

Appendix I
Traffic Impact Analysis



August 22, 2022

Ryan Meyer
Director, Planning & Programming
Lehigh-Northampton Airport Authority
3311 Airport Road
Allentown, PA 18109

RE: Highway Occupancy Permit Application No. 272245

Dear Ryan Meyer:

PennDOT has reviewed the Transportation Impact Assessment (TIA) dated July 7, 2022 prepared by The Pidcock Company, for the proposed North Cargo Facility. The improvements identified in the TIA are approved as submitted.

The TIA identified the following proposed development:
Up to the 200,000 S.F. Cargo Facility upon which the TIA is based
New AM/PM Trips = 104/116

Based on this TIA and other than pavement and curb tie-ins, there are no improvements required within PENNDOT right-of-way. The site access through the existing local road, Willow Brook Road South, must be reconfigured and widened to provide for the anticipated truck turning movements into and out of the site access to and from Race Street.

This approval is for the TIA only, and is based on the presented land use, trip generation, design horizon year, and proposed mitigation. Any modifications to these parameters will require a revision of the TIA.

This approval is provided for LNAA's use in obtaining the required environmental clearances for the development of the property. Please proceed with the remaining Highway Occupancy Permit process, being sure to conform to all Department regulations and policies as outlined in Chapter 441 and Publication 282.

Should you have any questions, please contact my office at 610.871.4477.

Sincerely,

A handwritten signature in black ink, appearing to read "B. J. Boyer".

Brian J Boyer
Assistant District Traffic & Operations Manager
District Engineering 5-0

Ryan Meyer
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August 22, 2022

050/BJB/amv/ HOP Application No. 272245 – scope of improvements for Initial North
Cargo Environmental Clearance

bcc: Brian Boyer, Assist District Traffic & Operations Manager
Marah Haddad, District Permit Manager (EPS)
Ted Fenstermaker, Lehigh County Permit Supervisor

TRANSPORTATION IMPACT ASSESSMENT

FOR THE

NORTH CARGO AREA DEVELOPMENT

LOCATED IN

**HANOVER TOWNSHIP
LEHIGH COUNTY, PENNSYLVANIA**

PREPARED FOR



March 31, 2022

THE PIDCOCK COMPANY
CIVIL ENGINEERING AND LAND PLANNING ARCHITECTURE LAND SURVEYING

Oxford Drive at Fish Hatchery Road
Allentown, Pennsylvania

Executive Summary

The Lehigh Northampton Airport Authority (LNAA) proposes to expand its air cargo processing facilities to augment the existing South Cargo area accessed off Postal Road. The proposed North Cargo area would be accessed off Race Street (SR 1004) in Hanover Township, Lehigh County as shown in Exhibit 1.

The operation of the existing 67,036 SF Air Cargo Facility off Postal Road is proposed to be replicated and expanded with a North Cargo facility to be accessed at the Willow Brook Road intersection. Based on the trip generation rate for the existing Air Cargo Facility, the proposed 200,000 SF facility is anticipated to generate 104 AM Peak hour trips and 116 PM Peak hour trips, with 51 truck trips during each peak hour. Car traffic is anticipated to follow existing traffic patterns. Truck traffic is anticipated to be to/from Route 22.

The Race Street and Willow Brook Road intersection is anticipated to operate at LOS C during both the AM and PM Peak hours with all movements at LOS D or better as seen in Exhibit 2.

The westbound left turn lane is proposed to be lengthened to provide 175-feet of storage by restriping the existing gore area.

If required by PENNDOT, the eastbound Race Street approach could be restriped and signing could be modified to provide a dedicated right turn lane without impacting overall or eastbound approach operations.



DRWN. BY:
BMC
CHKD. BY:
BEH
FIELD BOOK:

SCALE:
NO SCALE
DATE:
MARCH 2022
PROJ. NO.:
21051

LEHIGH NORTHAMPTON AIRPORT AUTHORITY
NORTH CARGO DEVELOPMENT TRAFFIC ASSESSMENT
HANOVER TOWNSHIP, LEHIGH COUNTY, PENNSYLVANIA
THE PIDCOCK COMPANY
CIVIL ENGINEERING AND LAND PLANNING ARCHITECTURE LAND SURVEYING
2451 PARKWOOD DRIVE ALLENTOWN, PENNSYLVANIA 18103
PROJECT LOCATION MAP

EXHIBIT
1

Exhibit 2: Level of Service Summary Table

1	TURN MOVEMENT	2022		2024				TURN MOVEMENT
		Existing		NO-BUILD		BUILD		
		AM PEAK	PM PEAK	AM PEAK	PM PEAK	AM PEAK	PM PEAK	
Willow Brook Road & Race Street	EASTBOUND							EASTBOUND
	LEFT	B(16.9)	B(18.7)	C(31.4)	C(28.1)	D(36.8)	C(32.4)	LEFT
	THROUGH	B(12.3)	A(8.2)	C(21.6)	B(12.1)	C(24.8)	B(13.9)	THROUGH
	THROUGH/RIGHT	B(12.3)	A(8.2)	C(21.6)	B(12.1)	C(24.8)	B(13.9)	THROUGH/RIGHT
	APPROACH LOS	B(13.6)	B(11.2)	C(24.7)	B(16.7)	C(28.6)	B(19.2)	APPROACH LOS
	WESTBOUND							WESTBOUND
	LEFT	B(13.4)	A(8.9)	C(23.8)	B(13.1)	C(30.9)	B(16.5)	LEFT
	THROUGH	B(12.9)	B(11.6)	C(22.5)	B(16.9)	C(25.8)	B(19.7)	THROUGH
	RIGHT	A(0.0)	A(0.0)	A(0.0)	A(0.0)	A(0.0)	A(0.0)	RIGHT
	APPROACH LOS	B(12.9)	B(11.6)	C(22.5)	B(16.9)	C(26.8)	B(19.4)	APPROACH LOS
	NORTHBOUND							NORTHBOUND
	LEFT	C(22.5)	C(24.9)	D(38.2)	D(35.2)	D(39.1)	D(36.3)	LEFT
	THROUGH/RIGHT	C(22.7)	C(25.4)	D(38.6)	D(36.0)	D(45.5)	D(42.0)	THROUGH/RIGHT
	APPROACH LOS	C(22.6)	C(25.3)	D(38.5)	D(35.8)	D(45.4)	D(41.7)	APPROACH LOS
	SOUTHBOUND							SOUTHBOUND
	LEFT	B(15.5)	C(20.6)	C(24.0)	C(27.0)	C(29.0)	C(32.5)	LEFT
	RIGHT	B(14.0)	B(19.4)	B(13.2)	C(20.3)	B(15.1)	C(23.3)	RIGHT
	APPROACH LOS	B(15.2)	C(20.3)	C(22.5)	C(26.0)	C(27.1)	C(31.1)	APPROACH LOS
	INTERSECTION LOS	B(14.3)	B(14.0)	C(23.2)	C(20.9)	C(28.0)	C(25.0)	INTERSECTION LOS

= LOS D or better, <10 sec. delay increase

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Introduction

The Lehigh Northampton Airport Authority (LNAA) proposes to expand its air cargo processing facilities to augment the existing South Cargo area accessed off Postal Road. The proposed North Cargo area would be accessed off Race Street (SR 1004) in Hanover Township, Lehigh County as shown in Figure 1.

This Traffic Impact Assessment (TIA) has been prepared to analyze any traffic impacts on the surrounding road network that might arise from this development, and to provide recommendations for mitigation of any traffic impacts. Based on the limited traffic volumes anticipated to be generated by the development, the scope of the study is limited to the proposed connection to Race Street at Willow Brook Road.

Traffic counts were performed by Imperial Traffic & Data Collection on Tuesday, January 11, 2022, at the study intersection. In addition to the study intersection, traffic counts were performed at the three driveways of the previously approved warehouse developments included in the Rockefeller development located along Willow Brook Road to identify remaining traffic from the development to be included as background growth.

This TIA investigates the Levels of Service (LOS) for the Existing Conditions and the 2024 “No Build” conditions for the study intersection. These analyses predict the operational characteristics of the intersection without the proposed development. In addition, the Levels of Service for the 2024 Build conditions are analyzed. These analyses predict the operational characteristics of the intersection with the traffic generation from the proposed development.

Existing Conditions

As described above, the proposed North Air Cargo facility will be located on the south side of Race Street (SR 1004).

The following provides a description of the roadways that are included within the study area.

Study Roadways

Race Street (SR 1004) is oriented in an east/west direction and is generally a five-lane roadway that provides two travel lanes in each direction with dedicated left turn lanes or a center left turn only lane east of Willow Brook Road. West of Willow Brook Road, Race Street narrows to a 2-lane facility. Race Street is classified as an Urban Minor Arterial roadway with a Suburban Corridor Community Arterial typology. This roadway

is under the jurisdiction of PENNDOT. The posted speed limit is 45 MPH along Race Street.

Willow Brook Road extends in a north/south direction from Race Street to 10th Street. Willow Brook Road provides two travel lanes in each direction along the entire length within the study area. Willow Brook Road is classified as a Rural Minor Collector and has a Rural Local Community Collector typology. Willow Brook Road has a posted speed limit of 35 MPH. Currently under the jurisdiction of Hanover Township, Lehigh County, this roadway is planned to be transferred to PENNDOT jurisdiction.

Study Intersection

The following intersection was studied as part of this study:

Race Street (SR 1004) & Willow Brook Road

This intersection is a four-legged intersection and is controlled by a traffic signal. The northbound approach consists of a 40-foot left turn lane and a shared through/right lane which serves as an access roadway to one remaining residential property. The southbound Willow Brook Road approach consists of a left turn lane, a shared left/through lane, and a 400-foot right turn lane. The eastbound Race Street approach consists of a 175-foot left turn lane, a through lane, and a shared through/right lane. The westbound approach consists of a 75-foot left-turn lane, a through lane, and a channelized right turn lane. This intersection operates with three phases: split phasing for the northbound and southbound approaches and permitted phasing for the Race Street movements. Pedestrian accommodations are provided on all four sides of the intersection. The traffic signal is equipped with emergency preemption capabilities and volume density operations along Race Street. The traffic signal plan is attached in Appendix A.

Figure 2 illustrates the existing lane configuration, traffic control, and storage lengths for the study intersection.

Transit

Currently, LANTA currently provides services along Race Street by way of Route 319. A copy of LANTA's current bus routes within the study area is attached in Appendix B.

Traffic Data Collection

Existing traffic data was obtained from manual turning movement traffic counts performed by Imperial Traffic & Data Collection on Tuesday, January 11, 2022. The traffic counts were performed from 6:00 – 9:00 AM and 4:00 – 7:00 PM. Appendix C contains the existing traffic count data.

Description of Capacity Analyses

Capacity analyses were performed to evaluate the traffic conditions at the studied intersection. Signalized intersections are analyzed for their ability to serve traffic volumes and to determine the level of operational service for each movement at an intersection. The analyses in this study were performed using the latest Highway Capacity Manual (HCM 6th Edition) methodology using the Synchro v10.0, software developed by Trafficware Inc. Synchro is computerized software widely accepted as an analysis tool for signalized intersections. PENNDOT local values from Publication 46 (Traffic Engineering Manual) were used for the Base Saturation Flow Rates and Traffic Signal Control Calibration Parameters. The local values are found in Publication 46 Exhibits 10-9 and 10-10 and are included in Appendix D.

Level of Service at a signalized intersection is generally defined in terms of average control delay per vehicle, which is a measure of loss of travel time. Delay is dependent on a number of factors, including width of the roadways, number of lanes, turning volumes, heavy vehicle (truck) volumes, the green time to cycle length ratio (g/c), and the volume to capacity (v/c) ratio for the approach in question. The criteria for the various level of service designations are as follows:

<u>Level of Service</u>	<u>Average Delay Per Vehicle (seconds)</u>
A	10.0 or less
B	10.1 to 20.0
C	20.1 to 35.0
D	35.1 to 55.0
E	55.1 to 80.0
F	80.1 or greater

In addition to the delay criterion, when a movement, approach, or intersection operates with a v/c ratio greater than 1 (volume exceeds capacity), the LOS is identified as F, regardless of the calculated delay.

Levels of Service range from values A through F as indicated above. Level of Service A is considered free flow, where the motorist can make any movement with little or no delay. Level of Service F is considered failure, where traffic is proceeding so slowly that it causes frustration for the motorist. Levels of Service B through E indicate increasing delays for each level. Further definitions of Levels of Service are in found in Appendix E. The LOS is calculated for each movement of the approach; i.e., a left turn lane could be operating at LOS F while the through lane could be operating at LOS B. Generally, if a facility is found to be operating at a LOS C or higher in rural areas or LOS D or higher in urban areas, the facility is considered to be adequate. These levels of service allow the motorist to proceed through an intersection without serious delays.

Existing Traffic Volumes

As mentioned above, the traffic counts utilized for this TIA were performed in January 2022 at the study intersection to collect data for the AM and PM peak hours. A summary of the 2022 existing traffic volumes is shown on Figure 3. A spreadsheet containing the existing traffic volumes is included in Appendix E.

Existing Capacity Analysis

The 2022 existing traffic volumes were used to perform the capacity analysis for the traffic conditions as they currently exist. The Capacity Analysis/Level of Service worksheets for the 2022 existing conditions are contained in Appendix F. A summary of the results for the AM and PM peak hours are provided in Table 1. Figure 4 depicts the 2022 Existing Levels of Service for the study intersection and is described below.

Race Street (SR 1004) & Willow Brook Road/Private Driveway

This signalized intersection currently operates with all movements at LOS C or better during the AM and PM peaks. The overall intersection currently operates at LOS B during both peaks.

2024 Base Traffic Volumes

The 2022 existing traffic volumes depicted on Figure 3 were projected to 2024 to calculate the 2024 base traffic volumes. To project the existing traffic volumes, PENNDOT's background growth rates for July 2021 to August 2022 for an urban highway was utilized to calculate the 2024 base traffic volumes. Based on PENNDOT data, the growth rate for an urban non-interstate highway in Lehigh County is 0.59 percent per year. The growth rate was compounded over 2 years (1.0118) and applied to the 2022 existing traffic volumes depicted on Figure 3 to obtain the 2024 base traffic volumes shown on Figure 5. The spreadsheet containing the calculations is included in Appendix E.

Other Developments

The entire Rockefeller Development, otherwise known as the Allen Township Industrial Development, has not been fully built out. The traffic study prepared by The Pidcock Company dated December 13, 2013, included a 1,200,000 square foot RDH hub (FedEx) along with two 1,000,000 square foot traditional warehouses. The proposed development is located along Willow Brook Road north of Race Street. Figure 6 depicts the approved

truck traffic for the Rockefeller development while Figure 7 depicts the approved car traffic for the development.

Currently, the RDH hub is partially built out and occupied while two high-cube warehouses totaling 1,320,145 SF have been constructed and are partially occupied. A third 456,500 SF High-Cube warehouse is under development.

Traffic counts were performed at the driveway intersections along Willow Brook Road to determine the amount of traffic the currently constructed and occupied development is generating. Copies of the traffic counts are included in Appendix C. The existing traffic volumes entering and exiting the developments (in total for the three driveways) were identified and distributed to the study intersection based on the existing traffic patterns for both the truck traffic and car traffic. These volumes are identified in the spreadsheet in Appendix E and shown in Figures 8 (Trucks) and 9 (Cars).

The existing Rockefeller traffic in Figures 8 and 9 was subtracted from the approved Rockefeller traffic in Figures 6 and 7 to identify the additional traffic attributed to the Rockefeller Development that is to be included as background growth at the study intersection. These volumes are shown in Figures 10 (Trucks) and 11 (Cars).

Projected 2024 No Build Traffic Volumes

The 2024 base traffic volumes depicted on Figure 5 were added to the additional Rockefeller development traffic volumes depicted on Figures 10 and 11 to obtain the 2024 no build traffic volumes depicted on Figure 12. The spreadsheet containing the calculations is included in Appendix E.

Due to the separate truck volumes to be added as background growth, the heavy vehicle percentage of traffic was revised to account for the additional truck movements. A spreadsheet documenting the calculations is included in Appendix H.

Projected 2024 No Build Capacity Analysis

A 2024 no build analysis has been completed utilizing the 2024 no build traffic volumes depicted in Figure 12. The Capacity Analysis / Level of Service worksheets for the 2024 no build conditions are contained in Appendix G. A summary of the results for the AM and PM Peak hours are provided in Table 1. Figure 13 depicts the 2024 no build levels of service for the study intersection as described below.

Race Street (SR 1004) & Willow Brook Road / Private Driveway

With existing signal timings, this intersection is anticipated to operate with all movements at LOS D or better during the AM and PM peaks. The overall intersection is anticipated to operate at LOS C during both peak hours.

Proposed Development

The proposed development is anticipated to consist of 200,000 square feet of air cargo area, with access opposite Willow Brook Road. An overview plan is provided in Figure 14.

The proposed development is an augmentation of the existing air cargo facility located along Postal Road. The existing 67,036 SF facility has two driveway connections: Truck traffic has access directly off Postal Road and there is an employee driveway connection accessing Hangar Place. The air cargo facility is not consistent with any ITE Land Use as products will be brought to and from the facility by airplane with trucks transferring the materials or goods to other facilities in the Lehigh Valley or beyond. Conversely, trucks may deliver materials and goods to the cargo facility prior to being loaded onto an airplane.

Proposed Site Trip Generation

Traffic counts were completed at the driveways of the existing facility to identify the entering and exiting trip generation. Copies of the traffic counts are included in Appendix C. A summary of the existing facility traffic volumes is included in Figure 15.

With the anticipated operation of the new air cargo facility matching the existing operations, the trip generation characteristics of the existing facility were calculated based on the area of the existing building. A spreadsheet identifying these calculations is included in Appendix I.

Based on the existing building trip generation characteristics, traffic for the new facility was determined. The trip generation calculations are included in Appendix I and summarized in Table 2. The new air cargo facility is anticipated to generate 104 AM Peak hour trips and 116 PM Peak hour trips, with 51 AM Truck trips and 51 PM Truck trips.

Proposed Site Trip Distribution

The traffic volumes generated by the proposed development were distributed to the roadway network based on existing traffic patterns and regional destinations for the truck and car traffic independently as discussed below.

Car Traffic

The car trip distributions are based on the car trip distributions utilized in the PENNDOT and Hanover Township approved Rockefeller TIS for the RDH Hub and warehouses and the existing traffic count. The following distribution percentages were utilized for the AM and PM peaks.

Direction	AM Peak		PM Peak	
	Entering	Exiting	Entering	Exiting
West via Race Street	11%	7%	8%	11%
North via Willow Brook Road	23%	12%	12%	21%
East via Race Street	66%	81%	80%	68%

The trip distribution for the Cars traffic is provided on Figure 16. The spreadsheet containing the calculations is included in Appendix E.

Truck Traffic

The truck trip distributions for the cargo facility are also consistent with the truck trip distributions utilized in the PENNDOT and Hanover Township approved Rockefeller TIS for the RDH Hub and warehouses. The trip distribution percentages for trucks in the Rockefeller TIS assumed all truck traffic was destined to and from Route 22. The following distribution percentages were utilized for the AM and PM peaks.

Direction	Percentages	
	Entering	Exiting
Route 22	100%	100%

The trip distribution for the Truck traffic is provided on Figure 17. The spreadsheet containing the calculations is included in Appendix E.

Trip Assignments

The trip distribution percentages for the cars traffic depicted on Figure 16 were applied to the trip generation calculations for the car traffic to calculate the trip assignments depicted on Figure 18. The spreadsheet containing the calculations is included in Appendix E.

The trip distribution percentages for the truck traffic depicted on Figure 17 were applied to the trip generation calculations for the truck traffic to calculate the trip assignments depicted on Figure 19. The spreadsheet containing the calculations is included in Appendix E.

Projected 2024 Build Traffic Volumes

The 2024 no build traffic volumes depicted on Figure 12 were added to the trip assignments for the air cargo facility on Figure 18 (Cars) and Figure 19 (Trucks) to obtain the 2024 build traffic volumes depicted on Figure 20. The spreadsheet containing the calculations is included in Appendix E.

Due to the separate truck volumes added for the development, the heavy vehicle percentage of traffic was revised to account for the additional truck movements. A spreadsheet documenting the calculations is included in Appendix H.

Projected 2024 Build Capacity Analysis

The 2024 build traffic volumes depicted on Figure 20 were utilized to perform capacity analyses for the conditions that will be present in 2024. The operating characteristics, and resulting levels of service, are described below for the study intersection. The capacity analysis/level of service worksheets for the 2024 Build condition are contained in Appendix J. A summary of the results for the AM and PM peaks can be seen in Table 1. Figure 21 depicts the 2024 Build Levels of Service for the study intersection.

Race Street (SR 1004) & Willow Brook Road / Private Driveway

With existing signal timings, this intersection is anticipated to operate with all movements at LOS D or better during the AM and PM peaks. The overall intersection is anticipated to operate at LOS C during both peak hours. All movements are anticipated to operate at the No Build condition except the eastbound left turn movement during the AM Peak which is anticipated to degrade from LOS C to LOS D with an increase in delay of less than 6 seconds.

Queue Length Calculations

For the study intersection, a queue analysis was completed identifying the required storage lengths. The queue length analyses, based on HCM 2010 95th percentile queuing calculations are included in the various Appendices with the capacity analyses. Table 3 identifies the existing storage lengths, the existing, 2024 No Build, and 2024 Build queue lengths, and the proposed storage lengths. All movements are anticipated to have queuing that will be within the existing storage.

Publication 46 Turn Lane Warrants

In addition to queue length analyses, PENNDOT Publication 46 provides turn lane warrant and minimum storage length calculations. Calculations are included in Appendix K which indicate that based on the anticipated traffic volumes, a 175-foot left turn lane is required. No eastbound right turn lane is required based on the anticipated traffic volumes.

To extend the existing westbound left turn lane, the existing gore striping is proposed to be modified as depicted in Figure 22. Figure 23 depicts the proposed lane configuration and storage lengths.

Alternative Analysis

Comments by PENNDOT on previous industrial development projects indicate that a separate right turn lane could be required along Race Street at the Willow Brook Road access to the proposed Air Cargo Facility. The general requirement for a separate right turn lane at an industrial development is not applicable in this case. The second eastbound through lane on Race Street at Willow Brook Road develops 264 feet in advance of the intersection and was constructed due to the availability of the second eastbound through lane east of the intersection to accommodate the southbound dual left turn movement. Therefore, a right-turning vehicle is not slowing in an established through lane, but the development of the lane is consistent with a right turn lane. Further, the truck traffic to/from the facility is all anticipated to be to/from Route 22 and will therefore not be making the eastbound right turn into the site. Finally, eastbound right turn volumes are anticipated to be 4 vehicles during the AM Peak Hour (1 vehicle every 15 minutes) and 5 vehicles during the PM Peak Hour (1 vehicle every 12 minutes).

If required by PENNDOT, the eastbound approach of Race Street to Willow Brook Road could be restriped and resigned to restrict the existing through/right turn lane to be a right turn only lane. Based on PENNDOT Publication 46, the minimum right turn lane length for a 45 MPH roadway is 150-feet. The potential restriping is shown in Figure 22. Capacity analyses for this lane configuration provided in Appendix L show that the eastbound through movement continues to operate at LOS C during the AM Peak and LOS B during the PM Peak.

Conclusions and Recommendations

Based on the preceding TIA and a review of Tables 1 and 3, which provide a summary of the Level of Service for each traffic condition and queue analysis, respectively, the following conclusions and recommendations are offered:

- The existing 67,036 SF Air Cargo Facility off Postal Road is proposed to be augmented with a new North Cargo facility to be accessed from Race Street at the Willow Brook Road intersection.
- Based on the trip generation rate for the existing Air Cargo Facility, the proposed 200,000 SF facility is anticipated to generate 104 AM Peak hour trips and 116 PM Peak hour trips, with 51 truck trips during each peak hour.
- Car traffic is anticipated to follow existing traffic patterns. Truck traffic is anticipated to be to/from Route 22.
- The Race Street and Willow Brook Road intersection is anticipated to operate at LOS C during both the AM and PM Peak hours with all movements at LOS D or better.
- The westbound left turn lane is proposed to be lengthened to provide 175-feet of storage by restriping the existing gore area.
- If required by PENNDOT, the eastbound Race Street approach could be restriped and signing can be modified to provide a dedicated right turn lane without impacting overall or eastbound approach operations.

TABLES

Table 1: Level of Service Summary Table

1	TURN MOVEMENT	2022		2024				TURN MOVEMENT
		Existing		NO-BUILD		BUILD		
		AM PEAK	PM PEAK	AM PEAK	PM PEAK	AM PEAK	PM PEAK	
Willow Brook Road & Race Street	EASTBOUND							EASTBOUND
	LEFT	B(16.9)	B(18.7)	C(31.4)	C(28.1)	D(36.8)	C(32.4)	LEFT
	THROUGH	B(12.3)	A(8.2)	C(21.6)	B(12.1)	C(24.8)	B(13.9)	THROUGH
	THROUGH/RIGHT	B(12.3)	A(8.2)	C(21.6)	B(12.1)	C(24.8)	B(13.9)	THROUGH/RIGHT
	APPROACH LOS	B(13.6)	B(11.2)	C(24.7)	B(16.7)	C(28.6)	B(19.2)	APPROACH LOS
	WESTBOUND							WESTBOUND
	LEFT	B(13.4)	A(8.9)	C(23.8)	B(13.1)	C(30.9)	B(16.5)	LEFT
	THROUGH	B(12.9)	B(11.6)	C(22.5)	B(16.9)	C(25.8)	B(19.7)	THROUGH
	RIGHT	A(0.0)	A(0.0)	A(0.0)	A(0.0)	A(0.0)	A(0.0)	RIGHT
	APPROACH LOS	B(12.9)	B(11.6)	C(22.5)	B(16.9)	C(26.8)	B(19.4)	APPROACH LOS
	NORTHBOUND							NORTHBOUND
	LEFT	C(22.5)	C(24.9)	D(38.2)	D(35.2)	D(39.1)	D(36.3)	LEFT
	THROUGH/RIGHT	C(22.7)	C(25.4)	D(38.6)	D(36.0)	D(45.5)	D(42.0)	THROUGH/RIGHT
	APPROACH LOS	C(22.6)	C(25.3)	D(38.5)	D(35.8)	D(45.4)	D(41.7)	APPROACH LOS
	SOUTHBOUND							SOUTHBOUND
	LEFT	B(15.5)	C(20.6)	C(24.0)	C(27.0)	C(29.0)	C(32.5)	LEFT
	RIGHT	B(14.0)	B(19.4)	B(13.2)	C(20.3)	B(15.1)	C(23.3)	RIGHT
	APPROACH LOS	B(15.2)	C(20.3)	C(22.5)	C(26.0)	C(27.1)	C(31.1)	APPROACH LOS
	INTERSECTION LOS	B(14.3)	B(14.0)	C(23.2)	C(20.9)	C(28.0)	C(25.0)	INTERSECTION LOS

= LOS D or better, <10 sec. delay increase

Table 2: Development Trip Generation Summary

Land Use	Land Use	Size	Units	ADT	AM Peak			PM Peak		
					Enter	Exit	Total	Enter	Exit	Total
	Air Cargo Facility	200,000	S.F.		59	45	104	57	59	116
			Trucks		24	27	51	21	30	51
			Cars		35	18	53	36	29	65

Table 3: Queue Summary Table

1	TURN MOVEMENT	EXISTING STORAGE	2022		2024				PENNDOT TURN LANE LENGTHS	PROPOSED STORAGE	TURN MOVEMENT
			EXISTING QUEUES		NO BUILD QUEUES		BUILD QUEUES				
			AM Peak	PM PEAK	AM PEAK	PM PEAK	AM PEAK	PM PEAK			
Willow Brook Road & Race Street	EASTBOUND										EASTBOUND
	LEFT	175	53	50	133	85	158	100			LEFT
	THROUGH		50	30	108	55	128	68			THROUGH
	THROUGH/RIGHT		53	33	113	58	133	70			THROUGH/RIGHT
	WESTBOUND										WESTBOUND
	LEFT	75	0	0	0	0	48	28	175	175	LEFT
	THROUGH		70	163	150	268	175	313			THROUGH
	RIGHT		0	0	0	0	0	0			RIGHT
	NORTHBOUND										NORTHBOUND
	LEFT	40	0	0	0	0	0	3			LEFT
	THROUGH/RIGHT		0	3	3	3	58	58			THROUGH/RIGHT
	SOUTHBOUND										SOUTHBOUND
	LEFT		103	73	313	228	365	265			LEFT
	RIGHT	400	48	38	73	70	85	83			RIGHT

FIGURES

Drawing name: S:\LMAA\21051 North Cargo Development (Initial Allowance Only)\Civil Docs\Reports-Studies-Traffic Reports\2022-02-XX TIA Submission\Location Map.dwg Last Modified: Mar 30, 2022 - 9:43am
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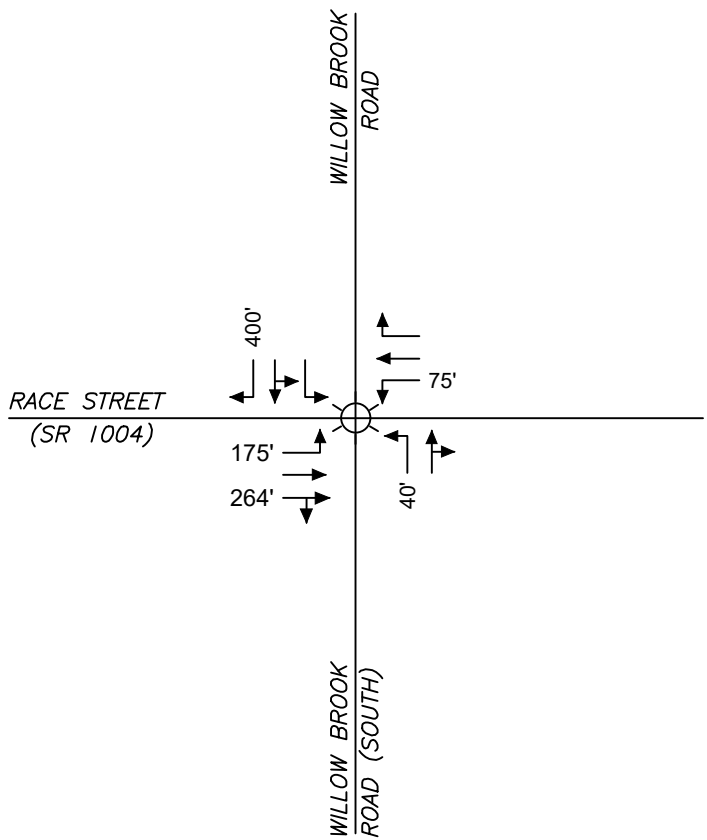
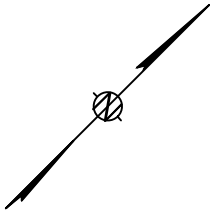


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FIELD BOOK:

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CIVIL ENGINEERING AND LAND PLANNING ARCHITECTURE LAND SURVEYING
2451 PARKWOOD DRIVE ALLENTOWN, PENNSYLVANIA 18103
PROJECT LOCATION MAP

FIGURE
1



LEGEND

 - SIGNALIZED INTERSECTION

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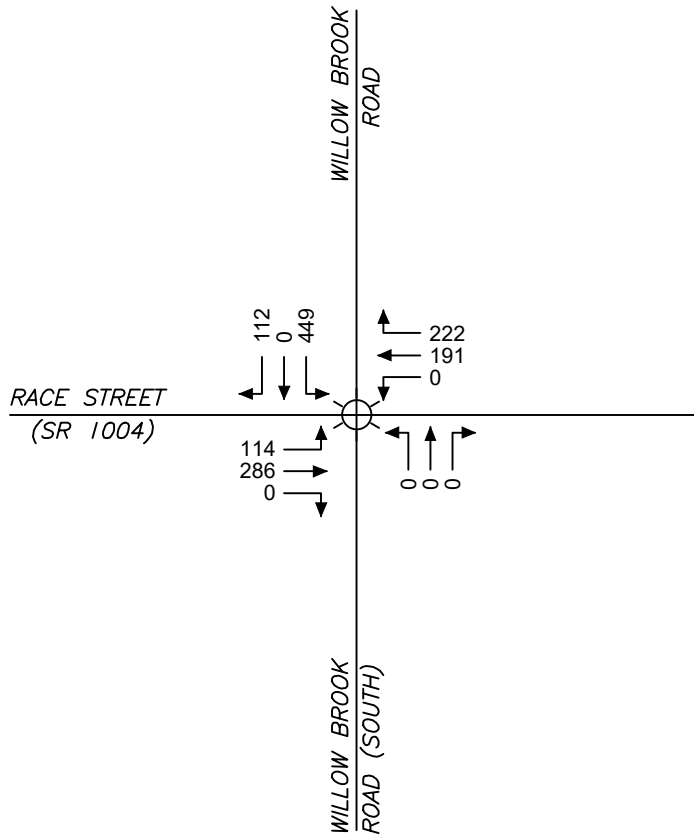
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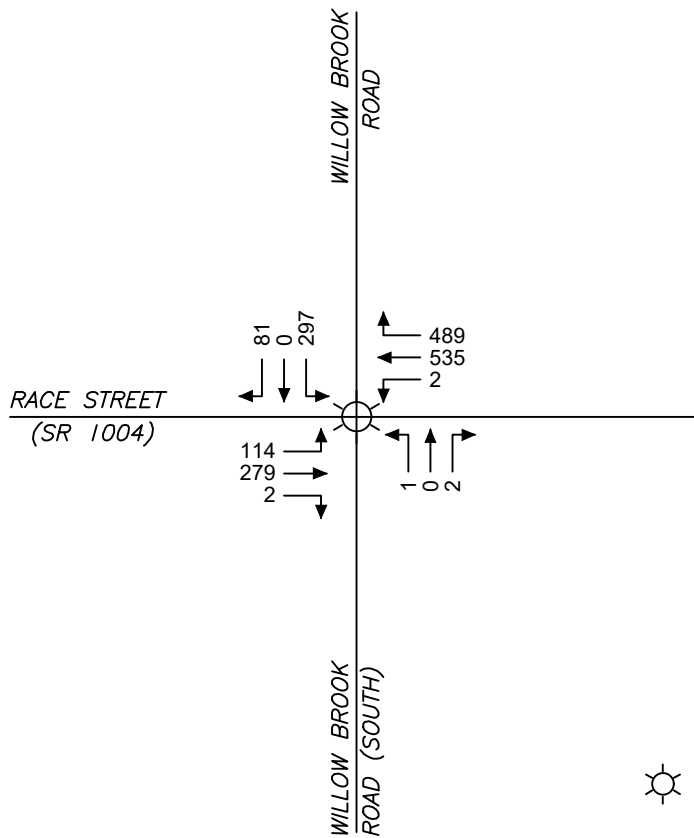
EXISTING LANE CONFIGURATIONS, STORAGE LENGTHS AND TRAFFIC CONTROL

FIGURE
2

AM PEAK



PM PEAK



LEGEND

 - SIGNALIZED INTERSECTION

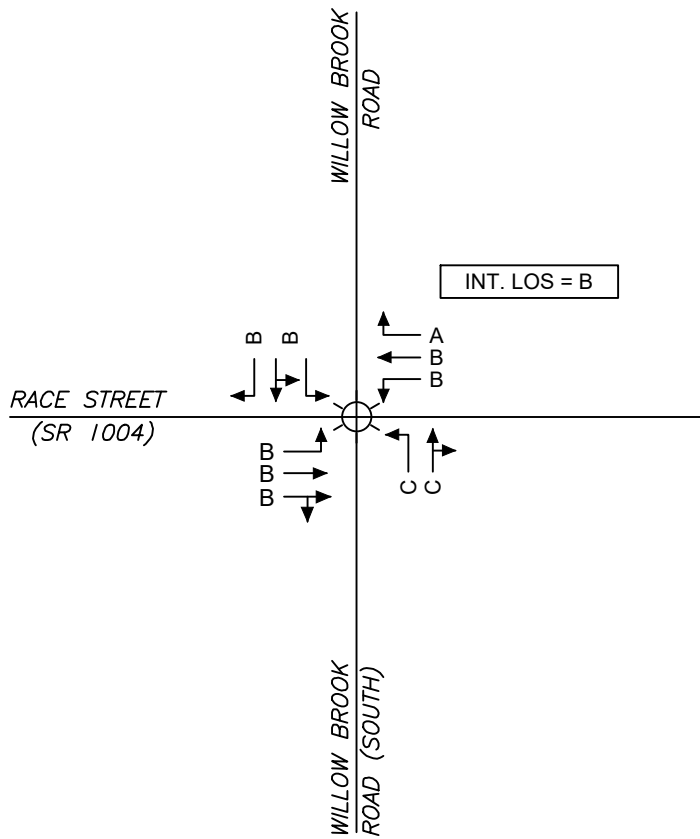
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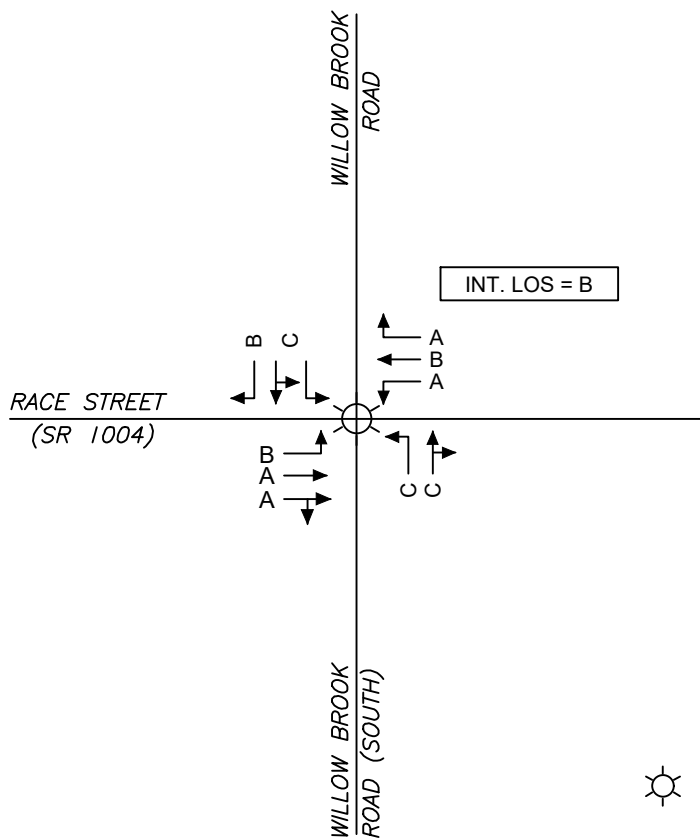
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2022 EXISTING TRAFFIC VOLUMES

FIGURE
3

AM PEAK



PM PEAK



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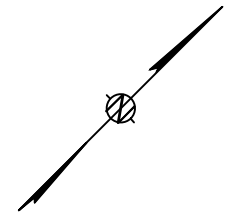
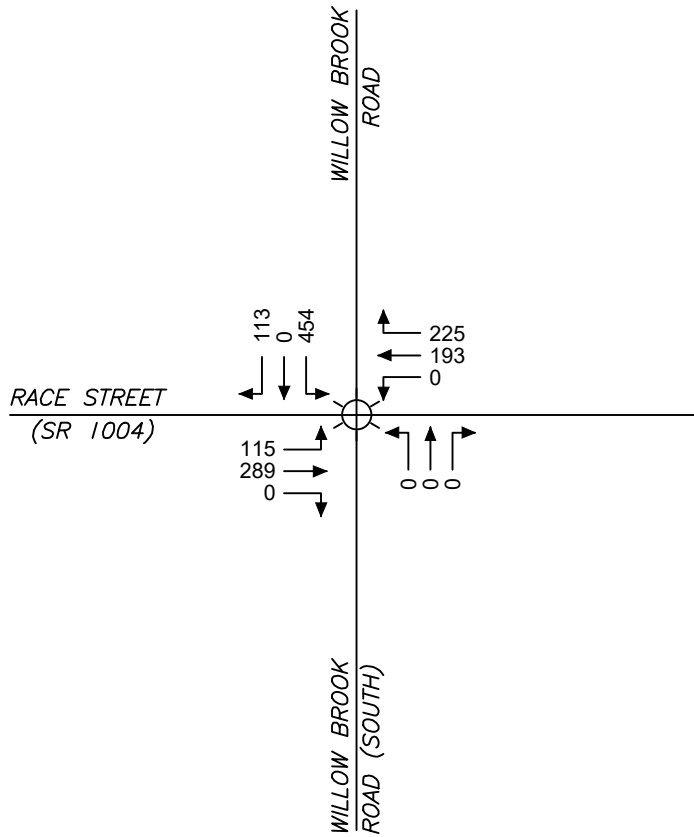
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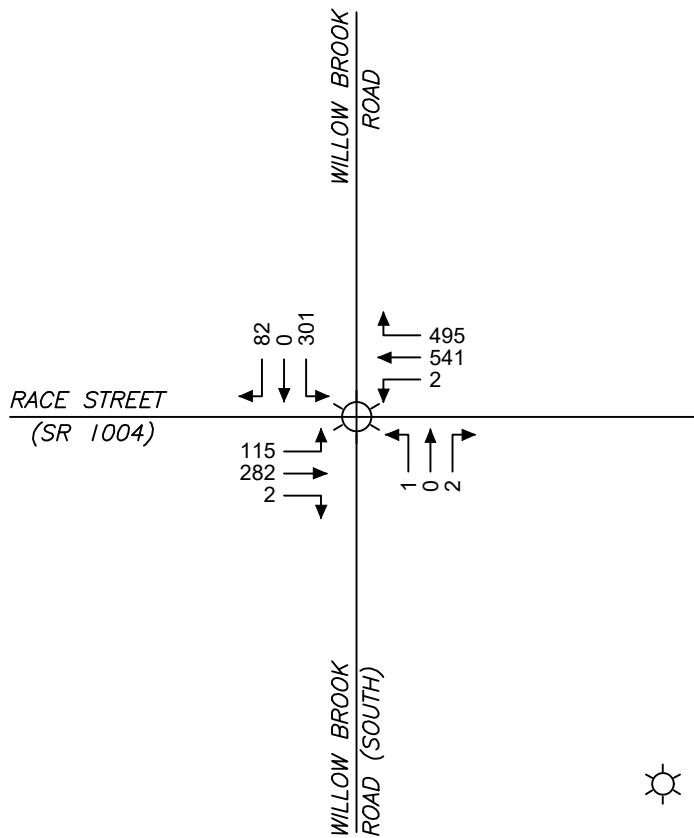
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2022 EXISTING LEVELS OF SERVICE

FIGURE
4

AM PEAK



PM PEAK



LEGEND



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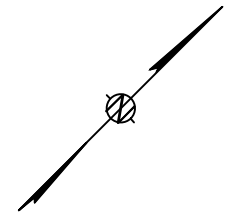
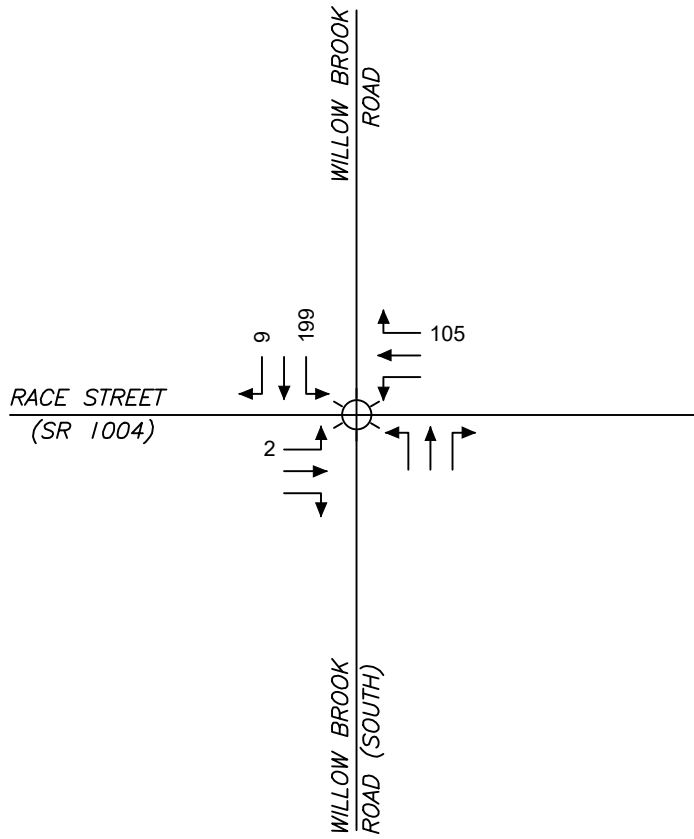
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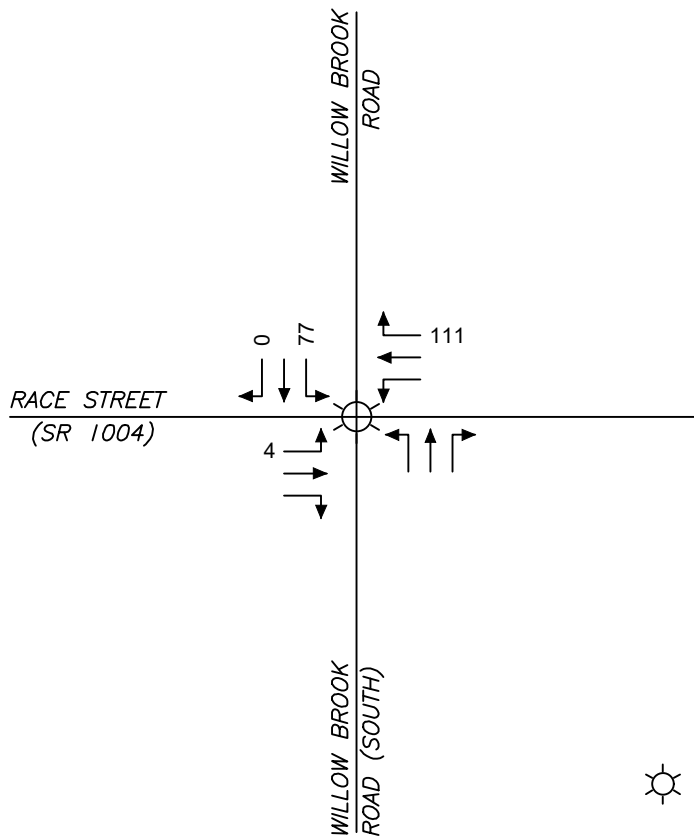
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2024 BASE TRAFFIC VOLUMES

FIGURE
5

AM PEAK



PM PEAK



LEGEND



- SIGNALIZED INTERSECTION

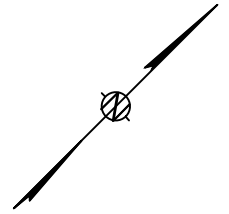
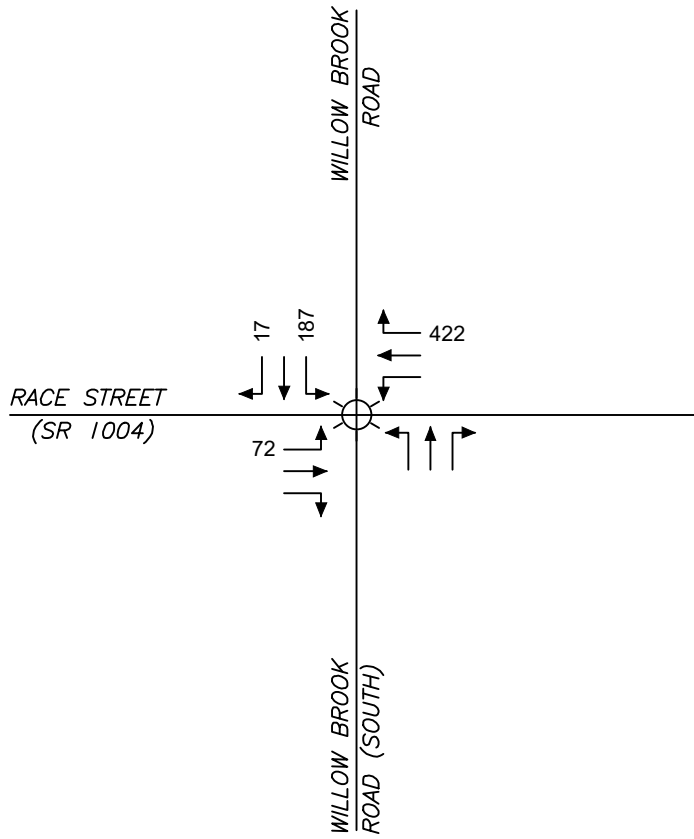
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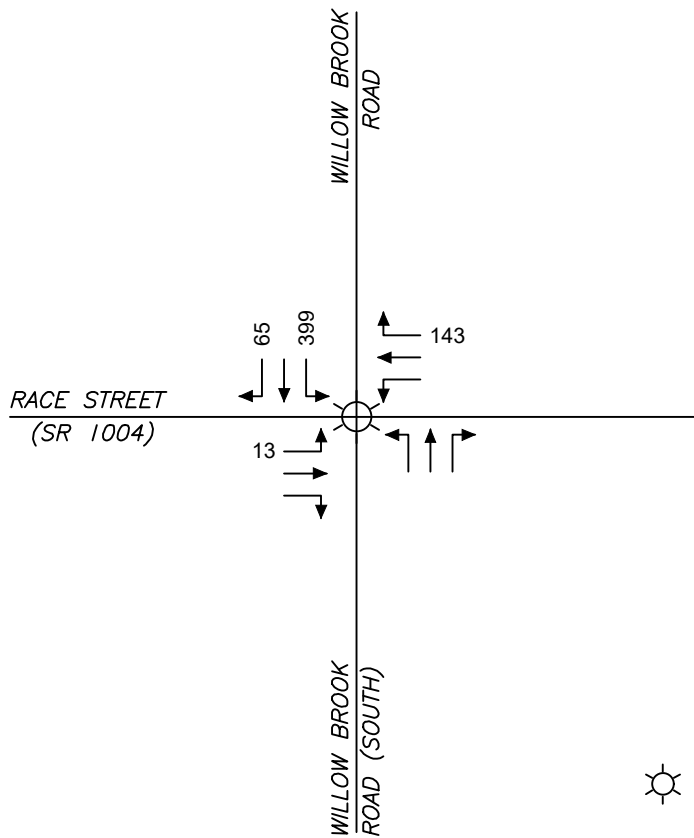
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APPROVED ROCKEFELLER TRAFFIC – TRUCKS

FIGURE
6

AM PEAK



PM PEAK



LEGEND



- SIGNALIZED INTERSECTION

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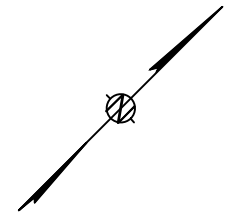
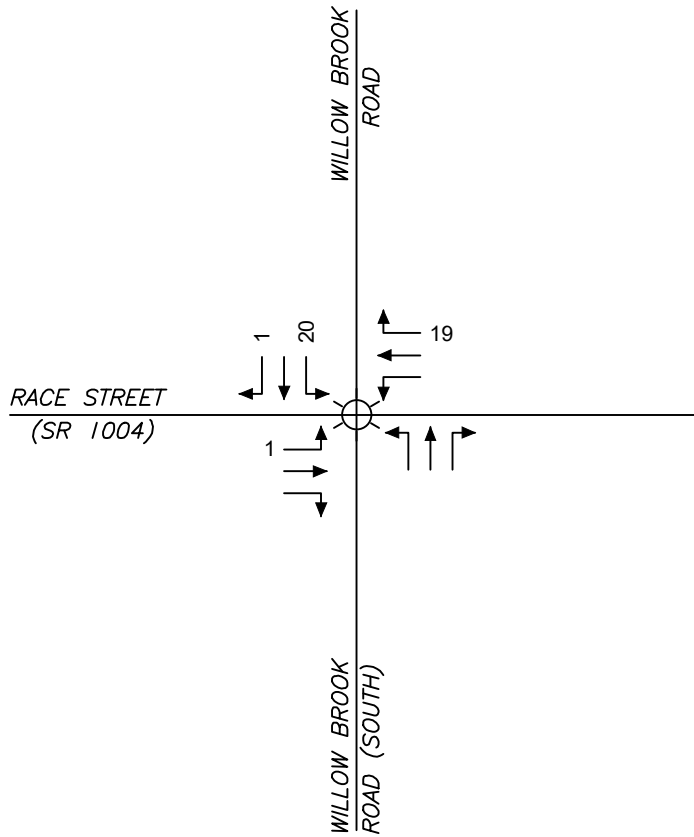
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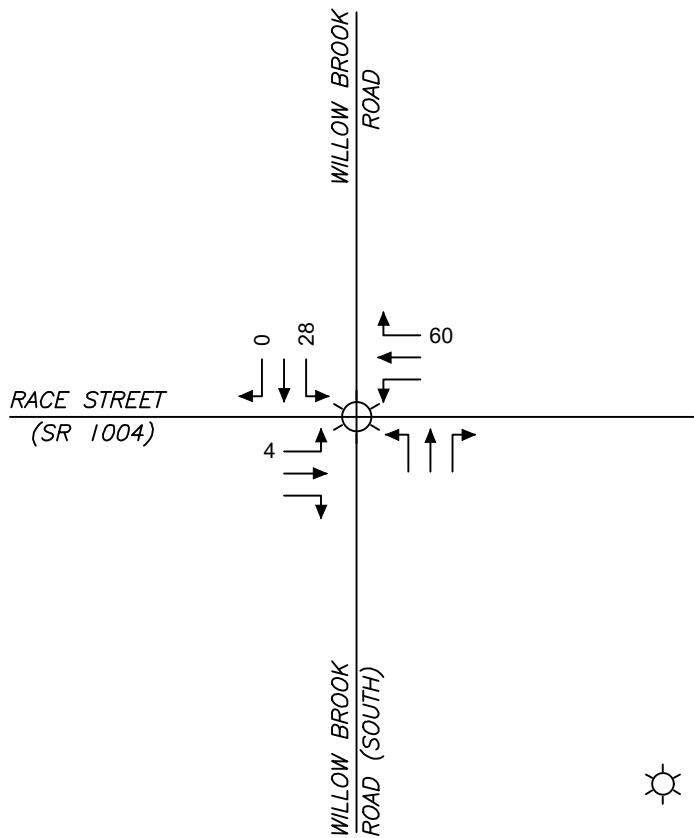
APPROVED ROCKEFELLER TRAFFIC – CARS

FIGURE
7

AM PEAK



PM PEAK



LEGEND

 - SIGNALIZED INTERSECTION

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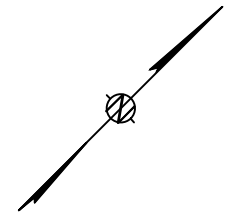
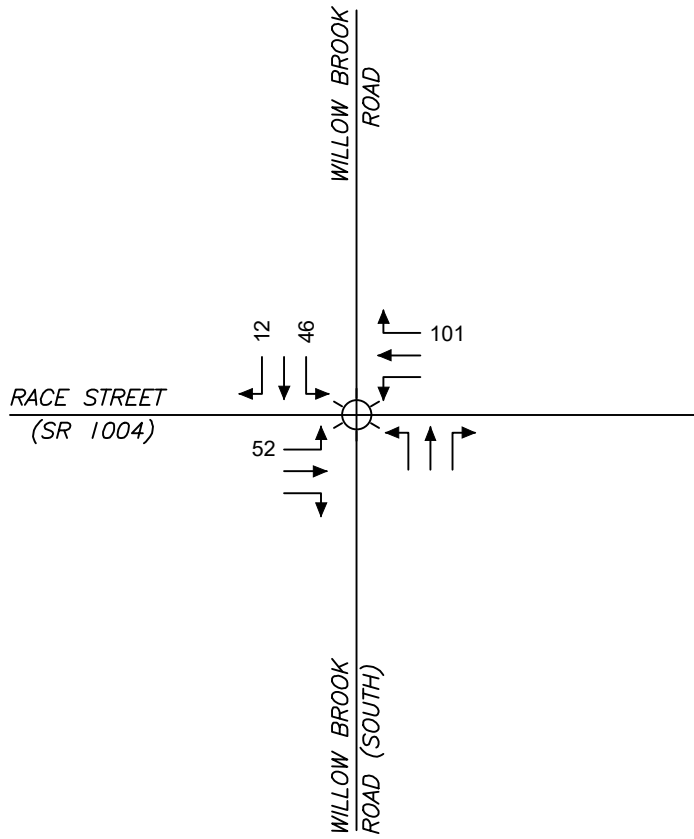
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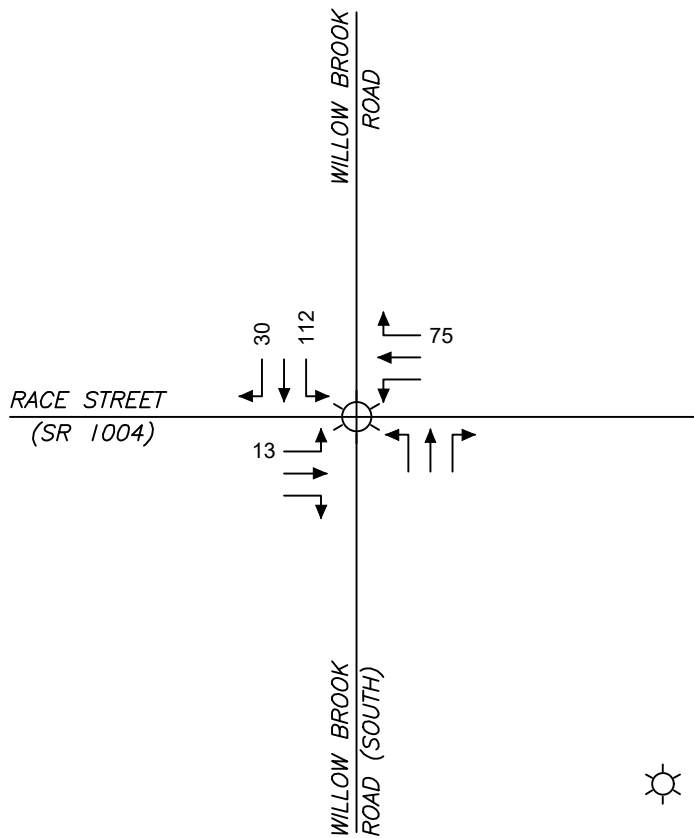
EXISTING 2022 ROCKEFELLER TRAFFIC – TRUCKS

FIGURE
8

AM PEAK



PM PEAK



LEGEND

 - SIGNALIZED INTERSECTION

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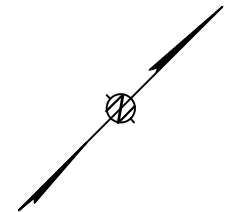
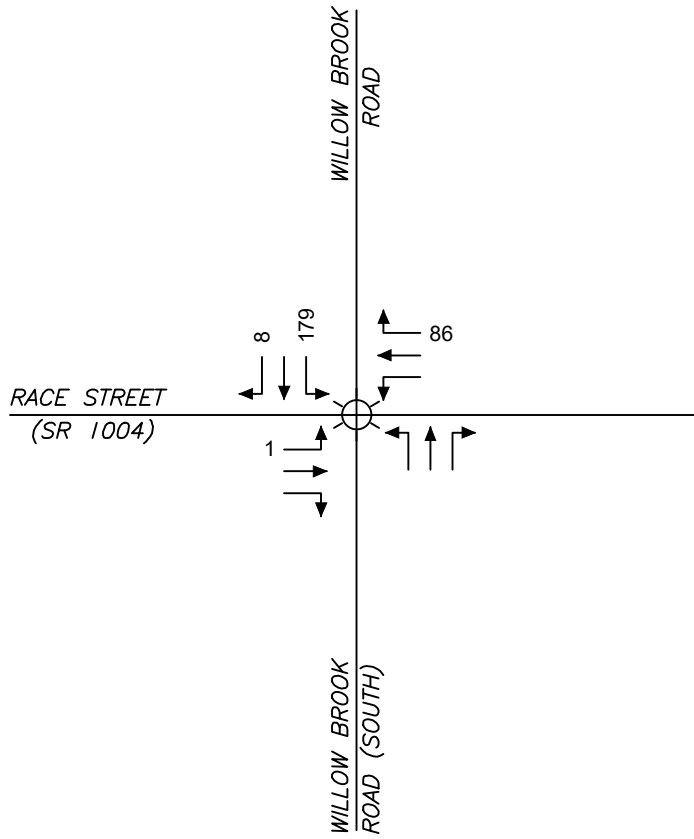
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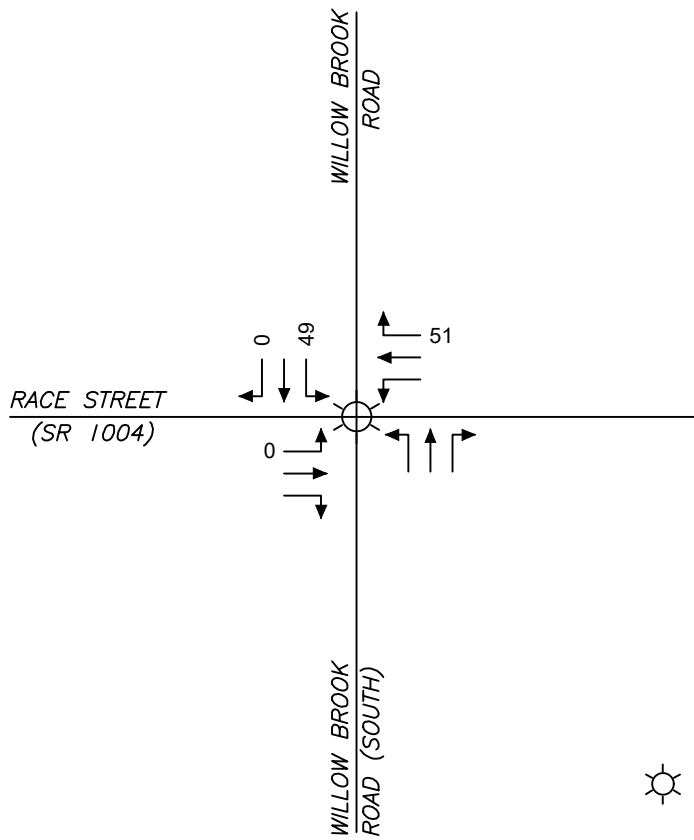
EXISTING 2022 ROCKEFELLER TRAFFIC – CARS

FIGURE
9

AM PEAK



PM PEAK



LEGEND



- SIGNALIZED INTERSECTION

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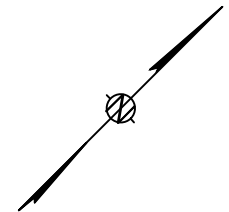
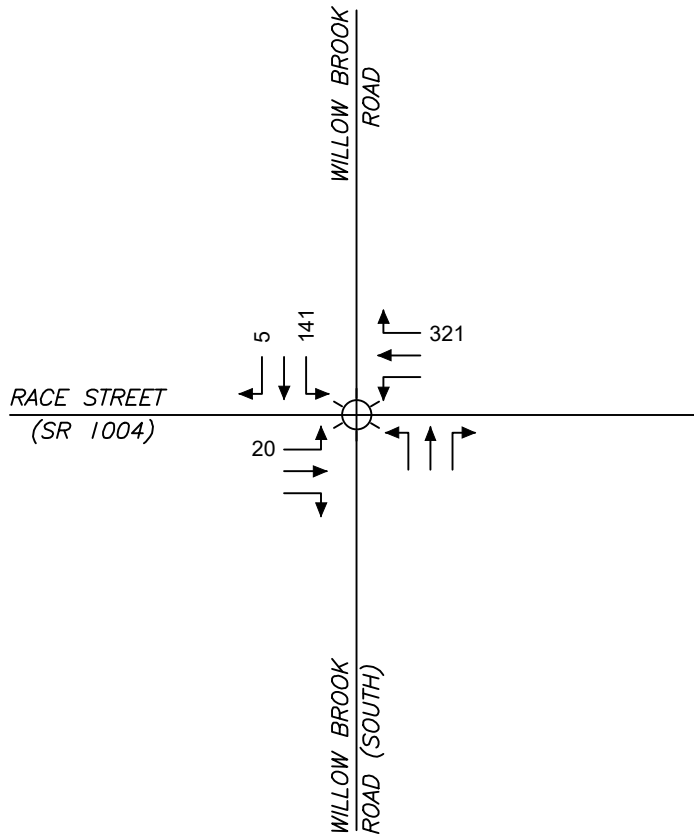
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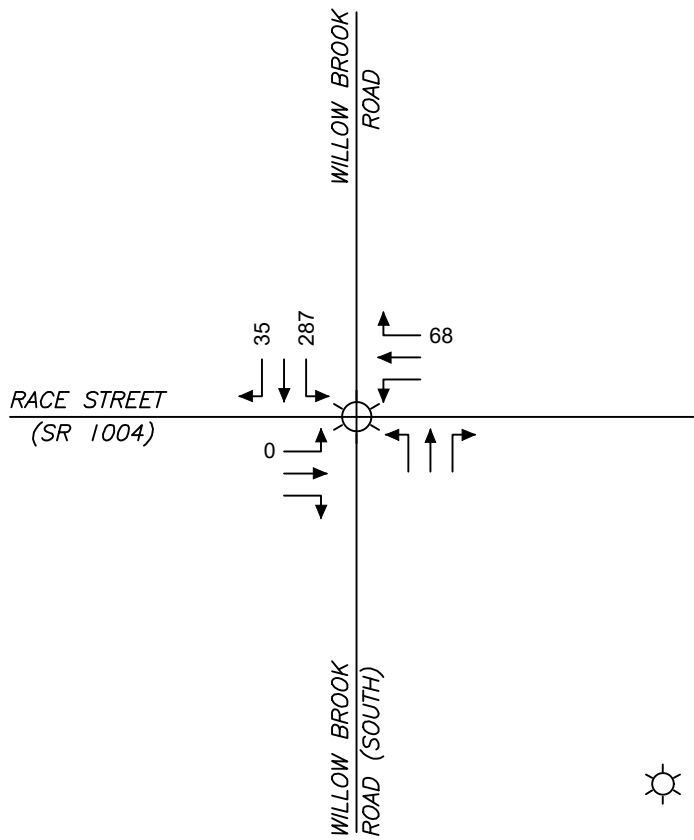
ADDITIONAL ROCKEFELLER TRAFFIC – TRUCKS

FIGURE
10

AM PEAK



PM PEAK



LEGEND



- SIGNALIZED INTERSECTION

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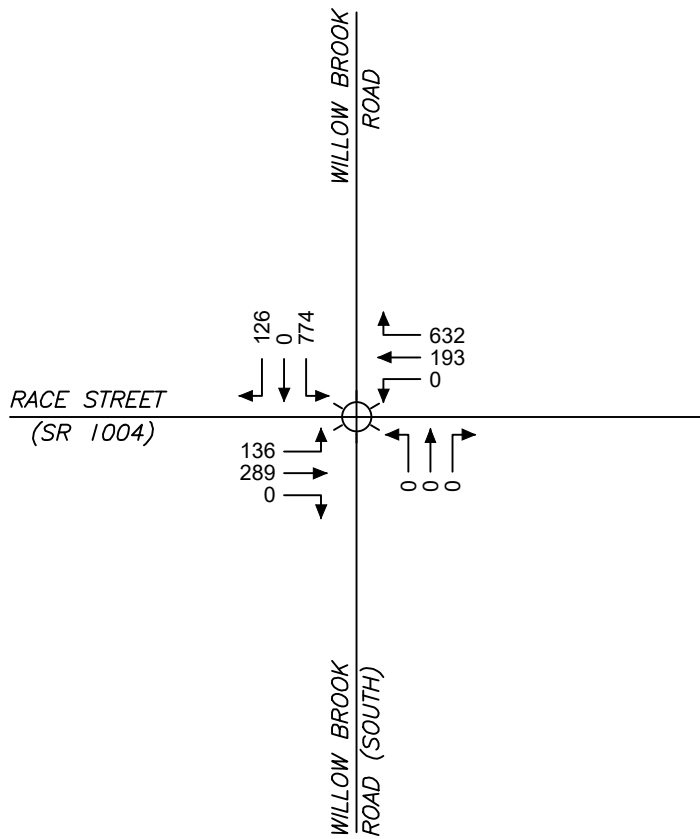
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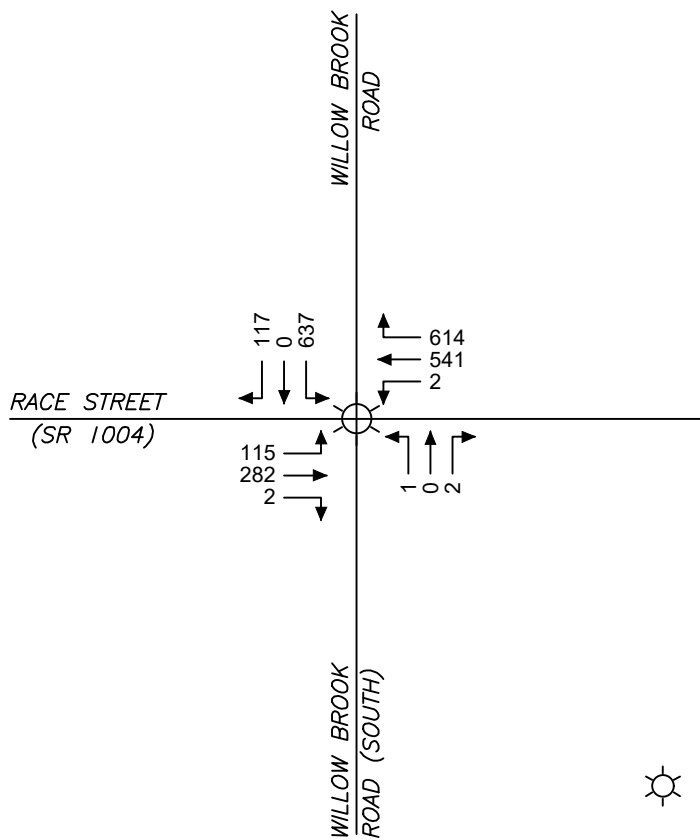
ADDITIONAL ROCKEFELLER TRAFFIC – CARS

FIGURE
11

AM PEAK



PM PEAK



LEGEND



- SIGNALIZED INTERSECTION

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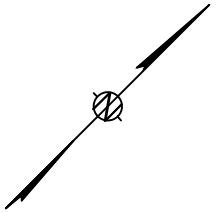
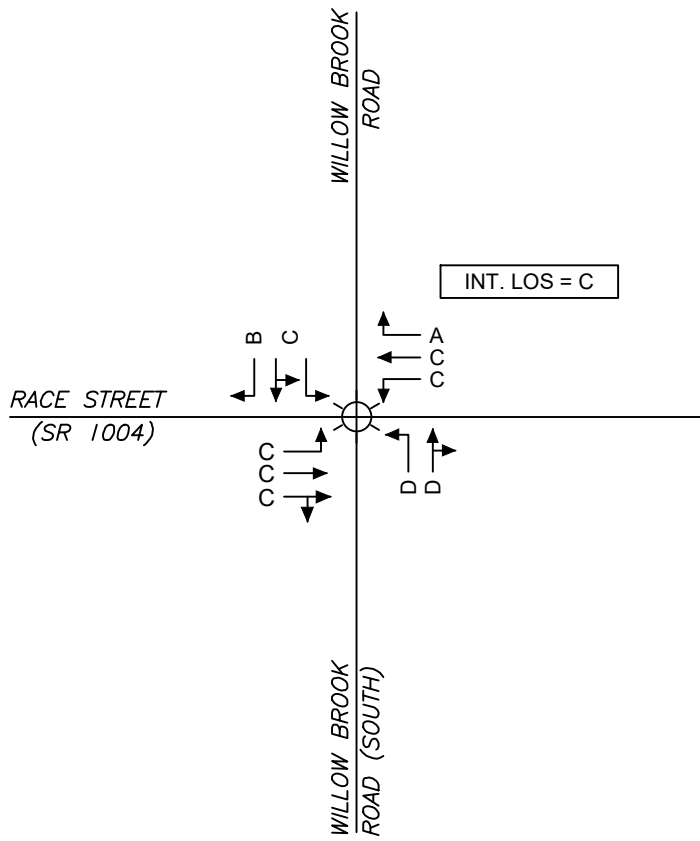
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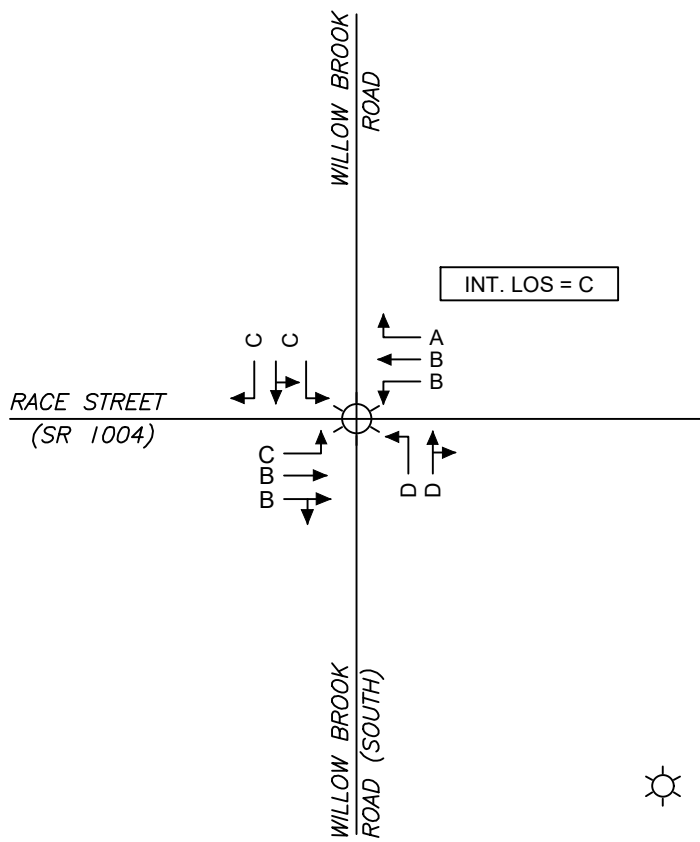
2024 NO BUILD TRAFFIC VOLUMES

FIGURE
12

AM PEAK



PM PEAK



LEGEND



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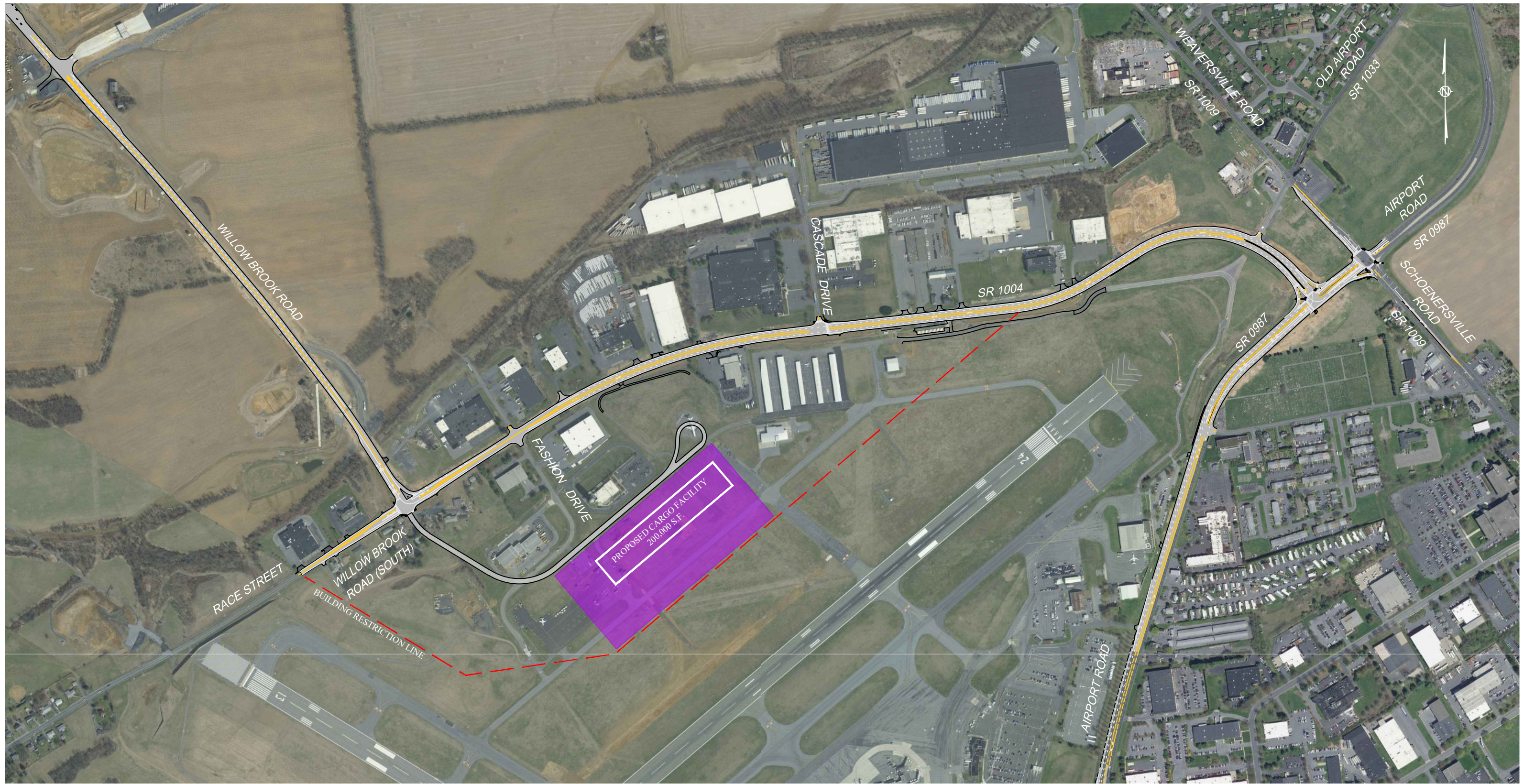
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2024 NO BUILD LEVELS OF SERVICE

FIGURE
13



LEHIGH NORTHAMPTON AIRPORT AUTHORITY

AIR CARGO FACILITY SITE PLAN
 HANOVER TOWNSHIP, LEHIGH COUNTY, PENNSYLVANIA
 MARCH 31, 2022

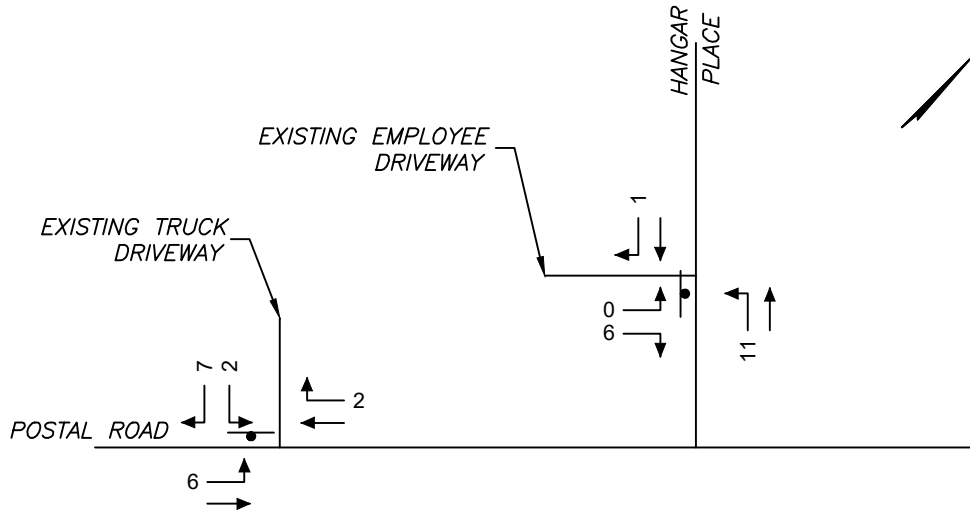
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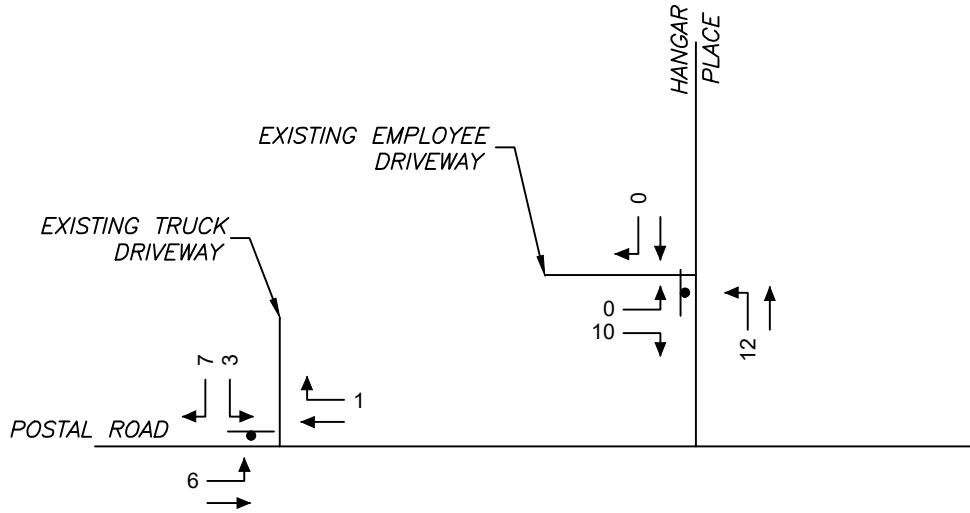
OXFORD DRIVE AT FISH HATCHERY ROAD
 ALLENTOWN, PENNSYLVANIA



AM PEAK



PM PEAK



LEGEND

—●— - STOP CONTROLLED

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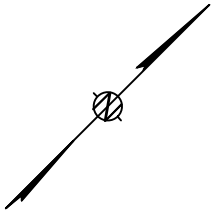
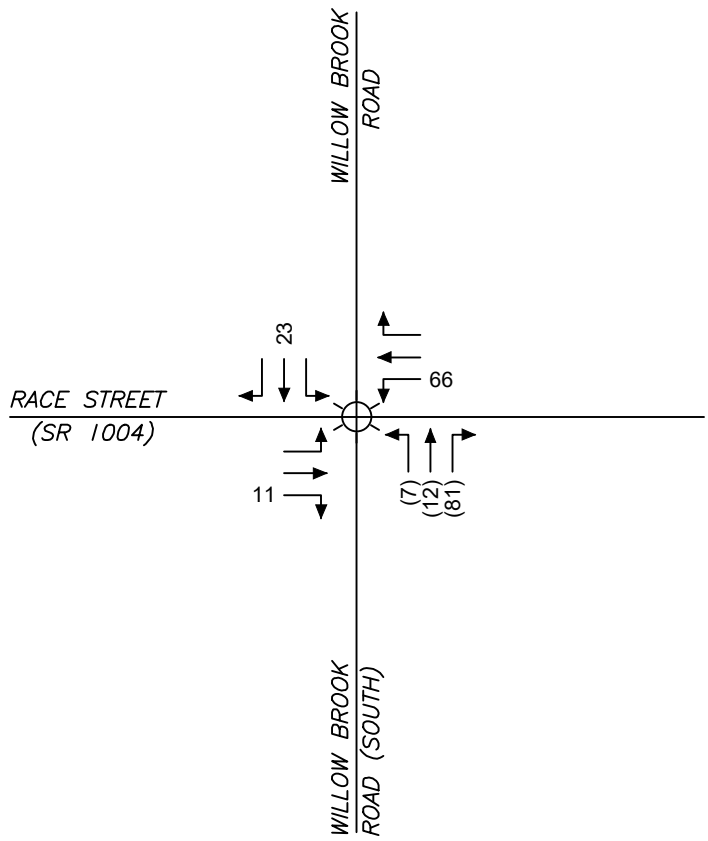
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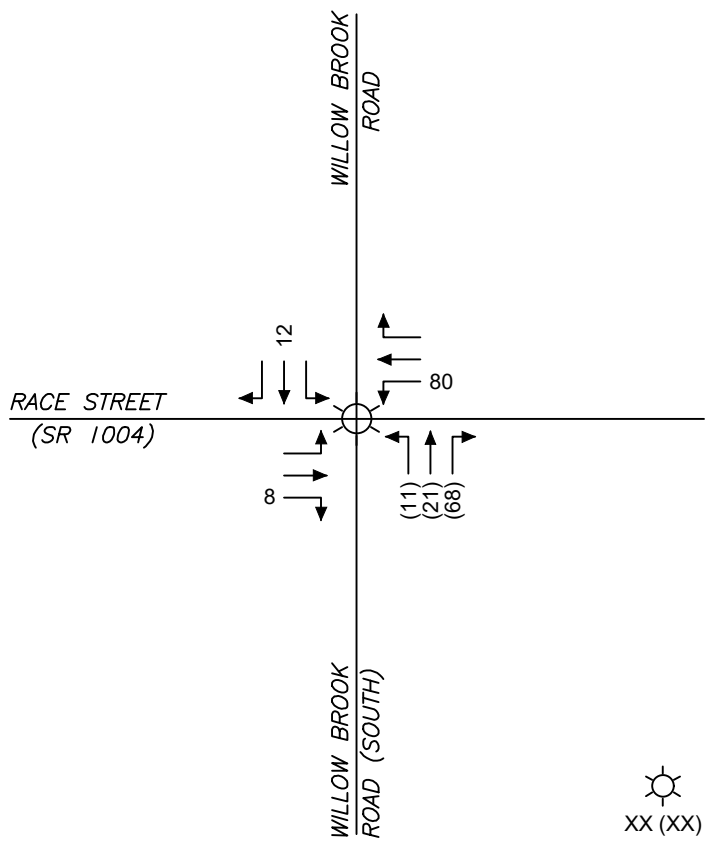
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EXISTING AIR CARGO FACILITY – 2022 TRAFFIC VOLUMES

FIGURE
15


AM PEAK



PM PEAK



LEGEND

-  - SIGNALIZED INTERSECTION
- XX (XX) - ENTERING (EXITING)

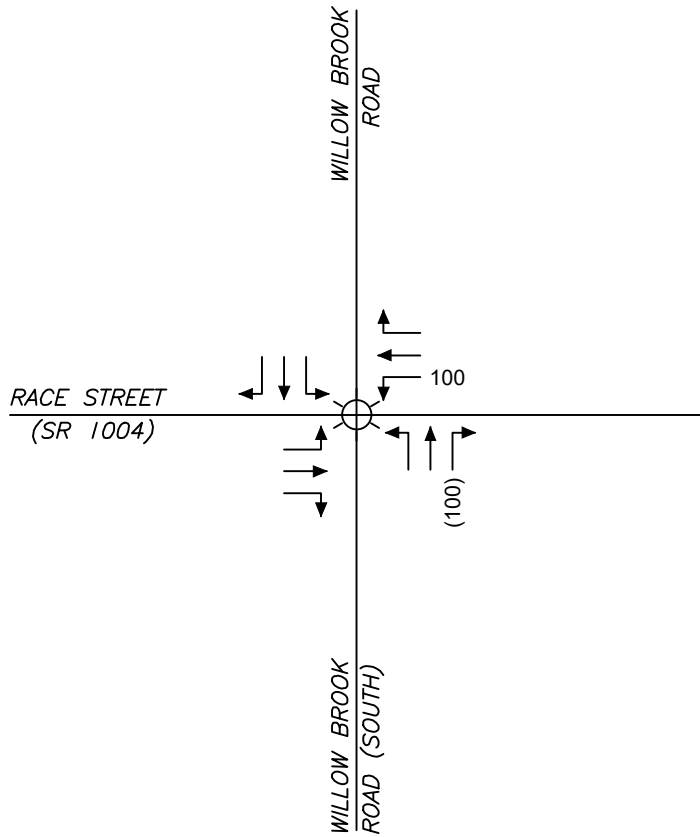
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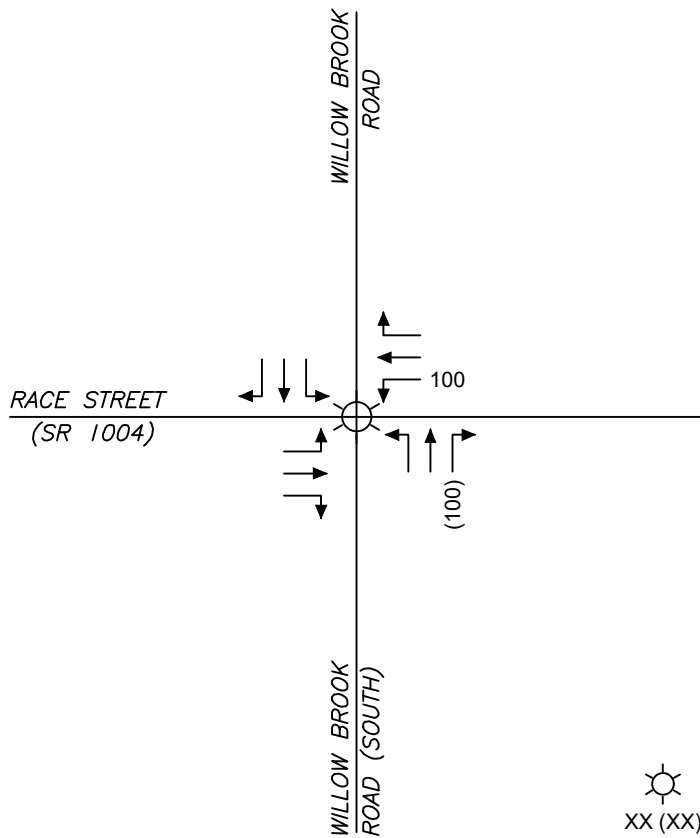
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PROPOSED AIR CARGO FACILITY – TRIP DISTRIBUTIONS – CARS

FIGURE
16


AM PEAK



PM PEAK



LEGEND

-  - SIGNALIZED INTERSECTION
- XX (XX) - ENTERING (EXITING)

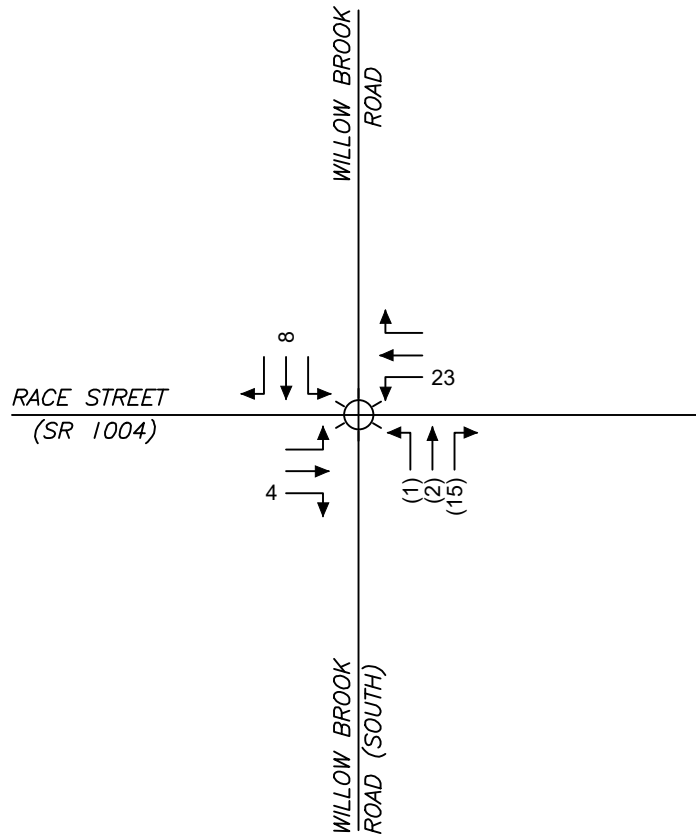
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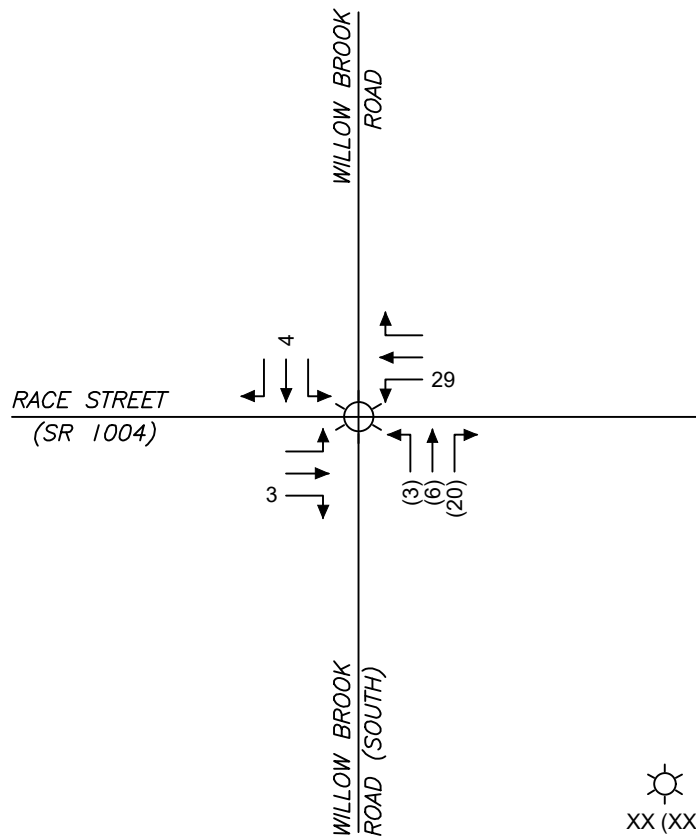
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PROPOSED AIR CARGO FACILITY – TRIP DISTRIBUTIONS – TRUCKS

FIGURE
17


AM PEAK



PM PEAK



LEGEND

-  - SIGNALIZED INTERSECTION
- XX (XX) - ENTERING (EXITING)

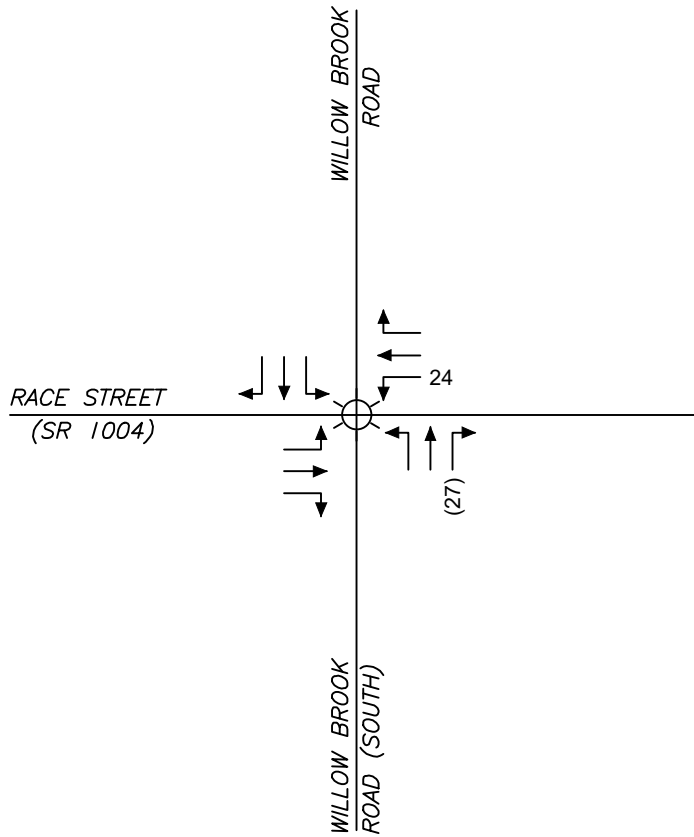
"NOT PUBLISHED; ALL RIGHTS RESERVED BY THE PIDCOCK COMPANY."

DRWN. BY: BMC	SCALE: NO SCALE
CHKD. BY: BEH	DATE: MARCH 2022
FIELD BOOK: ---	PROJ. NO.: 21051

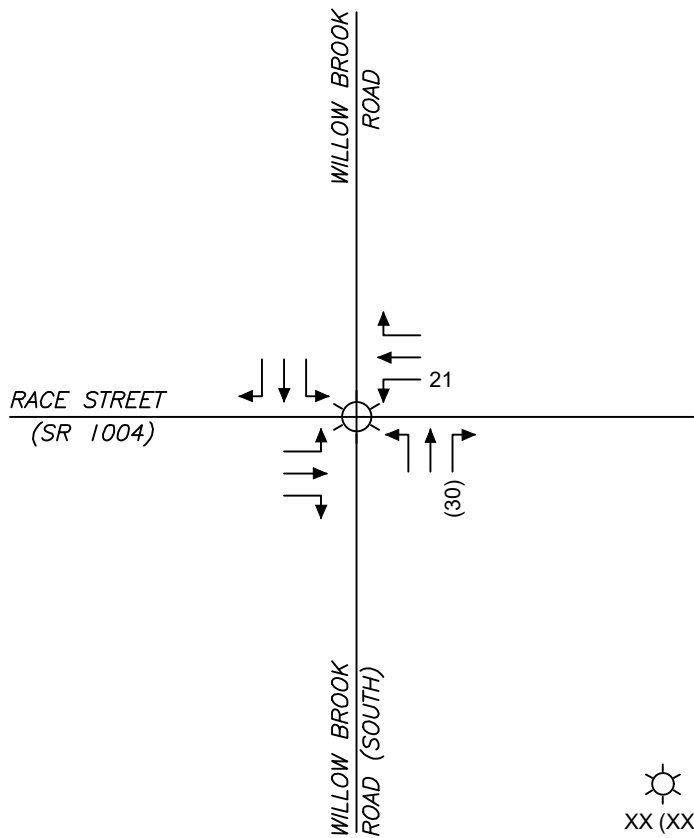
LEHIGH NORTHAMPTON AIRPORT AUTHORITY
 NORTH CARGO DEVELOPMENT TRAFFIC ASSESSMENT
 HANOVER TOWNSHIP, LEHIGH COUNTY, PENNSYLVANIA
THE PIDCOCK COMPANY
 CIVIL ENGINEERING AND LAND PLANNING ARCHITECTURE LAND SURVEYING
 2451 PARKWOOD DRIVE ALLENTOWN, PENNSYLVANIA 18103
PROPOSED AIR CARGO FACILITY – TRIP ASSIGNMENTS – CARS

FIGURE
18


AM PEAK



PM PEAK



LEGEND

-  - SIGNALIZED INTERSECTION
- XX (XX) - ENTERING (EXITING)

"NOT PUBLISHED; ALL RIGHTS RESERVED BY THE PIDCOCK COMPANY."

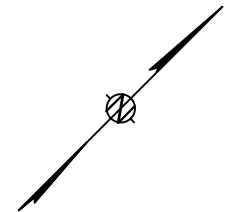
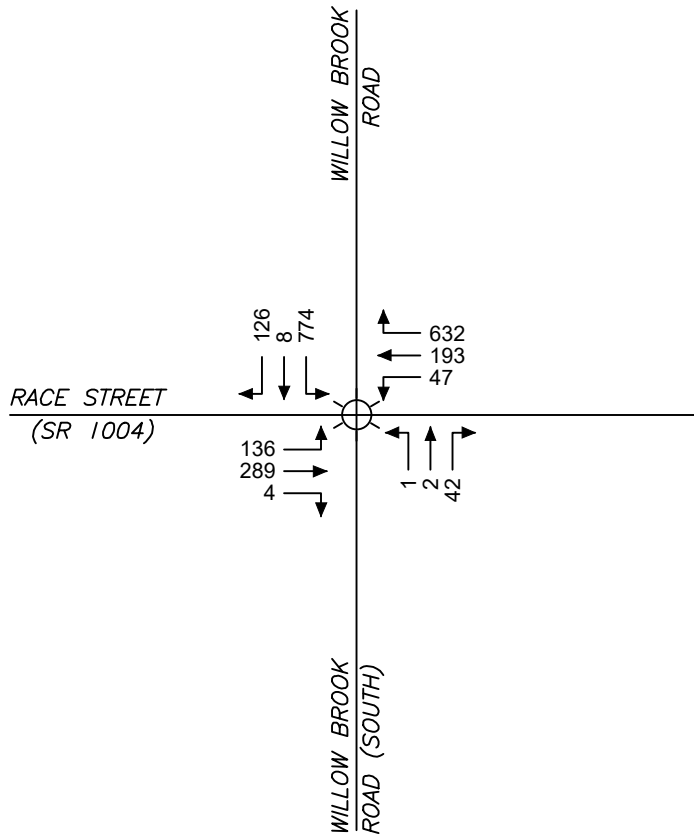
DRWN. BY: BMC	SCALE: NO SCALE
CHKD. BY: BEH	DATE: MARCH 2022
FIELD BOOK: ---	PROJ. NO.: 21051

LEHIGH NORTHAMPTON AIRPORT AUTHORITY
 NORTH CARGO DEVELOPMENT TRAFFIC ASSESSMENT
 HANOVER TOWNSHIP, LEHIGH COUNTY, PENNSYLVANIA
THE PIDCOCK COMPANY
 CIVIL ENGINEERING AND LAND PLANNING ARCHITECTURE LAND SURVEYING
 2451 PARKWOOD DRIVE ALLENTOWN, PENNSYLVANIA 18103

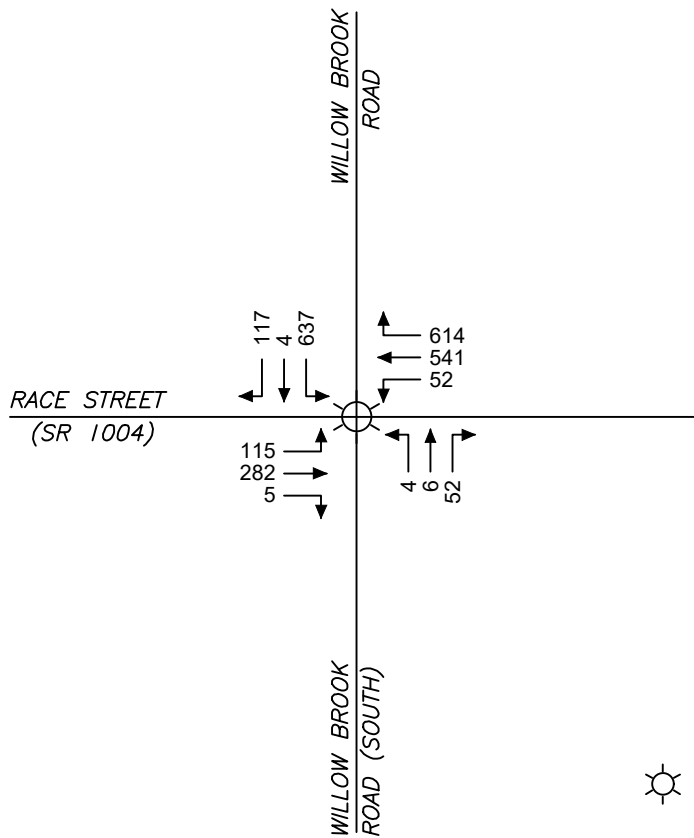
PROPOSED AIR CARGO FACILITY – TRIP ASSIGNMENTS – TRUCKS

FIGURE
19

AM PEAK



PM PEAK



LEGEND



- SIGNALIZED INTERSECTION

"NOT PUBLISHED; ALL RIGHTS RESERVED BY THE PIDCOCK COMPANY."

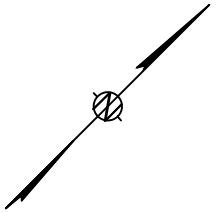
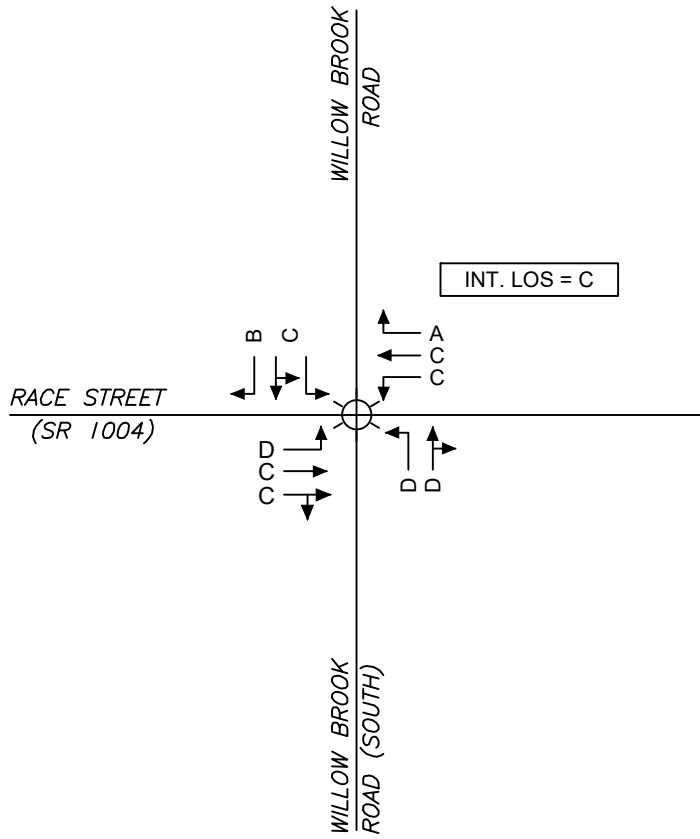
DRWN. BY:
BMC
CHKD. BY:
BEH
FIELD BOOK:

SCALE:
NO SCALE
DATE:
MARCH 2022
PROJ. NO.:
21051

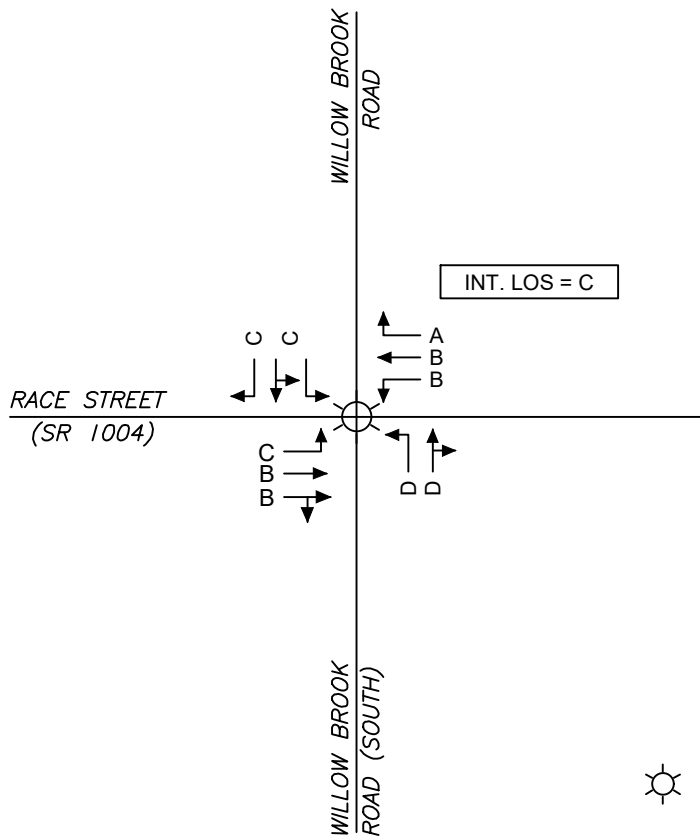
LEHIGH NORTHAMPTON AIRPORT AUTHORITY
NORTH CARGO DEVELOPMENT TRAFFIC ASSESSMENT
 HANOVER TOWNSHIP, LEHIGH COUNTY, PENNSYLVANIA
THE PIDCOCK COMPANY
 CIVIL ENGINEERING AND LAND PLANNING ARCHITECTURE LAND SURVEYING
 2451 PARKWOOD DRIVE ALLENTOWN, PENNSYLVANIA 18103
2024 BUILD TRAFFIC VOLUMES

FIGURE
20

AM PEAK



PM PEAK



LEGEND



- SIGNALIZED INTERSECTION

"NOT PUBLISHED; ALL RIGHTS RESERVED BY THE PIDCOCK COMPANY."

DRWN. BY:

BMC

CHKD. BY:

BEH

FIELD BOOK:

SCALE:

NO SCALE

DATE:

MARCH 2022

PROJ. NO.:

21051

LEHIGH NORTHAMPTON AIRPORT AUTHORITY

NORTH CARGO DEVELOPMENT TRAFFIC ASSESSMENT

HANOVER TOWNSHIP, LEHIGH COUNTY, PENNSYLVANIA

THE PIDCOCK COMPANY

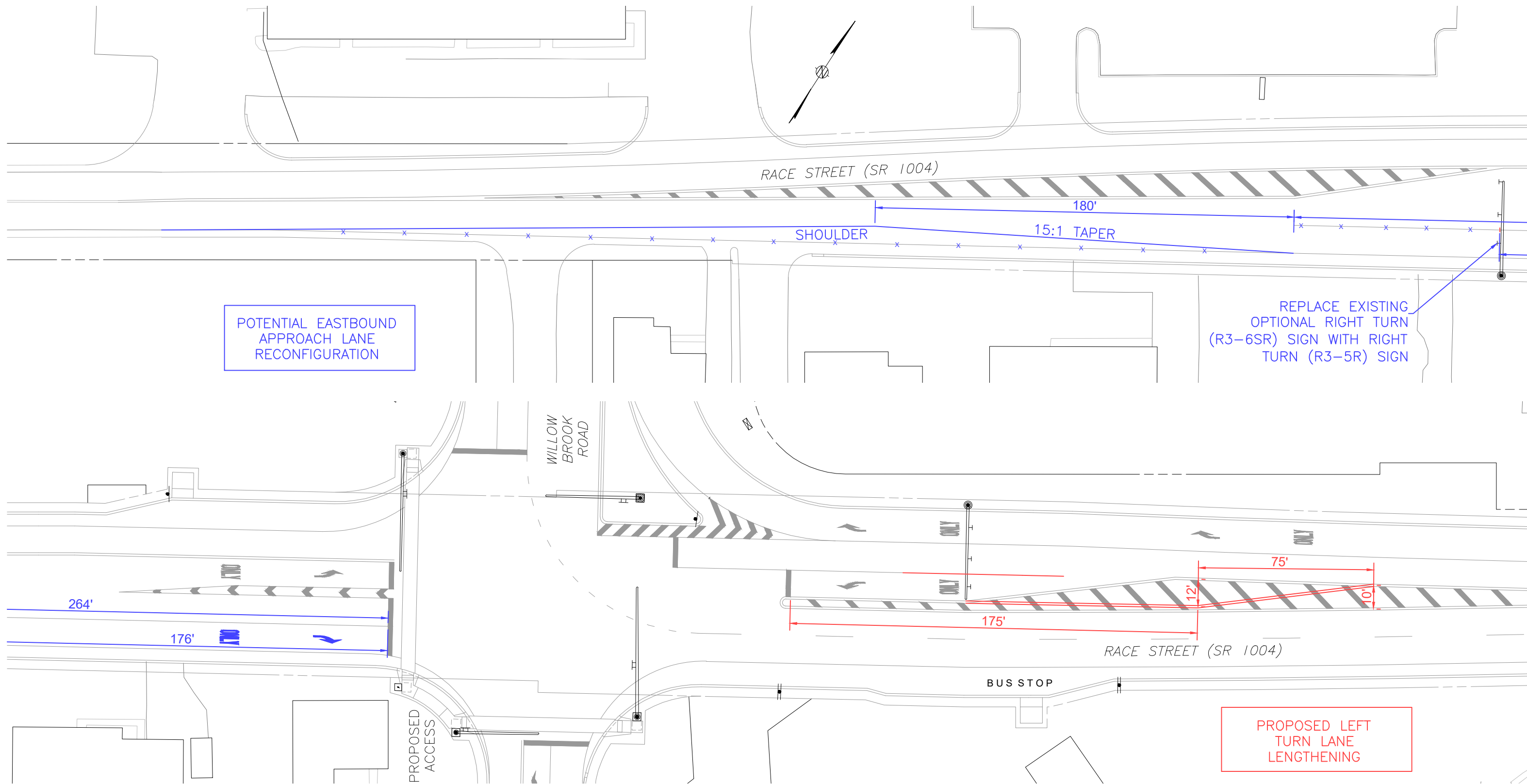
CIVIL ENGINEERING AND LAND PLANNING ARCHITECTURE LAND SURVEYING

2451 PARKWOOD DRIVE ALLENTOWN, PENNSYLVANIA 18103

2024 BUILD LEVELS OF SERVICE

FIGURE

21



LEHIGH NORTHAMPTON AIRPORT AUTHORITY
RACE STREET AND WILLOW BROOK ROAD RESTRIPIING
 HANOVER TOWNSHIP, LEHIGH COUNTY, PENNSYLVANIA
 MARCH 31, 2022

THE PIDCOCK COMPANY
 CIVIL ENGINEERING AND LAND PLANNING ARCHITECTURE LAND SURVEYING
 OXFORD DRIVE AT FISH HATCHERY ROAD
 ALLENTOWN, PENNSYLVANIA

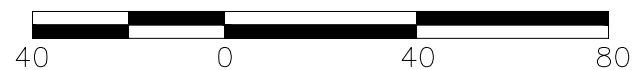
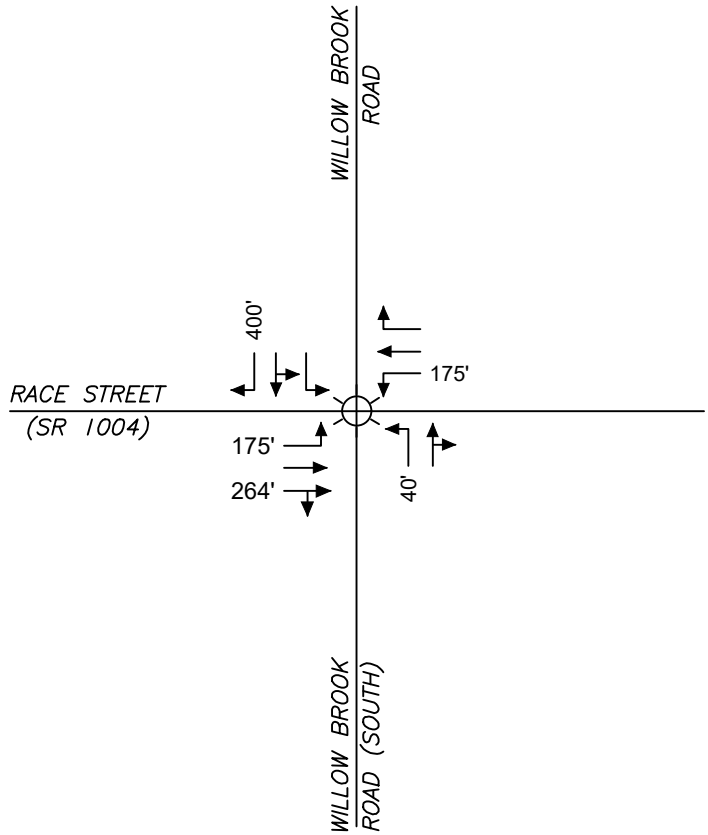
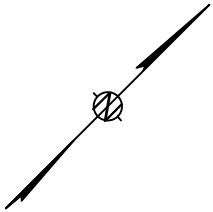


FIGURE 22



LEGEND

 - SIGNALIZED INTERSECTION

"NOT PUBLISHED; ALL RIGHTS RESERVED BY THE PIDCOCK COMPANY."

DRWN. BY:
BMC
CHKD. BY:
BEH
FIELD BOOK:

SCALE:
NO SCALE
DATE:
MARCH 2022
PROJ. NO.:
21051

LEHIGH NORTHAMPTON AIRPORT AUTHORITY
 NORTH CARGO DEVELOPMENT TRAFFIC ASSESSMENT
 HANOVER TOWNSHIP, LEHIGH COUNTY, PENNSYLVANIA
THE PIDCOCK COMPANY
 CIVIL ENGINEERING AND LAND PLANNING ARCHITECTURE LAND SURVEYING
 2451 PARKWOOD DRIVE ALLENTOWN, PENNSYLVANIA 18103
PROPOSED LANE CONFIGURATION AND STORAGE LENGTHS

FIGURE
23

APPENDIX A
EXISTING TRAFFIC SIGNAL
PERMIT PLANS

PHASING, TIMING and COLOR SEQUENCE CHART

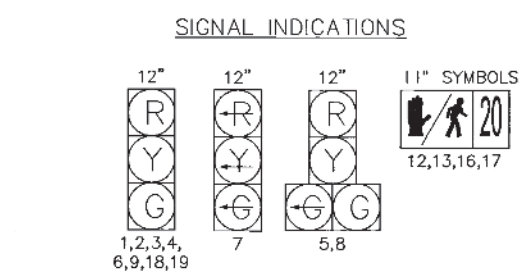
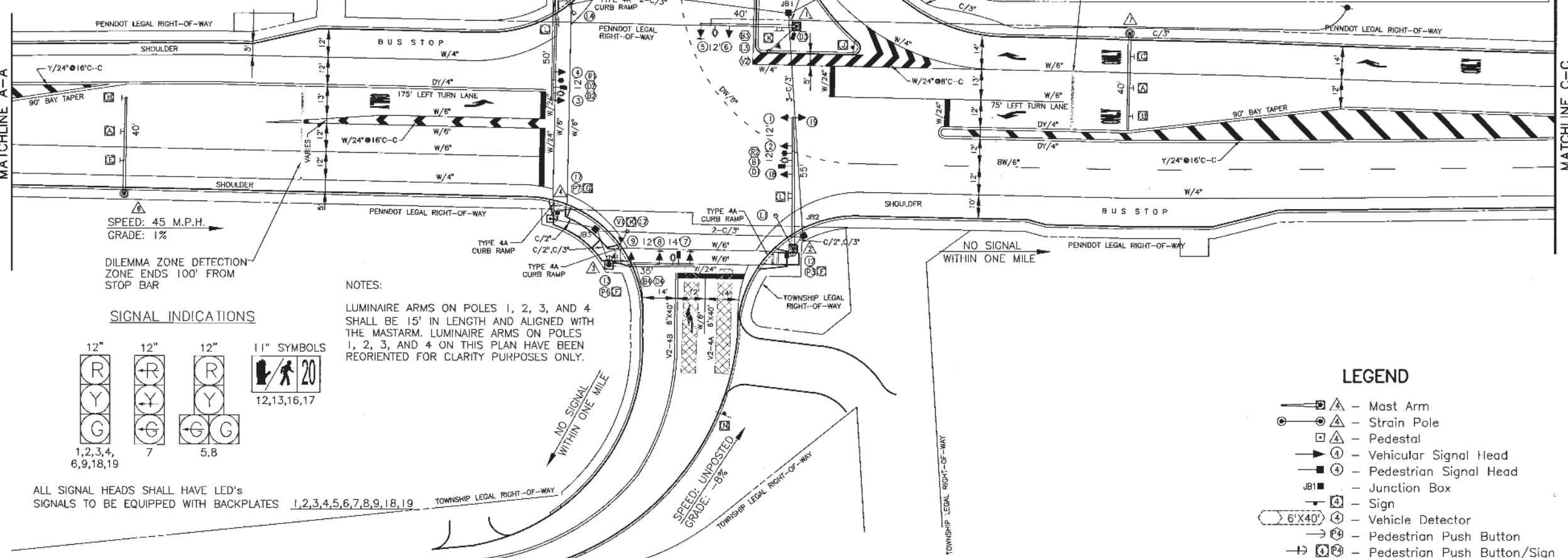
SIGNALS	PHASE 2+6				PHASE 4				PHASE 8				EMERGENCY FLASHING OPERATION
	1	2	3	4	5	6	7		8	9	10	11	
1	G	G	Y	R	R	R	R	R	R	R	R	Y	
2,18	G	G	Y	R	R	R	R	R	R	R	R	Y	
3,19	G	G	Y	R	R	R	R	R	R	R	R	Y	
4	G	G	Y	R	R	R	R	R	R	R	R	Y	
5	R	R	R	R	G	Y	R	R	R	R	R	Y	
6	R	R	R	R	G	Y	R	R	R	R	R	Y	
7	R	R	R	R	R	R	R	G	Y	R	R	Y	
8	R	R	R	R	R	R	R	G	Y	R	R	Y	
9	R	R	R	R	R	R	R	G	Y	R	R	Y	
12,13	M	FH	H	H	H	H	H	H	H	H	H	OFF	
16,17	H	H	H	H	H	H	H	H	H	H	H	OFF	

FIXED	5	2	4.5	2.5	3	3.5	2.5
MIN. GREEN	10						
MAX. INITIAL	29						
PASSAGE	**						
MAXIMUM I	36						
MAXIMUM II	26						
MAXIMUM III	45						
PEDESTRIAN*	9	22			7	22	
MEMORY	MIN RECALL	NON-LOCKING	NON-LOCKING				

* UPON PEDESTRIAN ACTUATION ONLY
 † UPON PEDESTRIAN ACTUATION ONLY, OTHERWISE HAND SYMBOL AT ALL TIMES

RACE STREET

NEAREST SIGNAL 3,700' AT FOURTEENTH STREET



ALL SIGNAL HEADS SHALL HAVE LED'S SIGNALS TO BE EQUIPPED WITH BACKPLATES 1,2,3,4,5,6,7,8,9,18,19

PLAN SYMBOL	SERIES	SIZE	QTY.	MESSAGE
(A)	R3-5A	30"X36"	2	STRAIGHT THROUGH
(B)	R3-5L	30"X36"	3	LEFT TURN
(C)	R3-5R	30"X36"	2	RIGHT TURN
(D)	R3-6LS	30"X36"	1	OPTIONAL LEFT TURN
(E)	R3-6SR	30"X36"	1	OPTIONAL RIGHT TURN
(F)	R10-3EL	9"X15"	3	EDUCATIONAL PUSH BUTTON FOR WALKING PERSON WITH COUNTDOWN TIMER <-
(G)	R10-3ER	9"X15"	1	EDUCATIONAL PUSH BUTTON FOR WALKING PERSON WITH COUNTDOWN TIMER ->
(H)	OM1-3	18"X18"	1	OBJECT MARKER
(I)	D3-4	66"X16"	2	Race St
(J)	D3-4	96"X16"	2	Willow Brook Rd
(K)	R3-8B	48"X30"	1	LANE USE CONTROL (L,LS,R)
(L)	R3-7L	30"X30"	1	LEFT LANE MUST TURN LEFT

SIGN NOTES:
 ** ALL SIGNS TO UTILIZE REFLECTORIZED TYPE III, IV, VI, VII, VIII, IX OR X SHEETING FOR LEGEND, BORDER, AND BACKGROUND.
 * OVERHEAD STREET NAME SIGNS TO BE STRUCTURE MOUNTED FLAT SHEET ALUMINUM WITH STIFFENERS. OVERHEAD STREET NAME SIGNS TO CONSIST OF WHITE LEGEND AND BORDER ON GREEN BACKGROUND.

PROGRAM CHART

EVENT NO.	DAY OF WEEK							TIME	CYCLE	OFFSET (SEC.)	REMARKS
	M	T	W	T	F	S	S				
1	X	X	X	X	X	X	X	00 00 00	---	---	MAX I, VOLUME DENSITY
2	X	X	X	X	X	X	X	06 30 00	---	---	MAX II, VOLUME DENSITY
3	X	X	X	X	X	X	X	09 30 00	---	---	MAX I, VOLUME DENSITY
4	X	X	X	X	X	X	X	15 30 00	---	---	MAX III, VOLUME DENSITY
5	X	X	X	X	X	X	X	18 30 00	---	---	MAX I, VOLUME DENSITY

ADVANCED DILEMMA ZONE NOTES:
 ESTIMATED TIME OF ARRIVAL: MINIMUM 2.3 SECONDS- MAXIMUM 5.2 SECONDS
 RANGE OF DETECTION: MINIMUM 100 FEET FROM STOP BAR MAXIMUM 400 FEET FROM STOP BAR
 MINIMUM SPEED BOUNDARY - 30 MPH ZONE MAY BE ADJUSTED FOR FIELD CONDITIONS

DENSITY ZONE NOTES:
 RANGE OF DETECTION: MINIMUM 30 FEET FROM STOP BAR MAXIMUM 100 FEET FROM STOP BAR
 MINIMUM SPEED BOUNDARY - 1 MPH-33 MPH ZONE MAY BE ADJUSTED FOR FIELD CONDITIONS

DISTRICT	COUNTY	ROUTE	SECTION	SHEET
5-0	LEHIGH	1004		2 OF 3
HANOVER TOWNSHIP				
PERMIT NO.	39-201-011	SHEET	2 OF 3	
DATE ISSUED	11-20-09	DATE REVISED	3-26-18	

GENERAL NOTES

Installation, operation and maintenance of this traffic signal to be in accordance with Pennsylvania Department of Transportation Regulations on Official Traffic Control Devices.
 No modifications of this installation are permitted unless prior approval is granted, in writing, by the Department.
 All maintenance necessary for proper visibility of the signals, including trimming trees, is the responsibility of the Permittee.
 All signs and pavement markings indicated on this drawing are considered part of the permit and are to be installed and maintained by the Permittee, unless otherwise indicated, except the longitudinal pavement markings on State highways which will be maintained by the Department.
 Install post mounted signals with the signal heads a minimum of 2 feet behind the face of the curb or edge of the shoulder. Support poles for overhead signals will have a minimum horizontal clearance of 2 feet.
 The bottom of signal heads and signs erected over the roadway are not to be less than 15 feet nor more than 19 feet above the roadway. The bottom of post mounted signal heads are to be not less than 8 feet nor more than 15 feet above the sidewalk or pavement grade.
 The minimum horizontal distance between signal heads measured at right angles to the approach is to be 8 feet.
 In addition to this signal permit, the permittee will obtain a Highway Occupancy Permit prior to any openings being made in or under any portion of a State Highway, if applicable.

This drawing cannot be used as a construction drawing unless the Permittee complies with the provisions of Act 287-1974 amended by Act 121-2008, Prevention of Damage to Underground Utilities. Prior to construction consult with utility companies to resolve any problems which may be created due to the location of utilities.
 Place pavement markings in accordance with the Department of Transportation Pavement Marking Standards TC-8600 Series.
 Maintenance and protection of traffic for the installation and maintenance of this traffic signal to be in accordance with Publication 213, Temporary Traffic Control Guidelines.
 Threaded plate mast arm connections will not be permitted for this Traffic Signal Permit.

- LEGEND
- Mast Arm
 - Strain Pole
 - Pedestal
 - Vehicular Signal Head
 - Pedestrian Signal Head
 - Junction Box
 - Sign
 - Vehicle Detector
 - Pedestrian Push Button
 - Pedestrian Push Button/Sign
 - Controller Assembly
 - W/4" - Solid White Line/Width
 - DW/4" - Dotted Extension Line/Width
 - BW/4" - Broken White Line/Width
 - Y/4" - Solid Yellow Line/Width
 - BY/4" - Broken Yellow Line/Width
 - DY/4" - Double Solid Yellow Line/Width
 - Emergency Preemption Beacon
 - Emergency Preemption Detector
 - Luminaire
 - Video Detector
 - Video Detection Area
 - Radar Detector
 - Radar Detection Area

County: LEHIGH

Municipality: HANOVER TOWNSHIP

Intersection: SR 1004 (RACE STREET) AND WILLOW BROOK ROAD

Reviewed: [Signature] 3/19/18
 Municipal Official Date

Reviewed: [Signature] 3/22/18
 District Traffic Signals Div. Date

Recommended: [Signature] 3/22/18
 District Traffic Engineer Date

Scale: 0 25 50 75

DISTRICT	COUNTY	ROUTE	SECTION	SHEET
5-0	LEHIGH	1004		3 OF 3
HANOVER TOWNSHIP				
PERMIT NO.	39-201-011	SHEET	3	OF 3
DATE ISSUED	11-20-09	DATE REVISED	3-26-18	

EMERGENCY PREEMPTION NOTES:

THE CONTROLLER SHALL BE EQUIPPED WITH EMERGENCY PREEMPTION FOR THE EASTBOUND AND WESTBOUND APPROACHES OF RACE STREET AND THE NORTHBOUND AND SOUTHBOUND APPROACHES OF WILLOW BROOK ROAD WITH AN INDICATOR LIGHT FOR EACH APPROACH. THE INDICATOR LIGHT SHALL CONSIST OF A FLASHING WHITE FLOOD LIGHT AND, IT SHALL FLASH FOR THE APPROPRIATE APPROACH DURING THE GREEN INTERVAL IN THE PREEMPTION PHASE TO CONFIRM THAT THE EMERGENCY VEHICLE HAS CONTROL OF THE INTERSECTION.

THE SIGNALS, WHEN ACTIVATED BY AN EMERGENCY VEHICLE, SHALL IMMEDIATELY TERMINATE ALL GREEN INDICATIONS, EXCEPT THE GREEN INDICATIONS FOR THE PHASE GOVERNED BY THE APPROACHING EMERGENCY VEHICLE, FOLLOWED BY SELECTIVE CLEARANCES DEPENDENT UPON THE PHASE IN WHICH THE PREEMPTION OCCURS. THE GREEN INDICATIONS FOR THE PREEMPTED PHASE SHALL REMAIN GREEN FOR THE DURATION OF SIGNAL PREEMPTION AND RED INDICATIONS DISPLAYED FOR ALL OTHER PHASES.

THE SIGNALS, WHEN ACTIVATED DURING ANY CLEARANCE INTERVAL BY AN EMERGENCY VEHICLE, SHALL TIME OUT ALL YELLOW AND RED INTERVALS, FOLLOWED BY THE GREEN INTERVAL OF THE PREEMPTION PHASE GOVERNED BY THE APPROACHING EMERGENCY VEHICLE.

IF THE SIGNALS, WHEN ACTIVATED BY AN EMERGENCY VEHICLE, ARE FLASHING ALL SIGNALS SHALL REMAIN FLASHING.

UPON COMPLETION OF PREEMPTION PHASE 2 OR 6, IN RETURNING TO NORMAL OPERATION, PHASE 2+6 INTERVAL 1 SHALL FOLLOW.

UPON COMPLETION OF PREEMPTION PHASE 4 OR 8, IN RETURNING TO NORMAL OPERATION, PHASE 2+6 INTERVAL 1 SHALL FOLLOW.

IF THE PREEMPTION EQUIPMENT HAS ENCODING CAPABILITIES FOR VEHICLE IDENTIFICATION AND THERE IS THE NEED TO ALLOW PREEMPTION BY EMERGENCY VEHICLES FROM NEARBY MUNICIPALITIES WITH DIFFERENT EMITTERS, IT IS RECOMMENDED TO HAVE THE ZERO "00" FEATURE ON TO GIVE UNCODED EMITTERS THE ABILITY TO ACTIVATE THE EMERGENCY PREEMPTION.

IF THE SIGNALS HAVE BEEN ACTUATED BY A PEDESTRIAN PUSHBUTTON, AND THE SIGNAL IS SUBSEQUENTLY PREEMPTED BY AN APPROACHING EMERGENCY VEHICLE, THE PEDESTRIAN WALK (WALKING PERSON) INTERVAL SHALL TERMINATE IMMEDIATELY, FOLLOWED BY THE PEDESTRIAN CLEARANCE INTERVAL. THIS INTERVAL SHALL TIME OUT, FOLLOWED BY THE APPROPRIATE SELECTIVE CLEARANCES BEFORE GOING INTO EMERGENCY PREEMPTION.

TRAIN PREEMPTION SHALL TAKE PRECEDENCE OVER EMERGENCY VEHICLE PREEMPTION. EMERGENCY VEHICLES SHALL BE SERVED ON A "FIRST COME, FIRST SERVED" BASIS, UNLESS ANOTHER MODE OF OPERATION IS APPROVED BY PENNDOT. NO OTHER TYPES OR CLASSES OF VEHICLES SHALL BE PERMITTED TO PREEMPT THE TRAFFIC SIGNAL UNLESS APPROVED BY PENNDOT.

GENERAL NOTES

Installation, operation and maintenance of this traffic signal to be in accordance with Pennsylvania Department of Transportation Regulations on Official Traffic Control Devices.

No modifications of this installation are permitted unless prior approval is granted, in writing, by the Department.

All maintenance necessary for proper visibility of the signals, including trimming trees, is the responsibility of the Permittee.

All signs and pavement markings indicated on this drawing are considered part of the permit and are to be installed and maintained by the Permittee, unless otherwise indicated, except the longitudinal pavement markings on State highways which will be maintained by the Department.

Install post mounted signals with the signal heads a minimum of 2 feet behind the face of the curb or edge of the shoulder. Support poles for overhead signals will have a minimum horizontal clearance of 2 feet.

The bottom of signal heads and signs erected over the roadway are not to be less than 15 feet nor more than 19 feet above the roadway. The bottom of post mounted signal heads are to be not less than 8 feet nor more than 15 feet above the sidewalk or pavement grade.

The minimum horizontal distance between signal heads measured at right angles to the approach is to be 8 feet.

In addition to this signal permit, the permittee will obtain a Highway Occupancy Permit prior to any openings being made in or under any portion of a State Highway, if applicable.

This drawing cannot be used as a construction drawing unless the Permittee complies with the provisions of Act 287-1974 amended by Act 121-2008, Prevention of Damage to Underground Utilities. Prior to construction consult with utility companies to resolve any problems which may be created due to the location of utilities.

Place pavement markings in accordance with the Department of Transportation Pavement Marking Standards TC-8600 Series.

Maintenance and protection of traffic for the installation and maintenance of this traffic signal to be in accordance with Publication 213, Temporary Traffic Control Guidelines.

Threaded plate mast arm connections will not be permitted for this Traffic Signal Permit.

County: LEHIGH

Municipality: HANOVER TOWNSHIP

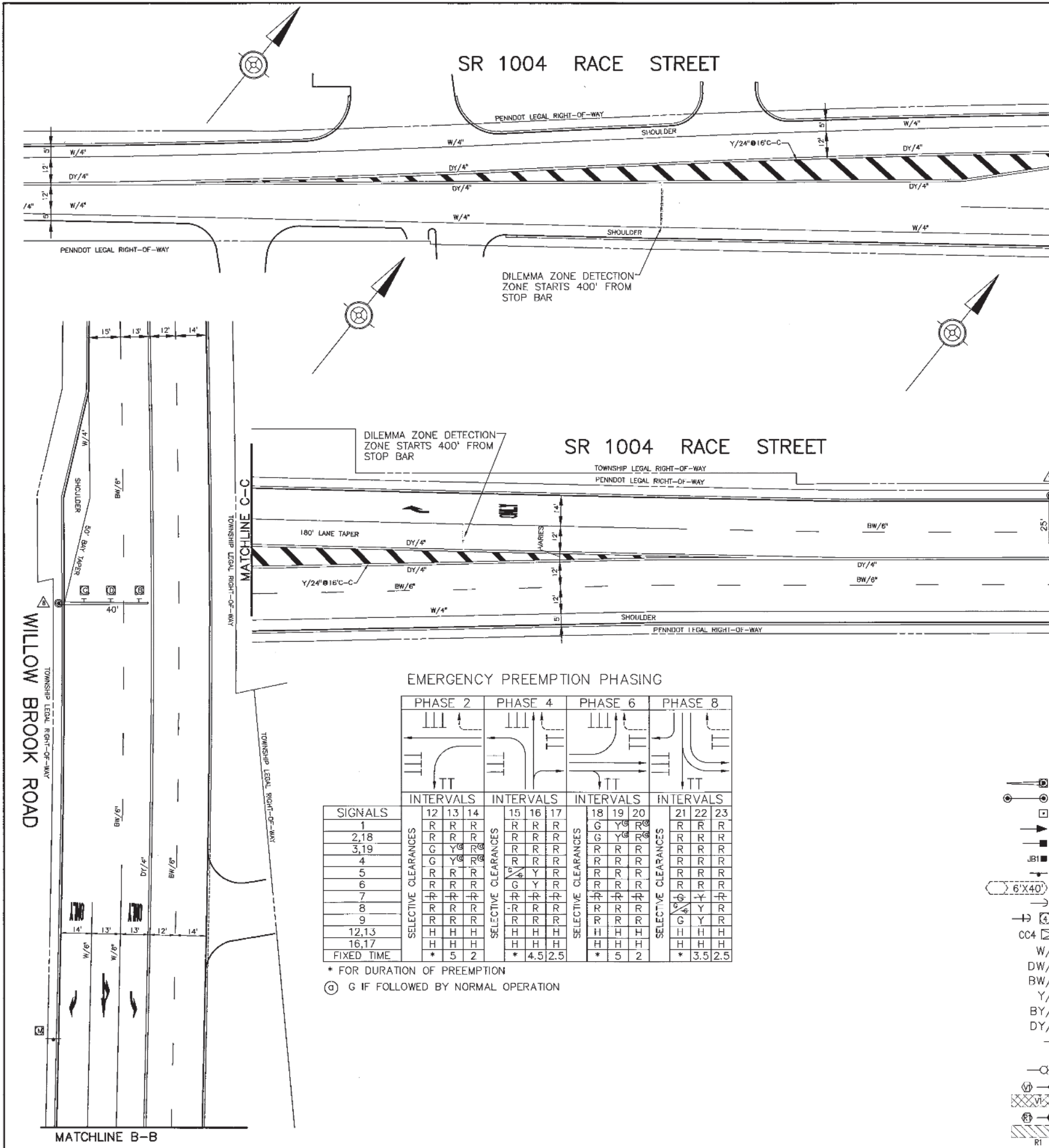
Intersection: SR 1004 (RACE STREET) AND WILLOW BROOK ROAD

Reviewed: [Signature] 3/17/18
Municipal Official Date

Reviewed: [Signature] 3/22/18
District Traffic Signals Div. Date

Recommended: [Signature] 3/22/18
District Traffic Engineer Date

Scale: 0 25 50 75



EMERGENCY PREEMPTION PHASING

SIGNALS	PHASE 2			PHASE 4			PHASE 6			PHASE 8		
	12	13	14	15	16	17	18	19	20	21	22	23
1	R	R	R	R	R	R	G	Y	R	R	R	R
2,18	R	R	R	R	R	R	R	R	R	R	R	R
3,19	G	Y	R	R	R	R	R	R	R	R	R	R
4	G	Y	R	R	R	R	R	R	R	R	R	R
5	R	R	R	R	R	R	R	R	R	R	R	R
6	R	R	R	R	R	R	R	R	R	R	R	R
7	R	R	R	R	R	R	R	R	R	R	R	R
8	R	R	R	R	R	R	R	R	R	R	R	R
9	R	R	R	R	R	R	R	R	R	R	R	R
12,13	H	H	H	H	H	H	H	H	H	H	H	H
16,17	H	H	H	H	H	H	H	H	H	H	H	H
FIXED TIME	* 5	2		* 4.5	2.5		* 5	2		* 3.5	2.5	

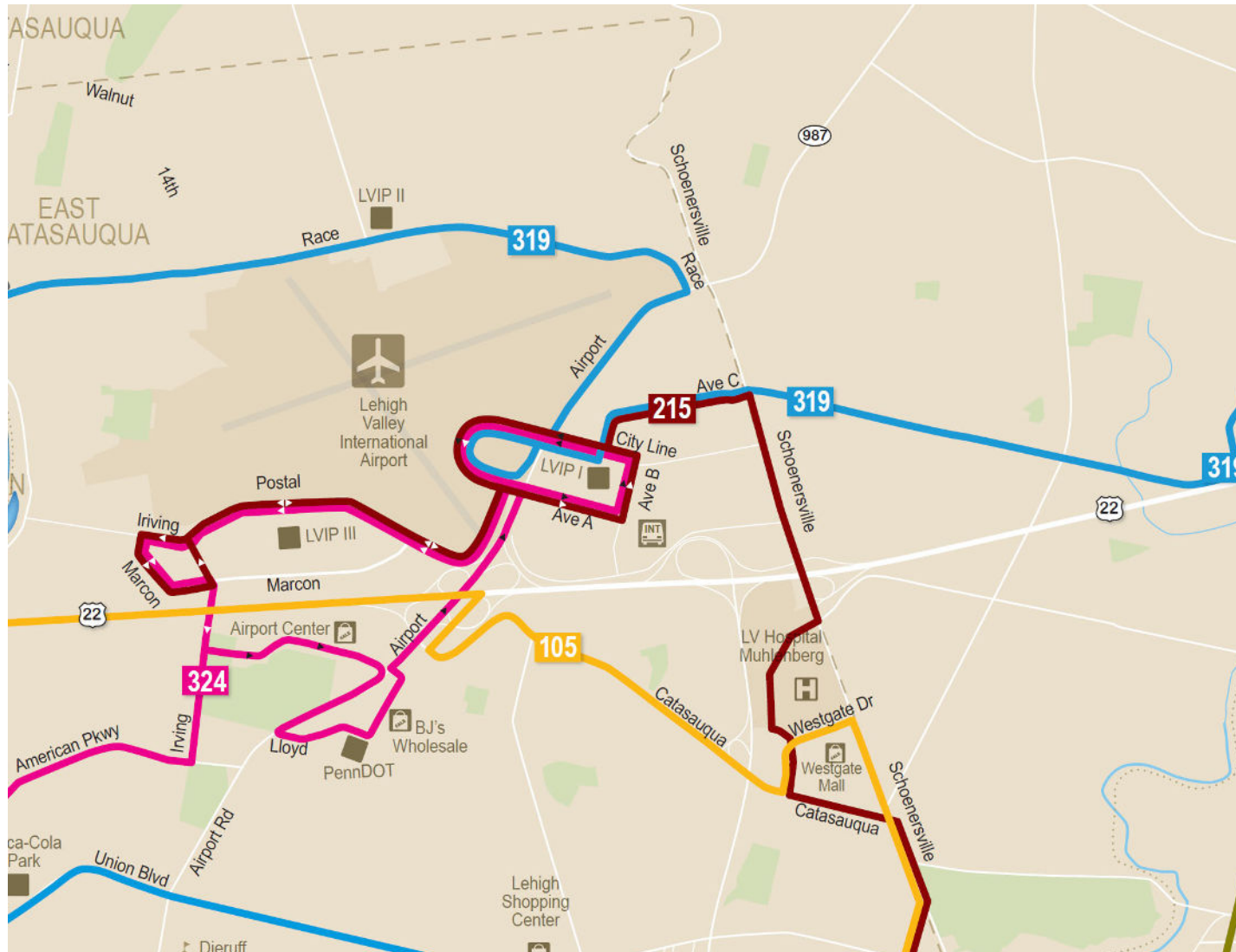
* FOR DURATION OF PREEMPTION
 (a) G IF FOLLOWED BY NORMAL OPERATION

LEGEND

- Mast Arm
- Strain Pole
- Pedestal
- Vehicular Signal Head
- Pedestrian Signal Head
- Junction Box
- Sign
- Vehicle Detector
- Pedestrian Push Button
- Pedestrian Push Button/Sign
- Controller Assembly
- W/4" — Solid White Line/Width
- DW/4" — Dotted Extension Line/Width
- BW/4" — Broken White Line/Width
- Y/4" — Solid Yellow Line/Width
- BY/4" — Broken Yellow Line/Width
- DY/4" — Double Solid Yellow Line/Width
- Emergency Preemption Beacon
- Emergency Preemption Detector
- Luminaire
- Video Detector
- Video Detection Area
- Radar Detector
- Radar Detection Area

APPENDIX B
LANTA BUS ROUTES

LANTA's Current Bus Routes



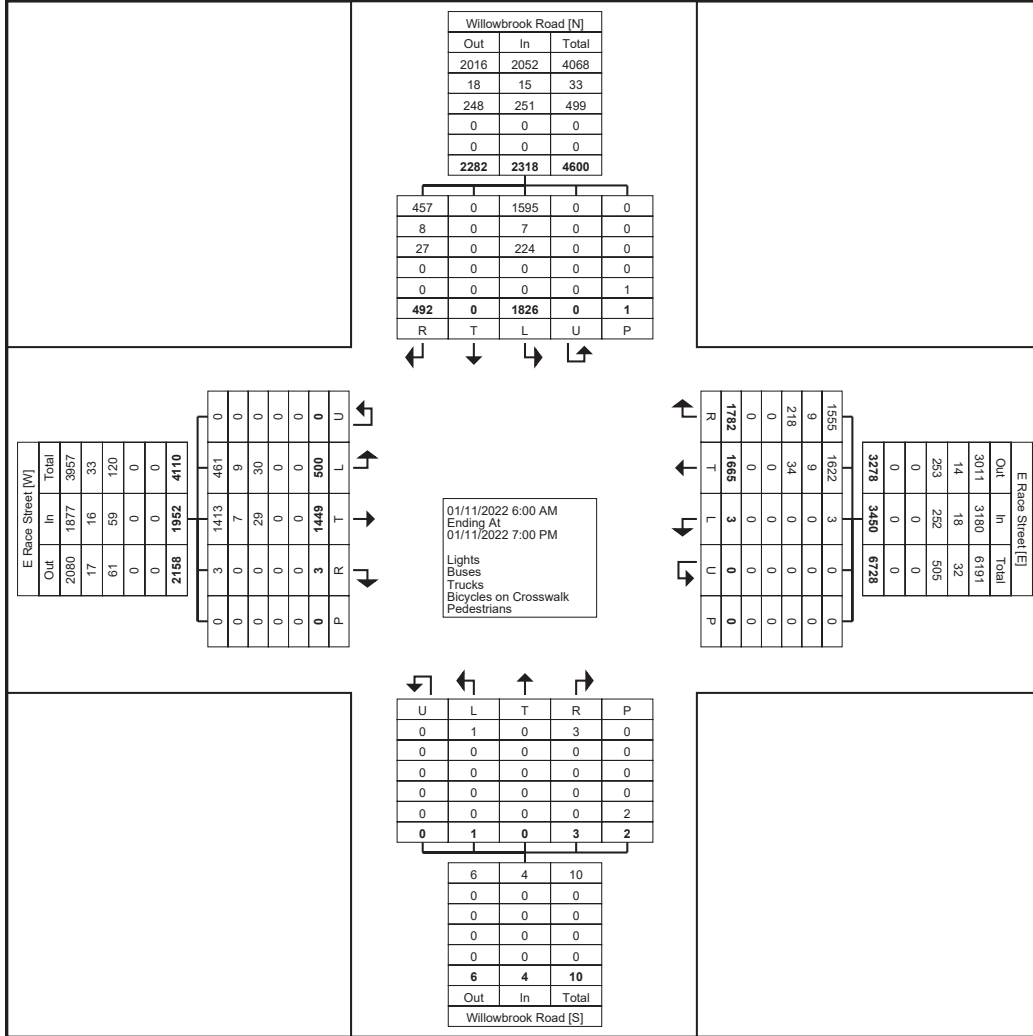
APPENDIX C
EXISTING TRAFFIC COUNTS



Project: Lehigh Valley Airport
 Municipality: Hanover, Lehigh
 County, PA
 Setup: NR
 Location: 40.658229, -
 75.445906

Imperial Traffic & Data Collection
 www.imperialtdc.com
 PO BOX 4637
 Cherry Hill, New Jersey, United States 08034
 609-706-6100 mklein@imperialtdc.com

Count Name: 4. Willowbrook
 Road and E Race Street_WD
 Site Code: 4
 Start Date: 01/11/2022
 Page No: 2



Turning Movement Data Plot

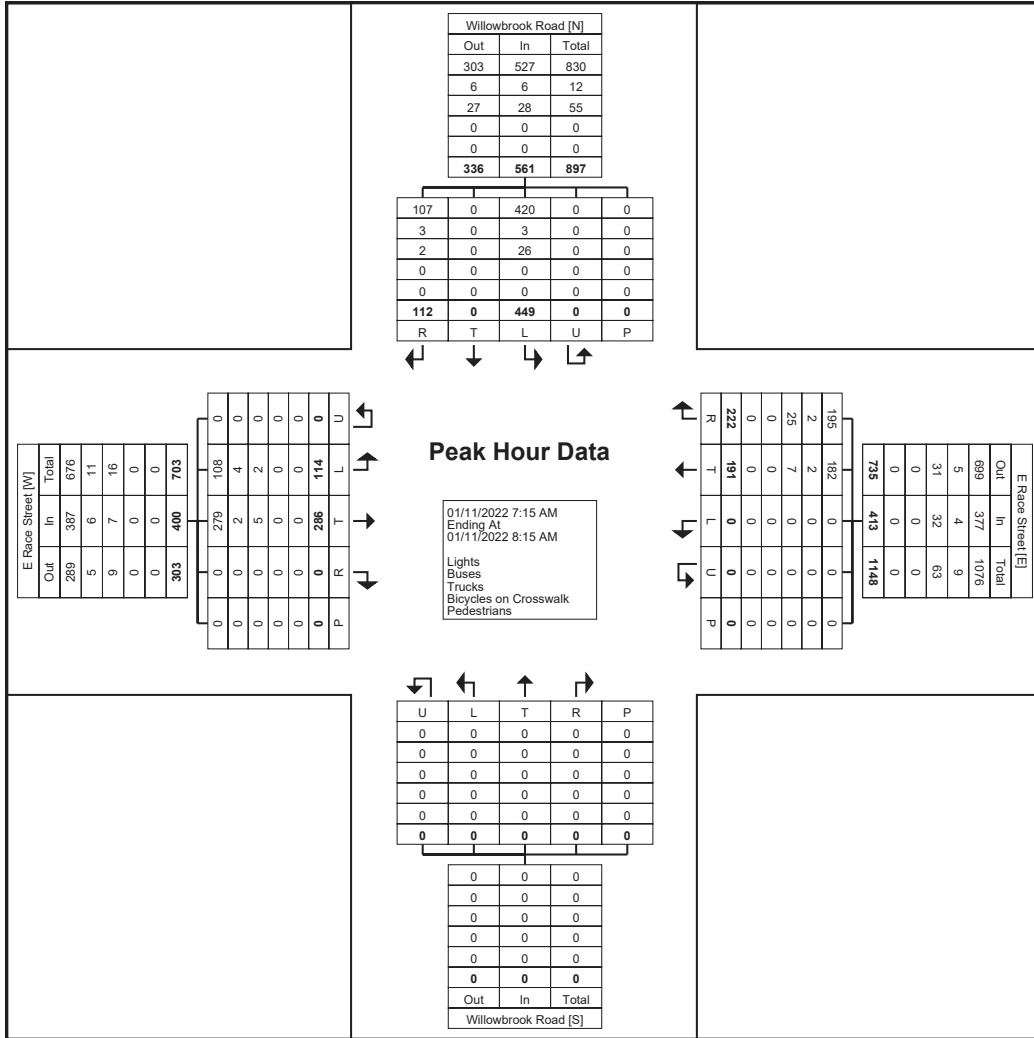


TRAFFIC & DATA COLLECTION

Project: Lehigh Valley Airport
Municipality: Hanover, Lehigh
County, PA
Setup: NR
Location: 40.658229, -
75.445906

Imperial Traffic & Data Collection
www.imperialtdc.com
PO BOX 4637
Cherry Hill, New Jersey, United States 08034
609-706-6100 mklein@imperialtdc.com

Count Name: 4. Willowbrook
Road and E Race Street_WD
Site Code: 4
Start Date: 01/11/2022
Page No: 6



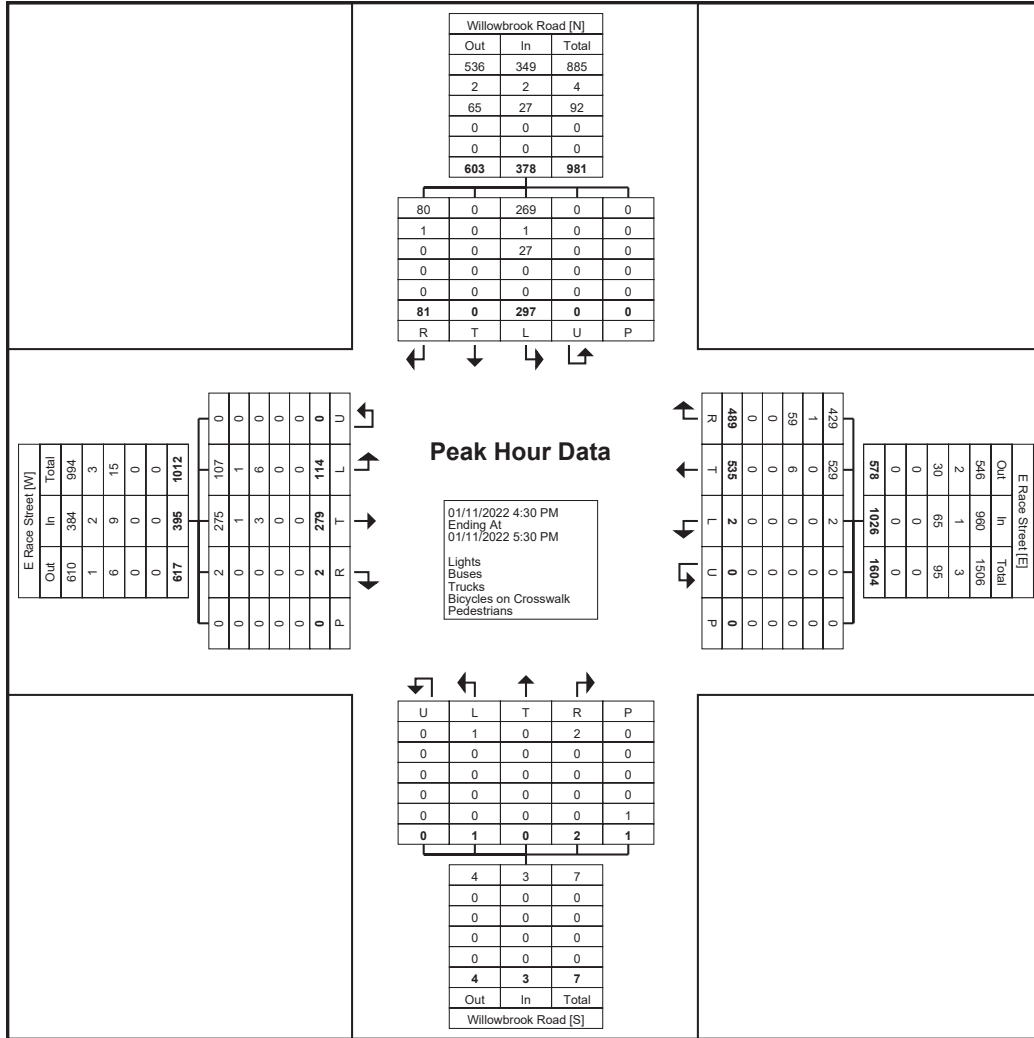
Turning Movement Peak Hour Data Plot (7:15 AM)



Project: Lehigh Valley Airport
 Municipality: Hanover, Lehigh
 County, PA
 Setup: NR
 Location: 40.658229, -
 75.445906

Imperial Traffic & Data Collection
 www.imperialtdc.com
 PO BOX 4637
 Cherry Hill, New Jersey, United States 08034
 609-706-6100 mklein@imperialtdc.com

Count Name: 4. Willowbrook
 Road and E Race Street_WD
 Site Code: 4
 Start Date: 01/11/2022
 Page No: 4



Turning Movement Peak Hour Data Plot (4:30 PM)



TRAFFIC & DATA COLLECTION

Project: Lehigh Valley Airport
 Municipality: Hanover, Lehigh
 County, PA
 Setup: MAK/DR
 Location: 40.672936, -75.45918

Imperial Traffic & Data Collection
 www.imperialtdc.com
 PO BOX 4637
 Cherry Hill, New Jersey, United States 08034
 609-706-6100 lklein@imperialtdc.com

Count Name: 1 AM, Willowbrook
 Road and Radar Drive
 Site Code: 1 AM
 Start Date: 01/11/2022
 Page No: 1

Turning Movement Data

Start Time	Radar Drive Westbound						Willowbrook Road Northbound						Willowbrook Road Southbound					Int. Total
	U-Turn	Left	Right	Right on Red	Peds	App. Total	U-Turn	Thru	Right	Right on Red	Peds	App. Total	U-Turn	Left	Thru	Peds	App. Total	
6:00 AM	0	11	0	1	0	12	0	15	5	0	0	20	0	1	58	0	59	91
6:15 AM	0	8	0	0	0	8	0	16	1	1	0	18	0	1	80	0	81	107
6:30 AM	0	4	0	0	0	4	0	35	6	0	0	41	0	0	76	0	76	121
6:45 AM	0	6	0	0	0	6	0	29	1	0	0	30	0	0	93	0	93	129
Hourly Total	0	29	0	1	0	30	0	95	13	1	0	109	0	2	307	0	309	448
7:00 AM	0	5	0	0	0	5	0	25	1	0	0	26	0	1	101	0	102	133
7:15 AM	0	2	0	0	0	2	0	49	2	1	0	52	0	0	152	0	152	206
7:30 AM	0	6	0	0	0	6	0	49	6	2	0	57	0	0	171	0	171	234
7:45 AM	0	7	0	0	0	7	0	48	5	0	0	53	0	1	107	0	108	168
Hourly Total	0	20	0	0	0	20	0	171	14	3	0	188	0	2	531	0	533	741
8:00 AM	0	5	0	0	0	5	0	32	4	0	0	36	0	1	84	0	85	126
8:15 AM	0	15	0	0	0	15	0	38	3	0	0	41	0	0	69	0	69	125
8:30 AM	0	99	7	12	0	118	0	46	0	0	0	46	0	0	75	0	75	239
8:45 AM	0	20	3	8	0	31	0	46	1	0	0	47	0	0	60	0	60	138
Hourly Total	0	139	10	20	0	169	0	162	8	0	0	170	0	1	288	0	289	628
Grand Total	0	188	10	21	0	219	0	428	35	4	0	467	0	5	1126	0	1131	1817
Approach %	0.0	85.8	4.6	9.6	-	-	0.0	91.6	7.5	0.9	-	-	0.0	0.4	99.6	-	-	-
Total %	0.0	10.3	0.6	1.2	-	12.1	0.0	23.6	1.9	0.2	-	25.7	0.0	0.3	62.0	-	62.2	-
Lights	0	22	0	0	-	22	0	410	27	4	-	441	0	5	1102	-	1107	1570
% Lights	-	11.7	0.0	0.0	-	10.0	-	95.8	77.1	100.0	-	94.4	-	100.0	97.9	-	97.9	86.4
Buses	0	0	0	0	-	0	0	7	0	0	-	7	0	0	4	-	4	11
% Buses	-	0.0	0.0	0.0	-	0.0	-	1.6	0.0	0.0	-	1.5	-	0.0	0.4	-	0.4	0.6
Trucks	0	166	10	21	-	197	0	11	8	0	-	19	0	0	20	-	20	236
% Trucks	-	88.3	100.0	100.0	-	90.0	-	2.6	22.9	0.0	-	4.1	-	0.0	1.8	-	1.8	13.0
Bicycles on Crosswalk	-	-	-	-	0	-	-	-	-	-	0	-	-	-	-	0	-	-
% Bicycles on Crosswalk	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Pedestrians	-	-	-	-	0	-	-	-	-	-	0	-	-	-	-	0	-	-
% Pedestrians	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

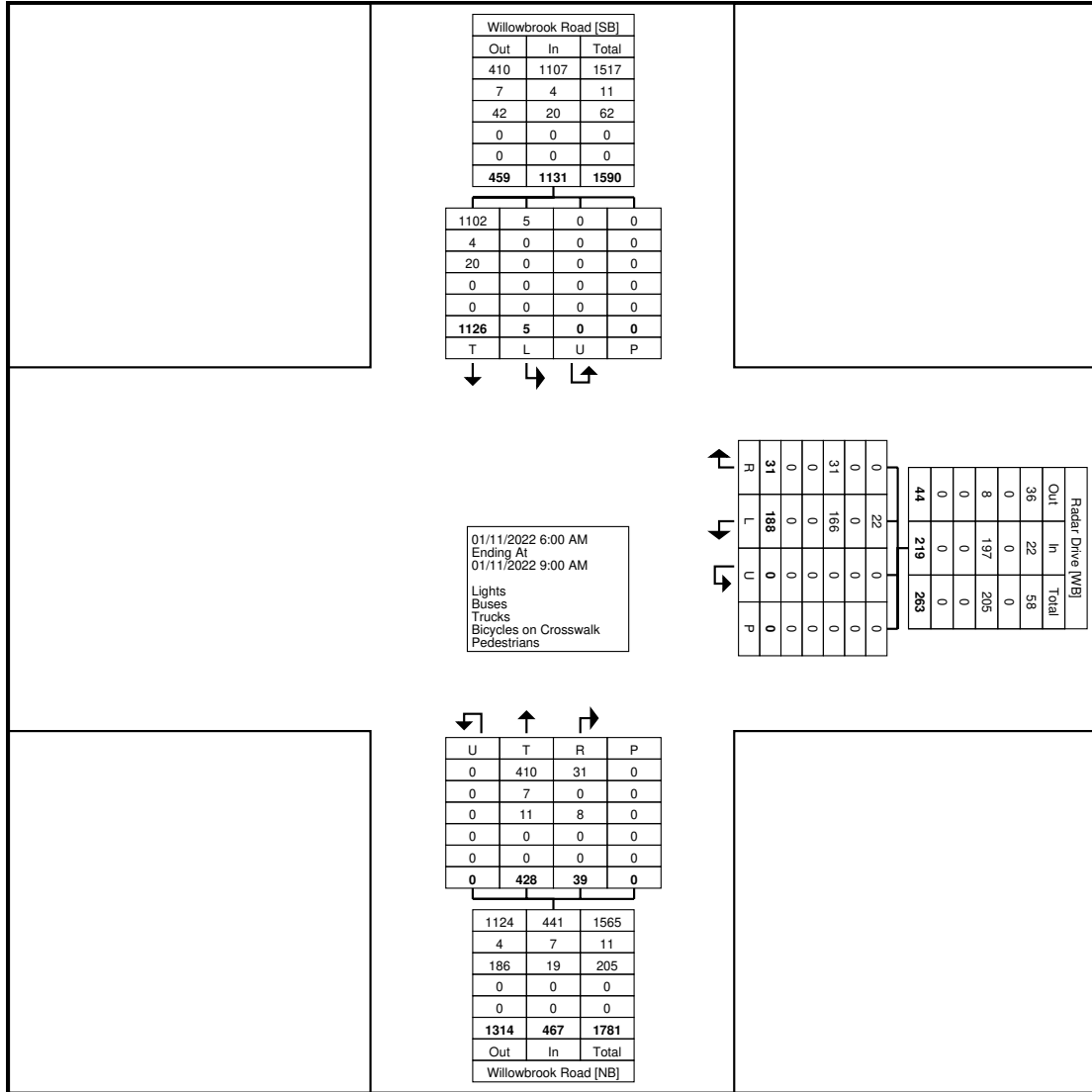


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Project: Lehigh Valley Airport
 Municipality: Hanover, Lehigh
 County, PA
 Setup: MAK/DR
 Location: 40.672936, -75.45918

Count Name: 1 AM. Willowbrook
 Road and Radar Drive
 Site Code: 1 AM
 Start Date: 01/11/2022
 Page No: 2



Turning Movement Data Plot

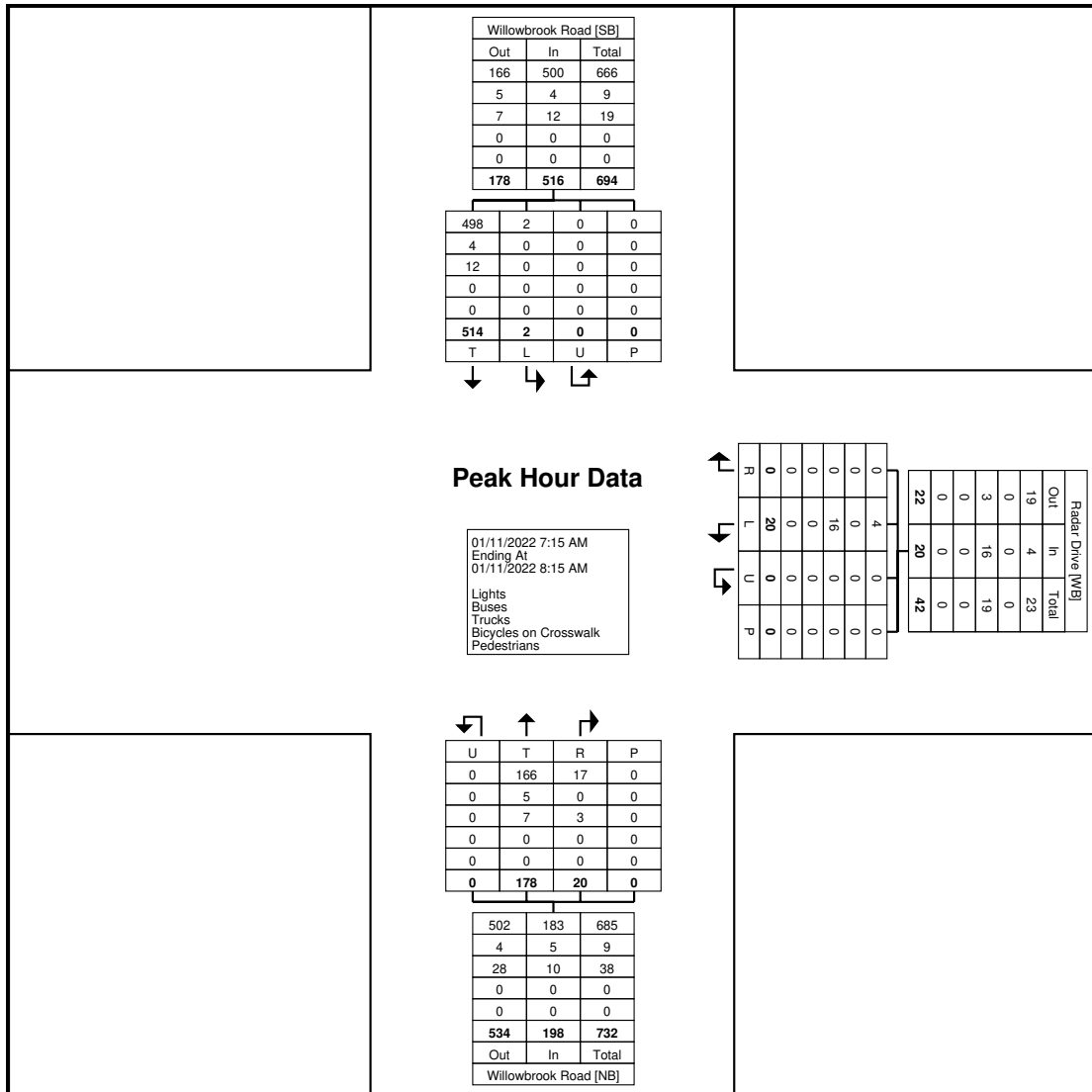


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 Setup: MAK/DR
 Location: 40.672936, -75.45918

Count Name: 1 AM. Willowbrook
 Road and Radar Drive
 Site Code: 1 AM
 Start Date: 01/11/2022
 Page No: 4



Turning Movement Peak Hour Data Plot (7:15 AM)



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Project: Lehigh Valley Airport
 Municipality: Hanover, Lehigh
 County, PA
 Setup: MAK/DR
 Location: 40.672936, -75.45918

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 609-706-6100 lklein@imperialtdc.com

Count Name: 1 PM. Willowbrook
 Road and Radar Drive
 Site Code: 1 PM
 Start Date: 01/11/2022
 Page No: 1

Turning Movement Data

Start Time	Radar Drive Westbound						Willowbrook Road Northbound						Willowbrook Road Southbound					Int. Total
	U-Turn	Left	Right	Right on Red	Peds	App. Total	U-Turn	Thru	Right	Right on Red	Peds	App. Total	U-Turn	Left	Thru	Peds	App. Total	
4:00 PM	0	6	0	2	0	8	0	121	11	3	0	135	1	3	50	0	54	197
4:15 PM	0	18	1	3	0	22	0	118	14	0	0	132	0	4	46	0	50	204
4:30 PM	0	17	0	0	0	17	0	110	13	1	0	124	0	0	65	0	65	206
4:45 PM	0	5	0	0	0	5	0	120	8	0	0	128	0	5	48	0	53	186
Hourly Total	0	46	1	5	0	52	0	469	46	4	0	519	1	12	209	0	222	793
5:00 PM	0	13	0	0	0	13	0	134	9	1	0	144	0	1	57	0	58	215
5:15 PM	0	4	0	0	0	4	0	143	2	0	0	145	0	2	57	0	59	208
5:30 PM	0	4	0	0	0	4	0	130	11	0	0	141	0	2	70	0	72	217
5:45 PM	0	7	0	0	0	7	0	111	8	0	0	119	0	1	39	0	40	166
Hourly Total	0	28	0	0	0	28	0	518	30	1	0	549	0	6	223	0	229	806
6:00 PM	0	8	0	0	0	8	0	73	4	0	0	77	0	2	52	0	54	139
6:15 PM	0	10	0	0	0	10	0	90	4	1	0	95	0	1	41	0	42	147
6:30 PM	0	6	0	0	0	6	0	68	5	0	0	73	0	2	43	0	45	124
6:45 PM	0	3	0	0	0	3	0	51	3	0	0	54	0	1	41	0	42	99
Hourly Total	0	27	0	0	0	27	0	282	16	1	0	299	0	6	177	0	183	509
Grand Total	0	101	1	5	0	107	0	1269	92	6	0	1367	1	24	609	0	634	2108
Approach %	0.0	94.4	0.9	4.7	-	-	0.0	92.8	6.7	0.4	-	-	0.2	3.8	96.1	-	-	-
Total %	0.0	4.8	0.0	0.2	-	5.1	0.0	60.2	4.4	0.3	-	64.8	0.0	1.1	28.9	-	30.1	-
Lights	0	30	1	4	-	35	0	1257	11	1	-	1269	1	3	600	-	604	1908
% Lights	-	29.7	100.0	80.0	-	32.7	-	99.1	12.0	16.7	-	92.8	100.0	12.5	98.5	-	95.3	90.5
Buses	0	1	0	0	-	1	0	1	0	0	-	1	0	0	0	-	0	2
% Buses	-	1.0	0.0	0.0	-	0.9	-	0.1	0.0	0.0	-	0.1	0.0	0.0	0.0	-	0.0	0.1
Trucks	0	70	0	1	-	71	0	11	81	5	-	97	0	21	9	-	30	198
% Trucks	-	69.3	0.0	20.0	-	66.4	-	0.9	88.0	83.3	-	7.1	0.0	87.5	1.5	-	4.7	9.4
Bicycles on Crosswalk	-	-	-	-	0	-	-	-	-	-	0	-	-	-	-	0	-	-
% Bicycles on Crosswalk	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Pedestrians	-	-	-	-	0	-	-	-	-	-	0	-	-	-	-	0	-	-
% Pedestrians	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

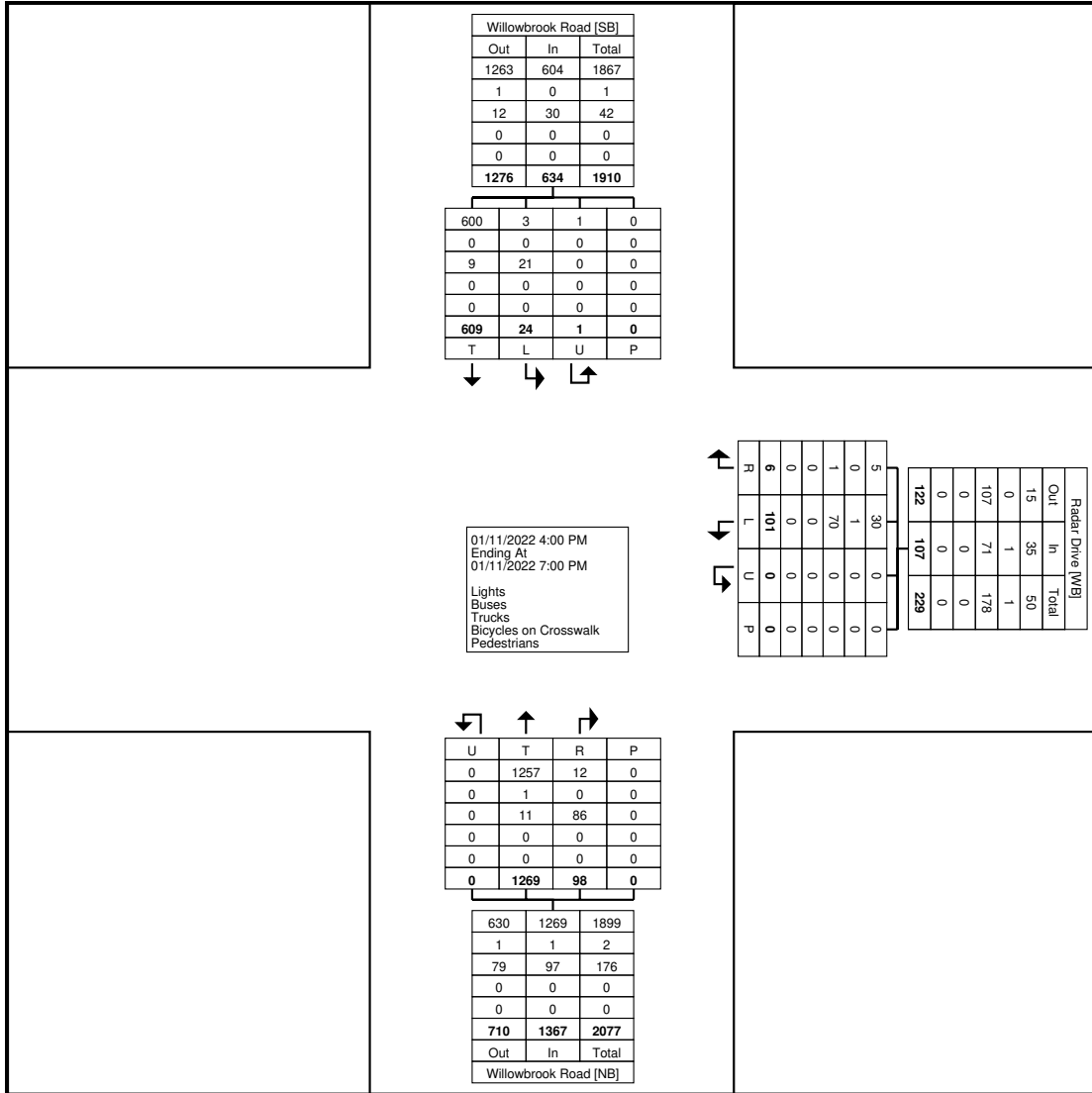


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Project: Lehigh Valley Airport
 Municipality: Hanover, Lehigh
 County, PA
 Setup: MAK/DR
 Location: 40.672936, -75.45918

Count Name: 1 PM. Willowbrook
 Road and Radar Drive
 Site Code: 1 PM
 Start Date: 01/11/2022
 Page No: 2



Turning Movement Data Plot

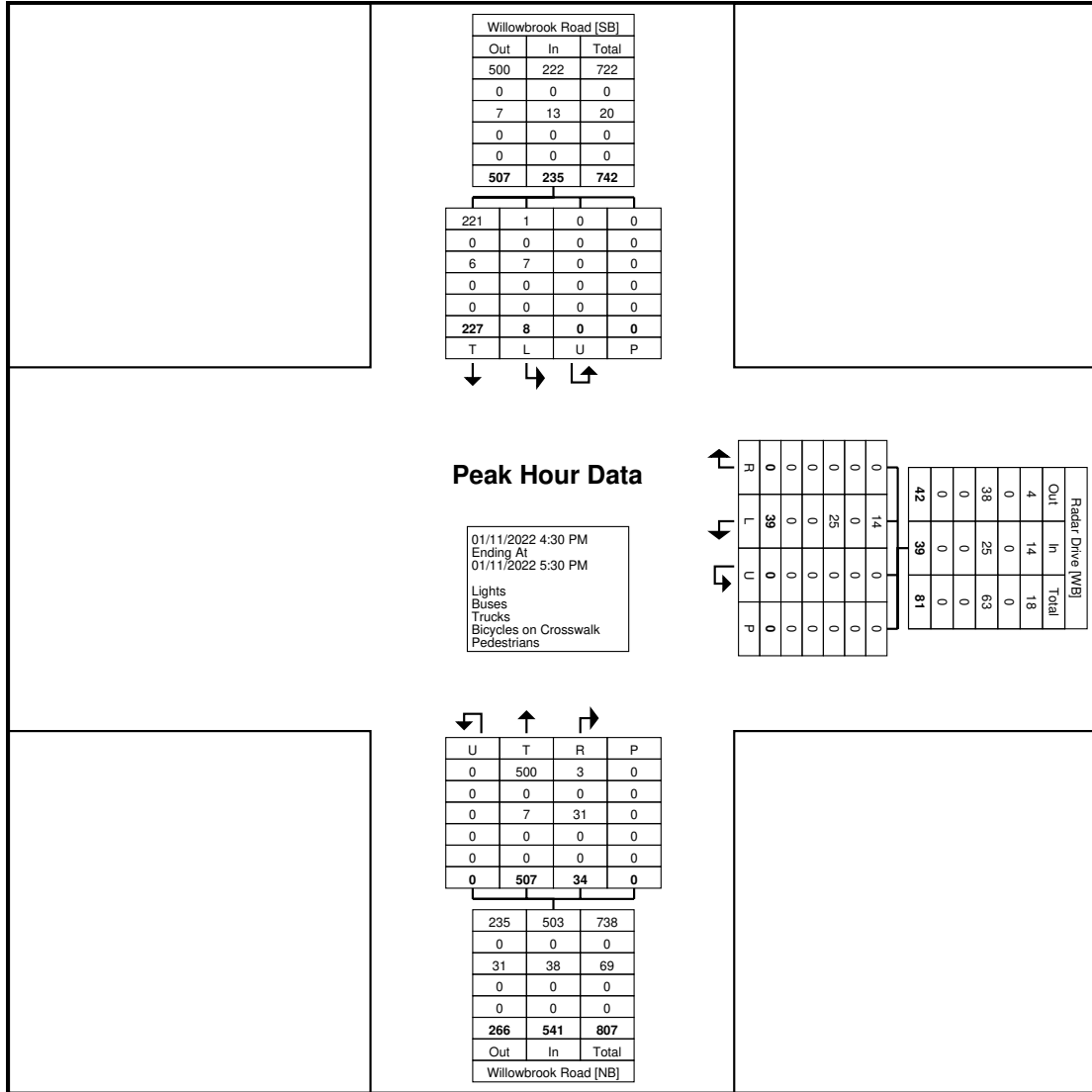


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Count Name: 1 PM. Willowbrook
 Road and Radar Drive
 Site Code: 1 PM
 Start Date: 01/11/2022
 Page No: 4



Turning Movement Peak Hour Data Plot (4:30 PM)

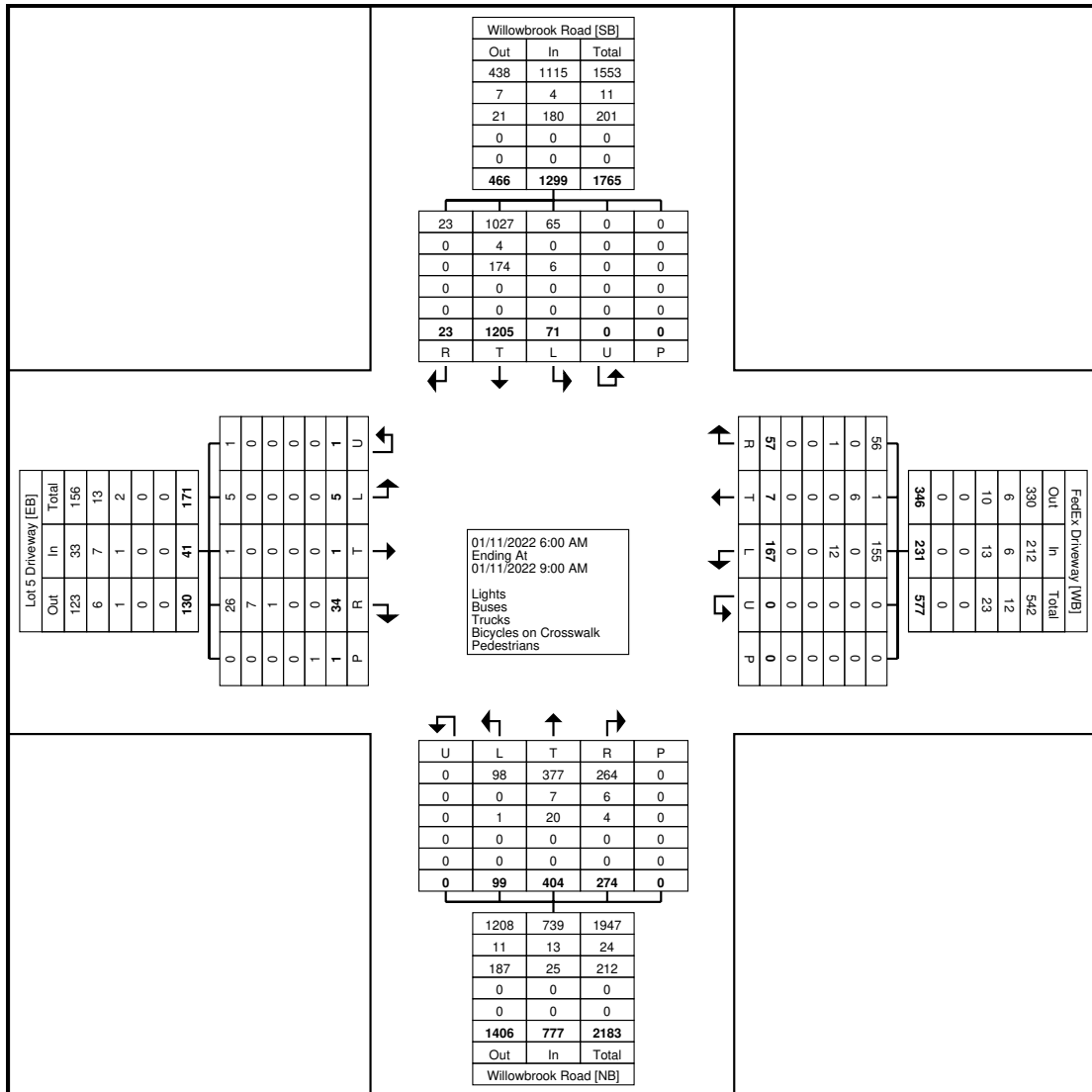


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Project: Lehigh Valley Airport
 Municipality: Hanover, Lehigh
 County, PA
 Setup: MAK/DR
 Location: 40.66805, -75.455792

Count Name: 2 AM. Willowbrook
 Road and FedEx Employee
 Driveway / Lot 5 Driveway
 Site Code: 2 AM
 Start Date: 01/11/2022
 Page No: 2



Turning Movement Data Plot



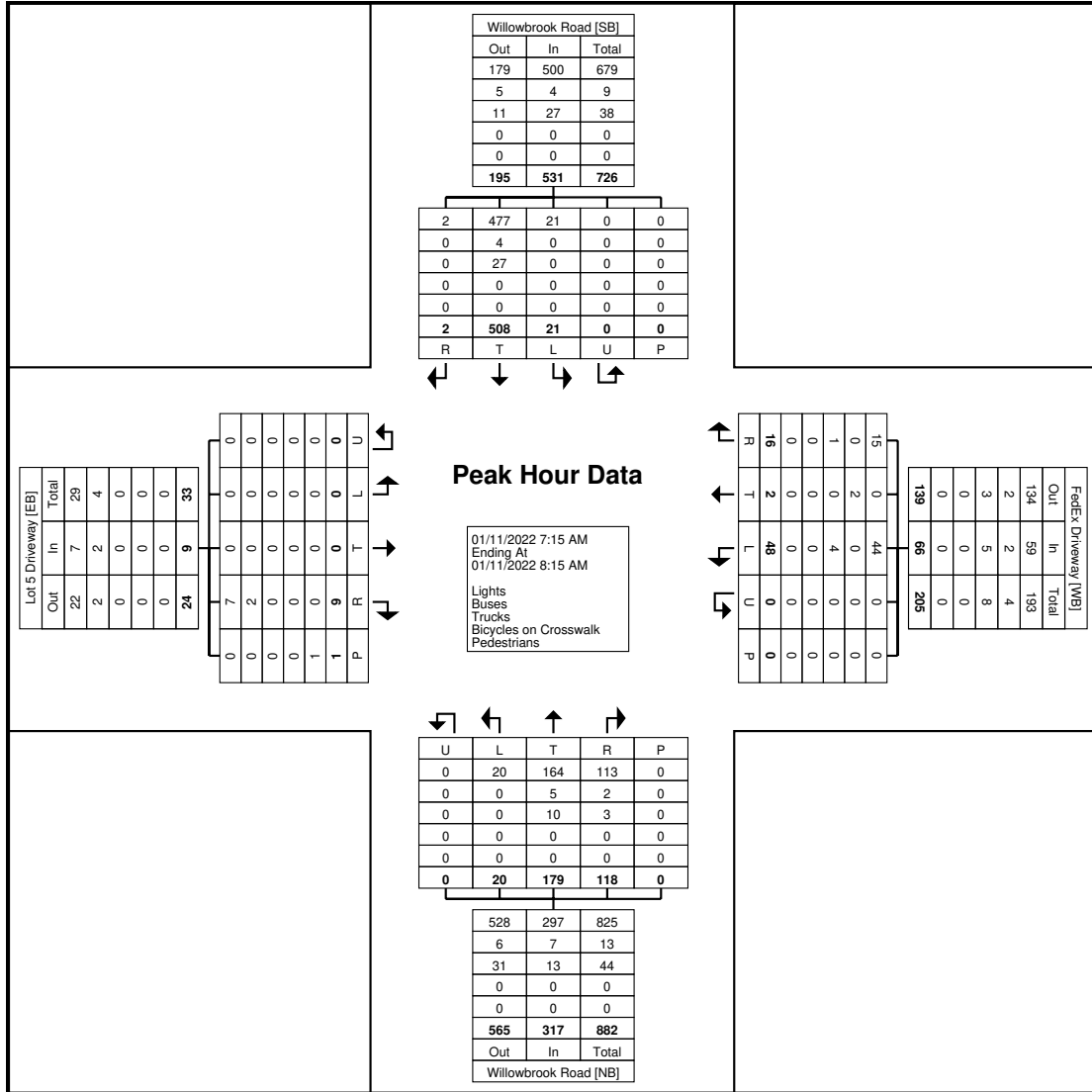
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Project: Lehigh Valley Airport
Municipality: Hanover, Lehigh
County, PA
Setup: MAK/DR
Location: 40.66805, -75.455792

Count Name: 2 AM. Willowbrook
Road and FedEx Employee
Driveway / Lot 5 Driveway
Site Code: 2 AM
Start Date: 01/11/2022
Page No: 4



Turning Movement Peak Hour Data Plot (7:15 AM)

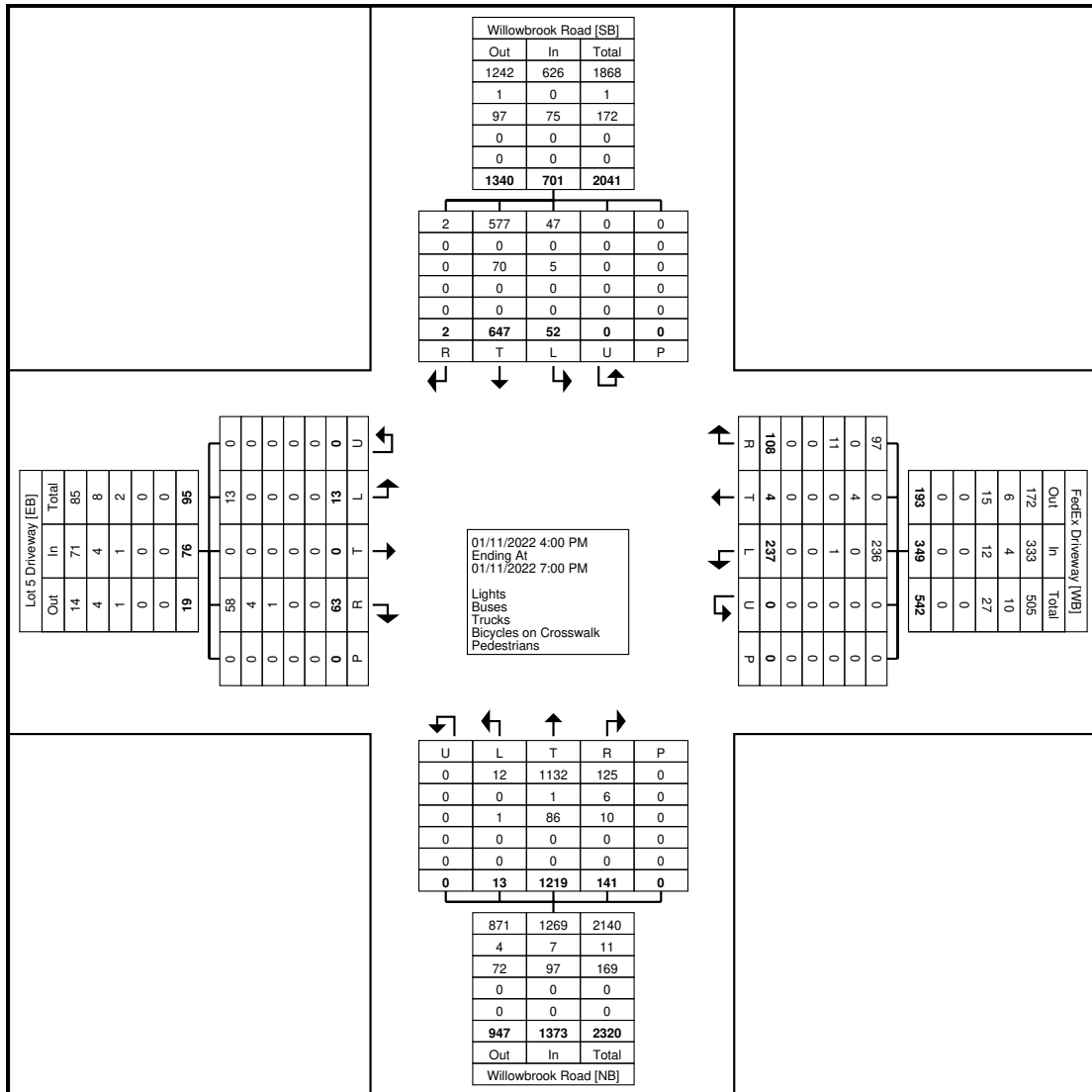


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Project: Lehigh Valley Airport
 Municipality: Hanover, Lehigh
 County, PA
 Setup: MAK/DR
 Location: 40.66805, -75.455792

Count Name: 2 PM. Willowbrook
 Road and FedEx Employee
 Driveway / Lot 5 Driveway
 Site Code: 2 PM
 Start Date: 01/11/2022
 Page No: 2



Turning Movement Data Plot



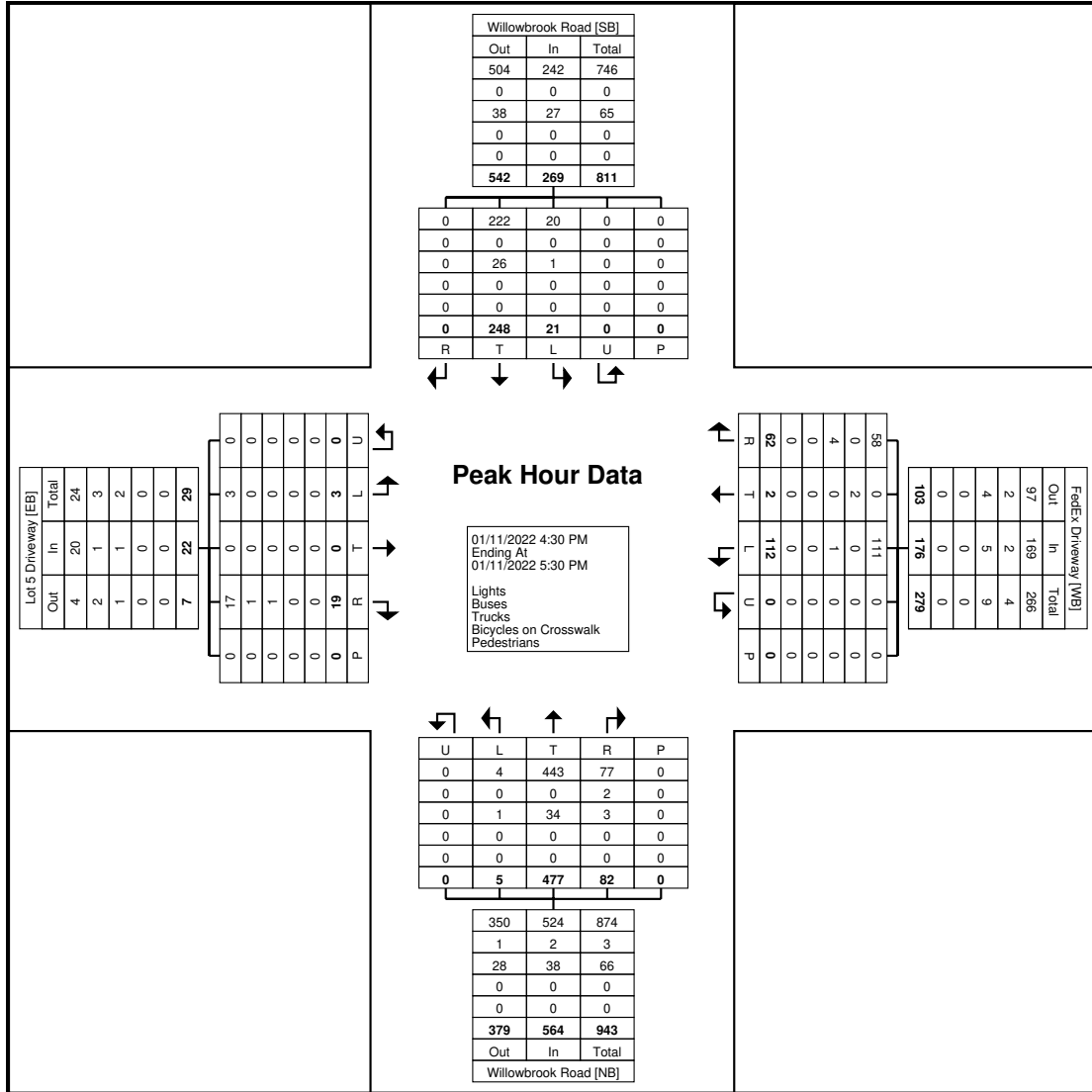
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Project: Lehigh Valley Airport
Municipality: Hanover, Lehigh
County, PA
Setup: MAK/DR
Location: 40.66805, -75.455792

Count Name: 2 PM. Willowbrook
Road and FedEx Employee
DRiveway / Lot 5 Driveway
Site Code: 2 PM
Start Date: 01/11/2022
Page No: 4



Turning Movement Peak Hour Data Plot (4:30 PM)



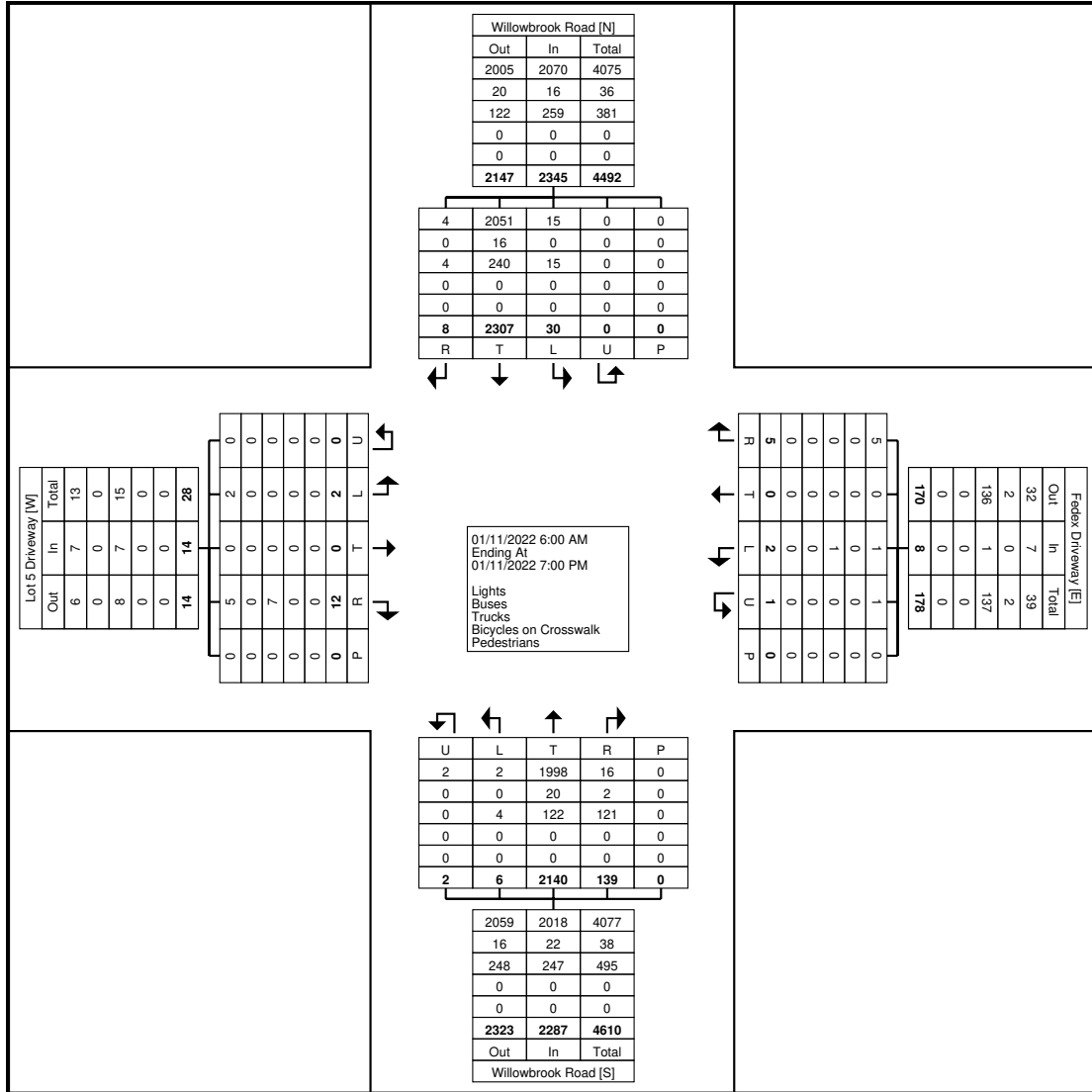
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Project: Lehigh Valley Airport
Municipality: Hanover, Lehigh
County, PA
Setup: NR
Location: 40.666226, -
75.453822

Count Name: 3. Willowbrook
Road and Lot 5 Southern
Driveway/Fedex Truck-in
Access_WD
Site Code: 3
Start Date: 01/11/2022
Page No: 2



Turning Movement Data Plot



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Count Name: 3. Willowbrook
Road and Lot 5 Southern
Driveway/Fedex Truck-in
Access_WD
Site Code: 3
Start Date: 01/11/2022
Page No: 3

Project: Lehigh Valley Airport
Municipality: Hanover, Lehigh
County, PA
Setup: NR
Location: 40.666226, -
75.453822

Turning Movement Peak Hour Data (4:30 PM)

Start Time	Lot 5 Driveway Eastbound						Fedex Driveway Westbound						Willowbrook Road Northbound						Willowbrook Road Southbound						Int. Total
	U-Turn	Left	Thru	Right	Peds	App. Total	U-Turn	Left	Thru	Right	Peds	App. Total	U-Turn	Left	Thru	Right	Peds	App. Total	U-Turn	Left	Thru	Right	Peds	App. Total	
4:30 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	127	10	0	137	0	1	109	0	0	110	247
4:45 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	139	9	0	148	0	0	80	1	0	81	229
5:00 PM	0	0	0	0	0	0	0	0	0	1	0	1	0	0	149	7	0	156	0	0	96	1	0	97	254
5:15 PM	0	0	0	1	0	1	0	0	0	0	0	0	0	0	153	7	0	160	0	2	89	0	0	91	252
Total	0	0	0	1	0	1	0	0	0	1	0	1	0	0	568	33	0	601	0	3	374	2	0	379	982
Approach %	0.0	0.0	0.0	100.0	-	-	0.0	0.0	0.0	100.0	-	-	0.0	0.0	94.5	5.5	-	-	0.0	0.8	98.7	0.5	-	-	-
Total %	0.0	0.0	0.0	0.1	-	0.1	0.0	0.0	0.0	0.1	-	0.1	0.0	0.0	57.8	3.4	-	61.2	0.0	0.3	38.1	0.2	-	38.6	-
PHF	0.000	0.000	0.000	0.250	-	0.250	0.000	0.000	0.000	0.250	-	0.250	0.000	0.000	0.928	0.825	-	0.939	0.000	0.375	0.858	0.500	-	0.861	0.967
Lights	0	0	0	0	-	0	0	0	0	1	-	1	0	0	527	4	-	531	0	0	348	0	-	348	880
% Lights	-	-	-	0.0	-	0.0	-	-	-	100.0	-	100.0	-	-	92.8	12.1	-	88.4	-	0.0	93.0	0.0	-	91.8	89.6
Buses	0	0	0	0	-	0	0	0	0	0	-	0	0	0	2	0	-	2	0	0	2	0	-	2	4
% Buses	-	-	-	0.0	-	0.0	-	-	-	0.0	-	0.0	-	-	0.4	0.0	-	0.3	-	0.0	0.5	0.0	-	0.5	0.4
Trucks	0	0	0	1	-	1	0	0	0	0	-	0	0	0	39	29	-	68	0	3	24	2	-	29	98
% Trucks	-	-	-	100.0	-	100.0	-	-	-	0.0	-	0.0	-	-	6.9	87.9	-	11.3	-	100.0	6.4	100.0	-	7.7	10.0
Bicycles on Crosswalk	-	-	-	-	0	-	-	-	-	-	0	-	-	-	-	-	0	-	-	-	-	-	0	-	-
% Bicycles on Crosswalk	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Pedestrians	-	-	-	-	0	-	-	-	-	-	0	-	-	-	-	-	0	-	-	-	-	-	0	-	-
% Pedestrians	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-



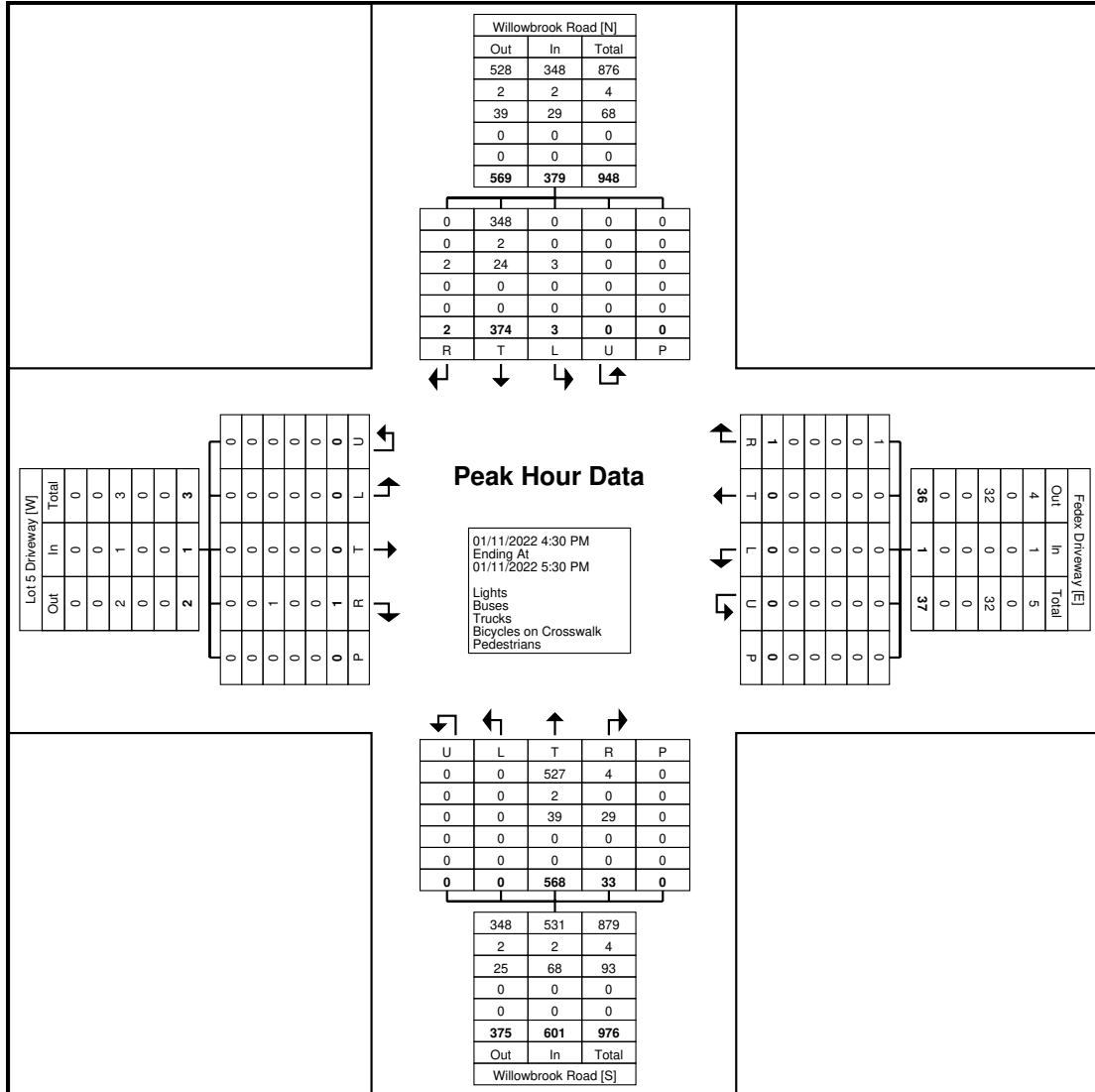
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Project: Lehigh Valley Airport
Municipality: Hanover, Lehigh
County, PA
Setup: NR
Location: 40.666226, -
75.453822

Count Name: 3. Willowbrook
Road and Lot 5 Southern
Driveway/Fedex Truck-in
Access_WD
Site Code: 3
Start Date: 01/11/2022
Page No: 4



Turning Movement Peak Hour Data Plot (4:30 PM)



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Count Name: 3. Willowbrook
Road and Lot 5 Southern
Driveway/Fedex Truck-in
Access_WD
Site Code: 3
Start Date: 01/11/2022
Page No: 5

Project: Lehigh Valley Airport
Municipality: Hanover, Lehigh
County, PA
Setup: NR
Location: 40.666226, -
75.453822

Turning Movement Peak Hour Data (7:15 AM)

Start Time	Lot 5 Driveway Eastbound						Fedex Driveway Westbound						Willowbrook Road Northbound						Willowbrook Road Southbound						Int. Total
	U-Turn	Left	Thru	Right	Peds	App. Total	U-Turn	Left	Thru	Right	Peds	App. Total	U-Turn	Left	Thru	Right	Peds	App. Total	U-Turn	Left	Thru	Right	Peds	App. Total	
7:15 AM	0	0	0	1	0	1	0	0	0	0	0	0	0	0	81	5	0	86	0	2	147	1	0	150	237
7:30 AM	0	0	0	0	0	0	0	1	0	0	0	1	1	1	90	3	0	95	0	6	185	0	0	191	287
7:45 AM	0	0	0	2	0	2	0	0	0	0	0	0	0	0	86	3	0	89	0	0	120	0	0	120	211
8:00 AM	0	0	0	0	0	0	0	0	0	0	0	0	0	2	58	3	0	63	0	3	101	0	0	104	167
Total	0	0	0	3	0	3	0	1	0	0	0	1	1	3	315	14	0	333	0	11	553	1	0	565	902
Approach %	0.0	0.0	0.0	100.0	-	-	0.0	100.0	0.0	0.0	-	-	0.3	0.9	94.6	4.2	-	-	0.0	1.9	97.9	0.2	-	-	-
Total %	0.0	0.0	0.0	0.3	-	0.3	0.0	0.1	0.0	0.0	-	0.1	0.1	0.3	34.9	1.6	-	36.9	0.0	1.2	61.3	0.1	-	62.6	-
PHF	0.000	0.000	0.000	0.375	-	0.375	0.000	0.250	0.000	0.000	-	0.250	0.250	0.375	0.875	0.700	-	0.876	0.000	0.458	0.747	0.250	-	0.740	0.786
Lights	0	0	0	3	-	3	0	0	0	0	-	0	1	1	295	2	-	299	0	7	521	1	-	529	831
% Lights	-	-	-	100.0	-	100.0	-	0.0	-	-	-	0.0	100.0	33.3	93.7	14.3	-	89.8	-	63.6	94.2	100.0	-	93.6	92.1
Buses	0	0	0	0	-	0	0	0	0	0	-	0	0	0	7	0	-	7	0	0	6	0	-	6	13
% Buses	-	-	-	0.0	-	0.0	-	0.0	-	-	-	0.0	0.0	0.0	2.2	0.0	-	2.1	-	0.0	1.1	0.0	-	1.1	1.4
Trucks	0	0	0	0	-	0	0	1	0	0	-	1	0	2	13	12	-	27	0	4	26	0	-	30	58
% Trucks	-	-	-	0.0	-	0.0	-	100.0	-	-	-	100.0	0.0	66.7	4.1	85.7	-	8.1	-	36.4	4.7	0.0	-	5.3	6.4
Bicycles on Crosswalk	-	-	-	-	0	-	-	-	-	-	0	-	-	-	-	-	0	-	-	-	-	-	0	-	-
% Bicycles on Crosswalk	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Pedestrians	-	-	-	-	0	-	-	-	-	-	0	-	-	-	-	-	0	-	-	-	-	-	0	-	-
% Pedestrians	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-



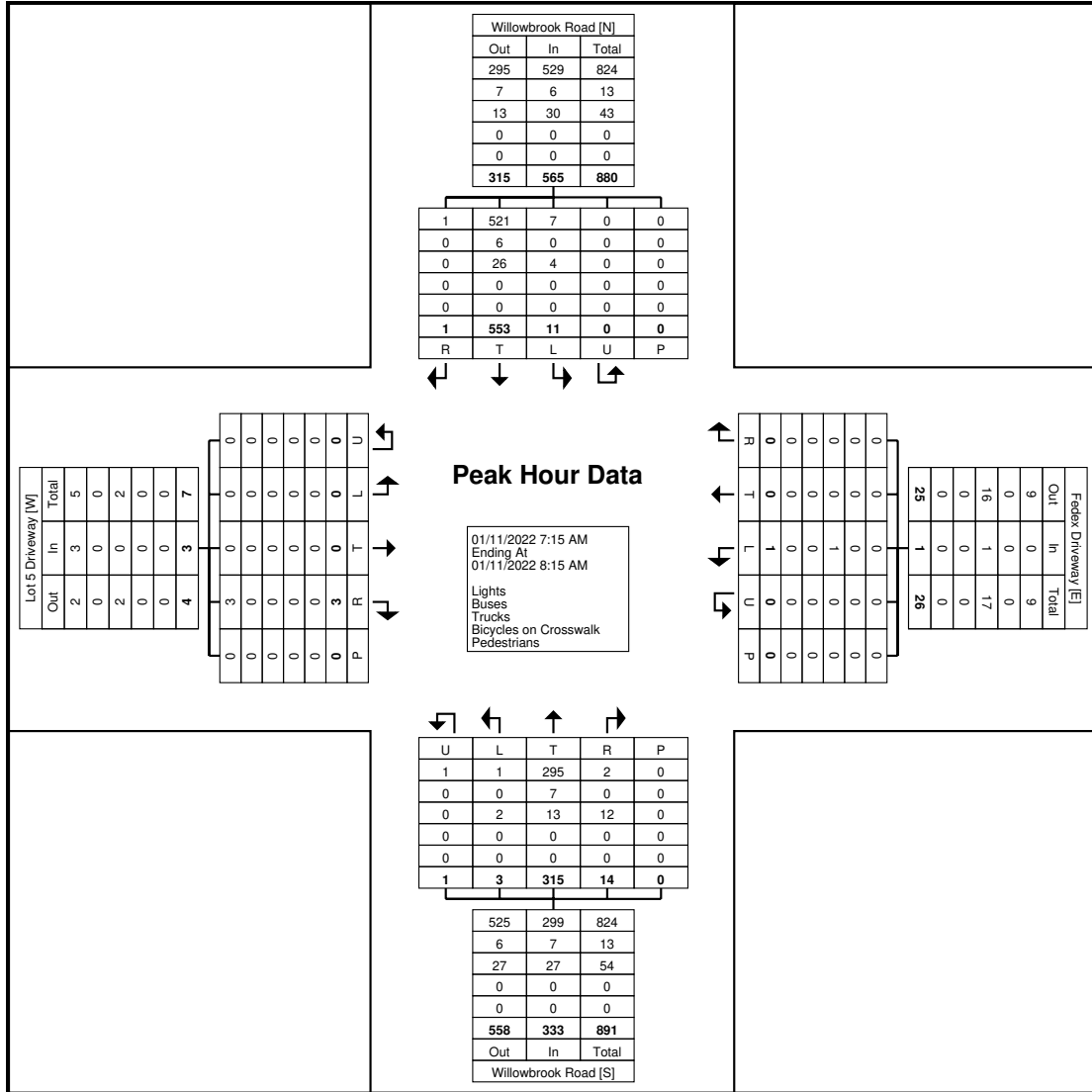
TRAFFIC & DATA COLLECTION

Imperial Traffic & Data Collection
www.imperialtdc.com
PO BOX 4637

Cherry Hill, New Jersey, United States 08034
609-706-6100 mklein@imperialtdc.com

Project: Lehigh Valley Airport
Municipality: Hanover, Lehigh
County, PA
Setup: NR
Location: 40.666226, -
75.453822

Count Name: 3. Willowbrook
Road and Lot 5 Southern
Driveway/Fedex Truck-in
Access_WD
Site Code: 3
Start Date: 01/11/2022
Page No: 6



Turning Movement Peak Hour Data Plot (7:15 AM)

THE PIDCOCK COMPANY

CIVIL ENGINEERING AND LAND PLANNING ARCHITECTURE LAND SURVEYING
2451 PARKWOOD DRIVE
ALLENTOWN, PA 18103

Lehigh Northampton Airport Authority
Air Cargo Facility
Project #21051

File Name : Air Cargo_Hangar Place
Site Code : 00000000
Start Date : 1/19/2022
Page No : 1

Groups Printed- Cars - Trucks - Buses

Start Time	Air Cargo Driveway Eastbound					Westbound					Hangar Place Northbound					Hangar Place Southbound					Int. Total
	Left	Thru	Right	Peds	App. Total	Left	Thru	Right	Peds	App. Total	Left	Thru	Right	Peds	App. Total	Left	Thru	Right	Peds	App. Total	
07:00 AM	0	0	2	0	2	0	0	0	0	0	6	0	0	0	6	0	0	1	0	1	9
07:15 AM	0	0	3	0	3	0	0	0	0	0	1	0	0	0	1	0	0	0	0	0	4
07:30 AM	0	0	1	0	1	0	0	0	0	0	3	0	0	0	3	0	0	0	0	0	4
07:45 AM	0	0	0	0	0	0	0	0	0	0	1	0	0	0	1	0	0	0	0	0	1
Total	0	0	6	0	6	0	0	0	0	0	11	0	0	0	11	0	0	1	0	1	18
08:00 AM	0	0	0	0	0	0	0	0	0	0	2	0	0	0	2	0	0	0	0	0	2
08:15 AM	0	0	1	0	1	0	0	0	0	0	2	0	0	0	2	0	0	0	0	0	3
08:30 AM	0	0	0	0	0	0	0	0	0	0	2	0	0	0	2	0	0	0	0	0	2
08:45 AM	0	0	1	0	1	0	0	0	0	0	4	0	0	0	4	0	0	0	0	0	5
Total	0	0	2	0	2	0	0	0	0	0	10	0	0	0	10	0	0	0	0	0	12
*** BREAK ***																					
04:00 PM	0	0	4	2	6	0	0	0	0	0	5	0	0	0	5	0	0	0	0	0	11
04:15 PM	0	0	3	0	3	0	0	0	0	0	3	0	0	0	3	0	0	0	0	0	6
04:30 PM	0	0	1	0	1	0	0	0	0	0	2	0	0	0	2	0	0	0	0	0	3
04:45 PM	0	0	2	0	2	0	0	0	0	0	2	0	0	0	2	0	0	0	0	0	4
Total	0	0	10	2	12	0	0	0	0	0	12	0	0	0	12	0	0	0	0	0	24
05:00 PM	0	0	4	0	4	0	0	0	0	0	3	0	0	0	3	0	0	0	0	0	7
05:15 PM	0	0	0	0	0	0	0	0	0	0	1	0	0	0	1	0	0	0	0	0	1
05:30 PM	0	0	2	0	2	0	0	0	0	0	1	0	0	0	1	0	0	0	0	0	3
05:45 PM	0	0	2	0	2	0	0	0	0	0	1	0	0	0	1	0	0	0	0	0	3
Total	0	0	8	0	8	0	0	0	0	0	6	0	0	0	6	0	0	0	0	0	14
Grand Total	0	0	26	2	28	0	0	0	0	0	39	0	0	0	39	0	0	1	0	1	68
Apprch %	0	0	92.9	7.1		0	0	0	0	0	100	0	0	0		0	0	100	0		
Total %	0	0	38.2	2.9	41.2	0	0	0	0	0	57.4	0	0	0	57.4	0	0	1.5	0	1.5	
Cars	0	0	26	2	28	0	0	0	0	0	39	0	0	0	39	0	0	1	0	1	68
% Cars	0	0	100	100	100	0	0	0	0	0	100	0	0	0	100	0	0	100	0	100	100
Trucks	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
% Trucks	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Buses	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
% Buses	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

THE PIDCOCK COMPANY

CIVIL ENGINEERING AND LAND PLANNING ARCHITECTURE LAND SURVEYING
2451 PARKWOOD DRIVE
ALLENTOWN, PA 18103

Lehigh Northampton Airport Authority
Air Cargo Facility
Project #20066

File Name : Postal_Air Cargo
Site Code : 00000000
Start Date : 1/19/2022
Page No : 1

Groups Printed- Cars - Trucks - Buses

Start Time	Postal Road Eastbound					Postal Road Westbound					Northbound					Air Cargo Driveway Southbound					Int. Total
	Left	Thru	Right	Peds	App. Total	Left	Thru	Right	Peds	App. Total	Left	Thru	Right	Peds	App. Total	Left	Thru	Right	Peds	App. Total	
07:00 AM	1	0	0	0	1	0	0	1	0	1	0	0	0	0	0	0	0	1	0	1	3
07:15 AM	1	0	0	0	1	0	0	0	0	0	0	0	0	0	0	1	0	1	0	2	3
07:30 AM	1	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	1	0	1	2
*** BREAK ***																					
Total	3	0	0	0	3	0	0	1	0	1	0	0	0	0	0	1	0	3	0	4	8
08:00 AM	1	0	0	0	1	0	0	1	0	1	0	0	0	0	0	1	0	1	0	2	4
08:15 AM	2	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	1	0	1	3
08:30 AM	0	0	0	0	0	0	0	1	0	1	0	0	0	0	0	0	0	4	0	4	5
08:45 AM	3	0	0	0	3	0	0	0	0	0	0	0	0	0	0	1	0	1	0	2	5
Total	6	0	0	0	6	0	0	2	0	2	0	0	0	0	0	2	0	7	0	9	17
*** BREAK ***																					
04:00 PM	2	0	0	0	2	0	0	1	0	1	0	0	0	0	0	1	0	1	0	2	5
04:15 PM	1	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
04:30 PM	1	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	3	0	3	4
04:45 PM	1	0	0	0	1	0	0	1	0	1	0	0	0	0	0	0	1	1	0	2	4
Total	5	0	0	0	5	0	0	2	0	2	0	0	0	0	0	1	1	5	0	7	14
05:00 PM	2	0	0	0	2	0	0	0	0	0	0	0	0	0	0	2	0	1	0	3	5
05:15 PM	2	0	0	0	2	0	0	0	0	0	0	0	0	0	0	1	0	1	0	2	4
05:30 PM	1	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	1	0	1	2
05:45 PM	1	0	0	0	1	0	0	0	0	0	0	0	0	0	0	2	0	0	0	2	3
Total	6	0	0	0	6	0	0	0	0	0	0	0	0	0	0	5	0	3	0	8	14
Grand Total	20	0	0	0	20	0	0	5	0	5	0	0	0	0	0	9	1	18	0	28	53
Apprch %	100	0	0	0		0	0	100	0		0	0	0	0		32.1	3.6	64.3	0		
Total %	37.7	0	0	0	37.7	0	0	9.4	0	9.4	0	0	0	0	0	17	1.9	34	0	52.8	
Cars	1	0	0	0	1	0	0	3	0	3	0	0	0	0	0	3	1	0	0	4	8
% Cars	5	0	0	0	5	0	0	60	0	60	0	0	0	0	0	33.3	100	0	0	14.3	15.1
Trucks	19	0	0	0	19	0	0	2	0	2	0	0	0	0	0	6	0	18	0	24	45
% Trucks	95	0	0	0	95	0	0	40	0	40	0	0	0	0	0	66.7	0	100	0	85.7	84.9
Buses	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
% Buses	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

APPENDIX D
PENNDOT PUBLICATION 46
EXCERPTS

10.4 Highway Capacity Manual (HCM) Analysis

Role

The Department accepts the use of the HCM2010 methods in order to meet the planning, operational, and design-level analysis needs of most traffic study projects. These methods should be the primary way of determining off-line performance measures as needed for a variety of traffic study projects reviewed and/or commissioned by the Department. The role of this section is to provide additional guidance on the specific methodological components for the core facility types addressed by the HCM2010. This section also includes recommended Pennsylvania default values for some calibration parameters as well as guidance as to when an alternative analysis tool should be used.

Online Material

With the HCM2010, an entire volume is located online at www.hcm2010.org. As interpretations and errata are addressed by the HCQS Committee, changes to the HCM2010 can be expected and would be posted on this site. Practitioners should be aware of the latest guidance and materials provided on this site. The Department may require time to respond to any changes made to the material posted on www.hcm2010.org, in order to update policies after the release of any additional or revised material having an impact on the guidance provided herein.

Pennsylvania Default Values

A limited number of studies throughout Pennsylvania have been conducted that provide initial estimates for some default values, which are organized by land use context only. These initial studies were conducted at select locations throughout the Commonwealth between April and May of 2012 under a myriad of geometric and operational conditions. These defaults are representative of conditions surveyed in Pennsylvania, but they may not be appropriate for all projects. Project-specific data measured locally in the field may be collected in order to justify changes to the default values noted herein or those recommended by the HCM2010. In the absence of locally-derived values, the Pennsylvania default values are recommended and should be used.

For those parameters without Pennsylvania default values or locally-collected data, the HCM2010 default values should be used. If the Pennsylvania default values provided herein or the HCM2010 default values are not appropriate for a given project, the collection and use of locally-collected data should be discussed at project scoping.

Land Use Context

In application of the Pennsylvania-specific default values herein, the traffic analysis project should identify the location of the given project area or facility in terms of its land use context; urban, suburban, or rural. The definitions for these land use contexts are provided in the Department's [March 2008 Smart Transportation Guidebook](#).

- 1) The rural land use context should be used for low density areas that have very little to no development along the major roadway system, or those uses which may be considered as rural hamlets.
- 2) The suburban land use context should be used for suburban neighborhood, corridor, and center land use conditions that feature a wide range of low to medium density development conditions, with some propensity towards mixed-use development.

- 3) The urban core land use context should be used for urban cores and major city centers that have the highest density development and a high amount of non-automobile traffic (i.e. pedestrian, bicycle, transit traffic).

Similarly, in application of the HCM2010 recommended default values, when necessary, the traffic analysis project should identify whether or not the given project area or facility is located within a metropolitan area with a population equal to or greater than 250,000 inhabitants. The definition for metropolitan areas should be based on the most recent guidance regarding metropolitan statistical areas (MSA) as defined by the [United States Census Bureau](#). Since the HCM2010 provides default values for only two possible land use context scenarios, it is important for the analyst to first determine whether or not a project is located in a MSA based on this guidance. These definitions should be used to identify the appropriate default values.

Base Saturation Flow Rates

Traffic analysis projects should use the Pennsylvania default values for base saturation flow rates as provided in Exhibit 10-9 below, unless local data is available, for the analysis of isolated and coordinated signalized intersections as well as urban street facilities, according to the corresponding land use context. The default base saturation flow rates in Exhibit 10-9 are not appropriate for use by other procedures or for the analysis of other facility types. Typically, a single base saturation flow rate should be used for all movements of a signalized intersection.

Exhibit 10-9 Pennsylvania Base Saturation Flow Rates (Signalized Intersections)

Base Saturation Flow Rates	HCM2010 Defaults (pcphpl)		Pennsylvania Defaults (pcphpl)		
	Metropolitan Areas	Other	Urban Core	Suburban	Rural
Signalized Intersections and Urban Streets	1900	1750	2100	1800	1650

Start-Up Lost Time, Extension of Effective Green Time, and Sneakers

Traffic analysis projects should use the Pennsylvania default values for start-up lost time, extension of effective green time, and number of left-turn sneakers as provided in Exhibit 10-10, unless local data is available, for the analysis of isolated and coordinated signalized intersections as well as urban street facilities, according to the corresponding land use context as well as total clearance time (yellow plus all-red time) for subject signal phase. Typically, start-up lost time and extension of effective green time should be applied on a movement basis for each signal phase at the subject signalized intersection. Typically, a single intersection-wide value should be provided for the number of left-turn sneakers.

Exhibit 10-10 Pennsylvania Traffic Signal Control Calibration Parameters (Signalized Intersections)

Traffic Signal Control Parameters	HCM2010 Defaults	Pennsylvania Defaults (seconds, or number of vehicles)		
	All Areas	Urban Core	Suburban	Rural
Start-Up Lost Time	2.0 seconds	2.5 seconds	2.5 seconds	3.0 seconds
Extension of Effective Green Time	2.0 seconds	3.0 seconds when Y+AR < 6.0 seconds, otherwise 4.0 seconds	3.0 seconds when Y+AR < 5.0 seconds, otherwise 3.5 seconds	2.0 seconds when Y+AR < 4.5 seconds otherwise 2.5 seconds
Number of Left Turn Sneakers	2 vehicles	2 vehicles	2 vehicles	2 vehicles

Y = Yellow change interval

AR = All-red clearance interval

Base Critical Headway at Two-Way Stop-Controlled (TWSC) Intersections

Traffic analysis projects should use the Pennsylvania default values for base critical headways as provided in Exhibit 10-11, unless local data is available, for the analysis of unsignalized two-way stop-controlled intersections, according to the corresponding land use context and critical movements shown below. The values provided in Exhibit 10-11 are for single or one-stage maneuvers only along two-lane and four-lane roadways. The default critical headway values for two-stage maneuvers and six-lane roadways as presented in [HCM2010 Chapter 19](#) should be used for those facility types, unless additional local data is available. Base critical headways should be applied for each critical movement at the subject intersection.

APPENDIX E
TRAFFIC PROJECTION
SPREADSHEETS

Volume Projection Spreadsheets

		1.0059										
AM Peak Hour		2022	2024	Total Approved Rockefeller Traffic		Existing Rockefeller Traffic (From Traffic Counts)				Additional Rockefeller Traffic Volumes		2024
Intersection	Movement	Existing	Base	Trucks	Cars	Enter		Exit		Trucks	Cars	No Build
						Trucks	Cars	Trucks	Cars			Volumes
	eb left	114	115	2	72	1	52			1	20	136
Willowbrook Road	eb thru	286	289	0	0					0	0	289
and	eb right	0	0	0	0					0	0	0
Race Street	wb left	0	0	0	0					0	0	0
	wb thru	191	193	0	0					0	0	193
	wb right	222	225	105	422	19	101			86	321	632
	nb left	0	0	0	0					0	0	0
	nb thru	0	0	0	0					0	0	0
	nb right	0	0	0	0					0	0	0
	sb left	449	454	199	187			20	46	179	141	774
	sb thru	0	0	0	0					0	0	0
1	sb right	112	113	9	17			1	12	8	5	126

Volume Projection Spreadsheets

		Cargo											
		Cars				Trucks				0			
AM Peak Hour		Enter		Exit		Enter		Exit		Total Volume	2024 Build Total Cargo		AM Peak Hour
		Percentage	Volume	Percentage	Volume	Percentage	Volume	Percentage	Volume			Movement	Intersection
	eb left									0	136	eb left	
Willowbrook Road	eb thru									0	289	eb thru	Willowbrook Road
and	eb right	11.00	4							4	4	eb right	and
Race Street	wb left	66.00	23			100.00	24			47	47	wb left	Race Street
	wb thru									0	193	wb thru	
	wb right									0	632	wb right	
	nb left			7.00	1					1	1	nb left	
	nb thru			12.00	2					2	2	nb thru	
	nb right			81.00	15			100.00	27	42	42	nb right	
	sb left									0	774	sb left	
	sb thru	23.00	8							8	8	sb thru	
1	sb right									0	126	sb right	1

Volume Projection Spreadsheets

		1.0059											
PM Peak Hour		2022	2024	Total Approved Rockefeller Traffic		Existing Rockefeller Traffic (From Traffic Counts)				Additional Rockefeller Traffic Volumes		2024	
Intersection	Movement	Existing	Base	Trucks	Cars	Enter		Exit		Trucks	Cars	No Build Volumes	
	eb left	114	115	4	13	4	13			0	0	115	
Willowbrook Road	eb thru	279	282	0	0					0	0	282	
and	eb right	2	2	0	0					0	0	2	
Race Street	wb left	2	2	0	0					0	0	2	
	wb thru	535	541	0	0					0	0	541	
	wb right	489	495	111	143	60	75			51	68	614	
	nb left	1	1	0	0					0	0	1	
	nb thru	0	0	0	0					0	0	0	
	nb right	2	2	0	0					0	0	2	
	sb left	297	301	77	399			28	112	49	287	637	
	sb thru	0	0	0	0					0	0	0	
1	sb right	81	82	0	65			0	30	0	35	117	

Volume Projection Spreadsheets

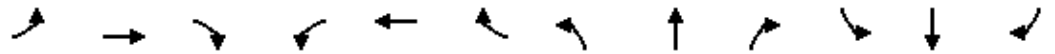
		Cargo										
		Cars				Trucks				0		
PM Peak Hour		Enter		Exit		Enter		Exit		Total Volume	2024 Build Total Cargo	Movement
			36		29		21		30			
Intersection	Movement	Percentage	Volume	Percentage	Volume	Percentage	Volume	Percentage	Volume			
	eb left									0	115	eb left
Willowbrook Road	eb thru									0	282	eb thru
and	eb right	8.00	3							3	5	eb right
Race Street	wb left	80.00	29			100.00	21			50	52	wb left
	wb thru									0	541	wb thru
	wb right									0	614	wb right
	nb left			11.00	3					3	4	nb left
	nb thru			21.00	6					6	6	nb thru
	nb right			68.00	20			100.00	30	50	52	nb right
	sb left									0	637	sb left
	sb thru	12.00	4							4	4	sb thru
1	sb right									0	117	sb right

APPENDIX F
EXISTING CAPACITY ANALYSIS
WORKSHEETS

AM PEAK

Lanes, Volumes, Timings
1: Willowbrook Road & Race Street

03/29/2022

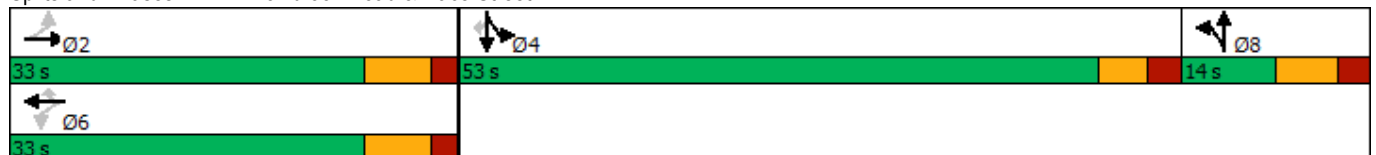


Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	114	286	1	1	191	222	1	1	1	449	1	112
Future Volume (vph)	114	286	1	1	191	222	1	1	1	449	1	112
Ideal Flow (vphpl)	1800	1800	1800	1800	1800	1800	1800	1800	1800	1800	1800	1800
Lane Width (ft)	13	12	12	12	13	12	12	12	12	13	13	12
Grade (%)		1%			1%			-8%				6%
Storage Length (ft)	175		0	75		0	40		0	0		400
Storage Lanes	2		0	1		1	1		0	1		1
Taper Length (ft)	25			25			25			25		
Right Turn on Red			Yes			Yes			Yes			Yes
Link Speed (mph)		45			45			35				35
Link Distance (ft)		534			1104			270				3640
Travel Time (s)		8.1			16.7			5.3				70.9
Confl. Peds. (#/hr)												
Confl. Bikes (#/hr)												
Peak Hour Factor	0.79	0.79	0.79	0.79	0.79	0.79	0.79	0.79	0.79	0.79	0.79	0.79
Growth Factor	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
Heavy Vehicles (%)	5%	2%	0%	0%	5%	12%	0%	0%	0%	6%	0%	4%
Bus Blockages (#/hr)	0	0	0	0	0	0	0	0	0	0	0	0
Parking (#/hr)												
Mid-Block Traffic (%)		0%			0%			0%				0%
Shared Lane Traffic (%)										50%		
Turn Type	Perm	NA		Perm	NA	Perm	Split	NA		Split	NA	Perm
Protected Phases		2			6		8	8		4		4
Permitted Phases	2			6		6						4
Detector Phase	2	2		6	6	6	8	8		4	4	4
Switch Phase												
Minimum Initial (s)	7.0	7.0		7.0	7.0	7.0	5.0	5.0		5.0	5.0	5.0
Minimum Split (s)	14.0	14.0		14.0	14.0	14.0	14.0	14.0		13.0	13.0	13.0
Total Split (s)	33.0	33.0		33.0	33.0	33.0	14.0	14.0		53.0	53.0	53.0
Total Split (%)	33.0%	33.0%		33.0%	33.0%	33.0%	14.0%	14.0%		53.0%	53.0%	53.0%
Yellow Time (s)	5.0	5.0		5.0	5.0	5.0	4.5	4.5		3.5	3.5	3.5
All-Red Time (s)	2.0	2.0		2.0	2.0	2.0	2.5	2.5		2.5	2.5	2.5
Lost Time Adjust (s)	-1.0	-1.0		-1.0	-1.0	-1.0	-1.0	-1.0		-1.0	-1.0	-1.0
Total Lost Time (s)	6.0	6.0		6.0	6.0	6.0	6.0	6.0		5.0	5.0	5.0
Lead/Lag												
Lead-Lag Optimize?												
Recall Mode	Min	Min		Min	Min	Min	None	None		None	None	None

Intersection Summary

Area Type: Other
 Cycle Length: 100
 Actuated Cycle Length: 47.5
 Natural Cycle: 55
 Control Type: Actuated-Uncoordinated























Splits and Phases: 1: Willowbrook Road & Race Street



HCM 6th Signalized Intersection Summary

1: Willowbrook Road & Race Street

03/29/2022

												
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	114	286	1	1	191	222	1	1	1	449	1	112
Future Volume (veh/h)	114	286	1	1	191	222	1	1	1	449	1	112
Initial Q (Qb), veh	0	0	0	0	0	0	0	0	0	0	0	0
Ped-Bike Adj(A_pbT)	1.00		1.00	1.00		1.00	1.00		1.00	1.00		1.00
Parking Bus, Adj	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Work Zone On Approach		No			No			No			No	
Adj Sat Flow, veh/h/ln	1793	1766	1794	1794	1793	1626	2098	2098	2098	1575	1663	1543
Adj Flow Rate, veh/h	144	362	1	1	242	0	1	1	1	569	0	142
Peak Hour Factor	0.79	0.79	0.79	0.79	0.79	0.79	0.79	0.79	0.79	0.79	0.79	0.79
Percent Heavy Veh, %	5	2	0	0	5	12	0	0	0	6	0	4
Cap, veh/h	405	1113	3	406	582		51	24	24	865	0	377
Arrive On Green	0.32	0.32	0.32	0.32	0.32	0.00	0.03	0.03	0.03	0.29	0.00	0.29
Sat Flow, veh/h	1152	3433	9	1032	1793	1378	1998	962	962	3001	0	1308
Grp Volume(v), veh/h	144	177	186	1	242	0	1	0	2	569	0	142
Grp Sat Flow(s),veh/h/ln	1152	1678	1765	1032	1793	1378	1998	0	1925	1500	0	1308
Q Serve(g_s), s	5.2	3.7	3.7	0.0	5.0	0.0	0.0	0.0	0.0	7.8	0.0	4.1
Cycle Q Clear(g_c), s	10.2	3.7	3.7	3.8	5.0	0.0	0.0	0.0	0.0	7.8	0.0	4.1
Prop In Lane	1.00		0.01	1.00		1.00	1.00		0.50	1.00		1.00
Lane Grp Cap(c), veh/h	405	544	572	406	582		51	0	49	865	0	377
V/C Ratio(X)	0.36	0.33	0.33	0.00	0.42		0.02	0.00	0.04	0.66	0.00	0.38
Avail Cap(c_a), veh/h	694	965	1014	664	1031		340	0	328	3067	0	1336
HCM Platoon Ratio	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Upstream Filter(I)	1.00	1.00	1.00	1.00	1.00	0.00	1.00	0.00	1.00	1.00	0.00	1.00
Uniform Delay (d), s/veh	16.4	12.0	12.0	13.4	12.4	0.0	22.3	0.0	22.3	14.7	0.0	13.3
Incr Delay (d2), s/veh	0.5	0.3	0.3	0.0	0.5	0.0	0.2	0.0	0.3	0.9	0.0	0.6
Initial Q Delay(d3),s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
%ile BackOfQ(95%),veh/ln	2.1	2.0	2.1	0.0	2.8	0.0	0.0	0.0	0.0	4.1	0.0	1.9
Unsig. Movement Delay, s/veh												
LnGrp Delay(d),s/veh	16.9	12.3	12.3	13.4	12.9	0.0	22.5	0.0	22.7	15.5	0.0	14.0
LnGrp LOS	B	B	B	B	B		C	A	C	B	A	B
Approach Vol, veh/h		507			243	A		3			711	
Approach Delay, s/veh		13.6			12.9			22.6			15.2	
Approach LOS		B			B			C			B	
Timer - Assigned Phs		2		4		6		8				
Phs Duration (G+Y+Rc), s		21.2		18.5		21.2		7.2				
Change Period (Y+Rc), s		7.0		6.0		7.0		7.0				
Max Green Setting (Gmax), s		26.0		47.0		26.0		7.0				
Max Q Clear Time (g_c+I1), s		12.2		9.8		7.0		2.0				
Green Ext Time (p_c), s		2.0		2.7		1.1		0.0				

Intersection Summary		
HCM 6th Ctrl Delay		14.3
HCM 6th LOS		B

Notes

User approved pedestrian interval to be less than phase max green.

User approved volume balancing among the lanes for turning movement.

Unsignalized Delay for [WBR] is excluded from calculations of the approach delay and intersection delay.

PM PEAK

Lanes, Volumes, Timings
1: Willowbrook Road & Race Street

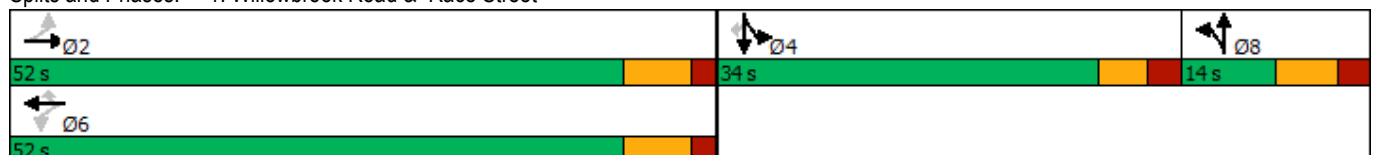
03/29/2022

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	114	279	2	2	535	489	1	1	2	297	1	81
Future Volume (vph)	114	279	2	2	535	489	1	1	2	297	1	81
Ideal Flow (vphpl)	1800	1800	1800	1800	1800	1800	1800	1800	1800	1800	1800	1800
Lane Width (ft)	13	12	12	12	13	12	12	12	12	13	13	12
Grade (%)		1%			1%			-8%				6%
Storage Length (ft)	175		0	75		0	40		0	0		400
Storage Lanes	2		0	1		1	1		0	1		1
Taper Length (ft)	25			25			25			25		
Right Turn on Red			Yes			Yes			Yes			Yes
Link Speed (mph)		45			45			35				35
Link Distance (ft)		691			1104			270				3640
Travel Time (s)		10.5			16.7			5.3				70.9
Confl. Peds. (#/hr)												
Confl. Bikes (#/hr)												
Peak Hour Factor	0.94	0.94	0.94	0.94	0.94	0.94	0.94	0.94	0.94	0.94	0.94	0.94
Growth Factor	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
Heavy Vehicles (%)	6%	1%	0%	0%	1%	12%	0%	0%	0%	9%	0%	1%
Bus Blockages (#/hr)	0	0	0	0	0	0	0	0	0	0	0	0
Parking (#/hr)												
Mid-Block Traffic (%)		0%			0%			0%				0%
Shared Lane Traffic (%)										50%		
Turn Type	Perm	NA		Perm	NA	Perm	Split	NA		Split	NA	Perm
Protected Phases		2			6		8	8		4		4
Permitted Phases	2			6		6						4
Detector Phase	2	2		6	6	6	8	8		4	4	4
Switch Phase												
Minimum Initial (s)	7.0	7.0		7.0	7.0	7.0	5.0	5.0		5.0	5.0	5.0
Minimum Split (s)	14.0	14.0		14.0	14.0	14.0	14.0	14.0		13.0	13.0	13.0
Total Split (s)	52.0	52.0		52.0	52.0	52.0	14.0	14.0		34.0	34.0	34.0
Total Split (%)	52.0%	52.0%		52.0%	52.0%	52.0%	14.0%	14.0%		34.0%	34.0%	34.0%
Yellow Time (s)	5.0	5.0		5.0	5.0	5.0	4.5	4.5		3.5	3.5	3.5
All-Red Time (s)	2.0	2.0		2.0	2.0	2.0	2.5	2.5		2.5	2.5	2.5
Lost Time Adjust (s)	-1.0	-1.0		-1.0	-1.0	-1.0	-1.0	-1.0		-1.0	-1.0	-1.0
Total Lost Time (s)	6.0	6.0		6.0	6.0	6.0	6.0	6.0		5.0	5.0	5.0
Lead/Lag												
Lead-Lag Optimize?												
Recall Mode	Min	Min		Min	Min	Min	None	None		None	None	None

Intersection Summary

Area Type:	Other
Cycle Length:	100
Actuated Cycle Length:	55
Natural Cycle:	60
Control Type:	Actuated-Uncoordinated

Splits and Phases: 1: Willowbrook Road & Race Street



HCM 6th Signalized Intersection Summary
 1: Willowbrook Road & Race Street

03/29/2022

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	114	279	2	2	535	489	1	1	2	297	1	81
Future Volume (veh/h)	114	279	2	2	535	489	1	1	2	297	1	81
Initial Q (Qb), veh	0	0	0	0	0	0	0	0	0	0	0	0
Ped-Bike Adj(A_pbT)	1.00		1.00	1.00		1.00	1.00		1.00	1.00		1.00
Parking Bus, Adj	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Work Zone On Approach		No			No			No			No	
Adj Sat Flow, veh/h/ln	1779	1780	1794	1794	1852	1626	2098	2098	2098	1532	1663	1585
Adj Flow Rate, veh/h	121	297	2	2	569	0	1	1	2	317	0	86
Peak Hour Factor	0.94	0.94	0.94	0.94	0.94	0.94	0.94	0.94	0.94	0.94	0.94	0.94
Percent Heavy Veh, %	6	1	0	0	1	12	0	0	0	9	0	1
Cap, veh/h	332	1606	11	593	863		49	15	31	533	0	245
Arrive On Green	0.47	0.47	0.47	0.47	0.47	0.00	0.02	0.02	0.02	0.18	0.00	0.18
Sat Flow, veh/h	846	3444	23	1094	1852	1378	1998	624	1249	2917	0	1343
Grp Volume(v), veh/h	121	146	153	2	569	0	1	0	3	317	0	86
Grp Sat Flow(s),veh/h/ln	846	1691	1776	1094	1852	1378	1998	0	1873	1459	0	1343
Q Serve(g_s), s	6.7	2.6	2.6	0.1	12.3	0.0	0.0	0.0	0.1	5.2	0.0	2.9
Cycle Q Clear(g_c), s	19.0	2.6	2.6	2.7	12.3	0.0	0.0	0.0	0.1	5.2	0.0	2.9
Prop In Lane	1.00		0.01	1.00		1.00	1.00		0.67	1.00		1.00
Lane Grp Cap(c), veh/h	332	789	828	593	863		49	0	46	533	0	245
V/C Ratio(X)	0.36	0.18	0.19	0.00	0.66		0.02	0.00	0.07	0.59	0.00	0.35
Avail Cap(c_a), veh/h	685	1494	1569	1050	1636		307	0	288	1625	0	748
HCM Platoon Ratio	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Upstream Filter(I)	1.00	1.00	1.00	1.00	1.00	0.00	1.00	0.00	1.00	1.00	0.00	1.00
Uniform Delay (d), s/veh	18.0	8.1	8.1	8.9	10.7	0.0	24.8	0.0	24.8	19.5	0.0	18.6
Incr Delay (d2), s/veh	0.7	0.1	0.1	0.0	0.9	0.0	0.2	0.0	0.6	1.1	0.0	0.9
Initial Q Delay(d3),s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
%ile BackOfQ(95%),veh/ln	2.0	1.2	1.3	0.0	6.5	0.0	0.0	0.0	0.1	2.9	0.0	1.5
Unsig. Movement Delay, s/veh												
LnGrp Delay(d),s/veh	18.7	8.2	8.2	8.9	11.6	0.0	24.9	0.0	25.4	20.6	0.0	19.4
LnGrp LOS	B	A	A	A	B		C	A	C	C	A	B
Approach Vol, veh/h		420			571	A		4				403
Approach Delay, s/veh		11.2			11.6			25.3				20.3
Approach LOS		B			B			C				C
Timer - Assigned Phs		2		4		6		8				
Phs Duration (G+Y+Rc), s		30.3		14.5		30.3		7.3				
Change Period (Y+Rc), s		7.0		6.0		7.0		7.0				
Max Green Setting (Gmax), s		45.0		28.0		45.0		7.0				
Max Q Clear Time (g_c+I1), s		21.0		7.2		14.3		2.1				
Green Ext Time (p_c), s		2.2		1.4		3.6		0.0				

Intersection Summary		
HCM 6th Ctrl Delay		14.0
HCM 6th LOS		B

Notes

User approved pedestrian interval to be less than phase max green.

User approved volume balancing among the lanes for turning movement.

Unsignalized Delay for [WBR] is excluded from calculations of the approach delay and intersection delay.

APPENDIX G
2024 NO BUILD CAPACITY ANALYSIS
WORKSHEETS

AM PEAK

Lanes, Volumes, Timings
1: Willowbrook Road & Race Street

03/29/2022

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	136	289	1	1	193	632	1	1	1	774	1	126
Future Volume (vph)	136	289	1	1	193	632	1	1	1	774	1	126
Ideal Flow (vphpl)	1800	1800	1800	1800	1800	1800	1800	1800	1800	1800	1800	1800
Lane Width (ft)	13	12	12	12	13	12	12	12	12	13	13	12
Grade (%)		1%			1%			-8%				6%
Storage Length (ft)	175		0	75		0	40		0	0		400
Storage Lanes	2		0	1		1	1		0	1		1
Taper Length (ft)	25			25			25			25		
Right Turn on Red			Yes			Yes			Yes			Yes
Link Speed (mph)		45			45			35				35
Link Distance (ft)		534			1104			270				3640
Travel Time (s)		8.1			16.7			5.3				70.9
Confl. Peds. (#/hr)												
Confl. Bikes (#/hr)												
Peak Hour Factor	0.79	0.79	0.79	0.79	0.79	0.79	0.79	0.79	0.79	0.79	0.79	0.79
Growth Factor	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
Heavy Vehicles (%)	5%	2%	0%	0%	5%	18%	0%	0%	0%	27%	0%	10%
Bus Blockages (#/hr)	0	0	0	0	0	0	0	0	0	0	0	0
Parking (#/hr)												
Mid-Block Traffic (%)		0%			0%			0%				0%
Shared Lane Traffic (%)										50%		
Turn Type	Perm	NA		Perm	NA	Perm	Split	NA		Split	NA	Perm
Protected Phases		2			6		8	8		4	4	
Permitted Phases	2			6		6						4
Detector Phase	2	2		6	6	6	8	8		4	4	4
Switch Phase												
Minimum Initial (s)	7.0	7.0		7.0	7.0	7.0	5.0	5.0		5.0	5.0	5.0
Minimum Split (s)	14.0	14.0		14.0	14.0	14.0	14.0	14.0		13.0	13.0	13.0
Total Split (s)	33.0	33.0		33.0	33.0	33.0	14.0	14.0		53.0	53.0	53.0
Total Split (%)	33.0%	33.0%		33.0%	33.0%	33.0%	14.0%	14.0%		53.0%	53.0%	53.0%
Yellow Time (s)	5.0	5.0		5.0	5.0	5.0	4.5	4.5		3.5	3.5	3.5
All-Red Time (s)	2.0	2.0		2.0	2.0	2.0	2.5	2.5		2.5	2.5	2.5
Lost Time Adjust (s)	-1.0	-1.0		-1.0	-1.0	-1.0	-1.0	-1.0		-1.0	-1.0	-1.0
Total Lost Time (s)	6.0	6.0		6.0	6.0	6.0	6.0	6.0		5.0	5.0	5.0
Lead/Lag												
Lead-Lag Optimize?												
Recall Mode	Min	Min		Min	Min	Min	None	None		None	None	None

Intersection Summary























Area Type:	Other
Cycle Length:	100
Actuated Cycle Length:	71.2
Natural Cycle:	80
Control Type:	Actuated-Uncoordinated

Splits and Phases: 1: Willowbrook Road & Race Street



HCM 6th Signalized Intersection Summary
 1: Willowbrook Road & Race Street

03/29/2022

												
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	136	289	1	1	193	632	1	1	1	774	1	126
Future Volume (veh/h)	136	289	1	1	193	632	1	1	1	774	1	126
Initial Q (Qb), veh	0	0	0	0	0	0	0	0	0	0	0	0
Ped-Bike Adj(A_pbT)	1.00		1.00	1.00		1.00	1.00		1.00	1.00		1.00
Parking Bus, Adj	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Work Zone On Approach		No			No			No			No	
Adj Sat Flow, veh/h/ln	1793	1766	1794	1794	1793	1542	2098	2098	2098	1269	1663	1459
Adj Flow Rate, veh/h	172	366	1	1	244	0	1	1	1	981	0	159
Peak Hour Factor	0.79	0.79	0.79	0.79	0.79	0.79	0.79	0.79	0.79	0.79	0.79	0.79
Percent Heavy Veh, %	5	2	0	0	5	18	0	0	0	27	0	10
Cap, veh/h	315	1042	3	319	544		34	16	16	1117	0	571
Arrive On Green	0.30	0.30	0.30	0.30	0.30	0.00	0.02	0.02	0.02	0.46	0.00	0.46
Sat Flow, veh/h	1150	3433	9	1028	1793	1307	1998	962	962	2417	0	1236
Grp Volume(v), veh/h	172	179	188	1	244	0	1	0	2	981	0	159
Grp Sat Flow(s),veh/h/ln	1150	1678	1765	1028	1793	1307	1998	0	1925	1208	0	1236
Q Serve(g_s), s	11.1	6.5	6.5	0.1	8.6	0.0	0.0	0.0	0.1	28.7	0.0	6.2
Cycle Q Clear(g_c), s	19.7	6.5	6.5	6.6	8.6	0.0	0.0	0.0	0.1	28.7	0.0	6.2
Prop In Lane	1.00		0.01	1.00		1.00	1.00		0.50	1.00		1.00
Lane Grp Cap(c), veh/h	315	509	536	319	544		34	0	32	1117	0	571
V/C Ratio(X)	0.55	0.35	0.35	0.00	0.45		0.03	0.00	0.06	0.88	0.00	0.28
Avail Cap(c_a), veh/h	363	579	609	362	619		204	0	197	1484	0	759
HCM Platoon Ratio	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Upstream Filter(I)	1.00	1.00	1.00	1.00	1.00	0.00	1.00	0.00	1.00	1.00	0.00	1.00
Uniform Delay (d), s/veh	29.9	21.2	21.2	23.8	21.9	0.0	37.8	0.0	37.8	19.0	0.0	13.0
Incr Delay (d2), s/veh	1.5	0.4	0.4	0.0	0.6	0.0	0.4	0.0	0.8	5.0	0.0	0.3
Initial Q Delay(d3),s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
%ile BackOfQ(95%),veh/ln	5.3	4.3	4.5	0.0	6.0	0.0	0.0	0.0	0.1	12.5	0.0	2.9
Unsig. Movement Delay, s/veh												
LnGrp Delay(d),s/veh	31.4	21.6	21.6	23.8	22.5	0.0	38.2	0.0	38.6	24.0	0.0	13.2
LnGrp LOS	C	C	C	C	C		D	A	D	C	A	B
Approach Vol, veh/h		539			245	A		3			1140	
Approach Delay, s/veh		24.7			22.5			38.5			22.5	
Approach LOS		C			C			D			C	
Timer - Assigned Phs		2		4		6		8				
Phs Duration (G+Y+Rc), s		29.7		41.1		29.7		7.3				
Change Period (Y+Rc), s		7.0		6.0		7.0		7.0				
Max Green Setting (Gmax), s		26.0		47.0		26.0		7.0				
Max Q Clear Time (g_c+I1), s		21.7		30.7		10.6		2.1				
Green Ext Time (p_c), s		1.1		4.4		1.0		0.0				

Intersection Summary		
HCM 6th Ctrl Delay		23.2
HCM 6th LOS		C

Notes

User approved pedestrian interval to be less than phase max green.

User approved volume balancing among the lanes for turning movement.

Unsignalized Delay for [WBR] is excluded from calculations of the approach delay and intersection delay.

PM PEAK

Lanes, Volumes, Timings
1: Willowbrook Road & Race Street

03/29/2022

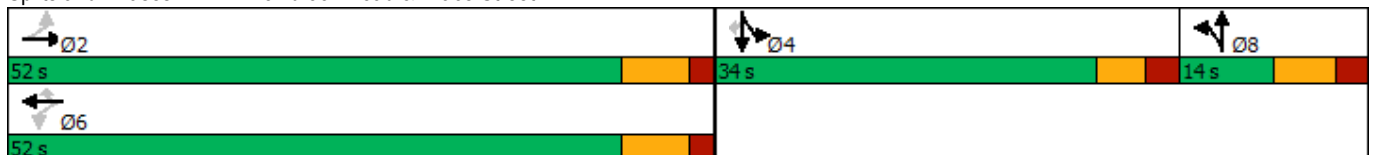


Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	115	282	2	2	541	614	1	1	2	637	1	117
Future Volume (vph)	115	282	2	2	541	614	1	1	2	637	1	117
Ideal Flow (vphpl)	1800	1800	1800	1800	1800	1800	1800	1800	1800	1800	1800	1800
Lane Width (ft)	13	12	12	12	13	12	12	12	12	13	13	12
Grade (%)		1%			1%			-8%				6%
Storage Length (ft)	175		0	75		0	40		0	0		400
Storage Lanes	2		0	1		1	1		0	1		1
Taper Length (ft)	25			25			25			25		
Right Turn on Red			Yes			Yes			Yes			Yes
Link Speed (mph)		45			45			35				35
Link Distance (ft)		691			1104			270				3640
Travel Time (s)		10.5			16.7			5.3				70.9
Confl. Peds. (#/hr)												
Confl. Bikes (#/hr)												
Peak Hour Factor	0.94	0.94	0.94	0.94	0.94	0.94	0.94	0.94	0.94	0.94	0.94	0.94
Growth Factor	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
Heavy Vehicles (%)	6%	1%	0%	0%	1%	18%	0%	0%	0%	12%	0%	1%
Bus Blockages (#/hr)	0	0	0	0	0	0	0	0	0	0	0	0
Parking (#/hr)												
Mid-Block Traffic (%)		0%			0%			0%				0%
Shared Lane Traffic (%)										50%		
Turn Type	Perm	NA		Perm	NA	Perm	Split	NA		Split	NA	Perm
Protected Phases		2			6		8	8		4		4
Permitted Phases	2			6		6						4
Detector Phase	2	2		6	6	6	8	8		4	4	4
Switch Phase												
Minimum Initial (s)	7.0	7.0		7.0	7.0	7.0	5.0	5.0		5.0	5.0	5.0
Minimum Split (s)	14.0	14.0		14.0	14.0	14.0	14.0	14.0		13.0	13.0	13.0
Total Split (s)	52.0	52.0		52.0	52.0	52.0	14.0	14.0		34.0	34.0	34.0
Total Split (%)	52.0%	52.0%		52.0%	52.0%	52.0%	14.0%	14.0%		34.0%	34.0%	34.0%
Yellow Time (s)	5.0	5.0		5.0	5.0	5.0	4.5	4.5		3.5	3.5	3.5
All-Red Time (s)	2.0	2.0		2.0	2.0	2.0	2.5	2.5		2.5	2.5	2.5
Lost Time Adjust (s)	-1.0	-1.0		-1.0	-1.0	-1.0	-1.0	-1.0		-1.0	-1.0	-1.0
Total Lost Time (s)	6.0	6.0		6.0	6.0	6.0	6.0	6.0		5.0	5.0	5.0
Lead/Lag												
Lead-Lag Optimize?												
Recall Mode	Min	Min		Min	Min	Min	None	None		None	None	None

Intersection Summary

Area Type:	Other
Cycle Length:	100
Actuated Cycle Length:	68.6
Natural Cycle:	75
Control Type:	Actuated-Uncoordinated

Splits and Phases: 1: Willowbrook Road & Race Street



HCM 6th Signalized Intersection Summary
 1: Willowbrook Road & Race Street

03/29/2022

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	115	282	2	2	541	614	1	1	2	637	1	117
Future Volume (veh/h)	115	282	2	2	541	614	1	1	2	637	1	117
Initial Q (Qb), veh	0	0	0	0	0	0	0	0	0	0	0	0
Ped-Bike Adj(A_pbT)	1.00		1.00	1.00		1.00	1.00		1.00	1.00		1.00
Parking Bus, Adj	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Work Zone On Approach		No			No			No			No	
Adj Sat Flow, veh/h/ln	1779	1780	1794	1794	1852	1542	2098	2098	2098	1488	1663	1585
Adj Flow Rate, veh/h	122	300	2	2	576	0	1	1	2	679	0	124
Peak Hour Factor	0.94	0.94	0.94	0.94	0.94	0.94	0.94	0.94	0.94	0.94	0.94	0.94
Percent Heavy Veh, %	6	1	0	0	1	18	0	0	0	12	0	1
Cap, veh/h	270	1555	10	535	836		38	12	24	837	0	397
Arrive On Green	0.45	0.45	0.45	0.45	0.45	0.00	0.02	0.02	0.02	0.30	0.00	0.30
Sat Flow, veh/h	840	3445	23	1091	1852	1307	1998	624	1249	2834	0	1343
Grp Volume(v), veh/h	122	147	155	2	576	0	1	0	3	679	0	124
Grp Sat Flow(s),veh/h/ln	840	1691	1776	1091	1852	1307	1998	0	1873	1417	0	1343
Q Serve(g_s), s	9.8	3.8	3.8	0.1	18.0	0.0	0.0	0.0	0.1	16.1	0.0	5.2
Cycle Q Clear(g_c), s	27.8	3.8	3.8	3.9	18.0	0.0	0.0	0.0	0.1	16.1	0.0	5.2
Prop In Lane	1.00		0.01	1.00		1.00	1.00		0.67	1.00		1.00
Lane Grp Cap(c), veh/h	270	764	802	535	836		38	0	36	837	0	397
V/C Ratio(X)	0.45	0.19	0.19	0.00	0.69		0.03	0.00	0.08	0.81	0.00	0.31
Avail Cap(c_a), veh/h	423	1072	1125	733	1173		220	0	206	1132	0	537
HCM Platoon Ratio	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Upstream Filter(I)	1.00	1.00	1.00	1.00	1.00	0.00	1.00	0.00	1.00	1.00	0.00	1.00
Uniform Delay (d), s/veh	26.9	12.0	12.0	13.1	15.9	0.0	34.9	0.0	35.0	23.7	0.0	19.9
Incr Delay (d2), s/veh	1.2	0.1	0.1	0.0	1.0	0.0	0.3	0.0	1.0	3.3	0.0	0.4
Initial Q Delay(d3),s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
%ile BackOfQ(95%),veh/ln	3.4	2.2	2.3	0.0	10.7	0.0	0.0	0.0	0.1	9.1	0.0	2.8
Unsig. Movement Delay, s/veh												
LnGrp Delay(d),s/veh	28.1	12.1	12.1	13.1	16.9	0.0	35.2	0.0	36.0	27.0	0.0	20.3
LnGrp LOS	C	B	B	B	B		D	A	D	C	A	C
Approach Vol, veh/h		424			578	A		4			803	
Approach Delay, s/veh		16.7			16.9			35.8			26.0	
Approach LOS		B			B			D			C	
Timer - Assigned Phs		2		4		6		8				
Phs Duration (G+Y+Rc), s		38.8		26.4		38.8		7.4				
Change Period (Y+Rc), s		7.0		6.0		7.0		7.0				
Max Green Setting (Gmax), s		45.0		28.0		45.0		7.0				
Max Q Clear Time (g_c+I1), s		29.8		18.1		20.0		2.1				
Green Ext Time (p_c), s		2.0		2.3		3.5		0.0				

Intersection Summary		
HCM 6th Ctrl Delay		20.9
HCM 6th LOS		C

Notes

User approved pedestrian interval to be less than phase max green.

User approved volume balancing among the lanes for turning movement.

Unsignalized Delay for [WBR] is excluded from calculations of the approach delay and intersection delay.

APPENDIX H
TRUCK PERCENTAGE
CALCULATIONS

Truck Percentage Calculations

AM Peak Hour											AM Peak Hour	
Intersection	Movement	Existing Trucks	Rockefeller Trucks	No-Build Trucks	No-Build Volumes	No-Build Truck %	Proposed Trucks	Build Trucks	Total Build Volumes	New Truck %	Movement	Intersection
Willowbrook Road and Race Street	eb left	6	1	7	136	5.00	0	7	136	5.00	eb left	Willowbrook Road and Race Street
	eb thru	7	0	7	289	2.00	0	7	289	2.00	eb thru	
	eb right	0	0	0	0	0.00	0	0	4	0.00	eb right	
	wb left	0	0	0	0	0.00	24	24	47	51.00	wb left	
	wb thru	9	0	9	193	5.00	0	9	193	5.00	wb thru	
	wb right	27	86	113	632	18.00	0	113	632	18.00	wb right	
	nb left	0	0	0	0	0.00	0	0	1	0.00	nb left	
	nb thru	0	0	0	0	0.00	0	0	2	0.00	nb thru	
	nb right	0	0	0	0	0.00	27	27	42	64.00	nb right	
	sb left	29	179	208	774	27.00	0	208	774	27.00	sb left	
	sb thru	0	0	0	0	0.00	0	0	8	0.00	sb thru	
	sb right	5	8	13	126	10.00	0	13	126	10.00	sb right	

Truck Percentage Calculations

PM Peak Hour											PM Peak Hour	
Intersection	Movement	Existing Trucks	Rockefeller Trucks	No-Build Trucks	No-Build Volumes	No-Build Truck %	Proposed Trucks	Build Trucks	Total Build Volumes	New Truck %	Movement	Intersection
Willowbrook Road	eb left	7	0	7	115	6.00	0	7	115	6.00	eb left	Willowbrook Road
	eb thru	4	0	4	282	1.00	0	4	282	1.00	eb thru	
and Race Street	eb right	0	0	0	2	0.00	0	0	5	0.00	eb right	and Race Street
	wb left	0	0	0	2	0.00	21	21	52	40.00	wb left	
	wb thru	6	0	6	541	1.00	0	6	541	1.00	wb thru	
	wb right	60	51	111	614	18.00	0	111	614	18.00	wb right	
	nb left	0	0	0	1	0.00	0	0	4	0.00	nb left	
	nb thru	0	0	0	0	0.00	0	0	6	0.00	nb thru	
	nb right	0	0	0	2	0.00	30	30	52	58.00	nb right	
	sb left	28	49	77	637	12.00	0	77	637	12.00	sb left	
	sb thru	0	0	0	0	0.00	0	0	4	0.00	sb thru	
1	sb right	1	0	1	117	1.00	0	1	117	1.00	sb right	1

APPENDIX I
TRIP GENERATION CALCULATIONS

Trip Generation Rate Calculations

Existing Building S.F.
67,036

AM Peak		
	Entering	Exiting
Cars	12	6
Trucks	8	9
Total by Enter/Exit	20	15
Total Driveway	35	
Calculated Trip Generation Rate		
AM Peak	0.52	
Overall Distributional Split		
	Entering	Exiting
Percentages	0.57	0.43
Cars vs. Truck Rate Calculations		
Total Cars	18	
Total Trucks	17	
Percent Trucks	0.49	
Truck Split Entering vs. Exiting		
	Entering	Exiting
Percentages	0.47	0.53

PM Peak		
	Entering	Exiting
Cars	12	10
Trucks	7	10
Total by Enter/Exit	19	20
Total Driveway	39	
Calculated Trip Generation Rate		
PM Peak	0.58	
Overall Distributional Split		
	Entering	Exiting
Percentages	0.49	0.51
Cars vs. Truck Rate Calculations		
Total Cars	22	
Total Trucks	17	
Percent Trucks	0.44	
Truck Split Entering vs. Exiting		
	Entering	Exiting
Percentages	0.41	0.59

THE PIDCOCK COMPANY

Civil Engineering and Land Planning • Architecture • Land Surveying
Oxford Drive at Fish Hatchery Road

2451 Parkwood Drive Allentown, Pennsylvania 18103-9608 610/791-2252 Fax 610/791-1256

SUBJECT: Trip Generation Calculations PROJECT NO: 21051
Lehigh Northampton Airport Authority CALCULATIONS BY: BMC DATE: March 30, 2022
North Cargo Development Traffic Assessment CHECKED BY: BEH DATE: March 31, 2022
SCALE: _____ SHEET 1 OF 2

Trip Generation Calculations for the Air Cargo Facility (See Trip Generation Rate Calculations):

S.F. Equation:

Assume 200,000 S.F.

Trip Generation:

$$X = 200,000 / 1,000$$

$$X = 200$$

AM Peak Hour of Adjacent Street Traffic (Calculated Trip Generation Rate):

$$T = 0.52 (x) X$$

$$T = 104$$

Entering Traffic:

$$104 (x) 57\% = 59$$

Exiting Traffic:

$$104 (x) 43\% = 45$$

Trucks (Calculated Truck Trip Generation Rate):

$$T = 104 (x) 0.49$$

$$T = 51$$

Entering Traffic:

$$51 (x) 47\% = 24$$

Exiting Traffic:

$$51 (x) 53\% = 27$$

Cars:

Entering Traffic:

$$59 - 24 = 35$$

Exiting Traffic

$$45 - 27 = 18$$

THE PIDCOCK COMPANY

Civil Engineering and Land Planning • Architecture • Land Surveying
Oxford Drive at Fish Hatchery Road

2451 Parkwood Drive Allentown, Pennsylvania 18103-9608 610/791-2252 Fax 610/791-1256

SUBJECT: Trip Generation Calculations PROJECT NO: 21051
Lehigh Northampton Airport Authority CALCULATIONS BY: BMC DATE: March 30, 2022
North Cargo Development Traffic Assessment CHECKED BY: BEH DATE: March 31, 2022
SCALE: _____ SHEET 2 OF 2

PM Peak Hour of Adjacent Street Traffic (Calculated Trip Generation Rate):

$$T = 0.58 (x) X$$
$$T = 116$$

Entering Traffic:
 $116 (x) 49\% = 57$

Exiting Traffic:
 $116 (x) 51\% = 59$

Trucks (Calculated Truck Trip Generation Rate):

$$T = 116 (x) 0.44$$
$$T = 51$$

Entering Traffic:
 $51 (x) 41\% = 21$

Exiting Traffic:
 $51 (x) 59\% = 30$

Cars:

Entering Traffic:
 $57 - 21 = 36$

Exiting Traffic
 $59 - 30 = 29$

APPENDIX J
2024 BUILD CAPACITY ANALYSIS
WORKSHEETS

AM PEAK

Lanes, Volumes, Timings
1: Willowbrook Road & Race Street

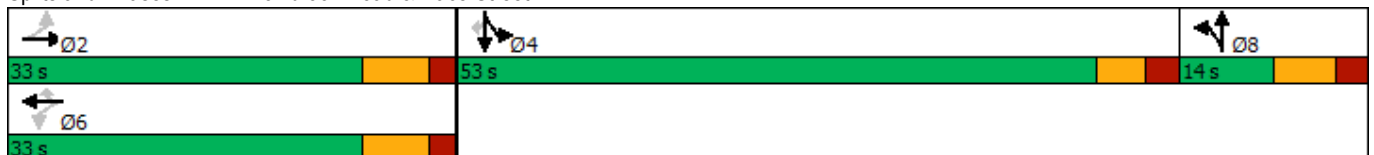
03/31/2022

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	136	289	4	47	193	632	1	2	42	774	8	126
Future Volume (vph)	136	289	4	47	193	632	1	2	42	774	8	126
Ideal Flow (vphpl)	1800	1800	1800	1800	1800	1800	1800	1800	1800	1800	1800	1800
Lane Width (ft)	13	12	12	12	13	12	12	12	12	13	13	12
Grade (%)		1%			1%			-8%				6%
Storage Length (ft)	175		0	175		0	40		0	0		400
Storage Lanes	2		0	1		1	1		0	1		1
Taper Length (ft)	25			25			25			25		
Right Turn on Red			Yes			Yes			Yes			Yes
Link Speed (mph)		45			45			35				35
Link Distance (ft)		534			1104			270				3640
Travel Time (s)		8.1			16.7			5.3				70.9
Confl. Peds. (#/hr)												
Confl. Bikes (#/hr)												
Peak Hour Factor	0.79	0.79	0.79	0.79	0.79	0.79	0.79	0.79	0.79	0.79	0.79	0.79
Growth Factor	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
Heavy Vehicles (%)	5%	2%	0%	51%	5%	18%	0%	0%	64%	27%	0%	10%
Bus Blockages (#/hr)	0	0	0	0	0	0	0	0	0	0	0	0
Parking (#/hr)												
Mid-Block Traffic (%)		0%			0%			0%				0%
Shared Lane Traffic (%)										50%		
Turn Type	Perm	NA		Perm	NA	Perm	Split	NA		Split	NA	Perm
Protected Phases		2			6		8	8		4		4
Permitted Phases	2			6		6						4
Detector Phase	2	2		6	6	6	8	8		4	4	4
Switch Phase												
Minimum Initial (s)	7.0	7.0		7.0	7.0	7.0	5.0	5.0		5.0	5.0	5.0
Minimum Split (s)	14.0	14.0		14.0	14.0	14.0	14.0	14.0		13.0	13.0	13.0
Total Split (s)	33.0	33.0		33.0	33.0	33.0	14.0	14.0		53.0	53.0	53.0
Total Split (%)	33.0%	33.0%		33.0%	33.0%	33.0%	14.0%	14.0%		53.0%	53.0%	53.0%
Yellow Time (s)	5.0	5.0		5.0	5.0	5.0	4.5	4.5		3.5	3.5	3.5
All-Red Time (s)	2.0	2.0		2.0	2.0	2.0	2.5	2.5		2.5	2.5	2.5
Lost Time Adjust (s)	-1.0	-1.0		-1.0	-1.0	-1.0	-1.0	-1.0		-1.0	-1.0	-1.0
Total Lost Time (s)	6.0	6.0		6.0	6.0	6.0	6.0	6.0		5.0	5.0	5.0
Lead/Lag												
Lead-Lag Optimize?												
Recall Mode	Min	Min		Min	Min	Min	None	None		None	None	None

Intersection Summary























Area Type:	Other
Cycle Length:	100
Actuated Cycle Length:	83.8
Natural Cycle:	80
Control Type:	Actuated-Uncoordinated

Splits and Phases: 1: Willowbrook Road & Race Street



HCM 6th Signalized Intersection Summary
 1: Willowbrook Road & Race Street

03/31/2022

												
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	136	289	4	47	193	632	1	2	42	774	8	126
Future Volume (veh/h)	136	289	4	47	193	632	1	2	42	774	8	126
Initial Q (Qb), veh	0	0	0	0	0	0	0	0	0	0	0	0
Ped-Bike Adj(A_pbT)	1.00		1.00	1.00		1.00	1.00		1.00	1.00		1.00
Parking Bus, Adj	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Work Zone On Approach		No			No			No			No	
Adj Sat Flow, veh/h/ln	1793	1766	1794	1078	1793	1542	2098	2098	1188	1269	1663	1459
Adj Flow Rate, veh/h	172	366	5	59	244	0	1	3	53	987	0	159
Peak Hour Factor	0.79	0.79	0.79	0.79	0.79	0.79	0.79	0.79	0.79	0.79	0.79	0.79
Percent Heavy Veh, %	5	2	0	51	5	18	0	0	64	27	0	10
Cap, veh/h	294	999	14	211	528		109	5	92	1103	0	564
Arrive On Green	0.29	0.29	0.29	0.29	0.29	0.00	0.05	0.05	0.05	0.46	0.00	0.46
Sat Flow, veh/h	1150	3390	46	615	1793	1307	1998	96	1697	2417	0	1236
Grp Volume(v), veh/h	172	181	190	59	244	0	1	0	56	987	0	159
Grp Sat Flow(s),veh/h/ln	1150	1678	1758	615	1793	1307	1998	0	1793	1208	0	1236
Q Serve(g_s), s	12.5	7.4	7.5	7.3	9.7	0.0	0.0	0.0	2.7	32.8	0.0	7.0
Cycle Q Clear(g_c), s	22.2	7.4	7.5	14.8	9.7	0.0	0.0	0.0	2.7	32.8	0.0	7.0
Prop In Lane	1.00		0.03	1.00		1.00	1.00		0.95	1.00		1.00
Lane Grp Cap(c), veh/h	294	495	518	211	528		109	0	97	1103	0	564
V/C Ratio(X)	0.59	0.37	0.37	0.28	0.46		0.01	0.00	0.57	0.90	0.00	0.28
Avail Cap(c_a), veh/h	310	519	544	220	555		183	0	164	1329	0	680
HCM Platoon Ratio	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Upstream Filter(I)	1.00	1.00	1.00	1.00	1.00	0.00	1.00	0.00	1.00	1.00	0.00	1.00
Uniform Delay (d), s/veh	34.2	24.3	24.3	30.2	25.1	0.0	39.1	0.0	40.3	21.8	0.0	14.8
Incr Delay (d2), s/veh	2.6	0.5	0.4	0.7	0.6	0.0	0.0	0.0	5.3	7.2	0.0	0.3
Initial Q Delay(d3),s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
%ile BackOfQ(95%),veh/ln	6.3	5.1	5.3	1.9	7.0	0.0	0.0	0.0	2.3	14.6	0.0	3.4
Unsig. Movement Delay, s/veh												
LnGrp Delay(d),s/veh	36.8	24.8	24.8	30.9	25.8	0.0	39.1	0.0	45.5	29.0	0.0	15.1
LnGrp LOS	D	C	C	C	C		D	A	D	C	A	B
Approach Vol, veh/h		543			303	A		57			1146	
Approach Delay, s/veh		28.6			26.8			45.4			27.1	
Approach LOS		C			C			D			C	
Timer - Assigned Phs		2		4		6		8				
Phs Duration (G+Y+Rc), s		31.7		44.8		31.7		10.7				
Change Period (Y+Rc), s		7.0		6.0		7.0		7.0				
Max Green Setting (Gmax), s		26.0		47.0		26.0		7.0				
Max Q Clear Time (g_c+I1), s		24.2		34.8		16.8		4.7				
Green Ext Time (p_c), s		0.5		4.1		1.2		0.0				

Intersection Summary

HCM 6th Ctrl Delay	28.0
HCM 6th LOS	C

Notes

- User approved pedestrian interval to be less than phase max green.
- User approved volume balancing among the lanes for turning movement.
- Unsignalized Delay for [WBR] is excluded from calculations of the approach delay and intersection delay.

PM PEAK

Lanes, Volumes, Timings
1: Willowbrook Road & Race Street

03/31/2022

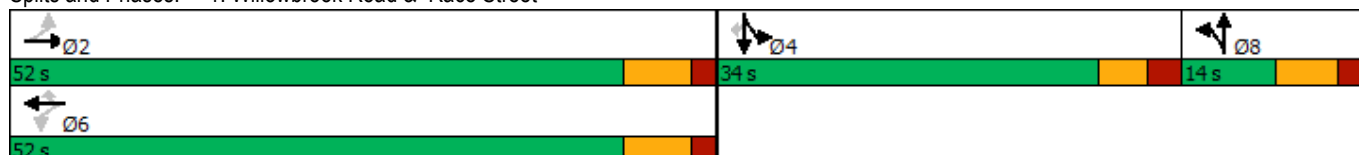


Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	115	282	5	52	541	614	4	6	52	637	4	117
Future Volume (vph)	115	282	5	52	541	614	4	6	52	637	4	117
Ideal Flow (vphpl)	1800	1800	1800	1800	1800	1800	1800	1800	1800	1800	1800	1800
Lane Width (ft)	13	12	12	12	13	12	12	12	12	13	13	12
Grade (%)		1%			1%			-8%				6%
Storage Length (ft)	175		0	175		0	40		0	0		400
Storage Lanes	2		0	1		1	1		0	1		1
Taper Length (ft)	25			25			25			25		
Right Turn on Red			Yes			Yes			Yes			Yes
Link Speed (mph)		45			45			35				35
Link Distance (ft)		691			1104			270				3640
Travel Time (s)		10.5			16.7			5.3				70.9
Confl. Peds. (#/hr)												
Confl. Bikes (#/hr)												
Peak Hour Factor	0.94	0.94	0.94	0.94	0.94	0.94	0.94	0.94	0.94	0.94	0.94	0.94
Growth Factor	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
Heavy Vehicles (%)	6%	1%	0%	40%	1%	18%	0%	0%	58%	12%	0%	1%
Bus Blockages (#/hr)	0	0	0	0	0	0	0	0	0	0	0	0
Parking (#/hr)												
Mid-Block Traffic (%)		0%			0%			0%				0%
Shared Lane Traffic (%)										50%		
Turn Type	Perm	NA		Perm	NA	Perm	Split	NA		Split	NA	Perm
Protected Phases		2			6		8	8		4		4
Permitted Phases	2			6		6						4
Detector Phase	2	2		6	6	6	8	8		4	4	4
Switch Phase												
Minimum Initial (s)	7.0	7.0		7.0	7.0	7.0	5.0	5.0		5.0	5.0	5.0
Minimum Split (s)	14.0	14.0		14.0	14.0	14.0	14.0	14.0		13.0	13.0	13.0
Total Split (s)	52.0	52.0		52.0	52.0	52.0	14.0	14.0		34.0	34.0	34.0
Total Split (%)	52.0%	52.0%		52.0%	52.0%	52.0%	14.0%	14.0%		34.0%	34.0%	34.0%
Yellow Time (s)	5.0	5.0		5.0	5.0	5.0	4.5	4.5		3.5	3.5	3.5
All-Red Time (s)	2.0	2.0		2.0	2.0	2.0	2.5	2.5		2.5	2.5	2.5
Lost Time Adjust (s)	-1.0	-1.0		-1.0	-1.0	-1.0	-1.0	-1.0		-1.0	-1.0	-1.0
Total Lost Time (s)	6.0	6.0		6.0	6.0	6.0	6.0	6.0		5.0	5.0	5.0
Lead/Lag												
Lead-Lag Optimize?												
Recall Mode	Min	Min		Min	Min	Min	None	None		None	None	None

Intersection Summary

Area Type:	Other
Cycle Length:	100
Actuated Cycle Length:	81.9
Natural Cycle:	80
Control Type:	Actuated-Uncoordinated

Splits and Phases: 1: Willowbrook Road & Race Street



HCM 6th Signalized Intersection Summary
 1: Willowbrook Road & Race Street

03/31/2022

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	115	282	5	52	541	614	4	6	52	637	4	117
Future Volume (veh/h)	115	282	5	52	541	614	4	6	52	637	4	117
Initial Q (Qb), veh	0	0	0	0	0	0	0	0	0	0	0	0
Ped-Bike Adj(A_pbT)	1.00		1.00	1.00		1.00	1.00		1.00	1.00		1.00
Parking Bus, Adj	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Work Zone On Approach		No			No			No			No	
Adj Sat Flow, veh/h/ln	1779	1780	1794	1233	1852	1542	2098	2098	1273	1488	1663	1585
Adj Flow Rate, veh/h	122	300	5	55	576	0	4	6	55	681	0	124
Peak Hour Factor	0.94	0.94	0.94	0.94	0.94	0.94	0.94	0.94	0.94	0.94	0.94	0.94
Percent Heavy Veh, %	6	1	0	40	1	18	0	0	58	12	0	1
Cap, veh/h	252	1516	25	381	824		119	11	97	813	0	386
Arrive On Green	0.45	0.45	0.45	0.45	0.45	0.00	0.06	0.06	0.06	0.29	0.00	0.29
Sat Flow, veh/h	840	3405	57	747	1852	1307	1998	178	1628	2834	0	1343
Grp Volume(v), veh/h	122	149	156	55	576	0	4	0	61	681	0	124
Grp Sat Flow(s),veh/h/ln	840	1691	1770	747	1852	1307	1998	0	1805	1417	0	1343
Q Serve(g_s), s	11.2	4.4	4.4	3.9	20.4	0.0	0.2	0.0	2.7	18.4	0.0	5.9
Cycle Q Clear(g_c), s	31.6	4.4	4.4	8.3	20.4	0.0	0.2	0.0	2.7	18.4	0.0	5.9
Prop In Lane	1.00		0.03	1.00		1.00	1.00		0.90	1.00		1.00
Lane Grp Cap(c), veh/h	252	753	788	381	824		119	0	107	813	0	386
V/C Ratio(X)	0.48	0.20	0.20	0.14	0.70		0.03	0.00	0.57	0.84	0.00	0.32
Avail Cap(c_a), veh/h	351	953	998	469	1043		196	0	177	1007	0	477
HCM Platoon Ratio	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Upstream Filter(I)	1.00	1.00	1.00	1.00	1.00	0.00	1.00	0.00	1.00	1.00	0.00	1.00
Uniform Delay (d), s/veh	31.0	13.8	13.8	16.3	18.2	0.0	36.2	0.0	37.4	27.3	0.0	22.9
Incr Delay (d2), s/veh	1.4	0.1	0.1	0.2	1.5	0.0	0.1	0.0	4.7	5.2	0.0	0.5
Initial Q Delay(d3),s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
%ile BackOfQ(95%),veh/ln	4.0	2.7	2.8	1.1	12.5	0.0	0.1	0.0	2.3	10.6	0.0	3.3
Unsig. Movement Delay, s/veh												
LnGrp Delay(d),s/veh	32.4	13.9	13.9	16.5	19.7	0.0	36.3	0.0	42.0	32.5	0.0	23.3
LnGrp LOS	C	B	B	B	B		D	A	D	C	A	C
Approach Vol, veh/h		427			631	A		65				805
Approach Delay, s/veh		19.2			19.4			41.7				31.1
Approach LOS		B			B			D				C
Timer - Assigned Phs		2		4		6		8				
Phs Duration (G+Y+Rc), s		42.3		28.4		42.3		10.9				
Change Period (Y+Rc), s		7.0		6.0		7.0		7.0				
Max Green Setting (Gmax), s		45.0		28.0		45.0		7.0				
Max Q Clear Time (g_c+I1), s		33.6		20.4		22.4		4.7				
Green Ext Time (p_c), s		1.7		2.0		3.9		0.0				

Intersection Summary		
HCM 6th Ctrl Delay		25.0
HCM 6th LOS		C

Notes

User approved pedestrian interval to be less than phase max green.

User approved volume balancing among the lanes for turning movement.

Unsignalized Delay for [WBR] is excluded from calculations of the approach delay and intersection delay.

APPENDIX K
PUBLICATION 46 TURN LANE
WARRANTS

Turn Lane Warrant and Length Analysis Workbook

STUDY LOCATION AND ANALYSIS INFORMATION

Municipality: <input type="text" value="Hanover Township"/>	Analysis Date: <input type="text" value="3/30/2022"/>
County: <input type="text" value="Lehigh County"/>	Conducted By: <input type="text" value="BEH"/>
PennDOT Engineering District: <input type="text" value="5"/>	Checked By: <input type="text" value="BMC"/>
	Agency/Company Name: <input type="text" value="The Pidcock Company"/>
Intersection & Approach Description: <input type="text" value="Race Street (SR 1004) WB Left Turn at Willow Brook Road"/>	
Analysis Period: <input type="text" value="2024 Build"/>	Number of Approach Lanes: <input type="text" value="1"/>
Design Hour: <input type="text" value="AM Peak Hour"/>	Undivided or Divided Highway: <input type="text" value="Undivided"/>
Intersection Control: <input type="text" value="Signalized"/>	
Posted Speed Limit (MPH): <input type="text" value="45"/>	Type of Analysis: <input type="text" value="Left Turn Lane"/>
Type of Terrain: <input type="text" value="Rolling"/>	Left or Right-Turn Lane Analysis?: <input type="text" value="Left Turn Lane"/>

VOLUME CALCULATIONS

Left Turn Lane Volume Calculations							
Movement	Include?	Volume	% Trucks	PCEV			
Advancing	Left	Yes	47	51.0%	83	Advancing Volume: <input type="text" value="291"/>	
	Through	-	193	5.0%	208		Opposing Volume: <input type="text" value="302"/>
	Right	No	632	18.0%	N/A		Left Turn Volume: <input type="text" value="83"/>
Opposing	Left	No	136	5.0%	N/A	% Left Turns in Advancing Volume: <input type="text" value="28.52%"/>	
	Through	-	289	2.0%	298		
	Right	Yes	4	0.0%	4		

Right Turn Lane Volume Calculations						
Movement	Include?	Volume	% Trucks	PCEV		
Advancing	Left	Yes	0	0.0%	N/A	Advancing Volume: <input type="text" value="N/A"/>
	Through	-	0	0.0%	N/A	Right Turn Volume: <input type="text" value="N/A"/>
	Right	-	0	0.0%	N/A	

TURN LANE WARRANT FINDINGS

Left Turn Lane Warrant Findings	Right Turn Lane Warrant Findings
Applicable Warrant Figure: <input type="text" value="Figure 3"/>	Applicable Warrant Figure: <input type="text" value="N/A"/>
Warrant Met?: <input type="text" value="Yes"/>	Warrant Met?: <input type="text" value="N/A"/>

TURN LANE LENGTH CALCULATIONS

Intersection Control: <input type="text" value="Signalized"/>	
Design Hour Volume of Turning Lane: <input type="text" value="83"/>	
Cycles Per Hour (Assumed): <input type="text" value="Known"/>	
Cycles Per Hour (If Known): <input type="text" value="36"/>	Average # of Vehicles/Cycle: <input type="text" value="2.0"/>

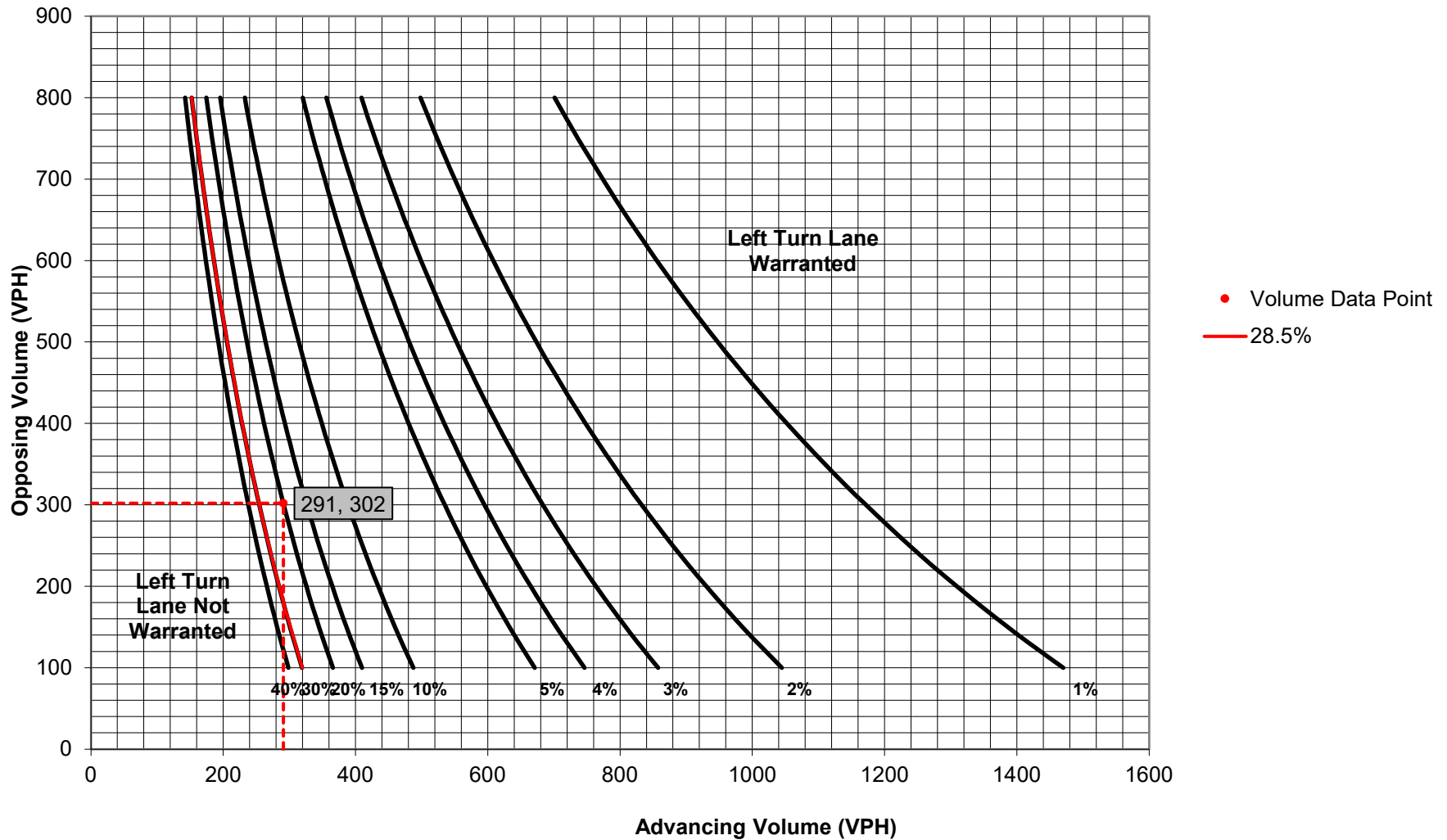
Type of Traffic Control	PennDOT Publication 46, Exhibit 11-6					
	Speed (MPH)					
	25-35		40-45		50-60	
	Turn Demand Volume					
	High	Low	High	Low	High	Low
Signalized	A	A	B or C	B or C	B or C	B or C
Unsignalized	A	A	C	B	B or C	B

Left Turn Lane Storage Length, Condition A:	<input type="text" value="N/A"/>	Feet
Condition B:	<input type="text" value="125"/>	Feet
Condition C:	<input type="text" value="175"/>	Feet
Required Left Turn Lane Storage Length:	<input type="text" value="175"/>	Feet

Additional Findings:

Additional Comments / Justifications:

**Figure 3. Warrant for left turn lanes on two-lane highways
(45 mph speed, unsignalized and signalized intersections)**
(L = % Left Turns in Advancing Volume)



Turn Lane Warrant and Length Analysis Workbook

STUDY LOCATION AND ANALYSIS INFORMATION

Municipality: <input type="text" value="Hanover Township"/>	Analysis Date: <input type="text" value="3/30/2022"/>
County: <input type="text" value="Lehigh County"/>	Conducted By: <input type="text" value="BEH"/>
PennDOT Engineering District: <input type="text" value="5"/>	Checked By: <input type="text" value="BMC"/>
	Agency/Company Name: <input type="text" value="The Pidcock Company"/>
Intersection & Approach Description: <input type="text" value="Race Street (SR 1004) WB Left Turn at Willow Brook Road"/>	
Analysis Period: <input type="text" value="2024 Build"/>	Number of Approach Lanes: <input type="text" value="1"/>
Design Hour: <input type="text" value="PM Peak Hour"/>	Undivided or Divided Highway: <input type="text" value="Undivided"/>
Intersection Control: <input type="text" value="Signalized"/>	
Posted Speed Limit (MPH): <input type="text" value="45"/>	Type of Analysis: <input type="text" value="Left Turn Lane"/>
Type of Terrain: <input type="text" value="Rolling"/>	Left or Right-Turn Lane Analysis?: <input type="text" value="Left Turn Lane"/>

VOLUME CALCULATIONS

Left Turn Lane Volume Calculations						
Movement	Include?	Volume	% Trucks	PCEV		
Advancing	Left	Yes	52	40.0%	84	Advancing Volume: <input type="text" value="634"/> Opposing Volume: <input type="text" value="292"/> Left Turn Volume: <input type="text" value="84"/>
	Through	-	541	1.0%	550	
	Right	No	614	18.0%	N/A	
Opposing	Left	No	115	6.0%	N/A	% Left Turns in Advancing Volume: <input type="text" value="13.25%"/>
	Through	-	282	1.0%	287	
	Right	Yes	5	0.0%	5	
Right Turn Lane Volume Calculations						
Movement	Include?	Volume	% Trucks	PCEV		
Advancing	Left	Yes	0	0.0%	N/A	Advancing Volume: <input type="text" value="N/A"/> Right Turn Volume: <input type="text" value="N/A"/>
	Through	-	0	0.0%	N/A	
	Right	-	0	0.0%	N/A	

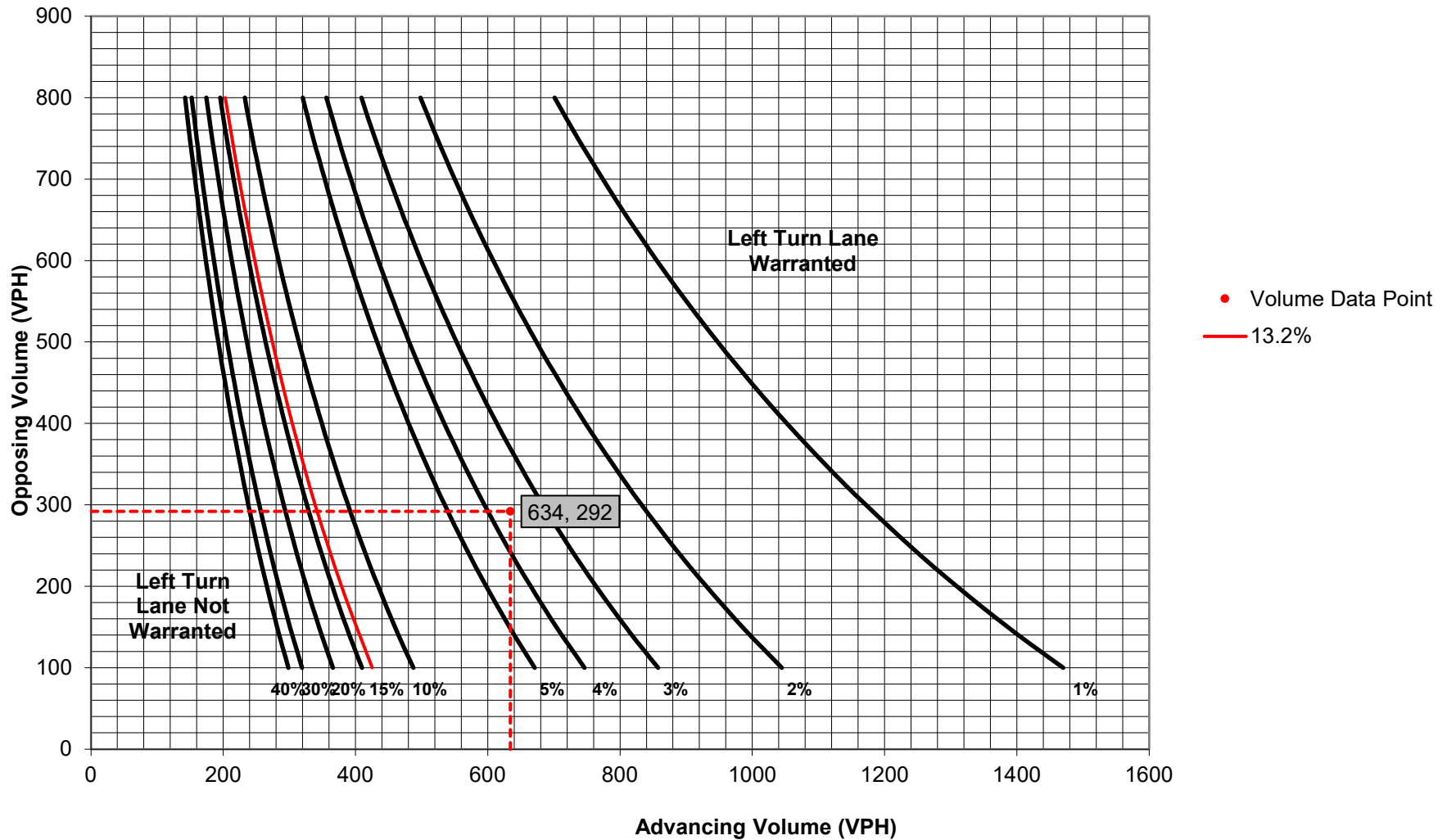
TURN LANE WARRANT FINDINGS

Left Turn Lane Warrant Findings	Right Turn Lane Warrant Findings
Applicable Warrant Figure: <input type="text" value="Figure 3"/>	Applicable Warrant Figure: <input type="text" value="N/A"/>
Warrant Met?: <input type="text" value="Yes"/>	Warrant Met?: <input type="text" value="N/A"/>

TURN LANE LENGTH CALCULATIONS

Intersection Control: <input type="text" value="Signalized"/>						
Design Hour Volume of Turning Lane: <input type="text" value="84"/>						
Cycles Per Hour (Assumed): <input type="text" value="Known"/>						
Cycles Per Hour (If Known): <input type="text" value="36"/>	Average # of Vehicles/Cycle: <input type="text" value="2.0"/>					
PennDOT Publication 46, Exhibit 11-6						
Type of Traffic Control	Speed (MPH)					
	25-35		40-45		50-60	
	Turn Demand Volume					
	High	Low	High	Low	High	Low
Signalized	A	A	B or C	B or C	B or C	B or C
Unsignalized	A	A	C	B	B or C	B
Left Turn Lane Storage Length, Condition A: <input type="text" value="N/A"/> Feet						
Condition B: <input type="text" value="125"/> Feet						
Condition C: <input type="text" value="175"/> Feet						
Required Left Turn Lane Storage Length: <input type="text" value="175"/> Feet						
Additional Findings: <input type="text" value="N/A"/>						
Additional Comments / Justifications:						

**Figure 3. Warrant for left turn lanes on two-lane highways
(45 mph speed, unsignalized and signalized intersections)**
(L = % Left Turns in Advancing Volume)



Turn Lane Warrant and Length Analysis Workbook

STUDY LOCATION AND ANALYSIS INFORMATION

Municipality: <input type="text" value="Hanover Township"/>	Analysis Date: <input type="text" value="3/30/2022"/>
County: <input type="text" value="Lehigh County"/>	Conducted By: <input type="text" value="BEH"/>
PennDOT Engineering District: <input type="text" value="5"/>	Checked By: <input type="text" value="BMC"/>
	Agency/Company Name: <input type="text" value="The Pidcock Company"/>
Intersection & Approach Description: <input type="text" value="Race Street (SR 1004) EB Right Turn at Willow Brook Road"/>	
Analysis Period: <input type="text" value="2024 Build"/>	Number of Approach Lanes: <input type="text" value="1"/>
Design Hour: <input type="text" value="AM Peak Hour"/>	Undivided or Divided Highway: <input type="text" value="Undivided"/>
Intersection Control: <input type="text" value="Signalized"/>	
Posted Speed Limit (MPH): <input type="text" value="45"/>	Type of Analysis: <input type="text" value="Right Turn Lane"/>
Type of Terrain: <input type="text" value="Rolling"/>	Left or Right-Turn Lane Analysis?: <input type="text" value="Right Turn Lane"/>

VOLUME CALCULATIONS

Left Turn Lane Volume Calculations							
Movement	Include?	Volume	% Trucks	PCEV			
Advancing	Left	No	0	0.0%	N/A	Advancing Volume: <input type="text" value="N/A"/>	
	Through	-	0	0.0%	N/A		Opposing Volume: <input type="text" value="N/A"/>
	Right	No	0	0.0%	N/A		Left Turn Volume: <input type="text" value="N/A"/>
Opposing	Left	No	0	0.0%	N/A	% Left Turns in Advancing Volume: <input type="text" value="N/A"/>	
	Through	-	0	0.0%	N/A		
	Right	No	0	0.0%	N/A		
Right Turn Lane Volume Calculations							
Movement	Include?	Volume	% Trucks	PCEV			
Advancing	Left	No	136	5.0%	N/A	Advancing Volume: <input type="text" value="302"/>	
	Through	-	289	2.0%	298		Right Turn Volume: <input type="text" value="4"/>
	Right	-	4	0.0%	4		

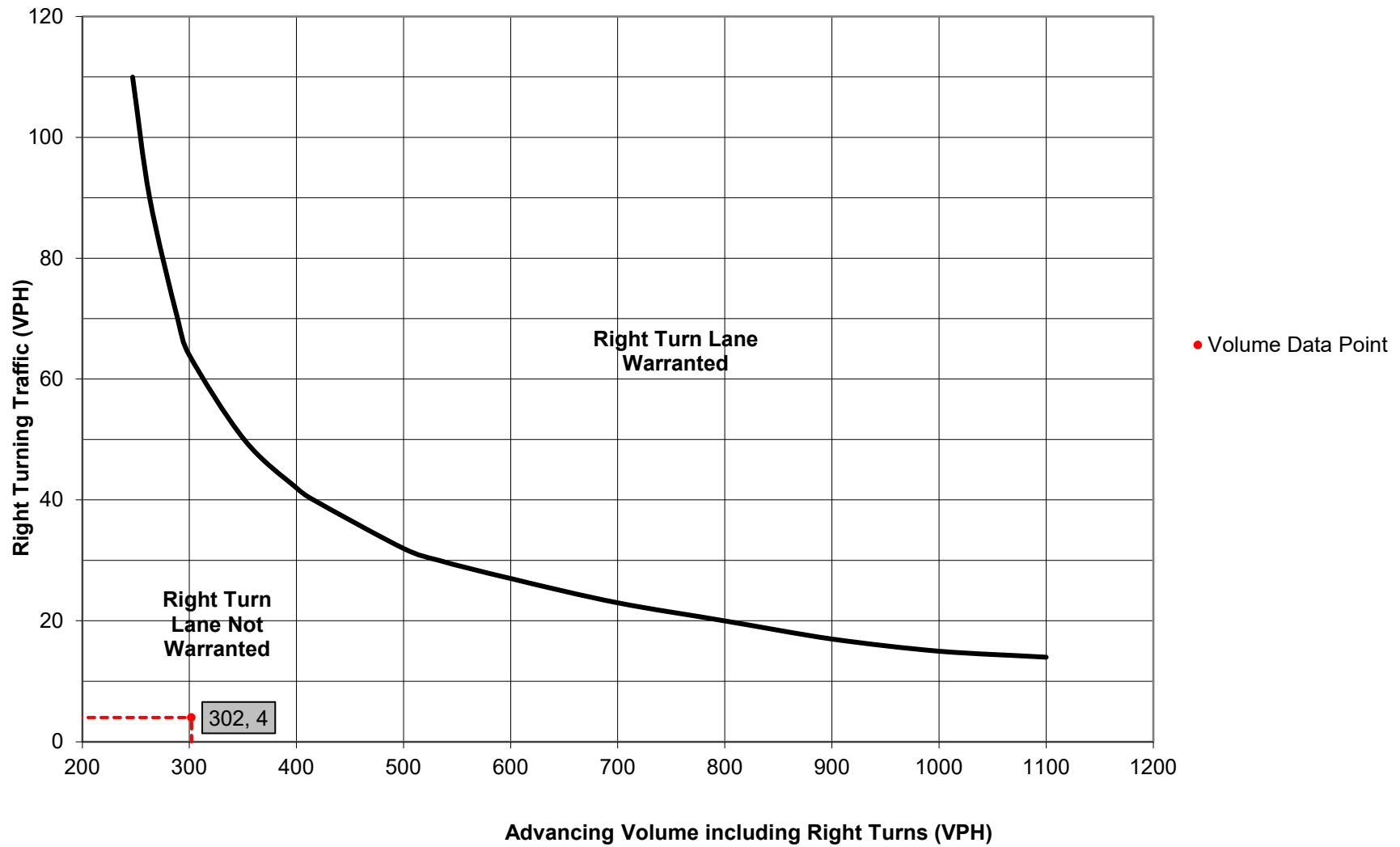
TURN LANE WARRANT FINDINGS

Left Turn Lane Warrant Findings	Right Turn Lane Warrant Findings
Applicable Warrant Figure: <input type="text" value="N/A"/>	Applicable Warrant Figure: <input type="text" value="Figure 10"/>
Warrant Met?: <input type="text" value="N/A"/>	Warrant Met?: <input type="text" value="No"/>

TURN LANE LENGTH CALCULATIONS

Intersection Control: <input type="text" value="Signalized"/>						
Design Hour Volume of Turning Lane: <input type="text" value="4"/>						
Cycles Per Hour (Assumed): <input type="text" value="Known"/>						
Cycles Per Hour (If Known): <input type="text" value="36"/>	Average # of Vehicles/Cycle: <input type="text" value="N/A"/>					
PennDOT Publication 46, Exhibit 11-6						
Type of Traffic Control	Speed (MPH)					
	25-35		40-45		50-60	
	Turn Demand Volume					
	High	Low	High	Low	High	Low
Signalized	A	A	B or C	B or C	B or C	B or C
Unsignalized	A	A	C	B	B or C	B
Right Turn Lane Storage Length, Condition A: <input type="text" value="N/A"/>		Feet				
Condition B: <input type="text" value="N/A"/>		Feet				
Condition C: <input type="text" value="N/A"/>		Feet				
Required Right Turn Lane Storage Length: <input type="text" value="N/A"/>		Feet				
Additional Findings: <input type="text" value="N/A"/>						
Additional Comments / Justifications: <input style="height: 40px;" type="text"/>						

**Figure 10. Warrant for right turn lanes on two-lane roadways
(45 mph or greater speeds, unsignalized and signalized intersections)**



Turn Lane Warrant and Length Analysis Workbook

STUDY LOCATION AND ANALYSIS INFORMATION

Municipality: <input type="text" value="Hanover Township"/>	Analysis Date: <input type="text" value="3/30/2022"/>
County: <input type="text" value="Lehigh County"/>	Conducted By: <input type="text" value="BEH"/>
PennDOT Engineering District: <input type="text" value="5"/>	Checked By: <input type="text" value="BMC"/>
	Agency/Company Name: <input type="text" value="The Pidcock Company"/>
Intersection & Approach Description: <input type="text" value="Race Street (SR 1004) EB Right Turn at Willow Brook Road"/>	
Analysis Period: <input type="text" value="2024 Build"/>	Number of Approach Lanes: <input type="text" value="1"/>
Design Hour: <input type="text" value="PM Peak Hour"/>	Undivided or Divided Highway: <input type="text" value="Undivided"/>
Intersection Control: <input type="text" value="Signalized"/>	
Posted Speed Limit (MPH): <input type="text" value="45"/>	Type of Analysis: <input type="text" value="Right Turn Lane"/>
Type of Terrain: <input type="text" value="Rolling"/>	Left or Right-Turn Lane Analysis?: <input type="text" value="Right Turn Lane"/>

VOLUME CALCULATIONS

Left Turn Lane Volume Calculations							
Movement	Include?	Volume	% Trucks	PCEV			
Advancing	Left	No	0	0.0%	N/A	Advancing Volume: <input type="text" value="N/A"/>	
	Through	-	0	0.0%	N/A		Opposing Volume: <input type="text" value="N/A"/>
	Right	No	0	0.0%	N/A		Left Turn Volume: <input type="text" value="N/A"/>
Opposing	Left	No	0	0.0%	N/A	% Left Turns in Advancing Volume: <input type="text" value="N/A"/>	
	Through	-	0	0.0%	N/A		
	Right	No	0	0.0%	N/A		
Right Turn Lane Volume Calculations							
Movement	Include?	Volume	% Trucks	PCEV			
Advancing	Left	No	115	6.0%	N/A	Advancing Volume: <input type="text" value="292"/>	
	Through	-	282	1.0%	287		Right Turn Volume: <input type="text" value="5"/>
	Right	-	5	0.0%	5		

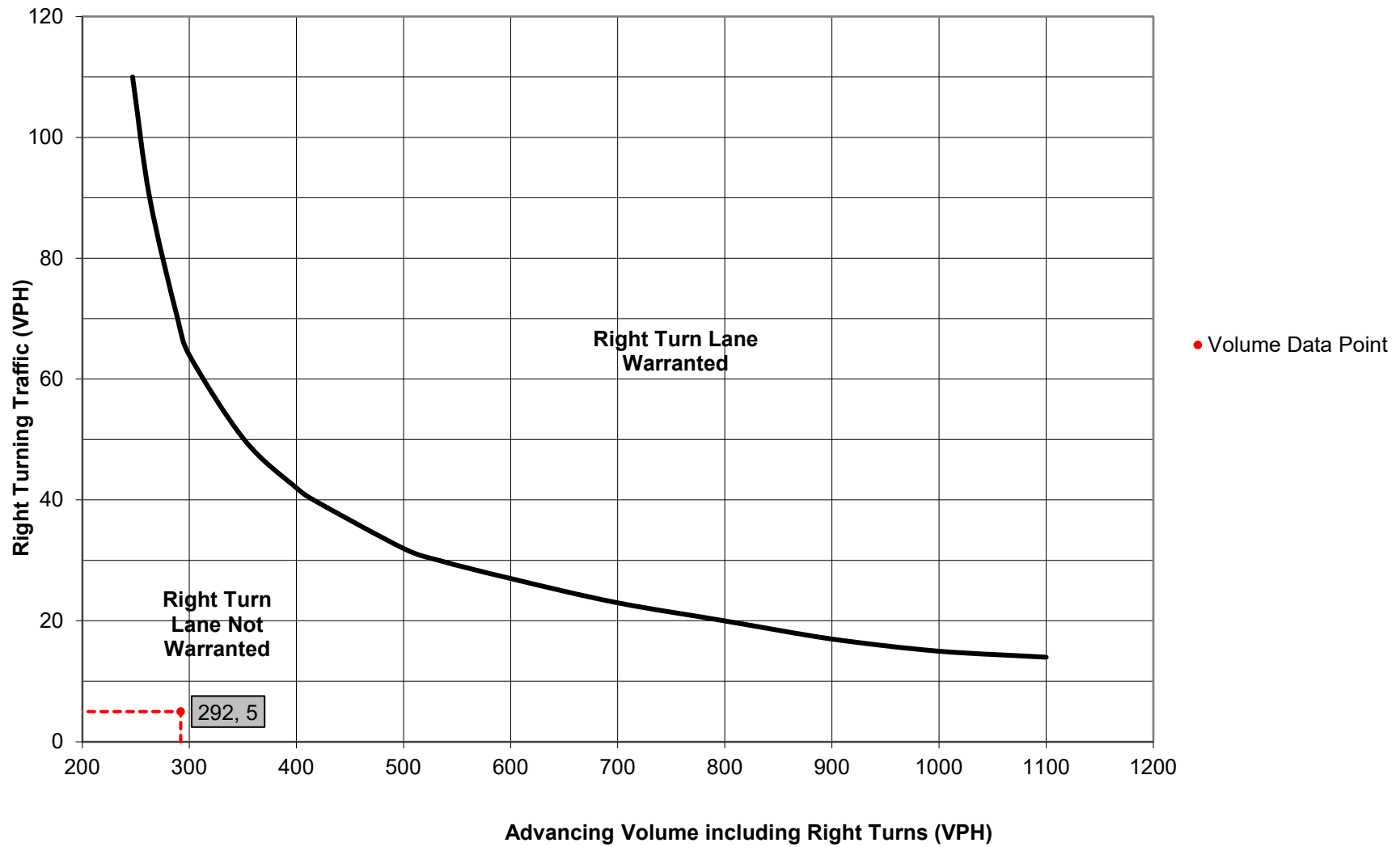
TURN LANE WARRANT FINDINGS

Left Turn Lane Warrant Findings	Right Turn Lane Warrant Findings
Applicable Warrant Figure: <input type="text" value="N/A"/>	Applicable Warrant Figure: <input type="text" value="Figure 10"/>
Warrant Met?: <input type="text" value="N/A"/>	Warrant Met?: <input type="text" value="No"/>

TURN LANE LENGTH CALCULATIONS

Intersection Control: <input type="text" value="Signalized"/>						
Design Hour Volume of Turning Lane: <input type="text" value="5"/>						
Cycles Per Hour (Assumed): <input type="text" value="Known"/>						
Cycles Per Hour (If Known): <input type="text" value="36"/>	Average # of Vehicles/Cycle: <input type="text" value="N/A"/>					
PennDOT Publication 46, Exhibit 11-6						
Type of Traffic Control	Speed (MPH)					
	25-35		40-45		50-60	
	Turn Demand Volume					
	High	Low	High	Low	High	Low
Signalized	A	A	B or C	B or C	B or C	B or C
Unsignalized	A	A	C	B	B or C	B
Right Turn Lane Storage Length, Condition A: <input type="text" value="N/A"/>		Feet				
Condition B: <input type="text" value="N/A"/>		Feet				
Condition C: <input type="text" value="N/A"/>		Feet				
Required Right Turn Lane Storage Length: <input type="text" value="N/A"/>		Feet				
Additional Findings: <input type="text" value="N/A"/>						
Additional Comments / Justifications: <input style="height: 40px;" type="text"/>						

**Figure 10. Warrant for right turn lanes on two-lane roadways
(45 mph or greater speeds, unsignalized and signalized intersections)**



11.16 Turn Lane Guidelines

General

The following turn lane guidelines have been developed to determine the warrants for turn lanes and to identify desirable length. The guidelines apply to highway occupancy permit projects, traffic signal permit projects, and Department construction projects. The guidelines apply for any one-hour period during the typical analysis periods. Typical analysis periods for projects are those for the future design year, as specified.

Traffic Engineering Software

In addition to the procedures outlined in this document, at the discretion of the Engineering District, an operational analysis may be conducted to determine whether turn lanes may be warranted and to identify associated storage lengths. The operational analysis shall be conducted utilizing traffic engineering software packages that are approved by the Department as prescribed in [12Traffic Engineering Software](#). The results of both procedures can then be compared, and the more conservative results may be used. For example, although the application of these turn lane guidelines may indicate a turn lane is not warranted, if the operational analysis identifies the need for a turn lane to achieve acceptable levels of service, then the incorporation of the turn lane into the design may be considered.

Additionally, in those cases involving closely spaced intersections and complex transportation systems when intersection function may be affected by adjacent locations, the operational analysis may yield more appropriate results based on site conditions and may be given more consideration than the results obtained from these guidelines.

Use the 95th percentile turn lane queue when estimating required storage length from traffic engineering software packages, unless directed otherwise.

Truck Adjustment Factors

To adjust for truck traffic, the following formula shall be used to develop a truck adjustment factor to be applied to the hourly volume to obtain a passenger-car equivalent volume for the advancing, opposing, and left turning volumes for both warrants and design:

$$T = 1 + P_T (E_T - 1)$$

where

E_T = passenger-car equivalent for trucks

P_T = proportion of trucks in the traffic stream (expressed as a decimal fraction)

T = truck adjustment factor

The value used for E_T shall be taken from the following table based on the terrain of the surrounding area:

Exhibit 11-5 Truck Adjustment Factors

Type of Terrain		
Level	Rolling	Mountainous
1.5	2.5	4.5

The hourly volume shall be multiplied by the truck adjustment factor (T), and the resulting passenger-car equivalent volume shall then be used in all subsequent calculations identified in these guidelines. The truck adjustment factors were taken from Reference 3 (see page 50).

Turn Lane Warrants

Use Figures 1 through 8 in the [Chapter 11 Appendix](#) page 60 to determine whether a left turn lane is warranted on two-lane and four-lane roadways at unsignalized and signalized intersections. Use Figures 9 through 12 in the [Chapter 11 Appendix](#) to determine whether a right turn lane is warranted on two-lane and four-lane roadways at unsignalized and signalized intersections. For unsignalized intersections, the warrants only apply to the free flow approach. For left turns, if the plotted point falls above the appropriate left turn percentage line (L), a left turn lane is considered warranted. Engineering District discretion should be used as to whether the actual left turn percentage should be rounded up or down to match one of the lines in the graph. A turn lane may be considered if the criteria is met for any one-hour period.

Figures 1 through 8 in the [Chapter 11 Appendix](#) were adapted from References 1, 2, 4, and 9. Figures 9 through 12 in the [Chapter 11 Appendix](#) were taken from Reference 5 (see page 50 for a list of references).

Turn Lane Storage Length

Use [Exhibit 11-6](#) through [Exhibit 11-8](#) to compute storage length for left and right turn lanes at unsignalized and signalized intersections. [Exhibit 11-6](#) to [Exhibit 11-8](#) were adapted from Reference 5. Minimum recommended storage length is 75 feet, and all results should be rounded the next highest 25-foot increment. Turn lane storage length does not include taper length.

Consider using dual left turn lanes at signalized intersections when the hourly left turn volume exceeds 300 vehicles per hour.

Exhibit 11-6 Turn Lane Storage - Type of Traffic Control Condition (A, B or C)

TYPE OF TRAFFIC CONTROL	SPEED (MPH)					
	25 – 35		40 – 45		50 - 60	
	TURN DEMAND VOLUME					
	HIGH	LOW*	HIGH	LOW*	HIGH	LOW*
SIGNALIZED	A	A	B or C**	B or C**	B or C**	B or C**
UNSIGNALIZED	A	A	C	B	B or C**	B

* LOW is considered 10% or less of approach traffic volume

** Whichever is greater

Exhibit 11-7 Turn Lane Storage – For Speed and Condition

CONDITION A	
SPEED (MPH)	STORAGE LENGTH
Any speed	Length from Exhibit 11-8
CONDITION B	
SPEED (MPH)	STORAGE LENGTH
40	75'
45	125'
50	175'
55	235'
60	295'
CONDITION C	
SPEED (MPH)	STORAGE LENGTH
40	61' + Additional length from Exhibit 11-8
45	75' + Additional length from Exhibit 11-8
50	93' + Additional length from Exhibit 11-8
55	114' + Additional length from Exhibit 11-8
60	131' + Additional length from Exhibit 11-8

Exhibit 11-8 Turn Lane Storage Based on Average No. of Vehicles/Cycle

Average no. of vehicles/cycle*	Length (feet)	Average no. of vehicles/cycle*	Length (feet)
1	75	17	600
2	100	18	625
3	150	19	650
4	175	20	675
5	200	21	725
6	250	22	750
7	275	23	775
8	325	24	800
9	350	25	825
10	375	30	975
11	400	35	1125
12	450	40	1250
13	475	45	1400
14	500	50	1550
15	525	55	1700
16	550	60	1850

* Average no. of vehicles/cycle = design hour volume of turning lane/cycles per hour

If cycles per hour are unknown, assume:

Unsignalized or 2 phase – 60 cycles per hour

3 phase – 40 cycles per hour

4 phase or more – 30 cycles per hour

At signalized intersections, consider dual left turn lanes and operational analysis.

Other Warranting Factors and Considerations

While the preceding sections present analytical procedures to determine whether turn lanes may be warranted, it must be recognized that there are other factors that may need to be considered. These factors may justify turn lanes at some locations where the numerical warrants are not satisfied.

Some of the factors, or combinations of factors, that may need to be considered and may justify turn lanes to preserve safe and efficient traffic flow include crash history; sight distance; deceleration requirements; the type and volume of turning traffic considering nearby land use; grades; locations on high-speed, multilane highways; 85th percentile and safe running speeds; and engineering judgment.

Example Problem

Problem Statement

Determine whether an exclusive left turn lane is warranted and its desired storage length on a signalized approach of a rural arterial highway (speed = 50 mph, 20% trucks, rolling terrain). Intersection approach volumes consist of 100 left turning vehicles per hour and 680 through vehicles per hour. Opposing traffic volume is 500 vehicles per hour. The traffic signal has a 90-second cycle length.

Determine Whether a Left Turn Lane Is Warranted

First, convert the hourly volume to a passenger-car equivalent volume:

$$T = 1 + .2 (2.5 - 1) = 1.3$$

$$\text{Passenger-car equivalent volume (left)} = 1.3 (100) = 130 \text{ vehicles}$$

$$\text{Passenger-car equivalent volume (through)} = 1.3 (680) = 884 \text{ vehicles}$$

$$\text{Passenger-car equivalent volume (opposing)} = 1.3 (500) = 650 \text{ vehicles}$$

$$\text{Passenger-car equivalent volume (advancing)} = 130 + 884 = 1,014 \text{ vehicles.}$$

Next, identify the percentage of left turns contained in the advancing volume:

$$L = 130/1014 = 12.8\%.$$

Then, use the appropriate graph from Figures 1 through 8 in the [Chapter 11 Appendix](#) to determine if a left turn lane is warranted. Therefore, based on site conditions, **Figure 4** will be utilized to plot the traffic information as follows:

APPENDIX L
ALTERNATIVE CAPACITY ANALYSIS
WORKSHEETS

AM PEAK

Lanes, Volumes, Timings
1: Willowbrook Road & Race Street

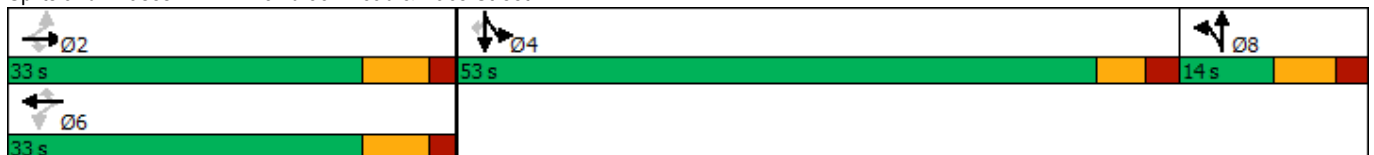
03/31/2022

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	136	289	4	47	193	632	1	2	42	774	8	126
Future Volume (vph)	136	289	4	47	193	632	1	2	42	774	8	126
Ideal Flow (vphpl)	1800	1800	1800	1800	1800	1800	1800	1800	1800	1800	1800	1800
Lane Width (ft)	13	12	12	12	13	12	12	12	12	13	13	12
Grade (%)		1%			1%			-8%				6%
Storage Length (ft)	175		0	175		0	40		0	0		400
Storage Lanes	1		1	1		1	1		0	1		1
Taper Length (ft)	25			25			25			25		
Right Turn on Red			Yes			Yes			Yes			Yes
Link Speed (mph)		45			45			35				35
Link Distance (ft)		534			1104			270				3640
Travel Time (s)		8.1			16.7			5.3				70.9
Confl. Peds. (#/hr)												
Confl. Bikes (#/hr)												
Peak Hour Factor	0.79	0.79	0.79	0.79	0.79	0.79	0.79	0.79	0.79	0.79	0.79	0.79
Growth Factor	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
Heavy Vehicles (%)	5%	2%	0%	51%	5%	18%	0%	0%	64%	27%	0%	10%
Bus Blockages (#/hr)	0	0	0	0	0	0	0	0	0	0	0	0
Parking (#/hr)												
Mid-Block Traffic (%)		0%			0%			0%				0%
Shared Lane Traffic (%)										50%		
Turn Type	Perm	NA	Perm	Perm	NA	Perm	Split	NA		Split	NA	Perm
Protected Phases		2			6		8	8		4	4	
Permitted Phases	2		2	6		6						4
Detector Phase	2	2	2	6	6	6	8	8		4	4	4
Switch Phase												
Minimum Initial (s)	7.0	7.0	7.0	7.0	7.0	7.0	5.0	5.0		5.0	5.0	5.0
Minimum Split (s)	14.0	14.0	14.0	14.0	14.0	14.0	14.0	14.0		13.0	13.0	13.0
Total Split (s)	33.0	33.0	33.0	33.0	33.0	33.0	14.0	14.0		53.0	53.0	53.0
Total Split (%)	33.0%	33.0%	33.0%	33.0%	33.0%	33.0%	14.0%	14.0%		53.0%	53.0%	53.0%
Yellow Time (s)	5.0	5.0	5.0	5.0	5.0	5.0	4.5	4.5		3.5	3.5	3.5
All-Red Time (s)	2.0	2.0	2.0	2.0	2.0	2.0	2.5	2.5		2.5	2.5	2.5
Lost Time Adjust (s)	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0		-1.0	-1.0	-1.0
Total Lost Time (s)	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0		5.0	5.0	5.0
Lead/Lag												
Lead-Lag Optimize?												
Recall Mode	Min	Min	Min	Min	Min	Min	None	None		None	None	None

Intersection Summary
























Area Type:	Other
Cycle Length:	100
Actuated Cycle Length:	84.8
Natural Cycle:	90
Control Type:	Actuated-Uncoordinated

Splits and Phases: 1: Willowbrook Road & Race Street



HCM 6th Signalized Intersection Summary
 1: Willowbrook Road & Race Street

03/31/2022

												
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	136	289	4	47	193	632	1	2	42	774	8	126
Future Volume (veh/h)	136	289	4	47	193	632	1	2	42	774	8	126
Initial Q (Qb), veh	0	0	0	0	0	0	0	0	0	0	0	0
Ped-Bike Adj(A_pbT)	1.00		1.00	1.00		1.00	1.00		1.00	1.00		1.00
Parking Bus, Adj	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Work Zone On Approach		No			No			No			No	
Adj Sat Flow, veh/h/ln	1793	1766	1794	1078	1793	1542	2098	2098	1188	1269	1663	1459
Adj Flow Rate, veh/h	172	366	5	59	244	0	1	3	53	987	0	159
Peak Hour Factor	0.79	0.79	0.79	0.79	0.79	0.79	0.79	0.79	0.79	0.79	0.79	0.79
Percent Heavy Veh, %	5	2	0	51	5	18	0	0	64	27	0	10
Cap, veh/h	302	534	459	154	542		107	5	91	1098	0	561
Arrive On Green	0.30	0.30	0.30	0.30	0.30	0.00	0.05	0.05	0.05	0.45	0.00	0.45
Sat Flow, veh/h	1150	1766	1521	615	1793	1307	1998	96	1697	2417	0	1236
Grp Volume(v), veh/h	172	366	5	59	244	0	1	0	56	987	0	159
Grp Sat Flow(s),veh/h/ln	1150	1766	1521	615	1793	1307	1998	0	1793	1208	0	1236
Q Serve(g_s), s	12.7	16.3	0.2	8.3	9.8	0.0	0.0	0.0	2.7	33.7	0.0	7.2
Cycle Q Clear(g_c), s	22.5	16.3	0.2	24.6	9.8	0.0	0.0	0.0	2.7	33.7	0.0	7.2
Prop In Lane	1.00		1.00	1.00		1.00	1.00		0.95	1.00		1.00
Lane Grp Cap(c), veh/h	302	534	459	154	542		107	0	96	1098	0	561
V/C Ratio(X)	0.57	0.69	0.01	0.38	0.45		0.01	0.00	0.58	0.90	0.00	0.28
Avail Cap(c_a), veh/h	302	534	459	154	542		179	0	160	1298	0	664
HCM Platoon Ratio	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Upstream Filter(I)	1.00	1.00	1.00	1.00	1.00	0.00	1.00	0.00	1.00	1.00	0.00	1.00
Uniform Delay (d), s/veh	34.3	27.5	21.8	38.3	25.2	0.0	40.0	0.0	41.3	22.5	0.0	15.3
Incr Delay (d2), s/veh	2.6	3.6	0.0	1.6	0.6	0.0	0.0	0.0	5.5	7.8	0.0	0.3
Initial Q Delay(d3),s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
%ile BackOfQ(95%),veh/ln	6.4	11.2	0.1	2.3	7.2	0.0	0.0	0.0	2.4	15.1	0.0	3.5
Unsig. Movement Delay, s/veh												
LnGrp Delay(d),s/veh	36.8	31.1	21.8	39.8	25.8	0.0	40.1	0.0	46.8	30.3	0.0	15.6
LnGrp LOS	D	C	C	D	C		D	A	D	C	A	B
Approach Vol, veh/h		543			303	A		57			1146	
Approach Delay, s/veh		32.8			28.5			46.7			28.3	
Approach LOS		C			C			D			C	
Timer - Assigned Phs		2		4		6		8				
Phs Duration (G+Y+Rc), s		33.0		45.6		33.0		10.8				
Change Period (Y+Rc), s		7.0		6.0		7.0		7.0				
Max Green Setting (Gmax), s		26.0		47.0		26.0		7.0				
Max Q Clear Time (g_c+I1), s		24.5		35.7		26.6		4.7				
Green Ext Time (p_c), s		0.4		3.9		0.0		0.0				

Intersection Summary

HCM 6th Ctrl Delay	30.0
HCM 6th LOS	C

Notes

- User approved pedestrian interval to be less than phase max green.
- User approved volume balancing among the lanes for turning movement.
- Unsignalized Delay for [WBR] is excluded from calculations of the approach delay and intersection delay.

PM PEAK

Lanes, Volumes, Timings
1: Willowbrook Road & Race Street

03/31/2022

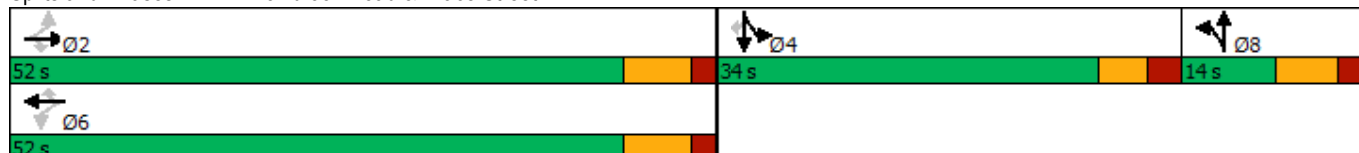


Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	115	282	5	52	541	614	4	6	52	637	4	117
Future Volume (vph)	115	282	5	52	541	614	4	6	52	637	4	117
Ideal Flow (vphpl)	1800	1800	1800	1800	1800	1800	1800	1800	1800	1800	1800	1800
Lane Width (ft)	13	12	12	12	13	12	12	12	12	13	13	12
Grade (%)		1%			1%			-8%				6%
Storage Length (ft)	175		0	175		0	40		0	0		400
Storage Lanes	1		1	1		1	1		0	1		1
Taper Length (ft)	25			25			25			25		
Right Turn on Red			Yes			Yes			Yes			Yes
Link Speed (mph)		45			45			35				35
Link Distance (ft)		691			1104			270				3640
Travel Time (s)		10.5			16.7			5.3				70.9
Confl. Peds. (#/hr)												
Confl. Bikes (#/hr)												
Peak Hour Factor	0.94	0.94	0.94	0.94	0.94	0.94	0.94	0.94	0.94	0.94	0.94	0.94
Growth Factor	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
Heavy Vehicles (%)	6%	1%	0%	40%	1%	18%	0%	0%	58%	12%	0%	1%
Bus Blockages (#/hr)	0	0	0	0	0	0	0	0	0	0	0	0
Parking (#/hr)												
Mid-Block Traffic (%)		0%			0%			0%				0%
Shared Lane Traffic (%)										50%		
Turn Type	Perm	NA	Perm	Perm	NA	Perm	Split	NA		Split	NA	Perm
Protected Phases		2			6		8	8		4	4	
Permitted Phases	2		2	6		6						4
Detector Phase	2	2	2	6	6	6	8	8		4	4	4
Switch Phase												
Minimum Initial (s)	7.0	7.0	7.0	7.0	7.0	7.0	5.0	5.0		5.0	5.0	5.0
Minimum Split (s)	14.0	14.0	14.0	14.0	14.0	14.0	14.0	14.0		13.0	13.0	13.0
Total Split (s)	52.0	52.0	52.0	52.0	52.0	52.0	14.0	14.0		34.0	34.0	34.0
Total Split (%)	52.0%	52.0%	52.0%	52.0%	52.0%	52.0%	14.0%	14.0%		34.0%	34.0%	34.0%
Yellow Time (s)	5.0	5.0	5.0	5.0	5.0	5.0	4.5	4.5		3.5	3.5	3.5
All-Red Time (s)	2.0	2.0	2.0	2.0	2.0	2.0	2.5	2.5		2.5	2.5	2.5
Lost Time Adjust (s)	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0		-1.0	-1.0	-1.0
Total Lost Time (s)	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0		5.0	5.0	5.0
Lead/Lag												
Lead-Lag Optimize?												
Recall Mode	Min	Min	Min	Min	Min	Min	None	None		None	None	None

Intersection Summary
























Area Type:	Other
Cycle Length:	100
Actuated Cycle Length:	81.9
Natural Cycle:	80
Control Type:	Actuated-Uncoordinated

Splits and Phases: 1: Willowbrook Road & Race Street



HCM 6th Signalized Intersection Summary
 1: Willowbrook Road & Race Street

03/31/2022

												
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	115	282	5	52	541	614	4	6	52	637	4	117
Future Volume (veh/h)	115	282	5	52	541	614	4	6	52	637	4	117
Initial Q (Qb), veh	0	0	0	0	0	0	0	0	0	0	0	0
Ped-Bike Adj(A_pbT)	1.00		1.00	1.00		1.00	1.00		1.00	1.00		1.00
Parking Bus, Adj	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Work Zone On Approach		No			No			No			No	
Adj Sat Flow, veh/h/ln	1779	1780	1794	1233	1852	1542	2098	2098	1273	1488	1663	1585
Adj Flow Rate, veh/h	122	300	5	55	576	0	4	6	55	681	0	124
Peak Hour Factor	0.94	0.94	0.94	0.94	0.94	0.94	0.94	0.94	0.94	0.94	0.94	0.94
Percent Heavy Veh, %	6	1	0	40	1	18	0	0	58	12	0	1
Cap, veh/h	252	793	677	337	825		119	11	97	813	0	385
Arrive On Green	0.45	0.45	0.45	0.45	0.45	0.00	0.06	0.06	0.06	0.29	0.00	0.29
Sat Flow, veh/h	840	1780	1521	747	1852	1307	1998	178	1628	2834	0	1343
Grp Volume(v), veh/h	122	300	5	55	576	0	4	0	61	681	0	124
Grp Sat Flow(s),veh/h/ln	840	1780	1521	747	1852	1307	1998	0	1805	1417	0	1343
Q Serve(g_s), s	11.2	9.2	0.1	4.3	20.5	0.0	0.2	0.0	2.7	18.4	0.0	5.9
Cycle Q Clear(g_c), s	31.6	9.2	0.1	13.5	20.5	0.0	0.2	0.0	2.7	18.4	0.0	5.9
Prop In Lane	1.00		1.00	1.00		1.00	1.00		0.90	1.00		1.00
Lane Grp Cap(c), veh/h	252	793	677	337	825		119	0	107	813	0	385
V/C Ratio(X)	0.48	0.38	0.01	0.16	0.70		0.03	0.00	0.57	0.84	0.00	0.32
Avail Cap(c_a), veh/h	351	1003	856	425	1043		196	0	177	1006	0	477
HCM Platoon Ratio	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Upstream Filter(I)	1.00	1.00	1.00	1.00	1.00	0.00	1.00	0.00	1.00	1.00	0.00	1.00
Uniform Delay (d), s/veh	31.0	15.1	12.6	19.6	18.2	0.0	36.2	0.0	37.4	27.3	0.0	22.9
Incr Delay (d2), s/veh	1.4	0.3	0.0	0.2	1.5	0.0	0.1	0.0	4.7	5.3	0.0	0.5
Initial Q Delay(d3),s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
%ile BackOfQ(95%),veh/ln	4.0	6.0	0.1	1.3	12.5	0.0	0.1	0.0	2.3	10.6	0.0	3.3
Unsig. Movement Delay, s/veh												
LnGrp Delay(d),s/veh	32.4	15.4	12.6	19.8	19.7	0.0	36.3	0.0	42.1	32.6	0.0	23.4
LnGrp LOS	C	B	B	B	B		D	A	D	C	A	C
Approach Vol, veh/h		427			631	A		65			805	
Approach Delay, s/veh		20.2			19.7			41.7			31.2	
Approach LOS		C			B			D			C	
Timer - Assigned Phs		2		4		6		8				
Phs Duration (G+Y+Rc), s		42.4		28.4		42.4		10.9				
Change Period (Y+Rc), s		7.0		6.0		7.0		7.0				
Max Green Setting (Gmax), s		45.0		28.0		45.0		7.0				
Max Q Clear Time (g_c+I1), s		33.6		20.4		22.5		4.7				
Green Ext Time (p_c), s		1.8		2.0		3.9		0.0				

Intersection Summary		
HCM 6th Ctrl Delay		25.4
HCM 6th LOS		C

Notes
 User approved pedestrian interval to be less than phase max green.
 User approved volume balancing among the lanes for turning movement.
 Unsignalized Delay for [WBR] is excluded from calculations of the approach delay and intersection delay.