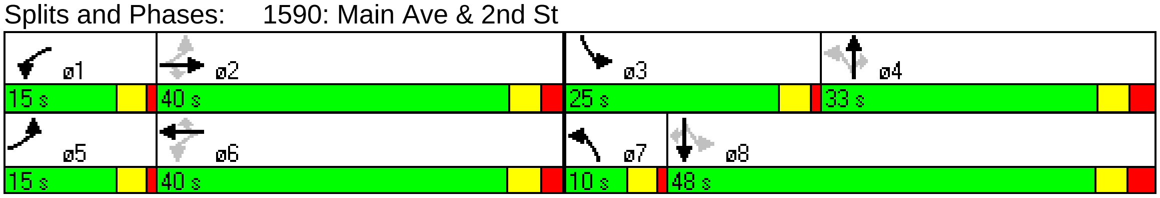
1590: Main Ave & 2nd St

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Total Lost Time (s)	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
Satd. Flow (prot)	1805	3574	1583	1805	3574	1583	1656	3574	1615	1770	3574	1615
Flt Permitted	0.288			0.192			0.556			0.510		
Satd. Flow (perm)	547	3574	1583	365	3574	1583	969	3574	1615	950	3574	1615
Satd. Flow (RTOR)			49			355			217			204
Volume (vph)	113	504	19	130	416	247	3	78	137	231	149	104
Lane Group Flow (vph)	192	741	76	203	586	433	12	217	217	398	324	204
Turn Type	pm+pt		Perm	pm+pt		Perm	pm+pt		Perm	pm+pt		Perm
Protected Phases	5	2		1	6		7	4		3	8	
Permitted Phases	2		2	6		6	4		4	8		8
Total Split (s)	15.0	40.0	40.0	15.0	40.0	40.0	10.0	33.0	33.0	25.0	48.0	48.0
Act Effct Green (s)	46.3	36.4	36.4	45.8	36.2	36.2	21.6	16.5	16.5	39.6	37.8	37.8
Actuated g/C Ratio	0.47	0.37	0.37	0.47	0.37	0.37	0.21	0.17	0.17	0.41	0.39	0.39
v/c Ratio	0.50	0.56	0.12	0.65	0.44	0.54	0.05	0.36	0.48	0.73	0.23	0.27
Control Delay	18.8	27.3	11.1	24.6	25.5	8.1	21.3	38.1	8.8	31.2	21.3	4.2
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	18.8	27.3	11.1	24.6	25.5	8.1	21.3	38.1	8.8	31.2	21.3	4.2
LOS	B	C	B	C	C	A	C	D	A	C	C	A
Approach Delay		24.4			19.2			23.4			21.8	
Approach LOS		C			B			C			C	

Intersection Summary

Cycle Length: 113
Actuated Cycle Length: 97.7
Control Type: Actuated-Uncoordinated
Maximum v/c Ratio: 0.73
Intersection Signal Delay: 21.8 — Intersection LOS: C
Intersection Capacity Utilization 50.6% — ICU Level of Service A
Analysis Period (min) 15

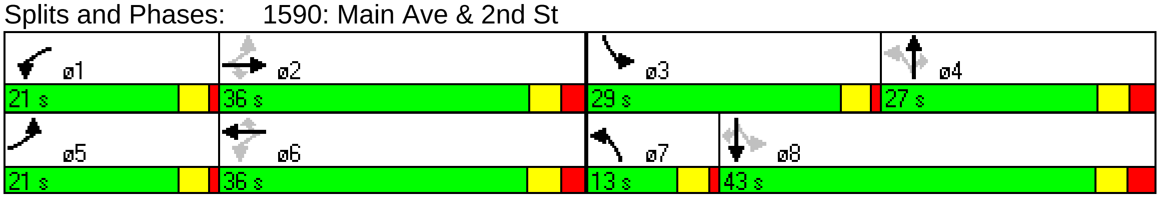
Splits and Phases: 1590: Main Ave & 2nd St



Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Total Lost Time (s)	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
Satd. Flow (prot)	1805	3574	1583	1805	3574	1583	1656	3574	1615	1770	3574	1615
Flt Permitted	0.389			0.125			0.548			0.553		
Satd. Flow (perm)	739	3574	1583	238	3574	1583	955	3574	1615	1030	3574	1615
Satd. Flow (RTOR)			13			297			215			215
Volume (vph)	251	784	13	194	388	279	1	142	211	378	260	157
Lane Group Flow (vph)	299	871	24	204	422	297	4	153	215	402	338	215
Turn Type	pm+pt		Perm	pm+pt		Perm	pm+pt		Perm	pm+pt		Perm
Protected Phases	5	2		1	6		7	4		3	8	
Permitted Phases	2		2	6		6	4		4	8		8
Total Split (s)	21.0	36.0	36.0	21.0	36.0	36.0	13.0	27.0	27.0	29.0	43.0	43.0
Act Effct Green (s)	49.6	35.3	35.3	43.7	32.3	32.3	20.0	15.2	15.2	40.2	38.5	38.5
Actuated g/C Ratio	0.50	0.36	0.36	0.44	0.33	0.33	0.19	0.15	0.15	0.41	0.39	0.39
v/c Ratio	0.57	0.68	0.04	0.72	0.36	0.41	0.02	0.28	0.50	0.70	0.24	0.28
Control Delay	19.8	32.2	16.8	34.5	28.1	5.4	22.0	39.8	9.9	30.0	21.6	4.2
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	19.8	32.2	16.8	34.5	28.1	5.4	22.0	39.8	9.9	30.0	21.6	4.2
LOS	B	C	B	C	C	A	C	D	A	C	C	A
Approach Delay		28.8			22.2			22.3			21.2	
Approach LOS		C			C			C			C	

Intersection Summary	
Cycle Length: 113	
Actuated Cycle Length: 99	
Control Type: Actuated-Uncoordinated	
Maximum v/c Ratio: 0.72	
Intersection Signal Delay: 24.2	Intersection LOS: C
Intersection Capacity Utilization 76.7%	ICU Level of Service D
Analysis Period (min) 15	

Splits and Phases: 1590: Main Ave & 2nd St

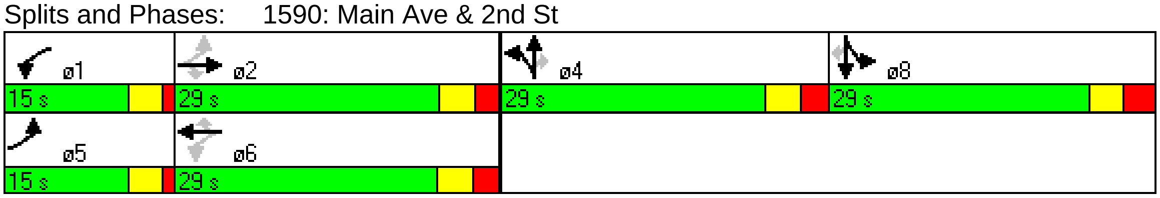


1590: Main Ave & 2nd St

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Total Lost Time (s)	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
Satd. Flow (prot)	1787	3574	1615	1805	3539	1583	1900	3574	1615	3433	1881	1599
Flt Permitted	0.160			0.406						0.950		
Satd. Flow (perm)	301	3574	1615	771	3539	1583	1900	3574	1615	3433	1881	1599
Satd. Flow (RTOR)			8			522			181			264
Volume (vph)	171	325	2	154	460	360	0	219	139	201	147	198
Lane Group Flow (vph)	209	382	8	188	687	522	0	284	181	254	179	264
Turn Type	pm+pt		Perm	pm+pt		Perm	Split		Perm	Split		Perm
Protected Phases	5	2		1	6		4	4		8	8	
Permitted Phases	2		2	6		6			4			8
Total Split (s)	15.0	29.0	29.0	15.0	29.0	29.0	29.0	29.0	29.0	29.0	29.0	29.0
Act Effct Green (s)	36.0	26.1	26.1	34.4	25.3	25.3		17.2	17.2	19.5	19.5	19.5
Actuated g/C Ratio	0.41	0.30	0.30	0.39	0.29	0.29		0.20	0.20	0.22	0.22	0.22
v/c Ratio	0.72	0.36	0.02	0.46	0.68	0.63		0.41	0.39	0.33	0.43	0.47
Control Delay	33.7	27.5	15.5	21.0	33.3	6.7		33.5	7.8	30.5	33.6	6.9
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0		0.0	0.0	0.0	0.0	0.0
Total Delay	33.7	27.5	15.5	21.0	33.3	6.7		33.5	7.8	30.5	33.6	6.9
LOS	C	C	B	C	C	A		C	A	C	C	A
Approach Delay		29.5			21.7			23.5			22.4	
Approach LOS		C			C			C			C	

Intersection Summary	
Cycle Length: 102	
Actuated Cycle Length: 88	
Control Type: Actuated-Uncoordinated	
Maximum v/c Ratio: 0.72	
Intersection Signal Delay: 23.6	Intersection LOS: C
Intersection Capacity Utilization 55.5%	ICU Level of Service B
Analysis Period (min) 15	

Splits and Phases: 1590: Main Ave & 2nd St

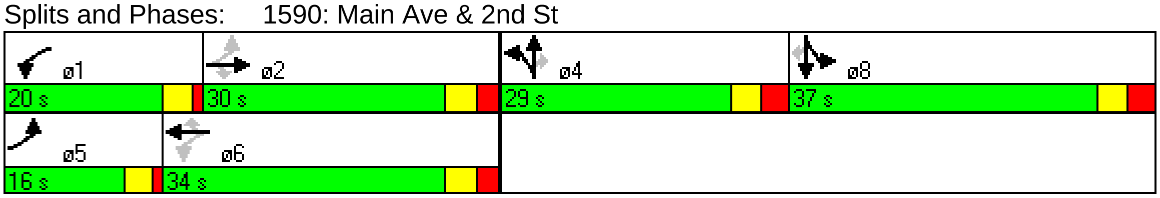


1590: Main Ave & 2nd St

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Total Lost Time (s)	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
Satd. Flow (prot)	1805	3574	1583	1805	3574	1583	1656	3574	1615	3433	1881	1615
Flt Permitted	0.269			0.133			0.950			0.950		
Satd. Flow (perm)	511	3574	1583	253	3574	1583	1656	3574	1615	3433	1881	1615
Satd. Flow (RTOR)			42			318			217			191
Volume (vph)	113	504	19	130	416	247	3	78	137	231	149	104
Lane Group Flow (vph)	192	741	76	203	586	433	12	217	217	398	324	204
Turn Type	pm+pt		Perm	pm+pt		Perm	Split		Perm	Split		Perm
Protected Phases	5	2		1	6		4	4		8	8	
Permitted Phases	2		2	6		6			4			8
Total Split (s)	16.0	30.0	30.0	20.0	34.0	34.0	29.0	29.0	29.0	37.0	37.0	37.0
Act Effct Green (s)	40.4	29.6	29.6	41.9	30.3	30.3	16.8	16.8	16.8	28.0	28.0	28.0
Actuated g/C Ratio	0.40	0.29	0.29	0.41	0.30	0.30	0.16	0.16	0.16	0.27	0.27	0.27
v/c Ratio	0.57	0.72	0.16	0.73	0.55	0.62	0.04	0.37	0.49	0.42	0.63	0.35
Control Delay	27.1	39.5	18.3	36.8	34.2	13.9	38.0	40.9	9.3	32.0	38.8	7.1
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	27.1	39.5	18.3	36.8	34.2	13.9	38.0	40.9	9.3	32.0	38.8	7.1
LOS	C	D	B	D	C	B	D	D	A	C	D	A
Approach Delay		35.5			27.5			25.4			28.9	
Approach LOS		D			C			C			C	

Intersection Summary	
Cycle Length: 116	
Actuated Cycle Length: 102.1	
Control Type: Actuated-Uncoordinated	
Maximum v/c Ratio: 0.73	
Intersection Signal Delay: 29.8	Intersection LOS: C
Intersection Capacity Utilization 44.4%	ICU Level of Service A
Analysis Period (min) 15	

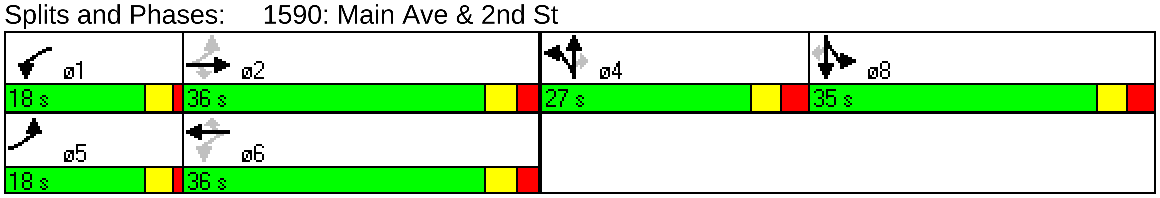
Splits and Phases: 1590: Main Ave & 2nd St



Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Total Lost Time (s)	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
Satd. Flow (prot)	1805	3574	1583	1805	3574	1583	1656	3574	1615	3433	1881	1615
Flt Permitted	0.382			0.125			0.950			0.950		
Satd. Flow (perm)	726	3574	1583	238	3574	1583	1656	3574	1615	3433	1881	1615
Satd. Flow (RTOR)			12			297			215			189
Volume (vph)	251	784	13	194	388	279	1	142	211	378	260	157
Lane Group Flow (vph)	299	871	24	204	422	297	4	153	215	402	338	215
Turn Type	pm+pt		Perm	pm+pt		Perm	Split		Perm	Split		Perm
Protected Phases	5	2		1	6		4	4		8	8	
Permitted Phases	2		2	6		6			4			8
Total Split (s)	18.0	36.0	36.0	18.0	36.0	36.0	27.0	27.0	27.0	35.0	35.0	35.0
Act Effct Green (s)	47.2	34.0	34.0	43.5	32.1	32.1	15.3	15.3	15.3	28.0	28.0	28.0
Actuated g/C Ratio	0.45	0.32	0.32	0.42	0.31	0.31	0.15	0.15	0.15	0.27	0.27	0.27
v/c Ratio	0.64	0.75	0.05	0.76	0.38	0.43	0.02	0.29	0.51	0.44	0.67	0.38
Control Delay	26.5	37.9	18.8	40.3	30.9	5.6	40.0	42.4	10.3	33.6	42.0	8.5
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	26.5	37.9	18.8	40.3	30.9	5.6	40.0	42.4	10.3	33.6	42.0	8.5
LOS	C	D	B	D	C	A	D	D	B	C	D	A
Approach Delay		34.7			24.8			23.8			30.9	
Approach LOS		C			C			C			C	

Intersection Summary	
Cycle Length: 116	
Actuated Cycle Length: 104.7	
Control Type: Actuated-Uncoordinated	
Maximum v/c Ratio: 0.76	
Intersection Signal Delay: 29.8	Intersection LOS: C
Intersection Capacity Utilization 69.4%	ICU Level of Service C
Analysis Period (min) 15	

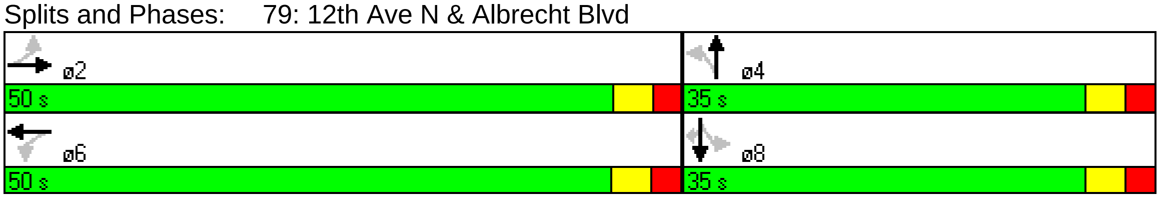
Splits and Phases: 1590: Main Ave & 2nd St



Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Total Lost Time (s)	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
Satd. Flow (prot)	1770	1857	0	1770	1820	0	0	1828	0	0	1790	1583
Flt Permitted	0.328			0.565				0.984			0.891	
Satd. Flow (perm)	611	1857	0	1052	1820	0	0	1811	0	0	1660	1583
Satd. Flow (RTOR)		2			16			2				37
Volume (vph)	75	239	6	6	438	78	3	16	2	8	2	35
Lane Group Flow (vph)	80	260	0	6	549	0	0	22	0	0	11	37
Turn Type	Perm			Perm			Perm			Perm		Perm
Protected Phases		2			6			4			8	
Permitted Phases	2			6			4			8		8
Total Split (s)	50.0	50.0	0.0	50.0	50.0	0.0	35.0	35.0	0.0	35.0	35.0	35.0
Act Effct Green (s)	72.2	72.2		72.2	72.2			13.3			13.3	13.3
Actuated g/C Ratio	0.85	0.85		0.85	0.85			0.16			0.16	0.16
v/c Ratio	0.15	0.16		0.01	0.35			0.08			0.04	0.13
Control Delay	0.8	0.4		2.7	3.5			29.6			31.1	12.2
Queue Delay	0.0	0.0		0.0	0.0			0.0			0.0	0.0
Total Delay	0.8	0.4		2.7	3.5			29.6			31.1	12.2
LOS	A	A		A	A			C			C	B
Approach Delay		0.5			3.5			29.6			16.6	
Approach LOS		A			A			C			B	

Intersection Summary	
Cycle Length: 85	
Actuated Cycle Length: 85	
Offset: 78 (92%), Referenced to phase 2:EBTL and 6:WBTL, Start of Green	
Control Type: Actuated-Coordinated	
Maximum v/c Ratio: 0.35	
Intersection Signal Delay: 3.7	Intersection LOS: A
Intersection Capacity Utilization 57.8%	ICU Level of Service B
Analysis Period (min) 15	

Splits and Phases: 79: 12th Ave N & Albrecht Blvd

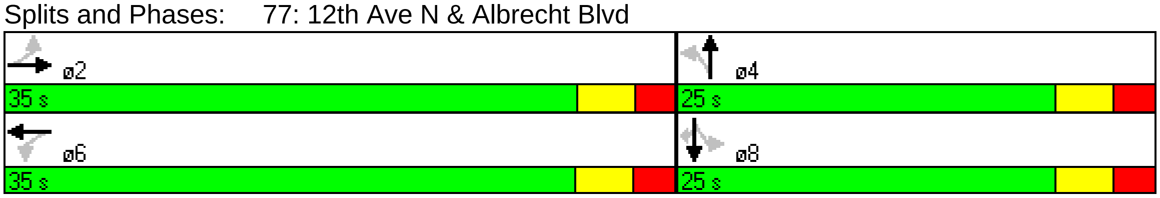


77: 12th Ave N & Albrecht Blvd

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Total Lost Time (s)	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
Satd. Flow (prot)	1770	1855	0	1770	1833	0	0	1827	0	0	1785	1583
Flt Permitted	0.379			0.525				0.993			0.844	
Satd. Flow (perm)	706	1855	0	978	1833	0	0	1820	0	0	1572	1583
Satd. Flow (RTOR)		4			15			2				57
Volume (vph)	60	292	8	6	409	50	1	13	2	21	3	54
Lane Group Flow (vph)	64	320	0	6	488	0	0	17	0	0	25	57
Turn Type	Perm			Perm			Perm			Perm		Perm
Protected Phases		2			6			4			8	
Permitted Phases	2			6			4			8		8
Total Split (s)	35.0	35.0	0.0	35.0	35.0	0.0	25.0	25.0	0.0	25.0	25.0	25.0
Act Effct Green (s)	47.2	47.2		47.2	47.2			13.3			13.3	13.3
Actuated g/C Ratio	0.79	0.79		0.79	0.79			0.22			0.22	0.22
v/c Ratio	0.12	0.22		0.01	0.34			0.04			0.07	0.14
Control Delay	2.8	2.4		3.8	4.6			17.8			19.2	7.4
Queue Delay	0.0	0.0		0.0	0.0			0.0			0.0	0.0
Total Delay	2.8	2.4		3.8	4.6			17.8			19.2	7.4
LOS	A	A		A	A			B			B	A
Approach Delay		2.5			4.6			17.8			11.0	
Approach LOS		A			A			B			B	

Intersection Summary	
Cycle Length: 60	
Actuated Cycle Length: 60	
Offset: 56 (93%), Referenced to phase 2:EBTL and 6:WBTL, Start of Green	
Control Type: Actuated-Coordinated	
Maximum v/c Ratio: 0.34	
Intersection Signal Delay: 4.5	Intersection LOS: A
Intersection Capacity Utilization 54.6%	ICU Level of Service A
Analysis Period (min) 15	

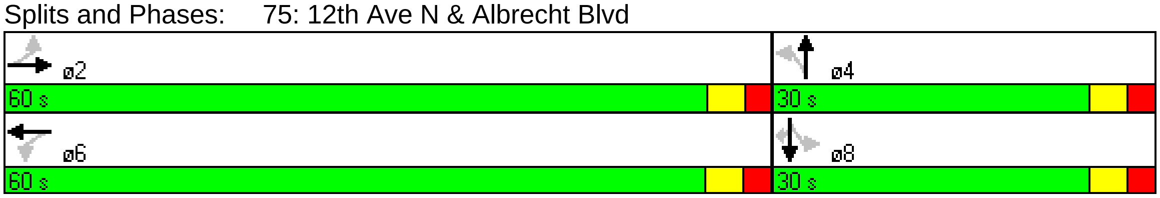
Splits and Phases: 77: 12th Ave N & Albrecht Blvd



Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Total Lost Time (s)	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
Satd. Flow (prot)	1770	1855	0	1770	1840	0	0	1815	0	0	1803	1583
Flt Permitted	0.421			0.337				0.974			0.868	
Satd. Flow (perm)	784	1855	0	628	1840	0	0	1783	0	0	1617	1583
Satd. Flow (RTOR)		3			10			2				54
Volume (vph)	49	549	13	3	408	37	3	10	2	22	11	51
Lane Group Flow (vph)	52	598	0	3	473	0	0	16	0	0	35	54
Turn Type	Perm			Perm			Perm			Perm		Perm
Protected Phases		2			6			4			8	
Permitted Phases	2			6			4			8		8
Total Split (s)	60.0	60.0	0.0	60.0	60.0	0.0	30.0	30.0	0.0	30.0	30.0	30.0
Act Effct Green (s)	76.4	76.4		76.4	76.4			8.6			8.6	8.6
Actuated g/C Ratio	0.85	0.85		0.85	0.85			0.10			0.10	0.10
v/c Ratio	0.08	0.38		0.01	0.30			0.09			0.23	0.27
Control Delay	1.2	1.7		2.0	2.5			34.3			40.6	14.4
Queue Delay	0.0	0.1		0.0	0.0			0.0			0.0	0.0
Total Delay	1.2	1.7		2.0	2.5			34.3			40.6	14.4
LOS	A	A		A	A			C			D	B
Approach Delay		1.7			2.5			34.3			24.7	
Approach LOS		A			A			C			C	

Intersection Summary	
Cycle Length: 90	
Actuated Cycle Length: 90	
Offset: 1 (1%), Referenced to phase 2:EBTL and 6:WBTL, Start of Green	
Control Type: Actuated-Coordinated	
Maximum v/c Ratio: 0.38	
Intersection Signal Delay: 4.1	Intersection LOS: A
Intersection Capacity Utilization 52.2%	ICU Level of Service A
Analysis Period (min) 15	

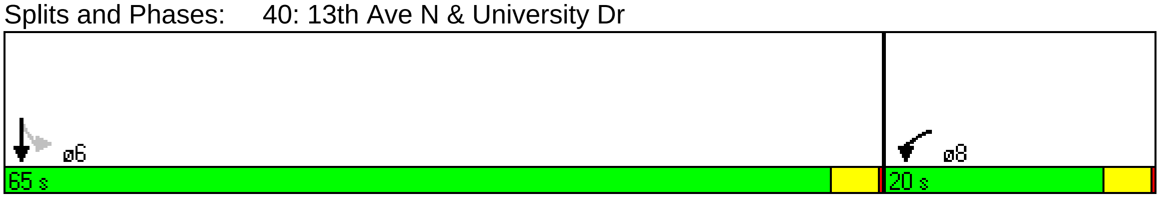
Splits and Phases: 75: 12th Ave N & Albrecht Blvd



Lane Group	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Total Lost Time (s)	4.0	4.0	4.0	4.0	4.0	4.0
Satd. Flow (prot)	1863	0	0	0	0	3539
Flt Permitted						
Satd. Flow (perm)	1863	0	0	0	0	3539
Satd. Flow (RTOR)						
Volume (vph)	0	0	0	0	0	0
Lane Group Flow (vph)	0	0	0	0	0	0
Turn Type					Perm	
Protected Phases	8					6
Permitted Phases					6	
Total Split (s)	20.0	0.0	0.0	0.0	65.0	65.0
Act Effct Green (s)						
Actuated g/C Ratio						
v/c Ratio						
Control Delay						
Queue Delay						
Total Delay						
LOS						
Approach Delay						
Approach LOS						

Intersection Summary	
Cycle Length: 85	
Actuated Cycle Length: 85	
Offset: 79 (93%), Referenced to phase 6:SBTL, Start of Green	
Control Type: Actuated-Coordinated	
Maximum v/c Ratio: 0.00	
Intersection Signal Delay: 0.0	Intersection LOS: A
Intersection Capacity Utilization 0.0%	ICU Level of Service A
Analysis Period (min) 15	

Splits and Phases: 40: 13th Ave N & University Dr



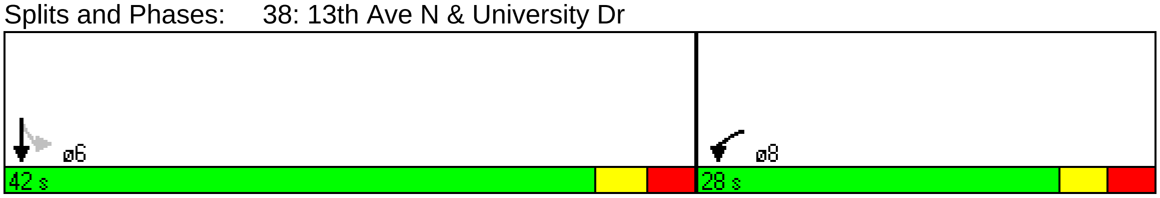
38: 13th Ave N & University Dr

Lane Group	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Total Lost Time (s)	4.0	4.0	4.0	4.0	4.0	4.0
Satd. Flow (prot)	1863	0	0	0	0	3539
Flt Permitted						
Satd. Flow (perm)	1863	0	0	0	0	3539
Satd. Flow (RTOR)						
Volume (vph)	0	0	0	0	0	0
Lane Group Flow (vph)	0	0	0	0	0	0
Turn Type					Perm	
Protected Phases	8					6
Permitted Phases					6	
Total Split (s)	28.0	0.0	0.0	0.0	42.0	42.0
Act Effct Green (s)						
Actuated g/C Ratio						
v/c Ratio						
Control Delay						
Queue Delay						
Total Delay						
LOS						
Approach Delay						
Approach LOS						

Intersection Summary

Cycle Length: 70
Actuated Cycle Length: 70
Offset: 66 (94%), Referenced to phase 6:SBTL, Start of Green
Control Type: Actuated-Coordinated
Maximum v/c Ratio: 0.00
Intersection Signal Delay: 0.0 — Intersection LOS: A
Intersection Capacity Utilization 0.0% — ICU Level of Service A
Analysis Period (min) 15

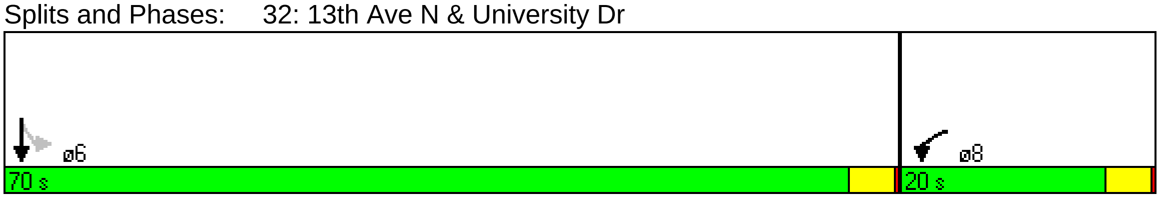
Splits and Phases: 38: 13th Ave N & University Dr



Lane Group	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Total Lost Time (s)	4.0	4.0	4.0	4.0	4.0	4.0
Satd. Flow (prot)	1863	0	0	0	0	3539
Flt Permitted						
Satd. Flow (perm)	1863	0	0	0	0	3539
Satd. Flow (RTOR)						
Volume (vph)	0	0	0	0	0	0
Lane Group Flow (vph)	0	0	0	0	0	0
Turn Type					Perm	
Protected Phases	8					6
Permitted Phases					6	
Total Split (s)	20.0	0.0	0.0	0.0	70.0	70.0
Act Effct Green (s)						
Actuated g/C Ratio						
v/c Ratio						
Control Delay						
Queue Delay						
Total Delay						
LOS						
Approach Delay						
Approach LOS						

Intersection Summary	
Cycle Length: 90	
Actuated Cycle Length: 90	
Offset: 25 (28%), Referenced to phase 6:SBTL, Start of Green	
Control Type: Actuated-Coordinated	
Maximum v/c Ratio: 0.00	
Intersection Signal Delay: 0.0	Intersection LOS: A
Intersection Capacity Utilization 0.0%	ICU Level of Service A
Analysis Period (min) 15	

Splits and Phases: 32: 13th Ave N & University Dr

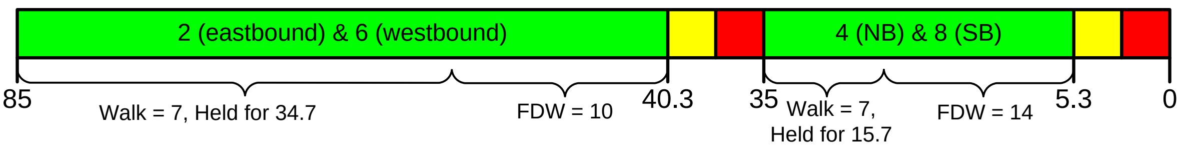


Appendix B: TSP Strategies for 12th Ave. N. & Albrecht Blvd.

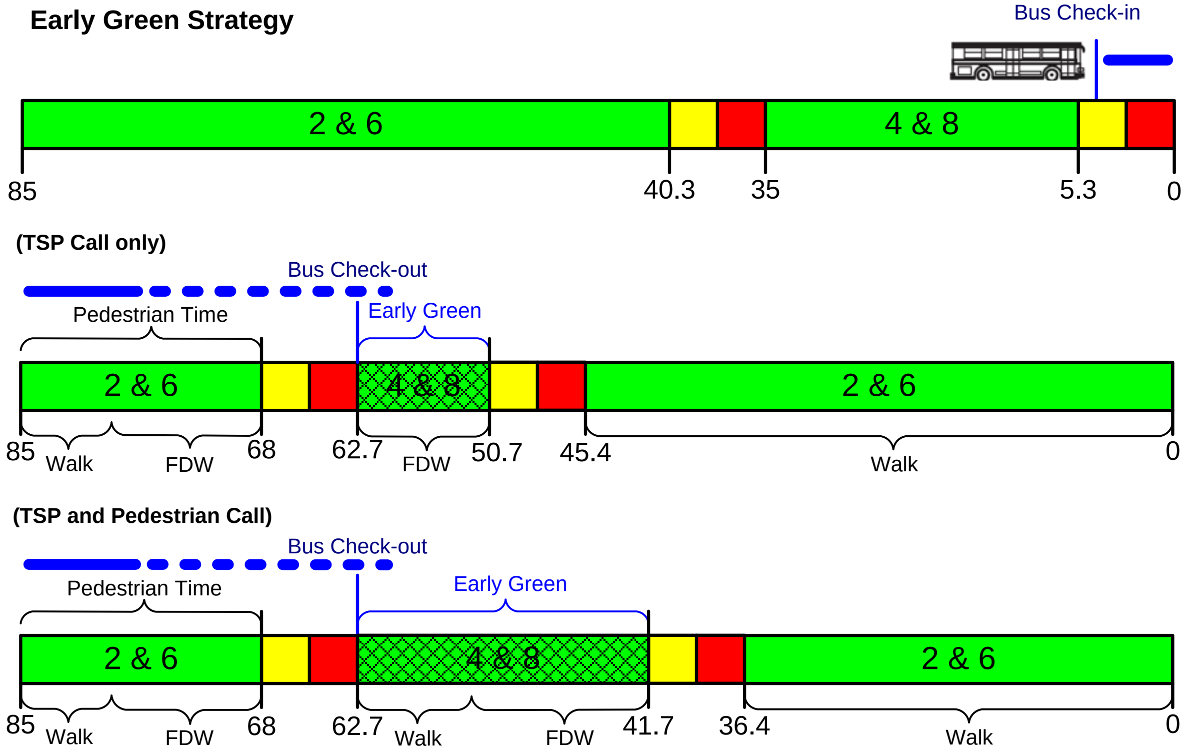
TSP Impacts at 12th Ave. N. & Albrecht Blvd.
Bus Phase: Phase 8 (southbound)

Timing Plan: AM Peak Plan (1/2/1),
TSP functions (Dwell in 2 & 6, Max Call of 10 sec.)

Minimum Green
Phases 2, 4, 6 and 8 = 12 sec

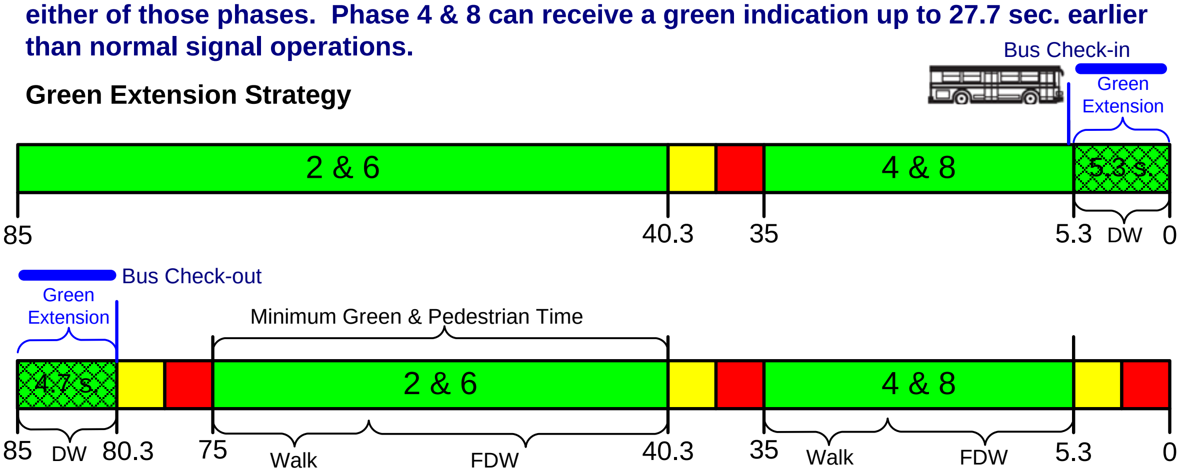


Early Green Strategy



Result: TSP call will provide an early green of 12 sec. to phase 4 or 8 if there is no pedestrian call on those phases, and 21 sec. to phases 4 & 8 if there is a pedestrian call on either of those phases. Phase 4 & 8 can receive a green indication up to 27.7 sec. earlier than normal signal operations.

Green Extension Strategy

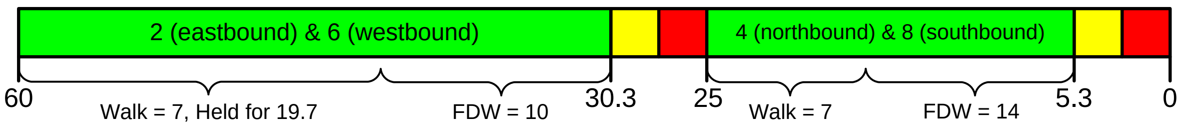


Result: TSP call will extend phases 4 & 8 by 10 sec.

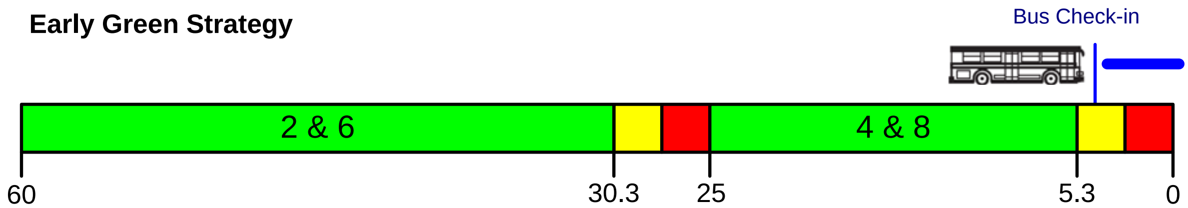
TSP Impacts at 12th Ave. N. & Albrecht Blvd.
Bus Phase: Phase 8 (southbound)

Minimum Green
Phases 2, 4, 6 and 8 = 12 sec

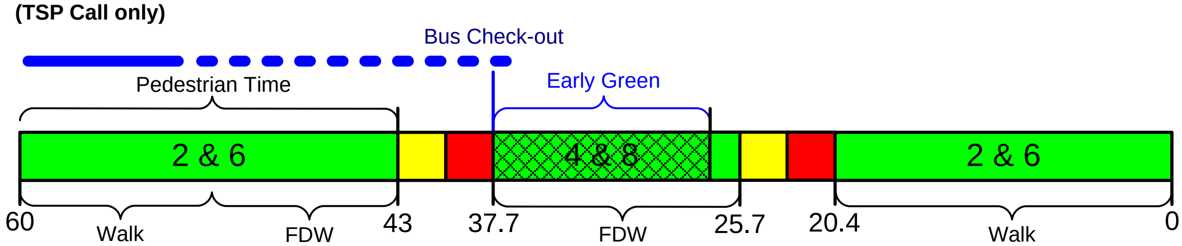
Timing Plan: Off (MID) Peak Plan (4/4/3),
TSP functions (Dwell in 2 & 6, Max Call of 10 sec.)



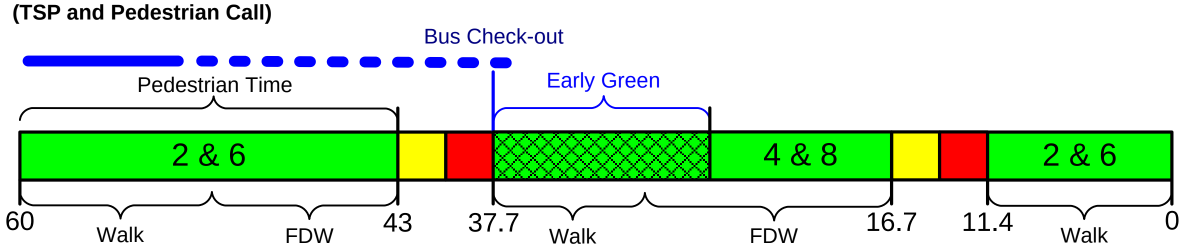
Early Green Strategy



(TSP Call only)

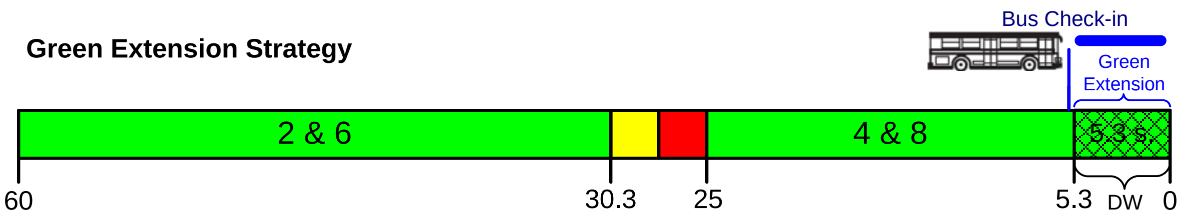


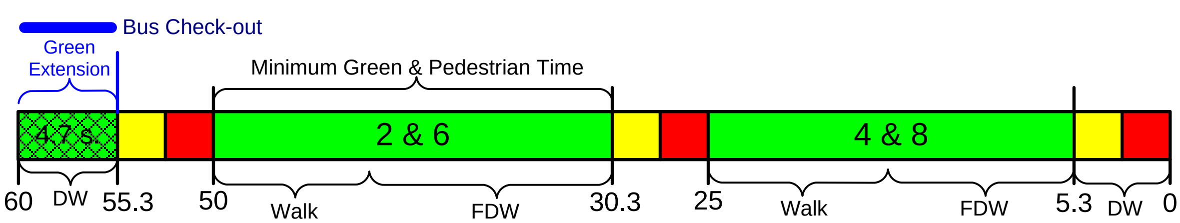
(TSP and Pedestrian Call)



Result: TSP call will provide an early green of 12 sec. and 21 sec. to phases 4 & 8 by giving the minimum time (greater of vehicle or pedestrian time) to non-TSP phases. Phase 4 & 8 can receive a green indication up to 12.7 sec. earlier than normal signal operations.

Green Extension Strategy



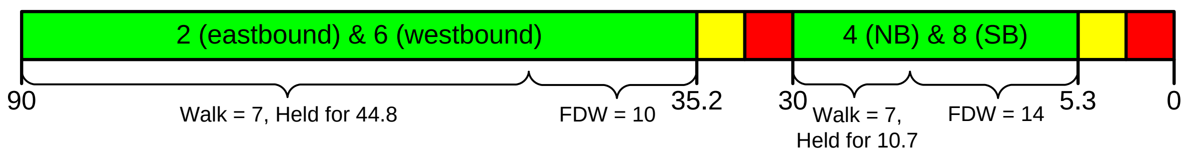


Result: TSP call will extend phases 4 & 8 by 10 sec.

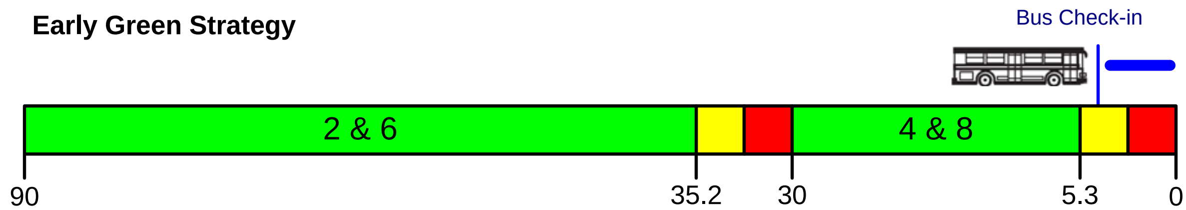
TSP Impacts at 12th Ave. N. & Albrecht Blvd.
Bus Phase: Phase 8 (southbound)

Minimum Green
Phases 2, 4, 6 and 8 = 12 sec

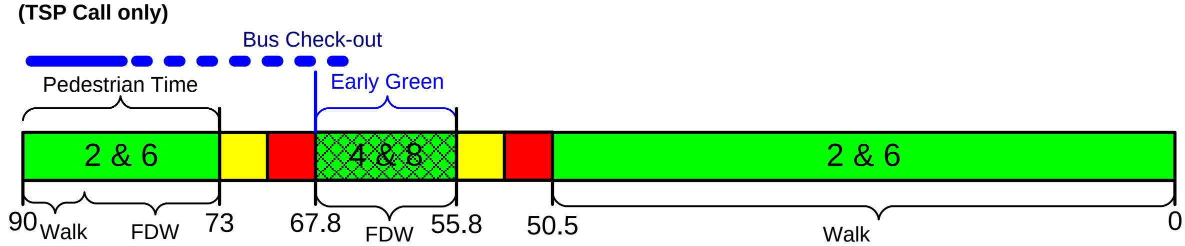
Timing Plan: PM Peak Plan (1/3/1),
TSP functions (Dwell in 2 & 6, Max Call of 10 sec.)



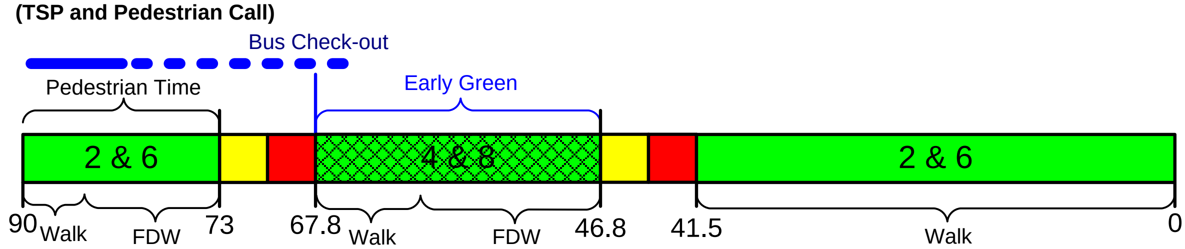
Early Green Strategy



(TSP Call only)

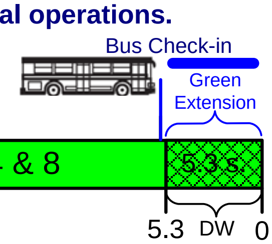


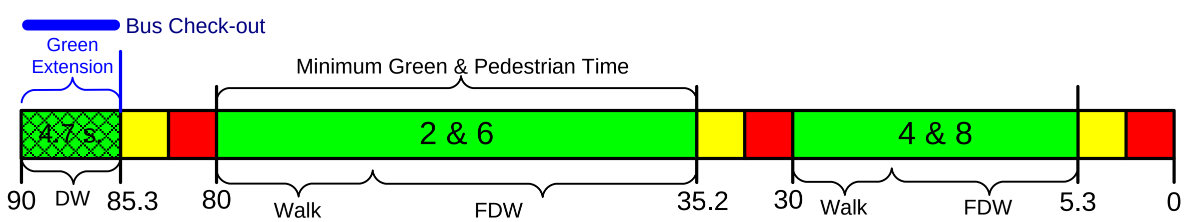
(TSP and Pedestrian Call)



Result: TSP call will provide an early green of 12 sec. and 21 sec. to phases 4 & 8 by giving the minimum time (greater of vehicle or pedestrian time) to non-TSP phases. Phase 4 & 8 can receive a green indication up to 37.8 sec. earlier than normal signal operations.

Green Extension Strategy





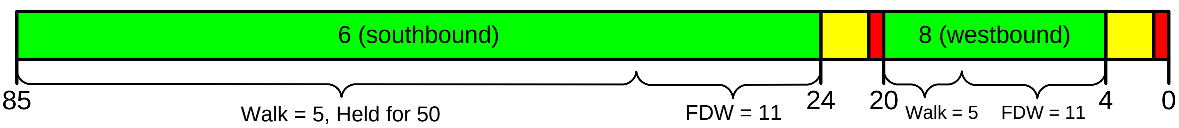
Result: TSP call will extend phases 4 & 8 by 10 sec.

Appendix C: TSP Strategies for 13th Ave. N. & University Dr.

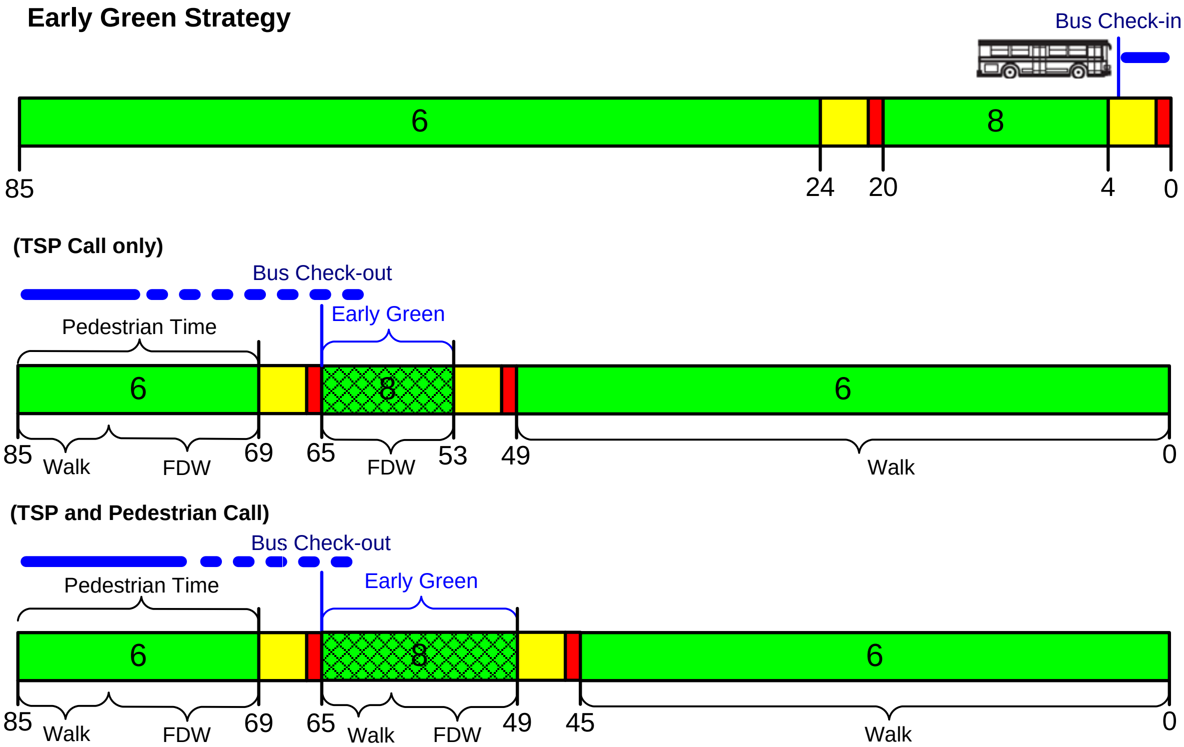
TSP Impacts at 13th Ave. N. & University Dr.
Bus Phase: Phase 8 (westbound)

Timing Plan: AM Peak Plan (1/2/1),
TSP functions (Dwell in 6, Max Call of 10 sec.)

Minimum Green
Phases 6 and 8 = 12 sec

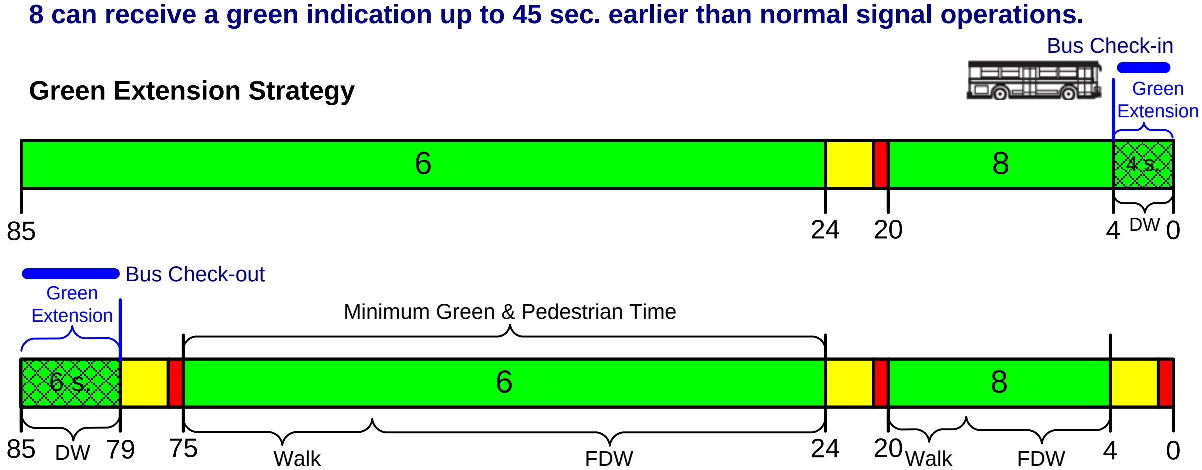


Early Green Strategy



Result: TSP call will provide an early green of 12 sec. to phase 8 if there is no pedestrian call on that phase, and 21 sec. to phase 8 if there is a pedestrian call on that phase. Phase 8 can receive a green indication up to 45 sec. earlier than normal signal operations.

Green Extension Strategy

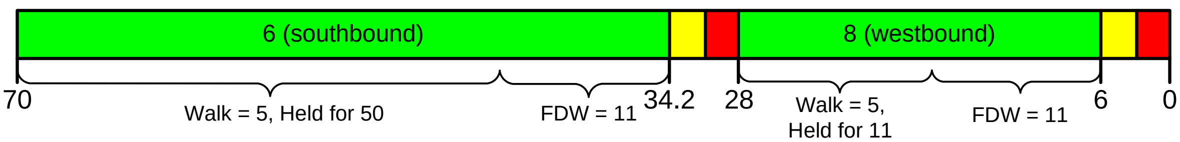


Result: TSP call will extend phase 8 by 10 sec.

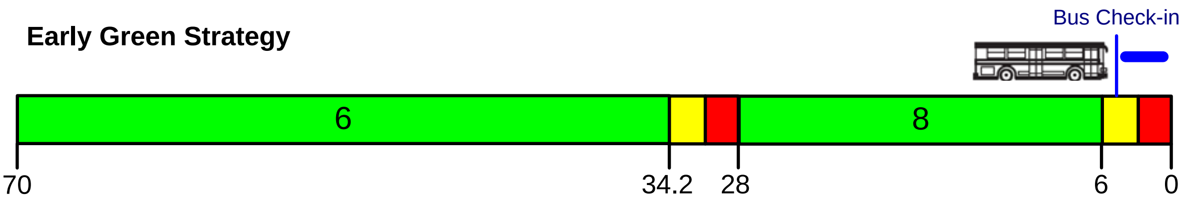
TSP Impacts at 13th Ave. N. & University Dr.
Bus Phase: Phase 8 (westbound)

Timing Plan: MID Peak Plan (1/4/1), TSP functions (Dwell in 6, Max Call of 10 sec.)

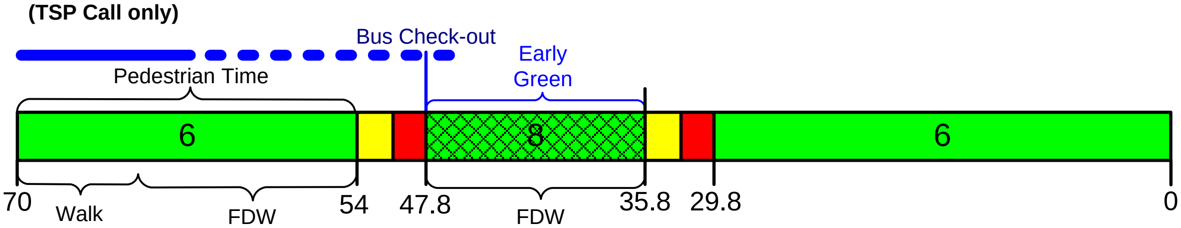
Minimum Green
Phases 6 and 8 = 12 sec



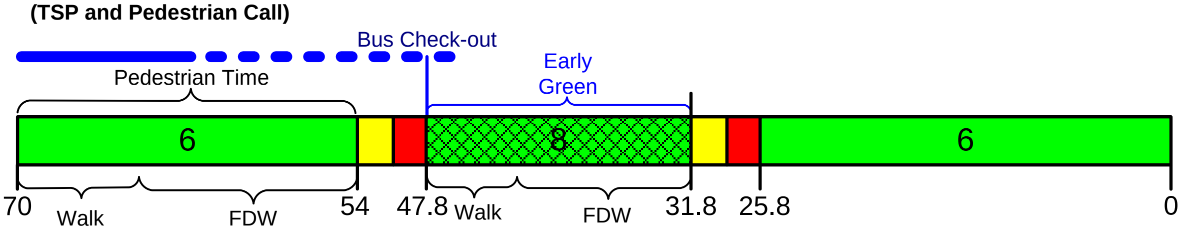
Early Green Strategy



(TSP Call only)

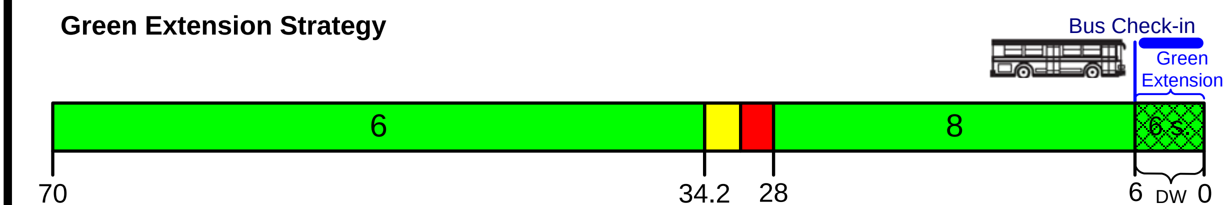


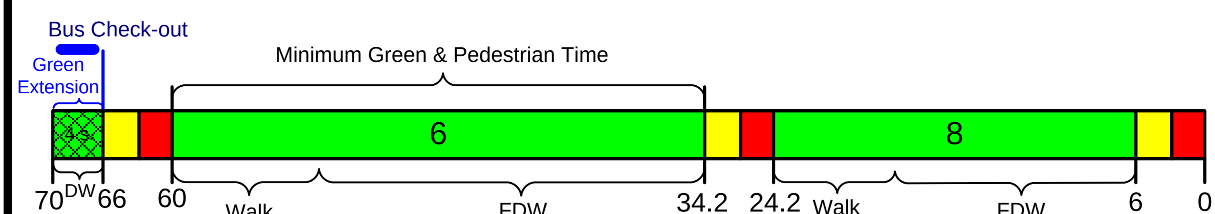
(TSP and Pedestrian Call)



Result: TSP call will provide an early green of 12 sec. to phase 8 if there is no pedestrian call on that phase, and 21 sec. to phase 8 if there is a pedestrian call on that phase. Phase 8 can receive a green indication up to 19.8 sec. earlier than normal signal operations.

Green Extension Strategy



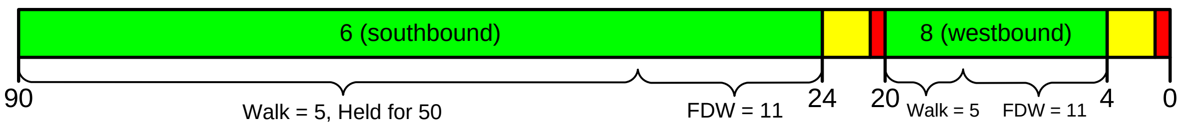


Result: TSP call will extend phase 8 by 10 sec.

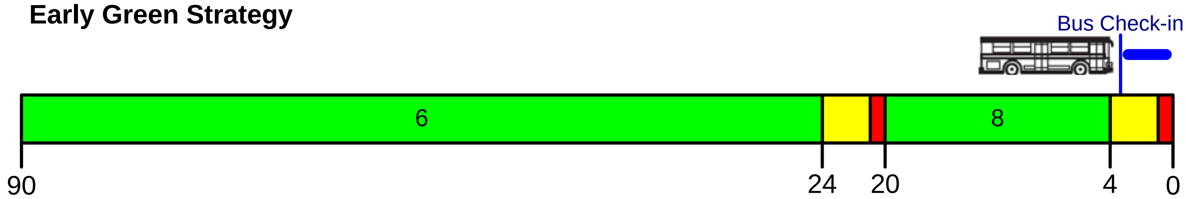
TSP Impacts at 13th Ave. N. & University Dr.
Bus Phase: Phase 8 (westbound)

Timing Plan: PM Peak Plan (1/2/1),
TSP functions (Dwell in 6, Max Call of 10 sec.)

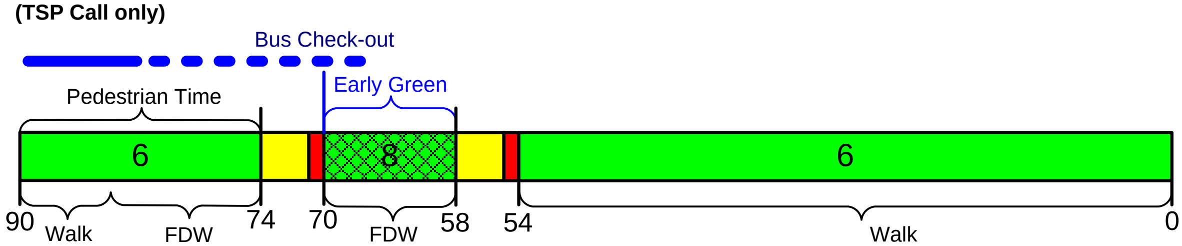
Minimum Green
Phases 6 and 8 = 12 sec



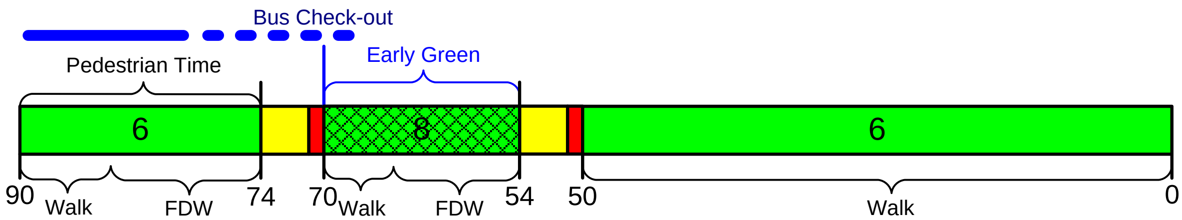
Early Green Strategy



(TSP Call only)

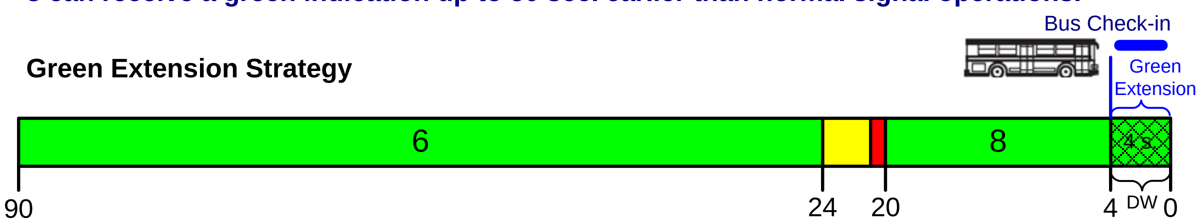


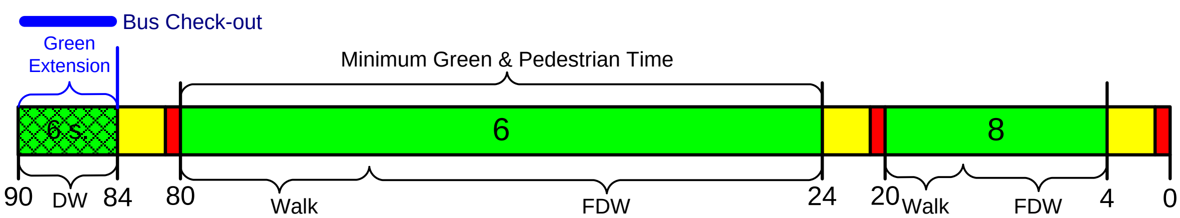
(TSP and Pedestrian Call)



Result: TSP call will provide an early green of 12 sec. to phase 8 if there is no pedestrian call on that phase, and 21 sec. to phase 8 if there is a pedestrian call on that phase. Phase 8 can receive a green indication up to 50 sec. earlier than normal signal operations.

Green Extension Strategy





Result: TSP call will extend phase 8 by 10 sec.