DELAWARE VALLEY
dvrpc
REGIONAL
PLANNING COMMISSION

AUGUST 2011

BEDMINSTER AND HILLTOWN TOWNSHIPS, BUCKS COUNTY

CONGESTION & CRASH Site Analysis Program

DELAWARE VALLEY
dvrpc
REGIONAL
PLANNING COMMISSION

AUGUST 2011

BEDMINSTER AND HILLTOWN TOWNSHIPS, BUCKS COUNTY

CONGESTION & CRASH Site Analysis Program

The Delaware Valley Regional Planning Commission is dedicated to uniting the region's elected officials, planning professionals, and the public with a common vision of making a great region even greater. Shaping the way we live, work, and play, DVRPC builds consensus on improving transportation, promoting smart growth, protecting the environment, and enhancing the economy. We serve a diverse region of nine counties: Bucks, Chester, Delaware, Montgomery, and Philadelphia in Pennsylvania; and Burlington, Camden, Gloucester, and Mercer in New Jersey. DVRPC is the federally designated Metropolitan Planning Organization for the Greater Philadelphia Region — leading the way to a better future.

The symbol in our logo is adapted from the official DVRPC seal and is designed as a stylized image of the Delaware Valley. The outer ring symbolizes the region as a whole while the diagonal bar signifies the Delaware River. The two adjoining crescents represent the Commonwealth of Pennsylvania and the State of New Jersey.

DVRPC is funded by a variety of funding sources including federal grants from the U.S. Department of Transportation's Federal Highway Administration (FHWA) and Federal Transit Administration (FTA), the Pennsylvania and New Jersey departments of transportation, as well as by DVRPC's state and local member governments. The authors, however, are solely responsible for the findings and conclusions herein, which may not represent the official views or policies of the funding agencies.

DVRPC fully complies with Title VI of the Civil Rights Act of 1964 and related statutes and regulations in all programs and activities. DVRPC's website (www.dvrpc.org) may be translated into multiple languages. Publications and other public documents can be made available in alternative languages and formats, if requested. For more information, please call (215) 238-2871.

Table of Contents

Figures and Tables

Appendix

Executive Summary

The goals of the Congestion and Crash Site Analysis Program (CCSAP) are to improve access and efficiency of the region's transportation system, improve safety and air quality, and reduce congestion through analyses of specific highway locations with demonstrated problems in both New Jersey and Pennsylvania.

Due to their many conflict points, intersections experience more crashes than midblock locations. In addition, the geometry of an intersection can present many issues for the road user. Assuring the efficient operation of intersections is an increasingly important issue as municipalities attempt to maximize roadway capacity to serve the growing demand for travel. The objective is to identify cost-effective improvements that will reduce crashes and congestion.

The intent for the Fiscal Year 2011 CCSAP is to examine either a signalized or unsignalized intersection identified on the 2010 High Risk Rural Road (HRRR) list generated by the Pennsylvania Department of Transportation's (PennDOT) Bureau of Highway Safety and Traffic Engineering (BHSTE). A range of appropriate intersections was developed through a data-driven process, and from those the Bucks County Planning Commission suggested the intersection of SR 113 (Bedminster Road/Souderton Road) and SR 313 (Dublin Pike), in Bedminster and Hilltown townships, Pennsylvania.

The study area experiences a relatively high number of crashes. With the help of input from the advisory committee (local, county, and state officials) and the analyses performed by Delaware Valley Regional Planning Commission (DVRPC), several improvement strategies were developed that would increase the safety and mobility of all road users traveling through this intersection. The list of advisory committee participants is provided in Appendix A.

The range of strategies developed included the following: adding signage, reconfiguring travel lanes and driveways, adding pavement markings, and adding sidewalks. Many of the above-mentioned strategies were recommended for implementation. The majority of these improvements were low-cost and short-term solutions to help improve traffic flow and safety of all roadway users traveling through the intersection of SR 113 and SR 313.

CHAPTER 1

Introduction

This technical report provides analysis and recommendations for the intersection of SR 113 (Bedminster Road/Souderton Road) and SR 313 (Dublin Pike), in Bedminster and Hilltown townships, Pennsylvania. The recommended strategies cover both safety and operational improvements. The safety improvements were developed based on professional knowledge and discussions with members of the study advisory committee. The resulting recommendations are in the final chapter of the report.

Methodology

Each year, PennDOT sets aside funding for safety improvements on High Risk Rural Road (HRRR). As part of keeping the CCSAP effective in financially constrained times, the intent for this year's program was to examine an individual intersection located on an HRRR. The term HRRR is described as roadways functionally classified as rural major or minor collectors or rural local roads with a fatal and incapacitating injury crash rate above the statewide average for those functional classes of roadways, or likely to experience an increase in traffic volume that leads to a crash rate in excess of the average statewide rate.

DVRPC performed a preliminary data analysis on the list of eligible locations provided by PennDOT's Bureau of Highway Safety and Traffic Engineering (BHSTE). As a result, four intersections in Bucks County were identified as candidate locations. After conferring with the Bucks County Planning Commission, the intersection of SR 113 and SR 313 was the location chosen to study.

The DVRPC study team conducted a field visit to observe the issues at this location. Data was then compiled and analyzed. This included crash records, Annual Average Daily Traffic (AADT) data, turning movement counts, and traffic signal timings. On April 13, 2011, a kick-off meeting was held among representatives from the following agencies: Bucks County Planning Commission, Hilltown Township, Bedminster Township, PennDOT District 6, and DVRPC. The kick-off meeting assisted in the identification of problems, with discussion of the advisory committee's observations and feedback.

Subsequently, technical analysis was performed to better understand and quantify the identified transportation problem areas. This included the preparation of a collision diagram displaying crash patterns and creating a map that highlighted the proposed improvements.

Based on the crash and Level of Service (LOS) analyses and kick-off meeting discussion, a set of potential improvements was developed that addressed the identified problems.

Findings and preliminary recommendations were presented to the advisory committee at a follow-up meeting held at the Bedminster Township Municipal Building on May 11, 2011. The purpose of the meeting was to discuss the recommendations and to get the advisory committee's perspectives on the practicality of the recommendations.

Level of Service (LOS) Analysis

LOS analysis is a common tool for assessment of transportation facilities and was used extensively for this project. When applied as a measure of performance for an entire or a particular component of an intersection, LOS has a precise meaning: the average delay experienced by a vehicle traveling through the intersection or a specific component of it. The parameters of delay that determine the various LOS categories for a signalized intersection are displayed in Table 1.

A review of the existing conditions and the various potential improvement scenarios was conducted using Synchro software for the study intersection. Necessary information for determining delay and LOS measures include turning movement counts, roadway geometry, signal timing, and signal actuation plans. The turning movement counts were mostly gathered by DVRPC staff; the signal timing, actuation data, and roadway geometrics were supplied by PennDOT.

Table 1: LOS Designations and Associated Delays

LOS	Signalized Intersection Total Delay per Vehicle (seconds/vehicle)
A - Desirable	≤ 10
B - Desirable	> 10 and ≤ 20
C - Desirable	> 20 and ≤ 35
D - Acceptable	> 35 and ≤ 55
E - Undesirable	> 55 and ≤ 80
F - Unsatisfactory	> 80

Source: Highway Capacity Manual, 2000

For signalized intersections, Synchro calculates a control delay and a queue delay. The control delay is calculated by a percentile delay method. This approach uses formulas from the *Highway Capacity Manual* to calculate delay; however, the final delay measure is taken from an average of the 10th, 30th, 50th, 70th, and 90th percentile volume levels. As a result, the calculated delay is a product of the various operating conditions that a driver at the signal may actually encounter.

For the revision of timing plans, Synchro is capable of optimizing intersection splits, cycle lengths, and offsets. These efforts seek to establish a timing plan that provides the most efficient performance and serves an optimal volume of vehicles.

CHAPTER 2

Study Location

The focus of the study as shown in Figures 1 and 3 is the intersection of SR 113 and SR 313. SR 113 provides access to Silverdale and Souderton and connects to key roads in north-central Bucks County, including SR 611 (Easton Road) and SR 309 (Bethlehem Pike). On a regional level, SR 313 is one of the main thoroughfares through Bucks County and connects to Doylestown and Quakertown. It also serves as the boundary between Hilltown and Bedminster townships.

SR 113 runs in a northeasterly and southwesterly direction. SR 313 runs in a northwesterly and southeasterly direction. For the purposes of this document, the orientation of SR 113 will be referenced as north and south. The SR 313 orientation will be denoted as east and west.

SR 113 and SR 313 Intersection

Northbound SR 113 (Souderton Road) is classified as a minor arterial. It contains one shared through and left-turn lane and one right-turn lane. Southbound SR 113 (Bedminster Road) is classified as a rural major collector. There is one right-turn lane and one shared through and left-turn lane. SR 313 is a principal arterial. In the westbound direction, there is one left-turn lane and one shared through and right-turn lane. In the eastbound direction, there is one left-turn lane, one through lane, and one right-turn lane. This intersection is signalized, and sidewalks are located on the southwest edge of the intersection.

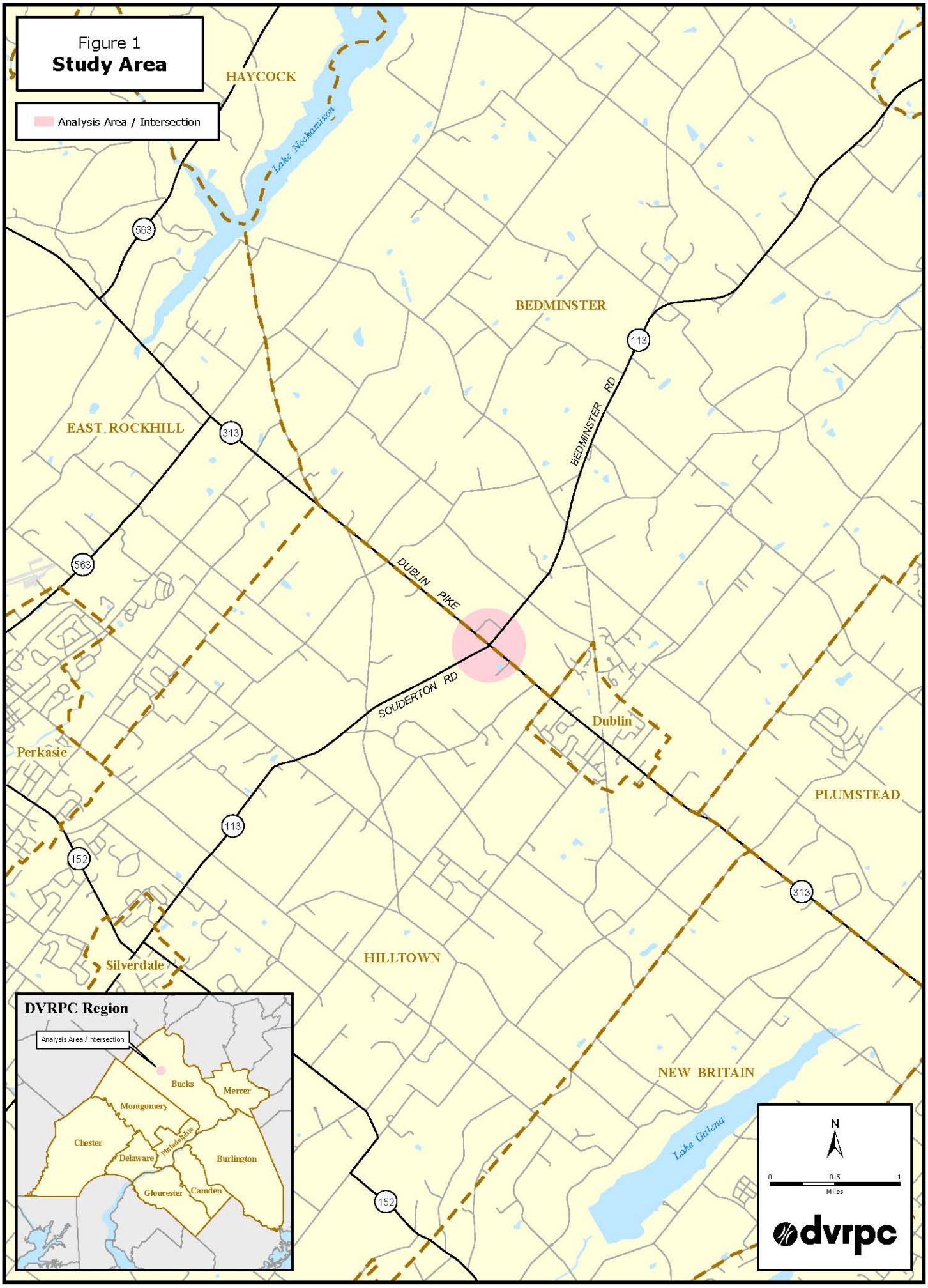


Figure 1
Study Area
Analysis Area / Intersection
HAYCOCK
Lake Nockamixon
563
BEDMINSTER
113
BEDMINSTER RD
EAST ROCKHILL
313
563
DUBLIN PIKE
SOUDERTON RD
Dublin
Perkasie
PLUMSTEAD
113
152
313
HILLTOWN
Silverdale
NEW BRITAIN
Lake Galena
152
DVRPC Region
Analysis Area / Intersection
Bucks
Mercer
Montgomery
Chester
Philadelphia
Delaware
Burlington
Gloucester
Camden
N
0
0.5
1
Miles
dvrpc

CHAPTER 3

Existing Conditions

The study intersection serves daily commuter traffic to Doylestown and Quakertown. In the area north of the study intersection, older traffic counts taken in 1995 on SR 113 showed an AADT volume of 4,500 vehicles. 2007 counts taken south of the intersection on SR 113 showed an AADT volume of approximately 8,000 vehicles. DVRPC counts taken in 2008 on SR 313 showed an AADT volume of approximately 18,000 vehicles in both directions.

The following bullets summarize some of the comments made by the study advisory committee at the kick-off meeting concerning existing traffic conditions at the study intersection.

Intersection Geometry

- Several signs and poles have been hit at the corner of the intersection because drivers are unaware of the slight turn to continue northbound. Speeding and lighting may also be factors.
- Several sideswipe and rear-end crashes have occurred along the northbound SR 113 approach.
- The southbound SR 113 shared through and left-turn lane is misaligned for the through movement.
- The westbound SR 313 stop bar is set too far back from the intersection.
- The intersection is skewed and has a hump in the middle of it. This is especially problematic for northbound SR 113 through traffic.

Access Management

- Wawa Convenience Store
  - Several left-turning crashes are clustered at the SR 113 Wawa driveway.
- CVS Drugstore
  - The dedicated left-turn lane on SR 313 for the CVS driveway is not justified.
  - The dedicated right-turn lane on SR 113 for the CVS driveway is not justified.
- Exxon Gas Station
  - The Exxon gas station driveway located closest to the intersection on SR 313 needs to be reconfigured.

Pedestrians

- Ample time is provided in the signal operation to cross SR 313 and SR 113. Supplemental 8" signal heads and push buttons are provided to help, but other pedestrian amenities are lacking.

Vacant Lot for Sale

- Unknown timeline for the development of the vacant parcel on the northeast corner of the intersection.

Signal Timing

This semi-actuated signal is not incorporated within any nearby signal coordination system. The cycle length in the morning and afternoon is 80 and 70 seconds, respectively. The westbound left-turn movement is permitted-protected. A permitted-protected signal phase provides a dedicated movement where the driver can turn left unimpeded as opposing traffic is held with a red signal. After the phase has ended, drivers have to wait for gaps created by the opposing traffic to turn left.

Turning Movement Counts

Manual turning movement counts were taken at the intersection. These counts were taken on March 2, 2011, between the hours of 6:00 AM and 9:00 AM and between 3:00 PM and 6:00 PM. A peak hour turning movement diagram is shown in Figure 2. The morning peak hour is 7:45 AM to 8:45 AM and the afternoon peak hour is 5:00 PM to 6:00 PM.

During the morning peak hour, 1,842 vehicles traveled through this intersection. The dominant movements in the morning are the eastbound (722 vehicles) and westbound (344 vehicles) through traffic along SR 313. The heavier eastbound movement represents 39 percent of the intersection's volume. Right-turn movements along SR 313 were fairly low, compared with the heavier right-turn movement along northbound SR 113 (114 vehicles).

During the afternoon peak period, traffic flow in the area increases from traffic conditions in the morning. In the afternoon, 1,942 vehicles traveled through the intersection. Similar to the morning peak period, the dominant movements are the eastbound (446 vehicles) and westbound (587 vehicles) through traffic along SR 313. The heavier westbound movement represents 30 percent of the intersection's volume. The northbound though and right-turn movements were fairly even with 155 and 152 vehicles, respectively. The westbound and eastbound right-turn movements along SR 313 and southbound SR 113 left-turn movement were under 50 vehicles.

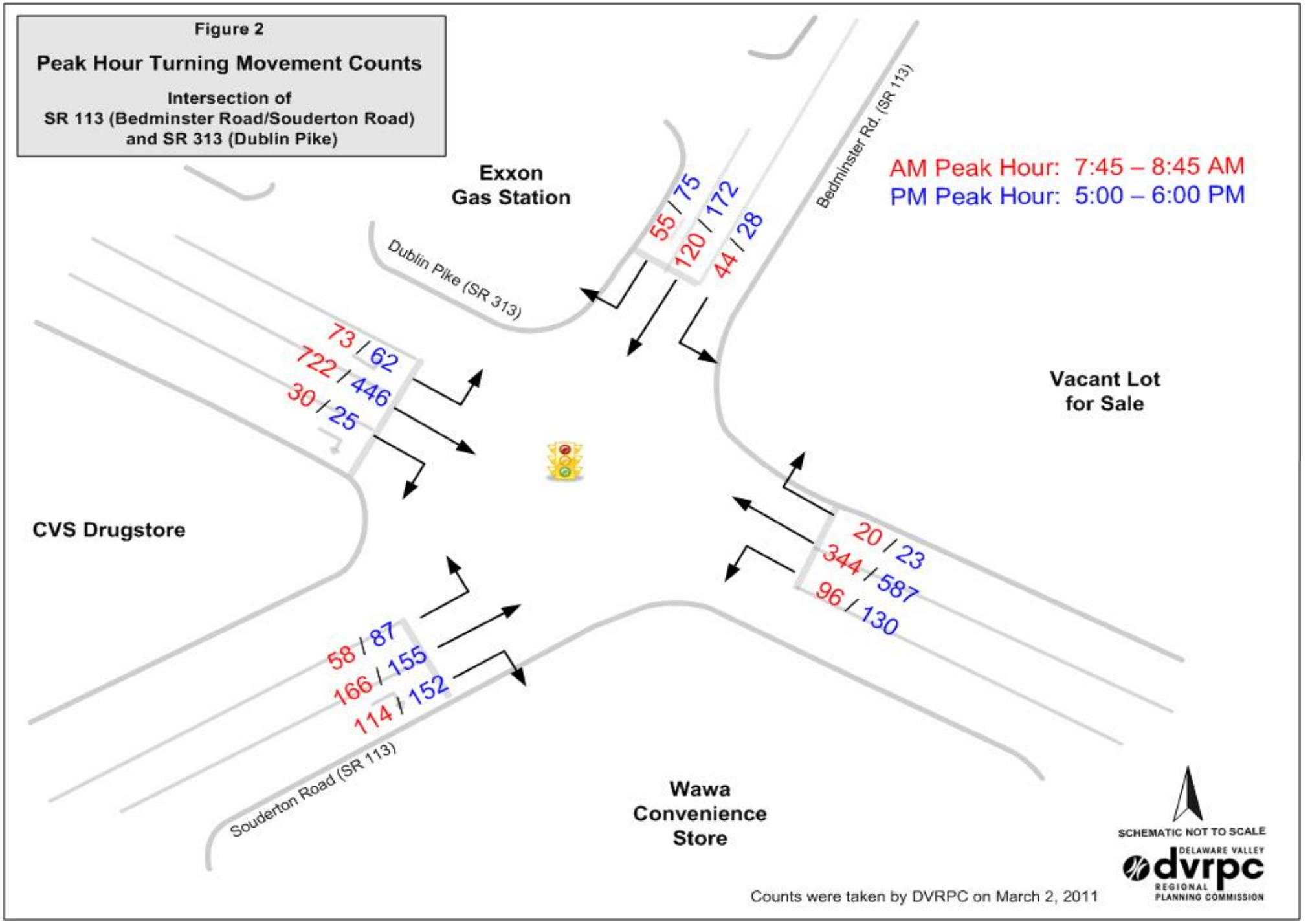


Figure 2
Peak Hour Turning Movement Counts
Intersection of
SR 113 (Bedminster Road/Souderton Road)
and SR 313 (Dublin Pike)
AM Peak Hour: 7:45 – 8:45 AM
PM Peak Hour: 5:00 – 6:00 PM
Exxon
Gas Station
Dublin Pike (SR 313)
Bedminster Rd. (SR 113)
55 / 75
120 / 172
44 / 28
73 / 62
722 / 446
30 / 25
Vacant Lot
for Sale
CVS Drugstore
20 / 23
344 / 587
96 / 130
58 / 87
166 / 155
114 / 152
Souderton Road (SR 113)
Wawa
Convenience
Store
SCHEMATIC NOT TO SCALE
DELAWARE VALLEY
dvrpc
REGIONAL
PLANNING COMMISSION
Counts were taken by DVRPC on March 2, 2011

Existing LOS

LOS analysis was conducted for the study intersection in order to determine the operational quality in terms of vehicle delay. Table 2 summarizes the LOS of the intersection under existing conditions.

As the table shows, during the morning and afternoon peak periods the intersection is currently operating at desirable conditions of LOS C and B, respectively. The northbound, southbound, and eastbound approaches operate at LOS C during both peak periods. In the morning and afternoon peak periods, the westbound approach experiences the least amount of delays: 8 and 13 seconds, respectively.

Table 2: Existing LOS Analysis

SR 113 and SR 313 Intersection				
	AM (80 sec.)		PM (70 sec.)	
Direction	Delay (s)	LOS	Delay (s)	LOS
Eastbound SR 313	31	C	21	C
Westbound SR 313	8	A	13	B
Northbound SR 113	31	C	27	C
Southbound SR 113	32	C	22	C
Total Intersection	**25**	**C**	**19**	**B**

Source: DVRPC, 2011

Land Use

The land use surrounding the immediate intersection of SR 113 and SR 313 is commercial. As shown in Figure 3, a CVS Drugstore and Wawa Convenience Store are located south of the intersection. An Exxon Gas Station and vacant lot for sale (zoned commercial) are located north of the intersection. Less than half of a mile north of the intersection is the Bedminster Crossing residential community. Stone Depot is located south of the intersection, behind the Wawa Convenience Store.

View of the Wawa Convenience Store (Source: DVRPC)

View of the vacant lot for sale, Exxon Gas Station and CVS Drugstore (Source: DVRPC)


Figure 3
Analysis Area
PA313 DUBLIN PIKE
PA113 BEDMINSTER RD
Exxon
Gas Station
CVS
Drugstore
Vacant Lot
for Sale
Wawa
Convenience
Store
PA113 SOUDERTON RD
PA313 DUBLIN PIKE
Stone
Depot
N
0 50 100
Feet
Aerial Imagery: DVRPC, 2010
dvrpc

Pedestrians

Pedestrian activity is evident in the study area and there has been one pedestrian crash in the period analyzed, 2005 through 2010. A sidewalk, a single pedestrian ramp, and supplemental signal heads were installed with the construction of the CVS Drugstore located on the southwest quadrant of the intersection. There are no painted crosswalks and no pedestrian ramps on the other three corners; there are no other sidewalks; and shoulder width varies throughout the study area.

CHAPTER 4

Crash Analysis

This analysis includes all crashes that occurred at the intersection of SR 113 and SR 313 between years 2005 to 2010. The main goals of this analysis are to highlight crash trends and determine causal factors. The collision diagram (Figure 4) is a graphic representation of the location, collision type, and frequency of vehicular crashes within the study area.

Data Description

The crash summaries and collision diagram used in this analysis were derived from reportable and non-reportable crash records. In Pennsylvania, a crash is considered reportable when a person is injured or killed, or if a vehicle needs to be towed from the scene. The reportable crashes were provided by PennDOT District 6, and were from years 2005 through 2009. During the data collection stage of this project, 2010 reportable crash data was not yet available from PennDOT. The non-reportable crash records were provided by the Hilltown and Bedminster Police Departments, and were from years 2005 through 2010. Since non-reportable crashes are managed by the local police departments they were able to provide records from 2010. Select statistics are summarized in Table 3. There were 18 reportable crashes recorded during the study period, and 29 non-reportable crashes submitted for consideration.

Reportable Crashes Coding Issue

Examination of the narratives and crash diagrams included with the police reports for the reportable crashes uncovered the following issues as they pertain to angle crashes. According to PennDOT, an angle crash is described as a crash that involves two vehicles that meet in a broadside or t-bone type collision. These crashes occur at a point of junction, such as an intersection, driveway, or entrance ramp. Prior to angle crash, the involved vehicles would be traveling in angular directions to one another; e.g. northbound vehicle colliding with an eastbound vehicle. For the purposes of this document, these crashes are described as “true” angle crashes.

A review of each crash report narrative and collision diagram revealed that some crashes coded as angle crashes involved vehicles turning left. In this case the drivers were typically driving in opposite directions (toward one another), and the crash occurred while one of the drivers was making a left turn. This is denoted in the document as a “left-turn” angle crash. This distinction is important because the improvements designed to reduce left-turn involved crashes are different

than those designed to mitigate angle crashes. These crashes are distinguished from a true angle crash with a unique symbol on the crash diagram.

Crash History

Major findings of **non-reportable** crash report analysis:

- Rear-end crashes were the most common collision type at 52 percent.
- The most common location for crashes is the eastbound approach, where 11 crashes occurred, including 10 rear-end collisions.
- The second most common location is the northbound approach, where eight crashes occurred, including three sideswipes and three rear-end collisions.
- January and August had no crashes.
- No crashes occurred on Saturdays.

Major findings of **reportable** crash report analysis:

- Rear-end crashes were the predominant collision type at 39 percent. The majority of these crashes occurred along the westbound and eastbound SR 313 approach.
- Five of the six "angle" crashes involved drivers turning left. Only one left-turn angle crash occurred at the intersection; the remaining five occurred at SR 113 Wawa and SR 313 CVS driveways.
- Three of the four hit-fixed-object crashes recorded involved a driver traveling northbound through the intersection colliding with an intersection feature (i.e., signage or pole). These incidents were likely the result of the hump and skew of the intersection.
- There was one pedestrian crash.

The following crash analysis refers only to the reportable crashes.

Of the 18 reportable crashes recorded during the analysis period there were no fatalities, seven injury crashes, and 11 property-damage-only crashes.

During the study period years 2005 through 2009 there were five crashes recorded in 2007, and the remaining years had either two, three, or four crashes. Considering crashes by month, there were no crashes in March, April, or May. The remaining months showed between one and four crashes each.

Crash trends by day of week showed Thursday through Saturday as having the highest totals, accounting for 67 percent. There were no crashes recorded between 7:00 AM and 10:00 AM. The remaining crashes were spread relatively evenly throughout the day, with the highest concentration during the early afternoon commute.

Details of all analyses are available upon request.

Table 3: Crash Summary for SR 113 and SR 313 Intersection

Collision Type	Reportable	Non-reportable
Angle – Left-Turn	5	1
Angle – True	1	3
Rear-end	7	15
Opposite Direction Sideswipe	0	5
Same Direction Sideswipe	0	1
Hit Fixed Object	4	4
Pedestrian	1	0
Total	**18**	**29**

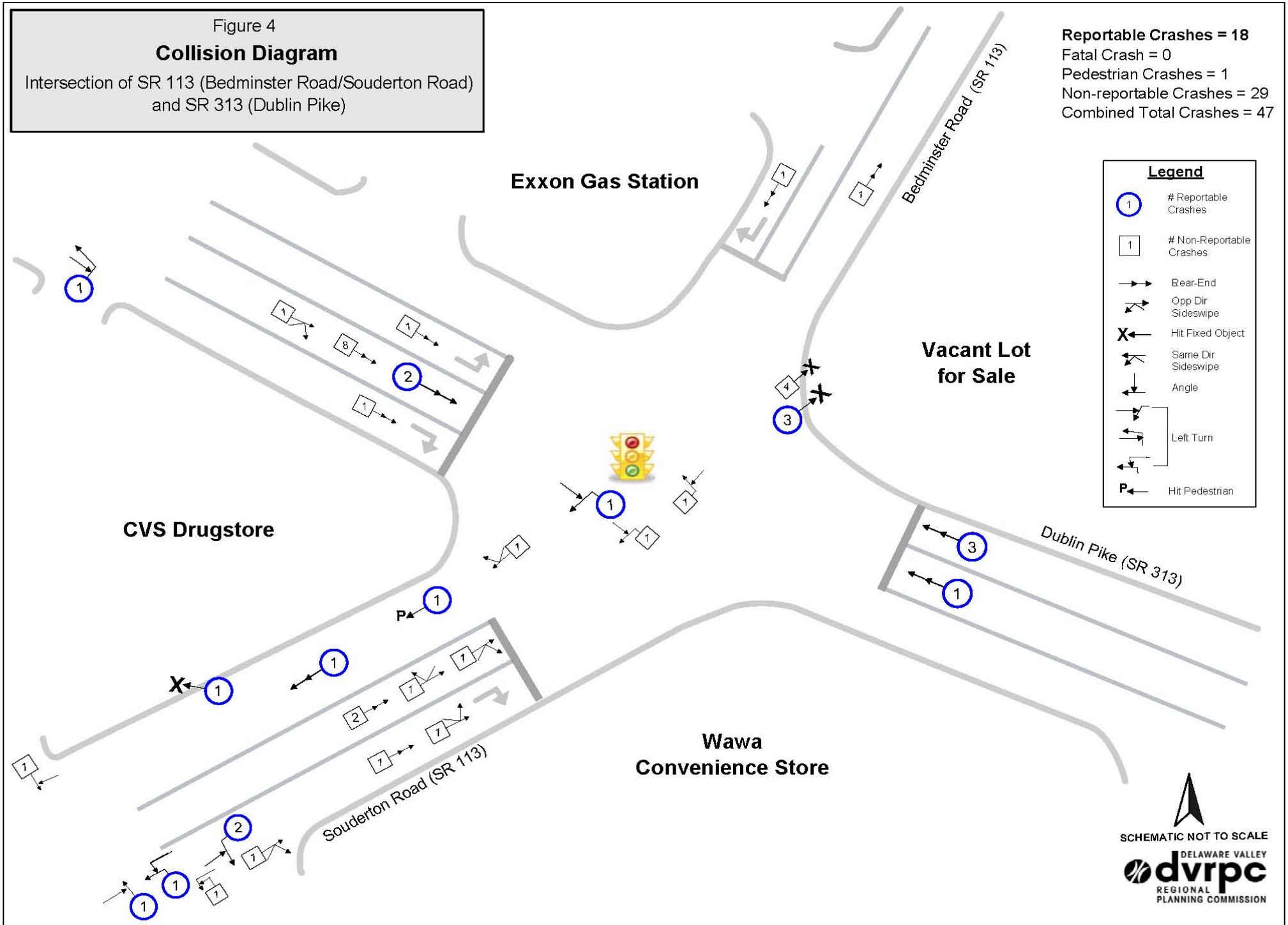
Source: DVRPC, 2011

Figure 4

Collision Diagram

Intersection of SR 113 (Bedminster Road/Souderton Road) and SR 313 (Dublin Pike)

Reportable Crashes = 18
Fatal Crash = 0
Pedestrian Crashes = 1
Non-reportable Crashes = 29
Combined Total Crashes = 47



DELAWARE VALLEY dvrpc REGIONAL PLANNING COMMISSION

CHAPTER 5

Issues and Potential Improvements

A range of strategies was developed by the stakeholders for this study, building on analysis. The strategies developed fell within the following two categories: safety and operational. Safety strategies consist of improvements that enhance and promote safer conditions for all roadway users traveling in the area. Examples of safety strategies include installing signage and adding or modifying pavement markings. Operational strategies include geometric improvements (e.g., changes in lane designation) at the intersection of SR 113 and SR 313.

Table 4 and the following sections describe the main issues and the corresponding strategies for alleviating these safety and operational concerns. The highlighted text in the table reflects the operational strategies. LOS analysis was also performed at this intersection to compare existing conditions with conditions if potential operations strategies were implemented.

Table 4: SR 113 and SR 313 Issues and Potential Strategies

Issues	Potential Strategies
Intersection Geometry	
■ 1. Several signs and poles have been hit at the corner of the intersection because drivers are unaware of the slight turn to continue northbound. Speeding and lighting may also be factors.	■ 1A. Add large reflective arrow sign or chevrons. ■ 1B. Add "dotted" pavement markings to guide northbound vehicles through the intersection. ■ 1C. Install a larger mast arm so the signal heads are over the travel lane.
■ 2. Several sideswipe and rear-end crashes along the northbound approach of SR 113.	■ 2. Restripe the northbound SR 113 approach to provide a dedicated left-turn lane.
■ 3. The southbound SR 113 shared through and left-turn lane is misaligned for the through movement.	■ 3A. Eliminate right-turn only lane and convert to shared through and right-turn lane. ■ 3B. Eliminate shared through and left-turn lane and convert to left-turn only lane. ■ 3C. Eliminate striping (located on the southbound departure lane next to the CVS property) and convert to a travel lane on southbound SR 113 (Souderton Road leg).
■ 4. The westbound stop bar on SR 313 is set too far back from the intersection.	■ 4. Shift the stop bar toward the intersection for the shared through and right-turn lane only.
■ 5. The intersection is skewed and has a hump in the middle of it. This is especially problematic for northbound SR 113 through traffic.	■ 5A. Properly realign the intersection, which could be done as part of the future redevelopment of the adjacent vacant parcel or future resurfacing project. ■ 5B. Determine the level of effort /feasibility of re-profiling the hump before resurfacing takes place.

Table 4: SR 113 and SR 313 Issues and Potential Strategies (continued)

Access Management	
Wawa Convenience Store	
■ 1. Several left-turning crashes clustered at the SR 113 Wawa driveway.	■ 1. Add left-turn lane access to Wawa driveway.
CVS Drugstore	
■ 2. The dedicated left-turn lane on SR 313 for the CVS driveway is not justified.	■ 2. Eliminate the left-turn lane and re-stripe with a two-way left-turn lane.
■ 3. The dedicated right-turn lane on southbound SR 113 for the CVS driveway is not justified.	■ 3. Eliminate the right-turn lane and convert to travel lane.
Exxon Gas Station	
■ 4. The Exxon Gas Station driveway located closest to the intersection on SR 313 needs to be reconfigured.	■ 4. Construct a physical diverter island to reinforce the current "right-in right-out" restriction.
Pedestrians	
■ 1. Lack of pedestrian amenities.	■ 1A. Add crosswalks. ■ 1B. Add sidewalks. ■ 1C. Add pedestrian countdown devices. ■ 1D. Add ADA ramps on the other three corners.
Vacant Land for Sale	
■ 1. Unknown timeline for the development of the vacant parcel.	■ 1A. Complex intersection improvements could be done by the developer once the property is sold. Such improvements could include realignment of the intersection and a potential reverse frontage road, which would provide access with neighboring commercial properties. ■ 1B. Relocate the existing mast pole so the signal heads can be aligned over the northbound travel lane.

Source: DVRPC, 2011

Operational Strategies – Signal Timing Improvements: Three Synchro Scenarios

Two scenarios were analyzed to determine the geometric impact on the operational performance of the study intersection. Since congestion was not an issue at this intersection, the existing signal timing remained the same for both scenarios tested. The operational strategies were refined so they could be simulated using Synchro software. Summaries and tables are provided for each of the scenarios. These results are for comparison to the existing LOS conditions documented in Chapter 3. The two scenarios are as follow:

Scenario #1 – Add Exclusive Left-Turn Lane to Northbound SR 113

Characteristics

- Restripe the northbound approach of the intersection to accommodate an exclusive left-turn lane.
- The through traffic and right-turn lanes will each have a lane for dedicated movements.

Advantages

- Given the current northbound SR 113 lane configuration of one shared through and left-turn lane and one dedicated right-turn lane, this scenario could help alleviate the sideswipe crashes problem (northbound through traffic trying to get around northbound left-turning traffic conflicting with right-turning vehicles).
- There is adequate right-of-way (ROW) on the northbound SR 113 approach to add the lane.
- Striping modifications may be implemented with little cost.

Disadvantages

- Given the current skewed alignment of the intersection, this scenario would likely create a sight distance issue for southbound SR 113 through traffic.

LOS Analysis

Under this scenario, the overall LOS and vehicle delay in the morning and afternoon peak period is nearly identical to results from existing conditions. Compared with the existing conditions, in the morning, all of the approaches for this scenario show a reduction in delay. During the afternoon peak period the northbound approach experiences a 9-second reduction delay. The delay on the southbound approach increases slightly from 22 seconds to 25 seconds, but remains at LOS C. These results are shown in Table 5 below.

Table 5: LOS Analysis – Scenario 1

	Existing Condition				Scenario 1			
	AM (80 sec)		PM (70 sec)		AM (80 sec)		PM (70 sec)	
Direction	Delay (s)	LOS	Delay (s)	LOS	Delay (s)	LOS	Delay (s)	LOS
Eastbound SR 313	31	C	21	C	26	C	19	B
Westbound SR 313	8	A	13	B	7	A	11	B
Northbound SR 113	31	C	27	C	25	C	18	B
Southbound SR 113	32	C	22	C	31	C	25	C
Total Intersection	**25**	**C**	**19**	**B**	**21**	**C**	**17**	**B**

Source: DVRPC, 2011

Scenario #2 – Change Southbound SR 113 Lane Configuration to One Shared Through and Right-Turn Lane and One Left-Turn Lane

Characteristics

- Eliminate right-turn only lane and convert to shared through and right-turn lane.
- Eliminate shared through and left-turn lane and convert to left-turn only lane.
- Eliminate striping (located on the travel lane next to the CVS property) and shift travel lane to previously striped area on southbound SR 113 (Souderton Road leg).
- Restripe the northbound approach of the intersection to accommodate an exclusive left-turn lane.
- The through traffic and right-turn lanes will each have a lane for dedicated movements.

Advantages

- A lane shift and better alignment for the through traffic to travel more safely through the intersection are created.
- By removing the striping, there is ROW for the departure lane on southbound SR 113 (Souderton Road leg) and the new northbound left-turn lane.
- Striping modifications may be implemented with little cost.

Disadvantages

- The new turning radius will not accommodate large trucks heading to westbound SR 313 from southbound SR 113; however, the existing condition does not either.
- Widening for the departure lane on northbound SR 113 (Bedminster Road leg) is required to construct a full transition to protect the southbound SR 113 left-turn lane.

LOS Analysis

This scenario shows a slight improvement over the LOS of existing conditions. In the morning, the overall LOS is the same as existing conditions, with all approaches showing a reduction in delay. In the afternoon, the southbound delay increases from 22 to 29 seconds; however, LOS remains at C. The other approaches experience a reduction in delay ranging between one and eight seconds. These results are shown in Table 6 below.

Table 6: LOS Analysis – Scenario 2

	Existing Condition				Scenario 2			
	AM (80 sec)		PM (70 sec)		AM (80 sec)		PM (70 sec)	
Direction	Delay (s)	LOS	Delay (s)	LOS	Delay (s)	LOS	Delay (s)	LOS
Eastbound SR 313	31	C	21	C	26	C	20	C
Westbound SR 313	8	A	13	B	7	A	12	B
Northbound SR 113	31	C	27	C	24	C	19	B
Southbound SR 113	32	C	22	C	31	C	29	C
Total Intersection	**25**	**C**	**19**	**B**	**21**	**C**	**18**	**B**

Source: DVRPC, 2011

Conclusions from Scenarios

Compared to existing traffic conditions, the two scenarios considered did not change the overall operation of vehicle flow through the study intersection. Current traffic volumes and turning movements have not exceeded the 2004 projected volumes from the CVS development that are shown on the signal permit, so there is room to be flexible with the proposed lane configurations. Safety is a significant issue at this intersection. Scenario 2 would likely make the intersection safer by improving sight distance.

Many of the strategies described in this chapter are graphically depicted in Figure 5.

Figure 5

Potential Improvements

Improvement Category:

AM = Access Management

FD = Future Development

IG = Intersection Geometry

P = Pedestrian

Note: **Green** text denotes shorter-term potential improvement

Blue text denotes longer-term potential improvement

PA 313 DUBLIN PIKE

PA 113 BEDMINSTER RD

PA 113 SOUDERTON RD

PA 313 DUBLIN PIKE

AM 3:
CONVERT LEFT-TURN ONLY LANE FOR CVS TO TWO-WAY LEFT-TURN LANE

P 1-B:
ADD SIDEWALK

AM 5:
CONVERT DRIVEWAY TO RIGHT-IN / RIGHT-OUT

IG 3-A:
CONVERT RIGHT-TURN ONLY LANE TO SHARED THROUGH / RIGHT-TURN LANE

P 1-B:
ADD SIDEWALK

P 1-B:
ADD SIDEWALK

IG 3-B:
CONVERT SHARED THROUGH / LEFT-TURN LANE TO LEFT-TURN ONLY LANE

IG 1-A:
ADD LARGE REFLECTIVE ARROW SIGN

P 1-A:
ADD CROSSWALKS AND ADA RAMPS

IG 1-B:
ADD GUIDELINES

FD 1:
POTENTIAL FRONTAGE ROAD CONTINGENT UPON POSSIBLE FUTURE COMMERCIAL DEVELOPMENT NEAR INTERSECTION

IG 3-C:
ELIMINATE STRIPING AND CONVERT TO TRAVEL LANE

IG 4:
SHIFT STOP BAR FOR THE SHARED THOUGH AND RIGHT-TURN LANE CLOSER TO THE INTERSECTION

AM 4:
CONVERT RIGHT-TURN ONLY LANE FOR CVS TO TRAVEL LANE

P 1-B:
ADD SIDEWALK

IG 5:
REALIGN INTERSECTION

AM 1:
ADD LEFT-TURN LANE ACCESS TO WAWA

IG 2:
ADD DEDICATED LEFT-TURN LANE ON NORTHBOUND SOUDERTON ROAD

AM 2:
ADD NO LEFT-TURN SIGN AT PARKING LOT EXIT

N

0 25 50
Feet

Aerial Imagery: DVRPC, 2010

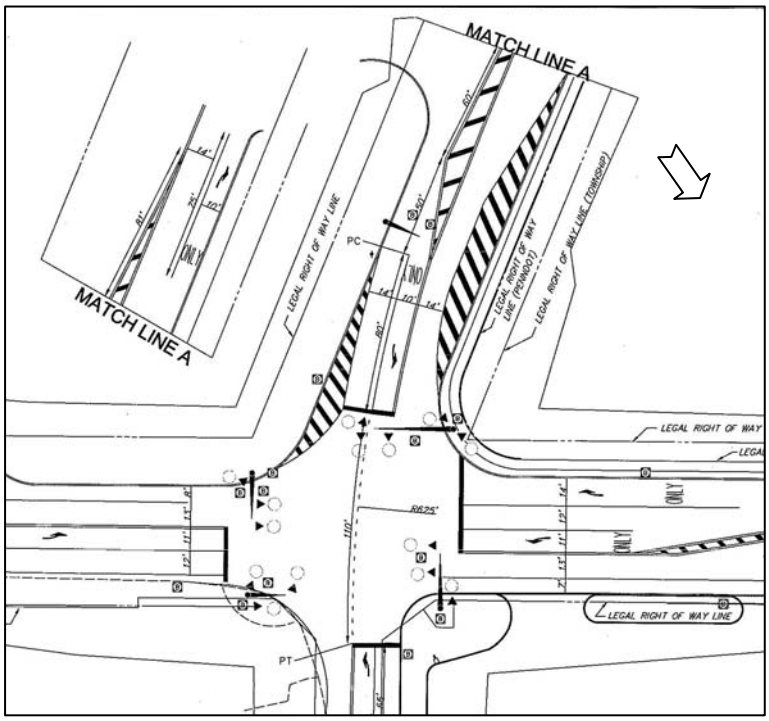
dvrpc

Recommendations

At the follow-up meeting held on May 18, 2011, representatives from the Bucks County Planning Commission, Hilltown and Bedminster townships, PennDOT District 6, and DVRPC worked together and developed a set of recommendations.

There was extensive discussion regarding the dedicated left-turn access at the Wawa driveway located on SR 113 and the three-lane conversion for the northbound SR 113 approach. PennDOT District 6 officials raised some concerns about the lane design (as depicted in Figure 5) to accommodate minimal vehicle storage for both the exclusive left-turn lane for the northbound SR 113 approach and Wawa driveway. After the follow-up meeting DVRPC staff conferred with PennDOT District 6 to recommend an alternative lane configuration for the northbound SR 113 approach. PennDOT District 6 checked storage and capacity levels for northbound SR 113 based on previous counts from the development on the northeast corner, as well as previous data. As depicted in Figure 6, the new two-lane configuration developed consists of creating one left-turn lane and one shared through and right-turn lane. No exclusive lane was created to turn into the Wawa driveway from southbound SR 113. There would be enough room for southbound SR 113 through vehicles to get around anyone desiring to turn left into the Wawa driveway.

Figure 6: PennDOT District 6 Alternative Northbound SR 113 Lane Configuration



Source: PennDOT District 6, 2011

Many of the recommendations are short-term and are generally low cost. According to PennDOT District 6 officials, this study intersection is slated to be repaved in 2012; thus, many of the improvements requiring restriping could be funded and implemented as part of the resurfacing project.

The short-term recommendations are listed in Table 7. The highlighted text in the table reflects the recommended improvements that could be implemented in conjunction with the resurfacing project.

Table 7: Short-term Recommended Improvements

Issues	Recommended Improvements
Intersection Geometry	
■ 1. Several signs and poles have been hit at the corner of the intersection because drivers are unaware of the slight turn to continue northbound. Speeding and lighting may also be factors.	■ 1A. Add overhead signage on the mast arm on the northbound SR 113 approach. ■ 1B. Add additional signage ahead of the intersection warning of the slight turn. ■ 1C. Add "dotted" pavement markers to guide northbound vehicles through the intersection.
■ 2. Several sideswipe and rear-end crashes along the northbound approach of SR 113.	■ 2. Restripe the lane configuration for one exclusive left-turn lane and one shared through and right-turn lane. This improvement is also beneficial for Issue #1.
■ 3. The southbound SR 113 shared through and left-turn lane is misaligned for the through movement.	■ 3. Restripe the lane configuration for one exclusive left-turn lane and one shared through and right-turn lane.
■ 4. The westbound stop bar is set too far back from the intersection.	■ 4. Consider relocating the stop bar toward the intersection for the shared through and right-turn lane.
■ 5. The intersection has a hump in the middle of it. This is especially problematic for northbound SR 113 through traffic.	■ 5. Determine the feasibility of removing the hump in the middle of the intersection. If feasible consider reprofiling SR 313.
Access Management	
CVS Drugstore ■ 1. The dedicated left-turn lane on westbound SR 313 for the CVS driveway is not justified. ■ 2. The dedicated right-turn lane on southbound SR 113 for the CVS driveway is not justified.	■ 1. Eliminate the left-turn lane and restripe with a two-way left-turn lane. ■ 2. Eliminate the right-turn lane and shift the travel lane for better alignment.
Exxon Gas Station ■ 3. The Exxon Gas Station driveway located closest to the intersection on SR 313 needs to be reconfigured.	■ 3. Construct a physical diverter island to reinforce the current "right-in right-out" restriction.
Pedestrians	
■ 1. Lack of pedestrian amenities.	■ 1. Add crosswalks. ■ 2. Add pedestrian countdown devices.

Source: DVRPC, 2011

As depicted in Table 8, five longer-term improvements were identified. These improvements are contingent upon the sale of the vacant property located on the northeast quadrant of the intersection. Once the property is sold, both townships and PennDOT District 6 would be supportive of these recommendations being done by the developer.

Table 8: Long-term Recommended Improvements

Issues	Recommended Improvements
Intersection Geometry	
■ 1. The intersection is skewed.	■ 1. Complex intersection improvements could be done by the developer once the property is sold. Such improvements could include realignment of the intersection.
Pedestrians	
■ 1. Lack of pedestrian amenities.	■ 1A. Add sidewalks along all four approaches to the intersection. ■ 1B. Add ADA ramps on the other three corners.
Vacant Land for Sale	
■ 1. Development of the vacant parcel.	■ 1A. Complex intersection improvements could be done by the developer once the property is sold. Such improvements could include construction of a potential reverse frontage road, which would provide access to neighboring commercial properties. ■ 1B. Shift the signal mast arm currently located on the northeast corner to properly align over the traffic lanes.

Source: DVRPC, 2011

APPENDIX A

Study Advisory Committee Members

Table A-1: Study Advisory Committee Members

Name	Organization	Title
Jack Terry	Bedminster Township	Township Manager
Eric Schaffhausen	Bedminster Township	Township Supervisor
Mark Ofner	Bedminster Township Police	Chief of Police
Bill Wert	Hilltown Township	Assistant Township Manager
Chris Engelhart	Hilltown Township Police	Chief of Police
Rich Brahler	Bucks County Planning Commission	Senior Transportation Planner
Larry Bucci	PennDOT District 6	Highway Safety Engineer
Nipul Patel	PennDOT District 6	Traffic Signal Engineer – Bucks County
Regina Moore	DVRPC	Transportation Engineer
Kevin Murphy	DVRPC	Principal Transportation Planner

Source: DVRPC, 2011

Publication Title:	Congestion and Crash Site Analysis Program – Bedminster and Hilltown Townships, Bucks County
Publication Number:	10015
Date Published:	August 2011
Geographic Area Covered:	Bedminster and Hilltown townships, Bucks County
Key Words:	Bedminster Road, Souderton Road, Dublin Pike, SR 113, SR 313, high risk rural road, HRRR, level of service, LOS, intersection, safety, crashes, traffic signal, roadway, improvements, turning movements, peak hour, strategies,

Abstract:

This document represents the findings and recommendations for the Congestion and Crash Site Analysis Program study conducted in Bucks County in Fiscal Year 2011. This Program represents an effort to improve the mobility and safety on roadways in the DVRPC region. The goal of the program is to identify cost-effective improvement strategies that will reduce congestion and crashes and improve mobility and safety for all road users.

Working with a data-driven process and the Bucks County Planning Commission, the intersection of SR 113 (Souderton Road/Bedminster Road) and SR 313 (Dublin Pike) was chosen for analysis. In-depth crash and level of service analyses were performed to quantify and gain an understanding of the issues. With input from the advisory committee, improvement strategies were identified to address the issues. As appropriate, proposed improvement strategies were tested for level of effectiveness.

Staff Contact:

Regina Moore
Transportation Engineer
☏ (215) 238-2862
rmoore@dvrpc.org

Delaware Valley Regional Planning Commission
190 N. Independence Mall West, 8th Floor
Philadelphia PA 19106
Phone: (215) 592-1800
Fax: (215) 592-9125
Internet: www.dvrpc.org

DELAWARE VALLEY
dvrpc
REGIONAL
PLANNING COMMISSION

190 N INDEPENDENCE MALL WEST
8TH FLOOR
PHILADELPHIA, PA 19106-1520
215.592.1800
WWW.DVRPC.ORG