DELAWARE VALLEY
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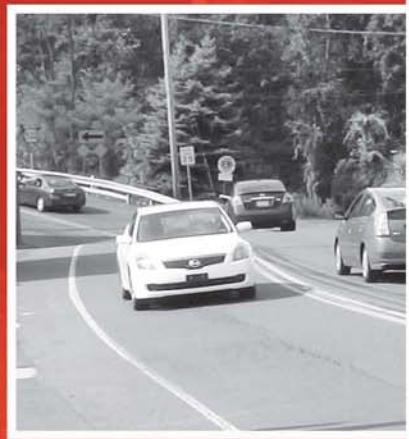
REGIONAL
PLANNING COMMISSION

DECEMBER 2009

NORTHAMPTON TOWNSHIP, BUCKS COUNTY

CONGESTION & CRASH site Analysis Program



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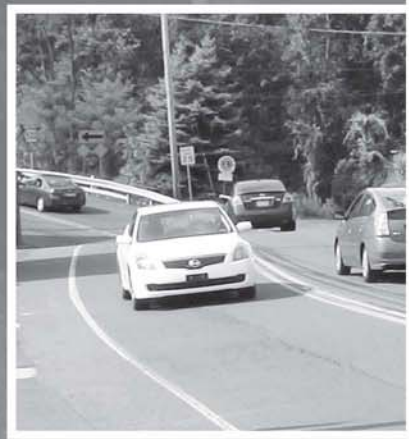

The Delaware Valley Regional Planning Commission is dedicated to uniting the region's elected officials, planning professionals and the public with a common vision of making a great region even greater. Shaping the way we live, work and play, DVRPC builds consensus on improving transportation, promoting 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. The diagonal line represents the Delaware River and the two adjoining crescents represent the Commonwealth of Pennsylvania and the State of New Jersey.

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Figures and Tables

Executive Summary

The goals of the Congestion and Crash Site Analysis Program are to improve the access and efficiency of the region's transportation system, improve safety and air quality, and reduce congestion through analyses for 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 Bucks County Planning Commission suggested the intersection of Buck Road (PA 532) and Holland Road, located in Northampton Township, Bucks County, as the candidate location for further study. At the initial field visit, township and county officials requested that the scope of the analysis be expanded to include four surrounding intersections. This allows analysis of the majority of the Holland Business District. These additional four intersections contribute to the large amount of congestion and crashes experienced during peak hours. Local officials identified this area as the highest priority for roadway improvements in Northampton Township. Traffic and operational issues within the Holland Business District have also prompted Pennsylvania State Representative Scott Petri to request PennDOT officials to undertake investigating these areas of concern.

This report examines potential improvement strategies that would increase the safety and mobility of all road users traveling along Buck Road in the Holland Road vicinity. The following five intersections were analyzed:

- Rocksville Road at Holland Road;
- Buck Road at Rocksville Road;
- Buck Road at Holland Road;
- Buck Road at Chinquapin Road, and
- Buck Road at Old Bristol Road.

CHAPTER 1

Introduction

This technical report provides analysis and recommendations for five intersections within the Holland Business District (see Study Area description below) in Northampton Township, Bucks County. The recommended strategies cover both safety and operational improvements. The operational improvements pertain to the two signalized intersections in the study area. The operational improvements were modeled and the results compared to existing conditions. It was not possible to model the safety improvements, but they were developed based on professional knowledge and discussion by state, regional, county, and local staff members. The resulting recommendations are in the final chapter of the report.

Methodology

The DVRPC study team conducted field visits at the location to observe the issues. Data was then compiled and analyzed. This included crash records data, average annual daily traffic (AADT) data, turning movement counts, and traffic signal timings. Stakeholder meetings were held among representatives of Bucks County, Northampton Township, PennDOT, Bucks County TMA, and staff from the offices of State Representative Scott Petri and Senator Robert Tomlinson. These meetings assisted in the identification of problems, with discussion of the study team's observations and local stakeholder feedback.

The study team conducted follow-up field views to better define the existing conditions and refine the identification of problems. Subsequently, a technical analysis was performed to better understand and quantify the identified transportation problem areas. This included the preparation of collision diagrams displaying crash patterns and the completion of level of service (LOS) analyses for existing conditions.

Based on the crash and LOS analyses, a set of improvements was developed that addresses the identified problems.

Findings and preliminary recommendations were presented to stakeholders at a follow-up meeting. The purpose of the meeting was to discuss the recommendations and get the local officials' perspectives of the practicality of the recommendations.

LOS Analysis

LOS analysis is a common tool for the assessment of transportation facilities and is used extensively in this report. 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 exact parameters of delay that determine the various LOS categories for a signalized and an unsignalized intersection are displayed in Table 1.

A review of the existing conditions and of the various improvement scenarios was conducted using Synchro traffic signal software for the project intersections. 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: Level of Service (LOS) Designations and Associated Delays

LOS	Signalized Intersection Total Delay per Vehicle (seconds/vehicle)	Unsignalized Intersection Total Delay per Vehicle (seconds/vehicle)
A – Desirable	≤ 10	≤ 10
B – Desirable	> 10 and ≤ 20	> 10 and ≤ 15
C – Desirable	> 20 and ≤ 35	> 15 and ≤ 25
D – Acceptable	> 35 and ≤ 55	> 25 and ≤ 35
E – Undesirable	> 55 and ≤ 80	> 35 and ≤ 55
F – Unsatisfactory	> 80	> 55

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 (HCM) to calculate delay; however, the final delay measure is taken from an average of the 10th, 30th, 50th, 70th, and 90th percentile volume levels. As a result, the calculated delay is a product of the various operating conditions that a signal may actually encounter. The queue delay is utilized whenever two signalized intersections are located within a critical distance of one another. If the intersections are within that distance, then calculations are made to determine the extent to which queue interactions (such as queue spillback and queue blocking) reduce capacity and, consequently, increase delay.

For an unsignalized intersection, Synchro only utilizes control delay, for which it relies exclusively upon HCM methods.

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 Holland Business District, as shown in Figure 1, is defined as Buck Road where it intersects Rocksville Road, Holland Road, Chinquapin Road, and Old Bristol Road. A 1,200-foot section of Holland Road between Rocksville Road and Buck Road is also included as part of the study.

Buck Road is classified as a principal arterial and it runs in a north-south direction from Rocksville Road (northern limit) to Old Bristol Road (southern limit) for a distance of approximately a half mile within the study area. The width of Buck Road varies throughout its length. It carries between two and three lanes, with additional turning lanes at Holland Road and Old Bristol Road. On a regional level, Buck Road connects with several key roads, including Roosevelt Boulevard (US 1), Cottman Avenue (PA 73), Red Lion Road (PA 63), Street Road (PA 132), Newtown Bypass (PA 332), and River Road (PA 32).

Given the large scope of the study area, the analyses performed for the intersections have been divided into the following three sections:

Section A: Vicinity of Rocksville Road

Rocksville Road forms the northern limits of the study area. It has a cross-section of two lanes and wide shoulders. Rocksville Road is a neighborhood street that intersects Holland Road and Buck Road.

Section B: Vicinity of Holland Road and Buck Road Intersection

Holland Road (SR 2067) is classified as an urban collector. It runs in a north-south direction along a steep grade and is located in the central portion of the study area. The “Y” intersection of Holland Road and Buck Road is signalized. Holland Road has a two-lane cross-section with variable shoulder width.

Chinquapin Road (SR 2025) is centrally located in the study area. It contains a two-lane cross-section with narrow shoulders. Classified as a local road, Chinquapin Road intersects with Buck Road on a steep up-grade and skewed angle.

Section C: Old Bristol Road and Buck Road Intersection

Old Bristol Road (SR 2025) is located within the southern limits of the study area. It is classified as an urban collector. It intersects with Buck Road on a steep down-grade and is signalized. Old Bristol Road carries two lanes with shoulders.

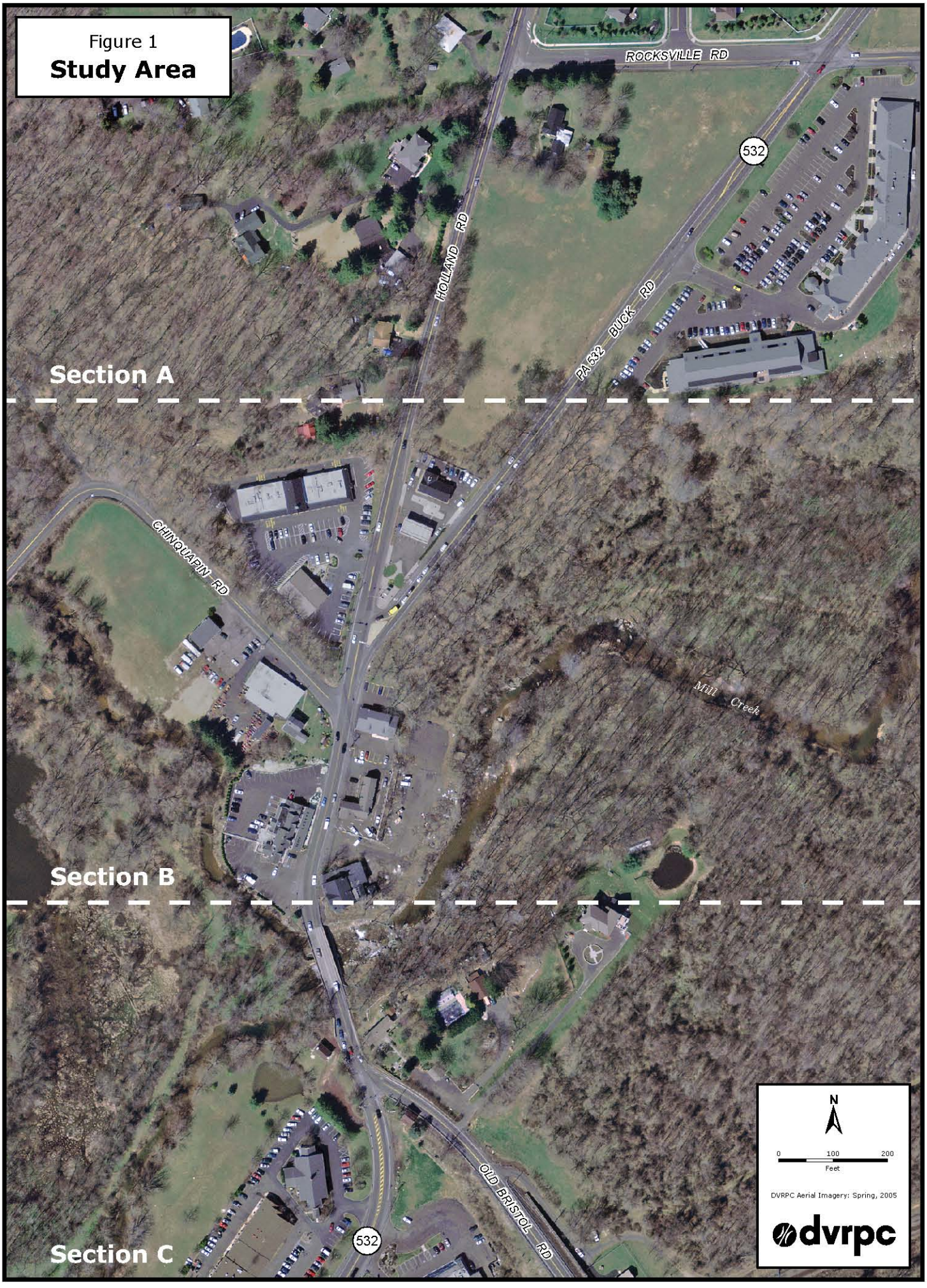


Figure 1
Study Area
ROCKSVILLE RD
532
HOLLAND RD
PA 532 BUCK RD
Section A
CHINQUAPIN RD
Mill Creek
Section B
OLD BRISTOL RD
532
Section C
N
0
100
200
Feet
DVRPC Aerial Imagery: Spring, 2005
dvrpc

CHAPTER 3

Existing Conditions

Buck Road is a significant regional route that traverses Northampton Township. The Holland Business District experiences heavy commuter through movements to and from adjacent major roadways and the surrounding residential areas. Traffic counts taken in 2007 on Buck Road showed AADT volume in both directions of 18,934 vehicles between Old Bristol Road and Rocksville Road, and 19,044 vehicles between Old Bristol Road and Chinquapin Road.

Turning Movement Counts

Manual turning movement counts were taken at the following intersections: Rocksville Road and Holland Road; Rocksville Road and Buck Road; Holland Road and Buck Road; Chinquapin Road and Buck Road; and Old Bristol Road and Buck Road. These counts were taken in September 2008 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 7:30 AM to 8:30 AM and the afternoon peak hour is 5:00 PM to 6:00 PM.

The dominant movements in the morning peak hour are the southbound and northbound through movements along Buck Road between Holland Road/Buck Road and Buck Road/Old Bristol Road intersections with 779 and 634 vehicles, respectively. Traffic patterns onto and from Chinquapin Road are fairly light, with the highest movement consisting of left turns from northbound Buck Road. Through movements along Buck Road and Holland Road are dominant among both the Rocksville Road intersections.

The dominant movements in the afternoon peak hour occurred between the intersections of Buck Road and Holland Road and Buck Road and Old Bristol Road. The highest movement in the afternoon is the northbound through movement, with 678 vehicles between the Holland Road/Buck Road and Buck Road/Old Bristol Road intersections. Right turns and left turns from the two Rockville Road and Chinquapin Road intersections are low, ranging between eight and 100 vehicles.

Existing LOS Analysis

A LOS analysis was performed for each study intersection. Summaries and Tables 2 through 4 are provided below describing the LOS and vehicle delay associated at each of the intersections.

Section A: Vicinity of Rocksville Road

The results of the LOS analysis conducted for both Rocksville Road intersections are similar. Given the light traffic volumes and stop-controlled movements along the Rocksville Road approaches, both intersections perform at optimal levels.

During the morning and afternoon peak periods, both intersections operate at a LOS A, with overall vehicle delay ranging between one and four seconds. For the Rocksville Road/Holland Road intersection, the westbound approach experiences a LOS C, and the highest amount of delay of 19 and 16 seconds in the morning and afternoon peak hours, respectively. The delay is experienced because this approach is stop controlled. Similarly, for the Rocksville Road/Buck Road intersection, as a result of the stop sign, delay occurs on the eastbound and westbound legs. In the afternoon, vehicle delay is higher, ranging between 24 and 27 seconds. See Table 2 for details on the LOS analysis performed for Section A.

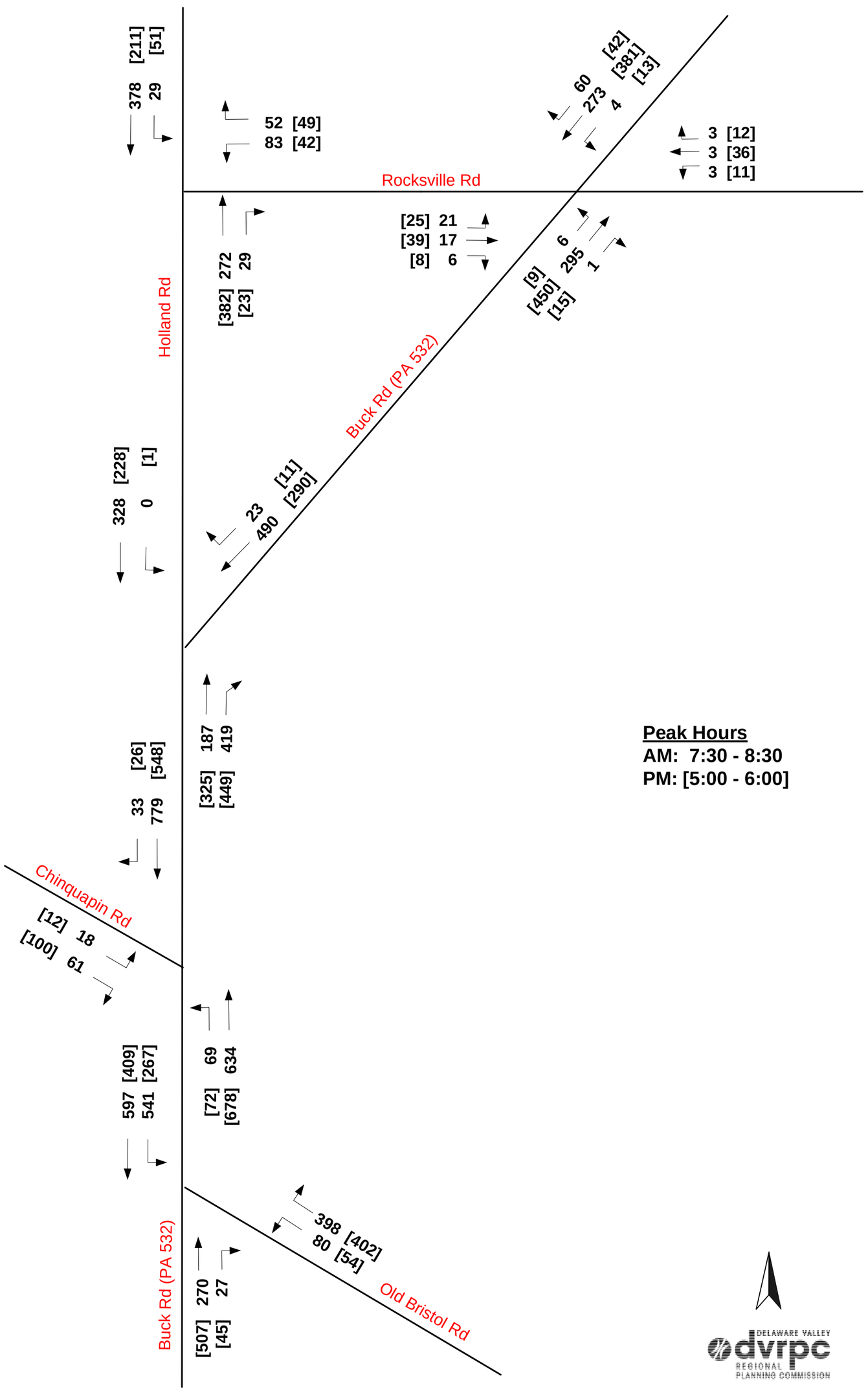
Table 2: Existing LOS Analysis – Section A: Vicinity of Rocksville Road

Holland Road and Rocksville Road Intersection				
	AM		PM	
Direction	**Delay (s)**	**LOS**	**Delay (s)**	**LOS**
Holland Road – southbound	1	A	2	A
Holland Road – northbound	0	A	0	A
Rocksville Road – westbound	19	C	16	C
Total Intersection	**3**	**A**	**2**	**A**
Rocksville Road and Buck Road Intersection				
	AM		PM	
Direction	**Delay (s)**	**LOS**	**Delay (s)**	**LOS**
Buck Road – southbound	0	A	0	A
Buck Road – northbound	0	A	0	A
Rocksville Road – westbound	14	B	27	D
Rocksville Road – eastbound	15	B	24	C
Total Intersection	**1**	**A**	**4**	**A**

Source: DVRPC, 2009

Figure 2

Peak Hour Turning Movement Counts



Section B: Vicinity of Holland Road and Buck Road Intersection

The Holland Road and Buck Road intersection is signalized. As shown in Table 3, the current cycle length during both peak periods is 90 seconds. As a result of the traffic volume and signal timing, in the morning and afternoon, the southwest Buck Road approach experiences the highest vehicle delays. The wait time for vehicles along this approach averages nearly one minute in the morning and 42 seconds in the afternoon. Compared to the southwest Buck Road approach, traffic conditions along the southbound Holland Road (less traffic) and the northbound Buck Road approach (heavy right-turn movements with exclusive right-turn lane) perform better, with delays ranging between six and 14 seconds. Despite the longer dwell time along the southwest Buck Road approach, overall this intersection performs well during both the AM and PM peak hour, with a desirable LOS C and B, respectively.

As depicted in Table 3, during the AM and PM peak period, the overall LOS for the Chinquapin Road and Buck Road intersection is A. The eastbound approach has the highest delay of 28 and 19 seconds in the morning and afternoon, respectively. Given the congestion through this area in the morning the southbound approach experiences a delay of 13 seconds and LOS B. In the afternoon, minimal delay is experienced along the northbound and southbound approaches.

Table 3: Existing LOS Analysis – Section B: Vicinity of Holland Road and Buck Road Intersection

Holland Road and Buck Road Intersection				
	AM (90 sec.)		PM (90 sec.)	
Direction	**Delay (s)**	**LOS**	**Delay (s)**	**LOS**
Buck Road – southwestbound	59	E	42	D
Buck Road – northbound	6	A	14	B
Holland Road – southbound	13	B	9	A
Total Intersection	**26**	**C**	**20**	**B**
Chinquapin Road and Buck Road Intersection				
	AM		**PM**	
Buck Road – southbound	13	B	0	A
Buck Road – northbound	3	A	2	A
Chinquapin Road - eastbound	28	D	19	C
Total Intersection	**3**	**A**	**3**	**A**

Source: DVRPC, 2009

Section C: Vicinity of Old Bristol Road and Buck Road Intersection

Similar to the Holland Road and Buck Road intersection, the Old Bristol Road and Buck Road intersection is signalized and operates on a 90-second cycle during peak periods. Given the high traffic volumes and tight geometry, this intersection also experiences the highest amount of congestion. In the morning and afternoon peak periods, the northbound Buck Road approach experiences the highest vehicle delays. As depicted in Table 4, the wait time for vehicles along this approach averages 42 seconds and 28 seconds in the morning and afternoon, respectively. The westbound and southbound approaches average 30 seconds of vehicle delay in the morning and less than 20 seconds of delay in the afternoon. Overall, in both the morning and afternoon, the LOS is desirable.

Table 4: Existing LOS Analysis – Section C: Vicinity of Old Bristol Road and Buck Road Intersection

Old Bristol Road and Buck Road Intersection				
	AM (90 sec.)		PM (90 sec.)	
Direction	**Delay (s)**	**LOS**	**Delay (s)**	**LOS**
Buck Road – southwestbound	26	C	11	B
Buck Road – northbound	42	D	28	C
Old Bristol Road – westbound	33	C	19	B
Total Intersection	**30**	**C**	**19**	**B**

Source: DVRPC, 2009

Travel Speeds

The majority of the study area is posted at 25 mph. Past the signalized intersection of Holland Road and Buck Road, a 40 mph posted speed limit sign is located along northbound Buck Road heading towards Rocksville Road. The elevation drops approximately 60 feet from Rocksville Road to the Holland Road and Buck Road intersection. Given this sharp change in elevation faster travel speeds were observed along Holland Road and Buck Road; specifically in the vicinity of the Rocksville intersections.

Bicyclists and Pedestrians

Bicyclist and pedestrian mobility in the area is limited. At the intersection of Holland Road and Buck Road, pedestrian movements are prohibited. There are no sidewalks, and shoulder width varies throughout the study area.

Land Use

The land use of the study area is predominately commercial, with pockets of vacant and residential parcels located in the northern and southern boundaries. Businesses in the area consist of a gas station, small strip shopping centers, and a Wawa convenience store. Residential development is located along the west side of Holland Road between Rocksville Road, and north of the businesses at Holland Road and Buck Road. Residences are also located adjacent to the Old Bristol Road and Buck Road intersection. A vacant parcel is located in the area between Rocksville Road and the intersection of Holland Road and Buck Road.

Commercial area approaching the Buck Road/Holland Road intersection

Commercial area located north of the Old Bristol Road/Buck Road intersection

CHAPTER 4

Crash Analysis

The focus for this analysis was all crashes that occurred on both Buck and Holland Roads, from Old Bristol Road to Rocksville Road, and in a short buffer area beyond. The main goals of this analysis are to identify problematic locations, highlight crash trends, and determine causal factors. The initial analysis revealed three distinct areas of crash concentrations for analysis referred to as Sections A, B and C. The summary in Table 5 details collision type, whether the crash occurred at an intersection or between intersections, and crash severity, per analysis section. Collision diagrams are graphic representations of the location, collision type, and frequency of vehicular crashes within the study area at each of the three focus areas.

Data Description

The crash data used in this analysis was from reportable crashes provided by PennDOT District 6 and non-reportable crash reports provided by the Northampton Township Police Department. In Pennsylvania, a crash is considered reportable if a person is injured or killed, or if a vehicle needs to be towed from the scene. Data from years 2003 – 2007 was utilized. There were no traffic fatalities in this period of time.

Table 5: Crash Data Summary (2003-2007)

	Section A		Section B		Section C		Totals
Reportable	25		40		17		82
Non reportable	33		64		36		133
Totals	58		104		53		215
Collision Type							
Rear-End	9	15.52%	49	47.12%	32	60.38%	90
Angle	25	43.10%	20	19.23%	6	11.32%	51
Same Direction Sideswipe	4	6.90%	12	11.54%	4	7.55%	21
Left-Turn	8	13.79%	11	10.58%	3	5.66%	23
Hit Fixed Object	4	6.90%	8	7.69%	2	3.77%	14
Opposite Direction Sideswipe	2	3.45%	1	0.96%	3	5.66%	5
Hit Pedestrian	~	~	1	0.96%	~	~	~
Head On	2	3.45%	~	~	3	5.66%	5
Hit Animal	4	6.90%	2	1.92%	~	~	6

Table 5: Crash Data Summary (2003-2007) (continued)

	Section A		Section B		Section C		Totals
Location Type							
At Intersection	42	72.41%	47	45.19%	36	67.92%	125
Not at Intersection	16	27.59%	57	54.81%	17	32.08%	90
Severity							
Injury	10	17.24%	24	23.08%	4	7.55%	38
Property Damage Only	48	82.76%	80	76.92%	49	92.45%	177

Source: PennDOT and Northampton Township Police

Section A: Vicinity of Rocksville Road

There were 25 reportable and 33 non-reportable crashes recorded in Section A during the analysis period, for a total of 58 crashes. According to the crash summary, there were no recorded fatalities, ten injury crashes, and 48 property-damage-only crashes. This section showed the highest percentage of crashes recorded as "at intersection," with 72 percent. Though only ten of the 58 crashes were associated with the intersection of Rocksville and Holland Roads, and another two on Holland Road not at the intersection, the remaining 46 crashes occurred along Buck Road with a high concentration in the vicinity of the Buck Road and Holland Road intersection.

Collision Type

As shown in Figure 3, rear-end crashes were not the predominant crash type in Section A. Instead, angle crashes topped the list, at 43 percent (25 crashes), which is more than twice the rear-end crashes, at 16 percent. Crashes associated with left turns accounted for 14 percent. As a result of higher speeds along Buck Road, these left-turn movements become more problematic. There were also four hit animal crashes, all of which were deer. This section of the study area is flanked by forest.

Crash Trends

On average there were over 11 crashes per year between 2003 and 2007. During most months, this section saw between three and seven crashes, with the only anomaly being November, when nine crashes occurred. Regarding frequency by day of week the highest total occurred on Saturday, when 13 crashes were recorded. Unlike sections B and C, the time-of-day crash line shows frequency scattered throughout the daytime hours of 7:00 AM to 6:00 PM. Given the fact that the majority of incidents along Buck Road occurred at the intersection and in the vicinity of shopping plaza entrance (which are closely spaced to one another), exchanges to and from Buck Road are likely contributors to this trend.

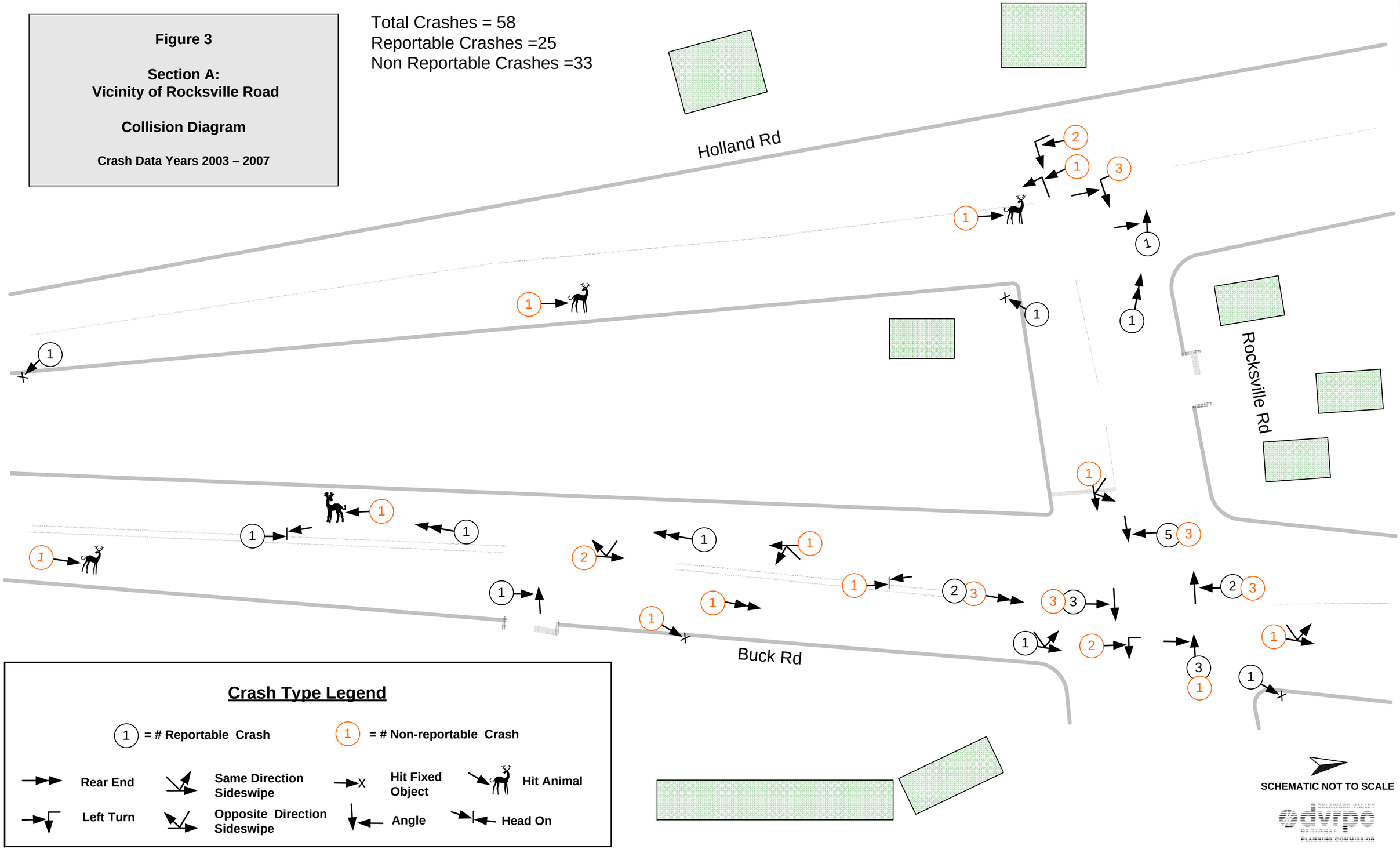
Figure 3

Section A:
Vicinity of Rocksville Road

Collision Diagram

Crash Data Years 2003 – 2007

Total Crashes = 58
Reportable Crashes =25
Non Reportable Crashes =33



Crash Type Legend

(1) = # Reportable Crash

(1) = # Non-reportable Crash

- Rear End
- Same Direction Sideswipe
- Hit Fixed Object
- Hit Animal
- Left Turn
- Opposite Direction Sideswipe
- Angle
- Head On

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Section B: Vicinity of Holland Road and Buck Road Intersection

There were 40 reportable and 64 non-reportable crashes recorded in this section during the analysis period, for a total of 104 crashes—the largest total of the three sections. According to the crash summary, there were no recorded fatalities, 24 injury crashes, and 80 property-damage-only crashes. Injury crashes are more significant in this section of the corridor than in sections A and C, where there were only 14 injury crashes combined.

Collision Type

As indicated in Figure 4 rear-end crashes were the predominant crash type, at 47 percent (49 crashes), though angle crashes were also significant, at 19 percent, or 20 crashes. This can be attributed to the greater number of driveways located in Section B (i.e., gas station, Wawa, and office center; in addition, Chinquapin Road intersects here). Same-direction sideswipe crashes were more significant here than anywhere else in the study area (11 percent). Field observations revealed that northbound traffic uses the shoulder to circumvent vehicles queuing to turn left onto Chinquapin Road. This issue is addressed in the recommendations section.

Crash Trends

There was an average of 21 crashes per year between 2003 and 2007. In 2005, there was a spike of 28 crashes, and then a continual drop to 16 in 2007, which could not be explained by local officials. Weekday crashes in this section were consistent, ranging between 15 and 21 crashes per day. Crash totals dropped noticeably on Saturday and Sunday, which saw only 8 and nine crashes, respectively. This corresponds with the weekday congestion reported by local officials. In addition, crashes were concentrated during the AM peak (6:00 AM to 8:00 AM), and even more so in the afternoon into early evening, corresponding with the PM peak (3:00 PM to 7:00 PM), when 47 percent of the crashes occurred.

Section C: Vicinity of the Old Bristol Road and Buck Road Intersection

There were 17 reportable and 36 non-reportable crashes recorded in Section C during the analysis period. According to the crash summary, there were no recorded fatalities, 4 injury crashes, and 49 property-damage-only crashes. Most of the crashes in this section are concentrated close to the intersection.

Collision Type

As shown in Figure 5, rear-end crashes accounted for the largest percentage by collision type representing 60 percent, or 32 crashes, more than five times the next-highest collision type (angle, at 11 percent). Rear-end crashes were high on Old Bristol Road at the Buck Road approach—most likely due to the steep slope. Through field visits and meetings with local

officials, it was apparent that this slope, with its compromised sight distance and frequent queue of vehicles, could be difficult to manage safely. This situation is worsened by inclement weather.

Related to both safety and congestion are the crashes associated with the pinch-point created by the narrow bridge along Buck Road just north of the signal at Old Bristol Road. With only enough room for southbound vehicles to queue side by side two deep, the opportunity for sideswipe crashes increases as drivers seeking to continue south on Buck Road try to squeeze by those waiting to turn left onto Old Bristol Road. This condition is exacerbated during the congested peak periods.

Crash Trends

There were approximately 11 crashes each year between 2003 and 2007, except in 2005, which saw an unexplained drop to six crashes. Tuesday through Friday averaged between eight and ten crashes per day, while Sunday and Monday averaged only four crashes each. Crashes were concentrated during the afternoon and into early evening, leaving the rest of the day relatively flat. A short spike of five crashes was recorded during the 8:00 AM to 9:00 AM hour.

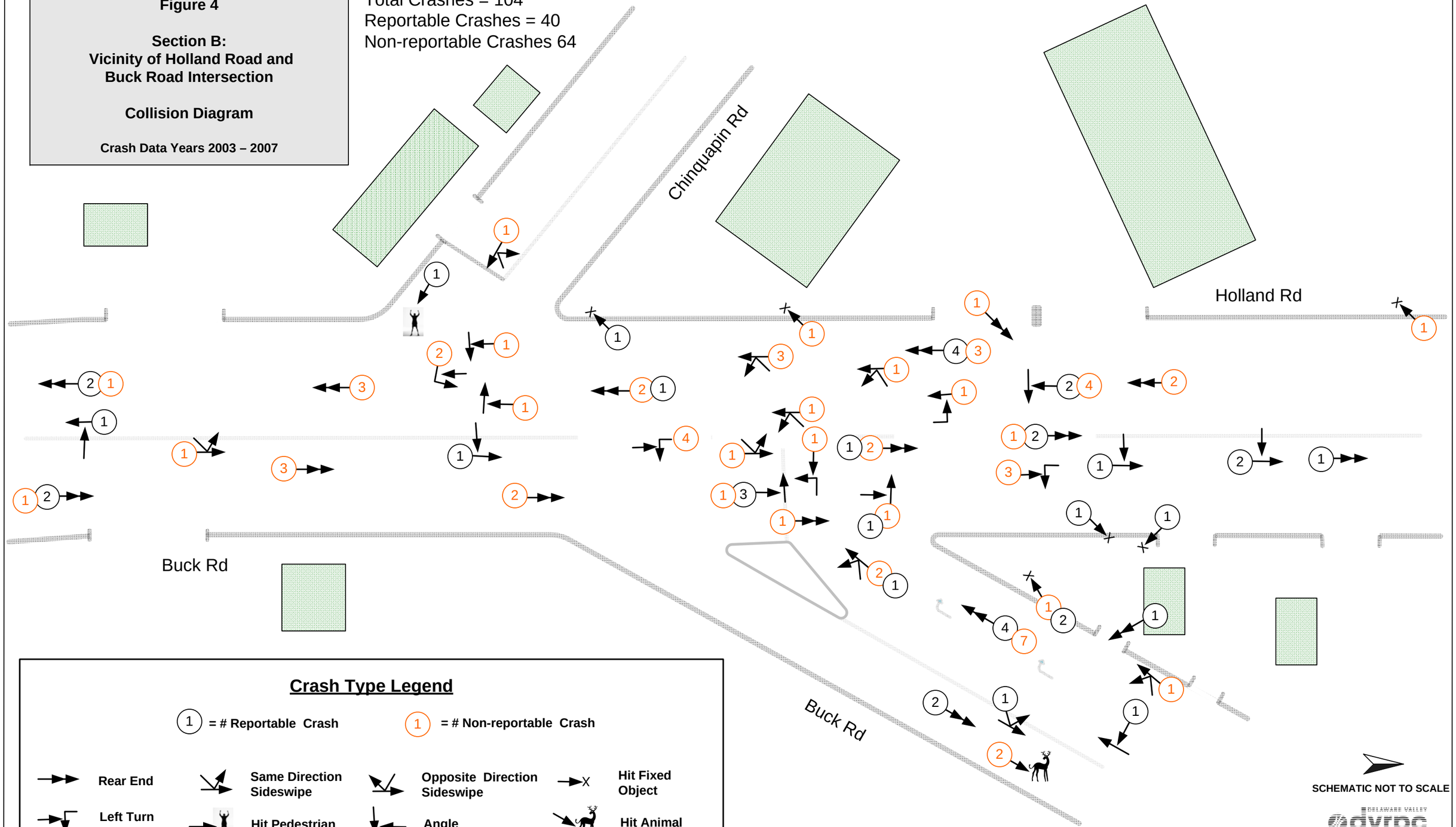
Figure 4

Section B:
Vicinity of Holland Road and Buck Road Intersection

Collision Diagram

Crash Data Years 2003 – 2007

Total Crashes = 104
Reportable Crashes = 40
Non-reportable Crashes 64



Crash Type Legend

(1) = # Reportable Crash

(1) = # Non-reportable Crash

- Rear End
- Same Direction Sideswipe
- Opposite Direction Sideswipe
- Hit Fixed Object
- Left Turn
- Hit Pedestrian
- Angle
- Hit Animal

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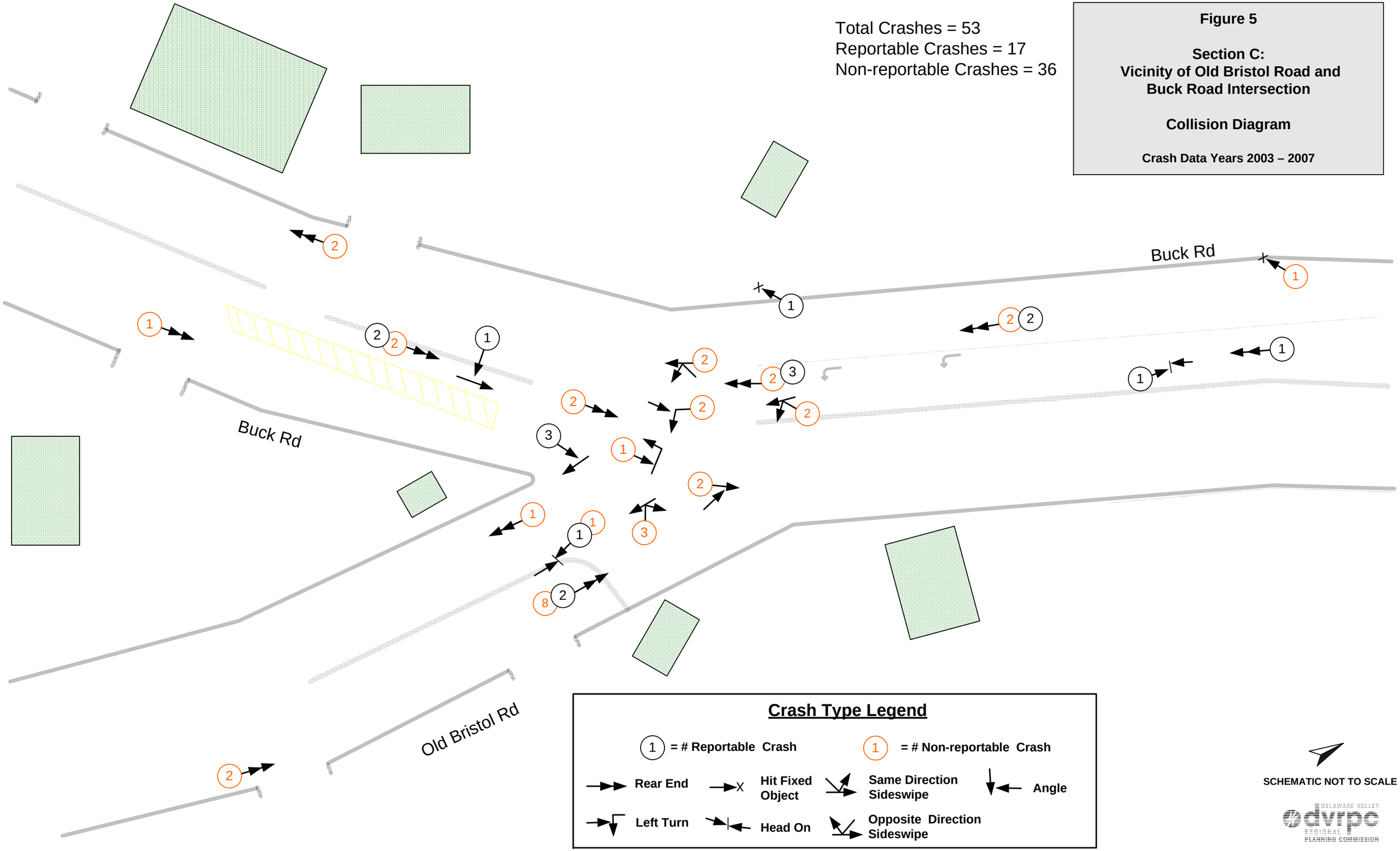
Total Crashes = 53
Reportable Crashes = 17
Non-reportable Crashes = 36

Figure 5

Section C:
Vicinity of Old Bristol Road and Buck Road Intersection

Collision Diagram

Crash Data Years 2003 – 2007



Crash Type Legend

(1) = # Reportable Crash
(1) = # Non-reportable Crash

- Rear End
- Hit Fixed Object
- Same Direction Sideswipe
- Angle
- Left Turn
- Head On
- Opposite Direction Sideswipe

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CHAPTER 5

Potential Improvements

A range of strategies was agreed upon for each section of the study area. The strategies developed fell within the following two categories: safety and operational. Safety strategies consist of improvements that enhance and promote safer operational conditions for all roadway users traveling in the area. Examples of safety strategies include installing signage and pavement markings. Operational strategies include geometric improvements that involve changing the traffic signal timing and/or geometry at key signalized intersections. A LOS analysis was performed to compare existing conditions with potential strategies at three of the five intersections with major geometric alternatives.

Section A: Vicinity of Rocksville Road

Goal

- Warn drivers traveling along Buck Road and Holland Road of upcoming intersections at Rocksville Road

Rocksville Road and Holland Road Intersection

Issues

- Motorists are speeding through the intersection along Holland Road
- There is no advanced indication of the intersection

Safety Strategies

- Add an intersection-ahead sign along northbound and southbound Holland Road warning of the intersection with Rocksville Road
- Add pavement markings at the intersection and along Rocksville Road to delineate traffic movements

Rocksville Road and Buck Road Intersection

Issues

- High number of angle crashes
- Speeding through the intersection along Buck Road

Safety Strategies

- Add pavement markings at the intersection and along Rocksville Road to delineate traffic movements
- Consider a signal warrant analysis, especially if the southwest quadrant of intersection is developed

Most of the safety-related strategies developed for both intersections are graphically depicted in Figure 6.

Section B: Vicinity of Holland Road and Buck Road Intersection

Goals

- To relieve congested conditions in the area
- Minimize vehicle conflict, particularly in accessing the gas station, Wawa/shopping centers, and Chinquapin Road
- Provide safer driving operations

Holland Road and Buck Road Intersection

Issues

- High number of crashes (rear-ends, angles, sideswipes)
- Traffic congestion, especially caused by northbound Holland Road traffic turning left into the Wawa/shopping center
- Poor access management at Wawa/shopping center and gas station
- Southwestbound Buck Road right-turn lane at the intersection is underutilized (very low right-turn movements)

Safety Strategies

- Provide better access management at Wawa/shopping center
  - Along southbound Holland Road at the driveway, install ”don’t block the driveway” sign and install “don’t block the box” pavement marking
- Provide better access management at gas station
  - At the driveway closest to the intersection along Buck Road, convert the driveway to right-in and right-out only; the second driveway furthest away from the intersection will remain the same, as a two-way entrance and exit for the gas station
  - At the driveway closest to the intersection along Holland Road, convert the driveway to right-in and right-out only; the second driveway furthest away from the intersection will remain the same, as a two-way entrance and exit for gas station

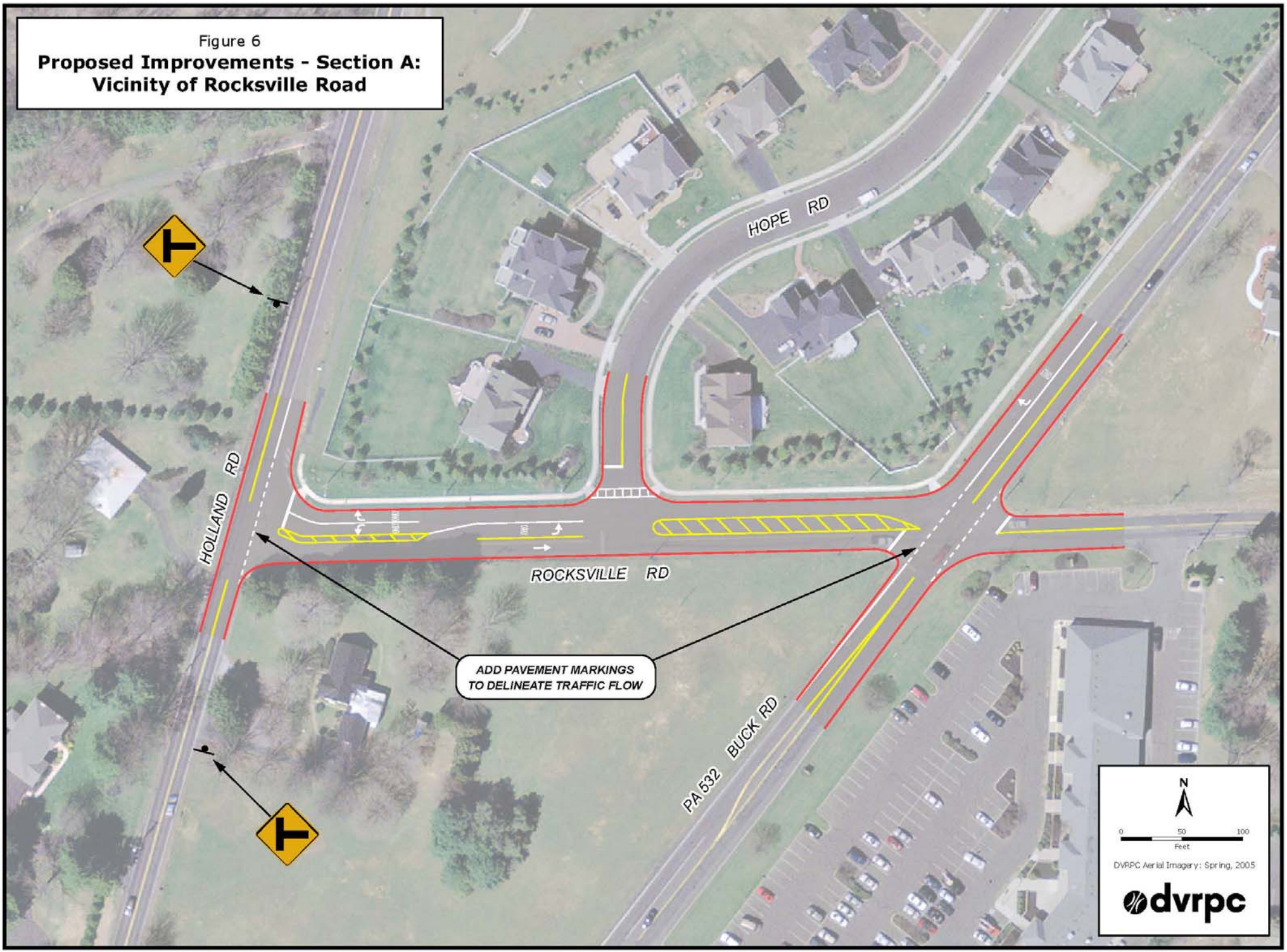


Figure 6
Proposed Improvements - Section A:
Vicinity of Rocksville Road
HOPE RD
HOLLAND RD
ROCKSVILLE RD
ADD PAVEMENT MARKINGS
TO DELINEATE TRAFFIC FLOW
PA 532 BUCK RD
N
0
50
100
Feet
DVRPC Aerial Imagery: Spring, 2005
dvrpc

Operational Strategies – Geometric and Signal Timing Improvements

- Just south of the intersection, create two lanes (the left lane will be dedicated for northbound Holland Road traffic; the right lane will be dedicated for northbound Buck Road traffic)
- Eliminate the right-turn lane along southwestbound Buck Road approaching the intersection
- Retime the traffic signal

LOS Analysis

The LOS analysis performed for this intersection reflects the operational improvements described above. As shown in Table 6, the morning peak hour's overall delay for the intersection is 20 seconds (LOS B). This represents a six-second improvement from existing conditions. The cycle length is reduced to 60 seconds, compared to 90 seconds for the existing condition. The southwest Buck Road approach experiences the largest reduction in delay, at 22 seconds (LOS C). The LOS remains the same for the Holland Road approach, which has a one-second increase in vehicle delay.

For the afternoon peak hour, LOS for the intersection remains at B, with an eight-second reduction in delay. Cycle length is decreased from 90 seconds to 50 seconds. The northbound Buck Road and southbound Holland Road approaches operate at optimal conditions (LOS A). Compared to existing conditions, the southwest Buck Road approach experiences a nine-second reduction in delay (LOS C).

Table 6: Proposed Improvements LOS Analysis – Section B: Holland Road and Buck Road Intersection

	AM (60 sec. cycle)		PM (50 sec. cycle)	
Direction	**Delay (sec)**	**LOS**	**Delay (sec)**	**LOS**
Buck Road southwestbound	37	D	33	C
Buck Road northbound	10	A	5	A
Holland Road southbound	14	B	8	A
Total Intersection	**20**	**B**	**12**	**B**

Source: DVRPC, 2009

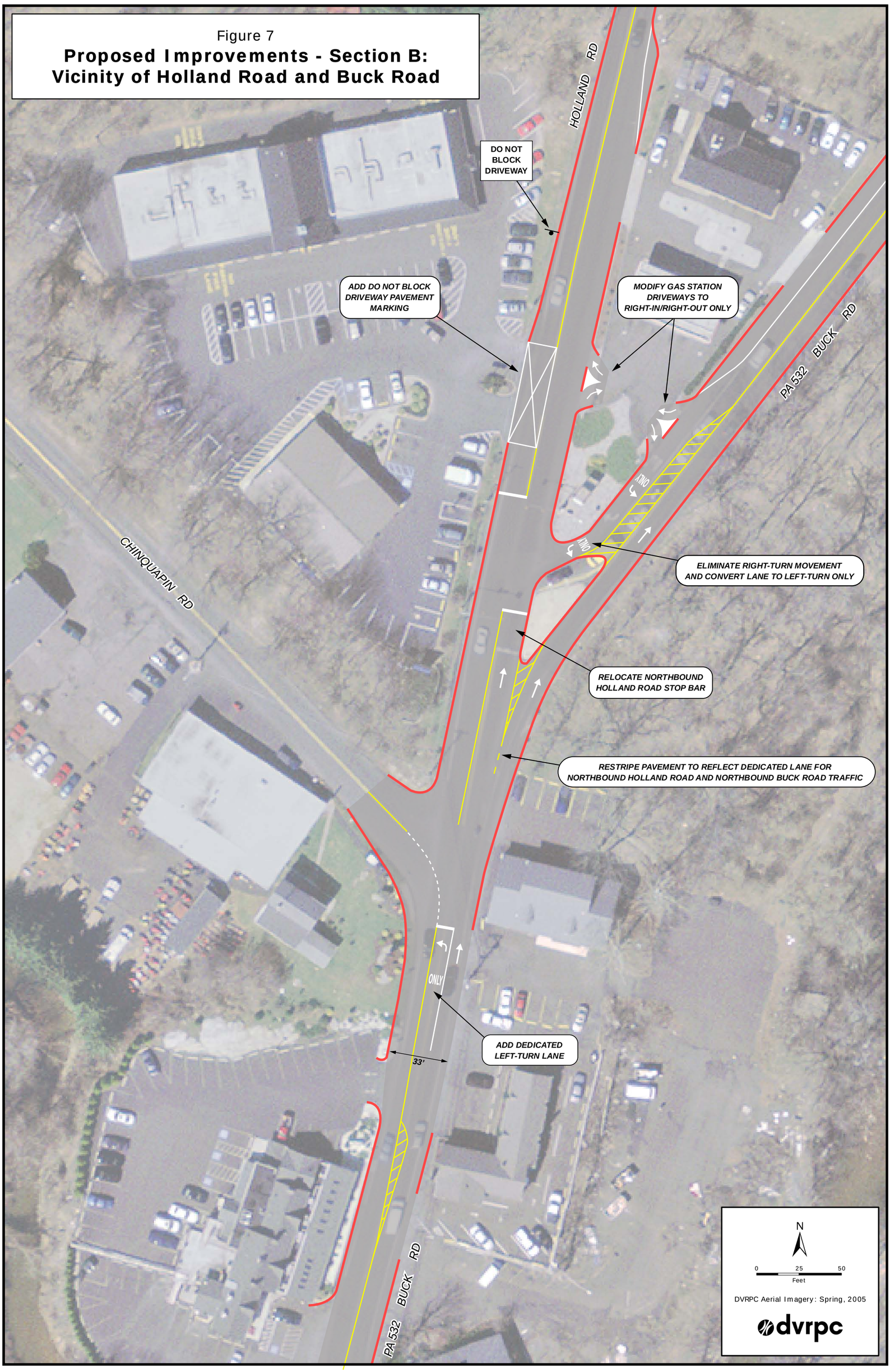
Chinquapin Road and Buck Road Intersection

Issues

- Northbound traffic along Buck Road is using the shoulder to go around vehicles queuing to turn left onto Chinquapin Road
- The northbound Buck Road traffic blocks the intersection because of queuing from the traffic signal at the Holland Road and Buck Road intersection.

Figure 7

Proposed Improvements - Section B: Vicinity of Holland Road and Buck Road



Operational Strategy – Geometric Improvement

- Add a dedicated northbound left-turn lane at the intersections for vehicles turning left onto Chinquapin Road

LOS Analysis

The LOS analysis performed for this intersection reflects the geometric improvement described above. Similar to existing conditions, during the morning peak hour, the intersection operates at LOS A, with three seconds of overall delay. The southbound and northbound Buck Road approaches operate at optimal conditions with zero and 11 seconds of vehicle delay, respectively. The delay experienced at the eastbound Chinquapin Road approach is increased from 28 seconds (existing condition) to 38 seconds.

For the afternoon peak hour, the overall average delay remains the same as the existing conditions. Compared with existing afternoon conditions, the LOS and delay on all approaches are the same. See Table 7.

Table 7: Proposed Improvements LOS Analysis – Section B: Chinquapin Road and Buck Road Intersection

	AM		PM	
Direction	**Delay (sec)**	**LOS**	**Delay (sec)**	**LOS**
Buck Road southbound	0	A	0	A
Buck Road northbound	11	B	9	A
Chinquapin Road eastbound	38	E	20	C
Total Intersection	**3**	**A**	**3**	**A**

Source: DVRPC, 2009

Many of the strategies described above are graphically depicted in Figure 7.

Section C: Vicinity of Old Bristol Road and Buck Road Intersection

Goals

- Ease traffic congestion in the area
- Provide safer traffic operations

Issues

- Along southbound Buck Road, there is a short dedicated left-turn lane that causes southbound through traffic to back up along Buck Road
- Tight turning radius for Old Bristol Road vehicles turning right onto northbound Buck Road
- There is a curve and steep downgrade along Old Bristol Road approaching the signal at Buck Road, which causes sight distance issues
- Long traffic queues at the northbound Buck Road approach due to the one-lane configuration (shared through and right-turn movements)

Operational Strategies – Geometric and Signal Timing Improvements

- Retime the signal
- Realign the intersection
- Install channelized westbound Old Bristol Road right-turn lane
- Extend the southbound left-turn lane along Buck Road
- Add a dedicated right-turn lane for northbound Buck Road

LOS Analysis

The LOS analysis performed for this intersection reflects the operational improvements described above. As shown in Table 8, the morning peak hour overall delay is 13 seconds (LOS B). Compared with existing conditions, the alternative modeled reduced the cycle length from 90 seconds to 60 seconds. This represents a 17-second improvement from existing conditions. LOS for all of the approaches is improved. The northbound Buck Road approach experiences the largest decrease in delay, at 20 seconds (LOS C).

For the afternoon peak hour, LOS for the intersection remains at B. The cycle length is decreased from the existing 90 seconds to 55 seconds. Given the higher traffic volumes through the intersection, the northbound approach experiences the highest amount of delay at 28 seconds (LOS C). Delay along the westbound Old Bristol Road approach is 18 seconds (LOS B).

Table 8: Proposed Improvements LOS Analysis – Section C: Vicinity of Old Bristol Road and Buck Road Intersection

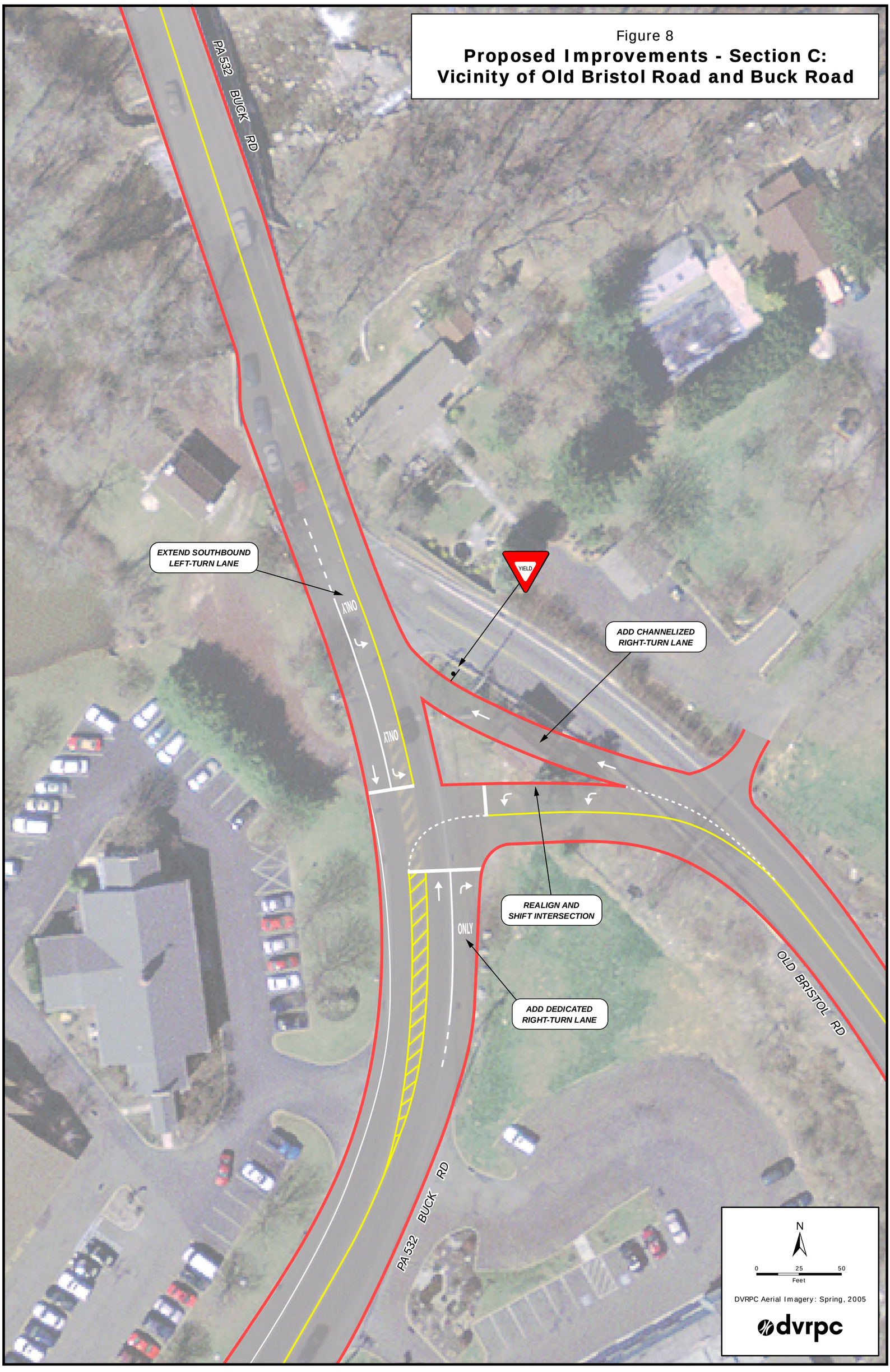
	AM (60 sec. cycle)		PM (55 sec. cycle)	
Direction	**Delay (sec)**	**LOS**	**Delay (sec)**	**LOS**
Buck Road southbound	10	A	7	A
Buck Road northbound	22	C	28	C
Old Bristol Road westbound	15	B	18	B
Total Intersection	**13**	**B**	**17**	**B**

Source: DVRPC, 2009

Many of the strategies described above are graphically depicted in Figure 8.

Figure 8

Proposed Improvements - Section C: Vicinity of Old Bristol Road and Buck Road



Recommendations

The agreed-upon strategies should provide safety and operational benefit within the Holland Business District. Many of the strategies identified are short term, low cost, and should be implemented rather quickly. Recommended improvements include installation of signage, adding pavement markings, and retiming the traffic signals. Other strategies such as improving access management and reconfiguring the intersections, though important and applicable, are more expensive and will require a longer time frame for implementation. A summary of recommended strategies for the Holland Road Business District is reflected below in Table 9.

Table 9: Recommended Strategies

	Recommended Improvements
Section A: Vicinity of Rocksville Road	
Rocksville Road/Holland Road	■ Install safety signage (short-term) ■ Add pavement markings at intersection and along Rocksville Road (short-term)
Rocksville Road/Buck Road	■ Retime signal (short-term) ■ Add pavement markings at intersection and along Rocksville Road (short-term) ■ Conduct warrant accessment for a traffic signal (ONLY if adjacent parcel is developed)
Section B: Vicinity of Holland Road and Buck Road Intersection	
Holland Road/Buck Road	■ Eliminate the southbound Buck Road dedicated right-turn lane (short-term) ■ Stripe northbound Buck Road to accommodate traffic continuing north on either Holland Road or Buck Road (short-term) ■ Install safety signage (short-term) ■ Provide modified access management techniques to the gas station and Wawa/shopping center driveways (medium-term, as it will require negotiation with business owners)
Chinquapin Road/Buck Road	■ Add exclusive left-turn lane (short to medium-term; likely to require ROW from adjacent businesses)
Section C: Vicinity of Old Bristol Road And Buck Road Intersection	
Old Bristol Road/Buck Road	■ Retime signal (short-term) ■ Stripe northbound Buck Road right-turn lane (short-term) ■ Realign the intersection (long-term; many of these improvements, such as extending southbound Buck Road left-turn lane and installing channelized right-turn lane along Old Bristol Road, are included with this recommendation)

Source: DVRPC, 2009

As depicted in Table 9, the majority of the strategies identified as recommended potential improvements are short-term and should be implemented with ease and minimal labor requirements. The two medium-term and one long-term recommendations are located in the areas with the most congestion. Although these improvements are longer term, more expensive, and will require negotiations with adjacent property owners, they will likely provide the most benefit in providing safer traffic operations and relieving congestion in the area.

The strategies presented in this report support findings from other analyses performed by PennDOT and Northampton Township.

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Abstract:

This document represents the findings and recommendations for the Bucks County Congestion and Crash Site Analysis project. This project represents an effort to improve the mobility and safety of the 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 the Bucks County Planning Commission, five intersections located in the Holland Business District (Rocksville Road/Holland Road; Rocksville Road/Buck Road; Buck Road/Holland Road; Buck Road/Chinquapin Road; and Buck Road/Old Bristol Road) were chosen for analysis. These intersections were identified as having congestion and safety issues. In-depth crash and level of service analyses were performed to quantify and gain an understanding of the issues. With input from local stakeholders, improvement strategies were identified to address the issues. As appropriate, proposed improvement strategies were tested for level of effectiveness.

Staff Contacts:

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

Kevin Murphy
Principal Planner
☏ (215) 238-2864
kmurphy@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