TABLE OF CONTENTS PAGE

TECHNICAL APPENDICES

LIST OF FIGURES — PAGE

LIST OF TABLES — PAGE

EXECUTIVE SUMMARY

The Pennsylvania Department of Transportation (PENNDOT) initiated the Congested Corridor Improvement Program (CCIP) to identify several congested corridors in the Commonwealth and, in conjunction with its partners, define and implement the needed improvements. The goal of the CCIP is a 20 percent reduction in peak hour travel time on the improved transportation corridor. A Standard Study Methodology (SSM) was 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 simulation models as analysis tools to evaluate the operational impacts of improvement alternatives.

Four (4) of the total 17 corridors were identified for early-action implementation. The early-action corridors are intended to provide a method for reviewing the success of the program and making any refinements to the process. The US 11/15 corridor in Cumberland County was selected as the early-action corridor in the Harrisburg region. The US 11/15 corridor, nominated by the Tri-County Regional Planning Commission (TCRPC) as authorized by the Harrisburg Area Transportation Study (HATS) Coordinating Committee, is located in PENNDOT Engineering District 8-0.

The US 11/15 corridor is located in Upper Allen Township, Lower Allen Township, Camp Hill Borough, Lemoyne Borough, Wormleysburg Borough, and East Pennsboro Township in Cumberland County. The corridor study limits extend approximately 11 miles from the Pennsylvania Turnpike (I-76) to Interstate 81. The corridor limits include six (6) limited access interchanges as follows:

- US 11/15 & Pennsylvania Turnpike (I-76)
- US 11/15 & Rossmoyne Road/Wesley Drive
- US 11/15 & Slate Hill Road
- US 11/15 & Simpson Ferry Road
- US 11/5 & PA 581
- US 11/15 & I-81

The corridor limits also include 14 signalized intersections as follows:

- US 11/15 & PA 581 (Ramp C)
- US 11/15 & Harvard Avenue/Camp Hill Mall Entrance
- US 11/15 & Chestnut Street/Trindle Road
- US 11/15 & Market Street/Carlisle Pike
- US 11/15 & Brentwater Road
- US 11/15 & Country Club Road
- US 11/15 & 21st Street
- US 11/15 & 12th Street/Erford Road
- US 11/15 & 2nd Street
- US 11/15 & Front Street
- US 11/15 & Stella Street
- US 11/15 & Market Street
- US 11/15 & Summerdale Plaza
- US 11/15 & Summerdale Road/Valley Street

Several on-going transportation studies and engineering efforts, which are currently underway in different phases within the study limits, were reviewed including the *Cumberland-Perry Counties Safety and Congestion Management Study*, US 11/15 & PA 581 Interchange Reconstruction Project, US 11/15 & 21st Street Intersection Reconstruction Project, and US 11/15 & Valley Street Intersection Traffic and Safety Study. In addition, HATS recently developed an *ITS Early Deployment Strategic Pla*n for the Harrisburg metropolitan area.

EXISTING CONDITIONS

An inventory of existing roadway features was developed through available as-built plans and field observation data for the entire length of the study limits including each of the six (6) limited access interchanges and 14 signalized intersections. There are no existing intelligent transportation systems (ITS) facilities within the study limits of the corridor. Pedestrian facilities are provided throughout much of the corridor, including a pedestrian bridge over the limited access section of the corridor and a pedestrian tunnel under the fee access section of the corridor. There are no existing bicycle facilities within the project limits.

The Cumberland-Dauphin-Harrisburg Transit Authority is the legal name for Capital Area Transit (CAT), the provider of mass transit service for the Harrisburg metropolitan region. CAT operates 13 bus routes on the West Shore of the Susquehanna River, eight (8) of which operate within the limits of the study. CAT operates eight (8) Park & Rides on the West Shore, three (3) of which are located within or immediately outside the limits of the study. CAT also promotes a Commuter Benefits Program to encourage the use of transit instead of personal vehicles to help alleviate congestion.

Upon review of the available traffic data within the study limits and identification of traffic data required to evaluate improvement alternatives, it became apparent an extensive traffic data collection effort was necessary. The traffic data collection included mainline traffic volume counts, manual turning movement counts, and a baseline travel time study. The mainline traffic volume counts were performed for a period of one full week from Sunday April 21, 2002 to Sunday April 28, 2002 using automatic traffic recorders (ATRs). Vehicle and pedestrian turning movement counts were performed at the 14 signalized intersections for the AM peak period (6:00 AM to 9:00 AM), Mid-Day peak period (11:00 AM to 1:00 PM), and PM peak period (3:00 PM to 6:00 PM) on Tuesday, April 23, 2002 and Wednesday April 24, 2002. The travel time and delay study was performed on the same days as the manual turning movement counts using procedures described in the Travel Time and Delay Study guidelines in the *ITE Manual of Transportation Engineering Studies*.

The entire corridor, including the six (6) limited access interchanges and 14 signalized intersections, was analyzed using the weekday AM, Mid-Day, and PM peak hour volumes. The traffic analysis and simulation software packages of Synchro and SimTraffic were used for the analysis of the free access section of the corridor from PA 581 to Summerdale Road/Valley Street. The traffic analysis software package of CORridor SIMulation (CORSIM) was used for the limited access sections of the corridor from the Pennsylvania Turnpike (I-76) to PA 581 and Summerdale Road/Valley Street to I-81. The software simulation package of TRAFVU was then used to view the simulation of the entire corridor.

The traffic analysis and simulation software packages were calibrated to match the baseline travel time study. The highest simulated travel times occurred in the northbound direction during the AM peak hour (22.4 minutes) and in the southbound direction during the PM peak hour (24.2 minutes).

The software package of Synchro 5.0 was used to determine the levels of service (LOS) at each of the signalized intersections. The Percentile Delay Method was used to determine the intersection control delay. The LOS measurements indicate that five (5) of the intersections operate a LOS D or worse during the AM peak hour, and six (6) intersections operate a LOS D or worse during the PM peak hour.

The reported crashes within the study limits were reviewed for the past three (3) years of available data from the PENNDOT database. A study of the crash data for the corridor identified the highest concentration of reportable crashes at the following interchanges and intersections:

- US 11/15 & Simpson Ferry Road Interchange
- US 11/15 & PA 581 Interchange
- US 11/15 & 21st Street Intersection
- US 11/15 & Summerdale Road/Valley Street Intersection

The mid-block section from Market Street to Summerdale Plaza has a high concentration of reportable crashes.

2012 NO-BUILD CONDITIONS

A 10-year design year was chosen for this study due to the focus on the Short-Term improvements. Traffic volumes for any major roadway projects that fall under the Long-Term improvement recommendations will most likely need to be projected to a 20-year design year for further analysis under a separate effort. The programmed roadway projects along the study limits were evaluated for consideration in the future No-Build conditions including the US 11/15 & PA 581 Interchange Reconstruction Project, US 11/15 & 21st Street Intersection Reconstruction Project, planned local traffic restrictions in Camp Hill Borough, planned renovations to the Camp Hill Mall, and planned land development. The proposed alignment in the US 11/15 & PA 581 Interchange Reconstruction Project was the only modifications that were made to the existing conditions simulation model. The existing traffic volumes were projected to the design year using a two (2) percent per year growth factor, based on planning information from TCRPC.

As with the existing conditions, the entire corridor was analyzed using the AM, Mid-Day, and PM peak hour volumes. The simulated travel time in the northbound direction during the AM peak hour increased from 22.4 minutes to 26.2 minutes (16.8%), and the simulated travel time in the southbound direction during the PM peak hour increased from 24.2 minutes to 30.8 minutes (27.1%). Intersection delays during the AM peak hour would increase at all 13 of the unimproved intersections, and the number of intersections operating at a LOS D or worse grows from five (5) to six (6). Intersection delays during the PM peak hour would also increase at all 13 of the unimproved intersections, and the number of intersections operating at a LOS D or worse grows from six (6) to seven (7).

SUMMARY OF ADVERSE CONDITIONS

The US 11/15 corridor was nominate for the CCIP due to its significant importance to the commuting public and the movement of goods within the HATS region. Furthermore, the corridor is an important link that connects the Mid-Atlantic States to New York and Canada. Being a major commuter route, the study corridor is subject to recurring peak period traffic congestion. The adverse conditions are summarized at the following locations:

US 11/15 & Simpson Ferry Road Interchange – Substandard acceleration/deceleration lane lengths and traffic weaving conditions due to proximity to the PA 581 interchange.

US 11/15 & PA 581 Interchange – Substandard acceleration/deceleration lane lengths and traffic weaving conditions due to proximity to the Simpson Ferry Road interchange. Also, the traffic signal at the off-ramp currently operates at LOS F in the PM peak hour and LOS D in the AM peak hour.

US 11/15 & Harvard Avenue/Camp Hill Mall Intersection – The left turn movement on the northbound US 11/15 approach, which is destined for the Camp Hill Mall, is not adequate to support the current traffic volumes in the PM peak hour and future traffic volumes in the Mid-Day and PM peak hours.

US 11/15 & Chestnut Street/Trindle Road and US 11/15 & Market Street/Carlisle Pike Intersections – These two intersections are similar in operation. Traffic volumes from residential areas west of the corridor are using Trindle Road (PA 501) and Carlisle Pike (US 11) to access the M. Harvey Taylor Bridge via US 11/15. Therefore, these eastbound approaches contain a significant amount of left turn movements throughout all three (3) peak periods. Furthermore, the through movements at these approaches are also heavy in traffic volumes, as well as turning movements from the northbound and southbound US 11/15 approaches. These intersections currently operate at a LOS D or worse in all three (3) peak periods, and they are anticipated to operate at a LOS F in all peak periods in the design year.

US 11/15 & 21st Street Intersection – The 21st Street intersection has unique geometry and operation, which causes it to be the most significant bottleneck within the study limits. A stop sign, yield sign, poor merge condition and a traffic signal all within a few hundred feet of each other create a bottleneck for southbound US 11/15. The intersection currently operates at LOS F during all three (3) peak periods with intersection delay over 160 seconds per vehicle in the AM and PM peak hours. The intersection is also anticipated to operate at LOS F during all peak periods in the design year, but the intersection delay is anticipated to increase to over 190 seconds in the AM peak hour and 250 seconds in the PM peak hour.

US 11/15 & 12th Street/Erford Road – This intersection has a significant amount of eastbound and westbound traffic along 12th Street and Erford Road, but also has high traffic volumes at the left turn movement of the northbound US 11/15 approach. The northbound left turning vehicles queue past the striped storage lane at the approach. The intersection currently operates at LOS D in the AM peak hour, but it is anticipated to operate at a LOS E in the AM peak hour and LOS D in the Mid-Day and PM peak hours in the design year.

US 11/15 & Stella Street Intersection – The high traffic volume at the left turn movement of the eastbound Stella Street approach is a major cause of delay in the PM peak hour. The intersection currently operates at LOS D in the PM peak hour, but is anticipated to operate at a LOS D in the AM peak hour and LOS in the PM peak hour in the design year.

Mid-Block between the intersections of US 11/15 & Market Street and US 11/15 & Summerdale Plaza – There are a relatively high number of reportable crashes over the past three (3) years within this section of the corridor. Multiple access points from both minor roads and businesses may be a factor in these crashes.

US 11/15 & Summerdale Road/Valley Street – There are a relatively high number of reportable crashes over the past three (3) years at this intersection. The crashes may be attributed to the geometry of the intersection.

ALTERNATIVES ANALYSIS

The alternatives in this study were divided into Short-Term and Long-Term improvements. The Short-Term improvements require a minimum time framework (0-3 years) to implement, and therefore can be completed with the schedule of CCIP. The Long-Term improvements (4-10 years) require thorough planning and extensive design, which may require special environmental consideration and right-of-way acquisition, and therefore may not be completed within the schedule of CCIP.

IDENTIFICATION OF SHORT-TERM IMPROVEMENT ALTERNATIVES

The PENNDOT CCIP Standard Study Methodology (SSM) provides the following Short-Term solutions that may be applicable as part of this program, which were evaluated within this report:

- Minor Geometric Improvements
- Traffic Signal Operations
- Multimodal Initiatives
- Intelligent Transportation Systems (ITS)
- Traffic Regulation
- Transportation Demand Management (TDM) Measures
- Planning and Zoning

Minor Geometric Improvements – PENNDOT Engineering District 8-0 is already addressing the major operational concerns along the limited access section of the corridor at the interchanges of US 11/15 & PA 581 and US 11/15 & Simpson Ferry Road. PENNDOT Engineering District 8-0 is also addressing the major bottleneck along the free access section of the corridor at the interchange of US 11/15 & 21st Street. Further geometric improvements were limited due to the fact that the US 11/15 corridor is almost fully developed, which limits the work that can be completed in the Short-Term. The following geometric improvements were identified through evaluation of adverse conditions, discussions with the local stakeholders, and traffic analysis:

- **US 11/15 & Harvard Avenue/Camp Hill Mall Entrance** – Extend the left turn lane of the northbound US 11/15 approach to create additional storage. This extension is consistent with plans by PENNDOT Engineering District 8-0, Camp Hill Borough, and future owner of Camp Hill Mall to relocate the mall entrance to Yale Avenue.

- **US 11/15 & 12th Street/Erford Road** – Extend the left turn lane of the northbound US 11/15 approach to create additional storage.

Traffic Signal Operations – Poor operational performance at the signalized intersections may be improved through traffic signal timing improvements. All traffic signal timings were optimized through the Synchro software package in the Short-Term Build conditions. Some of the traffic signals were evaluated in zones, or closed loop systems, to further enhance progression of traffic through the intersections.

At the time of this study, none of the existing traffic signals within the study limits of the US 11/15 corridor were capable of priority control for emergency response vehicle or buses. A priority control system may help travel to Holy Spirit Hospital, which is located in the vicinity of the study limits. Given that the emergency vehicle priority control systems do not have a direct benefit on the recurring congestions within the corridor, these systems would be considered enhancements to the corridor. A more detailed study would be required for a transit priority control system.

Multimodal Initiatives – The 2002 US Census Data estimates that 82 percent of Cumberland County residents that commute to work drive alone, 9 percent carpool, 1 percent use some sort of public transportation, 7 percent walk, and 1 percent use some other mode of transportation. With this in mind, a practical strategy to ease congestion along the study corridor is through mode shifts including buses, regional rail, Park & Ride lots, pedestrian and bicycle facilities. The following multi-modal efforts were identified to reduce single occupancy vehicle (SOV) travel:

- **Expanded Bus Service** – CAT has extensive transit facilities operating along the West Shore of the Susquehanna River and within the corridor study limits. The addition of new routes and increased frequency of existing services should help to improve ridership on the local buses. Although the anticipated ridership of new routes and expanded service is beyond the scope of this report, a public transit study would help determine the need for public transit within the study area. As part of the public transit study, the evaluation of bus bays or loading areas at side streets, and bus shelters to provide an inviting location for the public to wait for the bus should be considered.

- **Regional Rail –** CORRIDOR One is the proposed rail corridor that will serve a 54-mile stretch from Carlisle through Harrisburg, to Lancaster. Plans also include a rail station at Harrisburg International Airport. CORRIDOR One is the first corridor to be developed in the regional system. Once complete, a truly multi-modal system will connect five regional transportation corridors. The CORRIDOR One project is being pursued as a separate effort from this report.

- **Park & Ride Facilities** – CAT has three (3) Park & Ride facilities in the area of the corridor study limits. An unofficial Park & Ride lot is located at the Camp Hill Mall, which has been observed throughout this study. Camp Hill Borough met with the future owners of the Camp Hill Mall to discuss future transportation plans, including discussions of a potential Park & Ride facility with transit service. PENNDOT and CAT may help to facilitate the design and construction of the Park & Ride for consistency with any planned roadway modifications as part of the renovated Camp Hill Mall. Furthermore, the planned bus route from I-83/York County area to the West Shore Business complex may provide an opportunity for a Park & Ride facility at the intersection of US 11/15 & 12th Street/Erford Road.

- **Bicycle Facilities** – Bicycle facilities are also planned in the vicinity of the study corridor by PENNDOT as one of the Bicycle PA routes. The planned Touring Route J would lead from Harrisburg down to Gettysburg and intersect with Touring Route S. The route is not planned along the US 11/15 corridor study limits. Given the bicycle route planning above the corridor limits and below the corridor limits, further investigation within the study corridor and surrounding areas may provide a cohesive bicycle plan, which ties the plans together. The investigation may be in the form of a detailed study that evaluates demand, coordinates with other bicycle routes and planned roadway projects, and prioritizes projects with concepts and costs.

Intelligent Transportation Systems (ITS) – The location of the US 11/15 corridor in relation to the various bridges into Harrisburg and the other surrounding highways provides opportunities for alternative routes, such as the PA Turnpike, PA 581, and I-81, to be used during times of heavy traffic volumes or incidents. The dissemination of traveler information along each of the corridors throughout the region would improve delay, travel time and safety during recurring and non-recurring congestion. Efforts could include the deployment of sensors for vehicle and incident detection, closed circuit television (CCTV) cameras for incident detection and verification along the limited access sections of the corridors and interchanges, dynamic message signs (DMS) to disseminate traveler information, and a communications system to transfer the traffic data between the field devices and the PENNDOT Engineering District 8-0 office building. Further enhancements to the traveler information systems may include kiosks at major traffic generators and highway advisory radio (HAR) systems. PENNDOT Engineering District 8-0 does not currently operate a traffic management center (TMC) to receive the detector and video data, and disseminate the traveler information. Furthermore, PENNDOT Engineering District 8-0 does not currently monitor any CCTV systems. Therefore, the resources are not in place to handle these systems. With this in mind, ITS deployment recommendations will be considered a Long-Term initiative.

Traffic Regulations – The project team did not identify traffic regulation techniques, such as turn restrictions and lane restrictions, as applicable measures to alleviate traffic congestion within the corridor study limits. As a separate initiative from this study, PENNDOT Engineering District 8-0 and Camp Hill Borough have plans to install turn restrictions onto local roads from US 11/15 during the AM peak period for safety purposes.

Transportation Demand Management (TDM) Measures – Applicable Transportation Demand Management (TDM) measures include transportation management associations (TMAs) and commuter alternatives programs, both of which are described below:

- **Transportation Management Association (TMA)** – A TMA is a public private partnership that develops, supports, promotes, and improves new and existing transportation systems. There are no existing TMAs in the Harrisburg region, but there have been discussions for the formation of a Susquehanna Regional TMA. In addition, past discussions have included the formation of a TMA along the west shore area of the Susquehanna River that would be focused on the West Shore Business Complex.

- **Commuter Alternatives Program** – The purpose of a commuter alternatives program is to help the general public, including employers in the region, save time and money on the daily commute to work. The commuter alternatives program also helps to reduce traffic congestion and air pollution. Some of the services provided through the program include ride matching, variable work hour programs, and telecommuting.

These programs involve more than just the US 11/15 corridor in the study limits, and require extensive planning from the region. Therefore, these improvements are considered a Long-Term initiative for the region, which would directly benefit this corridor.

Planning and Zoning – The county and municipalities along the corridor have current comprehensive plans, zoning and subdivision regulations to guide growth. Additionally, Tri-County Regional Planning Commission (TCRPC) is creating a Regional Growth Management Plan to coordinate anticipated development and manage infrastructure investments in Cumberland, Dauphin, and Perry Counties. A few Mid-Block locations within the study area have a relatively high number of reportable crashes over the past three (3) years. The observation of a lack of access control, combined with the high frequency of crashes, indicate that access management strategies may improve the safety and operation of the corridor. Access Management Ordinances or overlay districts within the zoning ordinance are techniques adopted by the municipalities to set standards for the design and location of driveways and roadways seeking access to state or local roads.

ANALYSIS OF SHORT-TERM IMPROVEMENT ALTERNATIVES

The entire corridor was analyzed using the AM, Mid-Day, and PM peak hour volumes for the design year and compared to the 2012 No-Build conditions. Modifications to the 2012 No-Build conditions network consisted of traffic signal timing optimization and extended left turn lanes at the northbound US 11/15 approaches at Harvard Avenue/Camp Hill Mall Entrance and 12th Street/Erford Road. The simulated travel time in the northbound direction during the AM peak hour decreased from 26.2 minutes to 24.6 minutes (6.3%), and the simulated travel time in the southbound direction during the PM peak hour decreased from 30.8 minutes to 25.9 minutes (15.8%). Intersection delays during the AM peak hour would decrease at 12 of the 14 signalized intersections, and the number of intersections operating at a LOS D or worse decreases from six (6) to three (3). Intersection delays during the PM peak hour would decrease at eight (8) of the 14 signalized intersections, and the number of intersections operating at a LOS D or worse would increase slightly from seven (7) to eight (8), although overall delay would significantly decrease.

IDENTIFICATION OF LONG-TERM IMPROVEMENT ALTERNATIVES

The Long-Term improvements identified in this report consist of projects that were evaluated in the Short-Term improvements section, but would not be able to be completed within the immediate time frame of this initiative (0-3 years). The following Long-Term solutions were applicable:

- Major Geometric Improvements
- Multimodal Initiatives
- Intelligent Transportation Systems

Major Geometric Improvements – As noted in the Short-Term Build scenario, PENNDOT Engineering District 8-0 is already addressing the major operational concerns along the freeway section of the study corridor. The major bottleneck in the arterial section of the corridor is the US 11/15 & 21st Street intersection reconstruction project. The project team agreed to evaluate the effects of the current preferred alignment for the 21st Street intersection in the 2012 Long-Term Build conditions since the project is currently a concept without a construction date established. The following paragraph provides a description of the proposed roadway modifications:

- **US 11/15 & 21st Street Intersection** – Improvements at this intersection include reconfiguring the intersection to allow two (2) left turn lanes from northbound US 11/15 to north 21st Street. A left lane/exit from the westbound M. Harvey Taylor Bridge approach will be added from south of Erford Road to 21st Street. This left lane/exit will be for traffic coming from Harrisburg and southbound US 11/15 wishing to turn south onto 21st Street. The new lane will exit to the left and parallel the eastbound M. Harvey Taylor Bridge approach under the existing overpass of US 11/15 to 21st Street. A new traffic signal will be added at the merge of southbound US 11/15 and the M. Harvey Taylor Bridge approach. This will replace the existing stop sign and permit southbound US 11/15 traffic to merge with the M. Harvey Taylor Bridge approach traffic from Harrisburg before intersection with 21st Street. The new traffic signal and the associated merging of the traffic prior to the 21st Street intersection will eliminate the yield control for the southbound traffic that is located immediately following the existing traffic signal. Finally, the proposed improvements will include the widening to three (3) lanes on north 21st Street from US 11/15 to Center Street, yet the existing parking lane will be maintained.

Multimodal Initiatives – As noted in the Short-Term improvements scenario, CAT is planning multiple transit initiatives in the study area. These initiatives, such the addition of a route/link from I-83 York County to the West Shore Business Complex, and CORRIDOR One Rail Project, are certainly consistent with the long-range plans of this initiative. The following paragraph provides a brief summary of the CORRIDOR One Rail Project:

- **CORRIDOR One Rail Project –** One of the major projects in the planning stage at this time is the CORRIDOR One Rail Project, which is a proposed rail corridor that will serve a stretch from Carlisle through Harrisburg to Lancaster. This project is being pursued as a separate effort from this initiative, but should play a role in alleviating the traffic congestion in the area, including the study limits of the US 11/15 corridor.

Intelligent Transportation Systems (ITS) – As noted in the Short-Term improvements scenario, the location of the US 11/15 corridor in relation to the bridges into Harrisburg and the other surrounding highways provides opportunities for alternative routes, such as the PA Turnpike, PA 581, and I-81 to be used during times of heavy traffic volumes or incidents. The dissemination of traveler information along each of the corridors in the region would improve delay, travel time, and safety during recurring and non-recurring congestion. The following provides a brief summary of a potential ITS deployment strategy along the US 11/15 study corridor:

- **US 11/15 Study Corridor ITS Deployment** – The ITS devices and communications network deployed along the US 11/15 corridor may consist of sensors, such as microwave detectors, for vehicle and incident detection, closed circuit television (CCTV) cameras for incident detection and verification along the limited access sections of the corridor and interchanges, dynamic message signs (DMS) to disseminate traveler information, and a communications system to transfer traffic data between the field devices and the PENNDOT Engineering District 8-0 office building.

ANALYSIS OF LONG-TERM IMPROVEMENT ALTERNATIVES

The entire corridor was analyzed using the AM, Mid-Day, and PM peak hour volumes for the design year and compared to the 2012 No-Build conditions. Modifications to the 2012 No-Build conditions network consisted of traffic signal timing optimization and proposed alignment of the 21st Street intersection per the most recent concept plan. The simulated travel time in the northbound direction during the AM peak hour decreased from 26.2 minutes to 22.6 minutes (13.8%), and the simulated travel time in the southbound direction during the PM peak hour decreased from 30.8 minutes to 24.0 minutes (22.0%). Intersection delays during the AM peak hour would decrease at 12 of the 14 signalized intersections, and the number of intersections operating at a LOS D or worse decreases from six (6) to four (4). Intersection delays during the PM peak hour would decrease at 13 of the 14 signalized intersections, and the number of intersections operating at a LOS D or worse remains at seven (7).

RECOMMENDATIONS

Both the Short-Term and Long-Term improvement alternatives address the needs and objectives of this project. However, at this time, the Short-Term improvement alternative has the ability to be developed and constructed within the length of this program. The Short-Term improvement alternative is the focus of the recommendations and the Long-Term improvement alternatives should be studied further under a separate effort.

The Short-Term improvement recommendations are a combination of initiatives to be implemented by multiple agencies. The recommendations are separated into multiple projects under the following categories for planning purposes:

- Traffic Signal Operations
- Minor Geometric Improvements
- Multimodal Initiatives
- Planning and Zoning

The Long-Term improvement recommendations are also a combination of initiatives to be implemented by multiple agencies. The Long-Term improvement recommendations are outside the scope of this program. The recommendations are separated into multiple projects under the following categories for planning purposes:

- Traffic Signal Operations
- Major Geometric Improvements
- Multimodal Initiatives
- Intelligent Transportation Systems (ITS)
- Transportation Demand Management (TDM) Measures

The goal of the CCIP is to reduce the peak hour travel time on the improved corridor by a factor of 20 percent. The Short-Term improvement simulation model reveals a 16 percent improvement during the most congested period (PM peak hour) by simply re-timing the traffic signals. The other Short-Term improvement recommendations did not have the ability to be observed in the software, but it is anticipated that they will further enhance the operation and safety of the corridor. The Long-Term build simulation model indicates a 22 percent improvement by reconstructing the 21st Street intersection and re-timing the traffic signals. Similarly, the other Long-Term improvement recommendations could not be observed in the software, but are also anticipated to further enhance the operation and safety of the corridor.

This report identifies some of the needs within the corridor and specific projects that may help to address these needs. The projects have been prioritized within the Short-Term and Long-Term time frames, and Short-Term improvement recommendations have benefit/cost ratios where applicable to further prioritize the projects. The Short-Term improvement recommendations are ready to be moved into the next steps, which in some cases mean final design. The extensive amount of traffic data collected for this report and traffic software can be utilized for the next steps if the projects are procured within the next two years.

A summary of the Short-Term improvement recommendations is provided in Table 1. Also, a summary of the Long-Term improvement recommendations is provided in Table 2.

TABLE 1: SHORT-TERM IMPROVEMENT RECOMMENDATIONS

Traffic Signal Improvements		
Muncipality	***Project***	***Cost***
Camp Hill Borough	Traffic signal timing optimization for six (6) signalized intersections along US 11/15: ▪ PA 581 ▪ Harvard Avenue ▪ Chestnut Street ▪ Market Street ▪ Brentwater Road ▪ Country Club Road	$30,000
Wormleysburg Borough	Closed loop interconnection and traffic signal timing optimization for three (3) signalized intersections along US 11/15: ▪ 2nd Street ▪ Front Street ▪ Stella Street	$150,000

Minor Geometric Improvements		
Muncipality	***Project***	***Cost***
Camp Hill Borough	Extend northbound US 11/15 left turn lane at Harvard Avenue/Camp Hill Mall Entrance	Included in separate effort
Wormleysburg Borough	Extend northbound US 11/15 left turn lane at 12th Street/Erford Road	$5,000

Minor Geometric Improvements		
Muncipality	***Project***	***Cost***
Various	Transit study to investigate expanded bus service, bus bays, and bus shelters	$100,000
Various	Bicycle study to investigate facilities along the study corridor	$50,000
Camp Hill Borough	Formalize Park & Ride facility at the Camp Hill Mall	Included in separate effort

TABLE 1 (CONTINUED): SHORT-TERM IMPROVEMENT RECOMMENDATIONS

Planning and Zoning		
Muncipality	***Project***	***Cost***
Camp Hill Borough; Lemoyne Borough; Wormleysburg Borough; East Pennsboro Township	Develop access management plan along US 11/15 corridor and adopt access management overlay district.	$150,000

TABLE 2: LONG-TERM IMPROVEMENT RECOMMENDATIONS

Traffic Signal Improvements		
Muncipality	***Project***	***Cost***
Various	Emergency Vehicle Traffic Signal Priority	\$7,000 per intersection \$1,250 per emitter
Various	Needs Assessment Study for Transit Priority along the US 11/15 Corridor	\$100,000

Major Geometric Improvements		
Muncipality	***Project***	***Cost***
Camp Hill Borough and East Pennsboro Township	US 11/15 & 21st Street Intersection Reconstruction Project	\$3,300,000

Multimodal Initiatives		
Muncipality	***Project***	***Cost***
Various	CORRIDOR One Rail Project (Transitional Analysis Study)	\$1,400,000

Intelligent Transportation Systems (ITS)		
Muncipality	***Project***	***Cost***
Various	Construction of a Traffic & Incident Management System along US 11/15 (limited access sections) from PA Turnpike to I-81	\$4,000,000
Various	Construction of a Highway Advisory Radio (HAR) System along US 11/15 (limited access interchanges) from I-76 to I-81	\$120,000 (\$20,000 per interchange)
Various	Construction of Interactive Kiosks along US 11/15 in Cumberland County	\$250,000 (\$50,000 per kiosk)

Transportation Demand Management (TDM) Measures		
Muncipality	***Project***	***Cost***
Various	Transportation Management Association (TMA)	\$160,000 per year
Various	Commuter Alternatives Program	\$216,000 per year

I. INTRODUCTION

A. Background

The Pennsylvania Department of Transportation (PENNDOT) initiated the Congested Corridor Improvement Program (CCIP) to identify several congested corridors in the Commonwealth and, in conjunction with its partners, define and implement the needed improvements. The goal of the CCIP is a 20 percent reduction in peak hour travel time on the improved transportation corridor. The proposed improvements are directed at activities such as roadway geometry, signal operations, access management, multimodal initiatives, intelligent transportation systems (ITS), traffic regulation techniques, transportation demand management (TDM) measures, and planning and zoning practices that are appropriate for a particular transportation corridor. Transportation corridors and associated improvements are identified in partnership with Metropolitan Planning Organizations (MPOs) and Local Development Districts (LDDs), including utilization of existing congestion management systems (plans), which some MPOs/LDDs have already developed.

The CCIP initiative resulted from PENNDOT's recent strategic planning process, the "Moving Pennsylvania Forward Update." It falls under the Mobility and Access Strategic Focus Area and the High-Level Goal of Efficient Movement of People and Goods. In addition, this congested corridor initiative is consistent with the principles of regional and corridor-based planning advocated by PennPlan (Pennsylvania's Statewide Long-Range Transportation Plan) and Pennsylvania's Highway Congestion Management Strategic Plan, which was developed with input from planning partners and other stakeholders.

The CCIP study costs are funded by PENNDOT. However, 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 receive planning partner support for placement on the Transportation Improvement Plan (TIP) and the 12-Year Program for design and construction are considered for this initiative.

Four (4) of the total 17 corridors were identified for early-action implementation. The early-action corridors are intended to provide a method for reviewing the success of the program and making any refinements to the improvement process. The early-action corridors are located in the Philadelphia, Harrisburg, Pittsburgh and Northeastern Pennsylvania regions.

The US 11/15 corridor in Cumberland County was selected as the early-action corridor in the Harrisburg region. The US 11/15 corridor, nominated by the Tri-County Regional Planning Commission (TCRPC), as authorized by the Harrisburg Area Transportation Study (HATS) Coordinating Committee, is located in PENNDOT Engineering District 8-0. The original nomination was refined to include only the 'southern' section of the corridor, since a consultant is already under contract to study the 'northern' section. When both studies are complete the entire length of the originally-proposed corridor will have been evaluated.

The US 11/15 corridor is located just outside of Harrisburg, Pennsylvania. It is an important connection that links the Mid-Atlantic States to New York and Canada. Being a major commuter route, it is subject to recurring peak period congestion. The corridor limits extend approximately 11 miles and consist of 14 signalized intersections. The limited access portion of the study corridor includes six (6) interchanges.

The corridor traverses six (6) municipalities (Upper Allen Township, Lower Allen Township, Camp Hill Borough, Lemoyne Borough, Wormleysburg Borough, and East Pennsboro Township) from the project's southern limit, the Pennsylvania Turnpike, to the George N. Wade Bridge (I-81) in the north.

A review meeting was held on June 20, 2001 with the corridor stakeholders to discuss the background of the corridor, refine the corridor limits if warranted, identify risk factors and determine potential solutions. The US 11/15 corridor is most congested during the AM and PM peak periods in which the majority of traffic is traveling in the northbound direction toward Harrisburg in the AM peak period and in the southbound direction toward Camp Hill Borough in the PM peak period. Some of the potential solutions to alleviate congestion include traffic signal improvements, intersection geometry improvements and transit-related initiatives.

A Standard Study Methodology (SSM) was 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. In the past, corridors were typically of local interest and studied on an individual basis. However, the increasingly complex problems are becoming of wide interest and are best studied through a coordinated approach. The SSM identifies the steps involved in an engineering study of improvement alternatives and focuses on the use of simulation models as analysis tools to evaluate the operational impacts of improvement alternatives.

This study follows the three specific stages identified in the SSM. The first stage is the Identification of Viable Alternatives. This stage includes reviewing the scope of work, coordinating with multiple stakeholders, reviewing the project needs, and developing Short-Term and Long-Term improvement alternatives. The second stage is the Engineering Study. This stage involves selecting the analysis tools, determining data requirements, collecting data, establishing existing conditions, developing detailed improvement alternatives, and analyzing the effects of each alternative. The third, and final, stage is the Selection of Alternatives. This stage includes documenting the findings of the analysis, recommending improvement alternatives and documenting the study.

B. Study Location

The US 11/15 corridor is located in Upper Allen Township, Lower Allen Township, Camp Hill Borough, Lemoyne Borough, Wormleysburg Borough, and East Pennsboro Township in Cumberland County. The corridor limits extend approximately 11 miles from the Pennsylvania Turnpike (I-76) in Upper Allen Township to Interstate 81 in East Pennsboro Township. The corridor limits include six (6) limited access interchanges as follows:

- US 11/15 & Pennsylvania Turnpike (I-76)
- US 11/15 & Rossmoyne Road/Wesley Drive
- US 11/15 & Slate Hill Road
- US 11/15 & Simpson Ferry Road
- US 11/5 & PA 581
- US 11/15 & I-81

The corridor limits also include 14 signalized intersections as follows:

- US 11/15 & PA 581 (Ramp C)
- US 11/15 & Harvard Avenue/Camp Hill Mall Entrance
- US 11/15 & Chestnut Street/Trindle Road
- US 11/15 & Market Street/Carlisle Pike
- US 11/15 & Brentwater Road
- US 11/15 & Country Club Road
- US 11/15 & 21st Street
- US 11/15 & 12th Street/Erford Road
- US 11/15 & 2nd Street
- US 11/15 & Front Street
- US 11/15 & Stella Street
- US 11/15 & Market Street
- US 11/15 & Summerdale Plaza
- US 11/15 & Summerdale Road/Valley Street

C. Project Location Map

The study area has been identified in the attached Project Location Map, illustrated in Figure 1.

FIGURE 1: PROJECT LOCATION MAP

D. Original and Successor Projects

The Harrisburg Area Transportation Study (HATS) Coordinating Committee developed an *ITS Early Deployment Strategic Plan*. The purpose of the study was to identify the ITS strategies appropriate for the Harrisburg metropolitan area and to develop a deployment plan to provide the ITS improvements. The study focused on the existing transportation facilities, infrastructure and operations, as well as providing an ITS system architecture for the region.

E. Concurrent Projects

The US 11/15 corridor has several on-going transportation studies and engineering efforts that are currently in different phases. A summary of the known engineering studies and design projects follows.

Cumberland-Perry Counties Safety and Congestion Management Study (CMS)

The Tri-County Regional Planning Commission (TCRPC) is currently conducting a Cumberland-Perry Counties Safety and Congestion Management Study (CMS). This is a countywide transportation study that includes the northern portion of US 11/15 in the vicinity of the George Wade Bridge (I-81). The US 11/15 & Summerdale Road / Valley Street intersection and US 11/15 & Summerdale Plaza intersection are included in CMS and overlap with the limits of the CCIP study. The Cumberland-Perry CMS includes 17 municipalities, and turning movement traffic data were collected at select intersections. It should be noted that the two (2) intersections noted above were not included in the turning movement counts for the Cumberland-Perry CMS, but were counted in the CCIP study.

US 11/15 & PA 581 Interchange

The predominant future project along the corridor is the redesign of the US 11/15 & PA 581 interchange area with limits from Brentwater Road to Zimmerman Drive. PENNDOT Engineering District 8-0 is currently conducting preliminary engineering of the US 11/15 corridor for this massive roadway project. Construction is scheduled for 2004/2005, and the project is in the process of obtaining environmental clearances.

US 11/15 & 21st Street Intersection

Another roadway project that is planned for the US 11/15 corridor by PENNDOT Engineering District 8-0 includes the 21st Street intersection and the surrounding area. This project is currently in the preliminary engineering phase, and a construction date has not been established.

US 11/15 & Valley Street Intersection

PENNDOT Engineering District 8-0 is currently conducting a traffic and safety study that includes vehicle crash history, as well as traffic signing and pavement markings at the US 11/15 and Valley Road intersection.

F. Data Reviewed

Various sources of information were consulted for use in evaluating existing and proposed scenarios for the US 11/15 corridor in Cumberland County. The following information was provided by PENNDOT Engineering District 8-0:

- Traffic signal permit plans dated from 1967 to 2001
- Traffic signal permit plans dated 2001 for the signalized intersections located at the on and off-ramps of the various interchanges along the limited access portion of the corridor
- Roadway plans for the entire corridor
- Propose realignment plans for the US 11/15 & PA 581 interchange
- Aerial concepts plan for the US 11/15 & 21st Street intersection dated January 30, 2001

In addition to these data sources, several field visits were conducted to identify and document existing conditions. During these field visits, photographs, a video of the corridor, and field dimensions were obtained.

II. EXISTING CONDITIONS (2002)

A. Roadway Classification

Classification of the project limits of the study was performed using the guidelines and criteria suggested by the *Highway Capacity Manual 2000*. Based on Exhibit 10-5 of the *Highway Capacity Manual*, US 11/15 within the free-access portion of the project limits, was determined to be a Class IV arterial.

The PENNDOT Straight Line Diagrams for the study corridor are included in Appendix D for reference purposes.

B. Existing Roadway Inventory

The inventory of physical roadway features was conducted using available as-built plans and field observation data. The inventory is not intended to be an in-depth record within the study area. Rather, it documents areas of focus within the study limits.

1. LIMITED ACCESS INTERCHANGES

   a. US 11/15 & Pennsylvania Turnpike (I-76)

      The US 11/15 interchange with the Pennsylvania Turnpike is the southern most interchange located along the study corridor. This interchange is classified as a split partial cloverleaf that permits all movements. Furthermore, the interchange provides access to both the eastbound and westbound directions of the Pennsylvania Turnpike from US 11/15 northbound and southbound. The interchange consists of two (2) structures, one that carries the on and off-ramps over US 11/15, and a second that carries the Pennsylvania Turnpike over the study corridor.

   b. US 11/15 & Rossmoyne Road/Wesley Drive

      The US 11/15 & Rossmoyne Road/Wesley Drive interchange is considered a full diamond interchange. This interchange provides full access to both eastbound Rossmoyne Road and westbound Wesley Drive from both northbound and southbound directions of US 11/15. The interchange consists of one (1) structure that carries Wesley Drive over the study corridor and utilizes traffic signals to control the traffic coming from the US 11/15 off-ramps.

   c. US 11/15 & Slate Hill Road

      The US 11/15 & Slate Hill Road interchange is considered a partial diamond interchange. This interchange provides access for northbound US 11/15 traffic to eastbound Slate Hill Road. Other movements permitted at this location include allowing Slate Hill Road traffic to enter onto US 11/15 northbound and southbound, as well as southbound US 11/15 to either direction of Slate Hill Road. The interchange consists of one (1) structure that carries Slate Hill Road over US 11/15.

d. US 11/15 & Simpson Ferry Road

The US 11/15 & Simpson Ferry Road interchange is considered a full cloverleaf interchange that permits all movements between northbound/southbound US 11/15 and eastbound/westbound Simpson Ferry Road. This interchange includes one (1) structure that carries US 11/15 over Simpson Ferry Road.

e. US 11/5 & PA 581

The US 11/15 & PA 581 interchange is considered a full cloverleaf interchange that permits all movements between northbound/southbound US 11/15 and eastbound/westbound PA 581. This interchange includes one (1) structure that carries US 11/15 over PA 581.

f. US 11/15 & I-81

The US 11/15 and I-81 interchange is considered a full cloverleaf interchange that permits all movements between northbound/southbound US 11/15 and eastbound/westbound I-81. This interchange includes one (1) structure that carries US 11/15 over PA 581.

2. SIGNALIZED INTERSECTIONS

a. US 11/15 & PA 581 (Ramp C)

The intersection of US 11/15 (Southbound) and PA 581 (Ramp C) is a three-leg intersection. The lane configuration of the southbound US 11/15 approach consists of two (2) exclusive through lanes. The eastbound PA 581 (Ramp C) approach consists of two (2) right turn lanes. The northbound US 11/15 approach is separated from the southbound US 11/15 approach by a concrete median barrier and is not affected by the traffic signal.

The existing traffic signal is operating on a 160-second background cycle. The intersection operates under semi-actuated control with loop detectors located on the minor approach (Ramp C). The loop detectors are placed in Ramp C to help prevent traffic back-ups from the ramp onto the westbound PA 581 mainline. The existing controller for this traffic signal in interconnected to the adjacent signal located at Harvard Avenue. The master controller is located at the intersection of US 11/15 & Chestnut Street. The controllers are interconnected through communication cable in buried conduit and aerial cable on Pennsylvania Power & Light (PP&L) utility poles.

b. US 11/15 and Harvard Avenue/Camp Hill Mall Entrance

The intersection of US 11/15 and Harvard Avenue/Camp Hill Mall Entrance is a four-leg intersection. The lane configuration of the northbound and southbound US 11/15 approaches consists of an exclusive left turn lane, an exclusive through lane, and a shared through/right turn lane. The westbound Harvard Avenue approach consists of shared left turn/through/right turn lane. The eastbound Camp Hill Mall Entrance approach consists of an exclusive right turn lane and a shared through/left turn lane.

The existing traffic signal is operating on a 160-second background cycle. The intersection operates under fully actuated control with loop detectors located on all approaches. The existing controller for the traffic signal is interconnected to the adjacent traffic signals located at the intersections of US 11/15 & PA 581 and US 11/15 & Chestnut Street. The master controller is located at the intersection of US 11/15 & Chestnut Street. The controllers are interconnected through communication cable in buried conduit and aerial cable on Pennsylvania Power & Light (PP&L) utility poles.

c. US 11/15 and Chestnut Street/Trindle Road

The intersection of US 11/15 and Chestnut Street/Trindle Road is a four-leg intersection. The northbound US 11/15 approach consists of an exclusive left turn lane, an exclusive through lane, and a shared through/right turn lane. The southbound US 11/15 approach consists of an exclusive left turn lane, two exclusive through lanes, and an exclusive right turn lane. The westbound Chestnut Street approach and eastbound Trindle Road approach are offset approximately 15 feet at the intersection. The westbound Chestnut Street approach consists of an exclusive left turn lane and a shared through/right turn lane. The eastbound Trindle Road approach consists of an exclusive right turn lane, an exclusive through lane, and an exclusive left turn lane.

The existing traffic signal is operating on a 160-second background cycle. The intersection operates under fully actuated control with loop detectors located on all approaches. The existing controller for the traffic signal is interconnected to the adjacent traffic signals located at the intersections of US 11/15 & Harvard Avenue and US 11/15 & Market Street. The master controller is located at the intersection of US 11/15 & Chestnut Street. The controllers are interconnected through communication cable in buried conduit and aerial cable on Pennsylvania Power & Light (PP&L) utility poles

d. US 11/15 and Market Street/Carlisle Pike

The intersection of US 11/15 and Market Street is a four-leg intersection. The northbound US 11/15 approach consists of an exclusive left turn lane, two (2) exclusive through lanes, and an exclusive right turn lane. A concrete pedestrian island that includes handicap ramps and sidewalk along with the traffic signal controller assembly separates the exclusive right turn lane. The southbound US 11/15 approach consists of an exclusive left turn lane, two (2) exclusive through lanes, and an exclusive right turn lane. The eastbound Carlisle Pike and westbound Market Street approaches consist of an exclusive left turn lane and a shared through/right turn lane.

The existing traffic signal is operating on a 160-second background cycle. The intersection operates under fully actuated control with loop detectors located on all approaches. The existing controller for the traffic signal is interconnected to the adjacent traffic signals located at the intersections of US 11/15 & Chestnut Street/Trindle Road and US 11/15 & Brentwater Road. The master controller is located at the intersection of US 11/15 & Chestnut Street. The controllers are interconnected through communication cable in buried conduit and aerial cable on Pennsylvania Power & Light (PP&L) utility poles

e. US 11/15 and Brentwater Road

The intersection of US 11/15 and Brentwater Road is a three-leg intersection. The northbound US 11/15 approach consists of an exclusive left turn lane and two (2) exclusive through lanes. The southbound US 11/15 approach consists of an exclusive right turn lane and two (2) exclusive through lanes. The eastbound Brentwater Road approach consists of a shared left turn/right turn lane.

The existing traffic signal is operating on a 160-second background cycle. The intersection operates under fully actuated control with loop detectors located on all approaches. The existing controller for the traffic signal is interconnected to the adjacent traffic signals located at the intersections of US 11/15 & Market Street and US 11/15 & Country Club Road. The master controller is located at the intersection of US 11/15 & Chestnut Street. The controllers are interconnected through communication cable in buried conduit and aerial cable on Pennsylvania Power & Light (PP&L) utility poles

f. US 11/15 and Country Club Road

The intersection of US 11/15 and Country Club Road is a three-leg intersection. The northbound US 11/15 approach consists of an exclusive left turn lane and two (2) exclusive through lanes. The southbound US 11/15 approach consists of an exclusive right turn lane and two (2) exclusive through lanes. The eastbound (or southbound) Country Club Road approach consists of an exclusive left turn lane and an exclusive right turn lane.

The existing traffic signal is operating on a 160-second background cycle. The intersection operates under fully actuated control, with loop detectors located on all approaches. The existing controller for the traffic signal is interconnected to the adjacent traffic signal located at the intersection of US 11/15 & Brentwater Road. The master controller is located at the intersection of US 11/15 & Chestnut Street. The controllers are interconnected through communication cable in buried conduit and aerial cable on Pennsylvania Power & Light (PP&L) utility poles

g. US 11/15 and 21st Street

The intersection of US 11/15 and 21st Street is a five-leg intersection. The northbound US 11/15 approach consists of an exclusive left turn lane, an exclusive through lane, and a shared through/right turn lane. The southbound US 11/15 approach consists of an exclusive left turn lane and an exclusive through lane. The southbound US 11/15 traffic must stop at a stop sign approximately 300 feet prior to the signalized intersection and stop at a yield sign approximately 150 feet after the signalized intersection to allow the M. Harvey Taylor Bridge traffic to merge. The southbound M. Harvey Taylor Bridge approach consists of two (2) exclusive through lanes and an exclusive right turn lane. The right turn lane is channelized. The eastbound (or southbound) 21st Street approach consists of a shared left turn/through lane and an exclusive right turn lane. The westbound (or northbound) 21st Street approach consists of a shared left turn/through/right turn lane.

The existing traffic signal is operating on a 220-second background cycle. The intersection operates under fully actuated control with loop detectors located on all approaches. The existing controller for the traffic signal is interconnected to the adjacent traffic signals along 21st Street, and it serves as the master controller.

h. US 11/15 and 12th Street/Erford Road

The intersection of US 11/15 and 12th Street is a four-leg intersection. The northbound and southbound US 11/15 approaches consist of an exclusive left turn lane and a shared through/right turn lane. The eastbound (or southbound) Erford Road approach and westbound (or northbound) 12th Street approach consist of an exclusive left turn lane and shared through/right turn lane.

The existing traffic signal is operating on a 130-second background cycle. The intersection operates under fully actuated control with loop detectors located on all approaches. The existing controller for the traffic signal is interconnected with adjacent traffic signals along 12th Street/Erford Road. The master controller is located at the intersection of Erford Road & Poplar Church Road.

i. US 11/15 and 2nd Street

The intersection of US 11/15 and 2nd Street is a four-leg intersection. The northbound US 11/15 approach consists of a shared left turn/through lane and a shared through/right turn lane. The southbound US 11/15 approach consists of a shared left turn/through/right turn lane. The eastbound (or southbound) and westbound (or northbound) 2nd Street approaches consists of a shared left turn/through/right turn lane. The eastbound and westbound 2nd Street approaches have on-street parking accommodations.

The existing traffic signal is operating on a 70-second background cycle. The intersection operates under semi-actuated control with loop detectors located on the eastbound and westbound approaches of 2nd Street.

j. US 11/15 and Front Street

The intersection of US 11/15 and Front Street is a three-leg intersection. The northbound US 11/15 approach consists of an exclusive left turn lane and an exclusive right turn lane. The eastbound Front Street (southbound US 11/15) approach consists of an exclusive right turn lane and an exclusive through lane. The westbound Front Street approach consists of an exclusive left turn lane and an exclusive through lane.

The existing traffic signal is operating on a 100-second background cycle. The intersection operates under fully actuated control with loop detectors located on all approaches. The existing controller for the traffic signal is time-based coordinated (TBC) with the adjacent traffic signal at the intersection of US 11/15 & Stella Street.

k. US 11/15 and Stella Street

The intersection of US 11/15 and Stella Street is a three-leg intersection. The northbound US 11/15 approach consists of an exclusive left turn lane and an exclusive through lane. The southbound US 11/15 approach consists of an exclusive right turn lane and an exclusive through lane. The eastbound Stella Street approach consists of a shared left turn/right turn lane.

The existing traffic signal is operating on a 100-second background cycle. The intersection operates under fully actuated control with loop detectors located on all approaches. The existing traffic signal is time-based coordinated (TBC) with the adjacent traffic signal at the intersection of US 11/15 & Front Street.

l. US 11/15 and Market Street

The intersection of US 11/15 & Market Street is a four-leg intersection. The northbound US 11/15 approach consists of an exclusive through lane and a shared through/right turn lane. Left turns are not permitted for the northbound US 11/15 approach. The southbound US 11/15 approach consists of two (2) exclusive through lanes. Left or right turns are not permitted for the southbound US 11/15 approach at the intersection, but the movements can be made by utilizing the exit located approximately 200 feet prior to the intersection. The eastbound and westbound Market Street approaches consist of a shared left turn/through/right turn lane.

The existing traffic signal is operating on a 100-second background cycle. The intersection operates under fully actuated control with loop detectors located on all approaches.

m. US 11/15 and Summerdale Plaza

The intersection of US 11/15 and Summerdale Plaza is a three-leg intersection. The northbound US 11/15 approach consists of an exclusive left turn lane and an exclusive through lane. The southbound US 11/15 approach consists of a shared through/right turn lane. The eastbound Summerdale Plaza approach consists of an exclusive left turn lane and an exclusive right turn lane.

The existing traffic signal is operating on a 100-second background cycle. The intersection operates under fully actuated control with loop detectors located on all approaches.

n. US 11/15 and Summerdale Road/Valley Street

The intersection of US 11/15 and Summerdale Road/Valley Street is a three-leg intersection. The northbound US 11/15 approach consists of an exclusive left turn lane and two (2) exclusive through lanes. The southbound US 11/15 approach consists of an exclusive right turn lane and two (2) exclusive through lanes. The eastbound Valley Road approach consists of an exclusive right turn lane and two (2) exclusive left turn lanes.

The existing traffic signal is operating on a 80-second background cycle. The intersection operates under fully actuated control with loop detectors located on all approaches.

3. POSTED SPEED LIMITS

The posted speed limits within the corridor limits vary from 35 MPH to 55 MPH. The speed limit from the Pennsylvania Turnpike (I-76) to PA 581 is 55 MPH. The speed limit from PA 581 to 21st Street is 35 MPH. The speed limit from 21st Street to 2nd Street is 45 MPH. The speed limit from 2nd Street to Market Street is 35 MPH. The speed limit from Market Street to Summerdale Road/Valley Street is 40 MPH. The speed limit from Summerdale Road/Valley Street to I-81 is 45 MPH.

4. INTELLIGENT TRANSPORTATION SYSTEMS (ITS)

There are no existing ITS facilities located within the limits of this study area.

5. PEDESTRIAN/BICYCLE FACILITIES

Pedestrian phasing is properly addressed at all signalized intersections along the US 11/15 corridor. Pedestrian pushbuttons and signals predominantly exist at the intersections from Harvard Avenue to Summerdale Plaza. There are signs located at the Country Club intersection directing pedestrians wishing to cross US 11/15 to use the pedestrian underpass located between Country Club Road and 21st Street. Also, a pedestrian bridge crossing over the limited access portion of US 11/15 is located between Rossmoyne Road/Wesley Drive and Slate Hill Road. The corridor predominantly contains sidewalks along both sides of the roadway on the northbound and southbound directions except for the intersections at PA 581, 21st Street, and Summerdale Road/Valley Street.

There are no existing bicycle facilities within the limits of the study area.

C. Transit Service

The Cumberland-Dauphin-Harrisburg Transit Authority is the legal name for Capital Area Transit (CAT), the Harrisburg metropolitan region's provider of mass transportation services including CAT bus service, and other transit services. Capital Area Transit is governed by a seven-member board of directors representing the counties of Cumberland and Dauphin and the city of Harrisburg. The following transit services are applicable to this study:

1. BUSES

CAT has 13 bus routes that operate on the West Shore of the Susquehanna River. The following eight (8) bus routes operate within the study corridor:

<u>*Route B Highland Park*</u>

The Route B Highland Park bus traverses the US 11/15 study corridor from Simpson Ferry Road to Rossmoyne Road. The route provides service from West Port to the intersection of Commonwealth Avenue & North Street. This bus route uses the limited access portion of US 11/15 only during evening hours. The daytime bus route operates on local routes Wesley Drive and Simpson Ferry Road. The route provides service throughout the day from West Port until 11:46 PM and from Harrisburg until 10:30 PM.

Route D Shopper's Special

The Route D Shopper's Special bus traverses the US 11/15 study corridor between Simpson Ferry Road and 21st Street. The route provides service between the Capital City Mall and the Transfer Center in Harrisburg. This route begins at the Capital City Mall, then enters the US 11/15 corridor from Simpson Ferry Road. This route does not provide service to the commuting public, rather it targets mid-day travelers, departing the Capital City Mall to Harrisburg from 9:30 AM to 4:32 PM (M-F), and departing Harrisburg to the Capital City Mall from 9:00 AM to 3:50 PM (M-F). This bus route also provides service on Saturdays with buses departing the Capital City Mall from 9:35 AM to 4:05 PM, and departing Harrisburg from 9:00 AM to 3:35 PM.

Route DILL Dillsburg

The Route DILL Dillsburg bus traverses the US 11/15 study corridor from the PA Turnpike to the M. Harvey Talyor Memorial Bridge. The route provides service from the Economy Market, Dillsburg, to the intersection of 7th Street & Reilly Street, Harrisburg. This bus route uses the limited access portion of US 11/15 from PA 581 to travel into Harrisburg. Additionally, this route only provides service twice in the morning to Harrisburg, at 6:40 AM and 7:00 AM, and twice in the evening to Dillsburg, at 3:50 PM and 4:45 PM.

Route F Enola

The Route F Enola bus traverses the US 11/15 study corridor between Forster Street and State Road, and again at the Summerdale Plaza. The route provides service along the corridor from the Summerdale Plaza (park and ride facility) to Harrisburg. This bus travels from the shopping center along US 11/15 and uses Stella Street to access the M. Harvey Taylor Memorial Bridge. This route provides southbound service leaving Summerdale Plaza at 6:40 AM, 7:05 AM, 7:35 AM, 9:40 AM, 12:00 PM, 2:00 PM, 4:00 PM, and 4:50 PM (Monday through Friday). Northbound service leaving the downtown Harrisburg area is provided at 7:05 AM, 9:20 AM, 11:35 AM, 1:30 PM, 3:30 PM, 4:25 PM, 4:45 PM, and 5:20 PM (Monday through Friday).

Route M Downtown Mechanicsburg

The Route M Downtown Mechanicsburg bus traverses the US 11/15 study corridor between Chestnut Street/Trindle Road and Market Street/Carlisle Pike. The route provides service from the intersection of Main Street & Simpson Ferry Road, Mechanicsburg, to downtown Harrisburg. The route provides service from Mechanicsburg until 5:55 PM and from Harrisburg until 10:30 PM.

Route MA Arnold Logistics

The Route MA Arnold Logistics bus traverses the US 11/15 study corridor between Chestnut Street/Trindle Road and Market Street/Carlisle Pike. The route provides service from Arnold Logistics in Mechanicsburg to downtown Harrisburg. The route provides service from Arnold Logistics at 7:35 AM, 3:40 PM, 3:45 PM and 11:40 PM. The route provides service from Harrisburg at 6:20 AM, 6:30 AM, 2:20 PM, 3:15 PM, and 10:30 PM.

Route MB Mechanicsburg Brookspan/Square D

The Route MB Mechanicsburg Brookspan/Square D bus traverses the US 11/15 study corridor from the PA Turnpike to Market Street/Carlisle Pike. The route provides service from Brookspan in Mechanicsburg to downtown Harrisburg. The route provides service from Brookspan at 3:40 PM and 11:35 PM and from Harrisburg at 6:20 AM, 3:05 PM, and 10:30 PM.

Route MD Delbrook Manner

The Route MD Delbrook Manner bus traverses the US 11/15 study corridor from Chestnut Street/Trindle Road to 21st Street. The route provides service from the Delbrook Manner Apartments to Harrisburg. The bus route uses US 11/15 between Trindle Road and Market Street. The route provides service two (2) times in the morning, at 5:35 AM and 6:35 AM, from Delbrook Manner Apartments, and only once in the evening at 5:00 PM from Harrisburg.

CAT has preliminary plans to add a route/link that would connect the I-83/York County area to 12th/Market Streets and terminate near the West Shore Business complex. Additionally, CAT is currently investigating the feasibility of constructing a new West Shore Transportation Center in Lemoyne Borough. The proposed West Shore Transportation Center is part of the CORRIDOR One Rail Project from Lancaster to East Mechanicsburg.

2. PARK & RIDE

CAT has 15 Park & Ride locations that have access to CAT bus routes. At most locations, CAT offers express service during peak commuter periods with scheduled travel time averaging 50 minutes or less. Of the 15 Park & Ride locations, eight (8) are located on the West Shore of the Susquehanna River. The following three (3) CAT Park & Ride facilities are located within the vicinity the study corridor:

Summerdale Plaza Park & Ride

This facility was developed through an agreement between CAT and the owners of the shopping center. The Summerdale Plaza Park & Ride is the only official Park & Ride facility within the study limits, and it has access to the Route F Enola.

Weis Markets Park & Ride

The Weis Markets Park & Ride is located outside the corridor limits at the intersection of Simpson Ferry Raod and Wesley Drive. The Weis Markets Park & Ride has access to the Route B Highland Park, Route D Shopper's Special, and MX Mechanicsburg Express.

Winding Hill Park & Ride

The Winding Hill Park & Ride is located adjacent to the Pennsylvania Turnpike (I-76) at the Winding Road Exit of US 11/15. The Winding Hill Park & Ride has access to the Route DILL Dillsburg.

An unofficial Park & Ride lot exists in the parking lot of the Camp Hill Mall shopping center.

3. EMPLOYER PROGRAMS

CAT promotes a Commuter Benefit Program for businesses in the Harrisburg area to encourage the use of transit instead of personal vehicles to help alleviate congestion. The Federal government allows employers a tax deduction, as well as a reduction in payroll taxes, for providing their employees with the cost of public transit. Employers have several options in implementing the Commuter Benefit Program. In either case, the employer is not permitted to reduce the employee's compensation in exchange for providing this benefit. CAT provides the following three (3) options:

TransitChek® Vouchers

Employers purchase vouchers, called TransitCheks®, issued through the Delaware Valley Regional Planning Commission (DVRPC). The employer then issues the vouchers to participating employees. Employees, in turn, present the vouchers as payment to a participating transit agency. CAT and Amtrak are both participants in the Harrisburg area.

TransitChek® enables employers of any size to subsidize employees' commutes on public transit or vanpools. Employees can receive up to $100/month or $1200/year in TransitCheks®.

Monthly passes directly from Capital Area Transit

Employers can choose to purchase monthly pass stickers directly from CAT. The employer issues the stickers to each participating employee on a monthly basis. Arrangements can be made for each participating employee to obtain a photo ID card from CAT (at no charge). The monthly sticker is then attached to the ID card.

An added benefit to this option is CAT's Guaranteed Ride Home Program, which provides the employee a no cost emergency ride home via a local taxi in the event of a family emergency or illness. Guaranteed Ride Home is a special benefit for those companies that purchase monthly pass stickers directly from CAT at full face value. The Guaranteed Ride Home Program may be used as follows:

- The employee gets sick on the job and must leave the workplace prior to normal leave time.
- The employee's child becomes sick or injured and must be picked up.
- A crisis occurs involving the employee's family member and the employee must leave work.
- The program is designed for unexpected emergencies and may not be used for personal errands, pre-planned medical appointments, business-related travel or working late.

Shared commuting costs between employers and employees

Employers have the option of sharing the cost of transportation with their employees. Employees pay for the remainder using pre-tax dollars. The Guaranteed Ride Home Program is not available under an employer-employee cost-sharing program.

A summary of the transit information evaluate for this report is available in Appendix E. A full list of services provided by CAT is located on their website at www.cattransit.com.

D. Adjacent Land Use

From the Pennsylvania Turnpike to PA 581, the US 11/15 corridor traverses Upper Allen Township, Lower Allen Township, and Camp Hill Borough. The adjacent land use along this section of the corridor includes mixed commercial and light industrial. Some notable traffic generators include the Rossmoyne Industrial Park, Slate Hill Business Center, the Capital City Mall, Hampden Industrial Park, and the Camp Hill State Correctional Institution.

From PA 581 to Market Street, the US 11/15 corridor is primarily commercial with the Camp Hill Mall acting as a major traffic generator. The residential neighborhoods of Camp Hill Borough are beyond the local businesses in this section.

From Market Street to Front Street, the US 11/5 corridor is primarily residential with some commercial/business development at the intersections of US 11/15 & Market Street and US 11/15 & 21st Street.

From Front Street to Stella Street, the US 11/15 corridor borders a residential neighborhood with on-street parking along the southbound side and the Susquehanna River on the northbound side. From Stella Street to Valley Road, the corridor is primarily commercial and light industry. Two (2) important traffic generators include the Summerdale Plaza shopping center and the Norfolk Southern rail yard.

E. Traffic Data

1. DATA COLLECTION

Prior to performing the traffic data collection, several key items were determined. This task involved the identification of relevant traffic, signalization, and geometric data. The first step of this task was to define the evaluation time periods, and the second step was to identify the data that was required to evaluate the improvement alternatives.

Preliminary field views of the corridor, along with conversations with the project team, were conducted to assist with determining the morning and afternoon peak hour traffic demand hours, as well as a representative mid-day period. It was noted that the corridor has typical travel demand peak hours, and it was agreed that the morning peak hours will span from 6:00 AM to 9:00 AM and the evening peak hours will span from 3:00 PM to 6:00 PM. The Mid-Day period spans from 11:00 AM to 1:00 PM for this study.

A review of the operations and overall traffic pattern along the study corridor indicated that vehicular volume counts along the corridor and turning movement counts at signalized intersections were required for this study. Traffic data collection within the limits of the project by PENNDOT or the Tri-County Regional Planning Commission has not recently been performed. Therefore, it was determined that an extensive traffic data collection was necessary.

The following data were collected for this study to characterize the operation of the corridor and evaluate the improvement alternatives:

- Geometry of signalized intersections,
- Signal offset relationship between signalized intersections,
- Phase sequence and duration at signalized intersections,
- Reported crash history along the study corridor,
- Automatic traffic recorder (ATR) vehicular volume counts at three (3) locations along the corridor,
- Baseline travel time and delay data,
- Turning movement counts at signalized intersections,
- Pedestrian and heavy vehicle volume counts at the signalized intersections,
- Signalized intersection approach grades,
- Signalized intersection approach speeds, and
- Transit data.

The geometric data, signal information, and reportable crash history data were available upon request from the PENNDOT Engineering District 8-0 Office. All traffic counts and travel time studies were scheduled toward the beginning of the study and were coordinated with PENNDOT prior to proceeding.

a. Mainline Traffic Volume Counts

Lane specific traffic volume and vehicle classification counts along the mainline were performed with Automatic Traffic Recorders (ATRs). The ATR units were deployed at three (3) locations along the corridor, one (1) station at each end and a count station in the middle of the study limits. These locations were identified during the project kick-off meeting. Much appreciated and extensive cooperation was received from local municipal police authorities as they provided the maintenance and protection of traffic (MPT) while crews installed the ATR units and their associated pneumatic road tubes. ATRs were installed at the following locations:

- US 11/15 (milepost 39.8) between the PA Turnpike and Rossmoyne Road
- US 11/15 between 21st Street and 12th Street/Erford Road
- US 11/15 between Summerdale Road/Valley Street and I-81

The ATR units recorded traffic data for a period of one (1) full week, from Sunday, April 21, 2002 to Sunday, April 28, 2002. The ATR units were monitored daily to minimize data deficiencies or tube breaks over the entire data collection period. The traffic volumes were recorded in 15-minute intervals and included vehicle classifications, lane-specific traffic volumes, and speed and gap measurements.

A summary of the collected traffic volumes is shown in Table 2. The raw traffic data is available in Appendix A.

TABLE 3: COLLECTED ATR AVERAGE TRAFFIC VOLUMES

	ATR SITE #1: US 11/15 BETWEEN PA TURNPIKE AND ROSSYMOYE ROAD		ATR SITE #2: US 11/15 BETWEEN 21ST STREET AND 12TH STREET/ERFORD ROAD		ATR SITE #3: US 11/15 BETWEEN SUMMERDALE ROAD/VALLEY STREET AND I-81	
TIME	**NB**	**SB**	**NB**	**SB**	**NB**	**SB**
12:00 AM	173	236	52	25	107	89
1:00 AM	119	130	27	21	68	57
2:00 AM	102	116	14	13	51	39
3:00 AM	128	132	18	14	55	51
4:00 AM	216	160	22	19	97	107
5:00 AM	668	309	59	37	235	347
6:00 AM	1,862	771	217	125	595	888
7:00 AM	3,032	1,082	350	355	919	1,112
8:00 AM	2,362	1,181	431	309	837	924
9:00 AM	1,616	1,130	398	219	704	701
10:00 AM	1,444	1,227	364	214	727	635
11:00 AM	1,523	1,461	451	289	812	731
12:00 PM	1,641	1,586	589	351	897	818
1:00 PM	1,542	1,611	529	303	902	775
2:00 PM	1,530	1,801	461	272	1,004	847
3:00 PM	1,661	2,377	468	286	1,360	989
4:00 PM	1,804	2,953	437	325	1,436	1,136
5:00 PM	1,890	3,048	423	338	1,259	1,065
6:00 PM	1,558	1,859	344	218	890	813
7:00 PM	1,129	1,408	278	157	717	600
8:00 PM	910	1,252	267	164	620	537
9:00 PM	683	1,041	208	130	479	407
10:00 PM	442	620	131	84	322	325
11:00PM	328	454	103	53	219	192
TOTALS	28,363	27,945	6,641	4,321	15,312	14,185

b. Manual Turning Movement Counts

Vehicular and pedestrian turning movement counts were performed at the 14 signalized intersections within the study limits. The total volumes per movement were recorded in 15-minute intervals with electronic count boards. Heavy vehicles were counted separate from passenger vehicles. Pedestrians and bicyclists were also included in the counts. The turning movement counts were conducted for eight (8) hours from the hours of 6:00 AM to 9:00 AM, 11:00 AM to 1:00 PM, and 3:00 PM to 6:00 PM. The turning movement counts were performed on Tuesday, April 23, 2002, and Wednesday, April 24, 2002. Data collectors and program managers noted observations of poor traffic conditions, traffic signal operation issues and general mobility through the monitored intersection.

A summary of the collected peak hour turning movement volumes is shown in Figure 2. The raw traffic data is available in Appendix A.

FIGURE 2: COLLECTED PEAK HOUR TURNING MOVEMENT VOLUMES

c. Travel Time Study

The baseline travel time and delay data were collected in accordance with the Travel Time and Delay Study guidelines developed in the *ITE Manual of Transportation Engineering Studies*. The Average Vehicle Method, which is applicable to any route, but commonly used on arterial streets with at-grade intersections, was utilized for conducting the travel time and delay study. Using a test vehicle, data is recorded by an observer while the driver traverses the study corridor. The average vehicle method measures travel time, running time, distance traveled, and type, location, duration, and cause of traffic delays. During the AM, Mid-Day, and PM peak hours a driver and observer used a test vehicle, stopwatches and travel time form while driving the study limits in both the northbound and southbound travel directions in subsequent trips. Prior to performing the travel runs, control points such as overpasses at the interchanges along the limited access portion of the corridor and signalized intersections along the free-access section, were determined. While driving the test vehicle at the average observed speed of the surrounding traffic, the observer recorded the continuous time readings from the first stopwatch as the vehicle passed each control point. Using the second stopwatch, the observer recorded the amount of delay and noted the location, duration, and cause whenever the test vehicle traveled at a speed of less than five (5) MPH. The travel time and delay study was performed for the corridor on Tuesday, April 23, 2002.

A summary of the collected peak hour average travel times and speeds are shown in Table 4 and Table 5. The raw traffic data is available in Appendix A.

TABLE 4: COLLECTED PEAK HOUR AVERAGE TRAVEL TIMES

Northbound Direction (Seconds)

Corridor Link	AM	Mid-Day	PM
Pennsylvania Turnpike (I-76)	-	-	-
Rossmoyne Road	62.60	58.40	60.50
Slate Hill Road	41.40	36.40	42.00
Simpson Ferry Road	77.60	65.20	72.25
PA 581	23.20	22.40	31.50
Harvard Avenue/Camp Hill Mall	56.60	30.20	31.00
Chestnut Street/Trindle Road	44.60	51.20	43.00
Market Street/Carlisle Pike	23.60	36.60	34.00
Brentwater Road	90.40	49.00	51.75
Country Club Road	22.20	13.40	14.75
21st Street	95.00	78.80	82.75
12th Street/Erford Road	53.00	58.00	88.25
2nd Street	54.60	61.20	58.75
Front Street	53.40	24.20	49.25
Stella Street	48.00	53.80	79.75
Market Street	90.60	86.40	92.00
Summerdale Plaza	186.80	183.00	212.25
Summerdale Road/Valley Street	64.20	47.20	62.75
I-81	37.20	35.00	36.75
Totals (Seconds)	**1125.00**	**990.00**	**1143.00**
Totals (Minutes)	**18.75**	**16.50**	**19.05**

Southbound Direction (Seconds)

Corridor Link	AM	Mid-Day	PM
I-81	-	-	-
Summerdale Road/Valley Street	55.20	55.75	59.80
Summerdale Plaza	61.40	65.25	71.20
Market Street	181.00	175.50	177.60
Stella Street	91.00	96.75	105.60
Front Street	60.20	50.00	49.20
2nd Street	13.20	10.50	14.00
12th Street/Erford Road	68.40	84.25	70.80
21st Street	114.60	111.75	121.80
Country Club Road	66.00	85.25	113.20
Brentwater Road	14.80	28.00	23.20
Market Street/Carlisle Pike	72.00	93.75	186.80
Chestnut Sreet/Trindle Road	11.60	14.00	56.40
Harvard Avenue/Camp Hill Mall	36.20	41.25	26.00
PA 581	28.20	36.50	20.60
Simpson Ferry Road	26.60	23.50	21.80
Slate Hill Road	64.60	69.50	66.60
Rossmoyne Road	38.80	40.50	40.80
Pennsylvania Turnpike (I-76)	60.40	64.00	66.60
Totals (Seconds)	**1064.00**	**1146.00**	**1292.00**
Totals (Minutes)	**17.73**	**19.10**	**21.53**

TABLE 5: COLLECTED PEAK HOUR AVERAGE TRAVEL SPEEDS

Northbound Direction (MPH)

Corridor Link	AM	Mid-Day	PM
Pennsylvania Turnpike (I-76)	-	-	-
Rossmoyne Road	63.43	68.01	65.64
Slate Hill Road	61.05	69.37	61.08
Simpson Ferry Road	57.10	66.44	60.10
PA 581	46.86	50.37	41.01
Harvard Avenue/Camp Hill Mall	19.85	27.73	23.95
Chestnut Street/Trindle Road	32.95	25.68	35.74
Market Street/Carlisle Pike	26.07	16.08	22.46
Brentwater Road	33.23	36.95	35.55
Country Club Road	26.78	31.61	29.32
21st Street	32.75	31.25	30.92
12th Street/Erford Road	34.67	33.08	21.59
2nd Street	43.23	38.73	40.26
Front Street	6.38	8.01	4.56
Stella Street	37.62	34.41	23.89
Market Street	40.26	43.19	39.65
Summerdale Plaza	42.58	43.76	37.44
Summerdale Road/Valley Street	34.95	46.44	35.89
I-81	49.08	52.25	49.12

Southbound Direction (MPH)

Corridor Link	AM	Mid-Day	PM
I-81	-	-	-
Summerdale Road/Valley Street	33.51	35.05	31.73
Summerdale Plaza	36.44	33.59	31.30
Market Street	43.82	45.23	46.28
Stella Street	40.20	38.17	36.57
Front Street	32.48	38.52	36.89
2nd Street	14.06	17.25	14.11
12th Street/Erford Road	37.25	30.32	36.23
21st Street	18.95	17.64	18.73
Country Club Road	34.73	28.79	22.75
Brentwater Road	32.06	13.71	21.17
Market Street/Carlisle Pike	28.36	23.22	11.82
Chestnut Sreet/Trindle Road	32.08	28.21	16.78
Harvard Avenue/Camp Hill Mall	39.29	34.09	44.71
PA 581	37.21	28.32	36.43
Simpson Ferry Road	41.47	46.34	49.86
Slate Hill Road	67.10	62.19	64.90
Rossmoyne Road	65.78	62.55	62.00
Pennsylvania Turnpike (I-76)	65.75	62.77	59.77

2. ANALYSIS OF EXISTING CONDITIONS (2002)

The entire corridor, including the six (6) limited access interchanges and 14 signalized intersections in the study area, were analyzed using the weekday AM, Mid-Day, and PM peak hour volumes collected as part of this project. The traffic analysis and simulation software packages of Synchro and SimTraffic were used for the analysis of the free access section of the corridor from PA 581 to Summerdale Road/Valley Street. The traffic analysis software package of CORridor SIMulation (CORSIM) was used for the limited access sections of the corridor from the Pennyslvania Turnpike (I-76) to PA 581 and Summerdale/Valley Street to I-81. The software simulation package of TRAFVU was then used to view the simulation of the entire corridor. The traffic analysis output is available in Appendix B.

a. Simulated Travel Time

The traffic analysis and simulation software packages were calibrated to match the collected travel times during travel time and delay study. The simulated peak hour average travel times and speeds will be referred to as Existing Conditions (2002) Peak Hour Average Travel Times and speeds. The simulated data is shown in Table 6 and Table 7.

TABLE 6: SIMULATED EXISTING CONDITIONS (2002) PEAK HOUR AVERAGE TRAVEL TIMES

Northbound Direction (Seconds)

Corridor Link	AM	Mid-Day	PM
Pennsylvania Turnpike (I-76)	-	-	-
Rossmoyne Road	60.77	55.94	56.88
Slate Hill Road	41.45	41.38	41.81
Simpson Ferry Road	70.27	61.87	72.49
PA 581	37.46	29.52	38.73
Harvard Avenue/Camp Hill Mall	29.1	30.0	31.5
Chestnut Street/Trindle Road	63.3	56.8	66.1
Market Street/Carlisle Pike	40.1	33.2	27.6
Brentwater Road	86.5	67.0	69.9
Country Club Road	22.6	20.6	21.1
21st Street	176.9	40.7	42.0
12th Street/Erford Road	95.7	90.2	94.6
2nd Street	73.8	72.9	73.8
Front Street	49.4	48.5	47.1
Stella Street	68.1	72.9	87.6
Market Street	104.2	103.4	104.3
Summerdale Plaza	236.3	237.9	239.8
Summerdale Road/Valley Street	68.6	67.7	70.0
I-81	22.20	22.26	22.29
Totals (Seconds)	**1347**	**1153**	**1208**
Totals (Minutes)	**22.4**	**19.2**	**20.1**

Southbound Direction (Seconds)

Corridor Link	AM	Mid-Day	PM
I-81	-	-	-
Summerdale Road/Valley Street	31.69	31.25	31.65
Summerdale Plaza	66.5	67.6	68.5
Market Street	239.2	236.7	236.3
Stella Street	116.5	111.4	119.6
Front Street	57.8	57.8	57.8
2nd Street	17.6	16.4	17.3
12th Street/Erford Road	116.2	109.9	109.9
21st Street	115.7	107.1	214.6
Country Club Road	72.0	67.3	76.0
Brentwater Road	23.2	21.5	21.5
Market Street/Carlisle Pike	89.9	90.7	99.5
Chestnut Sreet/Trindle Road	28.3	37.2	38.9
Harvard Avenue/Camp Hill Mall	55.7	66.6	76.4
PA 581	31.0	37.0	90.3
Simpson Ferry Road	27.96	32.99	34.27
Slate Hill Road	54.33	58.18	58.70
Rossmoyne Road	36.84	36.63	37.50
Pennsylvania Turnpike (I-76)	61.32	62.38	66.11
Totals (Seconds)	**1242**	**1248**	**1455**
Totals (Minutes)	**20.7**	**20.8**	**24.2**

TABLE 7: SIMULATED EXISTING CONDITIONS (2002) PEAK HOUR AVERAGE TRAVEL SPEEDS

Northbound Direction (MPH)

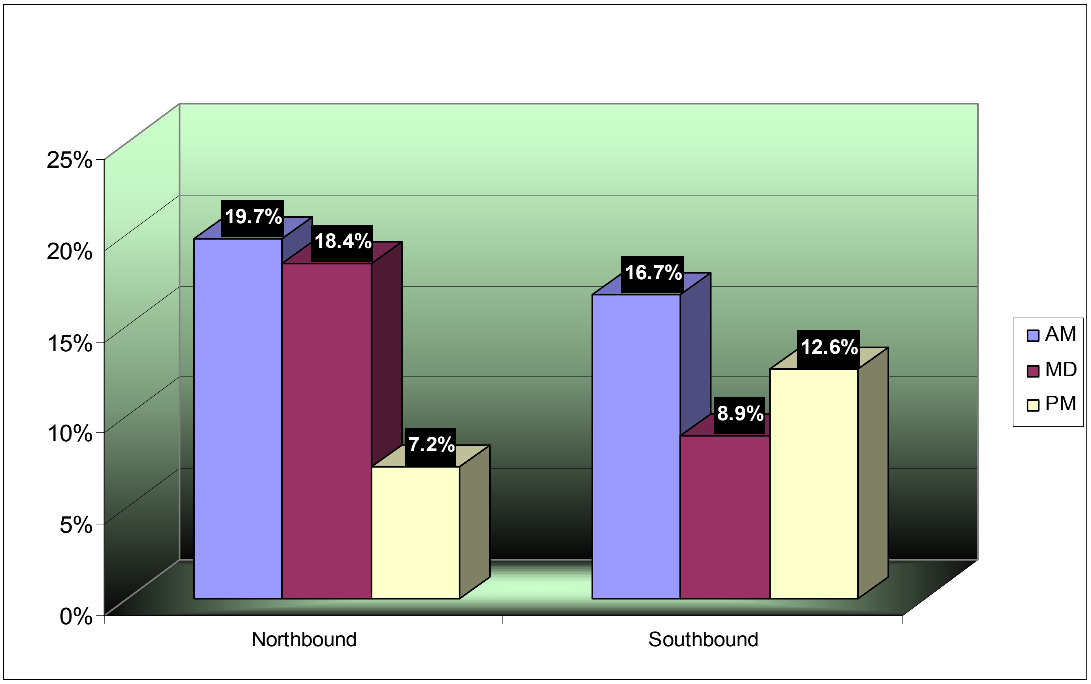
Corridor Link	**AM**	**Mid-Day**	**PM**
Pennsylvania Turnpike (I-76)	-	-	-
Rossmoyne Road	78.1	84.8	83.4
Slate Hill Road	62.5	62.6	61.9
Simpson Ferry Road	60.4	68.6	58.5
PA 581	29.8	37.8	28.8
Harvard Avenue/Camp Hill Mall	21.3	20.7	19.7
Chestnut Street/Trindle Road	12.8	14.2	12.2
Market Street/Carlisle Pike	7.3	8.8	10.5
Brentwater Road	21.5	27.8	26.6
Country Club Road	16.3	17.9	17.4
21st Street	1.1	4.7	4.6
12th Street/Erford Road	21.0	22.4	21.3
2nd Street	33.7	34.1	33.7
Front Street	4.6	4.7	4.8
Stella Street	25.1	23.4	19.5
Market Street	33.4	33.7	33.4
Summerdale Plaza	34.5	34.2	34.0
Summerdale Road/Valley Street	31.3	31.8	30.7
I-81	78.6	78.5	78.3

Southbound Direction (MPH)

Corridor Link	**AM**	**Mid-Day**	**PM**
I-81	-	-	-
Summerdale Road/Valley Street	55.1	55.9	55.2
Summerdale Plaza	32.3	31.8	31.2
Market Street	34.1	34.4	34.5
Stella Street	29.9	31.3	29.1
Front Street	29.5	29.5	29.5
2nd Street	12.9	13.9	13.2
12th Street/Erford Road	21.4	22.6	22.6
21st Street	27.3	27.3	27.3
Country Club Road	23.6	25.3	22.4
Brentwater Road	15.9	17.1	17.1
Market Street/Carlisle Pike	20.7	20.5	18.7
Chestnut Sreet/Trindle Road	10.3	7.8	7.5
Harvard Avenue/Camp Hill Mall	14.5	12.2	10.6
PA 581	20.0	16.8	6.9
Simpson Ferry Road	39.9	33.8	32.5
Slate Hill Road	78.1	73.0	72.3
Rossmoyne Road	70.3	70.6	69.0
Pennsylvania Turnpike (I-76)	77.4	76.1	71.8

The collected travel times and simulated travel times were within 20 percent on both travel directions for each simulation model in the AM, Mid-Day, and PM peak hours as shown in Figure 3.

FIGURE 3: DIFFERENCE BETWEEN COLLECTED AND SIMULATED EXISTING CONDITIONS (2002) PEAK HOUR AVERAGE TRAVEL TIMES



AM Peak Hour

The total travel time for the corridor is 22.4 minutes in the northbound direction and 20.7 minutes in the southbound direction. The travel time calculations in the northbound direction reveal that travel speeds are below 20 MPH at the intersection of US 11/15 & Harvard Avenue/Camp Hill Mall Entrance and single digits at the intersection of US 11/15 & Front Street. The travel time calculations in the southbound direction reveals that travel speeds are below 20 MPH at the intersections of US 11/15 & Front Street and US 11/15 & 21st Street.

Mid-Day Peak Hour

The total travel time for the corridor is 19.2 minutes in the northbound direction and 20.8 minutes in the southbound direction. The travel time calculations in the northbound direction reveal that travel speeds are below 20 MPH at the intersection of US 11/15 & Market Street/Carlisle Pike and single digits at the intersection of US 11/15 & Front Street. The travel time calculations in the southbound direction reveal that travel speeds are below 20 MPH at the intersections of US 11/15 & Front Street, US 11/15 & 21st Street, US 11/15 and Brentwater Road.

PM Peak Hour

The total travel time for the corridor is 20.1 minutes in the northbound direction and 24.2 minutes in the southbound direction. The travel time calculations in the northbound direction reveal that travel speeds are in the single digits at the intersection of US 11/15 & Front Street. The travel time calculations in the southbound direction reveal that travel times are below 20 MPH at the intersections of US 11/15 & Front Street, US 11/15 & 21st Street, US 11/15 & Market Street/Carlisle Pike, and US 11/15 & Chestnut Street/Trindle Road.

b. Intersection Level of Service

The software package of Synchro 5.0 was used to determine the intersection levels of service (LOS). The Percentile Delay Method was used to determine the intersection control delay. The control delay was then translated into a letter grade utilizing the criteria set by the *Highway Capacity Manual 2000* in Exhibit 16-2. Utilizing a penalty factor for queue lengths in delay calculations, the percentile method is an adequate methodology for actuated/coordinated signal systems that operate at or over saturation conditions.

For each of the 14 signalized intersections, Existing Conditions (2002) Signalized Intersection Levels of Service are shown in Figure 4.

FIGURE 4: EXISTING CONDITIONS (2002) SIGNALIZED INTERSECTIONS LOS

AM Peak Hour

Five (5) of the 14 intersections operate at a LOS D or worse. The most severe problem is at the intersection of US 11/15 & 21st Street, which operates at LOS F. The intersections of US 11/15 & Chestnut Street/Trindle Road and US 11/15 & Market Street/Carlisle Pike operated at LOS E. The remaining intersections, US 11/15 & PA 581 and US 11/15 & 12th Street/Erford Road, operate at a LOS D.

The intersection of US 11/15 & 21st Street operates with 165 seconds of delay per vehicle. Excess volume over capacity at the through and left turn movements of the northbound US 11/15 approach are the main cause of delay at the intersection. The high traffic volume at the eastbound and westbound 21st Street approaches also contribute to the delay at the intersection.

The intersection of US 11/15 & Chestnut Street/Trindle Road operates with 65 seconds of delay per vehicle. Excess volume over capacity at the through movements of the eastbound and westbound Chestnut Street approach is the main cause of delay at the intersection. The high traffic volume at the left turn movement of the eastbound Trindle Road approach also contributes to the delay at the intersection.

The intersection of US 11/15 & Market Street/Carlisle Pike operates with 62 seconds of delay per vehicle. High traffic volume at the through movements of the eastbound and westbound Market Street approaches is the main cause of delay at the intersection. The high traffic volume at the left turn movements of the eastbound Carlisle Pike and westbound Market Street approaches also contribute to the delay at the intersection.

The intersection of US 11/15 & 12th Street/Erford Road operates with 46 seconds of delay per vehicle. The high traffic volume at the left turn movement of the northbound US 11/15 approach is the main cause of delay at the intersection.

The intersection of US 11/15 & PA 581 (Ramp C) operates with 42 seconds of delay per vehicle. The high traffic volume at the eastbound PA 581 (Ramp C) approach is the main cause of delay at the intersection.

Mid-Day Peak Hour

Three (3) of the 14 intersections operate at a LOS D or worse. The most severe problems are at the intersections of US 11/15 & Market Street/Carlisle Pike and US 11/15 & 21st Street, which operate at a LOS F. The remaining intersection, US 11/15 & Chestnut Street/Trindle Road, operates at a LOS E.

The intersection of US 11/15 & 21st Street operates with 95 seconds of delay per vehicle. The high traffic volume at the left turn movement of the northbound US 11/15 approach is the main cause of delay at the intersection. The high traffic volume at the eastbound and westbound 21st Street approaches also contribute to the delay at the intersection.

The intersection of US 11/15 & Market Street/Carlisle Pike operates with 84 seconds of delay per vehicle. The high traffic volume at the through movements of the eastbound Carlisle Pike and westbound Market Street approaches are the main cause of delay at the intersection. The high traffic volume at the left turn movements of the eastbound Carlisle Pike and westbound Market Street approaches also contribute to the delay at the intersection.

The intersection of US 11/15 & Chestnut Street/Trindle Road operates with 78 seconds of delay per vehicle. The high traffic volume at the through movements of the eastbound Trindle Road and westbound Chestnut Street approaches are the main cause of delay at the intersection. The high traffic volume at the left turn movements of the eastbound Trindle Road and westbound Chestnut Street approaches also contribute to the delay at the intersection

PM Peak Hour

Six (6) of the 14 intersections operate at a LOS D or worse. The most severe problems are at the intersections of US 11/15 & PA 581 (Ramp C), US 11/15 & Chestnut Street/Trindle Road, and US 11/15 & 21st Street, which operate at a LOS F. The intersection of US 11/15 & Market Street/Carlisle Pike operates at LOS E. The remaining intersections, US 11/15 & Harvard Avenue and US 11/15 & Stella Street, operate at a LOS D.

The intersection of US 11/15 & 21st Street operates with 166 seconds of delay per vehicle. Excess volume over capacity at the left turn movement of the northbound US 11/15 approach is the main cause of delay. The high traffic volume at the eastbound and westbound 21st Street approaches also contribute to the delay at the intersection.

The intersection of US 11/15 & Chestnut Street/Trindle Road operates with 91 seconds of delay per vehicle. The high traffic volume at the through movements of the eastbound Trindle Road and westbound Chestnut Street approaches are the main cause of delay at the intersection. The high traffic volume at the left turn movements of the eastbound and westbound Chestnut Street/Trindle Road approaches and left turn movement of the northbound US 11/15 approach also contribute to the delay at the intersection.

The intersection of US 11/15 and PA 581 (Ramp C) operates with 85 seconds of delay per vehicle. Excess volume over capacity at the eastbound PA 581 (Ramp C) approach is the main cause of delay at the intersection.

The intersection of US 11/15 & Market Street/Carlisle Pike operates with 63 seconds of delay per vehicle. The high traffic volume at the through movements of the eastbound Carlisle Pike and westbound Market Street approaches are the main cause of delay at the intersection. The high traffic volume at the left turn movements of the eastbound Carlisle Pike and westbound Market Street approaches and left turn movement of the northbound US 11/15 approach also contribute to the delay at the intersection.

The intersection of US 11/15 & Stella Street operates with 41 seconds of delay per vehicle. The high traffic volume at the left turn and right turn movements of the eastbound Stella Street approach is the main cause of delay at the intersection.

The intersection of US 11/15 & Harvard Avenue/Camp Hill Mall Entrance operates with 36 seconds of delay per vehicle. The high traffic volume at the left turn movement of the northbound US 11/15 approach is the main cause of delay at the intersection.

F. Crash Summary Evaluation

The reported crashes within the study limits were reviewed for the past three (3) years of available data. Typically, crash data is intended to assist in the understanding of why and where crashes occur, determine crash-prone locations, and aid in deciding safety programs and countermeasures to implement. In most safety studies, crash severity is an important field found on the crash report as well as PENNDOT's database. PENNDOT typically codes the crash as fatal, injury (major or minor), or property damage only (PDO). Common coding for crash type is explained in further detail below:

- **Fatality**: death within 30 days of a crash as a result of injuries received from the incident.
- **Major Injury**: Serious, incapacitating, nonfatal injury such as a broken bone or massive blood loss.
- **Minor Injury**: A visible injury, yet not serious or incapacitating.
- **Property Damage Only (PDO)**: No injury has occurred as a result of the incident.

Crash data for this study was retrieved utilizing PENNDOT's database. At the time of the study, 2001 reportable crash data was not available; therefore, this effort focused on years 1998, 1999, and 2000. Most police crash reports typically include the roadway name, where the crash occurred, and the distance and direction from a known locatable reference point for a given crash. This information is coded into the PENNDOT database and the location of the occurrence is transferred to the Department's segment and offset referencing system. The crash data summarized for this report is available in Appendix C.

Focusing primarily on the reported causes of crashes can be misleading when searching for measures to reduce crashes and their consequences. It is necessary to also consider the events and/or the conditions that lead up to the incident occurring. In addition, once a crash-prone area has been identified, the analysis should review the roadway conditions leading up to the crash location, and not merely focus on one spot location.

Prior to conducting a review of the reported crash data for the corridor, PENNDOT Publication 201, "Engineering and Traffic Studies" was consulted for guidance. The publication explains that a crash analysis should include total number of crashes during the last three (3) years as well as number of crashes by type.

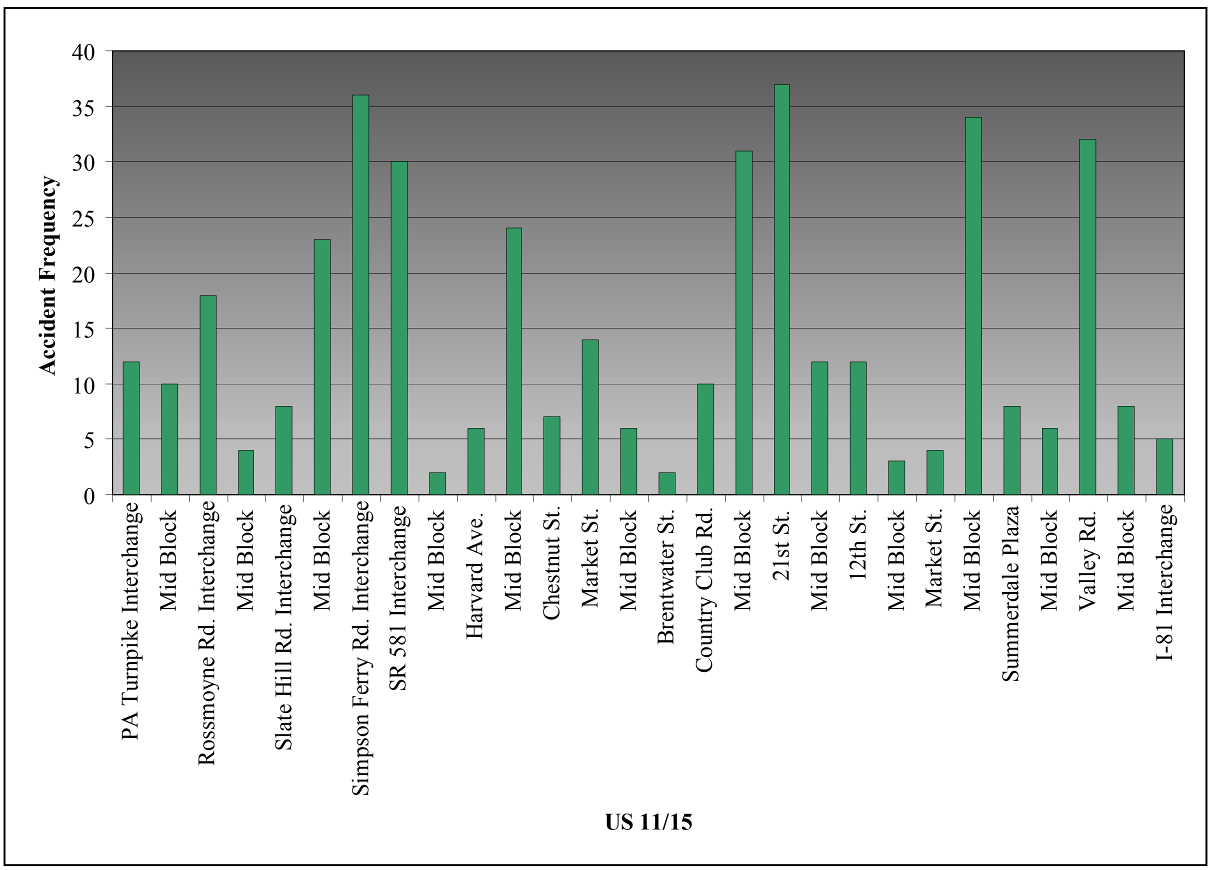
The first step in reducing the traffic data was to determine the time frame of the analysis and then eliminate all data that occurred outside of the period. For this study, based on PENNDOT's suggestion, a three-year period was considered appropriate to review. Once a preliminary review of the data was conducted to remove the crashes that occurred prior to 1998, a brief examination was completed to verify that the data was not biased as a result of large construction activities or other major traffic events.

Typical crash analysis studies focus on a specific location/intersection or a limited set of locations along a highway network. When performing a crash analysis along a length of a roadway network, it is necessary to separate the data into those crashes that occurred at point locations (intersections) and those that occurred along a given roadway section (mid-block). Point locations are short segments of a roadway that help to identify a problem point location such as intersections, curves, or bridges and are generally 0.2 to 0.3 miles in length. Roadway sections are usually longer in length and relatively homogeneous segments of highway, and are typically one (1) to two (2) miles in length. While separating the reportable crash data between mid-block and intersection occurrences, it was necessary to determine or define the limits of an intersection. Therefore, this analysis grouped crashes at an intersection as those that occurred on the approaches to the intersection up to 200 feet from the crossing street's centerline. Furthermore, the data that was reviewed for this study included only those reportable crashes that occurred on the corridor and did not include crashes that were reported on the minor side streets.

Crash analysis for this study includes only the reportable crash data, which consists of crashes involving fatalities, injuries, or where a vehicle must be towed. From the three (3) groups of crash type (fatality, injury, and property damage), totals were obtained for the signalized intersections and other interchanges along the corridor, as well as those that occurred within mid-block segments. From these totals, it is possible to determine intersections and roadway segments that tend to be more crash-prone than others. Upon determining locations of interest, further detailed analysis for the top ranking locations can be conducted. The threshold of crash frequency that was used to decide the locations to be investigated was arbitrarily selected.

Intersection crash data and mid-block crash data are graphically presented in Figure 9. A study of the crash data for the US 11/15 corridor study limits indicates that the interchanges at US 11/15 & Simpson Ferry Road and US 11/15 & PA 581,along with the signalized intersections at US 11/15 & 21st Street and US 11/15 & Summerdale Road/Valley Street, have the highest concentration of reportable crashes. The mid-block section of the US 11/15 corridor between Market Street and Summerdale Road/Valley Street also has a high concentration of reportable crashes, yet this is attributed due to the long distance between intersections.

FIGURE 5: INTERSECTION AND MID-BLOCK CRASH DATA (1998-2000)



III. 2012 NO-BUILD CONDITIONS

A 10-year design year was chosen for this study due to the focus on Short-Term improvements. Traffic volumes for any major roadway projects that fall under the Long-Term improvement recommendations will most likely need to be projected to a 20-year design year for further analysis, which is outside the scope of this study.

A. Identification of Roadway Modifications/Future Development

1. US 11/15 & PA 581 INTERCHANGE RECONSTRUCTION PROJECT

   The predominant future project along the corridor is the reconstruction of the interchange at US 11/15 & PA 581. PENNDOT Engineering District 8-0 is administering the project, and it is currently in preliminary engineering phase, including environmental clearances. The project is scheduled for construction in the Fall 2004 and Spring 2005.

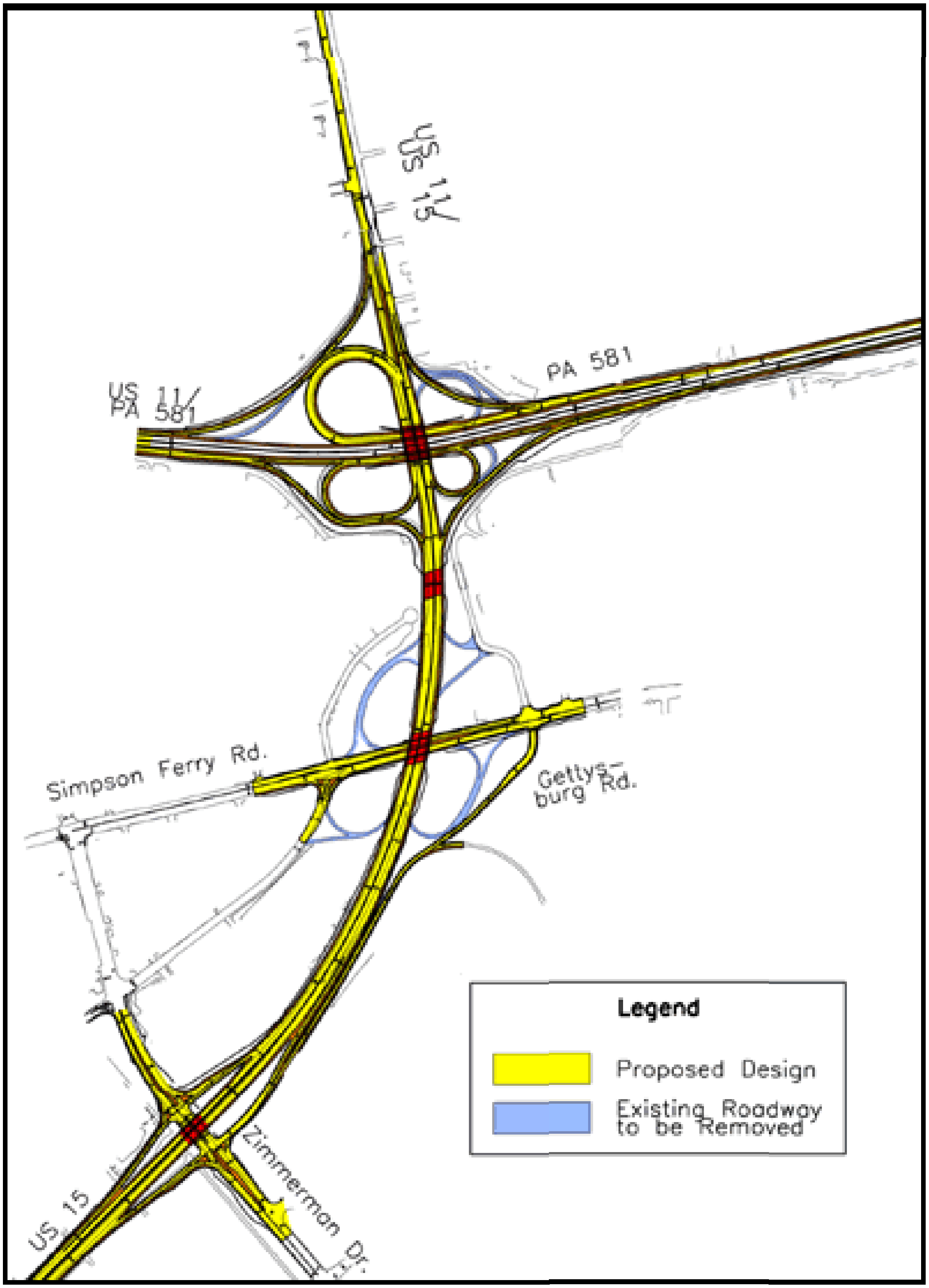
   The project scope of work includes reconstructing portions of the US 11/15 and PA 581 interchange. The existing off-ramp from US 11/15 northbound to PA 581 westbound will be removed. A traffic signal will be installed along westbound US 11/15 that will allow vehicles wishing to proceed on PA 581 to turn left and then merge with US 11/15 southbound exiting traffic prior to merging onto to PA 581 westbound. Additional improvements to the interchange at US 11/15 & PA 581 include greater on and off-ramp radii along with longer acceleration and deceleration lanes. Roadway improvements on the corridor include the addition of a northbound and southbound lane along US 11/15 and an additional lane for eastbound PA 581.

   The project also involves removing the existing interchange ramps at Simpson Ferry Road, which will reduce the weave conditions that exist along US 11/15 in the vicinity of the PA 581 interchange. A new diamond interchange will be constructed at Zimmerman Drive. This interchange will replace the Simpson Ferry Road interchange and will include a parallel service road along US 11/15 northbound that will connect Zimmerman Drive to Gettysburg Road.

   The project team agreed to include the proposed alignment of the reconstructed interchanges at US 11/15 and PA 581 and Simpson Ferry Road in the 2012 No-Build scenario, since this project is scheduled for construction by PENNDOT.

   The proposed alignment for the new interchange is shown in Figure 6.

FIGURE 6: PROPOSED ALIGNMENT FOR THE US 11/15 & PA 581 INTERCHANGE RECONSTRUCTION PROJECT



2. US 11/15 & 21st STREET INTERSECTION RECONSTRUCTION PROJECT

Another roadway project that is planned for the US 11/15 corridor by PENNDOT Engineering District 8-0 includes the 21st Street intersection and the surrounding area. This project is currently in the preliminary engineering phase and a construction date has not been established. Improvements at this intersection include reconfiguring the intersection to allow two (2) left turn lanes on northbound US 11/15. A left lane/exit from the westbound M. Harvey Taylor Bridge will be added south of Erford Road to 21st Street. This left lane/exit will be for traffic coming from Harrisburg wishing to turn south onto 21st Street. The new lane will exit to the left and parallel the eastbound M. Harvey Taylor Bridge under the existing overpass of US 11/15 to 21st Street. A new traffic signal will be added at the merge of southbound US 11/15 and the M. Harvey Taylor Bridge. This will replace the existing stop sign and permit southbound US 11/15 traffic to merge with the M. Harvey Taylor Bridge traffic from Harrisburg before the intersection with 21st Street. The new traffic signal and the associated merging of the traffic prior to the 21st Street intersection will eliminate the yield control for southbound traffic that is located immediately following the existing traffic signal. Finally, the proposed improvements will include the widening to three (3) lanes on north 21st Street from US 11/15 to Center Street, yet the existing parking lane will be maintained.

The project team agreed to include the proposed alignment of the reconstructed US 11/15 and 21st Street intersection in the 2012 Long-Term Build scenario, since this project is currently a concept design and does not have a construction date established.

The current preferred alignment for the new intersection is shown in Figure 7.

FIGURE 7: PREFERRED ALIGNMENT FOR THE US 11/15 & 21ST STREET INTERSECTION RECONSTRUCTION PROJECT

3. LOCAL TRAFFIC RESTRICTIONS IN CAMP HILL BOROUGH

PENNDOT Engineering District 8-0 has met with Camp Hill Borough regarding the right turns from northbound US 11/15 onto the various local streets from PA 581 to Chestnut Street/Trindle Road during the morning peak period. In order to address local safety concerns, PENNDOT and Camp Hill Borough will be installing DO NOT ENTER FROM 7AM – 9AM signs at the entrances to these local roadways. It is believed that this will reduce the traffic utilizing the side streets as short-cuts, yet will increase traffic traveling along northbound US 11/15 during the AM peak period.

Because the data collection for this study did not include the local streets or unsignalized intersections, the local traffic restrictions were not evaluated as part of this report.

4. CAMP HILL MALL ENTRANCE ALONG US 11/15

PENNDOT Engineering District 8-0 has also met with Camp Hill Borough and the future owner of the Camp Hill Mall to discuss potential changes to the shopping center. The entrance into the mall from northbound US 11/15, currently located at Harvard Avenue, may be relocated to Yale Avenue to provide additional queuing distance for the traffic turning left into the mall. The relocation will eliminate the traffic signal at Harvard Avenue and will include a proposed traffic signal at Yale Avenue. Additionally, traffic from Harvard Avenue would only be permitted to turn right onto US 11/15.

The Camp Hill Mall is planned for redevelopment into individual stand-alone buildings and strip mall type facilities. Also, a Super Giant supermarket is proposed for the northern portion of the shopping center. The square footage of building space may remain the same, but there may be an increase in parking spaces upon completion of the redevelopment. Camp Hill Borough has also spoken with the new mall owner regarding the possibility of a Park & Ride facility within the new shopping center that will include a bus drop-off area. Therefore, a bus drop-off at the intersection of US 11/15 & Harvard Avenue is not necessary. The improvements to the mall entrance, including an additional lane on southbound US 11/15 from Chestnut Street/Trindle Road to PA 581, and right turn restrictions to the local streets from US 11/15, may all be constructed during the mall improvements as a separate project from the US 11/15 & PA 581 interchange reconstruction project.

Given these improvements are only tentative at the time of this study, the roadway modifications were not evaluated as part of this report.

5. LAND DEVELOPMENT

Three (3) land development projects are tentatively planned within the corridor limits as follows:

- Two (2) warehouses, 500,000 square feet (SF) each, are planned to be constructed at a site in the vicinity of the US 11/15 & Slate Hill Road interchange in Lower Allen Township.

- Two (2) office buildings, each consisting of 45,000 SF of space, may be constructed in the vicinity of the intersection of US 11/15 & 12th Street/Erford Road. The site of the proposed office buildings is near the Ground Round restaurant.

- A proposed office building has been planned for a site east of Riverview Drive in Lemoyne Borough. Riverview Drive is located between 12th Street/Erford Road and 2nd Street along the study corridor.

Because the land development projects are tentatively planned and traffic impact studies (TIS) were not available during the data collection for this study, these land development projects were not evaluated as part of this report.

B. Analysis of 2012 No-Build Conditions

The existing traffic volumes were projected to the design year of 2012 using a 2.0 percent per year growth factor, based upon planning information provided by the Tri-County Regional Planning Commission (TCRPC). This growth factor is consistent with data used in previous studies conducted by both PENNDOT and the TCRPC.

The projected (2012) peak hour turning movement volumes, under a No-Build scenario, are summarized in Figure 8.

FIGURE 8: PROJECTED (2012) PEAK HOUR TURNING MOVEMENT VOLUMES

As with the Existing Conditions (2002), the entire corridor, including the six (6) limited access interchanges and 14 signalized intersections in the study area, were analyzed using the weekday AM, Mid-Day, and PM peak hour volumes projected for the design year of 2012. The traffic analysis and simulation software packages of Synchro and SimTraffic were used for the analysis of the free access section of the corridor from PA 581 to Summerdale Road/Valley Street. The traffic analysis software package of CORSIM was used for the limited access sections of the corridor from the Pennsylvania Turnpike (I-76) to PA 581 and Summerdale Road/Valley Street to I-81. The software simulation package of TRAFVU was then used to view the simulation of the entire corridor. For each of the peak periods, delay and level of service were determined for each individual movement as well as for each intersection. The traffic analysis output is available in Appendix B.

Roadway Network Modifications

The only change to the existing geometry was made to the interchanges at US 11/15 & PA 581 and US 11/15 & Simpson Ferry Road, which were reconfigured to match the proposed roadway and traffic signal improvements scheduled as part of the reconstruction project detailed previously in this report.

a. Simulated Travel Time

A simulation model using Synchro, SimTraffic, and CORSIM was developed for each peak period using the roadway modifications and projected turning movement volumes.

The anticipated peak hour average travel times and speeds along the study corridor are shown in Table 8 and Table 9.

TABLE 8: SIMULATED 2012 NO-BUILD PEAK HOUR AVERAGE TRAVEL TIMES

Northbound Direction (Seconds)

Corridor Link	AM	Mid-Day	PM
Pennsylvania Turnpike (I-76)	-	-	-
Rossmoyne Road	101.7	67.6	67.5
Slate Hill Road	64.8	61.8	61.8
Simpson Ferry Road	60.8	59.8	59.8
PA 581	63.2	60.0	59.9
Harvard Avenue/Camp Hill Mall	33.1	33.6	34.7
Chestnut Street/Trindle Road	91.9	68.6	82.9
Market Street/Carlisle Pike	59.6	37.7	39.1
Brentwater Road	143.2	84.2	88.2
Country Club Road	23.1	21.3	21.5
21st Street	172.4	46.5	47.0
12th Street/Erford Road	107.9	101.5	106.8
2nd Street	86.0	84.9	86.0
Front Street	52.5	51.3	49.4
Stella Street	69.8	75.7	117.9
Market Street	105.2	103.8	106.6
Summerdale Plaza	242.7	244.4	250.7
Summerdale Road/Valley Street	67.4	66.8	69.2
I-81	27.3	26.6	26.9
Totals (Seconds)	**1573**	**1296**	**1376**
Totals (Minutes)	**26.2**	**21.6**	**22.9**

Southbound Direction (Seconds)

Corridor Link	AM	Mid-Day	PM
I-81	-	-	-
Summerdale Road/Valley Street	32.5	31.9	31.8
Summerdale Plaza	67.0	69.2	70.8
Market Street	246.2	237.4	237.9
Stella Street	201.0	119.7	140.9
Front Street	57.8	57.8	57.8
2nd Street	17.9	16.6	17.6
12th Street/Erford Road	169.9	116.1	115.9
21st Street	76.4	70.7	70.4
Country Club Road	77.5	69.5	98.4
Brentwater Road	23.5	22.7	23.8
Market Street/Carlisle Pike	139.9	102.6	236.7
Chestnut Sreet/Trindle Road	57.3	41.6	130.8
Harvard Avenue/Camp Hill Mall	66.6	84.2	191.9
PA 581	42.3	41.9	178.0
Simpson Ferry Road	64.5	64.1	65.2
Slate Hill Road	50.6	50.5	50.9
Rossmoyne Road	44.0	42.5	43.0
Pennsylvania Turnpike (I-76)	84.9	86.2	87.2
Totals (Seconds)	**1520**	**1325**	**1849**
Totals (Minutes)	**25.3**	**22.1**	**30.8**

TABLE 9: SIMULATED 2012 NO-BUILD PEAK HOUR AVERAGE TRAVEL SPEEDS

Northbound Direction (MPH)

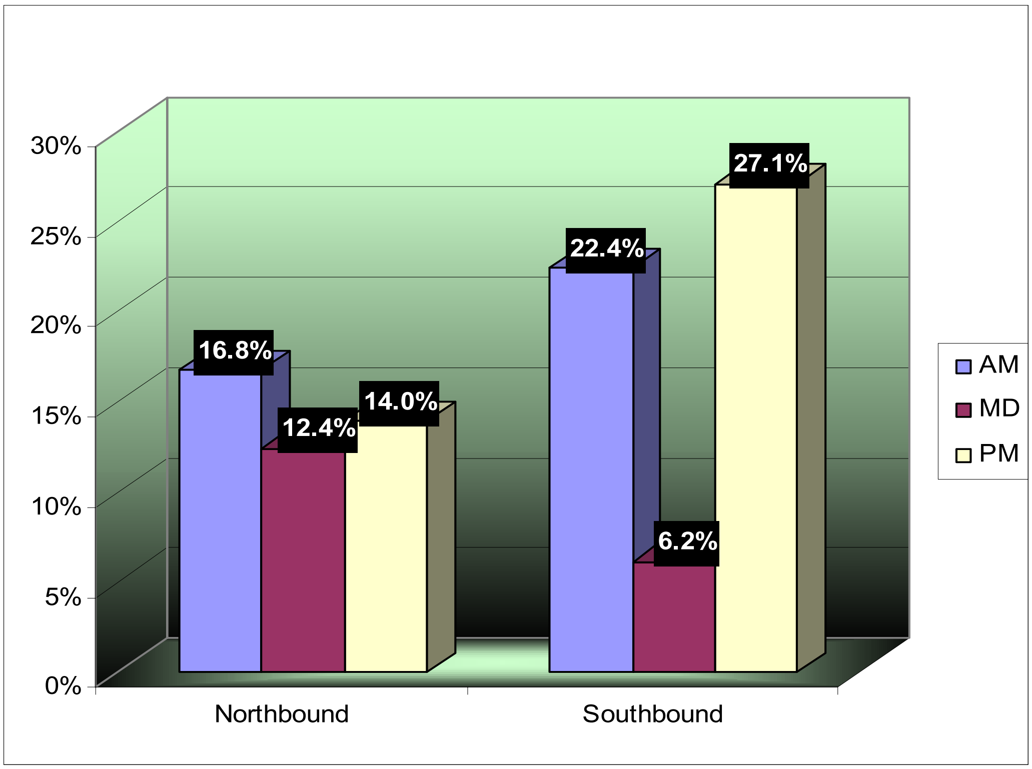
Corridor Link	AM	Mid-Day	PM
Pennsylvania Turnpike (I-76)	-	-	-
Rossmoyne Road	46.7	70.2	70.3
Slate Hill Road	39.9	41.9	41.9
Simpson Ferry Road	69.8	71.0	71.0
PA 581	17.6	18.6	18.6
Harvard Avenue/Camp Hill Mall	18.7	18.4	17.9
Chestnut Street/Trindle Road	8.8	11.8	9.8
Market Street/Carlisle Pike	4.9	7.7	7.4
Brentwater Road	13.0	22.1	21.1
Country Club Road	15.9	17.3	17.1
21st Street	1.1	4.3	4.2
12th Street/Erford Road	18.6	19.8	18.9
2nd Street	28.9	29.3	28.9
Front Street	4.3	4.4	4.6
Stella Street	24.4	22.5	14.5
Market Street	33.1	33.6	32.7
Summerdale Plaza	33.6	33.3	32.5
Summerdale Road/Valley Street	31.9	32.2	31.1
I-81	64.0	65.6	64.9

Southbound Direction (MPH)

Corridor Link	AM	Mid-Day	PM
I-81	-	-	-
Summerdale Road/Valley Street	53.7	54.7	54.9
Summerdale Plaza	32.1	31.1	30.4
Market Street	33.1	34.3	34.2
Stella Street	17.3	29.1	24.7
Front Street	29.5	29.5	29.5
2nd Street	12.7	13.7	12.9
12th Street/Erford Road	14.6	21.4	21.5
21st Street	27.3	27.3	27.3
Country Club Road	21.9	24.4	17.2
Brentwater Road	15.7	16.2	15.5
Market Street/Carlisle Pike	13.3	18.1	7.9
Chestnut Sreet/Trindle Road	5.1	7.0	2.2
Harvard Avenue/Camp Hill Mall	12.2	9.6	4.2
PA 581	14.9	14.8	3.5
Simpson Ferry Road	17.3	17.4	17.1
Slate Hill Road	83.9	84.0	83.4
Rossmoyne Road	58.8	60.9	60.2
Pennsylvania Turnpike (I-76)	55.9	55.1	54.4

The peak hour average travel times were compared against the Existing Conditions (2002) and the percentage changes in travel time are presented in Figure 9. Results indicate that there is an increase of 6 percent to 27 percent in travel time from the Existing (2002) to 2012 No-Build conditions.

FIGURE 9: INCREASE IN SIMULATED TRAVEL TIME FROM EXISTING CONDITIONS (2002) TO 2012 NO-BUILD CONDITIONS



AM Peak Hour

The total travel time for the corridor increases from 22.4 minutes to 26.2 minutes (16.8%) in the northbound direction and from 20.7 minutes to 25.3 minutes (22.4%) in the southbound direction. A more detailed examination of the travel time results indicates that the main bottleneck on this corridor is the 21st Street intersection. Furthermore, the proposed interchange and travel lane improvements along the study corridor from Zimmerman Drive to Chestnut Street/Trindle Road assist with moving vehicular traffic through the area. Yet, the movement of traffic through the Camp Hill area causes a greater traffic backup in the vicinity of 21st Street.

Mid-Day Peak Hour

The total travel time for the corridor increases from 19.2 minutes to 21.6 minutes (12.4%) in the northbound direction and from 20.8 minutes to 22.1 minutes (6.2%) in the southbound direction. The main bottleneck appears to be at the 21st Street intersection.

PM Peak Hour

The total travel time for the corridor increases from 20.1 minutes to 22.9 minutes (14.0%) in the northbound direction and from 24.2 minutes to 30.8 minutes (27.1%) in the southbound direction. The main bottlenecks appear to be at the intersections of US 11/15 & Chestnut Street/Trindle Road, US 11/15 & Market Street/Carlisle Pike, and US 11/15 & 21st Street intersection.

b. Intersection Level of Service

The Intersection Levels of Service were calculated for the 2012 No-Build conditions from the same method as the existing conditions.

For each of the 14 intersections, 2012 No-Build Conditions Signalized Intersection Levels of Service are shown in Figure 10.

FIGURE 10: 2012 NO-BUILD CONDITIONS SIGNALIZED INTERSECTIONS LOS

AM Peak Hour

Intersection delays would increase at all 13 of the unimproved intersections when compared to the existing conditions delays. The number of intersections operating at a LOS D or worse grows from five (5) to six (6). The intersections of US 11/15 & Chestnut Street/Trindle Road, US 11/15 & Market Street/Carlisle Pike, and US 11/15 & 21st Street would operate a LOS F. The intersection of US 11/15 & 12th Street/Erford Road would operate at LOS E. The remaining intersections, US 11/15 & Brentwater Road and US 11/15 & Stella Street, would operate at LOS D.

Intersection delay at US 11/15 & 21st Street would increase from 165 seconds to 195 seconds per vehicle. Excess volume over capacity at the through and left turn movements of the northbound US 11/15 approach are the main cause of delay at the intersection. The high traffic volume at the eastbound and westbound 21st Street approaches also contribute to the delay at the intersection.

Intersection delay at US 11/15 & Market Street/Carlisle Pike would increase from 62 seconds to 87 seconds of delay per vehicle. High traffic volume at the through and left turn movements of the eastbound Carlisle Pike and westbound Market Street approaches, along with the through movement of the southbound US 11/15 approach, are the main cause of delay at the intersection.

Intersection delay at US 11/15 & Chestnut Street/Trindle Road would increase from 65 seconds to 83 seconds of delay per vehicle. High traffic volume at the through and left turn movements of the eastbound Trindle Road and westbound Chestnut Street approaches, along with the through movement of the northbound US 11/15 approach, are the main cause of delay at the intersection.

Intersection delay at US 11/15 & 12th Street/Erford Road would increase from 46 seconds to 78 seconds of delay per vehicle. The high traffic volume at the left turn movement of the northbound US 11/15 approach is the main cause of delay at the intersection.

Intersection delay at the intersection of US 11/15 & Stella Street would increase to 53 seconds of delay per vehicle. The high traffic volume at the through movement of the southbound US 11/15 approach is the main cause of delay at the intersection.

Intersection delay at the intersection of US 11/15 & Brentwater Road would increase to 48 seconds of delay per vehicle. Excess volume over capacity at the eastbound Brentwater Raod approach, along with the through movement of the northbound US 11/15 approach, is the main cause of delay at the intersection.

Mid-Day Peak Hour

Intersection delays would increase at all 13 of the unimproved intersections when compared to the existing conditions delays. The number of intersections operating at a LOS D or worse grows from three (3) to five (5). The intersections of US 11/15 & Chestnut Street/Trindle Road, US 11/15 & Market Street/Carlisle Pike, and US 11/15 & 21st Street would operate at a LOS F. The remaining intersections, US 11/15 & Harvard Avenue/Camp Hill Mall Entrance & US 11/15 & 12th Street/Erford Road, would operate at a LOS D.

Intersection delay at US 11/15 & 21st Street would increase from 95 seconds to 158 seconds of delay per vehicle. Excess volume over capacity at the left turn movements of the northbound US 11/15 approach, along with the high traffic volume at the through movement of the southbound US 11/15 approach, are the main cause of delay at the intersection. The high traffic volume at the eastbound and westbound 21st Street approaches also contribute to the delay at the intersection.

Intersection delay at US 11/15 & Market Street/Carlisle Pike would increase from 84 seconds to 99 seconds of delay per vehicle. High traffic volume at the through and left turn movements of the eastbound Carlisle Pike and westbound Market Street approaches are the main cause of delay at the intersection.

Intersection delay at US 11/15 & Chestnut Street/Trindle Road would increase from 78 seconds to 90 seconds of delay per vehicle. High traffic volume at the through and left turn movements of the eastbound Trindle Road and westbound Chestnut Street approaches, along with the left turn movement of the northbound US 11/15 approach, are the main cause of delay at the intersection.

Intersection delay at US 11/15 & Harvard Avenue/Camp Hill Mall Entrance would increase to 42 seconds of delay per vehicle. Excess volume over capacity of the eastbound Camp Hill Mall Entrance approach, along with the high traffic volume at the left turn movement of the northbound US 11/15 approach, are the main cause of delay at the intersection.

Intersection delay at US 11/15 & 12th Street/Erford Road would increase to 40 seconds of delay per vehicle. The high traffic volume at the left turn movement of the northbound US 11/15 approach is the main cause of delay at the intersection.

PM Peak Hour

Intersection delays would increase at all 13 of the unimproved intersections when compared to the existing conditions delays. The number of intersections operating at a LOS D or worse grows from six (6) to seven (7). The intersections of US 11/15 & PA 581, US 11/15 & Harvard Avenue/Camp Hill Mall Entrance, US 11/15 & Chestnut Street/Trindle Road, US 11/15 & Market Street/Carlisle Pike, and US 11/15 & 21st Street would operate at a LOS F. The intersection of US 11/15 & Stella Street would operate at a LOS E. The remaining intersection, US 11/15 & 12th Street/Erford Road, would operate at a LOS D.

Intersection delay at US 11/15 & 21st Street would increase from 166 seconds to 253 seconds per vehicle. Excess volume over capacity at the left turn movements of the northbound US 11/15 approach, along with the high traffic volume at the through movements of the southbound US 11/15 approach, are the main cause of delay at the intersection. The high traffic volume at the eastbound and westbound 21st Street approaches also contribute to the delay at the intersection

Intersection delay at US 11/15 & Chestnut Street/Trindle Road would increase from 91 seconds to 130 seconds of delay per vehicle. High traffic volume at the through and left turn movements of the eastbound Trindle Road and westbound Chestnut Street approaches, along with the high traffic volumes of the left turn movement of the northbound US 11/15 approach and through movements of the southbound US 11/15 approach, are the main cause of delay at the intersection.

Intersection delay at US 11/15 & Market Street/Carlisle Pike would increase from 63 seconds to 123 seconds of delay per vehicle. High traffic volume at the through and left turn movements of the eastbound Carlisle Pike and westbound Market Street approaches, along with the high traffic volume at the through movement of the southbound US 11/15 approach, are the main cause of delay at the intersection.

Intersection delay at US 11/15 & Harvard Avenue/Camp Hill Mall Entrance would increase from 36 second to 100 seconds of delay per vehicle. High traffic volume at the through and left turn movements of the eastbound Camp Hill Mall Entrance and westbound Harvard Avenue approaches, along with the high traffic volume at the left turn movement of the northbound US 11/15 approach and through movement of the southbound US 11/15 approach, are the main cause of delay at the intersection.

The new signalized intersection of US 11/15 & PA 581 would operate with 81 seconds of delay per vehicle. Excess volume over capacity on the eastbound approach from PA 581 and high traffic volume at the through movement of the southbound US 11/15 approach are the main cause of delay at the intersection.

Intersection delay at US 11/15 & Stella Street would increase from 41 seconds to 74 seconds of delay per vehicle. The high traffic volume at the left turn and right turn movements of the eastbound Stella Street approach, along with the through movement of the northbound US 11/15 approach, are the main cause of delay at the intersection

Intersection delay at US 11/15 & 12th Street/Erford Road would increase to 45 seconds of delay per vehicle. High traffic volume at the left turn movement of the eastbound (or southbound) Erford Road approach is the main cause of delay at the intersection.

IV. SUMMARY OF ADVERSE CONDITIONS

The US 11/15 corridor was nominated for the Congested Corridor Improvement Program due to its significant importance to the commuting public and the movement of goods within the HATS region. Furthermore, the corridor is an important link that connects the Mid-Atlantic States to New York and Canada. Being a major commuter route, the study corridor is subject to recurring peak period traffic congestion. The adverse conditions at the following locations were noted through the project meetings, data collection procedures, and traffic analyses:

US 11/15 & Simpson Ferry Interchange

The US 11/15 & Simpson Ferry Road interchange (Highland Park/Shiremanstown), located in Lower Allen Township, presents concerns related to substandard acceleration/deceleration lane lengths and traffic weaving conditions along US 11/15. The substandard acceleration/deceleration lane lengths and traffic weaving conditions are due to proximity of the Simpson Ferry Road interchange with the PA 581 interchange. The poor operating conditions are apparent in the relatively high number of reportable crashes over the past three (3) years within the study corridor. The difficult roadway geometry, coupled with high traffic volumes on the study corridor and PA 581, results in excess volume over capacity that is apparent along US 11/15.

US 11/15 & PA 581 Interchange

The US 11/15 & PA 581 interchange, located in Camp Hill Borough, also presents concerns related to substandard acceleration/deceleration lane lengths and traffic weaving conditions along US 11/15 due to its proximity with the Simpson Ferry Road interchange. The off-ramp from westbound PA 581 to southbound US 11/15 reaches capacity during peak hour traffic conditions with traffic backing-up almost to the PA 581 mainline at times. The traffic signal at the off-ramp currently operates at a LOS F in the PM peak hour and LOS D in the AM peak hour. Another area of concern within the interchange is the off-ramp from northbound US 11/15 to westbound PA 581. The limited acceleration lane length, poor weaving conditions, and high vehicle volumes on the westbound PA 581 off-ramp causes travel delay along the northbound US 11/15 off-ramp. The eastbound PA 581 on-ramp to US 11/15 northbound has merge/diverge distance and short acceleration lane concerns. The poor operating conditions are again apparent in the relatively high number of reportable crashes over the past three (3) years within the study corridor. The difficult roadway geometry, coupled with high traffic volumes on the study corridor and PA 581, results in excess volume over capacity that is apparent along US 11/15.

US 11/15 & Harvard Avenue/Camp Hill Mall Entrance Intersection

The left turn movement on the northbound US 11/15 approach, which is destined for the Camp Hill Mall, is not adequate to support the current traffic volume in the PM peak hour and future traffic volume in the Mid-Day and PM peak hours. Several members of the CCIP Project Team also indicated that the left turn movement on the northbound US 11/15 tends to back up into the through lanes during peak shopping periods, such as the Christmas season, which further impacts the operations at the intersection.

US 11/15 & Chestnut Street/Trindle Road and US 11/15 & Market Street/Carlisle Pike Intersections

The two intersections at Chestnut Street/Trindle Road and Market Street/Carlisle Pike are similar in operation. Traffic volumes from residential areas west of the corridor, such as Carlisle, are using Trindle Road (PA 501) and Carlisle Pike (US 11) to access the M. Harvey Taylor Bridge via US 11/15. Therefore, these eastbound approaches contain a significant amount of left turn movements throughout all three (3) peak periods. Given that Chestnut Street/Trindle Road and Market Street/Carlisle Pike provide access in the eastbound and westbound directions within the study area, there are also a significant number of through movements at these approaches, as well as turning movements from the US 11/15 northbound and southbound approaches.

The intersection of US 11/15 & Chestnut Street/Trindle Road currently operates at a LOS E in the AM and Mid-Day peak hours and LOS F in the PM peak hour. The intersection is anticipated to operate at a LOS F in all three (3) peak hours in the 2012 No-Build conditions. The intersection of US 11/15 & Market Street/Carlisle Pike currently operates at a LOS E in the AM and PM peak hours and LOS F in the Mid-Day peak hour. The intersection is anticipated to operate at a LOS F in all three (3) peak hours in the 2012 No-Build conditions. Furthermore, traffic volumes may increase in the AM peak period along US 11/15 at these intersections due to traffic restrictions into Camp Hill Borough, which may further degrade the operating conditions at these intersections.

US 11/15 & 21st Street Intersection

The 21st Street intersection has unique geometry and operations, which causes this intersection to be the most significant bottleneck within the study limits. A stop sign, yield sign, poor merge condition and a traffic signal all within a few hundred feet of each other create a bottleneck for traffic traveling along southbound US 11/15 in the vicinity of the 21st Street intersection. Traffic traveling on southbound US 11/15, must stop at a stop sign, located approximately 300 feet prior to the 21st Street traffic signal, to allow traffic from Harrisburg wishing to turn left at the intersection to proceed. Once the southbound US 11/15 traffic travels through the stop sign and then crosses the signalized intersection, it then encounters a yield sign and cannot proceed until a gap in the traffic from Harrisburg occurs to allow the southbound US 11/15 traffic to merge. The major movement during the morning peak period is traffic traveling on northbound US 11/15 and then veering left onto the M. Harvey Taylor Memorial Bridge to Harrisburg. Also, the left turn movements from northbound US 11/15 on to 21st Street are heavy during the peak periods. It is not uncommon to witness traffic back-ups from 21st Street to Country Club Road along northbound US 11/15 during the morning peak period.

The intersection of US 11/15 & 21st Street currently operates at a LOS F in all three (3) peak hours with intersection delay of 165 seconds per vehicle in the AM peak hour, 95 seconds per vehicle in the Mid-Day peak hour, and 166 per vehicle seconds in the PM peak hour. The intersection is also anticipated to operate at LOS F in all three (3) peak hours in the 2012 No-Build conditions, but the intersection delay will increase to 195 seconds in the AM peak hour, 158 seconds in the Mid-Day peak hour, and 253 seconds in the PM peak hour. The poor operating conditions at the intersection and corresponding back-ups are also apparent in the relatively high number of reportable crashes over the past three (3) years within the study corridor

US 11/15 & 12th Street/Erford Road Intersection

The majority of existing traffic at the eastbound Erford Road and westbound 12th Street approaches are through movements, although the eastbound Erford Road approach also has a high traffic volume at the left turn movement. The majority of existing traffic at the northbound US 11/15 approach is left turn movements to westbound Erford Road, and the majority of existing traffic at the southbound US 11/15 approach is right turn movements to westbound Erford Road.

The intersection currently operates at a LOS D in the AM peak hour. The intersection is anticipated to operate at a LOS E in the AM peak hour and LOS D in the Mid-Day and PM peak hours during the 2012 No-Build conditions.

US 11/15 & Stella Street Intersection

The high traffic volume at the left turn movement of the eastbound Stella Street approach is the cause of the intersection delay in the PM peak hour. The high traffic volume at the through movement of the southbound US 11/15 approach is the cause of delay in the AM peak hour.

The intersection currently operates at a LOS D in the PM peak hour. The intersection is anticipated to operate at a LOS D in the AM peak hour and LOS E in the PM peak hour during the 2012 No-Build conditions.

Mid-Block between the intersections of US 11/15 & Market Street and US 11/15 & Summerdale Plaza

There are a relatively high number of reportable crashes over the past three (3) years in this section of the study corridor. This may be attributed to the fact that this is the longest section of the corridor between signalized intersections, which extends approximately 12,400 feet. Multiple access points from both minor roads and businesses may be a factor in these crashes.

US 11/15 & Summerdale Road/Valley Street

There are a relatively high number of reportable crashes over the past three (3) years within the study corridor at this intersection. This may be attributed to the geometry of the intersection.

V. ALTERNATIVES ANALYSIS

The alternatives under this study are divided into Short-Term and Long-Term improvements. The Short-Term improvements require a minimum time framework (0-3 years) to implement, and therefore can be completed within the CCIP schedule. The Long-Term improvements (4-10 years) require thorough planning and extensive design, which may require special environmental consideration and right-of-way acquisition, and therefore may not be completed within the CCIP schedule.

A. Short-Term Build Conditions (0-3 years)

1. IDENTIFICATION OF IMPROVEMENT ALTERNATIVES

A review of fairly low-cost and quick implementation improvements was performed before evaluating traditional roadway widening projects. The PENNDOT CCIP Standard Study Methodology (SSM) provides the following Short-Term solutions that may be applicable as part of this program:

- Minor Geometric Improvements
- Traffic Signal Operations
- Multimodal Initiatives
- Intelligent Transportation Systems (ITS)
- Traffic Regulation
- Transportation Demand Management (TDM) Measures
- Planning and Zoning

Minor Geometric Improvements

PENNDOT Engineering District 8-0 is already addressing major operational concerns along the freeway section of the study corridor at the interchanges of US 11/15 & PA 581 and US 11/15 & Simpson Ferry Road through the interchange reconstruction project. PENNDOT Engineering District 8-0 is also addressing the major bottleneck along the arterial section of the corridor at the intersection of US 11/15 & 21st Street through the intersection reconstruction project.

The US 11/15 corridor is almost fully developed at the major signalized intersections within the study limits, especially within Camp Hill Borough, thus limiting the extent of geometric improvements that can be evaluated for the Short-Term time frame. The following geometric improvements were identified through evaluation of the adverse conditions, discussions with the Project Team, and traffic analysis:

- US 11/15 & Harvard Avenue/Camp Hill Mall Intersection

  The left turn movement at the northbound US 11/15 approach destined for the Camp Hill Mall is a major cause of delay at this intersection, especially in the Mid-Day and PM peak hours.

The extension of the left turn lane is consistent with plans by PENNDOT Engineering District 8-0, Camp Hill Borough, and the future owner of the Camp Hill Mall, to relocate the entrance to the mall to Yale Avenue. The purpose of the relocation is to provide additional storage for traffic entering the mall.

- US 11/15 & 12th Street/Erford Road Intersection

  The left turn movement at the northbound US 11/15 approach destined for westbound Erford Road is a major cause of delay at this intersection, especially in the AM peak hour.

  The extension of the left turn lane can be accomplished through re-striping the roadway and converting a section of the center turn lane into a left turn lane.

Traffic Signal Operations

Poor operational performance at the signalized intersections along the corridor may be improved by signal timing improvements. All traffic signal timings were optimized through the Synchro software package in the Short-Term Build conditions. Some of the traffic signals were evaluated in zones, or closed loop systems, to further enhance progression of traffic through the intersections.

The following six (6) signalized intersections in Camp Hill Borough are already interconnected via aerial and underground communication cable:

- US 11/15 & PA 581
- US 11/15 & Harvard Avenue/Camp Hill Mall Entrance
- US 11/15 & Chestnut Street/Trindle Road
- US 11/15 & Market Street/Carlisle Pike
- US 11/15 & Brentwater Road
- US 11/15 & Country Club Road

The traffic signal timings for these six (6) signalized intersections would simply require retiming to match the current traffic conditions.

The existing traffic signals at the intersections of US 11/15 & 21st Street, located in Camp Hill Borough, and US 11/15 & 12th Street/Erford Road, located in Lemoyne Borough and East Pennsboro Township, are part of separate closed loop systems that are programmed to enhance progression in the eastbound and westbound direction. Therefore, these intersections were optimized as separate, stand-alone traffic signals.

The existing traffic signals at the intersections of US 11/15 & 2nd Street and US 11/15 & Front Street, both located in the Wormleysburg Borough, are time-based coordinated (TBC). Given the close proximity of the signalized intersection of US 11/15 & Stella Street, located approximately 2,500 feet from Front Street, it was evaluated in a zone with the intersections of US 11/15 & 2nd Street and US 11/15 & Front Street to further enhance progression through these three (3) intersections.

The existing traffic signals at the intersections of US 11/15 & Market Street and US 11/15 & Summerdale Plaza, both located in East Pennsboro Township, were optimized as separate, stand-alone traffic signals based on their distance of over 5,000 feet from the closest adjacent traffic signals.

The existing traffic signal at the intersection of Summerdale Road/Valley Street, located in East Pennsboro Township, is par of a separate closed loop system that is programmed to enhance progression in the eastbound direction of Valley Street. This traffic signal was optimized as a separate, stand-alone traffic signal.

At the time of this study, none of the existing traffic signals within the study limits of the US 11/15 corridor were capable of priority control for emergency response vehicle or buses. Priority control systems can enhance time-critical travel for emergency response vehicles by allowing the vehicles to request and receive green lights through signalized intersections. A priority control system may help travel to Holy Spirit Hospital, which is located in the vicinity of the study limits. Given that the emergency vehicle priority control systems do not have a direct benefit on the recurring congestion problems within the corridor, these systems would be considered enhancements to the corridor. Priority control systems can also enhance on-time performance for buses in the same manner. However, CAT would have to equip buses with emitters and make sure that those buses are used on the proper routes, which is sometimes difficult. There are different methods of control that would need to be evaluated (extended green, early green, etc.). A more detailed study would be required for a transit priority control system.

Multimodal Initiatives

The 2002 US Census Data estimates that 82 percent of Cumberland County residents that commute to work drive alone, 9 percent carpool, 1 percent use some sort of public transportation, 7 percent walk, and 1 percent use some other mode of transportation. With this in mind, a practical strategy to ease congestion along the study corridor is through mode shifts including buses, regional rail, Park & Ride lots, pedestrian and bicycle facilities.

CAT has extensive transit facilities operating along the West Shore of the Susquehanna River and within the corridor study limits. There are eight (8) bus routes that provide service within the study corridor limits. CAT has preliminary plans to add a route/link that would connect the I-83/York County area to the intersection of 12th Street & Market Street, and terminate near the West Shore Business complex. The addition of new routes and increased frequency of existing services should help to improve ridership on the local buses. Although the anticipated ridership of new routes and expanded service is beyond the scope of this report, a public transit study would help determine the need for public transit within the study area. As part of the public transit study, the evaluation of bus bays or loading areas at side streets, and bus shelters to provide an inviting location for the public to wait for the bus should be considered.

CAT is currently investigating the feasibility of constructing a new West Shore Transportation Center in Lemoyne Borough as part of the CORRIDOR One Rail Project. The proposed West Shore Transportation Center is part of the CORRIDOR One Rail Project from Lancaster to East Mechanicsburg. CORRIDOR One is the proposed rail corridor that will serve a 54-mile stretch from Carlisle through Harrisburg, to Lancaster. Plans also include a rail station at Harrisburg International Airport. CORRIDOR One is the first corridor to be developed in the regional system. Once complete, a truly multi-modal system will connect five regional transportation corridors. The CORRIDOR One project is being pursued as a separate effort from this report.

CAT has three (3) Park & Ride facilities in the area of the corridor study limits. An unofficial Park & Ride lot is located at the Camp Hill Mall, which has been observed throughout this study. Camp Hill

Borough met with the future of the owners of the Camp Hill Mall to discuss future transportation plans, which included discussions of a potential Park & Ride facility with transit service. PENNDOT and CAT may help to facilitate the design and construction of the Park & Ride for consistency with any planned roadway modifications as part of the renovated Camp Hill Mall. Furthermore, the planned bus route from I-83/York County area to the West Shore Business complex may provide an opportunity for a Park & Ride facility at the intersection of US 11/15 & 12th Street/Erford Road. The Park & Ride facility may be implemented through an agreement with the local officials and businesses in the Short-Term, until an official facility is approved and completed.

Pedestrian accommodations are provided throughout the US 11/15 corridor study limits. Bicycle facilities are potentially planned along the US 11/15 corridor north of the study limits as part of the Cumberland and Perry County Safety and Congestion Management Study. Bicycle facilities are also planned in the vicinity of the study corridor by PENNDOT as one of the Bicycle PA routes. The planned Touring Route J would lead from Harrisburg down to Gettysburg and intersect with Touring Route S. The route is not planned along the US 11/15 corridor study limits. Given the bicycle route planning above the corridor limits and below the corridor limits, further investigation within the study corridor and surrounding areas may provide a cohesive bicycle plan, which ties the plans together. The investigation may be in the form of a detailed study that evaluates demand, coordinates with other bicycle routes and planned roadway projects, and prioritizes projects with concepts and costs.

CAT has mode shift initiatives including guaranteed ride home programs, paratransit services, and promotion of TransitCheck.

Intelligent Transportation Systems (ITS)

The location of the US 11/15 corridor in relation to the various bridges into Harrisburg and the other surrounding highways provides opportunities for alternative routes, such as the PA Turnpike, PA 581, and I-81, to be used during times of heavy traffic volumes or incidents. The dissemination of traveler information along each of the corridors throughout the region would reduce delays, improve travel time, and enhance safety during recurring and non-recurring congestion. PENNDOT Engineering District 8-0 has established a Regional ITS Architecture for the Harrisburg area and developed an ITS early deployment plan. The focus of ITS initiatives throughout the region is primarily centered on the Capital Beltway, and allows for extending the Beltway efforts to the US 11/15 corridor via the interchanges at PA 581 and I-81.

Efforts could include the deployment of sensors for vehicle and incident detection, closed circuit television (CCTV) cameras for incident detection and verification along the limited access sections of the corridors and interchanges, dynamic message signs (DMS) to disseminate traveler information, and a communications system to transfer the traffic data between the field devices and the PENNDOT Engineering District 8-0 office building. Further enhancements to the traveler information systems may include kiosks at major traffic generators and highway advisory radio (HAR) systems.

PENNDOT Engineering District 8-0 does not currently operate a traffic management center (TMC) to receive the detector and video data, and disseminate the traveler information. Furthermore, PENNDOT Engineering District 8-0 does not currently monitor any CCTV systems. Therefore, the resources are not in place to handle these systems. With this in mind, ITS deployment recommendations will be considered a Long-Term initiative.

Traffic Regulations

The project team did not identify traffic regulation techniques, such as turn restrictions and lane restrictions, as applicable measures to alleviate traffic congestion within the corridor study limits. As a separate initiative from this study, PENNDOT Engineering District 8-0 and Camp Hill Borough have plans to install turn restrictions onto local roads from US 11/15 during the AM peak period for safety purposes.

Transportation Demand Management (TDM) Measures

Applicable Transportation Demand Management (TDM) measures include transportation management associations (TMAs) and commuter alternatives program that includes ride matching, variable work hour programs and telecommuting.

- Transportation Management Association (TMA)

  A TMA is a public private partnership that develops, supports, promotes, and improves new and existing transportation systems. TMAs can assist the public in finding alternative means of transportation to work or school in order to help reduce traffic congestion and improve mobility in high growth regions. Some of the ideas can include: vanpools, car pools, Park & Ride lots, ride matching, and up to date transit schedules. Other TMAs produce informative newsletters, which highlight the latest transportation issues and a weekly roadwork update. TMAs can also help employers hold transportation fairs in order to help disseminate information quickly and easily. In the Philadelphia region, the TMAs have been funded by PENNDOT in the past. PENNDOT has now asked that the region fund these agencies through congestion mitigation and air quality (CMAQ) funding.

  There are no existing TMAs in the Harrisburg region, but the formation of a Susquehanna Regional TMA has been discussed. In addition, past discussions have included the formation of a TMA along the west shore area of the Susquehanna River that would be focused on the West Shore Business Complex.

- Commuter Alternatives Program

  The purpose of a commuter alternatives program is to help the general public, including employers in the region, save time and money on the daily commute to work. The commuters alternatives program also helps to reduce traffic congestion and air pollution. Some of the services provided through the program include ride matching, variable work hour programs, and telecommuting.

  Ride matching programs can help the public find convenient transit services, car pools, vanpools, even walking and bicycling opportunities in a specific region. The Tri-County Regional Planning Commission currently has a link on their website to a questionnaire, which helps to facilitate this program in Cumberland, Dauphin, and Perry counties within the Harrisburg Region.

Variable work hour programs can be in two forms: flextime or a compressed work week. Research has shown that employees are more likely to consider shared commutes when a flexible work schedule is instituted. Flextime allows employees to alter their arrival and departure times slightly to accommodate commute schedules. The ultimate goal of a flextime policy is to allow employees to arrange a commute schedule convenient to transit schedules or to accommodate vanpool and carpool options. Compressed work weeks help reduce the number of single occupancy vehicle (SOV) travel to the worksite during the week in a way different from flextime. This option allows employees not affected by collective bargaining to condense the work hours into fewer days, thus increasing the work day, but decreasing the number of days spent at the work site.

Telecommuting allows employees to work from home via computer, fax, and telephone, as an alternative to physical commuting. This option is not suitable for all types of businesses, but can work well for those with a high percentage of employees who spend the majority of time in their office, using the computer and phone on a regular basis. Local businesses can help reduce single occupancy vehicle (SOV) travel to the worksite, in addition to saving on office space and overhead, by implementing a telecommuting policy.

Commuter alternative programs are administered through the local planning organization or TMA. Funding for these programs can be made available through federal CMAQ applications, PENNDOT, and local resources allocated through the regional TIP. A commuter alternatives program is currently being administered through the Tri-County Regional Planning Commission, in partnership with CAT, but the funding resources are limited.

These programs involve more than just the US 11/15 corridor in the study limits, and require extensive planning from the region. Therefore, these improvements are considered a Long-Term initiative for the region, which would directly benefit this corridor.

Planning and Zoning

The county and municipality along the corridor have current comprehensive plans, zoning and subdivision regulations to guide growth. Additionally, TCRPC is creating a Regional Growth Management Plan to coordinated anticipate development and manage infrastructure investments in Cumberland, Dauphin, and Perry Counties.

A Standard Land Use Questionnaire was distributed as part of this study to obtain existing land use policies that are in place along the corridor. The content of the questions are typical on PENNDOT's Highway Occupancy Permit (HOP) application process. At the time of this report, there were limited questionnaires that were completed and returned. The questionnaires are included in Appendix F.

A few Mid-Block locations within the study area have a relatively high number of reportable crashes over the past three (3) years. Problem areas include, sections of the corridor between Harvard Avenue/Camp Hill Mall Entrance and Chestnut Street/Trindle Road, Country Club Road and 21st Street, and Market Street and Summerdale Plaza. The observation of a lack of access control, combined with the high frequency of crashes, indicate that access management strategies may improve the safety and operation of the corridor. Access Management Ordinances or overlay districts within the zoning ordinance are techniques adopted by the municipalities to set standards for the design and location of driveways and roadways seeking access to state or local roads.

2. ANALYSIS OF IMPROVEMENT ALTERNATIVES

The entire corridor, including the six (6) limited access interchanges and 14 signalized intersections in the study area, were analyzed using the weekday AM, Mid-Day, and PM peak hour volumes projected for the design year of 2012. The traffic analysis and simulation software packages of Synchro and SimTraffic were used for the analysis of the free access section of the corridor from PA 581 to Summerdale Road/Valley Street. The traffic analysis software package of CORSIM was used for the limited access sections of the corridor from the Pennsylvania Turnpike (I-76) to PA 581 and Summerdale Road/Valley Street to I-81. The software simulation package of TRAFVU was then used to simulate the entire corridor. All traffic analysis techniques were consistent with the analysis of existing and future No-Build conditions. The traffic analysis output is available in Appendix B.

It is important to understand that many of the improvement alternatives discussed in this report cannot be modeled in the computer simulations, yet it is believed that these methods will have a positive effect in reducing traffic congestion since they have been applied to numerous similar roadway networks both within the state of Pennsylvania and throughout the nation and have yielded positive results. The following roadway network modifications to the 2012 No-Build conditions were evaluated in the software simulation models:

Traffic Signal Improvements

Traffic signal timing at each signalized intersection was optimized through the Synchro software package.

Minor Geometric Improvements

The left turn lanes at the northbound US 11/15 approach were extended at the Harvard Avenue/Camp Hill Mall Entrance intersection and 12th Street intersection.

a. Simulated Travel Time

A simulation model using Syncrho, SimTraffic, and CORSIM was developed for each peak period using the roadway improvements and projected turning movement counts.

The anticipated peak hour average travel times and speeds along the study corridor are shown in Table 9 and Table 10.

TABLE 10: SIMULATED 2012 SHORT-TERM BUILD PEAK HOUR AVERAGE TRAVEL TIMES

Northbound Direction (Seconds)

Corridor Link	**AM**	**Mid-Day**	**PM**
Pennsylvania Turnpike (I-76)	-	-	-
Rossmoyne Road	101.7	67.6	67.5
Slate Hill Road	64.8	61.8	61.8
Simpson Ferry Road	60.8	59.8	59.8
PA 581	63.2	60.0	59.9
Harvard Avenue/Camp Hill Mall	31.4	31.9	32.4
Chestnut Street/Trindle Road	43.0	44.7	38.5
Market Street/Carlisle Pike	28.1	40.5	25.0
Brentwater Road	73.8	70.8	70.4
Country Club Road	23.5	21.4	20.2
21st Street	274.5	27.3	35.6
12th Street/Erford Road	91.3	92.5	103.3
2nd Street	86.1	85.2	84.2
Front Street	38.7	33.9	45.8
Stella Street	59.8	64.7	150.6
Market Street	103.4	101.5	102.7
Summerdale Plaza	235.3	234.2	245.7
Summerdale Road/Valley Street	66.6	71.1	69.0
I-81	27.3	26.6	26.9
Totals (Seconds)	**1474**	**1196**	**1299**
Totals (Minutes)	**24.6**	**19.9**	**21.7**

Southbound Direction (Seconds)

Corridor Link	**AM**	**Mid-Day**	**PM**
I-81	-	-	-
Summerdale Road/Valley Street	32.5	31.9	31.8
Summerdale Plaza	63.1	75.4	63.1
Market Street	240.6	241.0	237.2
Stella Street	109.3	103.5	125.2
Front Street	57.8	57.8	57.8
2nd Street	16.1	16.2	16.8
12th Street/Erford Road	151.3	128.8	115.5
21st Street	65.6	53.7	57.7
Country Club Road	80.4	71.2	154.6
Brentwater Road	27.3	32.9	26.3
Market Street/Carlisle Pike	73.8	101.9	75.0
Chestnut Sreet/Trindle Road	19.8	34.4	38.9
Harvard Avenue/Camp Hill Mall	36.0	67.3	154.3
PA 581	46.2	40.2	156.0
Simpson Ferry Road	64.5	64.1	65.2
Slate Hill Road	50.6	50.5	50.9
Rossmoyne Road	44.0	42.5	43.0
Pennsylvania Turnpike (I-76)	84.9	86.2	87.2
Totals (Seconds)	**1264**	**1299**	**1556**
Totals (Minutes)	**21.1**	**21.7**	**25.9**

TABLE 11: SIMULATED 2012 SHORT-TERM BUILD PEAK HOUR AVERAGE TRAVEL SPEEDS

Northbound Direction (MPH)

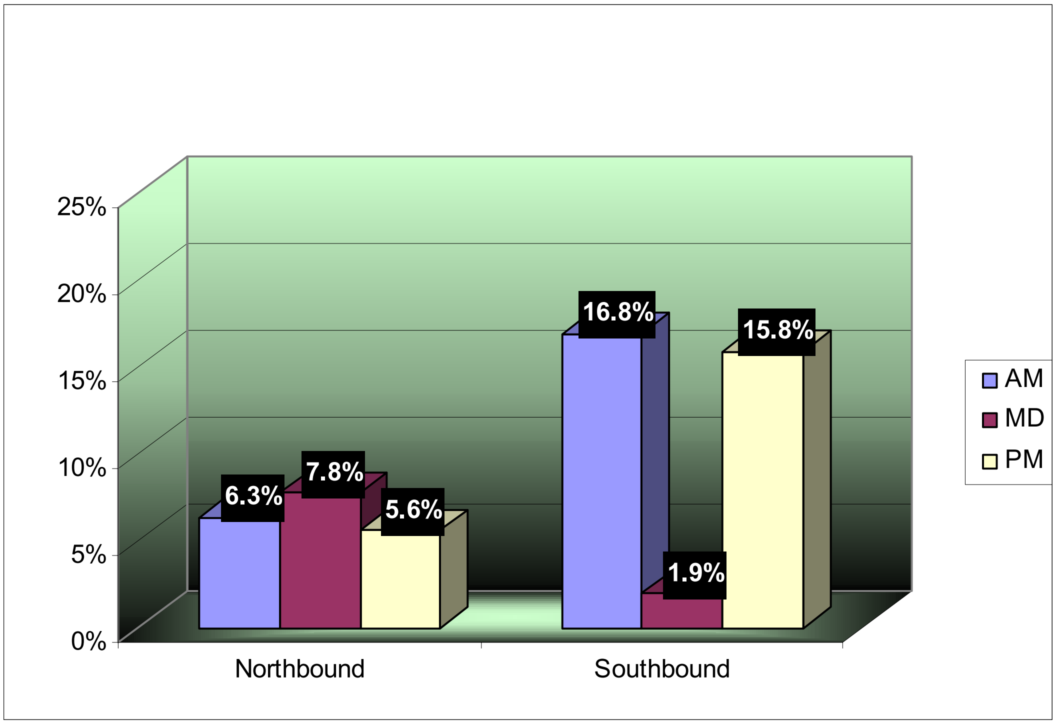
Corridor Link	AM	Mid-Day	PM
Pennsylvania Turnpike (I-76)	-	-	-
Rossmoyne Road	46.7	70.2	70.3
Slate Hill Road	39.9	41.9	41.9
Simpson Ferry Road	69.8	71.0	71.0
PA 581	17.6	18.6	18.6
Harvard Avenue/Camp Hill Mall	19.7	19.4	19.1
Chestnut Street/Trindle Road	19.2	16.2	20.6
Market Street/Carlisle Pike	10.0	7.2	11.5
Brentwater Road	25.1	26.3	26.4
Country Club Road	15.6	18.5	18.5
21st Street	0.7	7.1	5.4
12th Street/Erford Road	22.1	21.6	19.3
2nd Street	28.9	29.2	29.7
Front Street	5.9	7.0	5.0
Stella Street	28.5	26.1	11.3
Market Street	34.1	34.1	33.0
Summerdale Plaza	34.6	33.8	32.2
Summerdale Road/Valley Street	32.3	32.2	31.6
I-81	64.0	65.6	64.9

Southbound Direction (MPH)

Corridor Link	AM	Mid-Day	PM
I-81	-	-	-
Summerdale Road/Valley Street	53.7	54.7	54.9
Summerdale Plaza	34.1	33.1	34.1
Market Street	33.9	33.8	34.9
Stella Street	28.3	31.2	27.3
Front Street	29.5	29.5	29.5
2nd Street	14.1	11.9	13.6
12th Street/Erford Road	16.4	19.5	21.5
21st Street	27.3	27.3	27.3
Country Club Road	21.1	23.9	17.2
Brentwater Road	13.5	9.0	10.0
Market Street/Carlisle Pike	25.3	18.2	24.7
Chestnut Sreet/Trindle Road	14.7	6.0	7.8
Harvard Avenue/Camp Hill Mall	22.4	12.0	5.5
PA 581	13.5	15.4	4.0
Simpson Ferry Road	17.3	17.4	17.1
Slate Hill Road	83.9	84.0	83.4
Rossmoyne Road	58.8	60.9	60.2
Pennsylvania Turnpike (I-76)	55.9	55.1	54.4

The anticipated peak hour average travel times were compared with the 2012 No-Build conditions. From this comparison, the decreases in travel time from the 2012 No-Build conditions to the 2012 Short-Term Build conditions were calculated and presented in Figure 11. This graphic summarized the decreases in AM, Mid-Day, and PM travel times for both northbound and southbound traffic.

FIGURE 11: DECREASE IN SIMULATED TRAVEL TIME FROM 2012 NO-BUILD CONDITIONS TO 2012 SHORT-TERM BUILD CONDITIONS



AM Peak Hour

The total travel time for the corridor decreases from 26.2 minutes to 24.6 minutes (6.3%) in the northbound direction and from 25.3 minutes to 21.1 minutes (16.8%) in the southbound direction.

Mid-Day Peak Hour

The total travel time for the corridor decreases from 21.6 minutes to 19.9 minutes (7.8%) in the northbound direction and from 22.1 minutes to 21.7 minutes (1.9%) in the southbound direction.

PM Peak Hour

The total travel time for the corridor decreases from 22.9 minutes to 21.7 minutes (5.6%) in the northbound direction and from 30.8 minutes to 25.9 minutes (15.8%) in the southbound direction.

b. 2012 Short-Term Build Conditions Intersection Level of Service

The intersection level of service was calculated for the Short-Term Build conditions from the same method as the Existing and 2012 No-Build conditions.

For each of the 14 signalized intersections, Short-Term Build Conditions Intersection Levels of Service are shown in Figure 12.

FIGURE 12: 2012 SHORT-TERM BUILD SIGNALIZED INTERSECTIONS LOS

The results of the capacity analysis were then compared to the 2012 No-Build conditions.

AM Peak Hour

Intersection delays would decrease at 12 of the 14 signalized intersections when compared to 2012 No-Build conditions. The number of intersections operating at a LOS D or worse decreases from seven (7) to three (3). The intersection of US 11/15 & 21st Street would remain at a LOS F. The intersection of 12th Street/Erford Road would remain at a LOS E. The remaining intersection, US 11/15 & Chestnut Street/Trindle Road, would improve to a LOS D from a LOS F.

Intersection delay at US 11/15 & 21st Street would decrease from 195 seconds to 151 seconds of delay per vehicle. Excess volume over capacity at the through and left turn movements of the northbound US 11/15 approach continues to be the main cause of delay at the intersection. The high traffic volumes at the eastbound and westbound 21st Street approaches also contribute to the delay at the intersection.

Intersection delay at US 11/15 & 12th Street/Erford Road would decrease from 78 seconds to 68 seconds of delay per vehicle. The high traffic volume at the left turn movement of the northbound US 11/15 approach continues to be the main cause of delay at the intersection.

Intersection delay at US 11/15 & Chestnut Street/Trindle Road would decrease from 83 seconds to 45 seconds of delay per vehicle. High traffic volumes at the through and left turn movements of the eastbound Trindle Road approach and westbound Chestnut Street approach, along with the left turn movement of the northbound US 11/15 approach, are the main causes of delay at the intersection.

Mid-Day Peak Hour

Intersection delays would decrease at nine (9) of the 14 signalized intersections when compared to 2012 No-Build conditions. The number of intersections operating at a LOS D or worse decreases from five (5) to four (4). The intersections of US 11/15 & Chestnut Street/Trindle Road, US 11/15 & Market Street/Carlisle Pike, and US 11/15 & 21st Street would all improve to a LOS E from a LOS F. The remaining intersection, US 11/15 & 12th Street/Erford Road, would remain at a LOS D.

Intersection delay at US 11/15 & 21st Street would decrease from 158 seconds to 72 seconds of delay per vehicle. Excess volume over capacity at the left turn movement of the northbound US 11/15 approach remains the main cause of delay the intersection. The high traffic volume at the eastbound and westbound 21st Street approaches also contribute to the delay at the intersection.

Intersection delay at US 11/15 & Chestnut Street/Trindle Road would decrease from 90 seconds to 59 seconds of delay per vehicle. High traffic volume at the eastbound Trindle Road approach and westbound Chestnut Street approach, along with the left turn movement of the northbound US 11/15 approach, are the main causes of delay at the intersection.

Intersection delay at US 11/15 & Market Street/Carlisle Pike would decrease from 99 seconds to 57 seconds of delay per vehicle. High traffic volume at the left turn movements of the eastbound Carlisle Pike approach and westbound Market Street approach, along with the left turn movement of the northbound US 11/15 approach, are the main causes of delay at the intersection.

Intersection delay at US 11/15 & 12th Street/Erford Road would remain at 41 seconds of delay per vehicle. The high traffic volume at the left turn movement of the northbound US 11/15 approach remains the main cause of delay the intersection.

PM Peak Hour

Intersection delays would decrease at eight (8) of the 14 signalized intersections when compared to 2012 No-Build conditions. The number of intersections operating at a LOS D or worse increases slightly from seven (7) to eight (8), but the intersection delay would significantly decrease overall. The intersections of US 11/15 & PA 581, US 11/15 & Harvard Avenue/Camp Hill Mall Entrance, US 11/15 & Chestnut Street/Trindle Road, and US 11/15 & 21st Street would remain at a LOS F. The intersection of US 11/15 & Stella Street would remain at a LOS E. The intersections of US 11/15 & Market Street/Carlisle Pike, US 11/15 & Country Club Road, and US 11/15 & 12th Street/Erford Road would operate at a LOS D.

Intersection delay at the intersection of US 11/15 & Chestnut Street/Trindle Road would decrease from 130 seconds to 108 seconds of delay per vehicle. High traffic volume at the through and left turn movements of the eastbound Trindle Road approach and westbound Chestnut Street approach, along with the high traffic volume at the left turn movement of the northbound US 11/15 approach, are the main causes of delay at the intersection.

Intersection delay at the intersection of US 11/15 & PA 581 would increase slightly from 81 seconds to 99 seconds of delay per vehicle. Excess volume over capacity at the eastbound approach from PA 581 and a high traffic volume at the through movement of the southbound US 11/15 approach are the main cause of delay at the intersection.

Intersection delay at the intersection of US 11/15 & 21st Street would decrease from 253 seconds to 97 seconds of delay per vehicle. Excess volume over capacity at the left turn movement of the northbound US 11/15 approach, along with the high traffic volumes at the eastbound and westbound 21st Street approaches, remain the main causes of delay at the intersection.

Intersection delay at the intersection of US 11/15 & Harvard Avenue/Camp Hill Mall Entrance would decrease from 100 seconds to 87 seconds per vehicle. High traffic volume at the through and left turn movements of the eastbound Camp Hill Mall Entrance approach and westbound Harvard Avenue approach, along with the high traffic volume at the left turn movement of the northbound US 11/15 approach, remain the main causes of delay at the intersection.

Intersection delay at the intersection of US 11/15 & Stella Street would increase slightly from 74 seconds to 79 seconds per vehicle. The slight increase is attributed to the addition of this traffic signal into an interconnected system with the intersections of US 11/15 & 2nd Street and US 11/15 & Front Street. The high traffic volume at the left turn and right turn movements of the eastbound Stella Street approach, along with the through movement of the northbound US 11/15 approach, are the main causes of delay at the intersection.

Intersection delay at US 11/15 & Market Street/Carlisle Pike would decrease from 123 seconds to 49 seconds per vehicle. The high traffic volume at the through and left turn movements of the eastbound

Carlisle Pike approach and westbound Market Street approach, along with the left turn movement of the northbound US 11/15 approach, remain the primary causes of delay at this intersection.

Intersection delay at US 11/15 & Country Club Road would increase from 24 seconds to 40 seconds, which may be attributed to the traffic signal timing modifications necessary to balance the system. The high traffic volume at the left turn movement of the eastbound Country Club Road approach, along with the high traffic volume at the left turn movement of the northbound US 11/15 approach, are the main causes of delay at the intersection.

Intersection delay at US 11/15 & 12th Street/Erford Road would decrease from 45 seconds to 38 seconds per vehicle. High traffic volume at the left turn movement of the eastbound 12th Street approach, along with the high traffic volume at the left turn movement of the northbound US 11/15 approach, are the main causes of delay at the intersection.

B. Long-Term Build Conditions (4-10 years)

1. IDENTIFICATION OF IMPROVEMENT ALTERNATIVES

The Long-Term improvements require thorough planning and extensive design, which may require special environmental consideration and right-of-way acquisition, and therefore may not be completed within the CCIP schedule. The Long-Term improvements identified in this section consist of projects that were evaluated in the Short-Term improvements section, but would not be able to be completed within the immediate time frame of this initiative (0-3 years). The following Long-Term solutions are applicable as part of this program:

- Major Geometric Improvements
- Multimodal Initiatives
- Intelligent Transportation Systems (ITS)

Major Geometric Improvements

As noted in the Short-Term Build scenario, PENNDOT Engineering District 8-0 is already addressing the major operational concerns along the freeway section of the study corridor. The major bottleneck in the arterial section of the corridor is the US 11/15 & 21st Street intersection, which is scheduled for reconstruction. The project team agreed to evaluate the effects of the current preferred alignment for the 21st Street intersection in the 2012 Long-Term Build conditions since the project is currently a concept without a construction date established. The following paragraph provides a description of the proposed roadway modifications:

- US 11/15 & 21st Street Intersection

  Improvements at this intersection include reconfiguring the intersection to allow two (2) left turn lanes from northbound US 11/15 to north 21st Street. A left lane/exit from the westbound M. Harvey Taylor Bridge approach will be added from south of Erford Road to 21st Street. This left lane/exit will be for traffic coming from Harrisburg and southbound US 11/15 wishing to turn south onto 21st Street. The new lane will exit to the left and parallel the eastbound M. Harvey Taylor Bridge approach under the existing overpass of US 11/15 to 21st Street. A new traffic signal will be added at the merge of southbound US 11/15 and the M. Harvey Taylor Bridge approach. This will replace the existing stop sign and permit southbound US 11/15 traffic to merge with the M. Harvey Taylor Bridge approach traffic from Harrisburg before intersection with 21st Street. The new traffic signal and the associated merging of the traffic prior to the 21st Street intersection will eliminate the yield control for the southbound traffic that is located immediately following the existing traffic signal. Finally, the proposed improvements will include the widening to three (3) lanes on north 21st Street from US 11/15 to Center Street, yet the existing parking lane will be maintained.

Multimodal Initiatives

As noted in the Short-Term Build scenario, there are multiple transit initiatives in the study area by CAT. These initiatives, such as the addition of a route/link from I-83 York County to the West Shore Business Complex and CORRIDOR Onerail project, are certainly consistent with the long-range plans of this initiative. The following paragraph provides a brief summary of the CORRIDOR One Rail Project:

- CORRIDOR One Rail Project

  One of the major projects in the planning stage at this time is the CORRIDOR One Rail Project, which is a proposed rail corridor that will serve a stretch from Carlisle through Harrisburg to Lancaster. This project is being pursued as a separate effort from this initiative, but should play a role in alleviating the traffic congestion in the area, including the study limits of the US 11/15 corridor.

Intelligent Transportation Systems (ITS)

As noted in the Short-Term Build scenario, the location of the US 11/15 corridor in relation to the bridges into Harrisburg and the other surrounding highways provides opportunities for alternative routes, such as the PA Turnpike, PA 581, and I-81 to be used during times of heavy traffic volumes or incidents. The dissemination of traveler information along each of the corridors in the region would improve delay, travel time, and safety during recurring and non-recurring congestion. The following provides a brief summary of a potential ITS deployment strategy along the US 11/15 study corridor:

- US 11/15 Study Corridor ITS Deployment

  The ITS devices and communications network deployed along the US 11/15 corridor may consist of sensors, such as microwave detectors for vehicle and incident detection, closed circuit television (CCTV) cameras for incident detection and verification along the limited access sections of the corridor and interchanges, dynamic message signs (DMS) to disseminate traveler information, and a communications system to transfer traffic data between the field devices and the PENNDOT Engineering District 8-0 office building.

2. ANALYSIS OF IMPROVEMENT ALTERNATIVES

The entire corridor, including the six (6) limited access interchanges and 14 signalized intersections in the study area, were analyzed using the weekday AM, Mid-Day, and PM peak hour volumes projected for the design year of 2012. The traffic analysis and simulation software packages of Synchro and SimTraffic were used for the analysis of the free access section of the corridor from PA 581 to Summerdale Road/Valley Street. The traffic analysis software package of CORSIM was used for the limited access sections of the corridor from the Pennsylvania Turnpike (I-76) to PA 581 and Summerdale Road/Valley Street to I-81. The software simulation package of TRAFVU was then used to simulate the entire corridor. All traffic analysis techniques were consistent with the analysis of existing and future No-Build conditions. The traffic analysis output is available in Appendix B.

It is important to understand that many of the above alternatives cannot be modeled in the computer simulations, yet it is believed that these methods will have a positive effect in reducing traffic congestion since they have been applied to numerous similar roadway networks both within the state of Pennsylvania and throughout the nation and have yielded positive results. The following roadway network modifications to the 2012 No-Build conditions were evaluated in the software simulation models:

Traffic Signal Improvements

Traffic signal timing at each signalized intersection was optimized through the Synchro software package.

Major Geometric Improvements

The proposed improvements to the intersection of US 11/15 & 21st Street were included in the analysis and simulation software.

a. Simulated Travel Time

A simulation model using Synchro, SimTraffic and CORSIM was developed for each peak period using the proposed roadway improvements and projected turning movement counts.

The anticipated peak hour average travel times and speeds along the study corridor are shown in Table 12 and Table 13.

TABLE 12: SIMULATED 2012 LONG-TERM BUILD PEAK HOUR AVERAGE TRAVEL TIMES

Northbound Direction (Seconds)

Corridor Link	AM	Mid-Day	PM
Pennsylvania Turnpike (I-76)	-	-	-
Rossmoyne Road	101.7	67.6	67.5
Slate Hill Road	64.8	61.8	61.8
Simpson Ferry Road	60.8	59.8	59.8
PA 581	63.2	60.0	59.9
Harvard Avenue/Camp Hill Mall	31.3	31.4	33.9
Chestnut Street/Trindle Road	53.9	45.4	37.1
Market Street/Carlisle Pike	39.7	40.6	24.3
Brentwater Road	80.2	70.8	70.7
Country Club Road	23.1	20.8	20.1
21st Street	125.3	73.8	91.2
12th Street/Erford Road	87.0	86.1	104.0
2nd Street	84.5	85.0	85.9
Front Street	47.5	40.9	42.8
Stella Street	59.7	64.4	143.0
Market Street	103.2	102.9	102.9
Summerdale Plaza	236.4	239.7	245.7
Summerdale Road/Valley Street	66.6	66.7	68.7
I-81	27.3	26.6	26.9
Totals (Seconds)	**1356**	**1245**	**1346**
Totals (Minutes)	**22.6**	**20.7**	**22.4**

Southbound Direction (Seconds)

Corridor Link	AM	Mid-Day	PM
I-81	-	-	-
Summerdale Road/Valley Street	32.5	31.9	31.8
Summerdale Plaza	67.2	70.1	61.8
Market Street	242.2	235.5	237.1
Stella Street	132.1	116.1	122.1
Front Street	57.8	57.8	57.8
2nd Street	18.7	15.9	16.9
12th Street/Erford Road	105.4	96.1	116.2
21st Street	98.5	99.9	154.7
Country Club Road	73.0	71.2	70.2
Brentwater Road	27.4	28.0	20.5
Market Street/Carlisle Pike	87.7	97.0	87.5
Chestnut Sreet/Trindle Road	32.6	30.9	22.1
Harvard Avenue/Camp Hill Mall	39.1	46.9	96.4
PA 581	48.5	40.3	101.6
Simpson Ferry Road	64.5	64.1	65.2
Slate Hill Road	50.6	50.5	50.9
Rossmoyne Road	44.0	42.5	43.0
Pennsylvania Turnpike (I-76)	84.9	86.2	87.2
Totals (Seconds)	**1307**	**1281**	**1443**
Totals (Minutes)	**21.8**	**21.3**	**24.0**

TABLE 13: SIMULATED 2012 LONG-TERM BUILD PEAK HOUR AVERAGE TRAVEL SPEEDS

Northbound Direction (MPH)

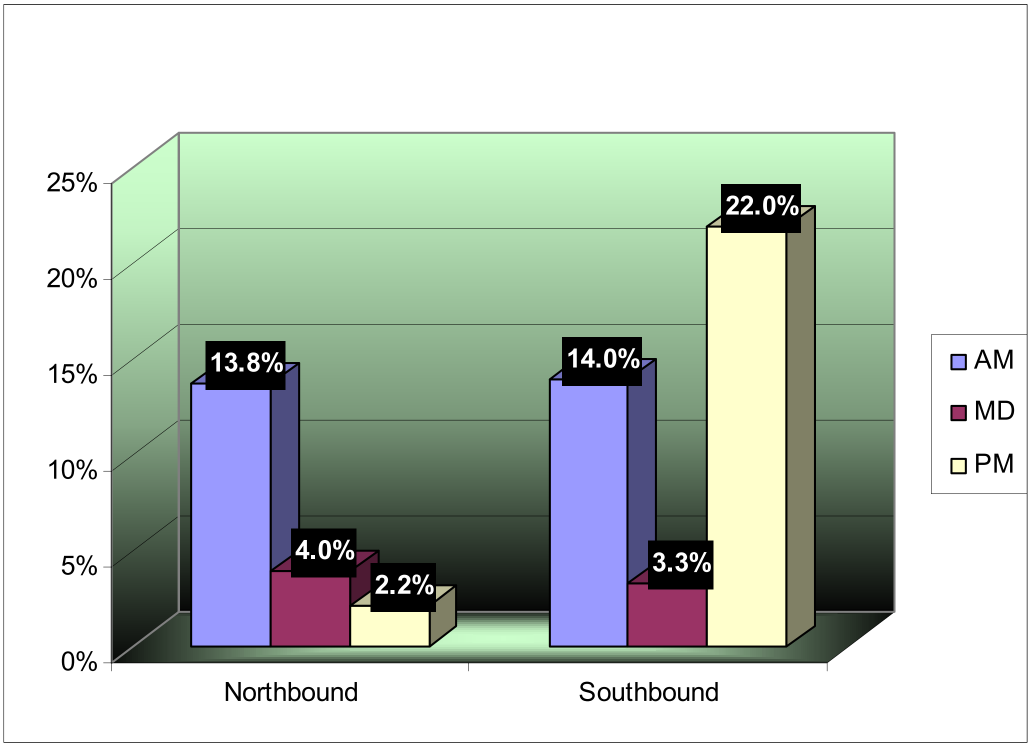
Corridor Link	AM	Mid-Day	PM
Pennsylvania Turnpike (I-76)	-	-	-
Rossmoyne Road	46.7	70.2	67.5
Slate Hill Road	39.9	41.9	61.8
Simpson Ferry Road	69.8	71.0	59.8
PA 581	17.6	18.6	59.9
Harvard Avenue/Camp Hill Mall	20.3	19.7	19.0
Chestnut Street/Trindle Road	15.0	17.8	15.4
Market Street/Carlisle Pike	7.3	7.2	8.2
Brentwater Road	23.2	26.3	26.3
Country Club Road	15.9	17.5	18.3
21st Street	15.1	25.6	20.8
12th Street/Erford Road	19.5	23.3	19.3
2nd Street	29.0	29.3	29.0
Front Street	5.3	5.7	5.3
Stella Street	26.6	25.7	11.9
Market Street	32.5	34.1	32.4
Summerdale Plaza	34.5	34.3	33.2
Summerdale Road/Valley Street	27.9	31.8	31.3
I-81	64.0	65.6	26.9

Southbound Direction (MPH)

Corridor Link	AM	Mid-Day	PM
I-81	-	-	-
Summerdale Road/Valley Street	53.7	54.7	54.9
Summerdale Plaza	34.1	29.5	34.8
Market Street	32.9	34.5	34.4
Stella Street	27.6	30.4	27.2
Front Street	29.5	29.5	29.5
2nd Street	12.5	15.5	13.6
12th Street/Erford Road	16.5	25.9	21.4
21st Street	20.5	20.1	13.0
Country Club Road	25.9	26.6	27.0
Brentwater Road	13.4	12.5	18.0
Market Street/Carlisle Pike	21.2	19.2	18.8
Chestnut Sreet/Trindle Road	8.9	9.4	4.7
Harvard Avenue/Camp Hill Mall	21.4	17.3	7.1
PA 581	14.0	15.4	6.5
Simpson Ferry Road	17.3	17.4	17.1
Slate Hill Road	83.9	84.0	83.4
Rossmoyne Road	58.8	60.9	60.2
Pennsylvania Turnpike (I-76)	55.9	55.1	54.4

The peak hour average travel times were compared against the 2012 No-Build conditions and are presented in Figure 13.

FIGURE 13: DECREASE IN SIMULATED TRAVEL TIME FROM 2012 NO-BUILD CONDITIONS TO 2012 LONG-TERM BUILD CONDITIONS



AM Peak Hour

The total travel time for the corridor decreases from 26.2 minutes to 22.6 minutes (13.8%) in the northbound direction and from 25.3 minutes to 21.8 minutes (14.0%) in the southbound direction.

Mid-day Peak Hour

The total travel time for the corridor decreases from 21.6 minutes to 20.7 minutes (4.0%) in the northbound direction and from 22.1 minutes to 21.3 minutes (3.3%) in the southbound direction.

PM Peak Hour

The total travel time for the corridor decreases from 22.9 minutes to 22.4 minutes (2.2%) in the northbound direction and from 30.8 minutes to 24.0 minutes (22.0%) in the southbound direction.

b. 2012 Long-Term Build Conditions Signalized Intersection Level of Service

The intersection level of service was calculated for the Long-Term Build conditions from the same method as the Existing and 2012 No-Build conditions.

For each of the 14 intersections, 2012 Long-Term Build Conditions Signalized Intersection Levels of Service are shown in Figure 14.

FIGURE 14: 2012 LONG-TERM BUILD SIGNALIZED INTERSECTIONS LOS

The results of the capacity analysis were then compared to the 2012 No-Build conditions.

AM Peak Hour

Intersection delays would decrease at 12 of the 14 signalized intersections during the AM peak hour when compared to 2012 No-Build conditions. The number of intersections operating at LOS D or worse decreases from seven (7) to four (4). None of the signalized intersections would operate at LOS F. The intersections of US 11/15 & 21st Street would improve to a LOS E from a LOS F, and the intersection of US 11/15 & 12th Street would remain at a LOS E. The remaining intersections, US 11/15 & Chestnut Street/Trindle Road and US 11/15 & Market Street/Carlisle Pike, would improve to a LOS D from a LOS F.

Intersection delay at US 11/15 & 21st Street would decrease from 195 seconds to 67 seconds of delay per vehicle. Excess volume over capacity at the through movement of the northbound US 11/15 approach, along with the high traffic volumes at the eastbound and westbound 21st Street approaches, continue to be the main causes of the remaining delay at the intersection.

Intersection delay at US 11/15 & 12th Street/Erford Road would decrease from 78 seconds to 62 seconds of delay per vehicle. The high traffic volume at the left turn movement of the northbound US 11/15 approach, along with the high traffic volume at the through movement of the westbound 12th Street approach, continue to be the main causes of the remaining delay at the intersection.

Intersection delay at US 11/15 & Chestnut Street/Trindle Road would decrease from 83 seconds to 40 seconds of delay per vehicle. High traffic volume at the through and left turn movement of the eastbound Trindle Road approach and westbound Chestnut Street approach continue to be main causes of the remaining delay at the intersection.

Intersection delay at US 11/15 & Market Street/Carlisle Pike would decrease from 87 seconds to 38 seconds of delay per vehicle. High traffic volume at the through and left turn movement of the eastbound Carlisle Pike approach and westbound Market Street approach continue to be main causes of the remaining delay at the intersection.

Mid-Day Peak Hour

Intersection delays would decrease at 10 of the 14 signalized intersections during the Mid-Day peak hour when compared to 2012 No-Build conditions. The number of intersections operating at LOS D or worse decreases from five (5) to four (4). None of the signalized intersections would operate at a LOS F. The intersection of US 11/15 & Chestnut Street/Trindle Road would improve to a LOS E from a LOS F. The remaining intersections, US 11/15 & Market Street/Carlisle Pike and US 11/15 & 21st Street, would improve to a LOS D, and the intersection of US 11/15 & 12th Street/Erford Road would remain at a LOS D.

Intersection delay at US 11/15 & Chestnut Street/Trindle Road would decrease from 90 seconds to 57 seconds of delay per vehicle. High traffic volume at the through and left turn movement of the eastbound Trindle Road approach and westbound Chestnut Street approach, along with the left turn movement of the northbound US 11/15 approach, continue to be main cause of the remaining delay at the intersection.

Intersection delay at US 11/15 & 21st Street would decrease from 158 seconds to 54 seconds of delay per vehicle. High traffic volume at the through movement of the southbound US 11/15 approach, along with the high traffic volumes at the eastbound and westbound 21st Street approaches, continue to be the main causes of the remaining delay at the intersection.

Intersection delay at US 11/15 & Market Street/Carlisle Pike would decrease from 99 seconds to 48 seconds of delay per vehicle. High traffic volume at the left turn movements of the eastbound Carlisle Pike approach and westbound Market Street approach continue to be main causes of the remaining delay at the intersection.

Intersection delay at US 11/15 & 12th Street/Erford Road would remain at 41 seconds of delay per vehicle. High traffic volume at the through movements of the westbound 12th Street approach and eastbound Erford Road approach continue to cause delay at the intersection.

PM Peak Hour

Intersection delay would decrease at 13 of the 14 signalized intersections during the PM peak hour when compared with the 2012 No-Build conditions. The number of intersections operating at a LOS D or worse would remain at seven (7). The intersections of US 11/15 & Chestnut Street/Trindle Road and US 11/15 & 21st Street would remain at a LOS F. The intersections of US 11/15 & Harvard Avenue/Camp Hill Mall Entrance would improve to a LOS E from a LOS F, and the intersection of US 11/15 & Stella Street would remain at a LOS E. The remaining intersections, US 11/15 & PA 581 and US 11/15 & Market Street/Carlisle Pike would improve to a LOS D from a LOS F, and the intersection of US 11/15 & 12th Street Erford Road would remain at a LOS D.

Intersection delay at US 11/15 & 21st Street would decrease from 253 seconds to 115 seconds of delay per vehicle. The high traffic volume at the left turn movement of the northbound US 11/15 approach, along with the high traffic volume at the through movement of the southbound US 11/15 approach, continue to be the main causes of remaining delay at the intersection.

Intersection delay at US 11/15 & Chestnut Street/Trindle Road would decrease from 130 seconds to 81 seconds of delay per vehicle. High traffic volume at the through and left turn movement of the eastbound Trindle Road approach and westbound Chestnut Street approach, along with the left turn movement of the northbound US 11/15 approach, continue to be the main causes of the remaining delay at the intersection.

Intersection delay at US 11/15 & Stella Street would remain at 75 seconds of delay per vehicle. High traffic volumes at the left turn movement of the eastbound Stella Street approach, along with the through movement of the northbound US 11/15 approach, continue to be the main causes of delay at the intersection.

Intersection delay at US 11/15 & Harvard Avenue would decrease from 100 seconds to 61 seconds of delay per vehicle. High traffic volumes at the left turn movement of the westbound Harvard Avenue approach, left turn movement of the northbound US 11/15 approach, and through movement of the southbound US 11/15 approach are the main causes of delay at the intersection.

Intersection delay at US 11/15 & PA 581 would decrease from 81 seconds to 53 seconds of delay per vehicle. High traffic volume at the right turn movement of the eastbound PA 581 approach, along with the high traffic volume at the through movement of the southbound US 11/15 approach, continue to be the main causes of remaining delay at the intersection.

Intersection delay at US 11/15 & Market Street/Carlisle Pike would decrease from 123 seconds to 47 seconds per vehicle. High traffic volume at the left turn movements of the eastbound Carlisle Pike approach and westbound Market Street approach continue to be the main causes of the remaining delay at the intersection.

Intersection delay at US 11/15 & 12th Street/Erford Road would decrease from 45 seconds to 37 seconds of delay per vehicle. High traffic volume at the left turn movement of the eastbound Erford Road approach, along with the left turn movement of the northbound US 11/15 approach, are the main causes of remaining delay at the intersection.

VI. RECOMMENDATIONS

Both the Short-Term (0-3 Years) and Long-Term (4-10 Years) improvement alternatives address the needs and objectives of this project. However, at this time, the Short-Term Build alternative has the ability to be developed and constructed within the length of this program. The Short-Term Build alternative is the focus of the recommendations and the Long-Term improvement alternatives should be studied further under a separate effort.

A. Short-Term Improvement Recommendations

The Short-Term improvement recommendations are a combination of initiatives to be implemented by multiple agencies. The recommendations are separated into multiple projects under the following categories for planning purposes:

- Traffic Signal Operations
- Minor Geometric Improvements
- Multimodal Initiatives
- Planning and Zoning

Benefit/Cost ratio calculations are provided where applicable and available in Appendix G.

Traffic Signal Operations

The existing traffic signals along the corridor present an immediate opportunity to improve travel time and delay within the study area. The recommended traffic signal improvements are a mixture of optimized timing and new hardware. The following two (2) traffic signal improvement projects have been identified through field observations, project meetings, and traffic analysis:

❑ Project 1: Camp Hill Traffic Signal Improvements (Timing Optimization)

Six (6) existing traffic signals along the US 11/15 study corridor limits within Camp Hill Borough are already interconnected via aerial and underground communication cable. The traffic signal timings for these intersections would simply require retiming to match the existing conditions. The following seven (7) traffic signals would be included in this project:

- US 11/15 & PA 581 (Existing traffic signal immediately; Proposed traffic signal in the future)
- US 11/15 & Harvard Avenue/Camp Hill Mall Entrance
- US 11/15 & Chestnut Street/Trindle Road
- US 11/15 & Market Street/Carlisle Pike
- US 11/15 & Brentwater Road
- US 11/15 & Country Club Road

This project should be procured immediately to take advantage of the traffic data and simulation models developed through this study. Approximate project cost to develop final timings, update traffic signal permit plan, and implement new timings is $30,000. A further analysis of the benefits of this project versus the cost indicates a benefit/cost ratio of 107.14.

- Project 2: Wormleysburg Traffic Signal Improvements (Interconnection and Timing Optimization)

  The existing traffic signals at the intersections of US 11/15 & 2nd Street and US 11/15 & Front Street are currently time-based coordinated (TBC). The existing traffic signal at the intersection of US 11/15 & Stella Street operates independently. Given the close proximity of the intersection of US 11/15 & Stella Street to the intersection of US 11/15 & Front Street, all three (3) traffic signals can be interconnected with optimized timings to enhance progression.

  This project should be procured immediately to take advantage of the traffic data and simulation models developed through this study. Approximate construction cost for above ground communication cable, master controller, software, warranty, and training is approximately $100,000. Design costs to develop final timings and construction plans are approximately $50,000. A further analysis of the benefits of this project versus the cost indicates a benefit/cost ratio of 3.82.

The traffic signals at the intersections of US 11/15 & 21st Street, US 11/15 & 12th Street/Erford Road, and US 11/15 & Summerdale Road/Valley Street are included in closed loop traffic signal systems that are timed to enhance progression in the eastbound and westbound directions. The intersection of US 11/15 & 21st Street is scheduled for improvements; the existing traffic signals will be modified and improved at that time. The LOS at the intersection will not improve significantly with only traffic signal modifications based on traffic signal timing optimization. Therefore, traffic signal improvements at the intersection of US 11/15 & 12th Street/Erford Road do not appear necessary. The intersection of US 11/15 & Summerdale Road/Valley Street is projected to operate at LOS A (Mid-Day), B (PM), and C (AM).

The remaining traffic signals within the study area at the intersections of US 11/15 & 2nd Street, US 11/15 & Front Street, US 11/15 & Market Street and US 11/15 & Summerdale Plaza, are projected to operate at a LOS A and LOS B in the future; therefore, modification of these traffic signals is not recommended at this time.

Minor Geometric Improvements

PENNDOT Engineering District 8-0 is already addressing the major operational concerns along the freeway section of the corridor at PA 589 and arterial section of the corridor at 21st Street through major geometric improvements. Given the US 11/15 corridor within the limits of this study is almost fully developed, the opportunities for minor geometric improvements are limited. The following two (2) minor geometric improvement projects have been identified through field observations, project meetings, and traffic analysis:

- Project 1: Intersection Safety Improvements at US 11/15 & Harvard Avenue/Camp Hill Mall Entrance

  Extending the left turn lane for northbound US 11/15 at the Harvard Avenue intersection to a minimum of 300 feet is included in the PA 581 interchange improvements. This will assist with providing additional queue length required for the seasonal traffic wishing to turn into the Camp Hill Mall shopping center. This improvement will also be provided if the entrance into the shopping center is relocated from Harvard Avenue to Yale Avenue. There would be no additional cost for this improvement since it will be included in either the PA 581 interchange improvements or Camp Hill Mall shopping center renovations. This project will primarily provide safety enhancements at the intersection; therefore, a benefit/cost ratio for the travel/time delay improvements was not calculated.

- Project 2: Intersection Safety Improvements at US 11/15 & 12th Street/Erford Road

  Extending the left turn lane from northbound US 11/15 onto Erford Avenue to a minimum of 250 feet will provide additional queue length for the morning peak traffic. Observing the US 11/15 northbound AM peak traffic indicated that the volume of vehicles wishing to turn left onto Erford Avenue would typically exceed the length of the left turn lane and the excess traffic would sit in the painted center turn lane. Currently the storage length is 120 feet, and the Synchro/SimTraffic software indicates a maximum queue length in the 2012 Short-Term Build conditions as 224 feet. The additional storage length would provide enhanced safety at the intersection approach, and it can be accomplished through re-striping of the current roadway. The cost for this work would be approximately $5,000. This project will primarily provide safety enhancements at the intersection; therefore, a benefit/cost ratio for the travel/time delay improvements was not calculated.

Multimodal Initiatives

The 2002 US Census Data estimates that 82 percent of Cumberland County residents commute to work alone, 9 percent carpool, 1 percent use some sort of public transportation, 7 percent walk, and 1 percent use some other mode of transportation. This data stresses the need for initiatives that support other modes of transportation, especially transit. The following three (3) multimodal projects have been identified through field observations, project meetings, and traffic analysis:

- Project 1: Park & Ride Facility at Camp Hill Mall

  An unofficial Park & Ride facility at the Camp Hill Mall has been observed throughout this study. It is advisable to establish an official Park & Ride Facility at the Mall. Camp Hill Borough has met with the future owners of the Camp Hill Mall to discuss future transportation plans, which included discussions for a Park & Ride facility with transit service. Camp Hill Borough, PENNDOT, and CAT should pursue this project with the developer, and the costs may be included within the renovations of the existing parking facilities. The ridership of this project cannot be calculated within the scope of this report; therefore, a benefit/cost ratio for the travel/time delay improvements was not calculated within this study.

- Project 2: Transit Needs Study

  CAT has extensive transit facilities operating along the West Shore of the Susquehanna River, yet the census data estimates that only 1 percent of county residents used public transportation in 2002. Although the anticipated ridership of new routes and expanded service is beyond the scope of this report, a detailed public transit study within the corridor limits may help better define the need and most appropriate allocation of resources. The transit study should investigate expanded bus routes based on origin and destination data, bus bays or loading areas on side streets at strategic stops, and bus shelters. The benefits of transit improvements will be determined through the needs study; therefore, a benefit/cost ratio for the travel/time delay improvements was not calculated within this study.

- Project 3: Bicycle Study

  Given some of the concurrent efforts to evaluate bicycle facilities in adjacent areas, it makes sense to identify opportunities within the study area. This report has identified two (2) efforts from the TCRPC in the Cumberland and Perry Counties Safety and Congestion Management System Needs Study and PENNDOT in Route J within the Bicycle PA program. A detailed bicycle study within the corridor limits may (1) help better define the need for these facilities through surveys and/or cooperation with local bicycle organizations, (2) coordinate with other adjacent projects and roadway projects, (3) develop cross section concepts and cost estimates, and (4) identify construction-funding sources. The benefits of bicycle facilities along the corridor will be determined through the bicycle study; therefore, a benefit/cost ratio for the travel/time delay improvements was not calculated within this study.

Planning and Zoning

A few mid-block locations within the study area have a relatively high number of reportable crashes over the past three years. The observed of lack of access control and high frequency of crashes suggest that access management strategies may improve the safety and operation of the corridor. The following project along the arterial section of the study corridor has been identified through field observations, project meetings, and traffic analysis:

- Project 1: Develop Access Management Plan along US 11/15 in Camp Hill Borough, Lemoyne Borough, Wormleysburg Borough, and East Pennsboro Township

  An access management plan will provide a detailed inventory of the current access facilities along the corridor, most likely on aerial photography. The access facilities are compared with the existing land use and zoning maps to identify specific locations where access points may be consolidated. In addition, access requirements for future development are provided. The access management recommendations are provided in language for an access management overlay district to be adopted into the municipal zoning ordinances.

  The cost to develop access management plan is approximately $150,000. Each municipality would be responsible to adopt the access management overlay district for the US 11/15 corridor within their zoning ordinances. Additional traffic counts at driveways can be applied to the simulation model to determine the benefits of access management improvements; therefore, a benefit/cost ratio for the travel/time delay improvements was not calculated within this study.

B. Long-Term Improvement Recommendations

The Long-Term improvement recommendations are a combination of initiatives to be implemented by multiple agencies. These recommendations are outside the scope of this program. The recommendations are separated into multiple projects under the following categories for planning purposes:

- Traffic Signal Operations
- Major Geometric Improvements
- Multimodal Initiatives
- Intelligent Transportation Systems (ITS)
- Transportation Demand Management (TDM) Measures

Traffic Signal Operations

A study conducted by the Department of Fire and Safety Services, St. Paul, Minnesota (1977) examined emergency vehicle crash rates before and after the installation of emergency vehicle traffic signal preemption. Between 1969 and 1976, the crash rate for emergency vehicles decreased by 70.8 percent. During this time period, the number of signalized intersections increased from 274 to 308, and the number of intersections with signal preemption grew from 28 to 285. Another study conducted in the City of Houston between 1991 and 1992 installed emergency preemption devices at 22 intersections within two (2) fire districts. After a year of operations, the average emergency vehicle travel time decreased 16 percent in one district and 23 percent in the other.

Enhancements to the existing traffic signal systems may be accomplished through traffic signal priority systems. Emergency vehicle priority systems can be implemented rather quickly, but transit priority systems require further analysis. Potential efforts are therefore categorized into two (2) separate efforts:

- Emergency Vehicle Traffic Signal Preemption
- Needs Assessment Study for Transit Priority along the US 11/15 Corridor

Major Geometric Improvements

PENNDOT Engineering District 8-0 is already addressing the major operational concerns along the freeway section of the corridor through the PA 581 interchange project. PENNDOT Engineering District 8-0 is also addressing the major bottleneck in the arterial section of the corridor at 21st Street, although this project is currently in the conceptual development stage. The analysis in this report shows significant improvement at the intersection of US 11/15 & 21st Street based on the current preferred alignment. Therefore, it is recommended that this project continue to be pursued, as it is consistent with the efforts of this study. The project effort will remain in the Long-Term recommendations as:

- US 11/15 & 21st Street Intersection Reconstruction Project

Multimodal Initiatives

The need for transit in the study area is clear from the 2002 census data. Given the lack of regional rail facilities in the study area, the CORRIDOR One Rail Project should fulfill some of this need. The CORRIDOR One Rail Project is consistent with the efforts of this study; therefore, it is recommend that this project continue to be pursued. This project will remain in the Long-Term recommendations as:

- CORRIDOR One Rail Project

Intelligent Transportation Systems (ITS)

The location of the US 11/15 corridor in relation to the various bridges into Harrisburg and the other surrounding highways provides opportunities for alternative routes, such as the PA Turnpike, PA 581, and I-81, to be used during times of heavy traffic volumes or incidents. The dissemination of traveler information systems along each of the corridors in the region would improve delay, travel time and safety during recurring and non-recurring congestion. Currently, PENNDOT Engineering District 8-0 does not have the resources to monitor and operate these systems, but a traffic management center (TMC) should be developed by PENNDOT in the Harrisburg area within the next 10 years to be consistent with the Regional ITS Architecture. Therefore, contingent upon development of a TMC, the following projects have been identified as Long-Term recommendations:

- Traffic and Incident Management System along US 11/15 in Cumberland County

  This project includes the deployment of sensors for vehicle and incident detection, closed circuit television (CCTV) cameras for incident detection and verification along the limited access sections of the corridors and interchanges, dynamic message signs (DMS) to disseminate traveler information, and a communications system to transfer data between the field devices and the PENNDOT Engineering District 8-0 office building.

  As part of this project, interagency agreements should be developed between PENNDOT and the Pennsylvania Turnpike Commission (PTC) to share traffic and incident data. This will become critical for providing information to the US 11/15 northbound motorists traveling south of the Pennsylvania Turnpike. By providing motorist with information in advance of the PA Turnpike it allows them the opportunity to avoid trouble areas on the PA Turnpike, or use the PA Turnpike as an alternate route if US 11/5 is congested. Likewise, providing information to motorist on the PA Turnpike prior to the US 11/15 interchange allows them to make an informed decision about using that exit or possibly continuing to the next exit due to travel conditions on the study corridor.

- Highway Advisory Radio (HAR) along US 11/15 in Cumberland County

  HAR provides highway users with information in their vehicles using AM or FM radio transmissions from a roadside transmitter. HAR can be used to provide notifications or warning of roadway incidents or congestion, warning of adverse environmental conditions, highway construction or maintenance, alternate route information, or tourist information.

- Interactive Kiosks along US 11/15 in Cumberland County

  Interactive kiosks can be placed at key locations or major traffic generators in the City of Harrisburg, such as the Camp Hill Mall, the Capital City Mall, and various office lobbies. These devices are typically built on a PC platform and are equipped with a communication link for accessing real-time information on the status of roadways and transit in the area.

Transportation Demand Management (TDM) Measures

The 2002 Census Data shows the need for reducing the amount of single occupancy vehicles (SOVs) along the study corridor and other corridors in the county. The following two (2) TDM projects have been identified through field observations, project meetings, and traffic analysis:

- Transportation Management Association (TMA)

  TMAs can assist the public in finding alternative means of transportation to work or school. TMAs are public private partnerships that develop, support, promote, and improve new and existing transportation systems. They work with employers in the region to help disseminate transportation information quickly and easily. The TMAs in the Philadelphia, PA region have been funded by PENNDOT in the past, but PENNDOT has now requested that the region fund these programs using CMAQ funding. Based on the TMA budgets allocated in the Delaware Valley Regional Planning Commission TIP, a TMA in the Harrisburg region, preferably in the West Shore area, would require approximately $160,000 per year. This would include $128,000 in CMAQ funding (80%) and would require $32,000 in local matching funds (20%).

- Commuter Alternatives Program

  A commuter alternatives program can help the general public, including employers in the region, save time and money on their daily commute to work while reducing traffic congestion and air pollution. Some of the services include ride matching, variable work hour programs, and telecommuting. These programs can be administered through the local planning organization or TMA. Although the commuter alternatives program is active within the Tri-County Regional Planning Commission, the funding and resources are limited. Therefore, further funding may enhance this program. A commuter alternatives program is also eligible for CMAQ funding. Again using the DVRPC TIP as a reference, a commuter alternatives program in the Harrisburg region would require approximately $270,000 per year. This would include $216,000 in CMAQ funding (80%), $18,000 in PENNDOT funding (6.67%), and $36,000 in local matching funds (13.33%).

VII. NEXT STEPS

The goal of this project is to achieve a reduction of peak hour travel time in the study corridor. The Short-Term improvement recommendations, which are the focus of this study, have the ability to be implemented immediately or within the next three (3) years at the latest.

This report identifies some of the needs within the corridor and specific projects that may help to address some of the needs. The projects have been prioritized within the Short-Term and Long-Term time frames, and Short-Term improvement recommendations have benefit/cost ratios where applicable to further prioritize the projects. The Short-Term improvement recommendations are ready to be moved into the next steps, which in some cases mean final design. The extensive traffic data collected for this report and traffic software can be utilized for the next steps if the projects are procured within the next two years.

A summary of the Short-Term Build action list and responsible agencies is provided in Table 14. Also, a summary of the Long-Term improvement recommendations is provided in Table 15.

TABLE 14: SHORT-TERM BUILD ACTION LIST

Traffic Signal Operations						
Municipality	***Concern/Issue***	***Jurisdiction***	***Next Steps***	***Projected Date of Completion***	***Cost***	***B/C Ratio***
Camp Hill Borough	Traffic signal timing optimization for six (6) signalized intersections: ▪ PA 581 ▪ Harvard Avenue ▪ Chestnut Street ▪ Market Street ▪ Brentwater Road ▪ Country Club Road	Local / PENNDOT	PENNDOT to procure engineering services for traffic signal timing optimization and implementation	Implemented by Summer 2003	$30,000	107.14
Borough of Wormleysburg	Closed loop interconnection and traffic signal timing optimization for three (3) signalized intersections along US 11/15: ▪ 2nd Street ▪ Front Street ▪ Stella Street	Local / PENNDOT	PENNDOT to procure engineering services for closed loop interconnection and traffic signal timing optimization	Implemented by Summer 2004	$150,000	3.82

TABLE 14 (CONTINUED)

Minor Geometric Improvements						
Municipality	***Concern/Issue***	***Jurisdiction***	***Next Steps***	***Projected Date of Completion***	***Cost***	***B/C Ratio***
Camp Hill Borough	Extend northbound US 11/15 left turn lane at Harvard Avenue/Camp Hill Mall Entrance	Local / PENNDOT	Coordinate with the PA 581 interchange reconstruction project & Camp Hill Mall renovation project	Late 2004 or early 2005	Included in separate effort	N/A
Lemoyne Borough and East Pennsboro Township	Extend northbound US 11/15 left turn lane at 12th Street/Erford Road	Local / PENNDOT	PENNDOT to investigate	Summer 2003	$5,000	N/A

TABLE 14 (CONTINUED)

Multimodal Initiatives						
Municipality	***Concern/Issue***	***Jurisdiction***	***Next Steps***	***Projected Date of Completion***	***Cost***	***B/C Ratio***
Various	Transit study to investigate expanded bus service, bus bays, and bus shelters	CAT	TCRPC allocate funding in TIP; CAT administer study	Summer 2005	$100,000	N/A
Various	Bicycle study to investigate facilities along the study corridor	Local/ PENNDOT	TCRPC allocate funding in TIP and administer study	Summer 2005	$50,000	N/A
Camp Hill Borough	Formalize Park & Ride facility at the Camp Hill Mall	Local / PENNDOT/ CAT	Camp Hill Borough/PENNDOT/CAT include facility in mall improvement plans	Summer 2004	Included in separate effort	N/A

TABLE 14 (CONTINUED)

Planning and Zoning Initiatives						
Municipality	***Concern/Issue***	***Jurisdiction***	***Next Steps***	***Projected Date of Completion***	***Cost***	***B/C Ratio***
Camp Hill Borough; Lemoyne Borough; Wormleysburg Borough; East Pennsboro Township	Access management along US 11/15	Local/ PENNDOT	Develop Access Management Plan and Adopt Access Management Overlay District Along US 11/15	Summer 2004	$150,000	N/A

TABLE 15: LONG-TERM BUILD RECOMMENDATIONS

Traffic Signal Improvements		
Muncipality	***Project***	***Cost***
Various	Emergency Vehicle Traffic Signal Priority	\$7,000 per intersection \$1,250 per emitter
Various	Needs Assessment Study for Transit Priority along the US 11/15 Corridor	\$100,000

Major Geometric Improvements		
Muncipality	***Project***	***Cost***
Camp Hill Borough and East Pennsboro Township	US 11/15 & 21st Street Intersection Reconstruction Project	\$3,300,000

Multimodal Initiatives		
Muncipality	***Project***	***Cost***
Various	CORRIDOR One Rail Project (Transitional Analysis Study)	\$1,400,000

Intelligent Transportation Systems (ITS)		
Muncipality	***Project***	***Cost***
Various	Construction of a Traffic & Incident Management System along US 11/15 (limited access sections) from I-76 to I-81	\$4,000,000 (\$1,000,000 per mile)
Various	Construction of a Highway Advisory Radio (HAR) System along US 11/15 (limited access interchanges) from I-76 to I-81	\$120,000 (\$20,000 per interchange)
Various	Construction of Interactive Kiosks along US 11/15 in Cumberland County	\$250,000 (\$50,000 per kiosk)

Transportation Demand Management (TDM) Measures		
Muncipality	***Project***	***Cost***
Various	Transportation Management Association (TMA)	\$160,000 per year
Various	Commuter Alternatives Program	\$216,000 per year