EVALUATION OF HIGH CRASH LOCATIONS (DARK CRITERIA) STUDY

LOCATION #1:
WELSH TRACT ROAD
MILEPOST 0.0 to 1.59
November 2012

Prepared for:
Delaware Department of Transportation

By:
Urban Engineers, Inc.

EXECUTIVE SUMMARY

The purpose of this study was to evaluate locations with the highest ratios of crashes occurring during dark conditions throughout the state of Delaware. The study included reviewing crash history and existing conditions of the locations, identifying specific sites where crashes are occurring and providing recommendations to improve conditions.

The Hazard Elimination Program (HEP) site selection process was used to determine ten (10) locations statewide with a dark crashes Critical Ratio greater than one and ten (10) or more crashes occurring in the three year study period within a one-mile roadway segment. Welsh Tract Road, from Milepost 0.0 to 1.59, was determined to be the location with the highest dark crashes Critical Ratio statewide.

Police crash reports were analyzed to identify high crash sites along Welsh Tract Road. The crash patterns at two sites, Welsh Tract Road and Ironside Road intersection and the horizontal curve at milepost 0.67, garnered evaluation for potential nighttime safety improvements.

Investigations showed that two ongoing residential development projects include roadway improvements on Welsh Tract Road. These improvements included widening travel lanes, adding shoulders, adding guardrail, slope grading, and realignment of the horizontal curve at Milepost 0.67.

Several safety improvement recommendations are included for both sites. Roadway lighting is not recommended for the Welsh Tract Road and Ironside Road intersection. At this time, roadway lighting is not recommended for the horizontal curve at milepost 0.67 because major improvements, including roadway realignment, are already proposed for this site as part of a planned development. A follow-up study is recommended to evaluate crash data at a time after the roadway realignment is constructed.

In the event the planned development-related roadway improvement projects do not move forward, the safety improvements and roadway lighting at the horizontal curve are recommended to be installed.

If the horizontal curve, guard rail, and slope issues are not addressed by the development-related roadway improvements project, a study is recommended to re-evaluate those concerns.

If the horizontal curve, guard rail, and slope issues are addressed by the development-related roadway improvements project, a follow-up study is recommended to evaluate the need for roadway lighting once crash data is available for the post-improvement conditions.

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1. INTRODUCTION

The purpose of this study was to evaluate locations with the highest ratios of crashes occurring during dark conditions throughout the state of Delaware. The study included reviewing crash history and existing conditions of the locations, identifying specific sites where crashes are occurring and providing recommendations to improve conditions.

The study included three parts:

Part 1: Location Selection – The Hazard Elimination Program (HEP) site selection process was used to determine ten (10) locations statewide with a dark crashes Critical Ratio greater than one and ten (10) or more crashes occurring in the three year study period within a one-mile roadway segment. Results from the location selection process were reviewed in coordination with DelDOT. Corridors that were already part of an ongoing HSIP or HEP project were not included in this study. The Critical Ratio methodology was used in the location selection process. The list of statewide 1.0 mile corridors ranked by Critical Ratio is included in Appendix D.

Part 2: Evaluation – After the list of the top ten locations was approved by DelDOT, initial review was performed for each selected location. The evaluation included field visits to the sites; collecting information on existing roadway and traffic conditions; crash analysis; preliminary lighting evaluation; and this report. The report includes existing lighting analysis; concept lighting improvement alternatives; other signing, striping and signal recommendations in accordance with the Delaware Strategic Highway Safety Plan (SHSP), particularly related to dark crashes; potential design/implementation issues, and identification of the need for more detailed studies (Phase II studies).

Part 3: Coordination – Coordination of implementation with ongoing DelDOT projects (HEP, Pavement & Rehabilitation, PD, etc.). When possible, DelDOT-approved recommendations are coordinated for inclusion into the construction of ongoing projects.

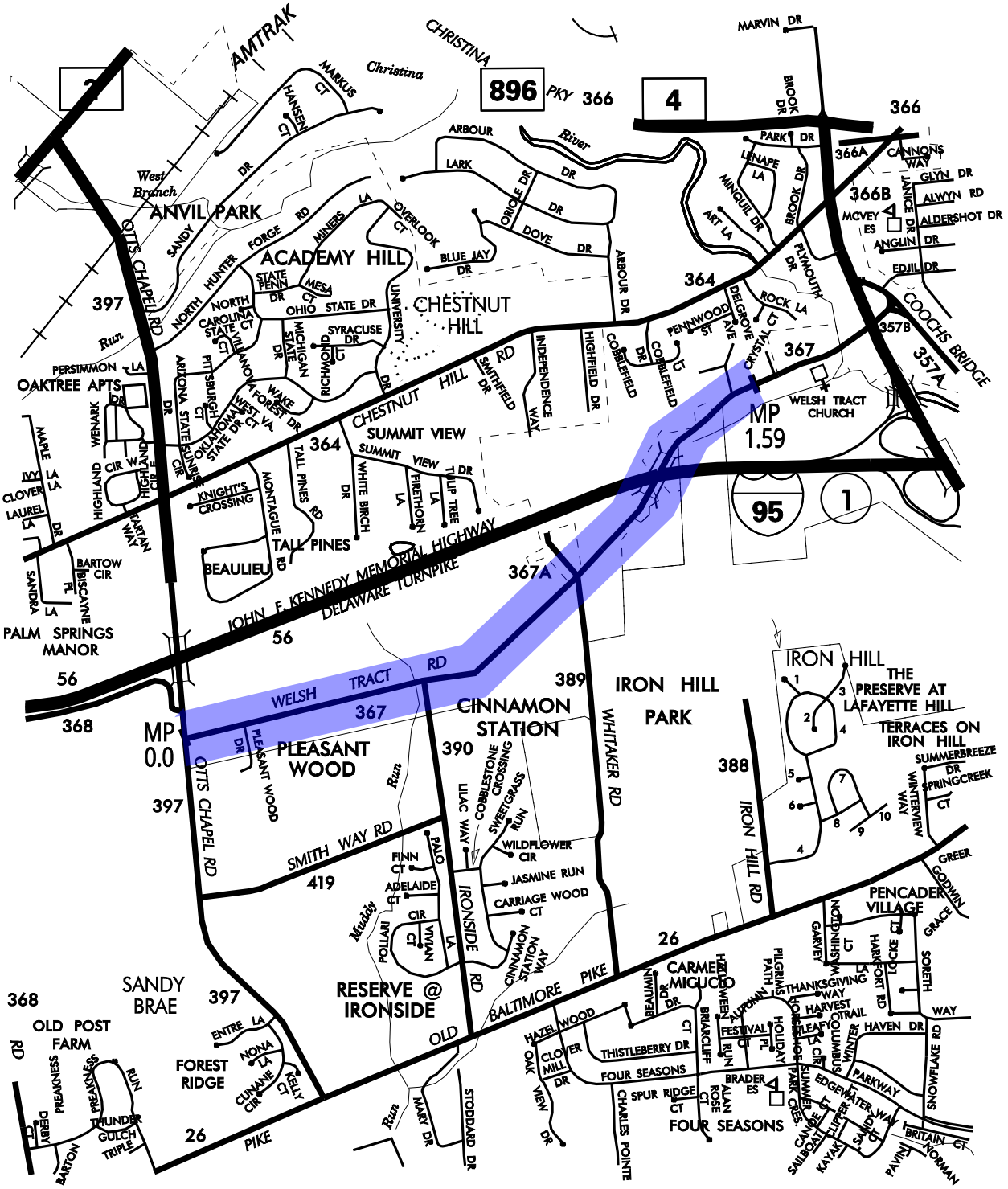
The location selection process resulted in a list of ten locations, including Welsh Tract Road from milepost 0 to 1.59.

Welsh Tract Road

Welsh Tract Road, from Milepost 0.0 to 1.59, was determined to be the location with the highest dark crashes Critical Ratio statewide. The evaluation and recommendations for Welsh Tract Road are included in this report.

Welsh Tract Road is an undivided, two-lane roadway in Newark, Delaware. The road is classified as a major collector roadway throughout the project area. The road experiences an ADT of around 4,400 vehicles.

A study area map is provided in Figure 1.



Project Area

FIGURE 1 - STUDY AREA MAP
Welsh Tract Road, MP 0-1.59
Newark, Delaware
New Castle County

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2. CRASH DATA SUMMARY AND ANALYSIS

This evaluation was based on crash data during the three year period from December 16, 2007 to December 16, 2010.

A total of 44 crashes occurred on Welsh Tract Road from milepost 0 to 1.59 during the evaluation period. Fifteen (15) of the crashes resulted in personal injuries (34%). Run-off-the-road collisions with fixed objects made up 26 of the 44 crashes (59%).

Of the 44 crashes, 20 (45%) occurred during dark conditions.

The highest number of crashes (14) at an individual site occurred at the horizontal curve at Milepost 0.67. Of these crashes, 8 of the 14 (57%) occurred during dark conditions.

Crashes were grouped together into sites based on their location along Welsh Tract Road.

Site #1: Welsh Tract Road @ Ott's Chapel Road Intersection (M.P. 0.0)

Crashes from Welsh Tract Road Milepost 0.0 to 0.06 were grouped into this site. There were two (2) total crashes at the site during the evaluation period. Both of the crashes occurred during daylight conditions.

This site was not selected for evaluation based on the crash history.

Site #2: Welsh Tract Road @ Pleasantwood Road Intersection (M.P. 0.14)

Crashes from Welsh Tract Road Milepost 0.11 to 0.15 were grouped into this site. There were five (5) total crashes at this site during the evaluation period. Two (2) of these crashes occurred during dark hours. One of the crashes during dark conditions involved a stolen vehicle running off the shoulder.

This site was not selected for evaluation based on the crash history.

Site #3: Welsh Tract Road @ Welsh Hill Road Intersection (M.P. 0.28)

A crash from Welsh Tract Road Milepost 0.32 was grouped into this site. There was one (1) crash in the vicinity of the Welsh Tract Road and Welsh Hill Road intersection.

This site was not selected for evaluation based on the crash history.

Site #4: Welsh Tract Road @ Ironside Road Intersection (M.P. 0.55)

Crashes from Welsh Tract Road Milepost 0.55 to 0.58 were grouped into this site. Over the evaluation period, five (5) total crashes occurred at this site, four (4) of these crashes occurred during dark conditions. The percentage of dark crashes was 80%.

A review of police crash reports showed that this intersection included three run-off-the-road crashes during dark conditions. In all three dark run-off-the-road crashes, the vehicle was heading westbound. One of the crashes was attributed to a driver taking the turn (horizontal curve at milepost 0.67) too fast. It is not clear based on the police reports, if the other run-off-the-road crashes were related to the horizontal curve.

None of the dark crashes involved collisions between Welsh Tract Road traffic and Ironside Road traffic.

This site was selected for evaluation based on the number and proportion of dark crashes.

Site #5: Welsh Tract Road @ Horizontal Curve (M.P. 0.67)

Crashes from Welsh Tract Road Milepost 0.62 to 0.71 were grouped into this site. Over the evaluation period, fourteen (14) total crashes occurred at this site, eight (8) of these crashes occurred during dark conditions. The percentage of dark crashes was 57%.

Of the fourteen (14) total crashes, thirteen (13) were run-off-the-road crashes. Of the eight (8) crashes during dark conditions, all were run-off-the-road crashes.

This site was selected for evaluation based on the number and proportion of dark crashes.

Site #6: Welsh Tract Road @ Whittaker Road Intersection (M.P. 0.97)

A crash from Welsh Tract Road Milepost 0.99 was grouped into this site. There was one (1) crash in the vicinity of the Welsh Tract Road and Whittaker Road intersection.

This site was not selected for evaluation based on the crash history.

Site #7: Welsh Tract Road @ Folk Memorial Park Entrance (M.P. 1.42)

Crashes from Welsh Tract Road Milepost 1.42 to 1.43 were grouped into this site. There were two (2) crashes in the vicinity of the Welsh Tract Road and the Folk Memorial Park entrance. One (1) of these crashes occurred during dark conditions.

This site was not selected for evaluation based on the crash history.

Site #8: Welsh Tract Road @ Villa Belmont Apartments Entrance (M.P. 1.52)

A crash from Welsh Tract Road Milepost 1.49 was grouped into this site. There was one (1) crash in the vicinity of the Villa Belmont Apartments entrance.

This site was not selected for evaluation based on the crash history.

3. ROADWAY AND SITE CHARACTERISTICS

There is no shoulder on Welsh Tract Road throughout the project area. The pavement width is as narrow as 19 feet across in some locations. Trees, such as those shown below in Photo 1, are present on both sides of the road for much of the 1.59 miles.

Photo 1: Facing West on Welsh Tract Road approaching Horizontal Curve (M.P. 0.67)

Site #4: Welsh Tract Road @ Ironside Road Intersection (M.P. 0.55)

Welsh Tract Road and Ironside Road meet at an unsignalized T-intersection at milepost 0.55 of Welsh Tract Road. There is no existing lighting at the intersection. All three approaches have a single lane. Ironside Road is stop-controlled. There are no sidewalks or crosswalks present at the intersection. The posted speed limit for Welsh Tract Road is 35 miles per hour at the site.

Photo 2: Facing East on Welsh Tract Road approaching Ironside Road

The Two-Direction Chevron Alignment warning sign facing the northbound Ironside Road approach is leaning backwards.

There are bridge parapets on the north and south side of Welsh Tract Road 85 feet west of Ironside Road. Guard rail is present on the north side of the parapet on the westbound approach only.

Photo 3: Bridge Parapets. Facing West on Welsh Tract Road west of Ironside Road

Site #5: Welsh Tract Road @ Horizontal Curve (M.P. 0.67)

A 270 foot-radius horizontal curve is present at milepost 0.67 of Welsh Tract Road. There is no existing lighting at the intersection. Welsh Tract Road is a two lane roadway at the curve. Both lanes have a width of 10.5 feet at the curve.

The horizontal curve is located on a slope. The eastbound approach to the horizontal curve features a 4.7% incline. The westbound approach to the horizontal curve features a 5% decline.

A Left Turn sign (W1-1L), 25 miles per hour Advisory Speed sign (W13-1-25) and Hidden Entrance plate (W11-24a-DE) is located 450 feet east of the horizontal curve on the westbound approach. Similarly, a Right Turn sign (W1-1R), 25 miles per hour Advisory Speed sign (W13-1-25) and Hidden Entrance plate (W11-24a-DE) is located 465 feet west of the horizontal curve on the eastbound approach.

The hidden entrance is a private driveway in the middle of the curve on the south side of Welsh Tract Road.

Photo 4: Horizontal Curve with grade change. Facing Westbound.

Two (2) Chevron Alignment signs (W1-8) are present on the south side of the Welsh Tract Road. The sign located at the horizontal curve is double-sided. The other sign is located approximately 115 feet east of the first sign. This sign is one-sided, facing westbound traffic only.

4. LIGHTING WARRANT EVALUATION

The DelDOT Lighting Guidelines contain the conditions for determining if lighting is warranted at a given site. A warrant analysis is included below for each site that was chosen for evaluation.

DelDOT uses utility pole-mounted lighting whenever possible. Delmarva Power utility poles are present on the north side of Welsh Tract Road for most of the corridor. These utility poles could potentially be used to install utility company-owned luminaires.

Section 2.3, *Lighting Warrants*, of the DelDOT Lighting Guidelines states that lighting should be installed at "locations where crash patterns indicate that lighting may reduce crashes and where the percentage of nighttime accidents is 40 percent or greater."

Site #4: Welsh Tract Road @ Ironside Road Intersection (M.P. 0.55)

Crash Patterns

The Crash Data Summary and Evaluation showed that there were five (5) total crashes near this intersection during the three year evaluation period. Four (4) of these crashes occurred during dark conditions. All four (4) of these dark crashes were run-off-the-road crashes.

The four (4) run-of-the-road crashes included the following contributing circumstances:

- Operating defective equipment (brake failure)
- Slippery roadway conditions
- Taking turn too fast
- Avoiding vehicle on oncoming lane

There were no identifiable crash patterns present in the crash data.

None of the dark crashes involved collisions between Welsh Tract Road traffic and Ironside Road traffic.

Percentage of Nighttime Crashes

Eighty percent (4 out of 5) of the crashes at the site occurred during dark conditions. The crash history at this intersection meets the conditions for a location where lighting "should be installed," as per Section 2.3 of the DelDOT Lighting Guidelines.

Lighting Warrant Results

Although this site has greater than 40% of crashes occurring during dark conditions, an examination of the police reports showed no identifiable crash pattern that would benefit from roadway lighting.

Site #5: Welsh Tract Road @ Horizontal Curve (M.P. 0.67)

Crash Patterns

All eight of the dark crashes at the horizontal curve were run-off-the-road crashes. The crash history shows a crash pattern that may benefit from lighting.

Percentage of Nighttime Crashes

Fifty-seven percent (8 out of 14) of the crashes occurred during dark conditions at this site.

Lighting Warrant Results

With 57% of crashes occurring during dark conditions, the crash history at this intersection meets the conditions for a location where lighting "should be installed," as per Section 2.3 of the DelDOT Lighting Guidelines.

5. PREVIOUS STUDIES RECOMMENDATIONS

Two previous studies were included in a review of previously recommended improvements at the sites.

1) **1998 HSIP – Site F Task I Report** included the following recommendations:

NOT IMPLEMENTED	Install guardrail on both sides of eastbound Welsh Tract Church Road and on the south side of the road on the westbound approach to protect motorists from fixed object collisions with the parapets.
IMPLEMENTED	Install W1-8 (Chevron Alignment) signs within the horizontal curve section east of Ironside Road on westbound Welsh Tract Church Road to better warn motorists.
NOT IMPLEMENTED	Install overhead lighting on the existing utility poles within the curve section (Pending success of other measures). Lighting should start in the tangent section prior to the curve and end in a tangent section after the curve (per DelDOT Highway Lighting Policy).

The study resolved to install chevrons and delineators within the curve section; and decided that the need for lighting would be assessed at a later date pending the success of other measures.

Safety recommendations for these sites were also included in a 2007 study.

2) **2007 HSIP – Site N Report** included the following recommendations:

NOT IMPLEMENTED	Install guardrail and delineators on the south side of Welsh Tract Road on both the leading and trailing edges of the bridge parapet located west of Ironside Road, continuing the guardrail on the trailing edge to the intersection at Ironside Road.
NOT IMPLEMENTED	Replace the damaged guardrail provided on the north side of Welsh Tract Road on the leading edge of the bridge parapet located west of Ironside Road and install delineators along the new guardrail.
NOT IMPLEMENTED	Install raised pavement markers on the approaches to and within the curve on Welsh Tract Road east of Ironside Road. Install following resurfacing by the Welsh Hill Preserve developer.
IMPLEMENTED	Install an Object Marker sign (OM-3) on the trailing edge of the guardrail provided on the north side of Welsh Tract Road to warn westbound vehicles of the bridge parapet over Muddy Run.
IMPLEMENTED	Install a double yellow centerline (100 feet) and a stop line on the northbound Ironside Road approach to Welsh Tract Road.
IMPLEMENTED	Replace the Turn warning signs (30” x 30”) on the eastbound and westbound Welsh Tract Road approaches to the curve east of Ironside Road with larger fluorescent yellow Turn warning signs (36” x 36”). Replace the existing 25 mph advisory speed plates with fluorescent yellow signs.
SIGN REPOSTED, ADDITIONAL SIGNS NOT	Repost the leaning Chevron Alignment warning sign located within the curve on Welsh Tract Road east of Ironside Road and install three additional Chevron Alignment warning signs.

INSTALLED	
IMPLEMENTED	Install a Two-Direction Large Arrow warning sign at the intersection of Ironside Road at Welsh Tract Road.
NOT IMPLEMENTED	Install Combination Horizontal Alignment/Intersection warning signs with supplemental name plaques on the eastbound and westbound Welsh Tract Road approaches to Ironside Road.
IMPLEMENTED	Install a Stop Ahead warning sign on the northbound Ironside Road approach to Welsh Tract Road.

6. PROPOSED IMPROVEMENTS FROM OTHER PROJECTS

Two residential developments are being constructed along Welsh Tract Road in the project area. As part of the development process, roadway improvements for Welsh Tract Road are included with each development.

Welsh Tract Road Improvements Accompanying Welsh Hill Preserve Development

Welsh Hill Preserve is a proposed 48-lot residential development located on the south side of Welsh Tract Road. The development entrance is proposed at approximately Milepost 0.28.

Roadway improvements are proposed for Welsh Tract Road, from the intersection with Ott's Chapel Road (Milepost 0.0) to the intersection with Ironside Road (Milepost 0.55). Improvements accompanying the Welsh Hill Preserve development include:

- Installing guardrail on both the east and west sides of the bridge parapet on the south side of Welsh Tract Road.
- Removing obstructions and slope grading within the clear zone on the north side of Welsh Tract Road.

Welsh Tract Road Improvements Accompanying Ironside Crossing Development

Ironside Crossing is a proposed 20-lot residential development located on the north side of Welsh Tract Road. The development entrance is proposed at approximately Milepost 0.74.

Roadway improvements are proposed for Welsh Tract Road, from approximately Milepost 0.61 to Milepost 0.76. Improvements accompanying the Ironside Crossing development include:

- Realigning the horizontal curve at Milepost 0.67. The horizontal curve radius is increased from 270' to 533'.
- Widening of travel lanes to 11' wide.
- Adding shoulders of a minimum of 5' wide, added on both sides of Welsh Tract Road.
- Adding sight distance easement on the north side of Welsh Tract Road.
- Relocating utility poles which were moved further from the roadway.
- Extending the right-of-way on the north side of Welsh Tract Road to provide space to make the improvements.

7. RECOMMENDATIONS

Recommendations are included below, and recommended improvements are summarized in the following table.

Site #4: Welsh Tract Road @ Ironside Road Intersection (M.P. 0.55)

Roadway Lighting

The crash history did not show a pattern of crashes that would benefit from lighting the intersection. Therefore, roadway lighting is not recommended for this site.

Other Improvements

Replace the damaged guardrail on the north side of Welsh Tract Road on the leading edge of the bridge parapet located west of Ironside Road and install delineators along the new guardrail. This recommendation was also included in the 2007 HSIP Report, but was not implemented.

Repost the leaning object markers (OM3) on the west side of the bridge parapet on both sides of the roadway.

Replace the Two-Direction Chevron Alignment warning sign facing the northbound Ironside Road approach that is leaning backwards.

Site #5: Welsh Tract Road @ Horizontal Curve (M.P. 0.67)

Roadway Lighting

The crash patterns at this site indicate that drivers are not aware of the horizontal curve or are not reducing speed appropriately to navigate the curve. The crash history included 57% of the crashes occurred during dark conditions.

However, the proposed Ironside Crossing development project includes a significant realignment of the horizontal curve radius, from 270' to 533'. This project also includes widening travel lanes and other safety improvements.

Instead of recommending that roadway lighting be installed at this time, it would be desirable to evaluate the crash data in a follow-up study once the improvements proposed through the Ironside Crossing development project are constructed. An evaluation of crash data after the improvements are constructed could determine if the realignment of the roadway has improved the safety conditions and reduced the need for roadway lighting.

If the proposed development-related roadway improvements projects do not move forward, roadway lighting at the horizontal curve is recommended to be installed.

Other Improvements

As part of the proposed development-related roadway improvements projects, install additional Chevron Alignment warning signs (W1-8) as a part of the horizontal curve realignment already proposed. The Ironside Crossing development roadway improvements will realign the horizontal curve radius from 270' to 533'. Table 2C-6 of the Delaware Manual on Uniform Traffic Control Devices shows that W1-8 signs shall be spaced every 120 feet for curves with a radius between 401' and 700'.

There is one (1) Chevron Alignment warning sign facing eastbound traffic. Two (2) additional Chevron Alignment warning signs should be placed west of the existing Chevron Alignment warning sign facing eastbound traffic. These signs should be spaced at approximately 120 feet apart. One (1) additional Chevron Alignment warning sign should be installed on the back of the existing Chevron Alignment warning sign facing westbound traffic, east of the existing sign facing eastbound traffic.

There are two (2) Chevron Alignment warning signs facing westbound traffic. One (1) additional Chevron Alignment warning sign should be installed on the back of the first new sign facing west, approximately 120 feet to the west of the existing Chevron Alignment warning sign.

If the proposed development-related roadway improvements projects do not move forward, the Chevron Alignment signs should still be installed.

Additional Studies

If the horizontal curve, guard rail, and slope issues are not addressed by the development-related roadway improvements project, a study is recommended to re-evaluate those concerns.

If the horizontal curve, guard rail, and slope issues are addressed by the development-related roadway improvements project, a follow-up study is recommended to evaluate the need for roadway lighting once crash data is available for the post-improvement conditions.

Recommended Improvements

Site	Recommended Improvement
#4. Welsh Tract Rd @ Ironside Rd Intersection (MP 0.55)	Replace the damaged guardrail on the north side of Welsh Tract Road on the leading edge of the bridge parapet and install delineators along the new guardrail.
	Repost the leaning object markers (OM3) on the west side of the bridge parapet on both sides of the roadway.
	Replace the Two-Direction Chevron Alignment warning sign facing the northbound Ironside Road approach that is leaning backwards.
#5. Welsh Tract Rd @ Horizontal Curve (MP 0.67)	As part of the proposed development-related roadway improvements projects, install additional Chevron Alignment warning signs (W1-8) as a part of the horizontal curve realignment already proposed. The Ironside Crossing development roadway improvements will realign the horizontal curve radius from 270' to 533'. Table 2C-6 of the Delaware Manual on Uniform Traffic Control Devices shows that W1-8 signs shall be spaced every 120 feet for curves with a radius between 401' and 700'. There is one (1) Chevron Alignment warning sign facing eastbound traffic. Two (2) additional Chevron Alignment warning signs should be placed west of the existing Chevron Alignment warning sign facing eastbound traffic. These signs should be spaced at approximately 120 feet apart. One (1) additional Chevron Alignment warning sign should be installed on the back of the existing Chevron Alignment warning sign facing westbound traffic, east of the existing sign facing eastbound traffic. There are two (2) Chevron Alignment warning signs facing westbound traffic. One (1) additional Chevron Alignment warning sign should be installed on the back of the first new sign facing west, approximately 120 feet to the west of the existing Chevron Alignment warning sign.
	If the horizontal curve, guard rail, and slope issues are not addressed by the development-related roadway improvements project, a study is recommended to re-evaluate those concerns.
	If the proposed development-related roadway improvements projects do not move forward, roadway lighting at the horizontal curve is recommended to be installed.
	Evaluate the crash data in a follow-up study once the improvements proposed through the Ironside Crossing development project are constructed. An evaluation of crash data after the improvements are constructed could determine if the realignment of the roadway has improved the safety conditions and reduced the need for roadway lighting.

APPENDIX A: Crash Data Summary

State of Delaware Crash Study Summary

Study Period from 12-16-2007 to 12-16-2010

Summary	
	# of Crashes
Total Crashes	44
Fatal Crashes	0
Total Alcohol-Related Crashes	1
Total Non Alcohol-Related Crashes	43
Total Fatalities	0
Total Pedestrian Fatalities	0
Total Pedestrian Injuries	0
Total Pedestrian Crashes	0
Total Motorcycle Crashes	0
Total Pedalcyclist Crashes	0

Classification		
	# of Crashes	**% of Total Crashes**
Non-Reportable	5	11.36%
Reportable	24	54.55%
Personal Injury	15	34.09%
Fatality	0	0.00%
Total	44	

Manner Of Impact		
	# of Crashes	**% of Total Crashes**
Front to rear	5	11.36%
Front to front	5	11.36%
Angle	4	9.09%
Sideswipe, same direction	3	6.82%
Sideswipe, opposite direction	3	6.82%
Rear to side	0	0.00%
Rear to rear	0	0.00%
Other	4	9.09%
Unknown	2	4.55%
Not a collision between two vehicles	18	40.91%
Total	44	

Alcohol Related Crashes by Classification					
	Non-reportable	Reportable	Personal Injury	Fatality	**Total**
Alcohol Related	0	1	0	0	1
Non-Alcohol Related	5	23	15	0	43
Total	5	24	15	0	44

Manner of Impact By Classification					
	Non-Reportable	Reportable	Personal Injury	Fatality	**Total**
Front to rear	0	4	1	0	5
Front to front	0	3	2	0	5
Angle	1	0	3	0	4
Sideswipe, same direction	1	2	0	0	3
Sideswipe, opposite direction	1	2	0	0	3
Rear to side	0	0	0	0	0
Rear to rear	0	0	0	0	0
Other	2	1	1	0	4
Unknown	0	1	1	0	2
Not a collision between two vehicles	0	11	7	0	18
Total	5	24	15	0	44

Day Of Week		
	# of Crashes	% of Total Crashes
Sunday	6	13.64%
Monday	6	13.64%
Tuesday	6	13.64%
Wednesday	6	13.64%
Thursday	6	13.64%
Friday	9	20.45%
Saturday	5	11.36%
Total	44	

Time Of Day (AM)		
	# of Crashes	% of Total Crashes
00:00 - 00:59	2	4.55%
01:00 - 01:59	1	2.27%
02:00 - 02:59	2	4.55%
03:00 - 03:59	1	2.27%
04:00 - 04:59	0	0.00%
05:00 - 05:59	0	0.00%
06:00 - 06:59	3	6.82%
07:00 - 07:59	3	6.82%
08:00 - 08:59	2	4.55%
09:00 - 09:59	2	4.55%
10:00 - 10:59	1	2.27%
11:00 - 11:59	2	4.55%
Total	19	

Time Of Day (PM)		
	# of Crashes	% of Total Crashes
12:00 - 12:59	2	4.55%
13:00 - 13:59	0	0.00%
14:00 - 14:59	5	11.36%
15:00 - 15:59	1	2.27%
16:00 - 16:59	2	4.55%
17:00 - 17:59	1	2.27%
18:00 - 18:59	2	4.55%
19:00 - 19:59	1	2.27%
20:00 - 20:59	2	4.55%
21:00 - 21:59	5	11.36%
22:00 - 22:59	1	2.27%
23:00 - 23:59	3	6.82%
Total	25	
Unknown Time	0	

Surface Conditions		
	# of Crashes	% of Total Crashes
Dry	25	56.82%
Wet	15	34.09%
Snow	1	2.27%
Ice/Frost	2	4.55%
Sand	0	0.00%
Water (standing,mo	0	0.00%
Slush	0	0.00%
Oil	0	0.00%
Mud, Dirt, Gravel	0	0.00%
Other	0	0.00%
Unknown	0	0.00%
Total	43	

Lighting Conditions		
	# of Crashes	% of Total Crashes
Daylight	22	50.00%
Dawn	1	2.27%
Dusk	1	2.27%
Dark-Lighted	2	4.55%
Dark-Not Lighted	18	40.91%
Dark-Unknown Lighting	0	0.00%
Other	0	0.00%
Unknown	0	0.00%
Total	44	

Weather Conditions		
	# of Crashes	% of Total Crashes
Clear	22	50.00%
Cloudy	9	20.45%
Fog, Smog, Smoke	2	4.55%
Rain	10	22.73%
Sleet, Hail (freezing rain or drizzle)	0	0.00%
Snow	1	2.27%
Blowing Snow	0	0.00%
Severe Crosswinds	0	0.00%
Blowing Sand, Soil, Dirt	0	0.00%
Other	0	0.00%
Unknown	0	0.00%
Total	44	

Most Harmful Event		
	# of Crashes	% of Total Crashes
Overturn/Rollover, Non-Collision	0	0.00%
Fire/Explosion, Non-Collision	0	0.00%
Immersion, Non-Collision	0	0.00%
Jackknife, Non-Collision	0	0.00%
Cargo/Equipment Loss or Shift, Non-Collision	0	0.00%
Fell/Jumped From Motor Vehicle, Non-Collision	0	0.00%
Thrown or Falling Object, Non-Collision	0	0.00%
Other Non-Collision, Non-Collision	1	2.27%
Pedestrian, Collision With Person, Motor Vehicle, or Non-Fixed Object	0	0.00%
Pedalcycle, Collision With Person, Motor Vehicle, or Non-Fixed Object	0	0.00%
Railway Vehicle (train, engine), Collision With Person, Motor Vehicle, or Non-Fixed Object	0	0.00%
Animal, Collision With Person, Motor Vehicle, or Non-Fixed Object	1	2.27%
Motor Vehicle in Transport, Collision With Person, Motor Vehicle, or Non-Fixed Object	14	31.82%
Legally Parked Motor Vehicle, Collision With Person, Motor Vehicle, or Non-Fixed Object	0	0.00%
Struck by Falling, Shifting Cargo or Anything Set in Motion by Motor Vehicle, Collision With Person, Motor Vehicle, or Non-Fixed Object	0	0.00%
Work Zone / Maintenance Equipment, Collision With Person, Motor Vehicle, or Non-Fixed Object	0	0.00%
Other Non-Fixed Object, Collision With Person, Motor Vehicle, or Non-Fixed Object	2	4.55%
Impact Attenuator/Crash Cushion, Collision With Fixed Object	0	0.00%
Bridge Overhead Structure, Collision With Fixed Object	0	0.00%
Bridge Pier or Support, Collision With Fixed Object	1	2.27%
Bridge Rail, Collision With Fixed Object	0	0.00%
Cable Barrier, Collision With Fixed Object	0	0.00%
Culvert, Collision With Fixed Object	0	0.00%
Curb, Collision With Fixed Object	1	2.27%
Ditch, Collision With Fixed Object	5	11.36%
Embankment, Collision With Fixed Object	9	20.45%

Guardrail Face, Collision With Fixed Object	0	0.00%
Guardrail End, Collision With Fixed Object	0	0.00%
Concrete Traffic Barrier, Collision With Fixed Object	0	0.00%
Other Traffic Barrier, Collision With Fixed Object	0	0.00%
Tree (standing), Collision With Fixed Object	8	18.18%
Utility Pole, Collision With Fixed Object	2	4.55%
Light Support, Collision With Fixed Object	0	0.00%
Traffic Sign Support, Collision With Fixed Object	0	0.00%
Overhead Sign Support, Collision With Fixed Object	0	0.00%
Traffic Signal Support, Collision With Fixed Object	0	0.00%
Fence, Collision With Fixed Object	0	0.00%
Mailbox, Collision With Fixed Object	0	0.00%
Other Post, Pole or Support, Collision With Fixed Object	0	0.00%
Other Fixed Object (wall, building, tunnel, etc.), Collision With Fixed Object	0	0.00%
Illegally Parked Motor Vehicle, Collision with person, vehicle, or object not fixed	0	0.00%
Stopped Motor Vehicle, Collision with person, vehicle, or object not fixed	0	0.00%
Unknown, Collision With Fixed Object	0	0.00%
Total	44	

Primary Contributing Circumstance		
	# of Crashes	**% of Total Crashes**
Speeding	2	4.55%
Failed to yield right of way	1	2.27%
Passed Stop Sign	0	0.00%
Disregard Traffic Signal	0	0.00%
Wrong side or wrong way	0	0.00%
Improper passing	0	0.00%
Improper lane change	0	0.00%
Following too close	0	0.00%
Made improper turn	0	0.00%
Driving under the influence	0	0.00%
Driver inattention, distraction, or fatigue	2	4.55%
Driving in a careless or reckless manner	4	9.09%
Driving in an aggressive manner	0	0.00%
Improper backing	1	2.27%
Other improper driving	0	0.00%
Mechanical defects	1	2.27%
Animal in Roadway - Deer	1	2.27%
Animal in Roadway - Other Animal	0	0.00%
Other environmental circumstances - weather, glare	3	6.82%
Roadway circumstances - debris, holes, work zone	0	0.00%
Other	2	4.55%
Unknown	1	2.27%
Total	18	

Driver Contributing Circumstance		
	# of Drivers	**% of Total Drivers**
No Contributing Action	19	28.79%
Failed to yield right of way	2	3.03%
Ran Red Light	0	0.00%
Ran Stop Sign	1	1.52%
Disregard other traffic sign	0	0.00%
Disregard other road markings	0	0.00%
Exceeded authorized speed limit	1	1.52%
Driving too fast for conditions	8	12.12%
Made an improper turn	0	0.00%
Improper backing	0	0.00%
Wrong side or wrong way	0	0.00%
Followed too closely	1	1.52%
Failure to keep in proper lane	2	3.03%
Ran off roadway	3	4.55%
Operating vehicle in erratic, reckless, careless, negligent or aggressive manner	3	4.55%
Swerving or avoiding due to wind, slippery surface, vehicle, object, non-motorist in roadway, etc.	0	0.00%
Over-correcting/over-steering	0	0.00%
Improper Passing	0	0.00%
Other Contributing Action	10	15.15%
Unknown	6	9.09%
Total	66	

CTY	RD	MP	C-MP	DIR	COMP/HQ#	Date	Time	Day	Fat	Inj	AL	LC	WC	SC	MHE	PC	Class	MOI
2007																		
N	367	0.64	0.64	5	3207159698	12/21/07	2053	6	0	0	N	05	04	02	26		02	00
N	367	1.28	1.28	5	0607121702	12/28/07	1152	6	0	0	N	01	02	01	13		03	01
N	367	1.28	1.28	5	0607122339	12/30/07	1212	1	0	0	N	01	01	01	13		02	01
2008																		
N	367	0.64	0.64	5	0208006400	1/22/08	2155	3	0	0	Y	05	01	04	26		02	00
N	367	0.58	0.58	5	3208017903	2/13/08	1918	4	0	0	N	05	04	02	31		02	00
N	367	1.26	1.26	5	0608074253	8/10/08	1818	1	0	0	N	01	02	01	13		02	01
N	367	0.71	0.71	5	3208052938	5/4/08	0007	1	0	0	N	05	02	01	31		03	00
N	367	0.62	0.62	5	3208042239	4/11/08	0338	6	0	0	N	05	01	01	31		02	00
N	367	0.15	0.15	5	3208058304	5/16/08	0210	6	0	0	N	05	04	02	32		02	00
N	367	0.57	0.57	5	0208070160	7/29/08	2134	3	0	0	N	04	01	01	26		03	00
N	367	0.57	0.57	5	3208090687	7/24/08	0729	5	0	0	N	01	02	02	13		02	05
N	367	0.37	0.37	5	3208041929	4/10/08	1404	5	0	0	N	01	01	01	26		03	00
N	367	0.68	0.68	5	3208133271	10/28/08	0655	3	0	0	N	05	04	02	31		02	00
N	367	0.15	0.15	5	3208151456	12/10/08	2104	4	0	0	N	05	03	02	26		03	00
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N	367	0.84	0.84	5	3208155919	12/21/08	2120	1	0	0	N	05	01	01	26		03	00
N	367	0.15	0.15	5	3208119573	9/25/08	1146	5	0	0	N	01	02	01	13		03	02
2009																		
N	367	0.75	0.75	5	3209057365	5/20/09	0030	4	0	0	N	05	01	01	31		02	00
N	367	1.3	1.3	5	0609070427	8/9/09	1218	1	0	0	N	01	02	01	13		02	04
N	367	0.99	0.99	5	3209079074	7/6/09	2325	2	0	0	N	04	01	01	13		03	03
N	367	0.68	0.68	5	3209064688	6/5/09	1820	6	0	0	N	01	04	02	31		02	00
N	367	0.79	0.79	5	3209048356	4/28/09	2305	3	0	0	N	05	01	01	31		03	00
N	367	0.65	0.65	5	3209107833	9/10/09	2045	5	0	0	N	05	02	01	26		03	99
N	367	1.49	1.49	5	3109022415	9/12/09	1608	7	0	0	N	01	04	02	13	01	02	00
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N	367	0.56	0.56	5	3209138066	11/26/09	0130	5	0	0	N	05	03	02	08	19	02	00
N	367	0.32	0.32	5	3209133157	11/13/09	1739	6	0	0	N	05	01	01	26		03	00
N	00367	1.3			0609115323	12/28/09	1513	2	0	0	N	01	01 -	01	13	11	02	01
2010																		
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N	00367	1.42	1.42	3	3110033529	10/18/10	1458	2	0	0	N	01	01 -	01	17	88	01	03
N	00367	0.62			3210019712	2/26/10	0829	6	0	1	N	01	06 -	03	31	12	03	02
N	00367	0.68			3210013009	2/5/10	0655	6	0	0	N	01	01 - 01	04	25	12	02	04
N	00367	0.65			3210004247	1/12/10	1459	3	0	0	N	01	01 - 01	01	26	12	02	05
N	00367	0.66	0.66	3	3210055462	5/23/10	2316	1	0	0	N	05	04 -	02	25	19	01	88
N	00367	0.68			3210043591	4/26/10	1034	2	0	0	N	01	04 -	02	17	01	02	88

CTY	RD	MP	C-MP	DIR	COMP/HQ#	Date	Time	Day	Fat	Inj	AL	LC	WC	SC	MHE	PC	Class	MOI
2010																		
N	00367	0.69			3210044329	4/28/10	0230	4	0	0	N	05	01 -	01	25	88	01	04
N	00367	0.11	0.11	3	3210070238	6/26/10	1430	7	0	0	N	01	01 -	01	13	14	02	01
N	00367	0.9	0.90	3	3210072035	6/30/10	1630	4	0	0	N	01	01 -	01	24	99	02	99
N	00367	1.43	1.43	3	3210128467	11/13/10	2110	7	0	0	N	05	01 -	01	12	17	01	88
N	00367	0.55			3210026405	3/15/10	2240	2	0	0	N	05	02 -	02	20	16	02	02
N	00367	0.38	0.38	3	3210100043	9/4/10	0950	7	0	1	N	01	01 -	01	25	11	03	88
N	00367	0.06			3210016484	2/17/10	0646	4	0	0	N	02	02 -		13	19	01	05
N	00367	0.11			3210039552	4/16/10	0740	6	0	0	N	01	01 -	01	25	12	02	02

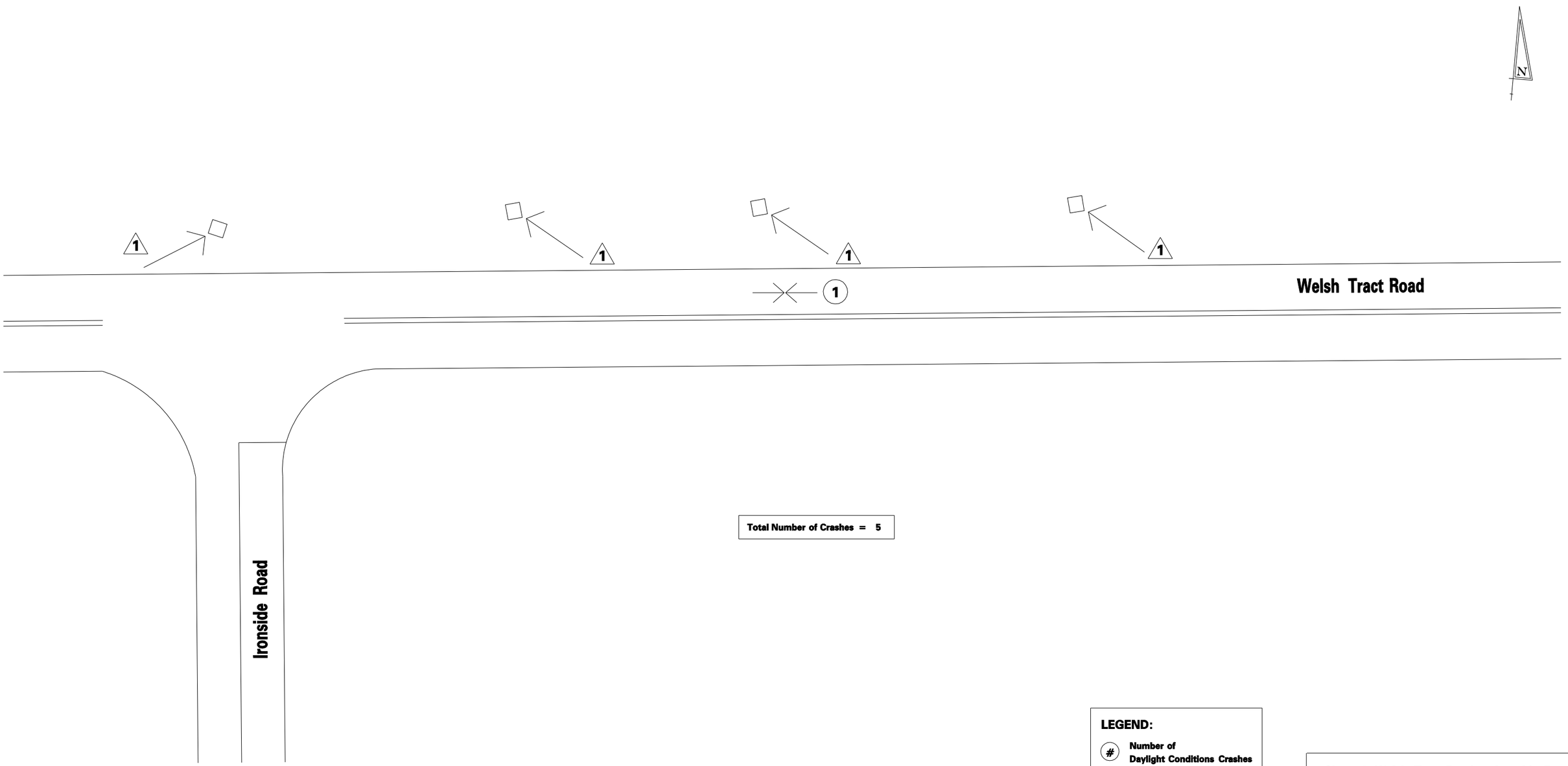
Report generated by tdtsswn at 2010-12-23 14:44:45.415

Report Legend

CTY - County
RD - Maintenance Road
MP - Milepoint
C-MP - Continuous Milepoint
DIR - Highway Direction
COMP/HQ# - Complaint Number/Headquarters Number
DAY - Day Of Week
Fat - Fatality
Inj - Injury
AL- Alcohol Involved
LC - Lighting Condition
WC - Weather Condition
SC - Surface Condition
MHE - Most Harmful Event
PC - Primary Contributing Circumstance
Class - Report Classification

APPENDIX B: Crash Diagrams

Site #4: Welsh Tract Road at Ironside Road
Site #5: Welsh Tract Road at Horizontal Curve



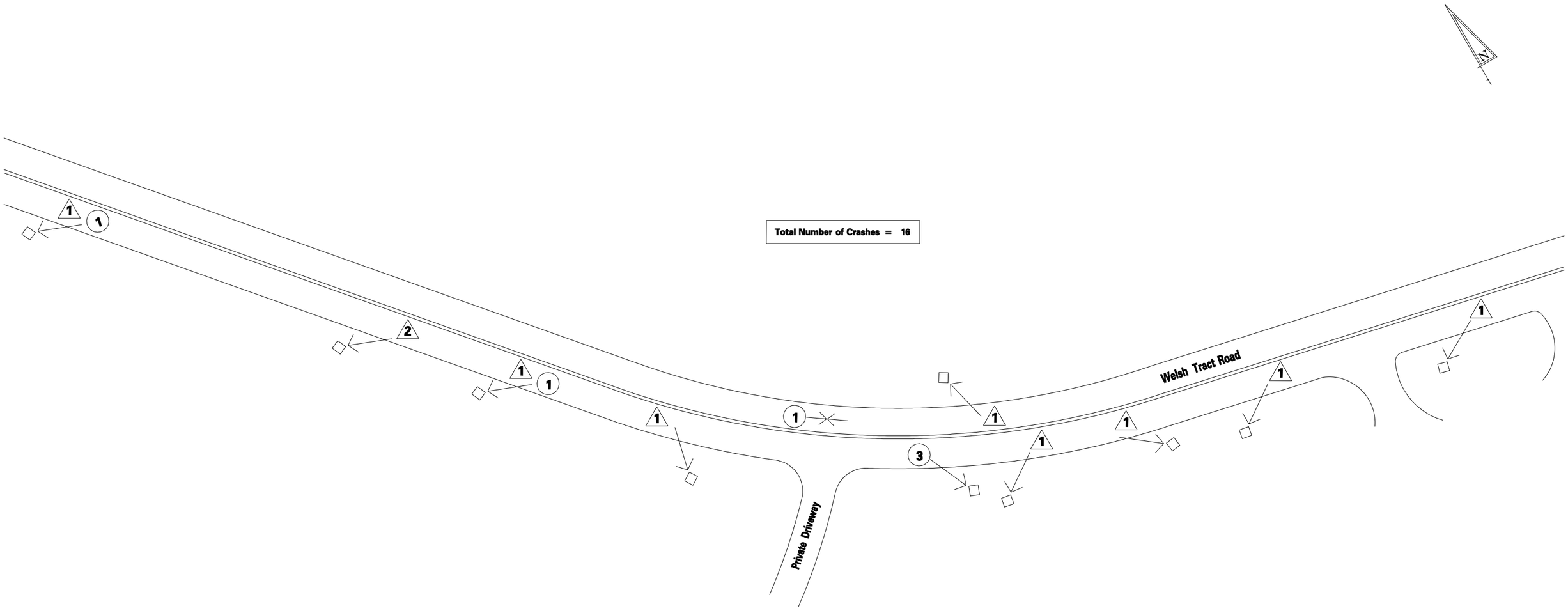
Total Number of Crashes = 5

LEGEND:

- Number of Daylight Conditions Crashes
- Number of Dark Conditions Crashes
- Hit Fixed Object
- Head–On Collision

Site #4: Welsh Tract Road at Ironside Road
December 2007 to December 2010
Location #1: Welsh Tract Road, MP 0.0 to 1.59
Evaluation of High Crash Locations
(Dark Criteria) Study

Urban Engineers, Inc.
2 Penns Way, Suite 309
New Castle, DE 19720



LEGEND:

- (#) Number of Daylight Conditions Crashes
- △# Number of Dark Conditions Crashes
- Hit Fixed Object
- Head–On Collision

Site #5: Welsh Tract Road at Horizontal Curve
December 2007 to December 2010
Location #1: Welsh Tract Road, MP 0.0 to 1.59
Evaluation of High Crash Locations
(Dark Criteria) Study

Urban Engineers, Inc.
2 Penns Way, Suite 309
New Castle, DE 19720

APPENDIX C: Previous Studies

1998 HSIP – Site F Task I Report
2007 HSIP – Site N Report

1998 HSIP – Site F Task I Report

INTRODUCTION

Site F is a 0.89 mile corridor located south of Newark along Welsh Tract Church Road from 0.20 miles east of Otts Chapel Road to 0.20 miles west of the I-95 overpass. Welsh Tract Road is a two-lane, two-way undivided, open-section roadway without shoulders. Within the limits of the site, there are two intersections, Ironside Road and Whitaker Road, and several residential driveways. The posted speed limit on Thompson Station Road is 35 miles per hour and the average daily traffic volume is 2,400.

ACCIDENT DATA SUMMARIES

A total of 27 accidents were reported during the three-year study period. Eighteen of the twenty-seven accidents occurred within the sharp curve between Ironside Road and Whitaker Road including four head on collisions, thirteen run off the road accidents and one rear end collision. Eleven of these accidents occurred in darkness and eleven involved injuries. A fatal accident occurred due to an eastbound motorist striking a bridge parapet located west of Ironside Road. Two accidents occurred at Whitaker Road, one accident occurred due to shrubbery in the roadway and the remaining five accidents occurred due to out of control vehicles. Fifteen (56%) of the 27 accidents occurred on wet (8), snowy (1), or icy (6) roadways. The following is a summary of the accident data:

TABLE 1

Accident Data Summary

Accident Severity		**Year**		**Collision Type**		**Surface**		**Lighting**	
Fatal	1 (4%)	1994	4 (15%)	Rear End	3 (11%)	Dry	12 (44%)	Day-light	14 (52%)
Injury	14 (52%)	1995	11 (41%)	Side-swipe	1 (4%)	Wet	8 (30%)	Dark/ Lit	1 (4%)
PDO	12 (44%)	1996	12 (44%)	Angle	5 (18%)	Snowy	1 (4%)	Dark/ Unlit	12 (44%)
				Head On	1 (4%)	Icy	6 (22%)		
				Other	17 (63%)				
Total	27		27		27		27		27

Primary Cause				
Speed too Fast - 18 (67%)	Pass Stop Sign - 1 (4%)	Driving Under Influence - 2 (7%)	Other - 4 (15%)	Unknown - 2 (7%)

FIELD OBSERVATIONS

- W1-1 (Turn) signs with 25 miles per hour Advisory Speed Plates are located on the eastbound and westbound approaches to the horizontal curve located between Ironside Drive and Whitaker Road.
- Based on trial runs the majority of motorists travel above the posted speed limit.

- The bridge parapets located west of Ironside Road are unprotected except for the north side of the parapet on the westbound approach. The parapets are located approximately 2 feet off the south side of roadway and less than one foot off the north side of the roadway and create a potential hazard for oncoming traffic.

REMEDIAL IMPROVEMENTS

- Install guardrail on both sides of eastbound Welsh Tract Church Road and on the south side of the road on the westbound approach to protect motorists from fixed object collisions with the parapets.
- Install W1-8 (Chevron Alignment) signs within the horizontal curve section east of Ironside Road on westbound Welsh Tract Church Road to better warn motorists.
- Install overhead lighting on the existing utility poles within the curve section (Pending success of other measures). Lighting should start in the tangent section prior to the curve and end in a tangent section after the curve (per DelDOT Highway Lighting Policy).

  These improvements with help to warn motorists of the severe curve section, especially during darkness when the majority of the accidents occurred. The assumed accident reduction with these improvements is 45 percent of the 11 night accidents within the curve section and 65 percent of the accidents at the bridge parapet, or 21 percent of the 27 total accidents.

ADDITIONAL STUDIES

The committee agreed to install chevrons and delineators within the curve section; the need for lighting will be assessed at a later date pending the success of other measures.

BENEFIT/COST SUMMARY

Equivalent Uniform Annual Benefit	$216,828.76
Equivalent Uniform Annual Cost	$3,924.42
Total Cost of Improvements	$28,250.00
Benefit/Cost Ratio	55.26

1998 HSIP – Site F Photolog

Photo 1 - Westbound Welsh Tract Road Approach to Curve Section

Photo 2 - Eastbound Welsh Tract Road Approach to Curve Section

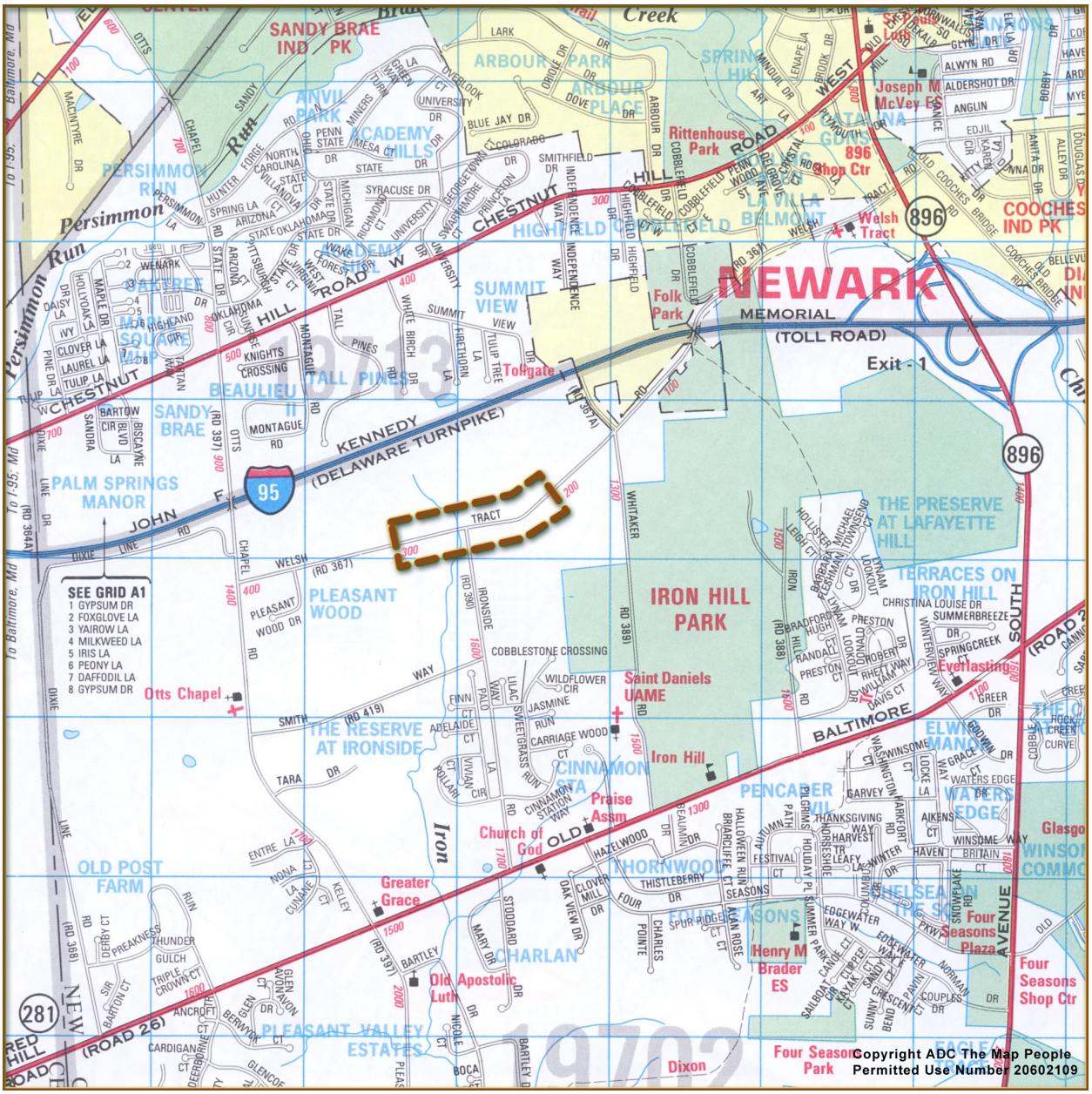
Photo 3 - Eastbound Welsh Tract Road Approach to Bridge Parapet

DelDOT
Delaware Department of Transportation

2007 Highway Safety Improvement Program – Site N (Rank 63)

N367 (Welsh Tract Road) – MP 0.40-0.79

From 0.16-mile west of Ironside Road to 0.2-mile west of Whitaker Road



INTRODUCTION

Site N is a 0.39-mile corridor located south of Newark along Welsh Tract Road from 0.16-mile west of Ironside Road to 0.20-mile west of Whitaker Road. Welsh Tract Road is a two-lane, undivided, open-section roadway without shoulders. The posted speed limit is 35 miles per hour. The ADT is approximately 3,400. Within the limits of the site, there is one unsignalized intersection at Ironside Road.

Other Relevant Projects: Welsh Tract Road from 0.20-mile east of Otts Chapel Road to 0.20-mile west of the I-95 overpass was identified as part of the 1998 Highway Safety Improvement Program – Site F.

Additionally, the Welsh Hill Preserve development, including 48 single-family houses, is proposed on the southwest corner of the intersection of Welsh Tract Road and Ironside Road. The developer is currently preparing plans that include the installation of guardrail on the south side of Welsh Tract Road on the leading and trailing edges of the Muddy Run stream culvert, drainage and sight distance improvements at the Ironside Road intersection, and widening of Welsh Tract Road to provide 12-foot lanes and 8-foot shoulders.

CRASH DATA SUMMARIES

A total of 16 crashes were reported during the three-year study period between January 2003 and December 2005, including 8 (50 percent) crashes that resulted in personal injuries. Additionally, 7 (44 percent) crashes occurred during darkness. The following is a summary of the crashes:

- Welsh Tract Road at Ironside Road/Muddy Run – 8 crashes
  - 4 westbound fixed-object crashes involved vehicles striking the bridge parapet and/or guardrail on the north side of the road (2 crashes involving drivers swerving to avoid animals in the roadway and 1 crash involving a driver under the influence)
  - 1 westbound fixed-object crash involving a vehicle striking the bridge parapet on the south side of the road
  - 1 westbound run-off-the-road crash involving a vehicle striking a tree (occurred when the westbound vehicle swerved to avoid an eastbound vehicle straddling the centerline)
  - 1 eastbound run-off-the-road crash involving a vehicle striking a mailbox and a tree
  - 1 westbound crash involving a deer
- Welsh Tract Road at curve east of Ironside Road – 8 crashes
  - 4 eastbound run-off-the-road/fixed-object crashes (2 crashes occurred when vehicles lost control after striking gravel in the roadway and 1 crash occurred when an eastbound vehicle swerved to avoid a westbound vehicle traveling over the double yellow centerline)
  - 2 westbound run-off-the-road/fixed-object crashes
  - 2 eastbound/westbound sideswipe crashes

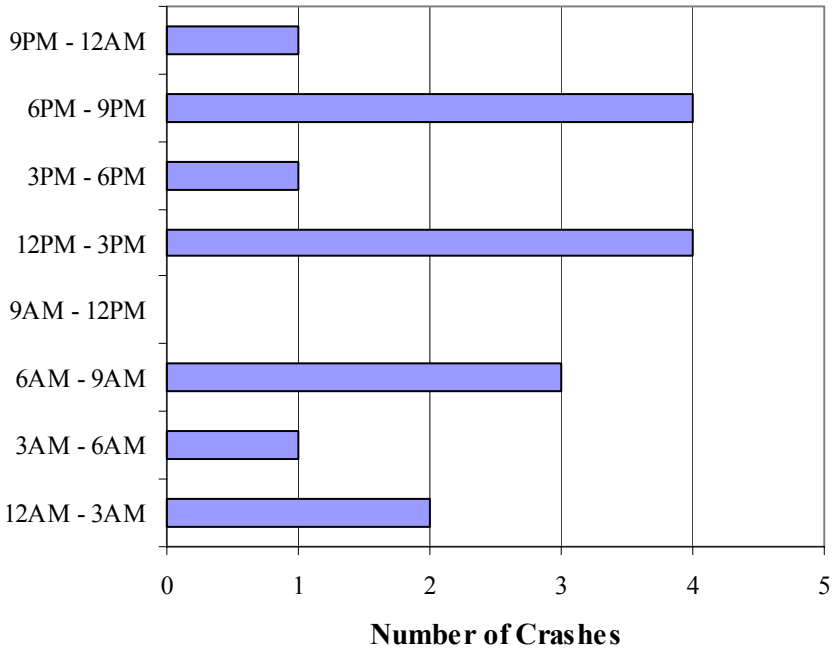
A categorical summary of the crashes by type, severity, surface condition, lighting condition, year, and primary cause is shown in Table 1.

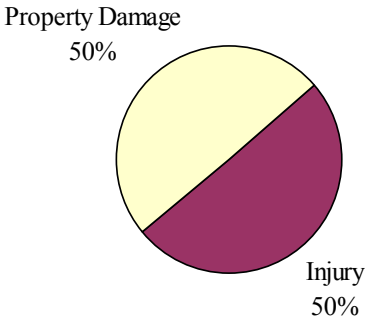
FIELD OBSERVATIONS

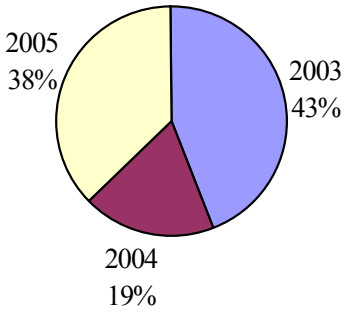
- Edgelines and double yellow centerline pavement markings are provided along Welsh Tract Road within the site limits. The pavement width is 19 feet.

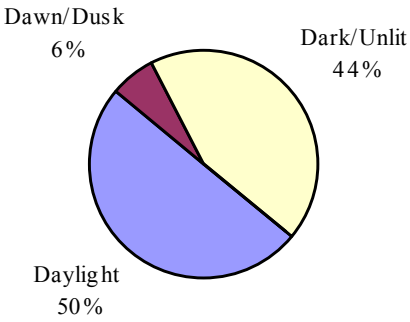
- No street lighting is provided on Welsh Tract Road within the site limits.

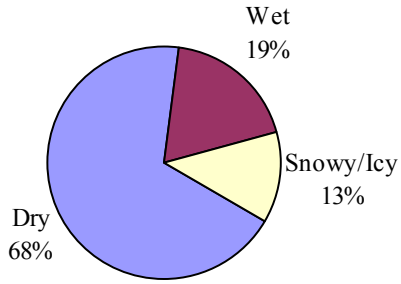
TABLE 1
Crash Data Summary

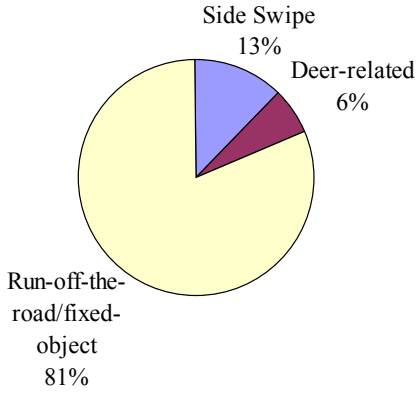












- Utility poles are located on the north side of Welsh Tract Road. Reflective delineators are posted on some of the utility poles.

- Turn warning signs (30" x 30") with 25 mph advisory speed plates and HIDDEN ENTRANCE plaques are posted on both the eastbound and westbound Welsh Tract Road approaches to the curve and Ironside Road.

- One leaning double-sided Chevron Alignment warning sign is posted within the curve.

- Approximately 65 feet of guardrail is provided on the north side of Welsh Tract Road on the leading edge of the bridge structure located west of Ironside Road over Muddy Run. The guardrail (consisting of 12'6" post-to-post sections) has been struck and the attachment of the guardrail to the parapet is badly damaged.

- An Object Marker is posted at the beginning of the guardrail on the westbound approach to the bridge parapet.

- During observations, vehicles on Welsh Tract Road were observed traveling at speeds significantly greater than the 35 mile per hour speed limit.

Curve Warning Speed Evaluation: A ball-bank indicator test was conducted on April 11, 2007 to determine the safe operating speed for motorists traveling on Welsh Tract Road through the curve east of Ironside Road. A summary of the test results, including the maximum safe operating speed, is shown in Table 1. As shown, the maximum safe operating speed through the curve is 25 miles per hour in the eastbound and westbound directions.

TABLE 1

Ball Bank Indicator Test Results

Travel Speed (mph)	Maximum Safe Operating Angle	Curve	
		Eastbound	Westbound
35	<12°	18°	15°
30	<12°	14°	12°
25[1]	<12°	**8**°	**7**°

[1]Maximum Safe Speed

Welsh Tract Road at Ironside Road

- All approaches to the intersection include a single shared lane. The northbound Ironside Road approach operates under "Stop" control.

- No pavement markings (stop line or double yellow centerline) are provided on the northbound Ironside Road approach to Welsh Tract Road.

- No Stop Ahead warning sign is posted on the northbound Ironside Road approach to Welsh Tract Road. No Side Road warning signs are posted on the eastbound and westbound Welsh Tract Road approaches to Ironside Road.

- An open, unprotected, drainage pipe is located on the southwest corner of the intersection adjacent to the pavement edge.

- Northbound vehicles were observed pulling far into the intersection to gain sight distance looking eastbound. After pulling forward, corner sight distances meet AASHTO requirements.

REMEDIAL IMPROVEMENTS

The following improvements will be completed by the developer of Welsh Hill Preserve:

- Install guardrail and delineators on the south side of Welsh Tract Road on both the leading and trailing edges of the bridge parapet located west of Ironside Road, continuing the guardrail on the trailing edge to the intersection at Ironside Road.

In addition, the HSIP committee recommends the following:

- Replace the damaged guardrail provided on the north side of Welsh Tract Road on the leading edge of the bridge parapet located west of Ironside Road and install delineators along the new guardrail.

- Install raised pavement markers on the approaches to and within the curve on Welsh Tract Road east of Ironside Road. Install following resurfacing by the Welsh Hill Preserve developer.

- Install an Object Marker sign (OM-3) on the trailing edge of the guardrail provided on the north side of Welsh Tract Road to warn westbound vehicles of the bridge parapet over Muddy Run.

- Install a double yellow centerline (100 feet) and a stop line on the northbound Ironside Road approach to Welsh Tract Road.

- Replace the Turn warning signs (30" x 30") on the eastbound and westbound Welsh Tract Road approaches to the curve east of Ironside Road with larger fluorescent yellow Turn warning signs (36" x 36"). Replace the existing 25 mph advisory speed plates with fluorescent yellow signs.

- Repost the leaning Chevron Alignment warning sign located within the curve on Welsh Tract Road east of Ironside Road and install three additional Chevron Alignment warning signs.

- Install a Two-Direction Large Arrow warning sign at the intersection of Ironside Road at Welsh Tract Road.

- Install Combination Horizontal Alignment/Intersection warning signs with supplemental name plaques on the eastbound and westbound Welsh Tract Road approaches to Ironside Road.

- Install a Stop Ahead warning sign on the northbound Ironside Road approach to Welsh Tract Road.

TOTAL COST OF IMPROVEMENTS - $12,000

ADDITIONAL STUDIES

The HSIP committee recommends no additional studies at this time.

Photo 1: Eastbound Welsh Tract Road at Muddy Run stream culvert (approaching Ironside Road)

Photo 2: Westbound Welsh Tract Road approaching Ironside Road and Muddy Run stream culvert

Photo 3: Eastbound Welsh Tract Road approaching curve east of Ironside Road

Photo 4: Eastbound Welsh Tract Road at curve east of Ironside Road

Photo 5: Westbound Welsh Tract Road approaching curve east of Ironside Road

Photo 6: Westbound Welsh Tract Road at curve east of Ironside Road

Photo 7: Welsh Tract Road at unprotected bridge parapet on the south side of the road

Photo 8: Damaged guardrail at leading edge of bridge parapet on the north side of Welsh Tract Road

APPENDIX D: Statewide 1.0 Mile Corridors Ranked by Critical Ratio

Delaware - Statewide

Accident Date Range	**Interval Length**	**Parameters**
01/01/2007 - 12/31/2009	1.0 mile	AMBIENT_LIGHT_PARAMETER-05

Rank	Crit. Ratio	County	Road	Road Name	Beg MP	End MP	# Accs	Notes
1	10.12	1	355D	Harmony Road	0	0.05	1	<10 accidents - Did not meet criteria
2	5.93	1	34H	US 13	0	0.1	1	<10 accidents - Did not meet criteria
3	4.48	1	367	Welsh Tract Road	0	0.99	19	Location #1
4	4.48	1	367	Welsh Tract Road	0.1	1.09	19	Location #1
5	4.01	1	367	Welsh Tract Road	0.2	1.19	17	Location #1
6	4.01	1	367	Welsh Tract Road	0.3	1.29	17	Location #1
7	3.78	1	367	Welsh Tract Road	0.4	1.39	16	Location #1
8	3.76	1	367	Welsh Tract Road	0.5	1.49	16	Location #1
9	3.7	3	199	Fowlers Beach Road	1.2	2.15	4	<10 accidents - Did not meet criteria
10	3.6	1	11A	Delaware Park Road	0	0.15	4	<10 accidents - Did not meet criteria
11	3.56	3	246	Albury Avenue	0.9	1.89	7	<10 accidents - Did not meet criteria
12	3.55	3	199	Fowlers Beach Road	1.1	2.09	4	<10 accidents - Did not meet criteria
13	3.51	3	396		1.8	2.79	6	<10 accidents - Did not meet criteria
14	3.51	3	396		1.9	2.89	6	<10 accidents - Did not meet criteria
15	3.46	2	14	SR 42	3	3.91	5	<10 accidents - Did not meet criteria
16	3.43	1	31A	Old Limestone Road	0	0.31	1	<10 accidents - Did not meet criteria
17	3.43	3	14C		0	0.29	1	<10 accidents - Did not meet criteria
18	3.27	3	60	SR 54	3.1	4.09	7	<10 accidents - Did not meet criteria
19	3.27	3	60	SR 54	3.2	4.19	7	<10 accidents - Did not meet criteria
20	3.27	3	60	SR 54	3.3	4.29	7	<10 accidents - Did not meet criteria
21	3.25	1	38	St. Andrews School Road	0	0.99	7	<10 accidents - Did not meet criteria
22	3.23	2	429	Mechanic Street	3.1	4.09	6	<10 accidents - Did not meet criteria
23	3.23	2	429	Mechanic Street	3.2	4.19	6	<10 accidents - Did not meet criteria
24	3.23	2	429	Mechanic Street	3.3	4.29	6	<10 accidents - Did not meet criteria
25	3.18	1	429	Mechanic Street	3.8	4.79	7	<10 accidents - Did not meet criteria
26	3.14	2	14	SR 42	2.9	3.89	5	<10 accidents - Did not meet criteria
27	3.09	2	14	SR 42	2.8	3.79	5	<10 accidents - Did not meet criteria
28	3.05	2	14	SR 42	2.7	3.69	5	<10 accidents - Did not meet criteria
29	3.05	3	246	Albury Avenue	1	1.99	6	<10 accidents - Did not meet criteria
30	3.04	2	14	SR 42	2.6	3.59	5	<10 accidents - Did not meet criteria
31	3.02	1	367	Welsh Tract Road	0.6	1.59	13	Location #1
32	3.02	3	396		2.2	3.16	5	<10 accidents - Did not meet criteria
33	3	3	542A		0	0.18	1	<10 accidents - Did not meet criteria
34	2.93	3	396		2	2.99	5	<10 accidents - Did not meet criteria
35	2.93	3	396		2.1	3.09	5	<10 accidents - Did not meet criteria
36	2.83	1	355B		0	0.26	1	<10 accidents - Did not meet criteria
37	2.83	3	361	West Avenue	2.3	3.29	8	<10 accidents - Did not meet criteria
38	2.81	1	12A	Farrand Drive Ext.	0	0.1	2	<10 accidents - Did not meet criteria
39	2.8	3	60	SR 54	4.8	5.79	6	<10 accidents - Did not meet criteria
40	2.8	3	60	SR 54	4.9	5.89	6	<10 accidents - Did not meet criteria
41	2.8	3	60	SR 54	5	5.99	6	<10 accidents - Did not meet criteria
42	2.79	3	361	West Avenue	2.2	3.19	8	<10 accidents - Did not meet criteria
43	2.78	3	361	West Avenue	2.1	3.09	8	<10 accidents - Did not meet criteria
44	2.75	3	261		1.1	2.09	8	<10 accidents - Did not meet criteria
45	2.71	1	429	Mechanic Street	3.7	4.69	6	<10 accidents - Did not meet criteria
46	2.71	3	544		0.2	1.19	6	<10 accidents - Did not meet criteria
47	2.69	1	224	Upper Snuffmill Road	0	0.95	6	<10 accidents - Did not meet criteria
48	2.69	1	429	Mechanic Street	3.6	4.59	6	<10 accidents - Did not meet criteria
49	2.69	2	429	Mechanic Street	2.8	3.79	5	<10 accidents - Did not meet criteria
50	2.69	2	429	Mechanic Street	2.9	3.89	5	<10 accidents - Did not meet criteria
51	2.69	2	429	Mechanic Street	3	3.99	5	<10 accidents - Did not meet criteria
52	2.66	3	199	Fowlers Beach Road	0.8	1.79	3	<10 accidents - Did not meet criteria
53	2.66	3	199	Fowlers Beach Road	0.9	1.89	3	<10 accidents - Did not meet criteria
54	2.66	3	199	Fowlers Beach Road	1	1.99	3	<10 accidents - Did not meet criteria
55	2.65	1	315A		0	0.08	1	<10 accidents - Did not meet criteria
56	2.65	3	261		1.2	2.19	7	<10 accidents - Did not meet criteria
57	2.58	1	318A	St. James Church Road	0	0.24	1	<10 accidents - Did not meet criteria
58	2.58	3	246		0.5	1.49	5	<10 accidents - Did not meet criteria
59	2.58	3	544		0.1	1.09	6	<10 accidents - Did not meet criteria
60	2.56	3	246	Albury Avenue	0.6	1.59	5	<10 accidents - Did not meet criteria
61	2.55	2	127		0	0.41	1	<10 accidents - Did not meet criteria
62	2.55	3	246	Albury Avenue	0.7	1.69	5	<10 accidents - Did not meet criteria
63	2.55	3	246	Albury Avenue	0.8	1.79	5	<10 accidents - Did not meet criteria
64	2.55	3	246	Albury Avenue	1.1	2.09	5	<10 accidents - Did not meet criteria

Delaware - Statewide

Accident Date Range	**Interval Length**	**Parameters**
01/01/2007 - 12/31/2009	1.0 mile	AMBIENT_LIGHT_PARAMETER-05

Rank	Crit. Ratio	County	Road	Road Name	Beg MP	End MP	# Accs	Notes
65	2.55	3	261		1	1.99	8	<10 accidents - Did not meet criteria
66	2.51	3	28	US 9	6	6.99	14	Location #2
67	2.5	2	295		0	0.99	3	<10 accidents - Did not meet criteria
68	2.5	2	295		0.1	1.09	3	<10 accidents - Did not meet criteria
69	2.46	3	361	West Avenue	1.9	2.89	8	<10 accidents - Did not meet criteria
70	2.44	2	88		0.2	1.19	4	<10 accidents - Did not meet criteria
71	2.43	2	14	SR 42	2.4	3.39	4	<10 accidents - Did not meet criteria
72	2.43	2	14	SR 42	2.5	3.49	4	<10 accidents - Did not meet criteria
73	2.42	2	88		0.3	1.29	4	<10 accidents - Did not meet criteria
74	2.4	2	88		0.4	1.39	4	<10 accidents - Did not meet criteria
75	2.4	3	544		0.3	1.29	5	<10 accidents - Did not meet criteria
76	2.38	2	14	SR 42	2.3	3.29	4	<10 accidents - Did not meet criteria
77	2.37	1	454	Sawmill Branch Road	0.5	1.46	3	<10 accidents - Did not meet criteria
78	2.37	3	28	US 9	5.9	6.89	13	Location #2
79	2.35	1	275	Golden Ring Road	1.4	2.39	8	<10 accidents - Did not meet criteria
80	2.35	1	275	Golden Ring Road	1.5	2.49	8	<10 accidents - Did not meet criteria
81	2.35	3	261		0.9	1.89	8	<10 accidents - Did not meet criteria
82	2.34	2	88		0.5	1.49	4	<10 accidents - Did not meet criteria
83	2.34	3	396		1.7	2.69	4	<10 accidents - Did not meet criteria
84	2.34	3	60	SR 54	3	3.99	5	<10 accidents - Did not meet criteria
85	2.34	3	60	SR 54	3.4	4.39	5	<10 accidents - Did not meet criteria
86	2.34	3	60	SR 54	3.5	4.49	5	<10 accidents - Did not meet criteria
87	2.34	3	60	SR 54	3.6	4.59	5	<10 accidents - Did not meet criteria
88	2.34	3	60	SR 54	3.7	4.69	5	<10 accidents - Did not meet criteria
89	2.34	3	60	SR 54	3.8	4.79	5	<10 accidents - Did not meet criteria
90	2.34	3	60	SR 54	5.1	6.09	5	<10 accidents - Did not meet criteria
91	2.32	3	361		2	2.99	7	<10 accidents - Did not meet criteria
92	2.31	2	271		3.1	4.01	2	<10 accidents - Did not meet criteria
93	2.28	1	260	Brecks Lane Road	0	0.57	2	<10 accidents - Did not meet criteria
94	2.28	2	384		3	3.99	7	<10 accidents - Did not meet criteria
95	2.27	2	88		0.1	1.09	4	<10 accidents - Did not meet criteria
96	2.22	1	429	Mechanic Street	3.5	4.49	5	<10 accidents - Did not meet criteria
97	2.22	2	207		2.9	3.89	4	<10 accidents - Did not meet criteria
98	2.22	2	207		3	3.99	4	<10 accidents - Did not meet criteria
99	2.21	1	429	Mechanic Street	3.3	4.29	5	<10 accidents - Did not meet criteria
100	2.21	1	82	SR 1	5.5	6.49	12	Location #3
101	2.19	3	261		0.8	1.79	8	<10 accidents - Did not meet criteria
102	2.17	1	275	Golden Ring Road	1.6	2.59	7	<10 accidents - Did not meet criteria
103	2.17	1	469	Black Diamond Road	0.4	1.39	3	<10 accidents - Did not meet criteria
104	2.17	1	469	Black Diamond Road	0.5	1.49	3	<10 accidents - Did not meet criteria
105	2.17	1	469	Black Diamond Road	0.6	1.59	3	<10 accidents - Did not meet criteria
106	2.17	1	469	Black Diamond Road	0.7	1.69	3	<10 accidents - Did not meet criteria
107	2.16	3	28	US 9	9.1	10.09	13	Location #4
108	2.15	2	30	Main Street	1.5	2.49	9	<10 accidents - Did not meet criteria
109	2.15	2	429		2.7	3.69	4	<10 accidents - Did not meet criteria
110	2.15	2	429		3.4	4.39	4	<10 accidents - Did not meet criteria
111	2.15	2	429		3.6	4.59	4	<10 accidents - Did not meet criteria
112	2.15	3	353		2.3	3.29	3	<10 accidents - Did not meet criteria
113	2.15	3	525		1.8	2.79	7	<10 accidents - Did not meet criteria
114	2.15	3	525		1.9	2.89	7	<10 accidents - Did not meet criteria
115	2.15	3	525		2	2.99	7	<10 accidents - Did not meet criteria
116	2.15	3	525		2.1	3.09	7	<10 accidents - Did not meet criteria
117	2.15	3	525		2.2	3.19	7	<10 accidents - Did not meet criteria
118	2.14	3	28	US 9	6.1	7.09	12	Location #2
119	2.14	3	361		2.4	3.39	6	<10 accidents - Did not meet criteria
120	2.13	1	452	Fieldsboro Road	0	0.99	3	<10 accidents - Did not meet criteria
121	2.13	1	452	Fieldsboro Road	0.1	1.09	3	<10 accidents - Did not meet criteria
122	2.13	1	452	Fieldsboro Road	0.2	1.19	3	<10 accidents - Did not meet criteria
123	2.13	1	452	Fieldsboro Road	0.3	1.29	3	<10 accidents - Did not meet criteria
124	2.13	1	452	Fieldsboro Road	0.4	1.39	3	<10 accidents - Did not meet criteria
125	2.13	1	452	Fieldsboro Road	0.5	1.49	3	<10 accidents - Did not meet criteria
126	2.13	1	452	Fieldsboro Road	0.6	1.59	3	<10 accidents - Did not meet criteria
127	2.13	2	30	Main Street	1.6	2.59	9	<10 accidents - Did not meet criteria
128	2.13	3	353		2.4	3.39	3	<10 accidents - Did not meet criteria

Delaware - Statewide
Accident Date Range 01/01/2007 - 12/31/2009
Interval Length 1.0 mile
Parameters AMBIENT_LIGHT_PARAMETER-05

Rank	Crit. Ratio	County	Road	Road Name	Beg MP	End MP	# Accs	Notes
129	2.12	2	8	US 113	9.6	10.59	13	Location #5
130	2.12	3	24	SR 24	18.2	19.19	7	<10 accidents - Did not meet criteria
131	2.12	3	24	SR 24	18.4	19.39	7	<10 accidents - Did not meet criteria
132	2.12	3	24	SR 24	18.5	19.49	7	<10 accidents - Did not meet criteria
133	2.11	3	246	Albury Avenue	0.3	1.29	4	<10 accidents - Did not meet criteria
134	2.11	3	261		1.3	2.29	5	<10 accidents - Did not meet criteria
135	2.11	3	353		2.1	3.09	3	<10 accidents - Did not meet criteria
136	2.11	3	477		0	0.99	3	<10 accidents - Did not meet criteria
137	2.1	1	26	Old Baltimore Pike	2.5	3.49	21	Location #6
138	2.1	3	48		7.2	8.19	7	<10 accidents - Did not meet criteria
139	2.1	3	48		7.3	8.29	7	<10 accidents - Did not meet criteria
140	2.1	3	48		7.4	8.39	7	<10 accidents - Did not meet criteria
141	2.1	3	48		7.5	8.49	7	<10 accidents - Did not meet criteria
142	2.1	3	48		7.6	8.59	7	<10 accidents - Did not meet criteria
143	2.1	3	48		7.7	8.69	7	<10 accidents - Did not meet criteria
144	2.1	3	48		7.8	8.79	7	<10 accidents - Did not meet criteria
145	2.1	3	48		7.9	8.89	7	<10 accidents - Did not meet criteria
146	2.1	3	48		8	8.99	7	<10 accidents - Did not meet criteria
147	2.09	2	30	Main Street	0.7	1.69	7	<10 accidents - Did not meet criteria
148	2.09	3	246	Albury Avenue	0.4	1.39	4	<10 accidents - Did not meet criteria
149	2.09	3	28	US 9	8.9	9.89	12	Location #4
150	2.07	3	246	Albury Avenue	1.8	2.7	3	<10 accidents - Did not meet criteria
151	2.07	3	326	State Street	0.8	1.79	8	<10 accidents - Did not meet criteria
152	2.06	2	188		0	0.32	1	<10 accidents - Did not meet criteria
153	2.06	3	353		2	2.99	3	<10 accidents - Did not meet criteria
154	2.06	3	353		2.5	3.49	3	<10 accidents - Did not meet criteria
155	2.05	1	26	Old Baltimore Pike	2.8	3.79	21	Location #6
156	2.05	3	594		0	0.99	6	<10 accidents - Did not meet criteria
157	2.04	2	30	Main Street	0.4	1.39	7	<10 accidents - Did not meet criteria
158	2.04	3	246		1.2	2.19	4	<10 accidents - Did not meet criteria
159	2.04	3	28	US 9	9	9.99	12	Location #4
160	2.04	3	544		0.4	1.39	4	<10 accidents - Did not meet criteria
161	2.03	2	303		1.2	2.19	2	<10 accidents - Did not meet criteria
162	2.02	1	301	Thompson's Station Road	0.3	1.29	9	<10 accidents - Did not meet criteria
163	2.02	1	301	Thompson's Station Road	0.4	1.39	9	<10 accidents - Did not meet criteria
164	2.02	2	54	Main Street	0.1	1.09	6	<10 accidents - Did not meet criteria
165	2.02	2	54	Main Street	0.2	1.19	6	<10 accidents - Did not meet criteria
166	2.02	2	54	Main Street	0.3	1.29	6	<10 accidents - Did not meet criteria
167	2.02	2	54	Main Street	0.4	1.39	6	<10 accidents - Did not meet criteria
168	2.02	2	54	Main Street	0.5	1.49	6	<10 accidents - Did not meet criteria
169	2.01	3	28	US 9	5.8	6.79	11	Location #4
170	2.01	3	488		2.8	3.79	4	<10 accidents - Did not meet criteria
171	2.01	3	488		2.9	3.89	4	<10 accidents - Did not meet criteria
172	2	1	82	SR 1	5.6	6.59	12	Location #3
173	2	1	9	SR 52	3.2	4.19	16	Location #7
174	2	2	8	US 113	9.7	10.69	12	Location #5
175	1.99	3	361		1.8	2.79	7	<10 accidents - Did not meet criteria
176	1.99	3	479A		0	0.6	2	<10 accidents - Did not meet criteria
177	1.98	1	26	Old Baltimore Pike	2.6	3.59	20	Location #6
178	1.98	1	26	Old Baltimore Pike	2.9	3.89	20	Location #6
179	1.98	1	9	SR 52	3.1	4.09	16	Location #7
180	1.98	2	325	Big Oak Road	1.4	2.39	4	<10 accidents - Did not meet criteria
181	1.98	2	73	North Street	4.3	5.29	7	<10 accidents - Did not meet criteria
182	1.98	3	207		1.3	2.29	7	<10 accidents - Did not meet criteria
183	1.98	3	353		1.9	2.89	3	<10 accidents - Did not meet criteria
184	1.98	3	544		1	1.99	2	<10 accidents - Did not meet criteria
185	1.97	1	26	Old Baltimore Pike	2.7	3.69	20	Location #6
186	1.97	2	30	Main Street	1.4	2.39	8	<10 accidents - Did not meet criteria
187	1.97	3	2	US 13	3.6	4.59	18	Location #8
188	1.96	1	383	Church Road	0.4	1.37	8	<10 accidents - Did not meet criteria
189	1.96	2	30	Main Street	0.3	1.29	7	<10 accidents - Did not meet criteria
190	1.96	2	384		3.1	4.09	6	<10 accidents - Did not meet criteria
191	1.96	3	16	SR 16	25.8	26.79	5	<10 accidents - Did not meet criteria
192	1.96	3	16	SR 16	25.9	26.89	5	<10 accidents - Did not meet criteria

Delaware - Statewide

Accident Date Range	**Interval Length**	**Parameters**
01/01/2007 - 12/31/2009	1.0 mile	AMBIENT_LIGHT_PARAMETER-05

Rank	Crit. Ratio	County	Road	Road Name	Beg MP	End MP	# Accs	Notes
193	1.96	3	16	SR 16	26	26.99	5	<10 accidents - Did not meet criteria
194	1.96	3	16	SR 16	26.1	27.09	5	<10 accidents - Did not meet criteria
195	1.96	3	353		2.6	3.59	3	<10 accidents - Did not meet criteria
196	1.95	2	73	North Street	4.2	5.19	7	<10 accidents - Did not meet criteria
197	1.95	3	326	State Street	0.7	1.69	8	<10 accidents - Did not meet criteria
198	1.94	1	32	US 40	4.2	5.19	25	Location #9
199	1.94	2	73	North Street	4.4	5.39	7	<10 accidents - Did not meet criteria
200	1.94	3	213	Walnut Street	8.1	9.09	5	<10 accidents - Did not meet criteria
201	1.94	3	484		2.7	3.69	4	<10 accidents - Did not meet criteria
202	1.92	1	17	SR 92	0	0.99	17	Location #10