McMAHON
TRANSPORTATION ENGINEERS & PLANNERS

Transportation Impact Study for the Crebilly Residential Development

Westtown Township, Chester County, PA

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Executive Summary

Toll Brothers, Inc. proposes a residential development, to be located on the Crebilly Farm property along the west side of U.S. Route 202 (Wilmington Pike), between West Pleasant Grove Road and Street Road (S.R. 0926), in Westtown Township, Chester County, Pennsylvania. Three potential alternatives are proposed for the development. Site plans for the three alternatives, prepared by ESE Consultants, Inc. and dated October 7, 2016, are described below and illustrated in **Figures 1A and 1B**.

- ***Alternative A (Plan A – Proposed Development):*** The plan includes 317 new dwelling units and 2 existing dwelling units. Access is provided via two full-movement accesses along West Pleasant Grove Road, a right-in/right-out access along U.S. Route 202 (Wilmington Pike), and a full-movement access along Street Road (S.R. 0926). This development alternative does not provide a public connector road.

- ***Alternative B (Plan B – Proposed Density Bonus Development):*** The plan includes 395 new dwelling units and 2 existing dwelling units. Access is identical to Alternative A. This development alternative does not provide a public connector road.

- ***Alternative C (Plan B – Proposed Density Bonus Development with Connector Road):*** The plan includes 395 new dwelling units and 2 existing dwelling units. Access is identical to Alternatives A and B, with the addition of a third full-movement access along West Pleasant Grove Road, which will serve as a connector road provided for public use between U.S. Route 202 (Wilmington Pike), Street Road (S.R. 0926), and West Pleasant Grove Road.

The scope of this transportation impact study is based PennDOT's guidelines, per the Department's publication *Policies and Procedures for Transportation Impact Studies Related to Highway Occupancy Permits*, dated January 28, 2009, and the requirements of the Township ordinances.

The purpose of this transportation impact study is to evaluate the traffic impacts of the proposed development. The scope of this study includes an evaluation of the existing 2016 weekday morning and weekday afternoon peak hours, as well as the future 2028 design year, five years beyond the anticipated build-out year, both without and with each development alternative at the following study intersections:

- U.S. Route 202 (Wilmington Pike) and Street Road (S.R. 0926) (signalized)
- U.S. Route 202 (Wilmington Pike) and West Pleasant Grove Road (unsignalized)
- Street Road (S.R. 0926) and Bridlewood Boulevard (unsignalized)
- Street Road (S.R. 0926) and New Street (signalized)
- U.S. Route 202 (Wilmington Pike) and Proposed Site Access (unsignalized)
- Street Road (S.R. 0926) and Proposed Site Access (signalized)
- West Pleasant Grove Road and Proposed West Site Access (unsignalized)
- West Pleasant Grove Road and Proposed East Site Access (unsignalized)
- West Pleasant Grove Road and Proposed Connector Road (unsignalized)

Based on trip generation data compiled for Residential Condominium / Townhouse (ITE Land Use Code 230) and Single Family Detached Housing (ITE Land Use Code 210) contained in the Institute of Transportation Engineers (ITE) publication entitled, *Trip Generation Manual, 9th Edition,* the proposed development alternatives will generate the following trips:

- ***Alternative A:*** A total of approximately 210 "new" trips during the weekday morning peak hour and 266 "new" trips during the weekday afternoon peak hour.

- ***Alternatives B & C:*** A total of approximately 223 "new" trips during the weekday morning peak hour and 280 "new" trips during the weekday afternoon peak hour.

Per the traffic evaluation, the following on-site and off-site traffic improvements are recommended to mitigate the proposed development impacts. Since some of these improvements are within the state's right-of-way, or located at traffic signals under the jurisdiction of PennDOT, coordination with PennDOT will be required to implement these improvements:

Site Accesses

U.S. Route 202 (Wilmington Pike) and Site Access

- Classified as a low volume driveway for Alternatives A and B, and a medium volume driveway for Alternative C with the connector road based on the anticipated daily traffic volumes.
- Provide one ingress lane and one egress lane for the site access.
- Provide a 150-foot (Alternatives A & B) or 175-foot (Alternative C) right-turn deceleration lane.
- Provide stop-control on the egress of the site access.

Street Road (S.R. 0926) and Site Access

- Classified as a medium volume driveway for Alternatives A and B, and a high volume driveway for Alternative C with the connector road, based on the anticipated daily traffic volumes.
- Provide one ingress lane and two egress lanes for the site access.
- Provide a 150-foot long left-turn lane.
- Provide a 150-foot (Alternatives A & B) or 175-foot (Alternative C) right-turn deceleration lane.
- Install a traffic signal, which is preliminarily warranted based on the criteria for Warrant 2 (Four-Hour Vehicular Volume) and Warrant 3 (Peak Hour).

West Pleasant Grove Road and West Site Access

- Classified as a low volume driveway based on the anticipated daily traffic volumes for all three alternatives.
- Provide one ingress lane and one egress lane for the site access.
- Provide stop-control on the egress of the site access.

West Pleasant Grove Road and East Site Access

- Classified as a low volume driveway based on the anticipated daily traffic volumes for all three alternatives.
- Provide one ingress lane and one egress lane for the site access.
- Provide stop-control on the egress of the site access.

West Pleasant Grove Road and Connector Road (Alternative C Only)

- Classified as a medium volume driveway based on the anticipated daily traffic volumes.
- Provide one ingress lane and one egress lane for the site access.
- Provide stop-control on the egress of the site access.

Off-Site Traffic Improvements

Street Road (S.R. 0926) and New Street

- Traffic signal optimization

The traffic analyses contained herein reveal that efficient access to and from the proposed development can be provided, and furthermore, site-generated traffic can be accommodated at the study area intersections with the recommended improvements.

Existing Transportation Settings and Conditions

The proposed development will be located on the Crebilly Farm property along the west side of U.S. Route 202 (Wilmington Pike), between West Pleasant Grove Road and Street Road (S.R. 0926), in Westtown Township, Chester County, Pennsylvania (**Figure 2**). The existing roadways and intersections in the vicinity of the site, which comprise the study area roadway network, are described in this section.

Roadway Characteristics

The study area roadway network and characteristics are summarized below in **Table 1**.

Table 1 - Existing Roadway Characteristics

Roadway Name (Jurisdiction)	Average Daily Traffic Volumes (vehicles per day)	Roadway Classification		Travel Lanes (per direction)	Posted Speed Limit (mph)
		Smart Transportation (1)	PennDOT/ Township (2)		
U.S. Route 202 (Wilmington Pike)	46,427 (3)	Regional Arterial	Urban – Principal Arterial	2	45
Street Road (S.R. 0926 – PA)	12,713 (3)	Community Arterial	Urban – Minor Arterial	1	45
New Street (Local)	3,615	Neighborhood Collector	Urban – Minor Collector	1	35
West Pleasant Grove Road (Local)	n/a	Local Road	Local Road	1	35
Bridlewood Boulevard (Local)	n/a	Local Road	Local Road	1	25

(1) Based on Table 5.1 – Roadway Categories in the PennDOT publication, *Smart Transportation Guidebook.*
(2) Based on the roadway classifications provided on PennDOT's Internet Traffic Monitoring System (iTMS) website.
(3) Based on traffic data from PennDOT's Internet Traffic Monitoring System (iTMS) website.

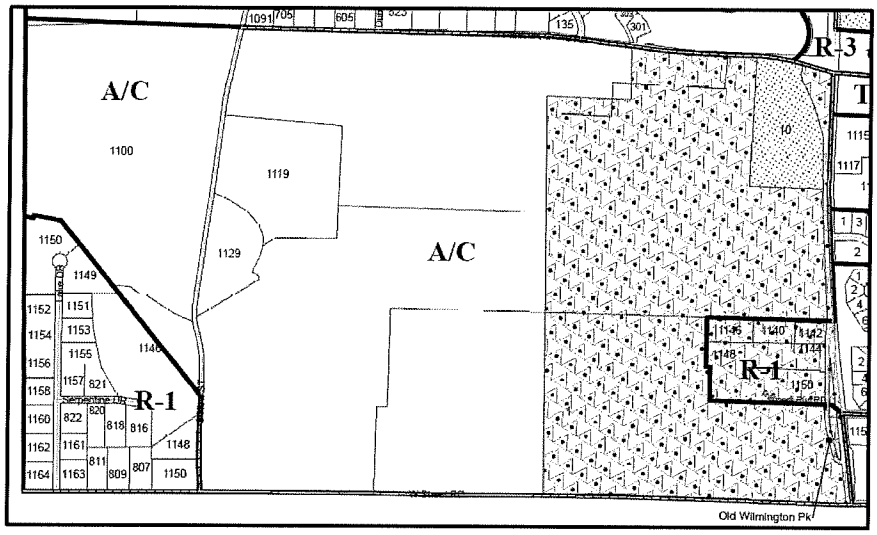
The following key intersections in the vicinity of the site comprise the study area:

- U.S. Route 202 (Wilmington Pike) and Street Road (S.R. 0926) (signalized)
- U.S. Route 202 (Wilmington Pike) and West Pleasant Grove Road (unsignalized)
- Street Road (S.R. 0926) and Bridlewood Boulevard (unsignalized)
- Street Road (S.R. 0926) and New Street (signalized)
- U.S. Route 202 (Wilmington Pike) and Proposed Site Access (unsignalized)
- Street Road (S.R. 0926) and Proposed Site Access (unsignalized)
- West Pleasant Grove Road and Proposed West Site Access (unsignalized)
- West Pleasant Grove Road and Proposed East Site Access (unsignalized)
- West Pleasant Grove Road and Proposed Connector Road (unsignalized)

The existing characteristics of the study intersections, including field sketches, and signal permit plans are provided in **Appendix A**.

Land Use Context

The proposed development is located in Westtown Township within the A/C – Agriculture/Cluster Residential District, as well as the R-1 – Rural/Suburban Residential District. The development is located along the west side of U.S. Route 202 (Wilmington Pike), between West Pleasant Grove Road and Street Road (S.R. 0926), as shown below on a portion of the Westtown Township Zoning Map. Per Westtown Township's Zoning Ordinance, the proposed residential development is permitted through conditional use within the A/C – Agriculture/Cluster Residential District in accordance with Article V and Article IX.



Source: Westtown Township Zoning Map

Area Transit Services

Transit services are currently not provided within the study area. The nearest SEPTA bus stop (SEPTA Bus Route 92) is located just north of the S.R. 0322 (High Street) and U.S. Route 202 intersection, approximately a mile and a half north of the site.

Pedestrian-Bicycle Facilities

Currently, there are no sidewalks along U.S. Route 202 (Wilmington Pike) and Street Road (S.R. 0926). The signalized intersection of U.S. Route 202 (Wilmington Pike) and Street Road (S.R. 0926) has limited pedestrian crossing amenities. There are pedestrian crosswalks, signals, and pushbuttons provided to cross the eastern leg of Street Road (S.R. 0926) and the southern leg of U.S. Route 202.

Traffic Count Data

Daily traffic counts were obtained from PennDOT's Internet Traffic Monitoring System (iTMS) website. The traffic count data is provided in **Appendix B**.

Manual turning movement traffic counts were conducted on Thursday, September 8, 2016, during the weekday morning peak period (7:00 AM to 9:00 AM) and the weekday afternoon peak period (4:00 PM to 6:00 PM) in accordance with Westtown Township's Ordinance Chapter 149-804.A(3)(g). The results of these traffic counts are tabulated by 15-minute intervals in **Appendix C**. The four highest consecutive 15-minute peak intervals during these traffic count periods constitute the peak hours that are the basis of this traffic analysis.

The northbound and southbound through volumes along U.S. Route 202 (Wilmington Pike) were balanced between West Pleasant Grove Road and Street Road (S.R. 0926). The resultant peak hour traffic volumes are depicted in **Figure 3A** for the weekday morning and weekday afternoon peak hours. The traffic volumes in Figure 3A were then analyzed to determine the existing operating conditions, and the results of this analysis are shown in **Figure 3B.** Specific details regarding the analysis results and traffic operations are provided later in this report.

Existing Queue Observations

At the intersection of U.S. Route 202 (Wilmington Pike) and PA Route 926 (Street Road) under existing conditions during the weekday morning and weekday afternoon commuter peak periods, oversaturation occurs on some movements. In accordance with the methodology contained in the *2010 Highway Capacity Manual*, queue observations were completed at the beginning of the weekday morning and weekday afternoon peak hours in order to account for these initial queues. The initial queues have been included in the detailed capacity/level-of-service analyses. Documentation of the queue observations is provided in **Appendix D**.

Site Characteristics

This section presents the details regarding the proposed site, including the incremental increase in traffic volumes generated by the development during the peak hours and the distribution of site traffic to the study area roadways, as well as the proposed site access configurations, traffic control, and sight distance requirements.

Trip Generation

Traffic volumes generated by the proposed development alternatives were prepared based on trip generation data compiled from numerous studies contained in the Institute of Transportation Engineers (ITE) publication, *Trip Generation, 9th Edition*. **Table 2** presents the anticipated vehicular trip generation for each of the proposed development alternatives. The detailed trip generation calculations are contained in **Appendix E.** All three development alternatives generate very similar weekday daily and peak hour site trips.

Table 2. Vehicular Trip Generation

Land Use	Size	Daily	Weekday Morning Peak Hour			Weekday Afternoon Peak Hour		
			In	Out	Total	In	Out	Total
Alternative A (1)	319 units	2,742	48	162	210	171	95	266
Alternatives B & C (2)	397 units	2,955	48	175	223	182	98	280

(1) Consisting of 2 existing and 200 new single-family dwelling units and 117 new carriage homes.
(2) Consisting of 2 existing and 152 new single-family dwelling units and 243 new carriage homes.

Trip Distribution and Assignment

Site-generated traffic will approach and depart the site via different routes depending on factors such as the existing traffic patterns, location of major roadways, and the location of the development's site accesses. The distribution percentages for the anticipated directions of approach and departure, as well as the traffic assignment percentages at each intersection for Alternatives A and B are illustrated in **Figure 4A**, and in **Figure 4B** for Alternative C which includes a connector road. Application of the percentages illustrated in **Figures 4A and 4B** to the new peak hour trips contained in Table 2, provides an estimate of site traffic to be added to the study area. The site-generated trips are also shown in **Figures 4C through 4E** for the weekday morning and weekday afternoon peak hours for the three development alternatives.

Site Access Configuration and Traffic Control

Access to the site for Alternatives A and B is proposed via two unsignalized full-movement accesses along West Pleasant Grove Road (one access opposite Dunvegan Road and one access opposite Hidden Pond Way), a right-in/right-out access along U.S. Route 202 (Wilmington Pike) approximately 1,850 feet north of Street Road (S.R. 0926), and a full-movement access along Street Road (S.R. 0926) approximately 1,400 feet west of U.S. Route 202 (Wilmington Pike).

Access to the site for Alternative C is proposed to be provided at the same locations as Alternatives A and B, with the addition of a third unsignalized full-movement access along West Pleasant Grove Road approximately 700 feet west of U.S. Route 202 (Wilmington Pike), which will also serve as a connector road provided for public use between U.S. Route 202 (Wilmington Pike), Street Road (S.R. 0926), and West Pleasant Grove Road.

The recommendations for the proposed access designs, including auxiliary turn lanes, traffic control, and geometric design, were based on industry accepted criteria and guidelines. Specifically, the need for left- and right-turn deceleration lanes was based on the current PennDOT guidelines in accordance with *Publication 46, Chapter 11 – Traffic Studies*. In addition, a preliminary traffic signal warrant analysis was conducted in accordance with PennDOT criteria contained in the Department's *Publication 212, Official Traffic Control Devices*, for the Four-Hour and Peak Hour Volume Warrants, which is based on the guidelines contained in the Federal Highway Administration's, *Manual on Uniform Traffic Control Devices (MUTCD)*. The various warrant/guideline analysis worksheets are contained in **Appendix F**.

Additionally, the geometric design of the proposed site accesses were preliminarily evaluated based on guidelines contained in the *Pennsylvania Code, Chapter 441, Access to and Occupancy of Highways by Driveways and Local Roads*, as well as local PennDOT District policies.

Based on the results of this evaluation, the following access configurations and traffic controls are recommended, subject to the detailed engineering of the site accesses:

U.S. Route 202 (Wilmington Pike) and Site Access

- Average Daily Traffic for each alternative:
  - Alternative A – 274 vehicles per day, Low Volume Driveway
  - Alternative B – 296 vehicles per day, Low Volume Driveway
  - Alternative C – 851 vehicles per day, Medium Volume Driveway
- Provide one ingress lane and one egress lane for the site access.
- Provide stop-control on the egress of the site access.
- *Alternatives A and B*: A right-turn deceleration lane is warranted based on PennDOT guidelines, and therefore, provide a 150-foot right-turn deceleration lane.
- *Alternative C*: A right-turn deceleration lane is warranted based on PennDOT guidelines, and therefore, provide a 175-foot right-turn deceleration lane.

Street Road (S.R. 0926) and Site Access

- Average Daily Traffic for each alternative:
  - Alternative A – 926 vehicles per day, Medium Volume Driveway
  - Alternative B – 998 vehicles per day, Medium Volume Driveway
  - Alternative C – 2,403 vehicles per day, High Volume Driveway
- Provide one ingress lane and two egress lanes for the site access.
- A left-turn lane is warranted based on PennDOT guidelines, and therefore, provide a 150-foot long left-turn lane.
- *Alternatives A and B*: A right-turn deceleration lane is warranted based on PennDOT guidelines, and therefore, provide a 150-foot right-turn deceleration lane.
- *Alternative C*: A right-turn deceleration lane is warranted based on PennDOT guidelines, and therefore, provide a 175-foot right-turn deceleration lane.
- Install a traffic signal, which is preliminarily warranted based on the criteria for Warrant 2 (Four-Hour Vehicular Volume) and Warrant 3 (Peak Hour).

West Pleasant Grove Road and West Site Access

- Average Daily Traffic for each alternative:
  - Alternative A – 89 vehicles per day, Low Volume Driveway
  - Alternative B – 97 vehicles per day, Low Volume Driveway
  - Alternative C – 56 vehicles per day, Low Volume Driveway
- Provide one ingress lane and one egress lane for the site access.
- Provide stop-control on the egress of the site access.
- A left-turn lane is not warranted based on PennDOT guidelines.
- A right-turn deceleration lane is not warranted based on PennDOT guidelines.

West Pleasant Grove Road and East Site Access

- Average Daily Traffic for each alternative:
  - Alternative A – 82 vehicles per day, Low Volume Driveway
  - Alternative B – 89 vehicles per day, Low Volume Driveway
  - Alternative C – 45 vehicles per day, Low Volume Driveway
- Provide one ingress lane and one egress lane for the site access.
- Provide stop-control on the egress of the site access.
- A left-turn lane is not warranted based on PennDOT guidelines.
- A right-turn deceleration lane is not warranted based on PennDOT guidelines.

West Pleasant Grove Road and Connector Road (Alternative C Only)

- Average Daily Traffic is 939 vehicles per day, and therefore, the driveway is classified as a Medium Volume Driveway.
- Provide one ingress lane and one egress lane for the site access.
- Provide stop-control on the egress of the site access.
- A left-turn lane is not warranted based on PennDOT guidelines.
- A right-turn deceleration lane is not warranted based on PennDOT guidelines.

Sight Distance

Sight distance field measurements and an evaluation were performed at each of the proposed site accesses. Generally, the prevailing (85th percentile) travel speed, roadway grades and profiles, and the number of travel lanes play a role in determining if safe sight distances are available for egress and ingress at the proposed accesses. The existing sight distances at the proposed accesses were measured and compared to PennDOT's sight distance requirements. These sight distance requirements are contained in *Pennsylvania Code, Chapter 441, Access to and Occupancy of Highways by Driveways and Local Roads*. **Table 3** summarizes the available sight distance measurements, as well as PennDOT's sight distance requirements at the proposed access locations.

Table 3. Sight Distance Evaluation

U.S. Route 202 (Wilmington Pike) and Site Access

Movement	Direction	Posted Speed (mph)	Approximate Grade	PennDOT Requirements (feet)		Available Sight Distance (feet)
				Desirable[1]	Acceptable[2]	
Exiting	Looking Left	45	-1.2%	500′	400′	1,000′+

Street Road (S.R. 0926) and Site Access

Movement	Direction	Posted Speed (mph)	Approximate Grade	PennDOT Requirements (feet)		Available Sight Distance (feet)
				Desirable[1]	Acceptable[2]	
Exiting	Looking Left	45	-2.6%	635′	412′	684′
	Looking Right	45	+4.4%	570′	362′	750′
Left turn Entering	Looking Ahead From the Rear	45	-2.6%	445′	412′	1,051′
		45	+4.4%	N/A	362′	750′

West Pleasant Grove Road and West Site Access

Movement	Direction	Posted Speed (mph)	Approximate Grade	PennDOT Requirements (feet)		Available Sight Distance (feet)
				Desirable[1]	Acceptable[2]	
Exiting	Looking Left	45	+2.6%	440′	254′	630′
	Looking Right	45	-2.2%	350′	276′	1,000′+
Left turn Entering	Looking Ahead From the Rear	45	+2.6%	300′	254′	1,000′+
		45	-2.2%	N/A	276′	665′

West Pleasant Grove Road and East Site Access

Movement	Direction	Posted Speed (mph)	Approximate Grade	PennDOT Requirements (feet)		Available Sight Distance (feet)
				Desirable[1]	Acceptable[2]	
Exiting	Looking Left	45	-5.4%	440′	295′	249′
	Looking Right	45	+1.4%	350′	259′	800′+
Left turn Entering	Looking Ahead From the Rear	45	-5.4%	300′	295′	800′+
		45	+1.4%	N/A	259′	348′

West Pleasant Grove Road and Connector Road (Alternative C Only)

Movement	Direction	Posted Speed (mph)	Approximate Grade	PennDOT Requirements (feet)		Available Sight Distance (feet)
				Desirable[1]	Acceptable[2]	
Exiting	Looking Left	45	+2.1%	440′	256′	436′
	Looking Right	45	0.0%	350′	265′	495′
Left turn Entering	Looking Ahead	45	+2.1%	300′	256′	415′
	From the Rear	45	0.0%	N/A	265′	650′

(1) Based on the desirable sight distance requirements contained in the *Pennsylvania Code, Chapter 441, Access to and Occupancy of Highways by Driveways and Local Roads* and the posted speed limit, unless otherwise noted.

(2) Based on the safe stopping sight distance requirements contained in the *Pennsylvania Code, Chapter 441, Access to and Occupancy of Highways by Driveways and Local Roads* and the posted speed limit.

As shown in **Table 3**, the existing available sight distances at the proposed site access intersections meet PennDOT's desirable sight distance criteria, with one exception. The available sight distance at West Pleasant Grove Road and East Site Access does not meet PennDOT's desirable or acceptable sight distance criteria for the left-turn exiting movement due to the vertical curvature of the roadway. The applicant will evaluate the access location further to ensure adequate sight distance is provided.

Proper landscaping must be maintained along the site frontage along U.S. Route 202 (Wilmington Pike), Street Road (S.R. 0926), and West Pleasant Grove Road for provision of adequate sight distance according to the above tables. The actual available sight distances should be verified during detailed engineering of the site access.

Future Traffic Conditions

This section presents the PennDOT design year (2028, or five years after the anticipated build-out year) traffic conditions, both without and with the proposed development, which is anticipated to be completed and fully occupied by 2023. The future 2028 design year without-development traffic volumes were estimated by increasing the existing 2016 traffic volumes to account for regional growth, as described below. The incremental increase due to the anticipated trip generation for the site was then added, resulting in the future 2028 design year with-development traffic volumes.

Regional Traffic Growth

To account for regional traffic growth, the existing traffic volumes were increased by an annual traffic growth rate of 1.71 percent per year compounded for 12 years to 2028, or 22.56 percent total to 2028. This growth rate is consistent with the traffic growth rate recommended by the PennDOT Bureau of Planning and Research *Growth Factors for August 2016 to July 2017* for similar, non-interstate urban roadways in Westtown Township.

Local Traffic Growth

To account for local traffic growth, the municipality was contacted to identify any other nearby future developments. Based upon coordination with Westtown Township, the existing traffic volumes were also increased by nearby approved developments in the vicinity of the proposed development. Specifically, the following developments were included:

- **Police Station Redevelopment:** 30,000 square feet of office space located on the northeast corner of the intersection of U.S. 202 (Wilmington Pike) and Pleasant Grove Road.

- **Arborview:** 16,800 square feet of office space and an 8,665 square-foot daycare center located on the west side of U.S. Route 202 (Wilmington Pike) between Skiles Boulevard and Pleasant Grove Road.

- **Condominium Development:** 39 condominiums in two buildings remain to be occupied/constructed on the west side of Gilpin Drive just north of Skiles Boulevard.

Additionally, the Township identified a 15-unit residential development currently under review along U.S. Route 202 (Wilmington Pike) at Jacqueline Drive, which is assumed to be part of the regional traffic growth since it will generate little additional traffic within the study area. Information regarding the nearby approved developments, obtained from Westtown Township, are provided in **Appendix G.**

Planned Roadway Improvements

U.S. Route 202/S.R. 0926/West Pleasant Grove Road Connector Road

In conjunction with the proposed development under Alternative C, access to the site is proposed to be provided along a connector road that will be constructed between U.S. Route 202 (Wilmington Pike), Street Road (S.R. 0926), and West Pleasant Grove Road, including a right-in/right-out access along U.S. Route 202 (Wilmington Pike), a full-movement access along Street Road (S.R. 0926), and two full-movement accesses along West Pleasant Grove Road. This connector road concept has been planned by the Township for a number of years, and it will alleviate traffic at the congested U.S. Route 202 (Wilmington Pike)/Street Road (S.R. 0926) intersection, and reroute traffic currently using West Pleasant Grove Road and New Street as an alternate route. In this analysis, we have utilized traffic diversions due to the provision of the connector road based on previous studies completed and accepted by the Township. The traffic diversions are provided in **Appendix H**.

West Pleasant Grove Road/Skiles Boulevard Connector Road

Ultimately through other development projects, the Township plans to extend this connector road further north from West Pleasant Grove Road to Skiles Boulevard. This will provide a fully connected roadway network on the west side of U.S. Route 202 from Street Road (S.R. 0926) to Skiles Boulevard, which will provide drivers with access to and from U.S. Route 202 via two signalized intersections. Traffic analysis with this additional roadway connection has been included for Alternative C only for informational purposes, since the status of the development in that area is unknown at this time.

PennDOT U.S. Route 202, Section 100

Additionally within this section of U.S. Route 202 (Wilmington Pike), designated as Section 100, several studies completed through PennDOT and the Delaware Valley Regional Planning Commission have identified the need for additional roadway capacity. At this time, PennDOT is underway with final design for improvements at the U.S. Route 202 (Wilmington Pike) and Street Road (S.R. 0926) intersection. Based on the current State Transportation Improvement Program (TIP) and the Conceptual Intersection Layout prepared by Urban Engineers and dated June 5, 2014, the project will include improvements that will help reduce traffic congestion and increase safety at the intersection through lane reconfigurations, striping, upgrades to the traffic signal, signal timing, and bicycle and pedestrian improvements. It is our understanding that the following roadway improvements are to pedestrian improvements. It is our understanding that the following roadway improvements are to be included:

- Southbound 130-foot right-turn deceleration lane on U.S. Route 202.
- Additional eastbound left-turn lane on PA Route 926, creating a double left-turn lane configuration with 380 feet of storage for each lane.

- Pedestrian and bicycle intersection improvements, including high-visibility crosswalks, ADA ramps, and sidewalk extension from the intersection east to Dalmally Drive.
- Traffic signal equipment upgrades, including pedestrian push buttons, countdown signal heads, and lighting.

Based on the TIP, the current project schedule indicates an estimated let date of July 2018; however, in light of the favorable state transportation funding situation, and the high priority for this project within Chester County, we understand this project may be accelerated to be completed more quickly.

Future Traffic Conditions

The total background growth and nearby approved development traffic volumes were then added to the existing 2016 traffic volumes to calculate the future 2028 without development traffic volumes. Next, the site generated traffic volumes, as shown in **Figures 4C through 4E**, were added to the future 2028 without-development traffic volumes to calculate the future 2028 with development traffic volumes.

The resultant future 2028 design year peak hour traffic volumes without development are illustrated in **Figure 5A,** and the future 2028 design year with-development peak hour traffic volumes are illustrated in **Figure 5B through 5D** for the weekday morning and weekday afternoon peak hours for each development alternative. These traffic volumes were then analyzed to determine the future 2028 without and with development operating conditions, and the results of this analysis are shown in **Figures 5E through 5H.** Detailed spreadsheets summarizing the 2028 traffic projections, including regional growth, other development trip assignments, and the site trip assignments for each intersection, are provided in **Appendix I.**

Capacity/Level-of-Service Results

The peak hour traffic volumes were analyzed to determine the existing and future operating conditions, both without and with the proposed development, in accordance with the standard techniques contained in the current *Highway Capacity Manual (2010)* for both signalized and unsignalized intersections. The HCM 2010 Methodology within Synchro 8.0 (build 806, rev. 77) traffic analysis software was utilized in the traffic analyses.

These standard capacity/level-of-service analysis techniques, which calculate total control delay, are described in **Appendix J** for both signalized and unsignalized intersections, as well as the correlation between average total control delay and the respective level-of-service (LOS) criteria for each intersection type.

According to PennDOT's *Policies and Procedures for Transportation Impact Studies Related to Highway Occupancy Permit Plans,* the following procedures and assumptions were utilized:

- For signalized intersections, the Pennsylvania base saturation flow rate (Exhibit 10-9) and Pennsylvania traffic signal control calibration parameters (Exhibit 10-10) outlined in PennDOT's *Publication 46, Traffic Engineering Manual,* were used.

- For unsignalized intersections, the base critical headways at TWSC intersections (Exhibit 10-11) and base follow-up headways at TWSC intersections (Exhibit 10-12) outlined in PennDOT's *Publication 46, Traffic Engineering Manual,* were used.

- All traffic signal timings at signalized intersections were optimized in without development conditions.

- If the evaluation of without-development to with-development indicates the overall intersection level of service has dropped, the applicant will be required to mitigate the level of service if the increase is greater than 10 seconds. If the overall intersection delay increase is less than or equal to 10 seconds, mitigation of the intersection will not be required.

The existing and design year 2028 traffic conditions, both without and with the proposed development, are summarized in **Figures 3B and 5E through 5H** while the detailed capacity/level-of-service analysis worksheets are provided in **Appendices K, L, M, N, and O.** The levels-of-service and queue matrices are provided in **Tables 7 and 8**.

Tables 4 and 5 below summarize the overall intersection results of the level-of-service analyses for the off-site study intersections for each peak hour.

Table 4. Overall Intersection Level-of-Service[1]
Weekday Morning Peak Hour

Intersection	Existing	Without Dev	With Development		
			Alternative A	Alternative B	Alternative C (With Connector Road)
U.S. Route 202 (Wilmington Pike) and Street Road (S.R. 0926)	F 104.1	F 117.9	F 134.3 (+16.4 seconds)	F 135.7 (+17.8 seconds)	F 138.3 (+20.4 seconds)
	NOTE: Under Alternative C, the overall intersection delay increases slightly compared to Alternative B, even though the site trip generation is the same and Southbound US Route 202 right-turn traffic is diverted to the Connector Road. This is further explained following Table 5.				
U.S. Route 202 (Wilmington Pike) and Pleasant Grove Road	A 0.7	A 1.4	A 1.7	A 1.7	A 1.7
Street Road (S.R. 0926) and New Street *(Note: Traffic decreases through this intersection under Alternative C due to the connector road)*	E 70.5	D 50.4	D 51.6	D 51.7	D 40.3 (-10.1 seconds)
Street Road (S.R. 0926) and Bridlewood Boulevard	A 1.3	A 1.2	A 2.0	A 1.9	A 1.9
U.S. Route 202 (Wilmington Pike) and Proposed Connector Road/Site Access	-	-	A 0.2	A 0.2	A 0.2
Street Road (S.R. 0926) and Proposed Site Access (Signalized)	-	-	A 9.6	A 10.1	B 16.6
West Pleasant Grove Road and West Site Access	-	-	A 0.3	A 0.3	A 0.1
West Pleasant Grove Road and East Site Access	-	-	A 0.2	A 0.3	A 0.2
West Pleasant Grove Road and Connector Road	-	-	-	-	A 2.4

(1) Without and with development conditions assume the completion of PennDOT's U.S. Route 202 and Street Road (S.R. 0926) improvement project, estimated to be let for construction by 2018.

Table 5. Overall Intersection Level-of-Service[1]
Weekday Afternoon Peak Hour

Intersection	Existing	Without Dev	With Development		
			Alternative A	Alternative B	Alternative C (With Connector Road)
U.S. Route 202 (Wilmington Pike) and Street Road (S.R. 0926)	F 139.8	F 150.0	F 165.2 (+15.2 seconds)	F 165.8 (+15.8 seconds)	F 168.9 (+18.9 seconds)
	NOTE: Under Alternative C, the overall intersection delay increases slightly compared to Alternative B, even though the site trip generation is the same and Southbound US Route 202 right-turn traffic is diverted to the Connector Road. This is further explained following Table 5.				
U.S. Route 202 (Wilmington Pike) and Pleasant Grove Road	A 0.8	A 1.9	A 2.0	A 2.0	A 2.0
Street Road (S.R. 0926) and New Street *(Note: Traffic decreases through this intersection under Alternative C due to the connector road)*	E 70.1	E 71.8	E 74.1	E 74.1	D 51.5 (-20.3 seconds)
Street Road (S.R. 0926) and Bridlewood Boulevard	A 1.4	A 1.3	A 2.1	A 2.1	A 2.1
U.S. Route 202 (Wilmington Pike) and Proposed Connector Road/Site Access	-	-	A 0.1	A 0.1	A 0.1
Street Road (S.R. 0926) and Proposed Site Access (Signalized)	-	-	A 6.6	A 6.7	B 12.5
West Pleasant Grove Road and Proposed West Site Access	-	-	A 0.0	A 0.0	A 0.2
West Pleasant Grove Road and Proposed East Site Access	-	-	A 0.3	A 0.3	A 0.2
West Pleasant Grove Road and Proposed Connector Road	-	-	-	-	A 2.8

(1) Without and with development conditions assume the completion of PennDOT's U.S. Route 202 and Street Road (S.R. 0926) improvement project, estimated to be let for construction by 2018.

It is noted that in Tables 4 and 5 at the intersection of U.S. Route 202 and Street Road (S.R. 0926) under Alternative C, the southbound U.S. Route 202 right-turn traffic volume and delay decreases compared to Alternative B, as traffic diverts to the connector road. All of the other traffic volumes and individual movement/lane group vehicular delays at the intersection are identical under Alternatives B and C. However, the overall intersection delay increases under Alternative C because it is calculated as a

weighted average using the individual movement delays and the traffic volumes. Since the southbound U.S. Route 202 right-turn movement experiences very little delay, the overall intersection delay is less when there is **more** right-turn traffic on this movement (under Alternative B without the connector road). The overall intersection level-of-service delay results for Alternatives B and C should be considered the same, as this is a shortcoming in the analysis methodology. Refer to the detailed level-of-service matrix at the end of this report for a comparison of the individual movement/lane group delays at this intersection.

The off-site study intersection of U.S. Route 202 (Wilmington Pike) and Street Road (S.R. 0926) does not satisfy PennDOT's mitigation criteria with the proposed development under the three alternatives since the increase in overall delay is greater than 10 seconds. Based on our knowledge of the intersection, there may not be an opportunity to complete additional improvements at this location to mitigate the traffic impact from the proposed residential development, beyond the improvements currently under design by PennDOT. In accordance with PennDOT criteria, an Alternative Transportation Plan (ATP) may be needed, to evaluate strategies beyond traditional intersection improvements. Based on the traffic benefit of the connector road under Alternative C, such improvements should be included in any ATP.

Queuing Analysis

A queuing analysis was completed at the study intersections based on the HCM 2010 methodology. Matrix tables which outline the results of the queuing analysis are provided at the end of this report. Based on the results of the queuing analysis and with the recommended site access designs, as outlined previously, the queues at the site access intersections are accommodated within the existing and proposed lane storages for all three alternatives. Additionally, based on the results of the queuing analysis, the queues are accommodated within the available lane storages at the majority of the off-site study intersections. Significant queues occur at the U.S. Route 202 (Wilmington Pike) and Street Road (S.R. 0926) intersection during both peak hours. With PennDOT's intersection improvements, the queues are significantly decreased at the intersection, and the queues with the proposed development are similar.

Conclusions and Recommendations

The following improvements are proposed in conjunction with the proposed development:

U.S. Route 202 (Wilmington Pike) and Site Access

- Classified as a low volume driveway for Alternatives A and B, and a medium volume driveway for Alternative C with the connector road based on the anticipated daily traffic volumes.
- Provide one ingress lane and one egress lane for the site access.
- Provide a 150-foot (Alternatives A & B) or 175-foot (Alternative C) right-turn deceleration lane.
- Provide stop-control on the egress of the site access.

Street Road (S.R. 0926) and Site Access

- Classified as a medium volume driveway for Alternatives A and B, and a high volume driveway for Alternative C with the connector road, based on the anticipated daily traffic volumes.
- Provide one ingress lane and two egress lanes for the site access.
- Provide a 150-foot long left-turn lane.
- Provide a 150-foot (Alternatives A & B) or 175-foot (Alternative C) right-turn deceleration lane.
- Install a traffic signal, which is preliminarily warranted based on the criteria for Warrant 2 (Four-Hour Vehicular Volume) and Warrant 3 (Peak Hour).

West Pleasant Grove Road and West Site Access

- Classified as a low volume driveway based on the anticipated daily traffic volumes for all three alternatives.
- Provide one ingress lane and one egress lane for the site access.
- Provide stop-control on the egress of the site access.

West Pleasant Grove Road and East Site Access

- Classified as a low volume driveway based on the anticipated daily traffic volumes for all three alternatives.
- Provide one ingress lane and one egress lane for the site access.
- Provide stop-control on the egress of the site access.

West Pleasant Grove Road and Connector Road (Alternative C Only)

- Classified as a medium volume driveway based on the anticipated daily traffic volumes.
- Provide one ingress lane and one egress lane for the site access.
- Provide stop-control on the egress of the site access.

Off-Site Traffic Improvements

Street Road (S.R. 0926) and New Street

- Traffic signal optimization

Since U.S. Route 202 (Wilmington Pike) and New Street (S.R. 0926) are State roads, the proposed site accesses along U.S. Route 202 (Wilmington Pike) and New Street (S.R. 0926) will be subject to the review and approval of PennDOT for issuance of a Highway Occupancy Permit, as well as any traffic signal timing changes.

The traffic analyses contained herein reveals that efficient access to and from the proposed development can be provided and that the adjacent roadways and intersections can accommodate the projected site-generated traffic.

Table 6. Level of Service Matrices

U.S. Route 202 (Wilmington Pike) and Street Road (S.R. 0926)

Time Period			Weekday Morning Peak Hour					Weekday Afternoon Peak Hour				
Design Year			2016	2028 Design Year				2016	2028 Design Year			
Development Condition			Existing	w/o Dev[1]	w/ Dev[1]			Existing	w/o Dev[1]	w/ Dev[1]		
					Alternative A	Alternative B	Alternative C			Alternative A	Alternative B	Alternative C
Street Road (S.R. 0926)	EB	Left	F 208.0	F	F	F	F	F 100.0	F	F	F	F
		Left	F	219.9	273.7	277.8	277.8	F	241.7	285.6	286.8	286.8
		Thru		F	F	F	F		F	F	F	F
		Right	209.8	207.6	249.5	254.8	254.8	110.9	170.8	208.4	210.5	210.5
	WB	Left	E 70.2	F 90.7	F 92.0	F 92.2	F 92.2	E 63.9	E 57.1	E 57.4	E 57.4	E 57.4
		Thru	E 66.4	F 137.8	F 146.3	F 150.1	F 150.1	E 79.7	F 225.7	F 255.3	F 257.0	F 257.0
		Right	E 58.8	D 49.8	D 50.0	D 50.0	D 50.0	E 56.8	D 46.7	D 46.7	D 46.7	D 46.7
U.S. Route 202 (Wilmington Pike)	NB	Left	D 37.8	C 29.4	C 29.8	C 29.8	C 29.8	D 41.0	C 30.3	D 37.1	D 38.4	D 38.4
		Thru	F 92.9	F 140.8	F 142.7	F 142.9	F 142.9	F 99.0	F 111.0	F 111.6	F 111.6	F 111.6
		Right	C 23.1	B 16.9	B 17.1	B 17.1	B 17.1	C 26.1	B 16.5	B 16.6	B 16.6	B 16.6
	SB	Left	D 39.6	C 31.0	C 32.0	C 32.3	C 32.3	E 62.5	D 44.5	D 47.5	D 47.5	D 47.5
		Thru	F 73.5 v/c> 1.0	F	F	F	F	F 226.8	F	F	F	F
		Thru	F	67 v/c > 1.0	82.2	82.5	82.5	F	189.9	210.8	211.9	211.9
		Right	77.6 v/c > 1.0	B 16.3	B 17.0	B 17.0	B 14.9	220.7	B 15.6	B 17.1	B 17.2	B 15.4
Overall			F 104.1	F 117.9	F 134.3	F 135.7	F 138.3	F 139.8	F 150.0	F 165.2	F 165.8	F 168.9

(1) Without and with development conditions asssume the completion of PennDOT's U.S. Route 202 and Street Road (S.R. 0926) improvement project.

Table 6. Level of Service Matrices

Street Road (S.R. 0926) and New Street

Time Period		Weekday Morning Peak Hour					Weekday Afternoon Peak Hour				
Design Year		2016	2028 Design Year				2016	2028 Design Year			
Development Condition		Existing	w/o Dev Optimized	w/ Dev			Existing	w/o Dev Optimized	w/ Dev		
				Alternative A	Alternative B	Alternative C			Alternative A	Alternative B	Alternative C
Street Road (S.R. 0926)	EB Left	A 9.8	D 46.7	F 49.6 v/c > 1.0	F 49.7 v/c > 1.0	F 49.5 v/c > 1.0	B 12.4	C 24.5	C 25.6	C 25.6	C 34.8
	EB Thru										
	EB Right										
	WB Left	A 5.8	B 13.1	B 13.7	B 13.8	B 15.3	A 9.8	B 16.5	B 17.0	B 17.0	D 48.9
	WB Thru										
	WB Right										
New Street	NB Left	C 33.3	C 24.3	C 24.4	C 24.4	C 24.4	C 34.9	C 29.9	C 30.0	C 30.0	C 30.0
	NB Thru										
	NB Right										
	SB Left	F 243.7	F 96.6	F 97.4	F 97.4	D 53.4	F 207.1	F 196.1	F 204.1	F 204.4	F 91.6
	SB Thru										
	SB Right										
Overall		E 70.5	D 50.4	D 51.6	D 51.7	D 40.3	E 70.1	E 71.8	E 74.1	E 74.1	D 51.5

Table 6. Level of Service Matrices

Street Road (S.R. 0926) and Bridlewood Boulevard

Time Period			Weekday Morning Peak Hour					Weekday Afternoon Peak Hour				
Design Year			2016	2028 Design Year				2016	2028 Design Year			
Development Condition			Existing	w/o Dev	w/ Dev			Existing	w/o Dev	w/ Dev		
					Alternative A	Alternative B	Alternative C			Alternative A	Alternative B	Alternative C
Street Road (S.R. 0926)	EB	Thru	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)
		Right	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)
	WB	Left	B 11.6	B 12.9	B 12.9	B 12.9	B 12.7	B 10.5	B 11.4	B 11.6	B 11.6	B 11.4
		Thru	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)
		Right										
Bridlewood Boulevard	NB	Left	C 23.5	C 19.5	E 42.0	E 42.0	E 40.3	D 25.5	C 19.5	E 48.1	E 48.1	F 50.1
		Right	B 14.6	C 17.9	C 18.0	C 18.0	C 17.4	B 13.4	C 16.0	C 16.4	C 16.5	C 15.8
Overall			A 1.3	A 1.2	A 2.0	A 1.9	A 1.9	A 1.4	A 1.3	A 2.1	A 2.1	A 2.1

(1) Movement operates at free-flow conditions.

Table 6. Level of Service Matrices

U.S. Route 202 (Wilmington Pike) and Pleasant Grove Road

Time Period			Weekday Morning Peak Hour					Weekday Afternoon Peak Hour				
Design Year			2016	2028 Design Year				2016	2028 Design Year			
Development Condition			Existing	w/o Dev	w/ Dev			Existing	w/o Dev	w/ Dev		
					Alternative A	Alternative B	Alternative C			Alternative A	Alternative B	Alternative C
Pleasant Grove Road	EB	Right	C 24.3	E 41.3	E 45.9	E 46.4	E 46.4	A 0.0	A 0.0	D 31.5	D 31.7	D 31.7
	WB	Right	C 23.4	E 35.6	E 37.8	E 37.8	E 37.8	C 20.4	D 31.9	D 33.1	D 33.1	D 33.1
U.S. Route 202 (Wilmington Pike)	NB	Left	C 19.2	D 27.4	D 27.9	D 27.9	D 27.9	C 20.8	D 33.5	E 36.2	E 36.4	E 36.4
		Thru	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)
		Thru/ Right	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)
	SB	Left	C 21.5	E 44.9	E 49.6	F 50.1	F 50.1	C 23.0	F 52.4	F 56.5	F 56.5	F 56.5
		Thru	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)
		Thru/ Right	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)
Overall			A 0.7	A 1.4	A 1.7	A 1.7	A 1.7	A 0.8	A 1.9	A 2.0	A 2.0	A 2.0

(1) Movement operates at free-flow conditions.

Table 6. Level of Service Matrices

U.S. Route 202 (Wilmington Pike) and Site Access

Time Period		Weekday Morning Peak Hour			Weekday Afternoon Peak Hour		
Design Year		2028 Design Year			2028 Design Year		
Development Condition		w/ Dev			w/ Dev		
		Alternative A	Alternative B	Alternative C	Alternative A	Alternative B	Alternative C
Site Access	EB Right	C 24.8	D 25.1	C 22.8	D 25.0	D 25.0	C 22.9
U.S. Route 202 (Wilmington Pike)	Thru (2) SB	(1)	(1)	(1)	(1)	(1)	(1)
	Right	(1)	(1)	(1)	(1)	(1)	(1)
Overall		A 0.2	A 0.2	A 0.2	A 0.1	A 0.1	A 0.1

(1) Movement operates at free-flow conditions.

Table 6. Level of Service Matrices

Street Road (S.R. 0926) and Site Access

Time Period			Weekday Morning Peak Hour			Weekday Afternoon Peak Hour		
Design Year			2028 Design Year			2028 Design Year		
Development Condition			w/ Dev			w/ Dev		
			Alternative A	Alternative B	Alternative C	Alternative A	Alternative B	Alternative C
Street Road (S.R. 0926)	EB	Left	A 4.9	A 5.1	A 5.8	A 6.9	A 7.0	A 8.4
		Thru	B 11.0	B 11.6	B 18.8	A 7.4	A 7.5	B 13.3
	WB	Thru	A 3.8	A 3.9	A 4.8	A 4.6	A 4.7	A 6.2
		Right	A 2.6	A 2.7	A 4.0	A 2.8	A 2.9	A 4.6
Site Access	SB	Left	C 21.6	C 21.8	C 20.0	B 17.8	B 17.9	B 16.8
		Right	B 20.0	C 20.0	C 26.4	B 17.8	B 17.8	C 26.1
Overall			A 9.6	B 10.1	B 16.6	A 6.6	A 6.7	B 12.5

Table 6. Level of Service Matrices

West Pleasant Grove Road and Connector Road

Time Period			Weekday Morning Peak Hour			Weekday Afternoon Peak Hour		
Design Year			2028 Design Year			2028 Design Year		
Development Condition			w/ Dev			w/ Dev		
			Alternative A	Alternative B	Alternative C	Alternative A	Alternative B	Alternative C
West Pleasant Grove Road	EB	Thru/ Right	---	---	(1)	---	---	(1)
	WB	Left/ Thru	---	---	A 8.4	---	---	A 8.5
Site Access	NB	Left	---	---	B 10.2	---	---	B 14.3
		Right						
Overall			---	---	A 2.4	---	---	A 2.8

(1) Movement operates at free-flow conditions.

Table 6. Level of Service Matrices

West Pleasant Grove Road and East Site Access

Time Period			Weekday Morning Peak Hour			Weekday Afternoon Peak Hour		
Design Year			2028 Design Year			2028 Design Year		
Development Condition			w/ Dev			w/ Dev		
			Alternative A	Alternative B	Alternative C	Alternative A	Alternative B	Alternative C
West Pleasant Grove Road	EB	Thru/ Right	(1)	(1)	(1)	(1)	(1)	(1)
	WB	Left/ Thru	A 8.2	A 8.2	A 8.3	A 8.1	A 8.1	A 8.1
East Site Access	NB	Left	A 8.4	A 8.4	A 8.6	A 8.1	A 8.1	A 8.3
		Right						
Overall			A 0.2	A 0.3	A 0.1	A 0.3	A 0.3	A 0.2

(1) Movement operates at free-flow conditions.

Table 6. Level of Service Matrices

West Pleasant Grove Road and West Site Access

Time Period			Weekday Morning Peak Hour			Weekday Afternoon Peak Hour		
Design Year			2028 Design Year			2028 Design Year		
Development Condition			w/ Dev			w/ Dev		
			Alternative A	Alternative B	Alternative C	Alternative A	Alternative B	Alternative C
West Pleasant Grove Road	EB	Thru/ Right	(1)	(1)	(1)	(1)	(1)	(1)
	WB	Left/ Thru	A 8.2	A 8.2	A 8.3	A 0.0	A 0.0	A 8.1
West Site Access	NB	Left	A 8.4	A 8.4	A 8.6	A 0.0	A 0.0	A 8.3
		Right						
Overall			A 0.3	A 0.3	A 0.2	A 0.0	A 0.0	A 0.2

(1) Movement operates at free-flow conditions.

Table 7. 95th Percentile Queue Matricies

U.S. Route 202 (Wilmington Pike) and Street Road (S.R. 0926)

Time Period					Weekday Morning Peak Hour					Weekday Afternoon Peak Hour				
Design Year			Current Storage [1]	Future Storage [1]	2016	2028 Design Year				2016	2028 Design Year			
							w/ Dev[2]					w/ Dev[2]		
Development Condition					Existing	w/o Dev[2]	Alternative A	Alternative B	Alternative C	Existing	w/o Dev[2]	Alternative A	Alternative B	Alternative C
Street Road (S.R. 0926)	EB	Left	450'	380'	1230	910	1095	1110	1110	625	748	858	860	860
		Left												
		Thru	*4,700*	*1,400'*	1363	918	1083	1103	1103	958	698	805	810	810
		Right												
	WB	Left	200'	200'	285	195	198	198	198	285	293	293	293	293
		Thru	*680'*	*680'*	258	445	463	470	470	450	895	988	993	993
		Right	215'	200'	45	48	48	48	48	48	55	55	55	55
U.S. Route 202 (Wilmington Pike)	NB	Left	305'	305'	25	25	30	30	30	45	40	103	108	108
		Thru	*2,800'*	*2,800'*	1328	2173	2183	2183	2183	1348	1963	1965	1965	1965
		Right	170'	170'	130	128	128	128	128	103	93	93	93	93
	SB	Left	375'	330'	63	65	73	73	73	148	210	220	220	220
		Thru	*4,400'*	*4,400'*	1788	1600	1733	1735	1735	2788	2553	2718	2725	2725
		Thru	*4,400'*		1850					2848				
		Right		130'		193	198	198	83		150	155	158	53

(1) Distance to adjacents signalized intersections shown in italics.

(2) Without and with development conditions asssume the completion of PennDOT's U.S. Route 202 and Street Road (S.R. 0926) improvement project.

Table 7. 95th Percentile Queue Matricies

Street Road (S.R. 0926) and New Street

Time Period			Current Storage [1]	Weekday Morning Peak Hour					Weekday Afternoon Peak Hour				
Design Year				2016	2028 Design Year				2016	2028 Design Year			
Development Condition				Existing	w/o Dev Optimized	w/ Dev			Existing	w/o Dev Optimized	w/ Dev		
						Alternative A	Alternative B	Alternative C			Alternative A	Alternative B	Alternative C
Street Road (S.R. 0926)	EB	Left		440	1043	1488	1490	1488	440	745	778	778	910
		Thru	*2,200'*										
		Right											
	WB	Left		188	318	338	338	355	288	448	465	465	843
		Thru	*4,700'*										
		Right											
New Street	NB	Left		113	118	120	120	120	240	270	273	273	273
		Thru	-										
		Right											
	SB	Left		1178	988	993	993	538	1410	1698	1738	1738	1043
		Thru	-										
		Right											

(1) Distance to adjacent signalized intersections shown in italics.

Table 7. 95th Percentile Queue Matricies

Street Road (S.R. 0926) and Bridlewood Boulevard

Time Period			Current Storage [1]	Future Storage [1]	Weekday Morning Peak Hour					Weekday Afternoon Peak Hour				
Design Year					2016	2028 Design Year				2016	2028 Design Year			
Development Condition					Existing	w/o Dev	w/ Dev			Existing	w/o Dev	w/ Dev		
							Alternative A	Alternative B	Alternative C			Alternative A	Alternative B	Alternative C
Street Road (S.R. 0926)	EB	Thru	*2,400'*	*2,400'*	-	-	-	-	-	-	-	-	-	-
		Right	350'	350'	-	-	-	-	-	-	-	-	-	-
	WB	Left	120'	120'	0	25	25	25	25	25	25	25	25	25
		Thru	*2,300'*	*1500'*	-	-	-	-	-	-	-	-	-	-
Bridlewood Boulevard	NB	Left	125'	120'	25	25	40	40	40	25	25	38	38	40
		Right			25	25	25	25	25	25	25	25	25	25

(1) Distance to adjacent signalized intersections shown in italics.

Table 7. 95th Percentile Queue Matricies

U.S. Route 202 (Wilmington Pike) and Pleasant Grove Road

Time Period			Weekday Morning Peak Hour					Weekday Afternoon Peak Hour				
Design Year		Current Storage [1]	2016	2028 Design Year				2016	2028 Design Year			
Development Condition			Existing	w/o Dev	w/ Dev			Existing	w/o Dev	w/ Dev		
					Alternative A	Alternative B	Alternative C			Alternative A	Alternative B	Alternative C
Pleasant Grove Road	EB Right	-	25	45	55	55	55	0	0	25	25	25
	WB Right	-	25	25	25	25	25	25	25	25	25	25
U.S. Route 202 (Wilmington Pike)	NB Left	350'	25	25	25	25	25	25	28	30	30	30
	NB Thru	*3,100'*	-	-	-	-	-	-	-	-	-	-
	NB Thru/ Right	*3,100'*	-	-	-	-	-	-	-	-	-	-
	SB Left	380'	25	60	65	68	68	40	105	113	113	113
	SB Thru	*1,200'*	-	-	-	-	-	-	-	-	-	-
	SB Thru/ Right	*1,200'*	-	-	-	-	-	-	-	-	-	-

(1) Distance to adjacent signalized intersections shown in italics.

Table 7. 95th Percentile Queue Matricies

U.S. Route 202 (Wilmington Pike) and Site Access

Time Period			Future Storage	Weekday Morning Peak Hour			Weekday Afternoon Peak Hour		
Design Year				2028 Design Year			2028 Design Year		
Development Condition				w/ Dev			w/ Dev		
				Alternative A	Alternative B	Alternative C	Alternative A	Alternative B	Alternative C
Site Access	EB	Right	-	25	25	25	25	25	25
U.S. Route 202 (Wilmington Pike)	SB	Thru (2)	-	-	-	-	-	-	-
		Right	225'	-	-	-	-	-	-

Table 7. 95th Percentile Queue Matricies

Street Road (S.R. 0926) and Site Access

Time Period				Weekday Morning Peak Hour			Weekday Afternoon Peak Hour		
Design Year			Future Storage [1]	2028 Design Year			2028 Design Year		
Development Condition				w/ Dev			w/ Dev		
				Alternative A	Alternative B	Alternative C	Alternative A	Alternative B	Alternative C
Street Road (S.R. 0926)	EB	Left	150'	25	25	25	25	25	25
		Thru	*1,350'*	430	443	540	325	325	413
	WB	Thru	*1,050'*	120	128	95	193	193	173
		Right	150'	25	25	25	25	25	35
Site Access	SB	Left		60	68	88	30	30	53
		Right		25	25	140	25	25	155

(1) Distance to adjacent signalized intersections shown in italics.

Table 7. 95th Percentile Queue Matricies

West Pleasant Grove Road and Connector Road

Time Period		Weekday Morning Peak Hour			Weekday Afternoon Peak Hour		
Design Year		2028 Design Year			2028 Design Year		
Development Condition		w/ Dev			w/ Dev		
		Alternative A	Alternative B	Alternative C	Alternative A	Alternative B	Alternative C
West Pleasant Grove Road	EB Thru	-	-	-	-	-	-
	EB Right						
	WB Left	-	-	25	-	-	25
	WB Thru						
Site Access	NB Left	-	-	25	-	-	25
	NB Right						

Table 7. 95th Percentile Queue Matricies

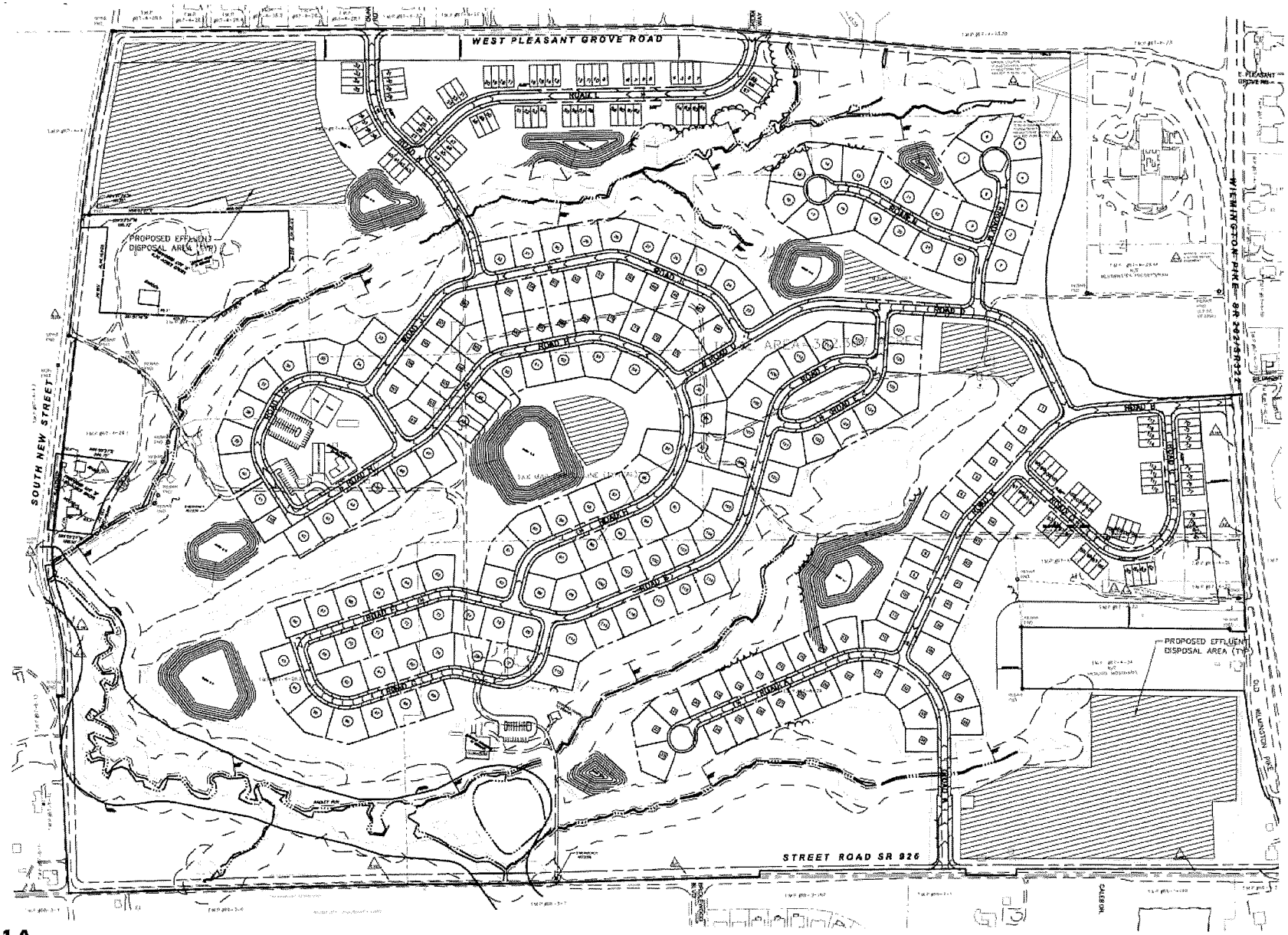
West Pleasant Grove Road and Eastern Site Access

Time Period		Weekday Morning Peak Hour			Weekday Afternoon Peak Hour		
Design Year		2028 Design Year			2028 Design Year		
Development Condition		w/ Dev			w/ Dev		
		Alternative A	Alternative B	Alternative C	Alternative A	Alternative B	Alternative C
West Pleasant Grove Road	EB Thru	-	-	-	-	-	-
	EB Right						
	WB Left	0	0	0	0	25	0
	WB Thru						
East Site Access	NB Left	0	0	0	0	0	0
	NB Right						

Table 7. 95th Percentile Queue Matricies

West Pleasant Grove Road and West Site Access

Time Period			Weekday Morning Peak Hour			Weekday Afternoon Peak Hour		
Design Year			2028 Design Year			2028 Design Year		
Development Condition			w/ Dev			w/ Dev		
			Alternative A	Alternative B	Alternative C	Alternative A	Alternative B	Alternative C
West Pleasant Grove Road	EB	Thru	-	-	-	-	-	-
		Right						
	WB	Left	0	0	0	0	0	0
		Thru						
West Site Access	NB	Left	0	0	0	0	0	0
		Right						



Schematic- Not To Scale

FIGURE 1A

Site Plan

Alternative A - Proposed Development

CREBILLY FARM RESIDENTIAL DEVELOPMENT

WESTTOWN TOWNSHIP, CHESTER COUNTY, PA

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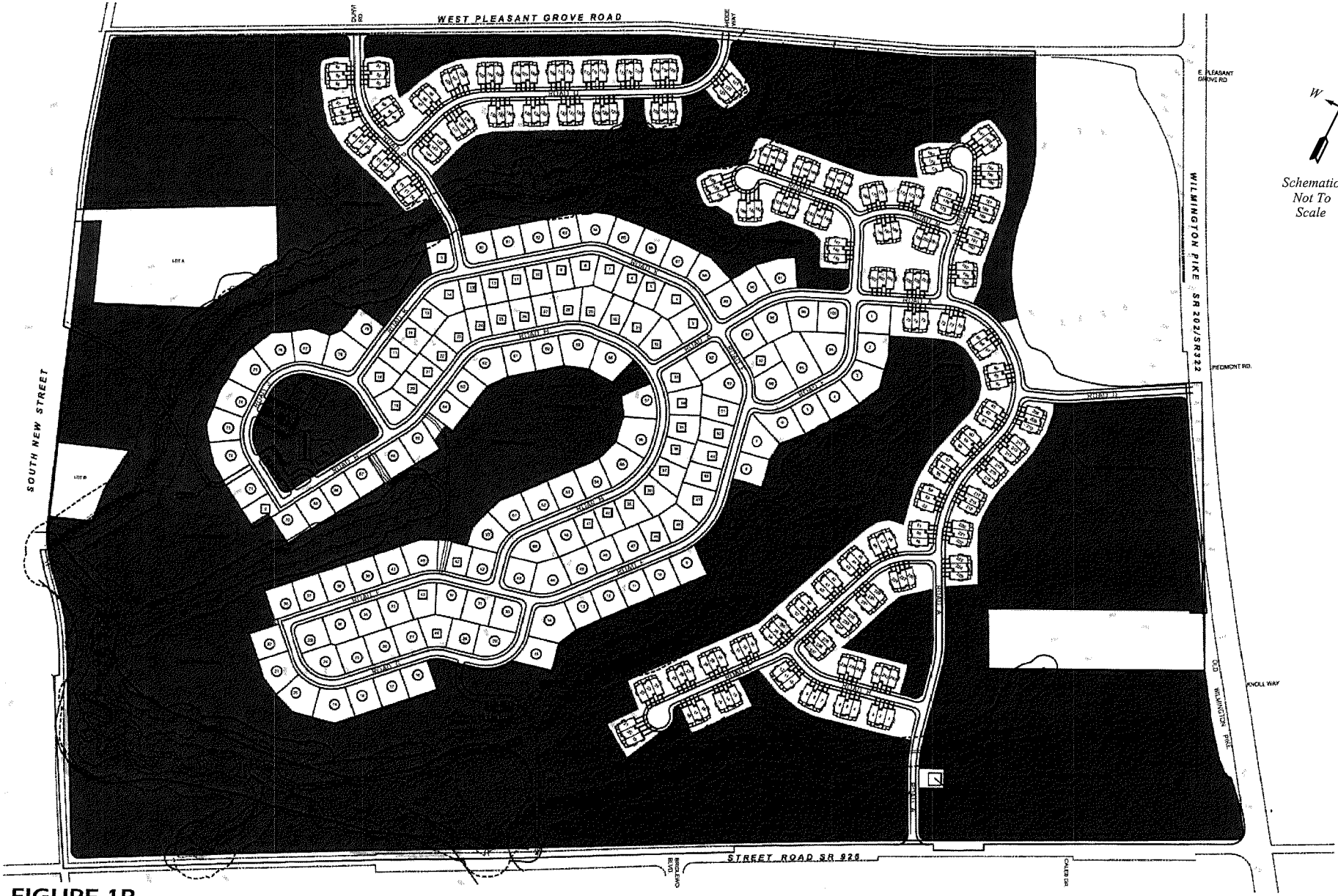

FIGURE 1B

Site Plan

Alternatives B & C - Proposed Density Bonus Development

CREBILLY FARM RESIDENTIAL DEVELOPMENT

WESTTOWN TOWNSHIP, CHESTER COUNTY, PA

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FIGURE 2
Site Location Map

CREBILLY FARM RESIDENTIAL DEVELOPMENT

WESTTOWN TOWNSHIP, CHESTER COUNTY, PA

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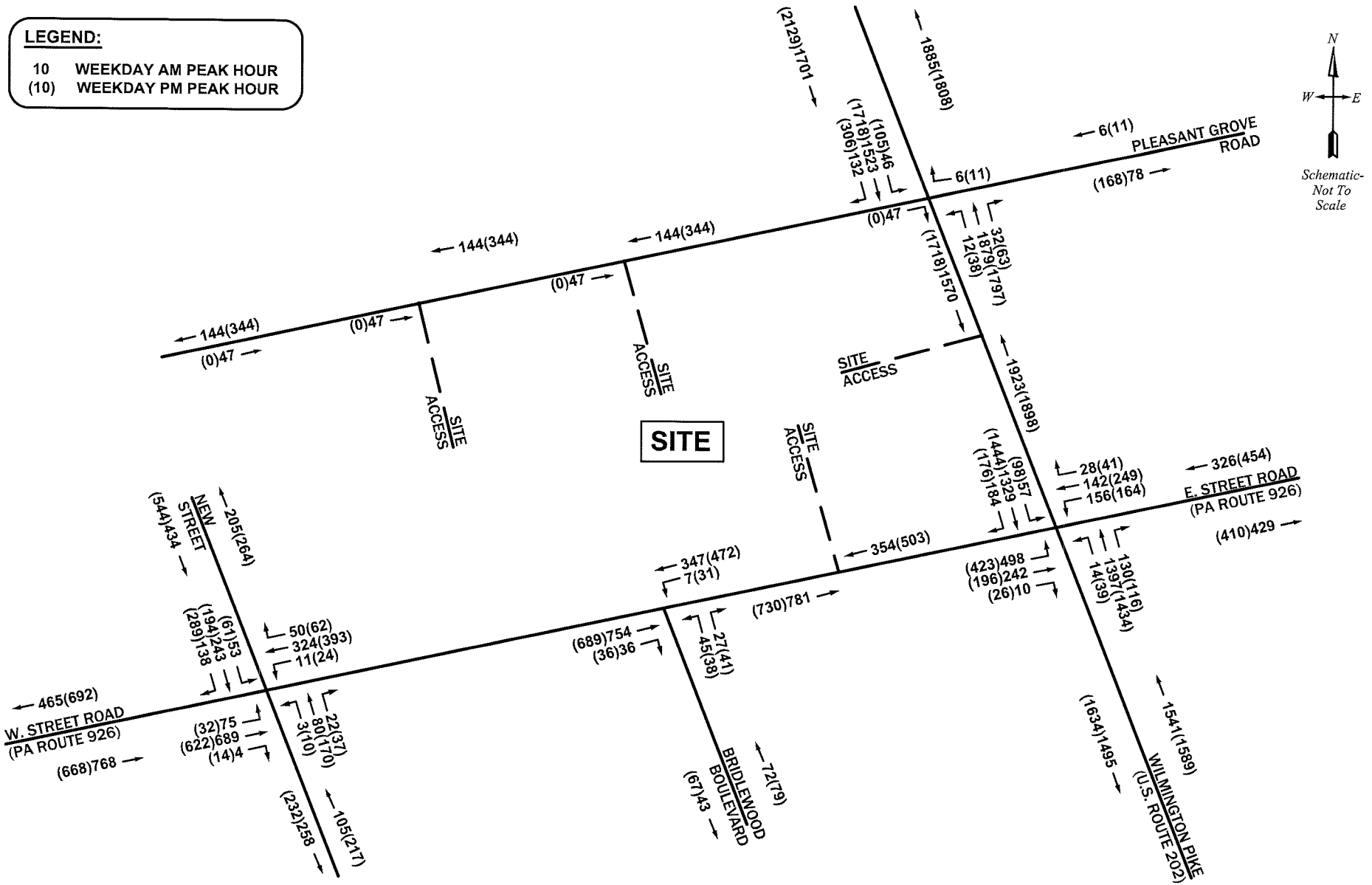

FIGURE 3A

2016 Existing Peak Hour Traffic Volumes

CREBILLY FARM RESIDENTIAL DEVELOPMENT

WESTTOWN TOWNSHIP, CHESTER COUNTY, PA

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(10/7/2016) I:\eng\816451 - Crebilly Farm\dwg\TIS Township Submission 2016-10-7\Figure 3A.dwg

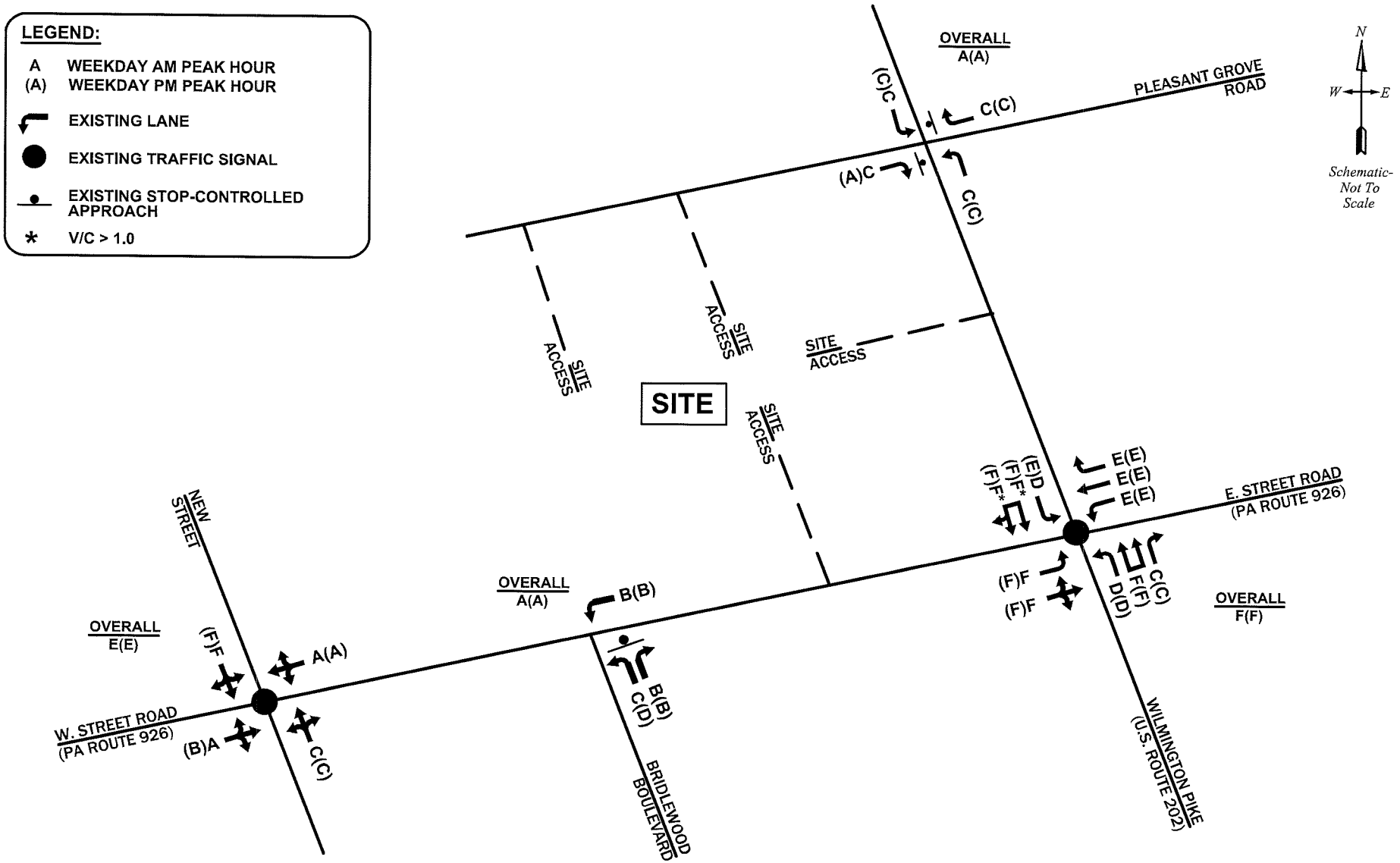

FIGURE 3B

2016 Existing Peak Hour Levels of Service

CREBILLY FARM RESIDENTIAL DEVELOPMENT

WESTTOWN TOWNSHIP, CHESTER COUNTY, PA

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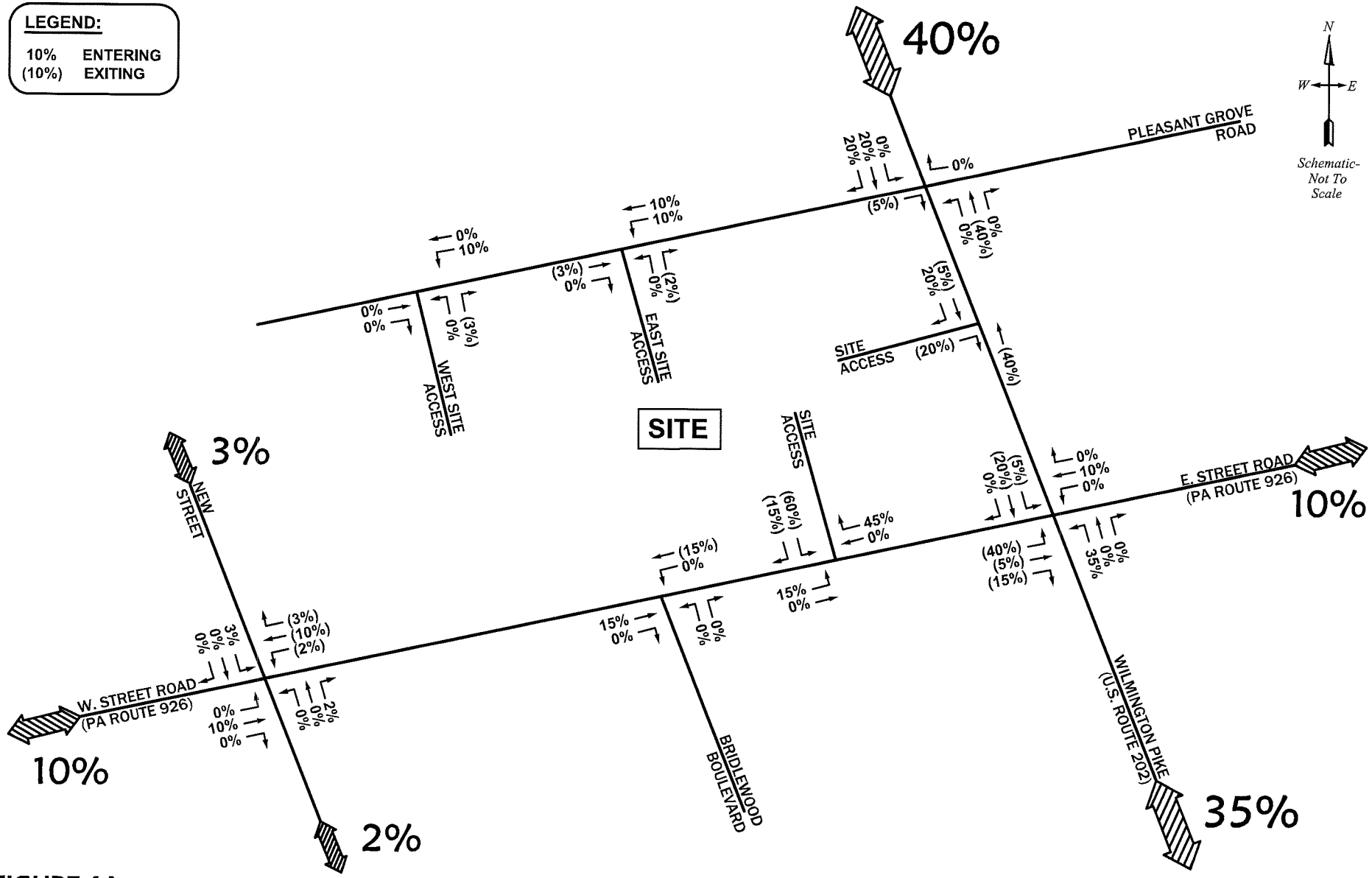

FIGURE 4A
Site Trip Distribution
Alternatives A and B

CREBILLY FARM RESIDENTIAL DEVELOPMENT

WESTTOWN TOWNSHIP, CHESTER COUNTY, PA

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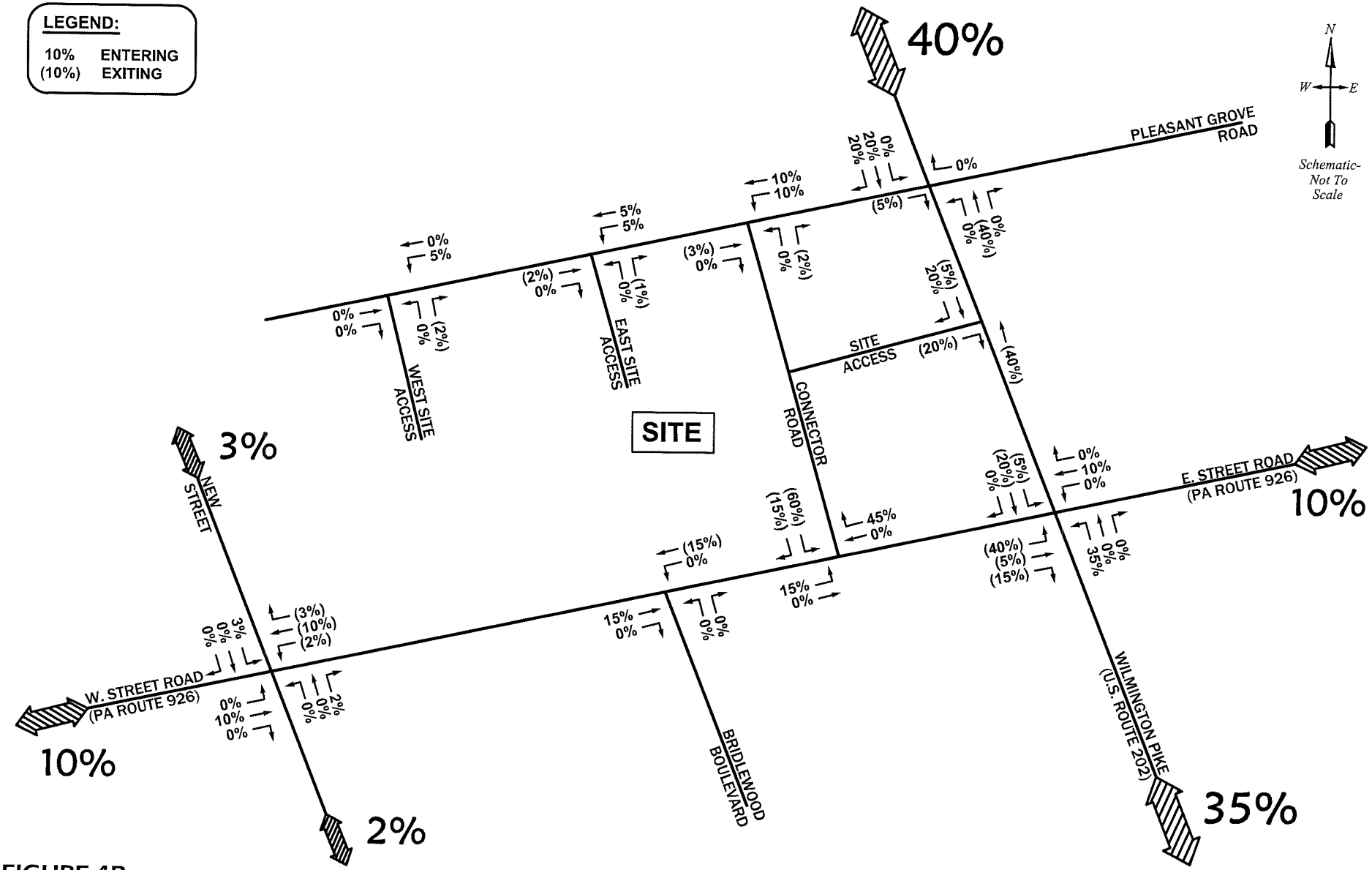

FIGURE 4B
Site Trip Distribution
Alternative C

CREBILLY FARM RESIDENTIAL DEVELOPMENT

WESTTOWN TOWNSHIP, CHESTER COUNTY, PA

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(10/7/2016) I:\eng\816451 - Crebilly Farm\dwg\TIS Township Submission 2016-10-7\Figure 4B.dwg

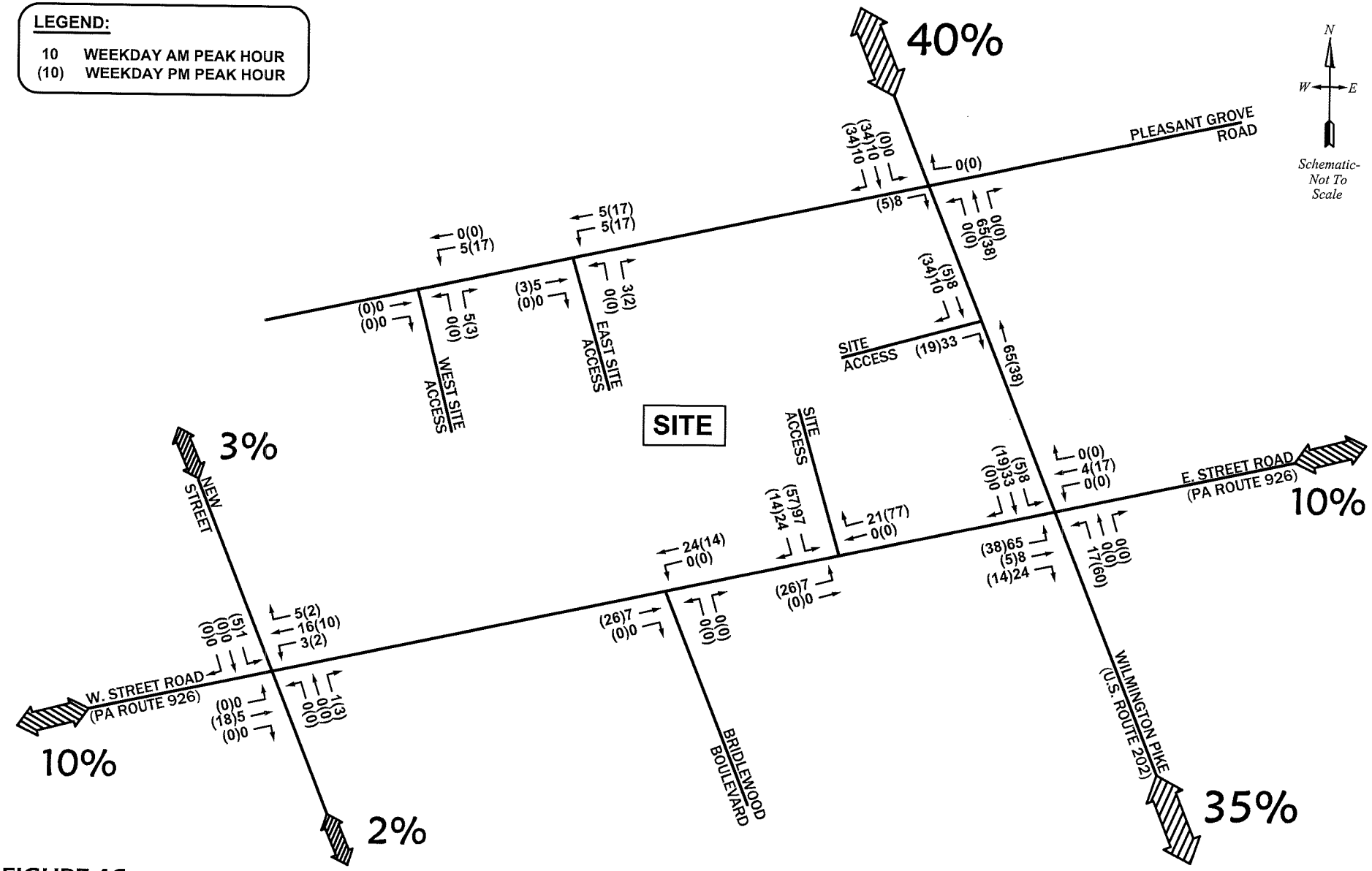

FIGURE 4C
Site Trip Assignment
Alternative A

CREBILLY FARM RESIDENTIAL DEVELOPMENT

WESTTOWN TOWNSHIP, CHESTER COUNTY, PA

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(10/7/2016) I:\eng\816451 - Crebilly Farm\dwg\TIS Township Submission 2016-10-7\Figure 4C.dwg

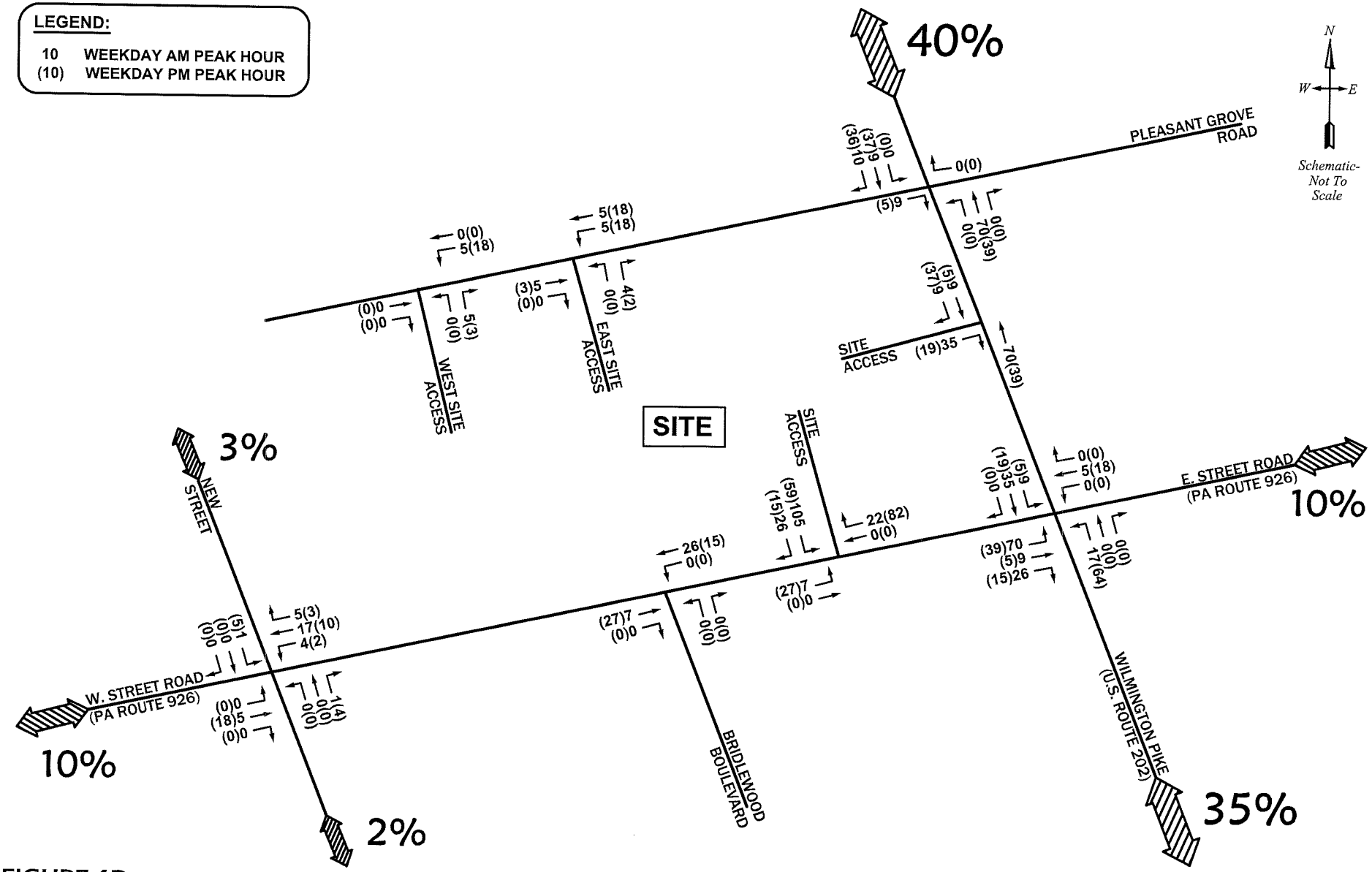

FIGURE 4D
Site Trip Assignment
Alternative B

CREBILLY FARM RESIDENTIAL DEVELOPMENT

WESTTOWN TOWNSHIP, CHESTER COUNTY, PA

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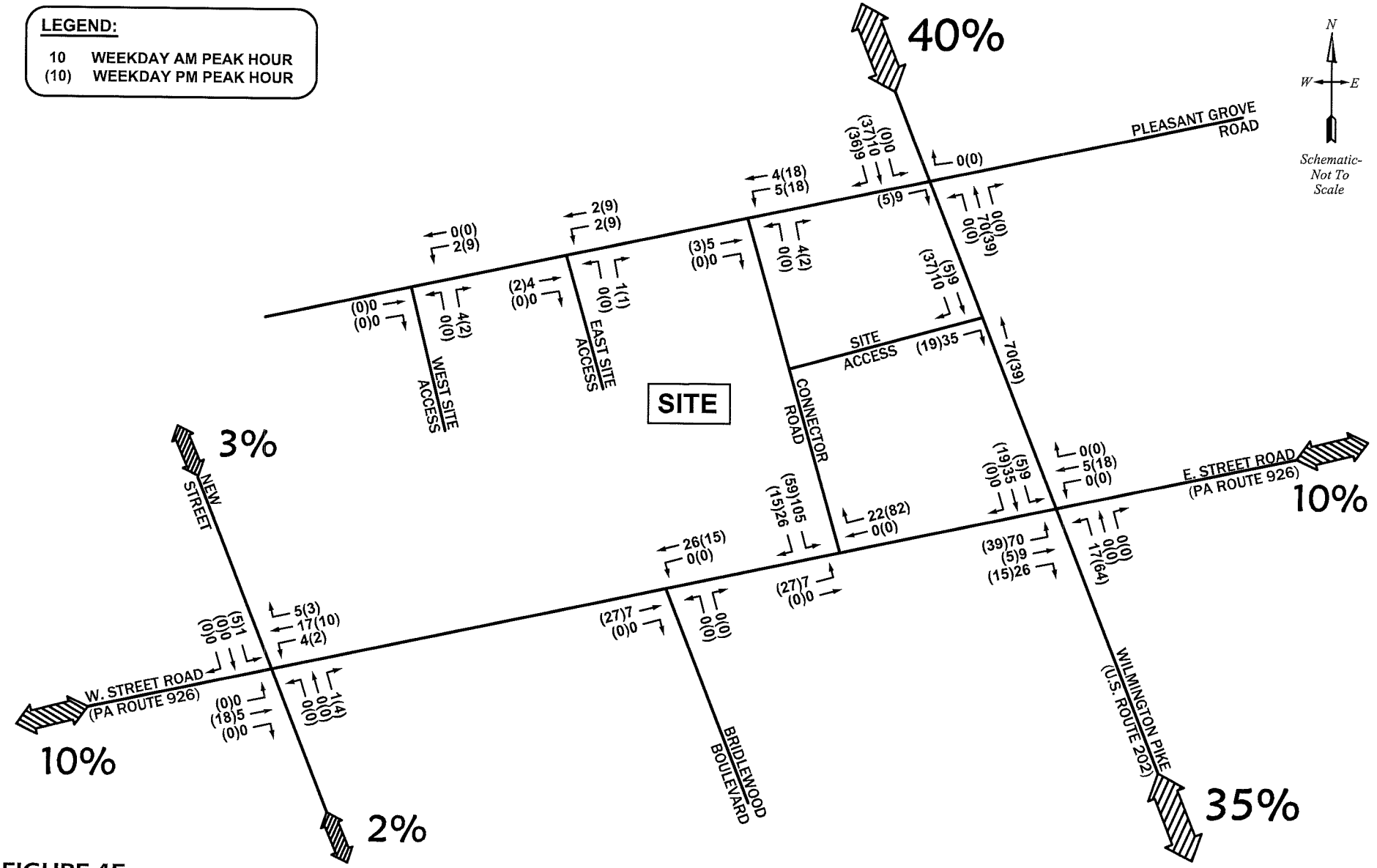

FIGURE 4E
Site Trip Assignment
Alternative C

CREBILLY FARM RESIDENTIAL DEVELOPMENT

WESTTOWN TOWNSHIP, CHESTER COUNTY, PA

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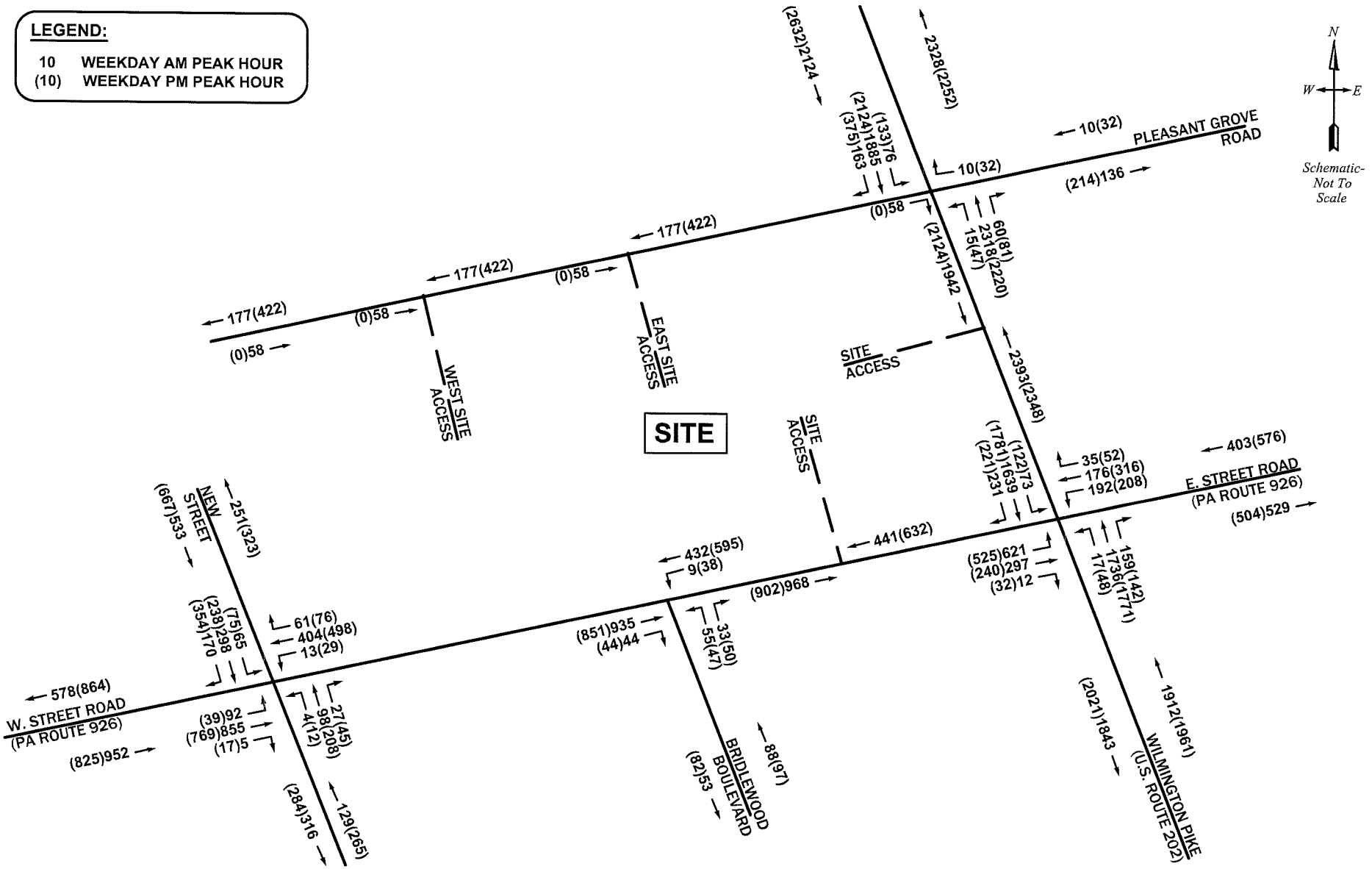

FIGURE 5A

2028 Future Peak Hour Traffic Volumes without Development

CREBILLY FARM RESIDENTIAL DEVELOPMENT

WESTTOWN TOWNSHIP, CHESTER COUNTY, PA

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(10/7/2016) I:\eng\816451 - Crebilly Farm\dwg\TIS Township Submission 2016-10-7\Figure 5A.dwg

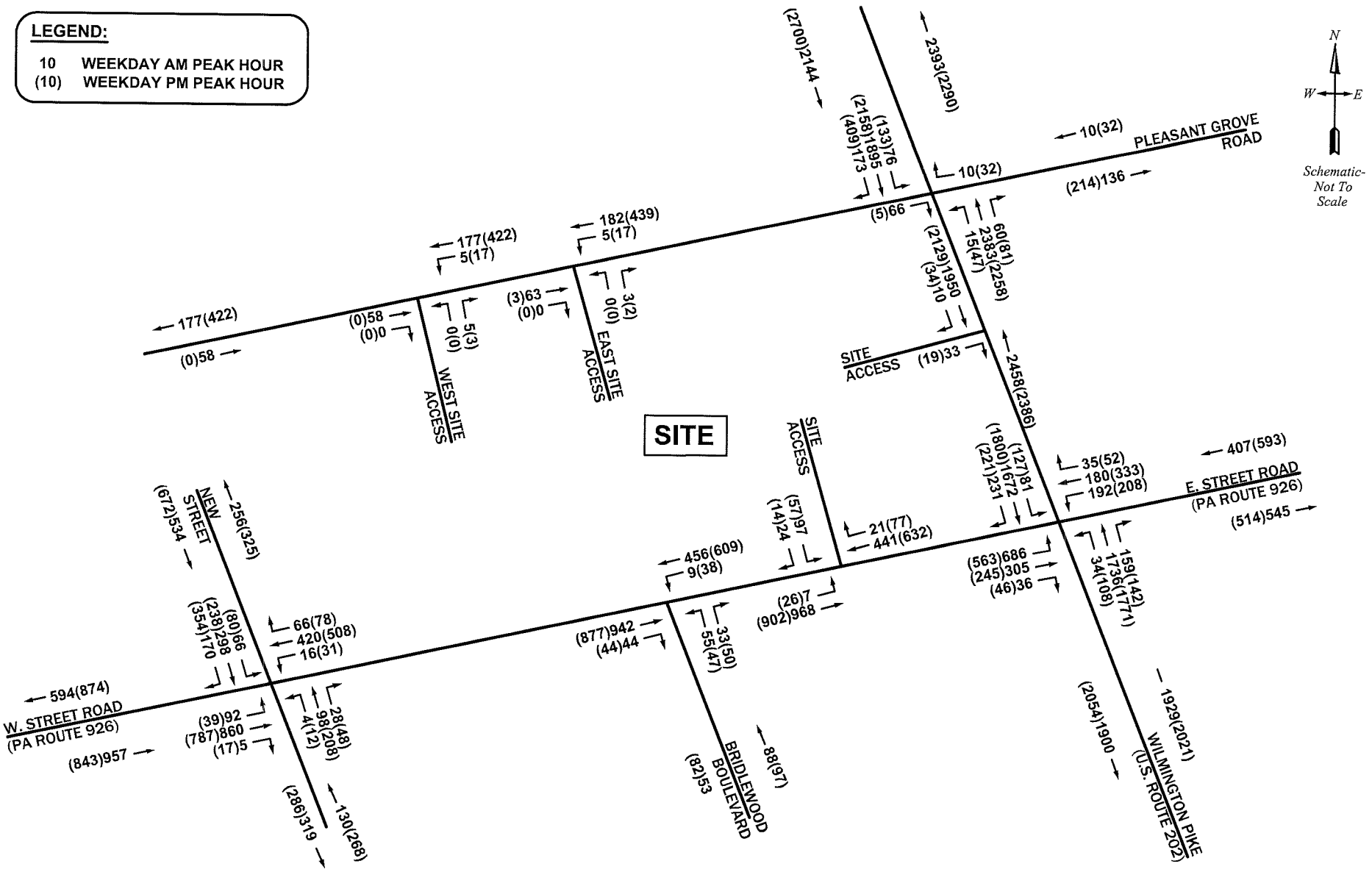

FIGURE 5B

2028 Future Peak Hour Traffic Volumes with Development
Alternative A - 317 New Units with No Traffic Diversions

CREBILLY FARM RESIDENTIAL DEVELOPMENT

WESTTOWN TOWNSHIP, CHESTER COUNTY, PA

(10/7/2016) I:\eng\816451 - Crebilly Farm\dwg\TIS Township Submission 2016-10-7\Figure 5B.dwg

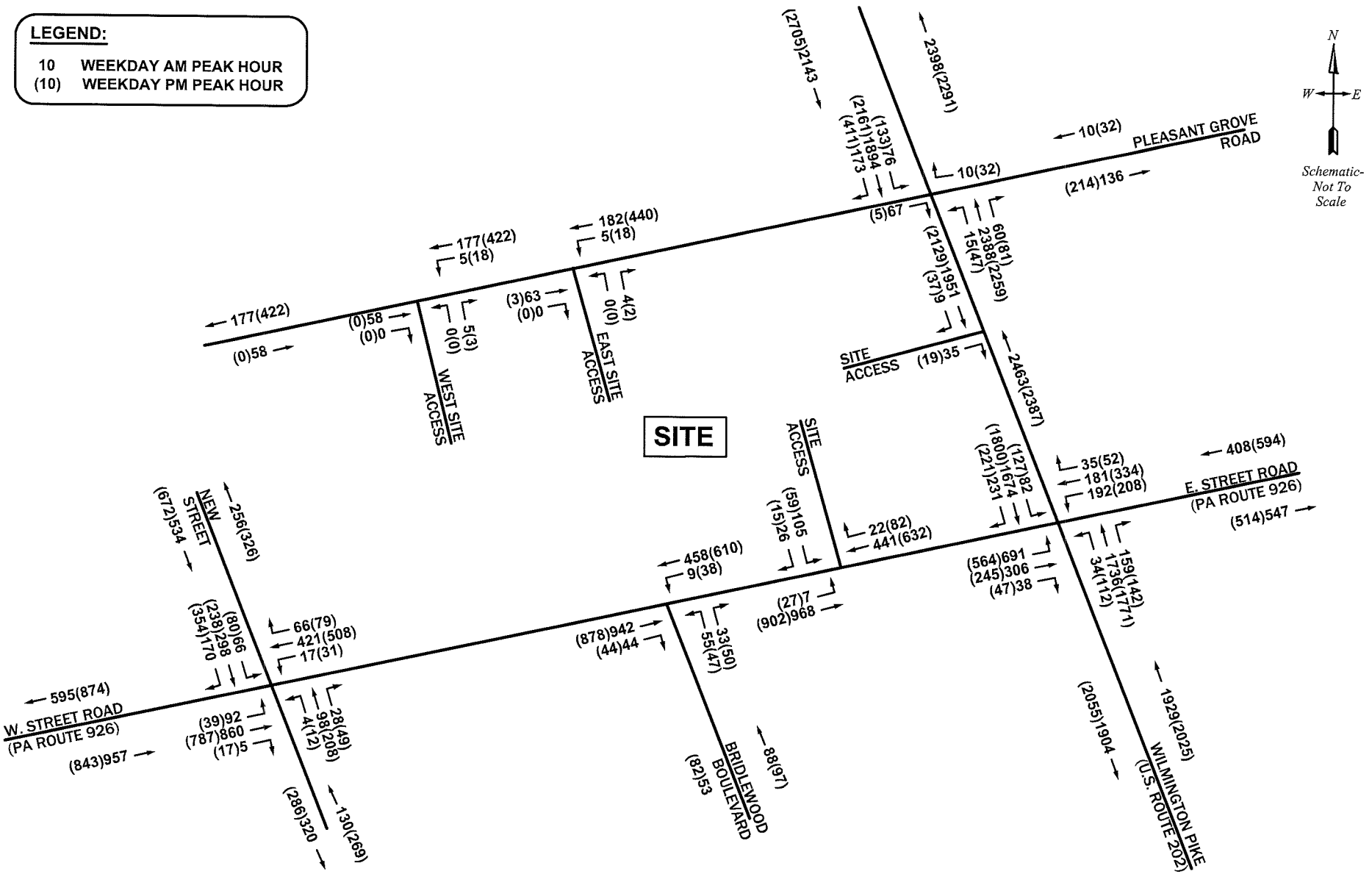

FIGURE 5C

2028 Future Peak Hour Traffic Volumes with Development
Alternative B - 395 New Units with No Traffic Diversions

CREBILLY FARM RESIDENTIAL DEVELOPMENT

WESTTOWN TOWNSHIP, CHESTER COUNTY, PA

(10/11/2016) I:\eng\816451 - Crebilly Farm\dwg\TIS Township Submission 2016-10-7\Figure 5C.dwg

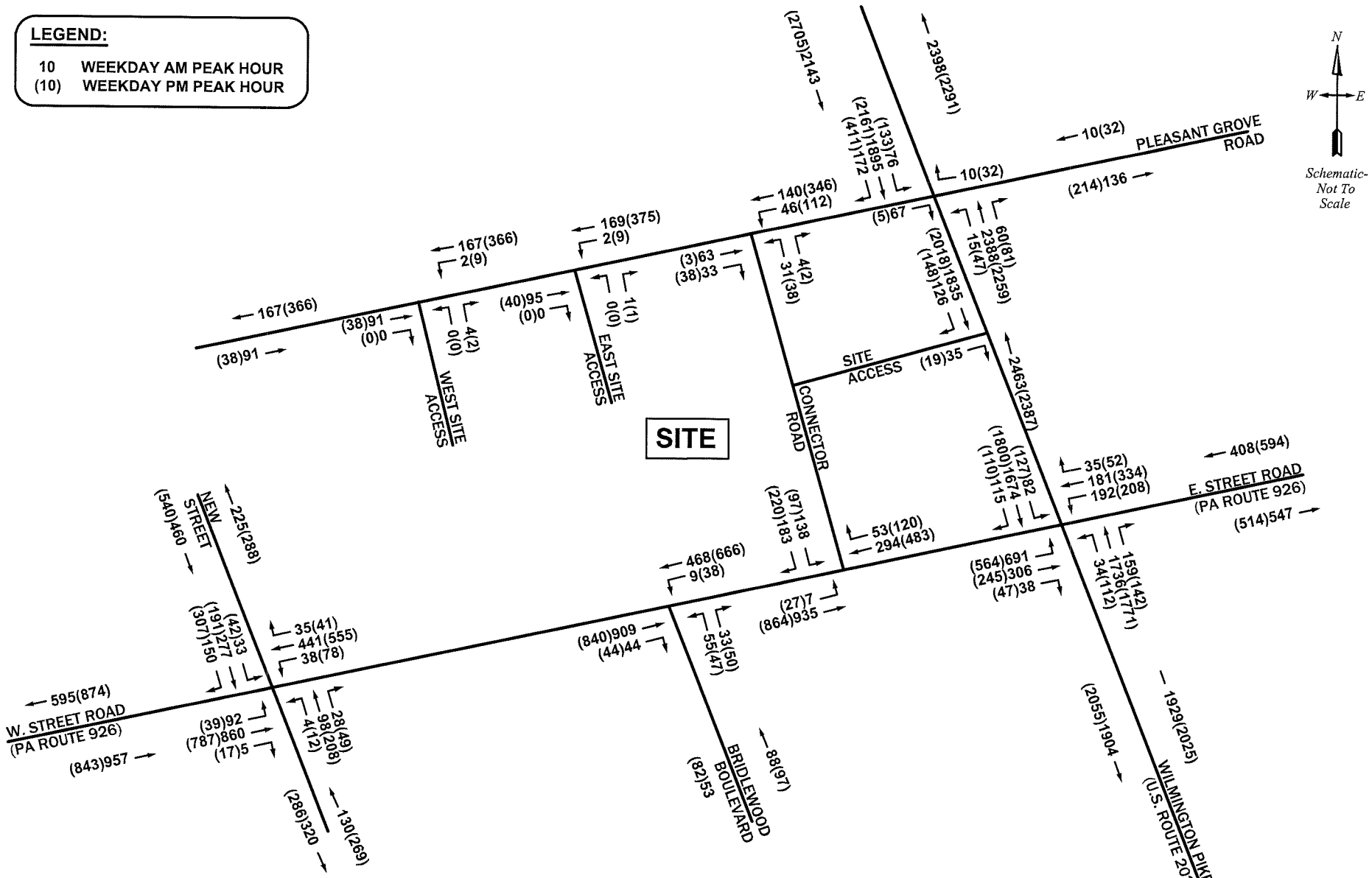

FIGURE 5D

2028 Future Peak Hour Traffic Volumes with Development
Alternative C - 395 New Units and Provision of Connector Road

CREBILLY FARM RESIDENTIAL DEVELOPMENT

WESTTOWN TOWNSHIP, CHESTER COUNTY, PA

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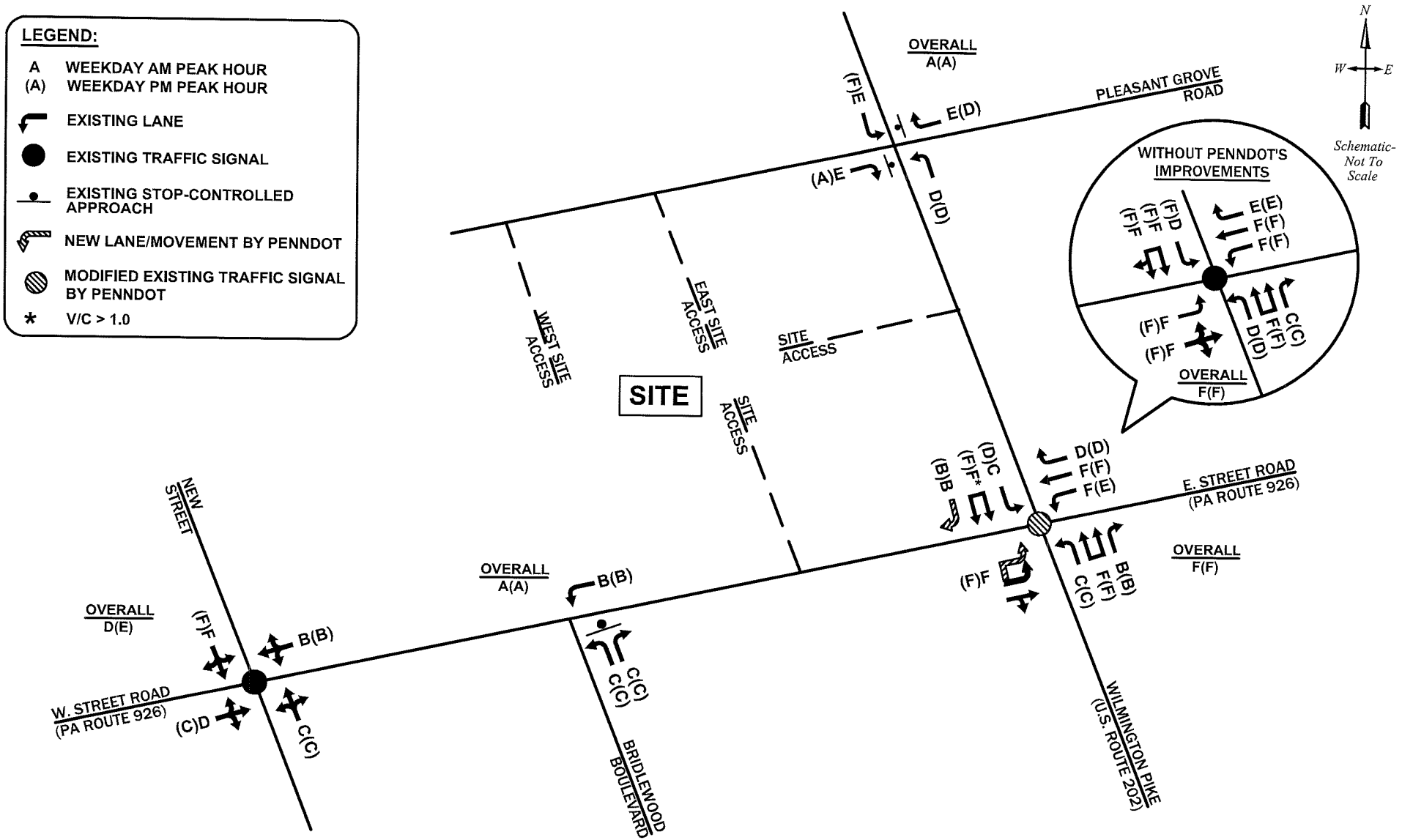

FIGURE 5E

2028 Future Peak Hour Levels of Service without Development

CREBILLY FARM RESIDENTIAL DEVELOPMENT

WESTTOWN TOWNSHIP, CHESTER COUNTY, PA

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(10/11/2016) I:\eng\816451 - Crebilly Farm\dwg\TIS Township Submission 2016-10-7\Figure 5E.dwg

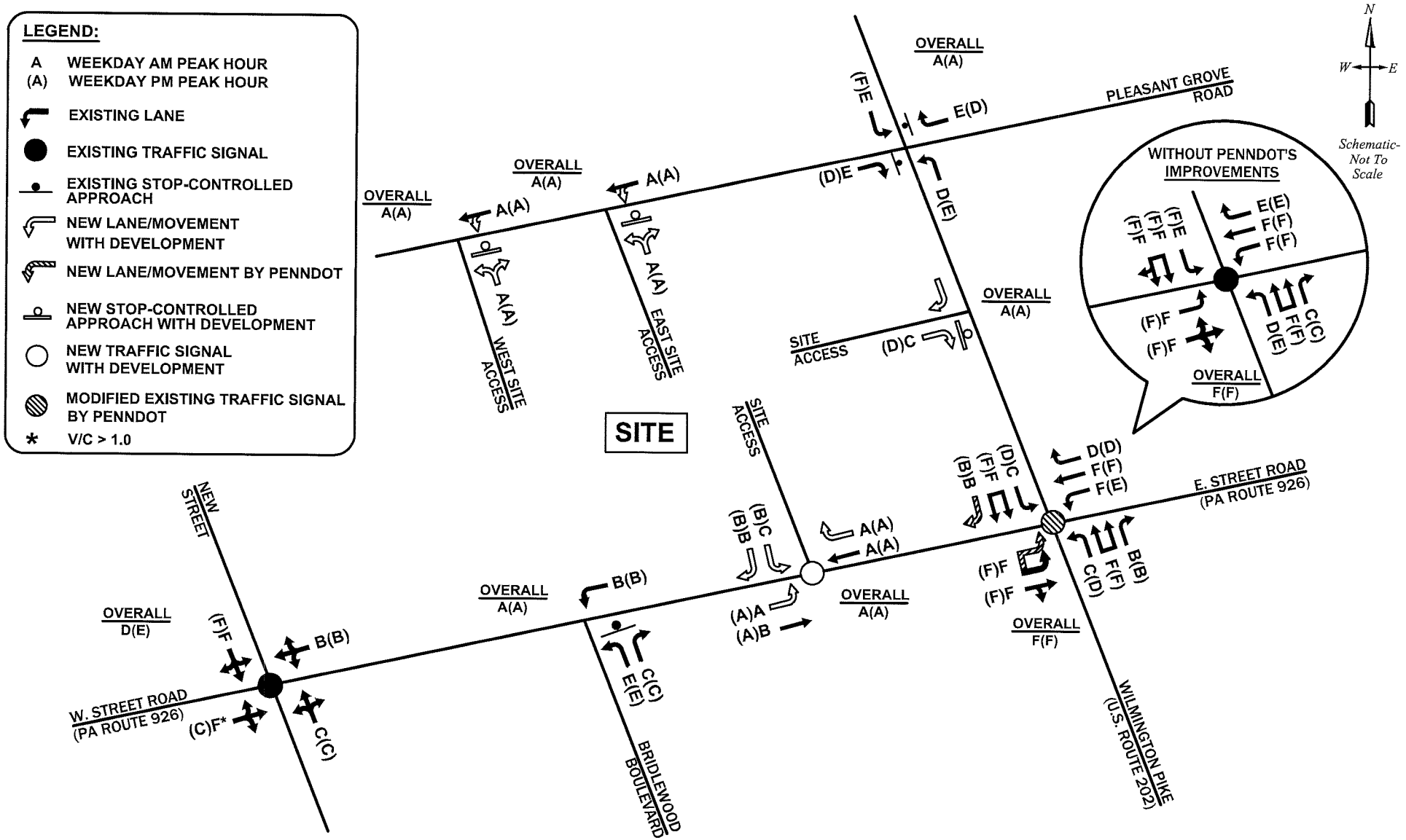

FIGURE 5F

2028 Future Peak Hour Levels of Service with Development

Alternative A - 317 New Units with No Traffic Diversions

CREBILLY FARM RESIDENTIAL DEVELOPMENT

WESTTOWN TOWNSHIP, CHESTER COUNTY, PA

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(10/11/2016) I:\eng\816451 - Crebilly Farm\dwg\TIS Township Submission 2016-10-7\Figure 5F.dwg

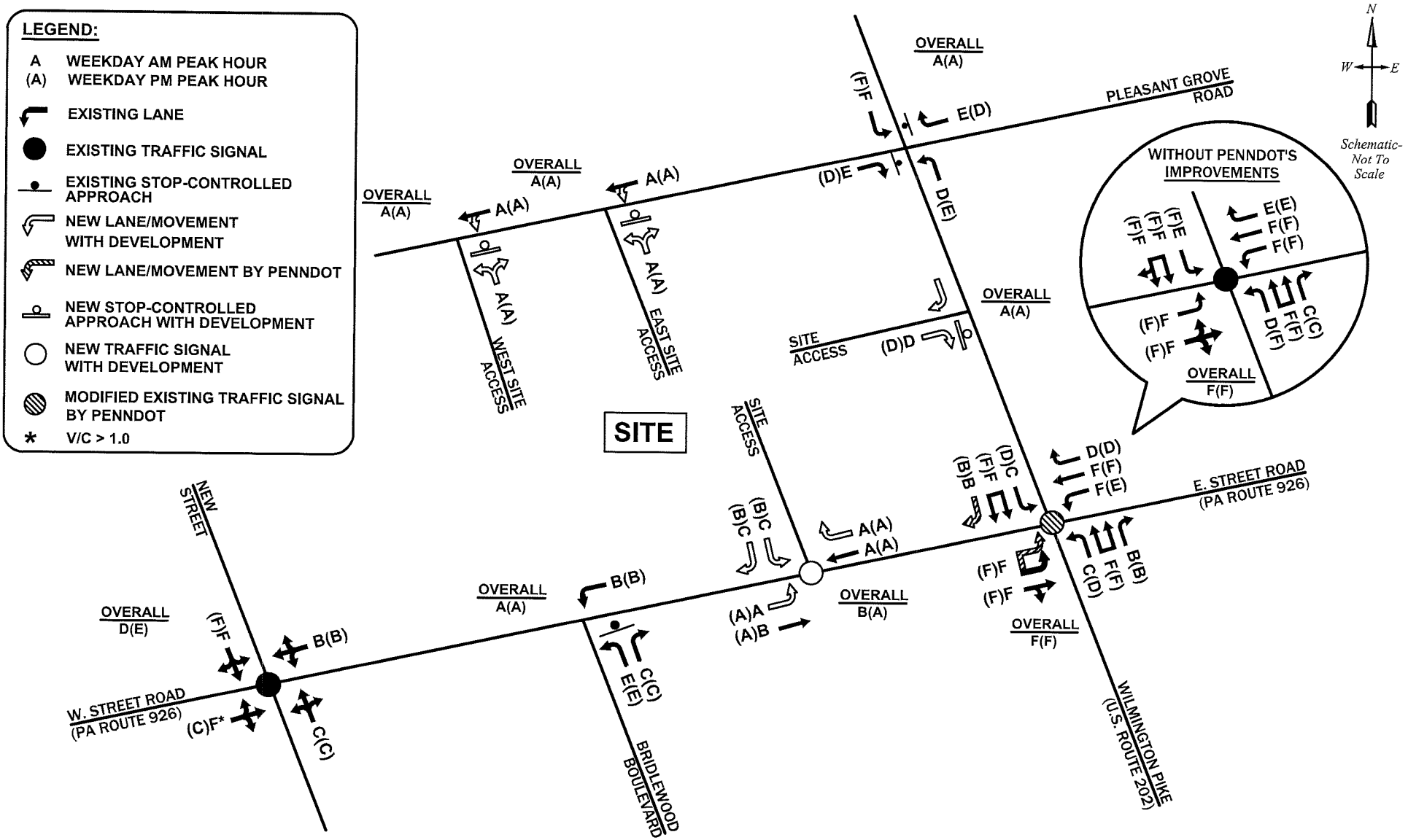

FIGURE 5G

2028 Future Peak Hour Levels of Service with Development

Alternative B - 395 New Units with No Traffic Diversions

CREBILLY FARM RESIDENTIAL DEVELOPMENT

WESTTOWN TOWNSHIP, CHESTER COUNTY, PA

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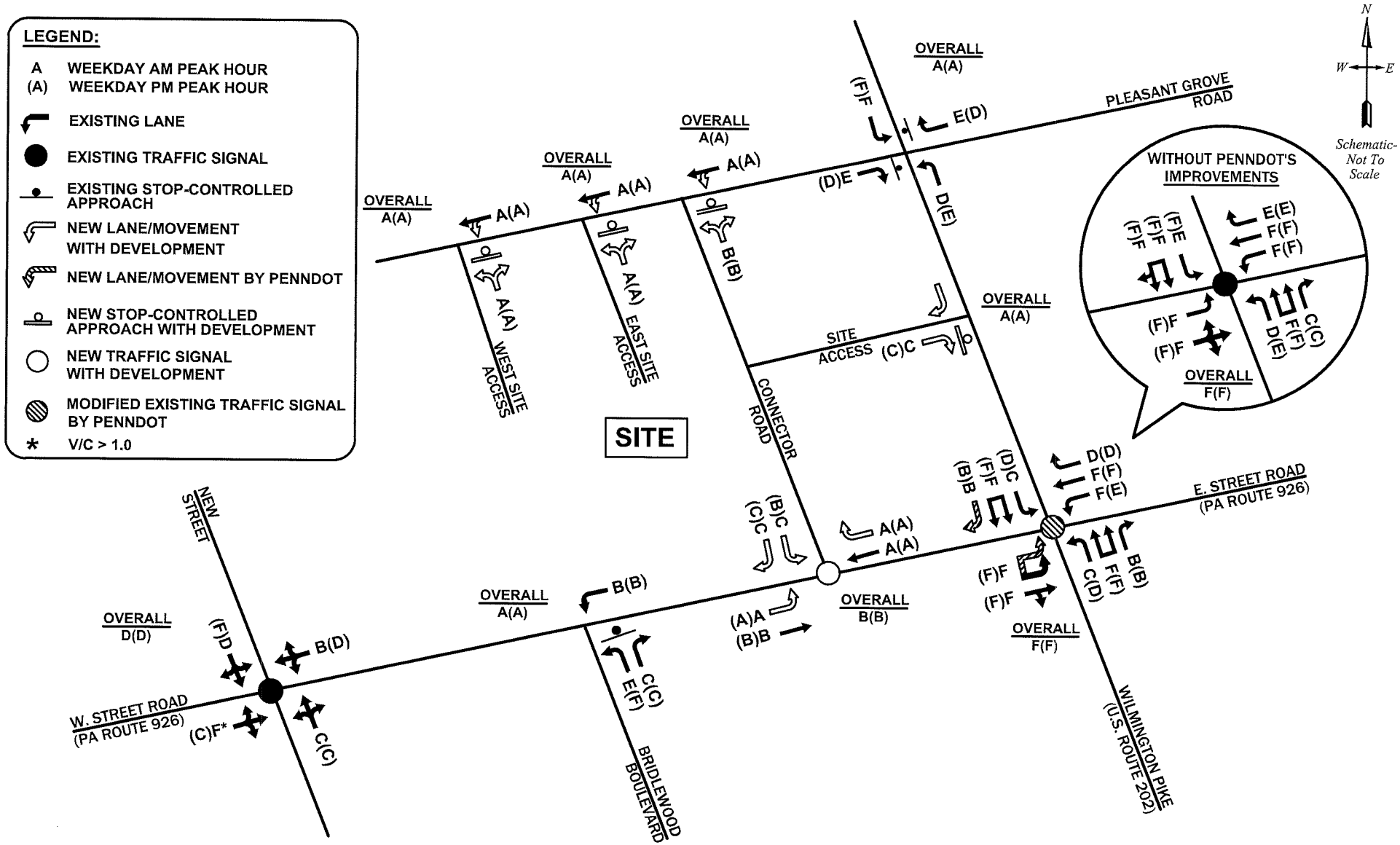

FIGURE 5H

2028 Future Peak Hour Levels of Service with Development

Alternative C - 395 New Units with Provision of Connector Road

CREBILLY FARM RESIDENTIAL DEVELOPMENT

WESTTOWN TOWNSHIP, CHESTER COUNTY, PA

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