CANAL POINTE BOULEVARD
ROAD DIET STUDY

West Windsor Township
Mercer County, New Jersey

Prepared for

West Windsor Township
271 Clarksville Road
West Windsor, NJ 08550

March 2015

04/02/15

THE Burns GROUP
ENGINEERING AND CONSTRUCTION

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INTRODUCTION

At the request of the Township of West Windsor, the Burns Group (formerly Orth-Rodgers & Associates, Inc.) (BURNS) has undertaken this Canal Pointe Boulevard Traffic Study in an effort to evaluate the existing and future conditions on Canal Pointe Boulevard, and to determine if any modifications to the roadway should be recommended to better serve all users. We note that this report was originally prepared in 2008, with a draft update prepared in 2013 reflecting updated traffic volumes, capacity analysis and crash history data. This version now includes full build-out of new facilities through 2018.

We have evaluated the physical condition, volumes, vehicular delays, speeds, crash history, pedestrian and bicycle facilities and transit facilities along the corridor. This report also summarizes the results of a signal warrant analysis for the intersection of Canal Pointe Boulevard with Carnegie Boulevard/ Carillon Boulevard. Finally, it discusses projected future traffic conditions along the roadway under existing conditions as well as with a 'Road Diet' reconfiguration; i.e. conversion of the existing four-lane section of Canal Pointe Boulevard to a three-lane section - two through lanes and one lane for left turns - plus bicycle lanes.

EXISTING CONDITIONS

Existing Roadway Conditions and Controls

This study reviews conditions on the entire length of Canal Pointe Boulevard, from Alexander Road to the Princeton Country Club, 1.7 miles altogether. The roadway actually has different names north and south of Farber Road; north of Farber Road it is known as Canal Pointe Boulevard, and south of Farber Road, it is Wheeler Way. For reasons of convenience it will typically be referred to only as "Canal Pointe Boulevard" throughout this report.

Canal Pointe Boulevard is a two-lane, two way roadway south of Meadow Road with four lanes to the north. The roadway is curbed its entire length. It is 36 ft. wide south of Emmons Drive, with no lane markings; 36 ft. wide north of Emmons Drive and south of Meadow Road; with two 18 ft. travel lanes; and four 11 ft. travel lanes (two in each direction) north of Meadow Road. Between Emmons Drive and Alexander Road, every roadway that intersects with Canal Pointe Boulevard is stop-controlled. At Emmons Drive, Wheeler Way is stop-controlled; and the intersection of Canal Pointe Boulevard and Alexander Road is signalized.

We note that, under a 2012 assignment under this contract, Burns conducted a traffic signal warrant analysis at the intersection of Canal Pointe Boulevard and Meadow Road. This evaluation concluded that the intersection was a candidate for signalization, and the traffic signal was designed, installed and is currently operational at this location. Traffic analysis of future conditions at this intersection have been conducted with the traffic signal in operation.

The right-of-way on the section of the roadway known as Wheeler Way is 60 feet, and the right-of-way of Canal Pointe Boulevard is typically 70 feet. However, the right-of-way is briefly 60 feet north of Bayberry Drive, and is 80 feet immediately south of Alexander Road.

Wheeler Way has a posted speed limit of 25 mph south of Farber Road, and Canal Pointe Boulevard is posted at 35 mph from Farber Road to the roadway's northern terminus at Alexander Road. On-street parking is only permitted on the section south of Emmons Drive.

Traffic Volumes

As part of the original 2008 iteration of this study, BURNS staff conducted peak hour traffic counts at 14 intersections along the Canal Pointe Boulevard corridor. Given that approximately five years have elapsed since this data was collected, this traffic count data has been updated.

The New Jersey Department of Transportation completed a traffic data collection program as part of its effort to identify traffic impacts associated with the then-proposed restrictions of left turns at a number of intersections along U.S. Route 1. BURNS was provided with traffic count data at the following Canal Pointe Boulevard intersections:

- Alexander Road
- Carnegie Center Boulevard / Carillon Boulevard
- Meadow Road[1]

In order to project existing 2013 traffic volumes, BURNS reviewed the summaries of the NJDOT traffic count data. The extensive count program included multiple days of traffic counts, and a set of figures provided by the NJDOT presented five to six sets of count data for each movement at these three intersections, for both the morning and evening peak hours. Each volume in this figure was an average computed over several days. In order to perform a conservative analysis, the highest volume presented for each movement was analyzed at each of these three intersections. In many cases, the peak volume chosen for analysis was the only one conducted while area schools and universities were in session. Note that since the potential 'Road Diet' treatment would not apply to the intersections with Farber Road and with Emmons Drive, these intersections are not included in the updated traffic volumes.

For the remaining intersections, updated "existing" volumes were projected as follows:

- Movements into and out of the residential areas along Canal Pointe Boulevard were not augmented, and were assumed to remain at levels observed in 2008, since development in those areas has not changed significantly in the interim;
- Movements into and out of the MarketFair development were increased by 5%, based on a proposed expansion of that site as detailed in a traffic impact analysis letter provided to BURNS;
- Through movements along Canal Pointe Boulevard were increased and "balanced" based on the volumes observed at the three intersections for which NJDOT count data was provided.

We note that, in general, the traffic counts provided by the NJDOT do suggest that volumes along Canal Pointe Boulevard increased. This is especially true of the roadway in the southbound direction, during the weekday evening peak hour: the data provided by the NJDOT indicates the southbound Canal Pointe Boulevard volume during this hour has increased by upwards of 400 vehicles per hour over the volumes observed by BURNS in 2008. These volumes were incorporated into our analysis because each data point represents the average volume computed over a two- to five-day period; and because this increase is reflected in the southbound direction, during the weekday evening peak hour, at all three intersections for which NJDOT count data was provided. Southbound U.S. Route 1 is typically very congested during this period and volumes do fluctuate based on Route 1 conditions and how many vehicles divert to Canal Pointe Boulevard.

Some of this increase in southbound traffic volumes may have been attributable to the closure of Quaker Road, to the south in Lawrence Township, for a construction project. Some traffic volumes were collected for the NJDOT study while Quaker Road was still open, but area schools and Princeton University were not in regular session at those times.

These existing peak hour volumes for the morning and evening peak hours are shown in Figures 1 and 2. Based upon typical peak hour factors, the average daily traffic volume on Canal Pointe Boulevard on the northern half of the corridor is likely in the range of 9,500 to 17,000; and 7,000 to 12,000 in the southern half of the corridor.

[1] As part of a 2012 assignment, BURNS conducted a traffic count at the Meadow Road intersection for the purposes of evaluating traffic signal warrants at that location. The NJDOT data is more recent and incorporates several days' worth of traffic volume data; therefore the NJDOT data was used for this analysis.

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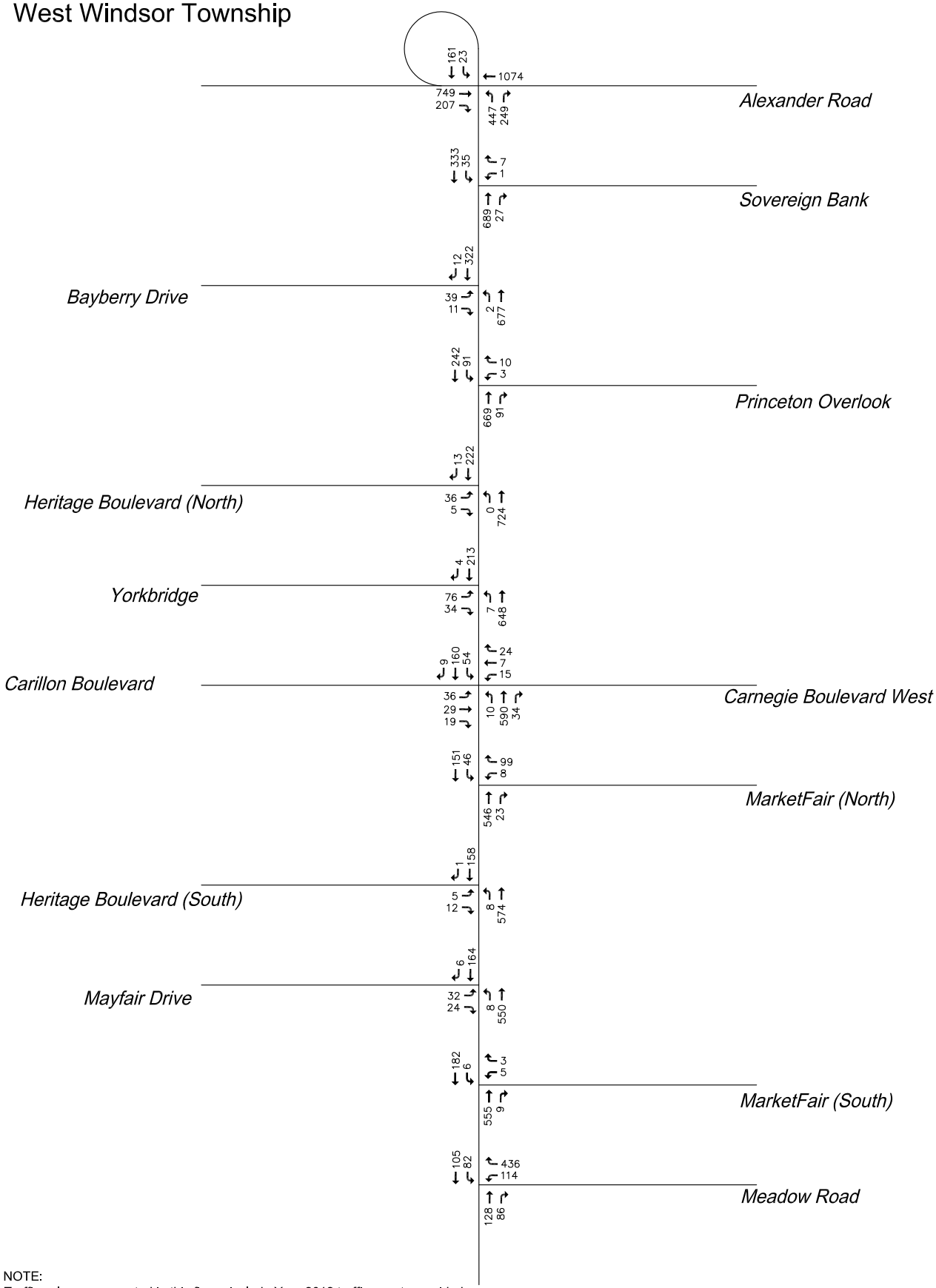
Figure 1

Existing* Weekday Morning Peak Hour Traffic Volumes
Canal Pointe Boulevard Study
West Windsor Township



* NOTE:
Traffic volumes presented in this figure include Year 2012 traffic counts provided by the NJDOT at the Canal Pointe Blvd intersections with Alexander Road, Carnegie Center/Carillon Blvds, and Meadow Road. Volumes at other intersections are per counts conducted by ORA in 2008, augmented to reflect through traffic volume increases observed between the 2008 and 2013 volumes.

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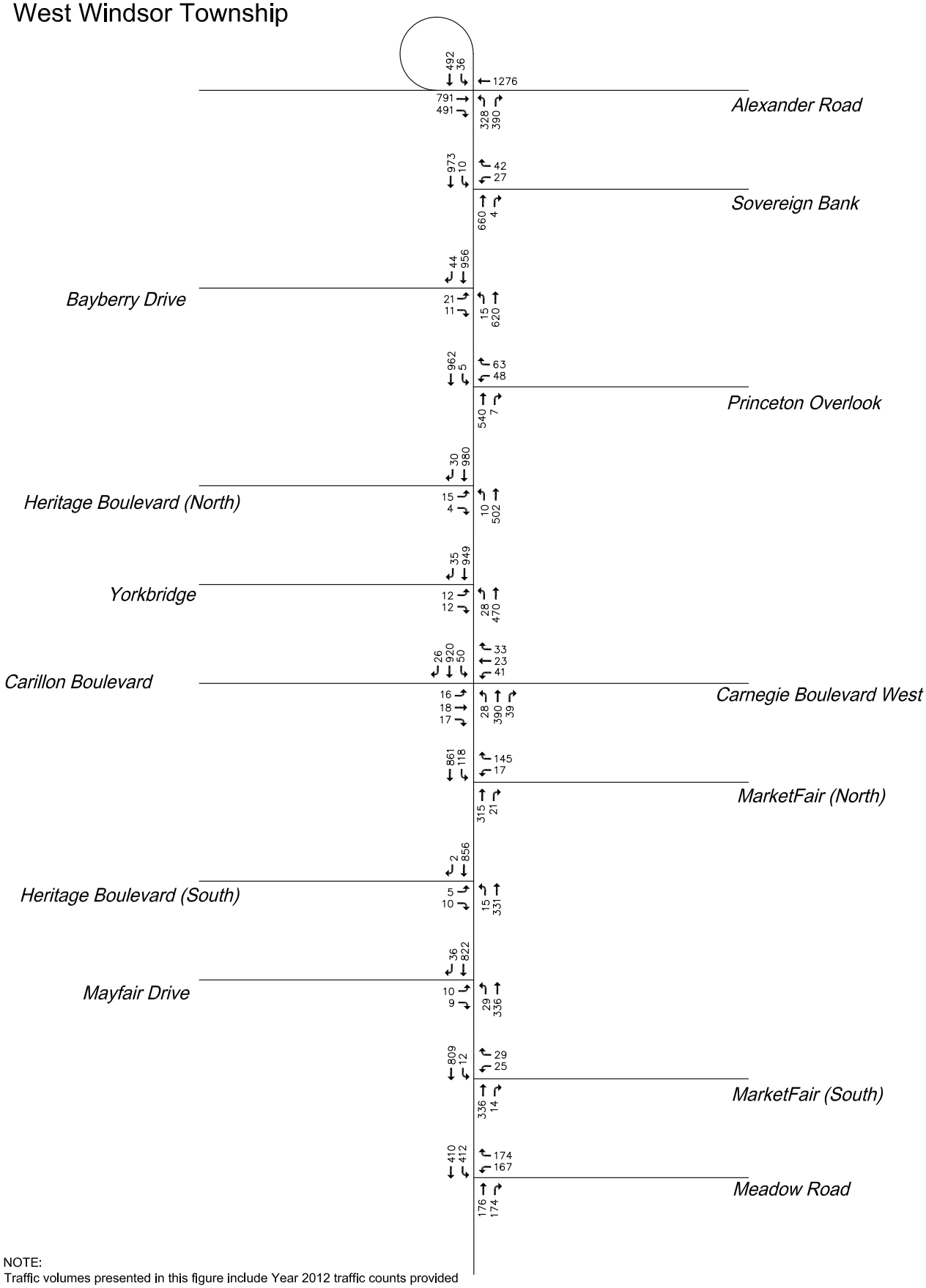
Figure 2

Existing* Weekday Evening Peak Hour Traffic Volumes
Canal Pointe Boulevard Study
West Windsor Township



* NOTE:
Traffic volumes presented in this figure include Year 2012 traffic counts provided by the NJDOT at the Canal Pointe Blvd intersections with Alexander Road, Carnegie Center/Carillon Blvds, and Meadow Road. Volumes at other intersections are per counts conducted by ORA in 2008, augmented to reflect through traffic volume increases observed between the 2008 and 2013 volumes.

Existing Peak Hour Intersection Levels of Service

While traffic volumes provide an important measure of activity on the area road system, evaluating how well that system accommodates those volumes is also important, i.e., a comparison of peak traffic volumes with available roadway capacity. By definition, capacity represents the maximum number of vehicles which can be accommodated given the constraints of roadway geometry, environment, traffic characteristics and controls.

Primarily, intersections control capacity in road networks, since conflicts exist at these points between through, crossing and turning traffic. Because of these conflicts, congestion occurs at intersections. Therefore, intersections are analyzed/studied when determining the quality of traffic flow along a corridor.

Although an unsignalized intersection on a through route is seldom critical to the overall capacity of the through route, it may significantly affect the capacity of the minor cross route and it may influence the quality of traffic flow on both. When analyzing unsignalized intersections, major street through movements and right turns are unimpeded and have the right-of-way over all side street traffic and left turns from the major street. All other turning movements in the intersection cross, merge with, or are otherwise impeded by major street movements.

Traffic delays at unsignalized intersections are determined by sequentially processing these impeded movements. For each impeded movement in turn, all conflicting flows are summed. It should be noted that the *Highway Capacity Manual* (HCM) assumes a random arrival for all the movements, which is not always the case (e.g., an adjacent signal will platoon vehicles).

Since operation at capacity is usually unsatisfactory to most drivers, a descriptive concept has been developed for unsignalized intersections called Level of Service. Level of service relates expected traffic delay to critical movement. Unsignalized levels of service range from Level of Service 'a' (indicating average delays of 10 seconds or less) to Level of Service 'f' (indicating average delays of greater than 50 seconds). Level of Service 'd' is generally considered as the acceptable limit of delay for most drivers in a suburban setting. A more detailed level of service description for unsignalized intersections is summarized in Table 1.

Table 1: Level of Service and Expected Delay for Unsignalized Intersections[2]

Level of Service	Average Total Delay Per Vehicle (seconds)
a	0 to 10.0
b	10.1 to 15.0
c	15.1 to 25.0
d	25.1 to 35.0
e	35.1 to 50.0
f	over 50.0

Note: In this report, the levels of service for signalized intersections are indicated in upper-case type, and the levels of service for unsignalized intersections are indicated in lower-case type.

At the signalized intersections, factors that affect the various approach capacities include width of approach, number of lanes, signal 'green' time, turning percentages, truck volumes, etc. However, operation at capacity can be less than satisfactory since substantial delays or reduced operating speeds are likely. Delays

[2] Transportation Research Board, Highway Capacity Manual, 2000, published by the Transportation Research Board, Washington, D.C., 2000.

cannot be related to capacity in a simple one-to-one fashion. It is possible to have delays in the Level of Service 'F' range without exceeding roadway capacity. Substantial delays can exist without exceeding capacity if one or more of the following conditions exist:

- long signal cycle lengths;
- a particular traffic movement experiences a long red time; or,
- progressive movement for a particular lane group is poor.

Table 2 describes the level of service ranges for signalized intersections.

Table 2: Level of Service and Expected Delay for Signalized Intersections[3]

Level of Service	Average Stopped Delay per Vehicle (seconds)
A	0 to 10.0
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	over 80.0

The existing levels of service and average seconds of delay are presented in Figures 3 and 4 for the weekday morning and evening peak hours, respectively.

As shown in Figure 3, during the morning peak hour, most delays along the corridor are minimal, and levels of service are virtually all at a level of service 'c' or above, with the exception of the westbound left turn from Carnegie Boulevard, which operates at level of service 'd'; and the left turn from Canal Pointe Boulevard onto Alexander Road, which operates at level 'F'. We note that signal timing/phasing modifications can improve all movements to level of service 'D' or better at this intersection.

Figure 4 shows that, during the evening peak hour, delays are generally higher than during the morning peak hour. As during the morning peak hour, the northbound Canal Pointe Boulevard left turn onto Alexander Road operates at level 'F' during the evening peak hour, but timing/phasing revisions could address this. Other movements operating at level 'e'/'f' during the evening peak hour include the eastbound Yorkbridge left turn, all movements on Carillon and Carnegie Center Boulevards, and the westbound Meadow Road left turn.

In summary, delays are minor for all vehicles currently traveling on Canal Pointe Boulevard turning left onto the minor streets and driveways. Delays are somewhat higher for vehicles waiting to turn onto Canal Pointe from side streets and driveways.

[3] Transportation Research Board, Highway Capacity Manual, 2000, published by the Transportation Research Board, Washington, D.C., 2000.

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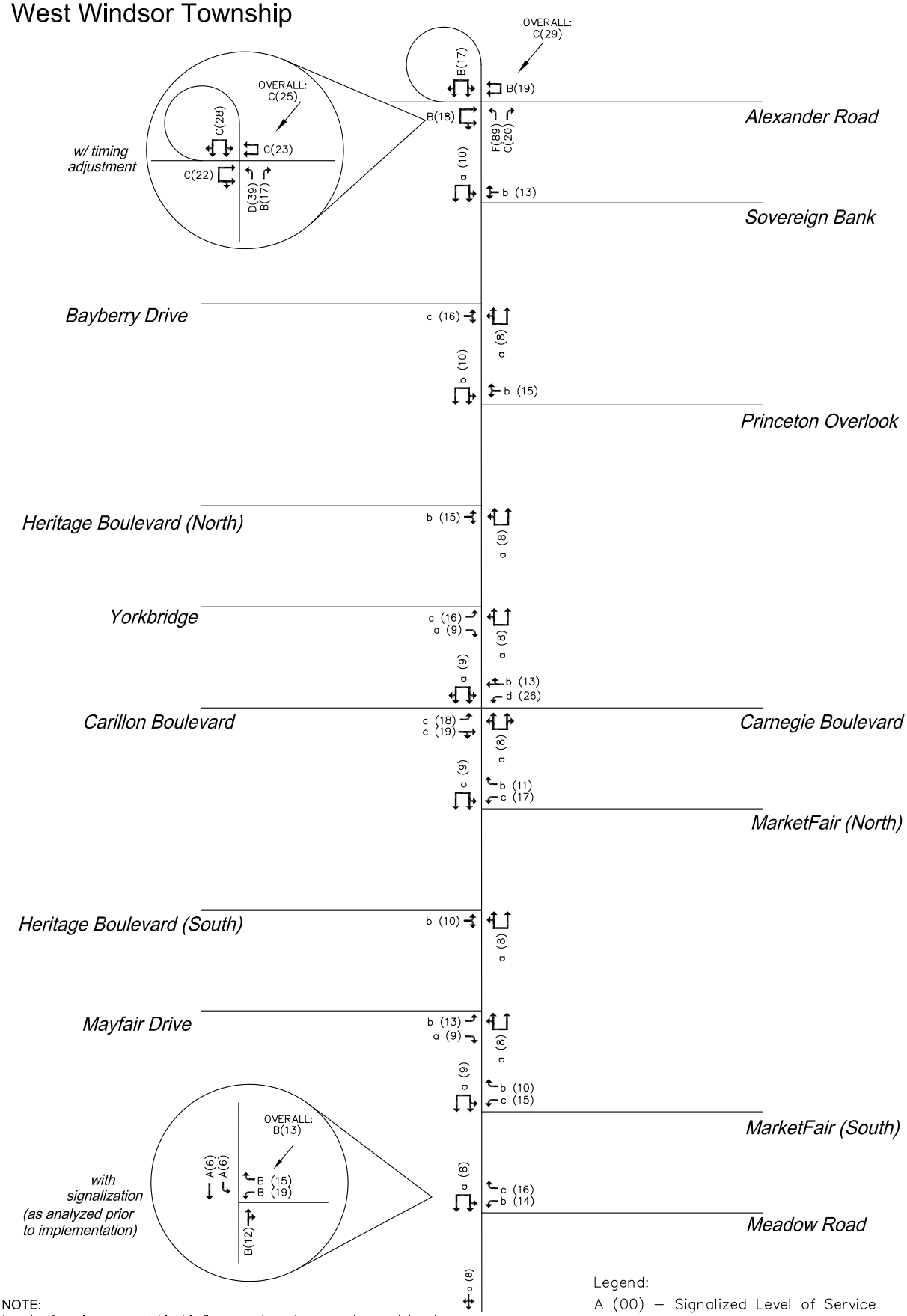
Figure 3

Existing* Weekday Morning Peak Hour Level of Service
Canal Pointe Boulevard Study
West Windsor Township



* NOTE:
Levels of service presented in this figure are based on capacity anaylsis using the traffic volumes presented in Figure 1, which reflect Year 2012 counts conducted by NJDOT at three intersections, and updated 2008 counts at the remaining intersections.

Legend:
A (00) – Signalized Level of Service
(Average Delay per Vehicle in Seconds)
a (00) – Unsignalized Level of Service
(Average Delay per Vehicle in Seconds)

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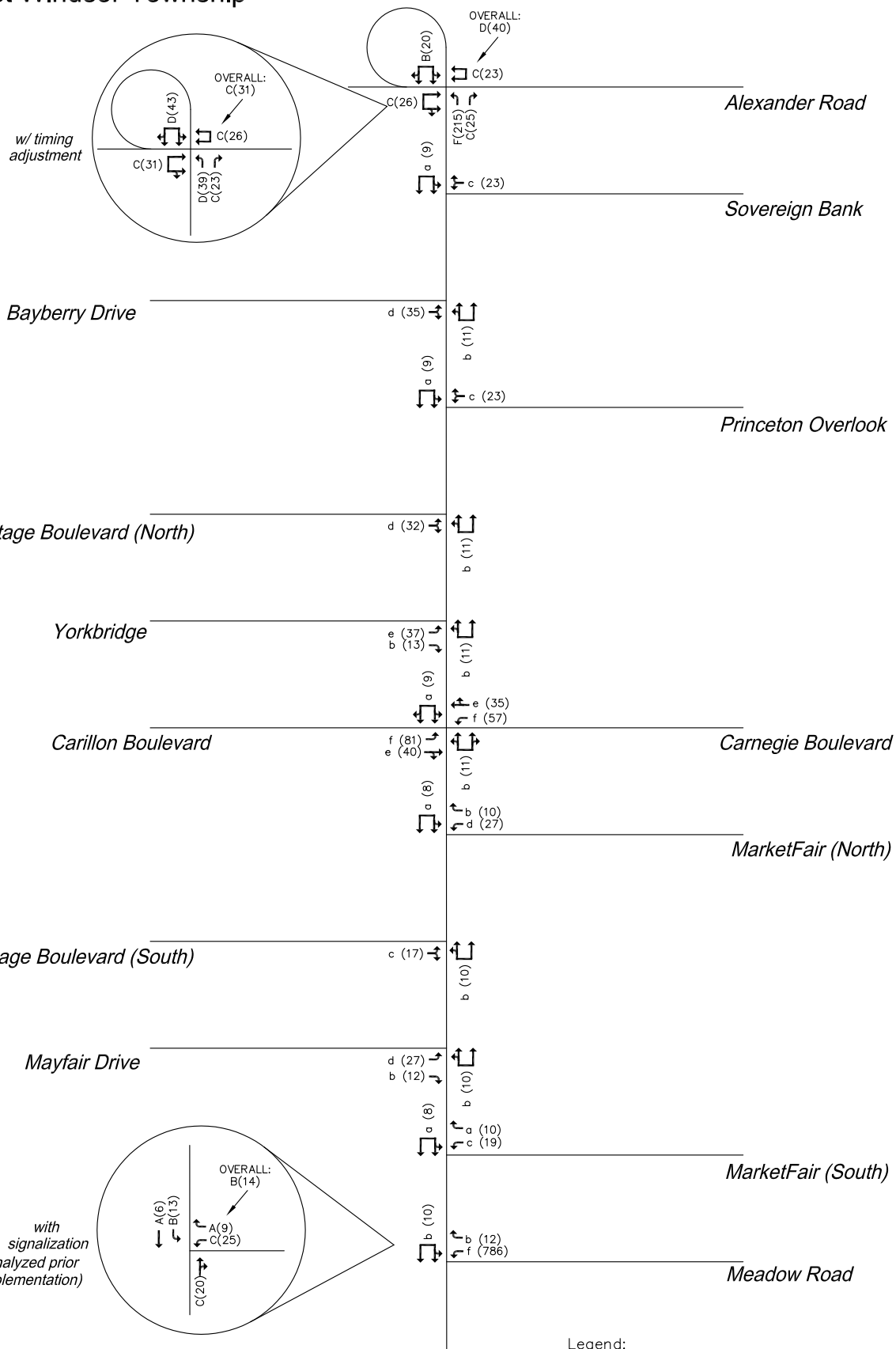
Figure 4

Existing* Weekday Evening Peak Hour Level of Service
Canal Pointe Boulevard Study
West Windsor Township



* NOTE:
Levels of service presented in this figure are based on capacity anaylsis using the traffic volumes presented in Figure 2, which reflect Year 2012 counts conducted by NJDOT at three intersections, and updated 2008 counts at the remaining intersections.

Legend:
A (00) – Signalized Level of Service
(Average Delay per Vehicle in Seconds)
a (00) – Unsignalized Level of Service
(Average Delay per Vehicle in Seconds)

Existing Vehicular Speeds

As part of the 2008 study, vehicular speeds of passing motorists were recorded during the mid-morning on Tuesday, June 10, 2008, and Wednesday, June 11, 2008. They were recorded at two locations: between Heritage Boulevard (south) and Mayfair Drive, and just south of the Santander Bank driveway. At each location, speeds of a total of 100 vehicles were recorded using a radar gun. Following are the results:

South of Santander Bank:

- 50th percentile – 38 mph
- 85th percentile – 42 mph

Between Heritage Boulevard and Mayfair Drive

- 50th percentile – 37 mph
- 85th percentile – 39 mph

As part of the 2012 warrant analysis at Meadow Road, BURNS staff also recorded speeds of vehicles as they passed through that intersection. The 85th-percentile speed observed at this location was 39 mph, relatively consistent with the values observed in 2008 as noted above.

The 50th percentile is the median speed; half of all motorists travel below this speed, and half of all motorists travel above this speed. The 85th percentile speed is that speed exceeded only by 15 percent of motorists, and is a measure often used by traffic engineers. The results indicate that speeding is common along Canal Pointe Boulevard. More than half of all motorists travel above the speed limit.

Many jurisdictions across the country recommend a "traffic calming" program when the 85th percentile speed is 5 mph above the speed limit. By reducing vehicular speeding, a traffic calming program can serve to improve comfort and safety for pedestrians and bicyclists alike. As indicated, the speed between Heritage Boulevard and Mayfair Drive is just below the measure typically used to initiate traffic calming programs, and the speed in the area of Sovereign Bank exceeds this measure.

Year 2008 Evaluation of Crash History (2005 - 2008)

An analysis was undertaken of all vehicular crashes along the corridor from May 14, 2005 to May 15, 2008. The West Windsor Township Police Department provided copies of reports for all crashes that occurred along Canal Pointe Boulevard during this time period. The primary purpose was to identify any "hot spots," or crash clusters that point to underlying geometric, signage or other physical conditions that could be rectified. For certain types of crash histories at unsignalized intersections, signalization is typically investigated as an option. All crashes have been diagrammed, as shown in Figure 5A and 5B.

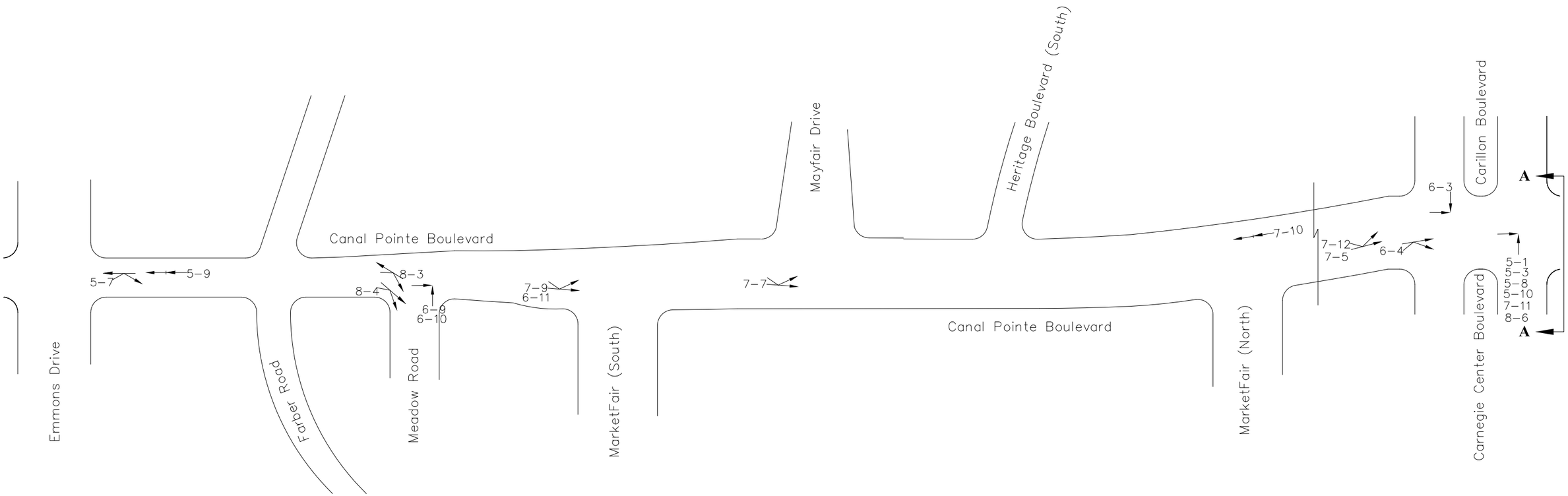
A total of 39 crashes were recorded along Canal Pointe Boulevard in the 2005-2008 study period:

- May 14 to December 31, 2005 – 9
- January 1 to December 31, 2006 – 11
- January 1 to December 31, 2007 – 13
- January 1 to May 15, 2008 – 6

As would be expected, the largest crash clusters occurred at the intersections of Canal Pointe Boulevard with side streets with the heaviest traffic volumes.

- Canal Pointe Boulevard and Alexander Road – 10
- Canal Pointe Boulevard and Carnegie Boulevard/ Carillon Boulevard – 10
- Canal Pointe Boulevard and Meadow Road – 4

At the intersection of Canal Pointe Boulevard and Alexander Road, the predominant crash types were right-angle, with four; and left-turn, with three.



LEGEND:
F.O. - Fixed Object

- Rear End

- Left Turn

- Right Angle

- Side Swipe

Figure 5A

Diagram of Crashes: 5/14/05 to 5/15/08

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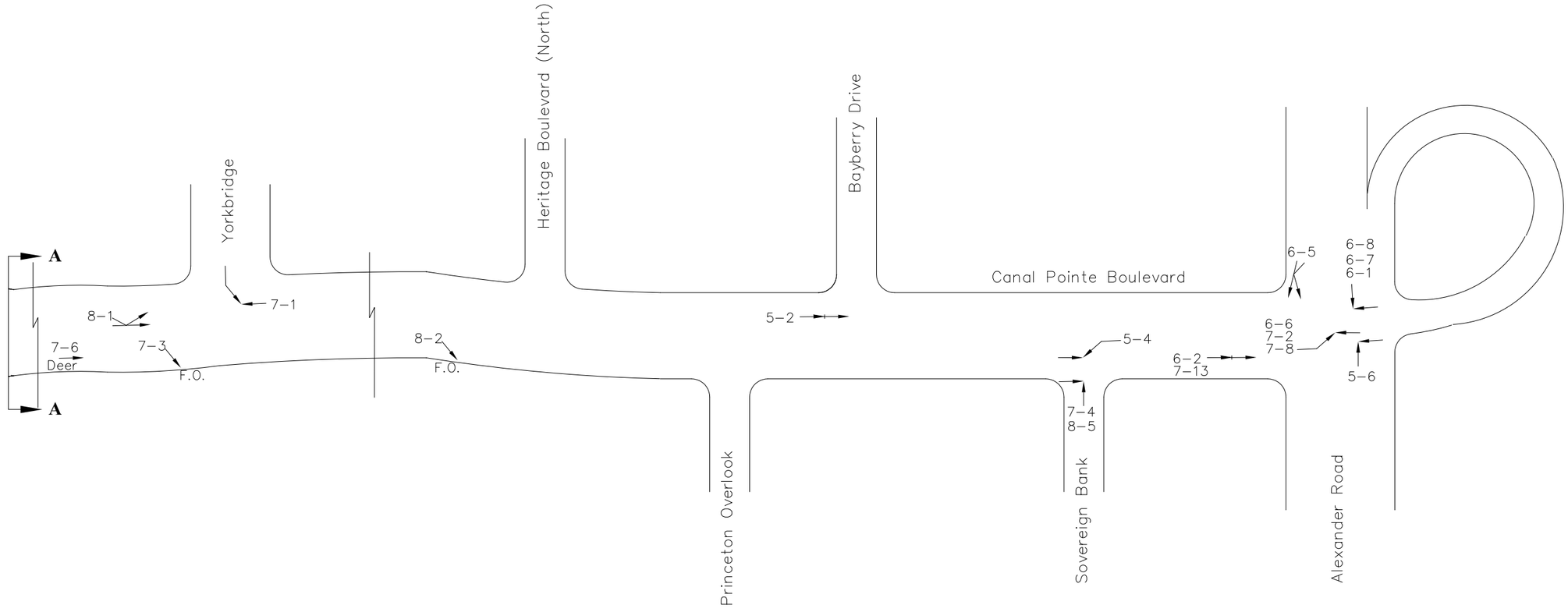
Not to Scale	DWG: Canal_Crash.dwg	Sht 1 of 2
	DATE: 07-02-2008	



LEGEND:
F.O. - Fixed Object

- Rear End

- Left Turn

- Right Angle

- Side Swipe

Figure 5B

Diagram of Crashes: 5/14/05 to 5/15/08

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West Windsor Township

Not to Scale	DWG: Canal_Crash.dwg	Sht 2 of 2
	DATE: 07-02-2008	

At the intersection of Canal Pointe Boulevard and Carnegie Boulevard/ Carillon Boulevard, the predominant crash type was the right-angle, with seven. Of these seven crashes, six involved collisions between westbound vehicles on Carnegie Boulevard and northbound vehicles on Canal Pointe Boulevard. This was the most pronounced pattern of any crashes along the corridor. Four of these crashes occurred in one year alone, 2005. If this pattern had continued or intensified in subsequent years, there would have been reason to consider signalization as a possible countermeasure. However, there was only one right-angle crash with this pattern in 2007, and one in 2008. It is noted that there is vegetation present along most of the intersection corners, and impeded sight distance can be a factor in such crashes. It is further noted that the *2005 High Priority Safety Mitigation Study* (discussed below) recommended reducing the height of the median on Carnegie Boulevard by trimming or reducing vegetation. If action was taken to implement the recommendation of this report, it would make sense that right-angle crashes decreased significantly after 2005.

In terms of crash types along the entire corridor, the predominant type was the right angle crash, with 15; and sideswipes, with 11. Of the sideswipe crashes, seven occurred when one motorist attempted to turn right from the inside lane, or turn left from the outside lane, on the multi-lane section of the roadway.

Year 2013 Evaluation of Crash History (2010-2013)

BURNS was provided with copies of reports for all crashes which occurred along the corridor covering the period from January, 2010 through February, 2013. This 37-month period is roughly equivalent to the three-year period evaluated as part of the 2008 study.

A total of 31 crashes were recorded along Canal Pointe Boulevard in the 2010-2013 study period:

- January 31, 2010 through January 30, 2011 (12 months): 11 crashes
- January 31, 2011 through January 30, 2012 (12 months): 5 crashes
- January 31, 2012 through February, 2013 (13 months): 15 crashes

As with the 2008 crash analysis, the largest crash clusters occurred at or in close proximity to the intersections of Canal Pointe Boulevard with side streets with the heaviest traffic volumes, i.e. Meadow Road (8 crashes) and Carnegie Boulevard / Carillon Boulevard (7 crashes). Other comments on the 2010-2013 crashes are as follows:

- Only three (3) crashes occurred at the Alexander Road intersection from 2010 to 2013, compared with ten (10) from 2005-2008.
- Six crashes occurred at the intersection of Canal Pointe Boulevard with Heritage Boulevard - however, Heritage Boulevard intersects Canal Pointe Boulevard twice, and none of these six reports indicated which intersection was the site of the crash. One report does note the nearby MarketFair access, which identifies it as the southern intersection, but for the remainder it is unclear.
- Of the 31 total crashes on the corridor, 27 (87%) occurred between noon and 11:00 p.m., and 18 of the 31 (58%) occurred between 4:00 p.m. and 8:00 p.m.
- The weather was clear and the roadway surface was dry for 23 of the 31 crashes (74%).

One purpose of this study is to evaluate the feasibility of a 'Road Diet' treatment for the Canal Pointe Boulevard corridor between Alexander Road and Meadow Road. This treatment would create one through travel lane in each direction, a center lane for left turns, and would add bicycle lanes. Based on BURNS's analysis of these 31 crashes, we believe that 13 of these (42%) would be addressed through a 'Road Diet' treatment. This includes 8 same-direction sideswipe crashes, presumably due to narrow lanes; 4 crashes in which a stopped turning vehicle in a through lane either was rear-ended or blocked another driver's visibility; and one crash in which a driver lost control after contacting a snowbank next to the curb.

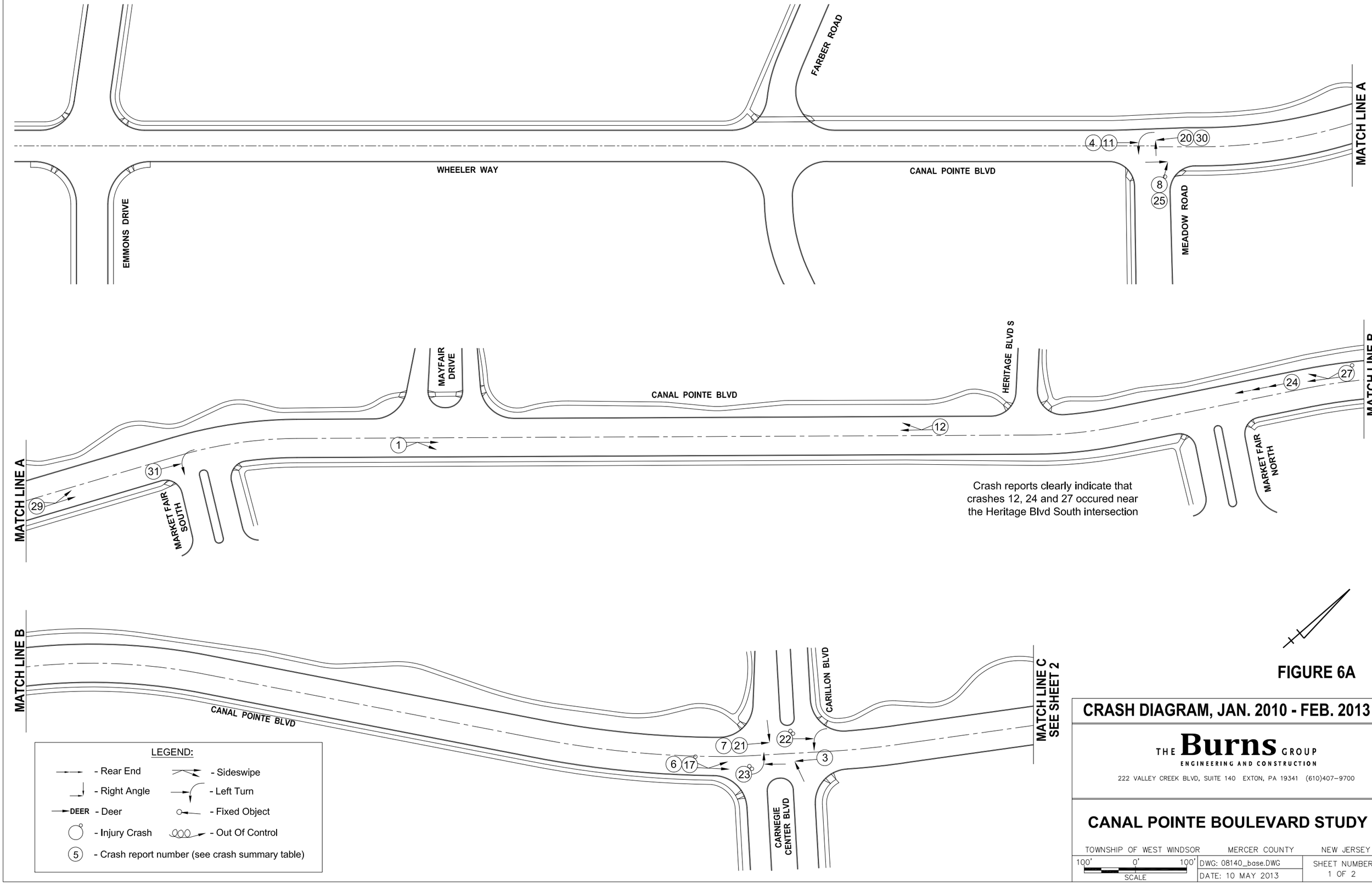

FIGURE 6A

CRASH DIAGRAM, JAN. 2010 - FEB. 2013

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CANAL POINTE BOULEVARD STUDY

TOWNSHIP OF WEST WINDSOR | MERCER COUNTY | NEW JERSEY

100' 0' 100' SCALE

DWG: 08140_base.DWG

DATE: 10 MAY 2013

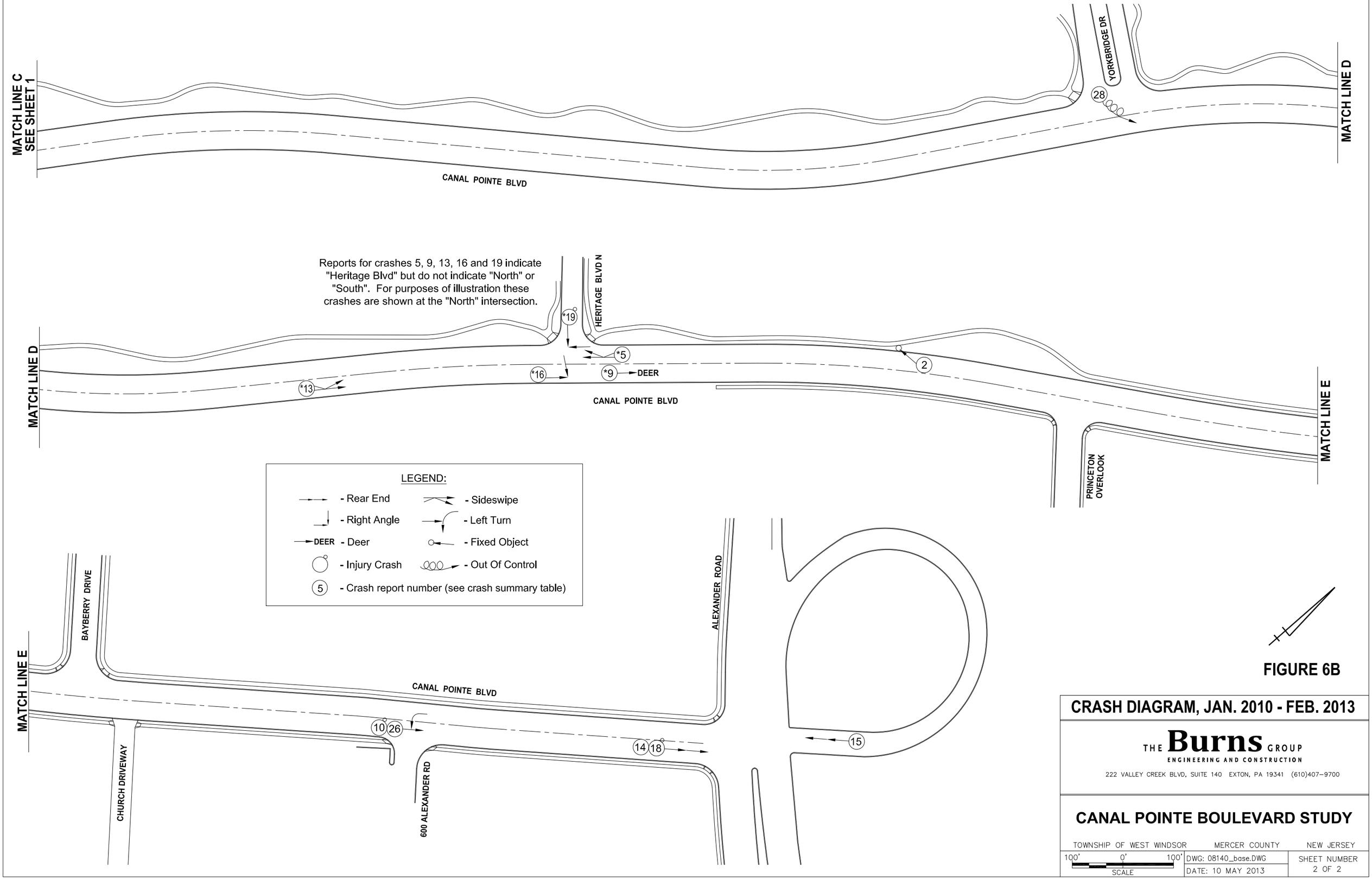

FIGURE 6B

CRASH DIAGRAM, JAN. 2010 - FEB. 2013

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CANAL POINTE BOULEVARD STUDY

TOWNSHIP OF WEST WINDSOR | MERCER COUNTY | NEW JERSEY

100' 0' 100' SCALE

DWG: 08140_base.DWG

DATE: 10 MAY 2013

SHEET NUMBER 2 OF 2

High Priority Safety Mitigation Study

It is noted that vehicular safety along Canal Pointe Boulevard was studied as part of the *High Priority Safety Mitigation Study*, conducted by Urbitran Associates in 2005. That study identified three intersections along Canal Pointe Boulevard as being among the top 15 locations selected for study: Canal Pointe Boulevard and Alexander Road; Canal Pointe Boulevard and Carnegie Boulevard/Carillon Boulevard; and Canal Pointe Boulevard and Meadow Road. The study recommended various measures to mitigate the number of crashes at each location, including signalization at both Carnegie Boulevard and Meadow Road. It appears that some strategies have been implemented, based upon the decline in the number of crashes at the intersections.

Signal Warrant Analysis

Conditions at the intersection of Canal Pointe Boulevard with Carnegie Boulevard/Carillon Boulevard were evaluated to determine if traffic signals are warranted at either location. For this warrant analysis, BURNS used an intersection traffic count conducted by the NJDOT on July 31, 2012; on this day, traffic volumes were collected between 6:30 and 9:30 a.m., and between 3:30 and 6:30 p.m. We note that this count was conducted during the summer, when area schools were not in session, and these volumes, especially during the evening peak hour, are lower than the peak hour volumes presented in Figures 1 and 2. However, for those volumes, only peak hour summaries were presented; the July count was used for this analysis because it provided six full hours of volume information. A separate adjustment for the higher through volumes on Canal Pointe Boulevard is discussed below.

The Manual on Uniform Traffic Control Devices presents eight different warrants, or sets of minimum criteria, which are used to justify the consideration of the installation of a traffic signal. These warrants are listed in the following table, along with a summary of the signal warrant analysis results.

Table 3: Traffic Signal Warrant Analysis, Carnegie/Carillon Boulevard

Warrant 1A: Minimum Vehicular Volume (8-hour)	No
Warrant 1B: Interruption of Continuous Traffic	No
Warrant 2: Four-Hour Vehicular Volume	No
Warrant 3: Peak Hour	No
Warrant 4: Pedestrian Volume	No
Warrant 5: School Crossing	N/A
Warrant 6: Coordinated Signal System	No
Warrant 7: Crash Experience	No
Warrant 8: Roadway Network	No
Warrant 9: Intersection Near Railroad Crossing	N/A

In summary, based on these traffic volumes, it does not appear that this intersection currently satisfies a warrant for installation of a traffic signal. However, it may in the future given potential area development.

As noted above, the peak hour traffic volumes on Canal Pointe Boulevard as presented in Figures 1 and 2 of this report reflect higher volumes than those in the count noted above. However, most of the volume increases, especially during the weekday evening peak hour, are to through movements on Canal Pointe Boulevard. For the most part, however, the major street volume criteria for these warrants are satisfied. The reason that the minimum criteria are not met for the warrants listed in Table 3 is primarily because the minor street volume is too low. We do not observe a significant difference in the approaching volumes on Carnegie Boulevard / Carillon Boulevard between the two sets of data; at least not enough of a difference to project that one or more traffic signal warrants would be satisfied.

A more detailed evaluation of signal warrant analysis for this intersection is presented in the Appendix to this report.

Existing Pedestrian Facilities

Sidewalks are found along most of Canal Pointe Boulevard. They are absent only on the east side of Canal Pointe south of Meadow Road, and on the east side of Canal Pointe, between Carnegie Center Boulevard and Heritage Boulevard (north). The latter section corresponds with the undeveloped tract at the Carnegie Center.

Following is a summary of pedestrian facilities at each intersection:

- Canal Pointe and Emmons Drive – Continental crosswalks on all legs except the eastern leg; curb ramps.
- Canal Pointe and Farber Road – Standard crosswalk on the western leg only; curb ramp on the two western corners.
- Canal Pointe and Meadow Road – No crosswalks; curb ramps on the eastern corners.
- Canal Pointe and MarketFair (south) – No crosswalk; curb ramps on the eastern corners
- Canal Pointe and Mayfair Drive – Continental crosswalk on the northern leg, with "Yield to Pedestrian" stanchion mounted on the centerline. Curb ramps on the western corners.
- Canal Pointe and Heritage Boulevard (south) – No crosswalk; curb ramps on the western corners
- Canal Pointe and MarketFair (north) – No crosswalk; curb ramps on the eastern corners Canal Pointe and Carillon Boulevard/ Carnegie Center Boulevard – No crosswalk; curb ramps present.
- Canal Pointe and Yorkbridge – No crosswalk; curb ramps on the western corners.
- Canal Pointe and Heritage Boulevard (north) – No crosswalk; curb ramps on the western corners.
- Canal Pointe and Bayberry Drive – No crosswalk; curb ramps present.
- Canal Pointe and Alexander Road – Crosswalks badly faded. Pedestrian signal is push-button actuated.

Existing Bicycle Facilities

There are no bicycle facilities along Canal Pointe Boulevard. Recommendations for a roadway compatible with bicycle travel, or specifically designated for bicycle travel, are found in NJDOT *Bicycle Compatible Roadways and Bikeways* (April 1996). For a bicycle-compatible roadway with Canal Pointe Boulevard's traffic volumes and speed (for the four-lane section), this report recommends a 14 ft. shared lane. The outside lanes on the four-lane section are 11 ft. in width. By NJDOT standards, Canal Pointe Boulevard is therefore incompatible for bicycle travel. This is not an indication that Canal Pointe Boulevard is unsafe, or should not be used by bicyclists. Rather, it is an indication that roadway conditions are not ideal for bicyclists. However, Canal Pointe Boulevard (Wheeler Way) is compatible for bicycle travel south of Meadow Road, since only two lanes are provided per direction, and the travel lanes are wider than those found on the four-lane section.

If a specifically designated facility is desired for Canal Pointe Boulevard, this report recommends a 5 ft. wide bike lane.

Pedestrian and Bicycle Activity

Pedestrian activity over the two hours of the 2008 weekday morning count period (7 to 9 AM) and the 2008 weekday evening count period (4 to 6 PM) is depicted in Figure 7. Relatively few pedestrians were recorded crossing Canal Pointe Boulevard in either time period. In the morning, the highest crossing was at Emmons Drive, where a total of 10 pedestrians crossed Canal Pointe. The second highest crossing was at Mayfair Drive, where seven people crossed. Three people were counted crossing Canal Pointe Boulevard at MarketFair (south), and one at MarketFair (north). Individual crossings were also recorded at the Santander Bank driveway, Princeton Overlook, Heritage Boulevard (north), and Meadow Road.

Not surprisingly, pedestrian activity along Canal Pointe Boulevard is much higher on the west side than the east side. On the west side, the highest pedestrian volumes were recorded at Meadow Road, with 30 pedestrians. Pedestrian activity along Canal Pointe was relatively high at Heritage Boulevard north and Yorkbridge, with 25 and 24 pedestrians respectively. Relatively high volumes were also recorded at MarketFair north and Heritage Boulevard south, at 16; Mayfair Drive and MarketFair south, with 12. On the east side, the highest crossings were seen at Meadow Road, Heritage Boulevard south, and MarketFair north, at three each.

In the evening, highest pedestrian volumes across Canal Pointe Boulevard were seen at Emmons Drive, with 20; Mayfair Drive, with 4; and Meadow Road, with 3. Individual crossings were recorded at a few other intersections. Highest activity along Canal Pointe was recorded at Yorkbridge with 31; MarketFair North, 30; and Farber Road, with 22. On the east side in the evening period, the only pedestrian activity observed was below Farber Road.

Bicycling activity along Canal Pointe Boulevard in the two-hour morning and two-hour evening peak period is depicted in Figure 8. In the morning, bicycling activity on Canal Pointe Boulevard was highest on the west side, with up to 7 bicyclists. On the east side, up to 5 bicyclists were recorded in the vicinity of Princeton Overlook.

In the evening, the number of bicyclists typically ranged from 7 to 11 on the west side. Bicycling was lighter on the east side, with 2 to 3 bicyclists present at most intersections with recorded activity. However, it was noted that 7 bicyclists were seen riding on the sidewalk along the east side of Canal Pointe Boulevard, to the MarketFair north driveway.

We note that these 2008 observations of pedestrian and bicycle traffic have not been updated as part of this 2014 update of the traffic report. Based on observations and our understanding of the minimal changes to the land uses along the corridor within the last five years, we believe that these levels of pedestrian and bicycle traffic are still accurate. We note that it is possible that these relatively low levels of pedestrian and bicycle traffic are not evidence of a lack of demand, but rather unwillingness by pedestrians and bicyclists to use/cross the facility in its current configuration.

Transit Facilities

Bus stops are located as follows:

- Southbound side of Canal Pointe Boulevard, north of Heritage Boulevard (north). Signed 600 to Trenton
- Northbound side of Canal Pointe Boulevard south of Heritage Boulevard (north). Signed 600 to Plainsboro.
- Southbound side of Canal Pointe Boulevard north of Carillon Boulevard. Signed 600.
- Northbound side of Canal Pointe Boulevard south of Carnegie Boulevard. Signed 600 and 605.

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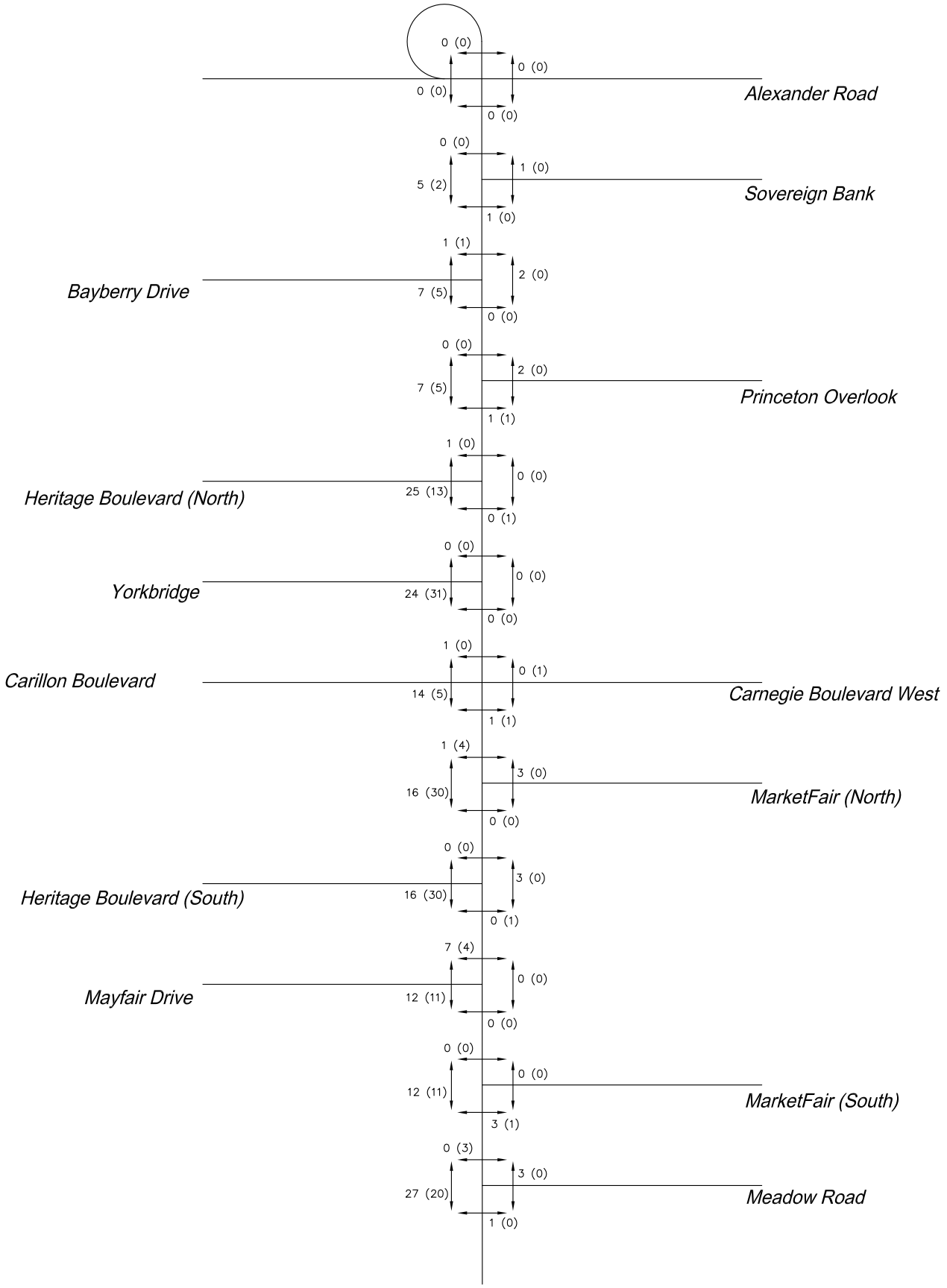
Figure 7

Existing* Weekday Morning and Evening Peak Period Pedestrian Volumes
Canal Pointe Boulevard Study
West Windsor Township



* NOTE:
Pedestrian volumes presented in this figure are volumes as observed through counts conducted by ORA in 2008.

Legend:
(#) – AM Pedestrian (PM) Volumes

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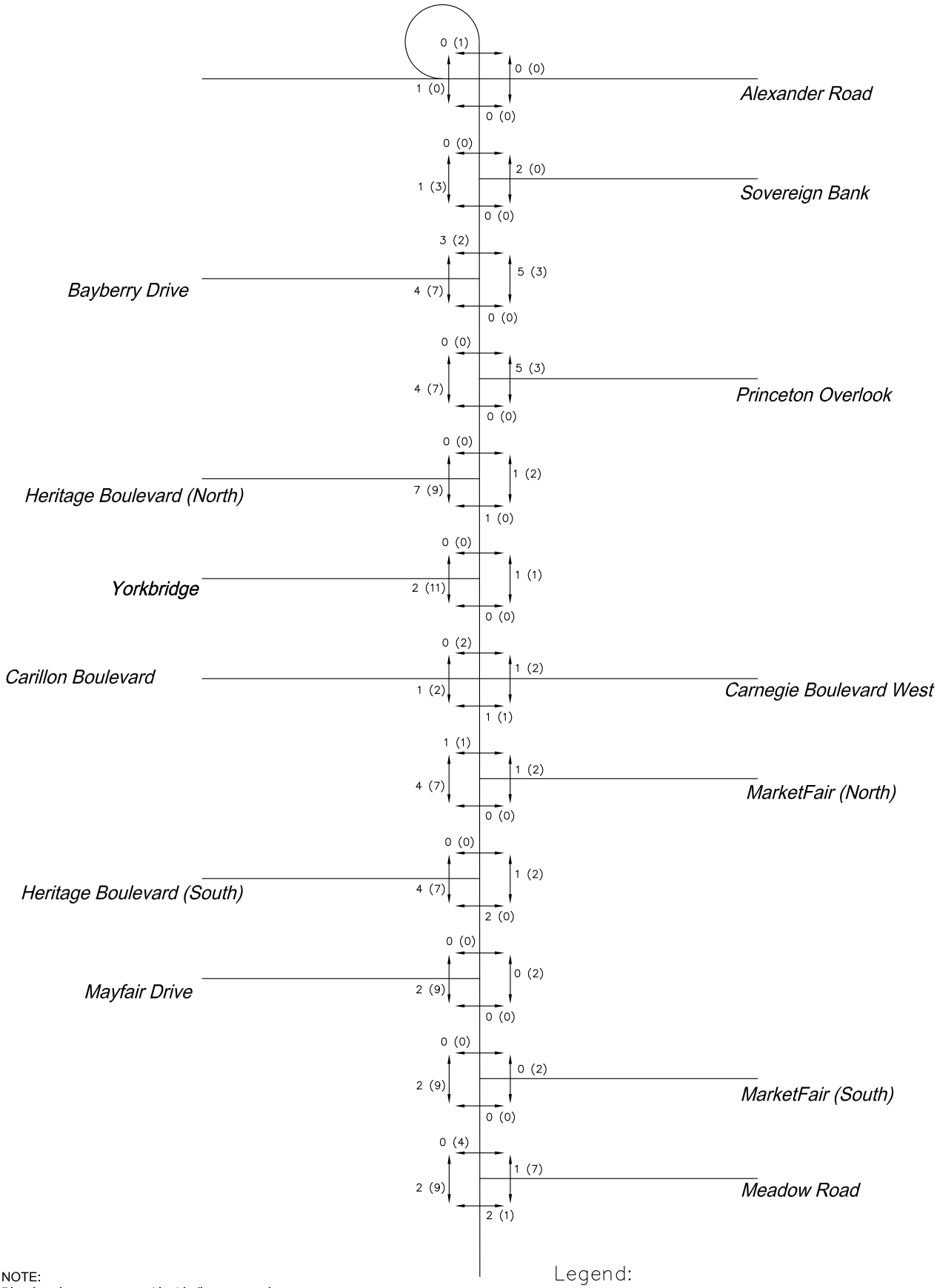
Figure 8

Existing* Weekday Morning and Evening Peak Period Bicycle Volumes
Canal Pointe Boulevard Study
West Windsor Township



* NOTE:
Bicycle volumes presented in this figure are volumes as observed through counts conducted by ORA in 2008.

Legend:
(#) – AM Bicycle (PM) Volumes

FUTURE CONDITIONS

'Road Diet'

A scenario to better accommodate bicyclists riding along Canal Pointe Boulevard, and pedestrians wishing to cross Canal Pointe Boulevard at various locations, is the implementation of a 'Road Diet' treatment. The classic application involves changing a four-lane cross-section to a three-lane cross-section (one through lane in each direction, with a left-turn lane). It is a recommended option for Canal Pointe Boulevard. With the space gained by converting four travel lanes into three travel lanes, it would be possible to install bike lanes on both sides of the roadway. It also reduces the width of the roadway in which crossing pedestrians would be exposed to vehicular traffic.

A number of effects can be predicted from implementing a 'Road Diet'. Vehicular speeding will likely be reduced. Since motorists will no longer be able to increase their travel speed by changing from one lane to another, and will need to stay within a platoon of cars on a regular basis, the "prudent motorist" will control the speed of other motorists.

In this case, the 'Road Diet' would also reduce crossing pedestrians' exposure to approaching vehicular traffic. Pedestrians would only have to cross three lanes of traffic, as opposed to four. We would expect long gaps in bicycle traffic within the 5-foot wide bicycle lanes that could be created immediately adjacent to the curb; occasional bicycles in this lane should not represent a significant impediment to pedestrian crossings. In fact, since New Jersey motor vehicle law considers bicycles to be vehicles, bicycle users would be required to stop for pedestrians in a crosswalk, the same as drivers of motor vehicles.

Another effect that can be predicted is an increase in vehicular delays at the stop-controlled side street approaches to intersections along the roadway. Since two lanes of moving traffic (per direction) would be condensed into a single lane, a 'Road Diet' would essentially serve to reduce the number of available gaps in which motorists on side streets and driveways would be able turn into Canal Pointe Boulevard.

Anticipated Land Use Development

Changes resulting from a 'Road Diet' treatment would also coincide with the continuing increase in traffic generated by planned land uses along, and in close proximity to, the study corridor.

Major planned land uses in the vicinity of Canal Pointe Boulevard anticipated to open within the next five years (i.e., by the year 2018) are listed in the following table.

Table 4: Anticipated Land Uses in the Study Area by Year 2018

Land Use	Description	Size
Carnegie Center Bldg 702, 703 or 704	Office	135,600 s.f.
Carnegie Center Bldg 803 & 804	Office	798,400 s.f.
Carnegie Center Bldg 901	Office	130,000 s.f.
Princeton Overlook	Office	150,000 s.f.
Princeton Theological Seminary	Apartments	400 units
Hilton Garden Inn	Office, hotel, restaurant	150,000 s.f. office 164 room hotel

Trips generated by all of these developments have been assigned to Canal Pointe Boulevard, based on previously conducted studies, and upon BURNS's knowledge of local traffic conditions.

In addition to trips generated by the specific land uses shown in Table 4, trips were added to Canal Pointe Boulevard based on projected "background traffic growth" of 1% per year. This accounts for trips generated by other land uses in proximity to the study area.

Traffic volumes were projected for the year 2018[4]. These projected volumes are illustrated in Figure 9 for the weekday morning and evening peak hours.

Future Peak Hour Levels of Service

Projected traffic volumes were analyzed at six representative intersections along Canal Pointe Boulevard to illustrate future traffic delays and corresponding levels of service that could be anticipated both with and without a 'Road Diet' scenario in place along Canal Pointe Boulevard based on 2018 volume projections. These are the intersections of Canal Pointe Boulevard with:

Alexander Road	Mayfair Drive
Bayberry Drive	Market Fair (South)
Carnegie Boulevard/ Carillon Boulevard	Meadow Road

The results of the analysis of delays and levels of service are shown in Table 5 for these six intersections.

Table 5: Projected Delays with Existing Roadway and 'Road Diet' Scenario

Canal Pointe Boulevard and Alexander Road								
	Peak Hour Level of Service (Delay in Seconds)							
	Year 2013		Year 2018				Year 2018 Road Diet Improvements	
Signal			No-Build		Road Diet			
Movement	AM	PM	AM	PM	AM	PM	AM	PM
NB Left	C (34)	E (73)	D (49)	F (177)	D (47)	F (195)	D (48)	F (130)
NB Right	B (11)	B (16)	B (14)	C (25)	B (14)	C (25)	B (16)	C (35)
SB LT-T	A (9)	B (14)	B (12)	B (11)	B (13)	B (15)	-	-
SB Left	-	-	-	-	-	-	C (31)	C (26)
SB Through	-	-	-	-	-	-	C (36)	F (157)
EB T-R	C (30)	D (47)	D (35)	F (131)	C (34)	F (131)	C (25)	E (73)
WB Through	C (23)	C (26)	C (22)	C (31)	C (22)	C (31)	B (18)	C (25)
Intersection	C (25)	C (34)	C (29)	E (74)	C (29)	E (77)	C (26)	E (68)

Canal Pointe Boulevard and Meadow Road								
	Peak Hour Level of Service (Delay in Seconds)							
	Year 2013		Year 2018				Year 2018 Road Diet Improvements	
Signal			No-Build		Road Diet			
Movement	AM	PM	AM	PM	AM	PM	AM	PM
NB T-R	B (11)	B (19)	C (21)	C (26)	C (21)	C (26)	C (21)	C (26)
SB Left	A (4)	B (12)	A (5)	C (34)	A (5)	C (34)	A (5)	C (34)
SB Through	A (5)	A (7)	A (4)	A (7)	A (4)	A (7)	A (4)	A (7)
WB Left	B (14)	C (21)	B (18)	C (25)	B (14)	C (25)	B (18)	C (25)
WB Right	A (2)	A (2)	B (13)	A (7)	B (13)	A (7)	B (13)	A (7)
Intersection	A (6)	B (12)	B (14)	C (21)	B (14)	C (21)	B (14)	C (21)

[4] BURNS' previous report for this study, prepared in 2008, also included an evaluation of the projected Year 2028 conditions. We will augment this report with an analysis of this scenario if we are provided with updated development projections for that time period and if directed to add this analysis.

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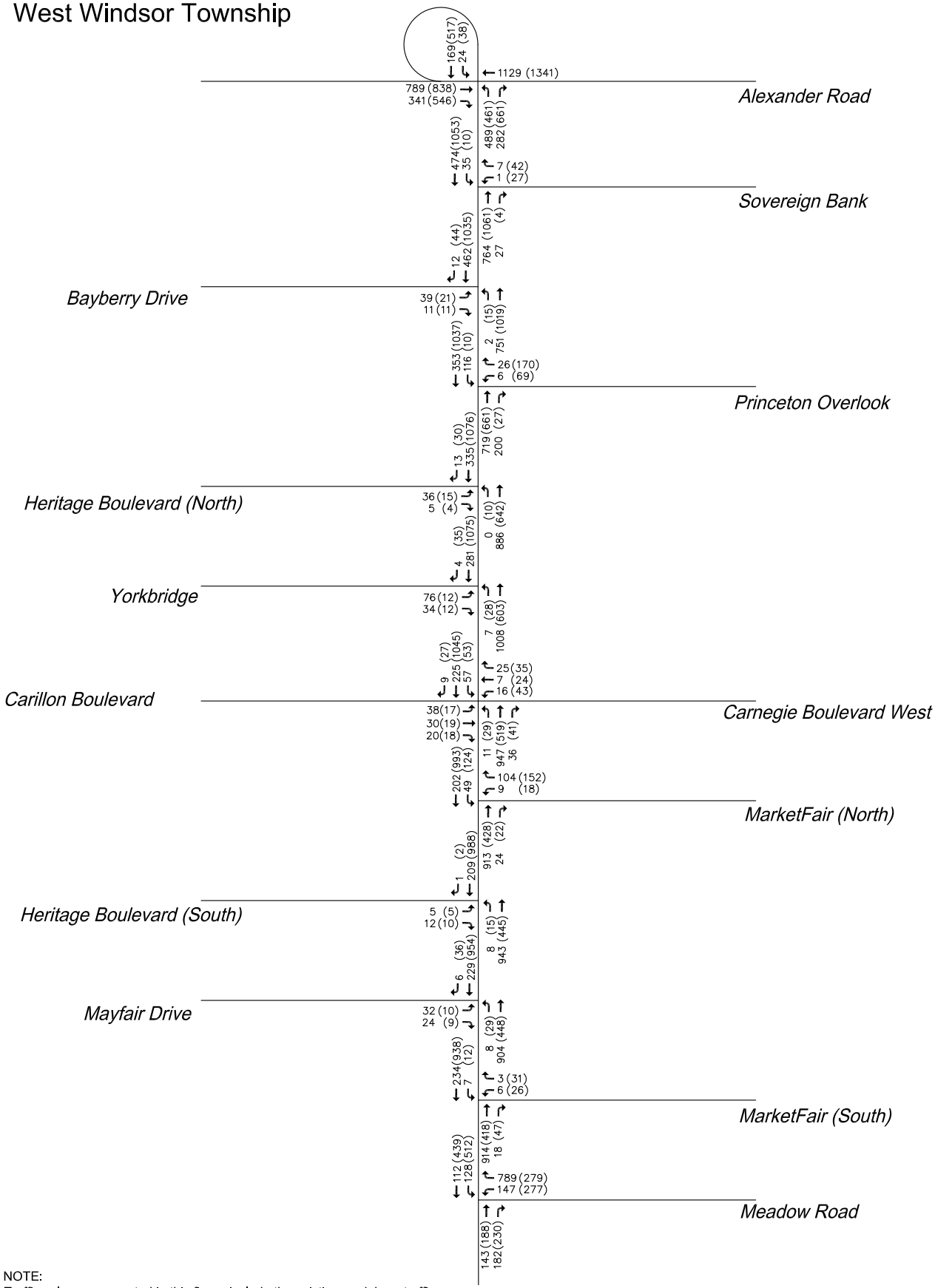
Figure 9

Projected Future Year 2018* Weekday Peak Hour Traffic Volumes
Canal Pointe Boulevard Study
West Windsor Township



AM PEAK/(PM PEAK) TRAFFIC VOLUMES – 789 (277)

* NOTE:
Traffic volumes presented in this figure include the existing peak hour traffic volumes shown in Figure 1, augmented by a 1% per year background growth rate, and projected future traffic volumes from proposed developments including the Hilton Garden Inn, two Carnegie Center buildings (901 and either 702, 703 or 704), and approx. 400 apartment units at the Princeton Theological Seminary.

Table 5 con't: Projected Delays with Existing Roadway and 'Road Diet' Scenario

Canal Pointe Boulevard and Bayberry Drive						
Unsignalized Movement	*Peak Hour Level of Service (Delay in Seconds)*					
	Year 2013		Year 2018 No Build		Year 2018 Road Diet	
	AM	PM	AM	PM	AM	PM
NB Left	a (8)	b (11)	a (9)	b (11)	a (9)	b (11)
EB L-R	c (16)	d (35)	c (20)	f (59)	d (31)	f (153)

Canal Pointe Boulevard and Carnegie Blvd/ Carillon Blvd						
Unsignalized Movement	*Peak Hour Level of Service (Delay in Seconds)*					
	Year 2013		Year 2018 No Build		Year 2018 Road Diet	
	AM	PM	AM	PM	AM	PM
NB Left	a (8)	b (11)	a (8)	b (11)	a (8)	b (12)
SB Left	a (9)	a (9)	b (11)	a (9)	b (11)	a (9)
WB Left	d (26)	f (57)	f (67)	f (134)	f (73)	f (633)
WB T-R	b (13)	e (35)	c (18)	f (62)	d (26)	f (66)
EB Left	c (18)	f (81)	d (30)	f (173)	f (94)	f (311)
EB T-R	c (19)	e (40)	e (36)	f (65)	e (37)	f (76)

Canal Pointe Boulevard and Mayfair Drive						
Unsignalized Movement	*Peak Hour Level of Service (Delay in Seconds)*					
	Year 2013		Year 2018 No Build		Year 2018 Road Diet	
	AM	PM	AM	PM	AM	PM
NB Left	a (8)	b (10)	a (8)	b (11)	a (8)	b (11)
EB Left	b (13)	d (27)	c (17)	e (36)	d (29)	e (43)
EB Right	a (9)	b (12)	a (9)	b (12)	a (10)	c (19)

Canal Pointe Boulevard and MarketFair South						
Unsignalized Movement	*Peak Hour Level of Service (Delay in Seconds)*					
	Year 2013		Year 2018 No Build		Year 2018 Road Diet	
	AM	PM	AM	PM	AM	PM
SB Left	a (9)	a (8)	b (11)	a (9)	b (10)	a (9)
WB Left	c (15)	c (19)	c (25)	c (23)	d (26)	e (43)
WB Right	b (10)	a (10)	b (12)	a (10)	c (18)	b (12)

As is evident from Table 5, certain vehicular delays are projected to worsen under both the "no build" and 'Road Diet' scenarios, although delays will be greater under the 'Road Diet' scenario. The level of service impacts at each of these intersections are described below:

- Alexander Road: The additional build-out added to the traffic projections for 2018 has a significant impact to the operational characteristics of this intersection. Originally reducing the loop road approach to a single lane for the 'Road Diet' does constrain the approach's capacity, specifically during the PM peak.

  The northbound left turn movement is severely constrained without additional phasing and timing. Potential northbound left turn queues of 534' (21 to 27 vehicles) may be observed a few times during the evening peak hour. With operational changes to the intersection, adding a northbound left turn phase and increasing the cycle time to 105 seconds helps to mitigate the delays seen to the northbound left turns while spreading the decreased capacity more equitably and helping to bring down the delays overall compared for the 'Road Diet' scenario without significant signalization improvements.

  The southbound loop approach is significantly affected with the introduction of the northbound left turn phase. What would have been a minimal delay (15 sec/veh) without the added phase, delay of over 150 sec/veh will be created. Because the width is available, it is recommended to reconfigure the left most lane into a left-turn only lane helping to reduce congestion and queuing on this approach.

- Bayberry Drive: The increased development traffic affects the Bayberry Drive approach under both conditions (non-road diet vs 'Road Diet' treatment). Resultant level 'f' operations on the Bayberry Drive approach during the PM peak hour will be experienced with delays just under a minute per vehicle to over two minutes per vehicle, respectively.

- Carnegie Boulevard / Carillon Boulevard: At this intersection, increased volumes will impact the Boulevards approaches even before the road diet is implemented. We note that, if traffic volume increases due to the level of development assumed in the 2018 analysis scenario, a traffic signal may be warranted at this intersection by that time. Signalization of the intersection would bring all levels of service to within acceptable limits, with or without the 'Road Diet' reconfiguration.

- Mayfair Drive: The increased traffic volumes do not significantly impact the Mayfair exiting left turn, but additional delay will be incurred after the 'Road Diet' implementation. The delay would be an additional 12 seconds during the morning and seven seconds during the evening peak hours, respectively.

- MarketFair South: Increased volumes through 2018 will have some impact to the exiting left turn during the PM peak hour. Implementation of the 'Road Diet' will impact the same movement during the PM by increasing delay an additional 20 seconds per vehicle.

It should be noted that the analysis of vehicular delays is conservative in several respects. As noted, the peak hour traffic volumes (especially during the weekday evening peak hour) collected by the NJDOT in August and September, 2012, were significantly higher than those collected by BURNS in 2008, and may have been affected by the Quaker Road construction closure. However, the higher Canal Pointe Boulevard volumes may also address days on which there is an incident on Route 1 that increases the volume due to traffic diversions. Therefore, the NJDOT counts were used at Alexander, Carnegie/Carillon and Meadow intersections along with BURNS's previously counted intersections and we have used these volumes for the analysis.

Furthermore, as land uses build out along the corridor, and volumes increase, it can be anticipated that "peak hour factors" along the corridor will similarly increase. That is, traffic flow during the peak traffic hours will become more consistent. Application of these increased peak hour factors would result in smaller vehicular delays.

Summary and Conclusions

Based on the analysis in this report, BURNS reasons that the potential reconfiguration of Canal Pointe Boulevard as a three-lane facility plus bicycle lanes would have the following benefits:

- Provision of only a single through travel lane in each direction can be expected to reduce overall travel speeds, since one slow vehicle would restrict the speeds of the vehicles following it, whereas under existing conditions those trailing vehicles have the ability to pass.
- Elimination of the four 11-foot wide travel lanes will address the pattern of same-direction sideswipe crashes, as noted in the two separate crash analyses performed by BURNS for this project.
- Provisions of left turn lanes at all intersections will allow turning vehicles to move out of the way of through vehicles, lessening the risk of rear-end crashes. This will also provide better alignment and sight lines for head-to-head left turning vehicles at the Carnegie/Carillon Boulevard intersection. In total, we believe that the 'Road Diet' reconfiguration will reduce crashes on the corridor, based on the patterns observed through the crash analyses.
- The conversion of the roadway from four lanes to three will reduce the exposure of pedestrians to moving traffic, and will reduce the length of time a crossing pedestrian must walk within active travel lanes in order to cross.
- Provision of striped bicycle lanes will significantly improve conditions for cyclists on this roadway, and would therefore fill an important gap in West Windsor Township's bicycle network.

As shown in the traffic analysis, the primary negative aspect of the 'Road Diet' reconfiguration of Canal Pointe Boulevard is the impacts on side street and driveway delays, most notably at the intersections of Alexander Road and Carnegie Boulevard / Carillon Boulevard. However, we note that volumes assumed for this analysis may be somewhat conservative, resulting in overprojections of delay. In addition, if volumes and delays do increase to this level, traffic signal warrants for the Carnegie/Carillon intersection may be satisfied. In fact, with regard to signal warrants, reduction in the number of Canal Pointe Boulevard through travel lanes from two to one per direction reduces the minimum major roadway volume criteria for the warrant analysis.

One additional observation is that the 'Road Diet' treatment is an appropriate measure between two diametrically opposed land uses where roadway users have completely different needs for the corridor. With residents tending to utilize the roadway not only as their gateway to/from their communities, but for direct routing that promotes their own personal day-to-day living seven days a week. The office employees tend to only see the corridor as their commuting route with little thought as to what interactions may occur outside their typical weekday jobs.

This 'Road Diet' will help to promote the actions previously stated (slowing speeds, reducing crashes, providing for other modes of travel) which benefits the residential community without negating the need for accessibility to the office complexes. It can be noted that commuter trips may significantly change since varying accessibility is still available via Brunswick Pike (US Route 1) at Overlook Center, Carnegie Center Boulevard, MarketFair and Meadow Road as well as at little further down at Farber Road and also Emmons Drive.

If the Canal Pointe Boulevard 'Road Diet' helps to regulate the number of motorists using the facility due to the introduced capacity constraints, is shouldn't be considered a substandard design in our opinion.

It is recommended that the 'Road Diet' be implemented as soon as practicably possible to ensure users get the full benefits during this current period before traffic growth and corporate expansion takes place.

Appendix