

Congested Corridor Improvement Program US 422



Lebanon County, PA
Borough of Palmyra
North Londonderry Township
Annville Township
Borough of Cleona



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Final Report July 2006



CONGESTED CORRIDOR IMPROVEMENT PROGRAM

US 422 Corridor – Palmyra/North Londonderry/Annville/Cleona

(PennDOT Bureau of Highway Safety & Traffic Engineering and PennDOT Engineering District 8-0)

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EXECUTIVE SUMMARY

Introduction

The Pennsylvania Department of Transportation (PennDOT) initiated the Congested Corridor Improvement Program (CCIP) as a pilot program to identify some of the more severely congested corridors in the Commonwealth in order to define and implement needed improvements. The goal of the CCIP is a 20 percent reduction in peak hour travel time on the improved transportation corridor. In addition to this goal, other parameters were reviewed to reflect improvements in travel through the corridor.

The Lebanon County Planning Department and Harrisburg Metropolitan Planning Organization (MPO) nominated the US 422 Corridor to be a part of the CCIP as it is the most heavily traveled corridor in Lebanon County and has congestion recurring during the peak periods. Originally, the US 422 Corridor was proposed to be two corridors; one in the Borough of Palmyra/North Londonderry Township with seven signals and a second corridor in Annville Township/Borough of Cleona with three signals. Due to the relative proximity of the two corridors, approximately 2.5 miles, the two corridors were combined into one. PennDOT accepted the US 422 Corridor nomination and included it in the program.

Analysis

Existing conditions of the corridor were established through review of data sources, several field visits, and collection of traffic data including daily counts, peak hour counts, and corridor peak hour travel times. The 10 signalized intersections were analyzed utilizing the methodology established in the *2000 Highway Capacity Manual (HCM)* that describes the operation of intersections controlled by traffic signals. *Synchro 6.0 (Build 614)* software was used to apply the general HCM methodology and to derive the Level of Service (LOS) and vehicular delay at the intersections. Based on the capacity analysis, two intersections in the PM peak hour are currently operating with an overall level of service (LOS) E and several intersections are operating with movements and approaches with a LOS F in the PM peak hour.

A 10-year design year was established for the CCIP projects; therefore, traffic volumes were projected to the year 2016. With input from the Lebanon County Planning Department and based on general background growth and specific land developments, traffic is expected to increase an average of approximately 22 percent. With the increase in traffic volumes, congestion and delays will become more noticeable and lengthy along the corridor. Based on the capacity analysis, two intersections in the AM peak hour, three intersections in the Midday peak hour, and six intersections in the PM peak hour would operate below a LOS D. It is estimated it will take over 40 minutes to travel the corridor in the eastbound direction during the future PM peak hour; this is three times longer than it takes today.



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Immediate term improvements were reviewed to improve the existing operations along the roadway network. In order to have minimal impact and cost, the improvements were limited to adjusting traffic signal cycle lengths, signal splits and offsets. The traffic signal timing improvements result in an overall decrease in delay and travel time along the corridor. Traveling eastbound through the Palmyra/North Londonderry corridor, the PM peak hour travel time is reduced by approximately 22 percent. On other sections of the corridors, the travel time changes were more negligible.

To improve future intersection operations and travel time, two short-term improvement options were reviewed. To contain costs, improvements reviewed for the short-term recommendations had minimal right-of-way impact. Overall, there were some slight changes in the LOS and operations at the intersections. The operational improvements were generally seen where specific geometric improvements were included. The travel time improvements were basically negligible in the Annville/Cleona section of the corridor as minimal signal improvements could be implemented. In the Palmyra/North Londonderry section of the corridor, the improvements in the study peak hours from an 8 to 77 percent reduction in travel time in the Midday peak hour. Greater improvements were realized in this area due to the improvements in the coordination of the traffic signal operations.

Two long-term improvement options were reviewed to improve future intersection operations and travel time. Long-term improvements included significant geometric improvements. The first long-term improvement option reviewed involves geometric improvements at specific intersections. The other long-term improvement option reviewed widens US 422 to include two travel lanes in each direction from Railroad Street to the east of the White Oak Street intersection. Significant LOS improvements were estimated with the construction of both improvement options. In the future AM and Midday peak hours, all of the intersections were estimated to be operating with a LOS D or better. The travel time improvements throughout the corridor were dramatic with reductions ranging from 12 to 91 percent. Option 4, the widening of US 422, basically provides enough capacity for the future traffic volumes to allow the corridor to operate with similar travel times to the existing conditions but would require significant right-of-way.

Several other improvement options were explored and include improvements such as access management, a one-way pair configuration with Cherry Street and US 422 in Palmyra, improved network connections, improvements in cross-section to make the transportation environment more alternate-mode friendly, and locating future traffic signals to maintain future progression and preserve the US 422 Corridor. These improvements were not formally analyzed utilizing Synchro and SimTraffic but are transportation improvement options and alternatives that may improve long-term traffic operations along the US 422 Corridor. These improvements could prove to be the most effective and least costly if they are incorporated into the MPO's planning process to guide future development. These types of improvements are geared toward land use



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and land development's influence on transportation rather than the transportation network reacting to what happens to the land along the corridor.

Observations

The scenarios reviewed were separated into the time frames in which they could be implemented. The first time frame is immediate, occurring in one year or less; the second is short-term, occurring in one to three years; and the third is long-term, occurring in three years or more. The immediate improvements can be completed using existing maintenance and operations funds. The short-term recommendations are currently prepared to a sufficient level of detail such that they can advance immediately into final design. Long-term improvement alternatives will require further and more detailed traffic, engineering and environmental studies, as well as public involvement efforts.

The immediate improvement recommendations are relatively low cost and include the following:

- Adjust signal timings.
- Include right turn delay detection at Grant Street, Apple Blossom Road, Shady Lane, and Wal-Mart Driveway.
- Repair loop detector(s) at Center Street.
- Remove nightly flashing signal operations at Railroad Street, Grant Street, Forge Road, and Duke Street.
- Delineate pavement markings at areas noted in the Summary of Adverse Conditions, Section IV.
- Provide crosswalks at Apple Blossom Road and US 422.
- Install missing lane control sign on the eastbound approach of the Grant Street and US 422 Intersection.
- Repair exposed wiring at Forge Road and US 422.
- Eliminate the conflicting signage at Hoffer Street.
- Install luminaires at Shady Lane and US 422.
- Install tether wire for the span wire installations at Mill Street and US 422 and Center Street and US 422.
- Replace burnt signal lenses at Center Street and US 422.

The short-term improvements include:

- Install new mast arms.
- Install new controller assemblies.
- Install new signal heads with light emitting diode (LED) indications.
- Install emergency vehicle pre-emption.
- Adjust signal timings.



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- Coordinate signal operations at Mill Street and Center Street.
- Provide global positioning system (GPS) coordination for the signals in the Borough of Palmyra.
- Include southbound left turn lane at Forge Road and US 422.
- Include northbound left turn lane at Apple Blossom Road.
- Include northbound and southbound left turn lane at Mill Street and US 422.
- Include southbound left turn lane at Center Street and US 422.
- Include Walk/Don't Walk pedestrian accommodations.
- Relocate pedestrian push button at Railroad Street and US 422.
- Install pedestrian push buttons for all movements at Mill Street and US 422.
- Install ramps at the intersections of Apple Blossom Road, Shady Lane, Wal-Mart Driveway, and Center Street.
- Replace utility pole span wire installation with mast arm installation at the Center Street and US 422 intersection.
- Reset signal head/mast arm locations to provide 40-ft between the nearest signal head and the stop bar at Grant Street and US 422.
- Re-stripe westbound left turn lane to add length at Forge Road and US 422.
- Replace head-in angle parking along US 422 west of White Oak Street with back-in angle parking.
- Remove parking along White Oak Street north of the US 422 intersection.

The long-term improvements are beyond the scope of the program and should be utilized as a planning tool. Two traffic scenarios were reviewed for long-term improvements; geometric improvements at specific intersections and widening US 422 to include two travel lanes in each direction from Railroad Street to east of the White Oak Street intersection.



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I. INTRODUCTION

A. *Background*

The Pennsylvania Department of Transportation (PennDOT) initiated the Congested Corridor Improvement Program (CCIP) to identify some of the more severely congested corridors in the Commonwealth in order to define and implement needed improvements. The goal of the CCIP is a 20 percent reduction in peak hour travel time on the improved transportation corridor. In addition to this goal, other parameters were reviewed to reflect improvements in travel through the corridor.

The CCIP initiative is consistent with the principles of regional and corridor-based planning advocated by Pennsylvania's Statewide Long-Range Transportation Plan (PennPlan) and Pennsylvania's Highway Congestion Management Strategic Plan. The CCIP study costs are funded by PennDOT. The actual implementation of the recommended improvements, including final design and construction costs, is funded through the 12-Year Program. For this reason, only corridors that received planning partner support for placement on the Transportation Improvement Plan (TIP) and the 12-Year Program for design and construction were considered for this initiative.

The corridor selection process began with PennDOT requesting each planning partner to nominate and submit information for corridors in their region. The Lebanon County Planning Department and Harrisburg Metropolitan Planning Organization (MPO) nominated the US 422 Corridor to be a part of the CCIP as it is the most heavily traveled corridor in Lebanon County and has congestion recurring during the peak periods. Originally the US 422 Corridor was proposed to be two corridors; one in the Borough of Palmyra/North Londonderry Township with seven signals and one in Annville Township/Borough of Cleona with three signals. Due to the relative proximity of the two corridors, approximately 2.5 miles, the two corridors were combined into one. Palmyra is currently located within the Harrisburg Area Transportation Study (HATS) study area. The Lebanon County MPO is in the process of incorporating Palmyra into their jurisdiction. The Lebanon County Planning Department nominated the US 422 Corridor in Palmyra and HATS included the funding for the project on their TIP. Since it is anticipated that Palmyra will be included in the Lebanon County MPO, funds for the CCIP improvements in Palmyra were included on the Lebanon County TIP. PennDOT accepted the US 422 Corridor nomination and included it in the program.

Three coordination meetings were held with the corridor stakeholders throughout the study. The meetings were held to identify project progress, exchange information, and to obtain consensus. The project kick-off meeting was held March 14, 2006. At the meeting, the study area was reviewed, the scope of work and project goals were identified, the data collection efforts were summarized, the analysis and volume projection methodology was determined, and concerns,



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problems, and issues within the study area were discussed. A status meeting was held April 24, 2006 to provide an update on the analysis and to reach an agreement on the next steps of the project. Existing conditions, corridor issues, future 2016 traffic projections, and potential improvement opportunities were also discussed. A final meeting was conducted on May 23, 2006. At this meeting all of the alternative analyses were presented, the signal equipment inventory was reviewed, and the study recommendations were determined. Minutes from each of these meetings are included in **Appendix A**.

This study follows the Standard Study Methodology (SSM) developed as part of the CCIP to provide a uniform approach to identify improvements and assess their effectiveness in accordance with the goal of the program. The SSM identifies the steps involved in an engineering study of improvement alternatives and focuses on the use of traffic simulation models as analysis tools to evaluate the operational impacts of improvement alternatives. This study, following the SSM, encompasses three specific stages – Identification of Viable Alternatives, Engineering Study and Selection of Alternatives.

B. Project Location

The US 422 Corridor is located in Lebanon County, which is located in south-central Pennsylvania. The corridor begins at the intersection of Railroad Street in the Borough of Palmyra, travels through North Londonderry Township, into Annville Township to the Borough of Cleona where the corridor terminates at the Center Street intersection. **Figure 1** highlights the US 422 Corridor location in Lebanon County and **Figures 2A and 2B** depict the corridor with the study intersections noted. The corridor is approximately 6.7 miles long and includes 10 signalized intersections. The cross-section varies between two lanes (one lane in each direction), three lanes (one lane in each direction with a continuous center left turn lane), and four lanes (one lane in each direction with a continuous left turn lane in each direction).

US 422 is part of the National Highway System and is also known as the Benjamin Franklin Highway. The US 422 Corridor is a component of the Keystone Corridor, from Philadelphia and Reading to Lancaster and Harrisburg, identified in PennPlan Moves. The Keystone Corridor supports major economic activities including technology, manufacturing, retail, agriculture, government, and tourism. In Lebanon County, the US 422 Corridor is a major link as it provides an east/west connection through the County. Approximately three miles east of the US 422 Corridor is the City of Lebanon. Lebanon Valley College, a small four-year private liberal arts college, is located north of the US 422 Corridor in Annville. In 2005, Lebanon Valley College reported approximately 1,600 full-time students with over 25 percent of them commuting to campus. Hershey, PA is located approximately four miles to the west of the US 422 Corridor.

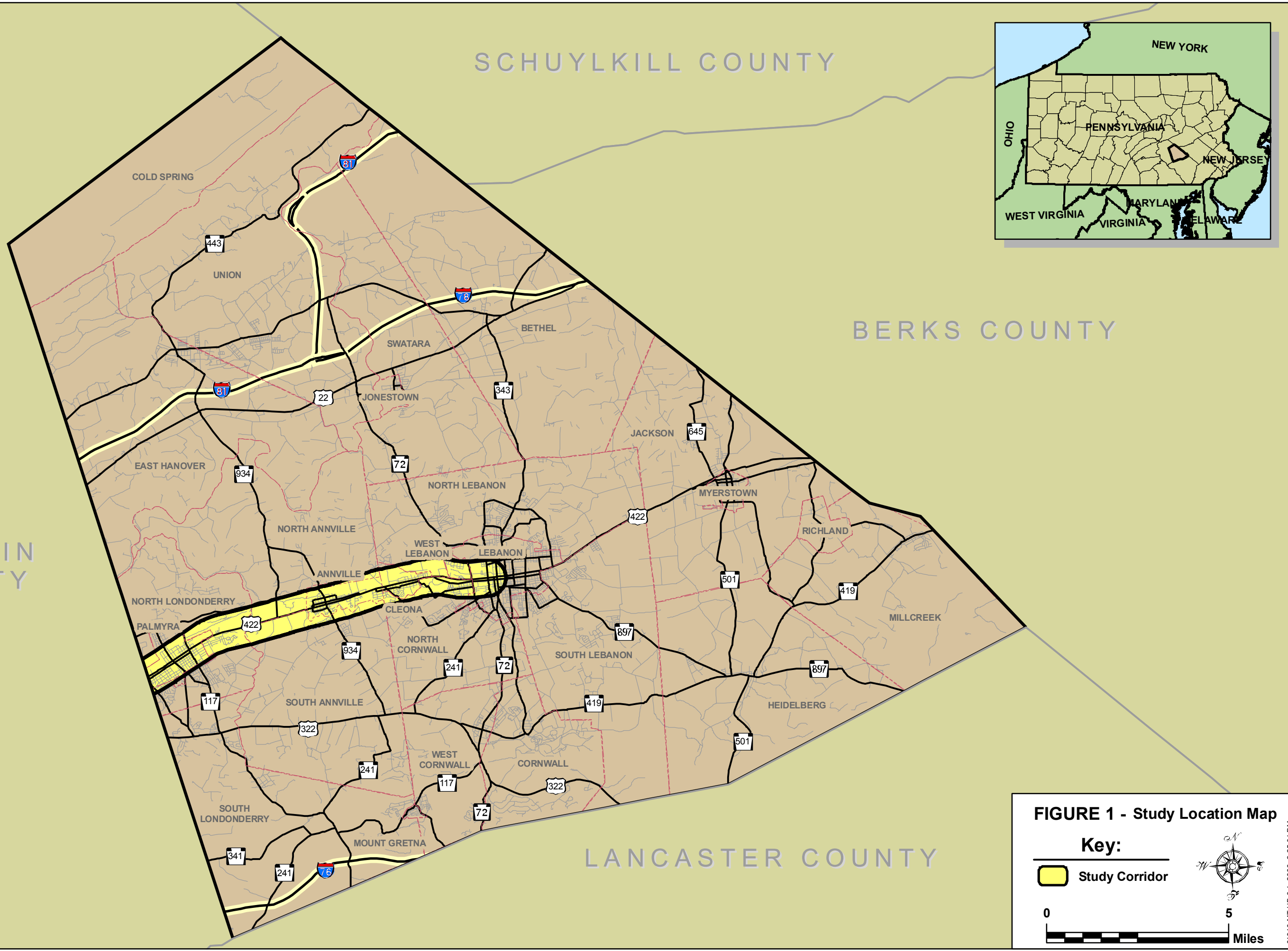


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The Hershey Chocolate factory, a major employment base, and Hershey Park, a major recreational site and tourist attraction, are located in Hershey, PA. Approximately 25 miles to the west of the US 422 Corridor is Harrisburg, PA; the State capitol. Harrisburg is a major employment center for the region. The US 422 Corridor is utilized heavily to access Lebanon County and the Harrisburg and Hershey areas.



DAUPHIN COUNTY

SCHUYLKILL COUNTY


BERKS COUNTY

LANCASTER COUNTY

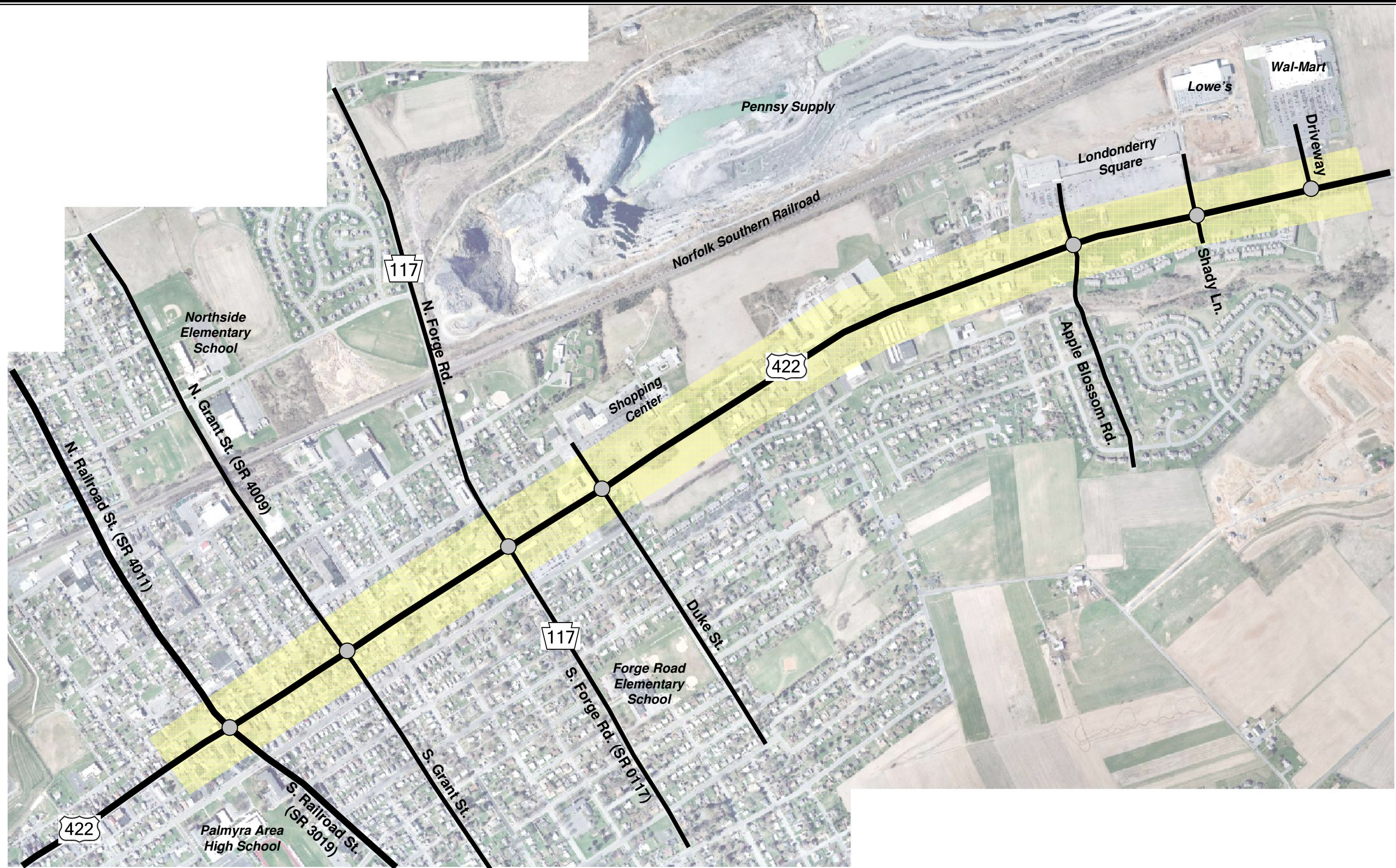


FIGURE 1 - Study Location Map

Key:

 Study Corridor





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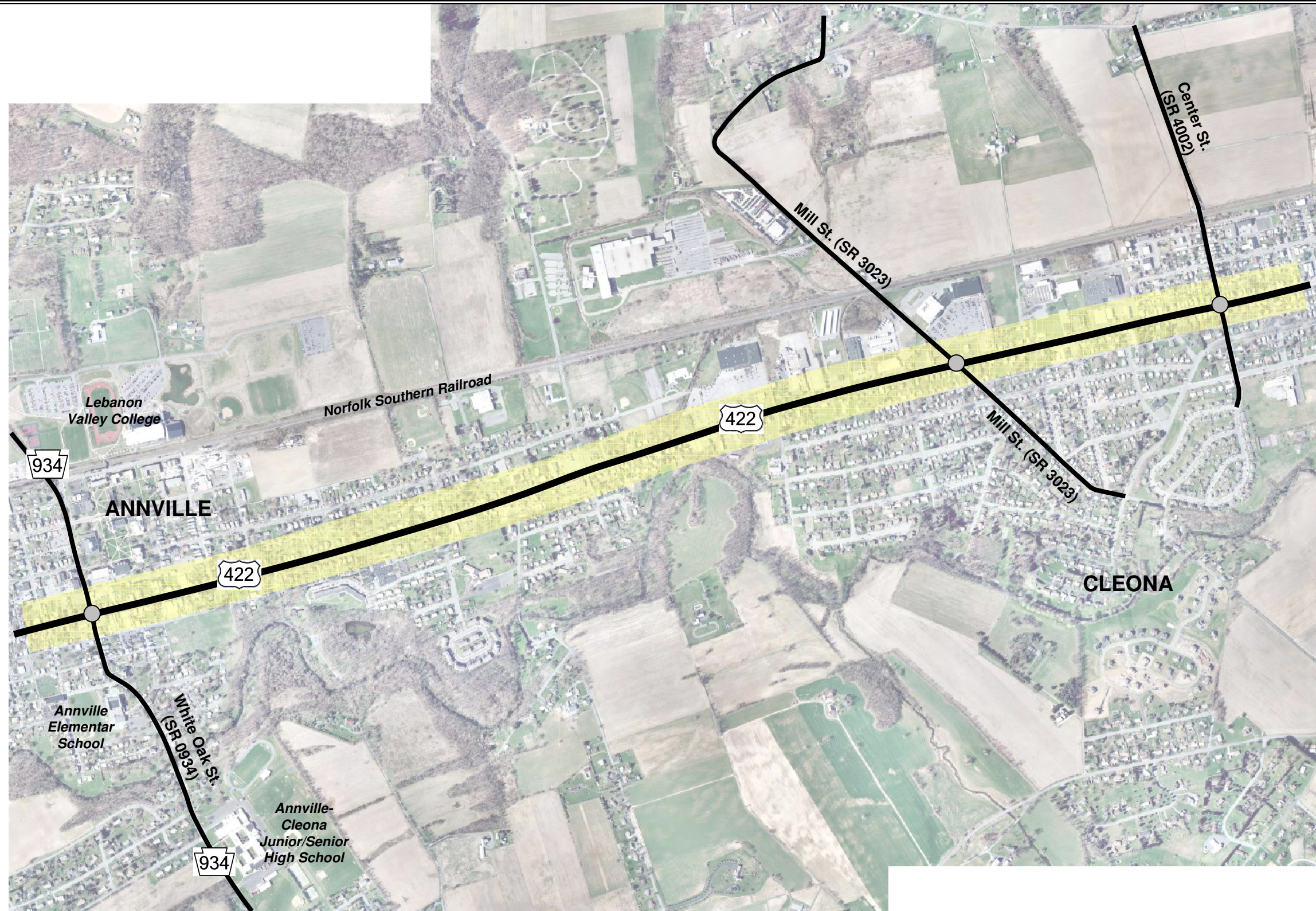
US 422
Lebanon County, Pennsylvania

Lebanon County Planning Department North Londonderry Township
Annville Township Palmyra Borough
Cleona Borough

FIGURE 2A - PALMYRA
Project Corridor & Traffic Count Locations

KEY:

- Project Corridor
- Signalized Intersections



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US 422
Lebanon County, Pennsylvania

Lebanon County Planning Department North Londonderry Township
Annville Township Palmyra Borough
Cleona Borough

**FIGURE 2B – ANNVILLE-CLEONA
Project Corridor & Traffic Count Locations**

- KEY:**
- Project Corridor
 - Signalized Intersections



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C. Major Area Transportation Projects

Beyond this study and its recommendations, there are no major transportation projects proposed within the immediate area.

D. Data Reviewed

In order to complete a thorough analysis of the corridor, the following data was collected and reviewed:

- Reportable crash data from January 1999 to December 2004.
- Signal plans for the 10 study intersections.
- Automatic Traffic Recorder (ATR) data collected at four locations from February 27 – March 7, 2006.
- Peak hour turning movement count data for the three intersections in Annville/Cleona collected on March 1, 2006 between 7:00-9:00AM, 11:00-1:00PM, and 3:00-6:00PM.
- Peak hour turning movement count data for the seven intersections in Palmyra/North Londonderry collected on March 7, 2006 between 6:30-9:00AM, 11:00-1:00PM, and 3:00-6:00PM.
- Travel time, speed, and delay field measurements conducted March 1, 2006 in Annville/Cleona and March 7, 2006 in Palmyra/North Londonderry.
- Traffic signal equipment inventory collected May 3, 2006.
- Transit information from the County of Lebanon Transit.
- Lebanon Valley College student and faculty data.
- Traffic Impact Studies for the Annville/Cleona High School, Palmyra Wal-Mart, and Clear Spring Business Park.
- Excerpts from the Campbelltown Connector and US 322 Improvements report.
- Lebanon County zoning maps.

In addition to these data sources, several field visits were conducted to identify and document existing conditions. During these visits, photographs along with visual information on intersection and signal characteristics were obtained. A photo log of the photographs taken can be found in **Appendix B**.



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II. EXISTING CONDITIONS

A. *Description of Roadway Network*

According to the County Functional Class Map, the entire US 422 is classified as an “other principal arterial highway.” Based on the municipal boundaries and the roadway characteristics, the 6.7 mile corridor can be divided into four sections. The limits of these sections are as follows:

- Section 1: Railroad Street to Duke Street
- Section 2: Duke Street to Wal-Mart Driveway
- Section 3: Wal-Mart Driveway to White Oak Street
- Section 4: White Oak Street to Center Street

The following provides a description of US 422 Corridor through these four sections. The lane configurations for each of the intersections are shown in **Figure 3A and 3B** on pages 15 and 16. There are no existing bicycle accommodations or Intelligent Transportation Systems (ITS) facilities located within the study area.

Section 1: Railroad Street to Duke Street

This section of the US 422 corridor is within the Borough of Palmyra. The roadway consists of one travel lane in each direction between Railroad Street and Forge Road with separate left-turn lanes present at the signalized intersections. Between Forge Road and Duke Street, the roadway consists of one travel lane in each direction with a continuous center left turn lane. Curbs and sidewalks are located on both sides of the roadway throughout the section. On-street parking is permissible in areas between Railroad Street and Forge Road. The posted speed transitions from 25 miles per hour (MPH) between Railroad Street and Grant Street to 35 MPH between Grant Street and Duke Street. The surrounding area includes a mix of residential and commercial land uses. There are four signalized intersections within the section; the traffic signals currently utilize time based coordination.



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- *Railroad Street (SR 4011/ SR 3019) and US 422*

The traffic signal operates with three phases with the northbound and southbound approaches operating split phased. The signal is semi-actuated with loop detectors present on the Railroad Street approaches. Crosswalks and pedestrian push buttons along with pedestrian signals are present on all approaches.



- *Grant Street (SR 4009) and US 422*

The traffic signal is two phased and semi-actuated with loop detectors present on the Grant Street approaches. Crosswalks and pedestrian push buttons are present on all approaches. Dedicated signals for pedestrian movements are not provided.





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- *Forge Road (PA 117) and US 422*

A three phase signal operation is present with protected/permitted phasing provided to the westbound left turning movement. The signal is semi-actuated with loop detectors present on the Forge Road approaches. Crosswalks and pedestrian push buttons are present on all approaches. A dedicated pedestrian signal is provided to protect pedestrians during the westbound protected left phase.



- *Duke Street and US 422*

The traffic signal operates with three phases; protected/permitted phasing is provided to the eastbound left turning movement. The signal is fully-actuated. Volume density loop detectors are in place on US 422 and presence loop detectors are in place on Duke Street. The northern leg of the intersection provides access to a shopping center. Crosswalks and pedestrian push buttons are present on all approaches. A dedicated pedestrian signal is provided to protect pedestrians during the eastbound protected left phase.





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Section 2: Duke Street to Wal-Mart Driveway

East of Duke Street through the Wal-Mart Driveway intersection, the corridor is in North Londonderry Township. The speed limit transitions from 35 MPH in the Borough of Palmyra to 40 MPH in North Londonderry Township. Through the entire section, the roadway consists of one travel lane in each direction with a continuous center left turn lane and shoulders varying in width from 5-ft to 10-ft. Some sections of the roadway are curbed; mainly at major intersections and driveways. On-street parking is restricted through this section and sidewalks are absent. The surrounding land use is almost entirely commercial with access to residential developments. There are three signalized intersections within the section; the traffic signals are interconnected with fiber optic cable.

- *Apple Blossom Road and US 422*

The northern leg of the intersection provides access to the North Londonderry Square shopping center. The traffic signal is fully actuated; volume density loop detectors are in place on US 422 and presence loop detectors are in place on Apple Blossom Road. A three phase operation is present with protected/permitted phasing provided to the eastbound left turning movement. Crosswalks and pedestrian push buttons are present on all approaches. Dedicated pedestrian signals are provided to protect pedestrians during the eastbound protected left phase.





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- *Shady Lane and US 422*

A three phased, fully actuated traffic signal is present. Protected/permitted phasing is provided to the eastbound left turning movement. Volume density loop detectors are in place on US 422 and presence loop detectors are in place on Shady Lane. The northern leg of the intersection provides access to the North Londonderry Square shopping center. Crosswalks and pedestrian push buttons with man/hand pedestrian signals are provided on all approaches. Emergency vehicle pre-emption is installed at the intersection.



- *Wal-Mart Driveway and US 422*

The traffic signal operates three phased with protected/permitted phasing provided to the eastbound left turning movement. The traffic signal is fully actuated with volume density loop detectors in place on US 422 and presence loop detectors in place on the Wal-Mart Driveway. Crosswalks and pedestrian push buttons with man/hand pedestrian signals are provided on all approaches of the intersection.





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Section 3: Wal-Mart Driveway to White Oak Street

In this section, US 422 exits North Londonderry Township east of the Wal-Mart Driveway, forms the border for North and South Annville Township and enters Annville Township. The roadway cross-section varies throughout this section. East of the Wal-Mart Driveway to approximately 2,000-ft east of the Clear Spring Road intersection (immediately east of Laudermilch Meats), the roadway consists of one travel lane in each direction with a continuous center left turn lane. The roadway then transitions to one travel lane in each direction for approximately 1,700-ft. After the two-lane cross-section, a continuous center left turn lane develops for approximately 800-ft. Finally the roadway transitions to one travel lane in each direction through Annville Township. Previously, the cross-section between the Wal-Mart Driveway and 2,000-ft east of Clear Spring Road included a 1,500-ft section of roadway with one travel lane in the eastbound direction and two travel lanes in the westbound direction. In May 2006, the roadway was re-striped to provide a continuous center left turn lane. East of the Wal-Mart Driveway to Annville Township, the posted speed is 55 MPH, on-street parking is restricted and sidewalks are absent. Shoulders are present in this area with a varying width of 5-ft to 10-ft. The surrounding land uses are mainly agricultural, with access to residential, commercial, and industrial areas. Once in Annville Township, the posted speed reduces to 25 MPH, on street parking is permitted and curbs and sidewalks are present. The surrounding land use is a mix of residential and commercial. There is one signalized intersection within the section which was recently updated and includes decorative streetscape features.

- *White Oak Street (PA 934) and US 422*

The traffic signal is fully actuated with a three phase signal operation. Protected/permissive left phasing is provided to the eastbound and westbound left turning movements. Crosswalks and pedestrian push buttons with man/hand pedestrian signals are provided on all approaches of the intersection.





CONGESTED CORRIDOR IMPROVEMENT PROGRAM

US 422 Corridor – Palmyra/North Londonderry/Annville/Cleona

(PennDOT Bureau of Highway Safety & Traffic Engineering and PennDOT Engineering District 8-0)

Section 4: White Oak Street to Center Street

The section crosses through Annville Township into the Borough of Cleona. East of the White Oak Street intersection, the roadway transitions to include a continuous center left turn lane and speed increases to 35 MPH. Between Mill and Center Street, the roadway cross section widens to include a continuous left turn lane in each direction. On-street parking is permitted through the entire section with some areas of restriction. Curbs and sidewalk are consistently present from White Oak Street to Weaber Street. East of Weaber Street, areas with curb and/or sidewalk become more intermittent. The surroundings include a mix of residential and commercial. There are two signalized intersections within the section; the signals are not coordinated.

- *Mill Street (SR 3023) and US 422*

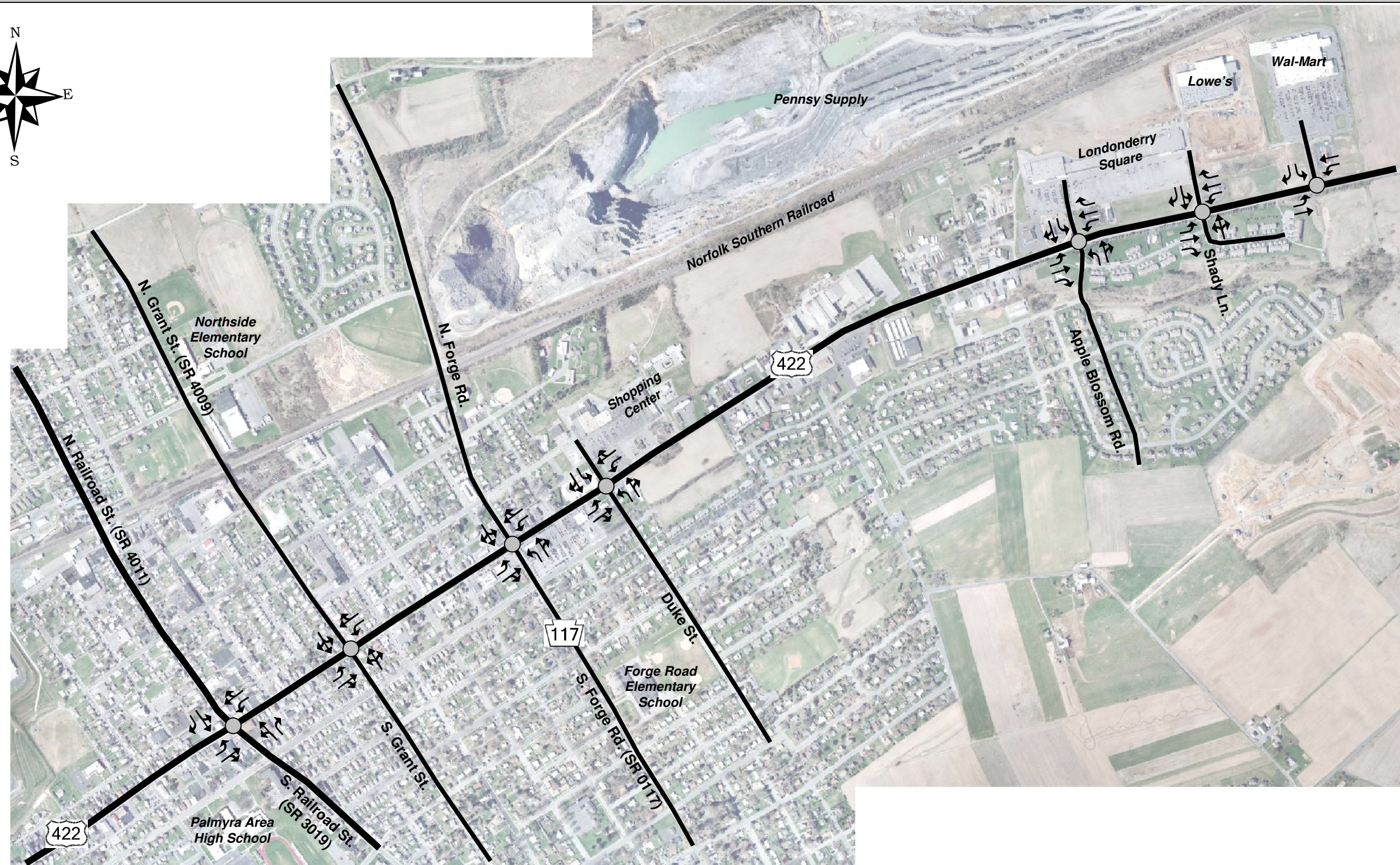
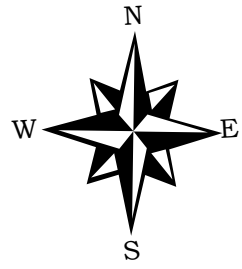
Protected/permissive phasing is provided to the eastbound and westbound left turning movements, creating a three phased operation. The signal is fully actuated. Crosswalks are present on all approaches. Pedestrian push buttons are provided to cross US 422. Dedicated signals for pedestrian movements are not provided.



- *Center Street (SR 4002) and US 422*

A three phase, semi-actuated signal operation is present. The eastbound left turn is protected/permissive and loop detectors are present on Center Street. Due to a loop detector malfunction on Center Street, a constant call is being made for the side street and the maximum amount of green time is given even when vehicles are not present. Crosswalks and pedestrian push buttons are present on all approaches. A dedicated pedestrian signal provides protection to pedestrians during the eastbound protected left phase.





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**PENNDOT DISTRICT 8-0
Congested Corridor Improvement Program**

US 422
Lebanon County, Pennsylvania

Lebanon County Planning Department North Londonderry Township
Annville Township Palmyra Borough
Cleona Borough

FIGURE 3A - PALMYRA
Existing Intersection Lane Configurations

- KEY:**
- Lane Movements
 - Signalized Intersections