



STATE OF DELAWARE
DEPARTMENT OF TRANSPORTATION
800 BAY ROAD
P.O. Box 778
DOVER, DELAWARE 19903

December 6, 2013

SHAILEN P. BHATT
SECRETARY

Mr. Guy DiMartino
Traffic Planning & Design, Inc.
2500 East High Street
Suite 650
Pottstown, PA 19464

Dear Mr. DiMartino:

The enclosed Traffic Impact Study (TIS) review letter for the **Delaware National** residential development has been completed under the responsible charge of a registered professional engineer whose firm is authorized to work in the State of Delaware. They have found the TIS to conform to DelDOT's Standards and Regulations for Subdivision Streets and State Highway Access and other accepted practices and procedures for such studies. DelDOT accepts this review letter and concurs with the recommendations.

If you have any questions concerning these letters, please contact me at (302) 760-2167.

Sincerely,

A handwritten signature in blue ink that reads "T. William Brestel for".

Troy Brestel
Project Engineer

TEB:km
Enclosures
cc with enclosures:

Mr. Andrew Semon, Toll Brothers, Inc.
Mr. Jeffrey M. Madden, ESE Consultants, Inc.
Ms. Constance C. Holland, Office of State Planning Coordination
Ms. Eileen Fogarty, New Castle County Department of Land Use
Mr. Andrew Parker, McCormick Taylor, Inc.
DelDOT Distribution



DelDOT Distribution

John Janowski, New Castle County Department of Land Use
Owen Robatino, New Castle County Department of Land Use
Frederick H. Schranck, Deputy Attorney General
Robert McCleary, Director, Transportation Solutions (DOTS)
Drew A. Boyce, Director, Planning
Mark Luszcz, Chief Traffic Engineer, Traffic, DOTS
Mark C. Tudor, Assistant Director, Project Development North, DOTS
J. Marc Coté, Assistant Director, Development Coordination
T. William Brockenbrough, Jr., County Coordinator, Development Coordination
Thomas E. Meyer, Traffic Studies Manager, Traffic, DOTS
Donald D. Weber, North District Engineer, North District
Kevin Canning, Canal District Public Works Engineer, Canal District
Wayne M. Henderson, Service Development Planner, Delaware Transit Corporation
John Garcia, New Castle Subdivision Coordinator, Development Coordination
Joshua Schwartz, Subdivision Manager, Development Coordination
Ahmed Abdelmoteleb, New Castle Traffic Engineer, Traffic, DOTS
Marco Boyce, Planning Supervisor, Statewide & Regional Planning
Claudy Joinville, Project Engineer, Development Coordination



December 6, 2013

Mr. Troy E. Brestel
Project Engineer
DelDOT Division of Planning
P.O. Box 778
Dover, DE 19903

RE: Agreement No. 1529
Traffic Impact Study Services
Task No. 3A – Delaware National

Dear Mr. Brestel,

McCormick Taylor has completed its review of the Traffic Impact Study (TIS) for the Delaware National development prepared by Traffic Planning and Design, Inc. (TPD), dated October 6, 2010. This review was assigned as Task Number 3A. TPD prepared the report in a manner generally consistent with DelDOT's *Standards and Regulations for Subdivision Streets and State Highway Access*. McCormick Taylor also reviewed TPD's TIS Addendum dated June 13, 2012, in which they provided additional analyses for two of the study intersections, and TPD's follow-up letter to DelDOT dated August 17, 2012, in which they summarized subsequent correspondence and analyses for one of the study intersections.

The TIS evaluates the impacts of the Delaware National development, proposed to be located on the south side of Delaware Route 48 (Lancaster Pike / New Castle Road 237), on the east and west sides of Hercules Road (New Castle Road 282) and west of Centerville Road (New Castle Road 272) in New Castle County, Delaware. In total, the proposed development would consist of 158 single-family detached houses and 106 townhouses on approximately 206 acres of land. However, the Wilmington and Western Railroad runs north and south through the site, and the development would therefore be divided into three parts. The part west of Hercules Road would have 20 single-family detached houses; the part east of Hercules Road but west of the railroad would have 104 single-family detached houses; and the part east of the railroad but west of Centerville Road would have 34 single-family detached houses and 106 townhouses. Originally, as analyzed by the TIS, three access points were proposed (one along Hercules Road and two along Penn Oak Drive), but the locations have since changed. Currently, three access points are proposed: one along Hercules Road (to serve all parts of the site west of the railroad), one along Red Clay Drive (to serve the majority of the site east of the railroad), and one along Penn Oak Drive (to serve less than 20 townhouses). Construction is anticipated to be complete by 2016.

The land is currently zoned as S (Suburban) within New Castle County, and will be developed under that zoning as an open-space planned residential development.

DelDOT currently has one relevant project in the study area. It is the Corridor Capacity Preservation Program (CCPP), which is a statewide program intended to sustain the capacity of adopted highway corridors by various means such as limiting access points and using service

roads for local vehicle trips. The general purpose of the program is to ensure that existing principal arterial roadways, including Delaware Route 48 between Hercules Road and Delaware Route 41 (Newport Gap Pike / New Castle Road 21), are able to efficiently carry regional traffic without impedance from the effects of local development. As the proposed Delaware National plan has no direct access to Delaware Route 48, DelDOT's CCPP Manager has indicated no objection to the proposed development.

Regarding DelDOT's Hazard Elimination Program (HEP) (formerly Highway Safety Improvement Program or HSIP), a 0.89-mile stretch of Delaware Route 48 including the signalized intersection with Centerville Road was within Site CC of the 2004 HEP. The HEP committee recommended remedial improvements consisting of installing pedestrian warning signs and relocating pedestrian signals, and these improvements have already been implemented. The committee recommended no additional studies.

Additionally, the TIS and McCormick Taylor assessed future conditions both with and without the proposed redevelopment of Barley Mill Plaza as a committed development (located along Delaware Route 48 just over one mile east of Centerville Road). As evaluated, Barley Mill Plaza would add 1,434,638 square feet of office space, 430,712 square feet of retail space, 54,900 square feet of restaurant space, a 200-room hotel, and 700 apartments. However, in February 2011, we learned that plans for the redevelopment of Barley Mill Plaza have been scaled back. Reportedly, the site will now be developed as a 1.6 million square-foot commercial and office complex, instead of a 2.8 million square-foot complex of offices, restaurants, shops, and residential condominiums. As such, for future scenarios that include Barley Mill Plaza, actual traffic volumes for certain movements at most intersections throughout the Delaware National study area may be lower than the volumes analyzed in this TIS and our review.

Based on our review, we have the following comments and recommendations:

The proposed development will not meet the New Castle County Level of Service (LOS) Standards as stated in Section 40.11.210 of the Unified Development Code (UDC) unless physical roadway and/or traffic control improvements are implemented at the following intersections:

<i>Intersection</i>	<i>Existing Traffic Control</i>	<i>Situations for which deficiencies occur</i>
Delaware Route 48 and Hercules Road	Signalized	2016 AM and PM without and with Delaware National (without and with Barley Mill Plaza)
Delaware Route 48 and Centerville Road	Signalized	2016 AM and PM without and with Delaware National (without and with Barley Mill Plaza)

All other intersections included in the scope of this TIS meet the LOS concurrency requirements of Section 40.11.210 of the New Castle County UDC.

Additionally, the stop-controlled minor street approaches at the following intersections will not meet the DelDOT level of service criteria unless physical roadway and/or traffic control improvements are implemented.

<i>Intersection</i>	<i>Existing Traffic Control</i>	<i>Situations for which deficiencies occur</i>
Hercules Road and Site Entrance	None; Proposed as Unsignalized	2016 AM with Delaware National (full-movement access) (without and with Barley Mill Plaza)
Delaware Route 48 and Stratton Drive	Unsignalized	2016 AM without and with Delaware National (without and with Barley Mill Plaza)
Delaware Route 48 and Westgate Drive	Unsignalized	2016 AM and PM without and with Delaware National (without and with Barley Mill Plaza)
Delaware Route 48 and Rolling Mill Road (New Castle Road 263)	Unsignalized	2016 PM without and with Delaware National (with Barley Mill Plaza)
Delaware Route 48 and Hampton Way	Unsignalized	2016 PM without and with Delaware National (with Barley Mill Plaza)
Hercules Road and Cheshire Court / Greenville Overlook Entrance	Unsignalized	2016 AM and PM without and with Delaware National (without and with Barley Mill Plaza)
Hercules Road and Tall Trees Lane	Unsignalized	2016 PM without and with Delaware National (without and with Barley Mill Plaza)
Centerville Road and Red Clay Drive	Unsignalized	2016 AM and PM without and with Delaware National (without and with Barley Mill Plaza)
Centerville Road and Spice Mill Circle	Unsignalized	2016 AM with Delaware National (with Barley Mill Plaza); 2016 PM without and with Delaware National (without and with Barley Mill Plaza)

The existing signalized intersection of Delaware Route 48 and Centerville Road exhibits LOS deficiencies under future conditions. In the TIS and the subsequent TIS Addendum, TPD identified improvements that would achieve acceptable LOS. However, these potential improvements were reviewed by DelDOT and found to be problematic due to safety concerns related to eliminating the exclusive right-turn lanes on Delaware Route 48. The improvements that DelDOT found to be acceptable, which include adding a third through lane while maintaining an exclusive right-turn lane in each direction of Delaware Route 48 (with analysis results shown under *Improvement Option 2* in Table 18 on Page 58 of this letter), are prohibitively expensive for the developer to construct on their own. Significantly, in our view, the intersection presently operates at an acceptable LOS D and there is question as to whether the larger developments (Barley Mill Plaza, the DuPont Chestnut Run site and Little Falls Center Lots 9 and 11) will be fully occupied by 2016.

An appropriate fix has not been identified for the intersection of Delaware Route 48 and Centerville Road to achieve the LOS concurrency requirement for New Castle County. This is due to the fact that in DelDOT's view, any such fix must not only work from a technical perspective regarding the placement of appropriately designed infrastructure improvements, but

also from a traffic management and safety perspective. Any such improvements to this intersection also carry with them an estimated cost far out of proportion to the measurable impact that this development proposal has on this intersection, either now or after full buildout. In consultation with Delaware National and its consultants, DelDOT has reviewed a TPD Conceptual Plan dated November 18, 2013, a copy of which is attached on Page 12. This Conceptual Plan describes certain improvements within the existing right of way that addresses LOS issues at the intersection. DelDOT remains concerned regarding traffic management at the intersection. The Conceptual Plan meets concurrency requirements and could be constructed by the developer; however, DelDOT will accept and require the developer to contribute towards a future project of the type described in the Conceptual Plan, although the specifics of any future project for improvements at this intersection are still to be determined, and while reserving the right to apply such funds to a different solution at this intersection, at such time and under such conditions as the Department may determine. This contribution is based upon this TPD Conceptual Plan and totals approximately \$1,100,000, which includes a payment of \$200,000 toward a traffic signal for the intersection of Delaware Route 48 and Centerville Road.

The proposed unsignalized full access site entrance on Hercules Road exhibits LOS deficiencies under future conditions. However, we do not recommend any further improvements be implemented by the developer at this intersection. The LOS deficiency would exist as LOS E only on the westbound minor street approach during the AM peak hour under the scenario with Barley Mill Plaza traffic included, and the 95th percentile queue length on that approach is expected to be 50 feet or less. Furthermore, if a roadway interconnection is eventually provided between Delaware National and the Hercules Research Center property, drivers wanting to make a westbound left from Delaware National onto southbound Hercules Road would have the option of doing so via the signalized intersection of Hercules Road and Hercules Research Center Entrance.

The following are existing unsignalized T-intersections that each exhibit LOS deficiencies on the minor street approach under future conditions, but we do not recommend any improvements be implemented by the developer at any of these intersections:

- Delaware Route 48 & Stratton Drive
- Delaware Route 48 & Westgate Drive
- Delaware Route 48 & Rolling Mill Road
- Delaware Route 48 & Hampton Way
- Hercules Road & Cheshire Court / Greenville Overlook Entrance
- Hercules Road & Tall Trees Lane
- Centerville Road & Spice Mill Circle

For the Stratton Drive intersection, the LOS deficiencies would exist only on the low-volume minor street approach during the AM peak hour (under all future scenarios), and the 95th percentile queue lengths on that approach are expected to be 50 feet or less. Trips generated by Delaware National will not add to volumes turning to or from Stratton Drive. Along the section

of Delaware Route 48 west of Hercules Road, trips generated by Delaware National will add less than five vehicles to the through movements in each direction during each peak hour.

For the Westgate Drive intersection, the LOS deficiencies would exist only on the low-volume minor street approach during the AM and PM peak hours (under all future scenarios), and the 95th percentile queue lengths on that approach are expected to be approximately 100 feet or less. Trips generated by Delaware National will not add to volumes turning to or from Westgate Drive. Along the section of Delaware Route 48 west of Hercules Road, trips generated by Delaware National will add less than five vehicles to the through movements in each direction during each peak hour. The northbound Westgate Drive left-turn volume is projected as zero or one vehicle during both peak hours, and the total exiting volume is projected as less than ten vehicles during the PM peak hour.

For the Rolling Mill Road and Hampton Way intersections, the LOS deficiencies would exist as LOS E only on the low-volume minor street approach during the PM peak hour (under all future scenarios). The 95th percentile queue lengths on the minor street approach of each intersection are expected to be 25 feet or less. These are both right-in/right-out intersections, so the minor street movement is right-turn only. At both intersections, the PM peak hour volume for the minor street movement is projected as less than 10 vehicles.

For the intersection of Hercules Road and Cheshire Court, a fourth leg was recently added to the intersection (Greenville Overlook entrance). This leg was added after the traffic counts for the Delaware National TIS were conducted. Volumes from Greenville Overlook (as a committed development) were included in the TIS for future conditions, but the TIS assumed the entrance would be at a different location further south on Hercules Road (south of Tall Trees Lane). As such, the TIS did not analyze the intersection of Hercules Road and Cheshire Court as a four-leg intersection. McCormick Taylor evaluated the intersection in the same manner as the TIS (using their volumes), and then conducted additional analysis with the fourth leg added and volumes redistributed to show the effect of the actual location of the Greenville Overlook entrance.

For the McCormick Taylor analyses of Hercules Road and Cheshire Court / Greenville Overlook Entrance as a four-leg intersection, the LOS deficiencies would occur on the minor street approaches during the AM and PM peak hours (under all future scenarios). On the eastbound Cheshire Court approach, the 95th percentile queue lengths are expected to be 25 feet or less, and the future volumes are projected to range from zero to two vehicles for both the left turn and the right turn during both peak hours. On the westbound Greenville Overlook Entrance approach, the 95th percentile queue lengths are expected to be as long as approximately 175 feet during the AM peak hour and 225 feet during the PM peak hour. However, if the westbound approach is treated as one shared through/left-turn lane and one right-turn lane (instead of one shared left/through/right-turn lane), the expected 95th percentile queue lengths would drop to approximately 100 feet or less during both peak hours. The westbound approach is wide enough that it could be restriped as two lanes. Signalization was also considered to alleviate the LOS deficiencies, but this would introduce lengthy delays and queues on the Hercules Road approaches. Therefore, we do not recommend that Delaware National be responsible for any

improvements at this intersection, but consideration should be given to restriping the westbound Greenville Overlook Entrance approach as two lanes.

For the intersection of Hercules Road and Tall Trees Lane, the LOS deficiencies would exist only on the low-volume minor street approach during the PM peak hour (under all future scenarios), and the 95th percentile queue lengths on that approach are expected to be 25 feet or less. The westbound Tall Trees Lane volumes are projected to range from zero to two vehicles for both the left turn and the right turn during both peak hours.

For the intersection of Centerville Road and Spice Mill Circle, the LOS deficiencies would exist only on the minor street approach during the AM peak hour (under the scenario with traffic from both Delaware National and Barley Mill Plaza included) and during the PM peak hour (under all future scenarios). During the deficient future AM peak hour, the 95th percentile queue lengths on the minor street approach are expected to be 25 feet or less, and the peak hour volume for the minor street approach is less than 10 vehicles. During the deficient PM peak hour, the 95th percentile queue lengths on the minor street approach are expected to be approximately 200 feet. Potential methods to address the LOS deficiency, including signalization or prohibiting turning movements, were considered but were determined to be infeasible and/or unjustified. Given that Spice Mill Circle serves only a self-contained parking lot for two office buildings (part of Little Falls Centre), there is only a short duration of high exiting traffic volumes during the PM peak hour, with low volumes of exiting traffic the rest of the day. As such, we do not recommend any improvements be implemented by the developer of Delaware National. However, if an internal connection could be negotiated to connect this parcel of Little Falls Centre with the parcel immediately to the north, which has access to Red Clay Drive, that connection could provide some relief for the Spice Mill Circle intersection.

Should the County choose to approve the proposed development, the following items should be incorporated into the site design and reflected on the record plan. All applicable agreements (i.e. letter agreements for off-site improvements and traffic signal agreements) should be executed prior to entrance plan approval for the proposed development.

1. The developer should improve Hercules Road from the Hercules Research Center Entrance to a point 300 feet south of Delaware Route 48 (just south of former golf cart tunnel) as needed in order to meet DelDOT's major collector road standards. These standards include but are not limited to twelve-foot travel lanes and eight-foot shoulders. The developer should provide a bituminous concrete overlay to the existing travel lanes, at DelDOT's discretion. DelDOT should analyze the existing lanes' pavement section and recommend an overlay thickness to the developer's engineer if necessary.

2. The developer should construct the site entrance on Hercules Road as a full-movement access point. The proposed configuration is shown in the table below.

Approach	Current Configuration	Proposed Configuration
Northbound Hercules Road	Two through lanes	One left-turn lane, two through lanes, and one right-turn lane
Southbound Hercules Road	Two through lanes	One left-turn lane, one exclusive through lane, and one shared through/right-turn lane
Eastbound West Site Entrance	Approach does not exist	One shared left/through/right-turn lane
Westbound East Site Entrance	Approach does not exist	One shared through/left-turn lane and one right-turn lane

Initial recommended minimum turn-lane lengths (excluding tapers) of the separate turn lanes are listed below. The developer should coordinate with DelDOT's Subdivision Section to determine final turn-lane lengths.

Approach	Left-Turn Lane	Right-Turn Lane
Northbound Hercules Road	120 feet*	110 feet*
Southbound Hercules Road	120 feet*	n/a
Eastbound West Site Entrance	n/a	n/a
Westbound East Site Entrance	n/a	50 feet**

* turn-lane length based on deceleration + storage length per DelDOT's *Standards and Regulations for Subdivision Streets and State Highway Access*

** turn-lane length based on storage length per queuing analysis

3. The developer should coordinate with DelDOT's Subdivision Section and New Castle County regarding a future interconnection between the proposed Delaware National site and the adjacent Hercules Research Center property (located immediately south of the portion of the Delaware National site east of Hercules Road). Such a connection would give the Delaware National property a secondary access point along Hercules Road, via the connection through the Hercules Research Center to the existing signal at the Hercules Road entrance.

4. The developer should construct the Site Entrance on Penn Oak Drive. The proposed configuration is shown in the table below.

Approach	Current Configuration	Proposed Configuration
Northbound Penn Oak Drive	One through lane	One shared through/right-turn lane
Southbound Penn Oak Drive	One through lane	One shared through/left-turn lane
Westbound Site Entrance	Approach does not exist	One shared left/right-turn lane

5. The developer should construct the Site Entrance on Red Clay Drive. The proposed configuration is shown in the table below.

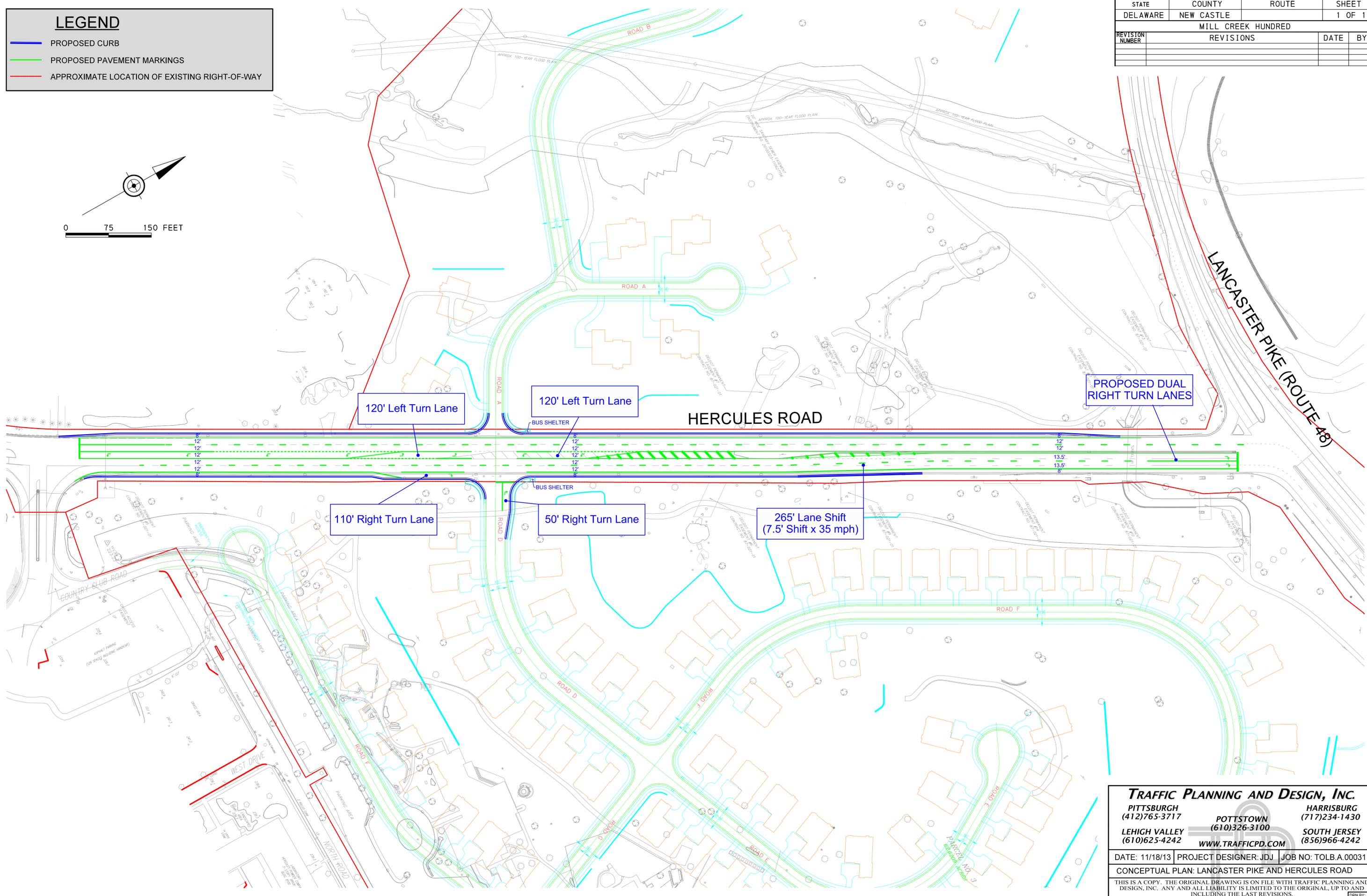
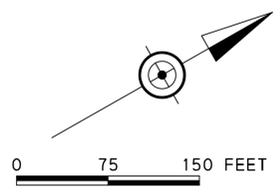
Approach	Current Configuration	Proposed Configuration
Northbound Site Entrance	Approach does not exist	One right-turn only lane
Eastbound Red Clay Drive	One through lane	One shared through/right-turn lane
Westbound Red Clay Drive	One through lane	One left-turn lane, one through lane

6. The developer should improve the intersection of Delaware Route 48 and Hercules Road by eliminating the northbound left-turn lane, as shown on the TPD Conceptual Plan for Lancaster Pike and Hercules Road (included on Page 9). The developer should coordinate with DeIDOT's Subdivision Section to discuss and conduct a public involvement effort and additional analyses of nearby intersections, both of which are required before this turning movement restriction can be implemented. The additional intersections to be analyzed due to redistribution of traffic volumes are: Hercules Road and Delaware Route 41 (Newport Gap Pike / New Castle Road 21), Delaware Route 41 and Loveville Road (New Castle Road 276), and Loveville Road and Delaware Route 48. The developer should also coordinate with DeIDOT's Subdivision Section regarding design details such as signing, striping, and other traffic control modifications associated with removal of the northbound Hercules Road left-turn lane.
7. The developer should enter into a traffic signal agreement with DeIDOT for the intersection of Delaware Route 48 and Hercules Road. The agreement will cover improvements noted in Item No. 6. The agreement should include pedestrian signals, crosswalks and interconnection at DeIDOT's discretion. One or more other developers may enter into a traffic signal agreement for this intersection as well. The developer should coordinate with DeIDOT on the implementation and equitable cost sharing of the traffic signal.

STATE	COUNTY	ROUTE	SHEET
DELAWARE	NEW CASTLE		1 OF 1
MILL CREEK HUNDRED			
REVISION NUMBER	REVISIONS	DATE	BY

LEGEND

- PROPOSED CURB
- PROPOSED PAVEMENT MARKINGS
- APPROXIMATE LOCATION OF EXISTING RIGHT-OF-WAY



120' Left Turn Lane

120' Left Turn Lane

PROPOSED DUAL RIGHT TURN LANES

HERCULES ROAD

110' Right Turn Lane

50' Right Turn Lane

265' Lane Shift
(7.5' Shift x 35 mph)

TRAFFIC PLANNING AND DESIGN, INC.

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LEHIGH VALLEY (610)625-4242	WWW.TRAFFICPD.COM	
SOUTH JERSEY (856)966-4242		

DATE: 11/18/13 | PROJECT DESIGNER: JDJ | JOB NO: TOLB.A.00031

CONCEPTUAL PLAN: LANCASTER PIKE AND HERCULES ROAD

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8. The developer should enter into a railroad grade crossing agreement with DelDOT to fund an equitable portion of any needed improvements for the Delaware Route 48 at-grade crossing located approximately 600 feet east of Hercules Road. Needed improvements may be identified by the Rail-Highway Grade Crossing Safety Program. Other developers may enter into an agreement for this railroad crossing as well. This is a Federally-funded project and as such the developer's equitable portion would be based solely on the State matching funds, which is 10% of the total project cost. The developer should coordinate with DelDOT on the implementation and equitable cost sharing of needed improvements. This railroad grade crossing agreement should expire seven years from the date of execution.

9. The developer should improve the intersection of Centerville Road and Red Clay Drive. The proposed configuration is shown in the table below.

Approach	Current Configuration	Proposed Configuration
Northbound Centerville Road	One left-turn lane, one through lane, and one right-turn lane	One left-turn lane, one through lane, and one right-turn lane
Southbound Centerville Road	Two left-turn lanes, one through lane, and one right-turn lane	One left-turn lane, one through lane, and one right-turn lane
Eastbound Red Clay Drive	One left-turn lane, one through lane, and one right-turn lane	One left-turn lane, one through lane, and one right-turn lane
Westbound Red Clay Drive	One left-turn lane, one through lane, and one right-turn lane	One left-turn lane, one through lane, and one right-turn lane

Initial recommended minimum turn-lane lengths (excluding tapers) of the separate turn lanes are listed below. The developer should coordinate with DelDOT's Subdivision Section to determine final turn-lane lengths.

Approach	Left-Turn Lane*	Right-Turn Lane*
Northbound Centerville Road	100 feet	125 feet
Southbound Centerville Road	250 feet	100 feet
Eastbound Red Clay Drive	175 feet	100 feet
Westbound Red Clay Drive	125 feet	200 feet

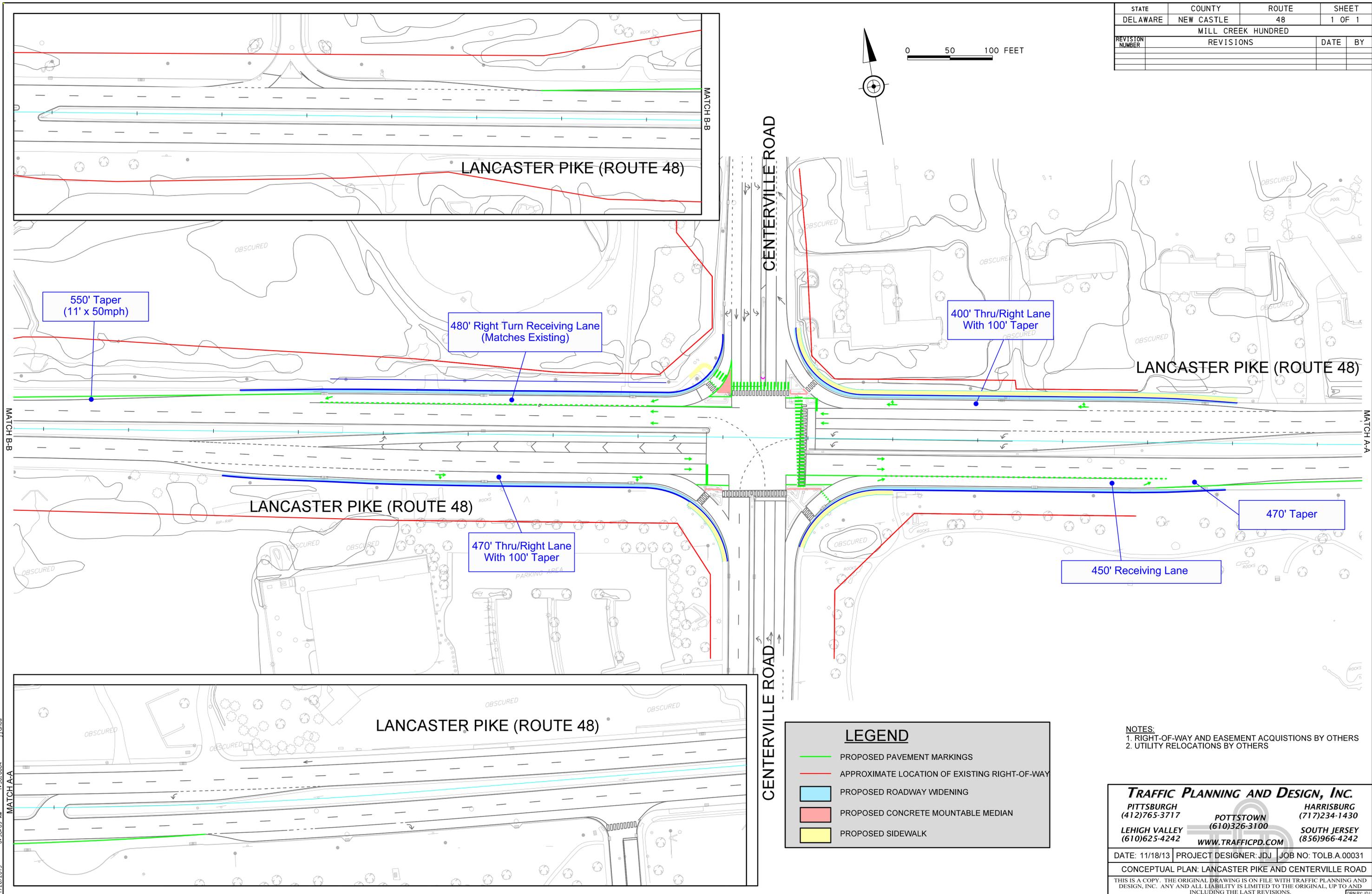
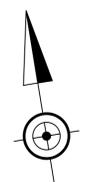
* turn-lane lengths based on storage length per queuing analysis, with 100-foot minimum

One or more other developers may share responsibility for these improvements. The developer should coordinate with DelDOT to determine design details, implementation, and/or contribution towards these improvements.

10. The developer should enter into a traffic signal agreement with DeIDOT for the intersection of Centerville Road and Red Clay Drive. The agreement will cover improvements noted in Item No. 9. The agreement should include pedestrian signals, crosswalks and interconnection at DeIDOT's discretion. One or more other developers may enter into a traffic signal agreement for this intersection as well. The developer should coordinate with DeIDOT on the implementation and equitable cost sharing of the traffic signal.
11. The developer should enter into a contribution agreement with DeIDOT to fund the Conceptual Plan improvements as set forth in the TPD Plan for Lancaster Pike and Centerville Road dated November 18, 2013 (included on Page 12), under the terms and conditions generally described above.

STATE	COUNTY	ROUTE	SHEET
DELAWARE	NEW CASTLE	48	1 OF 1
MILL CREEK HUNDRED			
REVISION NUMBER	REVISIONS	DATE	BY

0 50 100 FEET



LEGEND	
	PROPOSED PAVEMENT MARKINGS
	APPROXIMATE LOCATION OF EXISTING RIGHT-OF-WAY
	PROPOSED ROADWAY WIDENING
	PROPOSED CONCRETE MOUNTABLE MEDIAN
	PROPOSED SIDEWALK

- NOTES:
 1. RIGHT-OF-WAY AND EASEMENT ACQUISITIONS BY OTHERS
 2. UTILITY RELOCATIONS BY OTHERS

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CONCEPTUAL PLAN: LANCASTER PIKE AND CENTERVILLE ROAD

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12. The following bicycle, pedestrian, and transit improvements should be included:
- a. The existing golf cart tunnel under Hercules Road just south of Delaware Route 48 should be retained as a shared-use path.
 - b. The existing golf cart paths along the west side of Hercules Road that run from the tunnel under Hercules Road toward the Estate Homes should be retained as shared-use paths. These paths should be extended to connect to the proposed sidewalks along the cul-de-sacs in the Estate Homes section of the proposed development. A stub shared-use path should also be built to connect the northern path to the eastbound shoulder of Delaware Route 48, which would facilitate a connection to a potential future shared-use path along Delaware Route 48 to Hockessin.
 - c. The existing golf cart path that runs roughly parallel to Hercules Road along the east side of the road should be retained as a shared-use path. As needed, either the site plan should be revised so the proposed Village Homes residential lots avoid the alignment of the path, or portions of the path should be relocated to avoid the residential lots. This path should connect to the proposed sidewalks along the Hercules Road site entrance driveway and to the cul-de-sac further south. Alternatively, if it is infeasible to retain the existing path along Hercules Road, a new shared-use path should be constructed in a new alignment along the east side of Hercules Road.
 - d. The existing golf cart path along the south side of Delaware Route 48 that runs from the tunnel under Hercules Road to east of Red Clay Creek should be retained as a shared-use path. As needed, either the site plan should be revised so the proposed Village Homes residential lots avoid the alignment of the path, or portions of the path should be relocated to avoid the residential lots. Upgrades may be needed where this path crosses the railroad. A new section of shared-use path should also be built to connect this existing path from a point just west of the railroad crossing to the proposed sidewalk along the residential street in the northeastern portion of the Village Homes section of the proposed development.
 - e. East of Red Clay Creek, the existing golf cart path splits, with one path heading east towards Little Falls Village II and the other heading south to near the southern portion of Little Falls Village (and eventually to the southern end of Penn Oak Drive). The northern path should be retained as a shared-use path, connecting to the proposed sidewalk along the cul-de-sac for the proposed townhouses along the east side of the northern portion of Penn Oak Drive. From there, the shared-use path should continue south to connect with the sidewalk along Red Clay Drive. The western path should be retained as a shared-use path, connecting to the proposed sidewalk along a cul-de-sac for the proposed Executive Homes (to the south and west of Little Falls Village).
 - f. An easement should be provided for a shared-use pathway stub within Open Space H, which will ultimately form part of an off-alignment shared-use pathway connection from the Right-of-Way/shoulder of Delaware Route 48 to the west through Open Space E, C, and B. This will serve a future pathway connection to the commercial development on the southeast side of the intersection of Delaware Route 48 and

- Centerville Road and beyond to planned pathways along Delaware Route 141 (Centre Road / New Castle Road 271).
- g. Any shared-use paths being constructed, extended or relocated as described herein should be a minimum of eight feet wide (with ten feet wide preferred), with a minimum of a five-foot buffer from any roadway and should meet current AASHTO and ADA standards. Any existing golf cart paths to remain should be widened to a minimum of eight feet wide unless unfeasible (e.g. the existing golf cart tunnel under Hercules Road).
 - h. A note on the record plan should provide that a 15-foot wide public access easement shall exist along the centerline of all shared-use paths located in the open space, both newly constructed paths and previously existing golf cart paths. The note should further provide that the State of Delaware is granted unrestricted access to the open space for the purpose of improving substandard paths to meet AASHTO and ADA standards. If such improvements result in the realignment of a path or paths, the said 15-foot easement should apply to the new alignment of the path.
 - i. ADA compliant curb ramps and crosswalks should be provided at all pedestrian crossings, including across all site entrances. Type 3 curb ramps are discouraged.
 - j. Internal sidewalks for pedestrian safety and to promote walking as a viable transportation alternative should be constructed, on both sides of the street, along all streets within the development. These sidewalks should each be a minimum of five feet wide (with a minimum of a five-foot buffer from the roadway) and should meet current AASHTO and ADA standards. These internal sidewalks should connect each residential area to the previously described network of shared-use paths.
 - k. The developer should provide right of way for two future bus stops along the site frontage on both sides of Hercules Road (one stop on each side), at locations agreeable to the Delaware Transit Corporation (DTC).
 - l. If feasible, the developer should relocate the existing bus stop along eastbound Delaware Route 48 east of Hercules Road so that it is closer to Hercules Road. In that event, a shared-use path should be built to provide a pedestrian connection between this relocated bus stop and the proposed development. Regardless of whether the stop is relocated, parking facilities for bicyclists should be included at the bus stop. Relocation of this bus stop must be coordinated with the proposed improvements to the intersection of Delaware Route 48 and Hercules Road, and to the nearby at-grade railroad crossing, as described above in Item Nos. 6-8.
 - m. The developer should upgrade the existing bus stop along southbound Centerville Road north of Red Clay Drive to include an ADA-compliant concrete bus stop pad attached to the sidewalk. A location should also be identified for a corresponding bus stop along northbound Centerville Road. The sizes of these bus stop pads will be determined during the site plan review process.
 - n. The developer should coordinate with the DTC and DeIDOT regarding the details and implementation of all transit-related improvements.

Improvements in this TIS may be considered “significant” under DeIDOT’s *Work Zone Safety and Mobility Procedures and Guidelines*. These guidelines are available on DeIDOT’s website at http://www.deldot.gov/information/pubs_forms/manuals/de_mutcd/index.shtml. For any

additional information regarding the work zone impact and mitigation procedures during construction please contact Mr. Adam Weiser of DeIDOT's Traffic Section. Mr. Weiser can be reached at (302) 659-4073 or by email at Adam.Weiser@state.de.us.

Please note that this review generally focuses on capacity and level of service issues; additional safety and operational issues will be further addressed through DeIDOT's subdivision review process.

Additional details on our review of this TIS are attached. Please contact me at (302) 738-0203 or through e-mail at ajparker@mtmail.biz if you have any questions concerning this review.

Sincerely,

McCormick Taylor, Inc.



Andrew J. Parker, P.E., PTOE
Project Manager

Enclosure

General Information

Report date: TIS dated October 6, 2010; Addendum dated June 13, 2012

Prepared by: Traffic Planning and Design, Inc.

Prepared for: Toll Brothers, Inc.

Tax parcels: 07-031.00-001, 07-031.00-014, 08-027.00-001, and 08-027.00-007

Generally consistent with DelDOT's *Standards and Regulations for Subdivision Streets and State Highway Access*: Yes

Project Description and Background

Description: The proposed development would consist of 158 single-family detached houses and 106 townhouses.

Location: Delaware National is proposed to be located on the south side of Delaware Route 48 (Lancaster Pike / New Castle Road 237), on the east and west sides of Hercules Road (New Castle Road 282) and west of Centerville Road (New Castle Road 272) in New Castle County, Delaware. The Wilmington and Western Railroad runs north and south through the site, and the development would therefore be divided into three parts. The part west of Hercules Road would have 20 single-family detached houses; the part east of Hercules Road but west of the railroad would have 104 single-family detached houses; and the part east of the railroad but west of Centerville Road would have 34 single-family detached houses and 106 townhouses. A site location map is included on Page 17.

Amount of land to be developed: approximately 206 acres of land

Land use approval(s) needed: Subdivision approval. The land is currently zoned as S (Suburban) within New Castle County, and will be developed under that zoning as an open-space planned residential development.

Proposed completion date: 2016

Proposed access locations: Originally, as analyzed by the TIS, three access points were proposed (one along Hercules Road and two along Penn Oak Drive), but the locations have since changed. Currently, three access points are proposed: one along Hercules Road (to serve all parts of the site west of the railroad), one along Red Clay Drive (to serve the majority of the site east of the railroad), and one along Penn Oak Drive (to serve less than 20 townhouses). The site location map on Page 17 reflects the originally proposed access points. The revised site access plan would mean that the proposed access point nearest the southern part of Little Falls Village would no longer connect with Penn Oak Drive (as shown), but would now connect directly with Red Clay Drive just east of Penn Oak Drive (west of Little Falls Centre).

Daily Traffic Volumes:

- 2009 Average Annual Daily Traffic on Hercules Road: 9,531 vpd
- 2009 Average Annual Daily Traffic on Centerville Road: 8,641 vpd



Livable Delaware

(Source: Delaware Strategies for State Policies and Spending, July 2004)

Location with respect to the Strategies for State Policies and Spending Map of Delaware:

The proposed Delaware National is located within Investment Level 2. A small portion of the site is also located within an Out of Play area. Based on the Site Plan for the proposed Delaware National, it appears that no buildings or roads will be constructed within the Out of Play area.

Investment Level 2

These areas, generally adjacent to Investment Level 1 Areas, include less developed areas within municipalities, rapidly growing areas that have or will have public water and wastewater services, and may include smaller towns, rural villages, and suburban areas. These areas typically include single-family detached housing developments, commercial and office uses serving primarily local residents, and a limited range of entertainment, parks and recreation, cultural and institutional facilities.

In Investment Level 2 Areas, state investments and policies should be based on available infrastructure to accommodate orderly growth, encourage departure from the typical single-family-dwelling developments, promote a broader mix of housing types and commercial sites, and encourage development that is consistent with the character of the area. Transportation projects should expand or provide roadways, public transportation, pedestrian walkways, bicycle paths, and other transportation modes that manage flow, support economic development efforts, and encourage connections between communities and the use of local streets for local trips.

Out of Play

These include publicly owned lands, lands for which serious legal constraints on development are identified, and lands in some form of permanent open-space protection.

It is conceivable that public investments may be made in the “out of play areas” during the five-year period covered by this update of the Strategies. Because many of these lands are in the ownership of the Federal, State, or local governments, it is expected that funds will be expended on maintenance and management of the lands. Since many of the out of play lands are public parks and natural areas it is expected that funds will be expended on environmental protection, mitigation, and park development. Similarly, it is possible that other public facilities intended to further health, safety, and welfare goals may be constructed on out of play lands that are already in public ownership that are not otherwise constrained.

Proposed Development’s Compatibility with Livable Delaware:

The proposed Delaware National development falls within Investment Level 2 and is to be developed as a residential housing development with a mix of housing types, which is consistent with the character of Investment Level 2 areas. It is therefore concluded that the proposed development generally complies with the policies stated in the 2004 update of the Livable Delaware “Strategies for State Policies and Spending.”

Comprehensive Plan

New Castle County Comprehensive Plan:

(Source: New Castle County Comprehensive Plan Update, June 2008)

The proposed Delaware National is located in an area with future land use designated as Low Density Residential (1-3 dwelling units per acre).

Additionally, the parcel is currently zoned S (Suburban), and the developer does not plan to rezone the parcel. According to Section 40.02.232 of the New Castle County Unified Development Code (UDC), characteristics of S zoning include:

- This district permits a wide range of residential uses. This district includes all the newly developing areas designated as growth areas in the Comprehensive Development Plan.
- This district permits moderate to high density development and a full range of residential uses in a manner consistent with providing a high quality suburban character. Significant areas of open space and/or landscaping shall be provided to maintain the balance between green space and buildings that characterize suburban character. The highest densities are permitted in designed communities, hamlets and villages, through the use of Smart Code techniques.
- This district is not intended to be used for fully developed areas. Fully developed areas are zoned Neighborhood Conservation (NC). The Suburban District is used to in-fill tracts containing at least five (5) acres or where New Castle County seeks to redevelop the area to suburban character.

Proposed Development's Compatibility with Comprehensive Plan: The proposed Delaware National is planned as a residential housing development with some open space, which is compatible with S zoning and the New Castle County Comprehensive Plan. With 264 units on approximately 206 acres, the gross density of this residential development would be approximately 1.3 units per acre, which is within the desired range for Low Density Residential land use.

Transportation Analysis Zones (TAZ)

Transportation Analysis Zones (TAZ) where development would be located: 82, 133, and 134

TAZ Boundaries:



Current (2010) employment estimate: 1,089 jobs in TAZ 82, 572 jobs in TAZ 133, 20 jobs in TAZ 134

Future (2035) employment estimate: 1,215 jobs in TAZ 82, 562 jobs in TAZ 133, 19 jobs in TAZ 134

Current (2010) population estimate: 998 people in TAZ 82, 569 people in TAZ 133, 1,551 people in TAZ 134

Future (2035) population estimate: 1,193 people in TAZ 82, 1,072 people in TAZ 133, 1,655 people in TAZ 134

Current (2010) household estimate for TAZ: 418 houses in TAZ 82, 213 houses in TAZ 133, 581 houses in TAZ 134

Future (2035) household estimate for TAZ: 547 houses in TAZ 82, 441 houses in TAZ 133, 681 houses in TAZ 134

Relevant committed developments in TAZ: Little Falls Centre – Lot 4 and Little Falls Village II in TAZ 82; Greenville Overlook in TAZ 133; none in TAZ 134

Would the addition of committed developments to current estimates exceed future projections: TAZ 82: Yes for employment, No for population and households; TAZ 133 and TAZ 134: No

Would the addition of committed developments and the proposed development to current estimates exceed future projections: TAZ 82: Yes; TAZ 133: Yes; TAZ 134: No

Relevant Projects in the DelDOT Capital Transportation Program (FY 2010 – FY 2015)

DelDOT currently has one relevant project in the study area. It is the Corridor Capacity Preservation Program (CCPP), which is a statewide program intended to sustain the capacity of adopted highway corridors by various means such as limiting access points and using service roads for local vehicle trips. The general purpose of the program is to ensure that existing principal arterial roadways, including Delaware Route 48 between Hercules Road and Delaware Route 41 (Newport Gap Pike / New Castle Road 21), are able to efficiently carry regional traffic without impedance from the effects of local development. As the proposed Delaware National has no direct access to Delaware Route 48, DelDOT's CCPP Manager has indicated no objection to the proposed development.

Additionally, regarding DelDOT's Hazard Elimination Program (HEP) (formerly Highway Safety Improvement Program or HSIP), a 0.89-mile stretch of Delaware Route 48 including the signalized intersection with Centerville Road was within Site CC of the 2004 HEP. The HEP committee recommended remedial improvements consisting of installing pedestrian warning signs and relocating pedestrian signals, and these improvements have already been implemented. The committee recommended no additional studies.

Trip Generation

Trip generation for the proposed development was computed using comparable land uses and equations contained in Trip Generation, Eighth Edition, published by the Institute of Transportation Engineers (ITE). The following land uses were utilized to estimate the amount of new traffic generated for this development:

- 158 single-family detached houses (ITE Land Use Code 210)
- 106 townhouses/condominiums (ITE Land Use Code 230)

Table 1
DELAWARE NATIONAL PEAK HOUR TRIP GENERATION

Land Use	AM Peak Hour			PM Peak Hour		
	In	Out	Total	In	Out	Total
158 single-family detached houses	30	90	120	100	59	159
106 townhouses/condominiums	9	45	54	42	21	63
TOTAL TRIPS	39	135	174	142	80	222

Table 2
DELAWARE NATIONAL DAILY TRIP GENERATION

Land Use	Weekday ADT		
	In	Out	Total
158 single-family detached houses	792	792	1584
106 townhouses/condominiums	339	339	678
TOTAL TRIPS	1131	1131	2262

Overview of TIS

Intersections examined:

- 1) Hercules Road & Site Entrance
- 2) Penn Oak Drive & North Site Entrance (now just Penn Oak Drive & Site Entrance)
- 3) Penn Oak Drive & South Site Entrance (now Red Clay Drive & Site Entrance)
- 4) Delaware Route 48 & Hercules Road *
- 5) Delaware Route 48 & Stratton Drive
- 6) Delaware Route 48 & Westgate Drive
- 7) Delaware Route 48 & Rolling Mill Road (New Castle Road 263)
- 8) Rolling Mill Road & Foxhill Lane
- 9) Delaware Route 48 & Hampton Way
- 10) Hercules Road & Hercules Research Center Entrance
- 11) Hercules Road & Cheshire Court
- 12) Hercules Road & Tall Trees Lane
- 13) Red Clay Drive & Penn Oak Drive
- 14) Centerville Road & Red Clay Drive
- 15) Delaware Route 48 & Centerville Road *
- 16) Centerville Road & Spice Mill Circle

* Note: The TIS Addendum prepared by TPD (dated June 13, 2012) was limited to additional analyses for the intersections of Delaware Route 48 & Hercules Road and Delaware Route 48 & Centerville Road. These analyses were based on different sets of 2016 traffic volumes, as described below in Conditions 8 and 9 (Cases 4A and 4B).

Conditions examined:

- 1) 2010 existing conditions (Case 1)
- 2) 2016 without Delaware National and without Barley Mill Plaza (Case 2A)
- 3) 2016 without Delaware National and with Barley Mill Plaza (Case 2B)
- 4) 2016 with Delaware National, without Barley Mill Plaza, with rights-in rights-out access on Hercules Road (Case 3A)
- 5) 2016 with Delaware National, without Barley Mill Plaza, with full-movement access on Hercules Road (Case 3B)
- 6) 2016 with Delaware National, with Barley Mill Plaza, with rights-in rights-out access on Hercules Road (Case 3C)
- 7) 2016 with Delaware National, with Barley Mill Plaza, with full-movement access on Hercules Road (Case 3D)

- 8) 2016 without Delaware National and without Barley Mill Plaza; per TIS Addendum using revised growth rate for background traffic (Case 4A) *
- 9) 2016 with Delaware National and without Barley Mill Plaza; per TIS Addendum using revised growth rate for background traffic (Case 4B) *

* Note: Regarding the revised growth rate for background traffic, DelDOT had originally recommended an annual growth rate of 2.0% for Delaware Route 48, Hercules Road, and Centerville Road, and this growth rate was used in the original TIS analyses. For the TIS Addendum, TPD investigated census data for nearby areas and found that a different annual growth rate of 1.75% was appropriate, even somewhat conservative. This lower growth rate was used in the TIS Addendum analyses.

Peak hours evaluated: Weekday morning and evening peak hours

Committed developments considered:

- 1) Little Falls Centre – Lot 4 (61,800 square feet of office space)
- 2) Little Falls Centre – Lots 9 and 11 (203,500 square feet of office space)
- 3) L.A. Associates Expansion (41,106 square feet of office space)
- 4) DuPont Chestnut Run Plaza (741,078 square feet of office space)
- 5) Greenville Overlook (160 single-family detached houses)
- 6) Little Falls Village II (36 active-adult townhouses)
- 7) Barley Mill Plaza (1,434,638 square feet of office space, 430,712 square feet of retail space, 54,900 square feet of restaurant space, a 200-room hotel, and 700 apartments)

Note: In February 2011, we learned that plans for the redevelopment of Barley Mill Plaza have been scaled back. Reportedly, the site will now be developed as a 1.6 million square-foot commercial and office complex, instead of a 2.8 million square-foot complex of offices, restaurants, shops, and residential condominiums.

Intersection Descriptions

1) Hercules Road & Site Entrance

Type of Control: proposed two-way stop-controlled (four-leg intersection)

Northbound approach: (Hercules Road) existing two through lanes; proposed one left-turn lane, one exclusive through lane, and one shared through/right-turn lane

Southbound approach: (Hercules Road) existing two through lanes; proposed one left-turn lane, one exclusive through lane, and one shared through/right-turn lane

Eastbound approach: (Proposed West Site Entrance) proposed one shared left/through/right-turn lane, stop controlled

Westbound approach: (Proposed East Site Entrance) proposed one shared left/through/right-turn lane, stop controlled

Note: As directed in DelDOT's Scoping Letter, the proposed Hercules Road site entrance intersection was also evaluated with a rights-in rights-out configuration (Cases 3A and

3C). As evaluated in the TIS, the rights-in rights-out configuration applied only to the East Site Entrance, and is described as follows:

Northbound: one left-turn lane, one exclusive through lane, and one shared through/right-turn lane

Southbound: one exclusive through lane and one shared through/right-turn lane

Eastbound: one shared left/right-turn lane, stop controlled

Westbound: one right-turn-only lane, stop controlled

2) Penn Oak Drive & Site Entrance

Type of Control: proposed two-way stop-controlled (T-intersection)

Northbound approach: (Penn Oak Drive) existing one through lane; proposed one shared through/right-turn lane

Southbound approach: (Penn Oak Drive) existing one through lane; proposed one shared through/left-turn lane

Westbound approach: (Proposed Site Entrance) proposed one shared left/right-turn lane, stop controlled

3) Penn Oak Drive & South Site Entrance

Type of Control: proposed two-way stop-controlled (T-intersection)

Northbound approach: (Proposed South Site Entrance) proposed one shared through/left-turn lane

Southbound approach: (Penn Oak Drive) existing one right-turn lane; proposed one shared through/right-turn lane

Eastbound approach: (Penn Oak Drive) existing one left-turn lane; proposed one shared left/right-turn lane, stop controlled

Note: While this proposed site entrance location was analyzed by the TIS and McCormick Taylor, we learned in early March 2011 that the proposed location has changed. There will no longer be a site entrance connecting with Penn Oak Drive south of Red Clay Drive. Instead, the proposed entrance location has moved to Red Clay Drive, just east of Penn Oak Drive (west of Little Falls Centre). McCormick Taylor originally evaluated the entrance in the same Penn Oak Drive location as the TIS, and then conducted additional analysis with the entrance relocated to Red Clay Drive. For the entrance along Red Clay Drive, the proposed configuration is described as follows:

Northbound approach: (Proposed Site Entrance) proposed one right-turn-only lane, stop controlled

Eastbound approach: (Red Clay Drive) existing one through lane; proposed one shared through/right-turn lane

Westbound approach: (Red Clay Drive) existing one through lane, separated from eastbound lane by grass median; proposed one through lane, separated from eastbound lane by grass median

- 4) **Delaware Route 48 & Hercules Road**
Type of Control: signalized three-leg intersection
Northbound approach: (Hercules Road) one left-turn lane and two right-turn lanes
Eastbound approach: (Delaware Route 48) two through lanes and one right-turn lane
Westbound approach: (Delaware Route 48) two left-turn lanes and one through lane

- 5) **Delaware Route 48 & Stratton Drive**
Type of Control: two-way stop-controlled (T-intersection)
Northbound approach: (Stratton Drive) one shared left/right-turn lane, stop controlled
Eastbound approach: (Delaware Route 48) one through lane and one right-turn lane
Westbound approach: (Delaware Route 48) one left-turn lane and two through lanes

- 6) **Delaware Route 48 & Westgate Drive**
Type of Control: two-way stop-controlled (T-intersection)
Northbound approach: (Westgate Drive) one shared left/right-turn lane, stop controlled
Eastbound approach: (Delaware Route 48) one through lane and one right-turn lane
Westbound approach: (Delaware Route 48) one left-turn lane and one through lane

- 7) **Delaware Route 48 & Rolling Mill Road**
Type of Control: two-way stop-controlled (T-intersection)
Southbound approach: (Rolling Mill Road) one right-turn-only lane, stop controlled
Eastbound approach: (Delaware Route 48) two through lanes, separated from westbound lanes by grass median
Westbound approach: (Delaware Route 48) two through lanes (one marked for downstream left turns) and one right-turn lane

- 8) **Rolling Mill Road & Foxhill Lane**
Type of Control: two-way stop-controlled (T-intersection)
Northbound approach: (Rolling Mill Road) one shared through/left-turn lane
Southbound approach: (Rolling Mill Road) one shared through/right-turn lane
Eastbound approach: (Foxhill Lane) one shared left/right-turn lane, stop controlled

- 9) **Delaware Route 48 & Hampton Way**
Type of Control: two-way stop-controlled (T-intersection)
Southbound approach: (Hampton Way) one right-turn-only lane, stop controlled
Eastbound approach: (Delaware Route 48) two through lanes, separated from westbound lanes by grass median
Westbound approach: (Delaware Route 48) two through lanes and one right-turn lane

- 10) **Hercules Road & Hercules Research Center Entrance**
Type of Control: signalized three-leg intersection
Northbound approach: (Hercules Road) one through lane and one right-turn lane
Southbound approach: (Hercules Road) one left-turn lane and two through lanes
Westbound approach: (Hercules Research Center Driveway) one left-turn lane and one right-turn lane

11) Hercules Road & Cheshire Court

Type of Control: two-way stop-controlled (T-intersection)

Northbound approach: (Hercules Road) one shared through/left-turn lane

Southbound approach: (Hercules Road) one through lane and one right-turn lane

Eastbound approach: (Cheshire Court) one shared left/right-turn lane, stop controlled

Note: After the traffic counts were completed and the TIS was submitted, a fourth leg was recently added to this intersection (directly across from Cheshire Court) for the entrance to the new residential development of Greenville Overlook (currently under construction as of February 2011). The TIS did not account for this entrance in their analysis, and although the TIS did include future volumes generated by Greenville Overlook as a committed development, the trip assignment assumed this entrance was further south (somewhere beyond Tall Trees Lane). McCormick Taylor evaluated the intersection as both a three-leg intersection (to be consistent with the TIS), and as a four-leg intersection (to account for the actual location of the Greenville Overlook entrance). The base configuration of the four-leg intersection is described as follows:

Northbound approach: (Hercules Road) one shared left/through/right-turn lane

Southbound approach: (Hercules Road) one shared through/left-turn lane and one right-turn lane

Eastbound approach: (Cheshire Court) one shared left/through/right-turn lane, stop controlled

Westbound approach: (Greenville Overlook Entrance) one shared left/through/right-turn lane, stop controlled

12) Hercules Road & Tall Trees Lane

Type of Control: two-way stop-controlled (T-intersection)

Northbound approach: (Hercules Road) one shared through/right-turn lane

Southbound approach: (Hercules Road) one shared through/left-turn lane

Westbound approach: (Tall Trees Lane) one shared left/right-turn lane, stop controlled

13) Red Clay Drive & Penn Oak Drive

Type of Control: two-way stop-controlled (T-intersection)

Northbound approach: (Penn Oak Drive) one shared through/right-turn lane

Southbound approach: (Penn Oak Drive) one shared through/left-turn lane

Westbound approach: (Red Clay Drive) one shared left/right-turn lane, stop controlled

14) Centerville Road & Red Clay Drive

Type of Control: two-way stop-controlled (four-leg intersection)

Northbound approach: (Centerville Road) one left-turn lane, one through lane, and one right-turn lane

Southbound approach: (Centerville Road) two left-turn lanes, one through lane, and one right-turn lane

Eastbound approach: (Red Clay Drive) one left-turn lane, one through lane, and one right-turn lane, stop controlled

Westbound approach: (Red Clay Drive) one left-turn lane, one through lane, and one right-turn lane, stop controlled

15) Delaware Route 48 & Centerville Road

Type of Control: signalized four-leg intersection

Northbound approach: (Centerville Road) one exclusive left-turn lane, one shared through/left-turn lane, one exclusive through lane, and one right-turn lane

Southbound approach: (Centerville Road) one exclusive left-turn lane, one shared through/left-turn lane, one exclusive through lane, and one right-turn lane

Eastbound approach: (Delaware Route 48) one left-turn lane, two through lanes, and one right-turn lane

Westbound approach: (Delaware Route 48) two left-turn lanes, two through lanes, and one right-turn lane

16) Centerville Road & Spice Mill Circle

Type of Control: two-way stop-controlled (T-intersection)

Northbound approach: (Centerville Road) one left-turn lane and one through lane

Southbound approach: (Centerville Road) one through lane and one right-turn lane

Eastbound approach: (Spice Mill Circle) one left-turn lane and one right-turn lane, stop controlled

Safety Evaluation

Crash Data: Crash data was obtained for the years of 2007 through 2009 for the intersections in this study. The highest number of reportable crashes occurred at the signalized intersections of Delaware Route 48 & Hercules Road and Delaware Route 48 & Centerville Road (including the immediate approaches of those intersections). Delaware Route 48 & Hercules Road had a total of 20 crashes, and Delaware Route 48 & Centerville Road had a total of 9 crashes. There were numerous angle crashes at intersections, as well as rear-end crashes and crashes involving vehicles hitting fixed objects. Three fatal crashes were reported in the study area during this three-year period. Two of the fatal crashes were on Delaware Route 48 west of Hercules Road (both alcohol-related), and one was an angle crash at Centerville Road & Red Clay Drive (non-alcohol-related).

Sight Distance: The three site entrances for this proposed development (one on Hercules Road and two on Penn Oak Drive) would each have adequate sight distance. The proposed entrance along Hercules Road would be located on a straight section of roadway, and the entrances on Penn Oak Drive are within an existing low speed residential area.

Other than the proposed site entrances, the existing roadways in the study area have numerous grades and some curves that present safety concerns. In particular, Delaware Route 48 west of Hercules Road narrows down to a two-lane road with some moderate grades on a reverse curve as it cuts through a wooded area. Additionally, some of the smaller unsignalized intersections, such as Stratton Drive, Westgate Drive, and Rolling Mill Road on Delaware Route 48, and Cheshire Court and Tall Trees Lane on Hercules Road, are access points with limited sight distance due to vegetation, guardrail, and/or embankment near the intersection. Finally, the intersection of Centerville Road & Red Clay Drive is an unsignalized intersection with an unconventional configuration, as it has dual left-turn lanes on the southbound approach. This is unusual and is a safety concern as it may be unexpected or confusing for drivers who are unfamiliar with the intersection. Also, this configuration leads to lengthy peak hour delays for

drivers from Red Clay Drive who are crossing or turning left onto Centerville Road (especially under the projected future volumes).

Transit, Pedestrian, and Bicycle Facilities

Existing transit service: The Delaware Transit Corporation (DTC) currently operates two bus routes near the proposed Delaware National development. DART Route 20 travels along Delaware Route 48 between Wilmington and Hockessin. It makes 14 round trips each weekday, and none on weekends. DART Route 4 travels along Delaware Route 48 from Wilmington and, via a limited service extended route, serves Centerville Road and Red Clay Drive, including Agilent Technologies on the east side of Centerville Road. DART Route 4 only extends to Centerville Road four times each weekday, and not at all on weekends. There are signed bus stops in both directions of Delaware Route 48 just east of Hercules Road (near the railroad crossing) and just east of Centerville Road, and there is a signed stop on southbound Centerville Road just north of Red Clay Drive.

Planned transit service: McCormick Taylor contacted Mr. Ivan Mitchell, a Service Development Planner for the DTC, via email on February 4, 2011 to determine whether DTC has any plans to extend the existing transit system in the vicinity of the development. Mr. Mitchell replied on February 17, 2011, stating the following:

- DTC does not plan to serve the proposed Delaware National development onsite.
- DTC does not currently serve Hercules Road, but is open to service at a future date depending on ridership and funding. The developer should provide right of way for two future bus stops on Hercules Road, and sidewalk along the Hercules Road site frontage.
- The developer should relocate the existing bus stop along eastbound Delaware Route 48 east of Hercules Road so that it is closer to Hercules Road. Sidewalk to be constructed along the Hercules Road frontage should be extended along the south side of Delaware Route 48 to reach this relocated bus stop location.
- The developer should upgrade the existing bus stop along southbound Centerville Road north of Red Clay Drive to include a bus stop pad attached to the sidewalk. A corresponding bus stop location should be identified along northbound Centerville Road.
- The nearest Park & Ride facility is located at the intersection of Kennett Pike & DuPont Road. DTC requests that the developer contribute a one-time fee of \$1,000 towards the ongoing maintenance of this facility.

Existing bicycle and pedestrian facilities: According to the *New Castle County Bicycle Map*, Delaware Route 48 is designated as having above average cycling conditions with high traffic volumes (greater than 10,000 ADT). Hercules Road also has high traffic volumes, but below average cycling conditions. Rolling Mill Road is designated as having above average cycling conditions, and Centerville Road is designated as having average cycling conditions. There are currently sidewalks in place along Penn Oak Drive, Red Clay Drive, Hampton Way, and both sides of Centerville Road between Red Clay Drive and Delaware Route 48. There are no sidewalks along Hercules Road. There are crosswalks at the intersection of Delaware Route 48 & Centerville Road. There are no bicycle lanes within the project area.

Planned bicycle and pedestrian facilities: McCormick Taylor contacted Mr. Anthony Aglio with DeIDOT's Bicycle and Pedestrian Facilities Team via email on February 4, 2011 regarding planned or requested bicycle and pedestrian facilities in the area of this proposed development. Mr. Aglio and Mr. Marco Boyce provided comments to McCormick Taylor in a March 23, 2011 phone conversation. If the development does occur, the following requests should be incorporated into the project to facilitate bicycle and pedestrian transportation:

- a. The existing golf cart tunnel under Hercules Road just south of Delaware Route 48 should be retained as a shared-use path.
- b. The existing golf cart paths along the west side of Hercules Road that run from the tunnel under Hercules Road toward the Estate Homes should be retained as shared-use paths. As needed, these paths should be extended to connect to the proposed sidewalks along the cul-de-sacs in the Estate Homes section of the proposed development. A stub shared-use path should also be built to connect the northern path to the south side of Delaware Route 48, which would allow for a connection to a potential future shared-use path along Delaware Route 48 to Hockessin.
- c. The existing golf cart path along the east side of Hercules Road should be retained as a shared-use path. As needed, either the site plan should be revised so the proposed Village Homes residential lots avoid the alignment of the path, or portions of the path should be relocated to avoid the residential lots. This path should connect to the proposed sidewalks along the site entrance driveway and the cul-de-sac further south.
- d. The existing golf cart path along the south side of Delaware Route 48 that runs from the tunnel under Hercules Road to east of Red Clay Creek should be retained as a shared-use path. As needed, either the site plan should be revised so the proposed Village Homes residential lots avoid the alignment of the path, or portions of the path should be relocated to avoid the residential lots. Some upgrades may be needed at the path's at-grade railroad crossing. A stub shared-use path should also be built to connect this existing path from just west of the railroad crossing to the proposed sidewalk along the residential street in the northeastern portion of the Village Homes section of the proposed development.
- e. East of Red Clay Creek, the existing golf cart path splits, with one path heading east through Little Falls Village II and the other heading south to near the southern portion of Little Falls Village. The northern path should be retained as a shared-use path, connecting to the proposed sidewalk along the cul-de-sac for the proposed townhouses along the east side of the northern portion of Penn Oak Drive, and should continue south to connect with the sidewalk along Red Clay Drive. The western path should be retained as a shared-use path, connecting to the proposed sidewalk along a cul-de-sac for the proposed Executive Homes (to the south and west of Little Falls Village).
- f. Sidewalks should be included along all residential streets within the proposed development, including along a proposed stub street leading to the adjacent Hercules Research Center property on the east side of Hercules Road.
- g. Crosswalks should be included across all site entrances.

Previous Comments

All comments from DelDOT's Scoping Letter, Traffic Count Review, Preliminary TIS Review, and Revised Preliminary TIS Review were addressed in the Final TIS submission, with the following exceptions:

- There were no indications that the applicant contacted the DelDOT Bicycle and Pedestrian Coordinator for bicycle and pedestrian comments.
- The TIS did not follow DelDOT's updated analysis parameter requirements regarding peak hour factors as found in Section 2.9.11.6 of DelDOT's *Standards and Regulations for Subdivision Streets and State Highway Access*.

General HCS Analysis Comments

(see table footnotes on the following pages for specific comments)

- 1) For unsignalized intersections, the TIS and McCormick Taylor applied heavy vehicle factors (HV) by movement. For signalized intersections, the TIS and McCormick Taylor applied HV by lane group. For future conditions, the TIS and McCormick Taylor generally assumed future HV to be the same as existing HV.
- 2) For existing conditions, the TIS applied peak hour factors (PHF) by lane group (based on the traffic count data), and used these existing PHF for future conditions as well. McCormick Taylor determined an overall intersection PHF for each intersection and applied those PHFs to existing and future conditions.
- 3) The HCS analyses included in the TIS did not always reflect the lane widths observed in the field by McCormick Taylor. McCormick Taylor's HCS analyses incorporated the field-measured lane widths.
- 4) The TIS and McCormick Taylor used different cycle lengths and/or signal timing parameters when analyzing the signalized intersections in some cases.
- 5) The TIS included percent grade in their analysis of nearly every intersection for the TIS, although they did not include percent grade in the TIS Addendum analyses. McCormick Taylor could not confirm the percent grade and did not take it into consideration.
- 6) The TIS input existing Right-Turn-on-Red (RTOR) volumes for signalized intersection analyses of existing and future conditions for the TIS, although they did not input RTOR volumes in the TIS Addendum analyses. McCormick Taylor input no RTOR volumes, but did analyze right-turn movements as overlapping the protected left-turn phases.
- 7) The TIS analyzed four unsignalized intersections with a flared approach on the minor street. These four intersections were: Delaware Route 48 & Westgate Drive, Hercules Road & Cheshire Court, Hercules Road & Tall Trees Lane, and Red Clay Drive & Penn Oak Drive. McCormick Taylor's past experience has indicated that this can lead to unreliable results and that DelDOT generally prefers going with a more conservative approach of analyzing the flared approach as a shared lane. As such, McCormick Taylor did not analyze any intersections with a flared approach.
- 8) McCormick Taylor analyzed three unsignalized intersections including data for the nearby upstream signal. These three intersections were: Hercules Road & Site Entrance, Hercules Road & Cheshire Court, and Centerville Road & Red Clay Drive. The TIS did not analyze any intersections including data for an upstream signal.

Table 3
PEAK HOUR LEVELS OF SERVICE (LOS)
based on Traffic Impact Study for Delaware National
Report dated October 6, 2010
Prepared by Traffic Planning and Design, Inc.

Unsignalized Intersection ¹ Two-Way Stop Control	LOS per TIS		LOS per McCormick Taylor	
	Weekday AM	Weekday PM	Weekday AM	Weekday PM
Hercules Road & Site Entrance				
2016 with Delaware National (Case 3A)				
Northbound Hercules Road – Left	A (8.4)	B (11.6)	A (7.7)	A (9.9)
Eastbound West Site Entrance	C (19.2)	D (29.2)	B (11.9)	C (16.7)
Westbound East Site Entrance – Right	B (13.0)	A (9.7)	B (10.2)	A (9.5)
2016 with Delaware National (Case 3B)				
Northbound Hercules Road – Left	A (8.3)	B (11.4)	A (7.7)	A (9.8)
Southbound Hercules Road – Left	B (11.7)	A (8.5)	B (11.5)	A (8.6)
Eastbound West Site Entrance	C (19.5)	D (30.7)	B (12.5)	C (18.0)
Westbound East Site Entrance	F (64.1)	D (25.2)	E (35.1) ²	B (13.8)
2016 with Delaware National (Case 3B) <i>With Improvement Option 1</i> ³				
Northbound Hercules Road – Left	N/A	N/A	A (7.7)	A (9.8)
Southbound Hercules Road – Left	N/A	N/A	B (11.5)	A (8.6)
Eastbound West Site Entrance	N/A	N/A	B (12.5)	C (18.0)
Westbound East Site Entrance	N/A	N/A	D (32.2)	B (13.1)
2016 with Delaware National (Case 3C)				
Northbound Hercules Road – Left	A (8.6)	B (12.6)	A (7.8)	B (11.0)
Eastbound West Site Entrance	C (23.5)	E (39.0)	B (12.5)	C (22.0)
Westbound East Site Entrance – Right	B (13.9)	A (9.9)	B (10.2)	A (9.3)

¹ For both unsignalized and signalized intersection analyses, the numbers in parentheses following levels of service (LOS) are average delay per vehicle, measured in seconds. For signalized analyses, LOS analysis results are given for only the overall intersection delay.

² The 95th percentile queue length for the westbound East Site Entrance approach during the Case 3B AM peak hour is less than 2 vehicles.

³ Improvement Option 1 consists of adding a separate right-turn lane on the westbound East Site Entrance approach, as well as a separate right-turn lane on the northbound and southbound Hercules Road approaches as warranted by DeIDOT's *Standards and Regulations for Subdivision Streets and State Highway Access*.

Table 3 (continued)
PEAK HOUR LEVELS OF SERVICE (LOS)
based on Traffic Impact Study for Delaware National
Report dated October 6, 2010
Prepared by Traffic Planning and Design, Inc.

Unsignalized Intersection ⁴ Two-Way Stop Control	LOS per TIS		LOS per McCormick Taylor	
	Weekday AM	Weekday PM	Weekday AM	Weekday PM
Hercules Road & Site Entrance				
2016 with Delaware National (Case 3D)				
Northbound Hercules Road – Left	A (8.6)	B (12.4)	A (7.8)	B (10.8)
Southbound Hercules Road – Left	B (12.7)	A (8.7)	B (12.4)	A (8.8)
Eastbound West Site Entrance	C (23.7)	E (41.0)	B (13.2)	C (25.0)
Westbound East Site Entrance	F (118.2)	D (32.6)	F (50.8) ⁵	C (17.4)
2016 with Delaware National (Case 3D) With Improvement Option 1 ⁶				
Northbound Hercules Road – Left	N/A	N/A	A (7.8)	B (10.8)
Southbound Hercules Road – Left	N/A	N/A	B (12.4)	A (8.8)
Eastbound West Site Entrance	N/A	N/A	B (13.2)	C (24.6)
Westbound East Site Entrance	N/A	N/A	E (45.5) ⁷	C (16.3)

Signalized Intersection ⁴	LOS per TIS		LOS per McCormick Taylor	
	Weekday AM	Weekday PM	Weekday AM	Weekday PM
Hercules Road & Site Entrance				
2016 with Delaware National (Case 3D)	N/A	N/A	A (5.1)	A (4.3)

⁴ For both unsignalized and signalized intersection analyses, the numbers in parentheses following levels of service (LOS) are average delay per vehicle, measured in seconds. For signalized analyses, LOS analysis results are given for only the overall intersection delay.

⁵ The 95th percentile queue length for the westbound East Site Entrance approach during the Case 3D AM peak hour is approximately 2 vehicles.

⁶ Improvement Option 1 consists of adding a separate right-turn lane on the westbound East Site Entrance approach, as well as a separate right-turn lane on the northbound and southbound Hercules Road approaches as warranted by DelDOT's *Standards and Regulations for Subdivision Streets and State Highway Access*.

⁷ The 95th percentile queue length for the westbound East Site Entrance approach during the Case 3D AM peak hour (with Improvement Option 1) is less than 2 vehicles.

Table 4
PEAK HOUR LEVELS OF SERVICE (LOS)
based on Traffic Impact Study for Delaware National
Report dated October 6, 2010
Prepared by Traffic Planning and Design, Inc.

Unsignalized Intersection ⁸ Two-Way Stop Control (T-intersection)	LOS per TIS		LOS per McCormick Taylor	
	Weekday AM	Weekday PM	Weekday AM	Weekday PM
Penn Oak Drive & Site Entrance				
2016 with Delaware National (Cases 3A-3D)				
Southbound Penn Oak Drive – Left	A (7.2)	A (7.3)	A (7.2)	A (7.3)
Westbound Site Entrance	A (8.7)	A (8.7)	A (8.7)	A (8.7)

⁸ For both unsignalized and signalized intersection analyses, the numbers in parentheses following levels of service (LOS) are average delay per vehicle, measured in seconds. For signalized analyses, LOS analysis results are given for only the overall intersection delay.

Table 5
PEAK HOUR LEVELS OF SERVICE (LOS)
based on Traffic Impact Study for Delaware National
Report dated October 6, 2010
Prepared by Traffic Planning and Design, Inc.

Unsignalized Intersection ⁹ Two-Way Stop Control (T-intersection)	LOS per TIS		LOS per McCormick Taylor	
	Weekday AM	Weekday PM	Weekday AM	Weekday PM
Penn Oak Drive & South Site Entrance ¹⁰				
2016 with Delaware National (Cases 3A-3D)				
Northbound South Site Entrance – Left	A (7.2)	A (7.3)	A (7.3)	A (7.4)
Eastbound Penn Oak Drive	A (8.9)	A (9.0)	A (9.0)	A (9.1)

Unsignalized Intersection ⁹ Two-Way Stop Control (T-intersection)	LOS per TIS		LOS per McCormick Taylor	
	Weekday AM	Weekday PM	Weekday AM	Weekday PM
Red Clay Drive & Site Entrance ¹⁰				
2016 with Delaware National (Cases 3A-3D)				
Northbound Site Entrance – Right	N/A	N/A	A (8.8)	A (8.8)

⁹ For both unsignalized and signalized intersection analyses, the numbers in parentheses following levels of service (LOS) are average delay per vehicle, measured in seconds. For signalized analyses, LOS analysis results are given for only the overall intersection delay.

¹⁰ While this proposed site entrance location on Penn Oak Drive was analyzed by the TIS and McCormick Taylor, we learned in early March 2011 that the proposed location has changed. There will no longer be a site entrance connecting with Penn Oak Drive south of Red Clay Drive. Instead, the proposed entrance location has moved to Red Clay Drive, just east of Penn Oak Drive (west of Little Falls Centre). McCormick Taylor originally evaluated the entrance in the same Penn Oak Drive location as the TIS, and then conducted additional analysis with the entrance relocated as a right-in/right-out entrance on Red Clay Drive.

Table 6
PEAK HOUR LEVELS OF SERVICE (LOS)
based on Traffic Impact Study for Delaware National
Report dated October 6, 2010
Prepared by Traffic Planning and Design, Inc.

Signalized Intersection ¹¹	LOS per TIS ¹²		LOS per McCormick Taylor	
	Weekday AM	Weekday PM	Weekday AM	Weekday PM
Delaware Route 48 & Hercules Road				
2010 Existing (Case 1)	E (71.1)	F (82.1)	C (32.8)	C (28.4)
2016 without Delaware National (Case 2A)	F (173.2)	F (198.1)	F (83.7)	E (79.0)
2016 without Delaware National (Case 2B)	F (217.1)	F (244.0)	F (103.0)	F (107.1)
2016 with Delaware National (Cases 3A & 3B)	F (180.2)	F (204.8)	F (84.7)	F (82.1)
2016 with Delaware National (Cases 3A & 3B) With Improvement Option 1 ¹³	F (165.5)	F (141.5)	E (64.0) ¹⁴	D (52.5) ¹⁵
2016 with Delaware National (Cases 3A & 3B) With Improvement Option 2 ¹⁶	N/A	N/A	D (43.8) ¹⁷	D (52.2) ¹⁸

¹¹ For unsignalized analyses, the numbers in parentheses following levels of service are average delay per vehicle, measured in seconds. For signalized analyses, those numbers are X-critical, a composite volume-to-capacity ratio.

¹² The HCS analyses included in the TIS set the signal timings for all phases to their max splits (for all Cases during both peak hours). This assumption sometimes led to unrealistically poor results for the TIS. McCormick Taylor used lower splits when feasible to do so (within the parameters of DelDOT's timing plans for this signal), yielding more realistic results.

¹³ Improvement Option 1 consists of signal timing improvements by the TIS, basically consisting of reducing splits and overall cycle length. McCormick Taylor's analysis for Improvement Option 1 assumes some timing adjustments, also resulting in a lower cycle length.

¹⁴ Notable 95th percentile queue lengths for the Cases 3A & 3B AM peak hour (with Improvement Option 1) are approximately 81 vehicles for the eastbound Delaware Route 48 through lanes and 66 vehicles for the northbound Hercules Road right-turn lanes.

¹⁵ Notable 95th percentile queue lengths for the Cases 3A & 3B PM peak hour (with Improvement Option 1) are approximately 44 vehicles for the westbound Delaware Route 48 left-turn lanes and 161 vehicles for the westbound Delaware Route 48 through lane.

¹⁶ Improvement Option 2 consists of adding a third through lane to the eastbound approach of Delaware Route 48.

¹⁷ Notable 95th percentile queue lengths for the Cases 3A & 3B AM peak hour (with Improvement Option 2) are approximately 43 vehicles for the eastbound Delaware Route 48 through lanes and 64 vehicles for the northbound Hercules Road right-turn lanes.

¹⁸ Notable 95th percentile queue lengths for the Cases 3A & 3B PM peak hour (with Improvement Option 2) are approximately 44 vehicles for the westbound Delaware Route 48 left-turn lanes and 161 vehicles for the westbound Delaware Route 48 through lane.

Table 6 (continued)
PEAK HOUR LEVELS OF SERVICE (LOS)
based on Traffic Impact Study for Delaware National
Report dated October 6, 2010
Prepared by Traffic Planning and Design, Inc.

Signalized Intersection ¹⁹	LOS per TIS ²⁰		LOS per McCormick Taylor	
	Weekday AM	Weekday PM	Weekday AM	Weekday PM
Delaware Route 48 & Hercules Road				
2016 with Delaware National (Cases 3C & 3D)	F (224.6)	F (251.5)	F (105.2)	F (109.5)
2016 with Delaware National (Cases 3C & 3D) <i>With Improvement Option 1</i> ²¹	F (213.3)	F (178.5)	F (90.5) ²²	E (59.7) ²³
2016 with Delaware National (Cases 3C & 3D) <i>With Improvement Option 2</i> ²⁴	N/A	N/A	D (49.2) ²⁵	E (59.3) ²³
2016 with Delaware National (Cases 3C & 3D) <i>With Improvement Option 3</i> ²⁶	N/A	N/A	D (48.9) ²⁵	C (24.9) ²⁷

¹⁹ For unsignalized analyses, the numbers in parentheses following levels of service are average delay per vehicle, measured in seconds. For signalized analyses, those numbers are X-critical, a composite volume-to-capacity ratio.

²⁰ The HCS analyses included in the TIS set the signal timings for all phases to their max splits (for all Cases during both peak hours). This assumption sometimes led to unrealistically poor results for the TIS. McCormick Taylor used lower splits when feasible to do so (within the parameters of DelDOT's timing plans for this signal), yielding more realistic results.

²¹ Improvement Option 1 consists of signal timing improvements by the TIS, basically consisting of reducing splits and overall cycle length. McCormick Taylor's analysis for Improvement Option 1 assumes some timing adjustments, also resulting in a lower cycle length.

²² Notable 95th percentile queue lengths for the Cases 3C & 3D AM peak hour (with Improvement Option 1) are approximately 95 vehicles for the eastbound Delaware Route 48 through lanes and 82 vehicles for the northbound Hercules Road right-turn lanes.

²³ Notable 95th percentile queue lengths for the Cases 3C & 3D PM peak hour (with Improvement Option 1 or Improvement Option 2) are approximately 50 vehicles for the westbound Delaware Route 48 left-turn lanes and 180 vehicles for the westbound Delaware Route 48 through lane.

²⁴ Improvement Option 2 consists of adding a third through lane to the eastbound approach of Delaware Route 48.

²⁵ Notable 95th percentile queue lengths for the Cases 3C & 3D AM peak hour (with Improvement Option 2 or Improvement Option 3) are approximately 52 vehicles for the eastbound Delaware Route 48 through lanes and 72 vehicles for the northbound Hercules Road right-turn lanes.

²⁶ Improvement Option 3 consists of adding a third through lane to the eastbound approach of Delaware Route 48 and a second through lane to the westbound approach of Delaware Route 48.

²⁷ Notable 95th percentile queue lengths for the Cases 3C & 3D PM peak hour (with Improvement Option 3) are approximately 50 vehicles for the westbound Delaware Route 48 left-turn lanes and 24 vehicles for the westbound Delaware Route 48 through lanes.

Table 7
PEAK HOUR LEVELS OF SERVICE (LOS)
based on Traffic Impact Study Addendum for Delaware National
Addendum dated June 13, 2012
Prepared by Traffic Planning and Design, Inc.

Signalized Intersection ²⁸	LOS per TIS Addendum		LOS per McCormick Taylor	
	Weekday AM	Weekday PM	Weekday AM	Weekday PM
Delaware Route 48 & Hercules Road				
2016 without Delaware National (Case 4A)	E (64.9)	F (83.7)	E (57.9)	D (48.6)
2016 with Delaware National (Case 4B)	N/A	N/A	E (60.4) ²⁹	D (53.6) ³⁰
2016 with Delaware National (Case 4B) With TIS Addendum Improvement Option 1 ³¹	D (54.0)	C (24.0)	D (53.5) ³²	C (21.7) ³³

²⁸ For unsignalized analyses, the numbers in parentheses following levels of service are average delay per vehicle, measured in seconds. For signalized analyses, those numbers are X-critical, a composite volume-to-capacity ratio.

²⁹ Notable 95th percentile queue lengths for the Case 4B AM peak hour are approximately 79 vehicles for the eastbound Delaware Route 48 through lanes and 64 vehicles for the northbound Hercules Road right-turn lanes.

³⁰ Notable 95th percentile queue lengths for the Case 4B PM peak hour are approximately 43 vehicles for the westbound Delaware Route 48 left-turn lanes and 164 vehicles for the westbound Delaware Route 48 through lane.

³¹ Improvement Option 1 consists of eliminating the northbound Hercules Road left-turn movement onto westbound Delaware Route 48. The northbound Hercules Road approach would consist of two 15-foot wide right-turn lanes. The TIS and McCormick Taylor assumed that drivers affected by the turning movement restriction would make a right turn onto eastbound Delaware Route 48 and then a u-turn to westbound Delaware Route 48 where they would continue west past Hercules Road toward their destination.

³² Notable 95th percentile queue lengths for the Case 4B AM peak hour (with Improvement Option 1) are approximately 73 vehicles for the eastbound Delaware Route 48 through lanes and 48 vehicles for the northbound Hercules Road right-turn lanes.

³³ The 95th percentile queue length for the westbound Delaware Route 48 left-turn lanes during the Case 4B PM peak hour (with Improvement Option 1) is approximately 17 vehicles. The westbound Delaware Route 48 through lane has no queue under Improvement Option 1 because it is a free movement.

Table 8
PEAK HOUR LEVELS OF SERVICE (LOS)
based on Traffic Impact Study for Delaware National
Report dated October 6, 2010
Prepared by Traffic Planning and Design, Inc.

Unsignalized Intersection ³⁴ Two-Way Stop Control (T-intersection)	LOS per TIS		LOS per McCormick Taylor	
	Weekday AM	Weekday PM	Weekday AM	Weekday PM
Delaware Route 48 & Stratton Drive				
2010 Existing (Case 1)				
Northbound Stratton Drive	D (25.8)	C (16.5)	D (31.0)	C (18.4)
Westbound Delaware Route 48 – Left	B (13.1)	A (9.0)	B (13.4)	A (8.8)
2016 without Delaware National (Case 2A)				
Northbound Stratton Drive	E (47.8)	C (21.9)	F (67.9)	D (26.2)
Westbound Delaware Route 48 – Left	C (17.2)	A (9.5)	C (18.2)	A (9.3)
2016 without Delaware National (Case 2B)				
Northbound Stratton Drive	F (55.5)	C (23.8)	F (83.8)	D (29.0)
Westbound Delaware Route 48 – Left	C (18.4)	A (9.7)	C (19.6)	A (9.5)
2016 with Delaware National (Cases 3A & 3B)				
Northbound Stratton Drive	E (47.4)	C (22.1)	F (69.0) ³⁵	D (26.2)
Westbound Delaware Route 48 – Left	C (17.2)	A (9.5)	C (18.2)	A (9.3)
2016 with Delaware National (Cases 3A & 3B) With Improvement Option 1 ³⁶				
Northbound Stratton Drive	N/A	N/A	F (59.0) ³⁷	D (25.4)
Westbound Delaware Route 48 – Left	N/A	N/A	C (18.2)	A (9.3)
2016 with Delaware National (Cases 3A & 3B) With Improvement Option 2 ³⁸				
Northbound Stratton Drive	N/A	N/A	D (28.1)	C (22.7)
Westbound Delaware Route 48 – Left	N/A	N/A	C (18.2)	A (9.3)

³⁴ For both unsignalized and signalized intersection analyses, the numbers in parentheses following levels of service (LOS) are average delay per vehicle, measured in seconds. For signalized analyses, LOS analysis results are given for only the overall intersection delay.

³⁵ The 95th percentile queue length for the northbound Stratton Drive approach during the Cases 3A & 3B AM peak hour is just over 1 vehicle.

³⁶ Improvement Option 1 consists of adding a separate right-turn lane on the northbound Stratton Drive approach.

³⁷ The 95th percentile queue length for the northbound Stratton Drive approach during the Cases 3A & 3B AM peak hour (with Improvement Option 1) is less than 1 vehicle.

³⁸ Improvement Option 2 consists of adding a separate right-turn lane on the northbound Stratton Drive approach and adding a second through lane on the eastbound Delaware Route 48 approach.

Table 8 (continued)
PEAK HOUR LEVELS OF SERVICE (LOS)
based on Traffic Impact Study for Delaware National
Report dated October 6, 2010
Prepared by Traffic Planning and Design, Inc.

Unsignalized Intersection ³⁹ Two-Way Stop Control (T-intersection)	LOS per TIS		LOS per McCormick Taylor	
	Weekday AM	Weekday PM	Weekday AM	Weekday PM
Delaware Route 48 & Stratton Drive				
2016 with Delaware National (Cases 3C & 3D)				
Northbound Stratton Drive	F (55.5)	C (23.9)	F (83.8) ⁴⁰	D (29.3)
Westbound Delaware Route 48 – Left	C (18.4)	A (9.7)	C (19.6)	A (9.5)
2016 with Delaware National (Cases 3C & 3D) With Improvement Option 1 ⁴¹				
Northbound Stratton Drive	N/A	N/A	F (69.9) ⁴²	D (28.4)
Westbound Delaware Route 48 – Left	N/A	N/A	C (19.6)	A (9.5)
2016 with Delaware National (Cases 3C & 3D) With Improvement Option 2 ⁴³				
Northbound Stratton Drive	N/A	N/A	D (32.1)	D (25.4)
Westbound Delaware Route 48 – Left	N/A	N/A	C (19.6)	A (9.5)

³⁹ For both unsignalized and signalized intersection analyses, the numbers in parentheses following levels of service (LOS) are average delay per vehicle, measured in seconds. For signalized analyses, LOS analysis results are given for only the overall intersection delay.

⁴⁰ The 95th percentile queue length for the northbound Stratton Drive approach during the Cases 3C & 3D AM peak hour is less than 2 vehicles.

⁴¹ Improvement Option 1 consists of adding a separate right-turn lane on the northbound Stratton Drive approach.

⁴² The 95th percentile queue length for the northbound Stratton Drive approach during the Cases 3C & 3D AM peak hour (with Improvement Option 1) is approximately 1 vehicle.

⁴³ Improvement Option 2 consists of adding a separate right-turn lane on the northbound Stratton Drive approach and adding a second through lane on the eastbound Delaware Route 48 approach.

Table 9
PEAK HOUR LEVELS OF SERVICE (LOS)
based on Traffic Impact Study for Delaware National
Report dated October 6, 2010
Prepared by Traffic Planning and Design, Inc.

Unsignalized Intersection ⁴⁴ Two-Way Stop Control (T-intersection)	LOS per TIS		LOS per McCormick Taylor	
	Weekday AM	Weekday PM	Weekday AM	Weekday PM
Delaware Route 48 & Westgate Drive				
2010 Existing (Case 1)				
Northbound Westgate Drive	E (49.3)	C (23.9)	D (32.5)	C (20.4)
Westbound Delaware Route 48 – Left	B (11.7)	A (9.0)	B (11.5)	A (8.9)
2016 without Delaware National (Case 2A)				
Northbound Westgate Drive	F (*)	E (47.0)	F (83.5)	E (35.2)
Westbound Delaware Route 48 – Left	B (14.7)	A (9.5)	B (14.4)	A (9.5)
2016 without Delaware National (Case 2B)				
Northbound Westgate Drive	F (*)	F (55.6)	F (108.5)	E (43.7)
Westbound Delaware Route 48 – Left	C (15.6)	A (9.7)	C (15.2)	A (9.6)
2016 with Delaware National (Cases 3A & 3B)				
Northbound Westgate Drive	F (*)	E (47.1)	F (83.5) ⁴⁵	E (36.6) ⁴⁶
Westbound Delaware Route 48 – Left	B (14.7)	A (9.6)	B (14.4)	A (9.5)
2016 with Delaware National (Cases 3A & 3B) With Improvement Option 1 ⁴⁷				
Northbound Westgate Drive	N/A	N/A	F (83.5) ⁴⁵	E (35.5) ⁴⁶
Westbound Delaware Route 48 – Left	N/A	N/A	B (14.4)	A (9.5)
2016 with Delaware National (Cases 3A & 3B) With Improvement Option 2 ⁴⁸				
Northbound Westgate Drive	N/A	N/A	C (17.5)	E (41.3) ⁴⁶
Westbound Delaware Route 48 – Left	N/A	N/A	B (14.4)	A (9.5)

* HCS could not calculate delay

⁴⁴ For both unsignalized and signalized intersection analyses, the numbers in parentheses following levels of service (LOS) are average delay per vehicle, measured in seconds. For signalized analyses, LOS analysis results are given for only the overall intersection delay.

⁴⁵ The 95th percentile queue length for the northbound Westgate Drive approach during the Cases 3A & 3B AM peak hour (with or without Improvement Option 1) is approximately 4 vehicles.

⁴⁶ The 95th percentile queue length for the northbound Westgate Drive approach during the Cases 3A & 3B PM peak hour (with or without Improvement Option 1 or Improvement Option 2) is less than 1 vehicle. The PM peak hour volume on the northbound approach is less than 10 vehicles in all Cases.

⁴⁷ Improvement Option 1 consists of adding a separate right-turn lane on the northbound Westgate Drive approach.

⁴⁸ Improvement Option 2 consists of adding a second through lane on the eastbound Delaware Route 48 approach.

Table 9 (continued)
PEAK HOUR LEVELS OF SERVICE (LOS)
based on Traffic Impact Study for Delaware National
Report dated October 6, 2010
Prepared by Traffic Planning and Design, Inc.

Unsignalized Intersection ⁴⁹ Two-Way Stop Control (T-intersection)	LOS per TIS		LOS per McCormick Taylor	
	Weekday AM	Weekday PM	Weekday AM	Weekday PM
Delaware Route 48 & Westgate Drive				
2016 with Delaware National (Cases 3C & 3D)				
Northbound Westgate Drive	F (*)	F (55.7)	F (108.5) ⁵⁰	E (43.7) ⁵¹
Westbound Delaware Route 48 – Left	C (15.6)	A (9.7)	C (15.3)	A (9.7)
2016 with Delaware National (Cases 3C & 3D) With Improvement Option 1 ⁵²				
Northbound Westgate Drive	N/A	N/A	F (108.5) ⁵⁰	E (42.3) ⁵¹
Westbound Delaware Route 48 – Left	N/A	N/A	C (15.3)	A (9.7)
2016 with Delaware National (Cases 3C & 3D) With Improvement Option 2 ⁵³				
Northbound Westgate Drive	N/A	N/A	C (18.5)	F (51.1) ⁵¹
Westbound Delaware Route 48 – Left	N/A	N/A	C (15.3)	A (9.7)

* HCS could not calculate delay

⁴⁹ For both unsignalized and signalized intersection analyses, the numbers in parentheses following levels of service (LOS) are average delay per vehicle, measured in seconds. For signalized analyses, LOS analysis results are given for only the overall intersection delay.

⁵⁰ The 95th percentile queue length for the northbound Westgate Drive approach during the Cases 3C & 3D AM peak hour (with or without Improvement Option 1) is approximately 4 vehicles.

⁵¹ The 95th percentile queue length for the northbound Westgate Drive approach during the Cases 3C & 3D PM peak hour (with or without Improvement Option 1 or Improvement Option 2) is less than 1 vehicle. The PM peak hour volume on the northbound approach is less than 10 vehicles in all Cases.

⁵² Improvement Option 1 consists of adding a separate right-turn lane on the northbound Westgate Drive approach.

⁵³ Improvement Option 2 consists of adding a second through lane on the eastbound Delaware Route 48 approach.

Table 10
PEAK HOUR LEVELS OF SERVICE (LOS)
based on Traffic Impact Study for Delaware National
Report dated October 6, 2010
Prepared by Traffic Planning and Design, Inc.

Unsignalized Intersection ⁵⁴ Two-Way Stop Control (T-intersection)	LOS per TIS		LOS per McCormick Taylor	
	Weekday AM	Weekday PM	Weekday AM	Weekday PM
Delaware Route 48 & Rolling Mill Road				
2010 Existing (Case 1)				
Southbound Rolling Mill Road – Right	B (10.6)	C (16.5)	B (10.5)	C (19.9)
2016 without Delaware National (Case 2A)				
Southbound Rolling Mill Road – Right	B (11.3)	C (23.6)	B (11.2)	D (31.5)
2016 without Delaware National (Case 2B)				
Southbound Rolling Mill Road – Right	B (11.7)	D (26.8)	B (11.6)	E (37.1)
2016 with Delaware National (Cases 3A & 3B)				
Southbound Rolling Mill Road – Right	B (11.4)	C (24.0)	B (11.3)	D (32.1)
2016 with Delaware National (Cases 3C & 3D)				
Southbound Rolling Mill Road – Right	B (11.8)	D (27.4)	B (11.7)	E (38.0) ⁵⁵

⁵⁴ For both unsignalized and signalized intersection analyses, the numbers in parentheses following levels of service (LOS) are average delay per vehicle, measured in seconds. For signalized analyses, LOS analysis results are given for only the overall intersection delay.

⁵⁵ The 95th percentile queue length for the southbound Rolling Mill Road approach during the PM peak hour (in all Cases) is less than 1 vehicle. The PM peak hour volume on the southbound approach is less than 5 vehicles in all Cases.

Table 11
PEAK HOUR LEVELS OF SERVICE (LOS)
based on Traffic Impact Study for Delaware National
Report dated October 6, 2010
Prepared by Traffic Planning and Design, Inc.

Unsignalized Intersection ⁵⁶ Two-Way Stop Control (T-intersection)	LOS per TIS		LOS per McCormick Taylor	
	Weekday AM	Weekday PM	Weekday AM	Weekday PM
Rolling Mill Road & Foxhill Lane				
2010 and 2016 (All Cases Have Same Volumes)				
Northbound Rolling Mill Road – Left	NA	NA	A (7.7)	A (7.2)
Eastbound Foxhill Lane	NA	NA	A (8.6)	A (8.5)

⁵⁶ For both unsignalized and signalized intersection analyses, the numbers in parentheses following levels of service (LOS) are average delay per vehicle, measured in seconds. For signalized analyses, LOS analysis results are given for only the overall intersection delay.

Table 12
PEAK HOUR LEVELS OF SERVICE (LOS)
based on Traffic Impact Study for Delaware National
Report dated October 6, 2010
Prepared by Traffic Planning and Design, Inc.

Unsignalized Intersection ⁵⁷ Two-Way Stop Control (T-intersection)	LOS per TIS		LOS per McCormick Taylor	
	Weekday AM	Weekday PM	Weekday AM	Weekday PM
Delaware Route 48 & Hampton Way				
2010 Existing (Case 1)				
Southbound Hampton Way – Right	B (11.0)	C (18.7)	B (10.6)	C (19.8)
2016 without Delaware National (Case 2A)				
Southbound Hampton Way – Right	B (11.9)	D (28.4)	B (11.4)	D (30.9)
2016 without Delaware National (Case 2B)				
Southbound Hampton Way – Right	B (12.5)	D (33.1)	B (11.8)	E (36.6)
2016 with Delaware National (Cases 3A & 3B)				
Southbound Hampton Way – Right	B (12.0)	D (29.0)	B (11.4)	D (31.7)
2016 with Delaware National (Cases 3C & 3D)				
Southbound Hampton Way – Right	B (12.5)	D (34.0)	B (11.9)	E (37.4) ⁵⁸

⁵⁷ For both unsignalized and signalized intersection analyses, the numbers in parentheses following levels of service (LOS) are average delay per vehicle, measured in seconds. For signalized analyses, LOS analysis results are given for only the overall intersection delay.

⁵⁸ The 95th percentile queue length for the southbound Hampton Way approach during the PM peak hour (in all Cases) is less than 1 vehicle. The PM peak hour volume on the southbound approach is less than 10 vehicles in all Cases.

Table 13
PEAK HOUR LEVELS OF SERVICE (LOS)
based on Traffic Impact Study for Delaware National
Report dated October 6, 2010
Prepared by Traffic Planning and Design, Inc.

Signalized Intersection ⁵⁹	LOS per TIS ⁶⁰		LOS per McCormick Taylor	
	Weekday AM	Weekday PM	Weekday AM	Weekday PM
Hercules Road & Hercules Research Center Entrance				
2010 Existing (Case 1)	F (117.9)	C (23.9)	A (7.4)	A (5.9)
2016 without Delaware National (Case 2A)	F (275.9)	C (27.0)	B (14.9)	A (7.0)
2016 without Delaware National (Case 2B)	F (339.7)	C (29.6)	C (32.0)	A (7.0)
2016 with Delaware National (Case 3A)	F (267.0)	C (28.1)	C (24.9)	A (9.6)
2016 with Delaware National (Case 3B)	F (274.2)	C (28.2)	B (15.5)	A (7.0)
2016 with Delaware National (Case 3B) With Improvement Option 1 ⁶¹	F (124.5)	C (24.6)	N/A	N/A
2016 with Delaware National (Case 3C)	F (329.0)	C (31.0)	D (46.2)	B (10.1)
2016 with Delaware National (Case 3D)	F (337.2)	C (31.3)	C (33.3) ⁶²	A (6.9)
2016 with Delaware National (Case 3D) With Improvement Option 1 ⁶¹	F (170.6)	C (28.4)	N/A	N/A

⁵⁹ For unsignalized analyses, the numbers in parentheses following levels of service are average delay per vehicle, measured in seconds. For signalized analyses, those numbers are X-critical, a composite volume-to-capacity ratio.

⁶⁰ The HCS analyses included in the TIS set the signal timings for all phases to their max splits. For example, in the Case 1 AM peak hour, the TIS set the westbound phase green time to 54 seconds, even though the volume on that approach is only 5 vehicles for the entire AM peak hour. When the westbound phase is called, it will gap out much sooner than the max. This assumption led to unrealistically poor results for the TIS. McCormick Taylor used reasonable timings within the parameters of DeDOT's timing plans for this signal, yielding more realistic results.

⁶¹ Improvement Option 1 consists of signal timing improvements by the TIS. Essentially, this means not setting every phase to the max split. McCormick Taylor has no results for Improvement Option 1 because our timings were already set in this way.

⁶² The 95th percentile queue length for the northbound Hercules Road through movement during the Case 3D AM peak hour is approximately 104 vehicles.

Table 14
PEAK HOUR LEVELS OF SERVICE (LOS)
based on Traffic Impact Study for Delaware National
Report dated October 6, 2010
Prepared by Traffic Planning and Design, Inc.

Unsignalized Intersection ⁶³ Two-Way Stop Control (T-intersection)	LOS per TIS		LOS per McCormick Taylor	
	Weekday AM	Weekday PM	Weekday AM	Weekday PM
Hercules Road & Cheshire Court⁶⁴				
2010 Existing (Case 1)				
Northbound Hercules Road – Left	A (7.8)	A (9.6)	A (7.6)	B (10.2)
Eastbound Cheshire Court	D (30.0)	C (17.3)	C (18.5)	B (14.0)
2016 without Delaware National (Case 2A)				
Northbound Hercules Road – Left	A (8.1)	B (11.4)	A (7.8)	B (14.2)
Eastbound Cheshire Court	F (71.4)	D (27.9)	D (30.4)	D (26.7)
2016 without Delaware National (Case 2B)				
Northbound Hercules Road – Left	A (8.4)	B (12.5)	A (8.0)	C (17.7)
Eastbound Cheshire Court	F (118.0)	E (35.2)	E (39.6)	E (39.3)
2016 with Delaware National (Case 3A)				
Northbound Hercules Road – Left	A (8.3)	B (11.6)	A (7.9)	C (15.3)
Eastbound Cheshire Court	F (83.7)	D (29.0)	D (32.5)	D (29.3)
2016 with Delaware National (Case 3B)				
Northbound Hercules Road – Left	A (8.3)	B (11.6)	A (7.9)	B (14.7)
Eastbound Cheshire Court	F (83.7)	D (29.0)	D (32.5)	D (28.5)
2016 with Delaware National (Case 3C)				
Northbound Hercules Road – Left	A (8.6)	B (12.7)	A (8.1)	C (19.5)
Eastbound Cheshire Court	F (141.7)	E (36.8)	E (43.7) ⁶⁵	E (45.0) ⁶⁵
2016 with Delaware National (Case 3D)				
Northbound Hercules Road – Left	A (8.6)	B (12.7)	A (8.1)	C (18.8)
Eastbound Cheshire Court	F (141.7)	E (36.8)	E (43.3) ⁶⁵	E (43.3) ⁶⁵

⁶³ For both unsignalized and signalized intersection analyses, the numbers in parentheses following levels of service (LOS) are average delay per vehicle, measured in seconds. For signalized analyses, LOS analysis results are given for only the overall intersection delay.

⁶⁴ The results on this page are for the three-leg intersection configuration, as this intersection appeared when traffic counts were conducted in April 2010. Since that time, a fourth leg has been added (Greenville Overlook entrance). The TIS did not account for this fourth leg in their analysis of future conditions. As shown on this page, McCormick Taylor evaluated the intersection as a three-leg intersection (to be consistent with the TIS). McCormick Taylor also conducted additional analysis to account for the fourth leg, and that analysis is found on the next five pages.

⁶⁵ The 95th percentile queue length for the eastbound Cheshire Court approach during the Cases 3C & 3D AM and PM peak hour is less than 1 vehicle. AM/PM peak hr volumes on this approach are less than 5 vehicles (all Cases).

Table 14 (continued)
PEAK HOUR LEVELS OF SERVICE (LOS)
based on Traffic Impact Study for Delaware National
Report dated October 6, 2010
Prepared by Traffic Planning and Design, Inc.

Unsignalized Intersection ⁶⁶ Two-Way Stop Control	LOS per TIS		LOS per McCormick Taylor	
	Weekday AM	Weekday PM	Weekday AM	Weekday PM
Hercules Road & Cheshire Court / Greenville Overlook Ent. ⁶⁷				
2016 without Delaware National (Case 2A)				
Northbound Hercules Road – Left	NA	NA	A (7.8)	B (13.2)
Southbound Hercules Road – Left	NA	NA	B (12.4)	A (8.5)
Eastbound Cheshire Court	NA	NA	F (60.4) ⁶⁸	C (23.1) ⁶⁸
Westbound Greenville Overlook Entrance	NA	NA	F (105.9) ⁶⁹	F (213.6) ⁷⁰
2016 without Delaware National (Case 2B)				
Northbound Hercules Road – Left	NA	NA	A (7.9)	C (16.1)
Southbound Hercules Road – Left	NA	NA	B (13.6)	A (8.8)
Eastbound Cheshire Court	NA	NA	F (99.6) ⁶⁸	D (32.9) ⁶⁸
Westbound Greenville Overlook Entrance	NA	NA	F (218.9) ⁷¹	F (1160) ⁷²

⁶⁶ For both unsignalized and signalized intersection analyses, the numbers in parentheses following levels of service (LOS) are average delay per vehicle, measured in seconds. For signalized analyses, LOS analysis results are given for only the overall intersection delay.

⁶⁷ The results on this page are for the four-leg intersection configuration, which accounts for the Greenville Overlook entrance that was added sometime after traffic counts were conducted in April 2010.

⁶⁸ The 95th percentile queue length for the eastbound Cheshire Court approach during both the AM and PM peak hour is less than 1 vehicle, and the AM and PM peak hour volumes on this approach are less than 5 vehicles (for all Cases, with or without Improvement Option 1).

⁶⁹ The 95th percentile queue length for the westbound Greenville Overlook Entrance approach during the Case 2A AM peak hour is approximately 5 vehicles.

⁷⁰ The 95th percentile queue length for the westbound Greenville Overlook Entrance approach during the Case 2A PM peak hour is approximately 5 vehicles.

⁷¹ The 95th percentile queue length for the westbound Greenville Overlook Entrance approach during the Case 2B AM peak hour is approximately 7 vehicles.

⁷² The 95th percentile queue length for the westbound Greenville Overlook Entrance approach during the Case 2B PM peak hour is approximately 8 vehicles.

Table 14 (continued)
PEAK HOUR LEVELS OF SERVICE (LOS)
based on Traffic Impact Study for Delaware National
Report dated October 6, 2010
Prepared by Traffic Planning and Design, Inc.

Unsignalized Intersection ⁷³ Two-Way Stop Control	LOS per TIS		LOS per McCormick Taylor	
	Weekday AM	Weekday PM	Weekday AM	Weekday PM
Hercules Road & Cheshire Court / Greenville Overlook Ent. ⁷⁴				
2016 with Delaware National (Case 3A)				
Northbound Hercules Road – Left	NA	NA	A (7.9)	B (14.0)
Southbound Hercules Road – Left	NA	NA	B (12.5)	A (8.7)
Eastbound Cheshire Court	NA	NA	F (67.0) ⁷⁵	C (24.8) ⁷⁵
Westbound Greenville Overlook Entrance	NA	NA	F (126.5) ⁷⁶	F (478.1) ⁷⁷
2016 with Delaware National (Case 3A) With Improvement Option 1 ⁷⁸				
Northbound Hercules Road – Left	NA	NA	A (7.9)	B (14.0)
Southbound Hercules Road – Left	NA	NA	B (12.5)	A (8.7)
Eastbound Cheshire Court	NA	NA	F (67.0) ⁷⁵	C (24.8) ⁷⁵
Westbound Greenville Overlook Entrance	NA	NA	F (60.5) ⁷⁹	F (269.5) ⁸⁰

⁷³ For both unsignalized and signalized intersection analyses, the numbers in parentheses following levels of service (LOS) are average delay per vehicle, measured in seconds. For signalized analyses, LOS analysis results are given for only the overall intersection delay.

⁷⁴ The results on this page are for the four-leg intersection configuration, which accounts for the Greenville Overlook entrance that was added sometime after traffic counts were conducted in April 2010.

⁷⁵ The 95th percentile queue length for the eastbound Cheshire Court approach during both the AM and PM peak hour is less than 1 vehicle, and the AM and PM peak hour volumes on this approach are less than 5 vehicles (for all Cases, with or without Improvement Option 1).

⁷⁶ The 95th percentile queue length for the westbound Greenville Overlook Entrance approach during the Case 3A AM peak hour (without Improvement Option 1) is approximately 5 vehicles.

⁷⁷ The 95th percentile queue length for the westbound Greenville Overlook Entrance approach during the Case 3A PM peak hour (without Improvement Option 1) is approximately 6 vehicles.

⁷⁸ Improvement Option 1 would restripe the westbound approach as one shared through/left-turn lane and one right-turn lane.

⁷⁹ The 95th percentile queue length for the westbound Greenville Overlook Entrance approach during the Case 3A AM peak hour (with Improvement Option 1) is approximately 2 vehicles.

⁸⁰ The 95th percentile queue length for the westbound Greenville Overlook Entrance approach during the Case 3A PM peak hour (with Improvement Option 1) is approximately 3 vehicles.

Table 14 (continued)
PEAK HOUR LEVELS OF SERVICE (LOS)
based on Traffic Impact Study for Delaware National
Report dated October 6, 2010
Prepared by Traffic Planning and Design, Inc.

Unsignalized Intersection ⁸¹ Two-Way Stop Control	LOS per TIS		LOS per McCormick Taylor	
	Weekday AM	Weekday PM	Weekday AM	Weekday PM
Hercules Road & Cheshire Court / Greenville Overlook Ent. ⁸²				
2016 with Delaware National (Case 3B)				
Northbound Hercules Road – Left	NA	NA	A (7.9)	B (13.7)
Southbound Hercules Road – Left	NA	NA	B (12.5)	A (8.7)
Eastbound Cheshire Court	NA	NA	F (67.0) ⁸³	C (24.6) ⁸³
Westbound Greenville Overlook Entrance	NA	NA	F (126.5) ⁸⁴	F (366.3) ⁸⁵
2016 with Delaware National (Case 3B) With Improvement Option 1 ⁸⁶				
Northbound Hercules Road – Left	NA	NA	A (7.9)	B (13.7)
Southbound Hercules Road – Left	NA	NA	B (12.5)	A (8.7)
Eastbound Cheshire Court	NA	NA	F (67.0) ⁸³	C (24.6) ⁸³
Westbound Greenville Overlook Entrance	NA	NA	F (60.5) ⁸⁷	F (210.6) ⁸⁸

⁸¹ For both unsignalized and signalized intersection analyses, the numbers in parentheses following levels of service (LOS) are average delay per vehicle, measured in seconds. For signalized analyses, LOS analysis results are given for only the overall intersection delay.

⁸² The results on this page are for the four-leg intersection configuration, which accounts for the Greenville Overlook entrance that was added sometime after traffic counts were conducted in April 2010.

⁸³ The 95th percentile queue length for the eastbound Cheshire Court approach during both the AM and PM peak hour is less than 1 vehicle, and the AM and PM peak hour volumes on this approach are less than 5 vehicles (for all Cases, with or without Improvement Option 1).

⁸⁴ The 95th percentile queue length for the westbound Greenville Overlook Entrance approach during the Case 3B AM peak hour (without Improvement Option 1) is approximately 5 vehicles.

⁸⁵ The 95th percentile queue length for the westbound Greenville Overlook Entrance approach during the Case 3B PM peak hour (without Improvement Option 1) is approximately 6 vehicles.

⁸⁶ Improvement Option 1 would restripe the westbound approach as one shared through/left-turn lane and one right-turn lane.

⁸⁷ The 95th percentile queue length for the westbound Greenville Overlook Entrance approach during the Case 3B AM peak hour (with Improvement Option 1) is approximately 2 vehicles.

⁸⁸ The 95th percentile queue length for the westbound Greenville Overlook Entrance approach during the Case 3B PM peak hour (with Improvement Option 1) is approximately 3 vehicles.

Table 14 (continued)
PEAK HOUR LEVELS OF SERVICE (LOS)
based on Traffic Impact Study for Delaware National
Report dated October 6, 2010
Prepared by Traffic Planning and Design, Inc.

Unsignalized Intersection ⁸⁹ Two-Way Stop Control	LOS per TIS		LOS per McCormick Taylor	
	Weekday AM	Weekday PM	Weekday AM	Weekday PM
Hercules Road & Cheshire Court / Greenville Overlook Ent. ⁹⁰				
2016 with Delaware National (Case 3C)				
Northbound Hercules Road – Left	NA	NA	A (8.0)	C (17.5)
Southbound Hercules Road – Left	NA	NA	B (13.7)	A (8.9)
Eastbound Cheshire Court	NA	NA	F (110.7) ⁹¹	E (36.9) ⁹¹
Westbound Greenville Overlook Entrance	NA	NA	F (261.2) ⁹²	F (2150) ⁹³
2016 with Delaware National (Case 3C) <i>With Improvement Option 1</i> ⁹⁴				
Northbound Hercules Road – Left	NA	NA	A (8.0)	C (17.5)
Southbound Hercules Road – Left	NA	NA	B (13.7)	A (8.9)
Eastbound Cheshire Court	NA	NA	F (110.7) ⁹¹	E (36.9) ⁹¹
Westbound Greenville Overlook Entrance	NA	NA	F (105.0) ⁹⁵	F (1008) ⁹⁶

⁸⁹ For both unsignalized and signalized intersection analyses, the numbers in parentheses following levels of service (LOS) are average delay per vehicle, measured in seconds. For signalized analyses, LOS analysis results are given for only the overall intersection delay.

⁹⁰ The results on this page are for the four-leg intersection configuration, which accounts for the Greenville Overlook entrance that was added sometime after traffic counts were conducted in April 2010.

⁹¹ The 95th percentile queue length for the eastbound Cheshire Court approach during both the AM and PM peak hour is less than 1 vehicle, and the AM and PM peak hour volumes on this approach are less than 5 vehicles (for all Cases, with or without Improvement Option 1).

⁹² The 95th percentile queue length for the westbound Greenville Overlook Entrance approach during the Case 3C AM peak hour (without Improvement Option 1) is approximately 7 vehicles.

⁹³ The 95th percentile queue length for the westbound Greenville Overlook Entrance approach during the Case 3C PM peak hour (without Improvement Option 1) is approximately 9 vehicles.

⁹⁴ Improvement Option 1 would restripe the westbound approach as one shared through/left-turn lane and one right-turn lane.

⁹⁵ The 95th percentile queue length for the westbound Greenville Overlook Entrance approach during the Case 3C AM peak hour (with Improvement Option 1) is approximately 3 vehicles.

⁹⁶ The 95th percentile queue length for the westbound Greenville Overlook Entrance approach during the Case 3C PM peak hour (with Improvement Option 1) is approximately 4 vehicles.

Table 14 (continued)
PEAK HOUR LEVELS OF SERVICE (LOS)
based on Traffic Impact Study for Delaware National
Report dated October 6, 2010
Prepared by Traffic Planning and Design, Inc.

Unsignalized Intersection ⁹⁷ Two-Way Stop Control	LOS per TIS		LOS per McCormick Taylor	
	Weekday AM	Weekday PM	Weekday AM	Weekday PM
Hercules Road & Cheshire Court / Greenville Overlook Ent. ⁹⁸				
2016 with Delaware National (Case 3D)				
Northbound Hercules Road – Left	NA	NA	A (8.0)	C (17.1)
Southbound Hercules Road – Left	NA	NA	B (13.7)	A (8.9)
Eastbound Cheshire Court	NA	NA	F (110.7) ⁹⁹	E (36.0) ⁹⁹
Westbound Greenville Overlook Entrance	NA	NA	F (248.2) ¹⁰⁰	F (1702) ¹⁰¹
2016 with Delaware National (Case 3D) With Improvement Option 1 ¹⁰²				
Northbound Hercules Road – Left	NA	NA	A (8.0)	C (17.1)
Southbound Hercules Road – Left	NA	NA	B (13.7)	A (8.9)
Eastbound Cheshire Court	NA	NA	F (110.7) ⁹⁹	E (36.0) ⁹⁹
Westbound Greenville Overlook Entrance	NA	NA	F (99.6) ¹⁰³	F (821.8) ¹⁰⁴

Signalized Intersection ⁹⁷	LOS per TIS		LOS per McCormick Taylor	
	Weekday AM	Weekday PM	Weekday AM	Weekday PM
Hercules Road & Cheshire Court / Greenville Overlook Ent. ⁹⁸				
2016 with Delaware National (Cases 3A & 3B)	N/A	N/A	C (29.7)	C (26.2)
2016 with Delaware National (Cases 3C & 3D)	N/A	N/A	D (48.5)	C (28.8)

⁹⁷ For both unsignalized and signalized intersection analyses, the numbers in parentheses following levels of service (LOS) are average delay per vehicle, measured in seconds. For signalized analyses, LOS analysis results are given for only the overall intersection delay.

⁹⁸ The results on this page are for the four-leg intersection configuration, which accounts for the Greenville Overlook entrance that was added sometime after traffic counts were conducted in April 2010.

⁹⁹ The 95th percentile queue length for the eastbound Cheshire Court approach during both the AM and PM peak hour is less than 1 vehicle, and the AM and PM peak hour volumes on this approach are less than 5 vehicles (for all Cases, with or without Improvement Option 1).

¹⁰⁰ The 95th percentile queue length for the westbound Greenville Overlook Entrance approach during the Case 3D AM peak hour (without Improvement Option 1) is approximately 7 vehicles.

¹⁰¹ The 95th percentile queue length for the westbound Greenville Overlook Entrance approach during the Case 3D PM peak hour (without Improvement Option 1) is approximately 9 vehicles.

¹⁰² Improvement Option 1 would restripe the westbound approach as one shared through/left-turn lane and one right-turn lane.

¹⁰³ The 95th percentile queue length for the westbound Greenville Overlook Entrance approach during the Case 3D AM peak hour (with Improvement Option 1) is approximately 3 vehicles.

¹⁰⁴ The 95th percentile queue length for the westbound Greenville Overlook Entrance approach during the Case 3D PM peak hour (with Improvement Option 1) is approximately 4 vehicles.

Table 15
PEAK HOUR LEVELS OF SERVICE (LOS)
based on Traffic Impact Study for Delaware National
Report dated October 6, 2010
Prepared by Traffic Planning and Design, Inc.

Unsignalized Intersection ¹⁰⁵ Two-Way Stop Control (T-intersection)	LOS per TIS ¹⁰⁶		LOS per McCormick Taylor	
	Weekday AM	Weekday PM	Weekday AM	Weekday PM
Hercules Road & Tall Trees Lane				
2010 Existing (Case 1)				
Southbound Hercules Road – Left	A (9.8)	A (7.9)	B (10.1)	A (7.9)
Westbound Tall Trees Lane	B (15.0)	C (17.1)	C (16.9)	D (28.7)
2016 without Delaware National (Case 2A)				
Southbound Hercules Road – Left	B (11.7)	A (8.2)	B (11.8)	A (8.2)
Westbound Tall Trees Lane	C (20.9)	D (26.6)	C (23.9)	F (53.0)
2016 without Delaware National (Case 2B)				
Southbound Hercules Road – Left	B (12.6)	A (8.4)	B (12.9)	A (8.4)
Westbound Tall Trees Lane	C (24.1)	D (34.0)	D (28.7)	F (77.0)
2016 with Delaware National (Cases 3A & 3B)				
Southbound Hercules Road – Left	B (11.7)	A (8.3)	B (11.9)	A (8.3)
Westbound Tall Trees Lane	C (21.1)	D (28.7)	C (24.4)	F (60.4) ¹⁰⁷
2016 with Delaware National (Cases 3C & 3D)				
Southbound Hercules Road – Left	B (12.7)	A (8.5)	B (13.0)	A (8.6)
Westbound Tall Trees Lane	C (24.6)	E (36.9)	D (29.2)	F (86.8) ¹⁰⁷

¹⁰⁵ For both unsignalized and signalized intersection analyses, the numbers in parentheses following levels of service (LOS) are average delay per vehicle, measured in seconds. For signalized analyses, LOS analysis results are given for only the overall intersection delay.

¹⁰⁶ The TIS analyzed this intersection with volumes for future conditions that assumed the Greenville Overlook entrance would be located south of Tall Trees Lane. Sometime after traffic counts were conducted in April 2011, the actual entrance for Greenville Overlook was constructed as a fourth leg to the intersection of Hercules Road & Cheshire Court, which is north of Tall Trees Lane. McCormick Taylor adjusted volumes at the Tall Trees Lane intersection accordingly, and our analysis results shown here are based on those adjusted volumes.

¹⁰⁷ The 95th percentile queue length for the westbound Tall Trees Lane approach during the PM peak hour (in all Cases) is less than 1 vehicle. The PM peak hour volume on the westbound approach is less than 5 vehicles in all Cases.

Table 16
PEAK HOUR LEVELS OF SERVICE (LOS)
based on Traffic Impact Study for Delaware National
Report dated October 6, 2010
Prepared by Traffic Planning and Design, Inc.

Unsignalized Intersection ¹⁰⁸ Two-Way Stop Control (T-intersection)	LOS per TIS ¹⁰⁹		LOS per McCormick Taylor	
	Weekday AM	Weekday PM	Weekday AM	Weekday PM
Red Clay Drive & Penn Oak Drive				
2010 Existing (Case 1)				
Southbound Penn Oak Drive – Left	A (8.8)	A (8.8)	A (7.2)	A (7.2)
Westbound Red Clay Drive	A (7.2)	A (7.2)	A (8.5)	A (8.6)
2016 without Delaware National (Cases 2A & 2B)				
Southbound Penn Oak Drive – Left	A (8.8)	A (8.9)	A (7.2)	A (7.2)
Westbound Red Clay Drive	A (7.2)	A (7.2)	A (8.5)	A (8.6)
2016 with Delaware National (Cases 3A-3D) <i>with originally-proposed south site entrance location on Penn Oak Drive south of Red Clay Drive</i>				
Southbound Penn Oak Drive – Left	A (9.9)	B (10.5)	A (7.4)	A (7.3)
Westbound Red Clay Drive	A (7.2)	A (7.3)	A (9.0)	A (9.2)
2016 with Delaware National (Cases 3A-3D) <i>with redistributed volume due to relocated site entrance location on Red Clay Drive east of Penn Oak Drive</i>				
Southbound Penn Oak Drive – Left	NA	NA	A (7.3)	A (7.2)
Westbound Red Clay Drive	NA	NA	A (8.9)	A (9.1)

¹⁰⁸ For both unsignalized and signalized intersection analyses, the numbers in parentheses following levels of service (LOS) are average delay per vehicle, measured in seconds. For signalized analyses, LOS analysis results are given for only the overall intersection delay.

¹⁰⁹ The TIS analyzed this intersection with incorrect orientation in HCS, thereby treating the northbound and southbound approaches as stop-controlled when the actual stop sign is only on the westbound approach. McCormick Taylor analyzed this intersection with the correct orientation.

Table 17
PEAK HOUR LEVELS OF SERVICE (LOS)
based on Traffic Impact Study for Delaware National
Report dated October 6, 2010
Prepared by Traffic Planning and Design, Inc.

Unsignalized Intersection ¹¹⁰ Two-Way Stop Control (T-intersection)	LOS per TIS		LOS per McCormick Taylor	
	Weekday AM	Weekday PM	Weekday AM	Weekday PM
Centerville Road & Red Clay Drive ¹¹¹				
2010 Existing (Case 1)				
Northbound Centerville Road – Left	A (8.8)	A (8.3)	A (8.4)	A (8.2)
Southbound Centerville Road – Left	A (9.6)	A (8.3)	A (8.9)	A (8.3)
Eastbound Red Clay Drive	C (17.2)	C (18.3)	C (22.9)	D (28.5)
Westbound Red Clay Drive	C (24.5)	C (21.6)	C (24.3)	D (29.3)
2016 without Delaware National (Case 2A)				
Northbound Centerville Road – Left	A (9.8)	A (9.0)	A (9.2)	A (9.0)
Southbound Centerville Road – Left	B (14.3)	A (8.8)	B (11.3)	A (8.7)
Eastbound Red Clay Drive	F (*)	F (948.4)	F (324.1)	F (877.2)
Westbound Red Clay Drive	F (*)	F (143.3)	F (118.5)	F (208.3)
2016 without Delaware National (Case 2B)				
Northbound Centerville Road – Left	A (9.9)	A (9.1)	A (9.3)	A (9.1)
Southbound Centerville Road – Left	B (14.7)	A (8.9)	B (11.6)	A (8.8)
Eastbound Red Clay Drive	F (*)	F (1107)	F (391.5)	F (1007)
Westbound Red Clay Drive	F (*)	F (162.9)	F (131.5)	F (246.1)
2016 with Delaware National (Cases 3A & 3B)				
Northbound Centerville Road – Left	A (9.9)	A (9.6)	A (9.3)	A (9.3)
Southbound Centerville Road – Left	B (14.3)	A (8.8)	B (11.4)	A (8.7)
Eastbound Red Clay Drive	F (*)	F (2259)	F (522.8)	F (1208)
Westbound Red Clay Drive	F (*)	F (723.2)	F (145.4)	F (344.8)
2016 with Delaware National (Cases 3C & 3D)				
Northbound Centerville Road – Left	B (10.0+)	A (9.7)	A (9.4)	A (9.5)
Southbound Centerville Road – Left	B (14.7)	A (8.9)	B (11.6)	A (8.8)
Eastbound Red Clay Drive	F (*)	F (2796)	F (623.1)	F (1381)
Westbound Red Clay Drive	F (*)	F (945.9)	F (164.9)	F (392.9)

* HCS could not calculate delay

¹¹⁰ For both unsignalized and signalized intersection analyses, the numbers in parentheses following levels of service (LOS) are average delay per vehicle, measured in seconds. For signalized analyses, LOS analysis results are given for only the overall intersection delay.

¹¹¹ Per DelDOT's direction, the TIS and McCormick Taylor analyzed this intersection with one left-turn lane on the southbound approach, when there are actually two left-turn lanes on the southbound approach. Analysis of unsignalized intersections with double-left turn lanes is not possible using HCS. Furthermore, DelDOT provided direction that, if this configuration shows failing operations, the intersection should be analyzed with a signal.

Table 17 (continued)
PEAK HOUR LEVELS OF SERVICE (LOS)
based on Traffic Impact Study for Delaware National
Report dated October 6, 2010
Prepared by Traffic Planning and Design, Inc.

Signalized Intersection ¹¹²	LOS per TIS		LOS per McCormick Taylor	
	Weekday AM	Weekday PM	Weekday AM	Weekday PM
Centerville Road & Red Clay Drive ¹¹³				
2016 with Delaware National (Cases 3A & 3B)	A (8.1)	B (17.1)	C (21.8)	C (23.2)
2016 with Delaware National (Cases 3C & 3D)	A (8.2)	B (17.4)	C (25.2) ¹¹⁴	C (25.4) ¹¹⁵

¹¹² For unsignalized analyses, the numbers in parentheses following levels of service are average delay per vehicle, measured in seconds. For signalized analyses, those numbers are X-critical, a composite volume-to-capacity ratio.

¹¹³ DelDOT provided direction that, if the southbound single-left-turn-lane configuration shows failing unsignalized operations (which it did), the intersection should be analyzed with a signal and with a single left-turn lane on the southbound approach.

¹¹⁴ The 95th percentile queue length for the southbound Centerville Road left-turn lane during the Cases 3C & 3D AM peak hour is approximately 10 vehicles.

¹¹⁵ The 95th percentile queue lengths for the Cases 3C & 3D PM peak hour are approximately 7 vehicles for the eastbound Red Clay Drive left-turn lane, 5 vehicles for the westbound Red Clay Drive left-turn lane, 8 vehicles for the westbound Red Clay Drive right-turn lane, and 25 vehicles for the southbound Centerville Road through lane.

Table 18
PEAK HOUR LEVELS OF SERVICE (LOS)
based on Traffic Impact Study for Delaware National
Report dated October 6, 2010
Prepared by Traffic Planning and Design, Inc.

Signalized Intersection ¹¹⁶	LOS per TIS ^{117, 118}		LOS per McCormick Taylor	
	Weekday AM	Weekday PM	Weekday AM	Weekday PM
Delaware Route 48 & Centerville Road				
2010 Existing (Case 1)	F (98.4)	F (105.7)	D (41.5)	D (46.7)
2016 without Delaware National (Case 2A)	F (190.2)	F (188.9)	E (90.0)	F (120.7)
2016 without Delaware National (Case 2B)	F (226.9)	F (227.3)	F (130.7)	F (150.6)
2016 with Delaware National (Cases 3A & 3B)	F (197.5)	F (194.6)	F (100.1)	F (132.4)
2016 with Delaware National (Cases 3A & 3B) With Improvement Option 1 ¹¹⁹	F (201.1)	F (184.7)	F (84.6) ¹²⁰	F (103.7) ¹²¹
2016 with Delaware National (Cases 3A & 3B) With Improvement Option 2 ¹²²	N/A	N/A	D (45.3) ¹²³	D (48.0) ¹²⁴

¹¹⁶ For unsignalized analyses, the numbers in parentheses following levels of service are average delay per vehicle, measured in seconds. For signalized analyses, those numbers are X-critical, a composite volume-to-capacity ratio.

¹¹⁷ The TIS analyzed this intersection with a southbound approach configuration of one exclusive left-turn lane, one shared through/left-turn lane, and one right-turn lane. The actual configuration, as confirmed by McCormick Taylor during our field visit, has a southbound approach with one exclusive left-turn lane, one shared through/left-turn lane, one exclusive through lane, and one right-turn lane. The TIS was missing the second southbound through lane. McCormick Taylor analyzed the intersection with the actual field-observed lane configuration.

¹¹⁸ The HCS analyses included in the TIS set the signal timings for all phases to their max splits. This assumption led to unrealistically poor results for the TIS. McCormick Taylor used reasonable timings within the parameters of DelDOT's timing plans for this signal, yielding more realistic results.

¹¹⁹ Improvement Option 1 consists of signal timing improvements by the TIS. Essentially, this means not setting every phase to the max split, and reducing the cycle length. McCormick Taylor's analysis for Improvement Option 1 assumes some timing adjustments, resulting in a lower cycle length.

¹²⁰ Notable 95th percentile queue lengths for the Cases 3A & 3B AM peak hour (with Improvement Option 1) are approximately 35 vehicles for the northbound Centerville Road right-turn lane and 112 vehicles for the eastbound Delaware Route 48 through lanes.

¹²¹ Notable 95th percentile queue lengths for the Cases 3A & 3B PM peak hour (with Improvement Option 1) are approximately 25 vehicles for the northbound Centerville Road right-turn lane and 132 vehicles for the westbound Delaware Route 48 through lanes.

¹²² Improvement Option 2 consists of adding a third through lane to the eastbound and westbound approaches of Delaware Route 48.

¹²³ Notable 95th percentile queue lengths for the Cases 3A & 3B AM peak hour (with Improvement Option 2) are approximately 31 vehicles for the northbound Centerville Road right-turn lane and 58 vehicles for the eastbound Delaware Route 48 through lanes.

¹²⁴ Notable 95th percentile queue lengths for the Cases 3A & 3B PM peak hour (with Improvement Option 2) are approximately 21 vehicles for the northbound Centerville Road right-turn lane and 69 vehicles for the westbound Delaware Route 48 through lanes.

Table 18 (continued)
PEAK HOUR LEVELS OF SERVICE (LOS)
based on Traffic Impact Study for Delaware National
Report dated October 6, 2010
Prepared by Traffic Planning and Design, Inc.

Signalized Intersection ¹²⁵	LOS per TIS ^{126, 127}		LOS per McCormick Taylor	
	Weekday AM	Weekday PM	Weekday AM	Weekday PM
Delaware Route 48 & Centerville Road				
2016 with Delaware National (Cases 3C & 3D)	F (234.5)	F (233.0)	F (141.0)	F (160.3)
2016 with Delaware National (Cases 3C & 3D) <i>With Improvement Option 1</i> ¹²⁸	F (240.2)	F (224.4)	F (109.6) ¹²⁹	F (129.4) ¹³⁰
2016 with Delaware National (Cases 3C & 3D) <i>With Improvement Option 2</i> ¹³¹	N/A	N/A	D (54.4) ¹³²	D (51.6) ¹³³

¹²⁵ For unsignalized analyses, the numbers in parentheses following levels of service are average delay per vehicle, measured in seconds. For signalized analyses, those numbers are X-critical, a composite volume-to-capacity ratio.

¹²⁶ The TIS analyzed this intersection with a southbound approach configuration of one exclusive left-turn lane, one shared through/left-turn lane, and one right-turn lane. The actual configuration, as confirmed by McCormick Taylor during our field visit, has a southbound approach with one exclusive left-turn lane, one shared through/left-turn lane, one exclusive through lane, and one right-turn lane. The TIS was missing the second southbound through lane. McCormick Taylor analyzed the intersection with the actual field-observed lane configuration.

¹²⁷ The HCS analyses included in the TIS set the signal timings for all phases to their max splits. This assumption led to unrealistically poor results for the TIS. McCormick Taylor used reasonable timings within the parameters of DelDOT's timing plans for this signal, yielding more realistic results.

¹²⁸ Improvement Option 1 consists of signal timing improvements by the TIS. Essentially, this means not setting every phase to the max split, and reducing the cycle length. McCormick Taylor's analysis for Improvement Option 1 assumes some timing adjustments, resulting in a lower cycle length.

¹²⁹ Notable 95th percentile queue lengths for the Cases 3C & 3D AM peak hour (with Improvement Option 1) are approximately 42 vehicles for the northbound Centerville Road right-turn lane and 137 vehicles for the eastbound Delaware Route 48 through lanes.

¹³⁰ Notable 95th percentile queue lengths for the Cases 3C & 3D PM peak hour (with Improvement Option 1) are approximately 28 vehicles for the northbound Centerville Road right-turn lane and 160 vehicles for the westbound Delaware Route 48 through lanes.

¹³¹ Improvement Option 2 consists of adding a third through lane to the eastbound and westbound approaches of Delaware Route 48.

¹³² Notable 95th percentile queue lengths for the Cases 3C & 3D AM peak hour (with Improvement Option 2) are approximately 34 vehicles for the northbound Centerville Road right-turn lane and 75 vehicles for the eastbound Delaware Route 48 through lanes.

¹³³ Notable 95th percentile queue lengths for the Cases 3C & 3D PM peak hour (with Improvement Option 2) are approximately 23 vehicles for the northbound Centerville Road right-turn lane and 79 vehicles for the westbound Delaware Route 48 through lanes.

Table 19
PEAK HOUR LEVELS OF SERVICE (LOS)
based on Traffic Impact Study Addendum for Delaware National;
Addendum dated June 13, 2012 and Follow-up Letter from TPD to DelDOT dated August 17, 2012
Prepared by Traffic Planning and Design, Inc.

Signalized Intersection ¹³⁴	LOS per TIS Addendum/Letter		LOS per McCormick Taylor	
	Weekday AM	Weekday PM	Weekday AM	Weekday PM
Delaware Route 48 & Centerville Road				
2016 without Delaware National (Case 4A)	E (71.7)	F (99.5)	E (76.8)	F (94.0)
2016 with Delaware National (Case 4B)	N/A	N/A	F (80.7) ¹³⁵	F (98.8) ¹³⁶
2016 with Delaware National (Case 4B) With TIS Addendum Improvement Option 1 ¹³⁷	D (54.2)	D (54.7)	D (53.1) ¹³⁸	D (54.2) ¹³⁹
2016 with Delaware National (Cases 3A & 3B) With August 2012 Letter Alternative 1 ¹⁴⁰	D (53.8)	F (99.8)	D (45.0)	F (103.3)
2016 with Delaware National (Cases 3A & 3B) With August 2012 Letter Alternative 2 ¹⁴¹	F (102.4)	F (119.8)	E (79.6)	F (118.4)

¹³⁴ For unsignalized analyses, the numbers in parentheses following levels of service are average delay per vehicle, measured in seconds. For signalized analyses, those numbers are X-critical, a composite volume-to-capacity ratio.

¹³⁵ Notable 95th percentile queue lengths for the Case 4B AM peak hour are approximately 34 vehicles for the northbound Centerville Road right-turn lane and 108 vehicles for the eastbound Delaware Route 48 through lanes.

¹³⁶ Notable 95th percentile queue lengths for the Case 4B PM peak hour are approximately 25 vehicles for the northbound Centerville Road right-turn lane and 127 vehicles for the westbound Delaware Route 48 through lanes.

¹³⁷ Improvement Option 1 consists of converting the exclusive right-turn lanes on the eastbound and westbound approaches of Delaware Route 48 to shared through/right-turn lanes.

¹³⁸ Notable 95th percentile queue lengths for the Case 4B AM peak hour (with Improvement Option 1) are approximately 37 vehicles for the northbound Centerville Road right-turn lane and 66 vehicles for the eastbound Delaware Route 48 through lanes.

¹³⁹ Notable 95th percentile queue lengths for the Case 4B PM peak hour (with Improvement Option 1) are approximately 23 vehicles for the northbound Centerville Road right-turn lane and 70 vehicles for the westbound Delaware Route 48 through lanes.

¹⁴⁰ Alternative 1 consists of adding a third exclusive through lane on the eastbound approach of Delaware Route 48. TPD and McCormick Taylor used volumes from Cases 3A & 3B instead of volumes from Case 4B.

¹⁴¹ Alternative 2 consists of modifying the northbound and southbound Centerville Road approaches such that each would have two exclusive left-turn lanes, one exclusive through lane, and one exclusive right-turn lane. The phasing would change from split phasing to concurrent phasing with protected/prohibited left turns. TPD and McCormick Taylor used volumes from Cases 3A & 3B instead of volumes from Case 4B.

Table 20
PEAK HOUR LEVELS OF SERVICE (LOS)
based on Traffic Impact Study for Delaware National
Report dated October 6, 2010
Prepared by Traffic Planning and Design, Inc.

Unsignalized Intersection ¹⁴² Two-Way Stop Control (T-intersection)	LOS per TIS		LOS per McCormick Taylor	
	Weekday AM	Weekday PM	Weekday AM	Weekday PM
Centerville Road & Spice Mill Circle				
2010 Existing (Case 1)				
Northbound Centerville Road – Left	A (8.9)	A (8.7)	A (8.6)	A (8.8)
Eastbound Spice Mill Circle	C (17.1)	C (20.6)	C (19.7)	C (23.6)
2016 without Delaware National (Case 2A)				
Northbound Centerville Road – Left	A (9.4)	A (9.6)	A (9.0)	A (9.9)
Eastbound Spice Mill Circle	C (24.6)	E (40.9)	D (31.2)	F (60.6)
2016 without Delaware National (Case 2B)				
Northbound Centerville Road – Left	A (9.4)	A (9.7)	A (9.1)	B (10.0+)
Eastbound Spice Mill Circle	D (25.7)	E (45.0)	D (33.2)	F (69.6)
2016 with Delaware National (Cases 3A & 3B)				
Northbound Centerville Road – Left	A (9.6)	A (9.7)	A (9.2)	B (10.0+)
Eastbound Spice Mill Circle	D (26.4)	E (46.3)	D (34.1)	F (76.1) ¹⁴³
2016 with Delaware National (Cases 3C & 3D)				
Northbound Centerville Road – Left	A (9.7)	A (9.8)	A (9.3)	B (10.1)
Eastbound Spice Mill Circle	D (27.5)	F (51.4)	E (35.8) ¹⁴⁴	F (87.8) ¹⁴³

Signalized Intersection ¹⁴²	LOS per TIS		LOS per McCormick Taylor	
	Weekday AM	Weekday PM	Weekday AM	Weekday PM
Centerville Road & Spice Mill Circle				
2016 with Delaware National (Cases 3A & 3B)	N/A	N/A	A (6.8)	B (14.7)
2016 with Delaware National (Cases 3C & 3D)	N/A	N/A	A (7.1)	B (15.2)

¹⁴² For both unsignalized and signalized intersection analyses, the numbers in parentheses following levels of service (LOS) are average delay per vehicle, measured in seconds. For signalized analyses, LOS analysis results are given for only the overall intersection delay.

¹⁴³ The 95th percentile queue length for the eastbound Spice Mill Circle approach during the Cases 3A – 3D PM peak hour is approximately 8 vehicles.

¹⁴⁴ The 95th percentile queue length for the eastbound Spice Mill Circle approach during the Cases 3C & 3D AM peak hour is less than 1 vehicle. The AM peak hour volume on the eastbound approach is less than 10 vehicles in all Cases.