REGIONAL TRAFFIC SIGNAL PROGRAM CONSULTANT SERVICES

4TH CYCLE

SINC-UP Project Work Order 03:

SR 422 – Worthington Borough/ West Franklin Township

<u>Final</u> Signal Timing Optimization Report

November 8th, 2021

SPC REGIONAL TRAFFIC SIGNAL PROGRAM – CYCLE 4
SR 422 – WORTHINGTON BOROUGH-WEST FRANKLIN TOWNSHIP
SINC-UP PROJECT – WO #03
FINAL REPORT

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TABLE OF CONTENTS

LIST OF EXHIBITS

LIST OF APPENDICES

1.0 INTRODUCTION

1.1 PROJECT DESCRIPTION AND PURPOSE

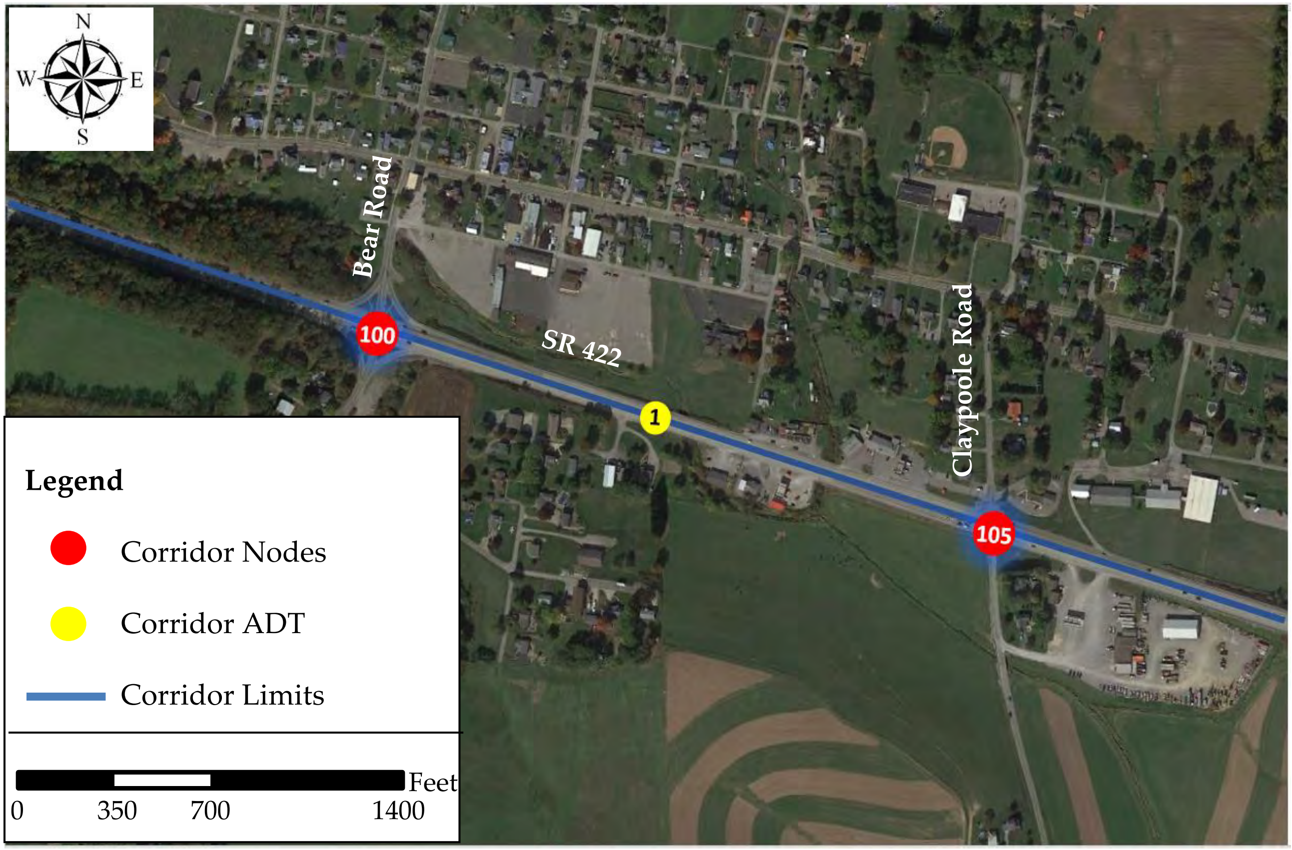
The Southwestern Pennsylvania Commission's (SPC) Regional Traffic Signal Program was established to assist local municipalities with improving traffic signal operations by optimizing signal timings and upgrading existing signal equipment. The State Route 422 (SR 422) Worthington Borough-West Franklin Township Signals In Coordination with Equipment Upgrades (SINC-UP) Project is a signal equipment upgrade and retiming project with the goal of optimizing signal operations at the study intersections along this corridor while considering the safety and mobility of all users of the intersections. The purpose of this report is to summarize the traffic evaluation and recommendations for the corridor. All work has been completed in accordance with policies, procedures, and specifications prepared or approved by PennDOT and the FHWA, where applicable. The goal of the project is to provide optimized signal timings for three weekday peaks (AM, Midday, and PM).

1.2 LOCATION AND STUDY AREA

The Worthington Borough-West Franklin Township, SR 422 corridor SINC-UP project is located in Armstrong County, Pennsylvania. The study area is comprised of two signalized intersections (***Exhibit 1***).

- 100 – SR 422 and Worthington-Slate Lick Road/Bear Road (SR 3011)
- 105 – SR 422 and Claypoole Road (SR 3009)

Exhibit 1: Project Location Map



2.0 TRAFFIC DATA

2.1 BASE DATA INVENTORY

The data collection efforts included an inventory of base data (***Appendix A***) and traffic counts. The inventory included:

- Lane configurations
- Lane widths
- Turn lane storage
- Approach grades
- Speed limits
- Signal Timings
- Signal Equipment

SR 422 is a four-lane divided roadway with additional storage lanes for left turning vehicles at all of the intersections along the mainline of the corridor. SR 422 is a state road and is classified as an Urban Other Principal Arterial Highway. The corridor is suburban with a few small businesses and residential units. The posted speed limit along SR 422 is 45 miles per hour (mph).

2.2 TRAFFIC COUNT DATA

Traffic counts were collected throughout the corridor and included a video midblock average daily traffic (ADT) count and video intersection turning movement counts (TMCs) (***Appendix B***).

2.2.1 Video Midblock Count

A Miovision video camera counted vehicles at one midblock location (ADT 1) along SR 422 between the two study intersections. The video midblock count collected total two-way traffic volumes by hour on Tuesday, April 14, 2021 and Wednesday, April 15, 2021. The data was summarized by total two-way hourly traffic volumes by day ***(Exhibit 2)*** and by directional traffic volume by hour during an average weekday (***Exhibit 3***). The Average Annual Daily Traffic (AADT) along SR 422 is approximately 13,050 vehicles per day.

Exhibit 2: SR 422 Two-Way Hourly Volumes

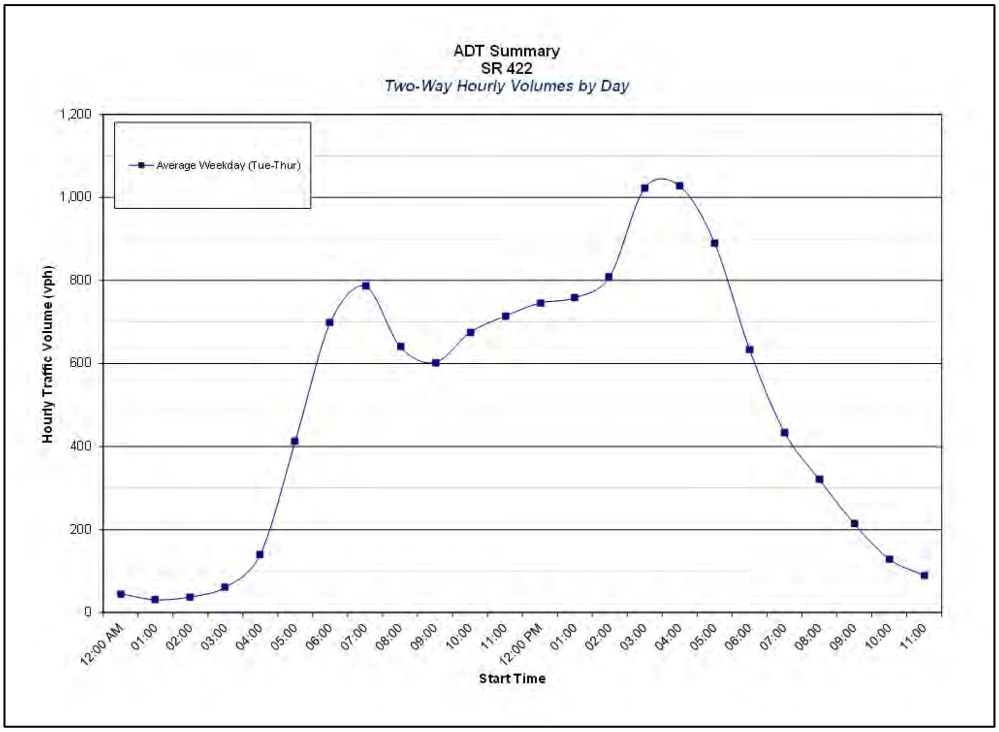
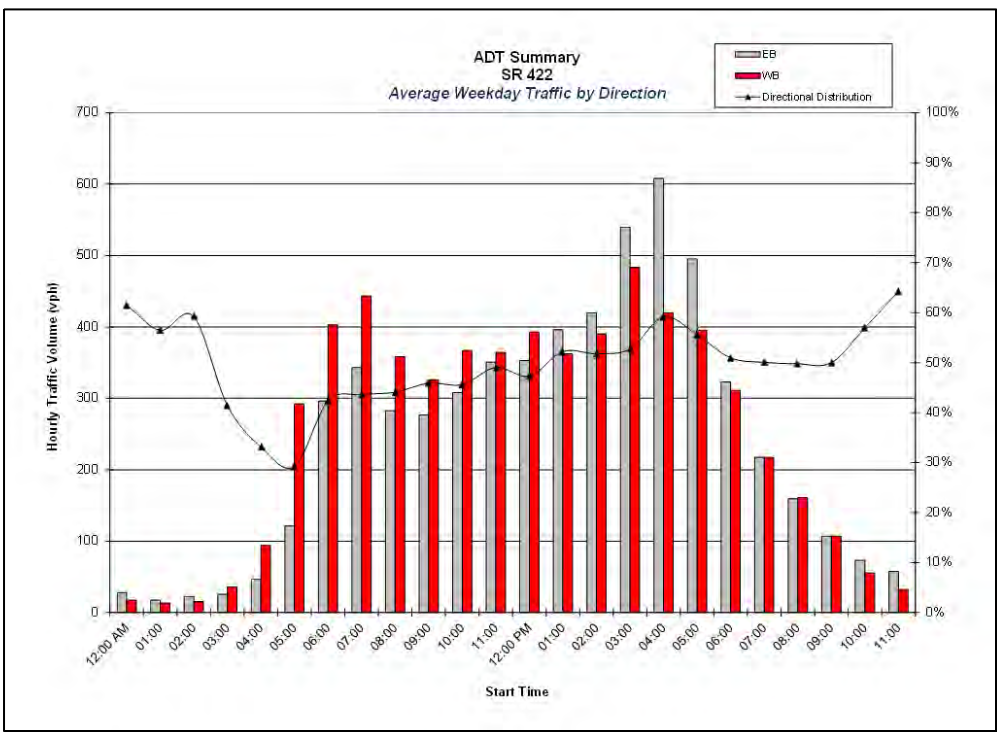


Exhibit 3: SR 422 Average Weekday Directional Traffic



2.2.2 Video Turning Movement Counts (TMCs)

Miovision video TMCs were conducted for six hours at each of the study intersections, two hours for each of the three peak periods. The TMCs were collected concurrently with the ADT to expedite the data collection process and to get consistent data. After the TMCs were collected and processed, the highest peak hour was determined by looking at each intersection's local peak hour and seeing what the most common trend for peak hours were. This was used to determine a global peak hour to use in the traffic models and for TMC balancing purposes. The one-hour peak hours are as follows:

- AM Peak – 7:00 am to 8:00 am
- MD Peak – 1:00 am to 2:00 pm
- PM Peak – 3:30 pm to 4:30 pm

The peak hour data (traffic volume, number of pedestrian and bicycles and percent trucks and buses) for each intersection was used in the traffic models. There were no pedestrians or bicycles recorded at the study intersections. Due to closely spaced intersections and limited number of side roads and / or driveways, the volumes were hard balanced so there were no volume differences between intersections.

2.2.3 COVID-19 Pandemic Correction

At the time of this analysis, the COVID-19 pandemic was ongoing, resulting in substantial traffic volume reductions nationwide, compared with pre-pandemic levels. Due to these impacts, real-time data collection was not to be used without an adjustment for the lower volumes (Strike Off Letter 494-20-04). To account for this drop-in traffic, volumes throughout the study area needed to be estimated through other methods.

To create reasonable traffic volumes throughout the study area, historic traffic counts were utilized. PennDOT's Traffic Information Respiratory (TIRe) ADT counts were compared to the collected ADT data. This was then used to grow the TMCs taken in April 2021 to the corrected pre-pandemic traffic volumes.

The TMCs were separately adjusted for each peak hour, but consistently for all intersections. The AM peak hour correction was determined to be an increase of approximately 26%. The midday peak hour correction was determined to be an increase of approximately 22%. The PM peak hour correction was determined to be an increase of approximately 18%. Lastly, a daily pandemic correction factor of an increase of approximately 5% was determined.

3.0 TRAFFIC ENGINEERING STUDIES

Various traffic engineering studies were conducted as part of this project ***(Appendix B)***. The field observations and engineering studies were collected to obtain field measurements related to the specific location which more accurately reflects the unique features of the local driving environment.

Field observations were recorded during the field view on April 15, 2021.

Queue length measurements usually are a piece of data used during model calibration and validation. Since these queues were measured during a pandemic, and expected to be lower than pre-pandemic queues, they were not utilized for calibration. The maximum observed queue was 7 vehicles at the along SR 422 during the weekday AM and PM peak period. Long queueing is not frequent for any movement in the study area.

Saturation flow rate represents the maximum number of vehicles per hour per lane that a signalized intersection can allow pass through if the green signal was on for a full hour, the queue was infinite, and the flow of vehicles was never stopped. There was not enough queued traffic to allow for saturation flow rate studies. The PennDOT Publication 46, Chapter 10 Pennsylvania default ideal saturation flow rate value for a suburban area type was utilized for calibration. The default ideal saturation flow rate of 1,800 vehicles per hour, per lane was used for all traffic models and all movements.

4.0 BASE TRAFFIC CONDITIONS ANALYSIS

Synchro and SimTraffic computer programs were used to perform capacity analysis and optimize the traffic signal timings. Synchro is a macroscopic capacity analysis and signal optimization computer program whereas SimTraffic is a microscopic traffic simulation computer program capable of modeling individual driver behavior and traffic flow on roadway networks.

After the Base Synchro Models of existing conditions were initially developed, the models were further refined to bring them in-line with field conditions (***Appendix C***). Synchro calibration and validation included using the default average ideal saturation flow rate of 1,800 vehicles per hour per lane.

The traffic flow and capacity were evaluated along SR 422 using Synchro 10 software. Due to limitations within the HCM 2010/6 methodology such as intersections with five or more approaches, exclusive pedestrian phases, complex controller operations, and detector placement; Synchro 10 was unable to report HCM 2010/6 LOS (Levels of Service). Instead, HCM 2000 LOS was reported from Synchro for all signalized intersections (***Appendix C***). Performance measures selected for this project include delay per vehicle and level of service (***Exhibit 4***).

Exhibit 4: Base Conditions Overall Intersections LOS

Node Number	Intersection	Peak Period	Base Model LOS (Average Delay) seconds	
100	SR 422 at Worthington-Slate Lick Road / Bear Road	AM	B	14.6
		MD	B	13.3
		PM	B	14.0
105	SR 422 at Claypoole Road	AM	B	12.4
		MD	B	14.0
		PM	B	14.9
(green)	=	LOS A, B, or C		
(yellow)	=	LOS D		
(orange)	=	LOS E		
(red)	=	LOS F		

The base model traffic operations show that there are no capacity issues, all study intersections operate acceptably, LOS B.

5.0 SIGNAL TIMING OPTIMIZATION

After the base conditions were established and evaluated, the next step was to evaluate the corridor and signals and try to solve the existing traffic concerns while planning for the future. The models were reviewed and updated for the future implementation year (2023) as indicated in the Scope of Work.

Evaluation of traffic signal phasing included reviewing vehicular and pedestrian signal operations. The two currently signalized intersections along SR 422 are all three phased operations.

Exhibit 5: Left Turn Phasing Calculations

Left Turn Phasing Calculations Summary						
Results based on both the 2 veh / cycle & Conflict Factor Threshold						
Intersection	**Movements**	**Existing Phasing**	**AM Peak**	**MD Peak**	**PM Peak**	**Recommendation**
			Calculated			
SR 422 at Worthington - Slate Lick Road / Bear Road	EB Left	Protected	Permitted	Permitted	Permitted	Protected
	WB Left	Protected	Permitted	Permitted	Permitted	Protected
	NB Left	Permitted	Permitted	Permitted	Permitted	Permitted
	SB Left	Permitted	Permitted	Permitted	Permitted	Permitted
SR 422 at Claypoole Road	EB Left	Protected	Permitted	Permitted	Permitted	Protected
	WB Left	Protected	Permitted	Permitted	Permitted	Protected
	NB Left	Permitted	Permitted	Permitted	Permitted	Permitted
	SB Left	Permitted	Permitted	Permitted	Permitted	Permitted

All left turns were evaluated for the intersections. Currently SR 422 at both study intersections have protected left turn phases (*Appendix D*). None of the left turns along SR 422 meet the conflict evaluation factors. It should be noted that the side street(s) only has a single lane and SR 422 is a higher speed corridor, 45 mph. A sight distance study is required to implement permitted left turn operations. Based on the speed limit, keeping protected left turns are recommended. Therefore, no changes are recommended for left turn phases (Exhibit 5).

5.1 Clearance Interval Review

Vehicle yellow change and red clearance intervals as well as Pedestrian Walk and Flashing Don't Walk intervals were reviewed as part of signal timing optimization. The computations were completed in accordance with PennDOT Publication 149M *Traffic Signal Design Handbook* procedures along with engineering judgment (***Appendix D***). The vehicle change and clearance intervals were modified in the optimized signal timing analysis if the calculations resulted in an increase when compared to the existing intervals.

5.1.1 Vehicle Yellow Change and Red Clearance

The vehicle yellow change and red clearance intervals are dependent upon posted speed limits, grades, width of intersection and engineering judgement. These intervals should be sufficient to allow a motorist to safely bring their vehicle to a stop under normal conditions, or if they are too close to stop, to proceed safely through the intersection.

The vehicle yellow change and red clearance intervals were modified in the optimized signal timing analysis if the calculations resulted in an increase when compared to the existing intervals (***Exhibit 6***). As documented above, a speed limit of 45 mph was used to calculate the yellow change and red clearance intervals along the entirety of SR 422. Any change in recommended clearance intervals are highlighted yellow.

Exhibit 6: Vehicle Yellow Change & Red Clearance Recommendations

Approach / Movement	Existing CCI'S				Proposed CCI'S			
	Permit Plan		Controller		Calculated		Recommended	
	Yellow Change Interval	Red Clearance Interval	Yellow Change Interval	Red Clearance Interval	Yellow Change Interval	Red Clearance Interval	Yellow Change Interval	Red Clearance Interval
100 - SR 422 at Worthington-Slate Lick Road/ Bear Road (SR 3011)								
EB SR 422	4.4	2.0	4.4	2.0	4.5	1.6	4.5	2.5
WB SR 422	4.4	2.0	4.4	2.0	4.3	1.8	4.5	2.5
NB Worthington-Stale Lick Rd	4.0	2.3	4.0	2.3	4.0	2.5	4.0	3.5
SB Bear Road	4.0	2.3	4.0	2.3	2.7	3.2	4.0	3.5
EBL SR 422	4.4	2.0	4.4	2.0	3.7	2.0	4.5	2.5
WBL SR 422	4.4	2.0	4.4	2.0	3.5	2.2	4.5	2.5
105 - SR 422 at Claypoole Road (SR 3009)								
EB SR 422	4.5	2.0	4.5	2.0	4.5	2.0	4.5	2.0
WB SR 422	4.5	2.0	4.5	2.0	4.5	1.8	4.5	2.0
NB Claypoole Road	3.7	2.5	4.0	2.3	3.3	2.9	4.0	3.0
SB Claypoole Road	3.7	2.5	4.0	2.3	3.7	3.0	4.0	3.0
EBL SR 422	4.5	2.0	4.5	2.0	3.8	2.0	4.5	2.0
WBL SR 422	4.5	2.0	4.5	2.0	3.8	1.8	4.5	2.0

5.1.2 Walk and Flashing Don't Walk

Pedestrian intervals are an integral part of every traffic signal especially where crosswalks and pedestrian signal indications are provided. The pedestrian phase should include a Walk interval and pedestrian change interval FDW (Flashing Don't Walk) sufficient to allow a pedestrian crossing the street to enter the crosswalk and travel to the far side of the traveled way being crossed.

The pedestrian clearance intervals were modified in the optimized signal timing analysis if the calculations resulted in an increase when compared to the existing intervals. These intervals are compared below (*Exhibit 7*). Any change in recommended "Walk" and "Flashing Don't Walk" are highlighted yellow.

Exhibit 7: Walk & Flashing Don't Walk Recommendations

Vehicle Approach	Crosswalk	Existing CCI'S				Proposed CCI'S			
		Permit Plan		Controller		Calculated		Recommended	
		WALK	Flashing DON'T WALK	WALK	Flashing DON'T WALK	WALK	Flashing DON'T WALK	WALK	Flashing DON'T WALK
100 - SR 422 at Worthington-Slate Lick Road/ Bear Road (SR 3011)									
EB SR 422	Southern	7	5	7	5	7	8	7	8
WB SR 422	Northern	7	5	7	5	7	8	7	8
NB Worthington-Stale Lick Rd	Eastern	7	18	7	18	7	22	7	22
SB Bear Road	Western	7	18	7	18	7	22	7	22
105 - SR 422 at Claypoole Road (SR 3009)									
EB SR 422	Southern	7	12	7	5	7	23	7	23
WB SR 422	Northern	7	12	7	5	7	23	7	23
NB Claypoole Road	Eastern	7	21	7	18	7	26	7	26
SB Claypoole Road	Western	7	21	7	18	7	26	7	26

5.2 EXISTING TRAFFIC OPERATIONAL CONCERNS

The consultant team met with PennDOT, Worthington Borough, and West Franklin Township on April 9, 2021. The following traffic operational concerns were discussed:

- Excessive side street delay time
- Signal equipment discussion (detection, signal ahead sign, and generator adaptor kit)

5.3 OPTIMIZED TIMING DEVELOPMENT

The base Synchro models were revised with future year 2023 traffic volumes and updated clearance intervals for comparison purposes. Next, the study corridor was evaluated to determine if both of the intersections should operate together. The advantages of operating in coordination are typically reducing the number of stops along the corridor, reducing travel time for mainline through traffic, and reducing signal delay for mainline through traffic. The disadvantages are typically an increase in delay for side streets and left turn movements.

Once the future volumes were generated, phasing evaluated, vehicle and pedestrian intervals reviewed and signal zones established, optimized timings were developed with existing traffic operational concerns in mind as well as improving operations for all users (***Exhibit 8***). The programmed maximum actuated cycle lengths for the two signals range from 94 to 98 seconds. There were instances with no side street/left turn demand, which resulted in longer mainline cycle lengths since there was no side street/left turn actuation. When there was side street/left turn actuation the average observed cycle length was approximately 70-90 seconds.

Exhibit 8: Zones & Cycle Lengths

Intersection	Dist. B/W Int. (feet)	Existing Synchro Actuated Cycle Lengths			Optimized Cycle Lengths (Scenario I Proposed)			Optimized Cycle Lengths (Scenario II Proposed)		
		AM	Midday	PM	AM	Midday	PM	AM	Midday	PM
100 – SR 422 at Worthington-Slate Lick Road / Bear Road	-	46.6	47.8	53.7	80	75	80	85	95	90
105 – SR 422 at Claypoole Road	2,290	42.8	51.0	56.3	80	75	80	85	95	90

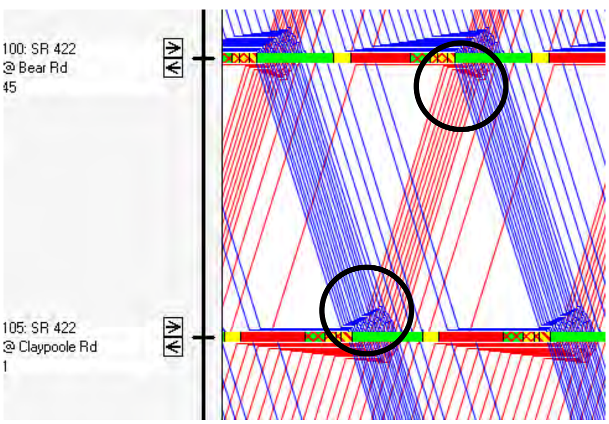
Optimized Scenario I utilized existing phasing sequence where the left turns always precede the through movement. Optimized Scenario II incorporates mainline lead/lag left turn phasing. A lagging left turn is when the left turn comes after the mainline through movement. The SPC Signals program has implemented numerous lagging left turn phases in PennDOT District 10.

Optimized Scenario II proposes lagging the westbound left turn at Worthington-Slate Lick Road / Bear Road and eastbound left turn at Claypoole Road. The other left turns remain leading (prior to the through movement). This phasing would be consistent for the duration of the day.

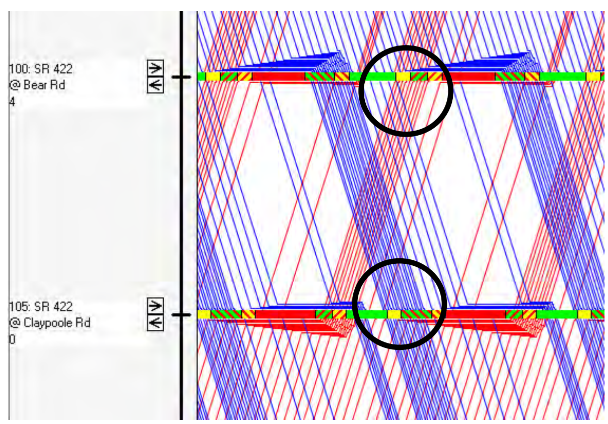
Both coordination strategies will limit the successive stopping along the SR 422 corridor, but Scenario II (lead/lag) provides better progression overall and is more flexible to varying side street demands. As show below, both EB (Blue) and WB (Red) traffic stutter (horizontal line; black circle) when approaching the downstream signal for Scenario I (existing phase sequence). If the side street demand is not as high, the platoon will be released earlier, which will also result in a longer stop at the adjacent signal since the platoon reaches the signal earlier and this scheme relies on the platoon using the beginning of the green time.

Scenario II shows no traffic stutter (no horizontal lines; black circle) at the adjacent signal. By lagging the internal left phases/turns, the coordination scheme will also be able to handle lighter side street traffic as the platoon reaches the adjacent signal in the back half of the split compared to the beginning (Scenario I). When the EB (Blue) and WB (Red) platoon crisscross in the middle of the roadway segment, as shown in the Optimized Scenario II, there is balanced progression. Additionally, if actuated, the internal left turn movement will be more efficiently serviced since the vehicle platoon will reach the left turn approximately at the time the lagging left turn is programmed to be actuated, which is at the end of the green time.

Optimized Scenario I



Optimized Scenario II



Both coordination scenarios use relatively tight/low cycle lengths that generally matched the field observed cycle length to meet the expectations of both side street and SR 422 commuters. The cycle lengths were balanced so that when present, side street commuters are not forced to idle too long but the cycle length long enough time to limit the stopping along SR 422.

The proposed signal timings did not accommodate pedestrian intervals. The signals will temporarily go to free operations to serve the pedestrian demand and will then return to coordination operations. The signal timing offset scheme was also developed with the goal to limit speeding along the corridor as the offsets were based on 45 mph posted speed limit.

5.4 Opening Year Operations

The recommended signal timings are anticipated to be implemented late 2022 or 2023. Therefore, the existing 2021 traffic volumes were grown by a linear growth rate provided by SPC's regional model for Worthington Borough and West Franklin Township. There are no known developments / Traffic Impact Studies along the corridor to further increase the traffic volumes during implementation. Traffic flow and capacity were evaluated along SR 422, using Synchro 10 software (***Appendix E*** & ***Exhibit 9***). Performance measures selected for this project include delay per vehicle and level of service.

Exhibit 9: Overall Intersection LOS Comparisons

Node Number	Intersection	Peak Period	Base Rev	Optimized Scenario I	Optimized Scenario II
100	**SR 422 at Worthington- Slate Lick Road / Bear Road**	**AM**	16.1 (B)	14.2 (B)	15.3 (B)
		MD	14.8 (B)	14.0 (B)	14.9 (B)
		PM	15.4 (B)	16.0 (B)	14.9 (B)
105	**SR 422 at Claypoole Road**	**AM**	11.9 (B)	11.8 (B)	11.6 (B)
		MD	14.6 (B)	14.0 (B)	16.8 (B)
		PM	15.5 (B)	14.7 (B)	15.7 (B)
(green)	**=**	**LOS A, B, or C**			
(yellow)	**=**	**LOS D**			
(orange)	**=**	**LOS E**			
(red)	**=**	**LOS F**			

The future year model traffic operations show that all study intersections still operate acceptably in the future, LOS B.

5.5 Comparison of Results

The base revised Synchro models were compared to the optimized timings to predict and show the benefits of signal re-timing ***(Exhibit 10, Exhibit 11, & Exhibit 12).*** The performance measures for comparison purposes includes overall network delays (which encompasses pedestrians and side street traffic), network stops, and comparison of SR 422 through traffic travel time and delays.

Exhibit 10: Overall Network Delays

1 HOUR PEAK NETWORK DELAY (HOURS)					
PEAK PERIOD	BASE REVISED SYNCHRO MODELS	OPTIMZED SCENARIO I SYNCRHO MODELS	% CHANGE	OPTIMZED SCENARIO II SYNCRHO MODELS	% CHANGE
AM PEAK	9	8	**11%**	8	**11%**
MD PEAK	10	8	**20%**	10	**0%**
PM PEAK	13	12	**8%**	12	**8%**

Exhibit 11: Overall Network Stops

1 HOUR PEAK NETWORK STOPS					
PEAK PERIOD	BASE REVISED SYNCHRO MODELS	OPTIMZED SCENARIO I SYNCRHO MODELS	% CHANGE	OPTIMZED SCENARIO II SYNCRHO MODELS	% CHANGE
AM PEAK	1388	1199	**14%**	987	**29%**
MD PEAK	1405	1154	**18%**	1008	**28%**
PM PEAK	1820	1606	**12%**	1363	**25%**

Exhibit 12: Arterial LOS for SR 422 Through Traffic

Performance Measure	Direction	AM Peak			MD Peak			PM Peak		
		Base w/ Rev Vol's & CCI's	Optimized Scenario I	Optimized Scenario II	Base w/ Rev Vol's & CCI's	Optimized Scenario I	Optimized Scenario II	Base w/ Rev Vol's & CCI's	Optimized Scenario I	Optimized Scenario II
Signal Delay (seconds)	EB	20.6	15.0	14.1	20.6	12.0	14.7	23.0	15.8	17.1
	WB	27.9	14.7	16.9	32.2	20.3	20.7	35.0	21.8	22.9
	% Change	-	**27%**	**32%**	-	**42%**	**29%**	-	**31%**	**26%**
		-	**47%**	**39%**	-	**37%**	**36%**	-	**38%**	**35%**
Travel Time (seconds)	EB	102.7	97.1	96.2	102.7	94.1	96.8	105.1	97.9	99.2
	WB	128.5	115.3	117.5	132.8	120.9	121.3	135.6	122.4	123.5
	% Change	-	**5%**	**6%**	-	**8%**	**6%**	-	**7%**	**6%**
		-	**10%**	**9%**	-	**9%**	**9%**	-	**10%**	**9%**

As can be seen in the comparison tables, both optimized timings scenarios should reduce overall network delay for all intersections. The through traffic on SR 422 should have reduced travel times and delay with a reduction of stops. Both optimized scenarios have comparable benefits to the base revised condition. Between the two scenarios, the first scenario generally has better delays and travel time, while Scenario II has more improved stops.

With the low baseline travel times and delays, the driver frustration along the corridor is more likely tied to successive stops at the two signals. Improving traffic progression, especially Scenario II, will provide noticeable benefit in terms of stops for the commuters. Reduction of stops improves environmental metrics and reduces the likelihood of rear end crashes and could potentially encourage higher speeds.

6.0 RECOMMENDATIONS

The following short-term recommendations would involve minimal capital costs and return immediate improvements in delay and safety within the project area.

6.1 SHORT-TERM RECOMMENDATIONS

The short-term recommendations are broken down into equipment and design recommendations and optimized signal timing recommendations.

6.1.1 Equipment and Design Recommendations

The equipment and design recommendations to coordinate traffic signals along SR 422 are shown in (***Exhibit 13***). Red text are new recommendations since initial scoping based on Preliminary Engineering field view or kick-off meeting requests.

Exhibit 13: Equipment Recommendations

#	Intersection	Recommended Equipment
100	SR 422 at SR 3011 (Worthington- Slate Lick Road / Bear Road)	• Add GPS unit • Add a UPS/ battery backup system • Replace the electrical service/ electrical disconnect boxes • Replace faded stop bar and crosswalk pavement markings • Replace all vehicular signal heads with new LED signal heads and add high visibility vehicular signal backplates • Replace all pedestrian signals with new LED countdown signals • Replace the entire controller cabinet assembly with a new pole mounted NEMA assembly (w/ generator adaptor kit) • Replace the rusted cabinet conduit elbow • Replace all pedestrian push buttons with new ADA compliant push buttons • Potential radar detection upgrade along SR 422 (if budget allows) • Potential upgrades to Signal Ahead Sign (if budget allows)
105	SR 422 at SR 3009 (Claypoole Road)	• Add GPS unit • Add a UPS/ battery backup system • Replace the electrical service/ electrical disconnect boxes • Replace all vehicular signal heads with new LED signal heads and add high visibility vehicular signal backplates • Replace all pedestrian signals with new LED countdown signals • Replace faded stop bar and crosswalk pavement markings • Replace the entire controller cabinet assembly with a new pole mounted NEMA assembly (w/ generator adaptor kit) • Replace the rusted cabinet conduit elbow • Replace all pedestrian push buttons with new ADA compliant push buttons • Potential radar detection upgrade along SR 422 (if budget allows) • Potential upgrades to Signal Ahead Sign (if budget allows)

6.1.2 Signal Timing Recommendations

The recommendations identified from the capacity analysis are as follows:

- Revise the existing yellow change, red clearance, Walk and Flashing Don't Walk intervals with the recommended intervals where applicable (*Appendix D* & *Section 5.1*).
- Revise the traffic signal timings including cycle lengths, splits, and offsets. The optimized scenario shall be selected by PennDOT/municipalities at the draft report meeting.

Based on the traffic volumes and directional flow from the ADT data (Appendix B & Section 2.2), the following timing plans are recommended by time of day (*Exhibit 14*).

Exhibit 14: Recommended Coordination Schedule

	Existing Schedule		Proposed Schedule	
Weekday (M-F)	All Day	Free	6:15 AM - 9:15 AM	AM Plan
			9:15 AM – 11:00 AM	Free
			11:00 AM - 2:30 PM	MD Plan
			2:30 PM - 6:30 PM	PM Plan
			All other times	Free
Weekend	All Day	Free	All Day	Free

7.0 DISCUSSION & CONCLUSIONS

Following additional coordination between SPC, PennDOT District 10-0, Worthington Borough, West Franklin Township, and the consultant team, including a final review (Draft Report) meeting on August 12th, 2021, to discuss items from the Kick-Off Meeting from April 28th, 2021 and to discuss the Draft Report.

7.1 Discussion

SPC and PennDOT voiced a few concerns of existing traffic operational issues. Those concerns were addressed and discussed at the Draft Report Meeting.

7.1.1 Evaluation of Traffic Operational Concerns

The recommended optimized timings were reviewed to determine whether all the concerns expressed by the committee have been addressed:

- Yellow and Red intervals were calculated by the longest intersection width to clear the intersection.
- Due to the low pedestrian counts at the intersections, pedestrian timings were not factored into the optimization. The signals will drop out of coordination to serve the pedestrian intervals and then the signals will return to coordination after the pedestrian phase/intervals.
- Since the municipalities have received complaints about the side street delay time, shorter cycle lengths (ie. 60 or 65 seconds) were investigated. However, due to potential lane imbalance after COVID, a shorter cycle length may be too quick to allow the observed higher volume right lane to clear. Also, the signal ahead sign requires an internal 17-21 seconds of additional clearance (green overlap), which would limit a low the cycle length.
- PennDOT would like to WRA investigate starting the midday coordination plan 11:00 AM instead of 9:15 AM. The start time of the midday coordination plan is to be monitored during implementation. The recommended coordination schedule was revised to have a free period between 9:15 and 11 AM.

7.2 Conclusions

The final review meeting discussed the contents of the Draft Report, including the proposed timings and recommended equipment upgrades. SPC, PennDOT District 12-0, Worthington Borough, West Franklin Township, and the consultant team are in agreement to move forward into Final Design with the project's short-term recommendations as detailed in the previous chapter with the following revisions, clarifications, or additions:

Draft Report Meeting

The final review meeting, meeting notes are included in Appendix F.

a. Revisions:

- There was a meeting with PennDOT District 10-0 on September 24, 2021 to discuss the advance overhead signal warning sign. It was determined to replace the internally illuminated sign with a static sign and LED border if budget allows. The overhead sign would still be the W3-3 "Signal Ahead Sign". The sign installation will resemble this sign (Exhibit 15) along US 19 near Tollgate School Rd except the sign will be mounted aerially on the existing mast arms. The existing flashing yellow signal heads will remain. The signal controller programming will be updated to remove additional clearance of the calculated travel time/flashing time between the overhead sign and applicable signal. This would improve traffic operations at the intersection as the side street traffic would no longer need to wait for the flashing time before proceeding to its signal phase during uncoordinated actuated operations.

  To provide additional guidance, PennDOT would like to install a distance ahead sign below the W3-3 sign. If there is adequate vertical clearance, the distance ahead plaque will be added beneath the aerial sign. If there is insufficient vertical clearance, an additional post mounted W3-3 sign and distance ahead plaque will be installed on the outside shoulder.

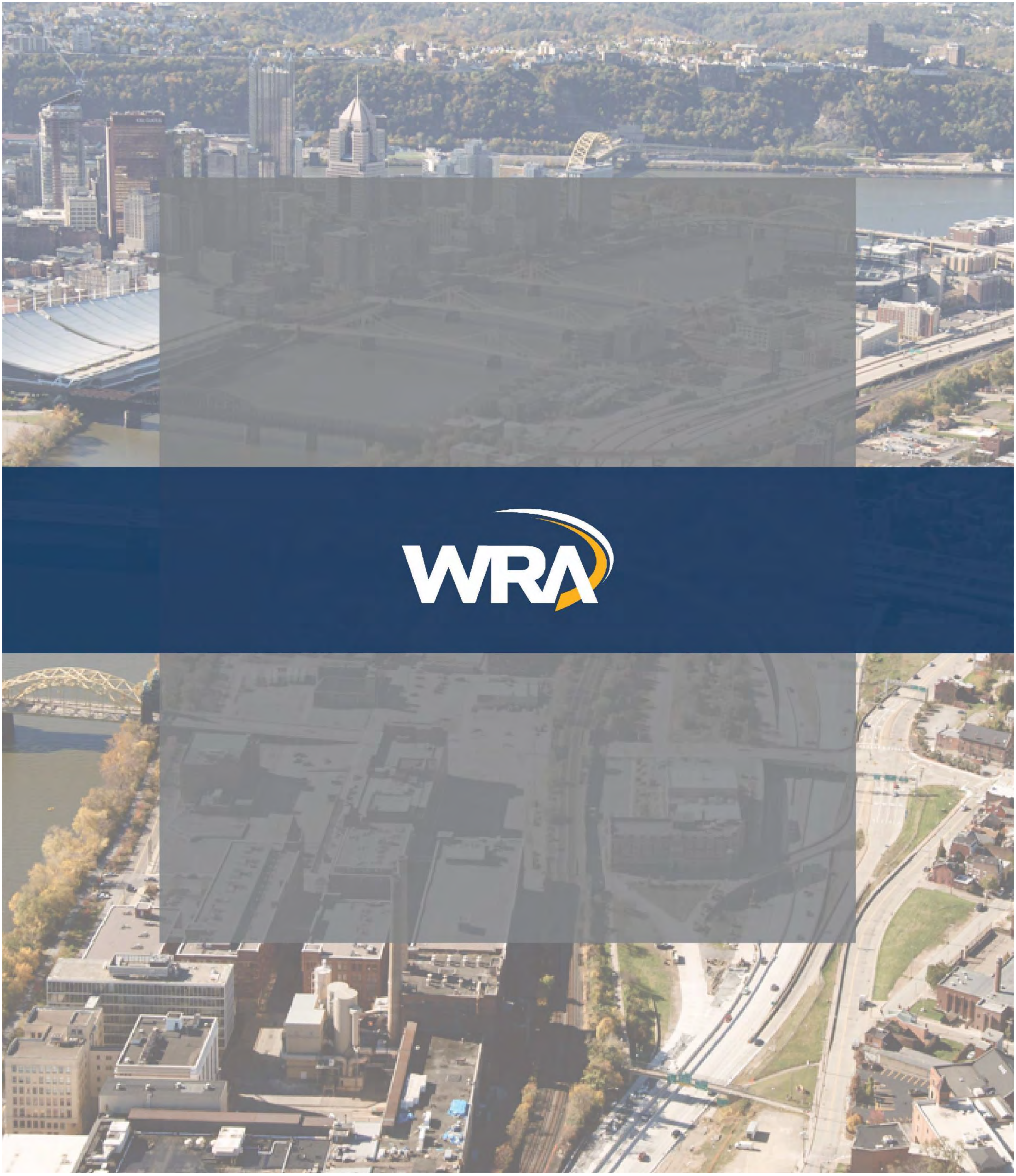
Exhibit 15: W3-3 Signal Ahead Sign

- As shown in Appendix G, the TE-672 "Pedestrian Accommodation at Intersections Checklist" form was completed as a combined form for the intersection documenting the need to keep the pedestrian accommodations at the intersection. This project will upgrade the pedestrian push buttons and upgrade the pedestrian signal heads to countdowns. This study documented a pedestrian count at the Claypoole Road intersection and the municipalities noted pedestrian activity at both intersections.

b. Clarifications:

- Implementing scenario 1, leading left operations, was agreed upon by all parties.
- Worthington Borough and West Franklin Township would like to upgrade the detection type to radar along SR 422, if budget allows.
- Signal Ahead changes documented on the previous page will be implemented if budget allows.
- All equipment and timings were agreed upon.

Field-implementation of the short-term recommendations and proposed timings for this corridor will most likely be completed during the Fall of 2022. The timings shown in this report and coordination schedule will be the starting point for implementation. All final timings, schedule changes and any equipment additions / modifications will be reflected on As-Built plans following implementation. An ***After Study*** documenting **Final** Before & After conditions will be submitted separately showing the benefits of this project. The estimated preliminary benefits are discussed in previous Section 5.0.


WRA