



Closed Loop Traffic Signal Systems Analysis: US 1 and PA 352 in Delaware County, Pennsylvania



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Executive Summary

This closed loop traffic signal system evaluation project is a collaborative effort of a steering committee comprised of the Delaware Valley Regional Planning Commission (DVRPC), the Delaware County Planning Department, the Pennsylvania Department of Transportation (PennDOT), McMahon Associates (working on behalf of PennDOT), and Middletown Township in Delaware County, Pennsylvania. This report examines the successful retiming effort of the current 10-signal closed loop system along US 1/Baltimore Pike and PA 352/Middletown Road in Delaware County, Pennsylvania, which has improved the system's overall performance. The results presented in this report are a compilation of all efforts from the participating agencies.

Measures of effectiveness for retiming the system include intersection level of service improvements, air quality improvements, and travel time savings. All intersections that performed poorly in the system benefited from optimized signal timings with better levels of service. Total vehicle emissions were reduced for the system. Overall travel time savings of 32 percent eastbound and 31 percent westbound in the peak AM hour, and 48 percent eastbound and 18 percent westbound in the peak PM hour were achieved along US 1. For the eastbound direction of PA 352, overall travel time savings of 28 percent in the peak AM hour and 55 percent in the peak PM hour were accomplished. Travel time along westbound PA 352 did not dramatically improve in either the peak AM or PM hours.

Background

Poor traffic signal timing accounts for an estimated 10 percent of all traffic delay—about 300 million vehicle-hours—on major roadways alone.¹ It can also contribute to an escalation in harmful emissions due to an increase of delays while waiting at poorly timed signals. Although it is well documented that retiming closed loop traffic signal systems is one of the easier and least costly ways to improve travel along a corridor, it is rarely accomplished on a regular schedule due to staffing constraints either on behalf of a municipality or a department of transportation. Another limitation may be a municipal engineering department's inexperience with operating a closed loop traffic signal system and/or maintaining the system. However, there are more than 330,000 traffic signals in the United States, and, according to U.S. Department of Transportation estimates, as many as 75 percent could be made to operate more efficiently by adjusting their timing plans, coordinating adjacent signals, or updating equipment.² Research has shown up to a 40 to 1 benefit-to-cost ratio for retiming traffic signal systems.

¹ U.S. Department of Transportation, Oak Ridge National Laboratory, "Temporary Losses of Highway Capacity and Impacts on Performance: Phase 2," Oakridge National Laboratory Report No. ORNL/TM-2004/209, Oak Ridge, TN: November 2004.

² U.S. Department of Transportation, "Intelligent Transportation Systems for Traffic Signal Control: Deployment Benefits and Lessons Learned." FHWA-JPO-07-004, January 2007, EDL# 14321, www.its.dot.gov/jpodocs/repts_te/14321.htm

One element of Intelligent Transportation Systems (ITS) is retiming closed loop traffic signal systems. According to DVRPC's Transportation Operations Master Plan, optimizing traffic signal operations is an objective to meet the goal of reducing traffic congestion through improved traffic management. More specifically, the plan suggests strategies such as systematically retiming traffic signals on priority networks and active monitoring of traffic signal systems. Therefore, incorporating ITS into the planning, design, and operation of traffic signal control systems will provide motorists with recognizable improvements in travel time, lower vehicle operating costs, and reduced vehicle emissions.³

The US 1/PA 352 closed loop traffic signal system was chosen based on a solicitation of municipalities in Delaware County from DVRPC and the Delaware County Planning Department. After a short list of potential candidates, PennDOT was consulted, and it was agreed upon by all parties that this 10-signal closed loop traffic signal system would be the best choice. It is a fairly new system, yet it does not have updated timings.

Project Outline

The steering committee met many times to discuss the process of retiming the closed loop traffic signal system. The following is a short description of the steps taken to complete this project. These steps are further described in subsequent chapters.

- ◆ Existing information was gathered, including previous traffic impact study reports conducted for the township, traffic counts, Synchro files, and travel time runs.
- ◆ Where applicable, new traffic counts were collected to supplement existing data.
- ◆ Synchro software was utilized as a tool for optimizing new traffic signal timings for the corridor.
- ◆ Optimum signal timing plans were selected, inputted into the local controllers, and field adjusted.
- ◆ New signal timings were given a trial period for study.
- ◆ "After" travel time runs were conducted to compare with the "before" runs.

³ Paulson, S. L., "Managing Traffic Flow through Signal Timing," Public Roads, January/February 2002. Article: www.tfhrc.gov/pubrds/janfeb02/timing.htm

Existing Conditions

Transportation Network

DVRPC's Congestion Management Process (CMP) is a systematic process to identify congestion and its causes, propose mitigation strategies, and evaluate the effectiveness of implemented strategies. The most recent CMP, adopted by the DVRPC Board in December 2008, identifies congested corridors and multimodal strategies to mitigate congestion. This study area is in CMP Corridor 5B–US 1 west of PA 252. “Closed Loop Computerized Traffic Signals” is considered a “Very Appropriate Strategy” for this subcorridor.

Major traffic generators such as the Granite Run Mall, Riddle Memorial Hospital, and the PennState Brandywine Campus are included in the study area. The following are descriptions of the transit, roadway, and traffic signal networks.

Transit

SEPTA Bus Routes 110, 111, 114, and 117 service the study area. All of these routes pass through the signalized intersections studied in the closed loop traffic signal system.

Arterial Network

US 1

Also known as Baltimore Pike, this roadway is a principal arterial in the study area. It generally provides two lanes in each direction throughout the corridor, with turn lanes at intersections. The posted speed limit is 45 miles per hour (mph). Although US 1 traverses the study area in an east-west orientation, it is designated as a north-south roadway over its entire length. Within the study area, US 1 provides access to two major traffic generators: the Granite Run Mall and Riddle Memorial Hospital. DVRPC conducted traffic counts in November 2008, which showed an Average Annual Daily Traffic (AADT) of 18,600 vehicles in the westbound direction and 18,000 vehicles in the eastbound direction.

PA 352

Also known as Middletown Road, this roadway is generally a two-lane principal arterial in the vicinity of the study area. PA 352 is designated as a north-south route, but for the purposes of this report it will be referred to as an east-west facility because of its orientation in the study area. It intersects US 1 at a grade-separated interchange and PA 452 at an at-grade intersection. It provides access to the Granite Run Mall and the PennState Brandywine Campus to the west of the study area. Thirty-five mph is the posted speed limit. Traffic counts that DVRPC conducted in March 2007 yielded an AADT of nearly 11,000 vehicles in the eastbound direction, and just over 12,000 vehicles in the westbound direction.

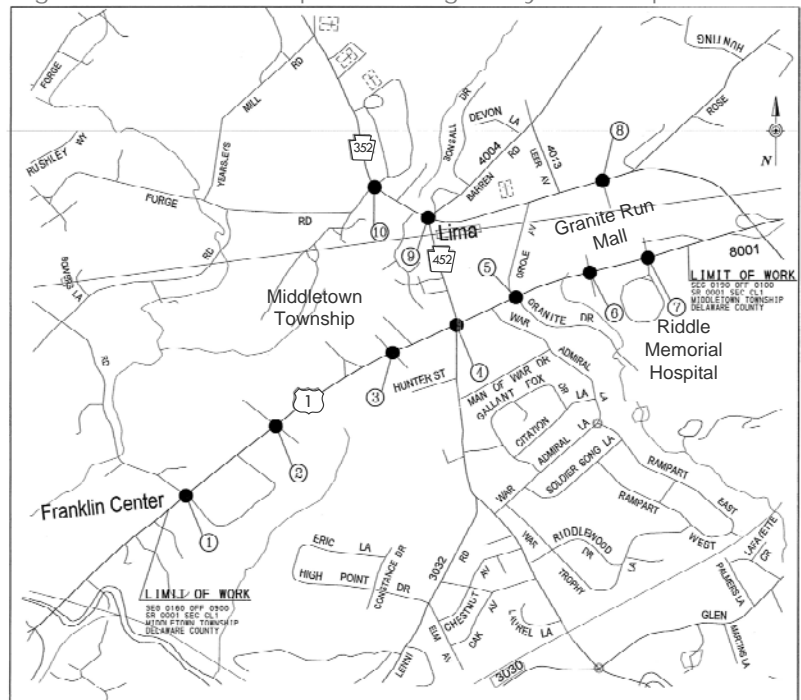
PA 452

Also known as Pennell Road, this is a north-south two-lane roadway in the study area with a posted speed limit of 35 mph. It intersects both US 1 to the south and PA 352 to the north, where it continues as Barren Road. Its AADT of about 10,000 vehicles was based on DVRPC traffic counts conducted in November 2008.

Closed Loop Traffic Signal System

Middletown Township operates a 10-signal closed loop traffic signal system, as depicted in **Figure 1**, encompassing the signalized intersections described in the next section. Basically, a closed loop traffic signal system is one that physically connects, through fiber optic cables, a series of traffic signals to a master controller, which is then monitored by the central monitor. In this case, the central monitor is placed in the Middletown Township Building, located on PA 452/Pennell Road, near the intersection of US 1. The US 1/PA 452 intersection is the master controller from which the nine other signals are timed. The signals are split into two zones, which are coordinated from the master controller. The seven signals along US 1 comprise the first zone and the three remaining signals along PA 352 make up the second zone.

Figure 1: Closed Loop Traffic Signal System Map



Source: PennDOT

The seven signals along US 1 comprise the first zone and the three remaining signals along PA 352 make up the second zone.

All intersections operate under actuated-coordinated control, which means that all signals are coordinated with each other and actuated as necessary with loop detectors at select approaches.

System loop detectors are located at four key intersections in the system, at each end of the zones: at intersections one, seven, ten, and eight. These system detectors send traffic volume data to the master controller for calculation of the duration of the minimum green time based on actual traffic demand. A volume-density detector is also located at intersection one. Both types of detectors have their data recorded and retained in the central monitor.

Signalized Intersections

The following signalized intersections compose the closed loop traffic signal system and are numbered based on the closed loop traffic signal layout, as shown in **Figure 1**.

1: US 1 and Valley Road

The first intersection in the system is included as part of the first zone of signals. It provides access to the Wawa Dairy and old Franklin Mint sites. This intersection also contains system and volume-density detectors along US 1 in the through lanes in both the eastbound and westbound approaches into the intersection. Since the old Franklin Mint site is no longer occupied, very little traffic uses the northbound approach.

2: US 1 and ACTS Driveway

The second intersection in the system is also in the first zone of signals. This intersection provides access to the Granite Farms Estate residential development north of the intersection, and the Pennsylvania State Police Media Barracks to the south. It is located 1,526 feet east of the first intersection.

3: US 1 and Executive Plaza Drive

The third intersection in the system, located 1,600 feet east of the previous intersection, is part of the first zone of signals. This intersection provides access to a car dealership and YMCA, both north of the intersection.

4: US 1 and PA 452

The fourth intersection in the system, and included as part of the first zone of signals, is the master controller for Middletown Township's closed loop traffic signal system. This is a major intersection, located 1,480 feet east of the third intersection.

5: US 1 and Oriole Avenue/Granite Drive

The fifth intersection in the system is also part of the first zone of signals. This intersection provides access to some commercial and residential developments. It is located 890 feet east of the previous intersection.

6: US 1 and Granite Run Mall Access

The sixth intersection in the system is included in the first zone of signals. This intersection provides access to the Granite Run Mall and mixed-use development. It is located 965 feet east of the fifth intersection.

7: US 1 and Riddle Memorial Hospital/Granite Run Mall Access

The seventh intersection in the system is part of the first zone of signals. This intersection provides access to the Granite Run Mall and Riddle Memorial Hospital. This intersection also contains system detectors along US 1 in the through lanes for both the eastbound and westbound lanes exiting the intersection. It is located 946 feet east of the previous intersection.

8: PA 352 and Granite Run Mall Access

The eighth intersection in the system is included as part of the second zone of signals. This intersection provides access to the Granite Run Mall, and also contains system detectors along PA 352 in the through lanes for both the eastbound and westbound lanes into the intersection.

9: PA 352 and PA 452

The ninth intersection in the system is part of the second zone of signals. It is located 2,411 feet west of the eighth intersection and 1,041 feet east of the Old Forge Road intersection.

10: PA 352 and Old Forge Road

The 10th intersection in the system is part of the second zone of signals. This intersection provides access to the Fair Acres (Delaware County Senior Assisted Living) residential development. Continuing west along PA 352 is the PennState Brandywine campus. This intersection also contains system detectors along PA 352 in the through lanes for both the eastbound and westbound lanes exiting the intersection.

Traffic Counts

Since the existing timings were based on old vehicular traffic counts, new counts needed to be taken. Recent traffic counts from three traffic impact studies supplied by Middletown Township

were supplemented with new counts taken by DVRPC in 2008 for the peak AM and PM periods. All traffic counts were looked at holistically and relatively balanced among the network. Peak AM and PM hour traffic volumes used in this analysis are shown in **Figures 2 and 3**.

Figure 2: Peak AM and PM Hour Traffic Volumes for US 1 (Zone 1)

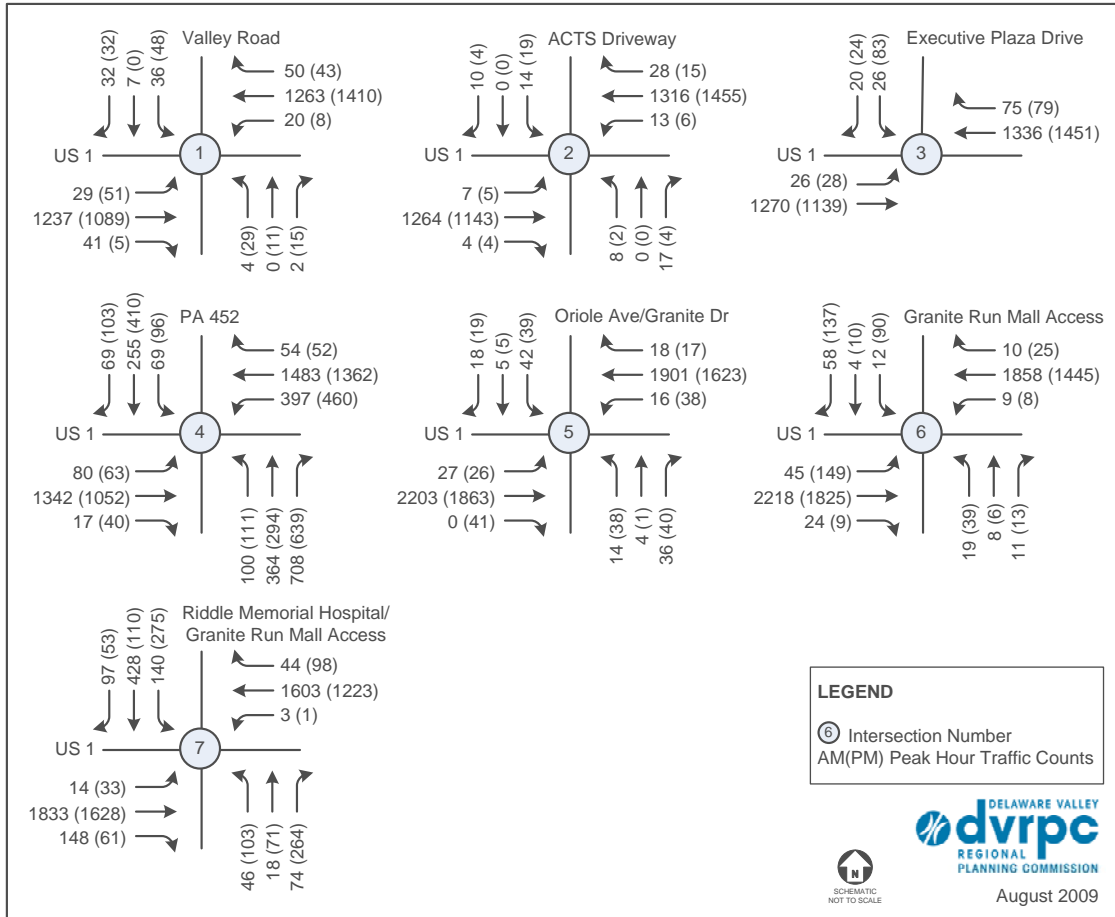
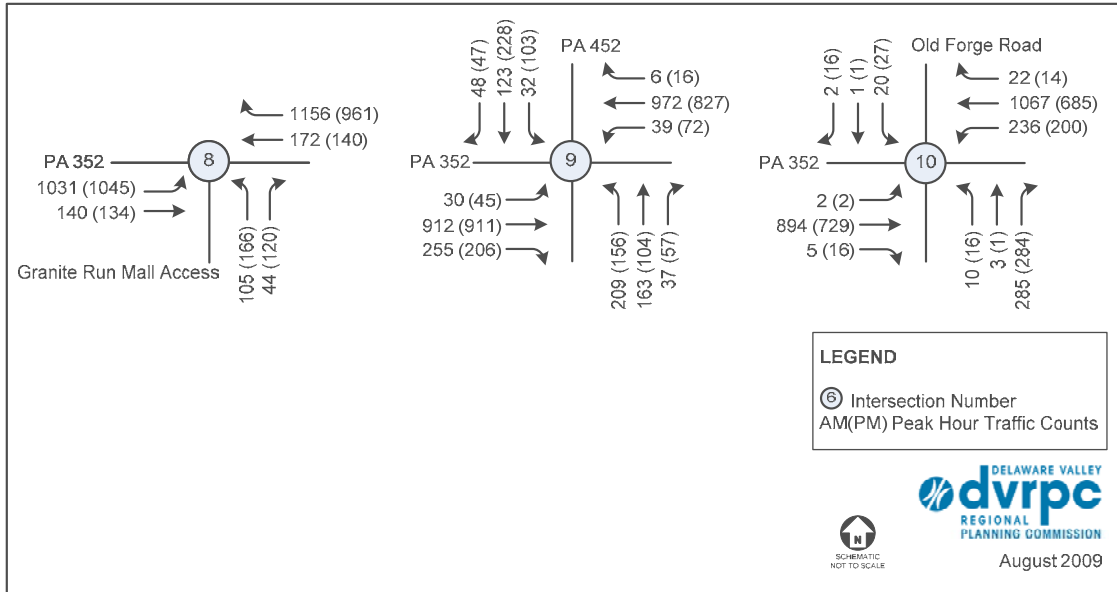


Figure 3: Peak AM and PM Hour Traffic Volumes for PA 352 (Zone 2)



Level of Service

Level of Service Methodology

Level of service (LOS) analysis is a common tool for assessment of transportation facilities and is used extensively in this report. This evaluation of the 10-signal closed loop traffic signal system in Middletown Township was conducted using the LOS procedure. When applied as a measure of performance for an intersection, LOS has a precise meaning: the average delay experienced by a vehicle traveling through the intersection or a specific component of it. In other words, LOS is a reflection of the average delay experienced by vehicles traversing an intersection. LOS analysis is a qualitative measure of operational conditions within a traffic stream. There are six defined LOS, A to F, which describe operations from best to worst for the facility under analysis. These levels are defined in terms of parameters perceived by drivers, as well as a range of operating conditions. The exact parameters of delay that determine the various LOS categories for a signalized intersection are displayed in **Table 1**.

Table 1: Level of Service Criteria for Signalized Intersections

Signalized Intersection LOS	Expected Traffic Delay	Delay (Seconds/Vehicle)
A (Desirable)	Very low delay, good progression; most vehicles do not stop at the intersection.	≤ 10
B (Desirable)	Good signal progression and/or short cycle length; more vehicles stop at the intersection than LOS A.	>10 – 20
C (Desirable)	Fair progression and/or longer cycle length; some vehicles stop at the intersection.	>20 – 35
D (Acceptable)	Congestion becomes more noticeable; individual approaches may experience cycle failures; longer delays from unfavorable progression, long cycle length, or high volume/capacity ratio; most vehicles stop at the intersection.	>35 – 55
E (Undesirable)	Usually considered the limit of acceptable delay indicative of poor progression, long cycle length, or high volume/capacity ratio; frequent individual cycle failures.	>55 – 80
F (Unsatisfactory)	Could be considered excessive delay in some areas, frequently an indication of oversaturation (i.e., arrival flow exceeded capacity), or very long cycle lengths with minimal side street green time. Capacity is not necessarily exceeded under this LOS.	>80

Source: Descriptions adapted from Highway Capacity Manual 2000

The LOS review of existing conditions and the retimed scenario was conducted using Synchro software for the project intersections. Synchro is a macroscopic traffic signal timing tool that can be used to optimize signal timing parameters for isolated intersections, arteries, and networks. For signalized intersections, Synchro software calculates a control delay and a queue delay. The control delay is calculated by a percentile delay method; this approach uses formulas from the industry standard Highway Capacity Manual (HCM) to calculate delay; however, the final delay measure is taken from an average of the 10th, 30th, 50th, 70th, and 90th percentile volume levels. As a result, the calculated delay is a product of the various operating conditions that a signal may actually encounter. The queue delay is utilized whenever two signalized intersections are located within a critical distance of one another. If the intersections are within that distance, then calculations are made to determine the extent to which queue interaction (such as queue spillback and queue blocking) reduce capacity and, consequently, increase delay.

Necessary information for determining delay and LOS measures include turning movement counts, roadway geometry, signal plans, and timing permits. Traffic count data was obtained by a combination of existing data and new counts gathered by DVRPC. Signal plans and timing permits were supplied by Middletown Township.

Existing Level of Service

In order to fully understand the operational conditions within the study area, the peak AM and PM LOS was evaluated as a system of all intersections within the closed loop traffic signal system. Existing conditions of the study area were analyzed by DVRPC using updated traffic volumes in order to evaluate the current traffic operations. The peak-hour volume data, as well as traffic

signal information, was analyzed using Synchro software to determine overall LOS for existing conditions, as shown in **Table 2**. Detailed Synchro reports, including individual approach delays and LOS for existing conditions, are contained in **Appendix A**.

Table 2: Overall Existing Level of Service – Peak AM and PM Hours

Intersection	Peak AM Hour		Peak PM Hour	
	Delay (sec/veh)	Overall LOS	Delay (sec/veh)	Overall LOS
1: US 1 and Franklin Mint	11.3	B	6.8	A
2: US 1 and ACTS Driveway	11.0	B	4.4	A
3: US 1 and Executive Drive	2.8	A	7.4	A
4: US 1 and PA 452	94.2	F	83.4	F
5: US 1 and Oriole Avenue/Granite Drive	7.1	A	7.7	A
6: US 1 and Granite Run Mall Access	7.1	A	14.0	B
7: US 1 and Riddle Memorial Hospital	27.3	C	23.3	C
8: PA 352 and Granite Run Mall Access	18.2	B	29.7	C
9: PA 352 and PA 452	75.5	E	65.1	E
10: PA 352 and Old Forge Road	19.8	B	15.2	B

Source: DVRPC, 2009

For existing conditions in both the peak AM and PM hours, the two poorest operating intersections are ones that cross PA 452: the intersection of US 1 at PA 452 and the intersection of PA 352 at PA 452. For the US 1/PA 452 intersection, in both the peak AM and PM hours, the worst performing approaches, with LOS F, include the US 1 eastbound through movement, the US 1 westbound left-turn movement, and the PA 452 southbound through/right-turn movement. Additionally, the PA 425 northbound through and right-turn movements fail in the peak AM hour. For the PA 352/PA 452 intersection, in both the peak AM and PM hours, the PA 352 eastbound approach operated at failing conditions.

Since the US 1/PA 452 intersection is the master controlling intersection for the closed loop traffic signal system, it is critical to improve its operation.

Optimized Signal Timings

Methodology

The closed loop traffic signal system's overall LOS performance was improved by optimizing the network using Synchro software, updating clearance interval calculations, and altering cycle lengths to maximize throughput along US 1 and PA 352.

In existing conditions, intersections along US 1 operated at 100- and 80-second cycle lengths in the peak AM and PM hours, respectively. In the optimized scenario, cycle lengths were increased along US 1 to 110-second cycle lengths for both the peak AM and PM hours. Along PA 352, intersections operated at 115- and 90-second cycle lengths in the existing conditions for the peak AM and PM hours, respectively. In the improvement scenario, the cycle length for intersections along PA 352 for only the peak AM hour increased to a 120-second cycle length. The peak PM hour cycle length for PA 352 remained unchanged.

The steering committee agreed on new timing plans for the signals. After field adjusting some intersections as needed, traffic timing permits were altered and approved by PennDOT for implementation during peak AM and PM periods. Midday peak-period timings were previously not part of the system's timing plans, but were generated by McMahon for this study and executed as such. As a final product, updated and marked timing permits plans were given to PennDOT based on the optimized scenario and field adjustments.

Level of Service Improvements

Tables 3 and 4 show overall intersection LOS improvements for the peak AM and PM hours. The midday peak-period timings were not analyzed, as there was nothing to compare them to. The peak AM, PM, and midday hour Synchro reports are included in **Appendix A** for further review.

Table 3: Overall Level of Service Improvements – Peak AM Hour

Intersection	Delay (sec/veh)		LOS		Improvement
	Before	After	Before	After	
1: US 1 and Franklin Mint	11.3	8.6	B	A	24%
2: US 1 and ACTS Driveway	11.0	4.6	B	A	58%
3: US 1 and Executive Drive	2.8	3.5	A	A	*
4: US 1 and PA 452	94.2	75.4	F	E	20%
5: US 1 and Oriole Avenue/ Granite Drive	7.1	7.6	A	A	*
6: US 1 and Granite Run Mall Access	7.1	7.2	A	A	*
7: US 1 and Riddle Memorial Hospital	27.3	27.5	C	C	*
8: PA 352 and Granite Run Mall Access	18.2	16.3	B	B	10%
9: PA 352 and PA 452	75.5	51.7	E	D	32%
10: PA 352 and Old Forge Road	19.8	17.8	B	B	10%

Source: DVRPC, 2009

*Negligible or no improvement shown and not needed at this intersection due to acceptable existing LOS for the peak AM hour.

Table 4: Overall Level of Service Improvements – Peak PM Hour

Intersection	Delay (sec/veh)		LOS		Improvement
	Before	After	Before	After	
1: US 1 and Franklin Mint	6.8	7.9	A	A	*
2: US 1 and ACTS Driveway	4.4	5.3	A	A	*
3: US 1 and Executive Drive	7.4	4.6	A	A	38%
4: US 1 and PA 452	83.4	66.0	F	E	21%
5: US 1 and Oriole Avenue/ Granite Drive	7.7	11.6	A	B	*
6: US 1 and Granite Run Mall Access	14.0	12.8	B	B	9%
7: US 1 and Riddle Memorial Hospital	23.3	23.2	C	C	*
8: PA 352 and Granite Run Mall Access	29.7	17.7	C	B	40%
9: PA 352 and PA 452	65.1	52.4	E	D	20%
10: PA 352 and Old Forge Road	15.2	14.8	B	B	*

Source: DVRPC, 2009

*Negligible or no improvement shown and not needed at this intersection for the peak PM hour due to acceptable existing LOS.

The primary goal of this project is improving the system's overall performance. Therefore, at intersections that were already operating at an acceptable LOS, "negligible" or "no improvements" was acceptable as a final result. In fact, even though at least a 20 percent decrease in overall delay in both the peak AM and PM hours at the intersection of US 1 and PA 452 was achieved, overall LOS at other intersections along US 1 was not significantly altered. Typically, noticeable decreases in delay at one intersection often occur at the expense of the others in the system. The intersection of PA 352 and PA 452 improved by 32 percent in the peak AM hour and 20 percent in the peak PM hour, while also not degrading LOS for the other intersections along PA 352.

Air Quality Improvements

The DVRPC region, including Delaware County, does not meet the federal health-based standards for two of the six National Ambient Air Quality Standards. The region is in "non attainment," or does not meet the standards, for ground level ozone and fine particle pollution (PM_{2.5}). Ground level ozone is not directly emitted, but is formed when volatile organic compounds (VOCs) from the combustion of fossil fuels combine with nitrogen oxides (NO_x) from transportation and industrial processes in the presence of sunlight. Ozone is a strong oxidant that irritates lung tissue and exacerbates asthma and other pulmonary diseases. PM_{2.5} is comprised of microscopic bits of dust, metals and liquids that can be emitted from a number of sources, contributes to heart and lung disease, and can cause premature death.

The Pennsylvania Air Quality Off-Network Estimator (PAQONE) was utilized to estimate total emissions savings gained by optimizing the US 1/PA 352 closed loop traffic signal system. PAQONE is a Windows-based transportation and air quality software analysis tool that analyzes individual projects that are not well represented in a regional travel demand model, and it can be used for Congestion Mitigation and Air Quality (CMAQ) evaluation. This tool estimates the travel and emissions impacts of projects based on a combination of project-level data and areawide and national default data. The emissions module is a stand-alone program that runs the EPA's MOBILE 6.2 model to create emission factors based on the local planning assumptions for the county in which the project is located. The analysis was performed for all intersections individually, then added together to illustrate cumulative effects for the overall system. Factors that were inputted into the model include AADT, improved intersection LOS, and the changes in green time between the existing and optimized scenario.

Results from the PAQONE analysis are detailed in **Appendix B** and summarized below. Retiming the closed loop traffic signal system reduces the emissions of ozone precursors (VOC and NO_x), PM_{2.5}, carbon monoxide (another important air pollutant), and sulfur dioxide (a contributor to fine particle formation). The analysis shows that this project provides a benefit to air quality of the region.

Total vehicle emissions saved throughout the 10-signal closed loop traffic signal system:

- ◆ VOC: 0.99 tons/year
- ◆ NO_x: 0.43 tons/year

- ◆ CO: 4.23 tons/year
- ◆ PM_{2.5}: 0.01 tons/year

Travel Time Savings

Travel time runs were originally performed by DVRPC in May 2008. Once new timing plans were agreed upon by the steering committee, and after several months of waiting for the travelers to adjust to the new timings, “after” travel time runs were conducted by DVRPC in May 2009.

Travel time runs were performed by DVRPC’s Travel Monitoring Unit via a GPS device installed in a vehicle to automatically record travel time and distance between intersections or controlled data points. A “floating car” method was utilized. For the US 1 corridor, eastbound and westbound recordings started at the Station Road intersection, which is west of the first intersection in the system, and ended at the US 1 bypass ramp to the PA 352 intersection. PA 352 timing runs were recorded eastbound and westbound from Heather Knoll Lane to the Williamston School entrance. For purposes of this analysis, overall results on US 1 and PA 352 for only the intersections in the closed loop traffic signal system, plus one intersection or data point at both ends of the corridors, is utilized.

Tables 5 and 6 compare travel time, average speed, and total delay for US 1 and PA 352. Multiple travel time runs were conducted and the average of all runs for each time period are presented. Total travel time is measured as the time it took to pass through all intersections in the zone plus one intersection or data point at either end. Total average speed is weighted by the distance between intersections or data points. Total delay is the compilation of delay experienced at each intersection or data point in the zone.

Results show the difference between the “before” and “after” runs on a typical weekday for the peak AM and PM hours. More detailed travel time run results for both corridors in the system are contained in **Appendix C**, which also details midday and free-flow travel time runs, which were not included in this analysis.

Table 5: Overall Travel Time Results – Peak AM Hour

Roadway		Travel Time (sec)		Average Speed (mph)		Total Delay (sec)		Travel Time Savings
		Before	After	Before	After	Before	After	
Zone 1	US 1 Eastbound	466.9	319.6	17.7	25.9	276.6	148.3	32%
	US 1 Westbound	312.0	216.0	26.5	38.3	135.1	43.6	31%
Zone 2	PA 352 Eastbound	241.0	173.0	19.3	26.9	125.4	59.0	28%
	PA 352 Westbound	157.6	167.5	29.5	27.8	44.3	54.0	*

Source: DVRPC, 2009

*No travel time savings for PA 352 Westbound due to atypical PennState Brandywine Campus class schedule on day of “after” travel time runs.

Table 6: Overall Travel Time Results – Peak PM Hour

Roadway		Travel Time (sec)		Average Speed (mph)		Total Delay (sec)		Travel Time Savings
		Before	After	Before	After	Before	After	
Zone 1	US 1 Eastbound	662.9	345.0	12.5	24.0	462.0	148.3	48%
	US 1 Westbound	282.3	232.3	29.3	35.6	103.1	50.3	18%
Zone 2	PA 352 Eastbound	378.7	170.5	12.3	27.3	261.0	55.0	55%
	PA 352 Westbound	152.4	171.0	30.5	27.2	37.6	57.5	*

Source: DVRPC, 2009

*No travel time savings for PA 352 Westbound due to atypical PennState Brandywine Campus class schedule on day of “after” travel time runs.

Clearly, retiming the signals along US 1 and eastbound PA 352 resulted in significant overall travel time savings, faster average speeds, and lower overall delay. Westbound PA 352 experienced a slight increase in overall travel time due to traffic to the PennState Brandywine Campus, which is located west of the signals, during the “after” travel time runs. This travel pattern is most likely due to the unpredictable nature of the college’s final exam schedule, which coincided with the “after” timing runs. It is important to note, however, that overall travel time along PA 352 in the westbound direction in both the peak AM and PM hours differed by less than 20 seconds between the “before” and “after” runs.

Recommendations

DVRPC's Transportation Operations Master Plan recommends specific strategies under the "Optimize Signal Operations" category to reduce traffic congestion. Each strategy is highlighted below, along with recommendations specific to this project:

- ◆ Strategy: Develop traffic signal priority network, and periodically update.
 - ◆ Recommendation: When developing the Pennsylvania network, DVRPC should ensure that the Middletown Township, Delaware County, closed loop traffic signal system is included.
- ◆ Strategy: Systematically retime traffic signals on priority network.
 - ◆ Recommendation: Per FHWA guidelines, it is suggested that closed loop traffic signal systems undergo periodic analysis. Therefore, it is recommended that at a minimum, Middletown Township review its timing plans for revisions in the year 2014 and every five subsequent years.
- ◆ Strategy: Upgrade and interconnect signals on priority network.
 - ◆ Recommendation: As its equipment is fairly new, Middletown Township should upgrade signal equipment and software in the future when needed for the system.
- ◆ Strategy: Improve signal maintenance.
 - ◆ Recommendation: Middletown Township should coordinate with PennDOT to establish a periodic inspection program of signal equipment and timing plans to ensure that the public investment in signal systems is properly maintained.
- ◆ Strategy: Upgrade traffic operations centers/training programs.
 - ◆ Recommendation: Middletown Township should implement a formal training program as software is upgraded. It may also be useful to receive special training on implementing emergency traffic signal timing programs for scenarios such as traffic diversions, emergency evacuations, or similar conditions.
- ◆ Strategy: Active monitoring of traffic signal systems.
 - ◆ Recommendation: Middletown Township should inspect intersection, system, and volume-density loop detectors frequently and field adjust timings as necessary.

Source Information

Traffic studies referenced:

McMahon, prepared for WV-PP Towne Center, LP, "Traffic Impact Study for the Development of the Franklin Mint Property," November 2007.

Pennoni Associates Inc, prepared for Simon Property Group, "Traffic Impact Study: Granite Run Mall," December 2007.

Orth-Rogers & Associates, Inc., "Traffic Impact Analysis: Riddle Memorial Hospital Medical Office Building," June 2007.

Other resources:

DVRPC, "Congestion Management Process," Publication #09028B, December 2008.

DVRPC, "Transportation Operations Master Plan," Publication #09049, July 2009.

FHWA Office of Operations Arterial Management Program:
www.ops.fhwa.dot.gov/arterial_mgmt/index.htm

ITS Applications Overview: www.itsoverview.its.dot.gov

National Traffic Signal Report Card: www.ite.org/reportcard

APPENDIX A



Synchro Reports

The following Synchro reports, produced in 2009, include peak AM and PM hour existing and optimized timings, as well as proposed midday optimized timings.

Peak AM Hour – Existing

The following pages contain brief LOS reports generated by Synchro. The analyses used existing timings and updated traffic volumes for the peak AM hour.

Lanes, Volumes, Timings
1: US 1 & VALLEY RD

Peak AM Hour
Existing Timings with Updated Volumes

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	29	1237	41	20	1263	50	4	0	2	36	7	32
Satd. Flow (prot)	1637	3257	0	1703	3523	1576	0	1471	0	1626	1503	0
Flt Permitted	0.149			0.151				0.815		0.752		
Satd. Flow (perm)	257	3257	0	271	3523	1576	0	1239	0	1287	1503	0
Satd. Flow (RTOR)		5				37		3			39	
Lane Group Flow (vph)	32	1420	0	22	1388	55	0	9	0	44	48	0
Turn Type	pm+pt			pm+pt		Perm	Perm			Perm		
Protected Phases	5	2		1	6			8				4
Permitted Phases	2			6		6	8			4		
Total Split (s)	25.0	53.0	0.0	25.0	53.0	53.0	22.0	22.0	0.0	22.0	22.0	0.0
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
Act Effct Green (s)	81.9	79.0		80.9	76.3	76.3		10.9		10.9	10.9	
Actuated g/C Ratio	0.82	0.79		0.81	0.76	0.76		0.11		0.11	0.11	
v/c Ratio	0.10	0.55		0.06	0.52	0.05		0.07		0.31	0.24	
Control Delay	2.9	7.4		3.6	14.2	7.0		33.2		46.0	18.9	
Queue Delay	0.0	0.0		0.0	0.0	0.0		0.0		0.0	0.0	
Total Delay	2.9	7.4		3.6	14.2	7.0		33.2		46.0	18.9	
LOS	A	A		A	B	A		C		D	B	
Approach Delay		7.3			13.7			33.2			31.9	
Approach LOS		A			B			C			C	

Intersection Summary

Cycle Length: 100

Actuated Cycle Length: 100

Offset: 59 (59%), Referenced to phase 2:EBTL and 6:WBTL, Start of Yellow

Control Type: Actuated-Coordinated

Maximum v/c Ratio: 0.55

Intersection Signal Delay: 11.3

Intersection LOS: B

Intersection Capacity Utilization 46.3%

ICU Level of Service A

Analysis Period (min) 15

Splits and Phases: 1: US 1 & VALLEY RD



Lanes, Volumes, Timings
2: US 1 & ACTS DRIVEWAY

Peak AM Hour
Existing Timings with Updated Volumes



Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	7	1264	4	13	1316	28	8	0	17	14	0	10
Satd. Flow (prot)	1611	3452	0	1660	3557	1698	0	1476	0	0	1736	1346
Flt Permitted	0.148			0.168				0.883			0.917	
Satd. Flow (perm)	251	3452	0	294	3557	1698	0	1324	0	0	1675	1346
Satd. Flow (RTOR)						20		25				16
Lane Group Flow (vph)	7	1349	0	15	1479	31	0	37	0	0	22	16
Turn Type	pm+pt			pm+pt		Perm	Perm			Perm		Perm
Protected Phases	5	2		1	6			8			4	
Permitted Phases	2			6		6	8			4		4
Total Split (s)	17.0	63.0	0.0	17.0	63.0	63.0	20.0	20.0	0.0	20.0	20.0	20.0
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	6.0
Act Effct Green (s)	85.9	84.0		86.8	86.6	86.6		9.1			9.2	7.2
Actuated g/C Ratio	0.86	0.84		0.87	0.87	0.87		0.09			0.09	0.07
v/c Ratio	0.02	0.47		0.04	0.48	0.02		0.26			0.14	0.14
Control Delay	2.4	10.9		3.6	10.3	5.2		25.9			43.1	22.2
Queue Delay	0.0	0.0		0.0	0.0	0.0		0.0			0.0	0.0
Total Delay	2.4	10.9		3.6	10.3	5.2		25.9			43.1	22.2
LOS	A	B		A	B	A		C			D	C
Approach Delay		10.9			10.1			25.9			34.3	
Approach LOS		B			B			C			C	

Intersection Summary

Cycle Length: 100

Actuated Cycle Length: 100

Offset: 13 (13%), Referenced to phase 2:EBTL and 6:WBTL, Start of Yellow

Control Type: Actuated-Coordinated

Maximum v/c Ratio: 0.48

Intersection Signal Delay: 11.0

Intersection LOS: B

Intersection Capacity Utilization 54.7%

ICU Level of Service A

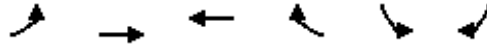
Analysis Period (min) 15

Splits and Phases: 2: US 1 & ACTS DRIVEWAY



Lanes, Volumes, Timings
3: US 1 & EXECUTIVE PLAZA DRIVE

Peak AM Hour
 Existing Timings with Updated Volumes



Lane Group	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Volume (vph)	26	1270	1336	75	26	20
Satd. Flow (prot)	1744	3371	3540	1689	1751	1567
Flt Permitted	0.117				0.950	
Satd. Flow (perm)	215	3371	3540	1689	1751	1567
Satd. Flow (RTOR)				86		40
Lane Group Flow (vph)	29	1427	1536	86	52	40
Turn Type	pm+pt			Perm		custom
Protected Phases	5	2	6			
Permitted Phases	2			6	4	4
Total Split (s)	17.0	80.0	63.0	63.0	20.0	20.0
Total Lost Time (s)	4.0	4.0	4.0	4.0	4.0	6.0
Act Effect Green (s)	83.9	84.7	76.9	76.9	10.4	8.4
Actuated g/C Ratio	0.84	0.85	0.77	0.77	0.10	0.08
v/c Ratio	0.09	0.50	0.56	0.07	0.29	0.24
Control Delay	1.4	2.5	1.5	0.0	44.6	16.8
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	1.4	2.5	1.5	0.0	44.6	16.8
LOS	A	A	A	A	D	B
Approach Delay		2.5	1.5		32.5	
Approach LOS		A	A		C	

Intersection Summary

Cycle Length: 100
 Actuated Cycle Length: 100
 Offset: 30 (30%), Referenced to phase 2:EBTL and 6:WBT, Start of Yellow
 Control Type: Actuated-Coordinated
 Maximum v/c Ratio: 0.56
 Intersection Signal Delay: 2.8
 Intersection Capacity Utilization 48.6%
 Analysis Period (min) 15
 Intersection LOS: A
 ICU Level of Service A

Splits and Phases: 3: US 1 & EXECUTIVE PLAZA DRIVE



Lanes, Volumes, Timings
4: US 1 & PENNELL RD/PA 452

Peak AM Hour
Existing Timings with Updated Volumes

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	80	1342	17	397	1483	54	100	364	708	69	255	69
Satd. Flow (prot)	1636	3498	0	1620	3454	0	1695	1784	1568	1631	1719	0
Flt Permitted	0.109			0.099			0.183			0.195		
Satd. Flow (perm)	188	3498	0	169	3454	0	326	1784	1568	335	1719	0
Satd. Flow (RTOR)		1			4				90		12	
Lane Group Flow (vph)	91	1544	0	446	1727	0	114	414	805	78	365	0
Turn Type	pm+pt			pm+pt			pm+pt		pm+ov	pm+pt		
Protected Phases	5	2		1	6		3	8	1	7	4	
Permitted Phases	2			6			8		8	4		
Total Split (s)	21.0	42.0	0.0	21.0	42.0	0.0	14.0	23.0	21.0	14.0	23.0	0.0
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
Act Effct Green (s)	48.1	38.0		59.0	47.3		29.8	21.8	42.8	28.8	19.1	
Actuated g/C Ratio	0.48	0.38		0.59	0.47		0.30	0.22	0.43	0.29	0.19	
v/c Ratio	0.38	1.16		1.29	1.06		0.49	1.06	1.11	0.35	1.08	
Control Delay	20.4	112.7		180.5	59.4		31.8	104.1	96.6	28.4	111.6	
Queue Delay	0.0	0.0		0.0	0.0		0.0	0.0	0.0	0.0	0.0	
Total Delay	20.4	112.7		180.5	59.4		31.8	104.1	96.6	28.4	111.6	
LOS	C	F		F	E		C	F	F	C	F	
Approach Delay		107.5			84.2			93.4			96.9	
Approach LOS		F			F			F			F	

Intersection Summary

Cycle Length: 100
 Actuated Cycle Length: 100
 Offset: 0 (0%), Referenced to phase 2:EBTL and 6:WBTL, Start of Yellow, Master Intersection
 Control Type: Actuated-Coordinated
 Maximum v/c Ratio: 1.29
 Intersection Signal Delay: 94.2
 Intersection Capacity Utilization 96.1%
 Analysis Period (min) 15
 Intersection LOS: F
 ICU Level of Service F

Splits and Phases: 4: US 1 & PENNELL RD/PA 452



Lanes, Volumes, Timings
5: US 1 & ORIOLE AVENUE

Peak AM Hour
Existing Timings with Updated Volumes

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	27	2203	0	16	1901	18	14	4	36	42	5	18
Satd. Flow (prot)	1660	3557	1810	1635	3500	0	0	1776	1568	0	1723	1531
Flt Permitted	0.055			0.056				0.766			0.734	
Satd. Flow (perm)	96	3557	1810	96	3500	0	0	1413	1568	0	1322	1531
Satd. Flow (RTOR)					2				41			21
Lane Group Flow (vph)	28	2295	0	17	1999	0	0	21	41	0	55	21
Turn Type	pm+pt		Perm	pm+pt			Perm		Perm	Perm		Perm
Protected Phases	5	2		1	6			8				4
Permitted Phases	2		2	6			8		8	4		4
Total Split (s)	17.0	63.0	63.0	17.0	63.0	0.0	20.0	20.0	20.0	20.0	20.0	20.0
Total Lost Time (s)	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	6.0	4.0	4.0	4.0
Act Effct Green (s)	81.3	78.4		80.3	75.8			11.5	9.5		11.5	11.5
Actuated g/C Ratio	0.81	0.78		0.80	0.76			0.12	0.10		0.12	0.12
v/c Ratio	0.13	0.82		0.08	0.75			0.13	0.22		0.36	0.11
Control Delay	3.3	7.8		2.2	4.8			39.9	15.4		46.6	16.3
Queue Delay	0.0	0.0		0.0	0.0			0.0	0.0		0.0	0.0
Total Delay	3.3	7.8		2.2	4.8			39.9	15.4		46.6	16.3
LOS	A	A		A	A			D	B		D	B
Approach Delay		7.7			4.7			23.7			38.2	
Approach LOS		A			A			C			D	

Intersection Summary

Cycle Length: 100

Actuated Cycle Length: 100

Offset: 12 (12%), Referenced to phase 2:EBTL and 6:WBTL, Start of Yellow

Control Type: Actuated-Coordinated

Maximum v/c Ratio: 0.82

Intersection Signal Delay: 7.1

Intersection LOS: A

Intersection Capacity Utilization 79.2%

ICU Level of Service D























Analysis Period (min) 15

Splits and Phases: 5: US 1 & ORIOLE AVENUE



Lanes, Volumes, Timings
6: US 1 & GRANITE RUN MALL ACCESS

Peak AM Hour
Existing Timings with Updated Volumes

												
Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	45	2218	24	9	1858	10	19	8	11	12	4	58
Satd. Flow (prot)	1652	3421	1478	1644	3522	1576	0	1835	1615	0	1675	1477
Flt Permitted	0.062			0.057				0.781			0.763	
Satd. Flow (perm)	108	3421	1478	99	3522	1576	0	1484	1615	0	1326	1477
Satd. Flow (RTOR)			25			10			13			67
Lane Group Flow (vph)	46	2287	25	9	1935	10	0	33	13	0	19	67
Turn Type	pm+pt		Perm	Perm		Perm	Perm		Perm	Perm		Perm
Protected Phases	5	2			6			8			4	
Permitted Phases	2		2	6		6	8		8	4		4
Total Split (s)	16.0	80.0	80.0	64.0	64.0	64.0	20.0	20.0	20.0	20.0	20.0	20.0
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
Act Effct Green (s)	84.7	85.5	85.5	78.1	78.1	78.1		9.6	9.6		9.6	9.6
Actuated g/C Ratio	0.85	0.86	0.86	0.78	0.78	0.78		0.10	0.10		0.10	0.10
v/c Ratio	0.21	0.78	0.02	0.12	0.70	0.01		0.23	0.08		0.15	0.33
Control Delay	7.3	9.2	1.7	2.2	3.4	0.0		45.0	20.2		43.1	15.1
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0		0.0	0.0		0.0	0.0
Total Delay	7.3	9.2	1.7	2.2	3.4	0.0		45.0	20.2		43.1	15.1
LOS	A	A	A	A	A	A		D	C		D	B
Approach Delay		9.1			3.4			38.0			21.3	
Approach LOS		A			A			D			C	

Intersection Summary

Cycle Length: 100

Actuated Cycle Length: 100

Offset: 5 (5%), Referenced to phase 2:EBTL and 6:WBTL, Start of Yellow

Control Type: Actuated-Coordinated

Maximum v/c Ratio: 0.78

Intersection Signal Delay: 7.1

Intersection LOS: A

Intersection Capacity Utilization 78.0%

ICU Level of Service D

Analysis Period (min) 15

Splits and Phases: 6: US 1 & GRANITE RUN MALL ACCESS



Lanes, Volumes, Timings
7: US 1 & GRANITE RUN MALL ACCESS

Peak AM Hour
Existing Timings with Updated Volumes

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	14	1833	148	3	1603	44	46	18	74	140	428	97
Satd. Flow (prot)	1719	3438	1641	0	3557	1591	1641	1727	1566	1778	1872	1697
Flt Permitted	0.067				0.951		0.142			0.742		
Satd. Flow (perm)	121	3438	1641	0	3383	1591	245	1727	1566	1389	1872	1697
Satd. Flow (RTOR)			129			34			16			99
Lane Group Flow (vph)	15	1950	157	0	1846	51	62	24	100	154	470	107
Turn Type	pm+pt		Perm	Perm		Perm	Perm		Perm	Perm		Perm
Protected Phases	5	2			6			8			4	
Permitted Phases	2		2	6		6	8		8	4		4
Total Split (s)	13.0	67.0	67.0	54.0	54.0	54.0	33.0	33.0	33.0	33.0	33.0	33.0
Total Lost Time (s)	4.0	4.0	4.0	6.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
Act Effct Green (s)	63.8	63.8	63.8		58.9	58.9	28.2	28.2	28.2	28.2	28.2	28.2
Actuated g/C Ratio	0.64	0.64	0.64		0.59	0.59	0.28	0.28	0.28	0.28	0.28	0.28
v/c Ratio	0.07	0.89	0.14		0.93	0.05	0.90	0.05	0.22	0.39	0.89	0.19
Control Delay	9.0	18.6	3.7		29.9	6.0	122.2	26.1	24.1	32.2	55.1	7.5
Queue Delay	0.0	0.0	0.0		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	9.0	18.6	3.7		29.9	6.0	122.2	26.1	24.1	32.2	55.1	7.5
LOS	A	B	A		C	A	F	C	C	C	E	A
Approach Delay		17.4			29.3			57.0			43.3	
Approach LOS		B			C			E			D	

Intersection Summary

Cycle Length: 100

Actuated Cycle Length: 100

Offset: 84 (84%), Referenced to phase 2:EBTL and 6:WBTL, Start of Yellow

Control Type: Actuated-Coordinated

Maximum v/c Ratio: 0.93

Intersection Signal Delay: 27.3

Intersection LOS: C

Intersection Capacity Utilization 89.4%

ICU Level of Service E

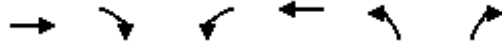
Analysis Period (min) 15

Splits and Phases: 7: US 1 & GRANITE RUN MALL ACCESS



Lanes, Volumes, Timings
 8: PA 352 & GRANITE RUN MALL ACCESS

Peak AM Hour
 Existing Timings with Updated Volumes



Lane Group	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations	↑	↗	↖	↑	↖	↗
Volume (vph)	1031	140	172	1156	105	44
Satd. Flow (prot)	1853	1680	1676	1827	1719	1538
Flt Permitted			0.076		0.950	
Satd. Flow (perm)	1853	1680	134	1827	1719	1538
Satd. Flow (RTOR)		146				56
Lane Group Flow (vph)	1074	146	187	1257	133	56
Turn Type		Perm	pm+pt			Perm
Protected Phases	2		1	6	8	
Permitted Phases		2	6			8
Total Split (s)	52.0	52.0	13.0	65.0	15.0	15.0
Total Lost Time (s)	4.0	4.0	4.0	4.0	4.0	4.0
Act Effct Green (s)	48.7	48.7	61.7	61.7	10.3	10.3
Actuated g/C Ratio	0.61	0.61	0.77	0.77	0.13	0.13
v/c Ratio	0.95	0.14	0.68	0.89	0.60	0.23
Control Delay	16.8	0.1	27.3	17.7	44.6	11.8
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	16.8	0.1	27.3	17.7	44.6	11.8
LOS	B	A	C	B	D	B
Approach Delay	14.8			18.9	34.9	
Approach LOS	B			B	C	

Intersection Summary

Cycle Length: 80

Actuated Cycle Length: 80

Offset: 46 (58%), Referenced to phase 2:EBT and 6:WBTL, Start of Yellow

Control Type: Actuated-Coordinated

Maximum v/c Ratio: 0.95

Intersection Signal Delay: 18.2

Intersection LOS: B

Intersection Capacity Utilization 79.6%

ICU Level of Service D

Analysis Period (min) 15

Splits and Phases: 8: PA 352 & GRANITE RUN MALL ACCESS



Lanes, Volumes, Timings
9: PA 352 & BARREN RD

Peak AM Hour
Existing Timings with Updated Volumes



Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		↕			↕			↕			↕	
Volume (vph)	30	912	255	39	972	6	209	163	37	32	123	48
Satd. Flow (prot)	0	1927	0	0	2158	0	0	2023	0	0	1583	0
Flt Permitted		0.960			0.917			0.595			0.891	
Satd. Flow (perm)	0	1852	0	0	1982	0	0	1235	0	0	1422	0
Satd. Flow (RTOR)		26			1			7			22	
Lane Group Flow (vph)	0	1222	0	0	1070	0	0	431	0	0	327	0
Turn Type	Perm			Perm			Perm			Perm		
Protected Phases		2			6			8			4	
Permitted Phases	2			6			8			4		
Total Split (s)	46.0	46.0	0.0	46.0	46.0	0.0	34.0	34.0	0.0	34.0	34.0	0.0
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
Act Effct Green (s)		42.6			42.6			29.4			29.4	
Actuated g/C Ratio		0.53			0.53			0.37			0.37	
v/c Ratio		1.22			1.01			0.94			0.61	
Control Delay		126.5			40.9			55.5			24.7	
Queue Delay		0.0			0.0			0.0			0.0	
Total Delay		126.5			40.9			55.5			24.7	
LOS		F			D			E			C	
Approach Delay		126.5			40.9			55.5			24.7	
Approach LOS		F			D			E			C	

Intersection Summary

Cycle Length: 80

Actuated Cycle Length: 80

Offset: 0 (0%), Referenced to phase 2:EBTL and 6:WBTL, Start of Yellow

Control Type: Actuated-Coordinated

Maximum v/c Ratio: 1.22

Intersection Signal Delay: 75.5

Intersection LOS: E

Intersection Capacity Utilization 118.8%

ICU Level of Service H

Analysis Period (min) 15

Splits and Phases: 9: PA 352 & BARREN RD



Lanes, Volumes, Timings
10: PA 352 & LIMA ESTATES DR

Peak AM Hour
Existing Timings with Updated Volumes



Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	2	894	5	236	1067	22	10	3	285	20	1	2
Satd. Flow (prot)	1676	1889	0	1668	1881	1652	0	1822	1553	0	1814	1615
Flt Permitted	0.129			0.079				0.754			0.725	
Satd. Flow (perm)	228	1889	0	139	1881	1652	0	1425	1553	0	1378	1615
Satd. Flow (RTOR)		1				27			102			4
Lane Group Flow (vph)	2	987	0	291	1317	27	0	16	343	0	40	4
Turn Type	Perm			pm+pt		Perm	Perm		pm+ov	Perm		Perm
Protected Phases		6		5	2			4	5		8	
Permitted Phases	6			2		2	4		4	8		8
Total Split (s)	48.0	48.0	0.0	16.0	64.0	64.0	16.0	16.0	16.0	16.0	16.0	16.0
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
Act Effct Green (s)	49.1	49.1		67.1	68.7	68.7		9.5	22.9		9.7	9.7
Actuated g/C Ratio	0.61	0.61		0.84	0.86	0.86		0.12	0.29		0.12	0.12
v/c Ratio	0.01	0.85		0.76	0.82	0.02		0.09	0.66		0.24	0.02
Control Delay	8.5	24.3		25.9	14.1	1.4		31.5	22.9		34.7	20.0
Queue Delay	0.0	0.0		0.0	0.0	0.0		0.0	0.0		0.0	0.0
Total Delay	8.5	24.3		25.9	14.1	1.4		31.5	22.9		34.7	20.0
LOS	A	C		C	B	A		C	C		C	B
Approach Delay		24.2			16.0			23.3			33.4	
Approach LOS		C			B			C			C	

Intersection Summary

Cycle Length: 80

Actuated Cycle Length: 80

Offset: 51 (64%), Referenced to phase 2:WBTL, Start of Yellow

Control Type: Actuated-Coordinated

Maximum v/c Ratio: 0.85

Intersection Signal Delay: 19.8

Intersection LOS: B

Intersection Capacity Utilization 90.7%

ICU Level of Service E

Analysis Period (min) 15

Splits and Phases: 10: PA 352 & LIMA ESTATES DR



Peak PM Hour – Existing

The following pages contain brief LOS reports generated by Synchro. The analyses used existing timings and updated traffic volumes for the peak PM hour.

Lanes, Volumes, Timings
1: US 1 & VALLEY RD

Peak PM Hour
Existing Timings with Updated Volumes



Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	51	1089	5	8	1410	43	29	11	15	48	0	30
Satd. Flow (prot)	1685	3367	0	1736	3592	1607	0	1775	0	1703	1524	0
Flt Permitted	0.124			0.212				0.815		0.684		
Satd. Flow (perm)	220	3367	0	387	3592	1607	0	1485	0	1226	1524	0
Satd. Flow (RTOR)		1				23		15			360	
Lane Group Flow (vph)	57	1216	0	9	1500	46	0	74	0	59	37	0
Turn Type	pm+pt			pm+pt		Perm	Perm			Perm		
Protected Phases	5	2		1	6			8			4	
Permitted Phases	2			6		6	8			4		
Total Split (s)	30.0	55.0	0.0	30.0	55.0	55.0	30.0	30.0	0.0	30.0	30.0	0.0
Total Lost Time (s)	4.0	5.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
Act Effct Green (s)	96.2	94.1		92.9	86.8	86.8		12.6		12.6	12.6	
Actuated g/C Ratio	0.84	0.82		0.81	0.75	0.75		0.11		0.11	0.11	
v/c Ratio	0.19	0.44		0.02	0.55	0.04		0.42		0.44	0.08	
Control Delay	3.8	5.4		1.0	4.5	2.5		44.5		56.8	0.3	
Queue Delay	0.0	0.0		0.0	0.0	0.0		0.0		0.0	0.0	
Total Delay	3.8	5.4		1.0	4.5	2.5		44.5		56.8	0.3	
LOS	A	A		A	A	A		D		E	A	
Approach Delay		5.3			4.5			44.5			35.0	
Approach LOS		A			A			D			D	

Intersection Summary

Cycle Length: 115

Actuated Cycle Length: 115

Offset: 91 (79%), Referenced to phase 2:EBTL and 6:WBTL, Start of Yellow

Control Type: Actuated-Coordinated

Maximum v/c Ratio: 0.55

Intersection Signal Delay: 6.8

Intersection LOS: A

Intersection Capacity Utilization 59.6%

ICU Level of Service B

Analysis Period (min) 15

Splits and Phases: 1: US 1 & VALLEY RD



Lanes, Volumes, Timings
2: US 1 & ACTS DRIVEWAY

Peak PM Hour
Existing Timings with Updated Volumes

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	5	1143	4	6	1455	15	2	0	4	19	0	4
Satd. Flow (prot)	1611	3452	0	1660	3557	1698	0	1328	0	0	1805	1400
Flt Permitted	0.140			0.210				0.873			0.752	
Satd. Flow (perm)	237	3452	0	367	3557	1698	0	1180	0	0	1429	1400
Satd. Flow (RTOR)					9			5				6
Lane Group Flow (vph)	5	1207	0	6	1532	16	0	8	0	0	27	6
Turn Type	pm+pt			pm+pt		Perm	Perm			Perm		Perm
Protected Phases	5	2		1	6			8			4	
Permitted Phases	2			6		6	8			4		4
Total Split (s)	17.0	72.0	0.0	17.0	72.0	72.0	26.0	26.0	0.0	26.0	26.0	26.0
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	6.0
Act Effct Green (s)	101.2	101.1		101.2	101.1	101.1		9.6			9.8	7.8
Actuated g/C Ratio	0.88	0.88		0.88	0.88	0.88		0.08			0.09	0.07
v/c Ratio	0.02	0.40		0.01	0.49	0.01		0.08			0.22	0.06
Control Delay	1.8	2.4		1.5	4.9	2.3		35.0			52.7	29.2
Queue Delay	0.0	0.0		0.0	0.0	0.0		0.0			0.0	0.0
Total Delay	1.8	2.4		1.5	4.9	2.3		35.0			52.7	29.2
LOS	A	A		A	A	A		C			D	C
Approach Delay		2.4			4.9			35.0			48.4	
Approach LOS		A			A			C			D	

Intersection Summary

Cycle Length: 115

Actuated Cycle Length: 115

Offset: 94 (82%), Referenced to phase 2:EBTL and 6:WBTL, Start of Yellow

Control Type: Actuated-Coordinated

Maximum v/c Ratio: 0.49

Intersection Signal Delay: 4.4

Intersection LOS: A

Intersection Capacity Utilization 58.6%

ICU Level of Service B

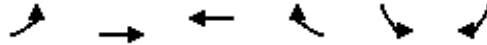
Analysis Period (min) 15

Splits and Phases: 2: US 1 & ACTS DRIVEWAY



Lanes, Volumes, Timings
3: US 1 & EXECUTIVE DRIVE

Peak PM Hour
 Existing Timings with Updated Volumes



Lane Group	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Volume (vph)	28	1139	1451	79	83	24
Satd. Flow (prot)	1761	3404	3575	1706	1700	1521
Flt Permitted	0.096				0.950	
Satd. Flow (perm)	178	3404	3575	1706	1700	1521
Satd. Flow (RTOR)				89		35
Lane Group Flow (vph)	30	1225	1630	89	122	35
Turn Type	pm+pt			Perm		custom
Protected Phases	5	2	6			
Permitted Phases	2			6	4	4
Total Split (s)	17.0	89.0	72.0	72.0	26.0	26.0
Total Lost Time (s)	4.0	4.0	4.0	4.0	4.0	6.0
Act Effect Green (s)	91.5	91.5	83.6	83.6	15.5	13.5
Actuated g/C Ratio	0.80	0.80	0.73	0.73	0.13	0.12
v/c Ratio	0.11	0.45	0.63	0.07	0.53	0.17
Control Delay	2.9	4.0	6.8	0.5	54.2	15.3
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	2.9	4.0	6.8	0.5	54.2	15.3
LOS	A	A	A	A	D	B
Approach Delay		4.0	6.5		45.5	
Approach LOS		A	A		D	

Intersection Summary

Cycle Length: 115
 Actuated Cycle Length: 115
 Offset: 17 (15%), Referenced to phase 2:EBTL and 6:WBT, Start of Yellow
 Control Type: Actuated-Coordinated
 Maximum v/c Ratio: 0.63
 Intersection Signal Delay: 7.4
 Intersection Capacity Utilization 51.8%
 Analysis Period (min) 15
 Intersection LOS: A
 ICU Level of Service A

Splits and Phases: 3: US 1 & EXECUTIVE DRIVE



Lanes, Volumes, Timings
4: US 1 & PENNELL RD/PA 452

Peak PM Hour
Existing Timings with Updated Volumes



Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	63	1052	40	460	1362	52	111	294	639	96	410	103
Satd. Flow (prot)	1668	3556	0	1652	3522	0	1745	1837	1615	1694	1789	0
Flt Permitted	0.118			0.105			0.129			0.303		
Satd. Flow (perm)	207	3556	0	183	3522	0	237	1837	1615	540	1789	0
Satd. Flow (RTOR)		3			3				89		11	
Lane Group Flow (vph)	65	1126	0	535	1644	0	122	323	702	114	611	0
Turn Type	pm+pt			pm+pt			pm+pt		pm+ov	pm+pt		
Protected Phases	5	2		1	6		3	8	1	7	4	
Permitted Phases	2			6			8		8	4		
Total Split (s)	28.0	38.0	0.0	28.0	38.0	0.0	14.0	35.0	28.0	14.0	35.0	0.0
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
Act Effct Green (s)	43.6	34.0		62.0	50.7		41.0	31.0	59.0	41.0	31.0	
Actuated g/C Ratio	0.38	0.30		0.54	0.44		0.36	0.27	0.51	0.36	0.27	
v/c Ratio	0.32	1.07		1.32	1.06		0.56	0.65	0.81	0.39	1.25	
Control Delay	24.5	80.4		190.1	62.1		33.8	44.5	28.8	27.2	163.3	
Queue Delay	0.0	0.0		0.0	0.0		0.0	0.0	0.0	0.0	0.0	
Total Delay	24.5	80.4		190.1	62.1		33.8	44.5	28.8	27.2	163.3	
LOS	C	F		F	E		C	D	C	C	F	
Approach Delay		77.3			93.5			33.7			141.9	
Approach LOS		E			F			C			F	

Intersection Summary

Cycle Length: 115

Actuated Cycle Length: 115

Offset: 0 (0%), Referenced to phase 2:EBTL and 6:WBTL, Start of Yellow, Master Intersection

Control Type: Actuated-Coordinated

Maximum v/c Ratio: 1.32

Intersection Signal Delay: 83.4

Intersection LOS: F

Intersection Capacity Utilization 103.2%

ICU Level of Service G

Analysis Period (min) 15

Splits and Phases: 4: US 1 & PENNELL RD/PA 452



Lanes, Volumes, Timings
5: US 1 & ORIOLE AVENUE

Peak PM Hour
Existing Timings with Updated Volumes

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	26	1863	41	38	1623	17	38	1	40	39	5	19
Satd. Flow (prot)	1693	3628	1569	1651	3531	0	0	1793	1599	0	1758	1561
Flt Permitted	0.091			0.063				0.684			0.715	
Satd. Flow (perm)	162	3628	1569	110	3531	0	0	1287	1599	0	1313	1561
Satd. Flow (RTOR)			30		2				49			28
Lane Group Flow (vph)	27	1941	43	40	1745	0	0	48	49	0	64	28
Turn Type	pm+pt		Perm	pm+pt			Perm		Perm	Perm		Perm
Protected Phases	5	2		1	6			8			4	
Permitted Phases	2		2	6			8		8	4		4
Total Split (s)	14.0	79.0	79.0	14.0	79.0	0.0	22.0	22.0	22.0	22.0	22.0	22.0
Total Lost Time (s)	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	6.0	4.0	4.0	4.0
Act Effct Green (s)	94.0	89.3	89.3	94.4	89.5			12.7	10.7		12.8	12.8
Actuated g/C Ratio	0.82	0.78	0.78	0.82	0.78			0.11	0.09		0.11	0.11
v/c Ratio	0.11	0.69	0.04	0.19	0.64			0.34	0.25		0.44	0.14
Control Delay	2.3	8.2	1.4	8.3	4.0			52.2	16.1		55.9	16.9
Queue Delay	0.0	0.0	0.0	0.0	0.0			0.0	0.0		0.0	0.0
Total Delay	2.3	8.2	1.4	8.3	4.0			52.2	16.1		55.9	16.9
LOS	A	A	A	A	A			D	B		E	B
Approach Delay		8.0			4.1			33.9			44.1	
Approach LOS		A			A			C			D	

Intersection Summary

Cycle Length: 115

Actuated Cycle Length: 115

Offset: 10 (9%), Referenced to phase 2:EBTL and 6:WBTL, Start of Yellow

Control Type: Actuated-Coordinated

Maximum v/c Ratio: 0.69

Intersection Signal Delay: 7.7

Intersection LOS: A

Intersection Capacity Utilization 69.8%

ICU Level of Service C

Analysis Period (min) 15

Splits and Phases: 5: US 1 & ORIOLE AVENUE



Lanes, Volumes, Timings
 6: US 1 & GRANITE RUN MALL ACCESS

Peak PM Hour
 Existing Timings with Updated Volumes

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	149	1825	9	8	1445	25	39	6	13	90	10	137
Satd. Flow (prot)	1668	3455	1492	1676	3592	1607	0	1822	1615	0	1809	1607
Flt Permitted	0.086			0.081				0.567			0.665	
Satd. Flow (perm)	151	3455	1492	143	3592	1607	0	1077	1615	0	1257	1607
Satd. Flow (RTOR)			10			23			23			161
Lane Group Flow (vph)	164	2005	10	9	1554	27	0	82	24	0	118	161
Turn Type	pm+pt		Perm	Perm		Perm	Perm		Perm	Perm		Perm
Protected Phases	5	2			6			8			4	
Permitted Phases	2		2	6		6	8		8	4		4
Total Split (s)	22.0	85.0	85.0	63.0	63.0	63.0	30.0	30.0	30.0	30.0	30.0	30.0
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
Act Effct Green (s)	89.2	89.2	89.2	71.8	71.8	71.8		17.8	17.8		17.8	17.8
Actuated g/C Ratio	0.78	0.78	0.78	0.62	0.62	0.62		0.15	0.15		0.15	0.15
v/c Ratio	0.56	0.75	0.01	0.10	0.69	0.03		0.49	0.09		0.61	0.42
Control Delay	19.4	11.6	2.8	5.5	11.8	0.4		53.4	15.5		57.7	9.5
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0		0.0	0.0		0.0	0.0
Total Delay	19.4	11.6	2.8	5.5	11.8	0.4		53.4	15.5		57.7	9.5
LOS	B	B	A	A	B	A		D	B		E	A
Approach Delay		12.2			11.6			44.8			29.9	
Approach LOS		B			B			D			C	

Intersection Summary

Cycle Length: 115
 Actuated Cycle Length: 115
 Offset: 96 (83%), Referenced to phase 2:EBTL and 6:WBTL, Start of Yellow
 Control Type: Actuated-Coordinated
 Maximum v/c Ratio: 0.75
 Intersection Signal Delay: 14.0
 Intersection Capacity Utilization 78.5%
 Analysis Period (min) 15
 Intersection LOS: B
 ICU Level of Service D

Splits and Phases: 6: US 1 & GRANITE RUN MALL ACCESS



Lanes, Volumes, Timings
7: US 1 & GRANITE RUN MALL ACCESS

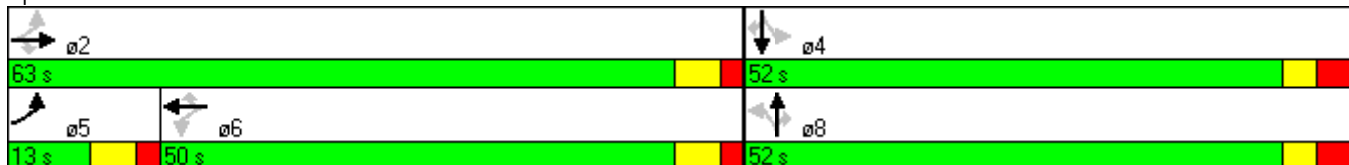
Peak PM Hour
Existing Timings with Updated Volumes

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	33	1628	61	1	1223	98	103	71	264	275	110	53
Satd. Flow (prot)	1770	3539	1689	0	3522	1576	1787	1881	1706	1796	1891	1714
Flt Permitted	0.121				0.954		0.648			0.691		
Satd. Flow (perm)	225	3539	1689	0	3360	1576	1219	1881	1706	1306	1891	1714
Satd. Flow (RTOR)			55			71			8			56
Lane Group Flow (vph)	37	1809	68	0	1262	101	132	91	338	293	117	56
Turn Type	pm+pt		Perm	Perm		Perm	Perm		Perm	Perm		Perm
Protected Phases	5	2			6			8			4	
Permitted Phases	2		2	6		6	8		8	4		4
Total Split (s)	13.0	63.0	63.0	50.0	50.0	50.0	52.0	52.0	52.0	52.0	52.0	52.0
Total Lost Time (s)	4.0	4.0	4.0	6.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
Act Effct Green (s)	73.5	73.5	73.5		65.6	65.6	33.5	33.5	33.5	33.5	33.5	33.5
Actuated g/C Ratio	0.64	0.64	0.64		0.57	0.57	0.29	0.29	0.29	0.29	0.29	0.29
v/c Ratio	0.14	0.80	0.06		0.66	0.11	0.37	0.17	0.67	0.77	0.21	0.10
Control Delay	11.4	17.2	5.6		22.3	7.0	33.6	28.7	40.9	50.0	29.6	6.8
Queue Delay	0.0	0.0	0.0		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	11.4	17.2	5.6		22.3	7.0	33.6	28.7	40.9	50.0	29.6	6.8
LOS	B	B	A		C	A	C	C	D	D	C	A
Approach Delay		16.7			21.2			37.2			39.7	
Approach LOS		B			C			D			D	

Intersection Summary

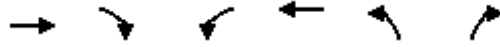
Cycle Length: 115
 Actuated Cycle Length: 115
 Offset: 64 (56%), Referenced to phase 2:EBTL and 6:WBTL, Start of Yellow
 Control Type: Actuated-Coordinated
 Maximum v/c Ratio: 0.80
 Intersection Signal Delay: 23.3
 Intersection Capacity Utilization 86.6%
 Analysis Period (min) 15
 Intersection LOS: C
 ICU Level of Service E

Splits and Phases: 7: US 1 & GRANITE RUN MALL ACCESS



Lanes, Volumes, Timings
 8: PA 352 & GRANITE RUN MALL ACCESS

Peak PM Hour
 Existing Timings with Updated Volumes



Lane Group	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations	↑	↗	↖	↑	↖	↗
Volume (vph)	1045	134	140	961	166	120
Satd. Flow (prot)	1872	1697	1660	1809	1787	1599
Flt Permitted			0.071		0.950	
Satd. Flow (perm)	1872	1697	124	1809	1787	1599
Satd. Flow (RTOR)		145				140
Lane Group Flow (vph)	1161	149	159	1092	193	140
Turn Type		Perm	pm+pt			Perm
Protected Phases	2		1	6	8	
Permitted Phases		2	6			8
Total Split (s)	50.0	50.0	21.0	71.0	19.0	19.0
Total Lost Time (s)	4.0	4.0	4.0	4.0	4.0	4.0
Act Effct Green (s)	52.7	52.7	68.2	68.2	13.8	13.8
Actuated g/C Ratio	0.59	0.59	0.76	0.76	0.15	0.15
v/c Ratio	1.06	0.14	0.55	0.80	0.70	0.38
Control Delay	49.5	0.2	20.4	12.8	50.4	9.4
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	49.5	0.2	20.4	12.8	50.4	9.4
LOS	D	A	C	B	D	A
Approach Delay	43.9			13.8	33.2	
Approach LOS	D			B	C	

Intersection Summary

Cycle Length: 90

Actuated Cycle Length: 90

Offset: 38 (42%), Referenced to phase 2:EBT and 6:WBTL, Start of Yellow

Control Type: Actuated-Coordinated

Maximum v/c Ratio: 1.06

Intersection Signal Delay: 29.7

Intersection LOS: C

Intersection Capacity Utilization 82.0%

ICU Level of Service D

Analysis Period (min) 15

Splits and Phases: 8: PA 352 & GRANITE RUN MALL ACCESS



Lanes, Volumes, Timings
9: PA 352 & BARREN RD

Peak AM Hour
Optimized Timings - Final



Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		↕			↕			↕			↕	
Volume (vph)	30	912	255	39	972	6	209	163	37	32	123	48
Satd. Flow (prot)	0	1927	0	0	2158	0	0	2023	0	0	1583	0
Flt Permitted		0.956			0.922			0.539			0.888	
Satd. Flow (perm)	0	1844	0	0	1993	0	0	1119	0	0	1417	0
Satd. Flow (RTOR)		23						5			15	
Lane Group Flow (vph)	0	1222	0	0	1070	0	0	431	0	0	327	0
Turn Type	Perm			Perm			Perm			Perm		
Protected Phases		2			6			8			4	
Permitted Phases	2			6			8			4		
Total Split (s)	70.0	70.0	0.0	70.0	70.0	0.0	40.0	40.0	0.0	40.0	40.0	0.0
Total Lost Time (s)	2.7	2.7	4.0	2.7	2.7	4.0	2.8	2.8	4.0	2.8	2.8	4.0
Act Effct Green (s)		67.3			67.3			37.2			37.2	
Actuated g/C Ratio		0.61			0.61			0.34			0.34	
v/c Ratio		1.07			0.88			1.13			0.67	
Control Delay		64.3			25.1			92.7			37.6	
Queue Delay		0.0			0.0			0.0			0.0	
Total Delay		64.3			25.1			92.7			37.6	
LOS		E			C			F			D	
Approach Delay		64.3			25.1			92.7			37.6	
Approach LOS		E			C			F			D	

Intersection Summary

Cycle Length: 110
 Actuated Cycle Length: 110
 Offset: 29 (26%), Referenced to phase 2:EBTL and 6:WBTL, Start of Green
 Control Type: Actuated-Coordinated
 Maximum v/c Ratio: 1.13
 Intersection Signal Delay: 51.7
 Intersection Capacity Utilization 118.8%
 Analysis Period (min) 15
 Intersection LOS: D
 ICU Level of Service H

Splits and Phases: 9: PA 352 & BARREN RD



Lanes, Volumes, Timings
10: PA 352 & LIMA ESTATES DR

Peak PM Hour
Existing Timings with Updated Volumes



Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	2	729	16	200	685	14	16	1	284	27	1	3
Satd. Flow (prot)	1676	1885	0	1685	1900	1669	0	1804	1553	0	1813	1615
Flt Permitted	0.383			0.142				0.713			0.715	
Satd. Flow (perm)	676	1885	0	252	1900	1669	0	1348	1553	0	1358	1615
Satd. Flow (RTOR)		2				15			138			3
Lane Group Flow (vph)	2	837	0	217	745	15	0	25	424	0	30	3
Turn Type	Perm			pm+pt		Perm	Perm		pm+ov	Perm		Perm
Protected Phases		6		5	2			4	5		8	
Permitted Phases	6			2		2	4		4	8		8
Total Split (s)	51.0	51.0	0.0	21.0	72.0	72.0	18.0	18.0	21.0	18.0	18.0	18.0
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
Act Effct Green (s)	54.1	54.1		77.3	78.9	78.9		9.4	27.9		9.5	9.5
Actuated g/C Ratio	0.60	0.60		0.86	0.88	0.88		0.10	0.31		0.11	0.11
v/c Ratio	0.00	0.74		0.42	0.45	0.01		0.18	0.74		0.21	0.02
Control Delay	10.5	20.3		4.3	5.1	1.8		38.9	25.4		39.7	24.0
Queue Delay	0.0	0.0		0.0	0.0	0.0		0.0	0.0		0.0	0.0
Total Delay	10.5	20.3		4.3	5.1	1.8		38.9	25.4		39.7	24.0
LOS	B	C		A	A	A		D	C		D	C
Approach Delay		20.3			4.9			26.1			38.3	
Approach LOS		C			A			C			D	

Intersection Summary

Cycle Length: 90

Actuated Cycle Length: 90

Offset: 60 (67%), Referenced to phase 2:WBTL and 6:EBTL, Start of Yellow

Control Type: Actuated-Coordinated

Maximum v/c Ratio: 0.74

Intersection Signal Delay: 15.2

Intersection LOS: B

Intersection Capacity Utilization 71.1%

ICU Level of Service C

Analysis Period (min) 15

Splits and Phases: 10: PA 352 & LIMA ESTATES DR



Peak AM Hour – Optimized Timings

The following pages contain brief LOS reports generated by Synchro. The analyses used improved optimized timings for the peak AM hour.

Lanes, Volumes, Timings
2: US 1 & ACTS DRIVEWAY

Peak AM Hour
Optimized Timings - Final

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	7	1264	4	13	1316	28	8	0	17	14	0	10
Satd. Flow (prot)	1611	3452	0	1660	3557	1698	0	1476	0	0	1736	1346
Flt Permitted	0.154			0.171				0.883			0.908	
Satd. Flow (perm)	261	3452	0	299	3557	1698	0	1324	0	0	1659	1346
Satd. Flow (RTOR)		1				22		25				16
Lane Group Flow (vph)	7	1349	0	15	1479	31	0	37	0	0	22	16
Turn Type	pm+pt			pm+pt		Perm	Perm			Perm		Perm
Protected Phases	5	2		1	6			8			4	
Permitted Phases	2			6		6	8			4		4
Total Split (s)	9.0	75.0	0.0	10.0	76.0	76.0	25.0	25.0	0.0	25.0	25.0	25.0
Total Lost Time (s)	2.5	3.1	4.0	3.1	3.1	3.1	4.3	4.3	4.0	4.3	4.3	6.3
Act Effct Green (s)	97.4	94.6		97.7	97.1	97.1		9.2			9.3	7.3
Actuated g/C Ratio	0.89	0.86		0.89	0.88	0.88		0.08			0.08	0.07
v/c Ratio	0.02	0.45		0.04	0.47	0.02		0.28			0.16	0.15
Control Delay	1.6	3.2		2.6	4.5	3.0		28.7			48.4	23.7
Queue Delay	0.0	0.0		0.0	0.0	0.0		0.0			0.0	0.0
Total Delay	1.6	3.2		2.6	4.5	3.0		28.7			48.4	23.7
LOS	A	A		A	A	A		C			D	C
Approach Delay		3.2			4.4			28.7			38.0	
Approach LOS		A			A			C			D	

Intersection Summary

Cycle Length: 110

Actuated Cycle Length: 110

Offset: 107 (97%), Referenced to phase 2:EBTL and 6:WBTL, Start of Green

Control Type: Actuated-Coordinated

Maximum v/c Ratio: 0.47

Intersection Signal Delay: 4.6

Intersection LOS: A

Intersection Capacity Utilization 55.2%

ICU Level of Service B

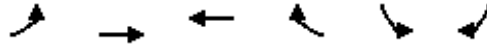
Analysis Period (min) 15

Splits and Phases: 2: US 1 & ACTS DRIVEWAY



Lanes, Volumes, Timings
3: US 1 & EXECUTIVE PLAZA DRIVE

Peak AM Hour
 Optimized Timings - Final



Lane Group	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Volume (vph)	26	1270	1336	75	26	20
Satd. Flow (prot)	1744	3371	3540	1689	1751	1567
Flt Permitted	0.126				0.950	
Satd. Flow (perm)	231	3371	3540	1689	1751	1567
Satd. Flow (RTOR)				86		40
Lane Group Flow (vph)	29	1427	1536	86	52	40
Turn Type	pm+pt			Perm		custom
Protected Phases	5	2	6			
Permitted Phases	2			6	4	4
Total Split (s)	9.0	81.0	72.0	72.0	29.0	29.0
Total Lost Time (s)	3.0	3.3	3.3	3.3	3.8	5.8
Act Effect Green (s)	94.8	95.2	88.0	88.0	10.7	8.7
Actuated g/C Ratio	0.86	0.87	0.80	0.80	0.10	0.08
v/c Ratio	0.09	0.49	0.54	0.06	0.31	0.25
Control Delay	2.8	3.6	1.6	0.0	50.1	18.0
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	2.8	3.6	1.6	0.0	50.1	18.0
LOS	A	A	A	A	D	B
Approach Delay		3.6	1.5		36.2	
Approach LOS		A	A		D	

Intersection Summary

Cycle Length: 110
 Actuated Cycle Length: 110
 Offset: 107 (97%), Referenced to phase 2:EBTL and 6:WBT, Start of Green
 Control Type: Actuated-Coordinated
 Maximum v/c Ratio: 0.54
 Intersection Signal Delay: 3.5
 Intersection Capacity Utilization 48.4%
 Analysis Period (min) 15
 Intersection LOS: A
 ICU Level of Service A

Splits and Phases: 3: US 1 & EXECUTIVE PLAZA DRIVE



Lanes, Volumes, Timings
4: US 1 & PENNELL RD/PA 452

Peak AM Hour
Optimized Timings - Final



Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	80	1342	17	397	1483	54	100	364	708	69	255	69
Satd. Flow (prot)	1636	3498	0	1620	3454	0	1695	1784	1568	1631	1719	0
Flt Permitted	0.095			0.087			0.159			0.163		
Satd. Flow (perm)	164	3498	0	148	3454	0	284	1784	1568	280	1719	0
Satd. Flow (RTOR)		1			5				32		11	
Lane Group Flow (vph)	91	1544	0	446	1727	0	114	414	805	78	365	0
Turn Type	pm+pt			pm+pt			pm+pt		pm+ov	pm+pt		
Protected Phases	5	2		1	6		3	8	1	7	4	
Permitted Phases	2			6			8		8	4		
Total Split (s)	10.0	48.0	0.0	25.0	63.0	0.0	10.0	27.0	25.0	10.0	27.0	0.0
Total Lost Time (s)	4.3	4.4	4.0	3.8	4.4	4.0	3.8	3.8	3.8	3.5	3.8	4.0
Act Effct Green (s)	49.4	43.6		69.2	58.6		30.2	25.2	50.2	30.0	23.2	
Actuated g/C Ratio	0.45	0.40		0.63	0.53		0.27	0.23	0.46	0.27	0.21	
v/c Ratio	0.61	1.11		1.18	0.94		0.73	1.01	1.10	0.50	0.98	
Control Delay	31.6	95.3		137.8	35.7		57.3	91.8	92.9	34.5	71.1	
Queue Delay	0.0	0.0		0.0	0.0		0.0	0.0	0.0	0.0	0.0	
Total Delay	31.6	95.3		137.8	35.7		57.3	91.8	92.9	34.5	71.1	
LOS	C	F		F	D		E	F	F	C	E	
Approach Delay		91.8			56.7			89.5			64.6	
Approach LOS		F			E			F			E	

Intersection Summary

Cycle Length: 110

Actuated Cycle Length: 110

Offset: 0 (0%), Referenced to phase 2:EBTL and 6:WBTL, Start of Green, Master Intersection

Control Type: Actuated-Coordinated

Maximum v/c Ratio: 1.18

Intersection Signal Delay: 75.4

Intersection LOS: E

Intersection Capacity Utilization 96.5%

ICU Level of Service F























Analysis Period (min) 15

Splits and Phases: 4: US 1 & PENNELL RD/PA 452



Lanes, Volumes, Timings
5: US 1 & ORIOLE AVENUE

Peak AM Hour
Optimized Timings - Final

												
Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	27	2203	0	16	1901	18	14	4	36	42	5	18
Satd. Flow (prot)	1660	3557	1810	1635	3500	0	0	1776	1568	0	1723	1531
Flt Permitted	0.058			0.048				0.767			0.734	
Satd. Flow (perm)	101	3557	1810	83	3500	0	0	1414	1568	0	1322	1531
Satd. Flow (RTOR)					2				41			21
Lane Group Flow (vph)	28	2295	0	17	1999	0	0	21	41	0	55	21
Turn Type	pm+pt		Perm	pm+pt			Perm		Perm	Perm		Perm
Protected Phases	5	2		1	6			8				4
Permitted Phases	2		2	6			8		8	4		4
Total Split (s)	10.0	75.0	75.0	9.0	74.0	0.0	26.0	26.0	26.0	26.0	26.0	26.0
Total Lost Time (s)	3.2	3.2	3.2	2.6	3.2	4.0	3.9	3.9	5.9	3.9	3.9	3.9
Act Effct Green (s)	92.5	89.5		92.0	86.8			11.7	9.7		11.7	11.7
Actuated g/C Ratio	0.84	0.81		0.84	0.79			0.11	0.09		0.11	0.11
v/c Ratio	0.13	0.79		0.09	0.72			0.14	0.23		0.39	0.12
Control Delay	1.5	5.6		3.6	8.0			45.0	16.8		52.9	18.2
Queue Delay	0.0	0.1		0.0	0.0			0.0	0.0		0.0	0.0
Total Delay	1.5	5.7		3.6	8.0			45.0	16.8		52.9	18.2
LOS	A	A		A	A			D	B		D	B
Approach Delay		5.6			7.9			26.3			43.3	
Approach LOS		A			A			C			D	

Intersection Summary

Cycle Length: 110
 Actuated Cycle Length: 110
 Offset: 97 (88%), Referenced to phase 2:EBTL and 6:WBTL, Start of Green
 Control Type: Actuated-Coordinated
 Maximum v/c Ratio: 0.79
 Intersection Signal Delay: 7.6
 Intersection Capacity Utilization 79.1%
 Analysis Period (min) 15
 Intersection LOS: A
 ICU Level of Service D

Splits and Phases: 5: US 1 & ORIOLE AVENUE



Lanes, Volumes, Timings

6: US 1 & GRANITE RUN MALL ACCESS

Peak AM Hour
Optimized Timings - Final

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	45	2218	24	9	1858	10	19	8	11	12	4	58
Satd. Flow (prot)	1652	3421	1478	1644	3522	1576	0	1835	1615	0	1675	1477
Flt Permitted	0.065			0.059				0.781			0.762	
Satd. Flow (perm)	113	3421	1478	102	3522	1576	0	1484	1615	0	1324	1477
Satd. Flow (RTOR)			25			9			10			66
Lane Group Flow (vph)	46	2287	25	9	1935	10	0	33	13	0	19	67
Turn Type	pm+pt		Perm	Perm		Perm	Perm		Perm	Perm		Perm
Protected Phases	5	2			6			8			4	
Permitted Phases	2		2	6		6	8		8	4		4
Total Split (s)	9.0	77.0	77.0	68.0	68.0	68.0	33.0	33.0	33.0	33.0	33.0	33.0
Total Lost Time (s)	3.7	3.7	3.7	3.7	3.7	3.7	4.4	4.4	4.4	4.4	4.4	4.4
Act Effct Green (s)	94.5	95.2	95.2	85.8	85.8	85.8		9.8	9.8		9.8	9.8
Actuated g/C Ratio	0.86	0.87	0.87	0.78	0.78	0.78		0.09	0.09		0.09	0.09
v/c Ratio	0.22	0.77	0.02	0.11	0.70	0.01		0.25	0.08		0.16	0.35
Control Delay	6.7	5.5	1.2	8.3	7.7	4.1		50.6	27.3		48.5	16.9
Queue Delay	0.0	0.1	0.0	0.0	0.0	0.0		0.0	0.0		0.0	0.0
Total Delay	6.7	5.6	1.2	8.3	7.7	4.1		50.6	27.3		48.5	16.9
LOS	A	A	A	A	A	A		D	C		D	B
Approach Delay		5.5			7.7			44.0			23.9	
Approach LOS		A			A			D			C	

Intersection Summary

Cycle Length: 110

Actuated Cycle Length: 110

Offset: 105 (95%), Referenced to phase 2:EBTL and 6:WBTL, Start of Green

Control Type: Actuated-Coordinated

Maximum v/c Ratio: 0.77

Intersection Signal Delay: 7.2

Intersection LOS: A

Intersection Capacity Utilization 78.6%

ICU Level of Service D

Analysis Period (min) 15

Splits and Phases: 6: US 1 & GRANITE RUN MALL ACCESS



Lanes, Volumes, Timings
7: US 1 & GRANITE RUN MALL ACCESS

Peak AM Hour
Optimized Timings - Final

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	14	1833	148	3	1603	44	46	18	74	140	428	97
Satd. Flow (prot)	1719	3438	1641	0	3557	1591	1641	1727	1566	1778	1872	1697
Flt Permitted	0.060				0.951		0.129			0.742		
Satd. Flow (perm)	109	3438	1641	0	3383	1591	223	1727	1566	1389	1872	1697
Satd. Flow (RTOR)			130			34			15			65
Lane Group Flow (vph)	15	1950	157	0	1846	51	62	24	100	154	470	107
Turn Type	pm+pt		Perm	Perm		Perm	Perm		Perm	Perm		Perm
Protected Phases	5	2			6			8			4	
Permitted Phases	2		2	6		6	8		8	4		4
Total Split (s)	9.0	73.0	73.0	64.0	64.0	64.0	37.0	37.0	37.0	37.0	37.0	37.0
Total Lost Time (s)	3.9	4.1	4.1	6.1	4.1	4.1	4.9	4.9	4.9	4.9	4.9	4.9
Act Effct Green (s)	70.1	69.9	69.9		66.3	66.3	31.1	31.1	31.1	31.1	31.1	31.1
Actuated g/C Ratio	0.64	0.64	0.64		0.60	0.60	0.28	0.28	0.28	0.28	0.28	0.28
v/c Ratio	0.10	0.89	0.14		0.90	0.05	0.98	0.05	0.22	0.39	0.89	0.20
Control Delay	6.5	18.6	1.3		28.2	5.6	152.1	28.5	26.5	35.0	58.0	14.2
Queue Delay	0.0	0.0	0.0		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	6.5	18.6	1.3		28.2	5.6	152.1	28.5	26.5	35.0	58.0	14.2
LOS	A	B	A		C	A	F	C	C	C	E	B
Approach Delay		17.2			27.6			68.6			46.7	
Approach LOS		B			C			E			D	

Intersection Summary

Cycle Length: 110

Actuated Cycle Length: 110

Offset: 2 (2%), Referenced to phase 2:EBTL and 6:WBTL, Start of Green

Control Type: Actuated-Coordinated

Maximum v/c Ratio: 0.98

Intersection Signal Delay: 27.5

Intersection LOS: C

Intersection Capacity Utilization 90.3%

ICU Level of Service E

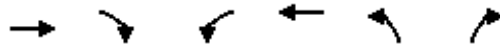
Analysis Period (min) 15

Splits and Phases: 7: US 1 & GRANITE RUN MALL ACCESS



Lanes, Volumes, Timings
 8: PA 352 & GRANITE RUN MALL ACCESS

Peak AM Hour
 Optimized Timings - Final



Lane Group	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations	↑	↗	↖	↑	↖	↗
Volume (vph)	1031	140	172	1156	105	44
Satd. Flow (prot)	1853	1680	1676	1827	1719	1538
Flt Permitted			0.123		0.950	
Satd. Flow (perm)	1853	1680	217	1827	1719	1538
Satd. Flow (RTOR)		146				56
Lane Group Flow (vph)	1074	146	187	1257	133	56
Turn Type		Perm	pm+pt			Perm
Protected Phases	2		1	6	8	
Permitted Phases		2	6			8
Total Split (s)	81.0	81.0	13.0	94.0	16.0	16.0
Total Lost Time (s)	3.3	3.3	2.8	3.3	4.0	4.0
Act Effect Green (s)	78.8	78.8	91.6	91.1	11.6	11.6
Actuated g/C Ratio	0.72	0.72	0.83	0.83	0.11	0.11
v/c Ratio	0.81	0.12	0.61	0.83	0.73	0.26
Control Delay	17.4	1.0	14.6	11.7	71.3	15.4
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	17.4	1.0	14.6	11.7	71.3	15.4
LOS	B	A	B	B	E	B
Approach Delay	15.4			12.1	54.8	
Approach LOS	B			B	D	

Intersection Summary

Cycle Length: 110
 Actuated Cycle Length: 110
 Offset: 85 (77%), Referenced to phase 2:EBT and 6:WBTL, Start of Green
 Control Type: Actuated-Coordinated
 Maximum v/c Ratio: 0.83
 Intersection Signal Delay: 16.3
 Intersection Capacity Utilization 79.6%
 Analysis Period (min) 15
 Intersection LOS: B
 ICU Level of Service D

Splits and Phases: 8: PA 352 & GRANITE RUN MALL ACCESS



Lanes, Volumes, Timings
9: PA 352 & BARREN RD

Peak AM Hour
Optimized Timings - Final



Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		↕			↕			↕			↕	
Volume (vph)	30	912	255	39	972	6	209	163	37	32	123	48
Satd. Flow (prot)	0	1927	0	0	2158	0	0	2023	0	0	1583	0
Flt Permitted		0.956			0.922			0.539			0.888	
Satd. Flow (perm)	0	1844	0	0	1993	0	0	1119	0	0	1417	0
Satd. Flow (RTOR)		23						5			15	
Lane Group Flow (vph)	0	1222	0	0	1070	0	0	431	0	0	327	0
Turn Type	Perm			Perm			Perm			Perm		
Protected Phases		2			6			8			4	
Permitted Phases	2			6			8			4		
Total Split (s)	70.0	70.0	0.0	70.0	70.0	0.0	40.0	40.0	0.0	40.0	40.0	0.0
Total Lost Time (s)	2.7	2.7	4.0	2.7	2.7	4.0	2.8	2.8	4.0	2.8	2.8	4.0
Act Effct Green (s)		67.3			67.3			37.2			37.2	
Actuated g/C Ratio		0.61			0.61			0.34			0.34	
v/c Ratio		1.07			0.88			1.13			0.67	
Control Delay		64.3			25.1			92.7			37.6	
Queue Delay		0.0			0.0			0.0			0.0	
Total Delay		64.3			25.1			92.7			37.6	
LOS		E			C			F			D	
Approach Delay		64.3			25.1			92.7			37.6	
Approach LOS		E			C			F			D	

Intersection Summary

Cycle Length: 110
 Actuated Cycle Length: 110
 Offset: 29 (26%), Referenced to phase 2:EBTL and 6:WBTL, Start of Green
 Control Type: Actuated-Coordinated
 Maximum v/c Ratio: 1.13
 Intersection Signal Delay: 51.7
 Intersection Capacity Utilization 118.8%
 Analysis Period (min) 15
 Intersection LOS: D
 ICU Level of Service H

Splits and Phases: 9: PA 352 & BARREN RD



Lanes, Volumes, Timings
10: PA 352 & LIMA ESTATES DR

Peak AM Hour
Optimized Timings - Final



Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	2	894	5	236	1067	22	10	3	285	20	1	2
Satd. Flow (prot)	1676	1889	0	1668	1881	1652	0	1822	1553	0	1814	1615
Flt Permitted	0.104			0.095				0.769			0.725	
Satd. Flow (perm)	184	1889	0	167	1881	1652	0	1454	1553	0	1378	1615
Satd. Flow (RTOR)						15			116			4
Lane Group Flow (vph)	2	987	0	291	1317	27	0	16	343	0	40	4
Turn Type	pm+pt			pm+pt		Perm	Perm		pm+ov	Perm		Perm
Protected Phases	5	2		1	6			8	1		4	
Permitted Phases	2			6		6	8		8	4		4
Total Split (s)	10.0	67.0	0.0	19.0	76.0	76.0	24.0	24.0	19.0	24.0	24.0	24.0
Total Lost Time (s)	3.1	3.3	4.0	3.1	3.3	3.3	3.3	3.3	3.1	3.3	3.3	3.3
Act Effct Green (s)	79.9	71.2		97.8	96.5	96.5		10.2	32.4		10.5	10.5
Actuated g/C Ratio	0.73	0.65		0.89	0.88	0.88		0.09	0.29		0.10	0.10
v/c Ratio	0.01	0.81		0.62	0.80	0.02		0.12	0.64		0.31	0.03
Control Delay	3.5	23.6		23.9	8.9	2.2		46.2	26.0		51.6	27.5
Queue Delay	0.0	0.0		0.0	0.1	0.0		0.0	0.0		0.0	0.0
Total Delay	3.5	23.6		23.9	8.9	2.2		46.2	26.0		51.6	27.5
LOS	A	C		C	A	A		D	C		D	C
Approach Delay		23.6			11.5			26.9			49.4	
Approach LOS		C			B			C			D	

Intersection Summary

Cycle Length: 110

Actuated Cycle Length: 110

Offset: 32 (29%), Referenced to phase 2:EBTL and 6:WBTL, Start of Green

Control Type: Actuated-Coordinated

Maximum v/c Ratio: 0.81

Intersection Signal Delay: 17.8

Intersection LOS: B

Intersection Capacity Utilization 78.3%

ICU Level of Service D

Analysis Period (min) 15

Splits and Phases: 10: PA 352 & LIMA ESTATES DR



Peak PM Hour – Optimized Timings

The following pages contain brief LOS reports generated by Synchro. The analyses used improved optimized timings for the peak PM hour.

Lanes, Volumes, Timings
1: US 1 & VALLEY RD

Peak PM Hour
Optimized Timings - Final

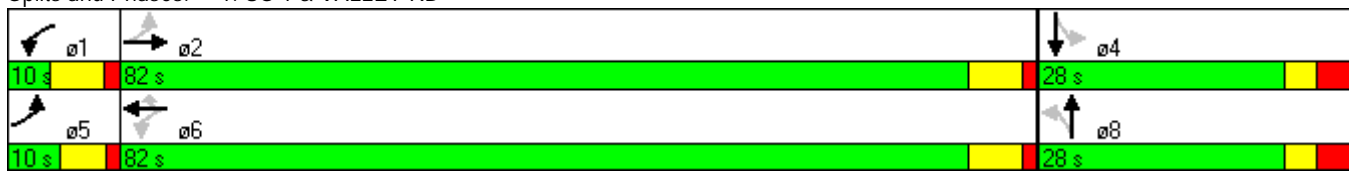


Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	51	1089	5	8	1410	43	29	11	15	48	0	30
Satd. Flow (prot)	1685	3367	0	1736	3592	1607	0	1775	0	1703	1524	0
Flt Permitted	0.132			0.211				0.815		0.679		
Satd. Flow (perm)	234	3367	0	386	3592	1607	0	1485	0	1217	1524	0
Satd. Flow (RTOR)		1				36		14			101	
Lane Group Flow (vph)	57	1216	0	9	1500	46	0	74	0	59	37	0
Turn Type	pm+pt			pm+pt		Perm	Perm			Perm		
Protected Phases	5	2		1	6			8			4	
Permitted Phases	2			6		6	8			4		
Total Split (s)	10.0	82.0	0.0	10.0	82.0	82.0	28.0	28.0	0.0	28.0	28.0	0.0
Total Lost Time (s)	2.4	4.2	4.0	3.2	3.2	3.2	4.1	4.1	4.0	4.1	4.1	4.0
Act Effct Green (s)	102.6	99.6		99.7	93.4	93.4		12.8		12.9	12.9	
Actuated g/C Ratio	0.86	0.83		0.83	0.78	0.78		0.11		0.11	0.11	
v/c Ratio	0.18	0.44		0.02	0.54	0.04		0.43		0.45	0.15	
Control Delay	3.4	4.9		1.9	6.8	1.7		47.1		59.9	1.2	
Queue Delay	0.0	0.0		0.0	0.0	0.0		0.0		0.0	0.0	
Total Delay	3.4	4.9		1.9	6.8	1.7		47.1		59.9	1.2	
LOS	A	A		A	A	A		D		E	A	
Approach Delay		4.8			6.6			47.1			37.3	
Approach LOS		A			A			D			D	

Intersection Summary

Cycle Length: 120
 Actuated Cycle Length: 120
 Offset: 60 (50%), Referenced to phase 2:EBTL and 6:WBTL, Start of Green
 Control Type: Actuated-Coordinated
 Maximum v/c Ratio: 0.54
 Intersection Signal Delay: 7.9 Intersection LOS: A
 Intersection Capacity Utilization 59.1% ICU Level of Service B
 Analysis Period (min) 15

Splits and Phases: 1: US 1 & VALLEY RD



Lanes, Volumes, Timings
2: US 1 & ACTS DRIVEWAY

Peak PM Hour
Optimized Timings - Final



Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	5	1143	4	6	1455	15	2	0	4	19	0	4
Satd. Flow (prot)	1611	3452	0	1660	3557	1698	0	1328	0	0	1805	1400
Flt Permitted	0.144			0.211				0.867			0.752	
Satd. Flow (perm)	244	3452	0	369	3557	1698	0	1172	0	0	1429	1400
Satd. Flow (RTOR)		1				11		5				6
Lane Group Flow (vph)	5	1207	0	6	1532	16	0	8	0	0	27	6
Turn Type	pm+pt			pm+pt		Perm	Perm			Perm		Perm
Protected Phases	5	2		1	6			8			4	
Permitted Phases	2			6		6	8			4		4
Total Split (s)	9.0	85.0	0.0	10.0	86.0	86.0	25.0	25.0	0.0	25.0	25.0	25.0
Total Lost Time (s)	2.5	3.1	4.0	3.1	3.1	3.1	4.3	4.3	4.0	4.3	4.3	6.3
Act Effct Green (s)	107.7	106.6		107.2	106.7	106.7		9.6			9.8	7.8
Actuated g/C Ratio	0.90	0.89		0.89	0.89	0.89		0.08			0.08	0.06
v/c Ratio	0.02	0.39		0.01	0.48	0.01		0.08			0.23	0.06
Control Delay	1.2	4.4		2.8	4.9	3.5		36.8			55.5	30.2
Queue Delay	0.0	0.0		0.0	0.0	0.0		0.0			0.0	0.0
Total Delay	1.2	4.4		2.8	4.9	3.5		36.8			55.5	30.2
LOS	A	A		A	A	A		D			E	C
Approach Delay		4.4			4.8			36.8			50.9	
Approach LOS		A			A			D			D	

Intersection Summary

Cycle Length: 120

Actuated Cycle Length: 120

Offset: 99 (83%), Referenced to phase 2:EBTL and 6:WBTL, Start of Green

Control Type: Actuated-Coordinated

Maximum v/c Ratio: 0.48

Intersection Signal Delay: 5.3

Intersection LOS: A

Intersection Capacity Utilization 59.1%

ICU Level of Service B

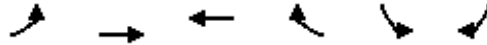
Analysis Period (min) 15

Splits and Phases: 2: US 1 & ACTS DRIVEWAY



Lanes, Volumes, Timings
3: US 1 & EXECUTIVE DRIVE

Peak PM Hour
 Optimized Timings - Final



Lane Group	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Volume (vph)	28	1139	1451	79	83	24
Satd. Flow (prot)	1761	3404	3575	1706	1700	1521
Flt Permitted	0.102				0.950	
Satd. Flow (perm)	189	3404	3575	1706	1700	1521
Satd. Flow (RTOR)				89		35
Lane Group Flow (vph)	30	1225	1630	89	122	35
Turn Type	pm+pt			Perm		custom
Protected Phases	5	2	6			
Permitted Phases	2			6	4	4
Total Split (s)	9.0	90.0	81.0	81.0	30.0	30.0
Total Lost Time (s)	3.0	3.3	3.3	3.3	3.8	5.8
Act Effect Green (s)	97.3	97.0	89.7	89.7	15.9	13.9
Actuated g/C Ratio	0.81	0.81	0.75	0.75	0.13	0.12
v/c Ratio	0.11	0.45	0.61	0.07	0.54	0.17
Control Delay	2.5	2.5	2.2	0.1	56.9	16.0
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	2.5	2.5	2.2	0.1	56.9	16.0
LOS	A	A	A	A	E	B
Approach Delay		2.5	2.1		47.8	
Approach LOS		A	A		D	

Intersection Summary

Cycle Length: 120
 Actuated Cycle Length: 120
 Offset: 101 (84%), Referenced to phase 2:EBTL and 6:WBT, Start of Green
 Control Type: Actuated-Coordinated
 Maximum v/c Ratio: 0.61
 Intersection Signal Delay: 4.6
 Intersection Capacity Utilization 51.6%
 Analysis Period (min) 15
 Intersection LOS: A
 ICU Level of Service A

Splits and Phases: 3: US 1 & EXECUTIVE DRIVE



Lanes, Volumes, Timings
4: US 1 & PENNELL RD/PA 452

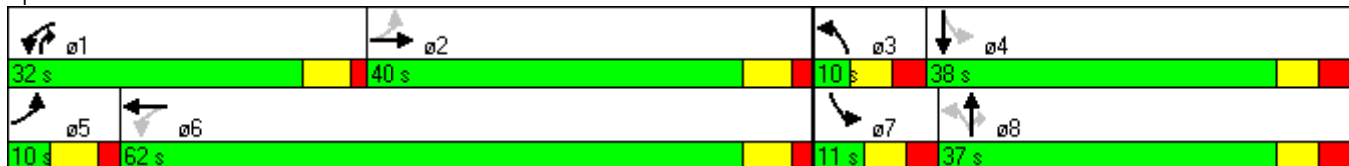
Peak PM Hour
Optimized Timings - Final

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	63	1052	40	460	1362	52	111	294	639	96	410	103
Satd. Flow (prot)	1668	3556	0	1652	3522	0	1745	1837	1615	1694	1789	0
Flt Permitted	0.112			0.102			0.120			0.298		
Satd. Flow (perm)	197	3556	0	177	3522	0	220	1837	1615	531	1789	0
Satd. Flow (RTOR)		3			4				43		11	
Lane Group Flow (vph)	65	1126	0	535	1644	0	122	323	702	114	611	0
Turn Type	pm+pt			pm+pt			pm+pt		pm+ov	pm+pt		
Protected Phases	5	2		1	6		3	8	1	7	4	
Permitted Phases	2			6			8		8	4		
Total Split (s)	10.0	40.0	0.0	32.0	62.0	0.0	10.0	37.0	32.0	11.0	38.0	0.0
Total Lost Time (s)	4.3	4.4	4.0	3.8	4.4	4.0	3.8	3.8	3.8	3.5	3.8	4.0
Act Effct Green (s)	41.4	35.6		68.2	59.6		39.4	33.2	65.2	42.0	34.2	
Actuated g/C Ratio	0.34	0.30		0.57	0.50		0.33	0.28	0.54	0.35	0.28	
v/c Ratio	0.47	1.07		1.20	0.94		0.81	0.64	0.78	0.44	1.18	
Control Delay	27.8	83.5		140.4	27.8		65.6	44.7	27.9	31.6	137.4	
Queue Delay	0.0	0.0		0.0	0.0		0.0	0.0	0.0	0.0	0.0	
Total Delay	27.8	83.5		140.4	27.8		65.6	44.7	27.9	31.6	137.4	
LOS	C	F		F	C		E	D	C	C	F	
Approach Delay		80.4			55.4			36.7			120.7	
Approach LOS		F			E			D			F	

Intersection Summary

Cycle Length: 120
 Actuated Cycle Length: 120
 Offset: 0 (0%), Referenced to phase 2:EBTL and 6:WBTL, Start of Green, Master Intersection
 Control Type: Actuated-Coordinated
 Maximum v/c Ratio: 1.20
 Intersection Signal Delay: 66.0
 Intersection Capacity Utilization 103.5%
 Analysis Period (min) 15
 Intersection LOS: E
 ICU Level of Service G

Splits and Phases: 4: US 1 & PENNELL RD/PA 452



Lanes, Volumes, Timings
5: US 1 & ORIOLE AVENUE

Peak PM Hour
Optimized Timings - Final



Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	26	1863	41	38	1623	17	38	1	40	39	5	19
Satd. Flow (prot)	1693	3628	1569	1651	3531	0	0	1793	1599	0	1758	1561
Flt Permitted	0.096			0.066				0.678			0.715	
Satd. Flow (perm)	171	3628	1569	115	3531	0	0	1275	1599	0	1313	1561
Satd. Flow (RTOR)			32		2				49			28
Lane Group Flow (vph)	27	1941	43	40	1745	0	0	48	49	0	64	28
Turn Type	pm+pt		Perm	pm+pt			Perm		Perm	Perm		Perm
Protected Phases	5	2		1	6			8				4
Permitted Phases	2		2	6			8		8	4		4
Total Split (s)	10.0	85.0	85.0	9.0	84.0	0.0	26.0	26.0	26.0	26.0	26.0	26.0
Total Lost Time (s)	3.2	3.2	3.2	2.6	3.2	4.0	3.9	3.9	5.9	3.9	3.9	3.9
Act Effct Green (s)	100.0	93.5	93.5	101.2	95.6			12.9	10.9		13.0	13.0
Actuated g/C Ratio	0.83	0.78	0.78	0.84	0.80			0.11	0.09		0.11	0.11
v/c Ratio	0.11	0.69	0.03	0.19	0.62			0.35	0.26		0.45	0.14
Control Delay	1.5	7.0	0.7	4.9	13.7			55.3	16.6		59.1	17.3
Queue Delay	0.0	0.0	0.0	0.0	0.3			0.0	0.0		0.0	0.0
Total Delay	1.5	7.0	0.7	4.9	14.0			55.3	16.6		59.1	17.3
LOS	A	A	A	A	B			E	B		E	B
Approach Delay		6.8			13.8			35.7			46.4	
Approach LOS		A			B			D			D	

Intersection Summary

Cycle Length: 120

Actuated Cycle Length: 120

Offset: 88 (73%), Referenced to phase 2:EBTL and 6:WBTL, Start of Green

Control Type: Actuated-Coordinated

Maximum v/c Ratio: 0.69

Intersection Signal Delay: 11.6

Intersection LOS: B

Intersection Capacity Utilization 69.7%

ICU Level of Service C

Analysis Period (min) 15

Splits and Phases: 5: US 1 & ORIOLE AVENUE



Lanes, Volumes, Timings
6: US 1 & GRANITE RUN MALL ACCESS

Peak PM Hour
Optimized Timings - Final



Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	149	1825	9	8	1445	25	39	6	13	90	10	137
Satd. Flow (prot)	1668	3455	1492	1676	3592	1607	0	1822	1615	0	1809	1607
Flt Permitted	0.090			0.081				0.571			0.672	
Satd. Flow (perm)	158	3455	1492	143	3592	1607	0	1085	1615	0	1271	1607
Satd. Flow (RTOR)			10			23			21			161
Lane Group Flow (vph)	164	2005	10	9	1554	27	0	82	24	0	118	161
Turn Type	pm+pt		Perm	Perm		Perm	Perm		Perm	Perm		Perm
Protected Phases	5	2			6			8			4	
Permitted Phases	2		2	6		6	8		8	4		4
Total Split (s)	19.0	87.0	87.0	68.0	68.0	68.0	33.0	33.0	33.0	33.0	33.0	33.0
Total Lost Time (s)	3.7	3.7	3.7	3.7	3.7	3.7	4.4	4.4	4.4	4.4	4.4	4.4
Act Effct Green (s)	93.8	93.8	93.8	76.5	76.5	76.5		18.1	18.1		18.1	18.1
Actuated g/C Ratio	0.78	0.78	0.78	0.64	0.64	0.64		0.15	0.15		0.15	0.15
v/c Ratio	0.56	0.74	0.01	0.10	0.68	0.03		0.50	0.09		0.61	0.42
Control Delay	18.1	10.7	3.2	10.6	9.5	2.7		56.1	18.1		60.6	9.8
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0		0.0	0.0		0.0	0.0
Total Delay	18.1	10.7	3.2	10.6	9.5	2.7		56.1	18.1		60.6	9.8
LOS	B	B	A	B	A	A		E	B		E	A
Approach Delay		11.2			9.4			47.5			31.3	
Approach LOS		B			A			D			C	

Intersection Summary

Cycle Length: 120

Actuated Cycle Length: 120

Offset: 52 (43%), Referenced to phase 2:EBTL and 6:WBTL, Start of Green

Control Type: Actuated-Coordinated

Maximum v/c Ratio: 0.74

Intersection Signal Delay: 12.8

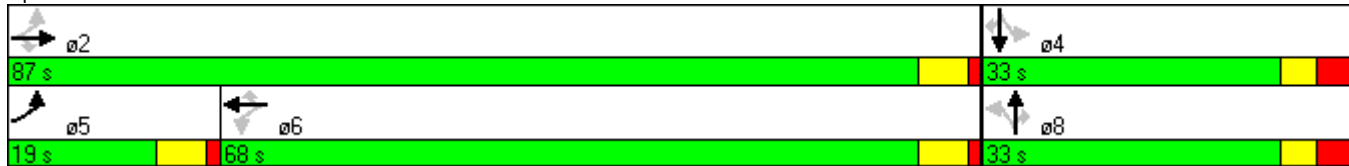
Intersection LOS: B

Intersection Capacity Utilization 85.5%

ICU Level of Service E
























Analysis Period (min) 15

Splits and Phases: 6: US 1 & GRANITE RUN MALL ACCESS



Lanes, Volumes, Timings
7: US 1 & GRANITE RUN MALL ACCESS

Peak PM Hour
Optimized Timings - Final

												
Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	33	1628	61	1	1223	98	103	71	264	275	110	53
Satd. Flow (prot)	1770	3539	1689	0	3522	1576	1787	1881	1706	1796	1891	1714
Flt Permitted	0.131				0.954		0.656			0.698		
Satd. Flow (perm)	244	3539	1689	0	3360	1576	1234	1881	1706	1320	1891	1714
Satd. Flow (RTOR)			68			85			21			56
Lane Group Flow (vph)	37	1809	68	0	1262	101	132	91	338	293	117	56
Turn Type	pm+pt		Perm	Perm		Perm	Perm		Perm	Perm		Perm
Protected Phases	5	2			6			8			4	
Permitted Phases	2		2	6		6	8		8	4		4
Total Split (s)	13.0	79.0	79.0	66.0	66.0	66.0	41.0	41.0	41.0	41.0	41.0	41.0
Total Lost Time (s)	3.9	4.1	4.1	6.1	4.1	4.1	4.9	4.9	4.9	4.9	4.9	4.9
Act Effct Green (s)	79.3	79.1	79.1		71.5	71.5	31.9	31.9	31.9	31.9	31.9	31.9
Actuated g/C Ratio	0.66	0.66	0.66		0.60	0.60	0.27	0.27	0.27	0.27	0.27	0.27
v/c Ratio	0.14	0.78	0.06		0.63	0.10	0.40	0.18	0.72	0.83	0.23	0.11
Control Delay	7.8	15.4	1.5		19.6	4.5	39.1	33.5	46.3	61.8	34.5	8.5
Queue Delay	0.0	0.1	0.0		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	7.8	15.5	1.5		19.6	4.5	39.1	33.5	46.3	61.8	34.5	8.5
LOS	A	B	A		B	A	D	C	D	E	C	A
Approach Delay		14.9			18.4			42.5			48.6	
Approach LOS		B			B			D			D	

Intersection Summary

Cycle Length: 120

Actuated Cycle Length: 120

Offset: 56 (47%), Referenced to phase 2:EBTL and 6:WBTL, Start of Green

Control Type: Actuated-Coordinated

Maximum v/c Ratio: 0.83

Intersection Signal Delay: 23.2

Intersection LOS: C

Intersection Capacity Utilization 88.2%

ICU Level of Service E

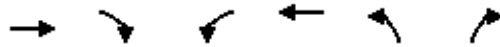
Analysis Period (min) 15

Splits and Phases: 7: US 1 & GRANITE RUN MALL ACCESS



Lanes, Volumes, Timings
 8: PA 352 & GRANITE RUN MALL ACCESS

Peak PM Hour
 Optimized Timings - Final



Lane Group	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations	↑	↗	↖	↑	↖	↗
Volume (vph)	1045	134	140	961	166	120
Satd. Flow (prot)	1872	1697	1660	1809	1787	1599
Flt Permitted			0.065		0.950	
Satd. Flow (perm)	1872	1697	114	1809	1787	1599
Satd. Flow (RTOR)		149				140
Lane Group Flow (vph)	1161	149	159	1092	193	140
Turn Type		Perm	pm+pt			Perm
Protected Phases	2		1	6	8	
Permitted Phases		2	6			8
Total Split (s)	66.0	66.0	9.0	75.0	15.0	15.0
Total Lost Time (s)	3.3	3.3	2.8	3.3	4.0	4.0
Act Effect Green (s)	62.7	62.7	72.2	71.7	11.0	11.0
Actuated g/C Ratio	0.70	0.70	0.80	0.80	0.12	0.12
v/c Ratio	0.89	0.12	0.80	0.76	0.89	0.44
Control Delay	14.9	0.2	45.8	9.0	78.2	11.4
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	14.9	0.2	45.8	9.0	78.2	11.4
LOS	B	A	D	A	E	B
Approach Delay	13.2			13.7	50.1	
Approach LOS	B			B	D	

Intersection Summary

Cycle Length: 90
 Actuated Cycle Length: 90
 Offset: 0 (0%), Referenced to phase 2:EBT and 6:WBTL, Start of Green
 Control Type: Actuated-Coordinated
 Maximum v/c Ratio: 0.89
 Intersection Signal Delay: 17.7
 Intersection Capacity Utilization 82.0%
 Analysis Period (min) 15
 Intersection LOS: B
 ICU Level of Service D

Splits and Phases: 8: PA 352 & GRANITE RUN MALL ACCESS



Lanes, Volumes, Timings
9: PA 352 & BARREN RD

Peak PM Hour
Optimized Timings - Final



Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		↕			↕			↕			↕	
Volume (vph)	45	911	206	72	827	16	156	104	57	103	228	47
Satd. Flow (prot)	0	1916	0	0	2151	0	0	1962	0	0	1695	0
Flt Permitted		0.938			0.834			0.542			0.800	
Satd. Flow (perm)	0	1801	0	0	1801	0	0	1089	0	0	1374	0
Satd. Flow (RTOR)		23			2			13			8	
Lane Group Flow (vph)	0	1197	0	0	964	0	0	387	0	0	397	0
Turn Type	Perm			Perm			Perm			Perm		
Protected Phases		2			6			8			4	
Permitted Phases	2			6			8			4		
Total Split (s)	59.0	59.0	0.0	59.0	59.0	0.0	31.0	31.0	0.0	31.0	31.0	0.0
Total Lost Time (s)	2.7	2.7	4.0	2.7	2.7	4.0	2.8	2.8	4.0	2.8	2.8	4.0
Act Effct Green (s)		56.3			56.3			28.2			28.2	
Actuated g/C Ratio		0.63			0.63			0.31			0.31	
v/c Ratio		1.05			0.86			1.11			0.91	
Control Delay		55.6			23.4			110.6			56.8	
Queue Delay		0.0			0.0			0.0			0.0	
Total Delay		55.6			23.4			110.6			56.8	
LOS		E			C			F			E	
Approach Delay		55.6			23.4			110.6			56.8	
Approach LOS		E			C			F			E	

Intersection Summary

Cycle Length: 90

Actuated Cycle Length: 90

Offset: 47 (52%), Referenced to phase 2:EBTL and 6:WBTL, Start of Green

Control Type: Actuated-Coordinated

Maximum v/c Ratio: 1.11

Intersection Signal Delay: 52.4

Intersection LOS: D

Intersection Capacity Utilization 111.0%

ICU Level of Service H

Analysis Period (min) 15

Splits and Phases: 9: PA 352 & BARREN RD



Lanes, Volumes, Timings
10: PA 352 & LIMA ESTATES DR

Peak PM Hour
Optimized Timings - Final



Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	2	729	16	200	685	14	16	1	284	27	1	3
Satd. Flow (prot)	1676	1885	0	1685	1900	1669	0	1804	1553	0	1813	1615
Flt Permitted	0.383			0.156				0.713			0.715	
Satd. Flow (perm)	676	1885	0	277	1900	1669	0	1348	1553	0	1358	1615
Satd. Flow (RTOR)		2				14			130			3
Lane Group Flow (vph)	2	837	0	217	745	15	0	25	424	0	30	3
Turn Type	pm+pt			pm+pt		Perm	Perm		pm+ov	Perm		Perm
Protected Phases	5	2		1	6			8	1		4	
Permitted Phases	2			6		6	8		8	4		4
Total Split (s)	10.0	49.0	0.0	17.0	56.0	56.0	24.0	24.0	17.0	24.0	24.0	24.0
Total Lost Time (s)	3.1	3.3	4.0	3.1	3.3	3.3	3.3	3.3	3.1	3.3	3.3	3.3
Act Effct Green (s)	64.5	55.7		78.7	77.5	77.5		9.3	27.9		9.3	9.3
Actuated g/C Ratio	0.72	0.62		0.87	0.86	0.86		0.10	0.31		0.10	0.10
v/c Ratio	0.00	0.72		0.39	0.46	0.01		0.18	0.74		0.21	0.02
Control Delay	3.0	18.9		6.4	4.6	2.9		39.1	26.2		39.9	24.0
Queue Delay	0.0	0.0		0.0	0.0	0.0		0.0	0.0		0.0	0.0
Total Delay	3.0	18.9		6.4	4.6	2.9		39.1	26.2		39.9	24.0
LOS	A	B		A	A	A		D	C		D	C
Approach Delay		18.9			5.0			26.9			38.5	
Approach LOS		B			A			C			D	

Intersection Summary

Cycle Length: 90

Actuated Cycle Length: 90

Offset: 49 (54%), Referenced to phase 2:EBTL and 6:WBTL, Start of Green

Control Type: Actuated-Coordinated

Maximum v/c Ratio: 0.74

Intersection Signal Delay: 14.8

Intersection LOS: B

Intersection Capacity Utilization 70.3%

ICU Level of Service C

Analysis Period (min) 15

Splits and Phases: 10: PA 352 & LIMA ESTATES DR



Midday – Optimized Timings

The following pages contain brief LOS reports generated by Synchro. These are created optimized timings for the midday timing plan.

Lanes, Volumes, Timings
1: US 1 & VALLEY RD

Peak Noon Hour
Optimized Timings - Final



Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	41	872	4	7	1168	36	24	9	12	39	0	24
Satd. Flow (prot)	1637	3270	0	1703	3523	1576	0	1494	0	1626	1455	0
Flt Permitted	0.167			0.272				0.817		0.745		
Satd. Flow (perm)	288	3270	0	488	3523	1576	0	1253	0	1275	1455	0
Satd. Flow (RTOR)		1				38		19			126	
Lane Group Flow (vph)	46	973	0	8	1284	40	0	71	0	48	29	0
Turn Type	pm+pt			pm+pt		Perm	Perm			Perm		
Protected Phases	5	2		1	6			8			4	
Permitted Phases	2			6		6	8			4		
Total Split (s)	9.0	53.0	0.0	10.0	54.0	54.0	27.0	27.0	0.0	27.0	27.0	0.0
Total Lost Time (s)	2.4	3.2	4.0	3.2	3.2	3.2	4.1	4.1	4.0	4.1	4.1	4.0
Act Effct Green (s)	74.1	72.0		71.9	67.3	67.3		11.2		11.2	11.2	
Actuated g/C Ratio	0.82	0.80		0.80	0.75	0.75		0.12		0.12	0.12	
v/c Ratio	0.12	0.37		0.02	0.49	0.03		0.41		0.30	0.10	
Control Delay	3.0	4.8		3.1	5.0	1.9		34.3		39.5	0.7	
Queue Delay	0.0	0.0		0.0	0.0	0.0		0.0		0.0	0.0	
Total Delay	3.0	4.8		3.1	5.0	1.9		34.3		39.5	0.7	
LOS	A	A		A	A	A		C		D	A	
Approach Delay		4.7			4.9			34.3			24.9	
Approach LOS		A			A			C			C	

Intersection Summary

Cycle Length: 90
 Actuated Cycle Length: 90
 Offset: 28 (31%), Referenced to phase 2:EBTL and 6:WBTL, Start of Green
 Control Type: Actuated-Coordinated
 Maximum v/c Ratio: 0.49
 Intersection Signal Delay: 6.3 Intersection LOS: A
 Intersection Capacity Utilization 50.0% ICU Level of Service A
 Analysis Period (min) 15

Splits and Phases: 1: US 1 & VALLEY RD



Lanes, Volumes, Timings
2: US 1 & ACTS DRIVEWAY

Peak Noon Hour
Optimized Timings - Final



Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	4	915	3	5	1206	12	2	0	3	15	0	3
Satd. Flow (prot)	1611	3452	0	1660	3557	1698	0	1491	0	0	1736	1346
Flt Permitted	0.175			0.270				0.850			0.753	
Satd. Flow (perm)	297	3452	0	472	3557	1698	0	1294	0	0	1376	1346
Satd. Flow (RTOR)		1				10		4				5
Lane Group Flow (vph)	4	976	0	6	1355	13	0	7	0	0	24	5
Turn Type	pm+pt			pm+pt		Perm	Perm			Perm		Perm
Protected Phases	5	2		1	6			8			4	
Permitted Phases	2			6		6	8			4		4
Total Split (s)	9.0	55.0	0.0	10.0	56.0	56.0	25.0	25.0	0.0	25.0	25.0	25.0
Total Lost Time (s)	2.5	3.1	4.0	3.1	3.1	3.1	4.3	4.3	4.0	4.3	4.3	6.3
Act Effct Green (s)	80.8	80.4		80.4	80.5	80.5		8.8			9.2	7.2
Actuated g/C Ratio	0.90	0.89		0.89	0.89	0.89		0.10			0.10	0.08
v/c Ratio	0.01	0.32		0.01	0.43	0.01		0.05			0.17	0.04
Control Delay	1.5	2.4		0.0	0.7	0.1		27.8			39.0	23.7
Queue Delay	0.0	0.0		0.0	0.0	0.0		0.0			0.0	0.0
Total Delay	1.5	2.4		0.0	0.7	0.1		27.8			39.0	23.7
LOS	A	A		A	A	A		C			D	C
Approach Delay		2.4			0.7			27.8			36.4	
Approach LOS		A			A			C			D	

Intersection Summary

Cycle Length: 90

Actuated Cycle Length: 90

Offset: 22 (24%), Referenced to phase 2:EBTL and 6:WBTL, Start of Green

Control Type: Actuated-Coordinated

Maximum v/c Ratio: 0.43

Intersection Signal Delay: 1.9

Intersection LOS: A

Intersection Capacity Utilization 52.2%

ICU Level of Service A

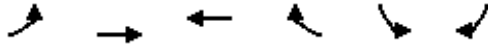
Analysis Period (min) 15

Splits and Phases: 2: US 1 & ACTS DRIVEWAY



Lanes, Volumes, Timings
 3: US 1 & EXECUTIVE PLAZA DRIVE

Peak Noon Hour
 Optimized Timings - Final



Lane Group	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Volume (vph)	22	912	1202	65	68	20
Satd. Flow (prot)	1744	3371	3540	1689	1751	1567
Flt Permitted	0.134			0.950		
Satd. Flow (perm)	246	3371	3540	1689	1751	1567
Satd. Flow (RTOR)				75	40	
Lane Group Flow (vph)	25	1025	1382	75	136	40
Turn Type	pm+pt		Perm		custom	
Protected Phases	5	2	6			
Permitted Phases	2			6	4	4
Total Split (s)	9.0	61.0	52.0	52.0	29.0	29.0
Total Lost Time (s)	3.0	3.3	3.3	3.3	3.8	5.8
Act Effct Green (s)	68.9	68.6	63.7	63.7	14.3	12.3
Actuated g/C Ratio	0.77	0.76	0.71	0.71	0.16	0.14
v/c Ratio	0.07	0.40	0.55	0.06	0.49	0.16
Control Delay	4.4	5.3	5.9	2.1	39.8	12.0
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	4.4	5.3	5.9	2.1	39.8	12.0
LOS	A	A	A	A	D	B
Approach Delay	5.3		5.7	33.4		
Approach LOS	A		A	C		

Intersection Summary

Cycle Length: 90

Actuated Cycle Length: 90

Offset: 79 (88%), Referenced to phase 2:EBTL and 6:WBT, Start of Green

Control Type: Actuated-Coordinated

Maximum v/c Ratio: 0.55

Intersection Signal Delay: 7.4

Intersection LOS: A

Intersection Capacity Utilization 44.7%

ICU Level of Service A

Analysis Period (min) 15

Splits and Phases: 3: US 1 & EXECUTIVE PLAZA DRIVE



Lanes, Volumes, Timings
4: US 1 & PENNELL RD/PA 452

Peak Noon Hour
Optimized Timings - Final



Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	50	842	32	327	967	37	79	209	455	71	304	76
Satd. Flow (prot)	1636	3487	0	1620	3450	0	1695	1784	1568	1631	1722	0
Flt Permitted	0.176			0.129			0.169			0.450		
Satd. Flow (perm)	303	3487	0	220	3450	0	301	1784	1568	772	1722	0
Satd. Flow (RTOR)		4			5				86		13	
Lane Group Flow (vph)	57	993	0	367	1129	0	90	238	517	80	427	0
Turn Type	pm+pt			pm+pt			pm+pt		pm+ov	pm+pt		
Protected Phases	5	2		1	6		3	8	1	7	4	
Permitted Phases	2			6			8		8	4		
Total Split (s)	10.0	31.0	0.0	22.0	43.0	0.0	10.0	27.0	22.0	10.0	27.0	0.0
Total Lost Time (s)	4.3	4.4	4.0	3.8	4.4	4.0	3.8	3.8	3.8	3.5	3.8	4.0
Act Effct Green (s)	34.8	28.6		50.8	42.2		28.5	23.6	45.2	29.1	23.6	
Actuated g/C Ratio	0.39	0.32		0.56	0.47		0.32	0.26	0.50	0.32	0.26	
v/c Ratio	0.28	0.89		0.92	0.70		0.47	0.51	0.62	0.26	0.93	
Control Delay	11.8	35.1		51.8	13.6		27.7	33.0	17.3	16.5	44.8	
Queue Delay	0.0	0.0		0.0	0.0		0.0	0.0	0.0	0.0	0.0	
Total Delay	11.8	35.1		51.8	13.6		27.7	33.0	17.3	16.5	44.8	
LOS	B	D		D	B		C	C	B	B	D	
Approach Delay		33.9			23.0			22.8			40.3	
Approach LOS		C			C			C			D	

Intersection Summary

Cycle Length: 90

Actuated Cycle Length: 90

Offset: 0 (0%), Referenced to phase 2:EBTL and 6:WBTL, Start of Green, Master Intersection

Control Type: Actuated-Coordinated

Maximum v/c Ratio: 0.93

Intersection Signal Delay: 28.1

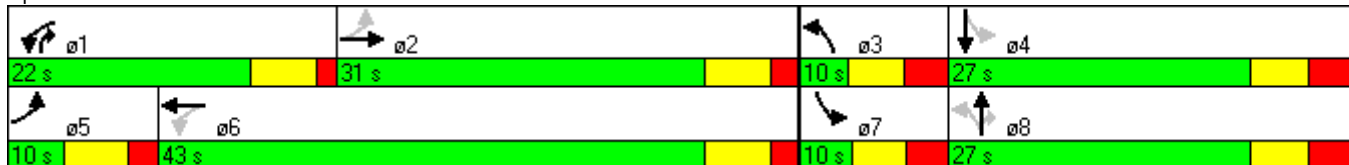
Intersection LOS: C

Intersection Capacity Utilization 81.1%

ICU Level of Service D

Analysis Period (min) 15

Splits and Phases: 4: US 1 & PENNELL RD/PA 452



Lanes, Volumes, Timings
5: US 1 & ORIOLE AVENUE

Peak Noon Hour
Optimized Timings - Final

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	22	1608	35	27	1152	12	30	1	31	31	4	15
Satd. Flow (prot)	1660	3557	1538	1635	3500	0	0	1759	1568	0	1725	1531
Flt Permitted	0.194			0.102				0.702			0.727	
Satd. Flow (perm)	339	3557	1538	176	3500	0	0	1295	1568	0	1309	1531
Satd. Flow (RTOR)			31		2				36			17
Lane Group Flow (vph)	23	1675	36	28	1212	0	0	35	36	0	41	17
Turn Type	pm+pt		Perm	pm+pt			Perm		Perm	Perm		Perm
Protected Phases	5	2		1	6			8				4
Permitted Phases	2		2	6			8		8	4		4
Total Split (s)	10.0	55.0	55.0	9.0	54.0	0.0	26.0	26.0	26.0	26.0	26.0	26.0
Total Lost Time (s)	3.2	3.2	3.2	2.6	3.2	4.0	3.9	3.9	5.9	3.9	3.9	3.9
Act Effct Green (s)	74.0	71.0	71.0	74.4	70.8			10.1	8.1		10.1	10.1
Actuated g/C Ratio	0.82	0.79	0.79	0.83	0.79			0.11	0.09		0.11	0.11
v/c Ratio	0.06	0.60	0.03	0.10	0.44			0.24	0.21		0.28	0.09
Control Delay	2.8	7.0	2.6	3.0	12.0			39.6	15.5		40.6	16.7
Queue Delay	0.0	0.0	0.0	0.0	0.0			0.0	0.0		0.0	0.0
Total Delay	2.8	7.0	2.6	3.0	12.0			39.6	15.5		40.6	16.7
LOS	A	A	A	A	B			D	B		D	B
Approach Delay		6.9			11.8			27.4			33.6	
Approach LOS		A			B			C			C	

Intersection Summary

Cycle Length: 90

Actuated Cycle Length: 90

Offset: 73 (81%), Referenced to phase 2:EBTL and 6:WBTL, Start of Green

Control Type: Actuated-Coordinated

Maximum v/c Ratio: 0.60

Intersection Signal Delay: 9.8

Intersection LOS: A

Intersection Capacity Utilization 62.7%

ICU Level of Service B























Analysis Period (min) 15

Splits and Phases: 5: US 1 & ORIOLE AVENUE



Lanes, Volumes, Timings
 6: US 1 & GRANITE RUN MALL ACCESS

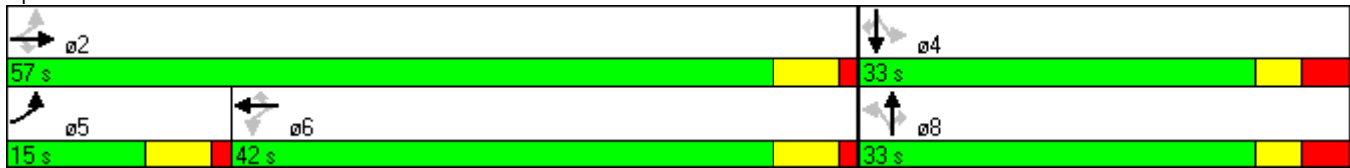
Peak Noon Hour
 Optimized Timings - Final

												
Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	129	1575	8	6	1026	18	31	5	10	71	8	108
Satd. Flow (prot)	1652	3421	1478	1644	3522	1576	0	1822	1615	0	1663	1477
Flt Permitted	0.194			0.146				0.710			0.716	
Satd. Flow (perm)	337	3421	1478	253	3522	1576	0	1349	1615	0	1244	1477
Satd. Flow (RTOR)			8			19			12			124
Lane Group Flow (vph)	133	1624	8	6	1069	19	0	43	12	0	91	124
Turn Type	pm+pt		Perm	Perm		Perm	Perm		Perm	Perm		Perm
Protected Phases	5	2				6			8			4
Permitted Phases	2		2	6		6	8		8	4		4
Total Split (s)	15.0	57.0	57.0	42.0	42.0	42.0	33.0	33.0	33.0	33.0	33.0	33.0
Total Lost Time (s)	3.7	3.7	3.7	3.7	3.7	3.7	4.4	4.4	4.4	4.4	4.4	4.4
Act Effct Green (s)	68.2	68.2	68.2	54.8	54.8	54.8		13.7	13.7		13.7	13.7
Actuated g/C Ratio	0.76	0.76	0.76	0.61	0.61	0.61		0.15	0.15		0.15	0.15
v/c Ratio	0.34	0.63	0.01	0.04	0.50	0.02		0.21	0.05		0.48	0.38
Control Delay	6.0	8.9	2.8	4.2	4.8	0.6		34.1	15.7		42.4	9.5
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0		0.0	0.0		0.0	0.0
Total Delay	6.0	8.9	2.8	4.2	4.8	0.6		34.1	15.7		42.4	9.5
LOS	A	A	A	A	A	A		C	B		D	A
Approach Delay		8.7			4.7			30.1			23.4	
Approach LOS		A			A			C			C	

Intersection Summary

Cycle Length: 90
 Actuated Cycle Length: 90
 Offset: 35 (39%), Referenced to phase 2:EBTL and 6:WBTL, Start of Green
 Control Type: Actuated-Coordinated
 Maximum v/c Ratio: 0.63
 Intersection Signal Delay: 8.7 Intersection LOS: A
 Intersection Capacity Utilization 77.4% ICU Level of Service D
 Analysis Period (min) 15

Splits and Phases: 6: US 1 & GRANITE RUN MALL ACCESS



Lanes, Volumes, Timings
7: US 1 & GRANITE RUN MALL ACCESS

Peak Noon Hour
Optimized Timings - Final



Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	28	1405	53	1	868	70	81	56	208	216	87	41
Satd. Flow (prot)	1719	3438	1641	0	3557	1591	1641	1727	1566	1778	1872	1697
Flt Permitted	0.194				0.954		0.695			0.708		
Satd. Flow (perm)	351	3438	1641	0	3393	1591	1200	1727	1566	1325	1872	1697
Satd. Flow (RTOR)			56			80			26			45
Lane Group Flow (vph)	30	1495	56	0	999	80	109	76	281	237	96	45
Turn Type	pm+pt		Perm	Perm		Perm	Perm		Perm	Perm		Perm
Protected Phases	5	2			6			8			4	
Permitted Phases	2		2	6		6	8		8	4		4
Total Split (s)	9.0	53.0	53.0	44.0	44.0	44.0	37.0	37.0	37.0	37.0	37.0	37.0
Total Lost Time (s)	3.9	4.1	4.1	6.1	4.1	4.1	4.9	4.9	4.9	4.9	4.9	4.9
Act Effct Green (s)	57.9	57.7	57.7		50.9	50.9	23.3	23.3	23.3	23.3	23.3	23.3
Actuated g/C Ratio	0.64	0.64	0.64		0.57	0.57	0.26	0.26	0.26	0.26	0.26	0.26
v/c Ratio	0.09	0.68	0.05		0.52	0.09	0.35	0.17	0.66	0.69	0.20	0.10
Control Delay	6.7	7.8	2.4		15.6	3.8	28.6	24.4	33.7	39.9	25.0	7.0
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	6.7	7.8	2.4		15.6	3.8	28.6	24.4	33.7	39.9	25.0	7.0
LOS	A	A	A		B	A	C	C	C	D	C	A
Approach Delay		7.6			14.8			31.0			32.2	
Approach LOS		A			B			C			C	

Intersection Summary

Cycle Length: 90

Actuated Cycle Length: 90

Offset: 21 (23%), Referenced to phase 2:EBTL and 6:WBTL, Start of Green

Control Type: Actuated-Coordinated

Maximum v/c Ratio: 0.69

Intersection Signal Delay: 15.6

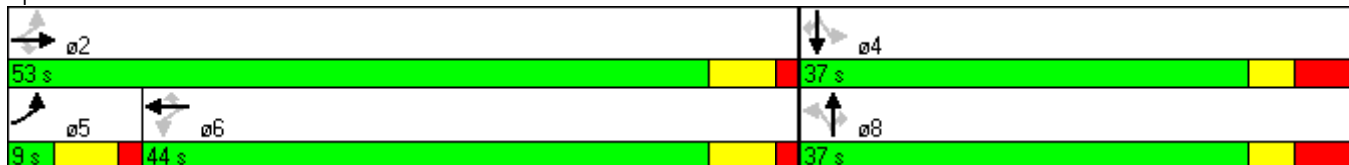
Intersection LOS: B

Intersection Capacity Utilization 75.3%

ICU Level of Service D

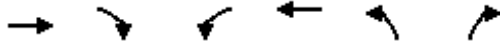
Analysis Period (min) 15

Splits and Phases: 7: US 1 & GRANITE RUN MALL ACCESS



Lanes, Volumes, Timings
 8: PA 352 & GRANITE RUN MALL ACCESS

Peak Noon Hour
 Optimized Timings - Final



Lane Group	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations	↑	↗	↖	↑	↖	↗
Volume (vph)	685	88	93	639	110	80
Satd. Flow (prot)	1853	1680	1676	1827	1719	1538
Flt Permitted			0.274		0.950	
Satd. Flow (perm)	1853	1680	483	1827	1719	1538
Satd. Flow (RTOR)		92				101
Lane Group Flow (vph)	714	92	101	695	139	101
Turn Type		Perm	pm+pt			Perm
Protected Phases	2		1	6	8	
Permitted Phases		2	6			8
Total Split (s)	60.0	60.0	10.0	70.0	20.0	20.0
Total Lost Time (s)	3.3	3.3	2.8	3.3	4.0	4.0
Act Effct Green (s)	61.1	61.1	70.2	69.7	13.0	13.0
Actuated g/C Ratio	0.68	0.68	0.78	0.77	0.14	0.14
v/c Ratio	0.57	0.08	0.21	0.49	0.56	0.33
Control Delay	5.3	0.1	3.8	5.5	44.1	10.0
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	5.3	0.1	3.8	5.5	44.1	10.0
LOS	A	A	A	A	D	B
Approach Delay	4.7			5.3	29.8	
Approach LOS	A			A	C	

Intersection Summary

Cycle Length: 90

Actuated Cycle Length: 90

Offset: 64 (71%), Referenced to phase 2:EBT and 6:WBTL, Start of Green

Control Type: Actuated-Coordinated

Maximum v/c Ratio: 0.57

Intersection Signal Delay: 8.2

Intersection LOS: A

Intersection Capacity Utilization 57.3%

ICU Level of Service B

Analysis Period (min) 15

Splits and Phases: 8: PA 352 & GRANITE RUN MALL ACCESS



Lanes, Volumes, Timings
9: PA 352 & BARREN RD

Peak Noon Hour
Optimized Timings - Final



Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		↕			↕			↕			↕	
Volume (vph)	38	762	172	48	550	11	111	74	41	76	169	35
Satd. Flow (prot)	0	1935	0	0	2149	0	0	2001	0	0	1600	0
Flt Permitted		0.961			0.883			0.584			0.836	
Satd. Flow (perm)	0	1863	0	0	1905	0	0	1197	0	0	1355	0
Satd. Flow (RTOR)		21			2			14			9	
Lane Group Flow (vph)	0	993	0	0	642	0	0	238	0	0	452	0
Turn Type	Perm			Perm			Perm			Perm		
Protected Phases		2			6			8			4	
Permitted Phases	2			6			8			4		
Total Split (s)	56.0	56.0	0.0	56.0	56.0	0.0	34.0	34.0	0.0	34.0	34.0	0.0
Total Lost Time (s)	2.7	2.7	4.0	2.7	2.7	4.0	2.8	2.8	4.0	2.8	2.8	4.0
Act Effct Green (s)		53.4			53.4			31.1			31.1	
Actuated g/C Ratio		0.59			0.59			0.35			0.35	
v/c Ratio		0.89			0.57			0.56			0.95	
Control Delay		24.5			14.8			18.2			61.3	
Queue Delay		0.0			0.0			0.0			0.0	
Total Delay		24.5			14.8			18.2			61.3	
LOS		C			B			B			E	
Approach Delay		24.5			14.8			18.2			61.3	
Approach LOS		C			B			B			E	

Intersection Summary

Cycle Length: 90

Actuated Cycle Length: 90

Offset: 25 (28%), Referenced to phase 2:EBTL and 6:WBTL, Start of Green

Control Type: Actuated-Coordinated

Maximum v/c Ratio: 0.95

Intersection Signal Delay: 28.3

Intersection LOS: C

Intersection Capacity Utilization 89.0%

ICU Level of Service E

Analysis Period (min) 15

Splits and Phases: 9: PA 352 & BARREN RD



Lanes, Volumes, Timings
10: PA 352 & LIMA ESTATES DR

Peak Noon Hour
Optimized Timings - Final



Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	2	610	13	144	492	10	12	1	221	21	1	2
Satd. Flow (prot)	1676	1885	0	1668	1881	1652	0	1805	1553	0	1814	1615
Flt Permitted	0.429			0.299				0.721			0.725	
Satd. Flow (perm)	757	1885	0	525	1881	1652	0	1363	1553	0	1378	1615
Satd. Flow (RTOR)		2				12			194			4
Lane Group Flow (vph)	2	684	0	178	607	12	0	15	266	0	42	4
Turn Type	pm+pt			pm+pt		Perm	Perm		pm+ov	Perm		Perm
Protected Phases	5	2		1	6			8	1		4	
Permitted Phases	2			6		6	8		8	4		4
Total Split (s)	10.0	49.0	0.0	17.0	56.0	56.0	24.0	24.0	17.0	24.0	24.0	24.0
Total Lost Time (s)	3.1	3.3	4.0	3.1	3.3	3.3	3.3	3.3	3.1	3.3	3.3	3.3
Act Effct Green (s)	72.7	64.0		78.1	76.9	76.9		9.8	19.6		10.0	10.0
Actuated g/C Ratio	0.81	0.71		0.87	0.85	0.85		0.11	0.22		0.11	0.11
v/c Ratio	0.00	0.51		0.30	0.38	0.01		0.10	0.54		0.27	0.02
Control Delay	2.0	9.5		2.1	2.6	1.2		36.2	12.1		40.4	22.5
Queue Delay	0.0	0.0		0.0	0.0	0.0		0.0	0.0		0.0	0.0
Total Delay	2.0	9.5		2.1	2.6	1.2		36.2	12.1		40.4	22.5
LOS	A	A		A	A	A		D	B		D	C
Approach Delay		9.4			2.5			13.4			38.8	
Approach LOS		A			A			B			D	

Intersection Summary

Cycle Length: 90

Actuated Cycle Length: 90

Offset: 26 (29%), Referenced to phase 2:EBTL and 6:WBTL, Start of Green

Control Type: Actuated-Coordinated

Maximum v/c Ratio: 0.54

Intersection Signal Delay: 7.7

Intersection LOS: A

Intersection Capacity Utilization 59.9%

ICU Level of Service B

Analysis Period (min) 15

Splits and Phases: 10: PA 352 & LIMA ESTATES DR



APPENDIX B



Output Report -- Transportation and Emissions Impacts: Total Emissions & Cost Effectiveness
Sorted by Project Type



Report ID Number 1
 Report Title US 1 and PA 352 Closed Loop Traffic Signal System
 Analysis Year 2009

Mobile Version Mobile 6.2
 Analysis Type Annual

<u>County</u>	<u>Description</u>	<u>Yr. Compl.</u>	<u>Vehicle</u>		<u>BUS VMT</u>	<u>Total Vehicle Emissions (Kg/Year)</u>				
			<u>VT</u>	<u>VMT</u>		<u>VOC</u>	<u>NOx</u>	<u>CO</u>	<u>PM2.5</u>	<u>SO2</u>
Delaware	US 1 & Valley Rd	2009	0	0	0	-89.67	-38.66	-383.53	-0.79	-0.20
Delaware	US 1 & ACTS Driveway	2009	0	0	0	-92.36	-39.82	-395.01	-0.82	-0.21
Delaware	US 1 & Executive Plaza Drive	2009	0	0	0	-62.20	-26.82	-266.05	-0.55	-0.14
Delaware	US 1 & PA 452	2009	0	0	0	-146.31	-62.73	-622.50	-1.28	-0.33
Delaware	US 1 & Oriole Ave	2009	0	0	0	-97.73	-41.99	-416.63	-0.86	-0.22
Delaware	US 1 & Granite Run Mall Access	2009	0	0	0	-55.29	-23.76	-235.68	-0.49	-0.12
Delaware	US 1 & Riddle Memorial Hospital	2009	0	0	0	-130.58	-55.98	-555.42	-1.15	-0.29
Delaware	PA 352 & Granite Run Mall Access	2009	0	0	0	-78.36	-33.65	-333.81	-0.69	-0.18
Delaware	PA 352 & PA 452	2009	0	0	0	-90.35	-38.73	-384.24	-0.79	-0.20
Delaware	PA 352 & Lima Estates Dr	2009	0	0	0	-59.72	-25.66	-254.57	-0.53	-0.13
Total impacts for all projects: (tons/year)						0	-0.43	-4.23	-0.01	-0.00

Source: PAQONE Report Executed by DVRPC, 2009

APPENDIX C



Travel Time Runs – Detailed Reports

“Before” Travel Time Runs

The following tables detail the average of at least three runs for each time period along US 1 and PA 352 for the AM, PM, freeflow, and midday hours for the “before” travel time runs, conducted May, 2008. The shaded cells indicate the values used for analysis purposes.

“Before” Travel Time Runs Results – Eastbound US 1, Peak AM and PM Hours

Data Point	AM Peak			PM Peak		
	Travel Time (sec)	Avg Speed (mph)	Total Delay (sec)	Total Delay (sec)	Avg Speed (mph)	Total Delay (sec)
[start]						
Station Rd	2.0	45.7	0.0	2.0	45.0	0.0
Valley Rd	40.0	51.5	0.0	50.0	41.2	1.3
Granite Farm Estates	40.3	25.9	16.3	28.3	36.5	2.3
Car Dealership Entrance	94.3	11.3	68.3	219.3	4.9	192.3
Median Brk (RV Sales Lot)	42.3	7.2	34.7	77.0	37	70.0
PA 452 Pennell Rd	159.3	4.4	141.3	195.3	3.5	178.3
Oriole Ave/Granite Dr	18.7	33.3	2.7	20.0	31.5	3.7
Granite Run Mall Ent (McDonalds)	14.7	43.5	0.0	20.3	32.3	3.7
Granite Run Mall Ent (Riddle Hospital)	30.3	21.6	13.3	24.7	26.3	7.7
PA 352 Overpass	27.0	40.5	0.0	28.0	42.5	2.7
US 1 Media Byp ramp	11.7	41.8	0.3	11.7	42.1	0.0
[end]	0.0	0.0	0.0	0.0	0.0	0.0
Total (Station Rd To PA 352 Overpass)	466.9	17.7	276.6	662.9	12.5	462.0

Source: DVRPC

"Before" Travel Time Runs Results – Eastbound US 1, Free Flow and Midday

Data Point	Free Flow			Midday		
	Travel Time (sec)	Avg Speed (mph)	Total Delay (sec)	Total Delay (sec)	Avg Speed (mph)	Total Delay (sec)
[start]						
Station Rd	2.7	39.1	0.0	1.3	36.8	0.0
Valley Rd	40.0	50.9	0.0	51.0	40.2	2.7
Granite Farm Estates	20.0	49.1	0.0	26.3	39.7	1.0
Car Dealership Entrance	63.0	19.9	33.3	32.7	33.3	5.7
Median Brk (RV Sales Lot)	31.7	12.5	22.0	10.7	28.4	2.7
PA 452 Pennell Rd	44.7	13.7	29.3	42.7	16.6	24.7
Oriole Ave / Granite Dr	38.7	15.7	22.7	27.3	24.4	9.3
Granite Run Mall Ent (McDonalds)	22.0	30.5	5.7	12.0	41.1	0.7
Granite Run Mall Ent (Riddle Hospital)	21.3	30.2	5.0	26.0	32.9	4.0
PA 352 Overpass	31.7	34.7	4.7	42.0	26.4	14.3
US 1 Media Byp ramp	10.3	45.1	0.0	10.0	48.1	0.0
[end]	0.0	0.0	0.0	0.0	0.0	0.0
Total (Station Rd To PA 352 Overpass)	313.1	26.4	122.7	270.7	30.5	65.1

Source: DVRPC

"Before" Travel Time Runs Results – Westbound US 1, Peak AM and PM Hours

Data Point	AM Peak			PM Peak		
	Travel Time (sec)	Avg Speed (mph)	Total Delay (sec)	Total Delay (sec)	Avg Speed (mph)	Total Delay (sec)
[start]						
US 1 Media Byp ramp	2.0	30.7	0.0	2.7	25.6	0.3
PA 352 Overpass	15.7	40.2	0.0	18.0	34.1	2.0
Granite Run Mall Ent (Riddle Hosp)	36.0	30.2	9.7	28.0	38.9	1.7
Granite Run Mall Ent (McDonalds)	19.3	33.4	4.0	17.3	36.9	1.7
Oriole Ave / Granite Dr	77.0	8.4	61.0	41.3	15.8	25.0
PA 3452 Pennell Rd	58.7	10.0	43.7	87.7	6.6	72.7
Median Brk (RV Sales Lot)	20.3	34.9	2.3	20.0	35.1	2.0
Car Dealership Entrance	17.0	19.0	9.0	7.7	43.4	0.0
Granite Farm Estates	24.3	45.7	0.7	23.7	47.2	0.0
Valley Rd	26.7	38.9	4.7	20.3	49.3	0.0
Station Rd	32.7	58.1	0.0	36.3	52.9	0.0
[end]	0.0	0.0	0.0	0.0	0.0	0.0
Total (PA 352 Overpass to Station Rd)	312.0	26.5	135.1	282.3	29.3	103.1

Source: DVRPC

"Before" Travel Time Runs Results – Westbound US 1, Free Flow and Midday

Data Point	Free Flow			Midday		
	Travel Time (sec)	Avg Speed (mph)	Total Delay (sec)	Total Delay (sec)	Avg Speed (mph)	Total Delay (sec)
[start]						
US 1 Media Byp ramp	2.0	25.6	0.3	2.3	33.9	0.0
PA 352 Overpass	17.7	34.7	2.3	15.0	41.0	0.0
Granite Run Mall Ent (Riddle Hosp)	47.0	23.1	20.7	33.3	32.3	6.0
Granite Run Mall Ent (McDonalds)	20.0	31.1	4.0	18.0	35.6	1.7
Oriole Ave / Granite Dr	38.0	17.5	21.0	28.3	23.7	11.3
PA 3452 Pennell Rd	27.3	22.2	12.0	28.7	20.9	13.0
Median Brk (RV Sales Lot)	25.3	29.0	6.7	17.3	40.3	0.3
Car Dealership Entrance	12.7	23.6	5.0	6.3	50.3	0.0
Granite Farm Estates	38.7	28.2	13.0	22.7	48.4	0.0
Valley Rd	29.3	35.4	5.7	22.3	47.0	0.0
Station Rd	44.0	45.0	0.0	37.7	51.2	0.0
[end]	0.0	0.0	0.0	0.0	0.0	0.0
Total (PA 352 Overpass to Station Rd)	282.3	29.3	88.1	214.6	38.5	32.3

Source: DVRPC

"Before" Travel Time Runs Results – Westbound PA 352, Peak AM and PM Hours

Data Point	AM Peak			PM Peak		
	Travel Time (sec)	Avg Speed (mph)	Total Delay (sec)	Total Delay (sec)	Avg Speed (mph)	Total Delay (sec)
[start]						
Williamson School Ent	2.0	31.0	0.0	1.3	34.3	0.0
US 1 overpass	36.7	46.0	0.0	38.7	44.3	0.0
Median Brk (Kohls Ent)	18.3	40.3	0.0	17.7	41.8	0.3
Rose Tree Rd	15.7	44.0	0.0	16.0	43.7	0.0
Granite Run Mall Ent (light)	19.0	18.9	10.0	11.0	30.0	3.0
Van Leer Ave	14.0	29.1	3.3	10.7	38.7	0.3
PA 452 / Barren Rd	58.3	20.7	28.3	62.7	20.0	30.0
Old Forge Rd	21.0	34.6	2.7	18.3	29.3	4.3
Yearsley Mill Rd	45.3	41.7	0.0	49.7	42.9	0.0
Penn State Ent (light)	27.7	22.0	12.3	24.3	25.2	9.3
Forge Rd	31.0	33.1	5.0	24.3	42.2	0.3
Heather Knoll La	36.3	44.4	0.0	33.3	48.9	0.0
[end]	0.0	0.0	0.0	0.0	0.0	0.0
Total (Rose Tree Rd to Yearsley Mill Rd)	157.6	29.5	44.3	152.4	30.5	37.6

Source: DVRPC

"Before" Travel Time Runs Results – Westbound PA 352, Free Flow and Midday

Data Point	Free Flow			Midday		
	Travel Time (sec)	Avg Speed (mph)	Total Delay (sec)	Total Delay (sec)	Avg Speed (mph)	Total Delay (sec)
[start]						
Williamson School Ent	2.0	28.6	0.0	2.0	30.7	0.0
US 1 overpass	39.0	44.5	0.0	37.3	45.4	0.0
Median Brk (Kohls Ent)	14.3	44.4	0.0	18.7	39.6	0.3
Rose Tree Rd	14.7	45.9	0.0	16.3	43.9	0.0
Granite Run Mall Ent (light)	12.3	37.6	1.3	6.0	51.6	0.3
Van Leer Ave	9.7	37.9	1.0	14.0	27.3	4.7
PA 452 / Barren Rd	33.7	37.3	3.0	48.3	28.6	13.3
Old Forge Rd	29.0	24.0	11.3	17.3	40.1	0.7
Yearsley Mill Rd	42.7	42.0	2.0	44.7	45.0	0.0
Penn State Ent (light)	14.0	46.2	0.0	19.3	31.5	5.0
Forge Rd	20.3	44.8	0.0	27.7	36.4	3.7
Heather Knoll La	31.3	52.3	0.0	33.3	48.5	0.0
[end]	0.0	0.0	0.0	0.0	0.0	0.0
Total (Rose Tree Rd to Yearsley Mill Rd)	127.4	36.5	18.6	130.3	35.7	19.0

Source: DVRPC

"Before" Travel Time Runs Results – Eastbound PA 352, Peak AM and PM Hours

Data Point	AM Peak			PM Peak		
	Travel Time (sec)	Avg Speed (mph)	Total Delay (sec)	Total Delay (sec)	Avg Speed (mph)	Total Delay (sec)
[start]						
Heather Knoll La	2.0	38.9	0.0	2.3	39.4	0.0
Forge Rd	35.3	47.2	0.0	34.3	45.6	0.0
Penn State Ent (light)	28.0	37.1	4.3	24.3	42.9	0.0
Yearsley Mill Rd	14.3	40.3	1.0	12.3	41.7	0.0
Old Forge Rd	124.7	15.3	76.7	241.3	8.1	192.0
PA 452 / Barren Rd	61.0	12.9	41.0	63.7	9.7	47.7
Van Leer Ave	33.0	34.5	3.7	42.0	31.4	8.7
Granite Run Mall Ent (light)	13.0	32.5	3.0	11.7	34.8	1.3
Rose Tree Rd	9.3	37.6	1.0	20.0	17.1	11.3
Median Brk (Kohls Ent)	15.7	42.7	0.0	12.3	46.3	0.0
US 1 overpass	17.0	43.8	0.0	26.3	27.2	9.0
Williamson School Ent	34.7	47.3	0.0	40.3	46.5	0.0
[end]	0.0	0.0	0.0	0.0	0.0	0.0
Total (Yearsley Mill Rd to Rose Tree Rd)	241.0	19.3	125.4	378.7	12.3	261.0

Source: DVRPC

"Before" Travel Time Runs Results – Eastbound PA 352, Free Flow and Midday

Data Point	Free Flow			Midday		
	Travel Time (sec)	Avg Speed (mph)	Total Delay (sec)	Total Delay (sec)	Avg Speed (mph)	Total Delay (sec)
[start]						
Heather Knoll La	2.0	38.2	0.0	2.0	36.1	0.0
Forge Rd	36.3	46.1	0.0	37.0	45.5	0.0
Penn State Ent (light)	20.0	46.0	0.0	25.7	40.9	1.7
Yearsley Mill Rd	13.7	46.5	0.0	14.7	39.1	1.0
Old Forge Rd	41.3	43.2	1.0	48.0	39.4	5.3
PA 452 / Barren Rd	26.3	27.8	7.7	29.0	25.7	10.0
Van Leer Ave	36.3	39.0	2.7	35.0	35.4	4.0
Granite Run Mall Ent (light)	15.3	23.6	6.3	13.0	31.5	2.7
Rose Tree Rd	8.0	39.1	0.7	8.7	38.7	0.0
Median Brk (Kohls Ent)	11.7	43.2	0.0	17.7	38.9	0.3
US 1 overpass	19.7	42.6	0.0	24.3	30.9	5.3
Williamson School Ent	41.0	45.9	0.0	39.7	41.0	0.0
[end]	0.0	0.0	0.0	0.0	0.0	0.0
Total (Yearsley Mill Rd to Rose Tree Rd)	127.2	36.6	18.4	133.7	34.8	22.0

Source: DVRPC

“After” Travel Time Runs

The following tables detail the average of at least three runs for each time period along US 1 and PA 352 for the AM, PM, freeflow, and midday hours for the “after” travel time runs, conducted May, 2009. The shaded cells indicate the values used for analysis purposes.

“After” Travel Time Runs Results – Eastbound US 1, Peak AM and PM Hours

Data Point	AM Peak			PM Peak		
	Travel Time (sec)	Avg Speed (mph)	Total Delay (sec)	Total Delay (sec)	Avg Speed (mph)	Total Delay (sec)
[start]						
Station Rd	2.3	43.5	0.0	2.0	45.0	0.0
Valley Rd	38.3	52.4	0.0	50.7	40.6	2.3
Granite Farm Estates	16.0	47.6	0.0	31.3	33.0	6.7
Car Dealership Entrance	17.0	47.0	0.0	26.7	40.5	1.0
Median Brk (RV Sales Lot)	29.0	19.3	16.3	29.3	9.8	22.3
PA 452 Pennell Rd	73.0	11.5	51.7	117.3	5.8	100.3
Oriole Ave/Granite Dr	67.3	7.6	54.0	18.3	34.3	2.0
Granite Run Mall Ent (McDonalds)	18.7	35.8	1.7	27.0	24.3	10.7
Granite Run Mall Ent (Riddle Hospital)	26.0	24.5	10.3	16.7	38.9	2.3
PA 352 Overpass	34.3	27.9	14.3	27.7	43.0	0.7
US 1 Media Byp ramp	8.7	64.7	0.0	12.7	38.8	1.3
[end]	0.0	0.0	0.0	0.0	0.0	0.0
Total (Station Rd to PA 352 Overpass)	319.6	25.9	148.3	345.0	24.0	148.3

Source: DVRPC

"After" Travel Time Runs Results – Eastbound US 1, Free Flow and Midday

Data Point	Free Flow			Midday		
	Travel Time (sec)	Avg Speed (mph)	Total Delay (sec)	Total Delay (sec)	Avg Speed (mph)	Total Delay (sec)
[start]						
Station Rd	2.3	44.7	0.0	1.3	36.8	0.0
Valley Rd	41.3	49.3	0.0	51.0	40.2	2.7
Granite Farm Estates	21.7	45.3	0.0	26.3	39.7	1.0
Car Dealership Entrance	36.0	34.8	6.0	32.7	33.3	5.7
Median Brk (RV Sales Lot)	8.3	47.5	0.0	10.7	28.4	2.7
PA 452 Pennell Rd	21.7	28.3	6.3	42.7	16.6	24.7
Oriole Ave / Granite Dr	16.3	37.2	0.3	27.3	24.4	9.3
Granite Run Mall Ent (McDonalds)	15.7	42.9	0.0	12.0	41.1	0.7
Granite Run Mall Ent (Riddle Hospital)	49.0	13.1	33.0	26.0	32.9	4.0
PA 352 Overpass	26.3	41.7	0.0	42.0	26.4	14.3
US 1 Media Byp ramp	11.7	39.9	0.7	10.0	48.1	0.0
[end]	0.0	0.0	0.0	0.0	0.0	0.0
Total (Station Rd to PA 352 Overpass)	236.3	35.0	45.6	298.6	27.7	109.7

Source: DVRPC

"After" Travel Time Runs Results – Westbound US 1, Peak AM and PM Hours

Data Point	AM Peak			PM Peak		
	Travel Time (sec)	Avg Speed (mph)	Total Delay (sec)	Total Delay (sec)	Avg Speed (mph)	Total Delay (sec)
[start]						
US 1 Media Byp ramp	2.0	25.6	0.0	2.7	25.6	0.3
PA 352 Overpass	17.0	39.8	0.0	18.0	34.1	2.0
Granite Run Mall Ent (Riddle Hosp)	42.3	25.6	16.3	28.0	38.9	1.7
Granite Run Mall Ent (McDonalds)	16.0	39.1	0.3	17.3	36.9	1.7
Oriole Ave / Granite Dr	14.3	45.8	0.0	41.3	15.8	25.0
PA 3452 Pennell Rd	30.3	19.5	16.0	87.7	6.6	72.7
Median Brk (RV Sales Lot)	15.7	45.0	0.0	20.0	35.1	2.0
Car Dealership Entrance	18.7	18.4	11.0	7.7	43.4	0.0
Granite Farm Estates	22.7	48.0	0.0	23.7	47.2	0.0
Valley Rd	20.0	52.1	0.0	20.3	49.3	0.0
Station Rd	36.0	54.2	0.0	36.3	52.9	0.0
[end]	0.0	0.0	0.0	0.0	0.0	0.0
Total (PA 352 Overpass to Station Rd)	216.0	38.3	43.6	232.3	35.6	50.3

Source: DVRPC

"After" Travel Time Runs Results – Westbound US 1, Free Flow and Midday

Data Point	Free Flow			Midday		
	Travel Time (sec)	Avg Speed (mph)	Total Delay (sec)	Total Delay (sec)	Avg Speed (mph)	Total Delay (sec)
[start]						
US 1 Media Byp ramp	2.0	25.6	0.0	2.0	33.4	0.0
PA 352 Overpass	16.0	38.4	1.0	16.3	41.0	0.0
Granite Run Mall Ent (Riddle Hosp)	25.0	43.5	0.3	25.0	43.7	0.0
Granite Run Mall Ent (McDonalds)	16.7	37.3	1.7	20.7	31.5	5.7
Oriole Ave / Granite Dr	28.0	23.7	11.0	17.7	36.7	1.7
PA 3452 Pennell Rd	17.7	34.3	2.0	39.0	15.6	23.3
Median Brk (RV Sales Lot)	31.0	23.7	12.0	18.3	38.8	0.3
Car Dealership Entrance	6.3	47.2	0.0	21.3	15.3	14.3
Granite Farm Estates	21.3	51.2	0.0	23.0	47.4	0.0
Valley Rd	22.7	45.8	0.0	21.0	49.1	0.0
Station Rd	56.3	35.2	10.3	45.7	43.0	4.0
[end]	0.0	0.0	0.0	0.0	0.0	0.0
Total (PA 352 Overpass to Station Rd)	225.0	36.8	37.3	231.7	35.7	49.3

Source: DVRPC

"After" Travel Time Runs Results – Westbound PA 352, Peak AM and PM Hours

Data Point	AM Peak			PM Peak		
	Travel Time (sec)	Avg Speed (mph)	Total Delay (sec)	Total Delay (sec)	Avg Speed (mph)	Total Delay (sec)
[start]						
Williamson School Ent	2.0	31.0	0.0	2.0	33.1	0.0
US 1 overpass	38.0	44.4	0.0	38.5	45.2	0.0
Median Brk (Kohls Ent)	19.0	38.9	1.0	18.0	40.6	0.5
Rose Tree Rd	16.5	41.8	0.0	16.0	43.2	0.0
Granite Run Mall Ent (light)	12.5	28.7	3.5	13.0	27.5	4.5
Van Leer Ave	24.5	16.6	14.0	10.5	37.6	1.0
PA 452 / Barren Rd	64.0	18.9	33.5	65.0	19.0	34.0
Old Forge Rd	22.0	33.1	3.0	36.5	19.6	18.0
Yearsley Mill Rd	44.5	42.5	0.0	46.0	40.6	0.0
Penn State Ent (light)	14.0	43.4	0.0	13.5	45.3	0.0
Forge Rd	25.5	40.2	0.0	23.0	44.3	0.0
Heather Knoll La	37.0	43.6	0.0	36.0	46.3	0.0
[end]	0.0	0.0	0.0	0.0	0.0	0.0
Total (Rose Tree Rd to Yearsley Mill Rd)	167.5	27.8	54.0	171.0	27.2	57.5

Source: DVRPC

"After" Travel Time Runs Results – Westbound PA 352, Free Flow and Midday

Data Point	Free Flow			Midday		
	Travel Time (sec)	Avg Speed (mph)	Total Delay (sec)	Total Delay (sec)	Avg Speed (mph)	Total Delay (sec)
[start]						
Williamson School Ent	4.0	38.2	0.0	2.7	34.3	0.0
US 1 overpass	37.7	45.1	0.0	38.0	44.9	0.0
Median Brk (Kohls Ent)	17.0	42.5	0.0	19.0	38.0	1.0
Rose Tree Rd	16.0	44.5	0.0	16.3	43.9	0.0
Granite Run Mall Ent (light)	9.0	39.0	0.7	8.3	41.7	0.0
Van Leer Ave	15.0	26.5	5.0	9.0	43.8	0.0
PA 452 / Barren Rd	38.7	32.0	8.3	38.7	32.3	8.7
Old Forge Rd	18.0	39.1	1.3	19.3	36.5	1.7
Yearsley Mill Rd	41.0	45.6	0.0	41.7	42.3	0.3
Penn State Ent (light)	13.3	47.3	0.0	18.7	44.1	0.0
Forge Rd	22.3	45.9	0.0	25.7	40.0	0.3
Heather Knoll La	36.0	45.8	0.0	37.0	44.7	0.0
[end]	0.0	0.0	0.0	0.0	0.0	0.0
Total (Rose Tree Rd to Yearsley Mill Rd)	121.7	38.2	15.3	117.0	39.8	10.7

Source: DVRPC

"After" Travel Time Runs Results – Eastbound PA 352, Peak AM and PM Hours

Data Point	AM Peak			PM Peak		
	Travel Time (sec)	Avg Speed (mph)	Total Delay (sec)	Total Delay (sec)	Avg Speed (mph)	Total Delay (sec)
[start]						
Heather Knoll La	3.0	38.2	0.0	4.0	39.2	0.0
Forge Rd	38.0	45.8	0.0	38.5	44.2	0.0
Penn State Ent (light)	24.5	40.9	1.0	29.5	35.4	4.0
Yearsley Mill Rd	15.0	41.1	0.0	15.0	39.1	0.5
Old Forge Rd	59.5	32.0	12.5	63.5	30.0	15.5
PA 452 / Barren Rd	59.5	11.6	42.0	50.0	14.6	31.5
Van Leer Ave	37.0	34.4	4.5	35.5	34.7	4.0
Granite Run Mall Ent (light)	10.0	39.8	0.0	12.5	33.2	2.5
Rose Tree Rd	7.0	42.3	0.0	9.0	33.9	1.5
Median Brk (Kohls Ent)	17.0	41.8	0.0	19.0	37.7	1.0
US 1 overpass	20.0	37.5	2.0	26.0	28.5	7.0
Williamson School Ent	37.0	45.1	0.0	40.5	40.1	1.0
[end]	0.0	0.0	0.0	0.0	0.0	0.0
Total (Yearsley Mill Rd to Rose Tree Rd)	173.0	26.9	59.0	170.5	27.3	55.0

Source: DVRPC

"After" Travel Time Runs Results – Eastbound PA 352, Free Flow and Midday

Data Point	Free Flow			Midday		
	Travel Time (sec)	Avg Speed (mph)	Total Delay (sec)	Total Delay (sec)	Avg Speed (mph)	Total Delay (sec)
[start]						
Heather Knoll La	3.0	35.0	0.0	3.0	35.9	0.0
Forge Rd	37.0	45.8	0.0	36.3	46.6	0.0
Penn State Ent (light)	23.0	45.8	0.0	27.3	38.0	3.7
Yearsley Mill Rd	13.3	43.8	0.0	16.3	36.1	2.0
Old Forge Rd	57.3	33.2	10.3	59.7	32.1	12.7
PA 452 / Barren Rd	21.0	34.5	2.7	19.7	36.8	1.7
Van Leer Ave	33.0	37.6	2.7	33.7	37.2	1.7
Granite Run Mall Ent (light)	8.7	45.2	0.0	21.7	18.0	12.0
Rose Tree Rd	7.3	44.9	0.0	9.7	34.5	0.7
Median Brk (Kohls Ent)	17.0	41.5	0.3	18.7	37.3	1.0
US 1 overpass	19.3	38.4	0.7	20.7	36.4	1.7
Williamson School Ent	35.7	46.3	0.0	35.3	45.8	0.0
[end]	0.0	0.0	0.0	0.0	0.0	0.0
Total (Yearsley Mill Rd to Rose Tree Rd)	127.3	36.6	15.7	144.5	32.2	28.8

Source: DVRPC

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Geographic Area Covered: DVRPC region, Middletown Township, Delaware County, Pennsylvania.

Key Words: Closed loop traffic signal systems, transportation operations, Intelligent Transportation Systems (ITS), traffic signals, traffic management, level of service analysis, air quality analysis, travel time study

Abstract: This report examines the successful retiming and optimization effort of the current 10-signal closed loop system along US 1/Baltimore Pike and PA 352/Middletown Road in Delaware County, Pennsylvania, to improve the system's overall performance. Measures of effectiveness for retiming the system include intersection level of service improvements, air quality improvements, and travel time savings.

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