Utilization of Remote Traffic Monitoring Devices for Urban Freeway Work Zone Assessment

MTC
MIDWEST TRANSPORTATION CONSORTIUM

Final Report
January 2012

SWZDI
Smart Work Zone Deployment Initiative

IOWA STATE UNIVERSITY
Institute for Transportation

Sponsored by
Smart Work Zone Deployment Initiative
Iowa Department of Transportation
Midwest Transportation Consortium
(InTrans Project 06-277)

About SWZDI

Iowa, Kansas, Missouri, and Nebraska created the Midwest States Smart Work Zone Deployment Initiative in 1999 and Wisconsin joined in 2001. Through this pooled-fund study, researchers investigate better ways of controlling traffic through work zones. Their goal is to improve the safety and efficiency of traffic operations and highway work.

About the MTC

The Midwest Transportation Consortium (MTC) is a Tier 1 University Transportation Center (UTC) that includes Iowa State University, the University of Iowa, and the University of Northern Iowa. The mission of the UTC program is to advance U.S. technology and expertise in the many disciplines comprising transportation through the mechanisms of education, research, and technology transfer at university-based centers of excellence. Iowa State University, through its Institute for Transportation (InTrans), is the MTC's lead institution.

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16. Abstract

The objective of this project was to promote and facilitate analysis and evaluation of the impacts of road construction activities in Smart Work Zone Deployment Initiative (SWZDI) states.

The two primary objectives of this project were to assess urban freeway work-zone impacts through use of remote monitoring devices, such as radar-based traffic sensors, traffic cameras, and traffic signal loop detectors, and evaluate the effectiveness of using these devices for such a purpose. Two high-volume suburban freeway work zones, located on Interstate 35/80 (I-35/I-80) through the Des Moines, Iowa metropolitan area, were evaluated at the request of the Iowa Department of Transportation (DOT).

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UTILIZATION OF REMOTE TRAFFIC MONITORING DEVICES FOR URBAN FREEWAY WORK ZONE ASSESSMENT

Final Report
January 2012

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The authors would like to thank the Iowa Department of Transportation (DOT), the Smart Work Zone Deployment Initiative (SWZDI)**,** and the Midwest Transportation Consortium (MTC) for sponsoring this research.

OVERVIEW

The two primary objectives of this project were to assess urban freeway work-zone impacts through use of remote monitoring devices, such as radar-based traffic sensors, traffic cameras, and traffic signal loop detectors, and evaluate the effectiveness of using these devices for such a purpose. Two high-volume suburban freeway work zones, located on Interstate 35/80 (I-35/I-80) through the Des Moines, Iowa metropolitan area, were evaluated at the request of the Iowa Department of Transportation (DOT).

This report is organized into two primary sections:

- Suburban Freeway Capacity Reduction with Ramp Closures
- Suburban Freeway Ramp Closures with Local Detour

The two sections and two associated appendices (A and B) focus on each work zone project independently. Each report section covers the following areas:

- Nature of the construction activity and work zone
- Assessment objective and metrics
- Data sources available for work zone assessment
- Data utilization, including assimilation, reduction, and integration
- Assessment results, including general experience using the remote data sets

The appendices provide images and summary data for each location in these work zones at a more detailed level.

SUBURBAN FREEWAY CAPACITY REDUCTION WITH RAMP CLOSURES

Work Zone Overview

The work zones of interest were located on east and westbound Interstate 35/80 in the northern Des Moines metropolitan area. Construction activities, during fall 2008, included removal and replacement of several bridge approach sections at six locations (Figure 1) within a six-mile section of freeway:

- Merle Hay Road (Iowa Highway 28)
- 2nd Avenue (Iowa Highway 415)
- Northeast 3rd Street
- East 4th Street (US Highway 69)
- Two railroad bridges

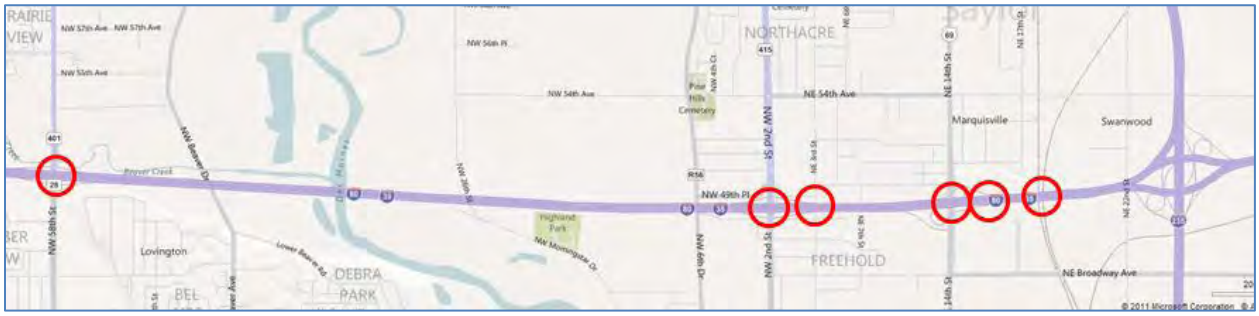


Figure 1. I-35/I-80 site map (Bing Maps n.d.)

At each site, traffic was reduced from three to two through lanes in each direction of travel. Lanes were shifted both to the inside and outside lanes (existing outside and shoulder) at various stages during construction, and a combination of portable concrete barriers and standard channeling devices were used in the work zones.

Speeds were reduced from 65 mph to 55 mph. Three entrance ramps were also closed during part of the construction: eastbound 2nd Avenue and both eastbound and westbound East 14th Street. Average annual daily traffic (AADT) on these ramps was approximately 3,900, 2,500 and 3,600, respectively.

The western most bridge (Merle Hay Road) was about 3.5 miles from the nearest bridge to the east. Three through lanes of traffic were maintained in each direction of travel between these bridges. The annual average traffic volume along this section of the freeway was approximately 87,000 AADT.

The other five bridges were located within two miles of each other. The bridges at 2nd Avenue and Northeast 3rd Street were within one-half mile of each other and one-half mile of the three eastern-most bridges.

The three eastern-most bridges were within 0.8 mile of each other and one-third mile from the Interstate 35/80/235 interchange.

AADT among the five eastern-most bridges ranged from approximately 69,000 to 76,000.

Construction was scheduled in two stages over 20 working days, with work occurring during peak periods. At times, during pavement curing, workers were not present in the work zone. To avoid delays, the Iowa DOT recommended that motorists find alternative routes during construction. A formal detour, which included both local and state-maintained roadways, was provided for the ramp closures.

Work Zone Assessment Objectives

The Iowa DOT currently assumes a capacity of 1,350 passenger cars per hour per lane (pc/h/ln) for freeway work zones with lanes closures, which is more conservative than the Transportation Research Board (TRB) *Highway Capacity Manual 2000,* which recommends 1,600 pc/h/ln for short-term freeway work zones and 1,860 vehicles per hour per lane (veh/hr/ln) for long-term construction zones (TRB 2000).

As noted previously, a combination of portable concrete barriers and standard channeling devices were used in this project, indicative of both long- and short-term work zones, respectively. The DOT identified volume (throughput) as the primary mobility performance measure of interest, particularly with respect to their assumed capacity. Performance of this work zone would serve as a frame of reference in planning future high volume, urban/suburban freeway projects.

Data Sources

As part of the Iowa DOT Des Moines area Intelligent Transportation System (ITS) deployment, also known as tripGuide™, a system of 43 closed circuit television cameras (Figure 2 and Figure 3) and 68 Wavetronix SmartSensors™ (Figure 4, Figure 5, and Figure 6) were installed on four routes within the area.

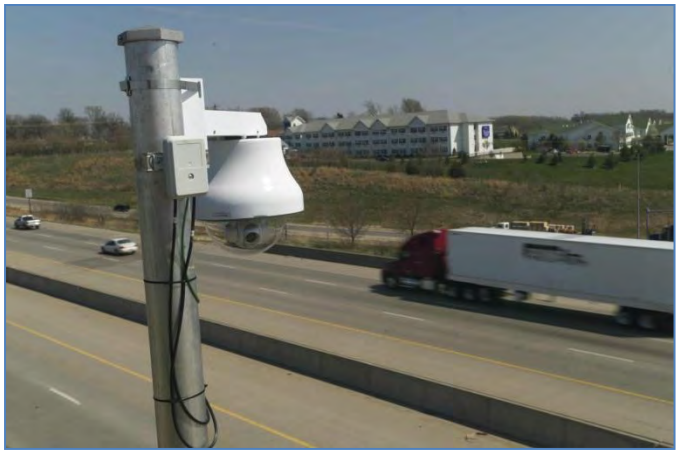


Figure 2. tripGuide camera (Iowa DOT n.d.)

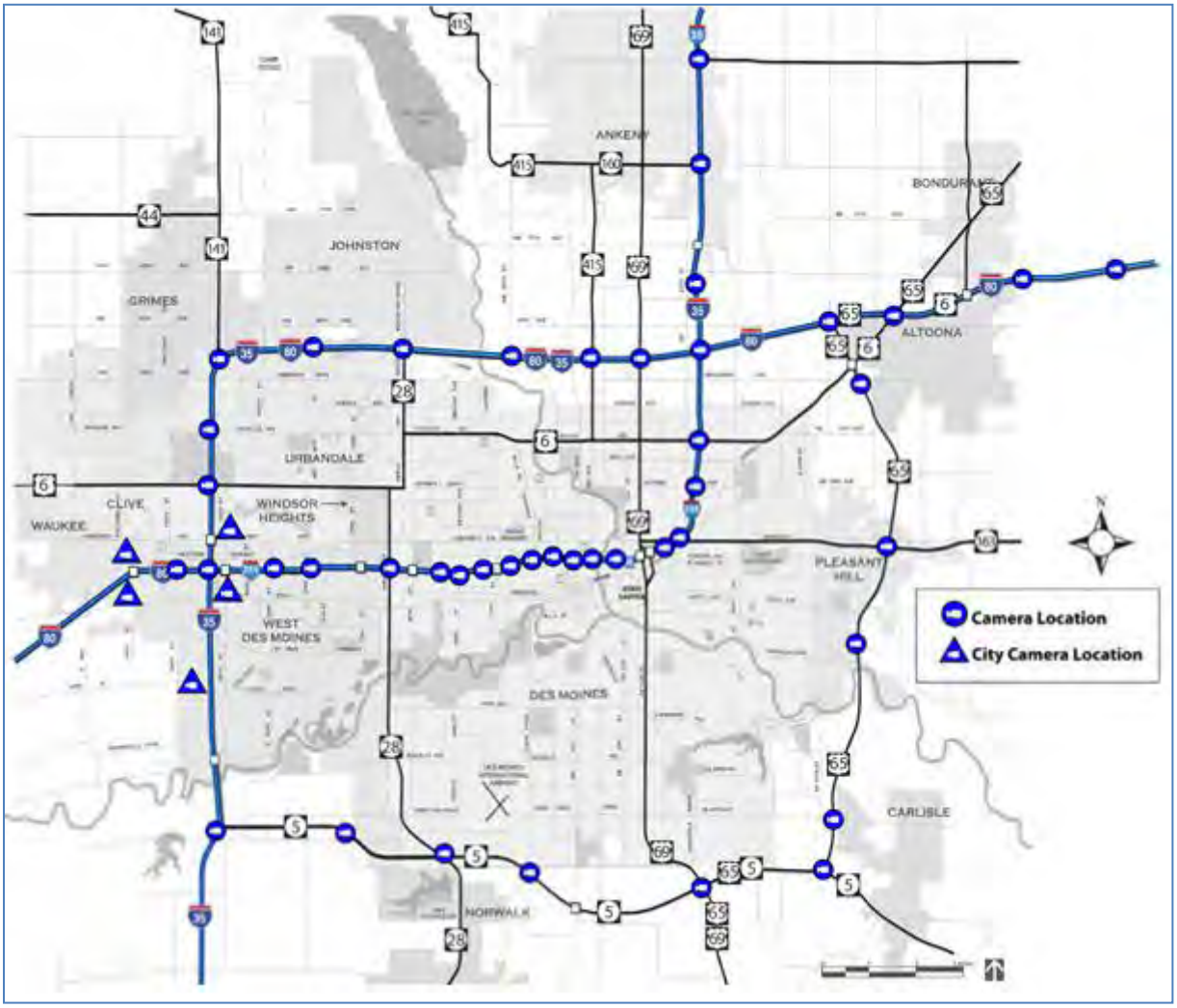


Figure 3. tripGuide camera locations (Iowa DOT n.d.)

Figure 4. Wavetronix SmartSensor (Iowa DOT n.d.)

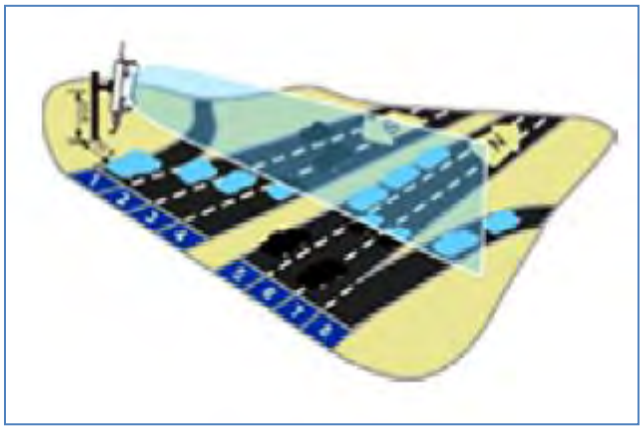


Figure 5. Wavetronix SmartSensor operation (Iowa DOT n.d.)

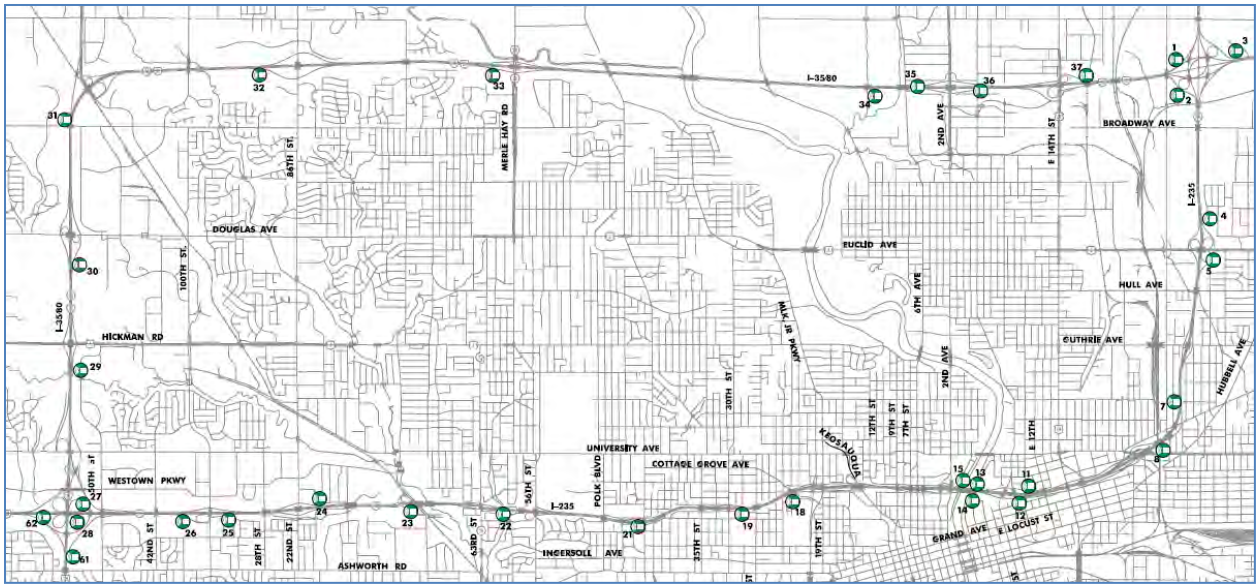


Figure 6. Wavetronix SmartSensor locations (Iowa DOT 2008)

The cameras transmit live video images (at a rate of 10 frames/sec) to authorized operators, who also have the ability to control the cameras remotely, including pan, tilt, and zoom. Static images, refreshed every 60 seconds, are available at a publicly-accessible web site (http://www.511ia.org/DM_Metro_tripGuide.asp) (Iowa DOT n.d.).

At the time of this project, still images were automatically archived within the Iowa DOT for a period of 24 to 48 hours, after which they were removed from the system automatically. Remote operators can archive video manually for a 15 minute interval (maximum) on a camera-by-camera basis, with no automated functionality available.

Three cameras were located within the I-35/80 work zone (Merle Hay Road, East 14th Street, and 2nd Avenue) facilitating the capture of traffic flow in the work areas.

The Wavetronix SmartSensors^{TM} utilize side-firing radar to measure vehicle presence, volume, occupancy, and speed in up to eight lanes of traffic. Summary volume, speed, occupancy, and class (small, medium, and large) data are presented in 15 minute bins by lane.

Class data are based on user-defined maximum, small, and medium vehicle lengths. Wireless communications protocols deliver these data to a central repository within the Iowa DOT for automated presentation of speed data on the tripGuide website. (Iowa DOT n.d.) At the time of this project, these data had to be manually archived and exported for future analysis.

Five sensors were located within the work zone areas to facilitate the capture of traffic flows. Examples of sensor positions (from MVDS33) are shown in Figure 7. All other sensor locations are presented in Appendix A.

- MVDS33 – eastbound to Merle Hay Road (Figure 7)
- MVDS34 – eastbound West to 2nd Avenue (Figure 27)
- MVDS35 – eastbound to 2nd Avenue (Figure 28)
- MVDS36 – eastbound from 2nd Avenue (Figure 29)
- MVDS37 – westbound to East 14th Street (Figure 30)

Figure 7. MVDS33 – eastbound to Merle Hay Road

All sites, except MVDS34 (Figure 27), consisted of three through lanes and an entrance/exit ramp in each direction of travel. MVDS34 was comprised entirely of through lanes.

Use of the sensor-based traffic volume data in this project represented an early attempt to utilize data beyond the speed data presented dynamically on the tripGuide website. Sensor data were archived manually under normal (non-work-zone) conditions to assess the typical operating characteristics of the sites.

Data Utilization

Traffic Sensors

Sensor data were archived manually, for varying time periods, and exported by Iowa DOT personnel for nearly 29 days before, during, and after the work zone presence. These data were provided in text file format with a two-line header separating the data for each sensor (Figure 8). Each row following the header represented summary data for a specific date, time (in 15 minute bins), and lane combination for the sensor.

IPAddress:Port	Location			Description		
xxx.xx.xx.xx:xxxx	MVDS34			I-35/80 EB WEST of 2nd AVENUE		
Timestamp	Lane	Volume	Speed	Occupancy	Class_S	Class_M	Class_L
2008-09-22 13:15:00	1	378	58.8	10.8	76.4	10.0	13.4
2008-09-22 13:15:00	2	248	68.6	6.2	67.7	23.7	8.4
2008-09-22 13:15:00	3	57	28.9	2.5	54.3	35.0	10.5
2008-09-22 13:15:00	4	214	77.0	6.4	33.6	51.3	14.9
2008-09-22 13:15:00	5	334	73.8	12.3	33.1	33.5	33.1
2008-09-22 13:15:00	6	234	72.1	9.0	35.0	34.1	30.7
2008-09-22 13:30:00	1	373	59.1	10.6	78.2	10.4	11.2
2008-09-22 13:30:00	2	228	69.6	6.0	65.3	24.9	9.6
2008-09-22 13:30:00	3	49	27.0	1.7	67.3	22.4	10.2
2008-09-22 13:30:00	4	237	77.0	7.5	33.7	46.8	19.3
2008-09-22 13:30:00	5	348	74.9	13.2	30.9	35.2	33.5
2008-09-22 13:30:00	6	238	72.7	9.4	23.9	43.2	32.7
2008-09-22 13:45:00	1	379	59.9	11.0	75.9	13.1	10.7
2008-09-22 13:45:00	2	249	65.2	6.4	70.2	22.4	7.2
2008-09-22 13:45:00	3	52	24.7	2.4	59.5	36.5	3.8
2008-09-22 13:45:00	4	239	75.9	7.2	45.1	38.4	16.2
2008-09-22 13:45:00	5	330	73.7	13.8	27.5	36.0	36.3
2008-09-22 13:45:00	6	239	70.8	9.5	33.0	40.5	26.3

Figure 8. Sensor data format

Given the data format (header included sensor location and no explicit sensor reference on each row), the data could not be integrated automatically into a database for aggregation and reduction. Therefore, procedures were developed to remove the headers and associate the location information with each row.

Data were then imported into a Microsoft Access database. Once completed, queries were used to aggregate data by location for several different factors, such as time period or interval, lane, and lane combinations. Given the Iowa DOT's interest in the throughput of the work zone, analysis focused on lane volume.

Hourly volumes were evaluated at each of the sensors for each lane independently, for through lanes (by direction of travel), and for all lanes (by direction of travel). The following hourly volumes were computed:

- Maximum
- Average morning (two-hour) peak – from 7:00 am to 9:00 am
- Average afternoon (two-hour) peak – from 4:00 pm to 6:00 pm

An important consideration in aggregating the volume data to an hourly basis was the presence of data in each of the contributing bins. In other words, if null values were present for one or more of the bins, the resulting hourly volumes were inaccurate and did not represent the entire period. These volumes were disregarded.

Unfortunately, incomplete volume data were found prominently throughout the data sets. Of the nearly 700 hourly volumes aggregated for each sensor in the work zone, only five percent, or fewer, were usable.

In some cases, lane shifts within the work zone were outside of the existing lane configurations for the sensors, or transitions were located at the sensors. One would expect no volume data for

such locations. However, at least one lane within the existing sensor configuration was often utilized through the work zone. Incomplete or no data were provided for these lanes as well.

Given the limited usable volume data, assessment of throughput within the work zone, even on a single-lane basis, could not be accomplished successfully. Any valid volume data for the month-long data collection period were assimilated and the results are presented in Table 1.

Table 1. Sensor-based hourly volumes

Sensor	Dir	Ramp		Through Lanes										All Lanes
				Outside			Middle			Inside			All	
		Type	Max VPH	Max VPH	AM Peak (Ave VPH)	PM Peak (Ave VPH)	Max VPH	AM Peak (Ave VPH)	PM Peak (Ave VPH)	Max VPH	AM Peak (Ave VPH)	PM Peak (Ave VPH)	Max VPH	Max VPH
MVDS33	EB	Exit	881	630	471	580	1,331	994	1,274	1,553	873	1,490	3,494	4,301
	WB	Ent	805	1,506	1,286	1,253	1,547	1,163	922	2,083	1,297	1,969	3,858	5,390
MVDS34	EB	-	-	2,160	1,027	1,303	1,856	1,144	1,493	1,765	734	983	4,819	4,819
	WB	-	-	1,388	443	562	1,875	988	1,157	2,137	1,401	1,541	5,322	5,322
MVDS35	EB	Exit	1,713	1,723	753	851	1,911	997	1,282	1,470	826	1,047	4,767	6,478
	WB	Ent	759	1,457	1,028	1,192	1,130	624	644	1,178	296	364	2,702	3,232
MVDS36	EB	Ent	883	1,316	343	860	1,351	277	818	755	186	453	3,422	4,239
	WB	Exit	795	1,403	497	1,013	1,025	357	649	160	26	105	2,560	3,355
MVDS37	EB	Ent	347	1,000	303	575	1,646	384	987	1,331	278	745	3,977	4,324
	WB	Exit	125	750	221	487	1,277	412	862	981	321	628	3,008	3,115

While these data may not provide an accurate perspective of the operating characteristics of the sites, they were collected using standard, systematic protocol for all analysis periods.

The data presented for sensors MVDS33, MVDS36, and MVDS37 represent less than two percent of the total hourly intervals collected. Three to five percent of the possible hourly volumes are presented for the remaining two sensors.

The maximum hourly volume of the three through lanes (in either direction) ranged from approximately 2,600 to 5,300. The maximum hourly volume for any one through lane was nearly 2,200, with the maximum peak average hourly volume of 2,000.

Assuming these volumes represented normal conditions, and if no diversion of traffic occurred during construction, the maximum capacity that each of the work zone through lanes would need to accommodate would be 1,300 to 2,700 vehicles per hour (VPH) or an average maximum of 1,900 VPH, depending on the location. This estimate also assumes that the two through lanes within the work zones must accommodate the existing demand for the three through lanes.

This maximum average is near the HCM 2000 observed average of 1,860 veh/h/ln for a three- to two-lane reduction in long-term construction zones. However, it is approximately 500 veh/h/ln greater than the Iowa DOT's assumed capacity.

Traffic Cameras

The poor quality of the traffic volume sensor data led the research team to consider and use the fixed video cameras along the corridor to collect volume data. Video, in Audio Video Interleave (AVI) format, was captured from the three traffic cameras within the work zone for different directions of travel, times of day, and work zone configurations.

As mentioned previously, video capture was initiated manually and terminated on a camera-by-camera basis. The nature of this process, and the later video reduction, limited the extent of observations. The locations and situations during which traffic data were captured are shown in Table 2.

Table 2. Traffic camera video collection

Observation ID	Location	Camera Direction	Duration (Min)	Date	Time of Day	Weather Conditions	Work Zone Activity	Through Lanes Observed/Open		
								EB	WB	Position
1	Merle Hay Road	WB	12	9/9/2008	15:03	Clear	Present	2	2	Outside
2	Merle Hay Road	EB	12	9/11/2008	12:00	Clear	Present	2	2	Outside
3	Merle Hay Road	EB	12	9/16/2008	16:45	Clear	Present	2	2	Inside
4	Second Ave	WB	15	9/9/2008	15:03	Clear	Present	2	2	Outside
5	Second Ave	WB	5	9/11/2008	16:12	Clear	Present	2	2	Outside
6	Second Ave	WB	3	9/11/2008	16:22	Clear	Present	2	2	Outside
7	Second Ave	WB	5	9/11/2008	16:42	Clear	Present	2	2	Outside
8	East 14th St	EB	15	9/9/2008	16:16	Clear	Present	2	-	Outside
9	East 14th St	EB	5	9/11/2008	15:59	Clear	Present	2	-	Outside
10	East 14th St	WB	2	9/12/2008	14:05	Rain	None Apparent	2	-	Inside
11	East 14th St	WB	2	9/12/2008	8:12	Clear	Unclear	2	-	Inside
12	East 14th St	EB	2	9/12/2008	8:05	Clear	Unclear	2	-	Inside
13	East 14th St	EB	2	9/13/2008	22:17	Dark	Possible	2	-	Inside
14	East 14th St	EB	5	10/15/2008	15:23	Clear	None	4	-	All

Video data were then reviewed and the observed traffic volumes were recorded manually for one-minute intervals for each through lane. Based on these vehicle counts, an equivalent vehicle per hour estimate was calculated for each interval as well as for the entire period.

Other pertinent observations, such as braking, evasive maneuvers, and heavy traffic conditions, were also recorded during data reduction. A sample image from the video reduction is shown in Figure 9 and the resulting summary data are in Table 3. Sample images and summary data for the entire video reduction are provided in Appendix A.

Figure 9. Merle Hay Road sample video reduction image – outside lanes 9/9/2008

Table 3. Merle Hay Road sample video reduction summary – outside lanes 9/9/2008

	EB Ln 1 (RT)		EB Ln 2 (LT)		WB Ln 3 (LT)		WB Ln 4 (RT)		
Frames	veh	veh/hr	veh	veh/hr	veh	veh/hr	veh	veh/hr	Comments
600	**7**	420	**26**	1,560	**18**	1,080	**11**	660	
1200	**18**	1,080	**25**	1,500	**24**	1,440	**11**	660	
1800	**10**	600	**29**	1,740	**24**	1,440	**18**	1,080	
2400	**17**	1,020	**22**	1,320	**20**	1,200	**14**	840	
3000	**13**	780	**34**	2,040	**20**	1,200	**14**	840	
3600	**12**	720	**35**	2,100	**28**	1,680	**14**	840	
4200	**12**	720	**17**	1,020	**19**	1,140	**13**	780	
4800	**9**	540	**22**	1,320	**25**	1,500	**10**	600	
5400	**13**	780	**18**	1,080	**17**	1,020	**6**	360	
6000	**16**	960	**25**	1,500	**27**	1,620	**9**	540	
6600	**16**	960	**25**	1,500	**11**	660	**11**	660	
7200	**11**	660	**25**	1,500	**30**	1,800	**13**	780	
Average=	**13**	770	**25**	1,515	**22**	1,315	**12**	720	

In this example, a maximum flow of 35 veh/min/ln was observed, equating to 2,100 veh/hr. The average lane volume for this lane during the 15 minute period was 25 veh/min (or 1,515 veh/hr). No braking was observed. However, when considering all observations, braking was reported under several circumstances, including high flow conditions (37 veh/min/ln), following an evasive maneuver, and during active work (saw cutting) adjacent to the through lanes.

In one situation, evasive maneuver-induced braking appeared to reduce the flow in one lane from 31 veh/min to 22 veh/min. Heavy traffic was (anecdotally) reported for lane volumes of 32, 34, and 38 veh/min or 1,920, 2,040 and 2,280 veh/hr, respectively. Table 4 presents summary volumes in, and near, peak traffic periods.

Table 4. Video reduction summary in peak periods

Observation ID		Eastbound				Westbound			
		Right Lane		Left Lane		Left Lane		Right Lane	
		veh	veh/hr	veh	veh/hr	veh	veh/hr	veh	veh/hr
1	Min	7	420	17	1,020	11	660	6	360
	Ave	13	770	25	1,515	22	1,315	12	720
	Max	18	1,080	35	2,100	30	1,800	18	1,080
2	Min	6	360	15	900	9	540	6	360
	Ave	11	655	18	1,090	18	1,060	11	630
	Max	14	840	25	1,500	26	1,560	16	960
3	Min	16	960	21	1,260	22	1,320	13	780
	Ave	21	1,245	30	1,805	28	1,705	18	1,085
	Max	26	1,560	37	2,220	38	2,280	24	1,440
4	Min	10	600	15	900	15	900	8	480
	Ave	19	1,124	21	1,240	23	1,396	13	772
	Max	27	1,620	31	1,860	34	2,040	19	1,140
5	Min	18	1,080	16	960	26	1,560	20	1,200
	Ave	22	1,296	24	1,440	30	1,800	23	1,360
	Max	25	1,500	29	1,740	37	2,220	25	1,500
6	Min	13	780	22	1,320	26	1,560	19	1,140
	Ave	24	1,440	26	1,560	30	1,800	20	1,180
	Max	31	1,860	30	1,800	36	2,160	21	1,260
7	Min	21	1,260	20	1,200	30	1,800	24	1,440
	Ave	24	1,452	26	1,572	31	1,872	29	1,740
	Max	28	1,680	33	1,980	33	1,980	33	1,980
8	Min	11	660	19	1,140				
	Ave	18	1,084	26	1,544				
	Max	29	1,740	31	1,860				
9	Min	9	540	24	1,440				
	Ave	13	804	28	1,692				
	Max	18	1,080	32	1,920				

The maximum average volume observed was 31 veh/min/ln (1,872 veh/hr/ln). The maximum volume observed in any one lane during any minute period was 38 vehicles (2,280 veh/hr/ln). Left (or inside) lanes, regardless of work zone configuration and through lane position, consistently carried higher traffic volumes. Estimated average volumes of more than 1,500 veh/hr/ln were consistently observed in these lanes.

The average volume in each through lane (in a single direction) was within two vehicles per minute approximately one-third of the time. Limited review after construction (under normal conditions) yielded a maximum flow of 21 veh/min/ln (1,260 veh/hr/ln).

Conclusions and Recommendations

Documenting the impacts of work zone activities to travel reliability should be one of the major benefits to having deployed ITS assets. However, as demonstrated in this project effort, if the equipment is not calibrated in coordination with the construction activities, the data have limited use.

Prioritizing the coordination of these assets with construction activities will ensure that essential observations and data collection, based on changes in work-zone configurations and activity levels, can be collected throughout the project. This will also ensure that valid data are obtained during the project.

Traffic sensor validation and manual reconfiguration may be necessary due to lane shifts within the work zone. Validation may then be accomplished via video review/reduction or field observations. Immediate download and review of tabular sensor data should be conducted to provide confidence in the accuracy of data collection. Visualization and review of dynamically presented sensor-based data, such as average speeds, can also serve this purpose, to a lesser degree.

If possible, developing a more automated means for capture of traffic camera-based data would be desirable to obtain and document traffic conditions over more, and different, conditions. This could also be accomplished through additional coordination with the appropriate traffic center.

Finally, consideration of the impact of vehicle type may be beneficial. This was not performed during this study, but video reduction indicated a high percentage of large vehicles during some of the analysis periods. Without considering vehicle type, analysis results suggest that the Iowa DOT assumed capacity of 1,350 pc/h/ln for freeway work zones with lane closures might be somewhat conservative.

In general, remote traffic monitoring devices provide excellent means to monitor and assess work zone performance, particularly those within existing infrastructure. In addition, these devices can provide a wealth of information while facilitating flexibility in data collection and reduction with limited additional investment.

Existing conditions may be evaluated and used to convey traffic demand more accurately in modeling and reliability. Actual performance may be used to adjust the model(s) and develop improved models for future work zones. However, interactive review and assessment of outputs must be conducted to ensure accurate and appropriate data collection.

If the Iowa DOT continues to rely on volume (throughput) as a primary mobility performance measure, tasks should be associated with each major construction project to adjust ITS equipment, capture operations data, and manage/store these data in a format that facilitates on-going continuous improvement efforts.

SUBURBAN FREEWAY RAMP CLOSURES WITH LOCAL DETOUR

Work Zone Overview

The work zone of interest was located on north and southbound I-35/80 in the western Des Moines metropolitan area. Construction, during spring 2010, consisted of bridge deck replacement over Walnut Creek, between the University Avenue and Hickman Road (US Highway 6) interchanges (Figure 10).

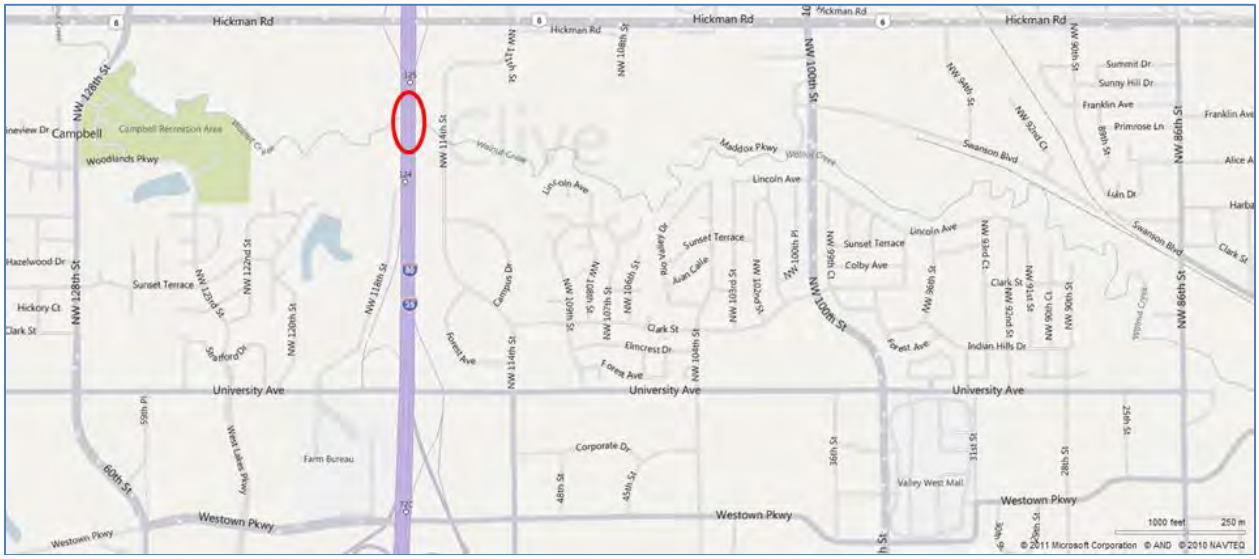


Figure 10. Walnut Creek Bridge site map (Bing Maps n.d.)

Throughout construction, three through lanes of traffic were open, but possibly shifted, in each direction of travel. The AADT for this portion of the Interstate was approximately 101,000 vehicles per day. The primary impact of the work zone on motorists was ramp closures at Hickman Road and University Avenue:

- Northbound off ramp to Hickman Road (8,800 AADT 2009)
- Southbound on ramp from Hickman Road (8,900 AADT 2009)
- Northbound on ramp from University Avenue (10,700 AADT 2009)
- Southbound off ramp to University Avenue, limited access from mainline (11,100 AADT 2009)

Detours were officially designated for each of the ramp closures. These detours predominately utilized local streets in the cities of Clive and West Des Moines, specifically University Avenue and NW 128th Street. Hickman Road/US 6, a state route, was also utilized. Figure 11 shows the four ramp closures in red and associated detour routes in green, with a red dot designating the destination.

Figure 11. Ramp closures and detour routes

Work Zone Assessment Objectives

Local agencies had several concerns regarding the project, particularly with respect to the increased demand on the adjacent surface streets and intersections resulting from the detours. The afternoon peak was of primary interest. Concerns also included use of non-designated detour routes, such as NW 114th Street/NW 111th Street located parallel to the Interstate.

As with the local agencies, the Iowa DOT was interested in the level of traffic displaced to the local system. This information would serve as a frame of reference in planning future high-volume, urban/suburban freeway projects involving ramp closures. There was also an interest in quantifying the degree of traffic diversion, if any, throughout the different phases of construction.

Data Sources

One Wavetronix SmartSensor™ (MVDS29 for I-35/80 northbound to Hickman Road) was located within the work zone, facilitating the capture of traffic flow in the work zone. At this location, the sensor captures data across three through lanes and an entrance/exit ramp in each direction of travel (Figure 12).

Figure 12. MVDS 29 – I-35/80 northbound to Hickman Road

However, in advance of construction, the overhead truss on which this sensor was located was removed. The sensor was eventually relocated to a temporary wood pole erected at

approximately the same location. This resulted in limited pre-work zone data for analysis (discussed later).

A second sensor (I-35/80 northbound to Douglas Avenue) was located within one-mile, north of the work zone, and consisted of a similar lane profile (Figure 13).

Figure 13. MVDS 30 – I-35/80 northbound to Douglas Avenue

As discussed previously, the data collected by theses sensors had to be archived manually and exported for future analysis.

Another primary data source was in-pavement, traffic signal loop detectors provided by the City of West Des Moines. These data were critical in evaluating the traffic impacts on the local, surface streets. Loop detector data were provided for seven intersections located at the ramps of interest (University Avenue only), the detour route, and other prominent intersections on or near the University Avenue corridor, east of the Interstate interchange:

- University Avenue and west ramp
- University Avenue and east ramp
- 50th Street and Corporate Drive
- University Avenue and 47th Street
- University Avenue and 128th Street/60th Street (designated detour)
- University Avenue and 35th Street/Valley West Drive/NW 100th Street
- University Avenue and 22nd Street/86th Street

The intersections are listed above in order of increasing distance from the interchange.

The designated detour was located approximately one mile west of the interchange, while the intersection of University Avenue and 22nd Street was located at the greatest distance, approximately two miles east of the interchange.

Unfortunately, no traffic data were available for the intersection of University Avenue and NW 114th Street, a likely, alternate route used by drivers. In addition, data were not available for intersections along Hickman Road (US Highway 6), which was reported to typically experience long queues during the afternoon peak, especially near the Interstate ramps. No data were available because it is located in a different jurisdiction, possessing different infrastructure.

Finally, because of observed traffic volumes during Interstate construction and ramp closures, the City of Clive used portable tube counters to collect data on the official detour (NW 128th Street) as well as on NW 114th Street. Limited historic data were available for NW 114th Street. Figure 14 presents an overview of the locations of data collection, not including NW 128th Street and Sunset Terrace.

Figure 14. Local traffic data

Both sensor data and loop detector data were archived under normal (non-work-zone) conditions to assess and establish a benchmark of typical operating characteristics.

Data Utilization

Construction Phasing

The timeline of construction was established by utilizing several sources, including the original plans, Des Moines Metro Alerts (issued by the Iowa DOT), and correspondence between the research team and local and state agencies. Assimilation of these data was necessary because project phases could, and did, vary from the original plans.

Ultimately, these data were used to establish different date thresholds to examine changes due to construction. Five thresholds (phases) for analysis were established as shown in Table 5. No construction occurred during the beginning and ending phases.

Table 5. Walnut Creek Bridge reconstruction phasing

Phase	Dates (2010)	Details
Pre-Construction	4/12 – 4/19	Data are only available for approximately one to two weeks before the closures occur
Phase 1: Northbound Ramps Closed	4/19 – 5/10	The Hickman northbound off ramp and University northbound on ramp are both closed
Phase 2: Northbound On Ramp Closed	5/10/ – 5/20	The Hickman northbound off ramp opens but the University northbound on ramp remains closed
Phase 3: Southbound On Ramp Closed	5/20 – 6/9	The Hickman southbound on ramp is closed
Post-Construction	6/9 – 7/1	Construction is concluded/no closures are present

Traffic Sensors

Based on experience from the previously-discussed project, Iowa DOT personnel attempted to adjust sensor configuration to account for changes in lane positions. In the previous project, changes in lane position resulted in limited data of use from within the work zone. This was accomplished, in part, by viewing the work zone interactively using a proximate traffic camera.

Sensor data were archived manually, for varying time periods, and exported by Iowa DOT personnel before, during, and after the work zone presence. Data were provided for all sensors in the system, not only the sensors of interest. Therefore, the data sets were quite voluminous, with nearly a million records present for each month.

Data were provided originally in text file format with a two-line header separating the data for each sensor (Figure 8). Each row following the header represented summary data for a specific date, time (in 15 minute bins), and lane combination for the sensor.

A new format was provided beginning in late April 2010 and better facilitated use in a relational database. Specifically, instead of header rows indicating sensor name and location, these attributes were provided with each row of data (Figure 15).

Time	Sensor	Lane_ID	Speed	Volume	Occupancy	Small	Medium	Large			
04-27-2010 12:00:00	MVDS11/I-235 WB 9th STREET WALL	1	50	47	2	94	4	2			
04-27-2010 12:00:00	MVDS11/I-235 WB 9th STREET WALL	2	61	123	7	34	59	7			
04-27-2010 12:00:00	MVDS11/I-235 WB 9th STREET WALL	3	64	180	8	7	84	8			
04-27-2010 12:00:00	MVDS11/I-235 WB 9th STREET WALL	4	66	170	7	15	75	10			
04-27-2010 12:00:00	MVDS11/I-235 WB 9th STREET WALL	5	69	66	3	33	59	8			
04-27-2010 12:15:00	MVDS11/I-235 WB 9th STREET WALL	1	51	51	2	96	2	2			
04-27-2010 12:15:00	MVDS11/I-235 WB 9th STREET WALL	2	60	124	6	45	48	6			
04-27-2010 12:15:00	MVDS11/I-235 WB 9th STREET WALL	3	63	198	9	14	77	9			
04-27-2010 12:15:00	MVDS11/I-235 WB 9th STREET WALL	4	66	190	8	13	80	7			
04-27-2010 12:15:00	MVDS11/I-235 WB 9th STREET WALL	5	68	57	3	42	56	2			
04-27-2010 12:30:00	MVDS11/I-235 WB 9th STREET WALL	1	50	54	2	91	4	6			
04-27-2010 12:30:00	MVDS11/I-235 WB 9th STREET WALL	2	61	132	6	39	56	5			
04-27-2010 12:30:00	MVDS11/I-235 WB 9th STREET WALL	3	62	223	9	17	78	4			
04-27-2010 12:30:00	MVDS11/I-235 WB 9th STREET WALL	4	64	183	8	20	73	7			
04-27-2010 12:30:00	MVDS11/I-235 WB 9th STREET WALL	5	70	64	3	20	77	3			

Figure 15. New sensor data format

New procedures were developed to aggregate data (new format) by location for several different factors, such as time period or interval, lane, and lane combinations. Application of consistent naming conventions and aggregation procedures was also verified. Previous data sets were then reformatted and integrated into a comprehensive database.

Weekday, hourly volumes were evaluated at each of the sensors for each lane independently, for through lanes (by direction of travel), and for all lanes (by direction of travel). The following hourly volumes were computed:

- 12 hour (7:00 am to 7:00 pm)
- Average morning (two hour) peak – from 7:00 am to 9:00 am
- Average afternoon (two hour) peak – from 4:00 pm to 6:00 pm

Line plots were then created to present traffic volume data for each direction of travel and lane group (e.g., through, entrance/exit ramp) for the two sensors of interest and the time periods of interest. Given the limited availability of pre-construction data, sensor data from the same sensors and time period in 2009 were assimilated and used to provide a supplemental frame of reference. Sample 12 hour northbound through traffic at MVDS29 is shown in Figure 16. Figure 17 presents similar data at MVDS30, which is the sensor located northbound downstream. A total of 24 of these figures were created for evaluation and are included in Appendix B.

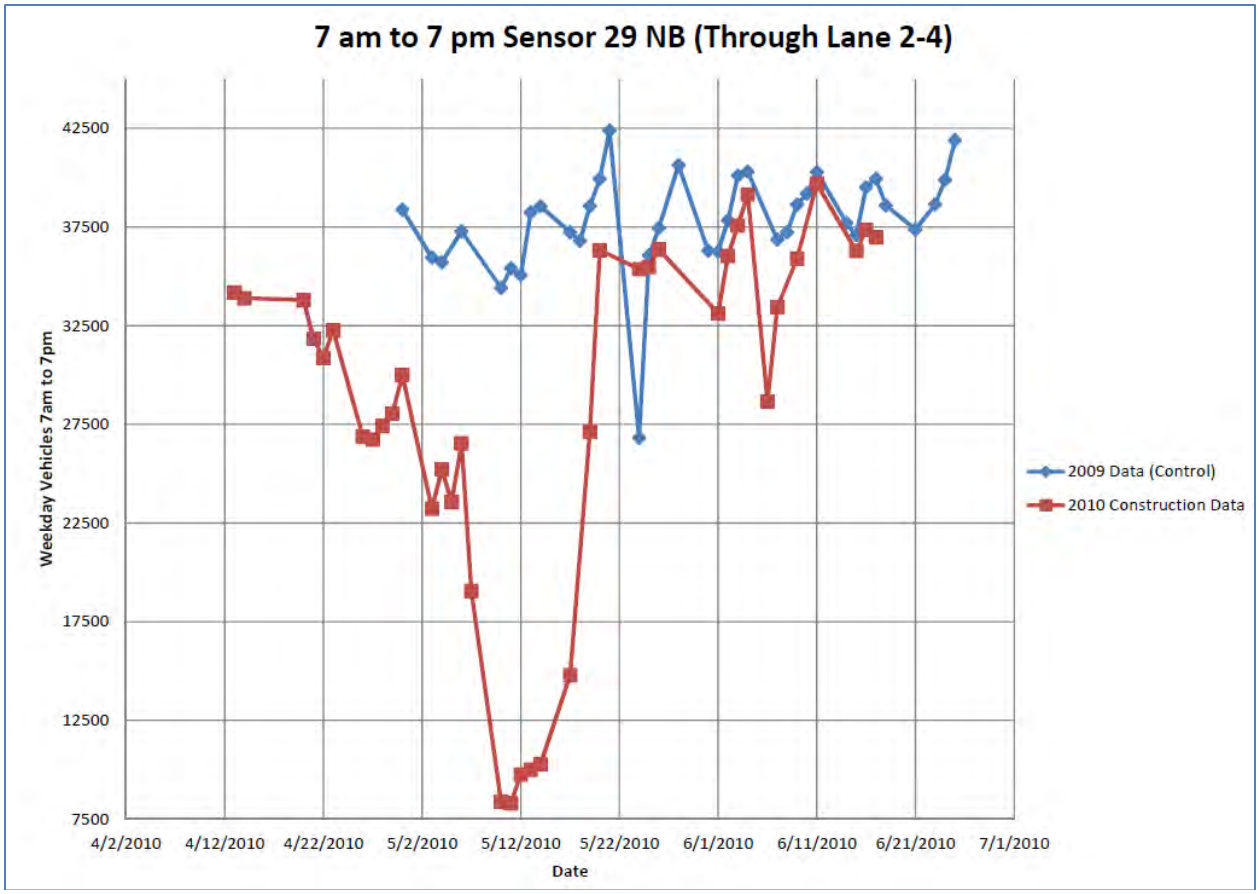


Figure 16. Sample Wavetronix-based 12 hour summary (MVDS29)

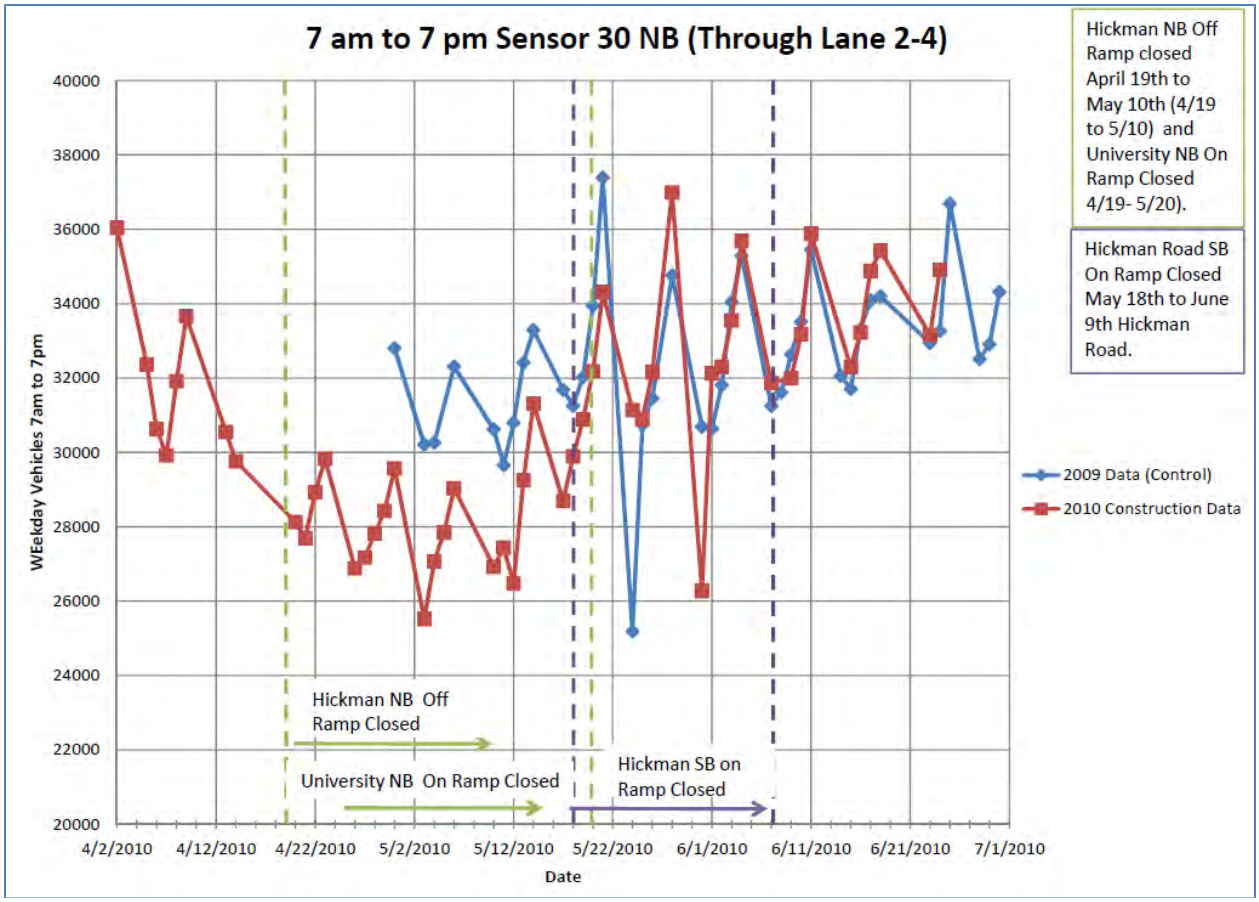


Figure 17. Sample Wavetronix-based 12 hour summary (MVDS30)

Immediately apparent in Figure 16 data was a dramatic decrease in through-traffic volumes during construction. The decrease was so significant that it was unrealistic (seven data points, which are fewer than 22,500 vehicles). This data suggested that, despite the concerted effort to reconfigure the sensor-based, one-lane position changes, accurate data were not being collected. Therefore, these data are of limited or no use in evaluating the performance of the work zone on the Interstate itself, and emphasis must be placed on the impact on the local and surface streets.

This conclusion is further supported by the summary data presented in Figure 17. The traffic volumes of this downstream sensor, while not located in the work zone, were more consistent with the 2009 reference volumes throughout construction.

In addition, after the majority of the lane impacts were completed near MVDS29, the volumes became very similar to those at MVDS30. This figure also conveys the general variations in traffic volumes by day of the week.

In general, a decrease in northbound traffic volumes at MVDS30 was observed for the three daily time periods (morning peak, afternoon peak, and 12 hour) during the first two construction phases (Table 6).

Table 6. Observed changes in northbound traffic at MVDS30

Time Period	Phase 1	Phase 2
Two-hour Morning Peak	-10%	-7%
Two-hour Afternoon Peak	-15%	-15%
12 Hour	-6%	-10%

A decrease in northbound entrance ramp volumes was also observed. This could either represent a diversion of traffic from the Interstate (to avoid the work zone) or traffic not using the northbound Hickman Road on ramp to access the Interstate after diversion to local streets. No changes were observed in the southbound direction during these phases.

In-Pavement Traffic Signal Loop Detector Counts

The City of West Des Moines supplied traffic signal, in-pavement loop detector data for seven intersections located at the ramps of interest (University Avenue only), the detour route, and other prominent intersections on or near the University Avenue corridor east of the Interstate interchange. Traffic count data were provided by date and 15 minute intervals for each intersection by approach and movement (left, through, and right) (Figure 18). These data were archived manually, for varying time periods, and exported by city personnel before, during, and after the work zone presence.

Turning Count Data

U-University @ 22nd Street

6/13/2010

0:00	East			West			North			South			
Min	Left	Through	Right	Left	Through	Right	Left	Through	Right	Left	Through	Right	Total
00	30	0	7	0	0	0	24	20	2	0	50	22	155
15	34	0	10	0	0	0	11	51	3	0	52	17	178
30	13	0	8	0	0	0	8	25	2	0	38	17	111
45	21	0	9	0	0	0	11	18	1	0	45	8	113
Hour	98	0	34	0	0	0	54	114	8	0	185	64	557

1:00	East			West			North			South			
Min	Left	Through	Right	Left	Through	Right	Left	Through	Right	Left	Through	Right	Total
00	21	0	5	1	0	0	6	33	2	0	33	9	110
15	23	0	17	0	0	0	7	29	2	0	33	8	119
30	13	0	15	0	0	0	9	9	1	0	37	8	92
45	31	0	20	1	1	1	8	17	1	0	88	41	209
Hour	88	0	57	2	1	1	30	88	6	0	191	66	530

Figure 18. Sample loop detector count format

The summary data were provided in PDF format. Therefore, appropriate data were extracted manually from these files and imported into corresponding Excel files for later analysis, which

was a time-consuming and potentially-error prone process. All count data were then integrated into an Access database, and several attributes were reformatted to facilitate analysis.

Weekday count data were summarized for each intersection approach and movement by date for the following time periods:

- 12 hour (7:00 am to 7:00 pm)
- Average morning (two-hour) peak
- Average afternoon (two-hour) peak

Scatter plots, denoting construction phases, were then created to present count data for all intersection approaches, as well as each approach independently, for the three time periods. Sample intersection and approach plots for the afternoon peak are provided in Figure 19 and Figure 20, respectively.

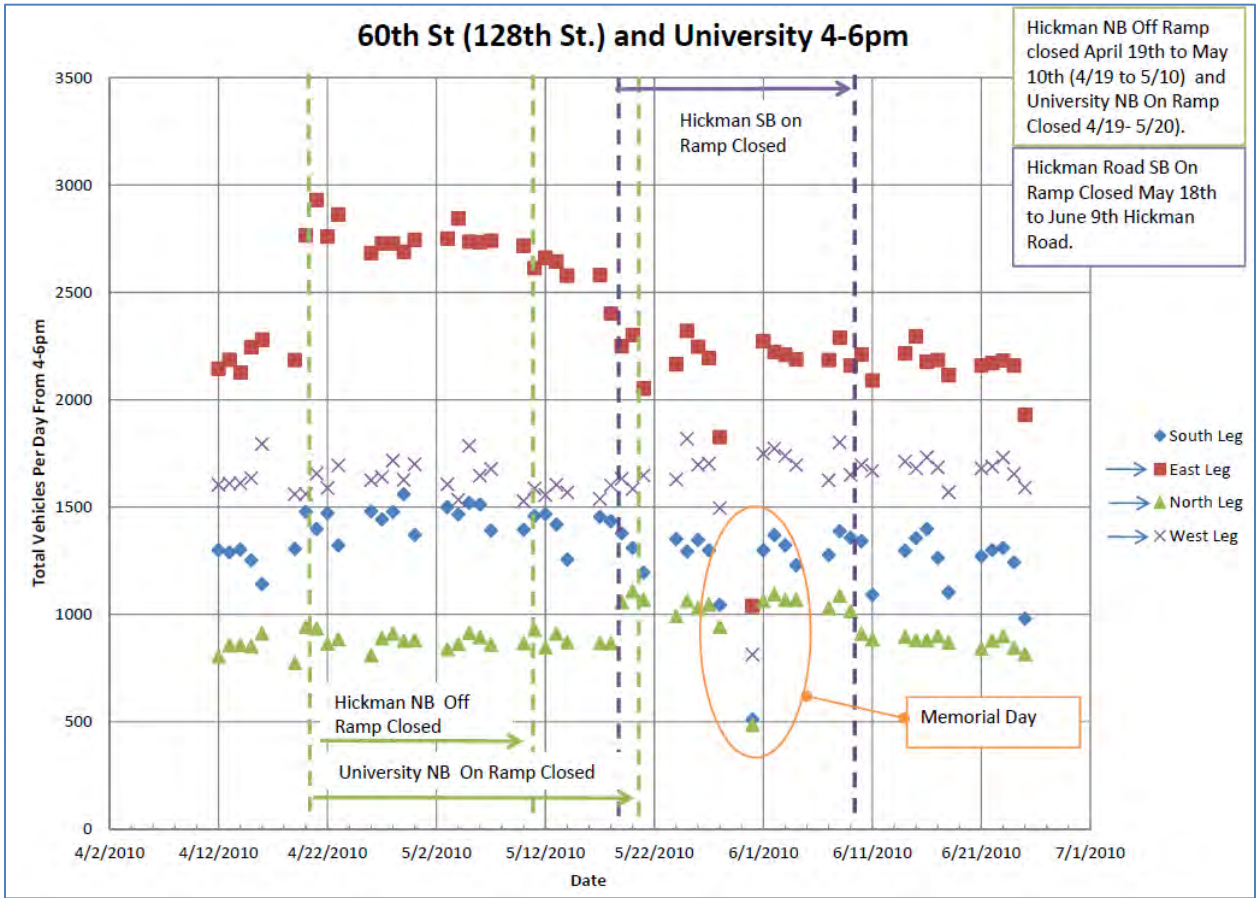


Figure 19. Sample intersection counts, 128th Street

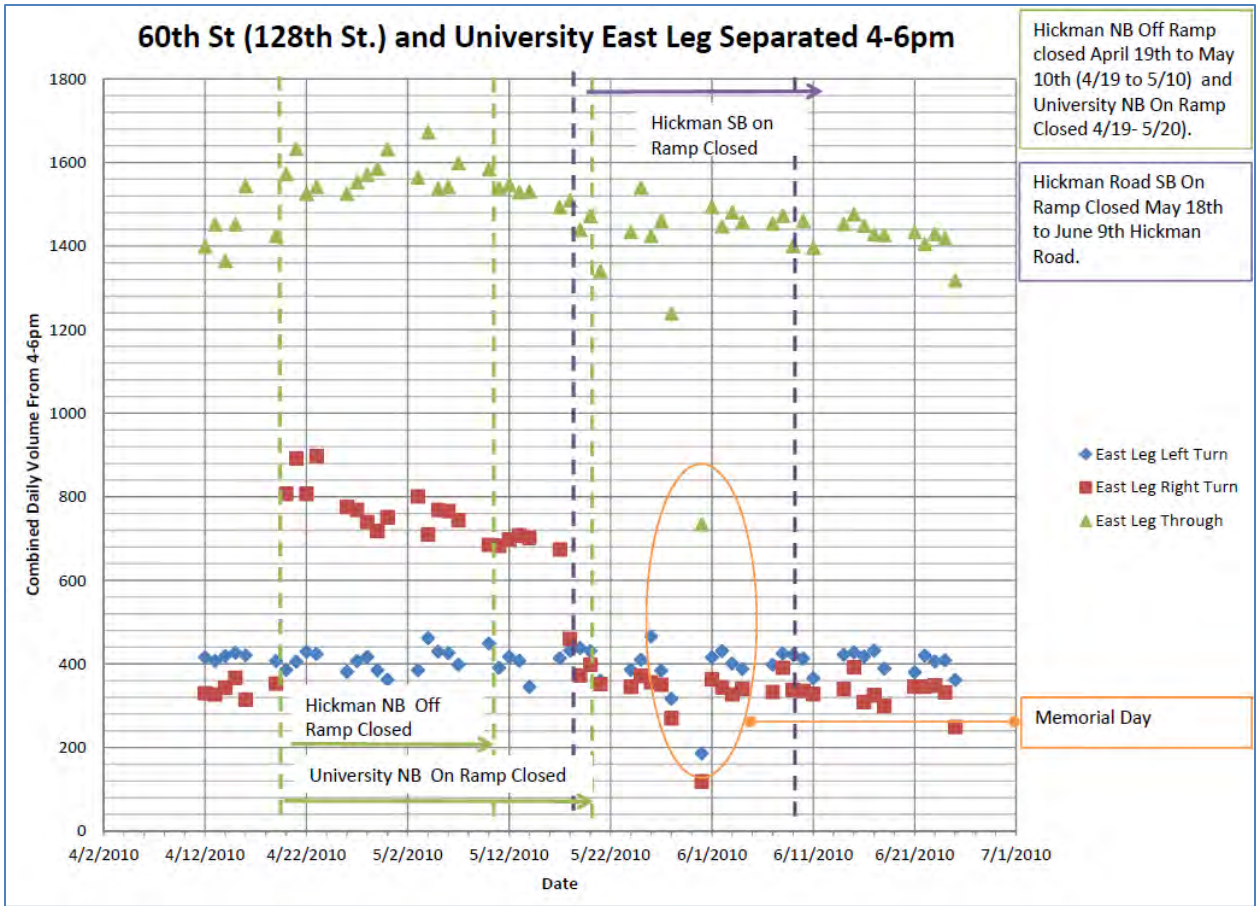


Figure 20. Sample intersection approach counts by movement, 128th Street

A total of 89 of figures were created for evaluation and are included in **Error! Reference source not found.**.

These plots were useful in not only assessing trends but also identifying data anomalies (e.g., large, inexplicable count increases/decreases). Without this visual component, identifying anomalies that may skew analysis results or limit interpretation is challenging when working with such voluminous data sets.

Figure 19 conveys the increase in traffic on the east approach of the designated detour during closure of the northbound University Avenue entrance ramp, followed by a return to "normal" conditions, most prominently.

A less pronounced increase is apparent on the northbound approach during the closure of the southbound Hickman Road entrance ramp. Figure 20 most notably presents the increase in right-turning traffic (onto the designated detour) during closure of the northbound University Avenue entrance ramp.

The volume increase is most prominent immediately following the closure but gradually decreases, possibly suggesting drivers selecting alternate paths. Both of these figures also convey the general, daily variations of approach and movement volumes.

As an additional example, Figure 21 presents the 12 hour impact of the University Avenue entrance ramp at the east approach to the ramp.

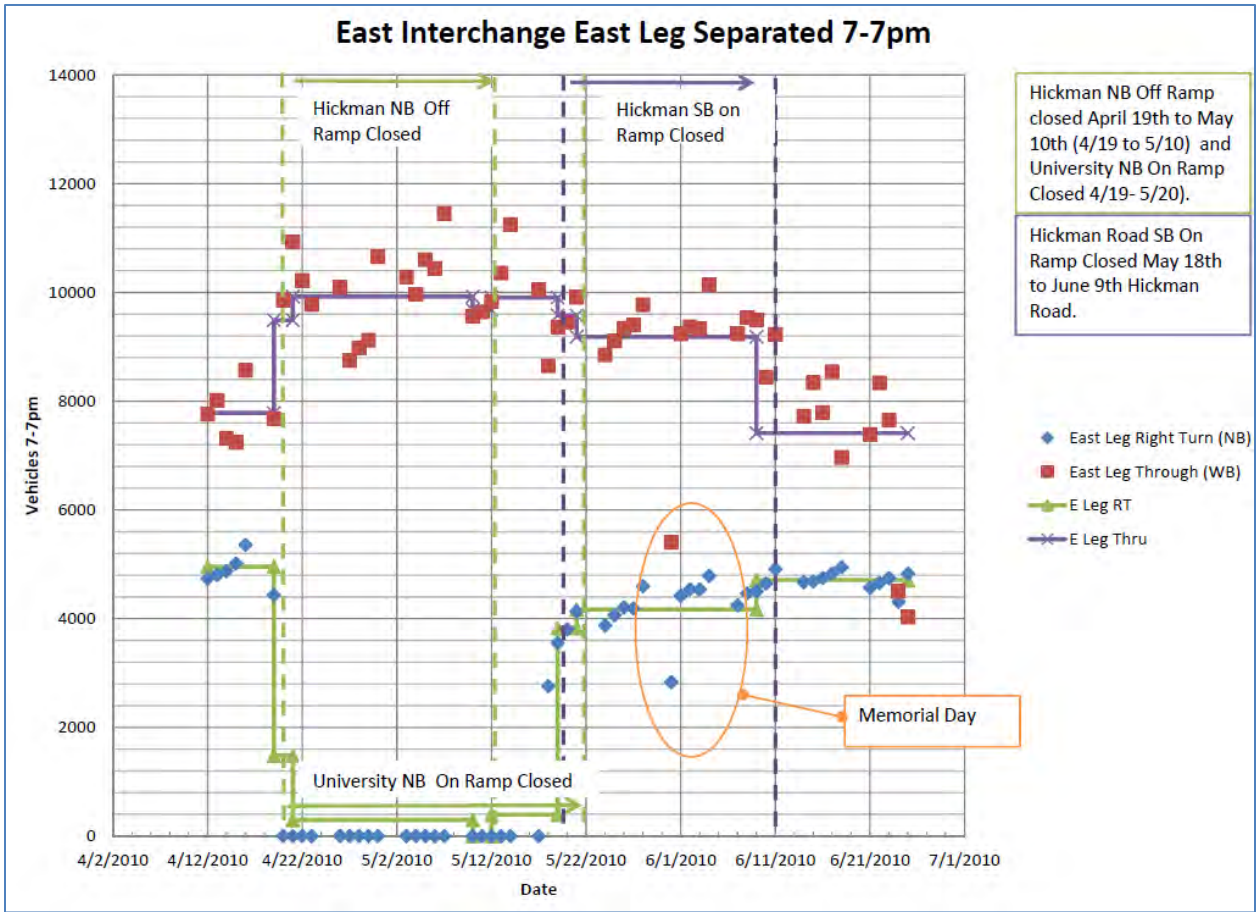


Figure 21. Sample intersection approach counts by movement, East University ramp

The figure clearly conveys the decrease in right turns onto the ramp (nearly 5,000 vehicles during this time period). The data in the figure also reveal that the increase in through movements (necessary to access the designated detour) was not of equal magnitude as the aforementioned decrease, suggesting that alternate routes were being used east of the intersection (e.g., 114th Street).

Average approach volumes (and standard deviations) were computed for each of the time periods and phases and compared to both baseline volumes and prior phase volumes. In some cases, considerable variation existed among approach and movement-based volumes, limiting the possible suitability of average comparisons. However, given the nature of the study, rigorous statistical analyses were not warranted.

Three tables presenting the aforementioned data were prepared. Table 7 presents the traffic volume change from baseline, while Table 8 presents the percent traffic volume change from the baseline. Table 8 also conveys categorized percent changes, expressed as the following:

- Less than 15 percent
- 15 to 30 percent
- 30 to 50 percent
- Greater than 50 percent

Table 7. Traffic volume change from baseline

		7-7pm Combined 12 Hour Volume					7-9am Combined 2 Hour Volume					4-6pm Combined 2 Hour Volume				
Int.	Approach	Before	Phase 1	Phase 2	Phase 3	After	Before	Phase 1	Phase 2	Phase 3	After	Before	Phase 1	Phase 2	Phase 3	After
60th & University	East	10068	2202	1711	-2	194	1476	195	137	-97	-56	2197	529	403	-76	-39
	North	4393	137	111	998	254	1030	26	-9	106	-31	857	19	22	157	18
	South	5568	533	455	158	111	759	100	70	16	-8	1257	189	155	-9	-11
	West	8353	-23	-190	169	175	1470	-41	-73	-72	-132	1651	-10	-82	-23	23
University & I-80 West Ramp	East	11213	3472	1693	785	15748	1795	736	99	7	2356	2118	700	390	132	2498
	North	9795	-2655	-691	-1863	-519	2618	-856	-163	-532	-258	1688	-442	-132	-344	-160
	South	1093	-274	77	57	-21	178	-54	-2	-3	-11	174	-37	-2	4	-12
	West	14796	-1241	-1813	150	-172	1881	-102	-308	25	-112	2994	-527	-535	-89	-111
University & I-80 East Ramp	East	12742	-2522	-2440	616	-617	1377	-391	-350	16	-97	2970	-771	-776	-55	-325
	North	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	South	5335	902	285	-46	-20	1501	192	46	-115	-107	866	201	38	-33	-9
	West	15411	-1202	-2062	-3518	-2424	2501	-222	-379	-438	-143	3196	-678	-883	-1101	-895
50th & University	East	N/A	-17	-18	-79	727	N/A	1	-1	1	22	N/A	-18	1	-33	241
	North	N/A	-43	-443	-467	8385	N/A	20	-27	-5	1460	N/A	62	-23	-96	1507
	South	N/A	-95	-481	-550	7478	N/A	37	-56	-60	1151	N/A	-25	-131	-119	1460
	West	N/A	92	20	30	806	N/A	5	1	6	63	N/A	16	2	-6	144
47th & University	East	9351	-355	-856	88	247	876	-39	-73	-26	-73	1918	-106	-200	-28	73
	North	1270	28	-64	-17	-1	86	-9	-17	-17	-16	277	7	5	-7	0
	South	299	-31	-50	-24	-32	9	1	-3	0	0	120	-22	-27	-19	-20
	West	10330	998	73	-702	-1222	1262	111	-58	-135	-193	1985	175	26	-306	-394
35th & University	East	8138	172	-109	26	1215	487	58	32	-21	431	1576	92	-22	-32	302
	North	8357	-29	-143	581	-3363	1145	35	12	131	-466	1616	-36	-51	57	-670
	South	7875	685	337	242	-844	820	140	111	64	267	1643	253	102	-5	-295
	West	9100	1788	1130	217	1319	722	166	105	-11	590	1829	390	221	-33	174
22nd & University	East	1201	85	-83	-101	-170	97	2	-2	-7	-7	224	41	-6	-20	-32
	North	10771	-65	-282	137	19	1706	2	40	-20	-90	2198	-2	-97	38	16
	South	6975	-172	-205	-364	-152	970	45	16	-26	1	1505	-129	-115	-187	-170
	West	7807	421	39	-174	-456	774	65	13	-26	-125	1548	67	-32	-94	-114

Table 8. Percent traffic volume change from baseline

Int.	Approach	7-7pm Combined 12 Hour Volume					7-9am Combined 2 Hour Volume					4-6pm Combined 2 Hour Volume				
		Before	Phase 1	Phase 2	Phase 3	After	Before	Phase 1	Phase 2	Phase 3	After	Before	Phase 1	Phase 2	Phase 3	After
60th & University	East	10,068	21.9%	17.0%	0.0%	1.9%	1,476	13.2%	9.3%	-6.6%	-3.8%	2,197	24.1%	18.3%	-3.5%	-1.8%
	North	4,393	3.1%	2.5%	22.7%	5.8%	1,030	2.6%	-0.9%	10.3%	-3.0%	857	2.2%	2.6%	18.3%	2.1%
	South	5,568	9.6%	8.2%	2.8%	2.0%	759	13.2%	9.2%	2.1%	-1.0%	1,257	15.1%	12.3%	-0.7%	-0.9%
	West	8,353	-0.3%	-2.3%	2.0%	2.1%	1,470	-2.8%	-4.9%	-4.9%	-9.0%	1,651	-0.6%	-4.9%	-1.4%	1.4%
University & I-80 West Ramp	East	11,213	31.0%	15.1%	7.0%	140.4%	1,795	41.0%	5.5%	0.4%	131.3%	2,118	33.0%	18.4%	6.3%	117.9%
	North	9,795	-27.1%	-7.1%	-19.0%	-5.3%	2,618	-32.7%	-6.2%	-20.3%	-9.8%	1,688	-26.2%	-7.8%	-20.4%	-9.5%
	South	1,093	-25.0%	7.1%	5.2%	-1.9%	178	-30.6%	-0.9%	-1.4%	-6.4%	174	-21.4%	-0.9%	2.6%	-7.0%
	West	14,796	-8.4%	-12.3%	1.0%	-1.2%	1,881	-5.4%	-16.4%	1.3%	-6.0%	2,994	-17.6%	-17.9%	-3.0%	-3.7%
University & I-80 East Ramp	East	12,742	-19.8%	-19.1%	4.8%	-4.8%	1,377	-28.4%	-25.4%	1.2%	-7.1%	2,970	-26.0%	-26.1%	-1.9%	-10.9%
	North	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	South	5,335	16.9%	5.3%	-0.9%	-0.4%	1,501	12.8%	3.1%	-7.7%	-7.1%	866	23.2%	4.4%	-3.9%	-1.0%
	West	15,411	-7.8%	-13.4%	-22.8%	-15.7%	2,501	-8.9%	-15.2%	-17.5%	-5.7%	3,196	-21.2%	-27.6%	-34.4%	-28.0%
50th & Corporate 1	East	N/A	-2.3%	-2.4%	-10.9%	727	N/A	6.5%	-6.8%	2.9%	22	N/A	-7.3%	0.4%	-13.7%	241
	North (SB)	N/A	-0.5%	-5.3%	-5.6%	8,385	N/A	1.4%	-1.8%	-0.3%	1,460	N/A	4.1%	-1.5%	-6.3%	1,507
	South (NB)	N/A	-1.3%	-6.4%	-7.4%	7,478	N/A	3.2%	-4.8%	-5.2%	1,151	N/A	-1.7%	-9.0%	-8.2%	1,460
	West	N/A	11.4%	2.4%	3.7%	806	N/A	8.0%	1.3%	9.7%	63	N/A	11.3%	1.7%	-4.2%	144
47th & University	East	9,351	-3.8%	-9.1%	0.9%	2.6%	876	-4.4%	-8.4%	-2.9%	-8.4%	1,918	-5.5%	-10.4%	-1.5%	3.8%
	North	1,270	2.2%	-5.1%	-1.3%	-0.1%	86	-11.0%	-19.6%	-19.9%	-19.2%	277	2.4%	1.9%	-2.5%	0.0%
	South	299	-10.3%	-16.8%	-8.1%	-10.8%	9	12.8%	-33.1%	-1.6%	-4.3%	120	-17.9%	-22.9%	-15.6%	-16.7%
	West	10,330	9.7%	0.7%	-6.8%	-11.8%	1,262	8.8%	-4.6%	-10.7%	-15.3%	1,985	8.8%	1.3%	-15.4%	-19.8%
35th & University	East	8,138	2.1%	-1.3%	0.3%	14.9%	487	12.0%	6.6%	-4.2%	88.4%	1,576	5.8%	-1.4%	-2.0%	19.2%
	North	8,357	-0.4%	-1.7%	7.0%	-40.2%	1,145	3.0%	1.1%	11.4%	-40.7%	1,616	-2.3%	-3.1%	3.5%	-41.5%
	South	7,875	8.7%	4.3%	3.1%	-10.7%	820	17.1%	13.6%	7.7%	32.5%	1,643	15.4%	6.2%	-0.3%	-17.9%
	West	9,100	19.6%	12.4%	2.4%	14.5%	722	23.0%	14.5%	-1.6%	81.7%	1,829	21.3%	12.1%	-1.8%	9.3%
22nd & University	East	1,201	7.1%	-6.9%	-8.4%	-14.2%	97	1.6%	-2.4%	-7.6%	-6.8%	224	18.5%	-2.6%	-9.1%	-14.4%
	North	10,771	-0.6%	-2.6%	1.3%	0.2%	1,706	0.1%	2.3%	-1.2%	-5.3%	2,198	-0.1%	-4.4%	1.7%	0.7%
	South	6,975	-2.5%	-2.9%	-5.2%	-2.2%	970	4.6%	1.6%	-2.7%	0.1%	1,505	-8.6%	-7.7%	-12.4%	-11.3%
	West	7,807	5.4%	0.5%	-2.2%	-5.8%	774	8.5%	1.7%	-3.3%	-16.1%	1,548	4.3%	-2.1%	-6.0%	-7.4%

Legend

Percent flagged	From	To
	15%	30%
	30%	50%
	50%	500%

Low Base Conditions
Not a Significant Change
Perceived Problems
Different Procedures

In addition, any possible concerns regarding the underlying data were also conveyed, such as low baseline traffic conditions and perceived data problems (issues). Table 9 presents the traffic volume change between phases. Complete summary tables, including other data sources (Wavetronix sensors and manual counts) are included in **Error! Reference source not found.**.

Table 9. Traffic volume change between phases

Int.	Approach	7-7pm Combined 12 Hour Volume					7-9am Combined 2 Hour Volume					4-6pm Combined 2 Hour Volume				
		Before	Phase 1	Phase 2	Phase 3	After	Before	Phase 1	Phase 2	Phase 3	After	Before	Phase 1	Phase 2	Phase 3	After
22nd & University	East	1201	85	-168	-18	-70	97	2	-4	-5	1	224	41	-47	-15	-12
	North	10771	-309	-216	419	-118	1706	2	38	-60	-70	2198	-2	-95	135	-23
	South	6975	-280	-33	-159	212	970	45	-29	-42	27	1505	-129	14	-72	17
	West	7807	161	-382	-213	-282	774	65	-52	-39	-99	1548	67	-99	-62	-21
35th & University	East	8138	-87	-281	135	1189	487	58	-26	-53	451	1576	92	-114	-10	334
	North	8357	-302	-114	724	-3944	1145	35	-23	119	-597	1616	-36	-14	108	-727
	South	7875	152	-348	-95	-1086	820	140	-29	-48	203	1643	253	-151	-106	-290
	West	9100	1149	-658	-913	1102	722	166	-61	-116	602	1829	390	-169	-254	207
47th & University	East	9351	-445	-501	944	159	876	-39	-34	48	-48	1918	-106	-95	172	101
	North	1270	63	-92	48	15	86	-9	-7	0	1	277	7	-1	-12	7
	South	299	-24	-19	26	-8	9	1	-4	3	0	120	-22	-6	9	-1
	West	10330	680	-925	-775	-520	1262	111	-169	-77	-58	1985	175	-149	-332	-88
50th & Corporate	East	N/A	710	-1	-62	79	N/A	23	-3	2	-1	N/A	223	19	-34	33
	North	N/A	8341	-399	-24	467	N/A	1479	-47	22	5	N/A	1569	-85	-72	96
	South	N/A	7383	-386	-69	550	N/A	1188	-93	-4	60	N/A	1435	-107	12	119
	West	N/A	898	-72	10	-30	N/A	68	-4	5	-6	N/A	160	-14	-8	6
60th & University	East	10068	1698	-490	-1714	197	1476	195	-58	-234	41	2197	529	-126	-480	37
	North	4393	74	-26	886	-744	1030	26	-35	115	-138	857	19	4	135	-139
	South	5568	326	-78	-297	-47	759	100	-31	-53	-24	1257	189	-34	-164	-2
	West	8353	-155	-167	359	5	1470	-41	-32	1	-61	1651	-10	-72	59	46
128th & Sunset	East	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	North	4783	38	192	1619	N/A	1379	4	-2	378	N/A	886	-2	26	317	N/A
	South	4791	1987	-358	-1301	N/A	524	278	-25	-106	N/A	1405	795	-128	-432	N/A
	West	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
114th St Clive Cut-through	East	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	North	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	South	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	West	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
University & I-80 East Ramp	East	12742	-1771	82	3056	-1233	1377	-391	42	366	-113	2970	-771	-5	721	-270
	North	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	South	5335	409	-617	-331	26	1501	192	-146	-161	8	866	201	-163	-72	25
	West	15411	657	-860	-1456	1094	2501	-222	-157	-59	294	3196	-678	-205	-218	206
University & I-80 West Ramp	East	11213	1835	-1780	-908	14963	1795	736	-637	-92	2349	2118	700	-310	-257	2365
	North	9795	-625	1964	-1172	1344	2618	-856	693	-369	275	1688	-442	311	-213	185
	South	1093	82	351	-21	-77	178	-54	53	-1	-9	174	-37	36	6	-17
	West	14796	-1258	-572	1963	-322	1881	-102	-207	333	-137	2994	-527	-8	446	-22

Finally, baseline volume comparison results by approach (including manual counts, to be discussed later) for all three construction phases and three time periods were compiled and presented in five maps.

- Pre-construction conditions (baseline conditions)
- Phase 1 comparison to baseline
- Phase 2 comparison to baseline
- Phase 3 comparison to baseline
- Post-construction conditions, comparison to baseline

These maps also presented any pertinent ramp closures, highlighted volume changes greater than five percent, and noted any sensor failures (or issues) that may misrepresent results. Figure 22 and Figure 23 represent Phase 1 percent volume change comparison maps. Figure 23 is localized to the University Avenue-I 35/80 interchange. All maps are included in **Error! Reference source not found.**.

Figure 22. Sample Phase 1 percent volume change from baseline

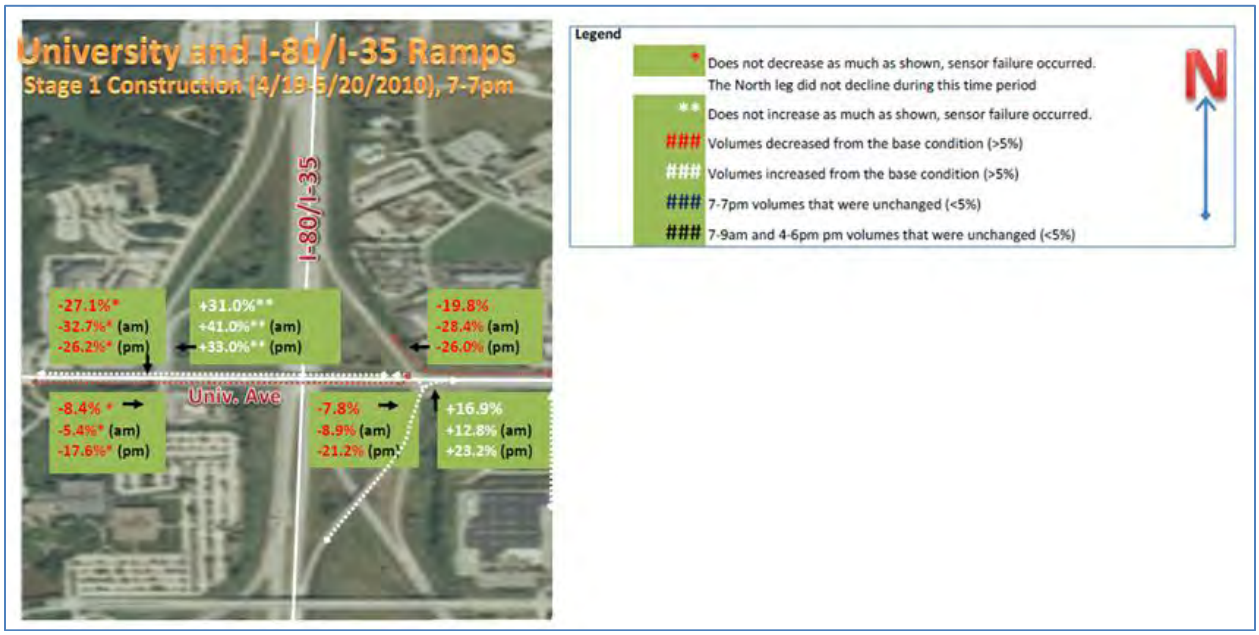


Figure 23. Sample Phase 1 percent volume change from baseline - interchange

University Avenue East Ramp with Interstate 35/80

East Approach: The 12 hour traffic volumes on the east approach decreased (from 12,742 vehicles) in the first two phases by approximately 19 percent. While the through movements increased (~2,000 vehicles), the increase was not as great as the right-turn movements decrease (~4,800 vehicles) due to the northbound ramp closure during these phases. Given the designated through movement would be necessary to access the designated detour route, it appears that drivers may have been using alternate routes.

During the two-hour morning peak, the traffic volume (from nearly 1,400 vehicles) also decreased during the first two phases, at approximately 28 percent and 25 percent, respectively. The through-movement increase was again less than the right-turn decrease.

As with the other time periods, a decrease in the two-hour afternoon peak (from 3,000 vehicles) during the first two phases was observed at approximately 26 percent. The through-movement increase was not equal to the right-turn movement decrease at 800 vehicles and 1,300 vehicles respectively.

South Approach: The south leg experienced an increase in 12 hour traffic (from 5,300 vehicles) of approximately 17 percent during the first phase of construction. This increase was equally distributed between the left- and right-turn movements. Increases were also observed during the peak periods with 13 percent in the morning and 23 percent in the afternoon. Drivers may have been attempting to avoid the work zone or exit early because of the northbound Hickman Road exit ramp closure. The right-turn movement saw the largest increase during the peak hours.

West Approach: Traffic on the west approach demonstrated high variability with low-ending through volumes compared to initial conditions. The immediate decrease in left turns due to the northbound University Avenue on ramp closure was clearly apparent. A similar increase in through movements was immediately observed, which was somewhat unexpected, but that decreased gradually over time.

One could expect that the origin of most of the eastbound drivers wanting to turn left onto the ramp was west of the Interstate, near the designated detour route. This may suggest that eastbound drivers did not use the designated detour route initially, either because they were not aware of it or of the ramp closure, but that drivers began using the detour route or other alternate routes eventually.

I-80/I-35 and University West Ramp

East Approach: As expected, traffic increased on the east approach during the first two project phases, at 31 percent and 15 percent, respectively, during the 12 hour period. The increase was almost entirely in the through movement. However, detector issues limited comprehensive assessment.

North Approach: During the 3rd construction phase when limited access to the southbound University Avenue exit ramp was provided, a decrease in traffic of approximately 20 percent was observed during all three periods (morning peak, afternoon peak, and 12 hour). The decrease was distributed equally between left and right turns.

South Approach: Very low traffic volumes existed on the south approach for all conditions. Therefore, it did not play a significant role in impact evaluation.

West Approach: The west approach experienced a decrease in traffic during the first two construction phases. For both the morning peak and 12 hour period, the decrease was more prominent in the 2nd phase. This may represent use of alternate routes by drivers due to increased awareness of the northbound University on ramp closure.

The observed changes during the first phase may also simply represent natural traffic variations. During the afternoon peak, the traffic volume decreases were greater. A decrease of approximately 18 percent was observed for the first two construction phases.

University Avenue and 128th Street (60th Street)

East Approach: Increases in traffic volumes were observed during the first two construction phases. This was to be expected given its designation as a detour route. The majority of the increases was represented by the right-turn movements (onto the detour); however, through-movements also increased. Right turns increased by approximately 150 vehicles, 400 vehicles, and 1,800 vehicles during the morning peak, afternoon peak, and 12 hour period, respectively.

During the morning peak, traffic increased by approximately 10 percent for the first two phases. The greatest increases were experienced during the afternoon peak at 24 and 18 percent. Total increases of 22 and 17 percent were observed through the 12 hour period.

North Approach: The north approach experienced a traffic volume increase during the 3rd construction phase. This can be explained by the limited access to the southbound University Avenue off ramp during this phase. Approach volumes increased by 10 percent during the morning peak, 18 percent during the afternoon peak, and 23 percent over the 12 hour period.

While all movements increased, left turns increased the most by approximately 130, 120, and 700 vehicles during the morning peak, afternoon peak, and 12 hour period, respectively.

South Approach: Traffic increased on the south approach during the first two construction phases. Increases ranged from 8 to 15 percent (during the three time periods), with the greater increases occurring during the first phase. The afternoon peak had the largest percentage increase in both phases.

University Avenue and 47th Street

Significant variations were exhibited in the east approach through-movement, limiting comprehensive analysis. In general, possible decreases in the east approach volumes during the first two construction phases, and an increase during the 3rd phase (morning peak), were observed. Similar variations in through movements were observed for the west approach, limiting analysis. Through movements appeared to increase during the first construction phase and decrease thereafter.

50th Street and Corporate Drive

Only minor changes in traffic were observed at this intersection during any time period or construction phase. This may be explained by natural variations in traffic patterns and the location of the intersection with respect to the project.

University Avenue and 35th Street/Valley West Drive

All movements on the west and south approaches increased during the first phase of construction, extending into the 2nd phase. Increases (from 9,100 vehicles) of approximately 23, 21, and 20 percent were observed for the morning peak, afternoon peak, and 12 hour period, respectively, on the west approach. Increases (from 7,900 vehicles) of approximately 17, 15, and 9 percent were observed for the morning peak, afternoon peak, and 12 hour period, respectively, on the south approach.

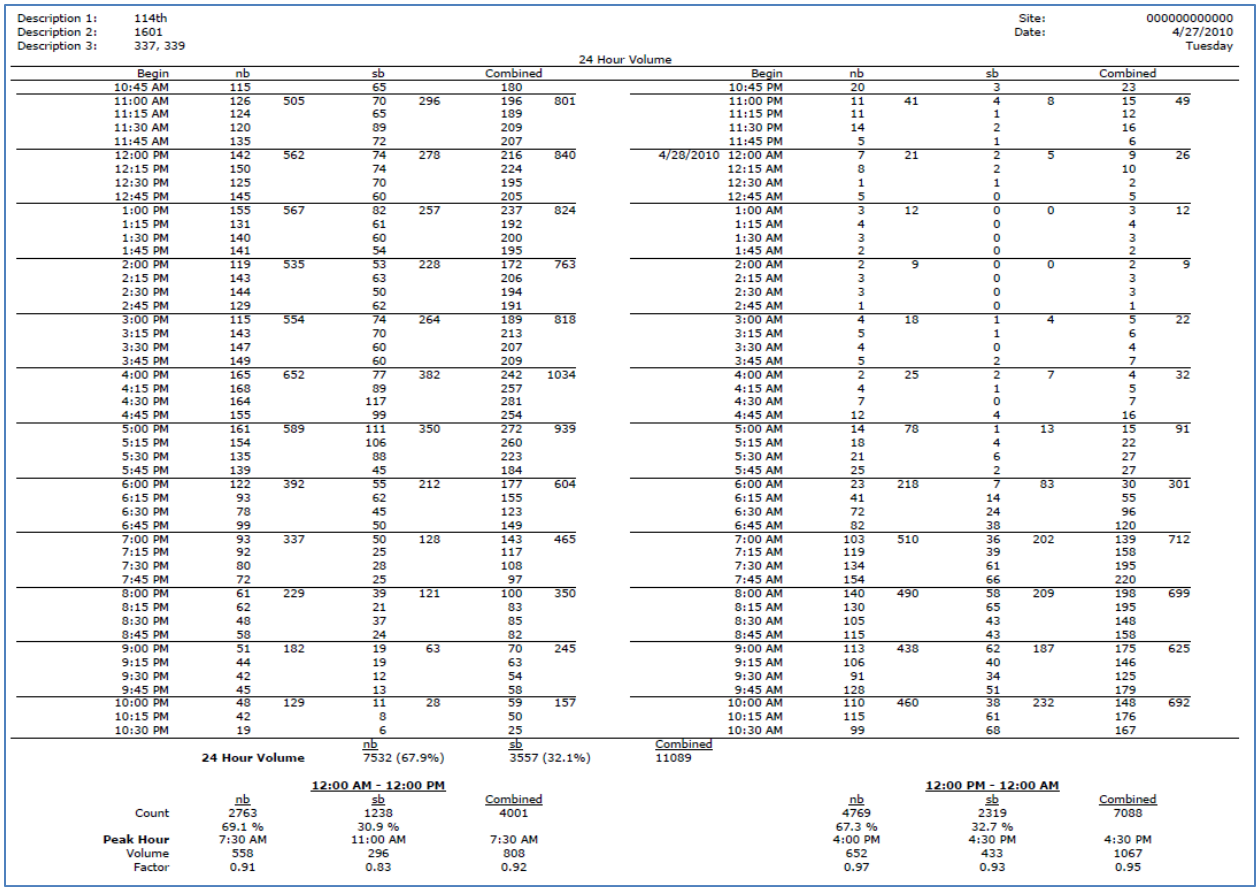
University Avenue and 22nd Street

A slight increase in traffic was observed on the west approach during the first phase of construction. Traffic then stabilized for the reminder of construction. Given the distance of this intersection from the immediately-impacted area and concerns about data quality, few other observations may be made.

Manual Counts

Based on observed traffic volume increases, the City of Clive collected traditional traffic tube-based count data for two streets—114th Street and 128th Street and Sunset Terrace, before and during the northbound University Avenue on ramp closure.

These data were provided in multiple formats, including Excel, Access, and PDF (Figure 24) for several locations.



Description 1: 114th
Description 2: 1601
Description 3: 337, 339

Site: 000000000000
Date: 4/27/2010
Tuesday

24 Hour Volume

Begin	nb		sb		Combined		Begin	nb		sb		Combined	
10:45 AM	115		65		180		10:45 PM	20		3		23	
11:00 AM	126	505	70	296	196	801	11:00 PM	11	41	4	8	15	49
11:15 AM	124		65		189		11:15 PM	11		1		12	
11:30 AM	120		89		209		11:30 PM	14		2		16	
11:45 AM	135		72		207		11:45 PM	5		1		6	
12:00 PM	142	562	74	278	216	840	4/28/2010 12:00 AM	7	21	2	5	9	26
12:15 PM	150		74		224		12:15 AM	8		2		10	
12:30 PM	125		70		195		12:30 AM	1		1		2	
12:45 PM	145		60		205		12:45 AM	5		0		5	
1:00 PM	155	567	82	257	237	824	1:00 AM	3	12	0	0	3	12
1:15 PM	131		61		192		1:15 AM	4		0		4	
1:30 PM	140		60		200		1:30 AM	3		0		3	
1:45 PM	141		54		195		1:45 AM	2		0		2	
2:00 PM	119	535	53	228	172	763	2:00 AM	2	9	0	0	2	9
2:15 PM	143		63		206		2:15 AM	3		0		3	
2:30 PM	144		50		194		2:30 AM	3		0		3	
2:45 PM	129		62		191		2:45 AM	1		0		1	
3:00 PM	115	554	74	264	189	818	3:00 AM	4	18	1	4	5	22
3:15 PM	143		70		213		3:15 AM	5		1		6	
3:30 PM	147		60		207		3:30 AM	4		0		4	
3:45 PM	149		60		209		3:45 AM	5		2		7	
4:00 PM	165	652	77	382	242	1034	4:00 AM	2	25	2	7	4	32
4:15 PM	168		89		257		4:15 AM	4		1		5	
4:30 PM	164		117		281		4:30 AM	7		0		7	
4:45 PM	155		99		254		4:45 AM	12		4		16	
5:00 PM	161	589	111	350	272	939	5:00 AM	14	78	1	13	15	91
5:15 PM	154		106		260		5:15 AM	18		4		22	
5:30 PM	135		88		223		5:30 AM	21		6		27	
5:45 PM	139		45		184		5:45 AM	25		2		27	
6:00 PM	122	392	55	212	177	604	6:00 AM	23	218	7	83	30	301
6:15 PM	93		62		155		6:15 AM	41		14		55	
6:30 PM	78		45		123		6:30 AM	72		24		96	
6:45 PM	99		50		149		6:45 AM	82		38		120	
7:00 PM	93	337	50	128	143	465	7:00 AM	103	510	36	202	139	712
7:15 PM	92		25		117		7:15 AM	119		39		158	
7:30 PM	80		28		108		7:30 AM	134		61		195	
7:45 PM	72		25		97		7:45 AM	154		66		220	
8:00 PM	61	229	39	121	100	350	8:00 AM	140	490	58	209	198	699
8:15 PM	62		21		83		8:15 AM	130		65		195	
8:30 PM	48		37		85		8:30 AM	105		43		148	
8:45 PM	58		24		82		8:45 AM	115		43		158	
9:00 PM	51	182	19	63	70	245	9:00 AM	113	438	62	187	175	625
9:15 PM	44		19		63		9:15 AM	106		40		146	
9:30 PM	42		12		54		9:30 AM	91		34		125	
9:45 PM	45		13		58		9:45 AM	128		51		179	
10:00 PM	48	129	11	28	59	157	10:00 AM	110	460	38	232	148	692
10:15 PM	42		8		50		10:15 AM	115		61		176	
10:30 PM	19		6		25		10:30 AM	99		68		167	

	nb	sb	Combined
24 Hour Volume	7532 (67.9%)	3557 (32.1%)	11089

	12:00 AM - 12:00 PM			12:00 PM - 12:00 AM		
	nb	sb	Combined	nb	sb	Combined
Count	2763	1238	4001	4769	2319	7088
	69.1 %	30.9 %		67.3 %	32.7 %	
Peak Hour	7:30 AM	11:00 AM	7:30 AM	4:00 PM	4:30 PM	4:30 PM
Volume	558	296	808	652	433	1067
Factor	0.91	0.83	0.92	0.97	0.93	0.95

Figure 24. Sample portable tube count format

Attributes included count location, counts by direction of travel for 15 minute intervals, and summary statistics (PDF only). Historic traffic data, from July 2005, were also provided for 114th Street for a frame of reference.

These data were converted into a more user friendly, consistent format and integrated into an Access database for processing and analysis. In some cases, duplicate records were identified and removed from consideration.

Four summary plots were created for each road. These included each time period of interest, i.e., morning peak, afternoon peak, 12 hour, as well as ADT. Directional traffic counts (north and southbound) were presented independently for 128th Street, while data for the two count locations were presented independently for 114th Street. A weekday average was also presented on the 114th Street ADT plot.

Following are the sample ADT plots for each site. Figure 25 presents the change in ADT along 128th Street (the designated detour) during the northbound University Avenue on ramp closure.

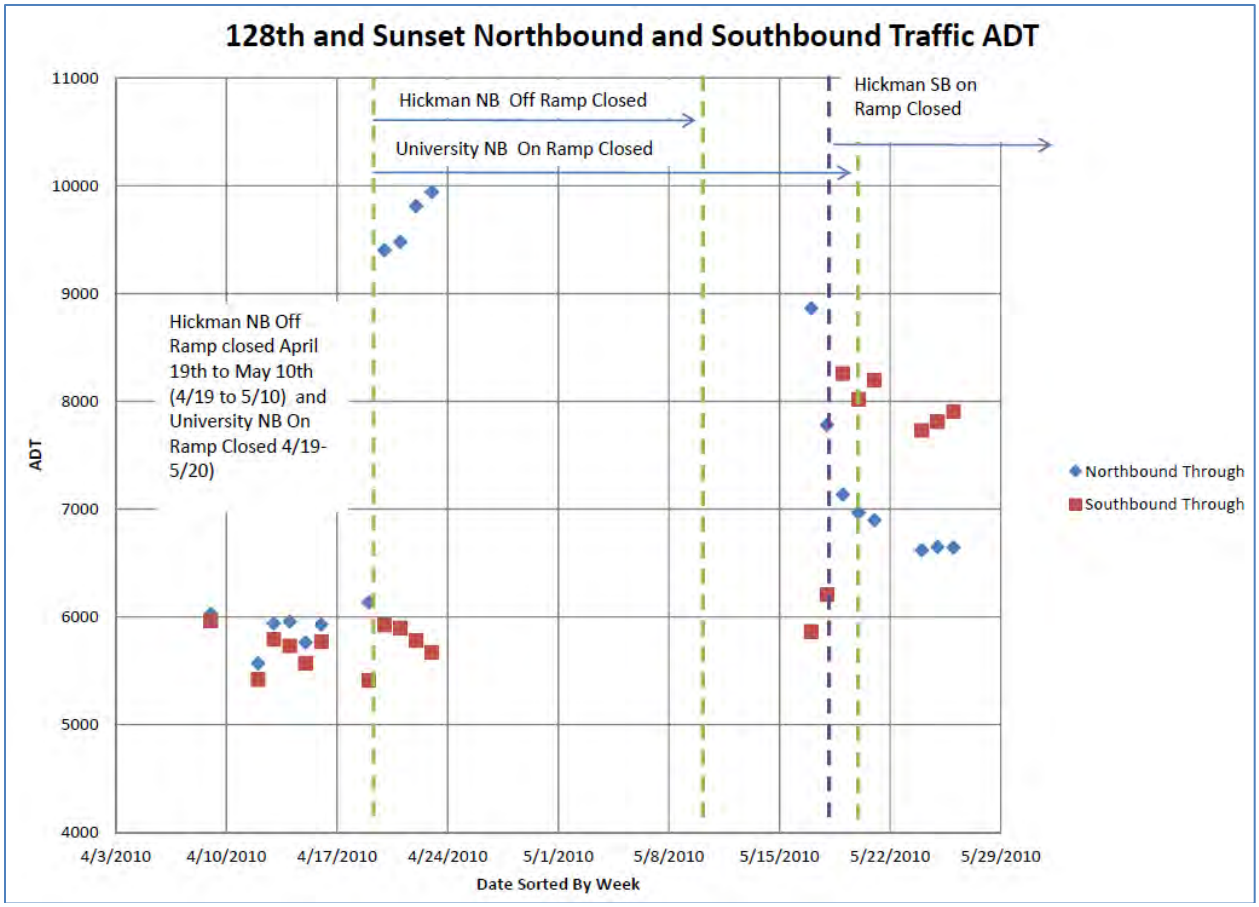


Figure 25. Sample 128th Street ADT change

From this figure, the immediate increase in northbound through traffic is clearly apparent (more than 3,000 vehicles a day). However, data are only available for the transitions between construction phases and not throughout an entire phase. Other data, such as intersection counts, should also be taken into consideration.

A similar, immediate increase in traffic is observed on 114th Street (not a designated detour), in Figure 26.

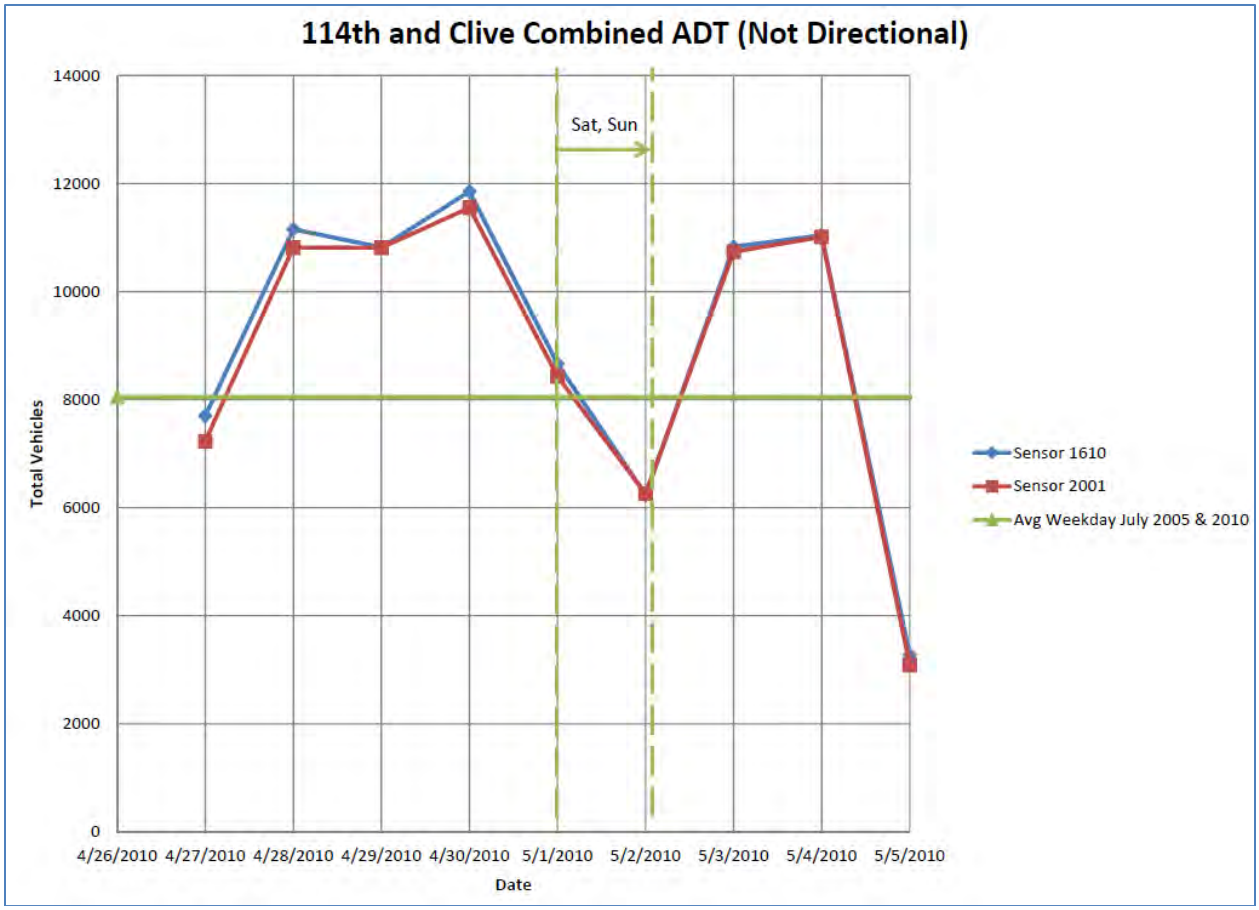


Figure 26. Sample 114th Street ADT change

This increase appeared to be more than 3,000 vehicles per day from the daily average; however, limited data (one week) were available, so other data, such as intersection counts, should also be taken into consideration during assessment.

All figures are included in **Error! Reference source not found.**.

While limited data were available for 128th Street (the designated detour) and Sunset Terrace, large fluctuations (increases) in traffic were present on both the north and south approaches.

For example, during the 3rd phase of construction, the north approach experienced increases of approximately 28, 38, and 39 percent for the morning peak, afternoon peak, and 12 hour period, respectively. As expected, significant increases in traffic were experienced on the south approach, particularly for the first two phases, where the increase was approximately 50 percent (Table 10).

Table 10. Traffic volume changes south approach of 128th Street/Sunset Terrace

Time Period	Phase 1	Phase 2	Phase 3
Two-hour Morning Peak	+53%	+48%	+28%
Two-hour Afternoon Peak	+57%	+47%	+17%
12 Hour	+42%	+43%	+16%

As noted previously, a significant bi-directional traffic increase, of possibly 3,000 to 6,000 vehicles daily, was observed along 114th Street. However, limited data were available; and, there were insufficient data to assess the peak periods.

Conclusions and Recommendations

A limitation of this project was the lack of available or reliable data for some key locations that were impacted by the construction activities, such as Hickman Road, I-35/80, and the intersection of University Avenue and 50th Street.

To obtain sufficient traffic data for these locations, additional investment in infrastructure and/or manual data collection would have been required, but was not within the project scope. Project emphasis was on utilization of existing infrastructure (resources) for work-zone impact assessment. Existing resources were quite extensive.

This project demonstrated that disparate data sets from various sources might be assimilated to conduct systematic analysis over a geographic area of interest. Traffic data, collected through various means, is typically quite extensive (voluminous) and requires a fair amount of effort to integrate, compile, and aggregate discrete data into the most pertinent components.

For example, in this project, 15 minute counts were aggregated into three analysis periods as well as specific locations and movements. Creation of a database facilitating flexibility in analysis is critical.

This project also demonstrated that challenges can exist in obtaining accurate data. Despite the effort to actively reconfigure a Wavetronix SmartSensor™ based on lane position changes, accurate data were not collected, significantly limiting analysis capabilities within the work zone. Data anomalies were also identified in the loop detector and traffic tube-based data. This highlights the need for attention to detail and application of basic quality control and assurance procedures.

Several different data presentation formats were used in this project, including maps, matrices (tables), and graphs. Each presented data at different scales and levels of aggregation. Maps and matrices conveyed average data throughout the system, while graphs provided more depth for individual locations. Used in conjunction, these techniques were all quite effective, and necessary, for data visualization and interpretation.

Evidence suggests that the demand on the local system (and surface streets) induced by ramp closures, particularly the northbound University Avenue entrance ramp, may have not followed anticipated patterns. For example, while traffic increased at or on the designated detour, the order of magnitude was not equivalent to the displaced traffic at the east ramp interchange.

Traffic reductions were experienced on the east approach to the ramp, indicating that westbound drivers were likely choosing alternate routes prior to the designated detour. This was also apparent on the west approach where a large shift in traffic was apparent from eastbound left turns (prohibited because of the ramp closure) to through movements. Theoretically, these through movements should have used the designated detour, given the trips originated west of the ramp closure.

These observations are also supported by the limited tube counts collected by the City of Clive. The observed traffic patterns, particularly eastbound, may suggest that a much more proactive and improved means of communication of the ramp closure and detour route may have been warranted or should be considered in future, similar projects.

The majority of traffic using a route other than the designated detour appears to have used 114th Street, a route parallel to the Interstate to the east. However, no intersection counts were available to confirm this definitively. Traffic data at intersections to the east of the closure demonstrate limited changes, again suggesting use of 114th Street by drivers. Traffic volume increases on this route may be comparable to those on the designated detour.

Unfortunately, given infrastructure limitations, this study could not effectively assess the impact on Hickman Road and its ramps. However, based on observed patterns at or on 128th Street and 114th Street, both intersections with Hickman Road experienced increased demand.

In general, several high-volume, congested intersections on University Avenue and Hickman Road, beyond those designated as detours, experienced traffic volume increases during the work zone, potentially having an impact on their levels of service. The City of West Des Moines employed traffic cameras to adjust signal timing to accommodate the increased demand. In future assessments, queuing may be another metric of interest.

Finally, detour compensation to the affected local agencies may not be sufficient if only the designated detour route is considered.

Even with a project kick-off meeting between the research team, the Iowa DOT, and impacted agencies, the data needs for this project were not met, and this is unfortunate. Future research efforts should include the resources to install field-monitoring assets to facilitate collecting the critical data needed to conduct a complete analysis.

Relying on existing data sources can consume unjustifiable efforts in reducing and formatting data, provides no means of quality control, and, as in this project, negates the opportunity to react to equipment failures during critical observational periods.

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APPENDIX A. SENSOR LOCATIONS AND MANUAL VIDEO REDUCTION

A.1 Sensor Locations

Figure 27. MVDS34 – eastbound West to 2nd Avenue

Figure 28. MVDS35 – eastbound to 2nd Avenue

Figure 29. MVDS36 – eastbound from 2nd Avenue

Figure 30. MVDS37 – westbound to East 14th Street

A.2 Traffic Camera Video Reduction

Figure 31. Merle Hay Road sample video reduction image – outside lanes 9/11/2008

Table 11. Merle Hay Road video reduction summary – outside lanes 9/11/2008

		EB Ln 1 (RT)		EB Ln 2 (LT)		WB Ln 3 (LT)		WB Ln 4 (RT)		
Minute	*Frames*	veh	veh/hr	veh	veh/hr	veh	veh/hr	veh	veh/hr	Comments
1	*600*	**10**	600	**16**	960	**19**	1,140	**16**	960	
2	*1200*	**13**	780	**15**	900	**9**	540	**14**	840	
3	*1800*	**9**	540	**25**	1,500	**17**	1,020	**12**	720	
4	*2400*	**13**	780	**20**	1,200	**19**	1,140	**15**	900	
5	*3000*	**12**	720	**17**	1,020	**14**	840	**8**	480	
6	*3600*	**6**	360	**17**	1,020	**17**	1,020	**8**	480	
7	*4200*	**12**	720	**18**	1,080	**18**	1,080	**11**	660	
8	*4800*	**8**	480	**15**	900	**22**	1,320	**6**	360	
9	*5400*	**11**	660	**15**	900	**21**	1,260	**10**	600	
10	*6000*	**14**	840	**22**	1,320	**26**	1,560	**6**	360	
11	*6600*	**12**	720	**20**	1,200	**17**	1,020	**12**	720	
12	*7200*	**11**	660	**18**	1,080	**13**	780	**8**	480	
	Average=	**11**	655	**18**	1,090	**18**	1,060	**11**	630	

Figure 32. Merle Hay Road sample video reduction sample image – inside lanes 9/16/2008

Table 12. Merle Hay Road video reduction summary – inside lanes 9/16/2008

		EB Ln 1 (RT)		EB Ln 2 (LT)		WB Ln 3 (LT)		WB Ln 4 (RT)		
Minute	*Frames*	veh	veh/hr	veh	veh/hr	veh	veh/hr	veh	veh/hr	Comments
1	*600*	**26**	1,560	**35**	2,100	**31**	1,860	**17**	1,020	
2	*1200*	**19**	1,140	**34**	2,040	**26**	1,560	**24**	1,440	
3	*1800*	**16**	960	**22**	1,320	**33**	1,980	**22**	1,320	
4	*2400*	**21**	1,260	**29**	1,740	**27**	1,620	**18**	1,080	
5	*3000*	**21**	1,260	**30**	1,800	**24**	1,440	**14**	840	
6	*3600*	**24**	1,440	**27**	1,620	**38**	2,280	**17**	1,020	heavy traffic
7	*4200*	**23**	1,380	**33**	1,980	**26**	1,560	**18**	1,080	
8	*4800*	**17**	1,020	**32**	1,920	**35**	2,100	**17**	1,020	
9	*5400*	**20**	1,200	**37**	2,220	**25**	1,500	**21**	1,260	
10	*6000*	**18**	1,080	**35**	2,100	**24**	1,440	**17**	1,020	
11	*6600*	**24**	1,440	**26**	1,560	**30**	1,800	**19**	1,140	
12	*7200*	**20**	1,200	**21**	1,260	**22**	1,320	**13**	780	
	Average=	**21**	1,245	**30**	1,805	**28**	1,705	**18**	1,085	

Figure 33. 2nd Avenue sample video reduction image – outside lanes 9/9/2008

Table 13. 2nd Avenue video reduction summary – outside lanes 9/9/2008

		EB Ln 1 (RT)		EB Ln 2 (LT)		WB Ln 3 (LT)		WB Ln 4 (RT)		
Minute	*Frames*	veh	veh/hr	veh	veh/hr	veh	veh/hr	veh	veh/hr	Comments
1	*600*	**10**	600	**16**	960	**17**	1,020	**16**	960	
2	*1200*	**24**	1,440	**20**	1,200	**28**	1,680	**16**	960	
3	*1800*	**19**	1,140	**17**	1,020	**24**	1,440	**11**	660	
4	*2400*	**15**	900	**21**	1,260	**26**	1,560	**15**	900	
5	*3000*	**23**	1,380	**19**	1,140	**21**	1,260	**12**	720	
6	*3600*	**19**	1,140	**21**	1,260	**27**	1,620	**8**	480	
7	*4200*	**17**	1,020	**22**	1,320	**17**	1,020	**12**	720	
8	*4800*	**18**	1,080	**22**	1,320	**20**	1,200	**12**	720	
9	*5400*	**27**	1,620	**23**	1,380	**34**	2,040	**19**	1,140	heavy traffic
10	*6000*	**19**	1,140	**22**	1,320	**28**	1,680	**14**	840	
11	*6600*	**14**	840	**21**	1,260	**19**	1,140	**12**	720	
12	*7200*	**19**	1,140	**15**	900	**15**	900	**9**	540	
13	*7800*	**18**	1,080	**17**	1,020	**20**	1,200	**13**	780	
14	*8400*	**15**	900	**23**	1,380	**32**	1,920	**13**	780	heavy traffic
15	*9000*	**24**	1,440	**31**	1,860	**21**	1,260	**11**	660	
	Average=	**19**	1,124	**21**	1,240	**23**	1,396	**13**	772	

Figure 34. 2nd Avenue sample video reduction image – outside lanes 9/11/2008

Table 14. 2nd Avenue video reduction summary – outside lanes 9/11/2008

		EB Ln 1 (RT)		EB Ln 2 (LT)		WB Ln 3 (LT)		WB Ln 4 (RT)		
Minute	*Frames*	veh	veh/hr	veh	veh/hr	veh	veh/hr	veh	veh/hr	Comments
1	*600*	**21**	1,260	**29**	1,740	**29**	1,740		-	Couldn't see LN4
2	*1200*	**18**	1,080	**20**	1,200	**27**	1,620		-	Couldn't see LN5
3	*1800*	**19**	1,140	**16**	960	**31**	1,860	**25**	1,500	brake lights wb
4	*2400*	**25**	1,500	**29**	1,740	**37**	2,220	**23**	1,380	brake lights wb
5	*3000*	**25**	1,500	**26**	1,560	**26**	1,560	**20**	1,200	brake lights wb
	Average=	**22**	1,296	**24**	1,440	**30**	1,800	**23**	816	

Figure 35. 2nd Avenue sample video reduction image – outside lanes 9/11/2008 (Part1)

Table 15. 2nd Avenue video reduction summary – outside lanes 9/11/2008 (Part 1)

		EB Ln 1 (RT)		EB Ln 2 (LT)		WB Ln 3 (LT)		WB Ln 4 (RT)		
Minute	*Frames*	veh	veh/hr	veh	veh/hr	veh	veh/hr	veh	veh/hr	Comments
1	*600*	**28**	1,680	**22**	1,320	**26**	1,560	**19**	1,140	
2	*1200*	**31**	1,860	**30**	1,800	**36**	2,160	**21**	1,260	
3	*1800*	**13**	780	**26**	1,560	**28**	1,680	**19**	1,140	
	Average=	**24**	1,440	**26**	1,560	**30**	1,800	**20**	1,180	

Figure 36. 2nd Avenue sample video reduction image – outside lanes 9/11/2008 (Part 2)

Table 16. 2nd Avenue video reduction summary – outside lanes 9/11/2008 (Part 2)

		EB Ln 1 (RT)		EB Ln 2 (LT)		WB Ln 3 (LT)		WB Ln 4 (RT)		
Minute	*Frames*	veh	veh/hr	veh	veh/hr	veh	veh/hr	veh	veh/hr	Comments
1	*600*	**21**	1,260	**24**	1,440	**31**	1,860	**24**	1,440	
2	*1200*	**25**	1,500	**26**	1,560	**31**	1,860	**31**	1,860	
3	*1800*	**23**	1,380	**33**	1,980	**31**	1,860	**33**	1,980	
4	*2400*	**28**	1,680	**28**	1,680	**30**	1,800	**29**	1,740	
5	*3000*	**24**	1,440	**20**	1,200	**33**	1,980	**28**	1,680	braking wb
	Average=	**24**	1,452	**26**	1,572	**31**	1,872	**29**	1,740	

Figure 37. East 14th Street sample video reduction image - outside lanes 9/9/2008

Figure 38. East 14th Street sample video reduction image - outside lanes - evasive action 9/9/2008

Table 17. East 14th Street video reduction summary - outside lanes 9/9/2008

		EB Ln 1 (RT)		EB Ln 2 (LT)		
Minute	*Frames*	veh	veh/hr	veh	veh/hr	Comments
1	*600*	**17**	1,020	**29**	1,740	
2	*1200*	**14**	840	**28**	1,680	major back up lane 2 (sudden stop)
3	*1800*	**15**	900	**19**	1,140	
4	*2400*	**20**	1,200	**29**	1,740	
5	*3000*	**19**	1,140	**29**	1,740	
6	*3600*	**29**	1,740	**31**	1,860	seems max flow left lane
7	*4200*	**11**	660	**22**	1,320	seems max flow left lane
8	*4800*	**23**	1,380	**22**	1,320	seems max flow left lane
9	*5400*	**19**	1,140	**24**	1,440	braking in left lane
10	*6000*	**21**	1,260	**23**	1,380	braking in left lane
11	*6600*	**19**	1,140	**29**	1,740	
12	*7200*	**16**	960	**27**	1,620	
13	*7800*	**21**	1,260	**27**	1,620	
14	*8400*	**12**	720	**22**	1,320	
15	*9000*	**15**	900	**25**	1,500	
	Average=	**18**	1,084	**26**	1,544	

Figure 39. East 14th Street sample video reduction image - outside lanes 9/11/2008

Table 18. East 14th Street video reduction summary - outside lanes 9/11/2008

		EB Ln 1 (RT)		EB Ln 2 (LT)		
Minute	*Frames*	veh	veh/hr	veh	veh/hr	Comments
1	*600*	**13**	780	**32**	1,920	
2	*1200*	**12**	720	**28**	1,680	
3	*1800*	**9**	540	**29**	1,740	
4	*2400*	**15**	900	**24**	1,440	
5	*3000*	**18**	1,080	**28**	1,680	
	Average=	**13**	804	**28**	1,692	

Figure 40. East 14th Street sample video reduction image - inside lanes 9/12/2008 (Part 1)

Table 19. East 14th Street video reduction summary - inside lanes 9/12/2008 (Part 1)

		EB Ln 1 (RT)		EB Ln 2 (LT)		
Minute	*Frames*	veh	veh/hr	veh	veh/hr	Comments
1	*600*	**19**	1,140	**12**	720	
2	*1200*	**16**	960	**17**	1,020	
	Average=	**18**	1,050	**15**	870	

Figure 41. East 14th Street sample video reduction image - inside lanes 9/12/2008 (Part 2)

Table 20. East 14th Street video reduction summary - inside lanes 9/12/2008 (Part 2)

		EB Ln 1 (RT)		EB Ln 2 (LT)		
Minute	*Frames*	veh	veh/hr	veh	veh/hr	Comments
1	*600*	**18**	1,080	**15**	900	
2	*1200*	**18**	1,080	**13**	780	
	Average=	**18**	1,080	**14**	840	

Figure 42. East 14th Street sample video reduction image - inside lanes 9/12/2008 (Part 3)

Table 21. East 14th Street video reduction summary - inside lanes 9/12/2008 (Part 3)

		EB Ln 1 (RT)		EB Ln 2 (LT)		
Minute	*Frames*	veh	veh/hr	veh	veh/hr	Comments
1	*600*	**15**	900	**14**	840	some braking due to saw cutting but free flow
2	*1200*	**16**	960	**10**	600	
	Average=	**16**	930	**12**	720	

Figure 43. East 14th Street sample video reduction image - inside lanes 9/13/2008

Table 22. East 14th Street video reduction summary - inside lanes 9/13/2008

		EB Ln 1 (RT)		EB Ln 2 (LT)		
Minute	*Frames*	veh	veh/hr	veh	veh/hr	Comments
1	*600*	**4**	240	**5**	300	
2	*1200*	**4**	240	**7**	420	
	Average=	**4**	240	**6**	360	

Figure 44. East 14th Street sample video reduction image - all lanes (no work zone) 10/15/2008

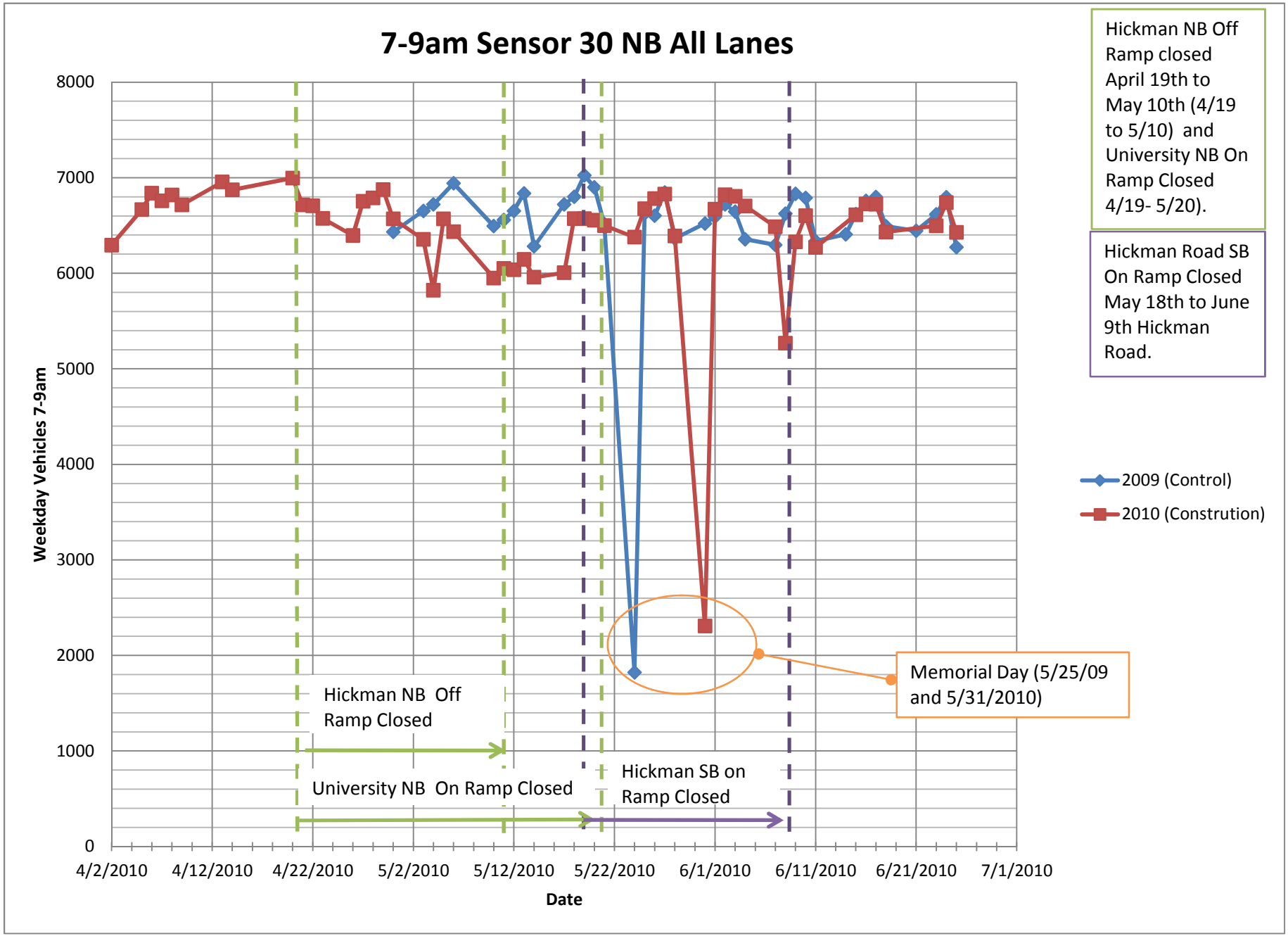
Table 23. East 14th Street video reduction summary - all lanes (no work zone) 10/15/2008

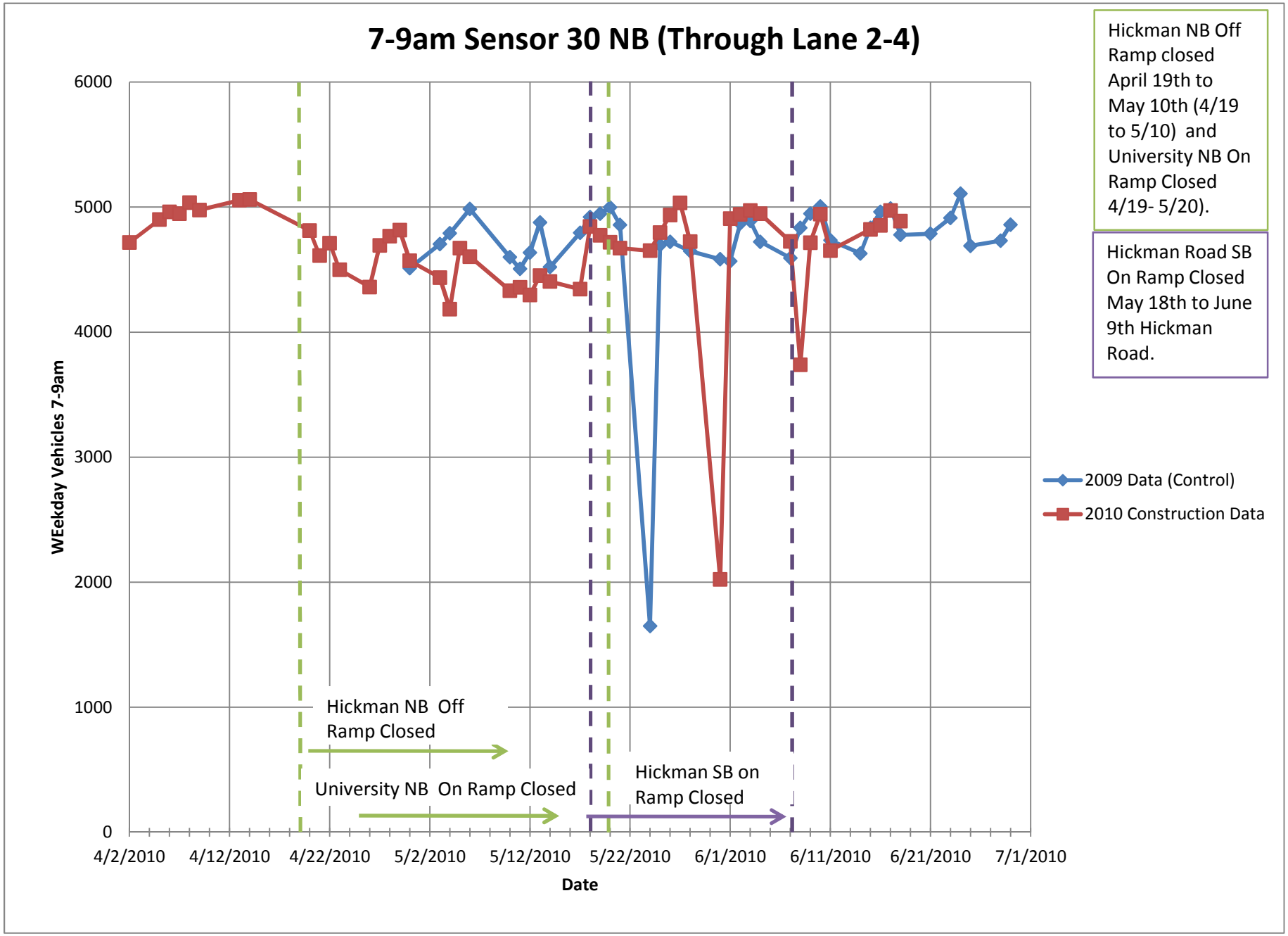
		EB Ln 1 (RT)		EB Ln 2		EB Ln 3		EB Ln 4 (LT)		
Minute	*Frames*	veh	veh/hr	veh	veh/hr	veh	veh/hr	veh	veh/hr	Comments
1	*600*	**0**	-	**10**	600	**11**	660	**13**	780	
2	*1200*	**1**	60	**8**	480	**8**	480	**21**	1,260	
3	*1800*	**0**	-	**10**	600	**17**	1,020	**13**	780	
4	*2400*	**1**	60	**9**	540	**7**	420	**15**	900	
5	*3000*	**0**	-	**10**	600	**16**	960	**15**	900	
	Average=	**0**	24	**9**	564	**12**	708	**15**	924	

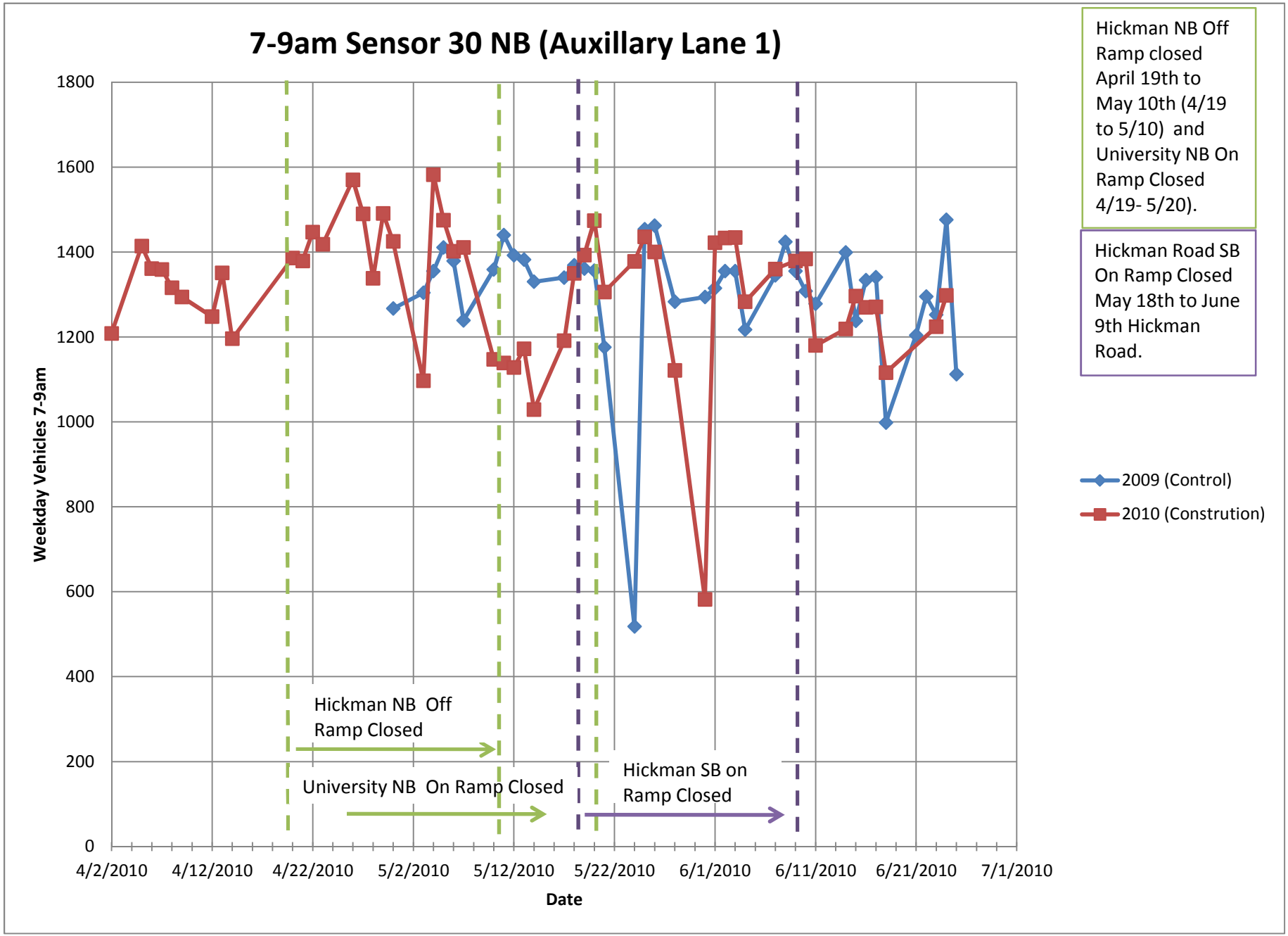
APPENDIX B. TRAFFIC VOLUME CHANGES

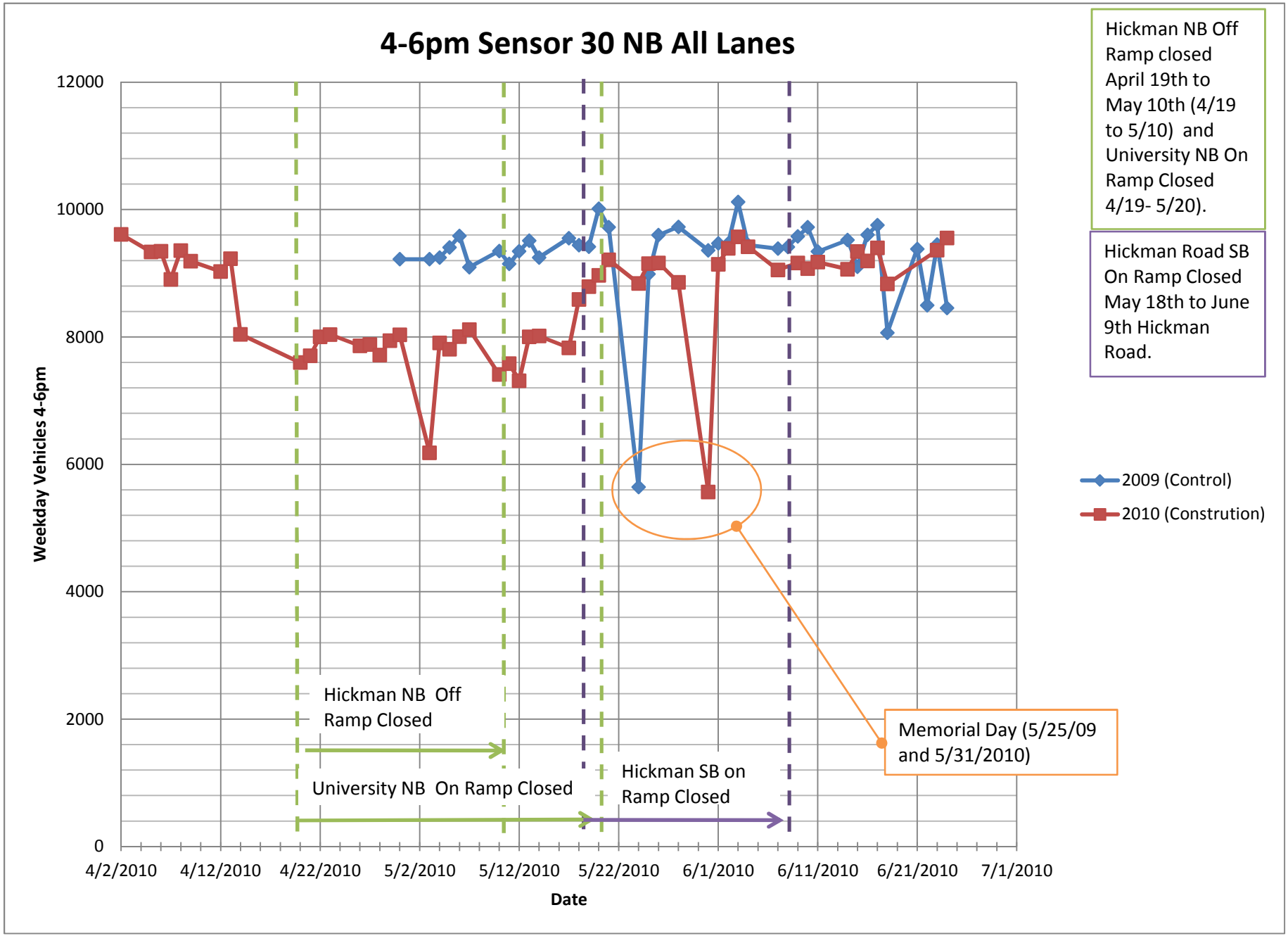
B.1 Freeway Mainline Traffic-Volume Changes

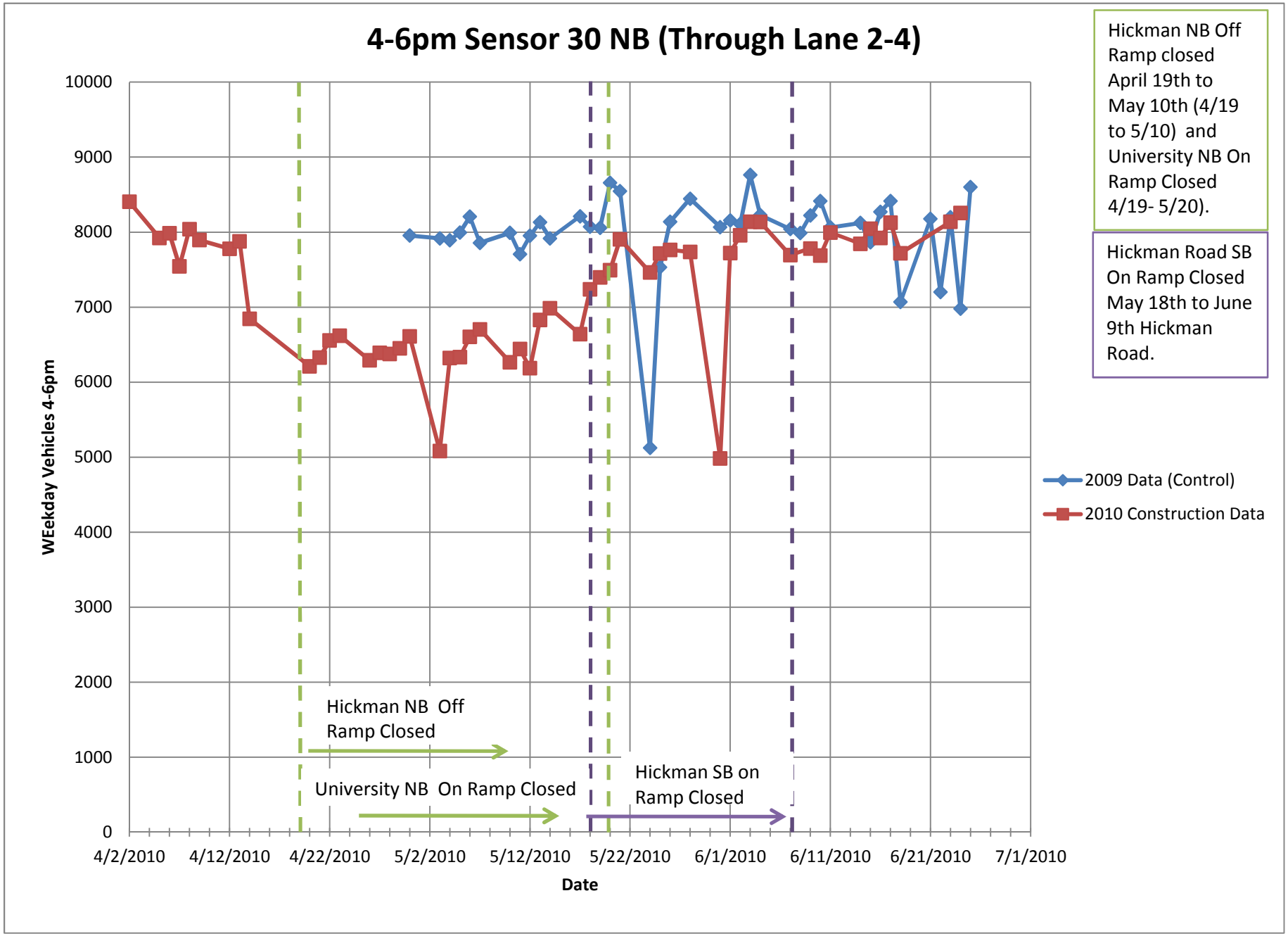
Sensor 30

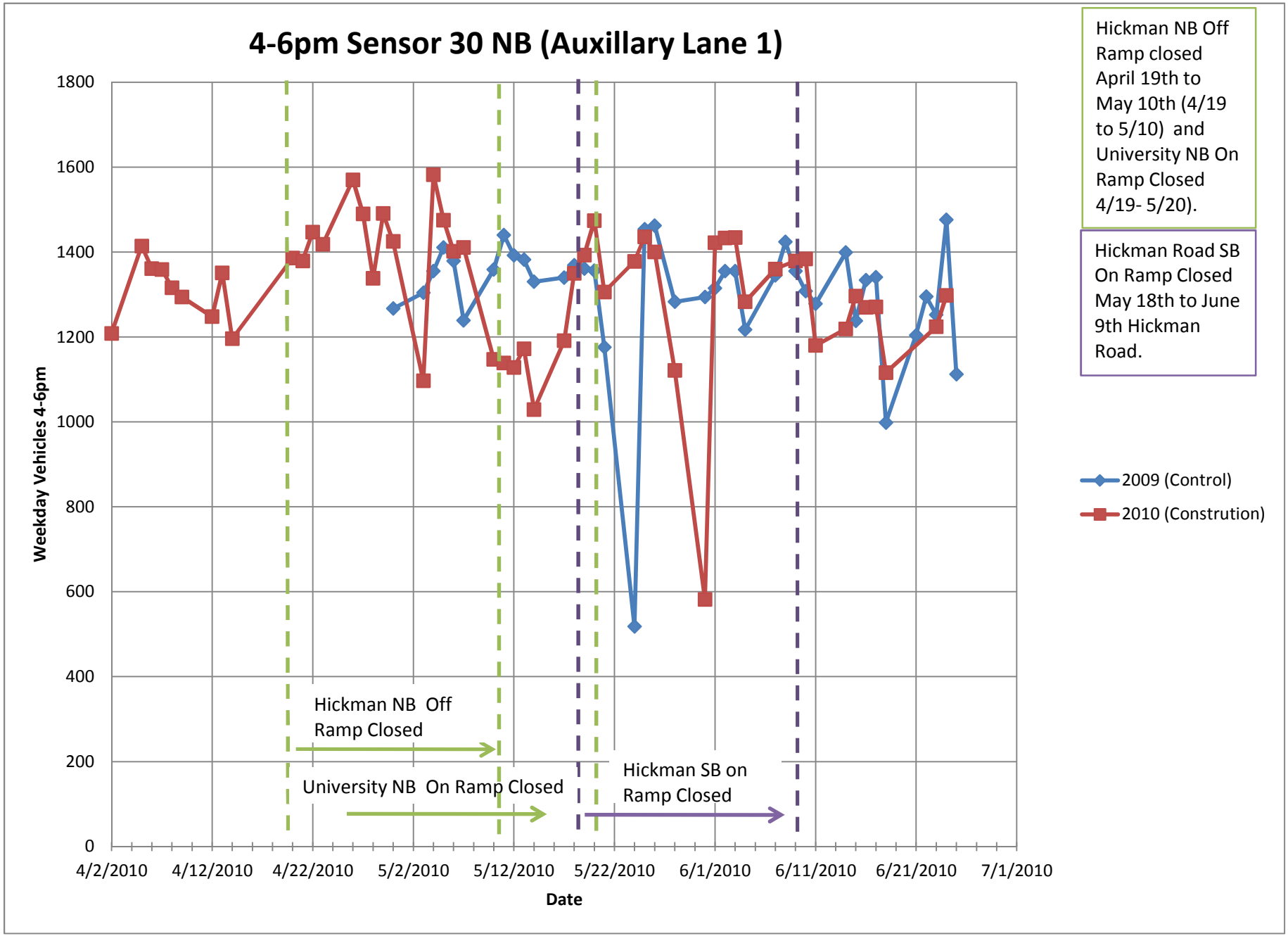

7-9am Sensor 30 NB All Lanes
Weekday Vehicles 7-9am
8000
7000
6000
5000
4000
3000
2000
1000
0
4/2/2010
4/12/2010
4/22/2010
5/2/2010
5/12/2010
5/22/2010
6/1/2010
6/11/2010
6/21/2010
7/1/2010
Date
Hickman NB Off Ramp closed April 19th to May 10th (4/19 to 5/10) and University NB On Ramp Closed 4/19- 5/20).
Hickman Road SB On Ramp Closed May 18th to June 9th Hickman Road.
2009 (Control)
2010 (Constrution)
Memorial Day (5/25/09 and 5/31/2010)
Hickman NB Off Ramp Closed
University NB On Ramp Closed
Hickman SB on Ramp Closed

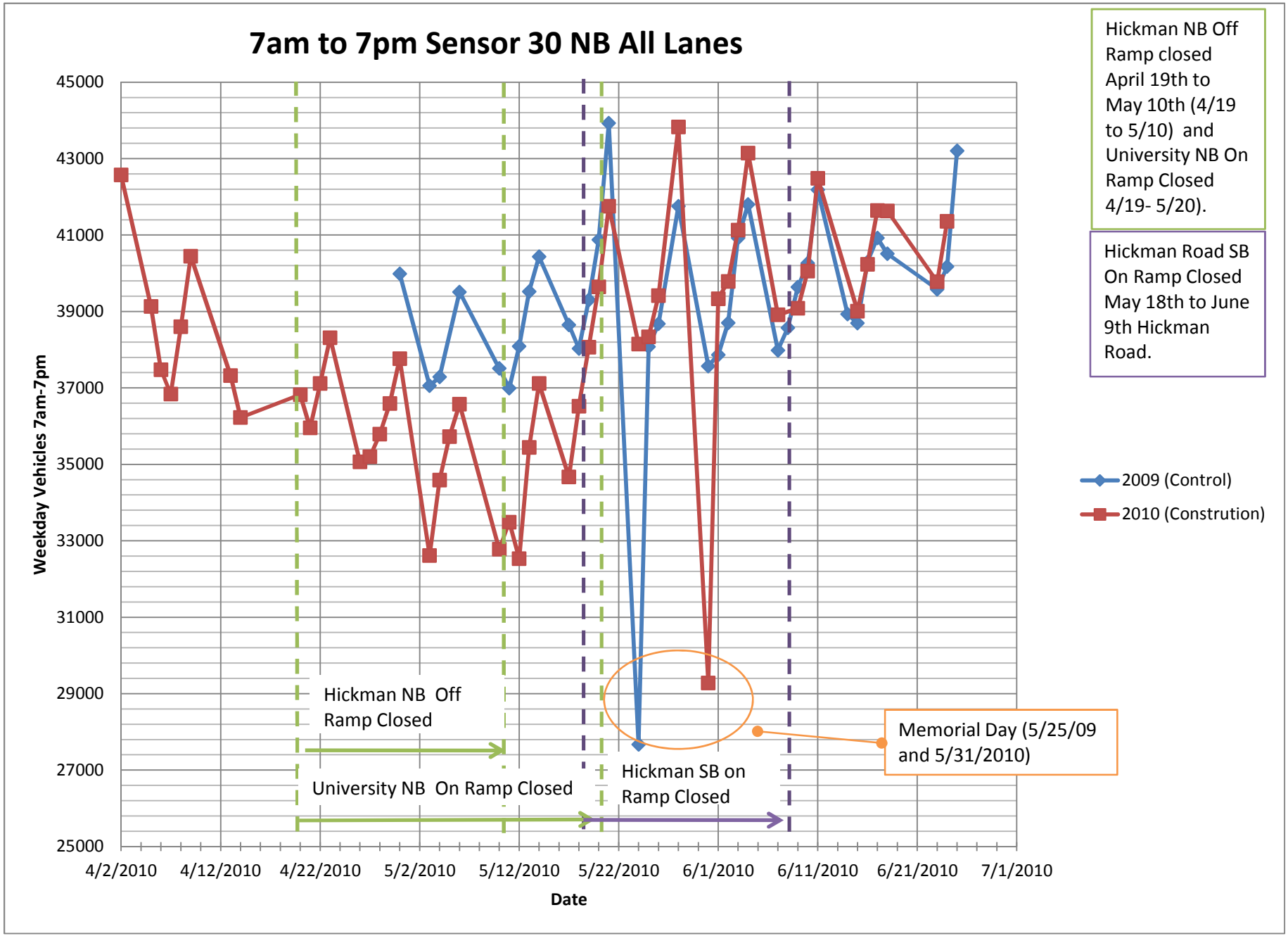

7-9am Sensor 30 NB (Through Lane 2-4)
Hickman NB Off Ramp closed April 19th to May 10th (4/19 to 5/10) and University NB On Ramp Closed 4/19- 5/20).
Hickman Road SB On Ramp Closed May 18th to June 9th Hickman Road.
WEekday Vehicles 7-9am
6000
5000
4000
3000
2000
1000
0
4/2/2010
4/12/2010
4/22/2010
5/2/2010
5/12/2010
5/22/2010
6/1/2010
6/11/2010
6/21/2010
7/1/2010
Date
2009 Data (Control)
2010 Construction Data
Hickman NB Off Ramp Closed
University NB On Ramp Closed
Hickman SB on Ramp Closed

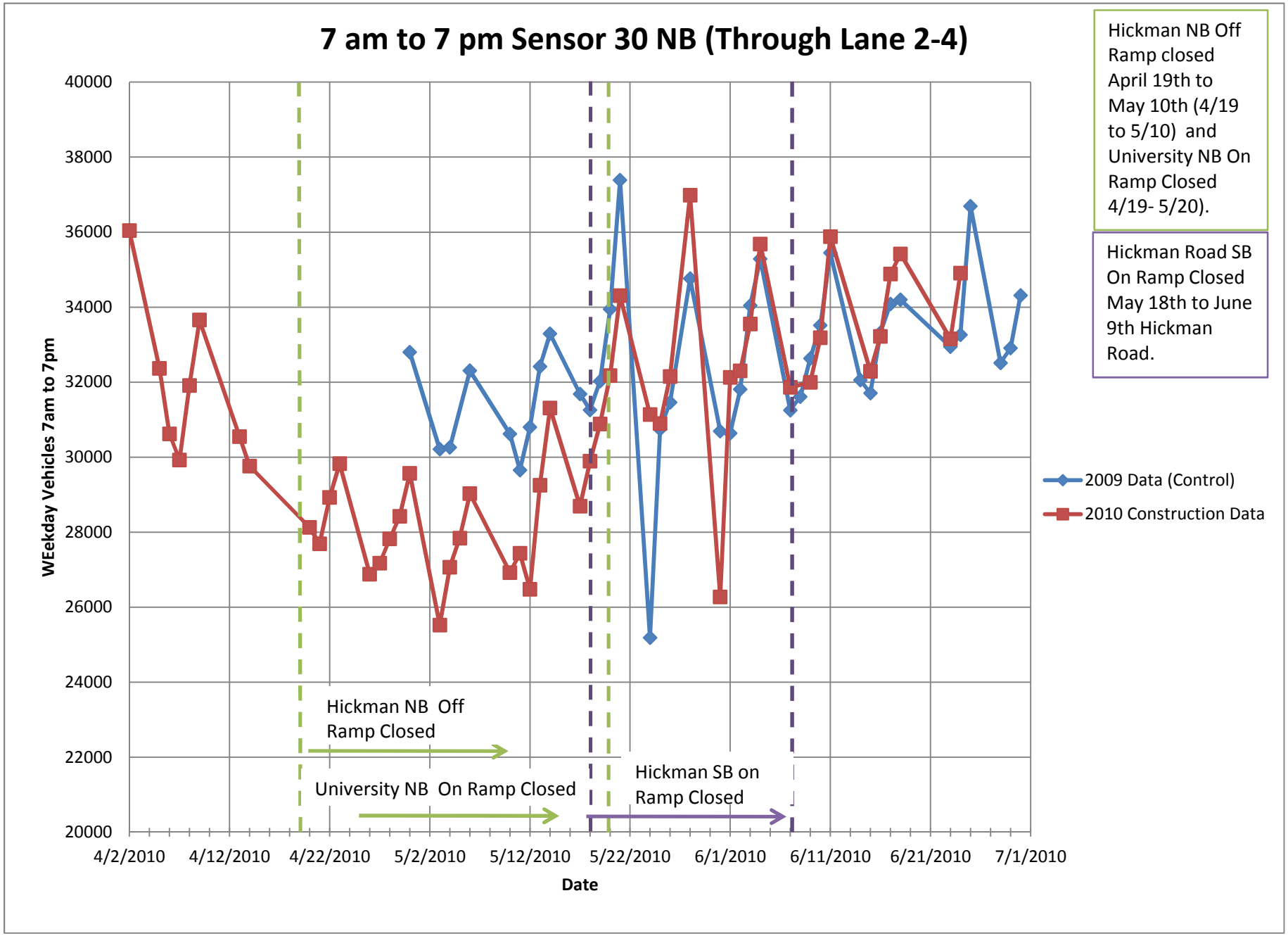

7-9am Sensor 30 NB (Auxillary Lane 1)
Weekday Vehicles 7-9am
1800
1600
1400
1200
1000
800
600
400
200
0
4/2/2010
4/12/2010
4/22/2010
5/2/2010
5/12/2010
5/22/2010
6/1/2010
6/11/2010
6/21/2010
7/1/2010
Date
Hickman NB Off Ramp Closed
University NB On Ramp Closed
Hickman SB on Ramp Closed
Hickman NB Off Ramp closed April 19th to May 10th (4/19 to 5/10) and University NB On Ramp Closed 4/19- 5/20).
Hickman Road SB On Ramp Closed May 18th to June 9th Hickman Road.
2009 (Control)
2010 (Constrution)

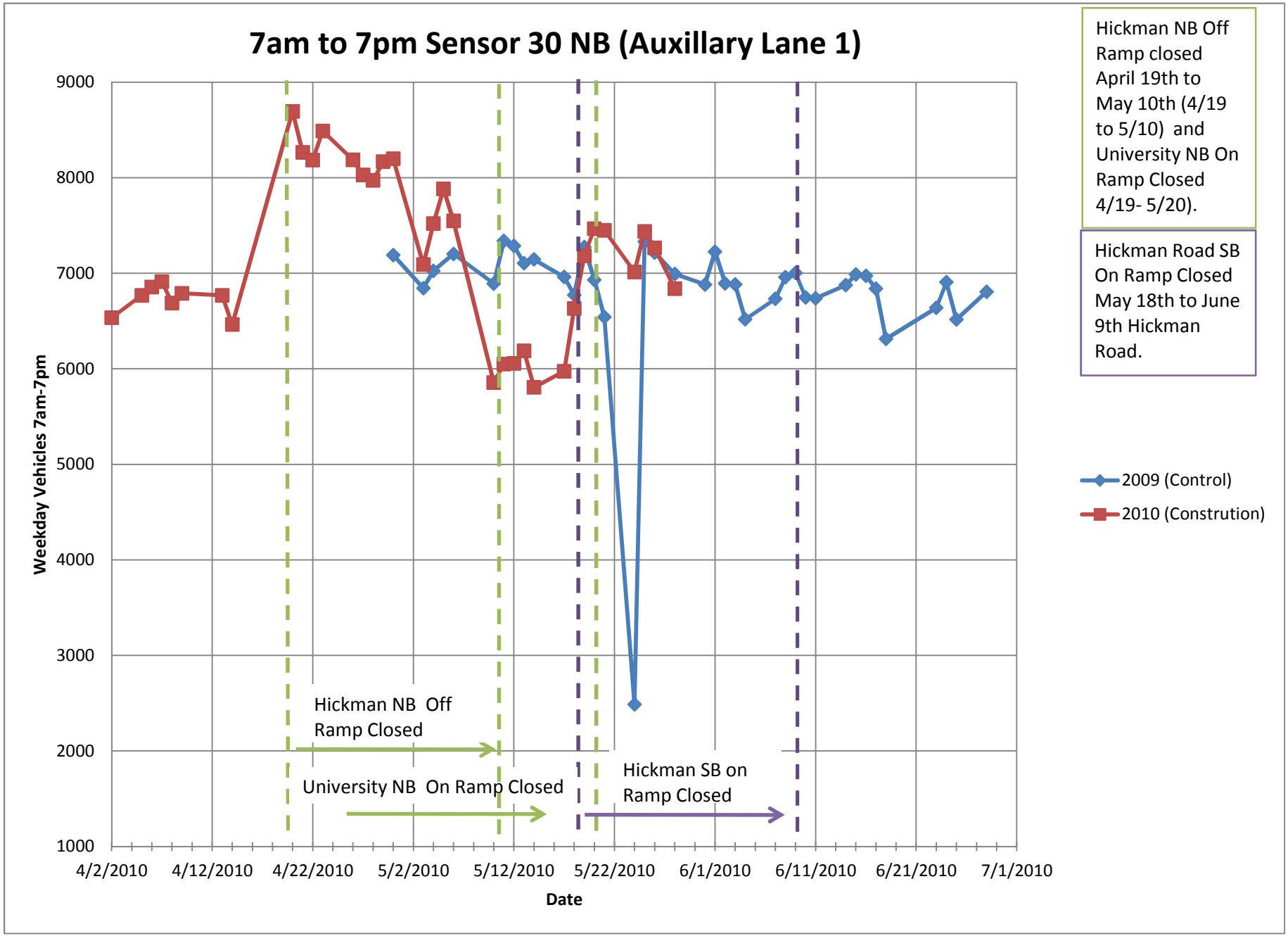

4-6pm Sensor 30 NB All Lanes
Weekday Vehicles 4-6pm
12000
10000
8000
6000
4000
2000
0
4/2/2010
4/12/2010
4/22/2010
5/2/2010
5/12/2010
5/22/2010
6/1/2010
6/11/2010
6/21/2010
7/1/2010
Date
Hickman NB Off Ramp closed April 19th to May 10th (4/19 to 5/10) and University NB On Ramp Closed 4/19- 5/20).
Hickman Road SB On Ramp Closed May 18th to June 9th Hickman Road.
2009 (Control)
2010 (Constrution)
Hickman NB Off Ramp Closed
University NB On Ramp Closed
Hickman SB on Ramp Closed
Memorial Day (5/25/09 and 5/31/2010)

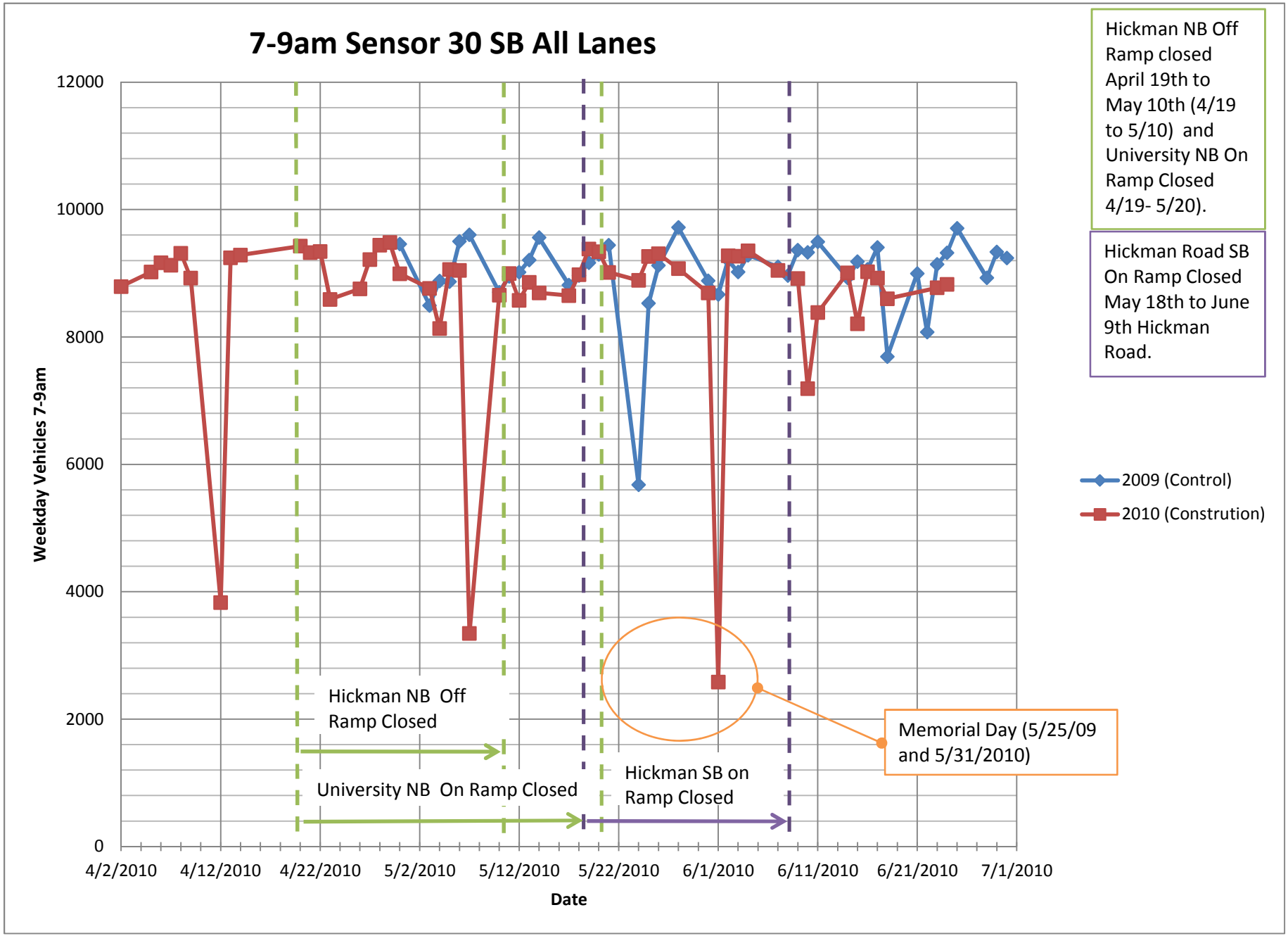

4-6pm Sensor 30 NB (Through Lane 2-4)
Hickman NB Off Ramp closed April 19th to May 10th (4/19 to 5/10) and University NB On Ramp Closed 4/19- 5/20).
Hickman Road SB On Ramp Closed May 18th to June 9th Hickman Road.
WEekday Vehicles 4-6pm
10000
9000
8000
7000
6000
5000
4000
3000
2000
1000
0
4/2/2010
4/12/2010
4/22/2010
5/2/2010
5/12/2010
5/22/2010
6/1/2010
6/11/2010
6/21/2010
7/1/2010
Date
2009 Data (Control)
2010 Construction Data
Hickman NB Off Ramp Closed
University NB On Ramp Closed
Hickman SB on Ramp Closed

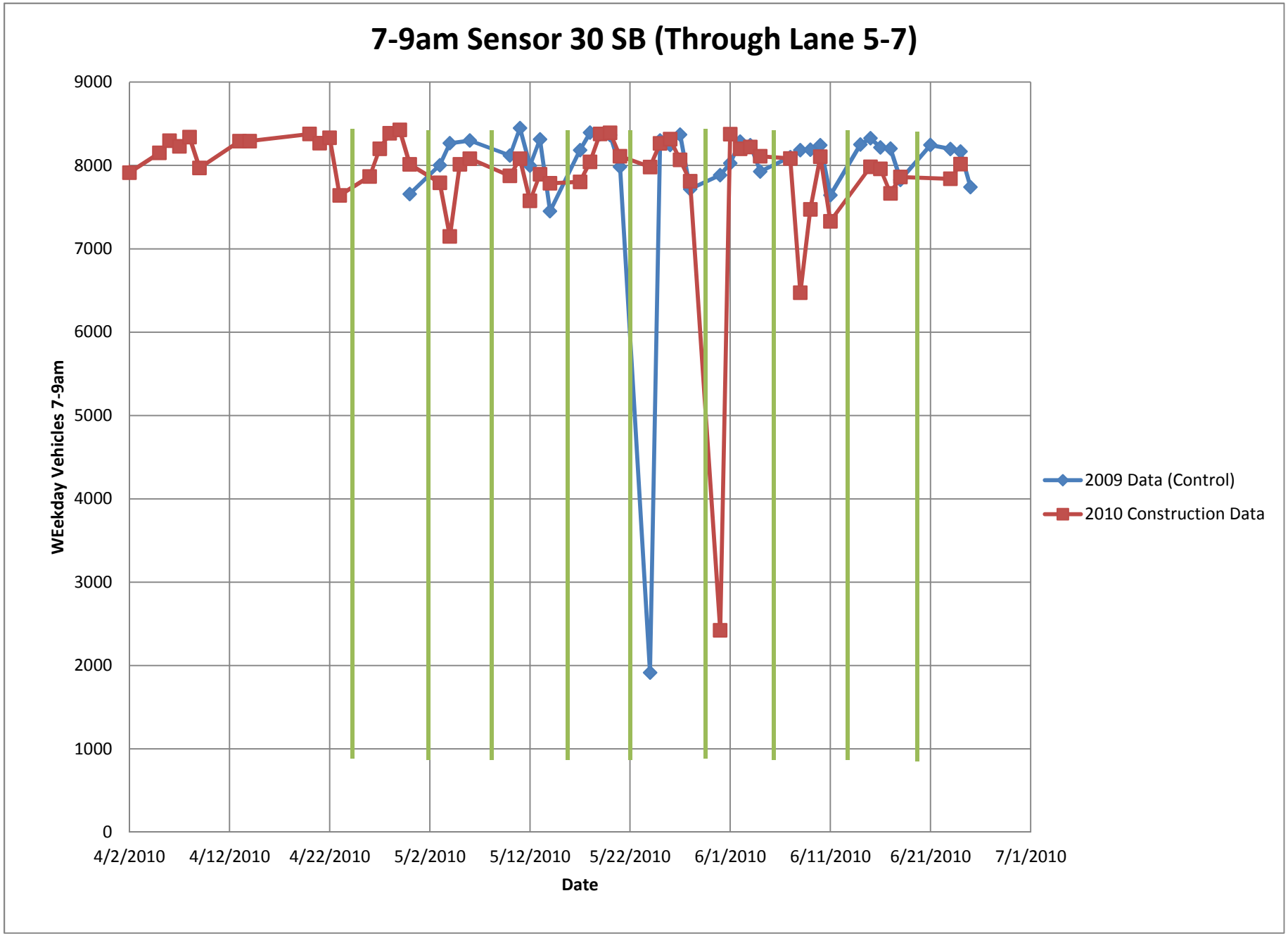

4-6pm Sensor 30 NB (Auxillary Lane 1)
Weekday Vehicles 4-6pm
1800
1600
1400
1200
1000
800
600
400
200
0
4/2/2010
4/12/2010
4/22/2010
5/2/2010
5/12/2010
5/22/2010
6/1/2010
6/11/2010
6/21/2010
7/1/2010
Date
Hickman NB Off Ramp Closed
University NB On Ramp Closed
Hickman SB on Ramp Closed
Hickman NB Off Ramp closed April 19th to May 10th (4/19 to 5/10) and University NB On Ramp Closed 4/19- 5/20).
Hickman Road SB On Ramp Closed May 18th to June 9th Hickman Road.
2009 (Control)
2010 (Constrution)

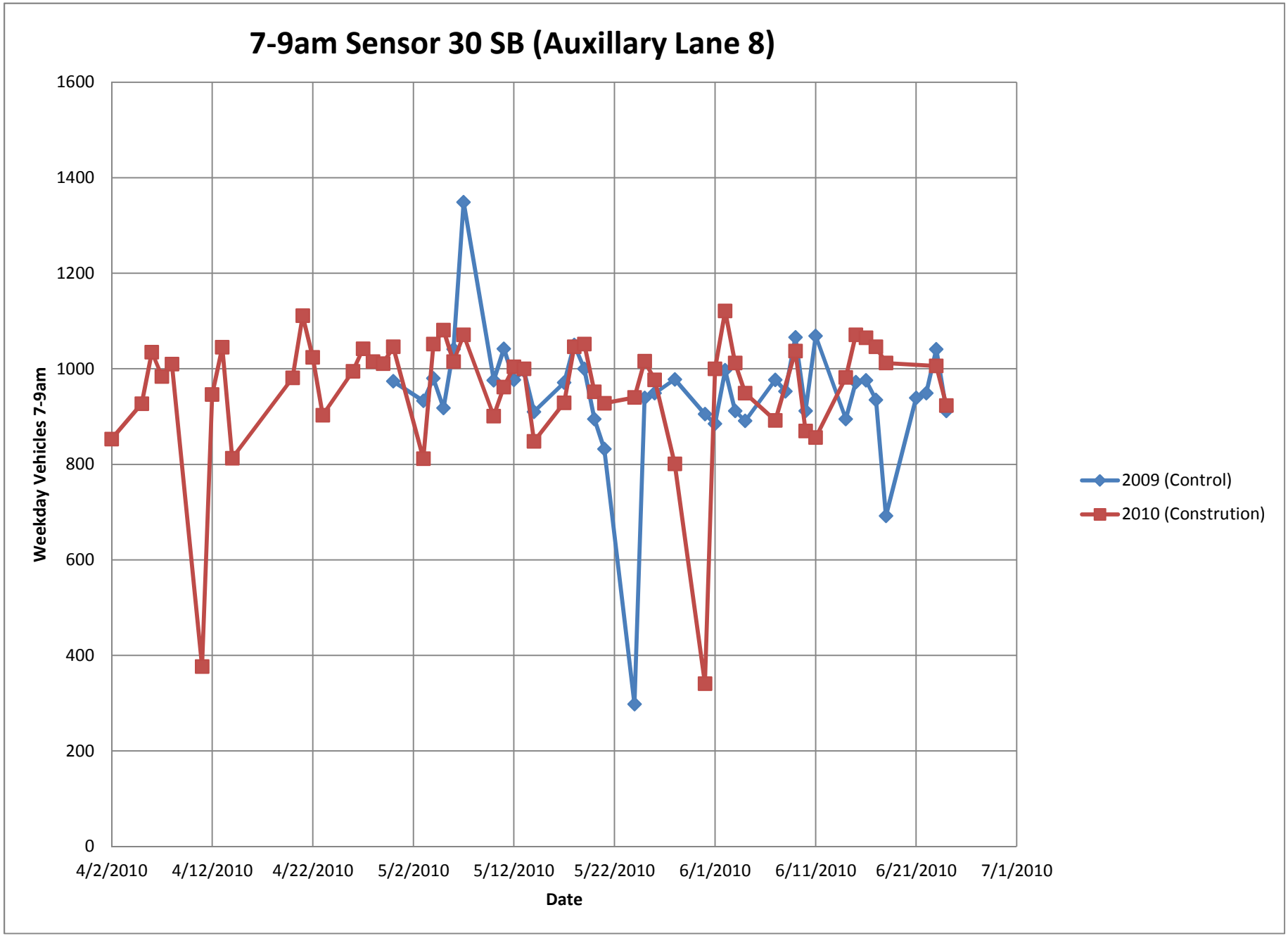

7am to 7pm Sensor 30 NB All Lanes
Weekday Vehicles 7am-7pm
45000
43000
41000
39000
37000
35000
33000
31000
29000
27000
25000
4/2/2010
4/12/2010
4/22/2010
5/2/2010
5/12/2010
5/22/2010
6/1/2010
6/11/2010
6/21/2010
7/1/2010
Date
Hickman NB Off Ramp closed April 19th to May 10th (4/19 to 5/10) and University NB On Ramp Closed 4/19- 5/20).
Hickman Road SB On Ramp Closed May 18th to June 9th Hickman Road.
2009 (Control)
2010 (Constrution)
Hickman NB Off Ramp Closed
University NB On Ramp Closed
Hickman SB on Ramp Closed
Memorial Day (5/25/09 and 5/31/2010)

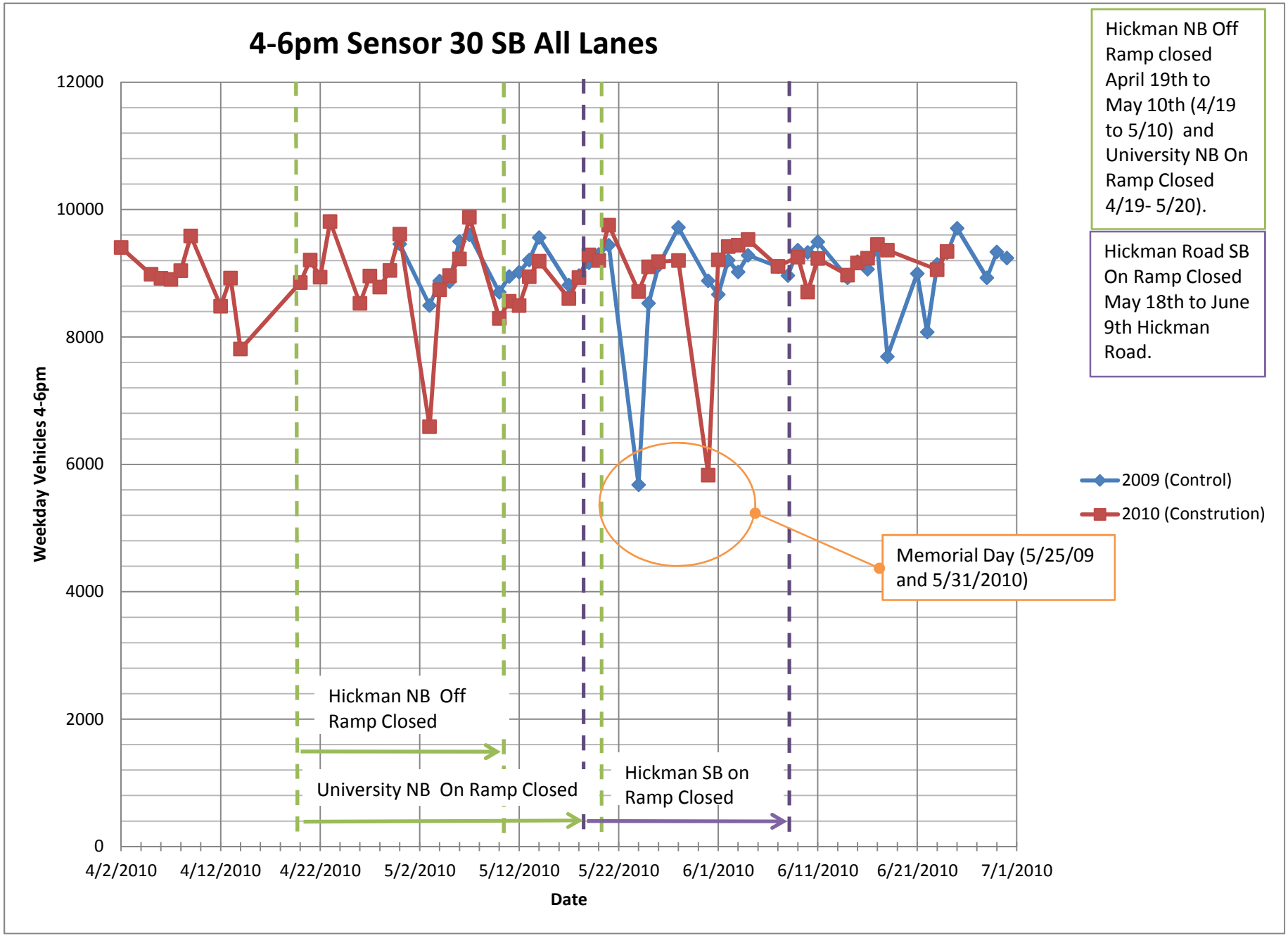

7 am to 7 pm Sensor 30 NB (Through Lane 2-4)
Hickman NB Off Ramp closed April 19th to May 10th (4/19 to 5/10) and University NB On Ramp Closed 4/19- 5/20).
Hickman Road SB On Ramp Closed May 18th to June 9th Hickman Road.
WEekday Vehicles 7am to 7pm
40000
38000
36000
34000
32000
30000
28000
26000
24000
22000
20000
4/2/2010
4/12/2010
4/22/2010
5/2/2010
5/12/2010
5/22/2010
6/1/2010
6/11/2010
6/21/2010
7/1/2010
Date
2009 Data (Control)
2010 Construction Data
Hickman NB Off Ramp Closed
University NB On Ramp Closed
Hickman SB on Ramp Closed

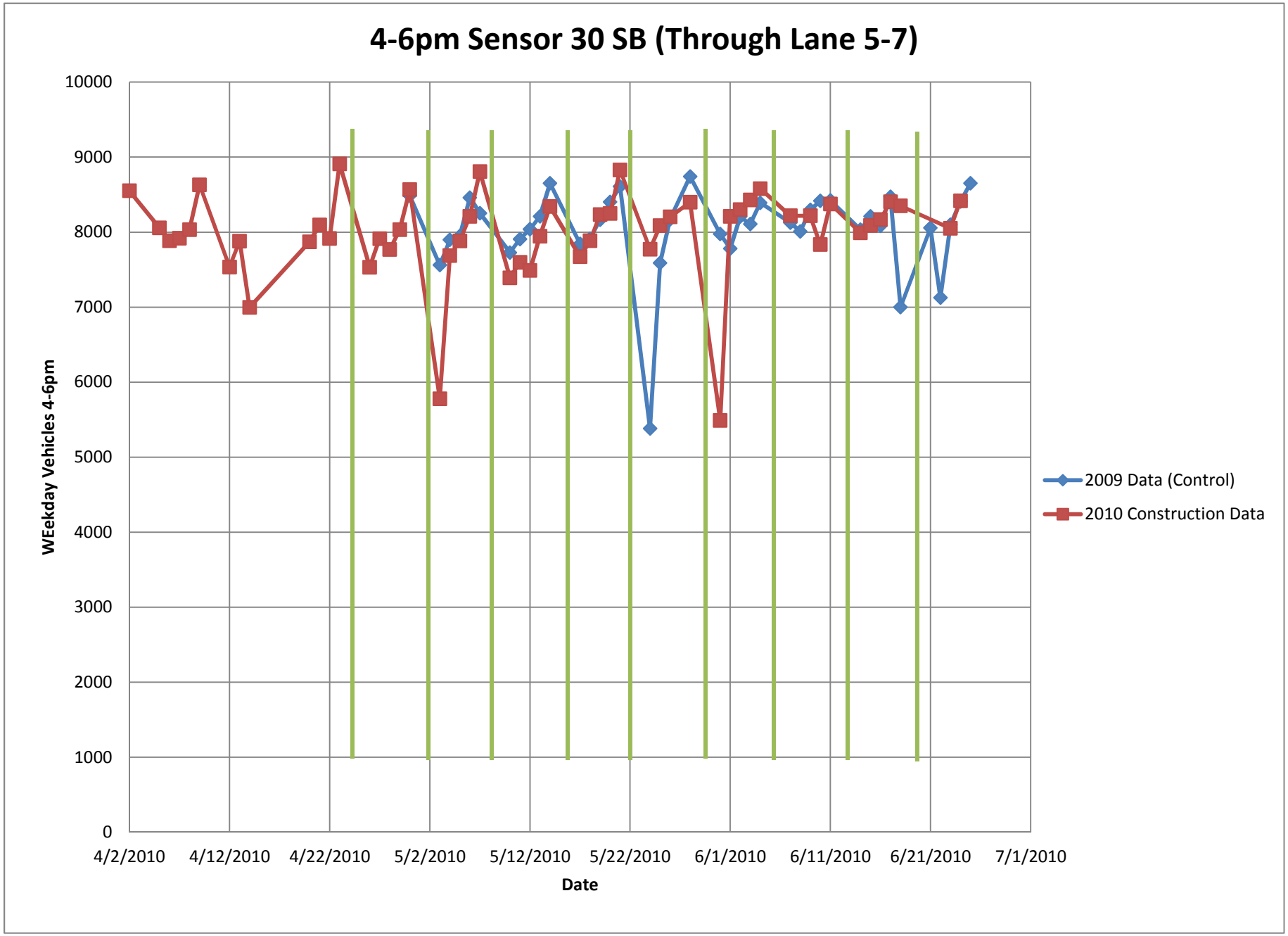

7am to 7pm Sensor 30 NB (Auxillary Lane 1)
Weekday Vehicles 7am-7pm
9000
8000
7000
6000
5000
4000
3000
2000
1000
4/2/2010
4/12/2010
4/22/2010
5/2/2010
5/12/2010
5/22/2010
6/1/2010
6/11/2010
6/21/2010
7/1/2010
Date
Hickman NB Off Ramp Closed
University NB On Ramp Closed
Hickman SB on Ramp Closed
Hickman NB Off Ramp closed April 19th to May 10th (4/19 to 5/10) and University NB On Ramp Closed 4/19- 5/20).
Hickman Road SB On Ramp Closed May 18th to June 9th Hickman Road.
2009 (Control)
2010 (Constrution)

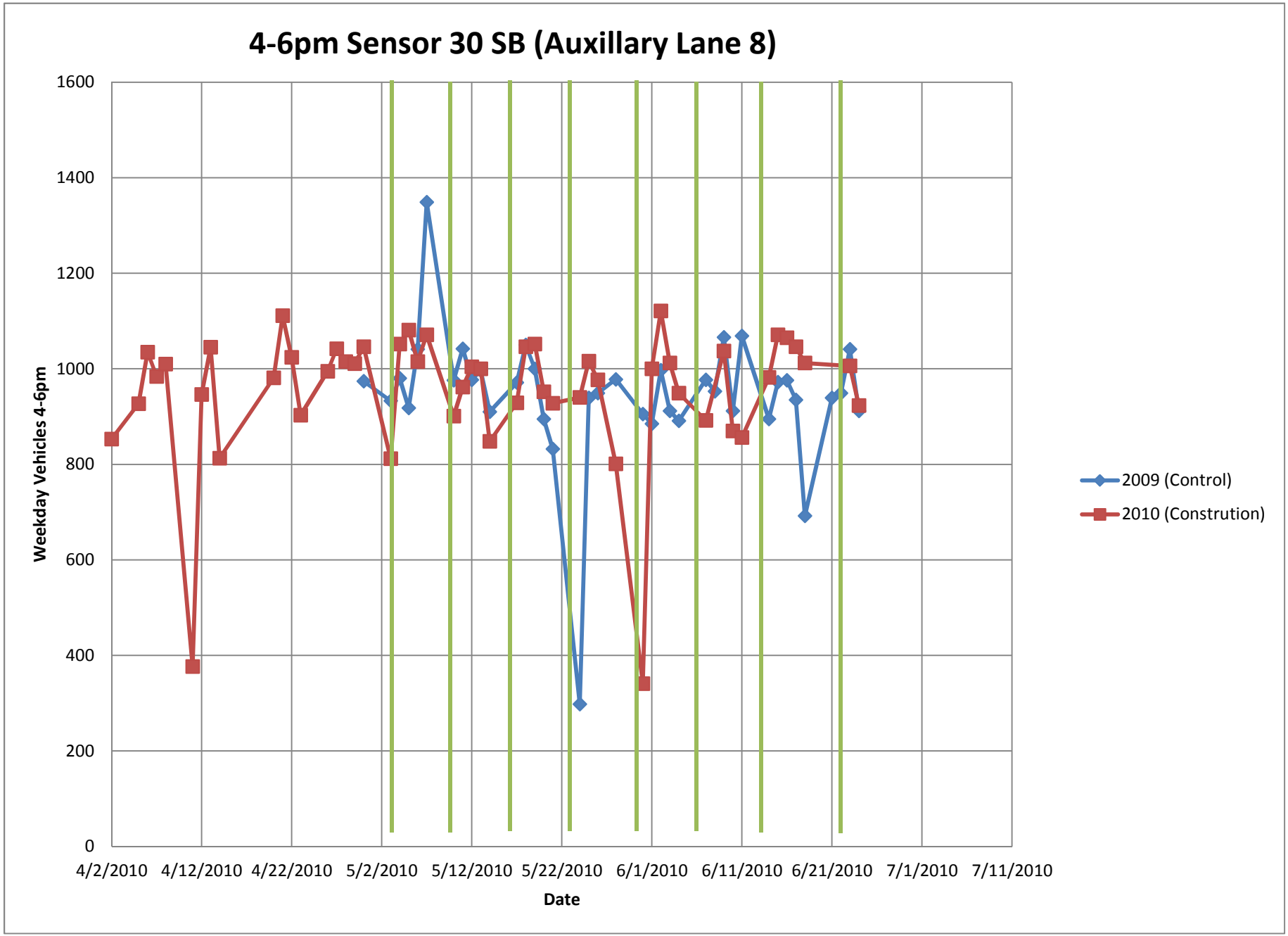

7-9am Sensor 30 SB All Lanes
Weekday Vehicles 7-9am
12000
10000
8000
6000
4000
2000
0
4/2/2010
4/12/2010
4/22/2010
5/2/2010
5/12/2010
5/22/2010
6/1/2010
6/11/2010
6/21/2010
7/1/2010
Date
Hickman NB Off Ramp closed April 19th to May 10th (4/19 to 5/10) and University NB On Ramp Closed 4/19- 5/20).
Hickman Road SB On Ramp Closed May 18th to June 9th Hickman Road.
2009 (Control)
2010 (Constrution)
Hickman NB Off Ramp Closed
University NB On Ramp Closed
Hickman SB on Ramp Closed
Memorial Day (5/25/09 and 5/31/2010)

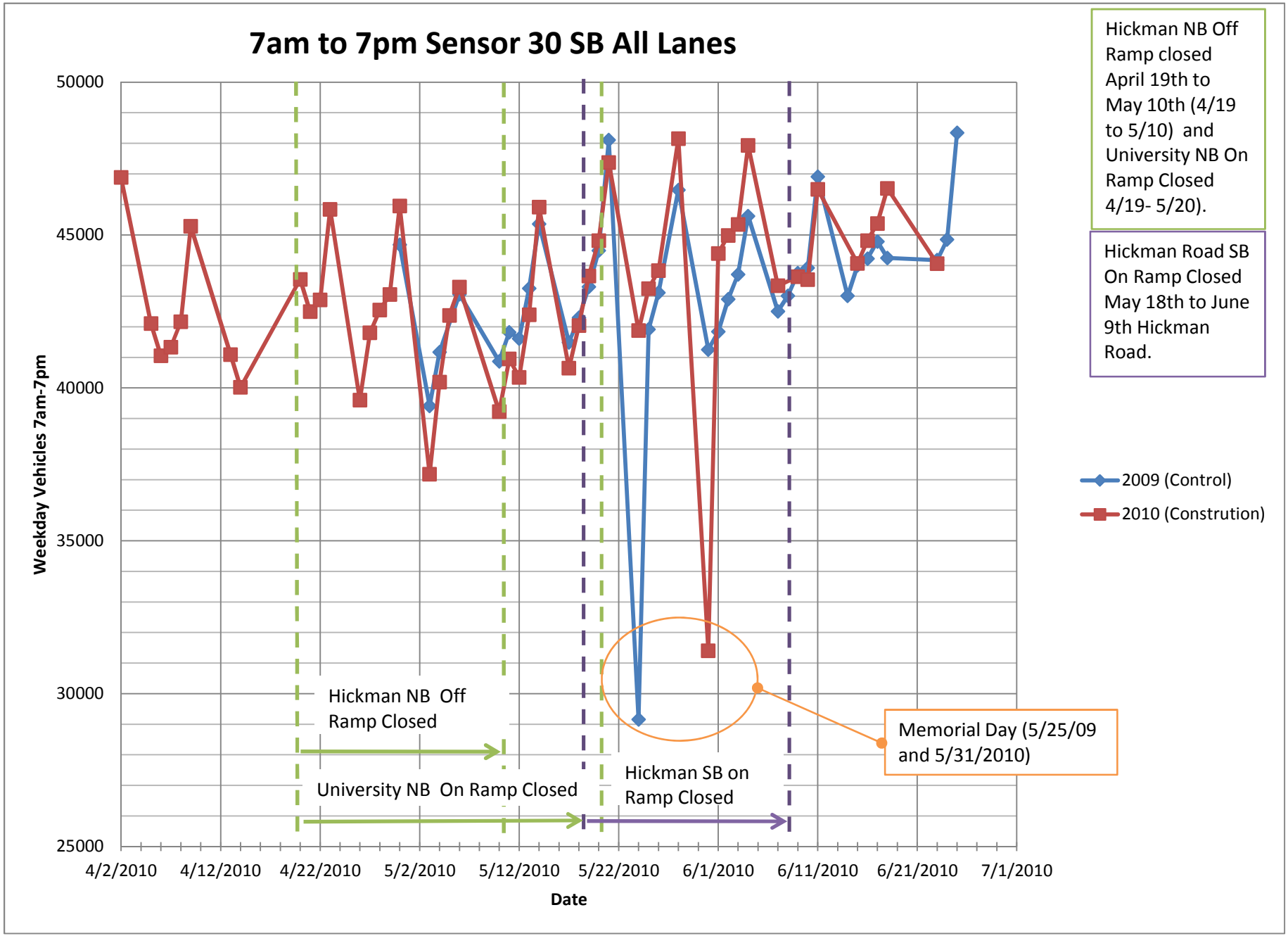

7-9am Sensor 30 SB (Through Lane 5-7)
WEekday Vehicles 7-9am
9000
8000
7000
6000
5000
4000
3000
2000
1000
0
4/2/2010
4/12/2010
4/22/2010
5/2/2010
5/12/2010
5/22/2010
6/1/2010
6/11/2010
6/21/2010
7/1/2010
Date
2009 Data (Control)
2010 Construction Data

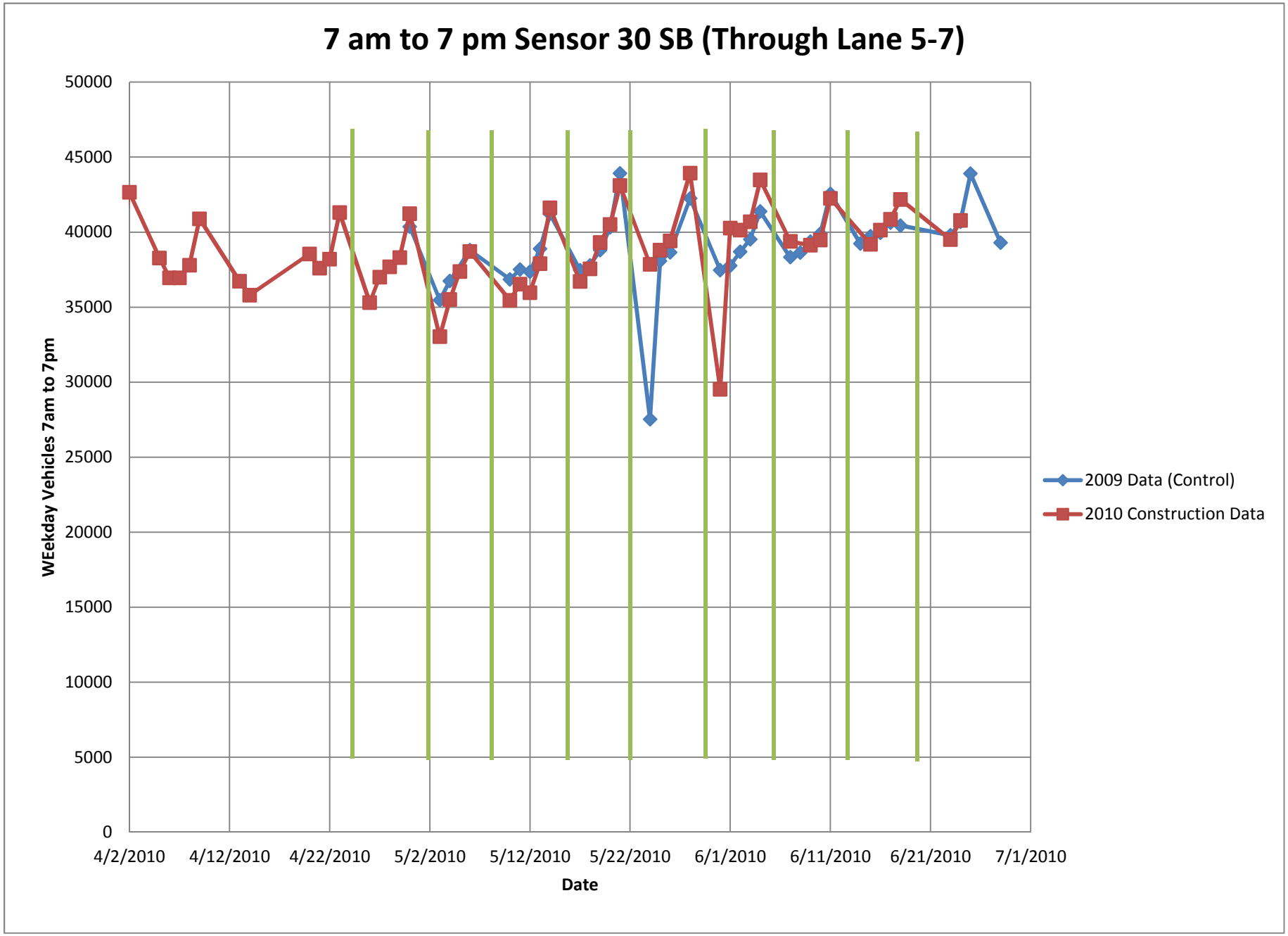

7-9am Sensor 30 SB (Auxillary Lane 8)
Weekday Vehicles 7-9am
1600
1400
1200
1000
800
600
400
200
0
4/2/2010
4/12/2010
4/22/2010
5/2/2010
5/12/2010
5/22/2010
6/1/2010
6/11/2010
6/21/2010
7/1/2010
Date
2009 (Control)
2010 (Constrution)

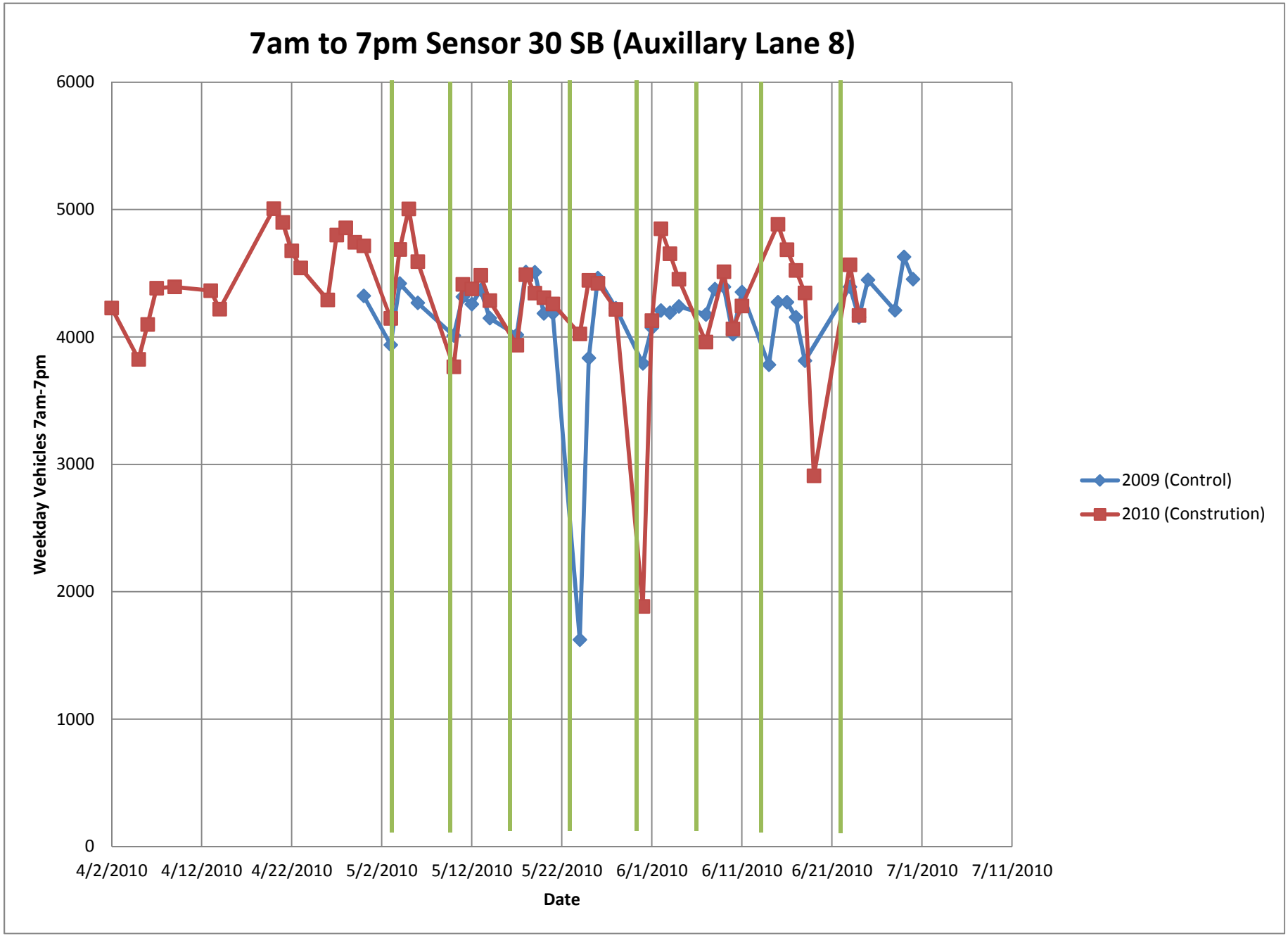

4-6pm Sensor 30 SB All Lanes
Weekday Vehicles 4-6pm
12000
10000
8000
6000
4000
2000
0
4/2/2010
4/12/2010
4/22/2010
5/2/2010
5/12/2010
5/22/2010
6/1/2010
6/11/2010
6/21/2010
7/1/2010
Date
Hickman NB Off Ramp closed April 19th to May 10th (4/19 to 5/10) and University NB On Ramp Closed 4/19- 5/20).
Hickman Road SB On Ramp Closed May 18th to June 9th Hickman Road.
2009 (Control)
2010 (Constrution)
Memorial Day (5/25/09 and 5/31/2010)
Hickman NB Off Ramp Closed
University NB On Ramp Closed
Hickman SB on Ramp Closed


4-6pm Sensor 30 SB (Through Lane 5-7)
WEekday Vehicles 4-6pm
10000
9000
8000
7000
6000
5000
4000
3000
2000
1000
0
4/2/2010
4/12/2010
4/22/2010
5/2/2010
5/12/2010
5/22/2010
6/1/2010
6/11/2010
6/21/2010
7/1/2010
Date
2009 Data (Control)
2010 Construction Data


4-6pm Sensor 30 SB (Auxillary Lane 8)
Weekday Vehicles 4-6pm
1600
1400
1200
1000
800
600
400
200
0
4/2/2010
4/12/2010
4/22/2010
5/2/2010
5/12/2010
5/22/2010
6/1/2010
6/11/2010
6/21/2010
7/1/2010
7/11/2010
Date
2009 (Control)
2010 (Constrution)

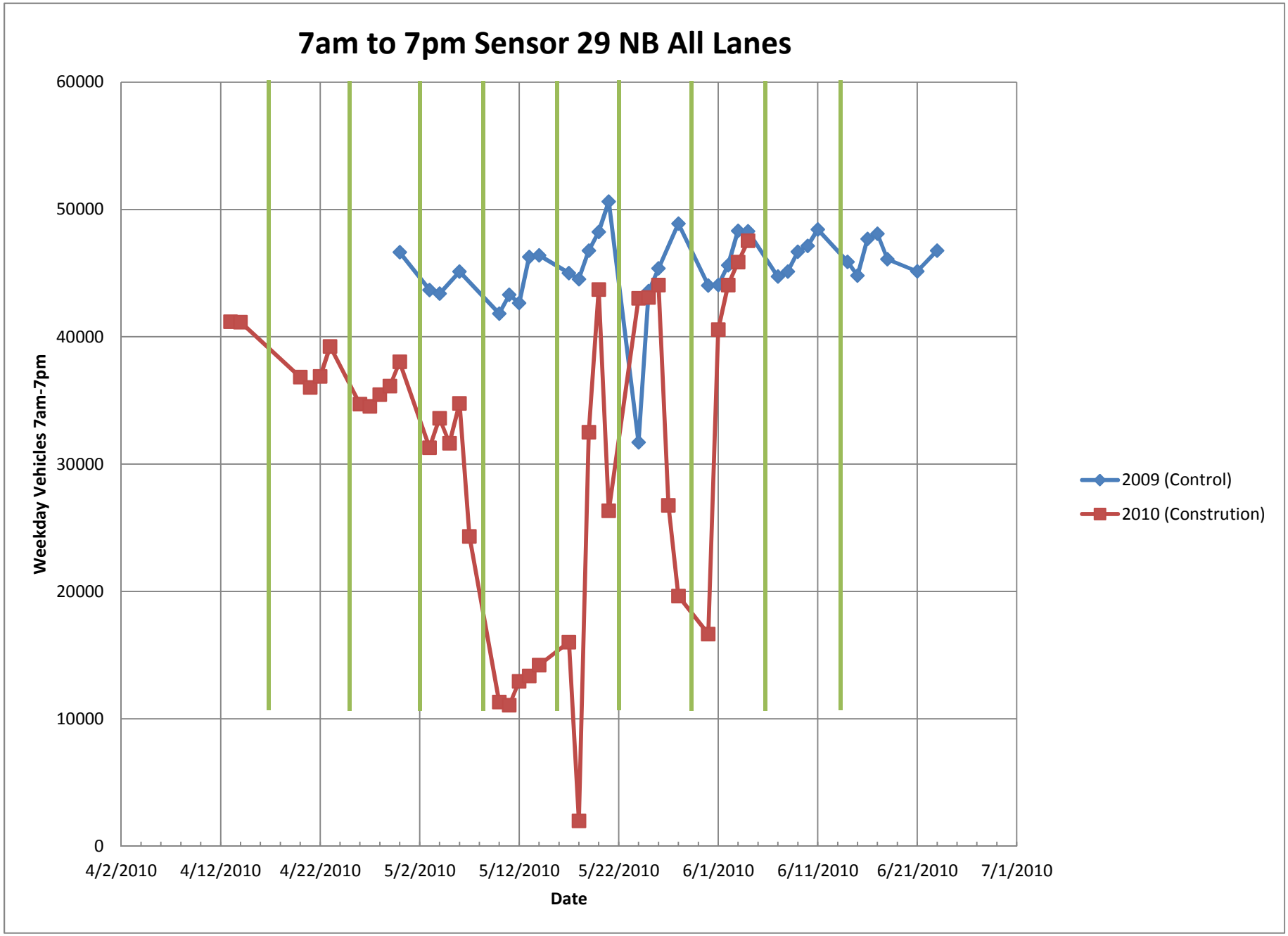

7am to 7pm Sensor 30 SB All Lanes
Weekday Vehicles 7am-7pm
50000
45000
40000
35000
30000
25000
4/2/2010
4/12/2010
4/22/2010
5/2/2010
5/12/2010
5/22/2010
6/1/2010
6/11/2010
6/21/2010
7/1/2010
Date
Hickman NB Off Ramp closed April 19th to May 10th (4/19 to 5/10) and University NB On Ramp Closed 4/19- 5/20).
Hickman Road SB On Ramp Closed May 18th to June 9th Hickman Road.
2009 (Control)
2010 (Constrution)
Hickman NB Off Ramp Closed
University NB On Ramp Closed
Hickman SB on Ramp Closed
Memorial Day (5/25/09 and 5/31/2010)

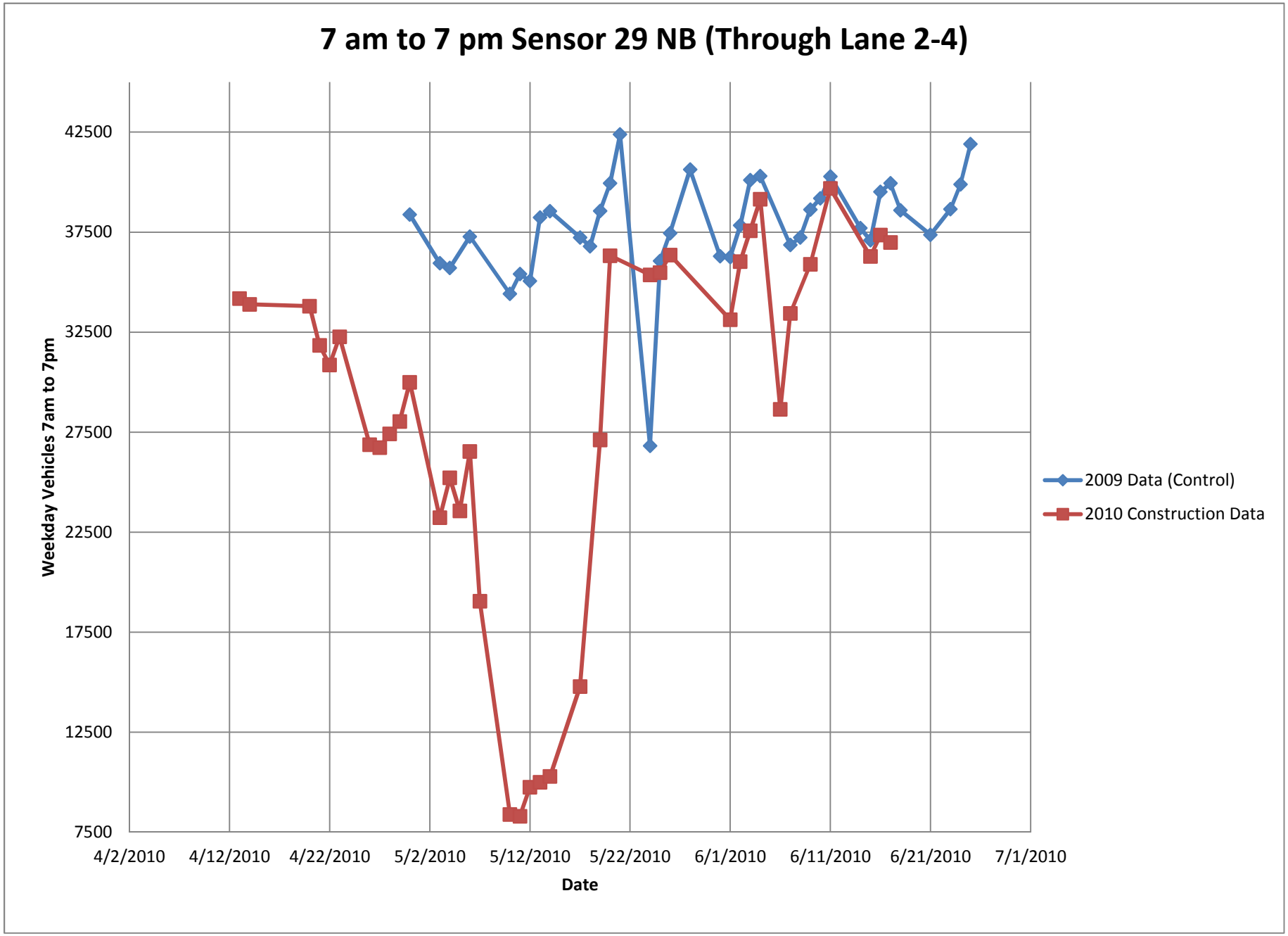

7 am to 7 pm Sensor 30 SB (Through Lane 5-7)
WEekday Vehicles 7am to 7pm
50000
45000
40000
35000
30000
25000
20000
15000
10000
5000
0
4/2/2010
4/12/2010
4/22/2010
5/2/2010
5/12/2010
5/22/2010
6/1/2010
6/11/2010
6/21/2010
7/1/2010
Date
2009 Data (Control)
2010 Construction Data

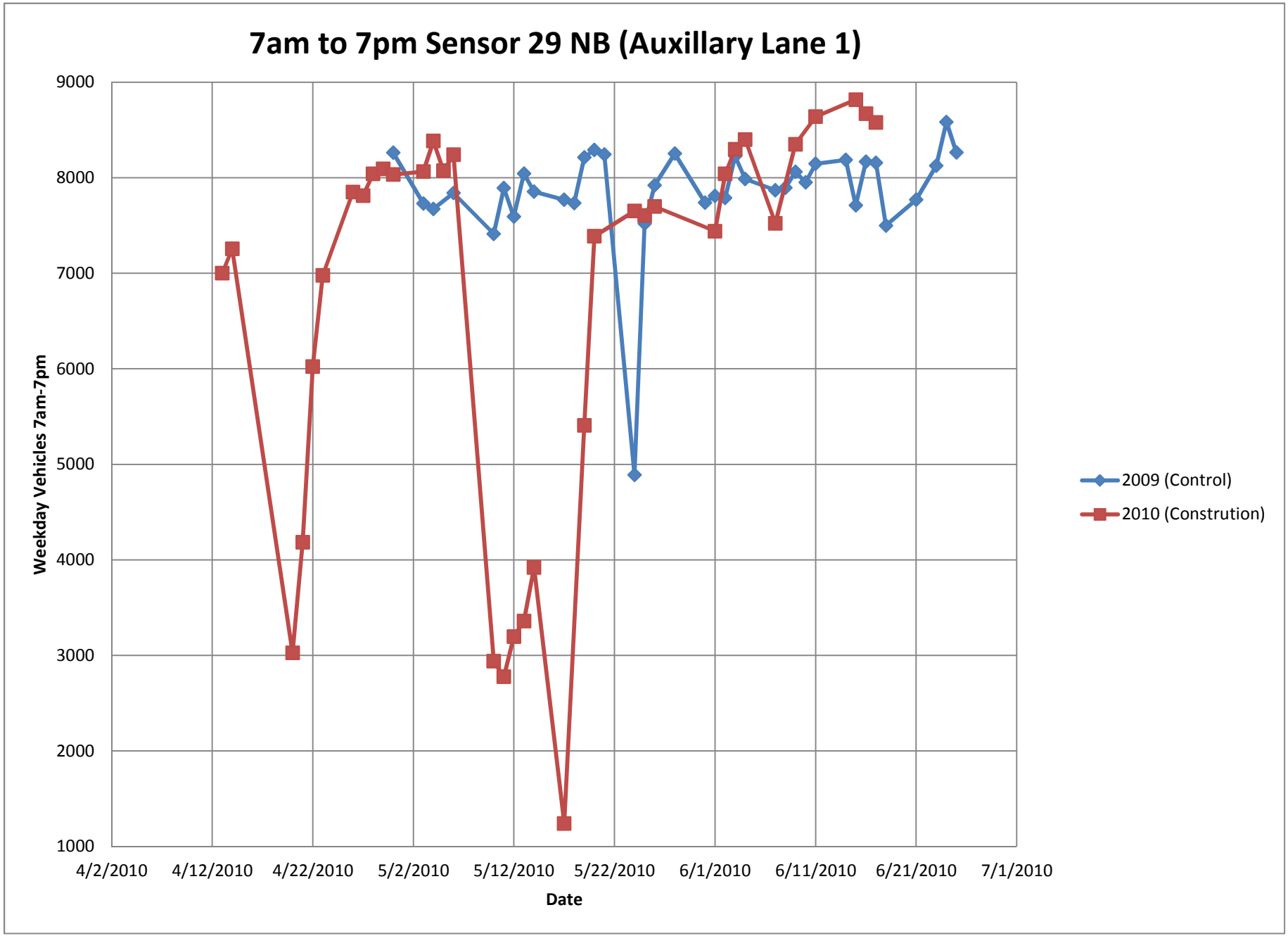

7am to 7pm Sensor 30 SB (Auxillary Lane 8)
Weekday Vehicles 7am-7pm
6000
5000
4000
3000
2000
1000
0
4/2/2010
4/12/2010
4/22/2010
5/2/2010
5/12/2010
5/22/2010
6/1/2010
6/11/2010
6/21/2010
7/1/2010
7/11/2010
Date
2009 (Control)
2010 (Constrution)

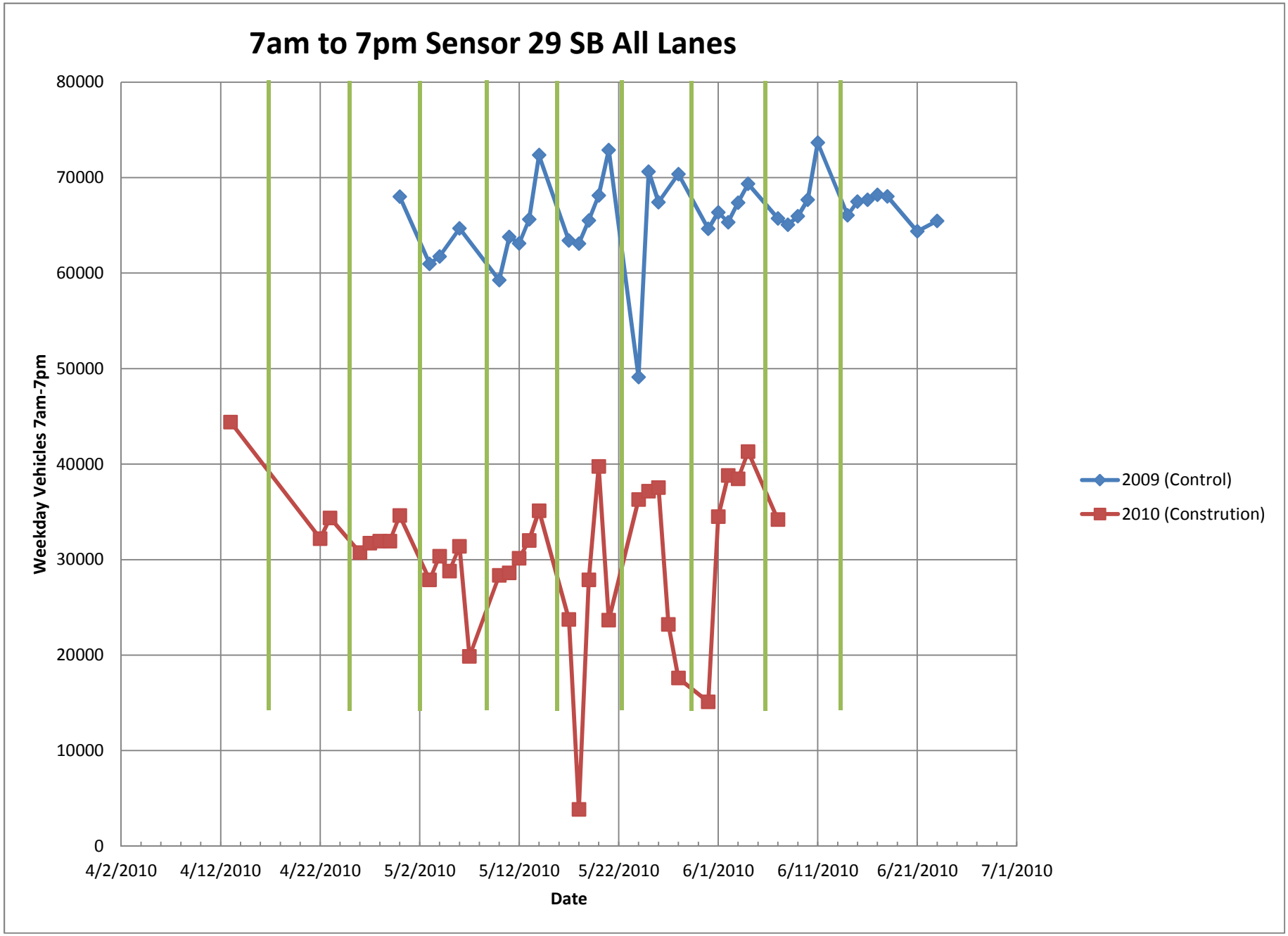
B.1 Freeway Mainline Traffic-Volume Changes

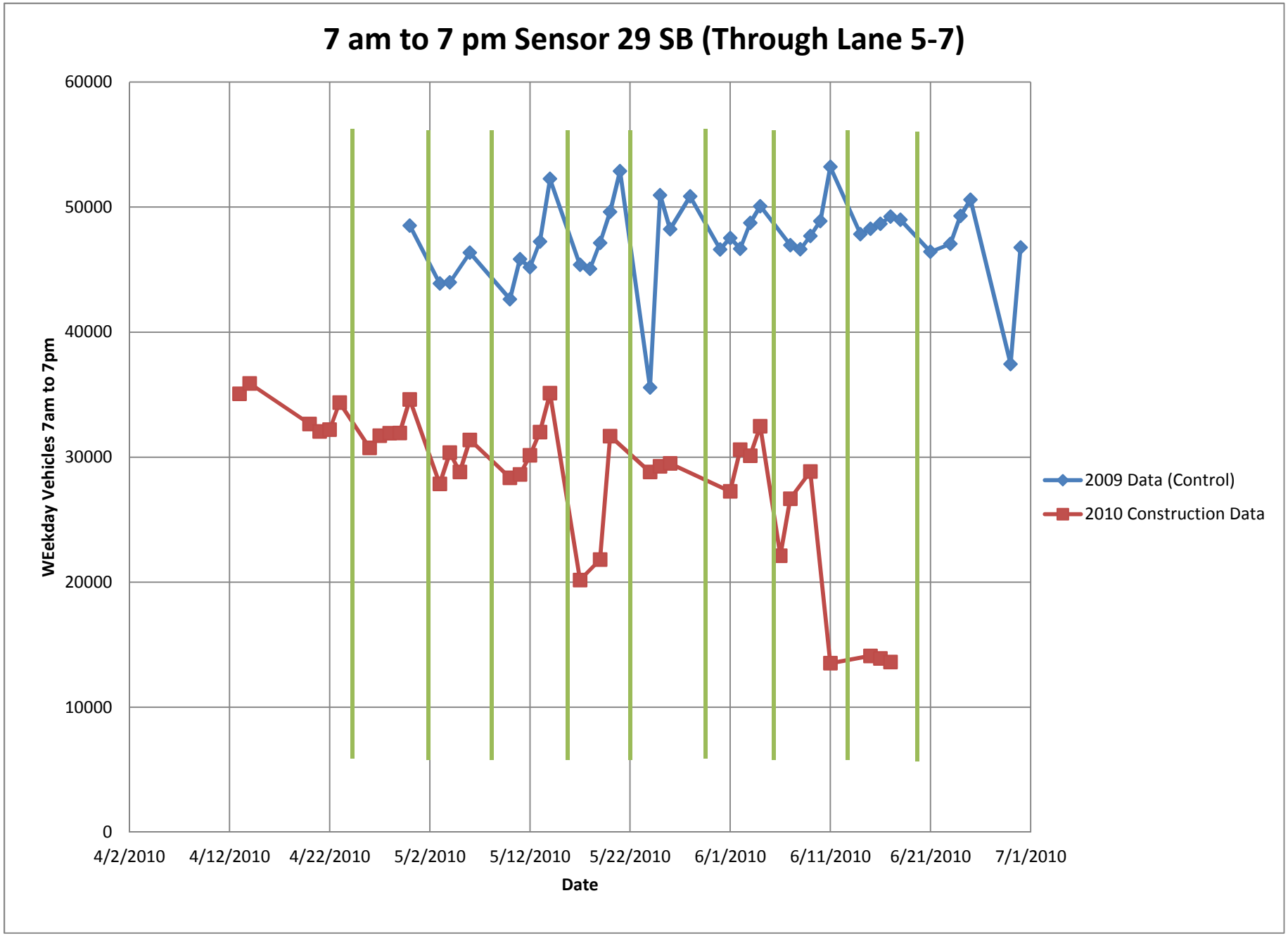
Sensor 29

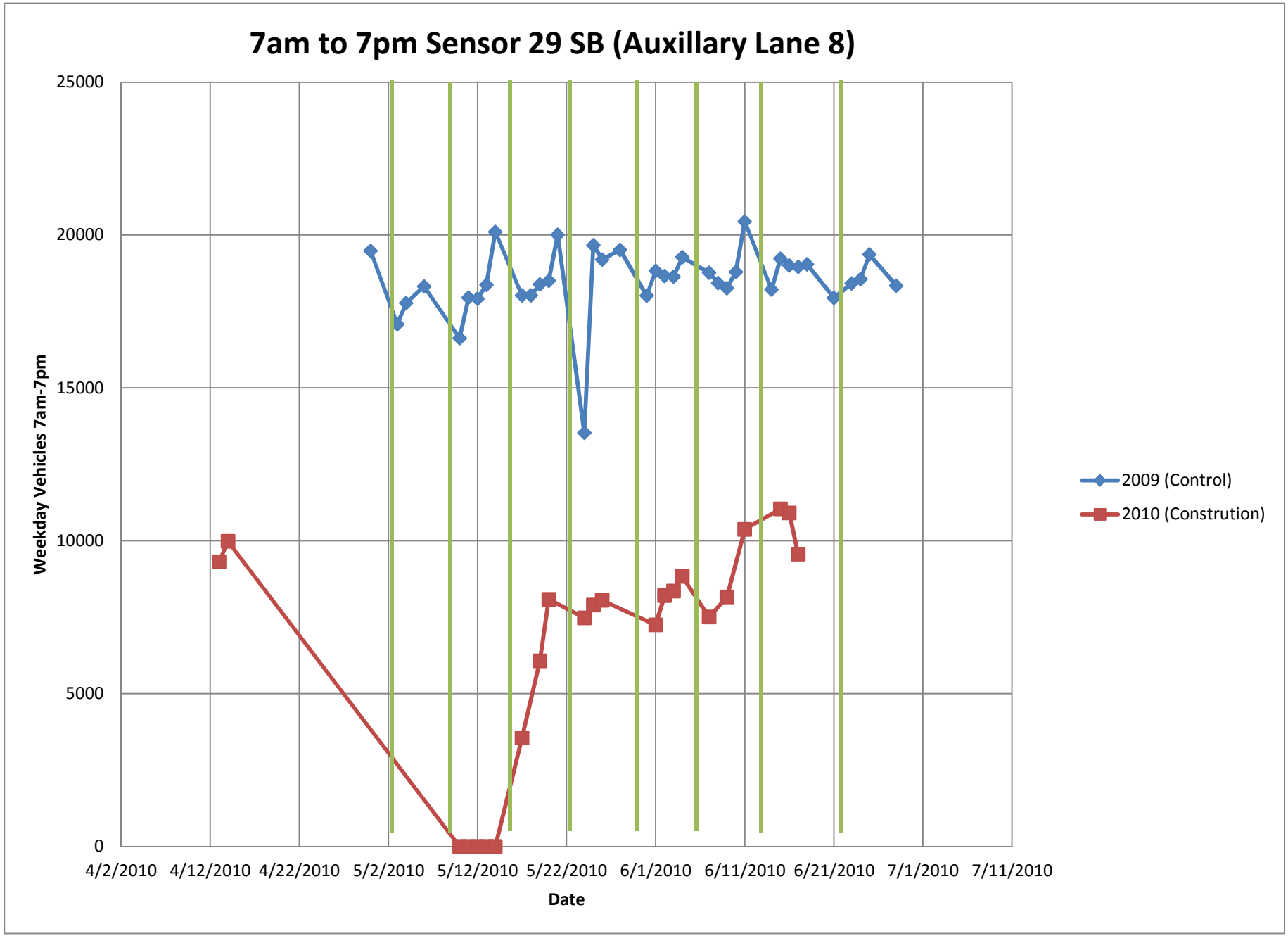

7am to 7pm Sensor 29 NB All Lanes
60000
50000
40000
30000
20000
10000
0
Weekday Vehicles 7am-7pm
4/2/2010
4/12/2010
4/22/2010
5/2/2010
5/12/2010
5/22/2010
6/1/2010
6/11/2010
6/21/2010
7/1/2010
Date
2009 (Control)
2010 (Constrution)


7 am to 7 pm Sensor 29 NB (Through Lane 2-4)
Weekday Vehicles 7am to 7pm
42500
37500
32500
27500
22500
17500
12500
7500
4/2/2010
4/12/2010
4/22/2010
5/2/2010
5/12/2010
5/22/2010
6/1/2010
6/11/2010
6/21/2010
7/1/2010
Date
2009 Data (Control)
2010 Construction Data


7am to 7pm Sensor 29 NB (Auxillary Lane 1)
Weekday Vehicles 7am-7pm
9000
8000
7000
6000
5000
4000
3000
2000
1000
4/2/2010
4/12/2010
4/22/2010
5/2/2010
5/12/2010
5/22/2010
6/1/2010
6/11/2010
6/21/2010
7/1/2010
Date
2009 (Control)
2010 (Constrution)

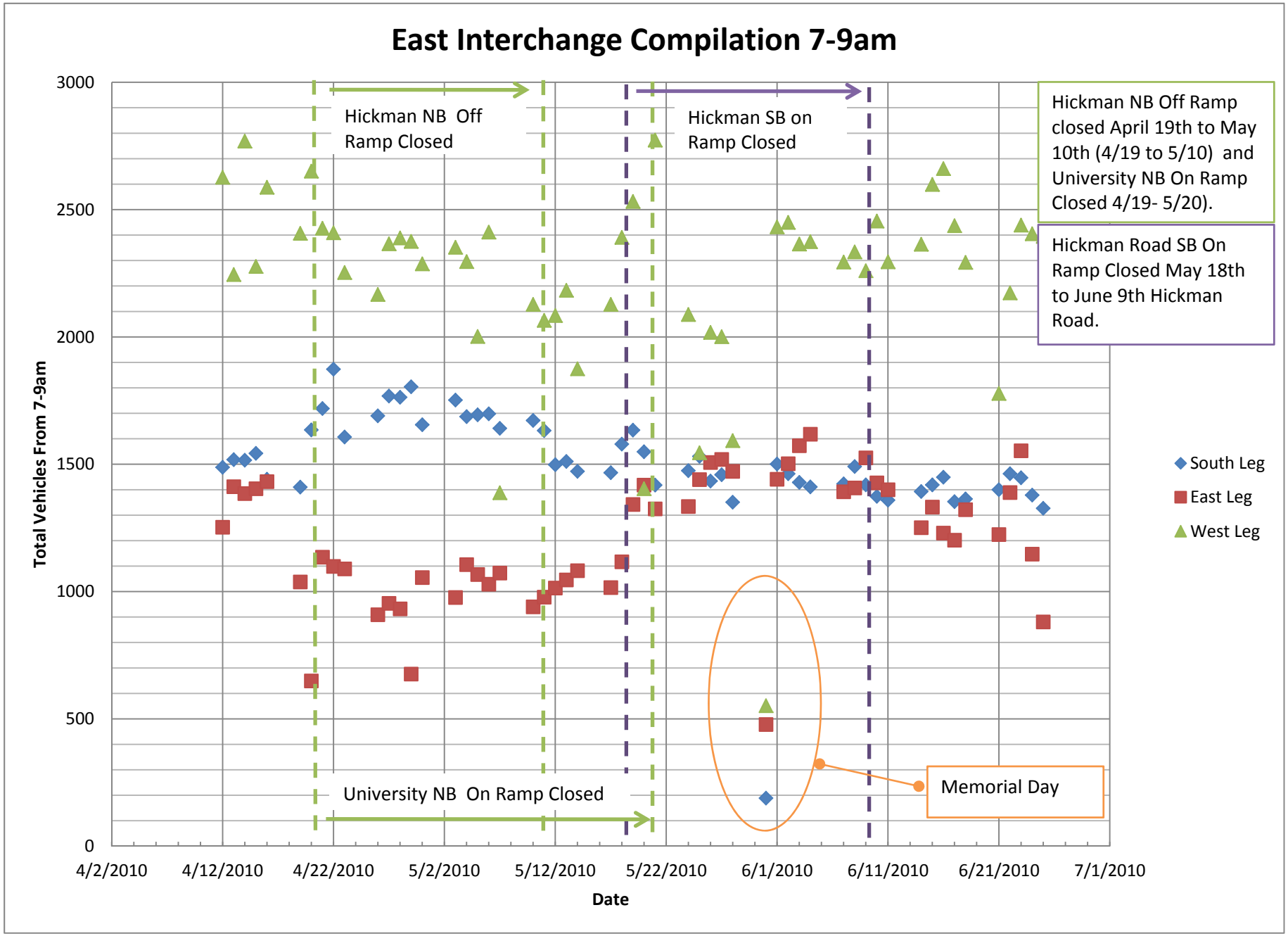

7am to 7pm Sensor 29 SB All Lanes
Weekday Vehicles 7am-7pm
80000
70000
60000
50000
40000
30000
20000
10000
0
4/2/2010
4/12/2010
4/22/2010
5/2/2010
5/12/2010
5/22/2010
6/1/2010
6/11/2010
6/21/2010
7/1/2010
Date
2009 (Control)
2010 (Constrution)

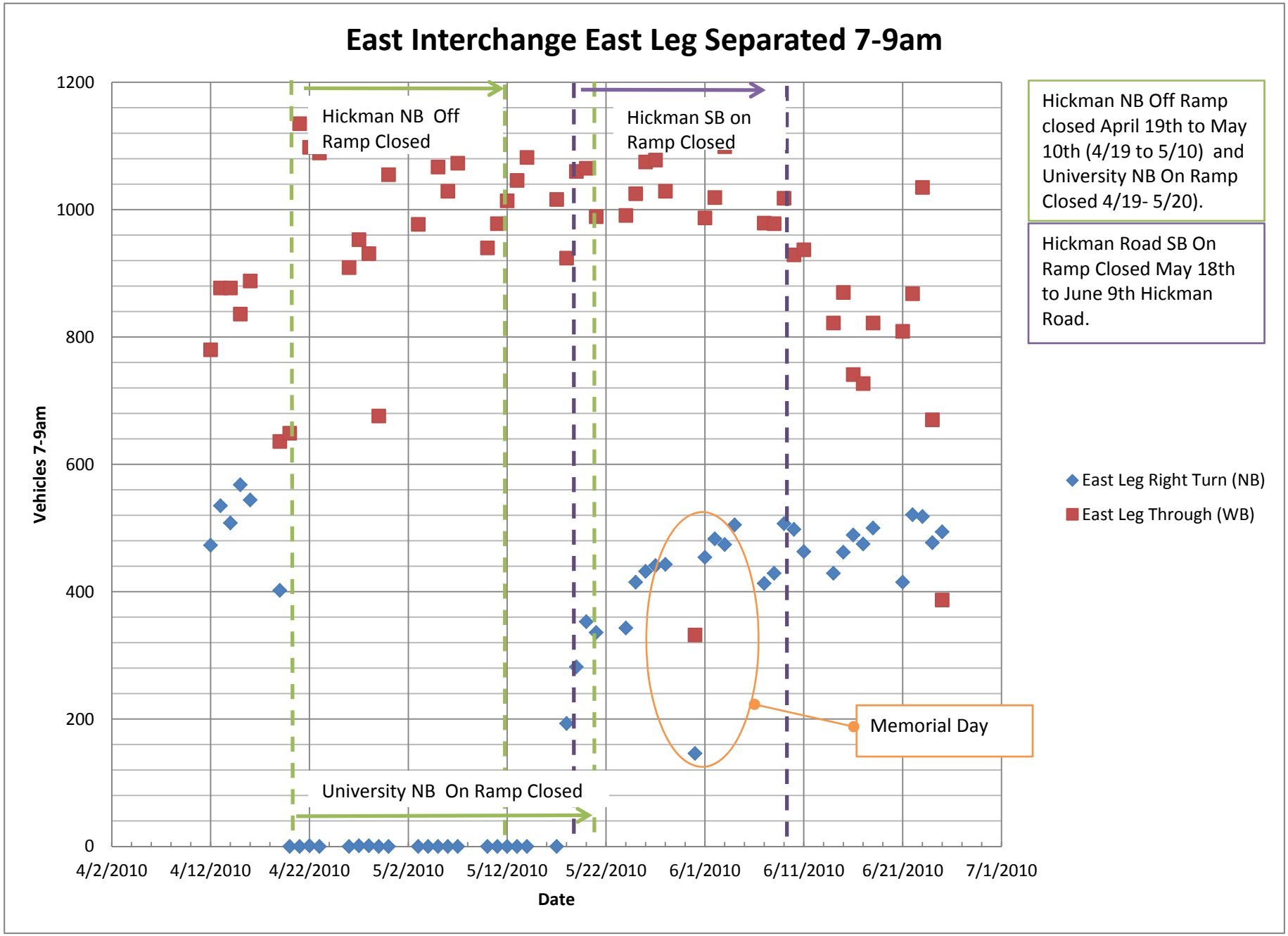

7 am to 7 pm Sensor 29 SB (Through Lane 5-7)
60000
50000
40000
30000
20000
10000
0
WEekday Vehicles 7am to 7pm
4/2/2010
4/12/2010
4/22/2010
5/2/2010
5/12/2010
5/22/2010
6/1/2010
6/11/2010
6/21/2010
7/1/2010
Date
2009 Data (Control)
2010 Construction Data

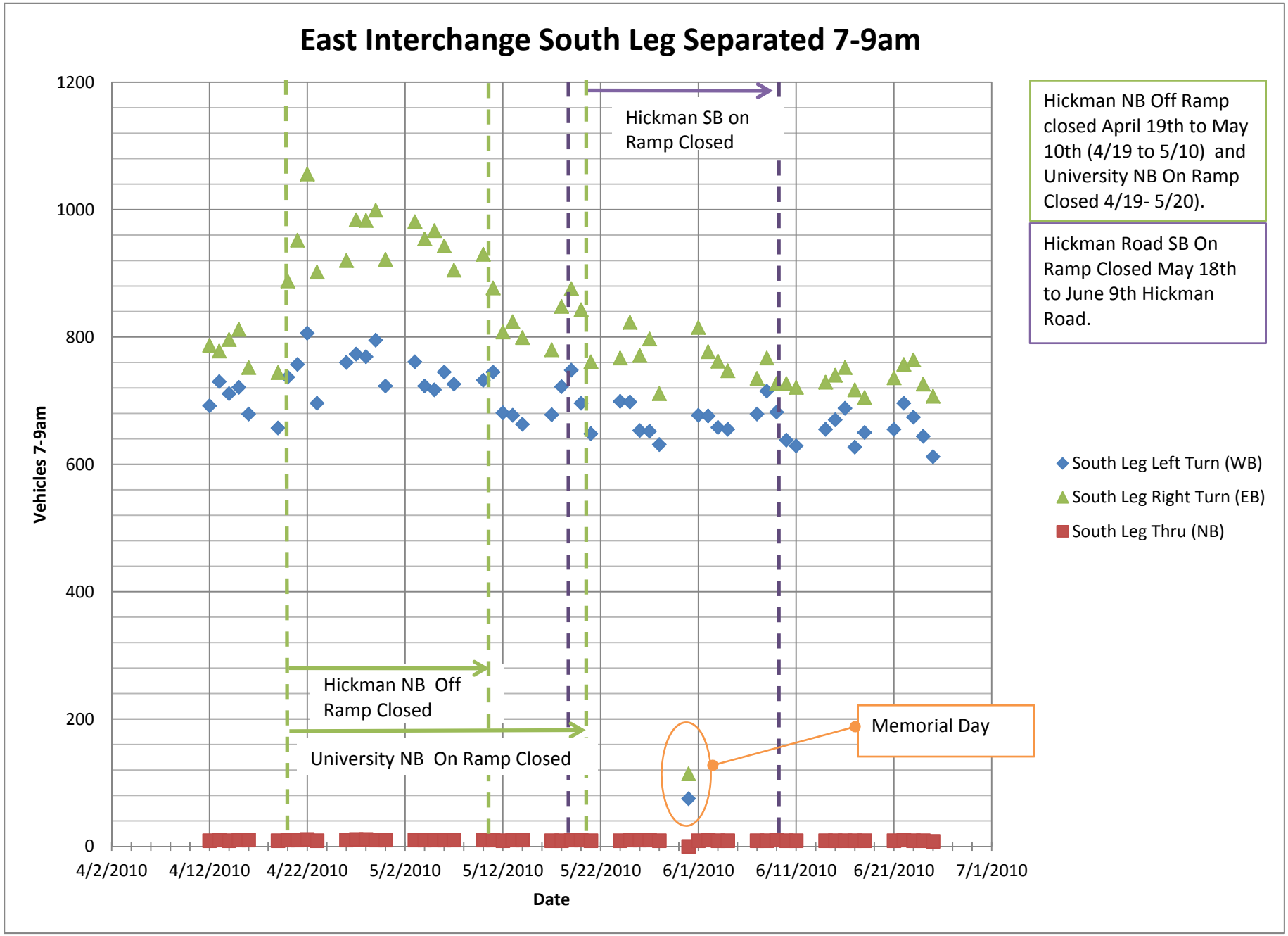

7am to 7pm Sensor 29 SB (Auxillary Lane 8)
Weekday Vehicles 7am-7pm
25000
20000
15000
10000
5000
0
4/2/2010
4/12/2010
4/22/2010
5/2/2010
5/12/2010
5/22/2010
6/1/2010
6/11/2010
6/21/2010
7/1/2010
7/11/2010
Date
2009 (Control)
2010 (Constrution)

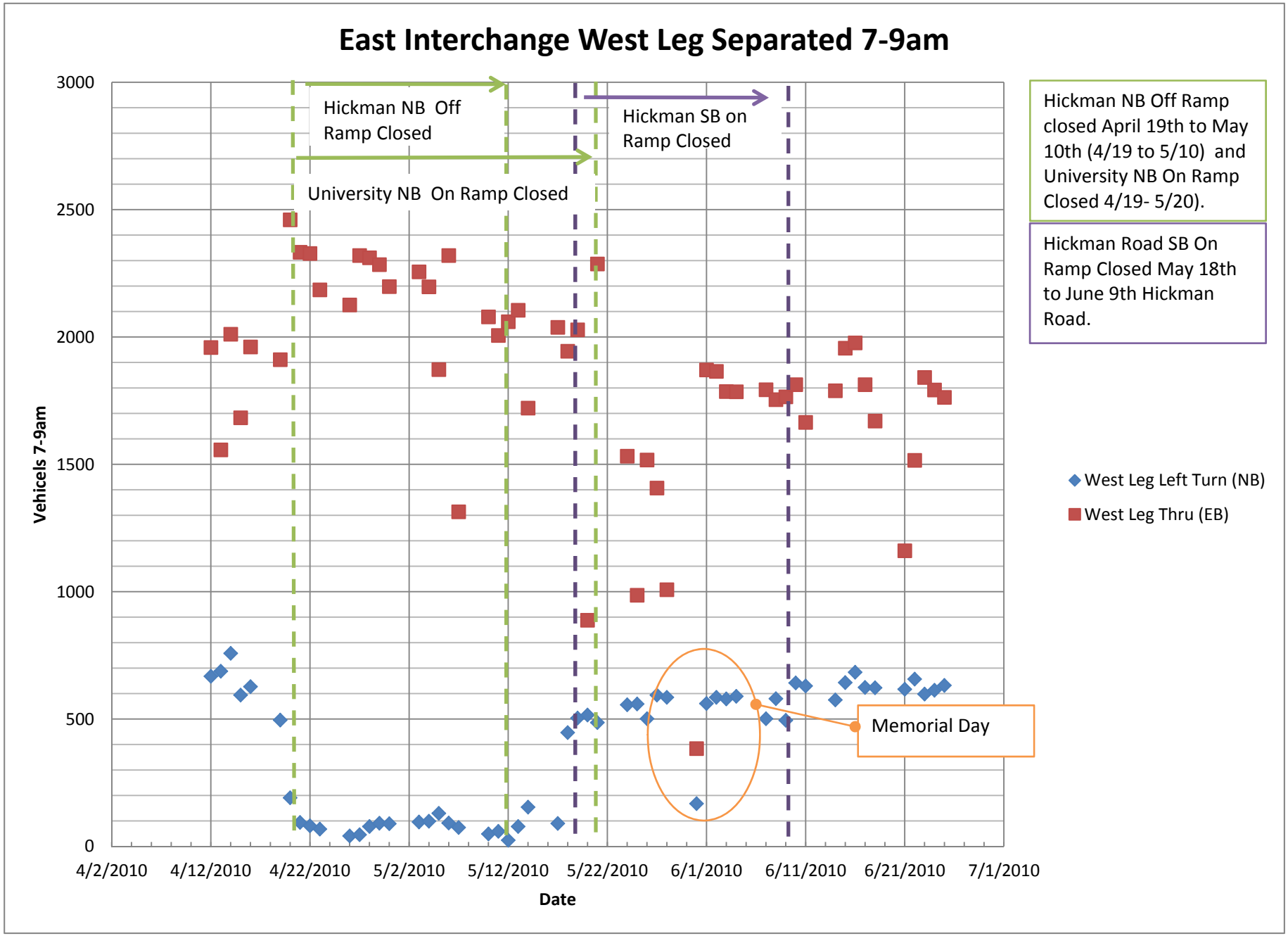
B.2 Intersection Traffic-Volume Changes

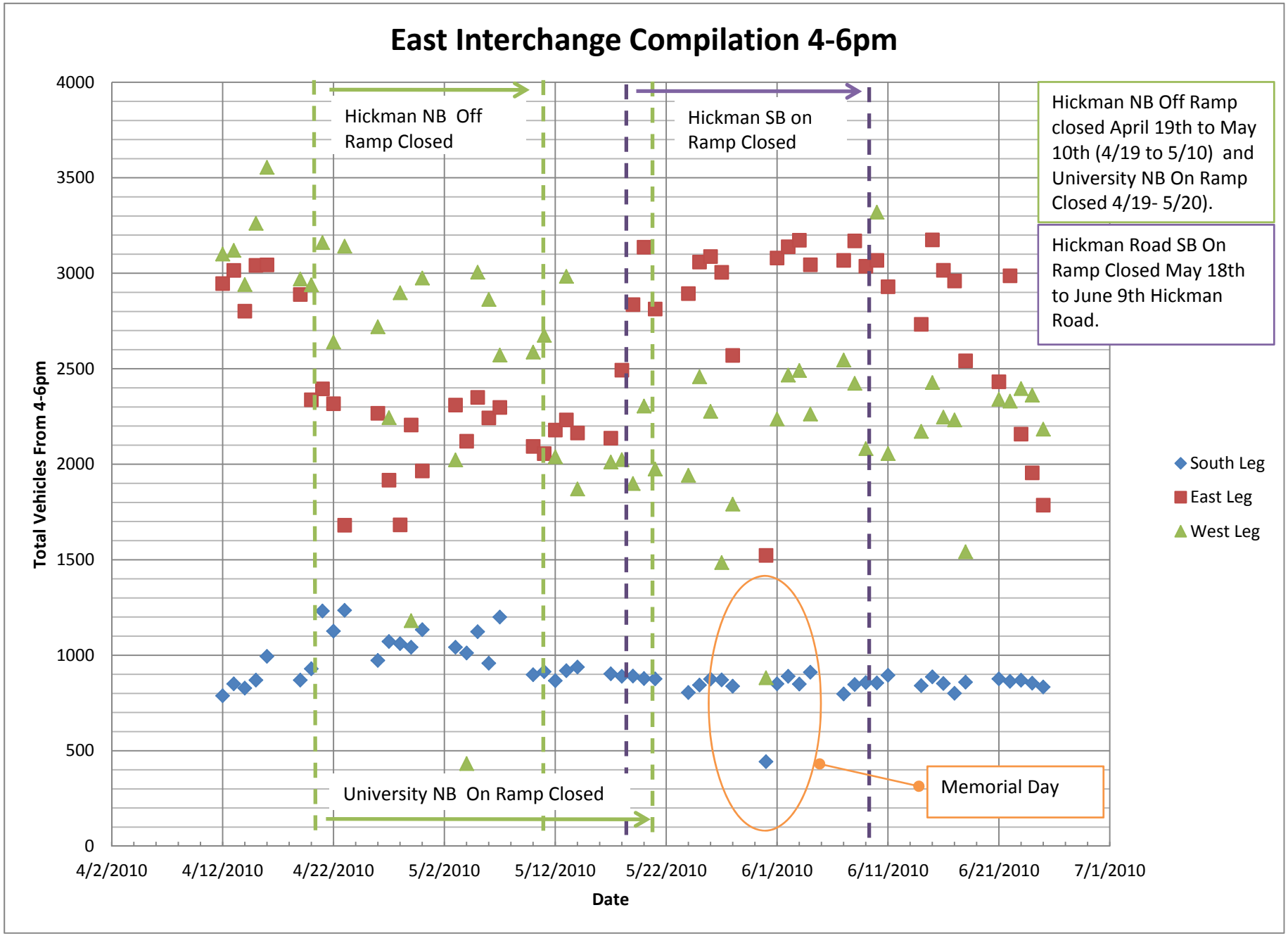
University and I-35 East Ramp

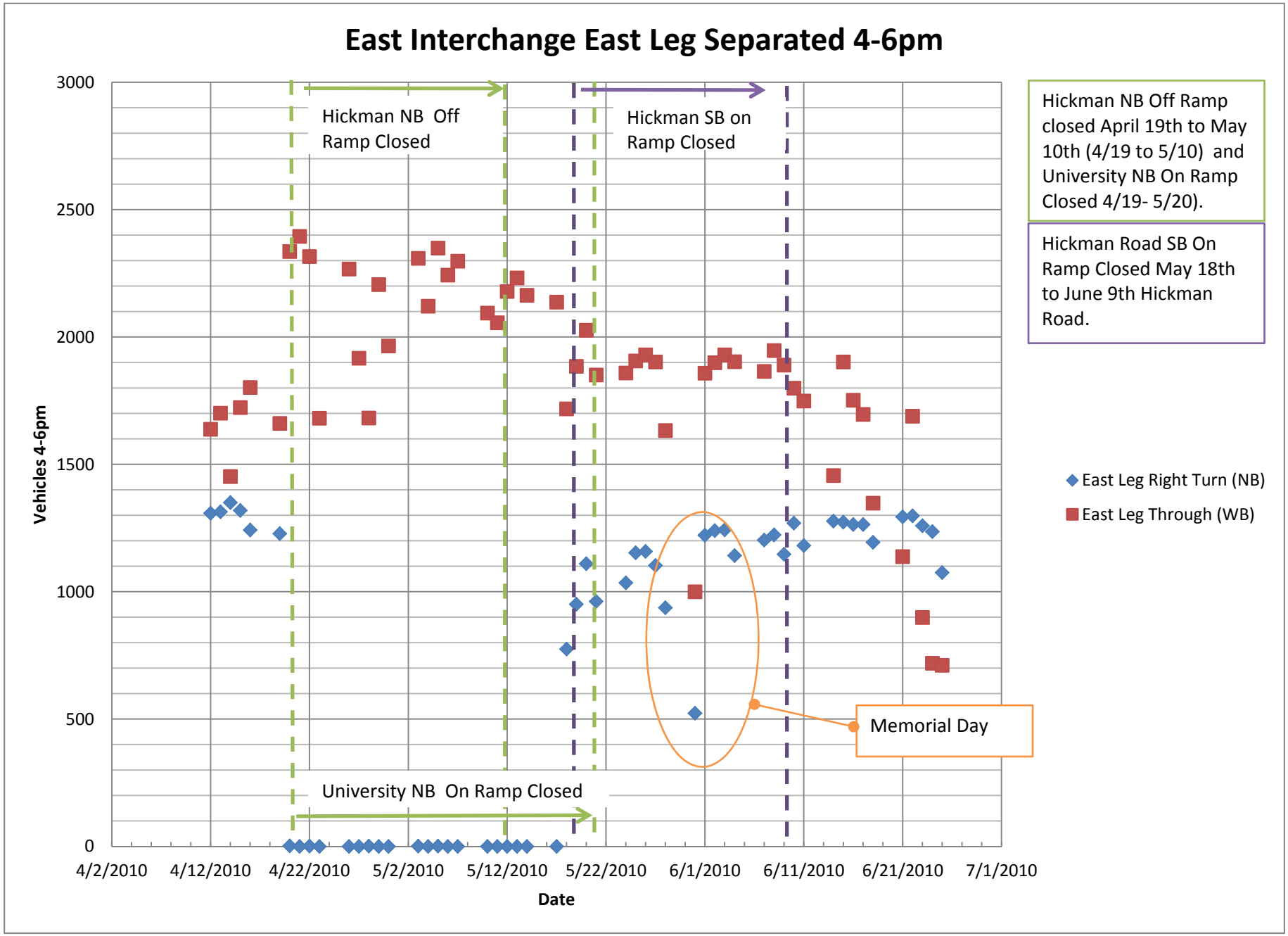

East Interchange Compilation 7-9am
Total Vehicles From 7-9am
3000
2500
2000
1500
1000
500
0
4/2/2010
4/12/2010
4/22/2010
5/2/2010
5/12/2010
5/22/2010
6/1/2010
6/11/2010
6/21/2010
7/1/2010
Date
Hickman NB Off Ramp Closed
Hickman SB on Ramp Closed
University NB On Ramp Closed
Hickman NB Off Ramp closed April 19th to May 10th (4/19 to 5/10) and University NB On Ramp Closed 4/19- 5/20).
Hickman Road SB On Ramp Closed May 18th to June 9th Hickman Road.
Memorial Day
South Leg
East Leg
West Leg

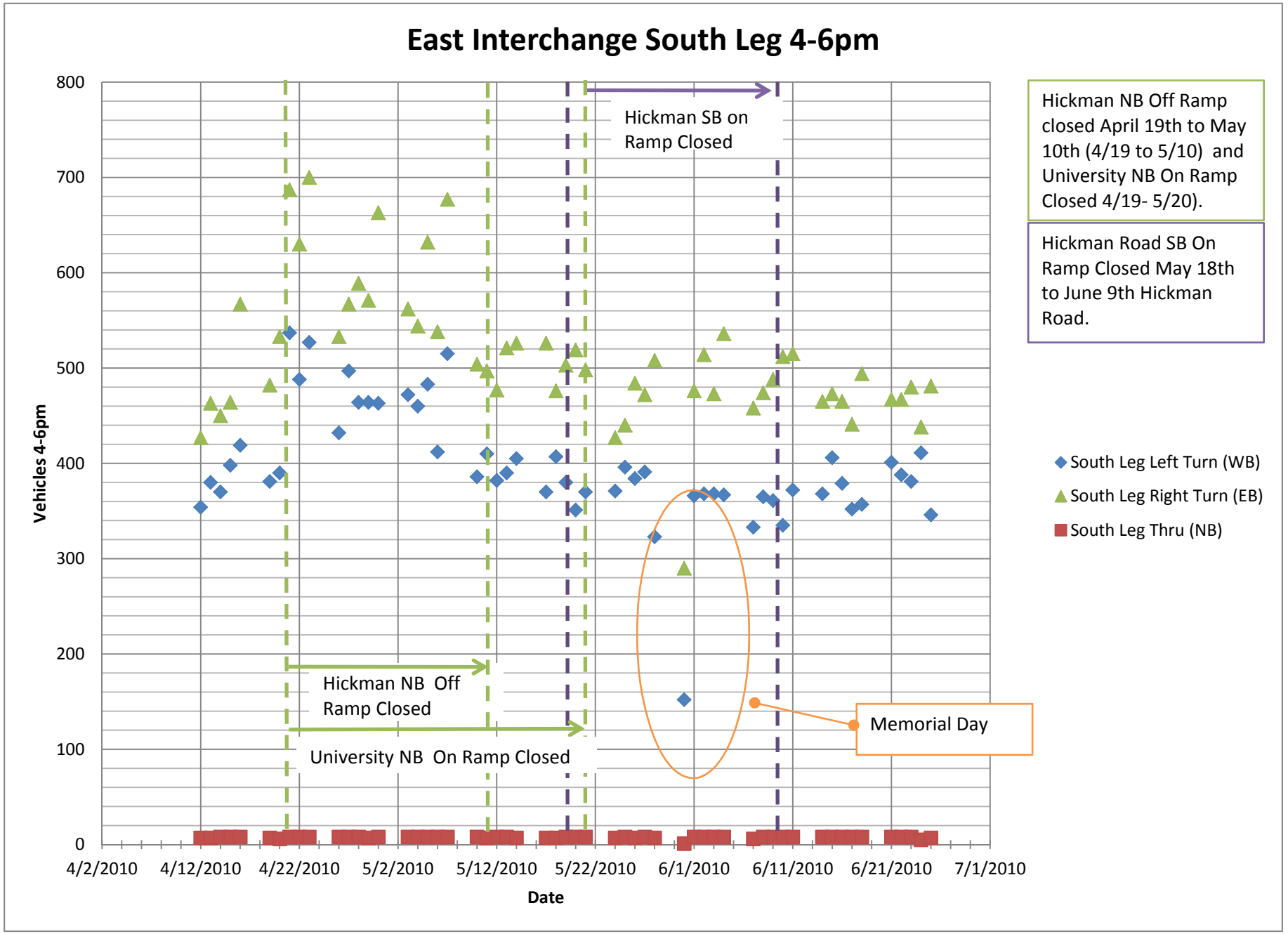

East Interchange East Leg Separated 7-9am
Vehicles 7-9am
1200
1000
800
600
400
200
0
4/2/2010
4/12/2010
4/22/2010
5/2/2010
5/12/2010
5/22/2010
6/1/2010
6/11/2010
6/21/2010
7/1/2010
Date
Hickman NB Off Ramp Closed
Hickman SB on Ramp Closed
University NB On Ramp Closed
Memorial Day
Hickman NB Off Ramp closed April 19th to May 10th (4/19 to 5/10) and University NB On Ramp Closed 4/19- 5/20).
Hickman Road SB On Ramp Closed May 18th to June 9th Hickman Road.
East Leg Right Turn (NB)
East Leg Through (WB)

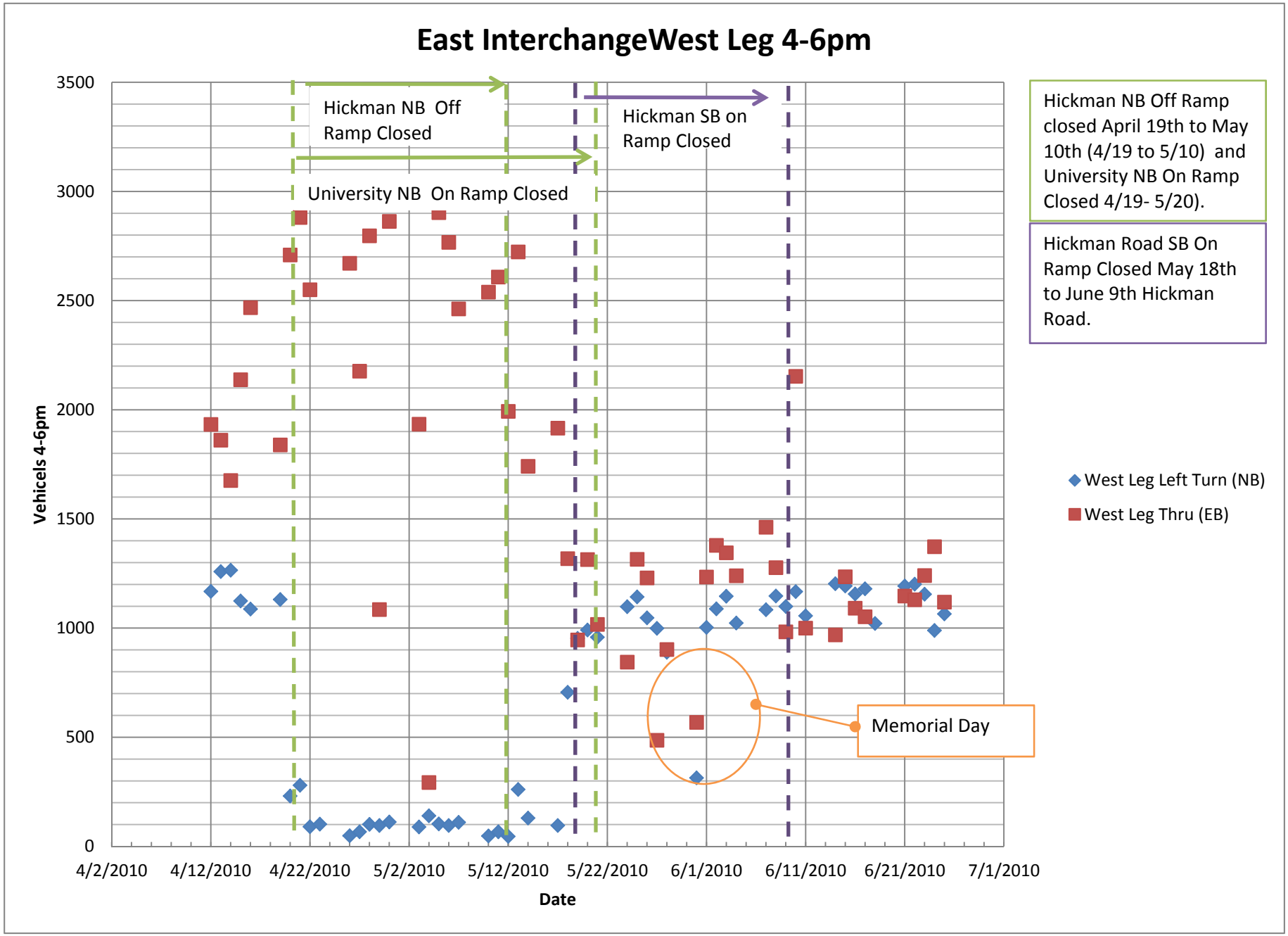

East Interchange South Leg Separated 7-9am
Vehicles 7-9am
1200
1000
800
600
400
200
0
4/2/2010
4/12/2010
4/22/2010
5/2/2010
5/12/2010
5/22/2010
6/1/2010
6/11/2010
6/21/2010
7/1/2010
Date
Hickman SB on Ramp Closed
Hickman NB Off Ramp Closed
University NB On Ramp Closed
Memorial Day
Hickman NB Off Ramp closed April 19th to May 10th (4/19 to 5/10) and University NB On Ramp Closed 4/19- 5/20).
Hickman Road SB On Ramp Closed May 18th to June 9th Hickman Road.
South Leg Left Turn (WB)
South Leg Right Turn (EB)
South Leg Thru (NB)

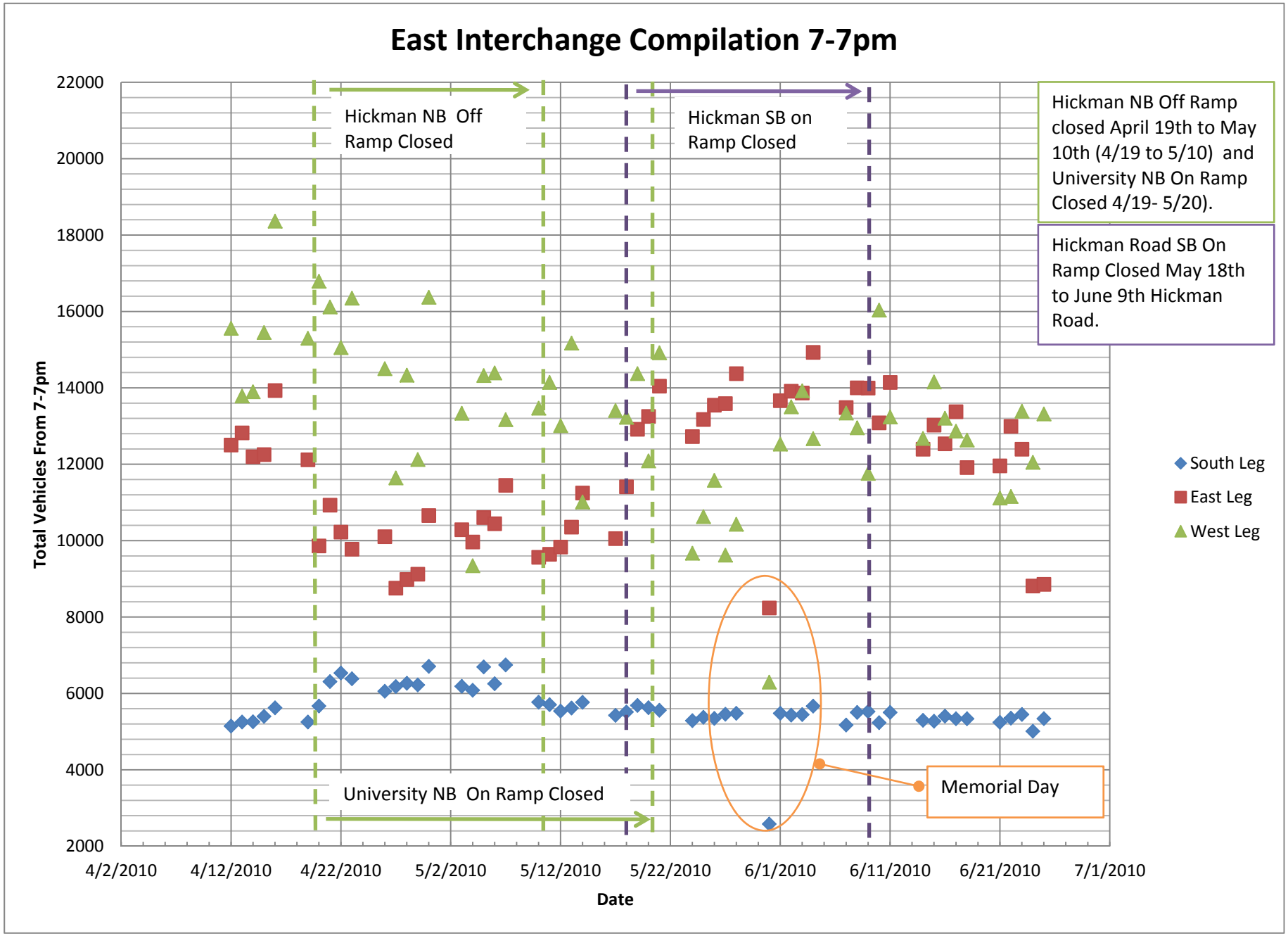

East Interchange West Leg Separated 7-9am
Hickman NB Off Ramp Closed
University NB On Ramp Closed
Hickman SB on Ramp Closed
Memorial Day
Hickman NB Off Ramp closed April 19th to May 10th (4/19 to 5/10) and University NB On Ramp Closed 4/19- 5/20).
Hickman Road SB On Ramp Closed May 18th to June 9th Hickman Road.
West Leg Left Turn (NB)
West Leg Thru (EB)
Vehicels 7-9am
3000
2500
2000
1500
1000
500
0
4/2/2010
4/12/2010
4/22/2010
5/2/2010
5/12/2010
5/22/2010
6/1/2010
6/11/2010
6/21/2010
7/1/2010
Date

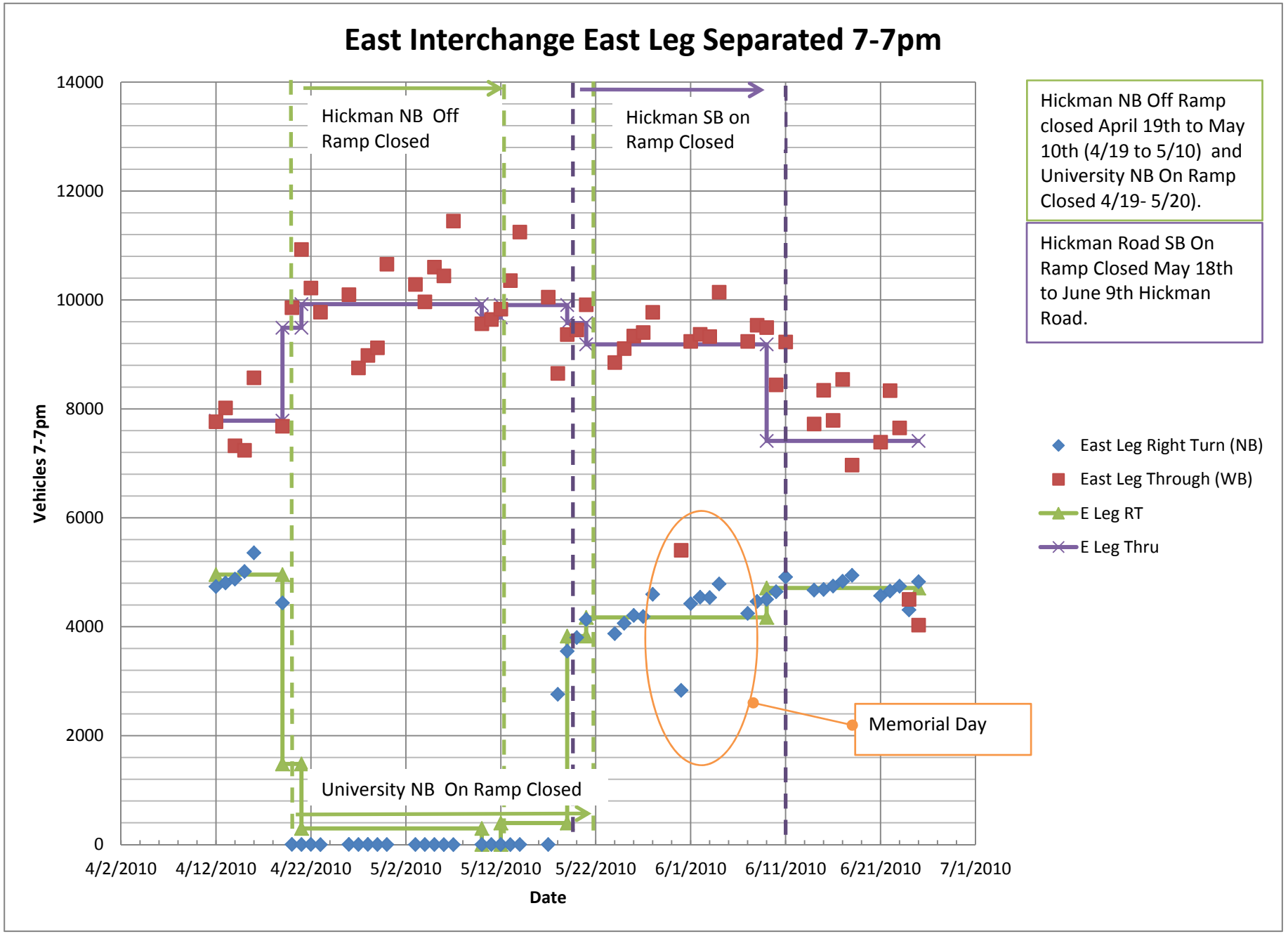

East Interchange Compilation 4-6pm
Total Vehicles From 4-6pm
4000
3500
3000
2500
2000
1500
1000
500
0
4/2/2010
4/12/2010
4/22/2010
5/2/2010
5/12/2010
5/22/2010
6/1/2010
6/11/2010
6/21/2010
7/1/2010
Date
Hickman NB Off Ramp Closed
Hickman SB on Ramp Closed
University NB On Ramp Closed
Hickman NB Off Ramp closed April 19th to May 10th (4/19 to 5/10) and University NB On Ramp Closed 4/19- 5/20).
Hickman Road SB On Ramp Closed May 18th to June 9th Hickman Road.
Memorial Day
South Leg
East Leg
West Leg

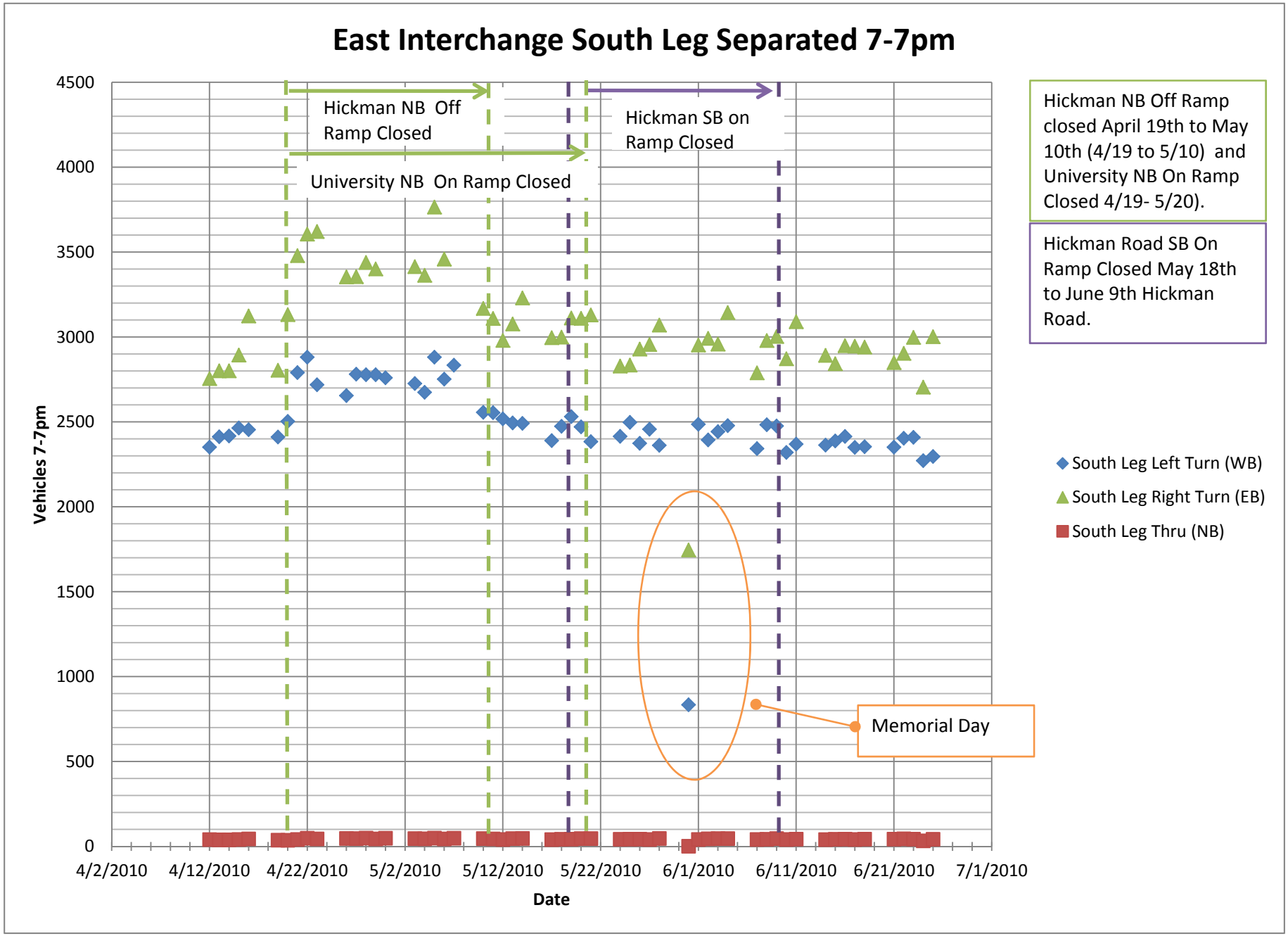

East Interchange East Leg Separated 4-6pm
Vehicles 4-6pm
3000
2500
2000
1500
1000
500
0
4/2/2010
4/12/2010
4/22/2010
5/2/2010
5/12/2010
5/22/2010
6/1/2010
6/11/2010
6/21/2010
7/1/2010
Date
Hickman NB Off Ramp Closed
Hickman SB on Ramp Closed
University NB On Ramp Closed
Memorial Day
Hickman NB Off Ramp closed April 19th to May 10th (4/19 to 5/10) and University NB On Ramp Closed 4/19- 5/20).
Hickman Road SB On Ramp Closed May 18th to June 9th Hickman Road.
East Leg Right Turn (NB)
East Leg Through (WB)

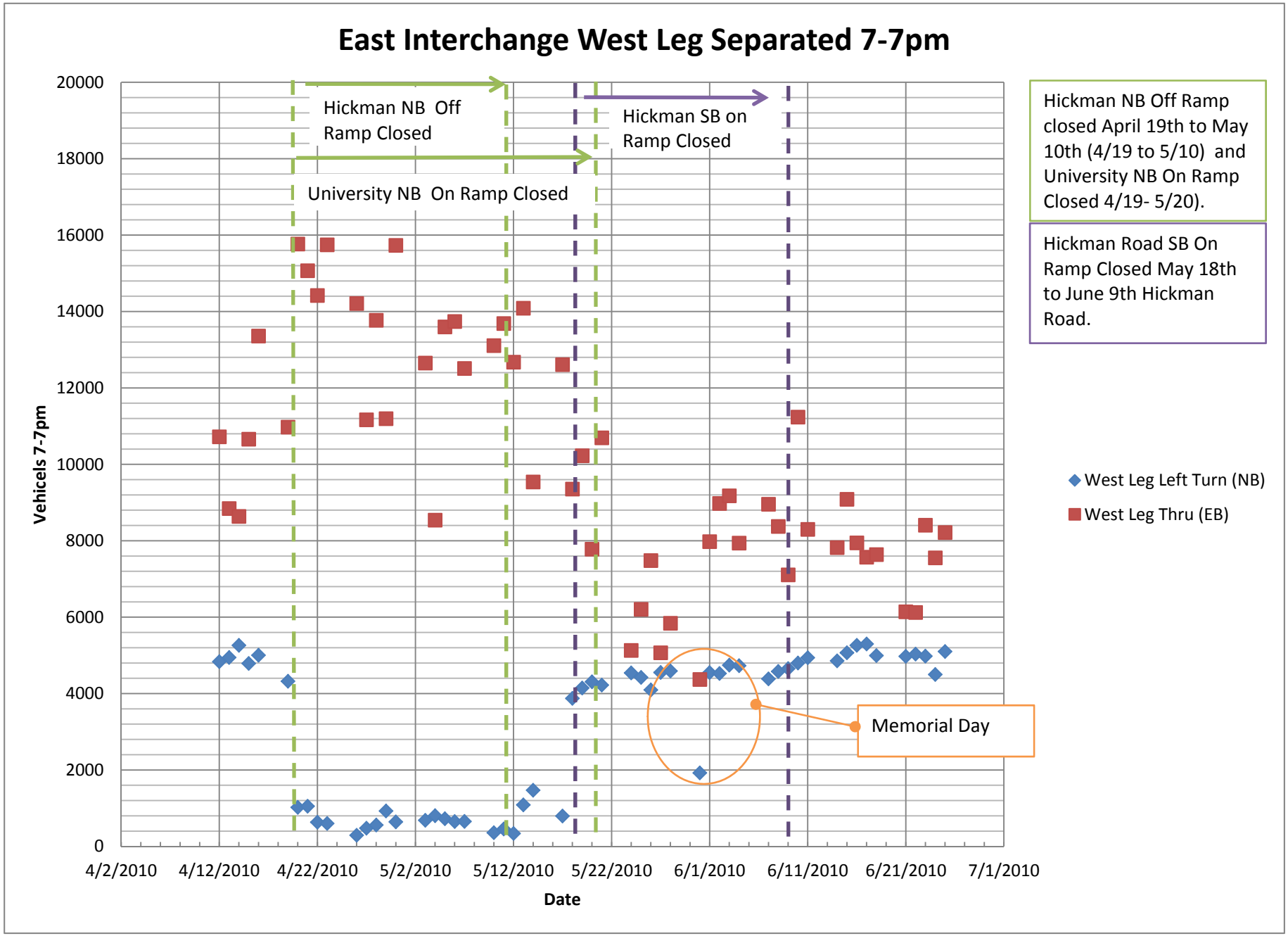

East Interchange South Leg 4-6pm
Vehicles 4-6pm
800
700
600
500
400
300
200
100
0
4/2/2010
4/12/2010
4/22/2010
5/2/2010
5/12/2010
5/22/2010
6/1/2010
6/11/2010
6/21/2010
7/1/2010
Date
Hickman SB on Ramp Closed
Hickman NB Off Ramp Closed
University NB On Ramp Closed
Memorial Day
Hickman NB Off Ramp closed April 19th to May 10th (4/19 to 5/10) and University NB On Ramp Closed 4/19- 5/20).
Hickman Road SB On Ramp Closed May 18th to June 9th Hickman Road.
South Leg Left Turn (WB)
South Leg Right Turn (EB)
South Leg Thru (NB)


East InterchangeWest Leg 4-6pm
Hickman NB Off Ramp Closed
University NB On Ramp Closed
Hickman SB on Ramp Closed
Memorial Day
Hickman NB Off Ramp closed April 19th to May 10th (4/19 to 5/10) and University NB On Ramp Closed 4/19- 5/20).
Hickman Road SB On Ramp Closed May 18th to June 9th Hickman Road.
West Leg Left Turn (NB)
West Leg Thru (EB)
Vehicels 4-6pm
3500
3000
2500
2000
1500
1000
500
0
4/2/2010
4/12/2010
4/22/2010
5/2/2010
5/12/2010
5/22/2010
6/1/2010
6/11/2010
6/21/2010
7/1/2010
Date


East Interchange Compilation 7-7pm
Total Vehicles From 7-7pm
22000
20000
18000
16000
14000
12000
10000
8000
6000
4000
2000
4/2/2010
4/12/2010
4/22/2010
5/2/2010
5/12/2010
5/22/2010
6/1/2010
6/11/2010
6/21/2010
7/1/2010
Date
Hickman NB Off Ramp Closed
Hickman SB on Ramp Closed
University NB On Ramp Closed
Memorial Day
Hickman NB Off Ramp closed April 19th to May 10th (4/19 to 5/10) and University NB On Ramp Closed 4/19- 5/20).
Hickman Road SB On Ramp Closed May 18th to June 9th Hickman Road.
South Leg
East Leg
West Leg

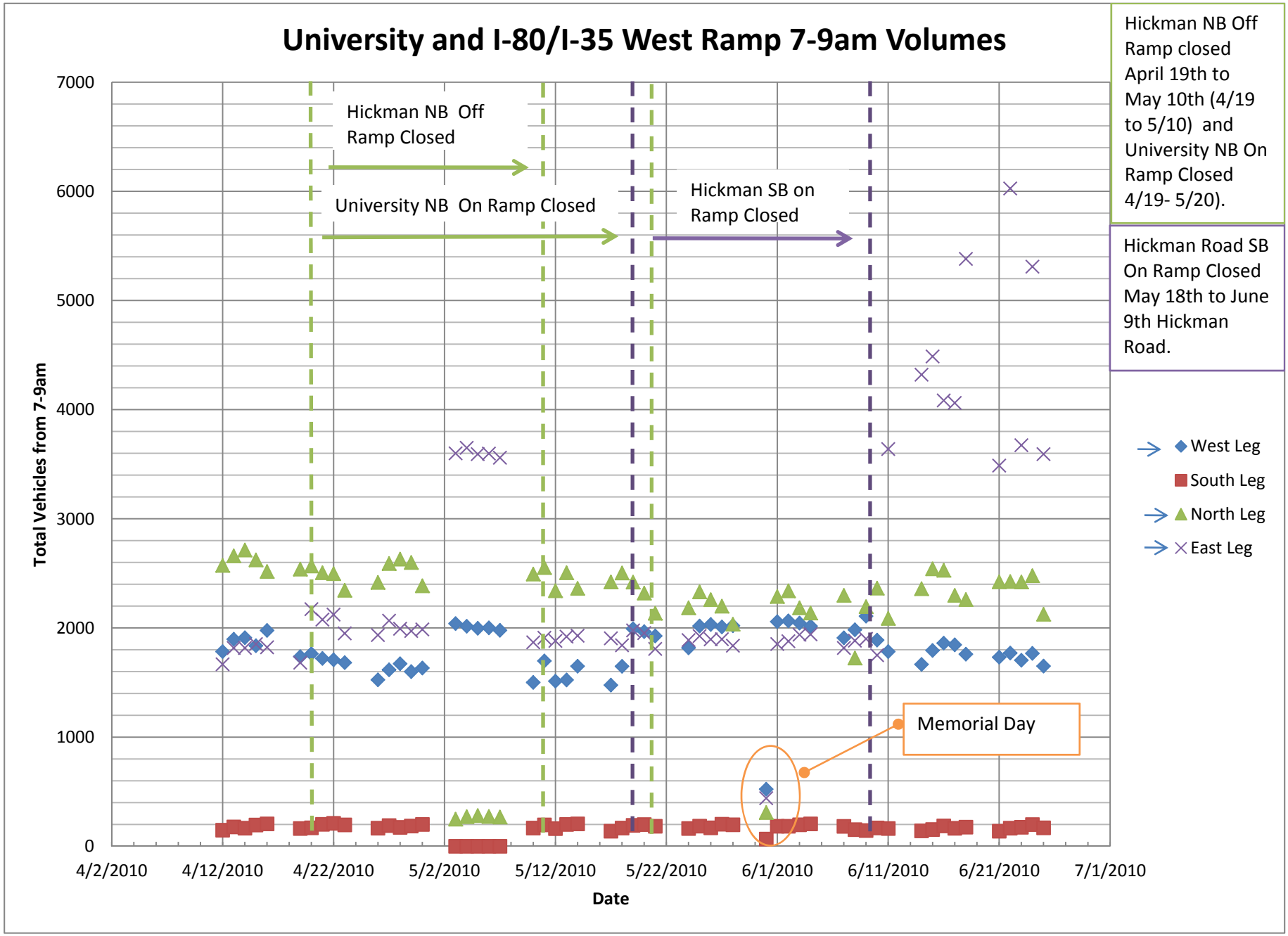

East Interchange East Leg Separated 7-7pm
Vehicles 7-7pm
14000
12000
10000
8000
6000
4000
2000
0
4/2/2010
4/12/2010
4/22/2010
5/2/2010
5/12/2010
5/22/2010
6/1/2010
6/11/2010
6/21/2010
7/1/2010
Date
Hickman NB Off Ramp Closed
Hickman SB on Ramp Closed
University NB On Ramp Closed
Memorial Day
Hickman NB Off Ramp closed April 19th to May 10th (4/19 to 5/10) and University NB On Ramp Closed 4/19- 5/20).
Hickman Road SB On Ramp Closed May 18th to June 9th Hickman Road.
East Leg Right Turn (NB)
East Leg Through (WB)
E Leg RT
E Leg Thru

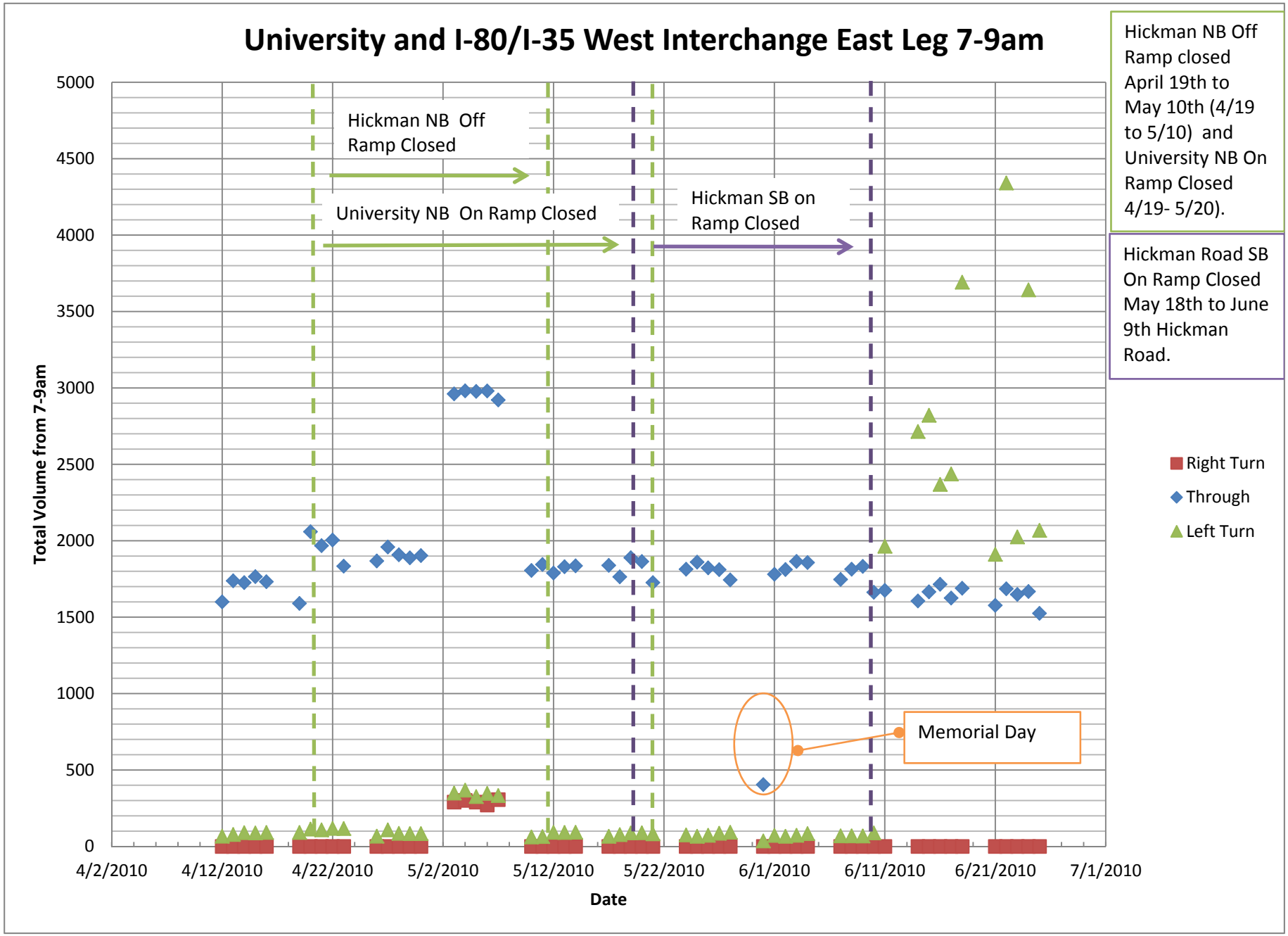

East Interchange South Leg Separated 7-7pm
Hickman NB Off Ramp Closed
University NB On Ramp Closed
Hickman SB on Ramp Closed
Hickman NB Off Ramp closed April 19th to May 10th (4/19 to 5/10) and University NB On Ramp Closed 4/19- 5/20).
Hickman Road SB On Ramp Closed May 18th to June 9th Hickman Road.
Memorial Day
South Leg Left Turn (WB)
South Leg Right Turn (EB)
South Leg Thru (NB)
Vehicles 7-7pm
Date
4500
4000
3500
3000
2500
2000
1500
1000
500
0
4/2/2010
4/12/2010
4/22/2010
5/2/2010
5/12/2010
5/22/2010
6/1/2010
6/11/2010
6/21/2010
7/1/2010

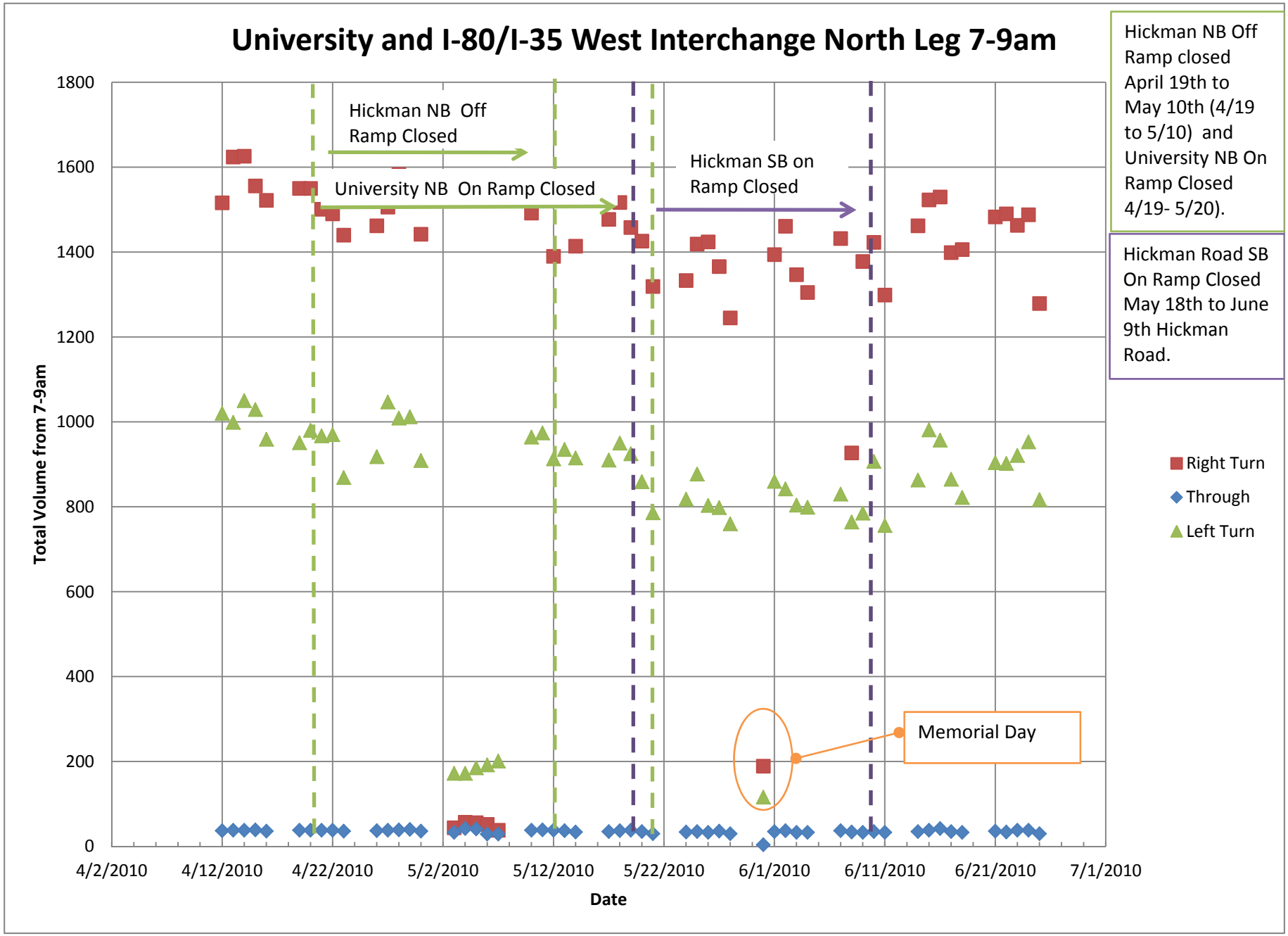

East Interchange West Leg Separated 7-7pm
Hickman NB Off Ramp Closed
University NB On Ramp Closed
Hickman SB on Ramp Closed
Hickman NB Off Ramp closed April 19th to May 10th (4/19 to 5/10) and University NB On Ramp Closed 4/19- 5/20).
Hickman Road SB On Ramp Closed May 18th to June 9th Hickman Road.
West Leg Left Turn (NB)
West Leg Thru (EB)
Memorial Day
Vehicels 7-7pm
Date
20000
18000
16000
14000
12000
10000
8000
6000
4000
2000
0
4/2/2010
4/12/2010
4/22/2010
5/2/2010
5/12/2010
5/22/2010
6/1/2010
6/11/2010
6/21/2010
7/1/2010

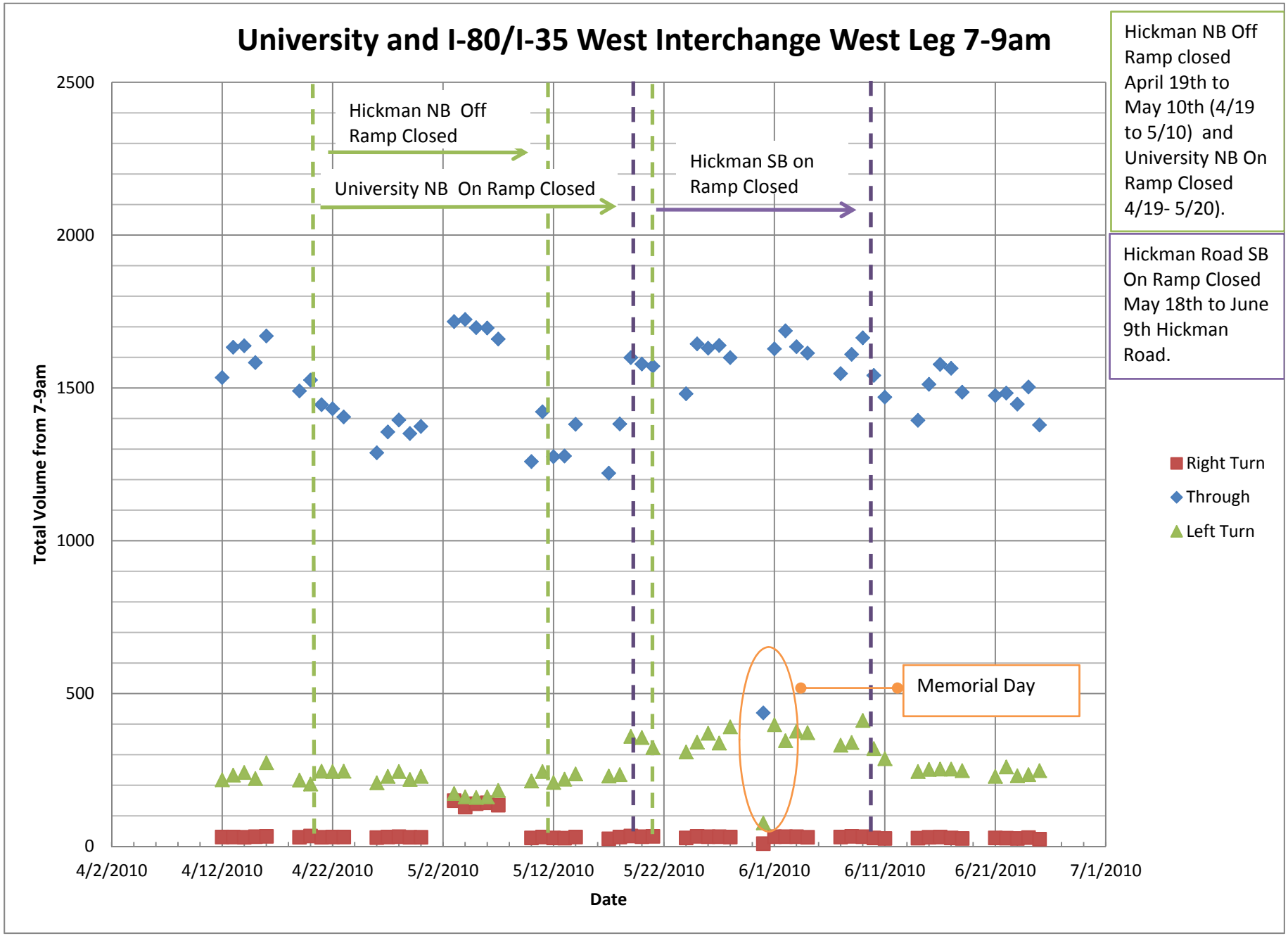
B.2 Intersection Traffic-Volume Changes

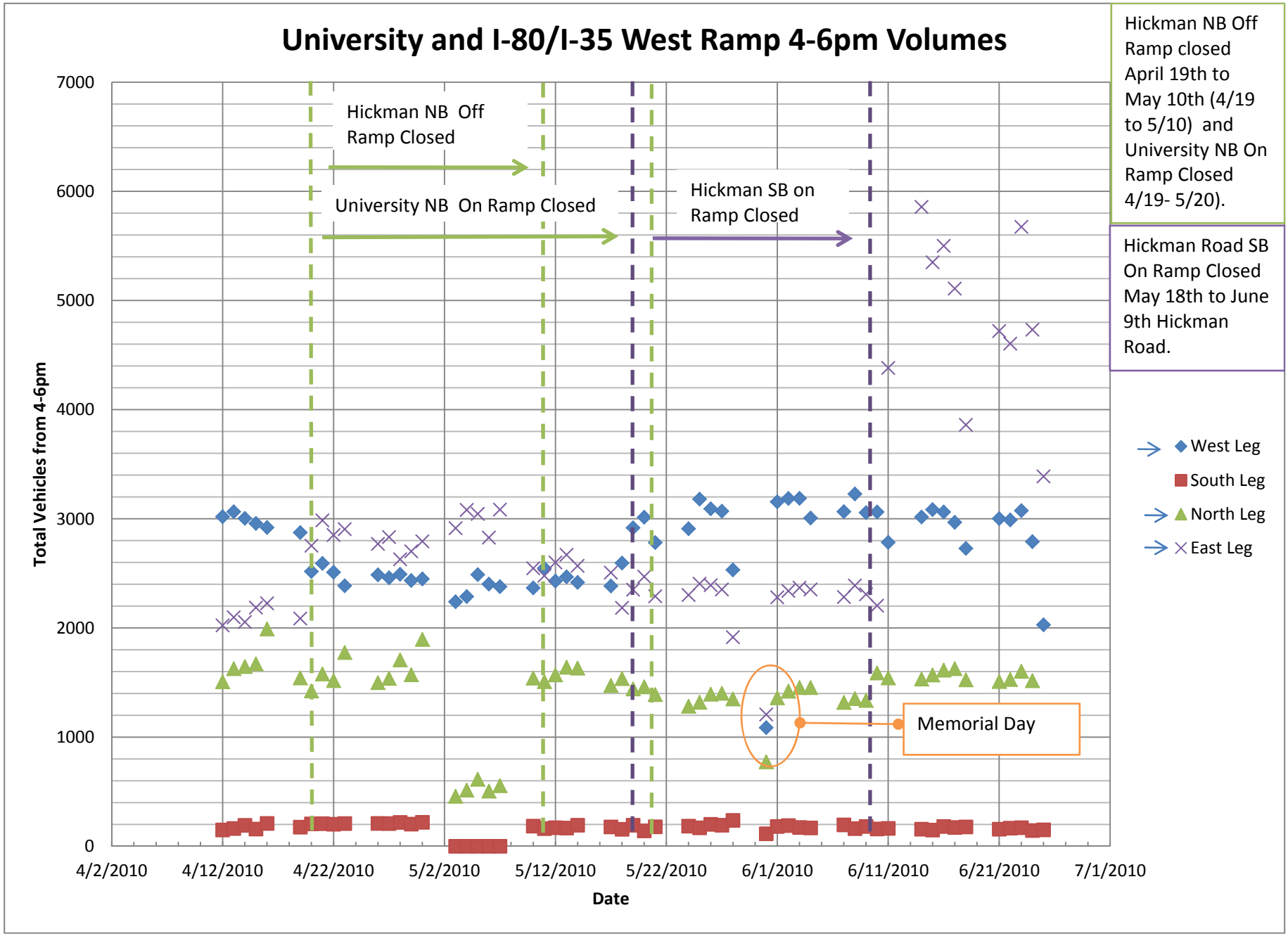
University and I-35 West Ramp

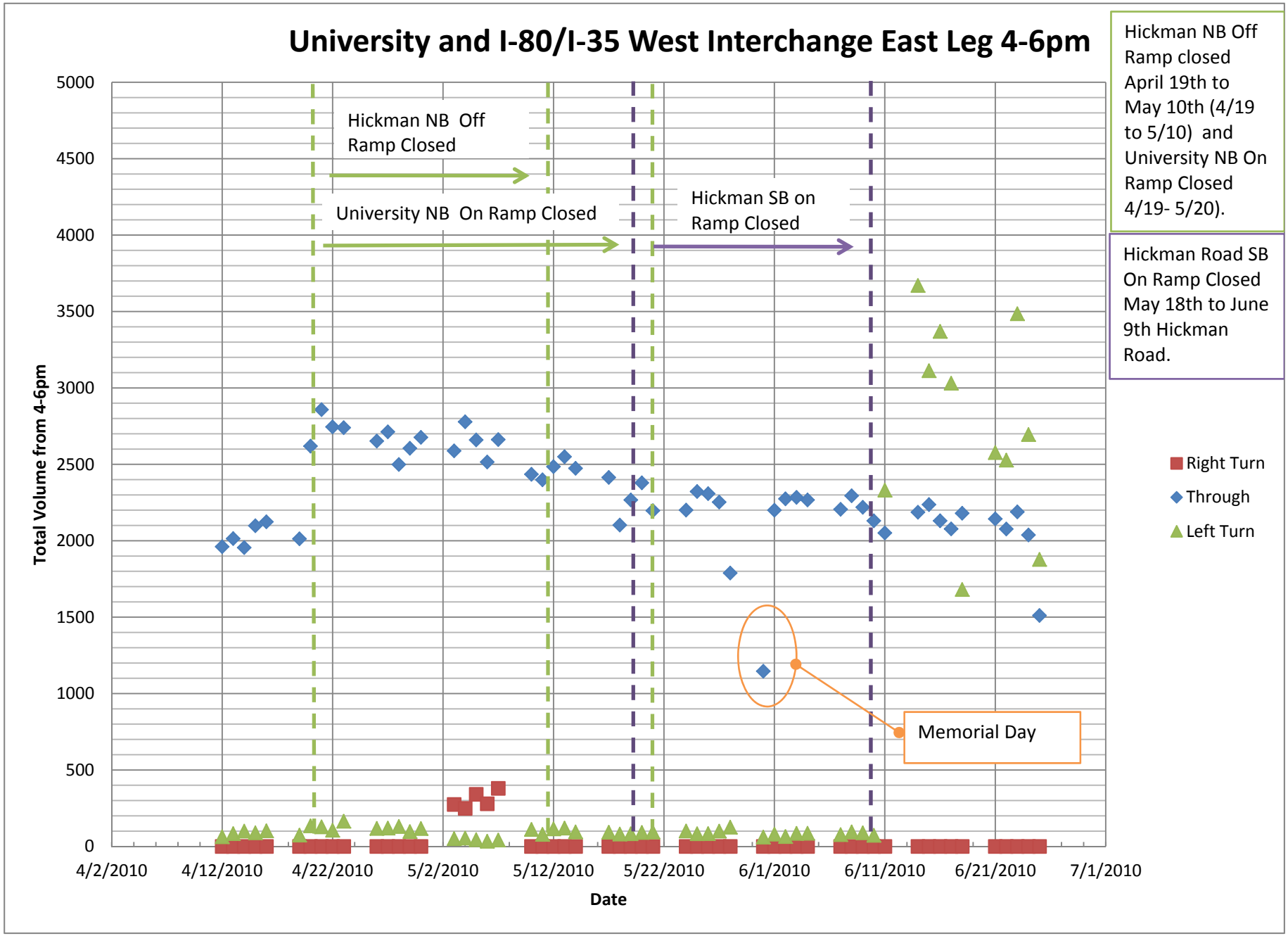

University and I-80/I-35 West Ramp 7-9am Volumes
Hickman NB Off Ramp closed April 19th to May 10th (4/19 to 5/10) and University NB On Ramp Closed 4/19- 5/20).
Hickman Road SB On Ramp Closed May 18th to June 9th Hickman Road.
Hickman NB Off Ramp Closed
University NB On Ramp Closed
Hickman SB on Ramp Closed
Memorial Day
West Leg
South Leg
North Leg
East Leg
Total Vehicles from 7-9am
Date
7000
6000
5000
4000
3000
2000
1000
0
4/2/2010
4/12/2010
4/22/2010
5/2/2010
5/12/2010
5/22/2010
6/1/2010
6/11/2010
6/21/2010
7/1/2010

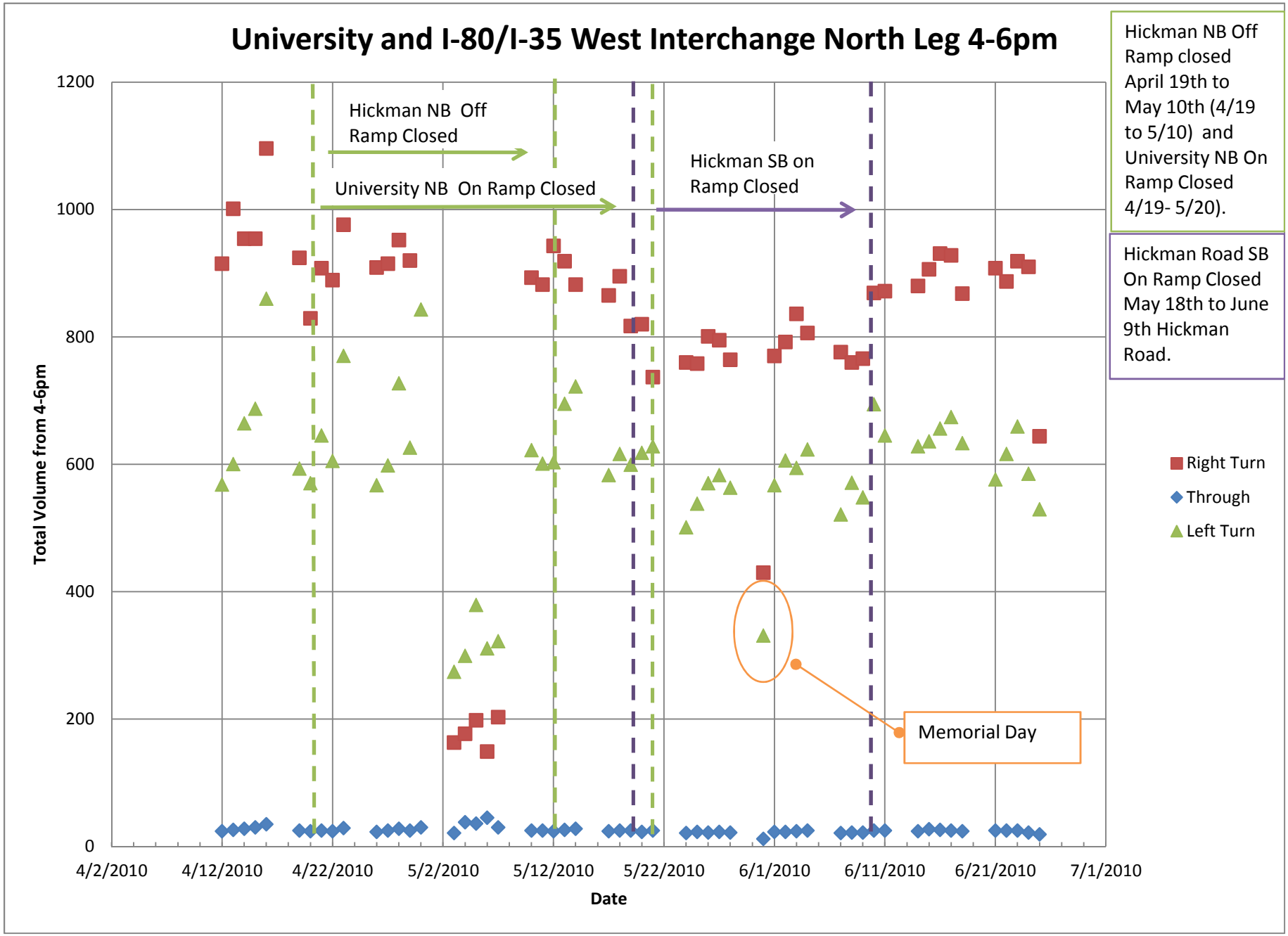

University and I-80/I-35 West Interchange East Leg 7-9am
Hickman NB Off Ramp closed April 19th to May 10th (4/19 to 5/10) and University NB On Ramp Closed 4/19- 5/20).
Hickman Road SB On Ramp Closed May 18th to June 9th Hickman Road.
Hickman NB Off Ramp Closed
University NB On Ramp Closed
Hickman SB on Ramp Closed
Memorial Day
Right Turn
Through
Left Turn
Total Volume from 7-9am
Date
5000
4500
4000
3500
3000
2500
2000
1500
1000
500
0
4/2/2010
4/12/2010
4/22/2010
5/2/2010
5/12/2010
5/22/2010
6/1/2010
6/11/2010
6/21/2010
7/1/2010

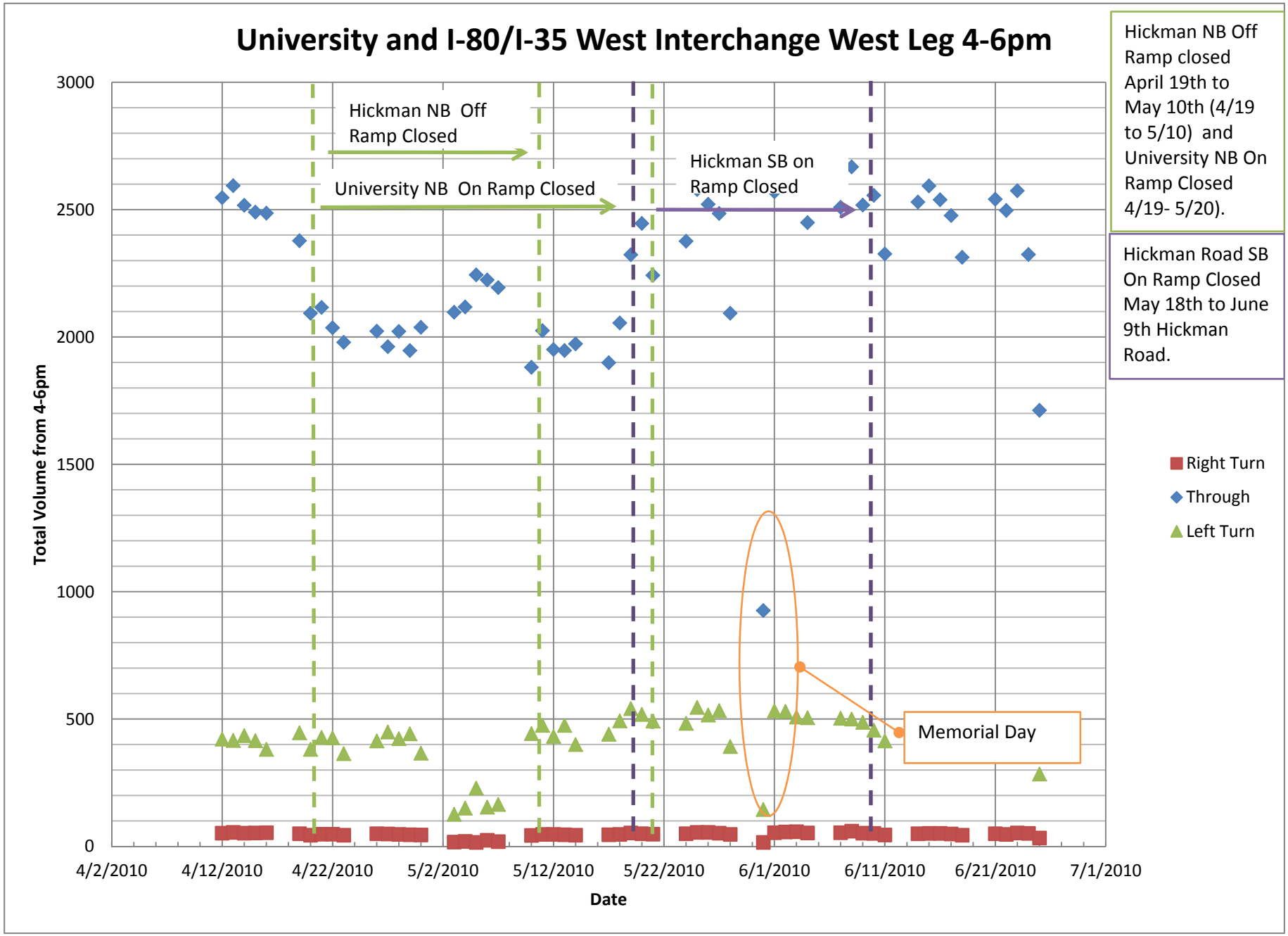

University and I-80/I-35 West Interchange North Leg 7-9am
Hickman NB Off Ramp Closed
University NB On Ramp Closed
Hickman SB on Ramp Closed
Memorial Day
Hickman NB Off Ramp closed April 19th to May 10th (4/19 to 5/10) and University NB On Ramp Closed 4/19- 5/20).
Hickman Road SB On Ramp Closed May 18th to June 9th Hickman Road.
Right Turn
Through
Left Turn
Total Volume from 7-9am
Date
0
200
400
600
800
1000
1200
1400
1600
1800
4/2/2010
4/12/2010
4/22/2010
5/2/2010
5/12/2010
5/22/2010
6/1/2010
6/11/2010
6/21/2010
7/1/2010

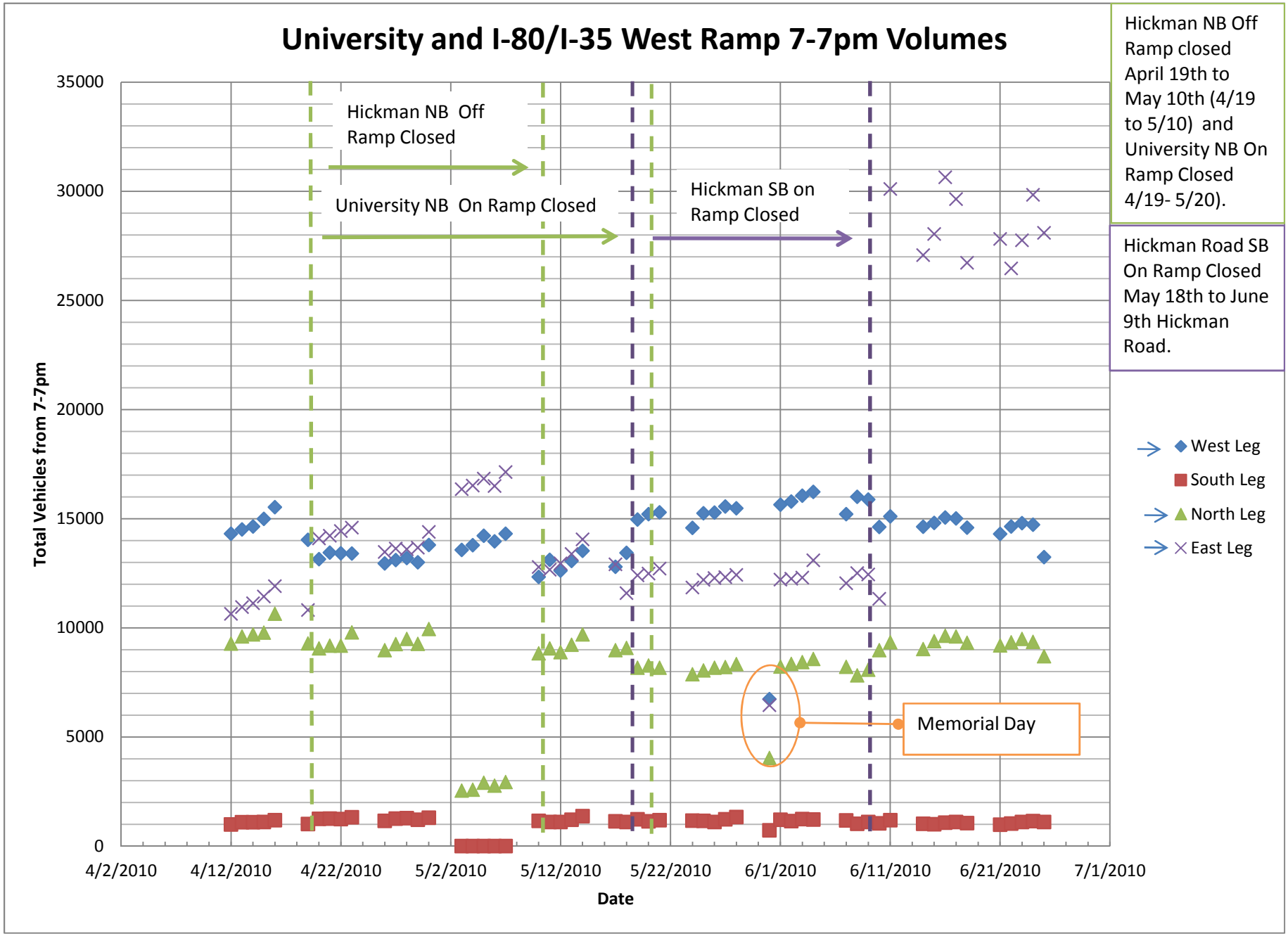

University and I-80/I-35 West Interchange West Leg 7-9am
Hickman NB Off Ramp Closed
University NB On Ramp Closed
Hickman SB on Ramp Closed
Memorial Day
Hickman NB Off Ramp closed April 19th to May 10th (4/19 to 5/10) and University NB On Ramp Closed 4/19- 5/20).
Hickman Road SB On Ramp Closed May 18th to June 9th Hickman Road.
Right Turn
Through
Left Turn
Total Volume from 7-9am
2500
2000
1500
1000
500
0
4/2/2010
4/12/2010
4/22/2010
5/2/2010
5/12/2010
5/22/2010
6/1/2010
6/11/2010
6/21/2010
7/1/2010
Date

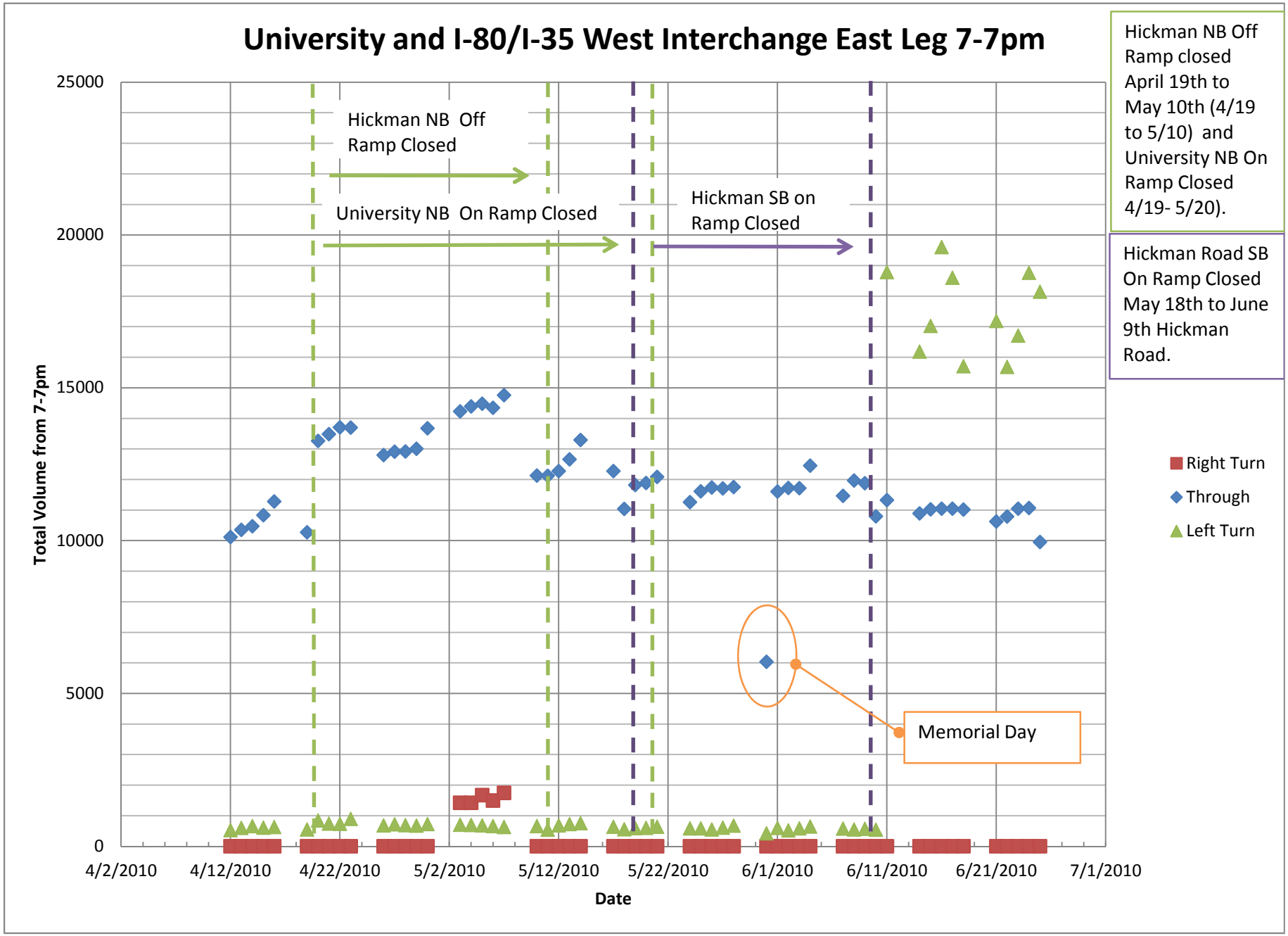

University and I-80/I-35 West Ramp 4-6pm Volumes
Hickman NB Off Ramp Closed
University NB On Ramp Closed
Hickman SB on Ramp Closed
Memorial Day
Hickman NB Off Ramp closed April 19th to May 10th (4/19 to 5/10) and University NB On Ramp Closed 4/19- 5/20).
Hickman Road SB On Ramp Closed May 18th to June 9th Hickman Road.
West Leg
South Leg
North Leg
East Leg
Total Vehicles from 4-6pm
Date
7000
6000
5000
4000
3000
2000
1000
0
4/2/2010
4/12/2010
4/22/2010
5/2/2010
5/12/2010
5/22/2010
6/1/2010
6/11/2010
6/21/2010
7/1/2010

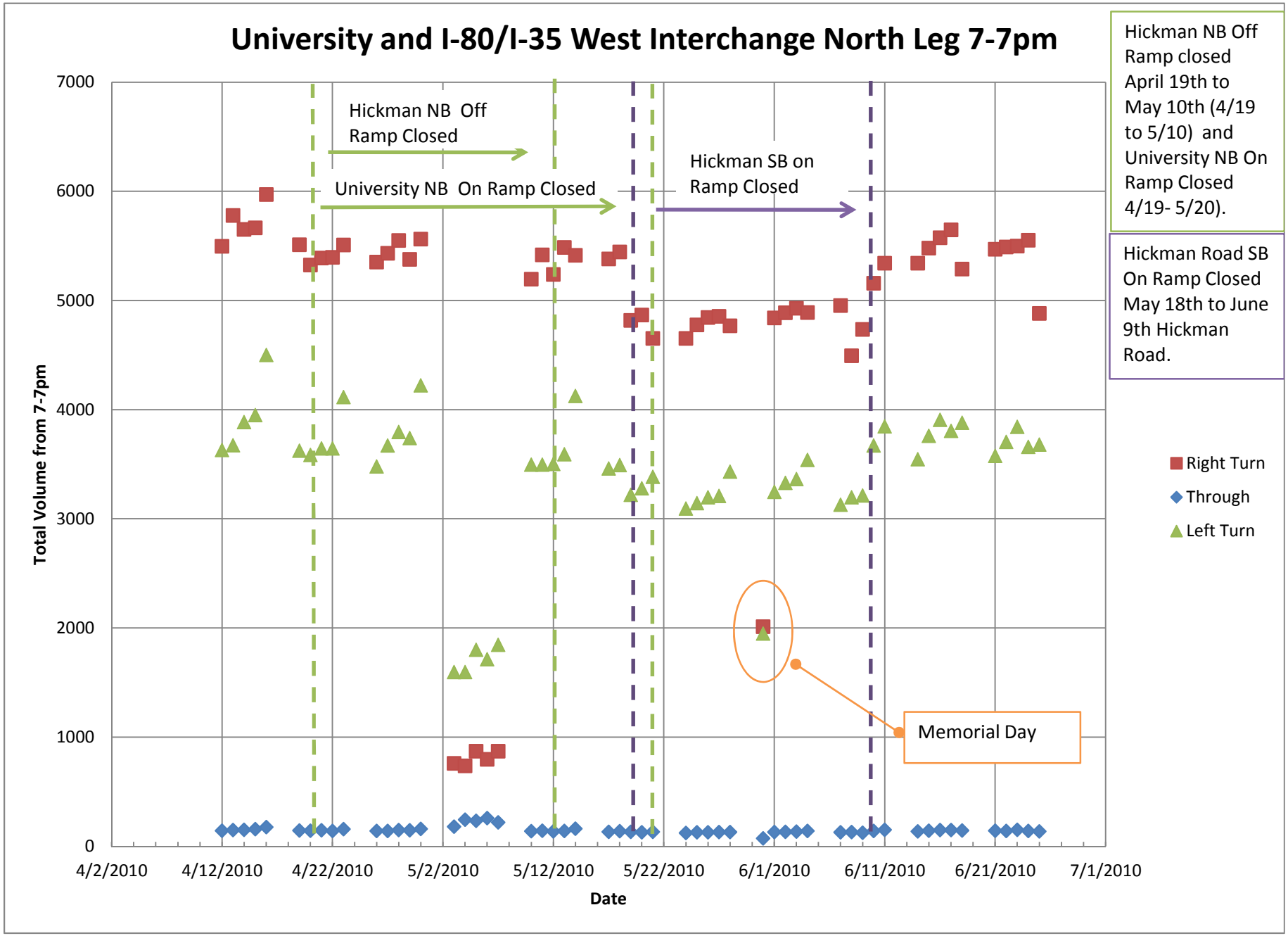

University and I-80/I-35 West Interchange East Leg 4-6pm
Hickman NB Off Ramp closed April 19th to May 10th (4/19 to 5/10) and University NB On Ramp Closed 4/19- 5/20).
Hickman Road SB On Ramp Closed May 18th to June 9th Hickman Road.
Hickman NB Off Ramp Closed
University NB On Ramp Closed
Hickman SB on Ramp Closed
Memorial Day
Right Turn
Through
Left Turn
Total Volume from 4-6pm
5000
4500
4000
3500
3000
2500
2000
1500
1000
500
0
4/2/2010
4/12/2010
4/22/2010
5/2/2010
5/12/2010
5/22/2010
6/1/2010
6/11/2010
6/21/2010
7/1/2010
Date

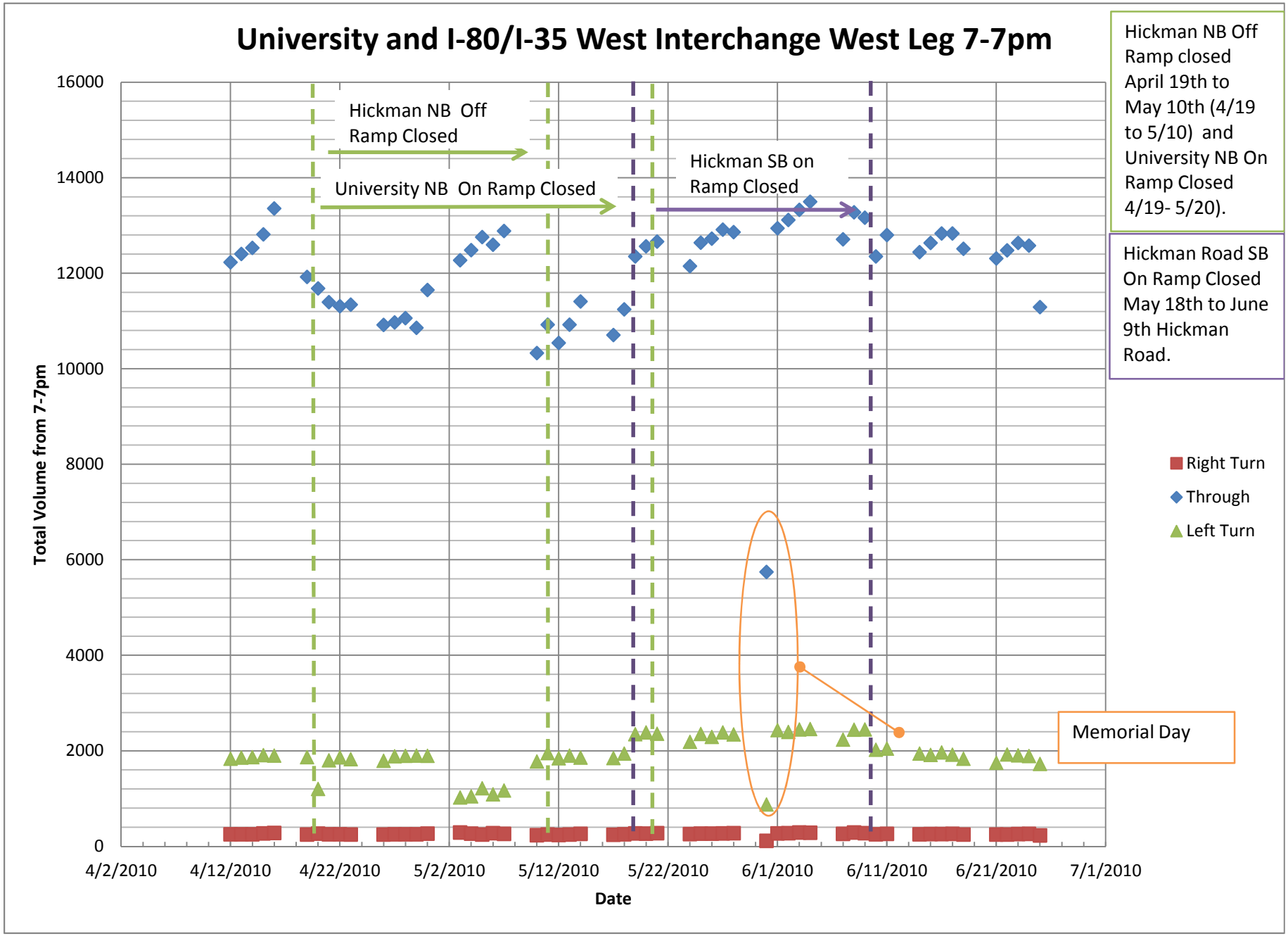

University and I-80/I-35 West Interchange North Leg 4-6pm
Hickman NB Off Ramp Closed
University NB On Ramp Closed
Hickman SB on Ramp Closed
Memorial Day
Hickman NB Off Ramp closed April 19th to May 10th (4/19 to 5/10) and University NB On Ramp Closed 4/19- 5/20).
Hickman Road SB On Ramp Closed May 18th to June 9th Hickman Road.
Right Turn
Through
Left Turn
Total Volume from 4-6pm
0
200
400
600
800
1000
1200
4/2/2010
4/12/2010
4/22/2010
5/2/2010
5/12/2010
5/22/2010
6/1/2010
6/11/2010
6/21/2010
7/1/2010
Date


University and I-80/I-35 West Interchange West Leg 4-6pm
Hickman NB Off Ramp closed April 19th to May 10th (4/19 to 5/10) and University NB On Ramp Closed 4/19- 5/20).
Hickman Road SB On Ramp Closed May 18th to June 9th Hickman Road.
Hickman NB Off Ramp Closed
University NB On Ramp Closed
Hickman SB on Ramp Closed
Memorial Day
Right Turn
Through
Left Turn
Total Volume from 4-6pm
3000
2500
2000
1500
1000
500
0
4/2/2010
4/12/2010
4/22/2010
5/2/2010
5/12/2010
5/22/2010
6/1/2010
6/11/2010
6/21/2010
7/1/2010
Date


University and I-80/I-35 West Ramp 7-7pm Volumes
Hickman NB Off Ramp Closed
University NB On Ramp Closed
Hickman SB on Ramp Closed
Memorial Day
Hickman NB Off Ramp closed April 19th to May 10th (4/19 to 5/10) and University NB On Ramp Closed 4/19- 5/20).
Hickman Road SB On Ramp Closed May 18th to June 9th Hickman Road.
West Leg
South Leg
North Leg
East Leg
Total Vehicles from 7-7pm
35000
30000
25000
20000
15000
10000
5000
0
4/2/2010
4/12/2010
4/22/2010
5/2/2010
5/12/2010
5/22/2010
6/1/2010
6/11/2010
6/21/2010
7/1/2010
Date

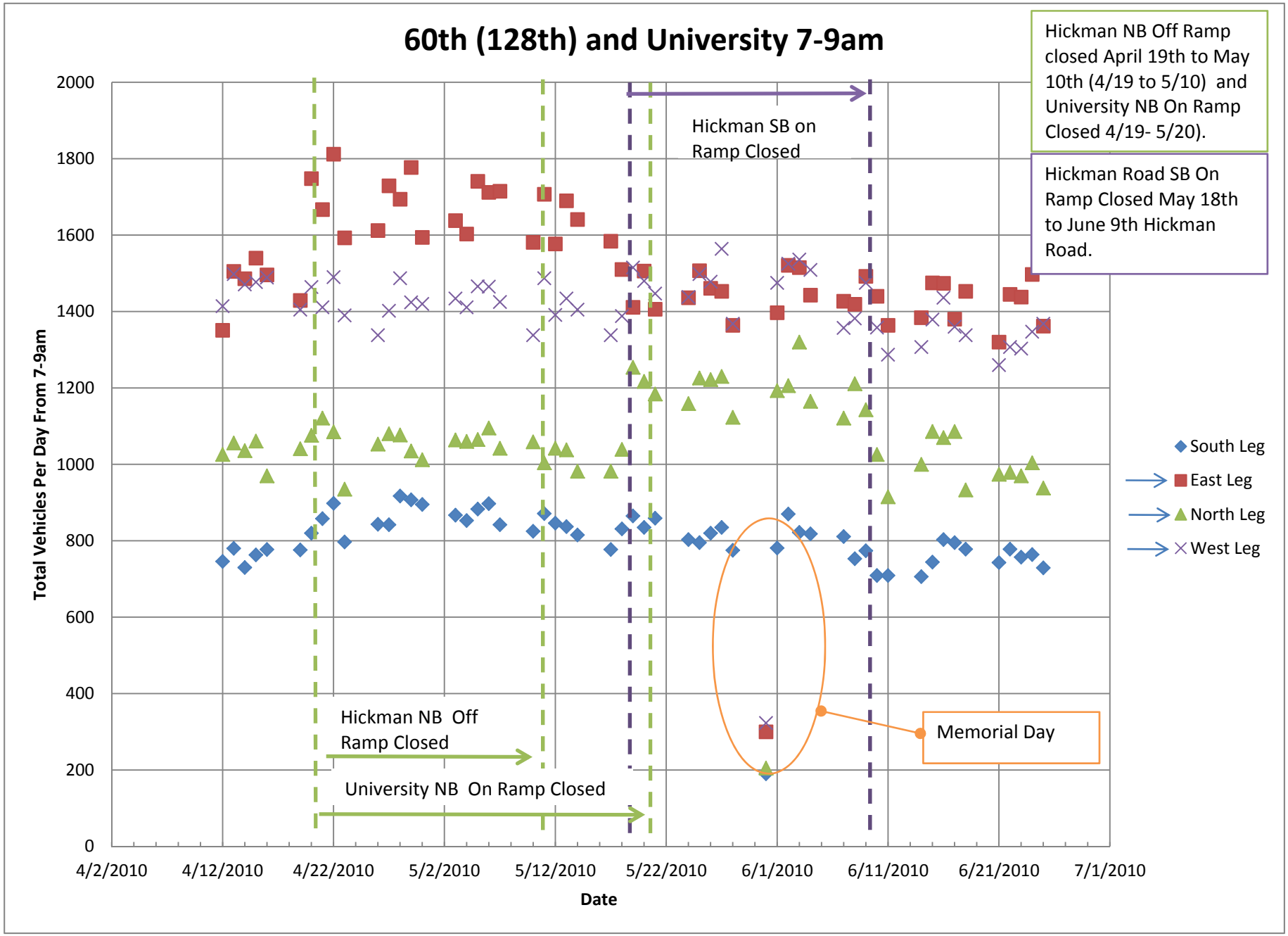

University and I-80/I-35 West Interchange East Leg 7-7pm
Hickman NB Off Ramp closed April 19th to May 10th (4/19 to 5/10) and University NB On Ramp Closed 4/19- 5/20).
Hickman Road SB On Ramp Closed May 18th to June 9th Hickman Road.
Hickman NB Off Ramp Closed
University NB On Ramp Closed
Hickman SB on Ramp Closed
Memorial Day
Right Turn
Through
Left Turn
Total Volume from 7-7pm
25000
20000
15000
10000
5000
0
4/2/2010
4/12/2010
4/22/2010
5/2/2010
5/12/2010
5/22/2010
6/1/2010
6/11/2010
6/21/2010
7/1/2010
Date

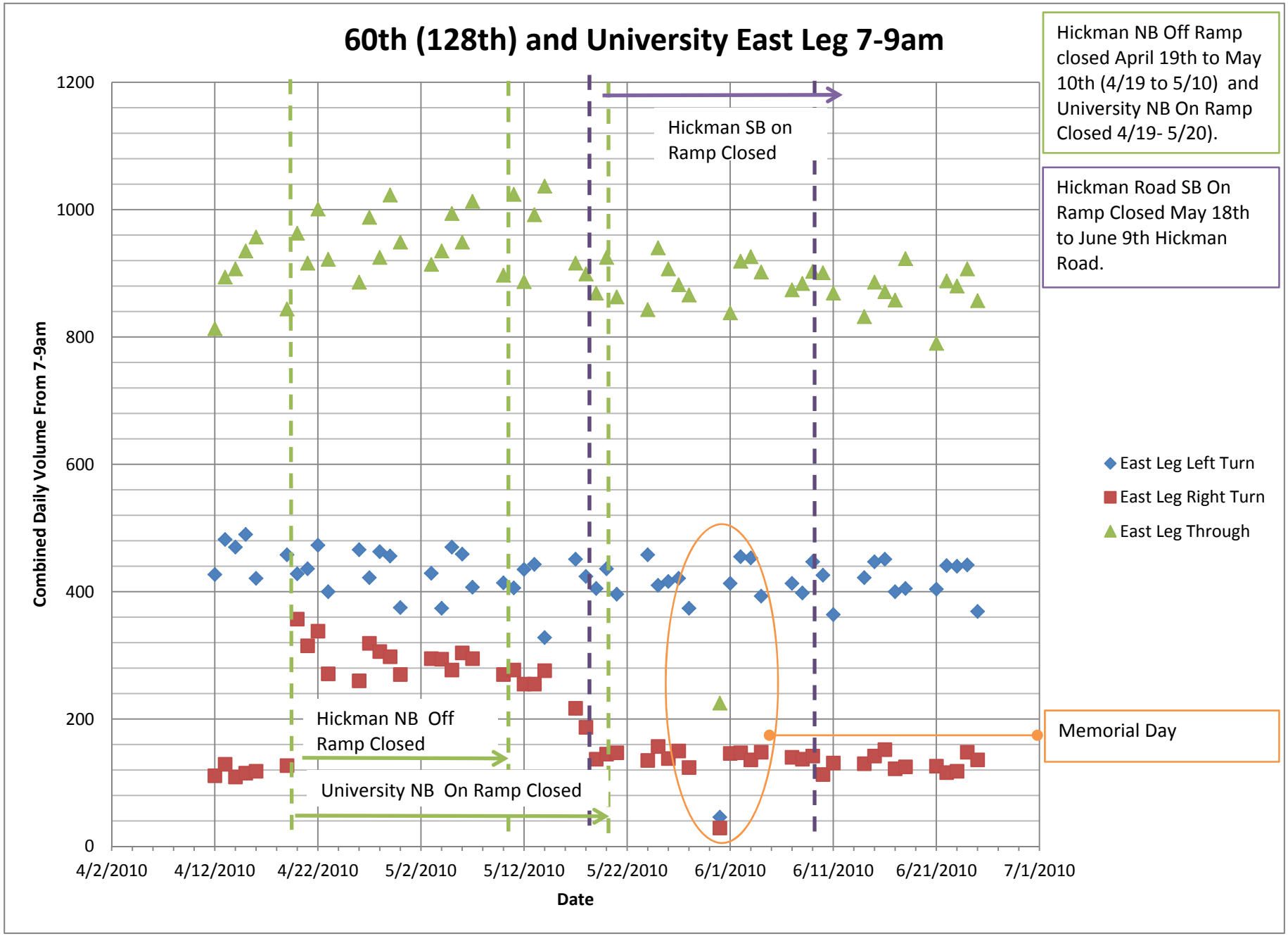

University and I-80/I-35 West Interchange North Leg 7-7pm
Hickman NB Off Ramp Closed
University NB On Ramp Closed
Hickman SB on Ramp Closed
Memorial Day
Hickman NB Off Ramp closed April 19th to May 10th (4/19 to 5/10) and University NB On Ramp Closed 4/19- 5/20).
Hickman Road SB On Ramp Closed May 18th to June 9th Hickman Road.
Right Turn
Through
Left Turn
Total Volume from 7-7pm
7000
6000
5000
4000
3000
2000
1000
0
4/2/2010
4/12/2010
4/22/2010
5/2/2010
5/12/2010
5/22/2010
6/1/2010
6/11/2010
6/21/2010
7/1/2010
Date

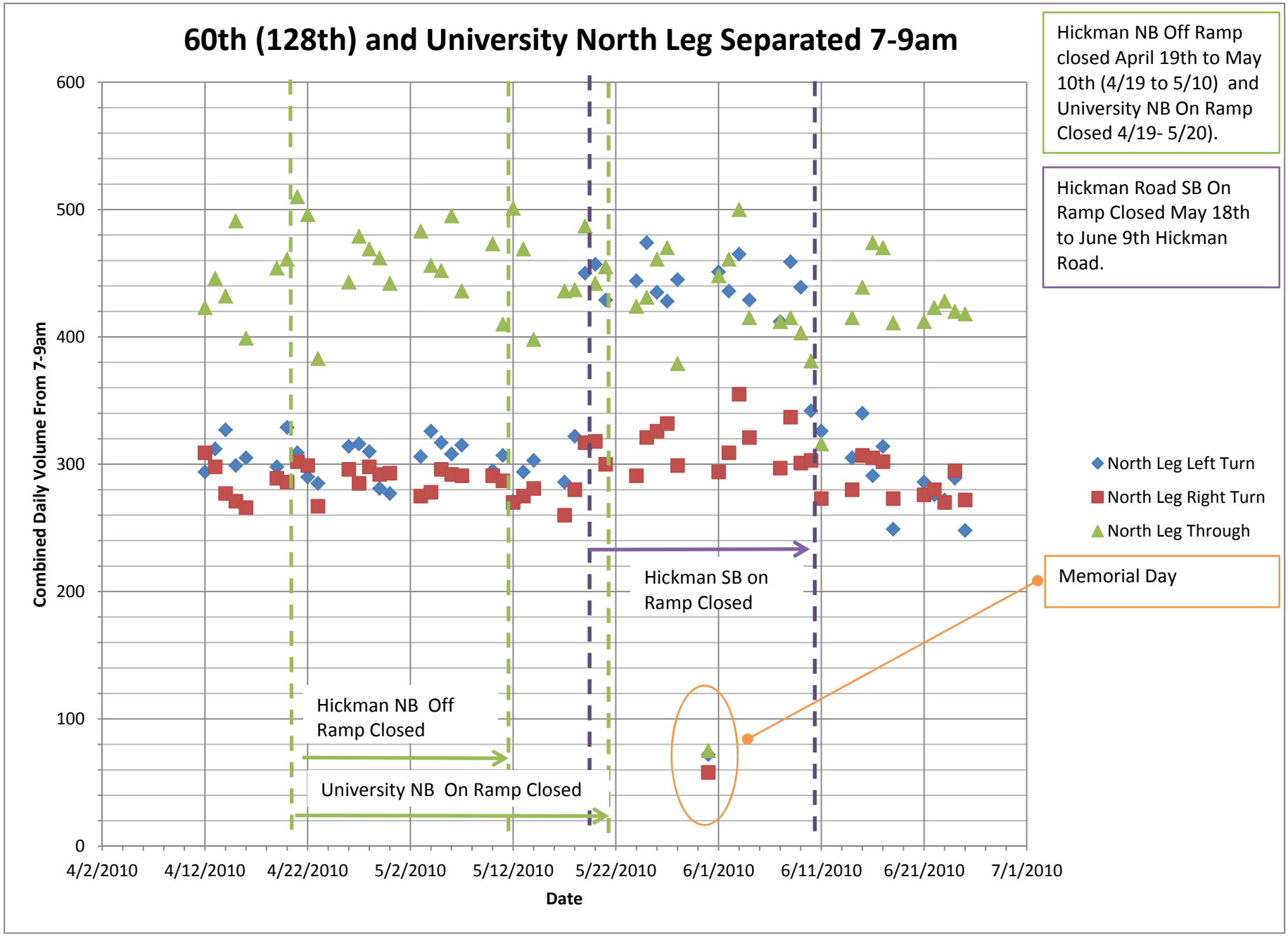

University and I-80/I-35 West Interchange West Leg 7-7pm
Hickman NB Off Ramp closed April 19th to May 10th (4/19 to 5/10) and University NB On Ramp Closed 4/19- 5/20).
Hickman Road SB On Ramp Closed May 18th to June 9th Hickman Road.
Hickman NB Off Ramp Closed
University NB On Ramp Closed
Hickman SB on Ramp Closed
Memorial Day
Right Turn
Through
Left Turn
Total Volume from 7-7pm
16000
14000
12000
10000
8000
6000
4000
2000
0
4/2/2010
4/12/2010
4/22/2010
5/2/2010
5/12/2010
5/22/2010
6/1/2010
6/11/2010
6/21/2010
7/1/2010
Date

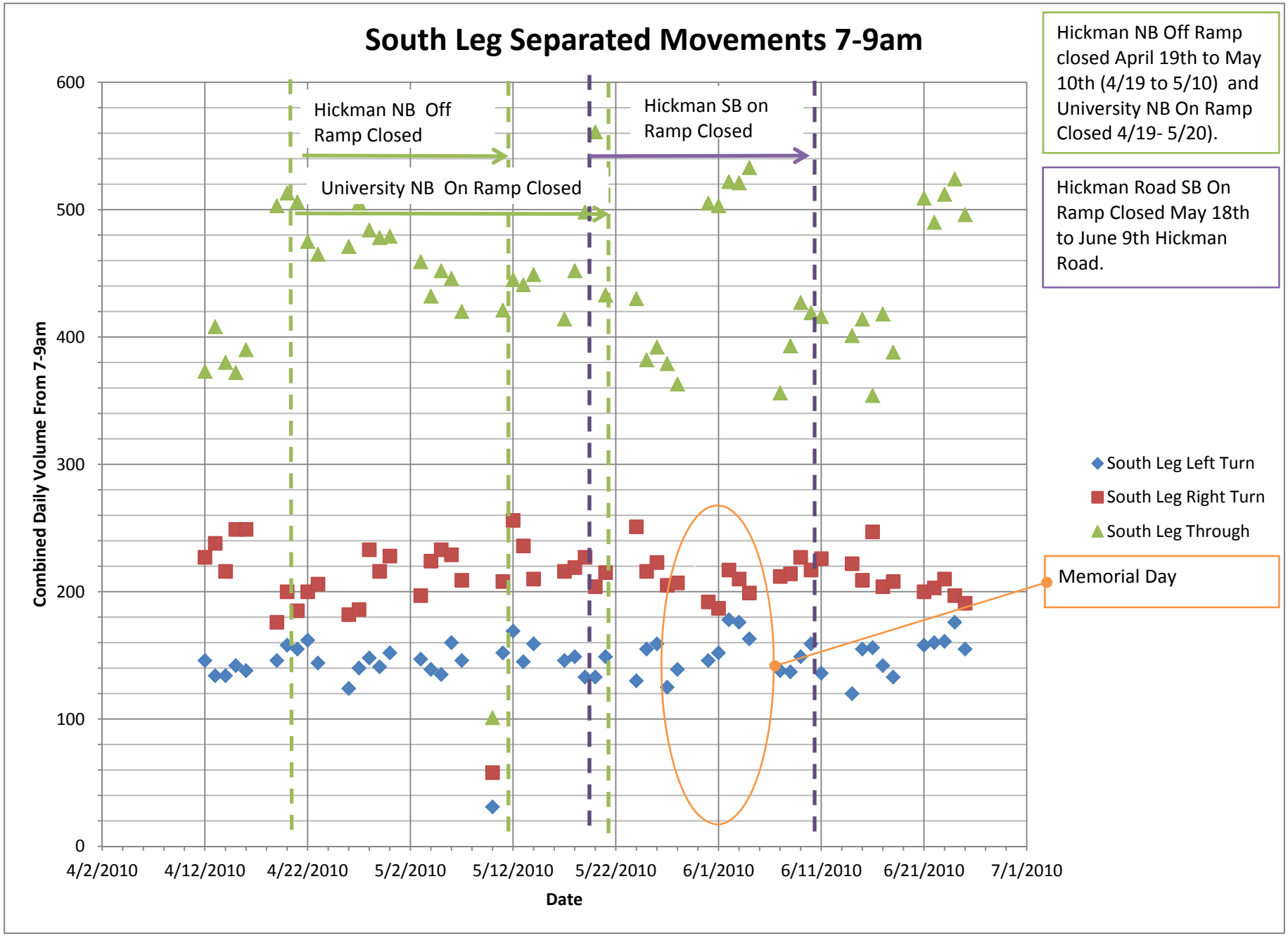
B.2 Intersection Traffic-Volume Changes

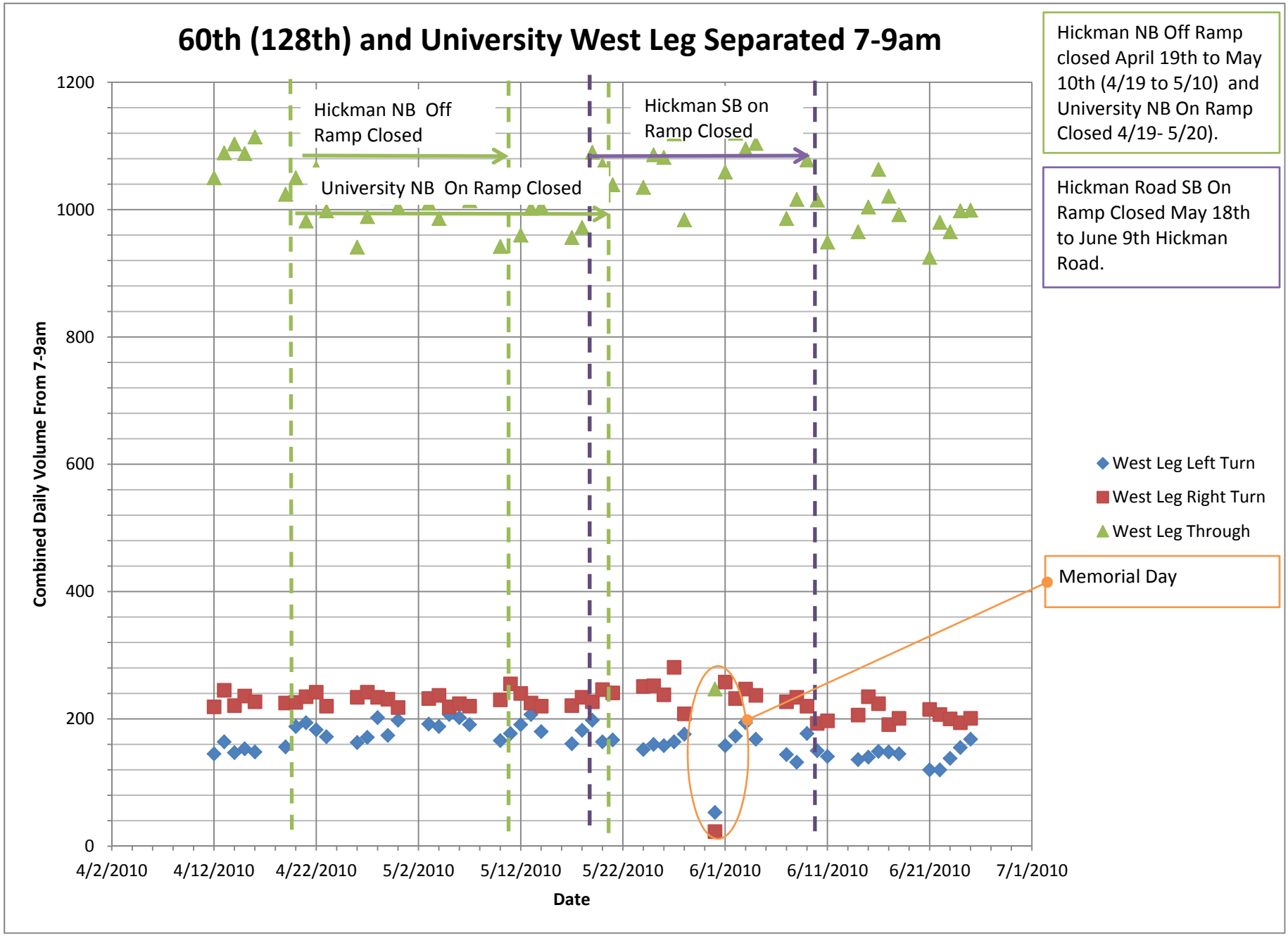
128th Street Clive (60th Street) and University Avenue

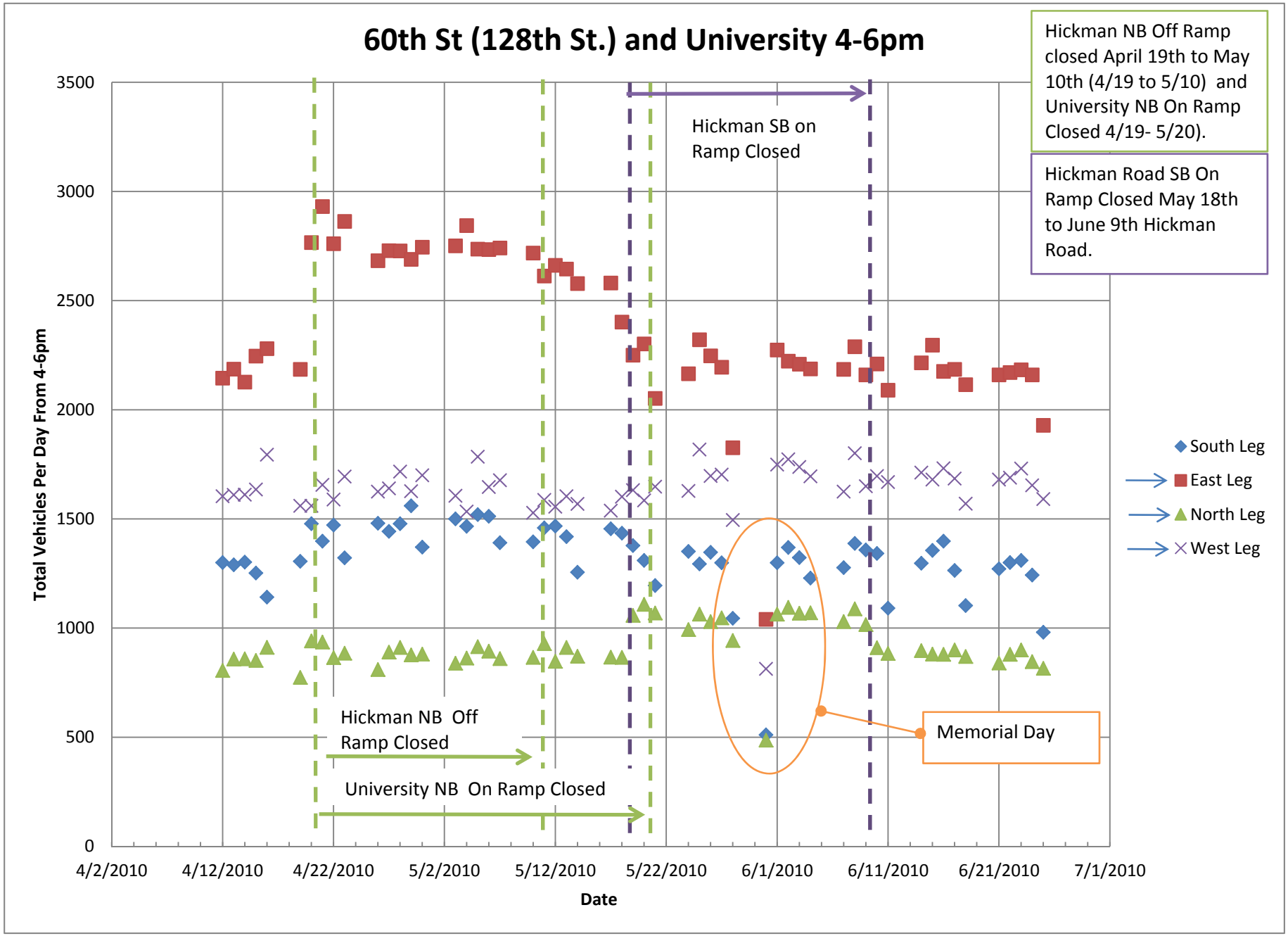

60th (128th) and University 7-9am
Hickman NB Off Ramp closed April 19th to May 10th (4/19 to 5/10) and University NB On Ramp Closed 4/19- 5/20).
Hickman Road SB On Ramp Closed May 18th to June 9th Hickman Road.
Hickman SB on Ramp Closed
Hickman NB Off Ramp Closed
University NB On Ramp Closed
Memorial Day
South Leg
East Leg
North Leg
West Leg
Total Vehicles Per Day From 7-9am
Date
2000
1800
1600
1400
1200
1000
800
600
400
200
0
4/2/2010
4/12/2010
4/22/2010
5/2/2010
5/12/2010
5/22/2010
6/1/2010
6/11/2010
6/21/2010
7/1/2010

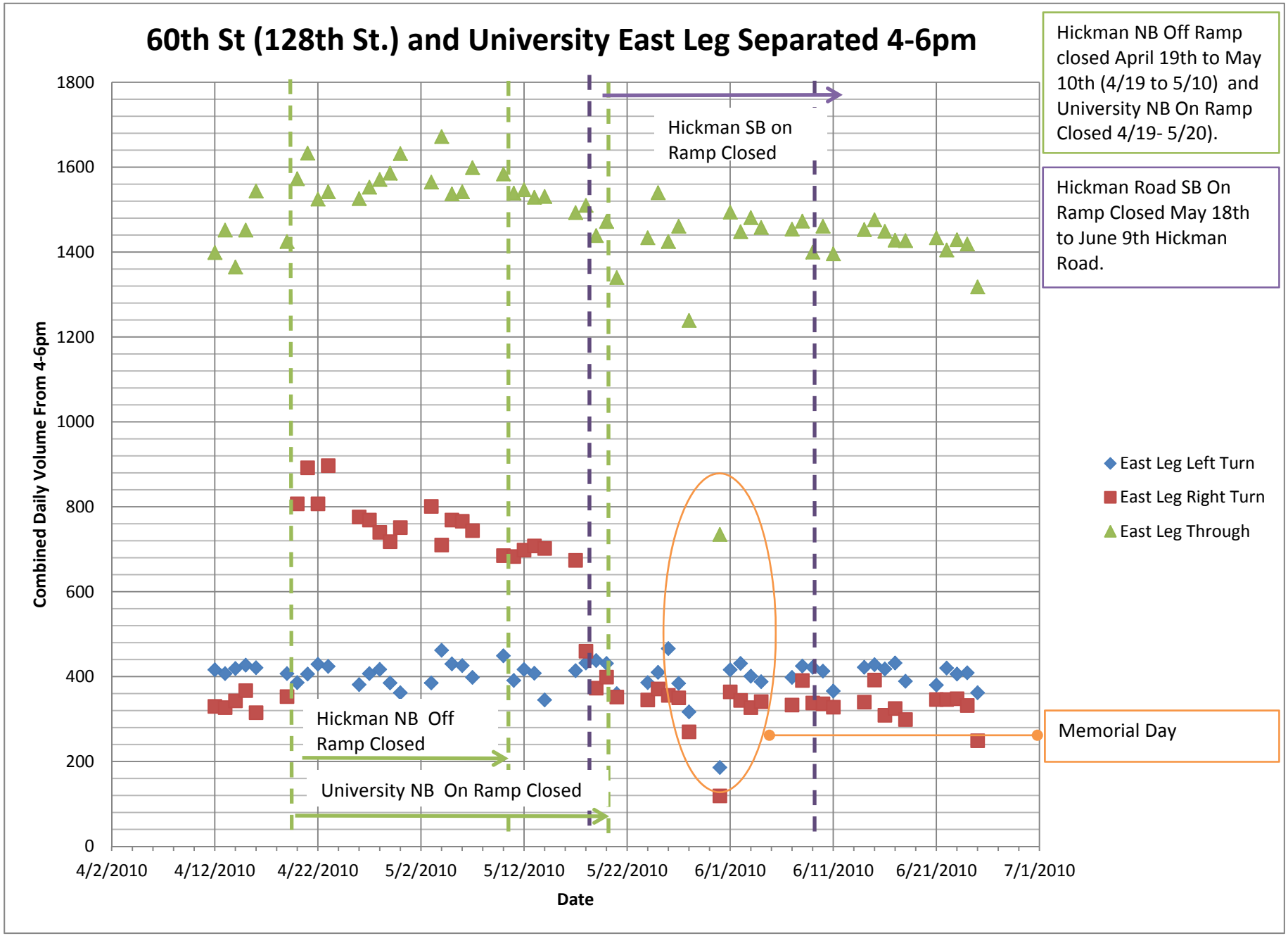

60th (128th) and University East Leg 7-9am
Hickman NB Off Ramp closed April 19th to May 10th (4/19 to 5/10) and University NB On Ramp Closed 4/19- 5/20).
Hickman Road SB On Ramp Closed May 18th to June 9th Hickman Road.
Hickman SB on Ramp Closed
Hickman NB Off Ramp Closed
University NB On Ramp Closed
Memorial Day
East Leg Left Turn
East Leg Right Turn
East Leg Through
Combined Daily Volume From 7-9am
Date
0
200
400
600
800
1000
1200
4/2/2010
4/12/2010
4/22/2010
5/2/2010
5/12/2010
5/22/2010
6/1/2010
6/11/2010
6/21/2010
7/1/2010

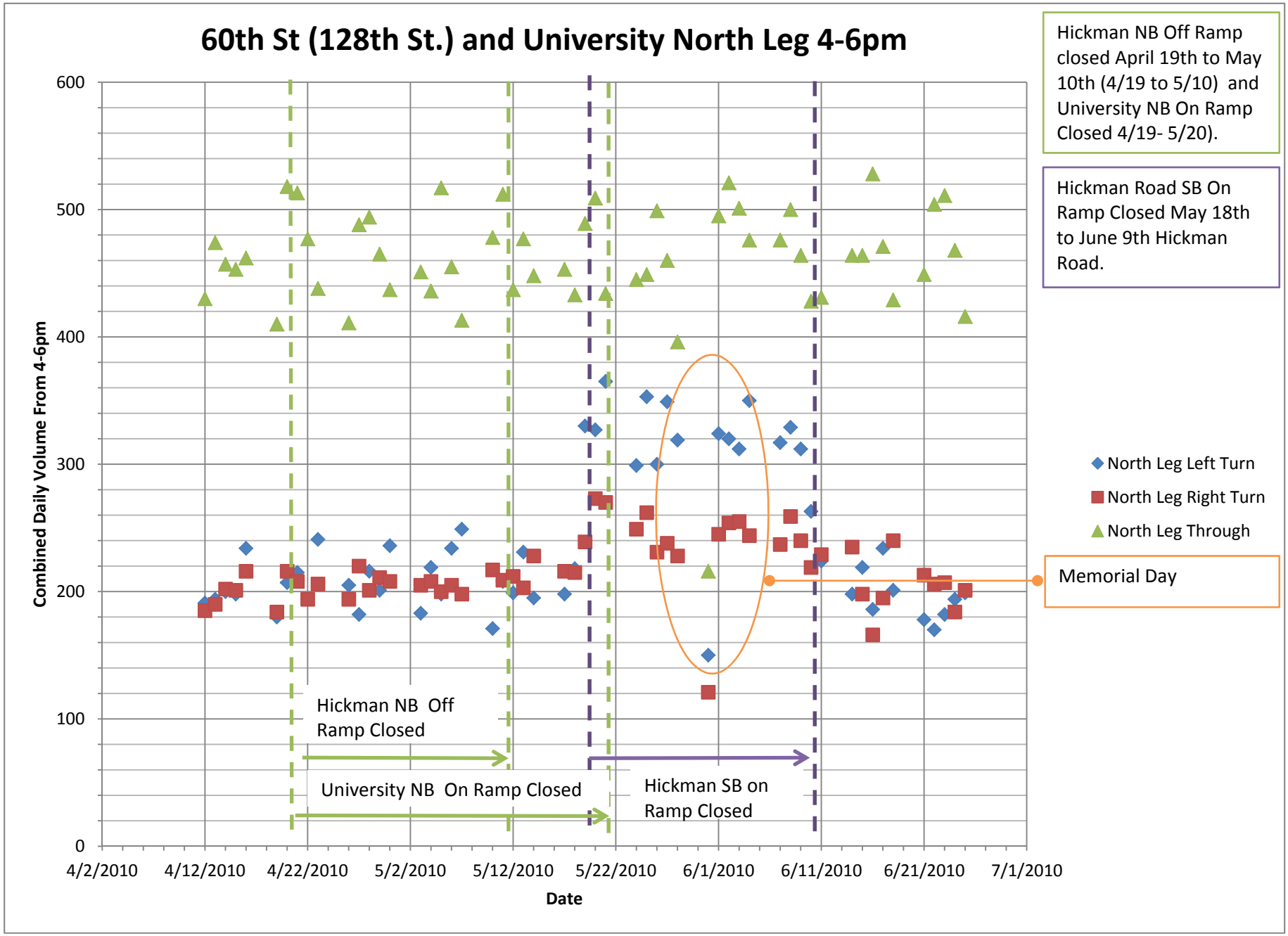

60th (128th) and University North Leg Separated 7-9am
Combined Daily Volume From 7-9am
600
500
400
300
200
100
0
4/2/2010
4/12/2010
4/22/2010
5/2/2010
5/12/2010
5/22/2010
6/1/2010
6/11/2010
6/21/2010
7/1/2010
Date
Hickman NB Off Ramp closed April 19th to May 10th (4/19 to 5/10) and University NB On Ramp Closed 4/19- 5/20).
Hickman Road SB On Ramp Closed May 18th to June 9th Hickman Road.
North Leg Left Turn
North Leg Right Turn
North Leg Through
Memorial Day
Hickman SB on Ramp Closed
Hickman NB Off Ramp Closed
University NB On Ramp Closed

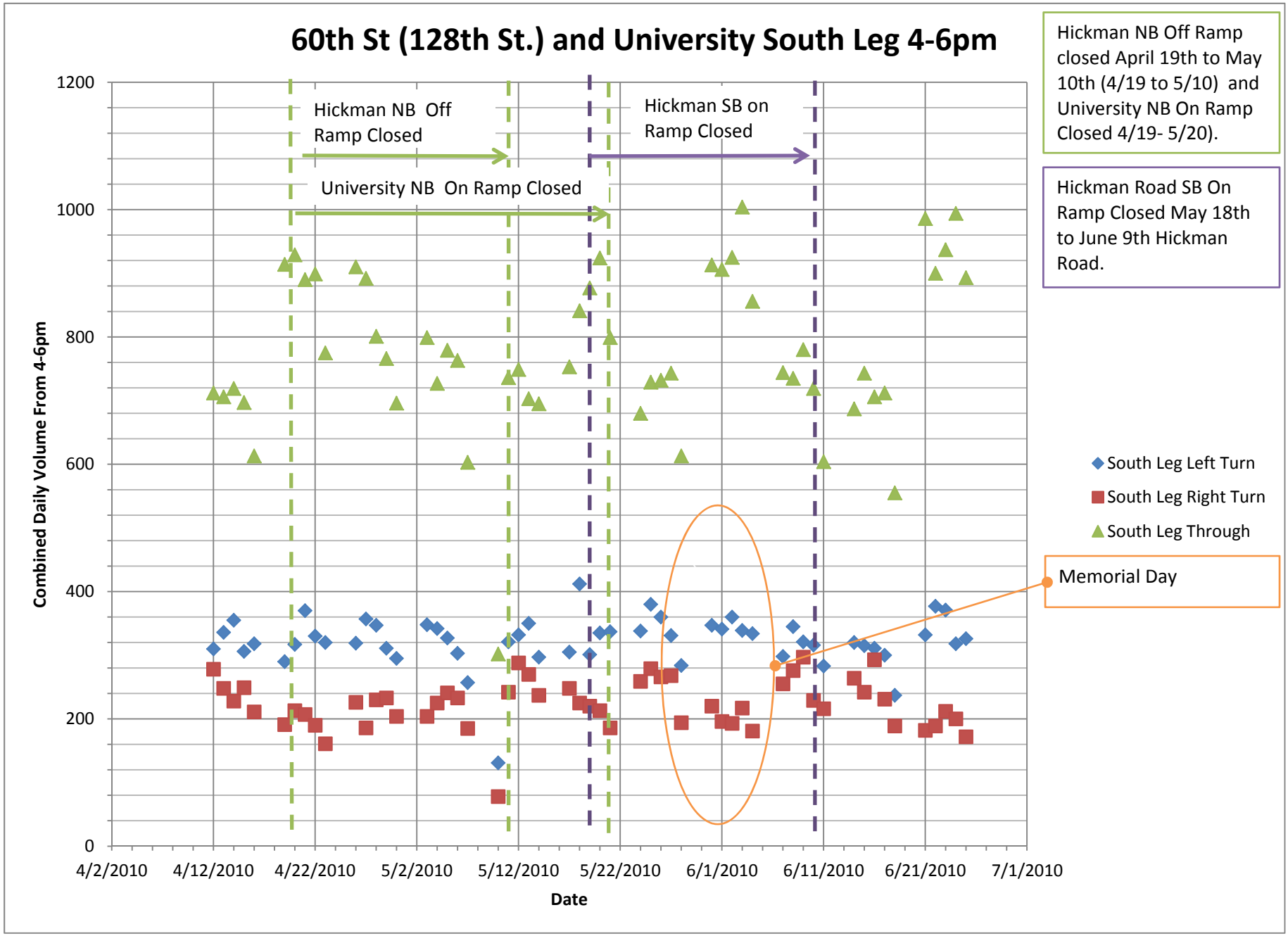

South Leg Separated Movements 7-9am
Hickman NB Off Ramp Closed
University NB On Ramp Closed
Hickman SB on Ramp Closed
Hickman NB Off Ramp closed April 19th to May 10th (4/19 to 5/10) and University NB On Ramp Closed 4/19- 5/20).
Hickman Road SB On Ramp Closed May 18th to June 9th Hickman Road.
South Leg Left Turn
South Leg Right Turn
South Leg Through
Memorial Day
Combined Daily Volume From 7-9am
Date
600
500
400
300
200
100
0
4/2/2010
4/12/2010
4/22/2010
5/2/2010
5/12/2010
5/22/2010
6/1/2010
6/11/2010
6/21/2010
7/1/2010

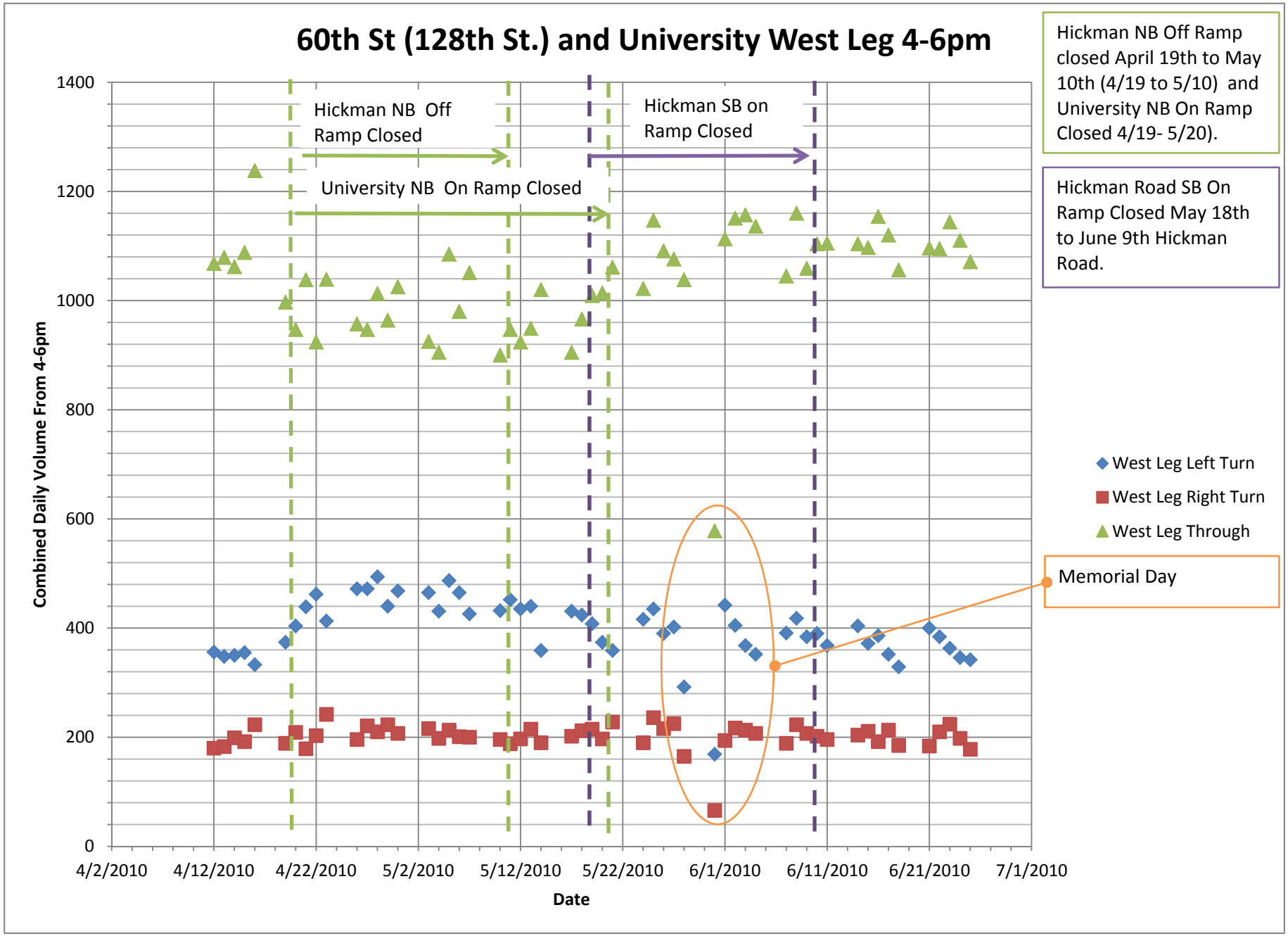

60th (128th) and University West Leg Separated 7-9am
Hickman NB Off Ramp closed April 19th to May 10th (4/19 to 5/10) and University NB On Ramp Closed 4/19- 5/20).
Hickman Road SB On Ramp Closed May 18th to June 9th Hickman Road.
Hickman NB Off Ramp Closed
University NB On Ramp Closed
Hickman SB on Ramp Closed
Memorial Day
West Leg Left Turn
West Leg Right Turn
West Leg Through
Combined Daily Volume From 7-9am
1200
1000
800
600
400
200
0
4/2/2010
4/12/2010
4/22/2010
5/2/2010
5/12/2010
5/22/2010
6/1/2010
6/11/2010
6/21/2010
7/1/2010
Date

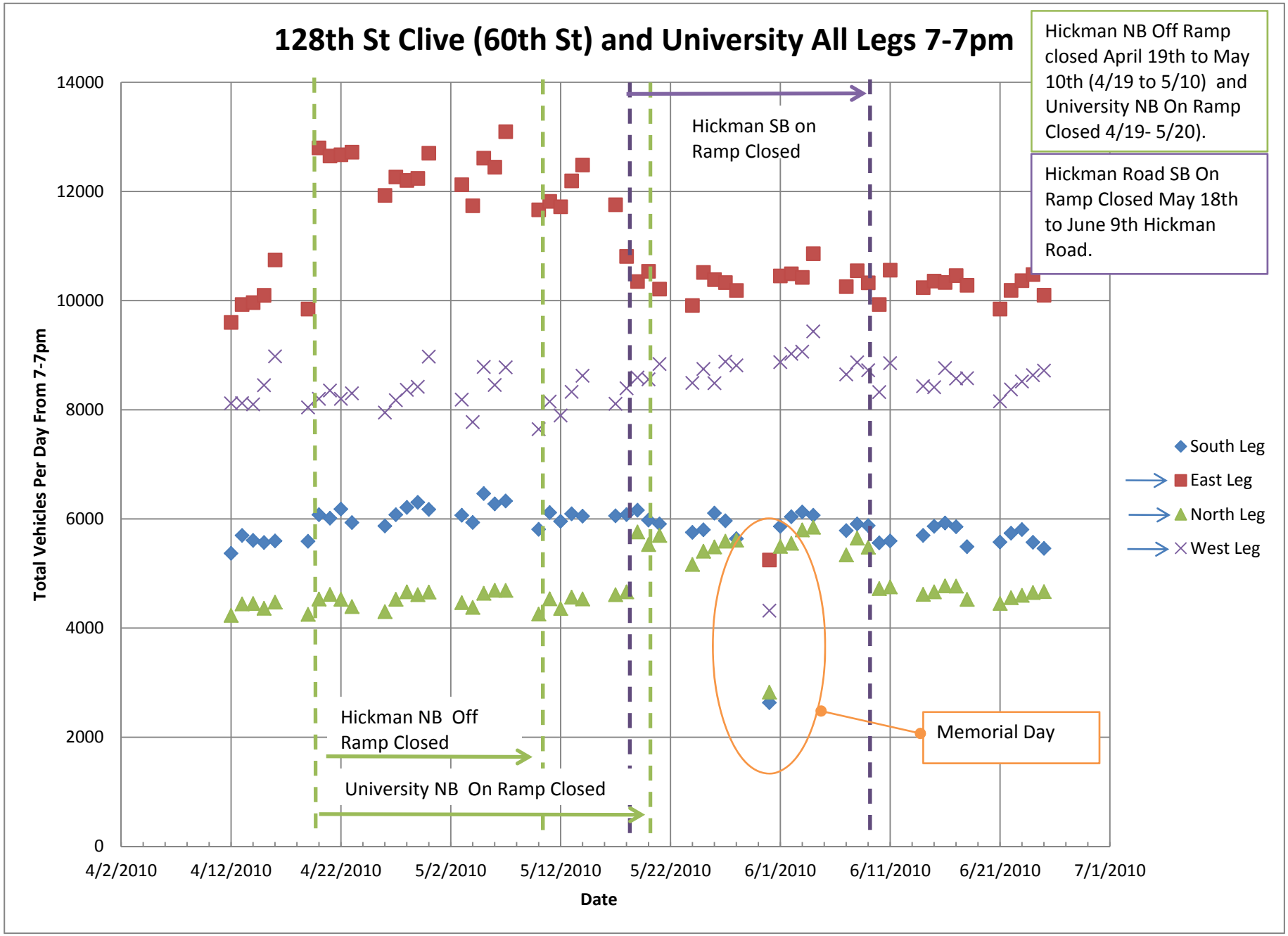

60th St (128th St.) and University 4-6pm
Hickman NB Off Ramp closed April 19th to May 10th (4/19 to 5/10) and University NB On Ramp Closed 4/19- 5/20).
Hickman Road SB On Ramp Closed May 18th to June 9th Hickman Road.
Hickman SB on Ramp Closed
Hickman NB Off Ramp Closed
University NB On Ramp Closed
Memorial Day
South Leg
East Leg
North Leg
West Leg
Total Vehicles Per Day From 4-6pm
Date
3500
3000
2500
2000
1500
1000
500
0
4/2/2010
4/12/2010
4/22/2010
5/2/2010
5/12/2010
5/22/2010
6/1/2010
6/11/2010
6/21/2010
7/1/2010

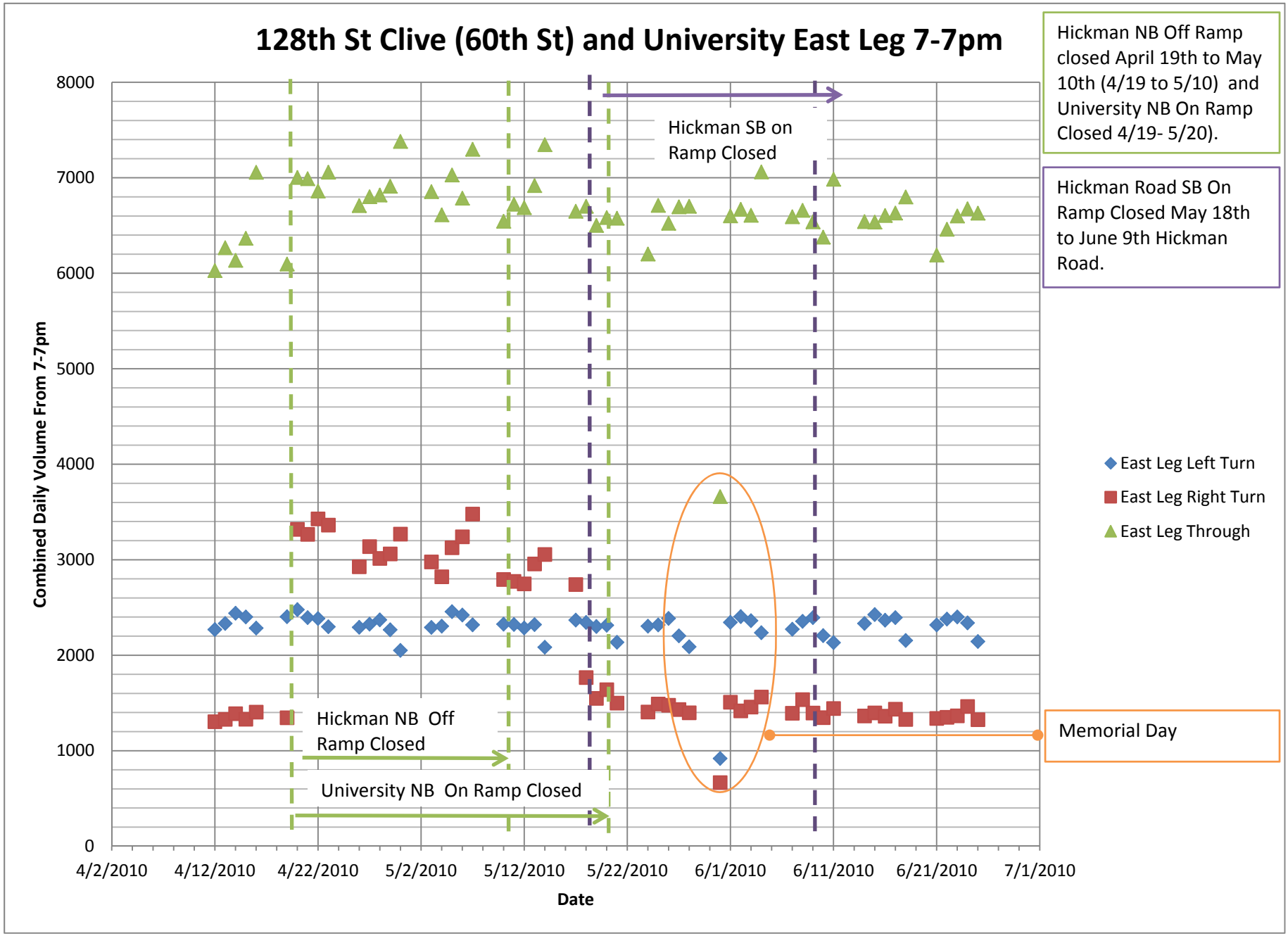

60th St (128th St.) and University East Leg Separated 4-6pm
Hickman NB Off Ramp closed April 19th to May 10th (4/19 to 5/10) and University NB On Ramp Closed 4/19- 5/20).
Hickman Road SB On Ramp Closed May 18th to June 9th Hickman Road.
Hickman SB on Ramp Closed
Hickman NB Off Ramp Closed
University NB On Ramp Closed
Memorial Day
East Leg Left Turn
East Leg Right Turn
East Leg Through
Combined Daily Volume From 4-6pm
Date
1800
1600
1400
1200
1000
800
600
400
200
0
4/2/2010
4/12/2010
4/22/2010
5/2/2010
5/12/2010
5/22/2010
6/1/2010
6/11/2010
6/21/2010
7/1/2010

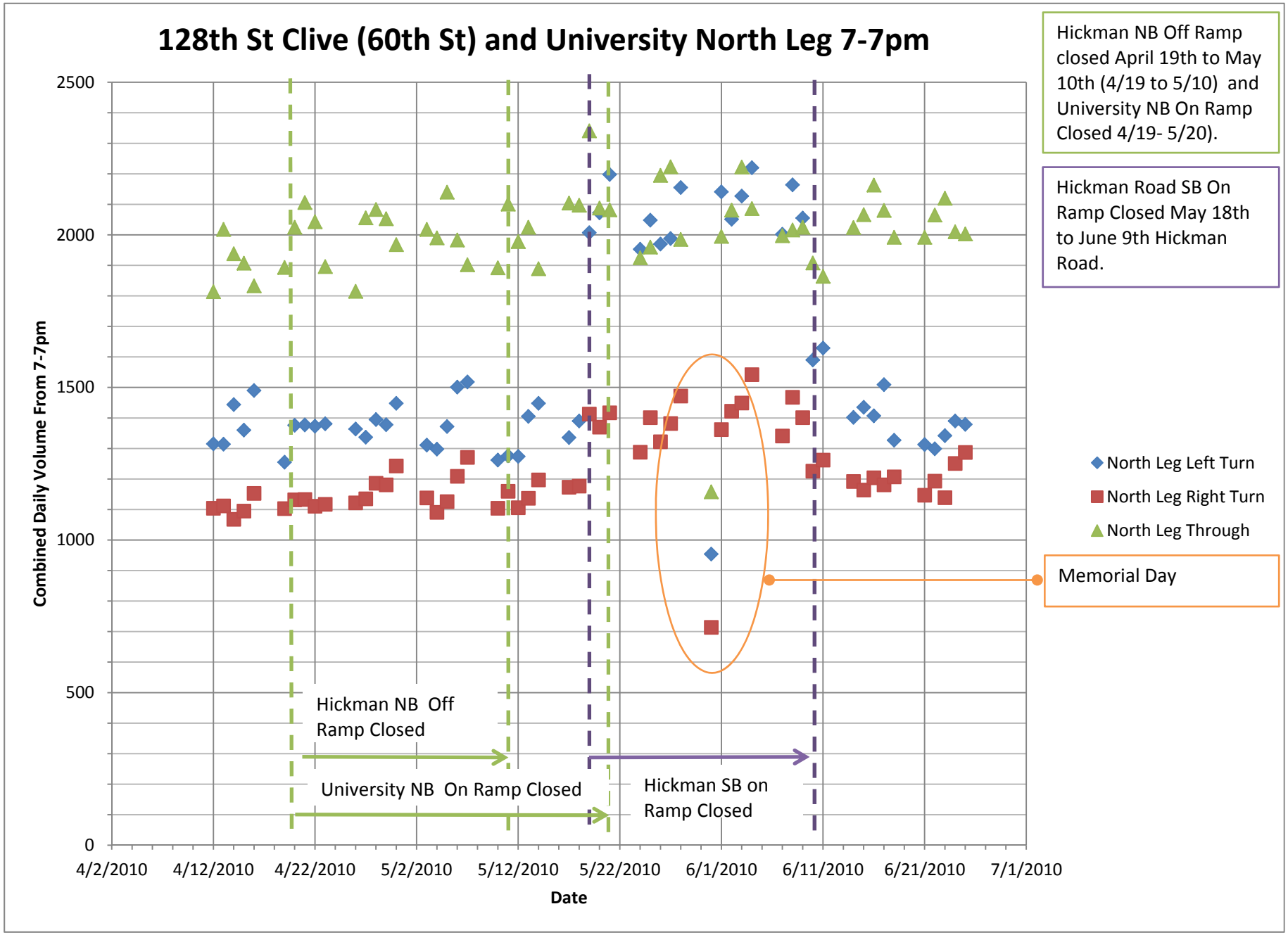

60th St (128th St.) and University North Leg 4-6pm
Hickman NB Off Ramp closed April 19th to May 10th (4/19 to 5/10) and University NB On Ramp Closed 4/19- 5/20).
Hickman Road SB On Ramp Closed May 18th to June 9th Hickman Road.
Combined Daily Volume From 4-6pm
600
500
400
300
200
100
0
4/2/2010
4/12/2010
4/22/2010
5/2/2010
5/12/2010
5/22/2010
6/1/2010
6/11/2010
6/21/2010
7/1/2010
Date
North Leg Left Turn
North Leg Right Turn
North Leg Through
Memorial Day
Hickman NB Off Ramp Closed
University NB On Ramp Closed
Hickman SB on Ramp Closed

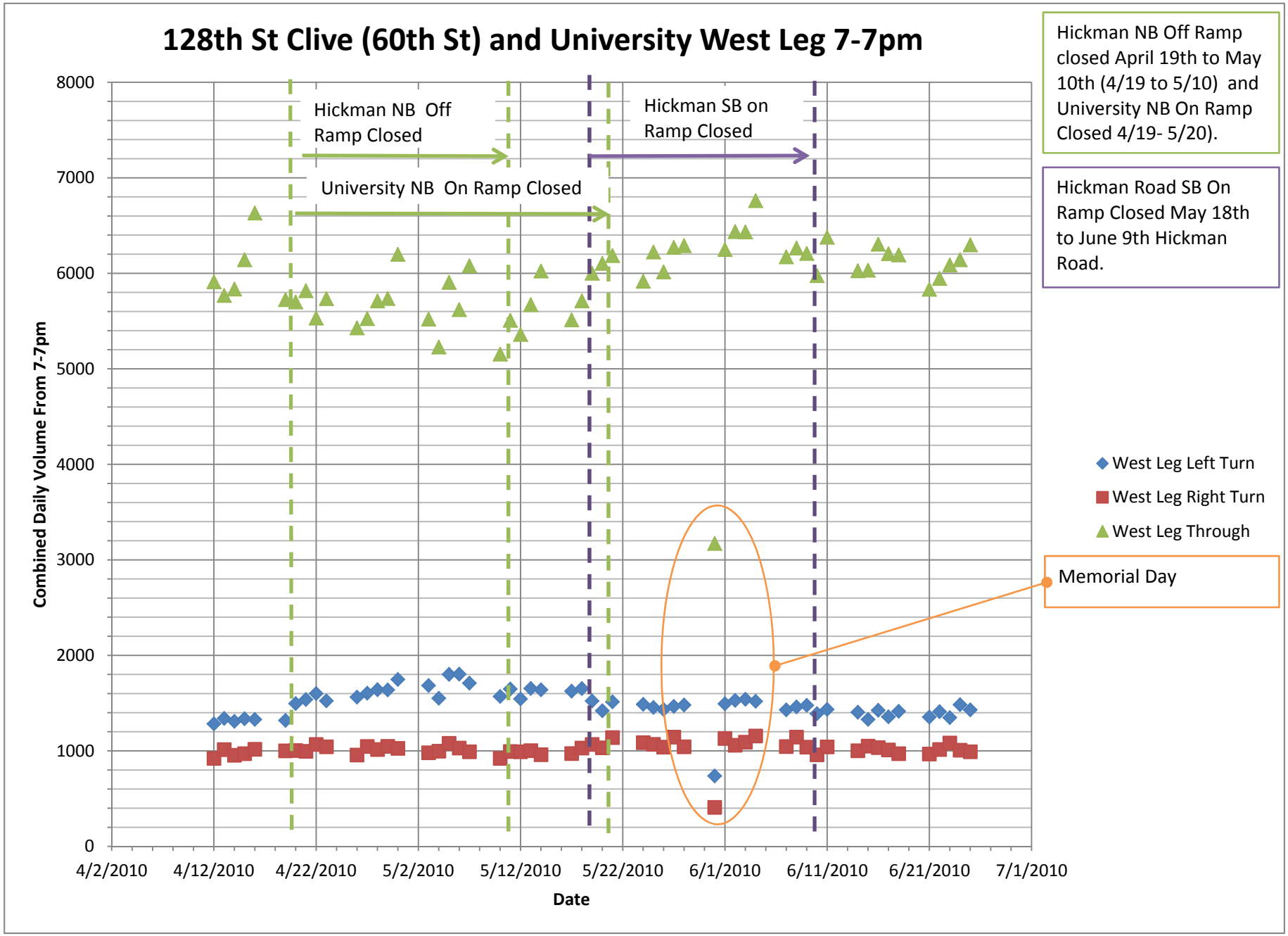

60th St (128th St.) and University South Leg 4-6pm
Hickman NB Off Ramp closed April 19th to May 10th (4/19 to 5/10) and University NB On Ramp Closed 4/19- 5/20).
Hickman Road SB On Ramp Closed May 18th to June 9th Hickman Road.
Hickman NB Off Ramp Closed
Hickman SB on Ramp Closed
University NB On Ramp Closed
South Leg Left Turn
South Leg Right Turn
South Leg Through
Memorial Day
Combined Daily Volume From 4-6pm
Date
0
200
400
600
800
1000
1200
4/2/2010
4/12/2010
4/22/2010
5/2/2010
5/12/2010
5/22/2010
6/1/2010
6/11/2010
6/21/2010
7/1/2010


60th St (128th St.) and University West Leg 4-6pm
Hickman NB Off Ramp closed April 19th to May 10th (4/19 to 5/10) and University NB On Ramp Closed 4/19- 5/20).
Hickman Road SB On Ramp Closed May 18th to June 9th Hickman Road.
Hickman NB Off Ramp Closed
Hickman SB on Ramp Closed
University NB On Ramp Closed
West Leg Left Turn
West Leg Right Turn
West Leg Through
Memorial Day
Combined Daily Volume From 4-6pm
Date
0
200
400
600
800
1000
1200
1400
4/2/2010
4/12/2010
4/22/2010
5/2/2010
5/12/2010
5/22/2010
6/1/2010
6/11/2010
6/21/2010
7/1/2010


128th St Clive (60th St) and University All Legs 7-7pm
Hickman NB Off Ramp closed April 19th to May 10th (4/19 to 5/10) and University NB On Ramp Closed 4/19- 5/20).
Hickman Road SB On Ramp Closed May 18th to June 9th Hickman Road.
Hickman SB on Ramp Closed
Hickman NB Off Ramp Closed
University NB On Ramp Closed
Memorial Day
South Leg
East Leg
North Leg
West Leg
Total Vehicles Per Day From 7-7pm
Date
14000
12000
10000
8000
6000
4000
2000
0
4/2/2010
4/12/2010
4/22/2010
5/2/2010
5/12/2010
5/22/2010
6/1/2010
6/11/2010
6/21/2010
7/1/2010

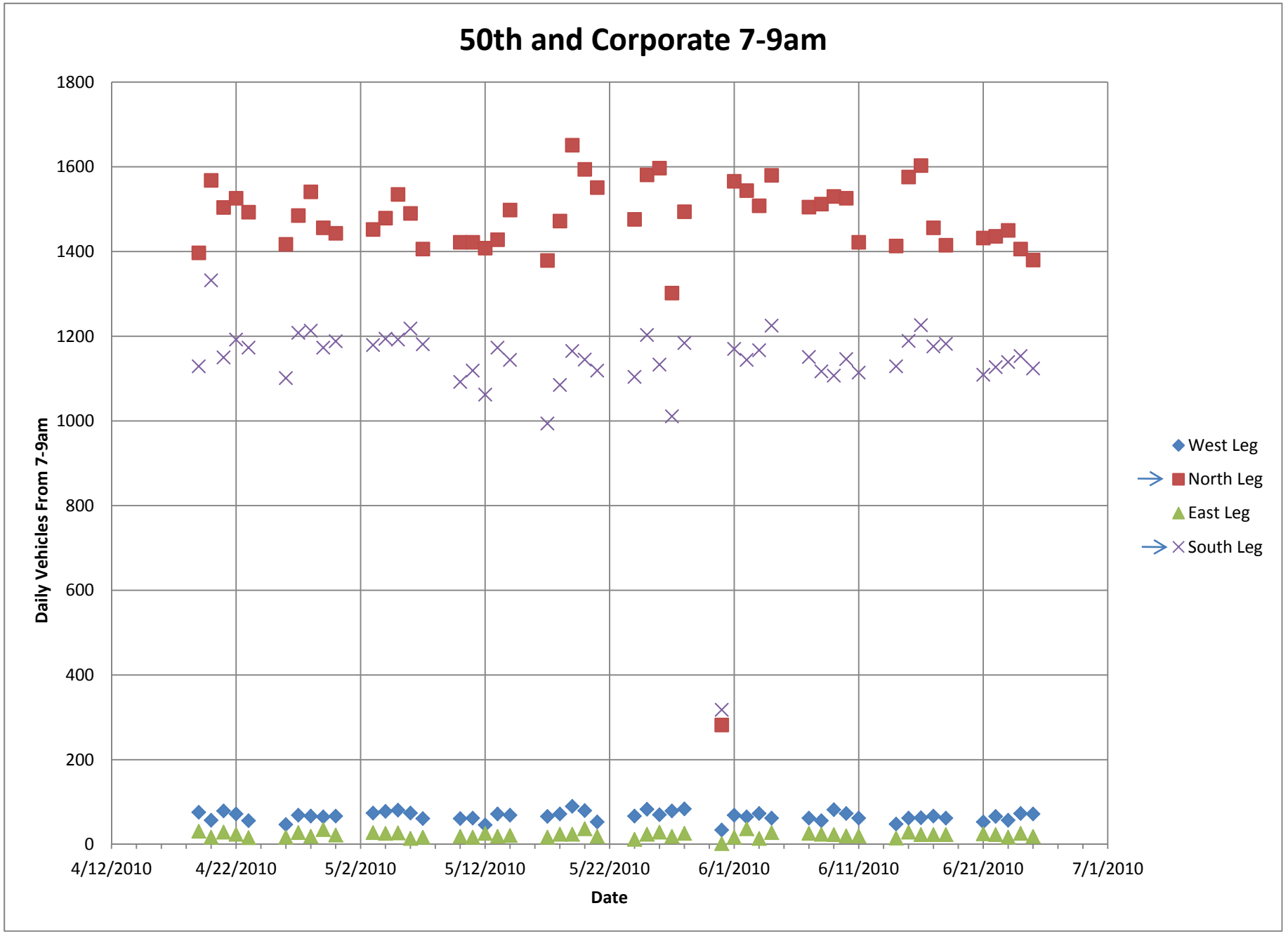

128th St Clive (60th St) and University East Leg 7-7pm
Hickman NB Off Ramp closed April 19th to May 10th (4/19 to 5/10) and University NB On Ramp Closed 4/19- 5/20).
Hickman Road SB On Ramp Closed May 18th to June 9th Hickman Road.
Hickman SB on Ramp Closed
Hickman NB Off Ramp Closed
University NB On Ramp Closed
Memorial Day
East Leg Left Turn
East Leg Right Turn
East Leg Through
Combined Daily Volume From 7-7pm
Date
8000
7000
6000
5000
4000
3000
2000
1000
0
4/2/2010
4/12/2010
4/22/2010
5/2/2010
5/12/2010
5/22/2010
6/1/2010
6/11/2010
6/21/2010
7/1/2010

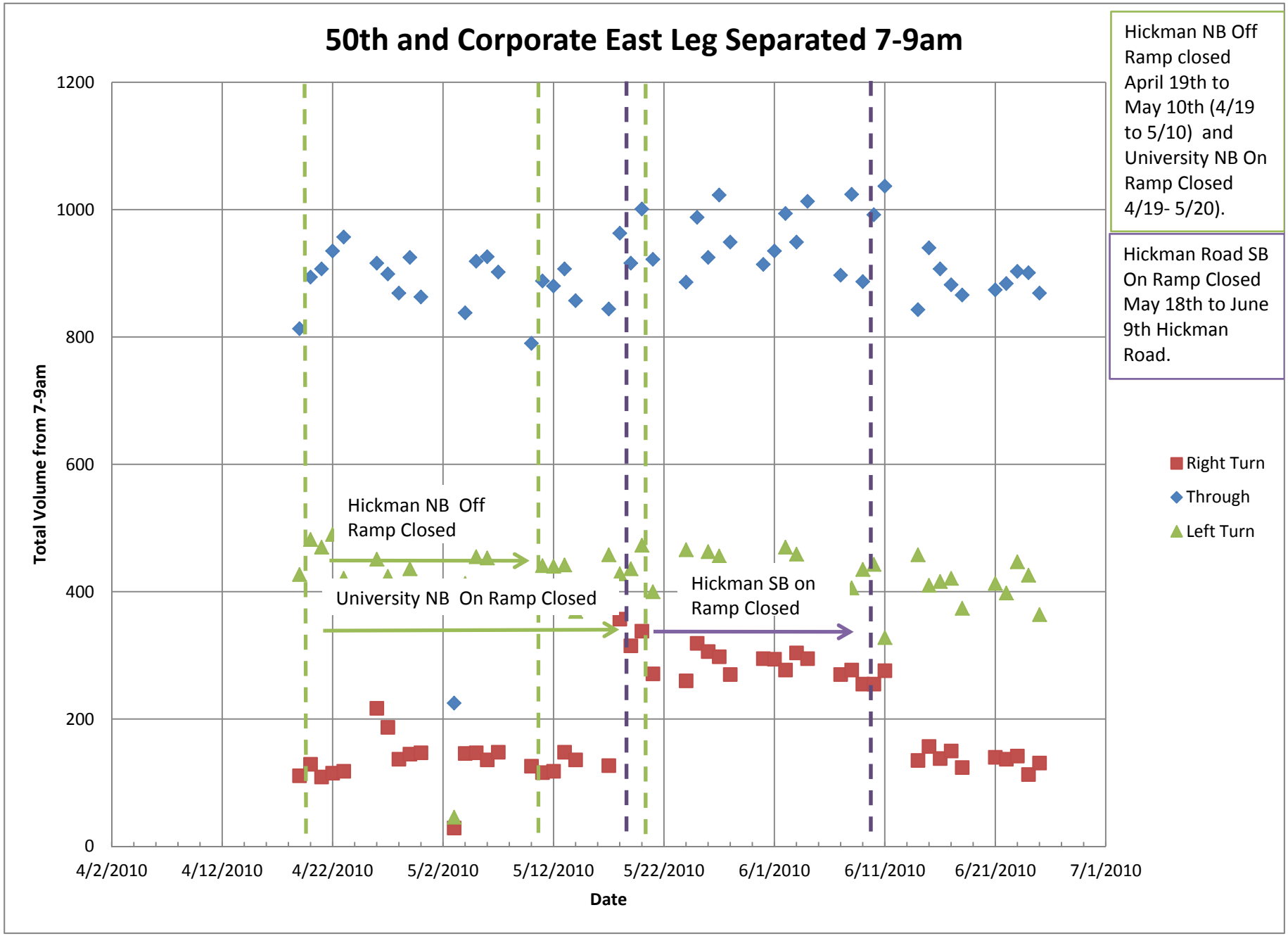

128th St Clive (60th St) and University North Leg 7-7pm
Hickman NB Off Ramp closed April 19th to May 10th (4/19 to 5/10) and University NB On Ramp Closed 4/19- 5/20).
Hickman Road SB On Ramp Closed May 18th to June 9th Hickman Road.
Combined Daily Volume From 7-7pm
2500
2000
1500
1000
500
0
4/2/2010
4/12/2010
4/22/2010
5/2/2010
5/12/2010
5/22/2010
6/1/2010
6/11/2010
6/21/2010
7/1/2010
Date
North Leg Left Turn
North Leg Right Turn
North Leg Through
Memorial Day
Hickman NB Off Ramp Closed
University NB On Ramp Closed
Hickman SB on Ramp Closed

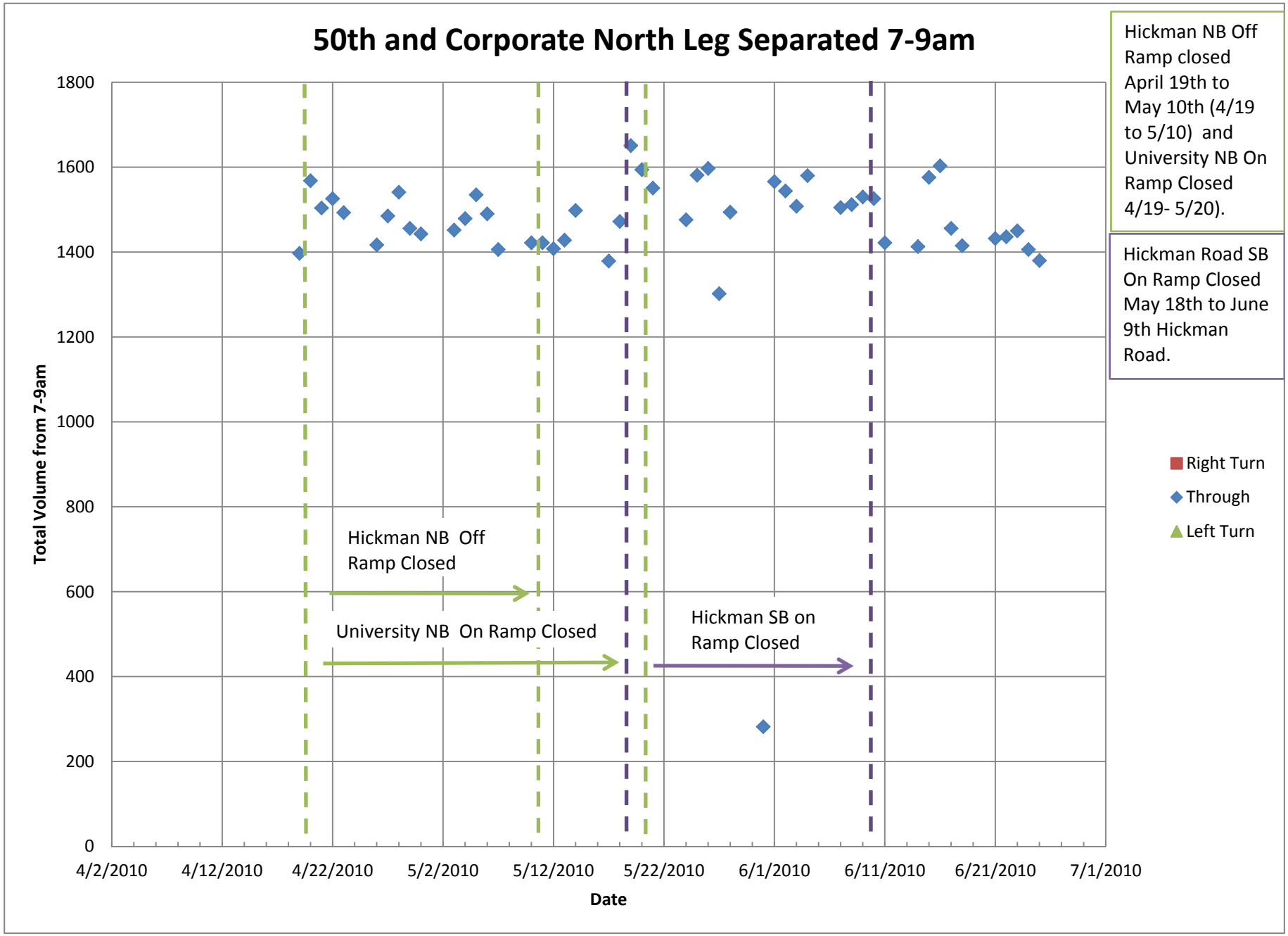

128th St Clive (60th St) and University West Leg 7-7pm
Hickman NB Off Ramp closed April 19th to May 10th (4/19 to 5/10) and University NB On Ramp Closed 4/19- 5/20).
Hickman Road SB On Ramp Closed May 18th to June 9th Hickman Road.
Hickman NB Off Ramp Closed
Hickman SB on Ramp Closed
University NB On Ramp Closed
West Leg Left Turn
West Leg Right Turn
West Leg Through
Memorial Day
Combined Daily Volume From 7-7pm
Date
8000
7000
6000
5000
4000
3000
2000
1000
0
4/2/2010
4/12/2010
4/22/2010
5/2/2010
5/12/2010
5/22/2010
6/1/2010
6/11/2010
6/21/2010
7/1/2010

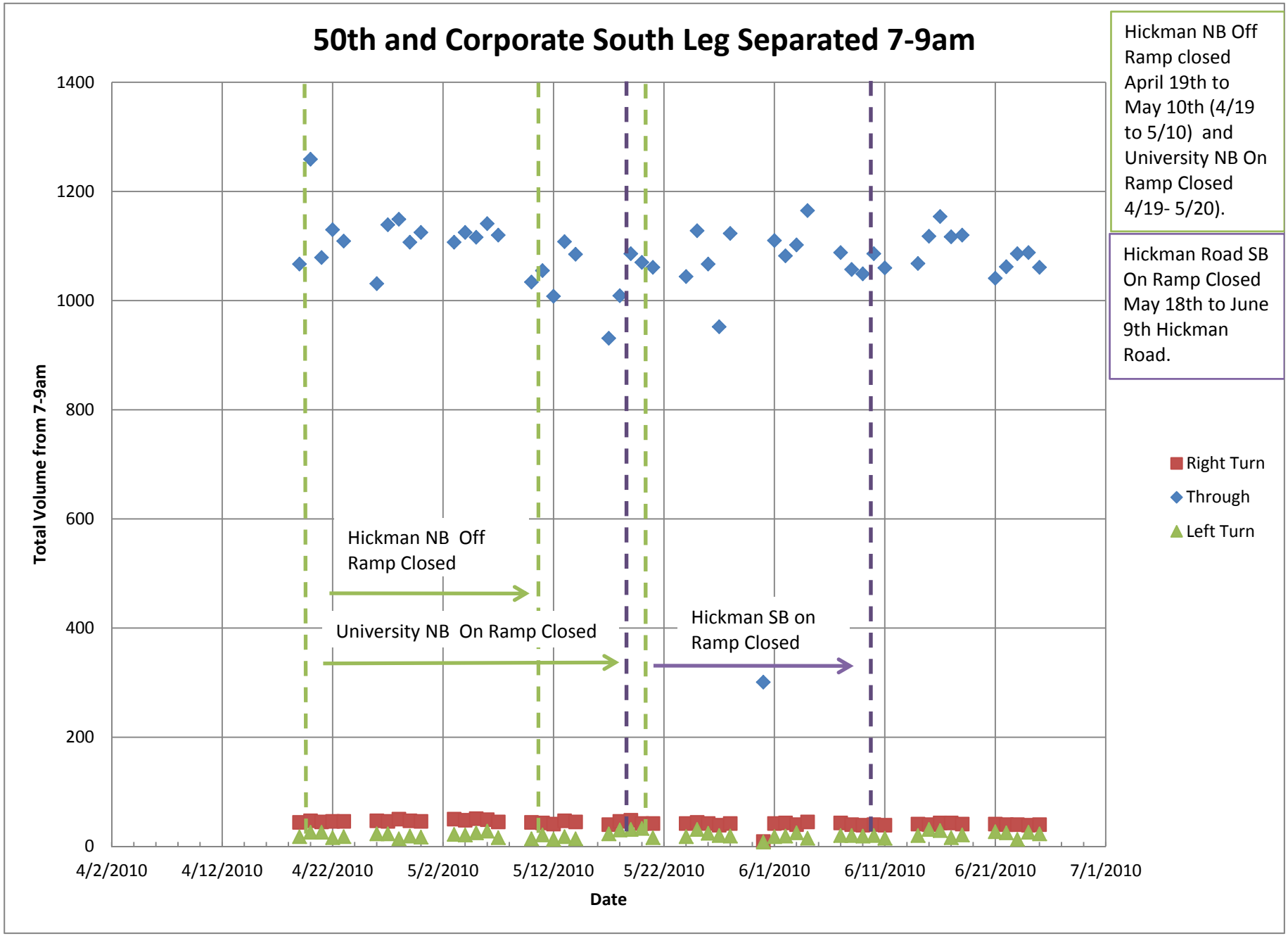
B.2 Intersection Traffic-Volume Changes

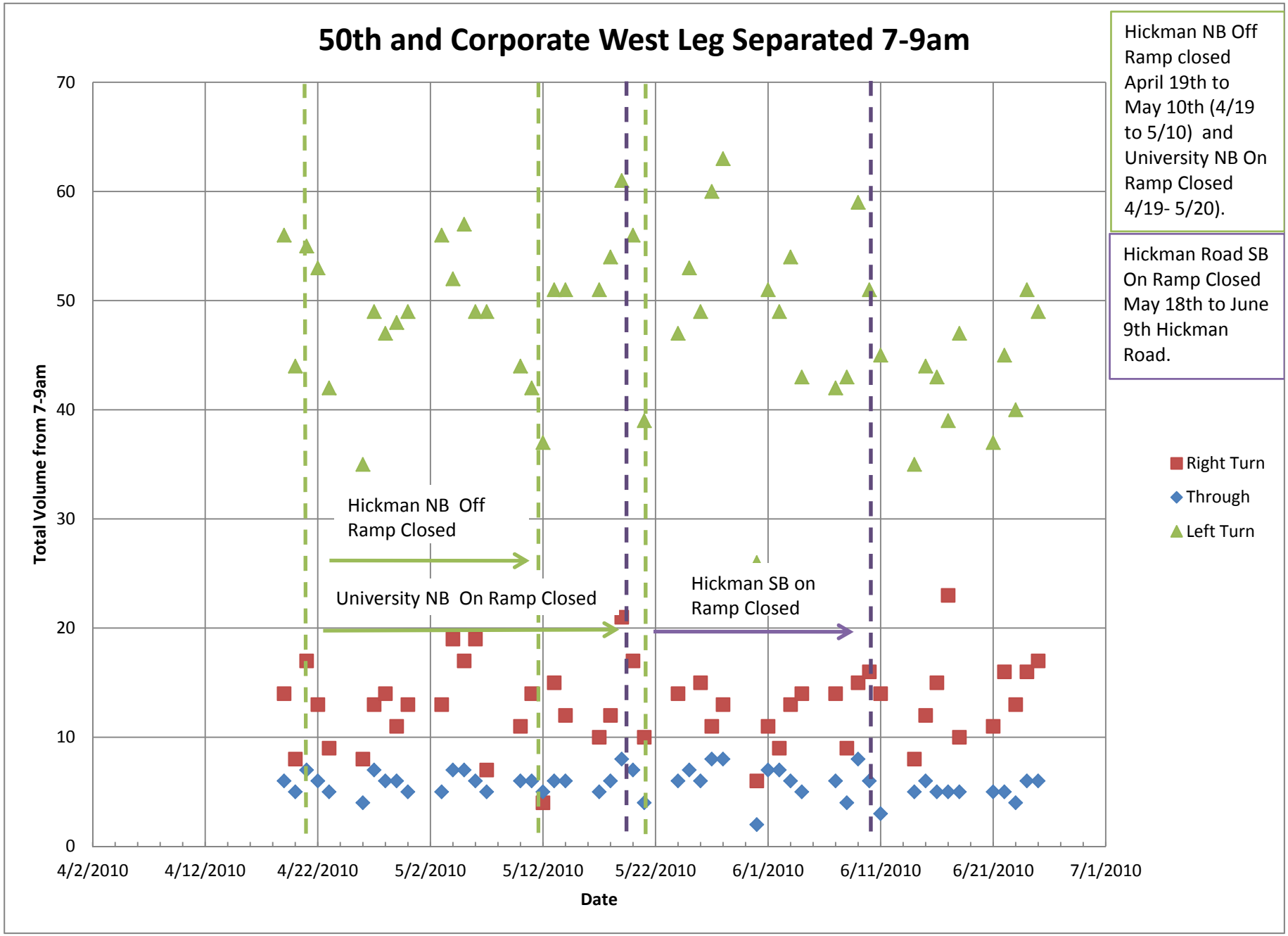
50th Street and Corporate Wood Drive

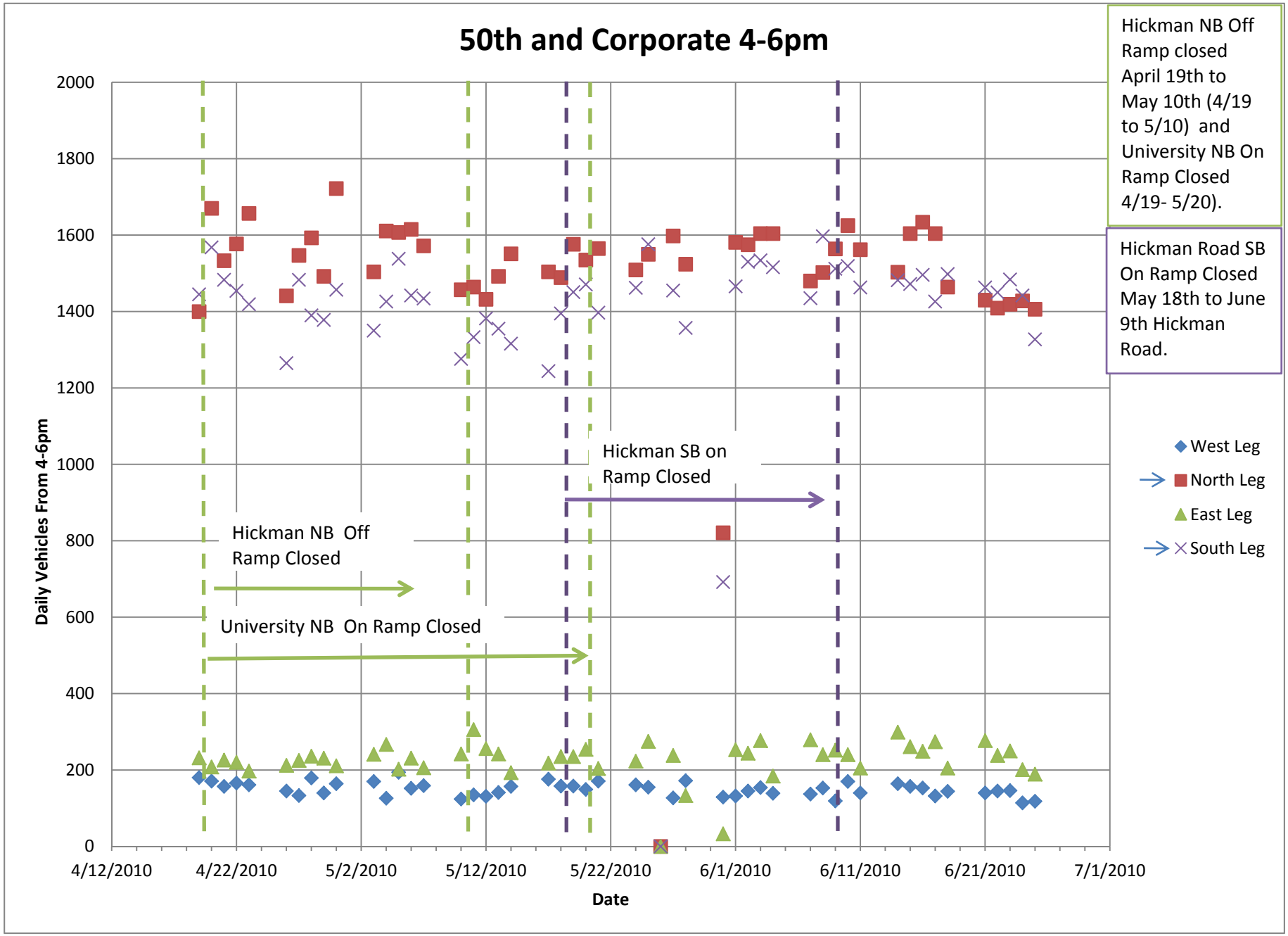

50th and Corporate 7-9am
1800
1600
1400
1200
1000
800
600
400
200
0
Daily Vehicles From 7-9am
4/12/2010
4/22/2010
5/2/2010
5/12/2010
5/22/2010
6/1/2010
6/11/2010
6/21/2010
7/1/2010
Date
West Leg
North Leg
East Leg
South Leg

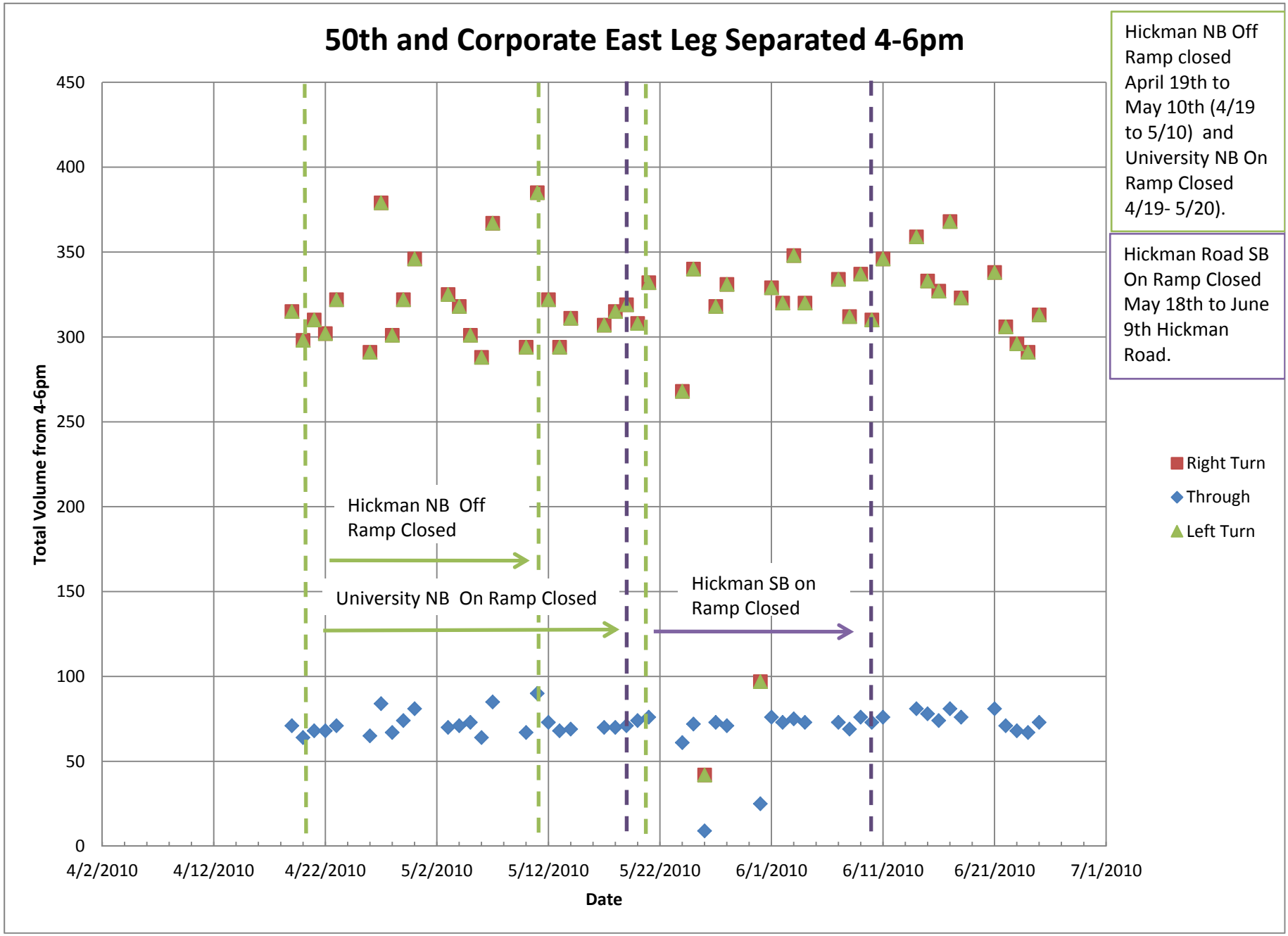

50th and Corporate East Leg Separated 7-9am
Hickman NB Off Ramp closed April 19th to May 10th (4/19 to 5/10) and University NB On Ramp Closed 4/19- 5/20).
Hickman Road SB On Ramp Closed May 18th to June 9th Hickman Road.
Total Volume from 7-9am
1200
1000
800
600
400
200
0
4/2/2010
4/12/2010
4/22/2010
5/2/2010
5/12/2010
5/22/2010
6/1/2010
6/11/2010
6/21/2010
7/1/2010
Date
Right Turn
Through
Left Turn
Hickman NB Off Ramp Closed
University NB On Ramp Closed
Hickman SB on Ramp Closed

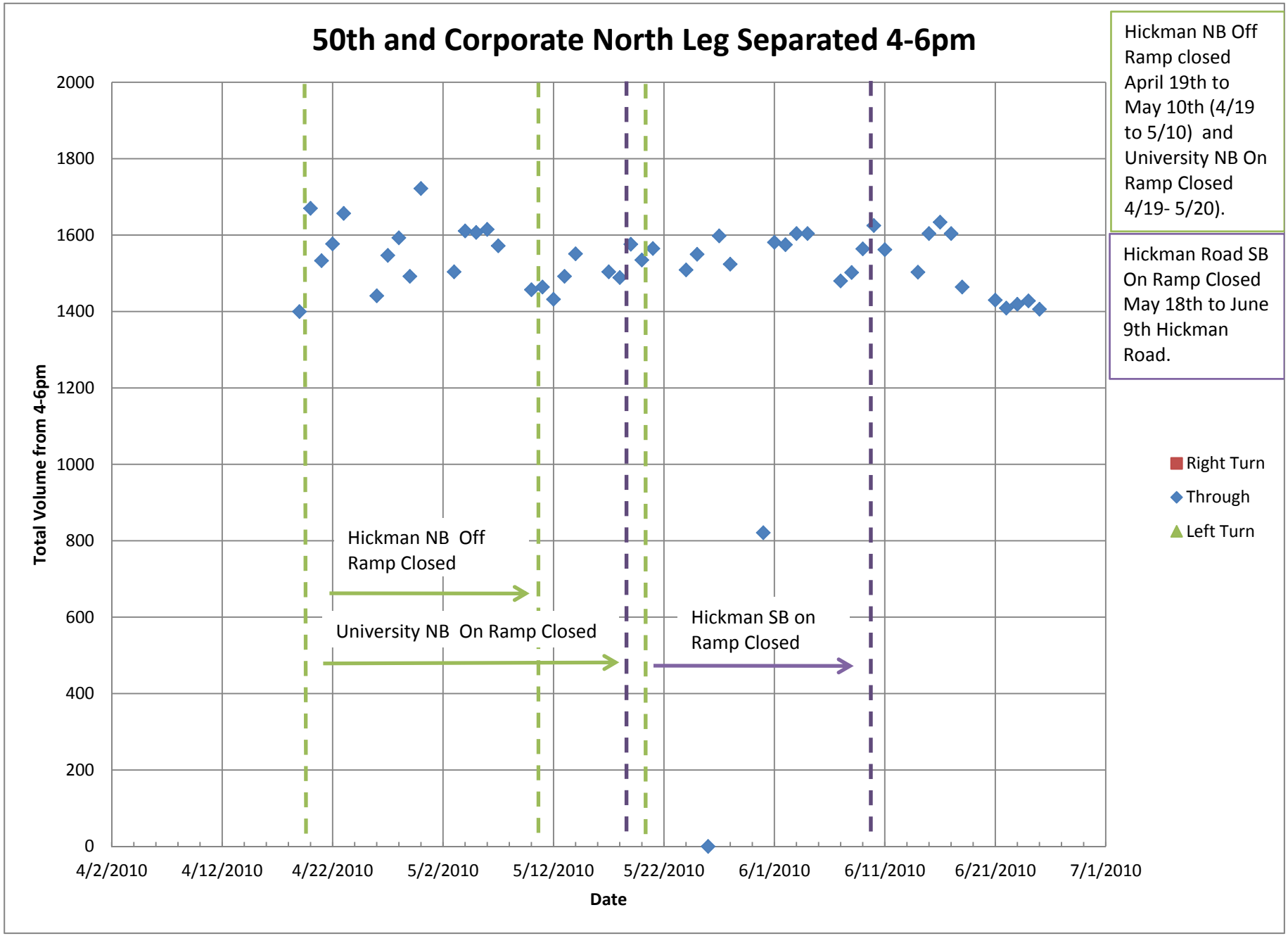

50th and Corporate North Leg Separated 7-9am
Total Volume from 7-9am
1800
1600
1400
1200
1000
800
600
400
200
0
4/2/2010
4/12/2010
4/22/2010
5/2/2010
5/12/2010
5/22/2010
6/1/2010
6/11/2010
6/21/2010
7/1/2010
Date
Hickman NB Off Ramp closed April 19th to May 10th (4/19 to 5/10) and University NB On Ramp Closed 4/19- 5/20).
Hickman Road SB On Ramp Closed May 18th to June 9th Hickman Road.
Right Turn
Through
Left Turn
Hickman NB Off Ramp Closed
University NB On Ramp Closed
Hickman SB on Ramp Closed

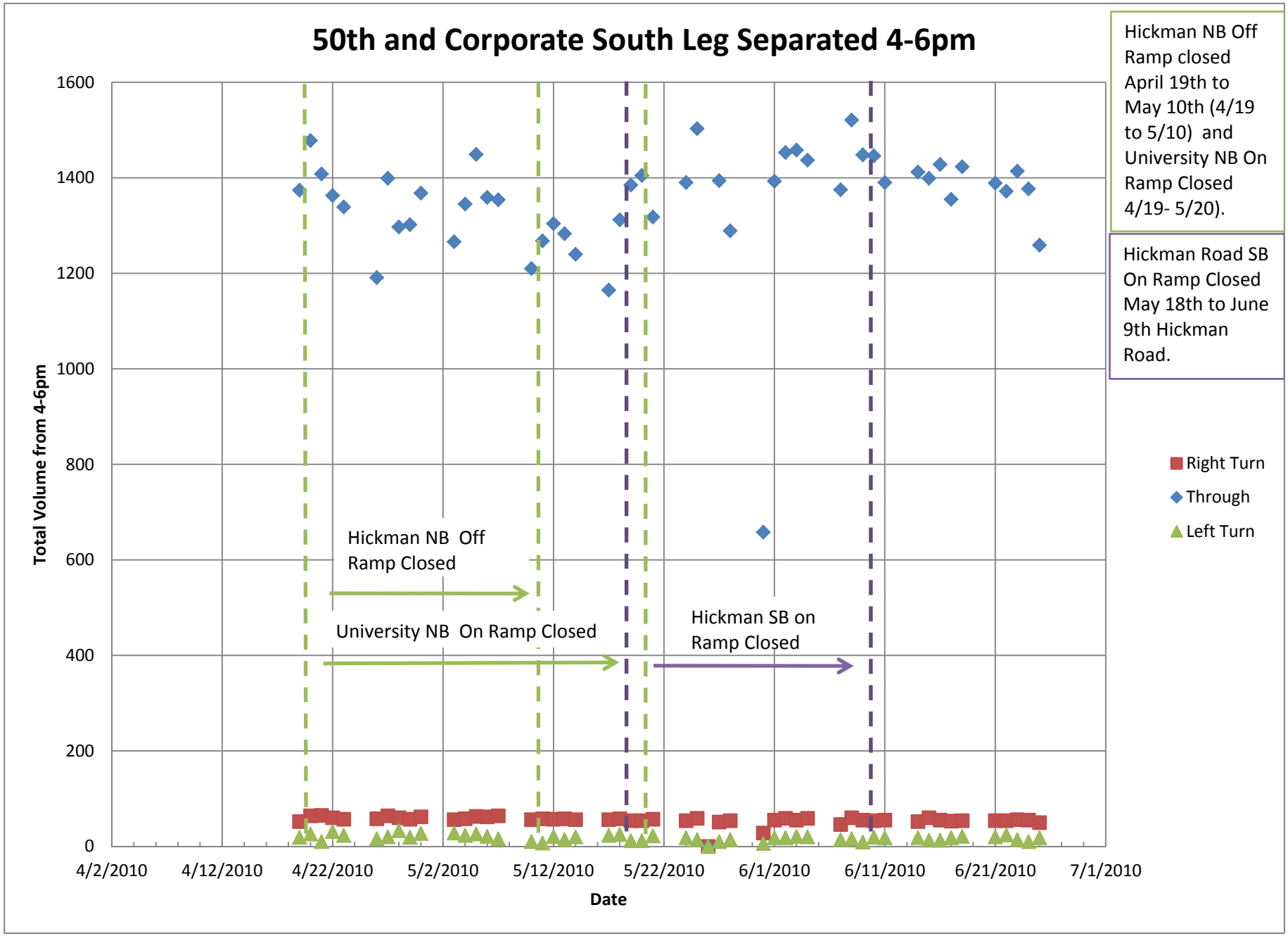

50th and Corporate South Leg Separated 7-9am
Hickman NB Off Ramp closed April 19th to May 10th (4/19 to 5/10) and University NB On Ramp Closed 4/19- 5/20).
Hickman Road SB On Ramp Closed May 18th to June 9th Hickman Road.
Right Turn
Through
Left Turn
Hickman NB Off Ramp Closed
University NB On Ramp Closed
Hickman SB on Ramp Closed
Total Volume from 7-9am
1400
1200
1000
800
600
400
200
0
4/2/2010
4/12/2010
4/22/2010
5/2/2010
5/12/2010
5/22/2010
6/1/2010
6/11/2010
6/21/2010
7/1/2010
Date

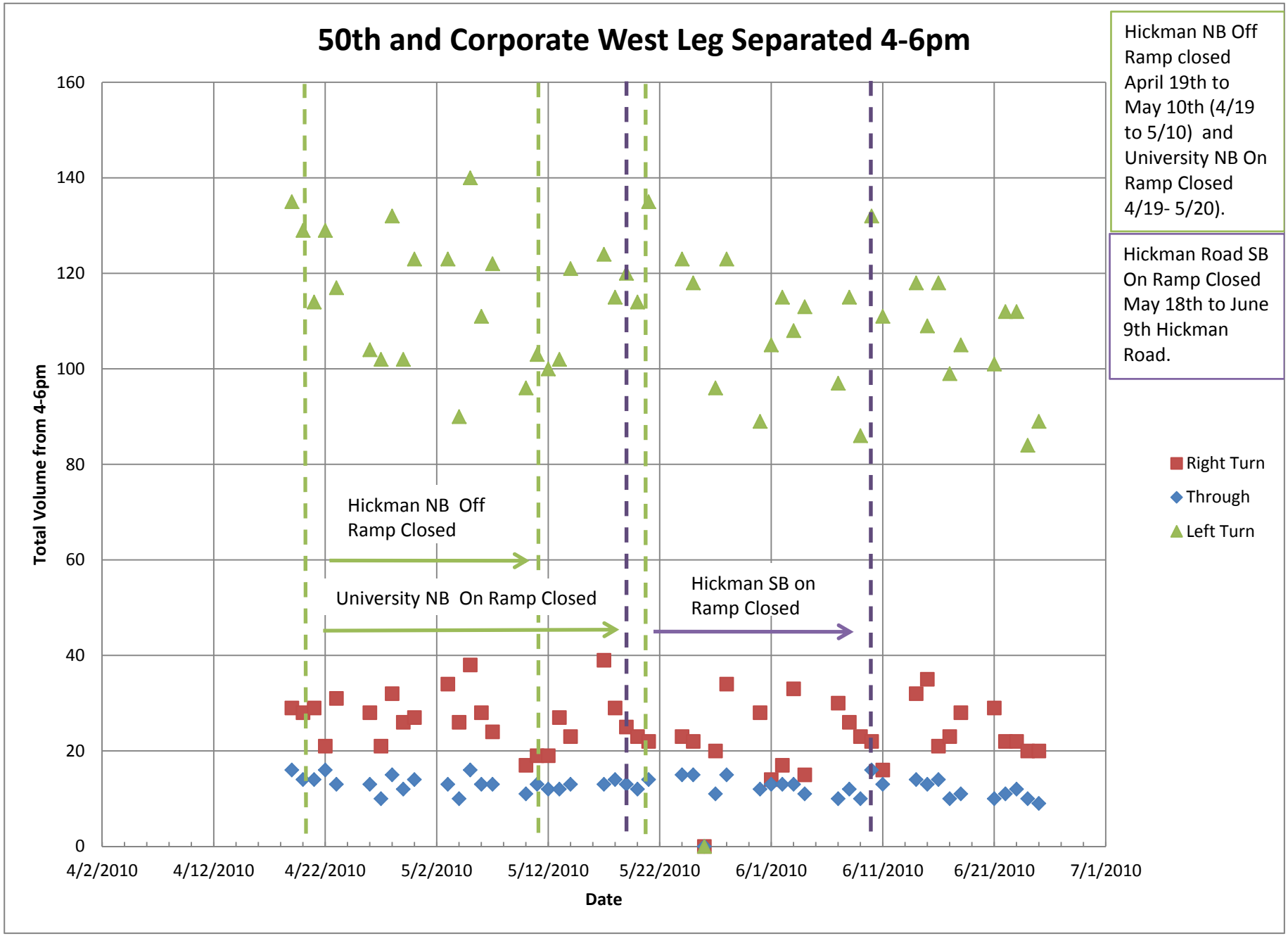

50th and Corporate West Leg Separated 7-9am
Hickman NB Off Ramp closed April 19th to May 10th (4/19 to 5/10) and University NB On Ramp Closed 4/19- 5/20).
Hickman Road SB On Ramp Closed May 18th to June 9th Hickman Road.
Total Volume from 7-9am
70
60
50
40
30
20
10
0
4/2/2010
4/12/2010
4/22/2010
5/2/2010
5/12/2010
5/22/2010
6/1/2010
6/11/2010
6/21/2010
7/1/2010
Date
Hickman NB Off Ramp Closed
University NB On Ramp Closed
Hickman SB on Ramp Closed
Right Turn
Through
Left Turn

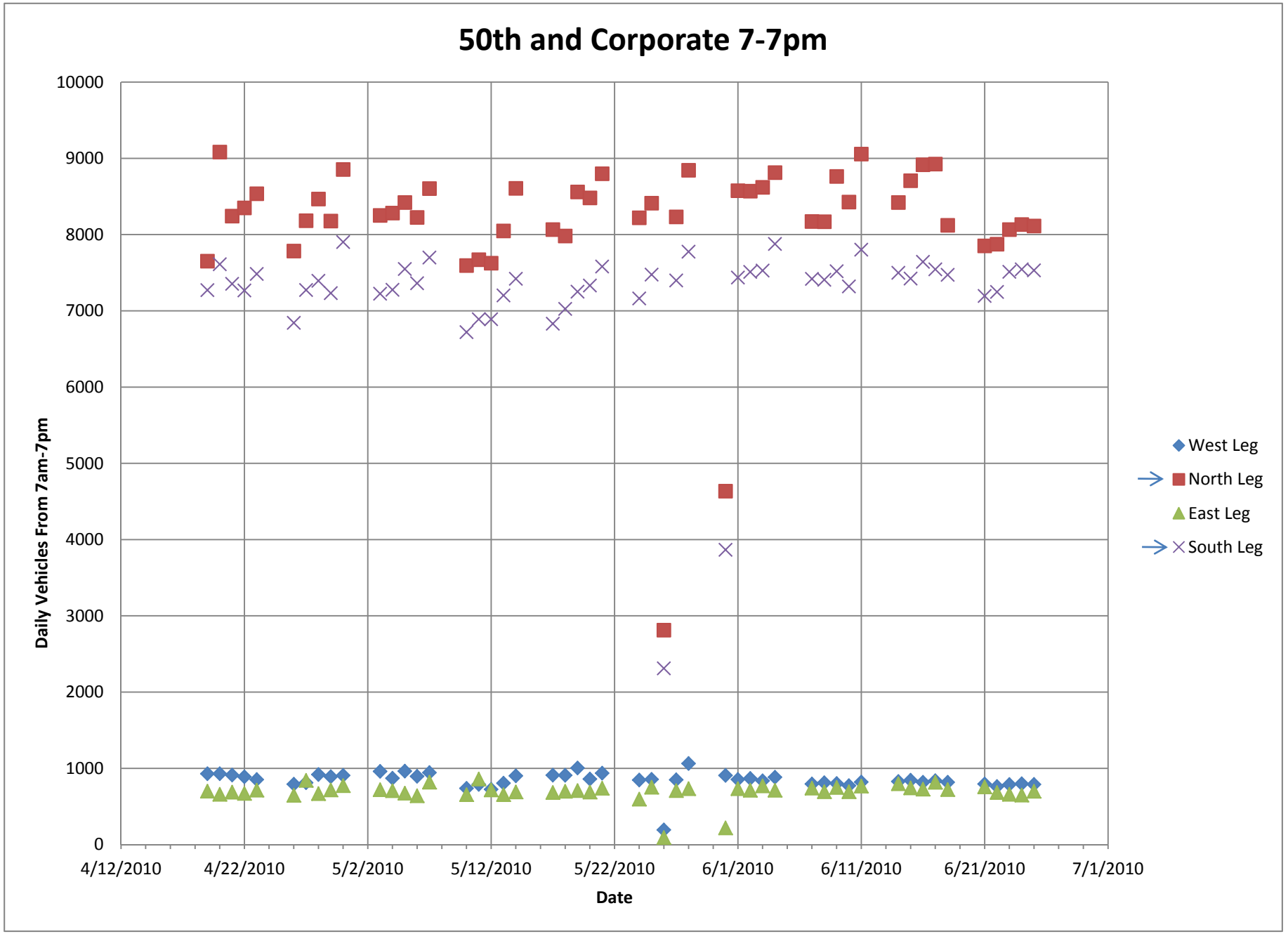

50th and Corporate 4-6pm
Hickman NB Off Ramp closed April 19th to May 10th (4/19 to 5/10) and University NB On Ramp Closed 4/19- 5/20).
Hickman Road SB On Ramp Closed May 18th to June 9th Hickman Road.
Hickman SB on Ramp Closed
Hickman NB Off Ramp Closed
University NB On Ramp Closed
West Leg
North Leg
East Leg
South Leg
Daily Vehicles From 4-6pm
Date
2000
1800
1600
1400
1200
1000
800
600
400
200
0
4/12/2010
4/22/2010
5/2/2010
5/12/2010
5/22/2010
6/1/2010
6/11/2010
6/21/2010
7/1/2010

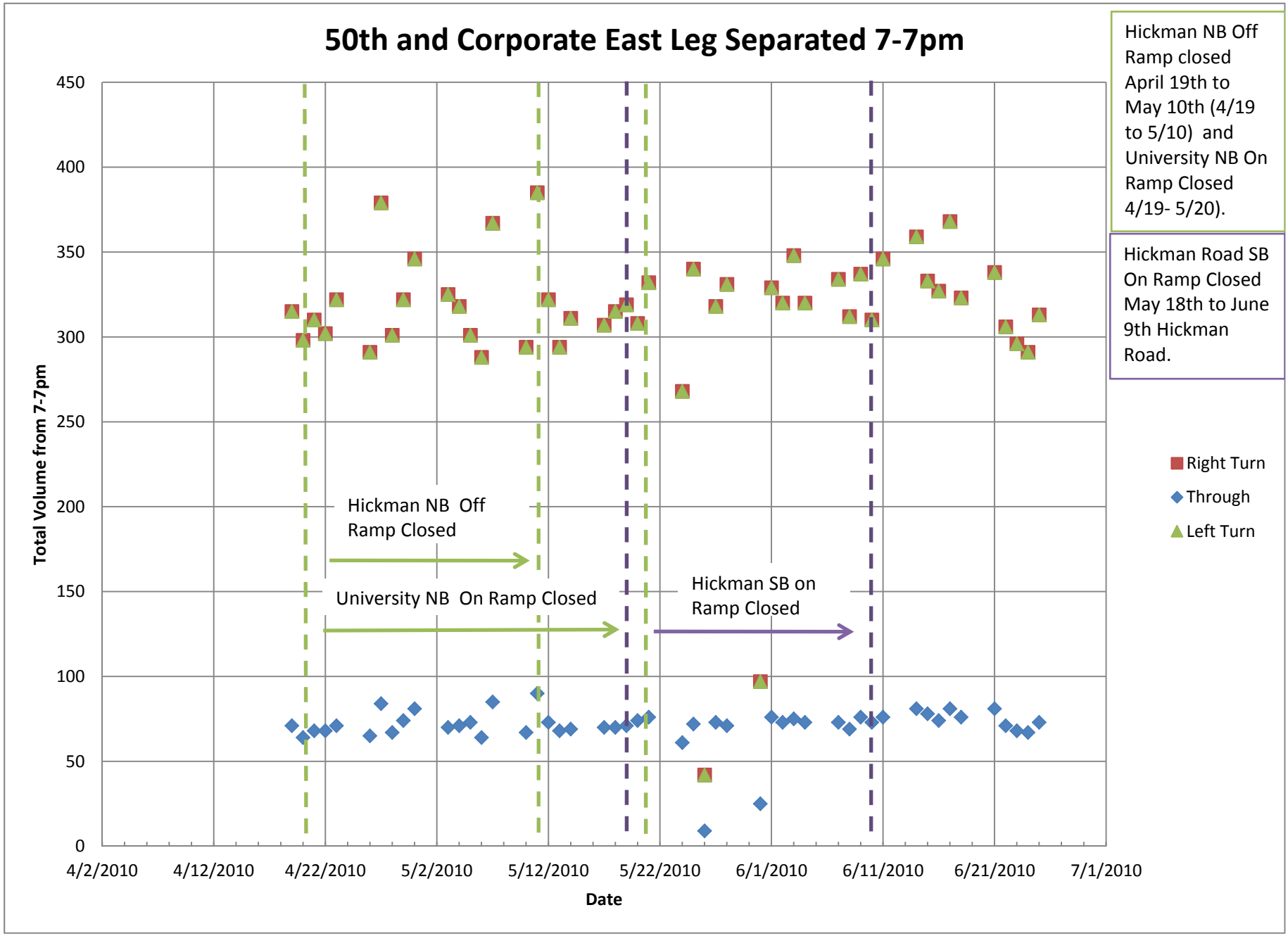

50th and Corporate East Leg Separated 4-6pm
Hickman NB Off Ramp closed April 19th to May 10th (4/19 to 5/10) and University NB On Ramp Closed 4/19- 5/20).
Hickman Road SB On Ramp Closed May 18th to June 9th Hickman Road.
Right Turn
Through
Left Turn
Hickman NB Off Ramp Closed
University NB On Ramp Closed
Hickman SB on Ramp Closed
Total Volume from 4-6pm
Date
450
400
350
300
250
200
150
100
50
0
4/2/2010
4/12/2010
4/22/2010
5/2/2010
5/12/2010
5/22/2010
6/1/2010
6/11/2010
6/21/2010
7/1/2010

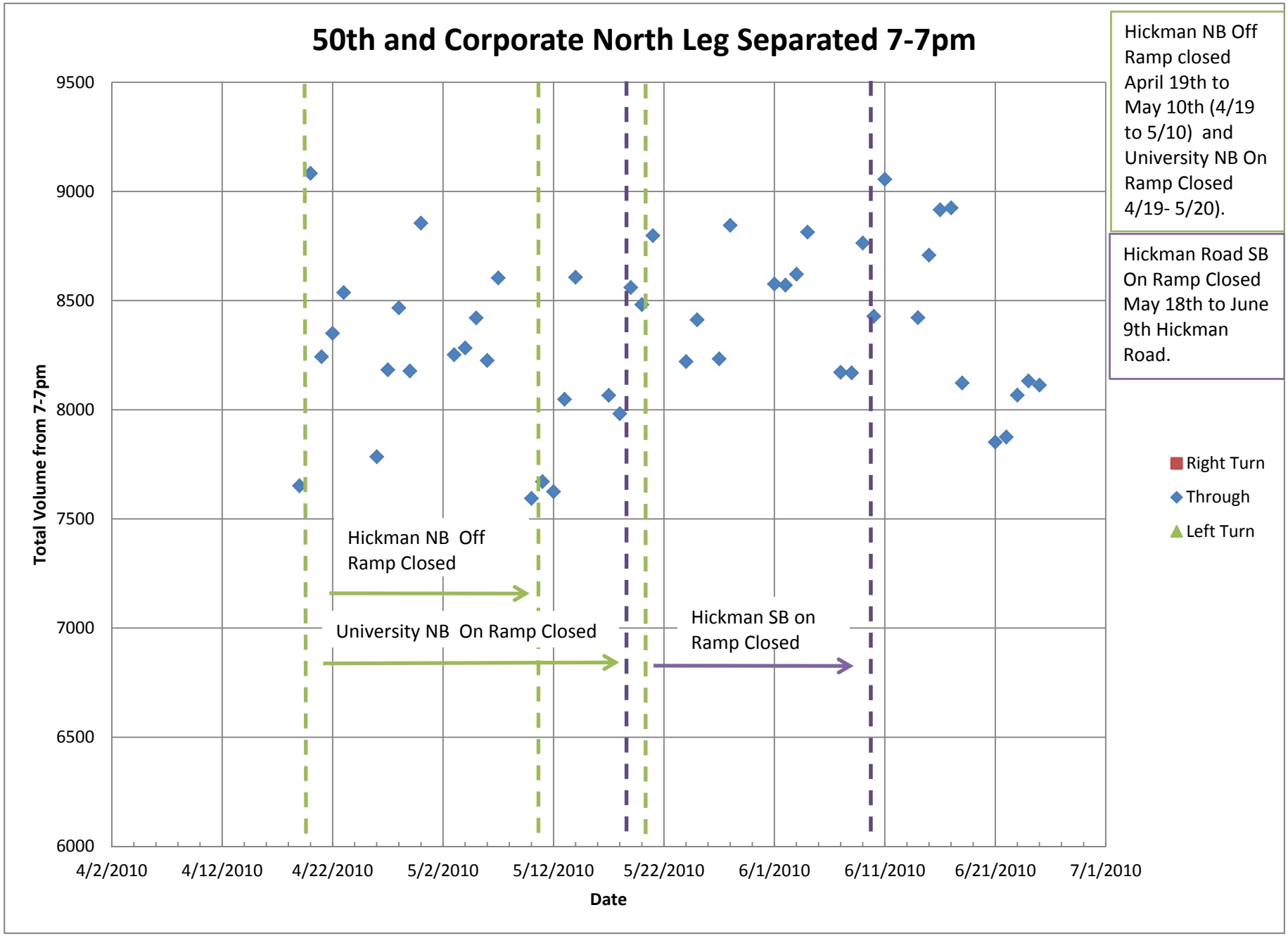

50th and Corporate North Leg Separated 4-6pm
Hickman NB Off Ramp closed April 19th to May 10th (4/19 to 5/10) and University NB On Ramp Closed 4/19- 5/20).
Hickman Road SB On Ramp Closed May 18th to June 9th Hickman Road.
Total Volume from 4-6pm
2000
1800
1600
1400
1200
1000
800
600
400
200
0
4/2/2010
4/12/2010
4/22/2010
5/2/2010
5/12/2010
5/22/2010
6/1/2010
6/11/2010
6/21/2010
7/1/2010
Date
Right Turn
Through
Left Turn
Hickman NB Off Ramp Closed
University NB On Ramp Closed
Hickman SB on Ramp Closed

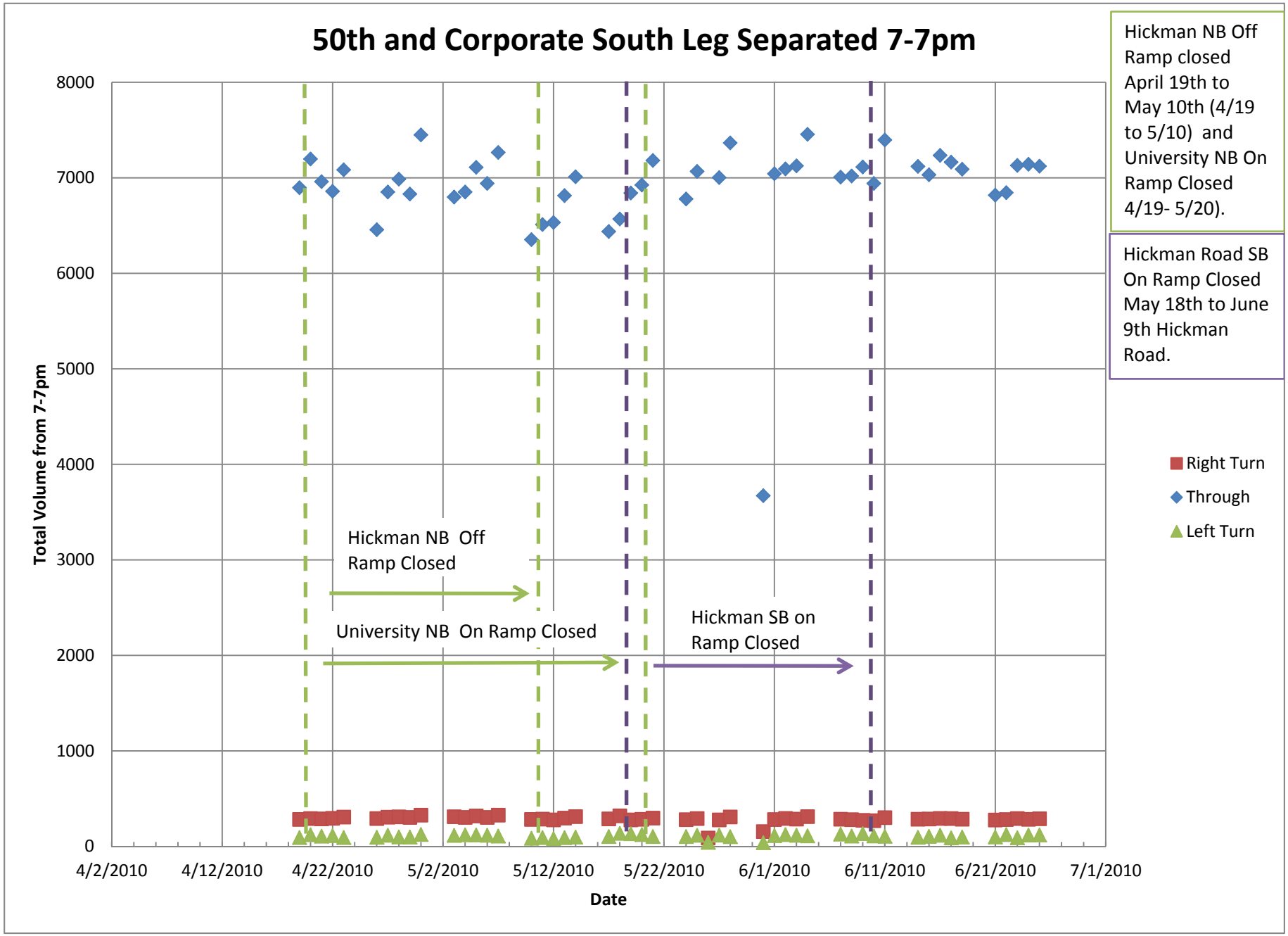

50th and Corporate South Leg Separated 4-6pm
Hickman NB Off Ramp closed April 19th to May 10th (4/19 to 5/10) and University NB On Ramp Closed 4/19- 5/20).
Hickman Road SB On Ramp Closed May 18th to June 9th Hickman Road.
Total Volume from 4-6pm
1600
1400
1200
1000
800
600
400
200
0
4/2/2010
4/12/2010
4/22/2010
5/2/2010
5/12/2010
5/22/2010
6/1/2010
6/11/2010
6/21/2010
7/1/2010
Date
Right Turn
Through
Left Turn
Hickman NB Off Ramp Closed
University NB On Ramp Closed
Hickman SB on Ramp Closed

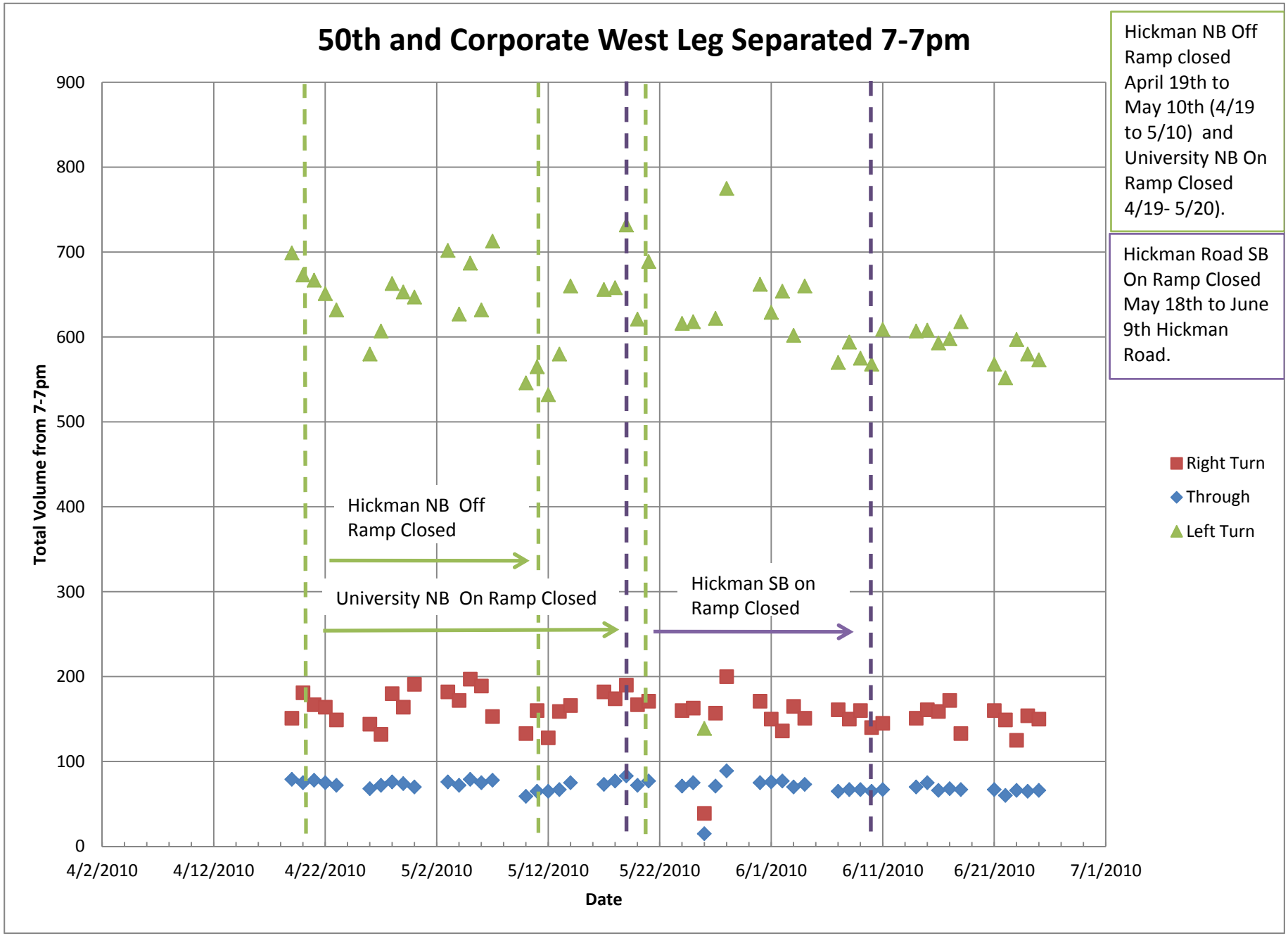

50th and Corporate West Leg Separated 4-6pm
Hickman NB Off Ramp closed April 19th to May 10th (4/19 to 5/10) and University NB On Ramp Closed 4/19- 5/20).
Hickman Road SB On Ramp Closed May 18th to June 9th Hickman Road.
Right Turn
Through
Left Turn
Hickman NB Off Ramp Closed
University NB On Ramp Closed
Hickman SB on Ramp Closed
Total Volume from 4-6pm
Date
0
20
40
60
80
100
120
140
160
4/2/2010
4/12/2010
4/22/2010
5/2/2010
5/12/2010
5/22/2010
6/1/2010
6/11/2010
6/21/2010
7/1/2010


50th and Corporate 7-7pm
Daily Vehicles From 7am-7pm
10000
9000
8000
7000
6000
5000
4000
3000
2000
1000
0
4/12/2010
4/22/2010
5/2/2010
5/12/2010
5/22/2010
6/1/2010
6/11/2010
6/21/2010
7/1/2010
Date
West Leg
North Leg
East Leg
South Leg


50th and Corporate East Leg Separated 7-7pm
Hickman NB Off Ramp closed April 19th to May 10th (4/19 to 5/10) and University NB On Ramp Closed 4/19- 5/20).
Hickman Road SB On Ramp Closed May 18th to June 9th Hickman Road.
Right Turn
Through
Left Turn
Hickman NB Off Ramp Closed
University NB On Ramp Closed
Hickman SB on Ramp Closed
Total Volume from 7-7pm
Date
450
400
350
300
250
200
150
100
50
0
4/2/2010
4/12/2010
4/22/2010
5/2/2010
5/12/2010
5/22/2010
6/1/2010
6/11/2010
6/21/2010
7/1/2010

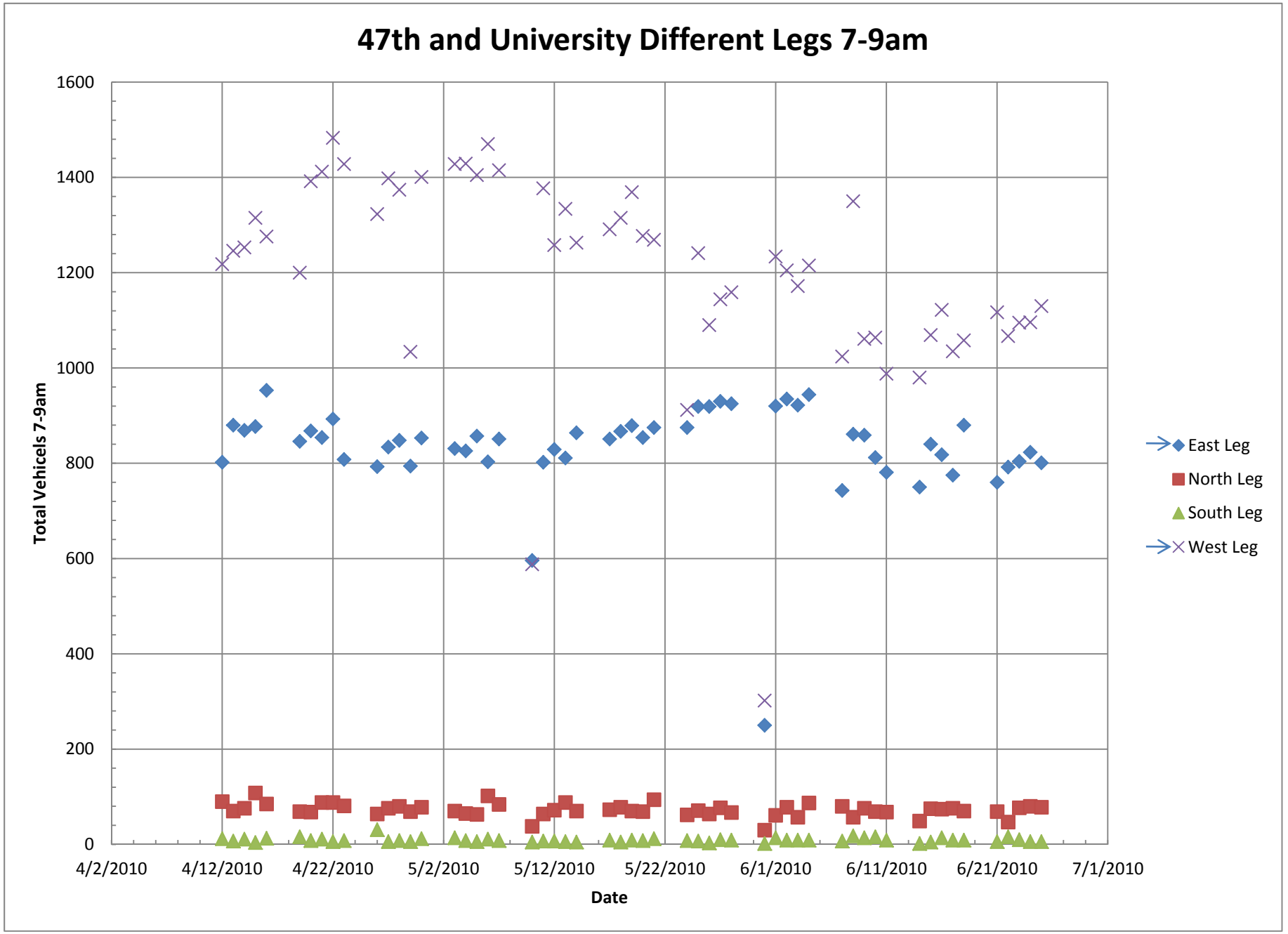

50th and Corporate North Leg Separated 7-7pm
Hickman NB Off Ramp closed April 19th to May 10th (4/19 to 5/10) and University NB On Ramp Closed 4/19- 5/20).
Hickman Road SB On Ramp Closed May 18th to June 9th Hickman Road.
Right Turn
Through
Left Turn
Total Volume from 7-7pm
9500
9000
8500
8000
7500
7000
6500
6000
4/2/2010
4/12/2010
4/22/2010
5/2/2010
5/12/2010
5/22/2010
6/1/2010
6/11/2010
6/21/2010
7/1/2010
Date
Hickman NB Off Ramp Closed
University NB On Ramp Closed
Hickman SB on Ramp Closed

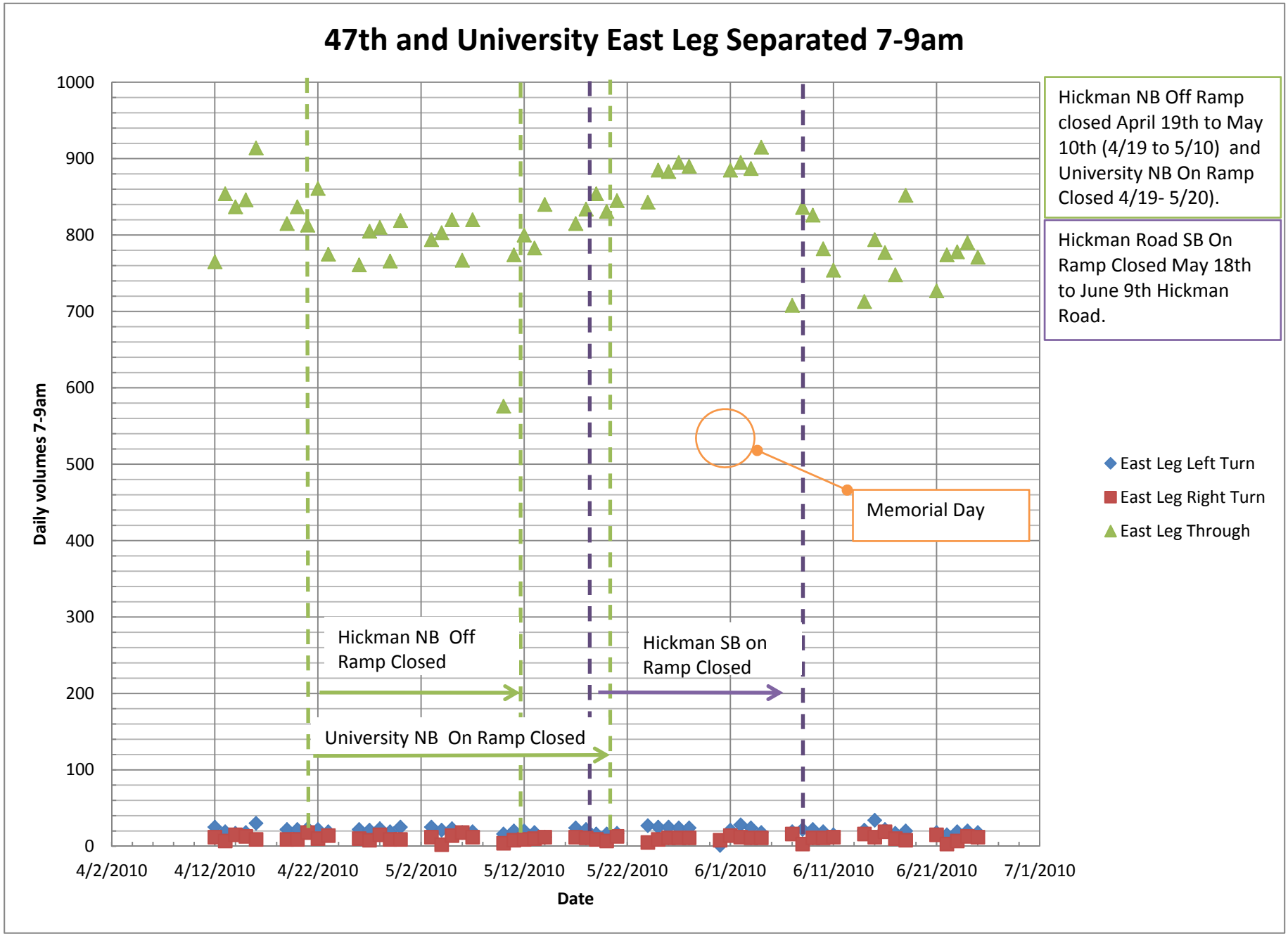

50th and Corporate South Leg Separated 7-7pm
Hickman NB Off Ramp closed April 19th to May 10th (4/19 to 5/10) and University NB On Ramp Closed 4/19- 5/20).
Hickman Road SB On Ramp Closed May 18th to June 9th Hickman Road.
Total Volume from 7-7pm
8000
7000
6000
5000
4000
3000
2000
1000
0
Hickman NB Off Ramp Closed
University NB On Ramp Closed
Hickman SB on Ramp Closed
Right Turn
Through
Left Turn
4/2/2010
4/12/2010
4/22/2010
5/2/2010
5/12/2010
5/22/2010
6/1/2010
6/11/2010
6/21/2010
7/1/2010
Date

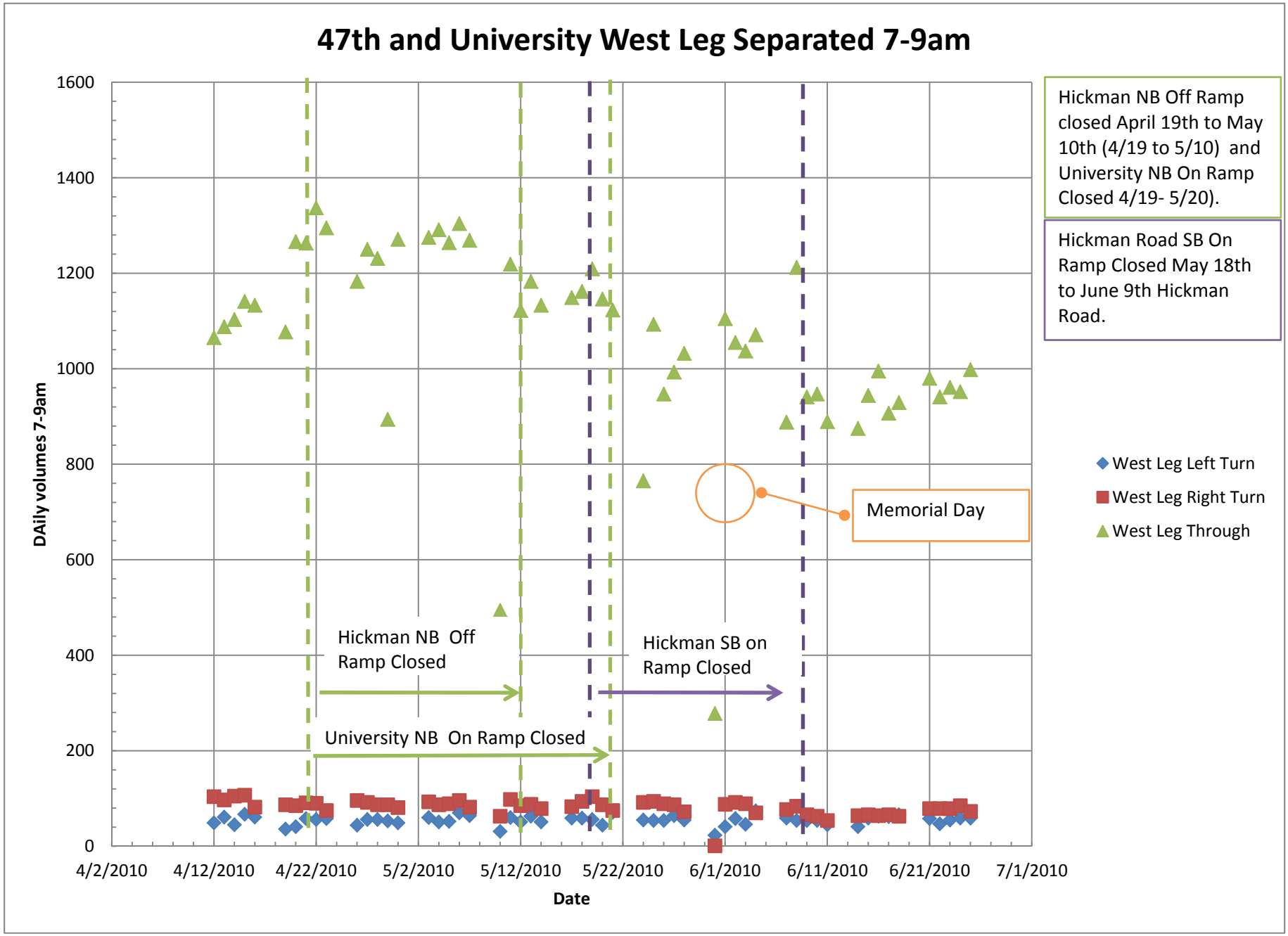

50th and Corporate West Leg Separated 7-7pm
Hickman NB Off Ramp closed April 19th to May 10th (4/19 to 5/10) and University NB On Ramp Closed 4/19- 5/20).
Hickman Road SB On Ramp Closed May 18th to June 9th Hickman Road.
Right Turn
Through
Left Turn
Hickman NB Off Ramp Closed
University NB On Ramp Closed
Hickman SB on Ramp Closed
Total Volume from 7-7pm
900
800
700
600
500
400
300
200
100
0
4/2/2010
4/12/2010
4/22/2010
5/2/2010
5/12/2010
5/22/2010
6/1/2010
6/11/2010
6/21/2010
7/1/2010
Date

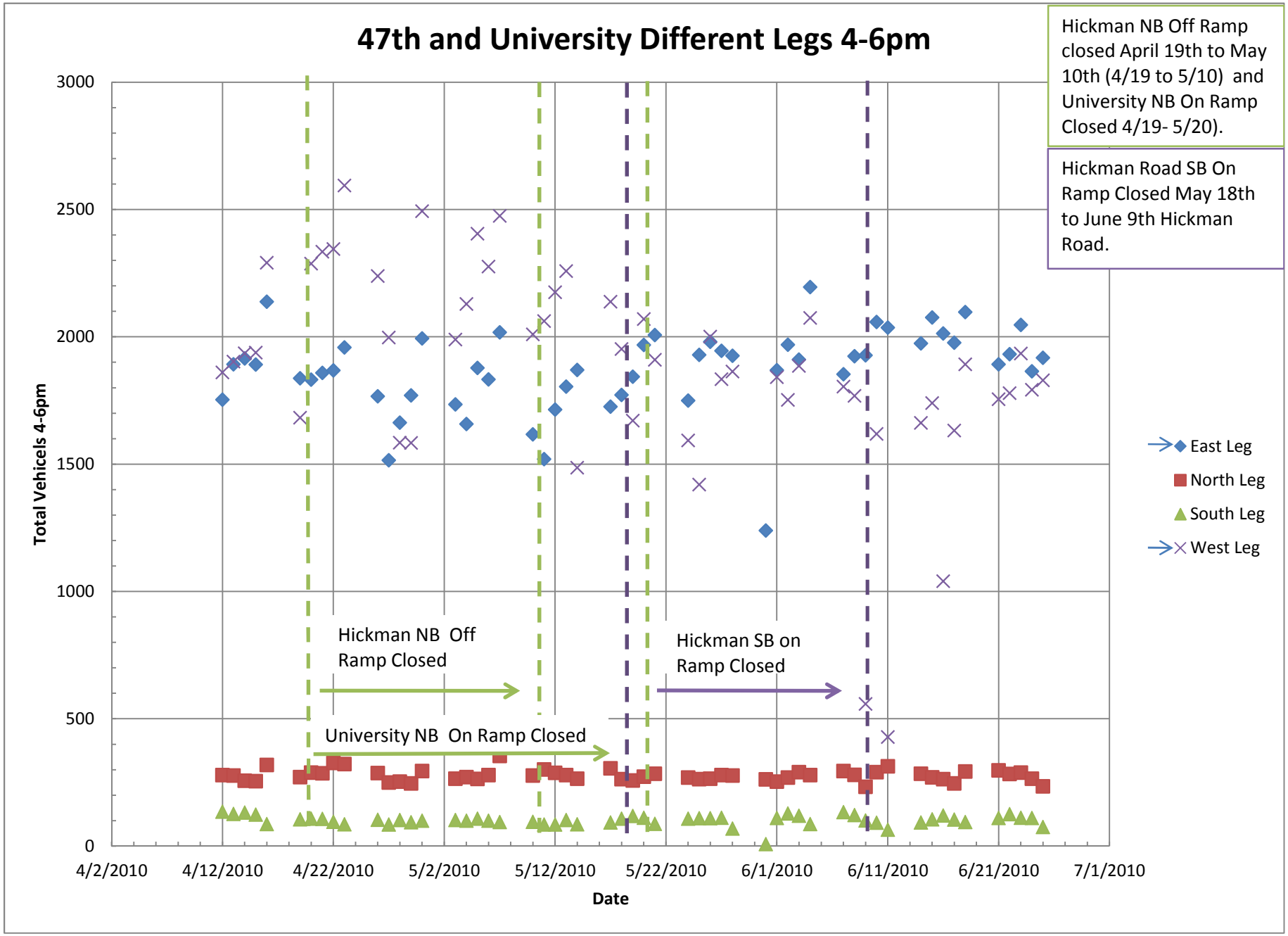
B.2 Intersection Traffic-Volume Changes

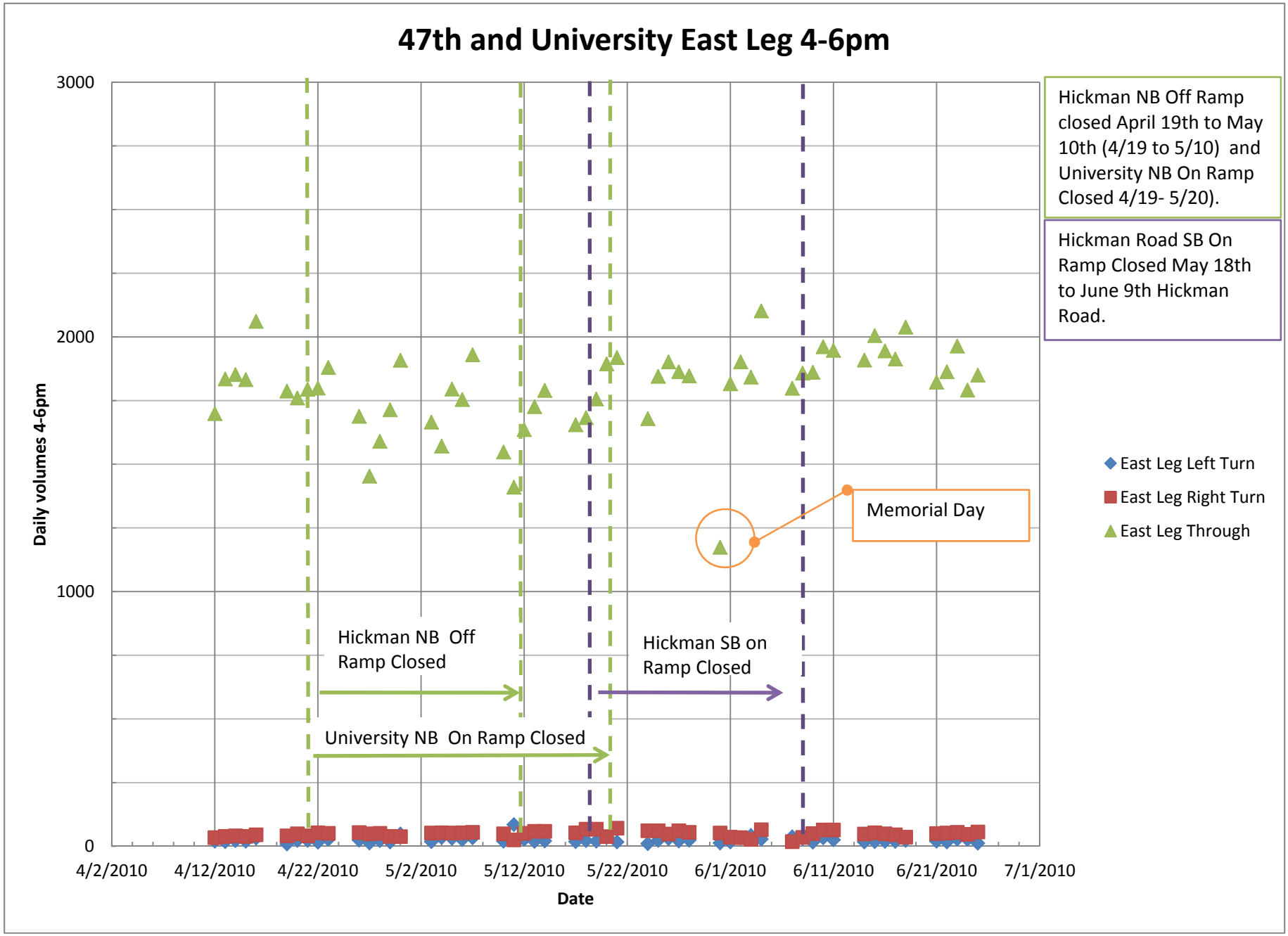
47th Street and University Avenue

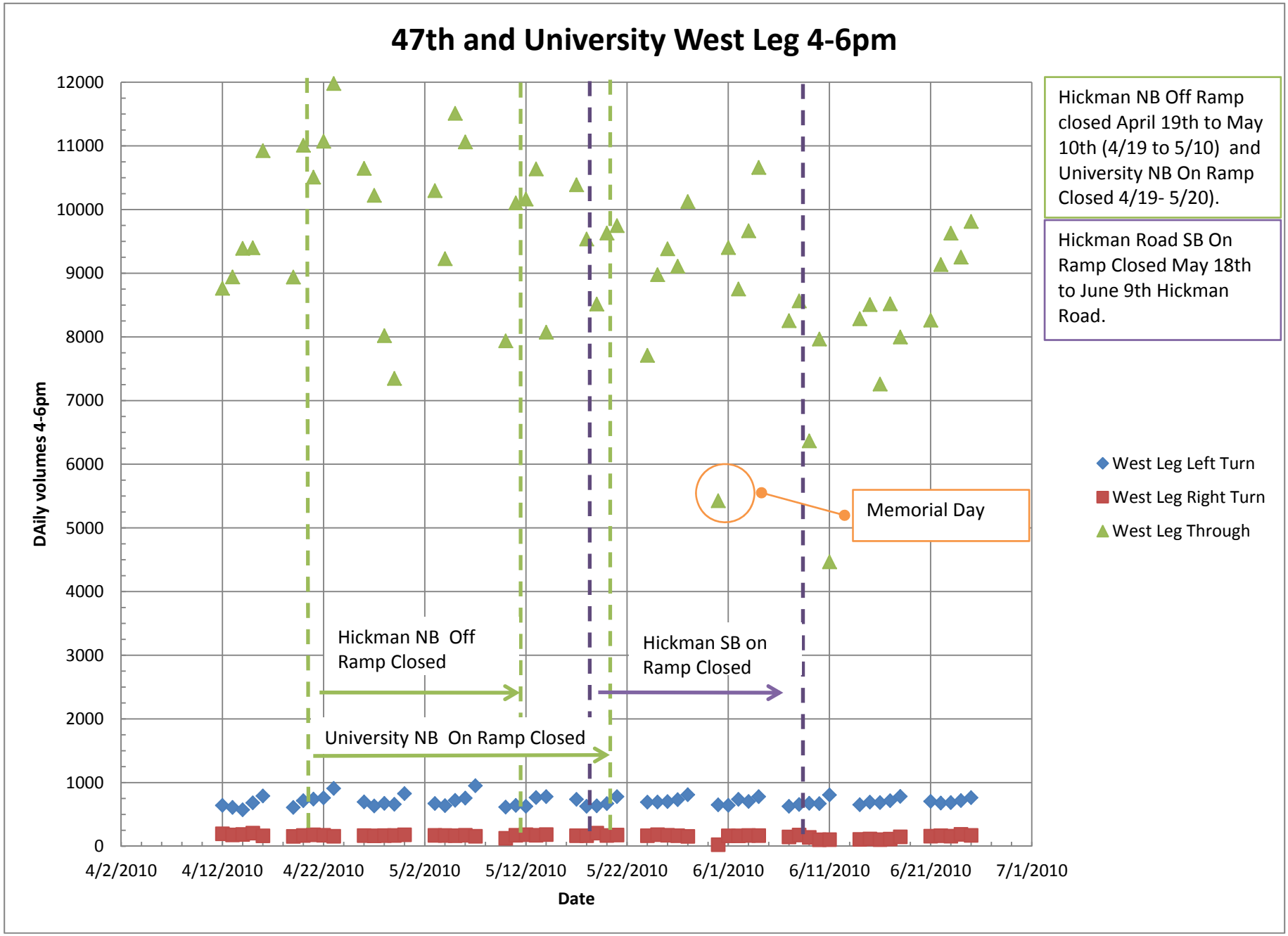

47th and University Different Legs 7-9am
Total Vehicels 7-9am
1600
1400
1200
1000
800
600
400
200
0
4/2/2010
4/12/2010
4/22/2010
5/2/2010
5/12/2010
5/22/2010
6/1/2010
6/11/2010
6/21/2010
7/1/2010
Date
East Leg
North Leg
South Leg
West Leg

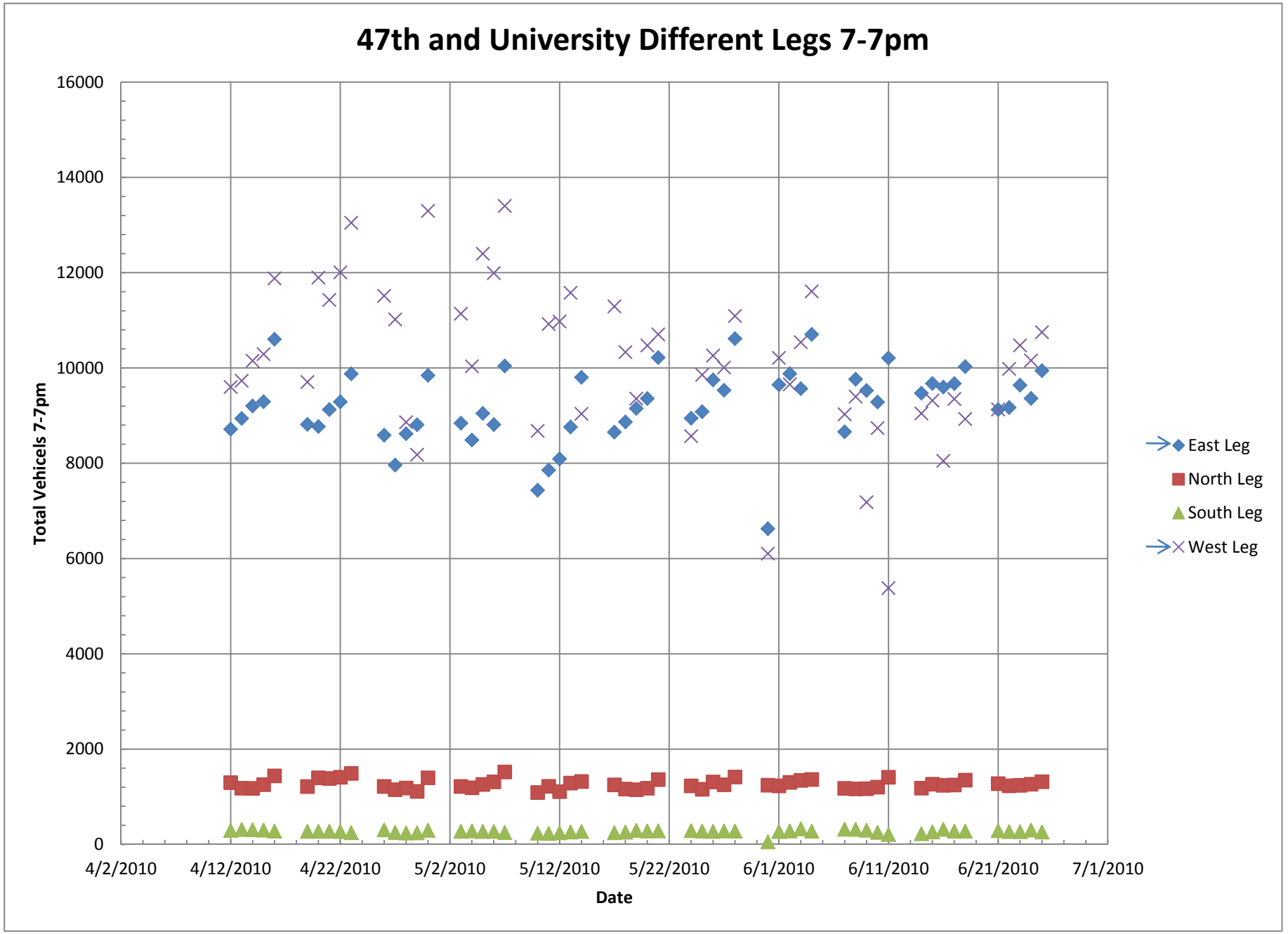

47th and University East Leg Separated 7-9am
Daily volumes 7-9am
1000
900
800
700
600
500
400
300
200
100
0
4/2/2010
4/12/2010
4/22/2010
5/2/2010
5/12/2010
5/22/2010
6/1/2010
6/11/2010
6/21/2010
7/1/2010
Date
Hickman NB Off Ramp closed April 19th to May 10th (4/19 to 5/10) and University NB On Ramp Closed 4/19- 5/20).
Hickman Road SB On Ramp Closed May 18th to June 9th Hickman Road.
East Leg Left Turn
East Leg Right Turn
East Leg Through
Memorial Day
Hickman NB Off Ramp Closed
Hickman SB on Ramp Closed
University NB On Ramp Closed

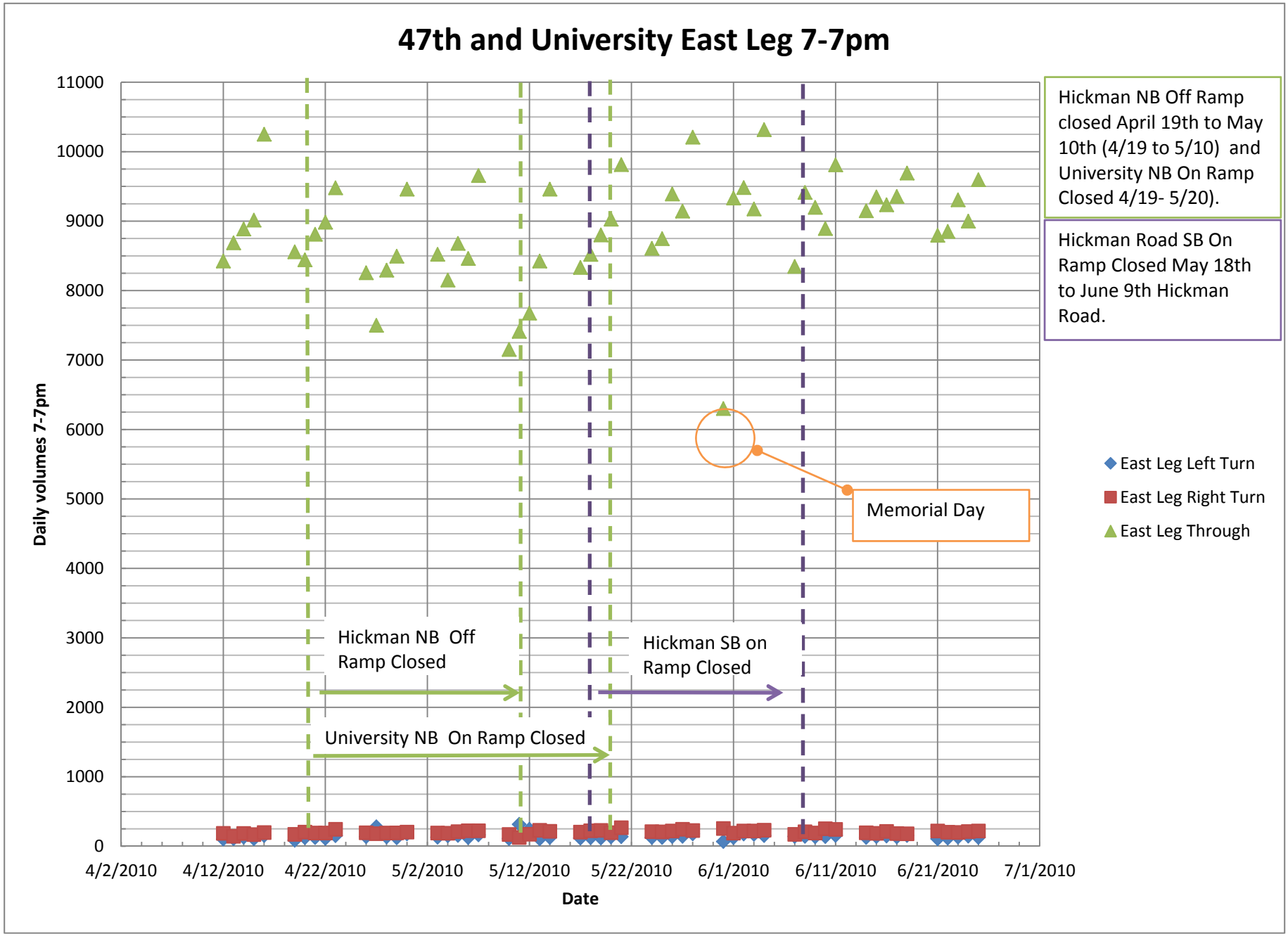

47th and University West Leg Separated 7-9am
DAily volumes 7-9am
1600
1400
1200
1000
800
600
400
200
0
4/2/2010
4/12/2010
4/22/2010
5/2/2010
5/12/2010
5/22/2010
6/1/2010
6/11/2010
6/21/2010
7/1/2010
Date
Hickman NB Off Ramp closed April 19th to May 10th (4/19 to 5/10) and University NB On Ramp Closed 4/19- 5/20).
Hickman Road SB On Ramp Closed May 18th to June 9th Hickman Road.
West Leg Left Turn
West Leg Right Turn
West Leg Through
Memorial Day
Hickman NB Off Ramp Closed
Hickman SB on Ramp Closed
University NB On Ramp Closed

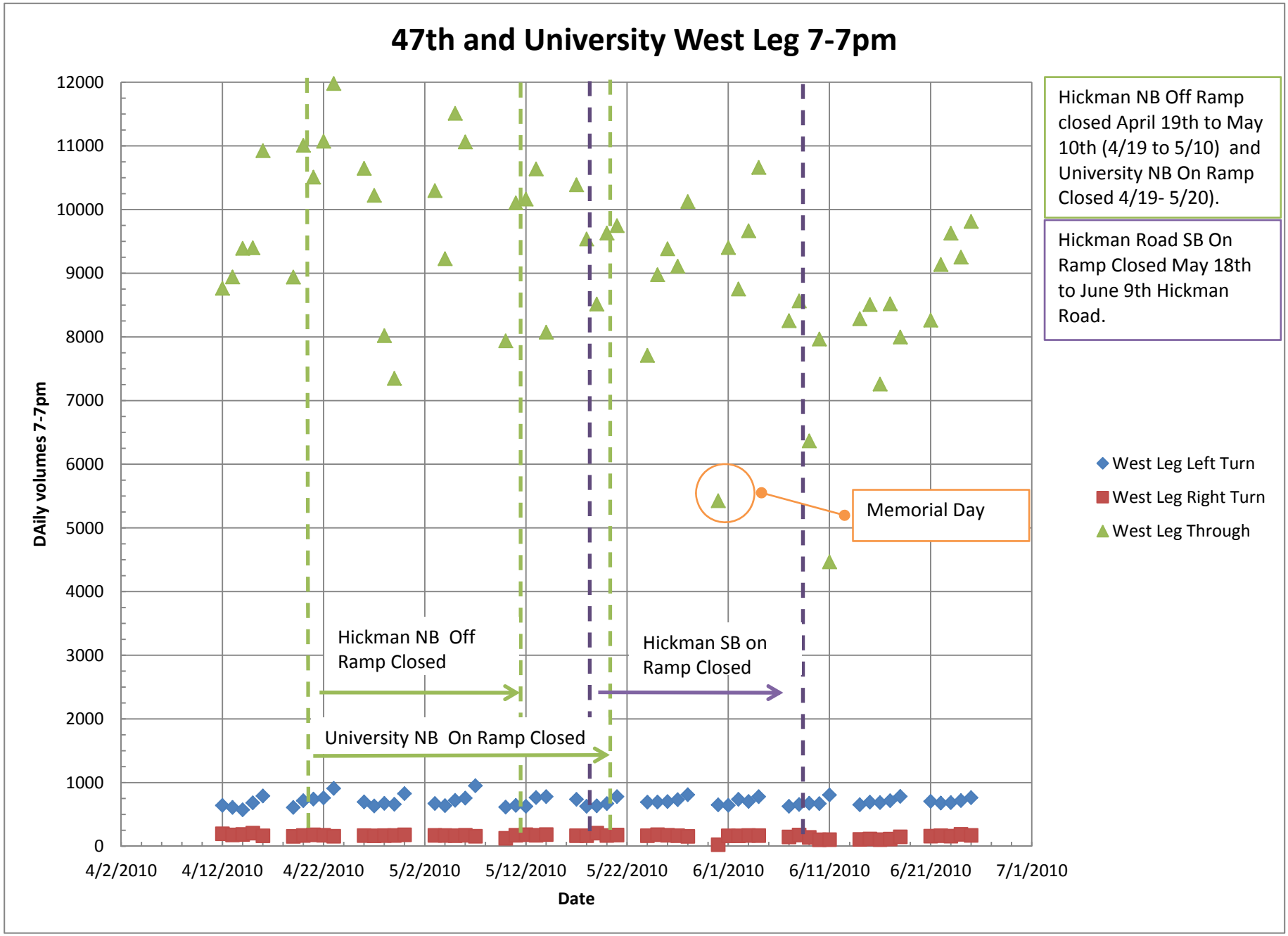

47th and University Different Legs 4-6pm
Hickman NB Off Ramp closed April 19th to May 10th (4/19 to 5/10) and University NB On Ramp Closed 4/19- 5/20).
Hickman Road SB On Ramp Closed May 18th to June 9th Hickman Road.
Total Vehicels 4-6pm
3000
2500
2000
1500
1000
500
0
4/2/2010
4/12/2010
4/22/2010
5/2/2010
5/12/2010
5/22/2010
6/1/2010
6/11/2010
6/21/2010
7/1/2010
Date
East Leg
North Leg
South Leg
West Leg
Hickman NB Off Ramp Closed
Hickman SB on Ramp Closed
University NB On Ramp Closed


47th and University East Leg 4-6pm
Daily volumes 4-6pm
3000
2000
1000
0
4/2/2010
4/12/2010
4/22/2010
5/2/2010
5/12/2010
5/22/2010
6/1/2010
6/11/2010
6/21/2010
7/1/2010
Date
Hickman NB Off Ramp closed April 19th to May 10th (4/19 to 5/10) and University NB On Ramp Closed 4/19- 5/20).
Hickman Road SB On Ramp Closed May 18th to June 9th Hickman Road.
East Leg Left Turn
East Leg Right Turn
East Leg Through
Memorial Day
Hickman NB Off Ramp Closed
Hickman SB on Ramp Closed
University NB On Ramp Closed


47th and University West Leg 4-6pm
DAily volumes 4-6pm
12000
11000
10000
9000
8000
7000
6000
5000
4000
3000
2000
1000
0
4/2/2010
4/12/2010
4/22/2010
5/2/2010
5/12/2010
5/22/2010
6/1/2010
6/11/2010
6/21/2010
7/1/2010
Date
Hickman NB Off Ramp closed April 19th to May 10th (4/19 to 5/10) and University NB On Ramp Closed 4/19- 5/20).
Hickman Road SB On Ramp Closed May 18th to June 9th Hickman Road.
West Leg Left Turn
West Leg Right Turn
West Leg Through
Memorial Day
Hickman NB Off Ramp Closed
Hickman SB on Ramp Closed
University NB On Ramp Closed

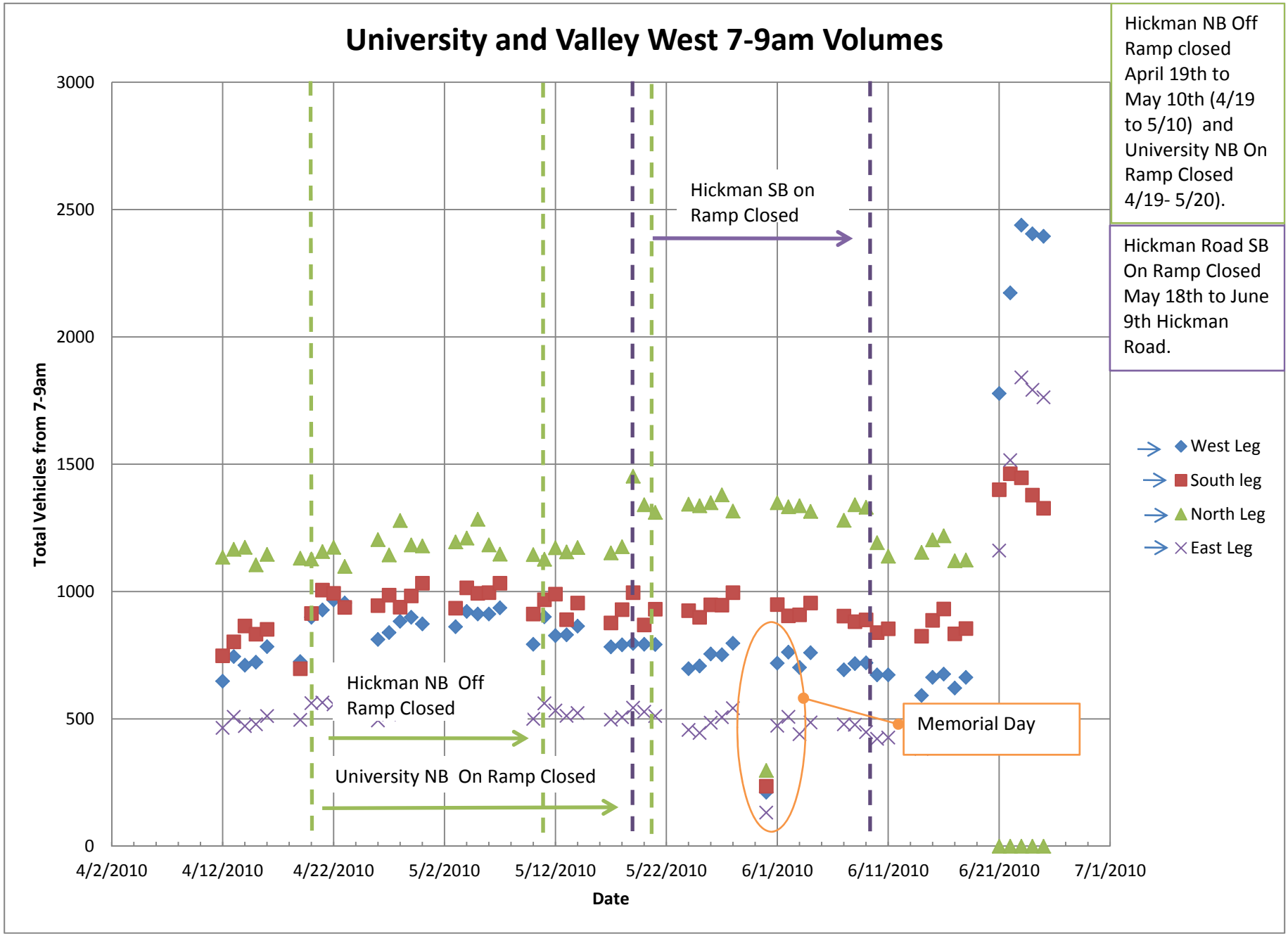

47th and University Different Legs 7-7pm
Total Vehicels 7-7pm
16000
14000
12000
10000
8000
6000
4000
2000
0
4/2/2010
4/12/2010
4/22/2010
5/2/2010
5/12/2010
5/22/2010
6/1/2010
6/11/2010
6/21/2010
7/1/2010
Date
East Leg
North Leg
South Leg
West Leg

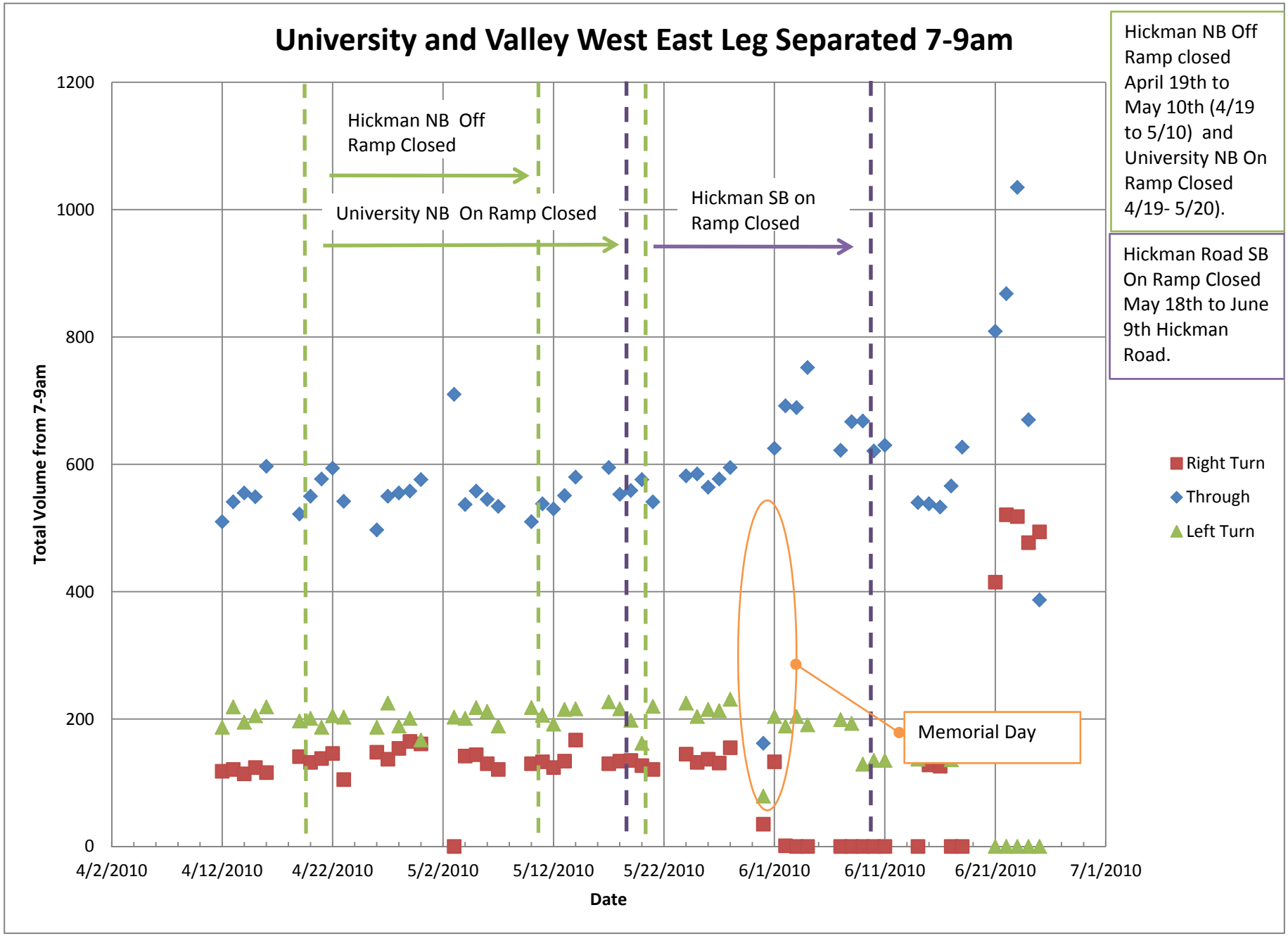

47th and University East Leg 7-7pm
Daily volumes 7-7pm
11000
10000
9000
8000
7000
6000
5000
4000
3000
2000
1000
0
4/2/2010
4/12/2010
4/22/2010
5/2/2010
5/12/2010
5/22/2010
6/1/2010
6/11/2010
6/21/2010
7/1/2010
Date
Hickman NB Off Ramp closed April 19th to May 10th (4/19 to 5/10) and University NB On Ramp Closed 4/19- 5/20).
Hickman Road SB On Ramp Closed May 18th to June 9th Hickman Road.
East Leg Left Turn
East Leg Right Turn
East Leg Through
Memorial Day
Hickman NB Off Ramp Closed
Hickman SB on Ramp Closed
University NB On Ramp Closed

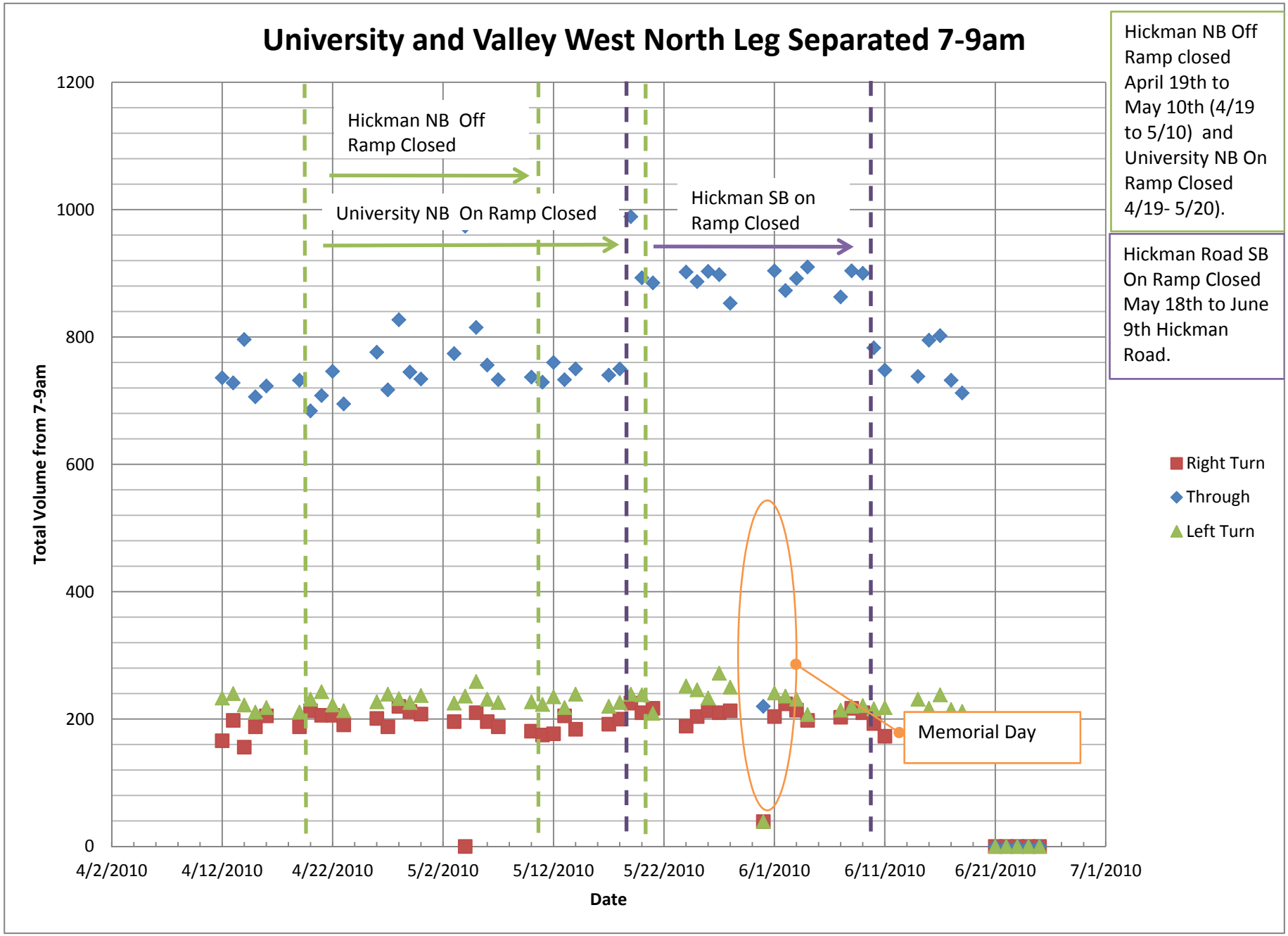

47th and University West Leg 7-7pm
DAily volumes 7-7pm
12000
11000
10000
9000
8000
7000
6000
5000
4000
3000
2000
1000
0
4/2/2010
4/12/2010
4/22/2010
5/2/2010
5/12/2010
5/22/2010
6/1/2010
6/11/2010
6/21/2010
7/1/2010
Date
Hickman NB Off Ramp closed April 19th to May 10th (4/19 to 5/10) and University NB On Ramp Closed 4/19- 5/20).
Hickman Road SB On Ramp Closed May 18th to June 9th Hickman Road.
West Leg Left Turn
West Leg Right Turn
West Leg Through
Memorial Day
Hickman NB Off Ramp Closed
Hickman SB on Ramp Closed
University NB On Ramp Closed

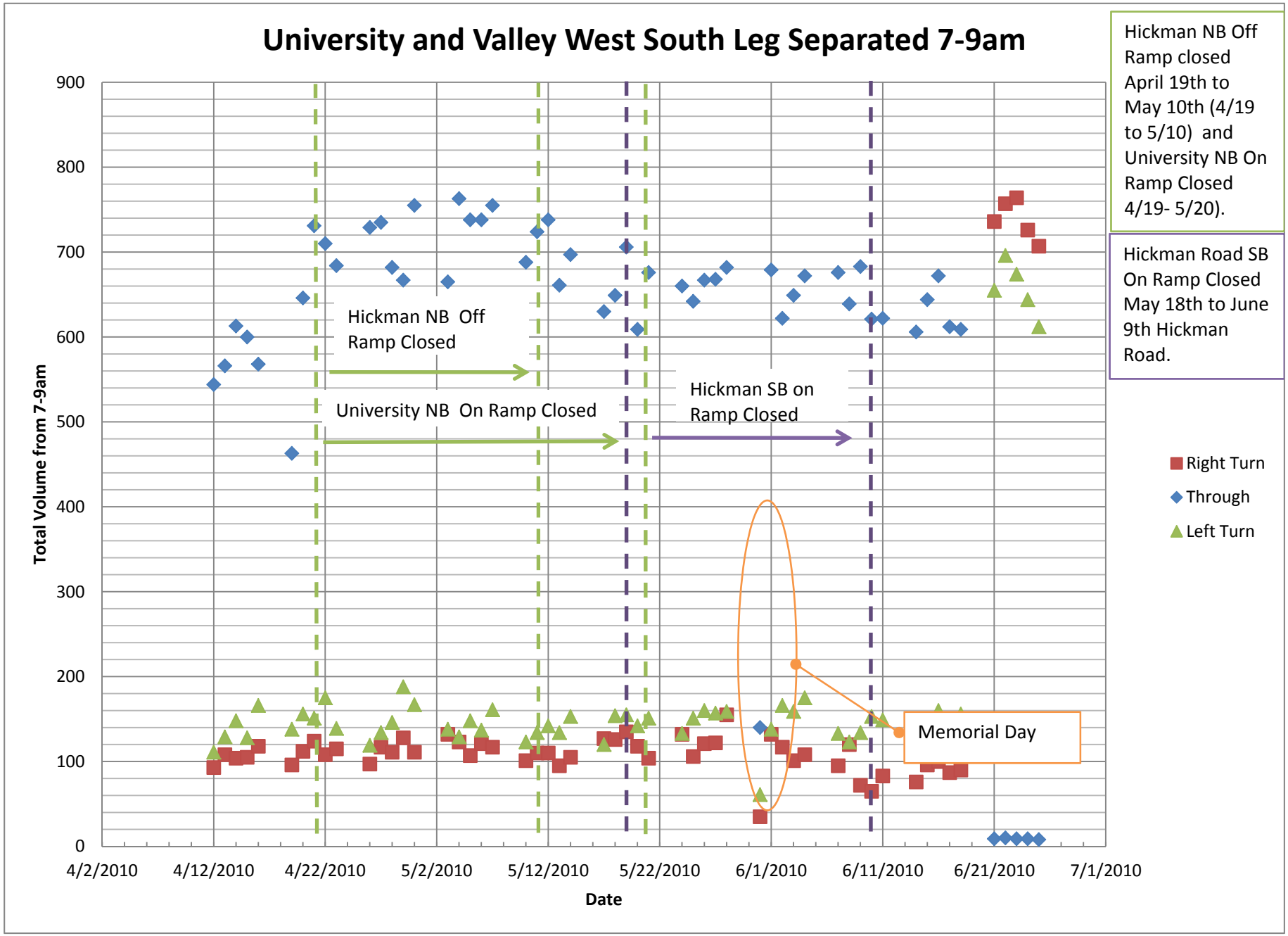
B.2 Intersection Traffic-Volume Changes

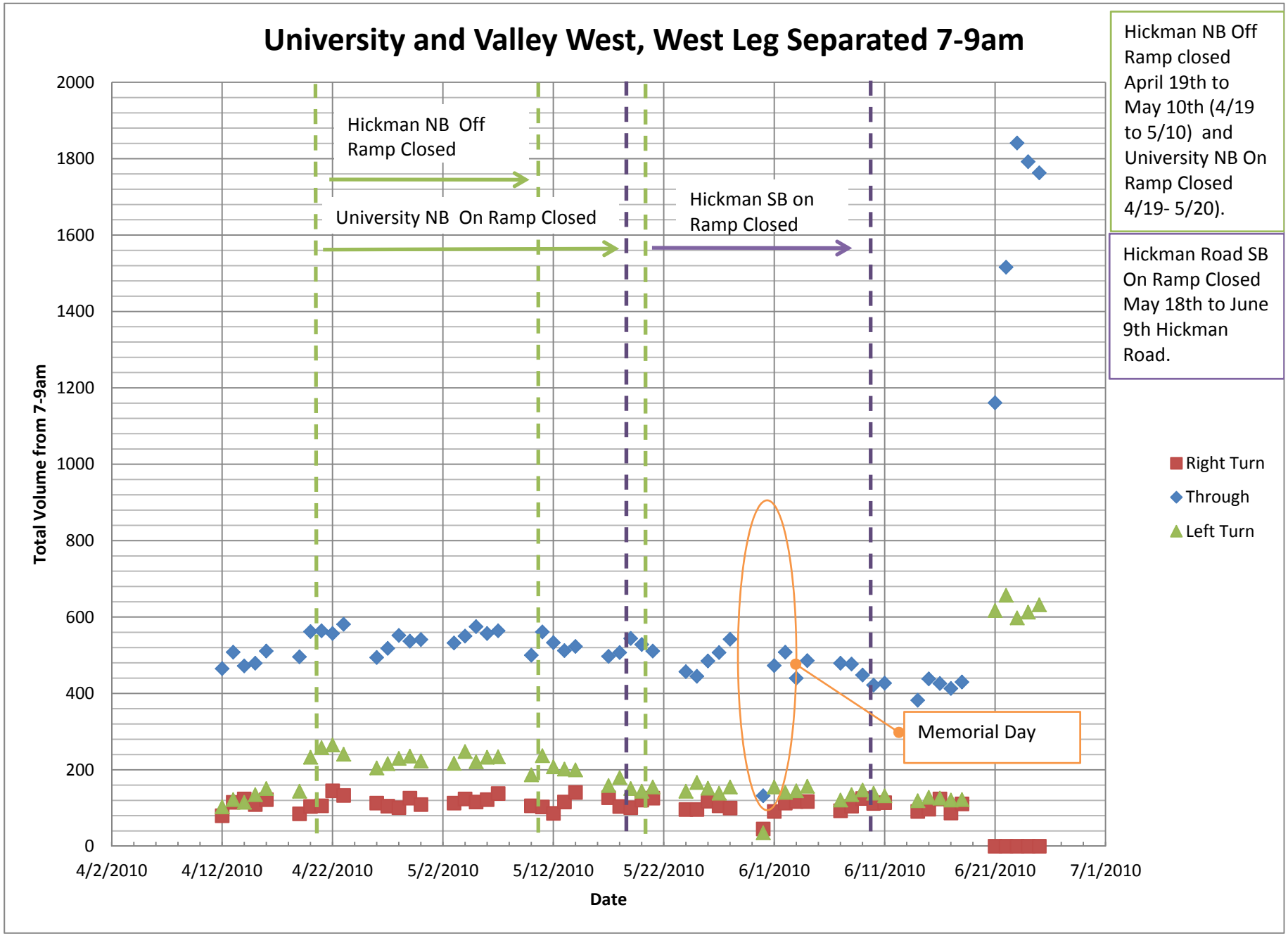
35th Street or Valley West Road and University Avenue

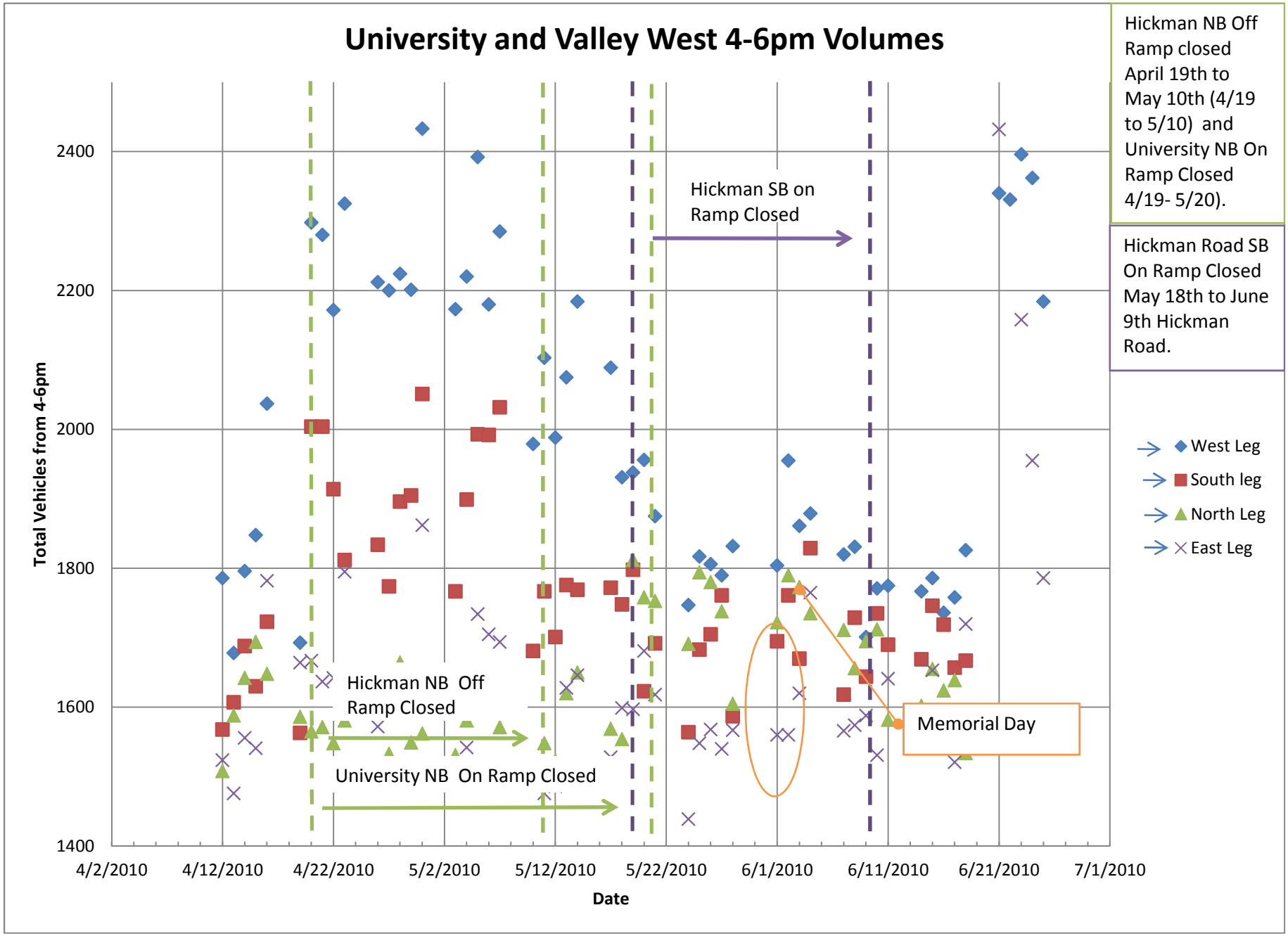

University and Valley West 7-9am Volumes
Total Vehicles from 7-9am
3000
2500
2000
1500
1000
500
0
4/2/2010
4/12/2010
4/22/2010
5/2/2010
5/12/2010
5/22/2010
6/1/2010
6/11/2010
6/21/2010
7/1/2010
Date
Hickman SB on Ramp Closed
Hickman NB Off Ramp Closed
University NB On Ramp Closed
Memorial Day
West Leg
South leg
North Leg
East Leg
Hickman NB Off Ramp closed April 19th to May 10th (4/19 to 5/10) and University NB On Ramp Closed 4/19- 5/20).
Hickman Road SB On Ramp Closed May 18th to June 9th Hickman Road.

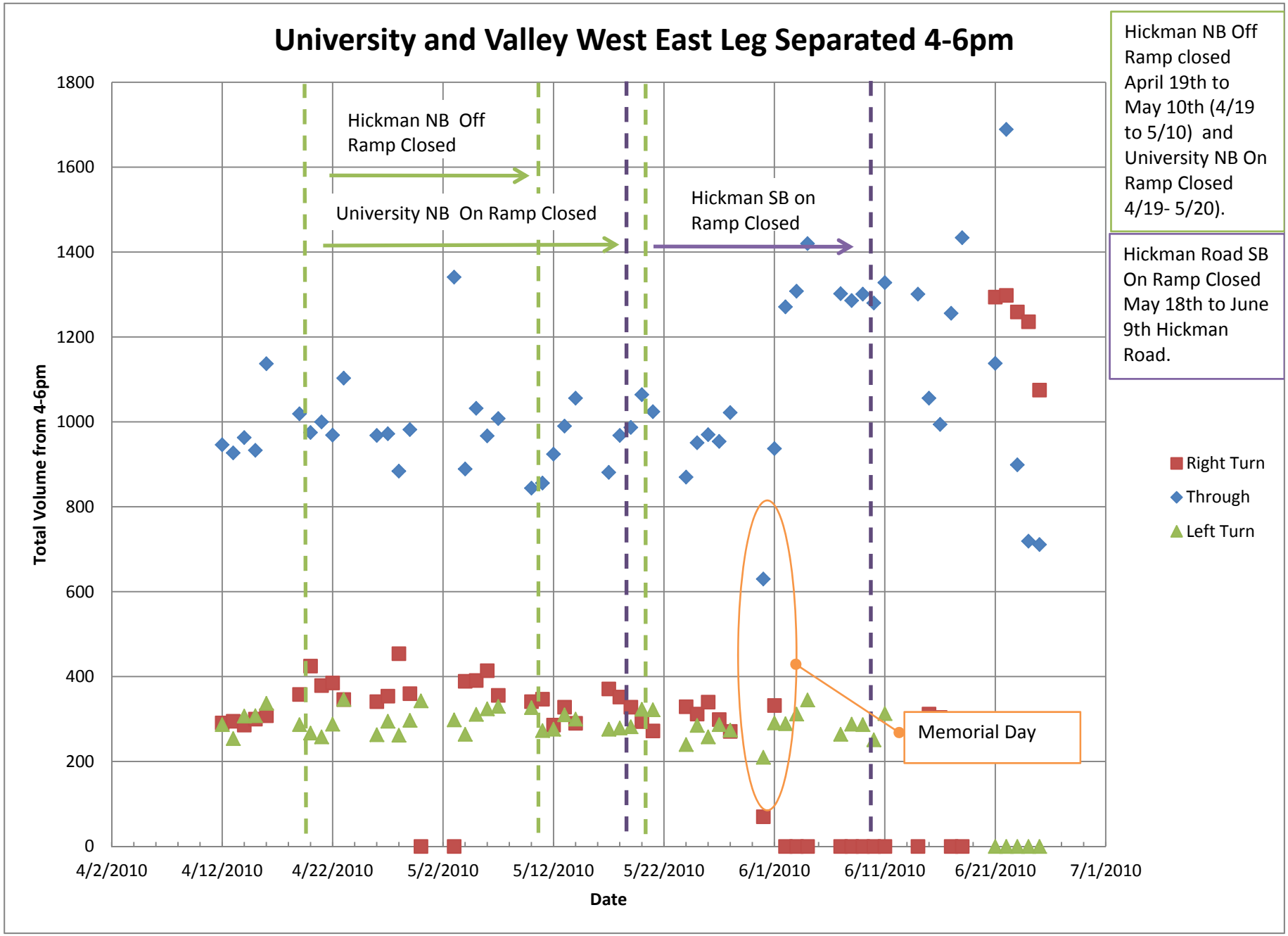

University and Valley West East Leg Separated 7-9am
Hickman NB Off Ramp Closed
University NB On Ramp Closed
Hickman SB on Ramp Closed
Memorial Day
Hickman NB Off Ramp closed April 19th to May 10th (4/19 to 5/10) and University NB On Ramp Closed 4/19- 5/20).
Hickman Road SB On Ramp Closed May 18th to June 9th Hickman Road.
Right Turn
Through
Left Turn
Total Volume from 7-9am
0
200
400
600
800
1000
1200
4/2/2010
4/12/2010
4/22/2010
5/2/2010
5/12/2010
5/22/2010
6/1/2010
6/11/2010
6/21/2010
7/1/2010
Date

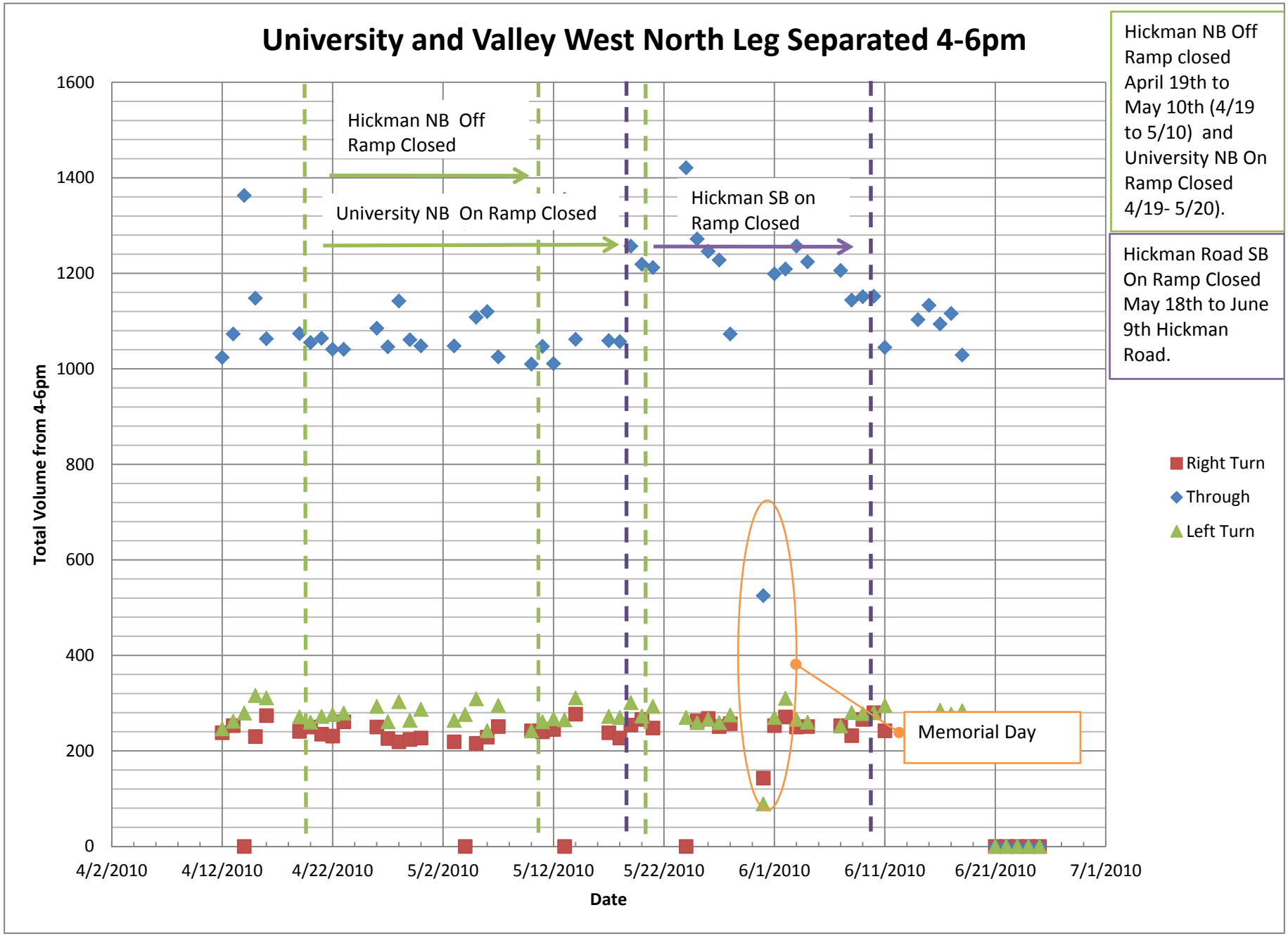

University and Valley West North Leg Separated 7-9am
Hickman NB Off Ramp closed April 19th to May 10th (4/19 to 5/10) and University NB On Ramp Closed 4/19- 5/20).
Hickman Road SB On Ramp Closed May 18th to June 9th Hickman Road.
Hickman NB Off Ramp Closed
University NB On Ramp Closed
Hickman SB on Ramp Closed
Memorial Day
Right Turn
Through
Left Turn
Total Volume from 7-9am
Date
1200
1000
800
600
400
200
0
4/2/2010
4/12/2010
4/22/2010
5/2/2010
5/12/2010
5/22/2010
6/1/2010
6/11/2010
6/21/2010
7/1/2010

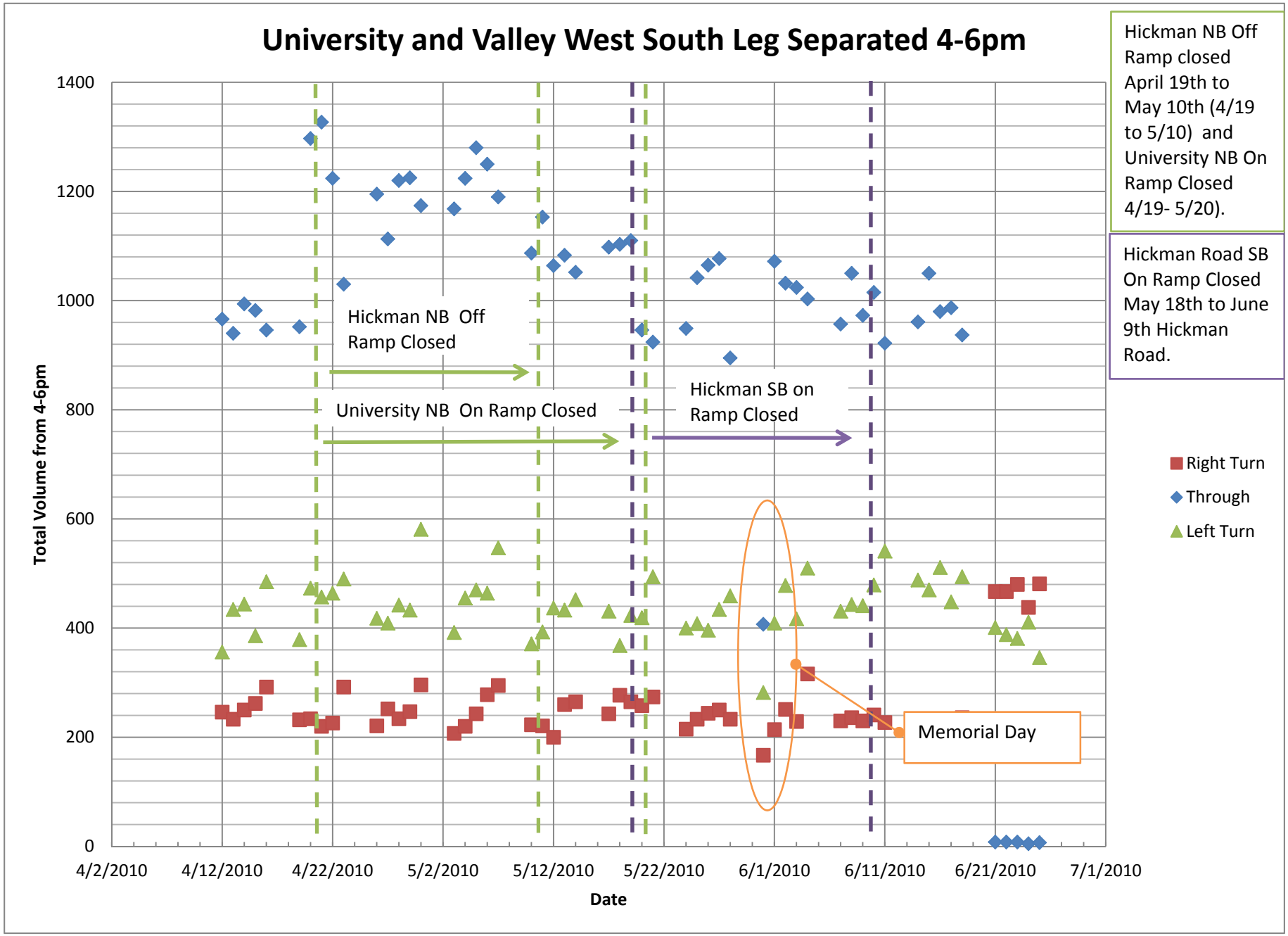

University and Valley West South Leg Separated 7-9am
Hickman NB Off Ramp closed April 19th to May 10th (4/19 to 5/10) and University NB On Ramp Closed 4/19- 5/20).
Hickman Road SB On Ramp Closed May 18th to June 9th Hickman Road.
Hickman NB Off Ramp Closed
University NB On Ramp Closed
Hickman SB on Ramp Closed
Memorial Day
Right Turn
Through
Left Turn
Total Volume from 7-9am
Date
900
800
700
600
500
400
300
200
100
0
4/2/2010
4/12/2010
4/22/2010
5/2/2010
5/12/2010
5/22/2010
6/1/2010
6/11/2010
6/21/2010
7/1/2010

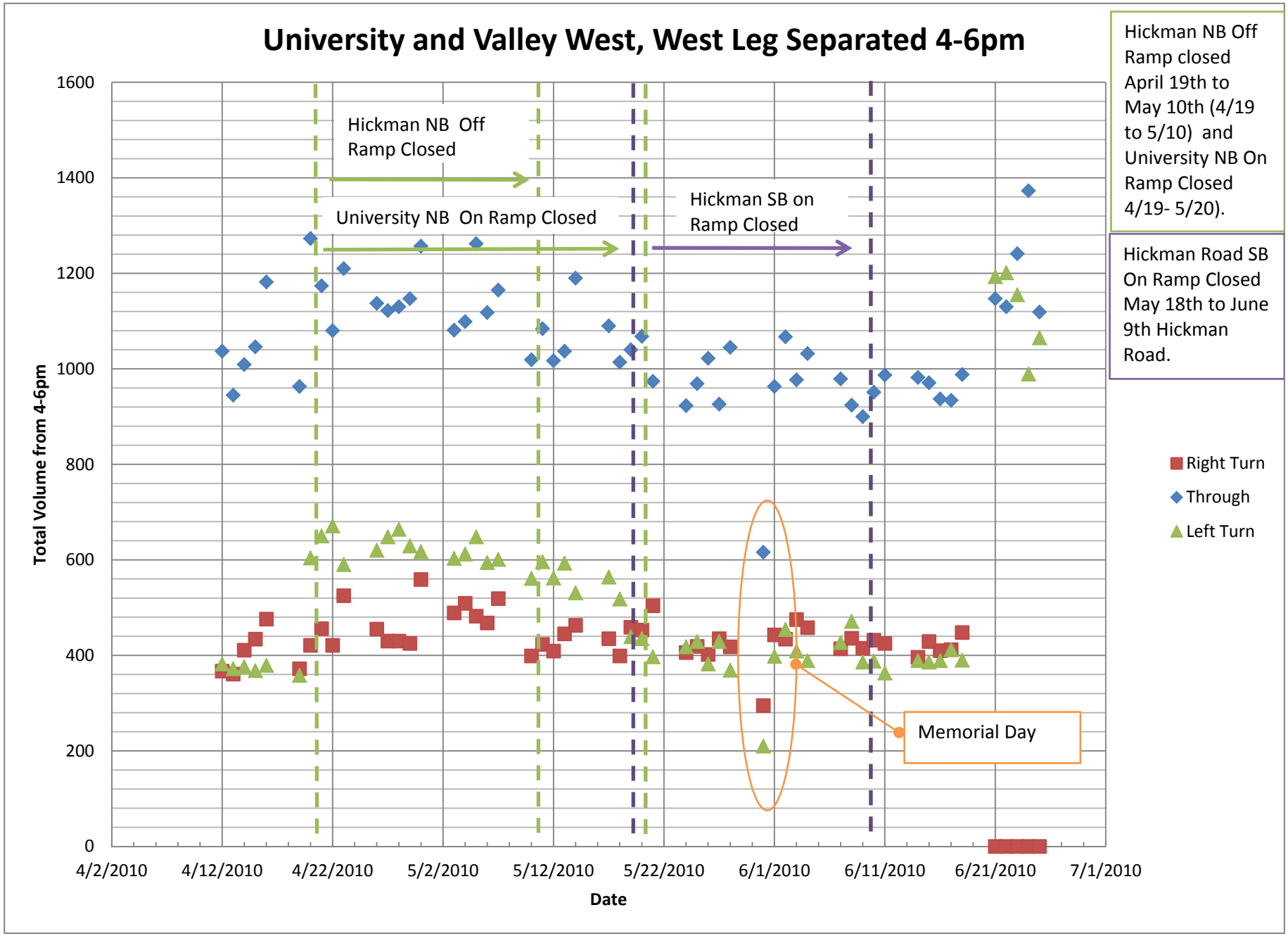

University and Valley West, West Leg Separated 7-9am
Hickman NB Off Ramp closed April 19th to May 10th (4/19 to 5/10) and University NB On Ramp Closed 4/19- 5/20).
Hickman Road SB On Ramp Closed May 18th to June 9th Hickman Road.
Hickman NB Off Ramp Closed
University NB On Ramp Closed
Hickman SB on Ramp Closed
Memorial Day
Right Turn
Through
Left Turn
Total Volume from 7-9am
Date
2000
1800
1600
1400
1200
1000
800
600
400
200
0
4/2/2010
4/12/2010
4/22/2010
5/2/2010
5/12/2010
5/22/2010
6/1/2010
6/11/2010
6/21/2010
7/1/2010

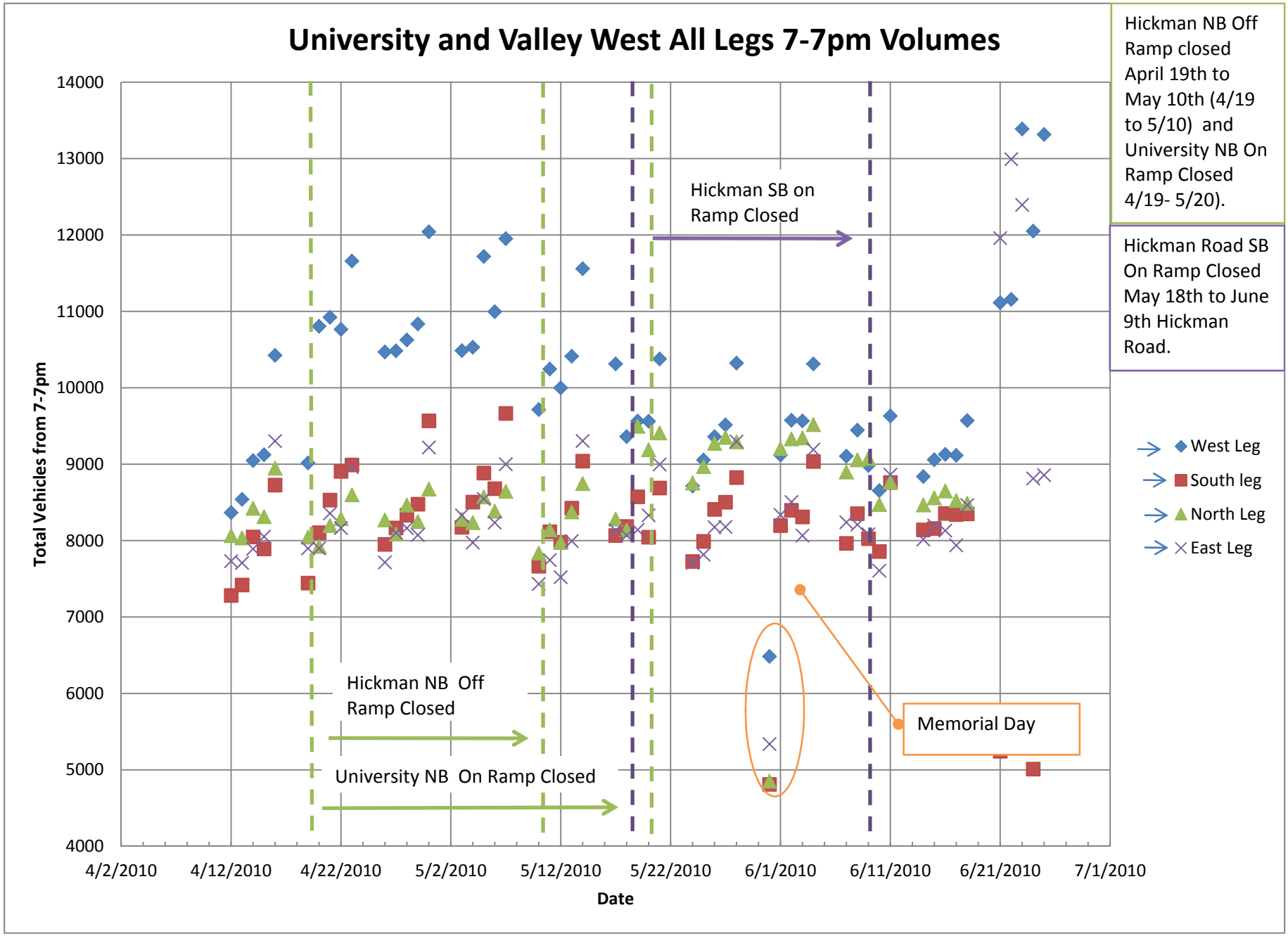

University and Valley West 4-6pm Volumes
Hickman NB Off Ramp closed April 19th to May 10th (4/19 to 5/10) and University NB On Ramp Closed 4/19- 5/20).
Hickman Road SB On Ramp Closed May 18th to June 9th Hickman Road.
Hickman SB on Ramp Closed
Hickman NB Off Ramp Closed
University NB On Ramp Closed
Memorial Day
West Leg
South leg
North Leg
East Leg
Total Vehicles from 4-6pm
2400
2200
2000
1800
1600
1400
4/2/2010
4/12/2010
4/22/2010
5/2/2010
5/12/2010
5/22/2010
6/1/2010
6/11/2010
6/21/2010
7/1/2010
Date

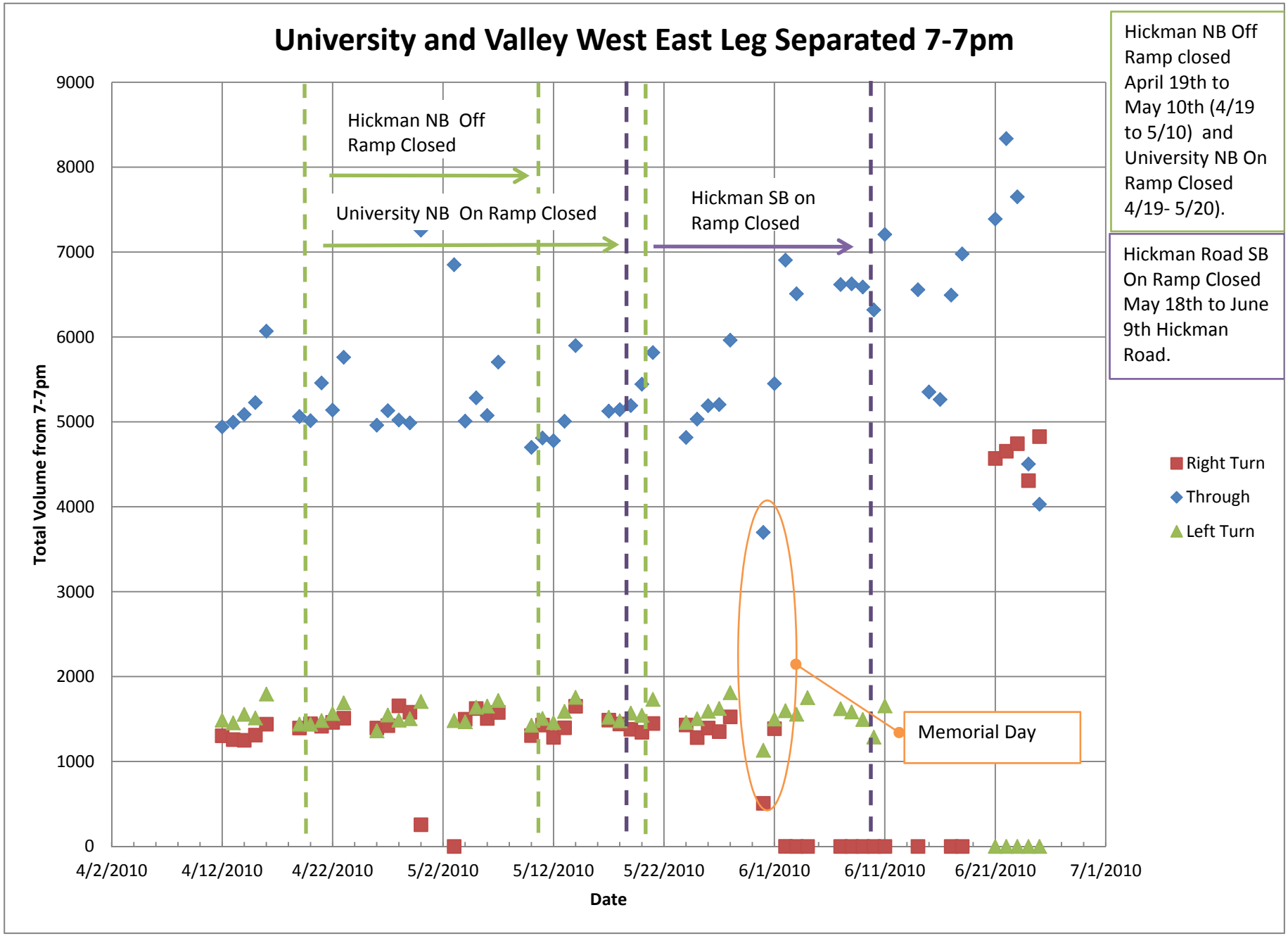

University and Valley West East Leg Separated 4-6pm
Hickman NB Off Ramp closed April 19th to May 10th (4/19 to 5/10) and University NB On Ramp Closed 4/19- 5/20).
Hickman Road SB On Ramp Closed May 18th to June 9th Hickman Road.
Hickman NB Off Ramp Closed
University NB On Ramp Closed
Hickman SB on Ramp Closed
Memorial Day
Right Turn
Through
Left Turn
Total Volume from 4-6pm
Date
1800
1600
1400
1200
1000
800
600
400
200
0
4/2/2010
4/12/2010
4/22/2010
5/2/2010
5/12/2010
5/22/2010
6/1/2010
6/11/2010
6/21/2010
7/1/2010

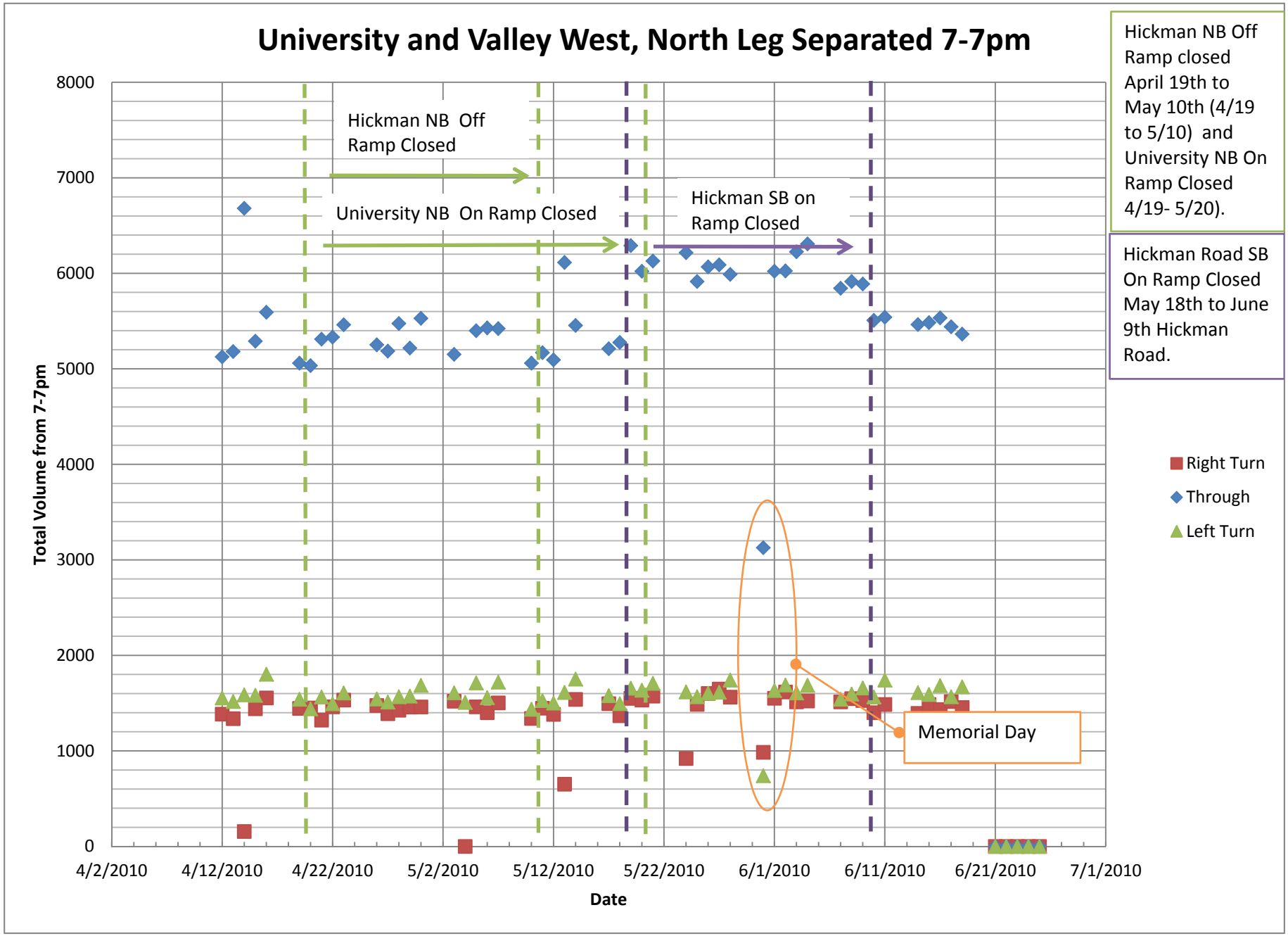

University and Valley West North Leg Separated 4-6pm
Hickman NB Off Ramp Closed
University NB On Ramp Closed
Hickman SB on Ramp Closed
Memorial Day
Hickman NB Off Ramp closed April 19th to May 10th (4/19 to 5/10) and University NB On Ramp Closed 4/19- 5/20).
Hickman Road SB On Ramp Closed May 18th to June 9th Hickman Road.
Right Turn
Through
Left Turn
Total Volume from 4-6pm
Date
0
200
400
600
800
1000
1200
1400
1600
4/2/2010
4/12/2010
4/22/2010
5/2/2010
5/12/2010
5/22/2010
6/1/2010
6/11/2010
6/21/2010
7/1/2010

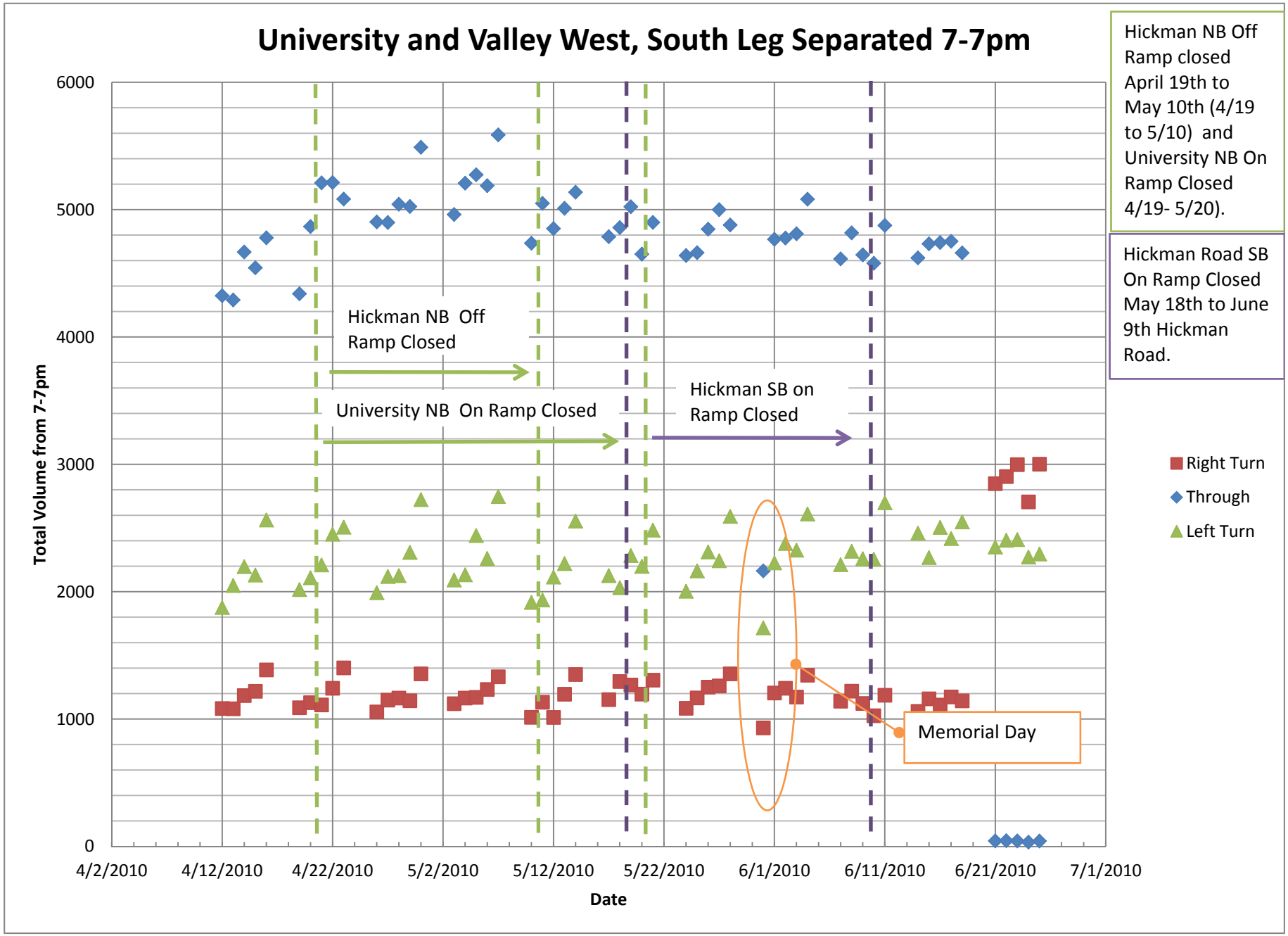

University and Valley West South Leg Separated 4-6pm
Hickman NB Off Ramp closed April 19th to May 10th (4/19 to 5/10) and University NB On Ramp Closed 4/19- 5/20).
Hickman Road SB On Ramp Closed May 18th to June 9th Hickman Road.
Total Volume from 4-6pm
1400
1200
1000
800
600
400
200
0
Hickman NB Off Ramp Closed
University NB On Ramp Closed
Hickman SB on Ramp Closed
Memorial Day
Right Turn
Through
Left Turn
4/2/2010
4/12/2010
4/22/2010
5/2/2010
5/12/2010
5/22/2010
6/1/2010
6/11/2010
6/21/2010
7/1/2010
Date

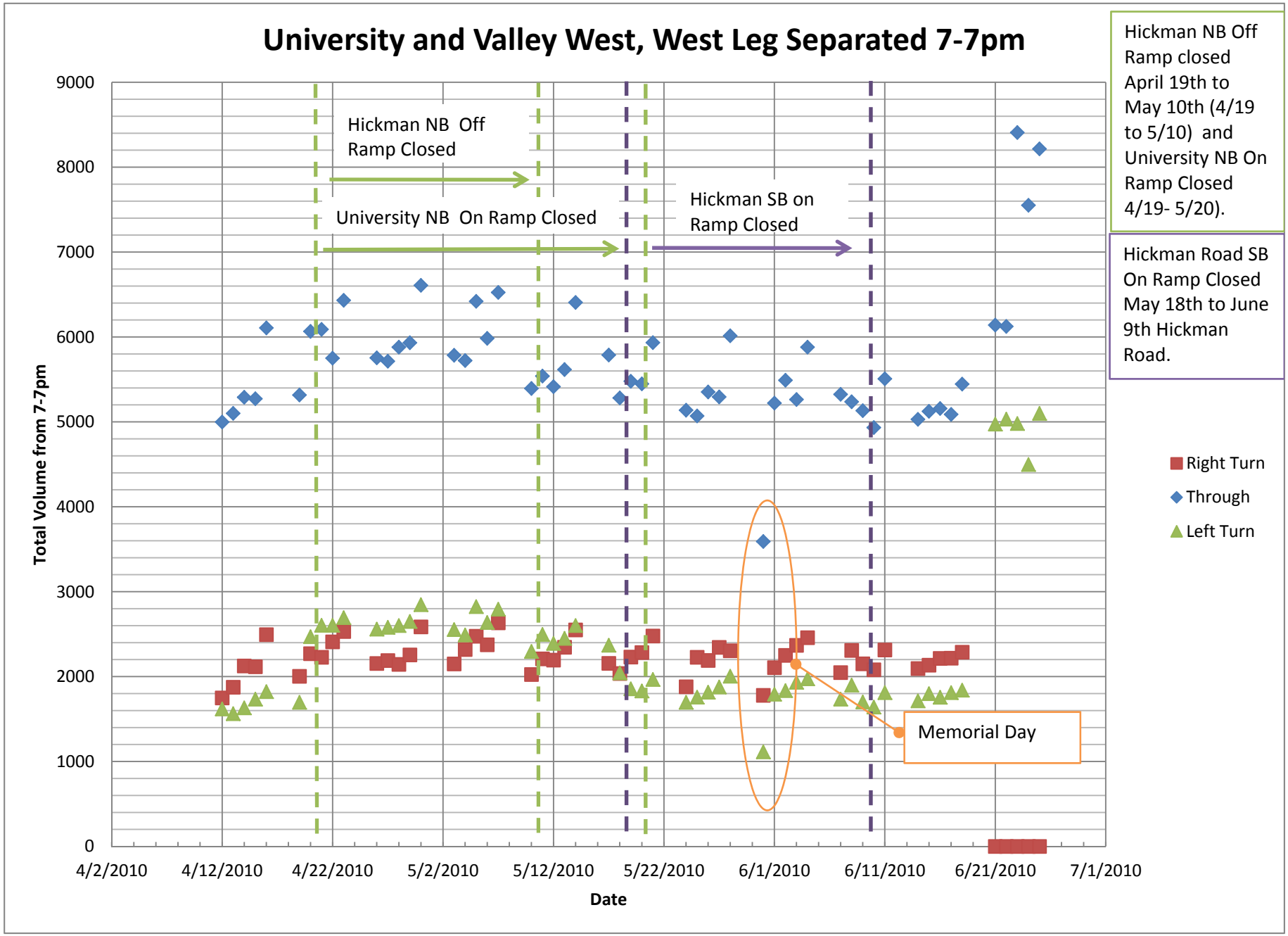

University and Valley West, West Leg Separated 4-6pm
Hickman NB Off Ramp closed April 19th to May 10th (4/19 to 5/10) and University NB On Ramp Closed 4/19- 5/20).
Hickman Road SB On Ramp Closed May 18th to June 9th Hickman Road.
Hickman NB Off Ramp Closed
University NB On Ramp Closed
Hickman SB on Ramp Closed
Memorial Day
Right Turn
Through
Left Turn
Total Volume from 4-6pm
Date
1600
1400
1200
1000
800
600
400
200
0
4/2/2010
4/12/2010
4/22/2010
5/2/2010
5/12/2010
5/22/2010
6/1/2010
6/11/2010
6/21/2010
7/1/2010


University and Valley West All Legs 7-7pm Volumes
Total Vehicles from 7-7pm
14000
13000
12000
11000
10000
9000
8000
7000
6000
5000
4000
4/2/2010
4/12/2010
4/22/2010
5/2/2010
5/12/2010
5/22/2010
6/1/2010
6/11/2010
6/21/2010
7/1/2010
Date
Hickman SB on Ramp Closed
Hickman NB Off Ramp closed April 19th to May 10th (4/19 to 5/10) and University NB On Ramp Closed 4/19- 5/20).
Hickman Road SB On Ramp Closed May 18th to June 9th Hickman Road.
Hickman NB Off Ramp Closed
University NB On Ramp Closed
Memorial Day
West Leg
South leg
North Leg
East Leg


University and Valley West East Leg Separated 7-7pm
Hickman NB Off Ramp Closed
University NB On Ramp Closed
Hickman SB on Ramp Closed
Memorial Day
Hickman NB Off Ramp closed April 19th to May 10th (4/19 to 5/10) and University NB On Ramp Closed 4/19- 5/20).
Hickman Road SB On Ramp Closed May 18th to June 9th Hickman Road.
Right Turn
Through
Left Turn
Total Volume from 7-7pm
9000
8000
7000
6000
5000
4000
3000
2000
1000
0
4/2/2010
4/12/2010
4/22/2010
5/2/2010
5/12/2010
5/22/2010
6/1/2010
6/11/2010
6/21/2010
7/1/2010
Date

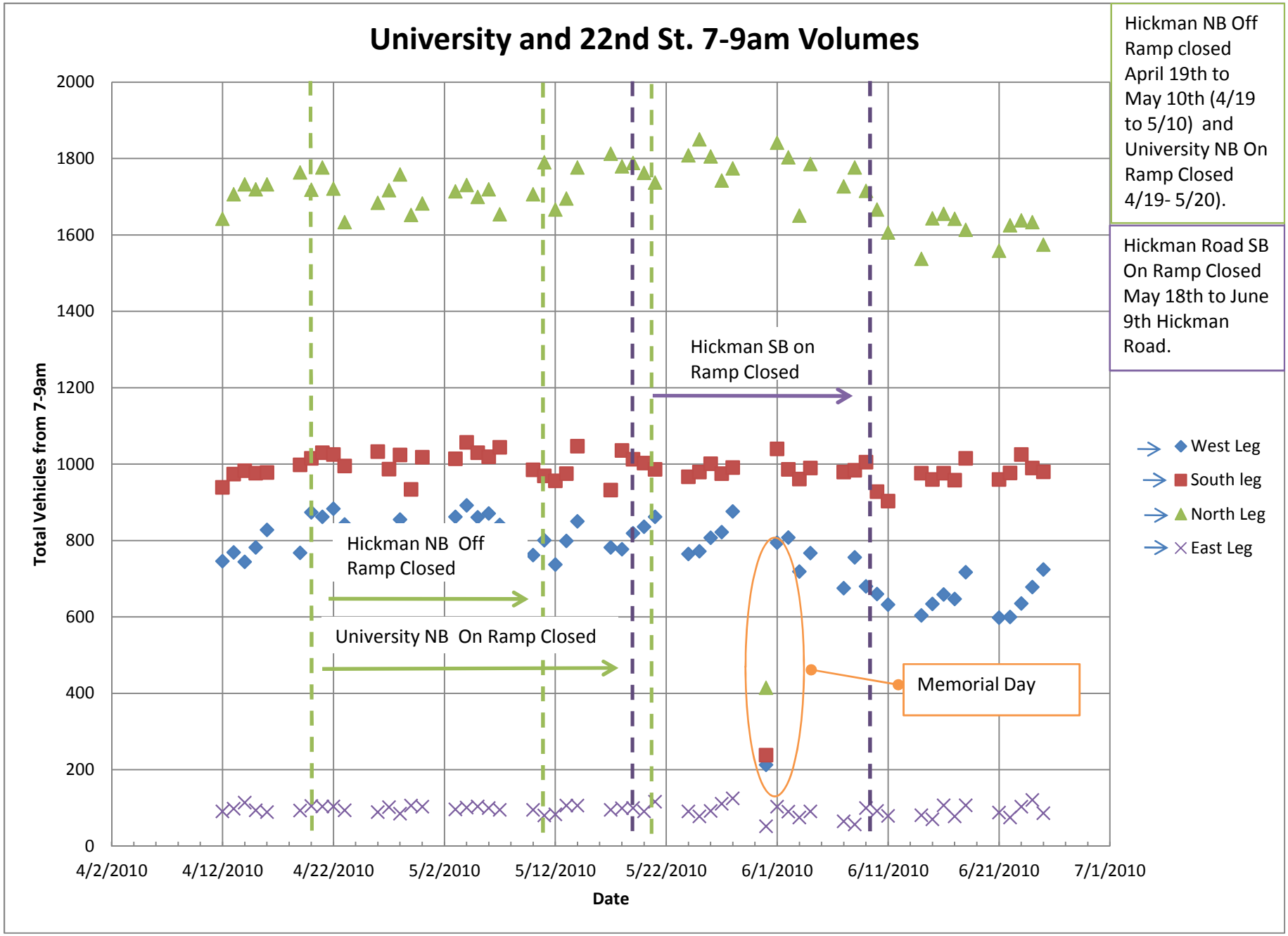

University and Valley West, North Leg Separated 7-7pm
Hickman NB Off Ramp Closed
University NB On Ramp Closed
Hickman SB on Ramp Closed
Memorial Day
Hickman NB Off Ramp closed April 19th to May 10th (4/19 to 5/10) and University NB On Ramp Closed 4/19- 5/20).
Hickman Road SB On Ramp Closed May 18th to June 9th Hickman Road.
Right Turn
Through
Left Turn
Total Volume from 7-7pm
8000
7000
6000
5000
4000
3000
2000
1000
0
4/2/2010
4/12/2010
4/22/2010
5/2/2010
5/12/2010
5/22/2010
6/1/2010
6/11/2010
6/21/2010
7/1/2010
Date

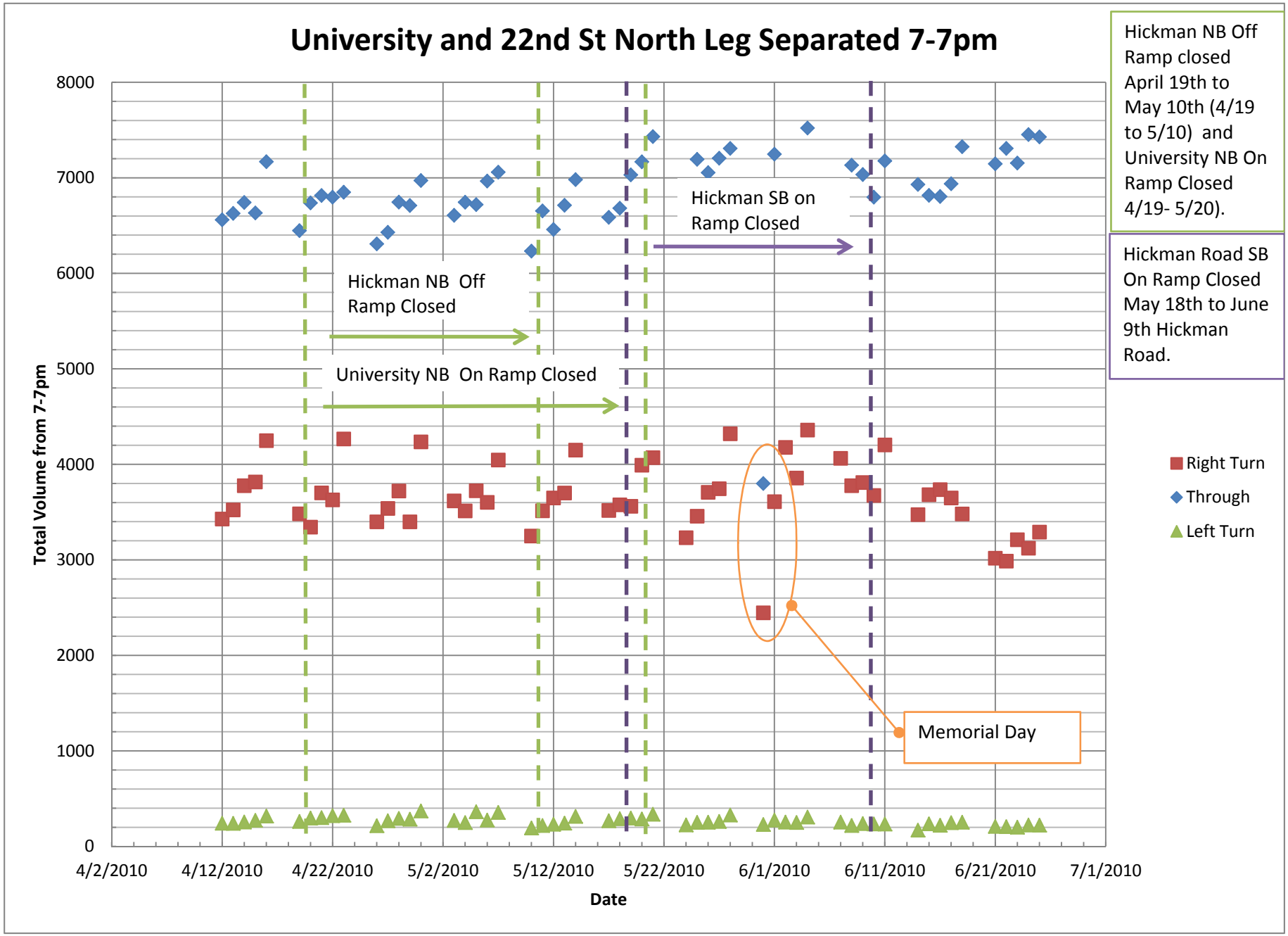

University and Valley West, South Leg Separated 7-7pm
Hickman NB Off Ramp closed April 19th to May 10th (4/19 to 5/10) and University NB On Ramp Closed 4/19- 5/20).
Hickman Road SB On Ramp Closed May 18th to June 9th Hickman Road.
Hickman NB Off Ramp Closed
University NB On Ramp Closed
Hickman SB on Ramp Closed
Memorial Day
Right Turn
Through
Left Turn
Total Volume from 7-7pm
Date
6000
5000
4000
3000
2000
1000
0
4/2/2010
4/12/2010
4/22/2010
5/2/2010
5/12/2010
5/22/2010
6/1/2010
6/11/2010
6/21/2010
7/1/2010

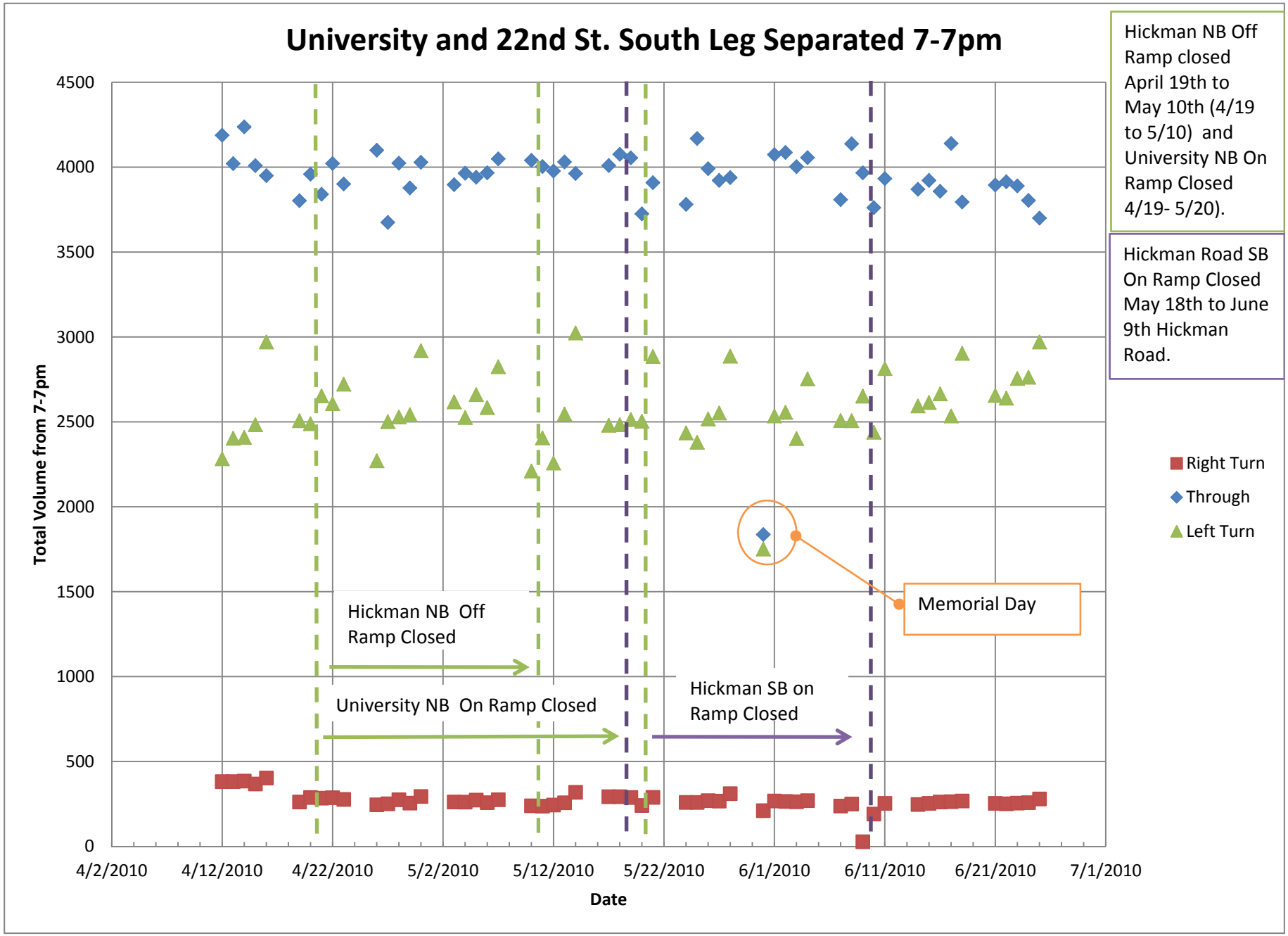

University and Valley West, West Leg Separated 7-7pm
Hickman NB Off Ramp closed April 19th to May 10th (4/19 to 5/10) and University NB On Ramp Closed 4/19- 5/20).
Hickman Road SB On Ramp Closed May 18th to June 9th Hickman Road.
Hickman NB Off Ramp Closed
University NB On Ramp Closed
Hickman SB on Ramp Closed
Memorial Day
Right Turn
Through
Left Turn
Total Volume from 7-7pm
Date
9000
8000
7000
6000
5000
4000
3000
2000
1000
0
4/2/2010
4/12/2010
4/22/2010
5/2/2010
5/12/2010
5/22/2010
6/1/2010
6/11/2010
6/21/2010
7/1/2010

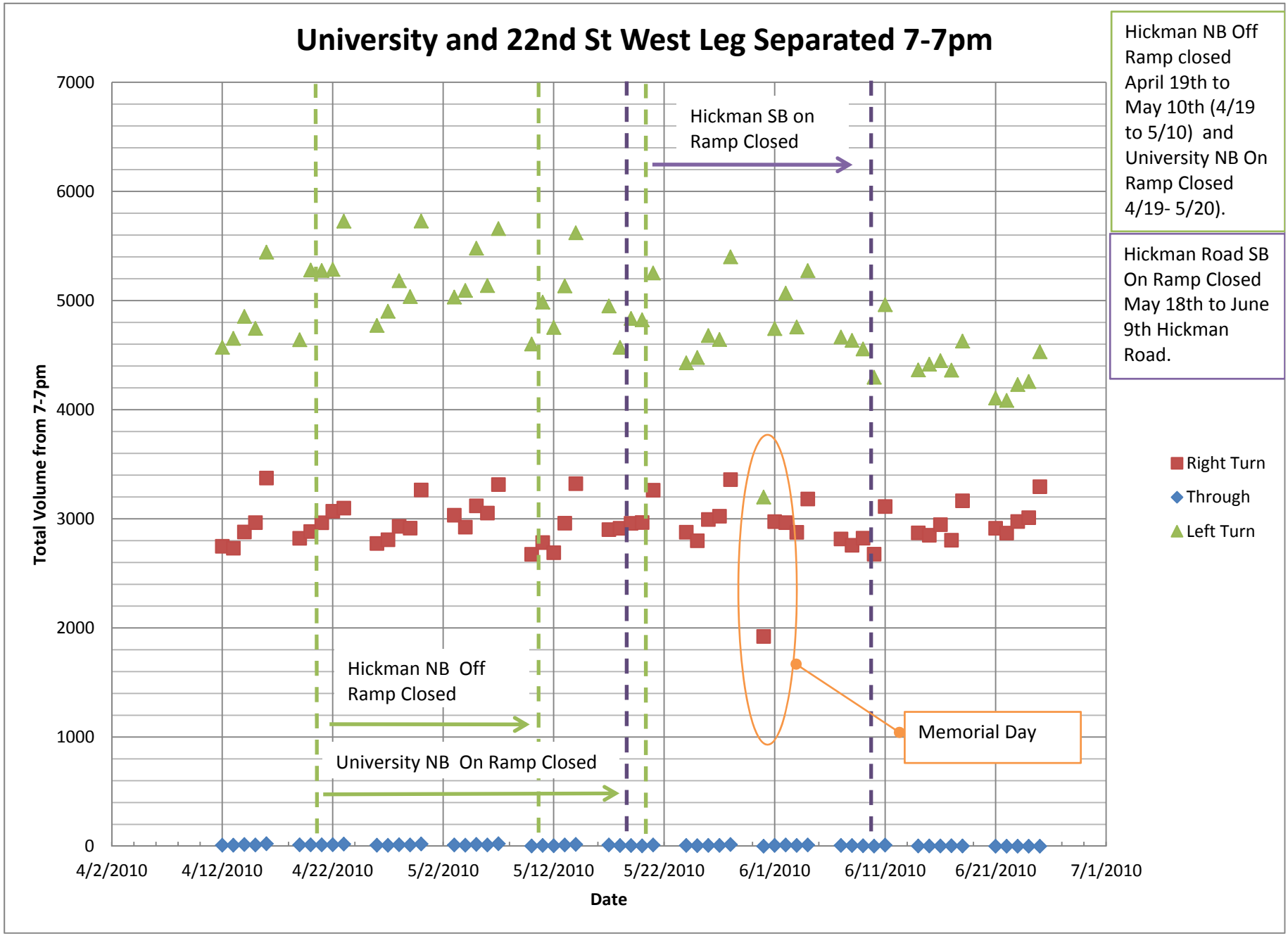
B.2 Intersection Traffic-Volume Changes

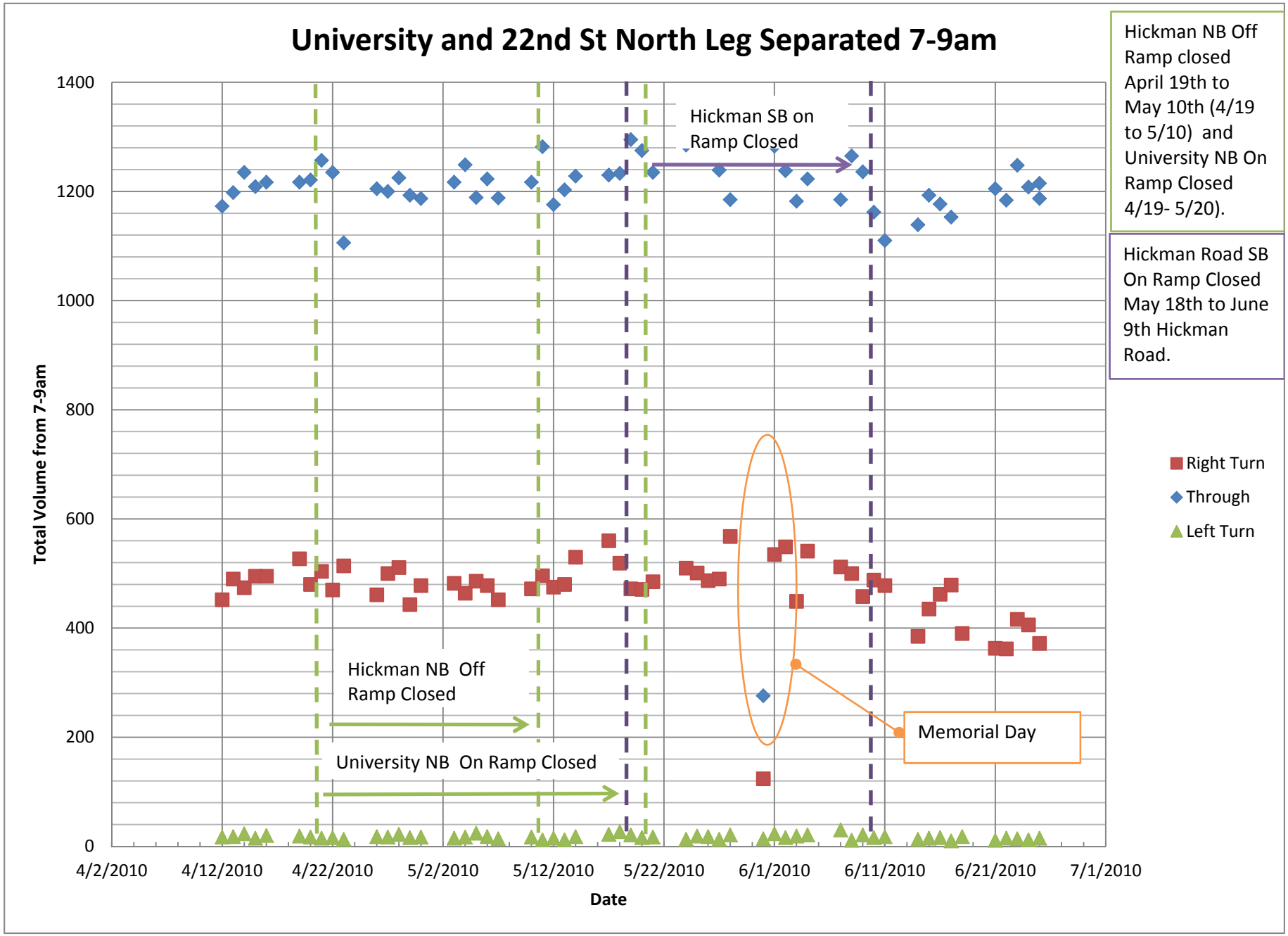
22nd Street and University Avenue

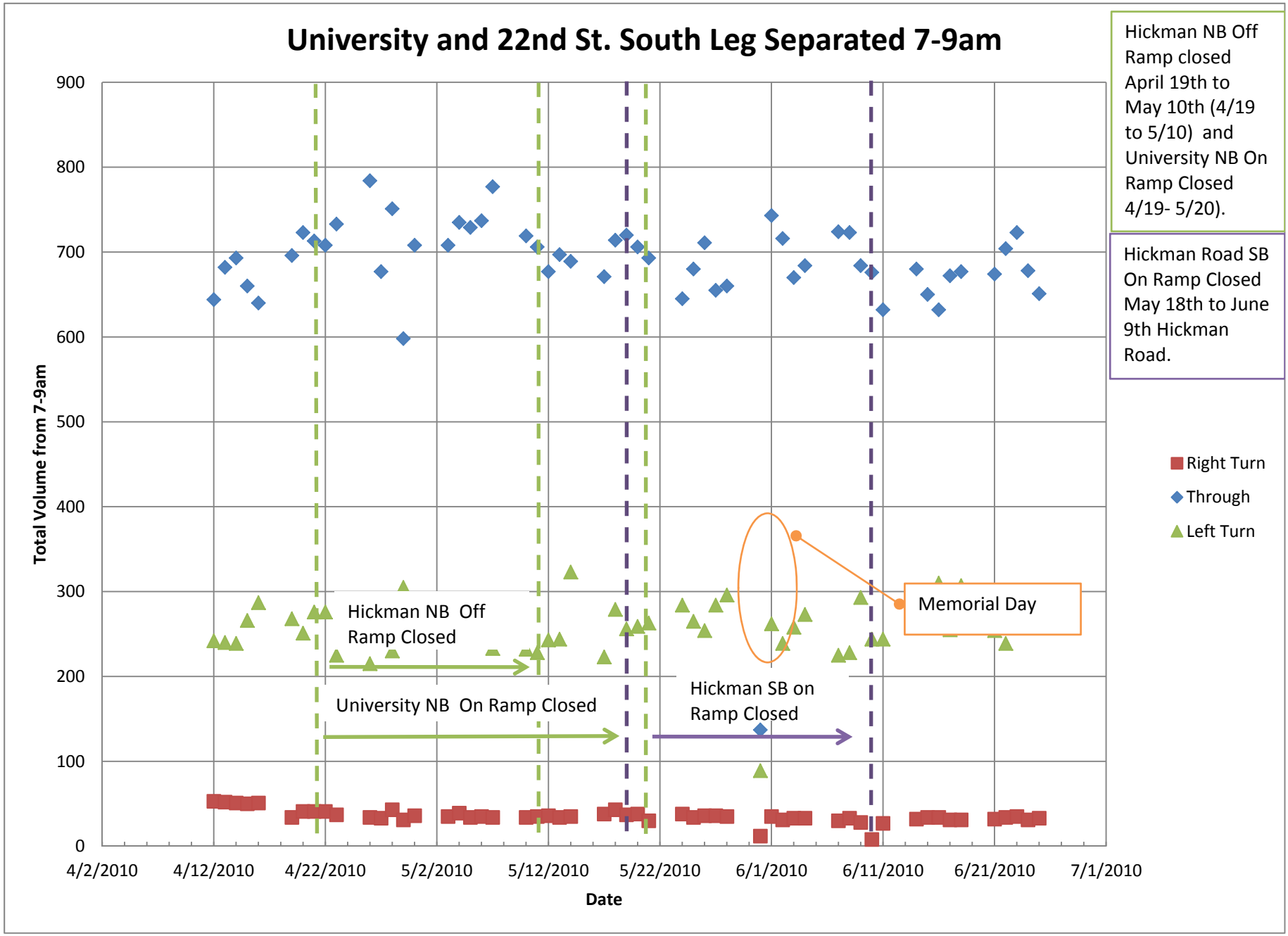

University and 22nd St. 7-9am Volumes
Hickman NB Off Ramp closed April 19th to May 10th (4/19 to 5/10) and University NB On Ramp Closed 4/19- 5/20).
Hickman Road SB On Ramp Closed May 18th to June 9th Hickman Road.
Total Vehicles from 7-9am
2000
1800
1600
1400
1200
1000
800
600
400
200
0
4/2/2010
4/12/2010
4/22/2010
5/2/2010
5/12/2010
5/22/2010
6/1/2010
6/11/2010
6/21/2010
7/1/2010
Date
Hickman SB on Ramp Closed
Hickman NB Off Ramp Closed
University NB On Ramp Closed
Memorial Day
West Leg
South leg
North Leg
East Leg

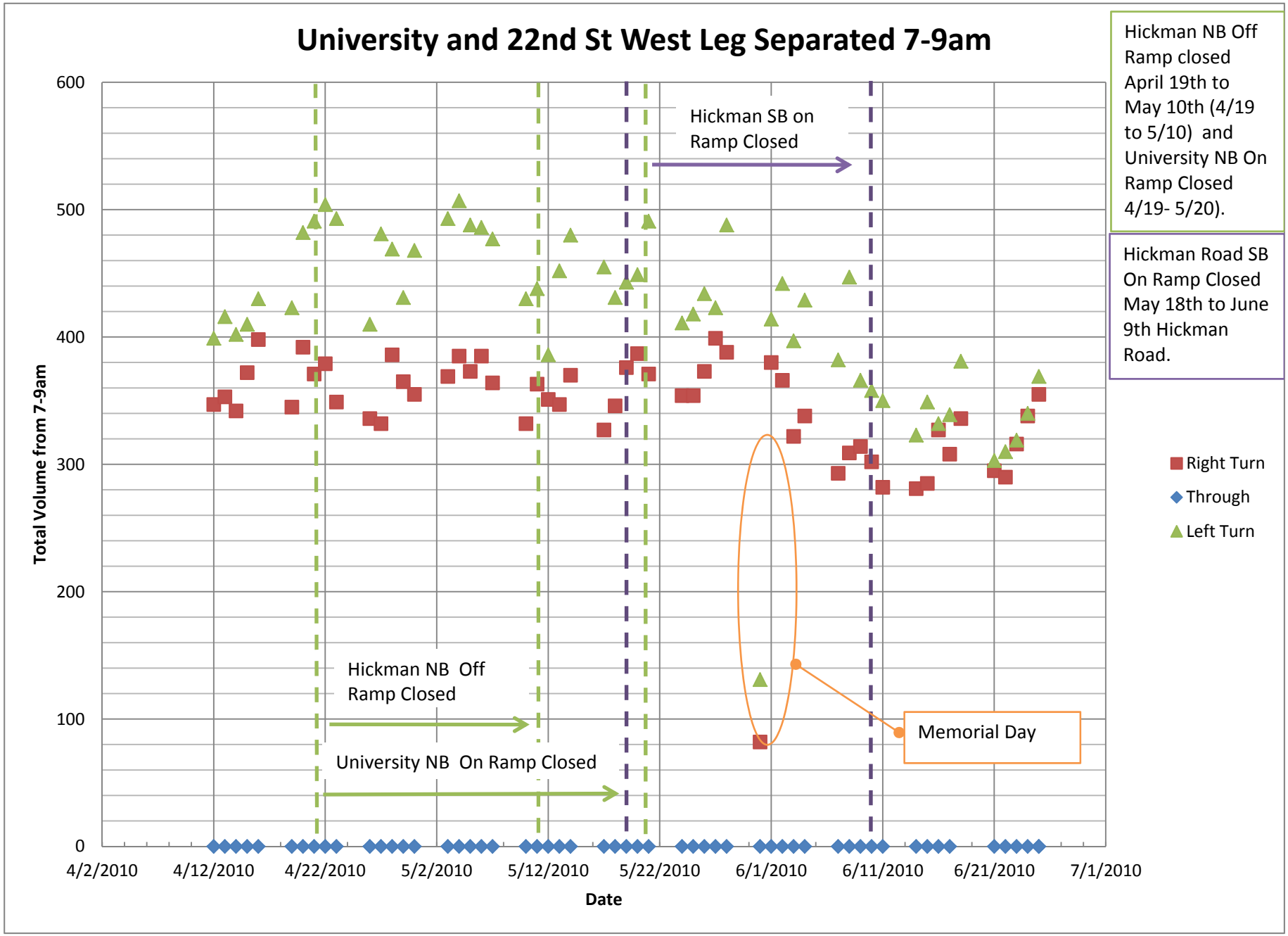

University and 22nd St North Leg Separated 7-7pm
Hickman NB Off Ramp closed April 19th to May 10th (4/19 to 5/10) and University NB On Ramp Closed 4/19- 5/20).
Hickman Road SB On Ramp Closed May 18th to June 9th Hickman Road.
Hickman SB on Ramp Closed
Hickman NB Off Ramp Closed
University NB On Ramp Closed
Memorial Day
Right Turn
Through
Left Turn
Total Volume from 7-7pm
Date
8000
7000
6000
5000
4000
3000
2000
1000
0
4/2/2010
4/12/2010
4/22/2010
5/2/2010
5/12/2010
5/22/2010
6/1/2010
6/11/2010
6/21/2010
7/1/2010

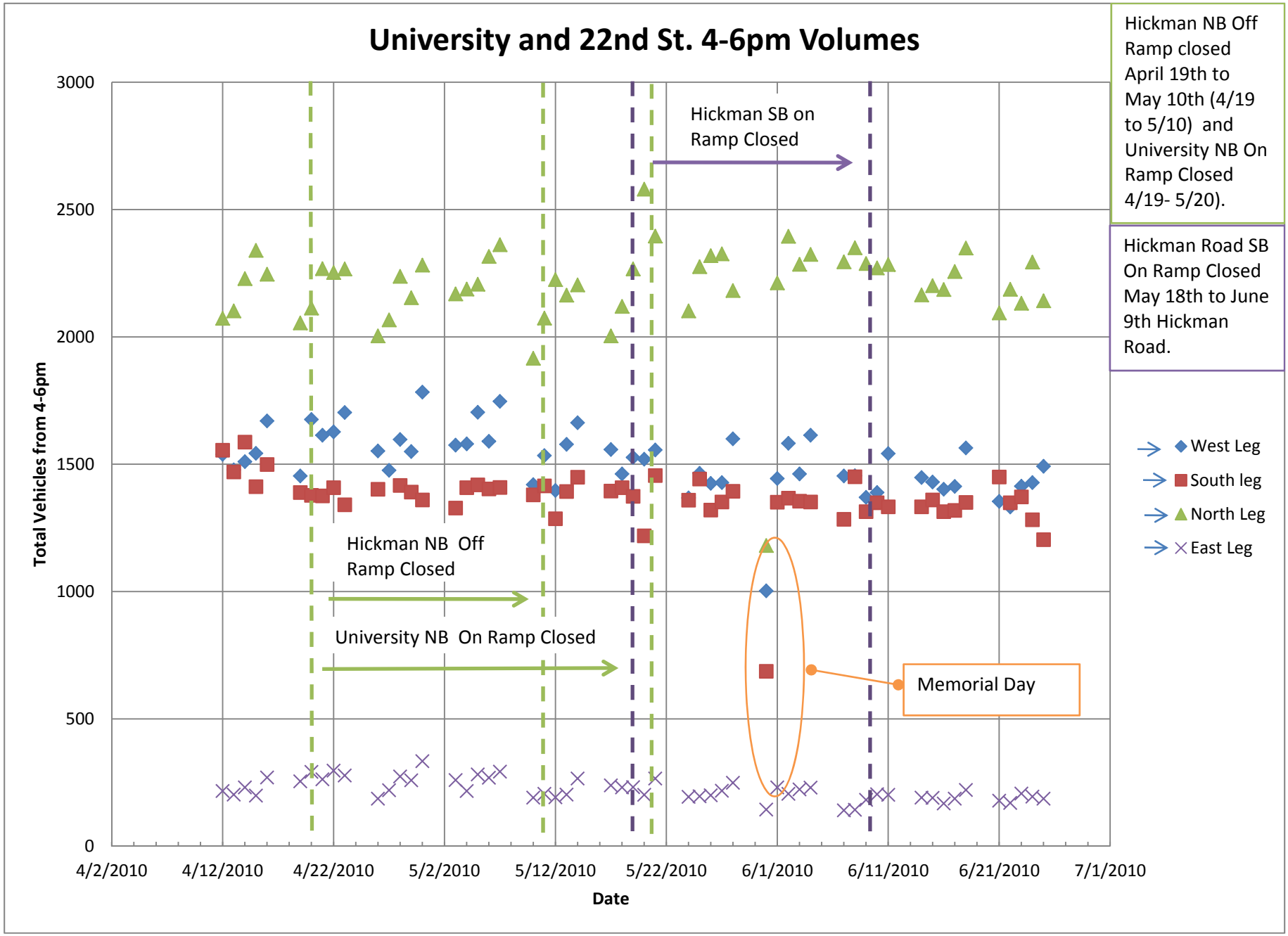

University and 22nd St. South Leg Separated 7-7pm
Total Volume from 7-7pm
4500
4000
3500
3000
2500
2000
1500
1000
500
0
4/2/2010
4/12/2010
4/22/2010
5/2/2010
5/12/2010
5/22/2010
6/1/2010
6/11/2010
6/21/2010
7/1/2010
Date
Hickman NB Off Ramp closed April 19th to May 10th (4/19 to 5/10) and University NB On Ramp Closed 4/19- 5/20).
Hickman Road SB On Ramp Closed May 18th to June 9th Hickman Road.
Right Turn
Through
Left Turn
Memorial Day
Hickman NB Off Ramp Closed
University NB On Ramp Closed
Hickman SB on Ramp Closed

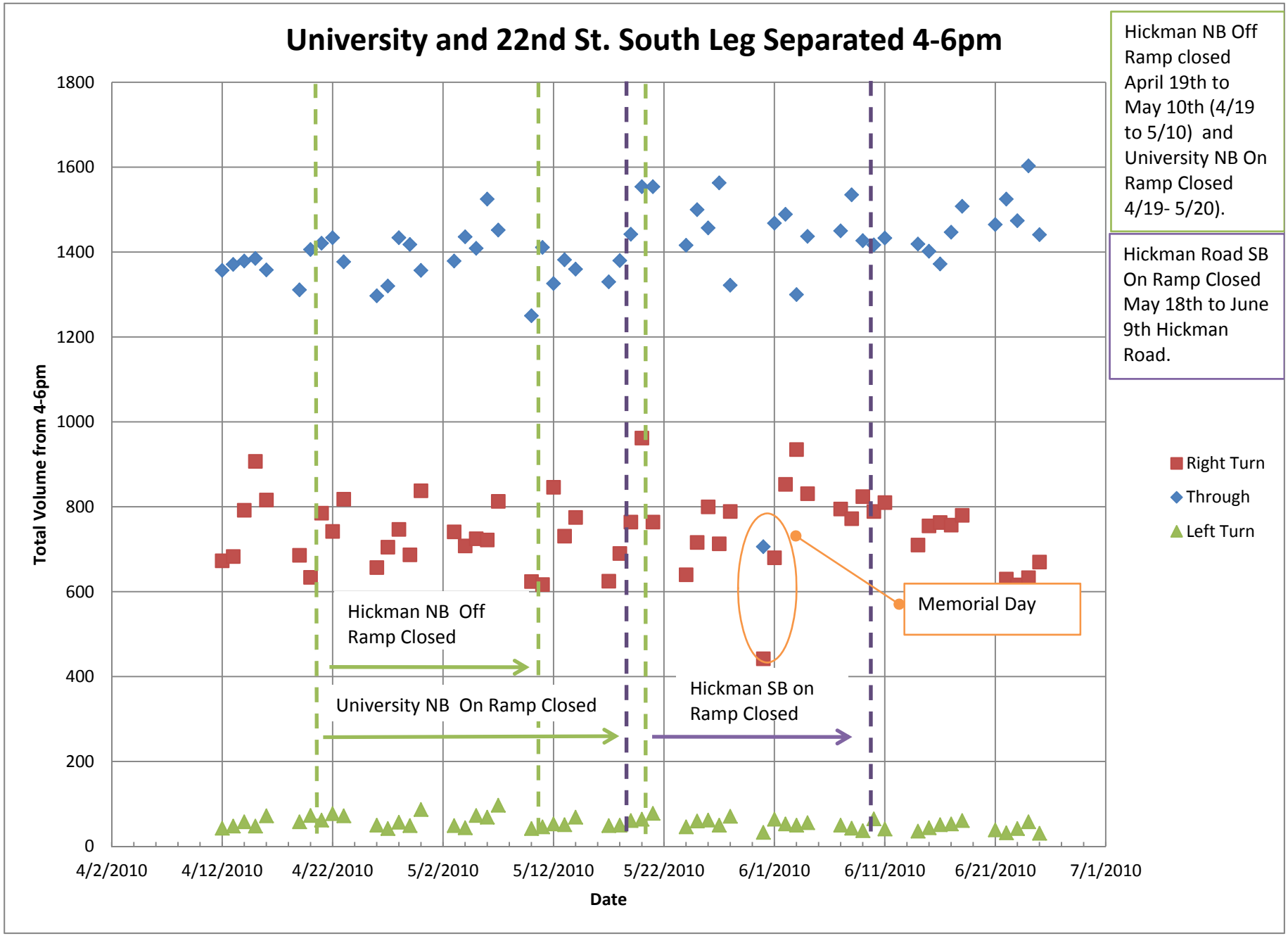

University and 22nd St West Leg Separated 7-7pm
Hickman NB Off Ramp closed April 19th to May 10th (4/19 to 5/10) and University NB On Ramp Closed 4/19- 5/20).
Hickman Road SB On Ramp Closed May 18th to June 9th Hickman Road.
Hickman SB on Ramp Closed
Hickman NB Off Ramp Closed
University NB On Ramp Closed
Memorial Day
Right Turn
Through
Left Turn
Total Volume from 7-7pm
Date
7000
6000
5000
4000
3000
2000
1000
0
4/2/2010
4/12/2010
4/22/2010
5/2/2010
5/12/2010
5/22/2010
6/1/2010
6/11/2010
6/21/2010
7/1/2010

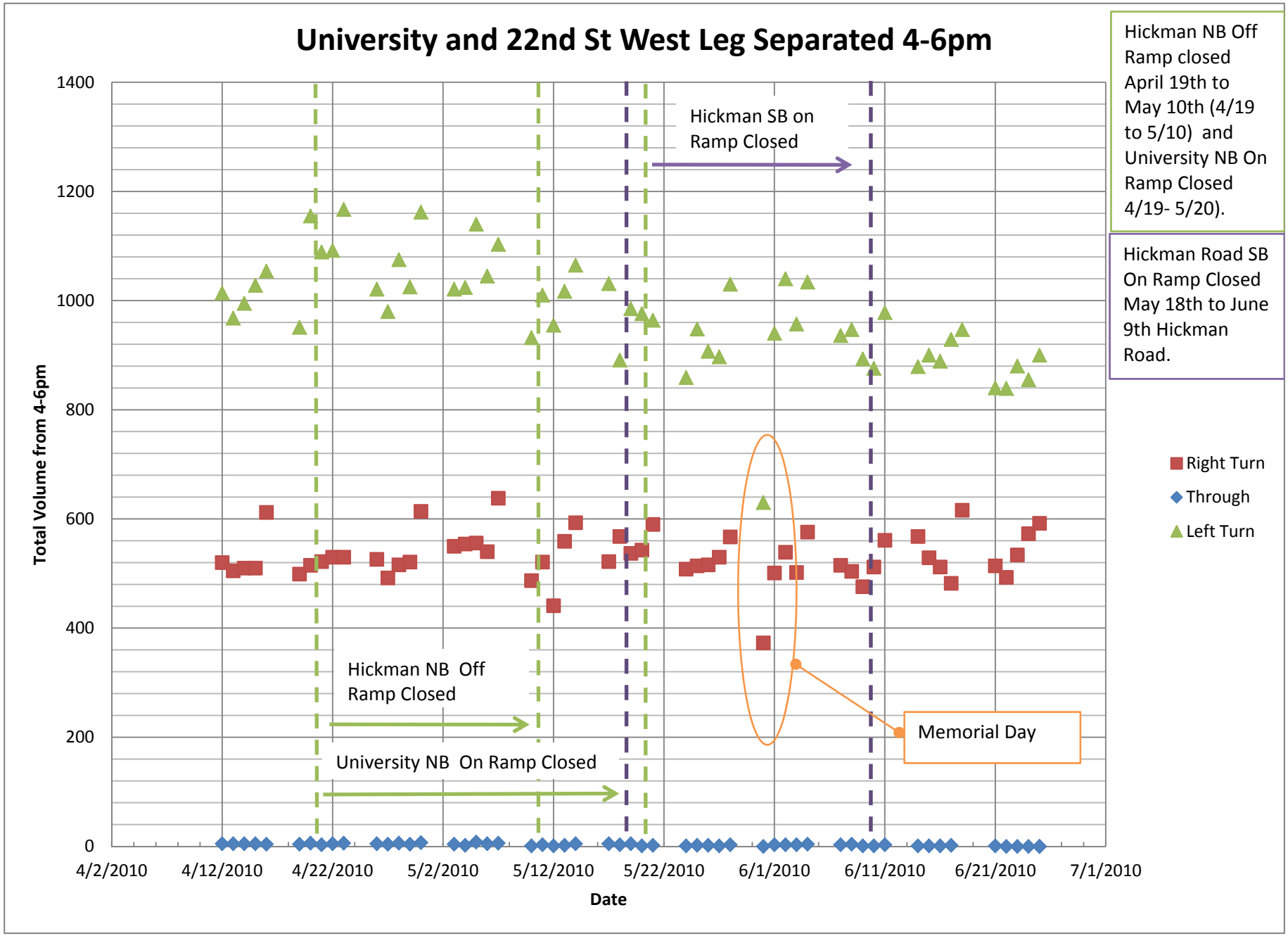

University and 22nd St North Leg Separated 7-9am
Hickman NB Off Ramp closed April 19th to May 10th (4/19 to 5/10) and University NB On Ramp Closed 4/19- 5/20).
Hickman Road SB On Ramp Closed May 18th to June 9th Hickman Road.
Hickman SB on Ramp Closed
Hickman NB Off Ramp Closed
University NB On Ramp Closed
Memorial Day
Right Turn
Through
Left Turn
Total Volume from 7-9am
Date
1400
1200
1000
800
600
400
200
0
4/2/2010
4/12/2010
4/22/2010
5/2/2010
5/12/2010
5/22/2010
6/1/2010
6/11/2010
6/21/2010
7/1/2010

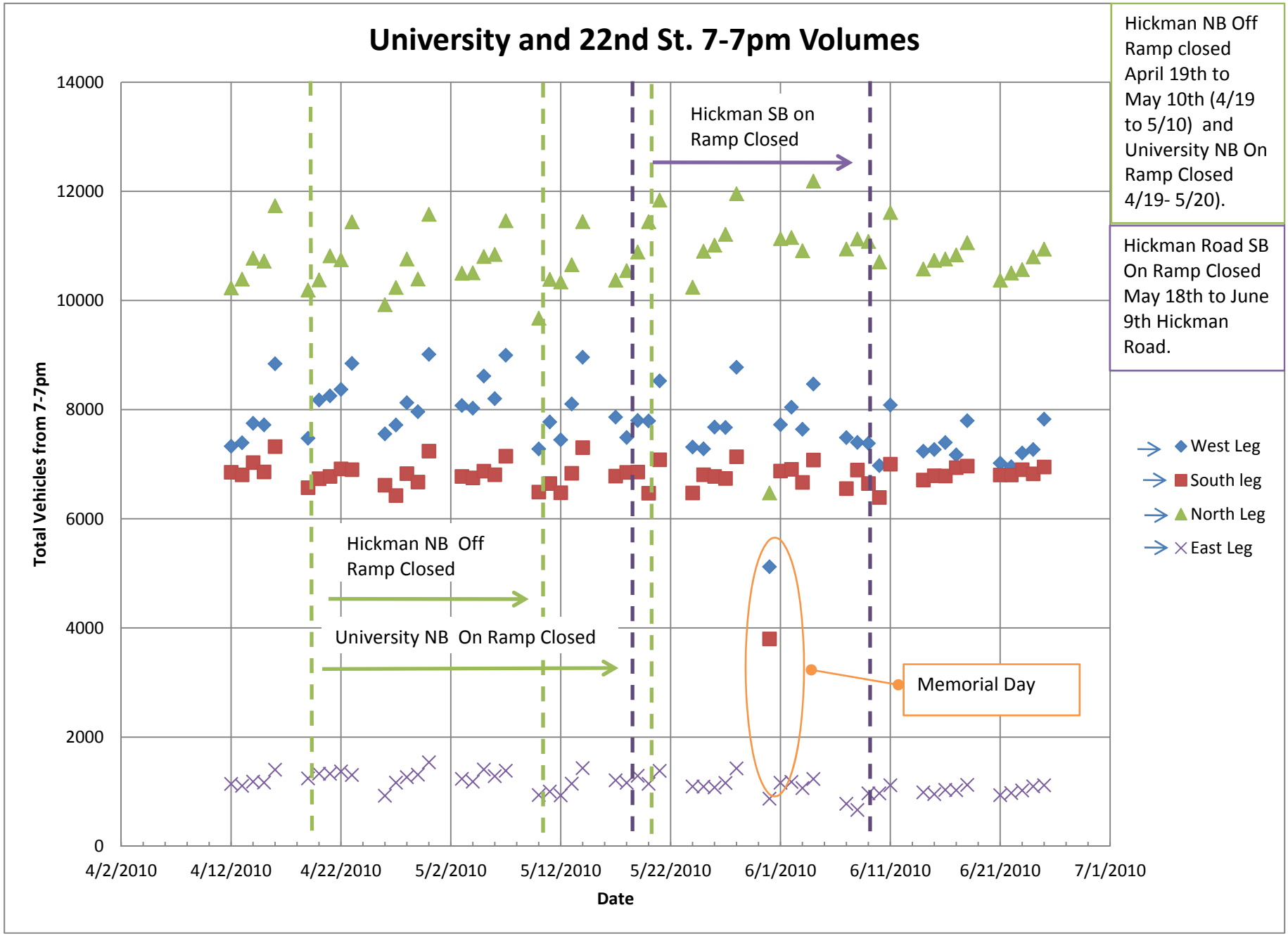

University and 22nd St. South Leg Separated 7-9am
Total Volume from 7-9am
900
800
700
600
500
400
300
200
100
0
4/2/2010
4/12/2010
4/22/2010
5/2/2010
5/12/2010
5/22/2010
6/1/2010
6/11/2010
6/21/2010
7/1/2010
Date
Hickman NB Off Ramp closed April 19th to May 10th (4/19 to 5/10) and University NB On Ramp Closed 4/19- 5/20).
Hickman Road SB On Ramp Closed May 18th to June 9th Hickman Road.
Right Turn
Through
Left Turn
Hickman NB Off Ramp Closed
University NB On Ramp Closed
Hickman SB on Ramp Closed
Memorial Day

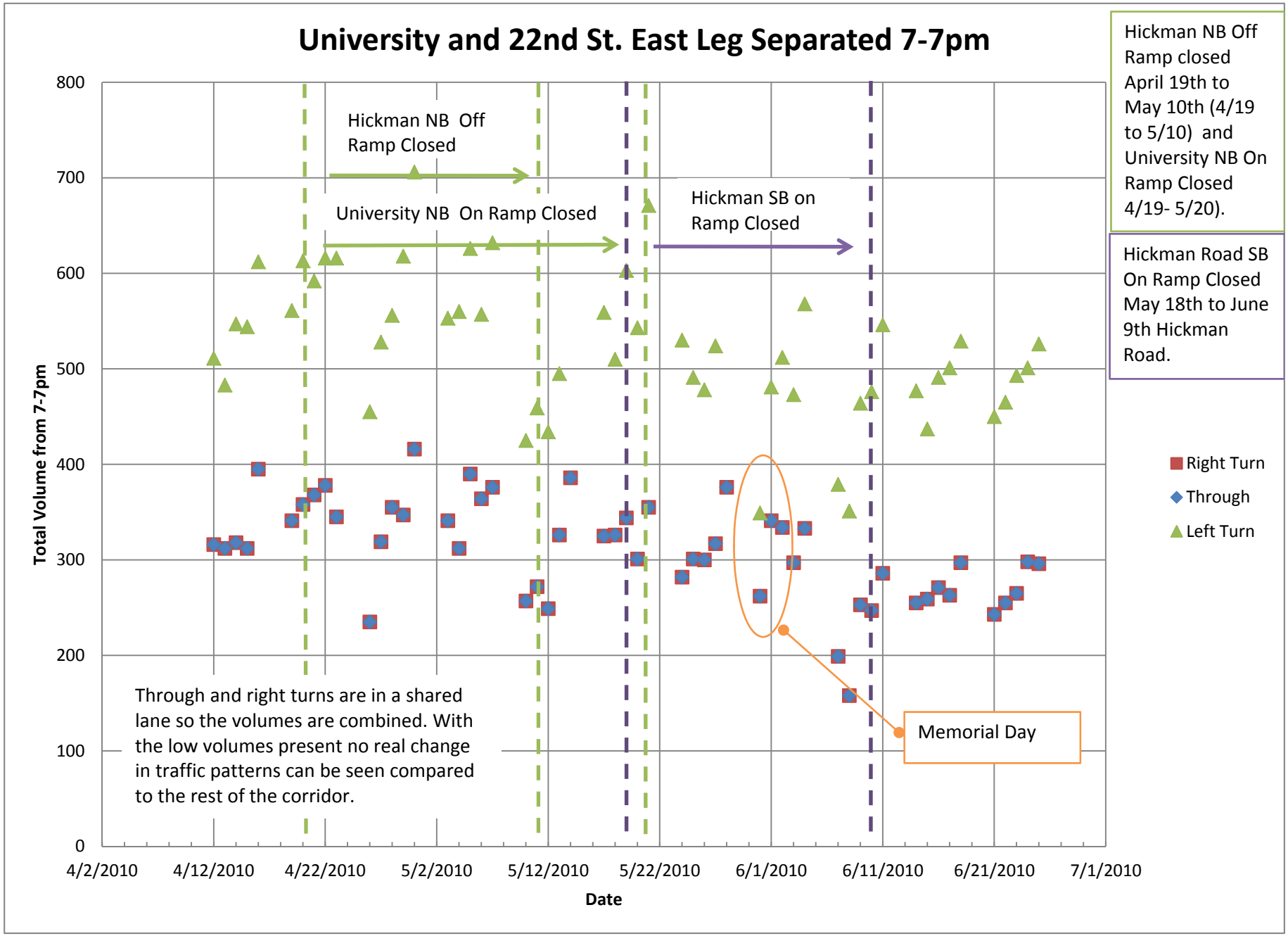

University and 22nd St West Leg Separated 7-9am
Hickman NB Off Ramp closed April 19th to May 10th (4/19 to 5/10) and University NB On Ramp Closed 4/19- 5/20).
Hickman Road SB On Ramp Closed May 18th to June 9th Hickman Road.
Hickman SB on Ramp Closed
Hickman NB Off Ramp Closed
University NB On Ramp Closed
Memorial Day
Right Turn
Through
Left Turn
Total Volume from 7-9am
Date
600
500
400
300
200
100
0
4/2/2010
4/12/2010
4/22/2010
5/2/2010
5/12/2010
5/22/2010
6/1/2010
6/11/2010
6/21/2010
7/1/2010


University and 22nd St. 4-6pm Volumes
Hickman NB Off Ramp closed April 19th to May 10th (4/19 to 5/10) and University NB On Ramp Closed 4/19- 5/20).
Hickman Road SB On Ramp Closed May 18th to June 9th Hickman Road.
Hickman SB on Ramp Closed
Hickman NB Off Ramp Closed
University NB On Ramp Closed
Memorial Day
West Leg
South leg
North Leg
East Leg
Total Vehicles from 4-6pm
Date
3000
2500
2000
1500
1000
500
0
4/2/2010
4/12/2010
4/22/2010
5/2/2010
5/12/2010
5/22/2010
6/1/2010
6/11/2010
6/21/2010
7/1/2010


University and 22nd St. South Leg Separated 4-6pm
Total Volume from 4-6pm
1800
1600
1400
1200
1000
800
600
400
200
0
4/2/2010
4/12/2010
4/22/2010
5/2/2010
5/12/2010
5/22/2010
6/1/2010
6/11/2010
6/21/2010
7/1/2010
Date
Hickman NB Off Ramp closed April 19th to May 10th (4/19 to 5/10) and University NB On Ramp Closed 4/19- 5/20).
Hickman Road SB On Ramp Closed May 18th to June 9th Hickman Road.
Right Turn
Through
Left Turn
Hickman NB Off Ramp Closed
University NB On Ramp Closed
Hickman SB on Ramp Closed
Memorial Day


University and 22nd St West Leg Separated 4-6pm
Hickman NB Off Ramp closed April 19th to May 10th (4/19 to 5/10) and University NB On Ramp Closed 4/19- 5/20).
Hickman Road SB On Ramp Closed May 18th to June 9th Hickman Road.
Hickman SB on Ramp Closed
Hickman NB Off Ramp Closed
University NB On Ramp Closed
Memorial Day
Right Turn
Through
Left Turn
Total Volume from 4-6pm
Date
1400
1200
1000
800
600
400
200
0
4/2/2010
4/12/2010
4/22/2010
5/2/2010
5/12/2010
5/22/2010
6/1/2010
6/11/2010
6/21/2010
7/1/2010


University and 22nd St. 7-7pm Volumes
Hickman NB Off Ramp closed April 19th to May 10th (4/19 to 5/10) and University NB On Ramp Closed 4/19- 5/20).
Hickman Road SB On Ramp Closed May 18th to June 9th Hickman Road.
Hickman SB on Ramp Closed
Hickman NB Off Ramp Closed
University NB On Ramp Closed
Memorial Day
West Leg
South leg
North Leg
East Leg
Total Vehicles from 7-7pm
Date
14000
12000
10000
8000
6000
4000
2000
0
4/2/2010
4/12/2010
4/22/2010
5/2/2010
5/12/2010
5/22/2010
6/1/2010
6/11/2010
6/21/2010
7/1/2010


University and 22nd St. East Leg Separated 7-7pm
Hickman NB Off Ramp closed April 19th to May 10th (4/19 to 5/10) and University NB On Ramp Closed 4/19- 5/20).
Hickman Road SB On Ramp Closed May 18th to June 9th Hickman Road.
Hickman NB Off Ramp Closed
University NB On Ramp Closed
Hickman SB on Ramp Closed
Right Turn
Through
Left Turn
Memorial Day
Through and right turns are in a shared lane so the volumes are combined. With the low volumes present no real change in traffic patterns can be seen compared to the rest of the corridor.
Total Volume from 7-7pm
0
100
200
300
400
500
600
700
800
4/2/2010
4/12/2010
4/22/2010
5/2/2010
5/12/2010
5/22/2010
6/1/2010
6/11/2010
6/21/2010
7/1/2010
Date

B.3 System-Wide Traffic-Volume Changes (Tabular)

Percent Volume Change From the Baseline

Int.	Approach	7-7pm Combined 12 Hour Volume					7-9am Combined 2 Hour Volume					4-6pm Combined 2 Hour Volume				
		Before	Phase 1	Phase 2	Phase 3	After	Before	Phase 1	Phase 2	Phase 3	After	Before	Phase 1	Phase 2	Phase 3	After
60th & University	East	10,068	21.9%	17.0%	0.0%	1.9%	1,476	13.2%	9.3%	-6.6%	-3.8%	2,197	24.1%	18.3%	-3.5%	-1.8%
	North	4,393	3.1%	2.5%	22.7%	5.8%	1,030	2.6%	-0.9%	10.3%	-3.0%	857	2.2%	2.6%	18.3%	2.1%
	South	5,568	9.6%	8.2%	2.8%	2.0%	759	13.2%	9.2%	2.1%	-1.0%	1,257	15.1%	12.3%	-0.7%	-0.9%
	West	8,353	-0.3%	-2.3%	2.0%	2.1%	1,470	-2.8%	-4.9%	-4.9%	-9.0%	1,651	-0.6%	-4.9%	-1.4%	1.4%
University & I-80 West Ramp	East	11,213	31.0%	15.1%	7.0%	140.4%	1,795	41.0%	5.5%	0.4%	131.3%	2,118	33.0%	18.4%	6.3%	117.9%
	North	9,795	-27.1%	-7.1%	-19.0%	-5.3%	2,618	-32.7%	-6.2%	-20.3%	-9.8%	1,688	-26.2%	-7.8%	-20.4%	-9.5%
	South	1,093	-25.0%	7.1%	5.2%	-1.9%	178	-30.6%	-0.9%	-1.4%	-6.4%	174	-21.4%	-0.9%	2.6%	-7.0%
	West	14,796	-8.4%	-12.3%	1.0%	-1.2%	1,881	-5.4%	-16.4%	1.3%	-6.0%	2,994	-17.6%	-17.9%	-3.0%	-3.7%
University & I-80 East Ramp	East	12,742	-19.8%	-19.1%	4.8%	-4.8%	1,377	-28.4%	-25.4%	1.2%	-7.1%	2,970	-26.0%	-26.1%	-1.9%	-10.9%
	North	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	South	5,335	16.9%	5.3%	-0.9%	-0.4%	1,501	12.8%	3.1%	-7.7%	-7.1%	866	23.2%	4.4%	-3.9%	-1.0%
	West	15,411	-7.8%	-13.4%	-22.8%	-15.7%	2,501	-8.9%	-15.2%	-17.5%	-5.7%	3,196	-21.2%	-27.6%	-34.4%	-28.0%
50th & Corporate 1	East	N/A	-2.3%	-2.4%	-10.9%	727	N/A	6.5%	-6.8%	2.9%	22	N/A	-7.3%	0.4%	-13.7%	241
	North (SB)	N/A	-0.5%	-5.3%	-5.6%	8,385	N/A	1.4%	-1.8%	-0.3%	1,460	N/A	4.1%	-1.5%	-6.3%	1,507
	South (NB)	N/A	-1.3%	-6.4%	-7.4%	7,478	N/A	3.2%	-4.8%	-5.2%	1,151	N/A	-1.7%	-9.0%	-8.2%	1,460
	West	N/A	11.4%	2.4%	3.7%	806	N/A	8.0%	1.3%	9.7%	63	N/A	11.3%	1.7%	-4.2%	144
47th & University	East	9,351	-3.8%	-9.1%	0.9%	2.6%	876	-4.4%	-8.4%	-2.9%	-8.4%	1,918	-5.5%	-10.4%	-1.5%	3.8%
	North	1,270	2.2%	-5.1%	-1.3%	-0.1%	86	-11.0%	-19.6%	-19.9%	-19.2%	277	2.4%	1.9%	-2.5%	0.0%
	South	299	-10.3%	-16.8%	-8.1%	-10.8%	9	12.8%	-33.1%	-1.6%	-4.3%	120	-17.9%	-22.9%	-15.6%	-16.7%
	West	10,330	9.7%	0.7%	-6.8%	-11.8%	1,262	8.8%	-4.6%	-10.7%	-15.3%	1,985	8.8%	1.3%	-15.4%	-19.8%
35th & University	East	8,138	2.1%	-1.3%	0.3%	14.9%	487	12.0%	6.6%	-4.2%	88.4%	1,576	5.8%	-1.4%	-2.0%	19.2%
	North	8,357	-0.4%	-1.7%	7.0%	-40.2%	1,145	3.0%	1.1%	11.4%	-40.7%	1,616	-2.3%	-3.1%	3.5%	-41.5%
	South	7,875	8.7%	4.3%	3.1%	-10.7%	820	17.1%	13.6%	7.7%	32.5%	1,643	15.4%	6.2%	-0.3%	-17.9%
	West	9,100	19.6%	12.4%	2.4%	14.5%	722	23.0%	14.5%	-1.6%	81.7%	1,829	21.3%	12.1%	-1.8%	9.5%
22nd & University	East	1,201	7.1%	-6.9%	-8.4%	-14.2%	97	1.6%	-2.4%	-7.6%	-6.8%	224	18.5%	-2.6%	-9.1%	-14.4%
	North	10,771	-0.6%	-2.6%	1.3%	0.2%	1,706	0.1%	2.3%	-1.2%	-5.3%	2,198	-0.1%	-4.4%	1.7%	0.7%
	South	6,975	-2.5%	-2.9%	-5.2%	-2.2%	970	4.6%	1.6%	-2.7%	0.1%	1,505	-8.6%	-7.7%	-12.4%	-11.3%
	West	7,807	5.4%	0.5%	-2.2%	-5.8%	774	8.5%	1.7%	-3.3%	-16.1%	1,548	4.3%	-2.1%	-6.0%	-7.4%
Clive Data																
128th & Inse 2	East	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	North (SB)	4783	0.8%	4.7%	38.5%	N/A	1379	0.3%	0.2%	27.6%	N/A	886	-0.2%	2.7%	38.4%	N/A
	South (NB)	4791	41.5%	43.3%	16.2%	N/A	524	53.0%	48.3%	28.1%	N/A	1405	56.6%	47.4%	16.7%	N/A
	West	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
114th St Clive Cut-through 3	East	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	North	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	South	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	West	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Wavetronic Data																
I-35/ I-80 Sensor 29 NB	East	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	North	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
	South	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
	West	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
I-35/ I-80 Sensor 29 SB	East	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	North	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
	South	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
	West	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
I-35/ I-80 Sensor 30 NB	East	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	North	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	South(NB)	38274	-5.9%	-9.5%	2.6%	6.5%	6740	-2.4%	-9.5%	-7.2%	-2.7%	9,177	-15.3%	-14.8%	-3.3%	0.5%
	West	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
I-35/ I-80 Sensor 30 SB	East	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	North (SB)	42489	-0.9%	-1.6%	3.0%	5.5%	8605	0.4%	1.9%	-0.5%	1.8%	8,907	0.4%	-2.1%	1.2%	2.9%
	South	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	West	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Notes

1. The after condition was used as the baseline because date was not available for a before condition.
2. Limited data was available but available data was during transition times successfully showing the changes in volume throughout the study period.
3. Not sufficient enough data was available to make a formal conclusion about the volume during the periods of interest.

Legend

Percent flagged	From	To
	15%	30%
	30%	50%
	50%	500%

Low Base Conditions
Not a Significant Change
Perceived Problems
Different Procedures

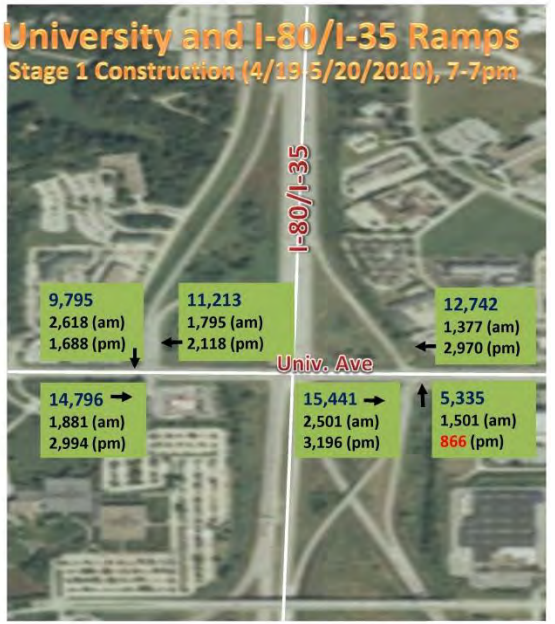
Raw Data: Initial Volume Change From the Baseline Updated

Int.	Approach	7-7pm Combined 12 Hour Volume					7-9am Combined 2 Hour Volume					4-6pm Combined 2 Hour Volume				
		Before	Phase 1	Phase 2	Phase 3	After	Before	Phase 1	Phase 2	Phase 3	After	Before	Phase 1	Phase 2	Phase 3	After
60th & University	East	10068	2202	1711	-2	194	1476	195	137	-97	-56	2197	529	403	-76	-39
	North	4393	137	111	998	254	1030	26	-9	106	-31	857	19	22	157	18
	South	5568	533	455	158	111	759	100	70	16	-8	1257	189	155	-9	-11
	West	8353	-23	-190	169	175	1470	-41	-73	-72	-132	1651	-10	-82	-23	23
University & I-80 West Ramp	East	11213	3472	1693	785	15748	1795	736	99	7	2356	2118	700	390	132	2498
	North	9795	-2655	-691	-1863	-519	2618	-856	-163	-532	-258	1688	-442	-132	-344	-160
	South	1093	-274	77	57	-21	178	-54	-2	-3	-11	174	-37	-2	4	-12
	West	14796	-1241	-1813	150	-172	1881	-102	-308	25	-112	2994	-527	-535	-89	-111
University & I-80 East Ramp	East	12742	-2522	-2440	616	-617	1377	-391	-350	16	-97	2970	-771	-776	-55	-325
	North	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	South	5335	902	285	-46	-20	1501	192	46	-115	-107	866	201	38	-33	-9
	West	15411	-1202	-2062	-3518	-2424	2501	-222	-379	-438	-143	3196	-678	-883	-1101	-895
50th & University	East	N/A	-17	-18	-79	727	N/A	1	-1	1	22	N/A	-18	1	-33	241
	North	N/A	-43	-443	-467	8385	N/A	20	-27	-5	1460	N/A	62	-23	-96	1507
	South	N/A	-95	-481	-550	7478	N/A	37	-56	-60	1151	N/A	-25	-131	-119	1460
	West	N/A	92	20	30	806	N/A	5	1	6	63	N/A	16	2	-6	144
47th & University	East	9351	-355	-856	88	247	876	-39	-73	-26	-73	1918	-106	-200	-28	73
	North	1270	28	-64	-17	-1	86	-9	-17	-17	-16	277	7	5	-7	0
	South	299	-31	-50	-24	-32	9	1	-3	0	0	120	-22	-27	-19	-20
	West	10330	998	73	-702	-1222	1262	111	-58	-135	-193	1985	175	26	-306	-394
35th & University	East	8138	172	-109	26	1215	487	58	32	-21	431	1576	92	-22	-32	302
	North	8357	-29	-143	581	-3363	1145	35	12	131	-466	1616	-36	-51	57	-670
	South	7875	685	337	242	-844	820	140	111	64	267	1643	253	102	-5	-295
	West	9100	1788	1130	217	1319	722	166	105	-11	590	1829	390	221	-33	174
22nd & University	East	1201	85	-83	-101	-170	97	2	-2	-7	-7	224	41	-6	-20	-32
	North	10771	-65	-282	137	19	1706	2	40	-20	-90	2198	-2	-97	38	16
	South	6975	-172	-205	-364	-152	970	45	16	-26	1	1505	-129	-115	-187	-170
	West	7807	421	39	-174	-456	774	65	13	-26	-125	1548	67	-32	-94	-114
							Clive Data									
128th & Sunset	East	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	North	4783	38	225	1843	N/A	1379	4	3	380	N/A	886	-2	24	340	N/A
	South	4791	1987	2076	775	N/A	524	278	253	147	N/A	1405	795	666	234	N/A
	West	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
114th St Clive Cut-through	East	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	North	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	South	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	West	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
							Wavetronic Data									
I-35/I-80 Sensor 29 NB	East	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	North	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
	South	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
	West	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
I-35/I-80 Sensor 29 SB	East	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	North	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
	South	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
	West	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
I-35/I-80 Sensor 30 NB	East	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	North	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	South	38274	-2264	-3624	1001	2501	6740	-159	-637	-485	-181	9177	-1406	-1357	-299	44
	West	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
I-35/I-80 Sensor 30 SB	East	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	North	42489	-376	-667	1254	2328	8605	31	167	-45	157	8907	32	-190	110	262
	South	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	West	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Initial Volume Baseline and With Change Between Phases

Int.	Approach	7-7pm Combined 12 Hour Volume					7-9am Combined 2 Hour Volume					4-6pm Combined 2 Hour Volume				
		Before	Phase 1	Phase 2	Phase 3	After	Before	Phase 1	Phase 2	Phase 3	After	Before	Phase 1	Phase 2	Phase 3	After
22nd & University	East	1201	85	-168	-18	-70	97	2	-4	-5	1	224	41	-47	-15	-12
	North	10771	-309	-216	419	-118	1706	2	38	-60	-70	2198	-2	-95	135	-23
	South	6975	-280	-33	-159	212	970	45	-29	-42	27	1505	-129	14	-72	17
	West	7807	161	-382	-213	-282	774	65	-52	-39	-99	1548	67	-99	-62	-21
35th & University	East	8138	-87	-281	135	1189	487	58	-26	-53	451	1576	92	-114	-10	334
	North	8357	-302	-114	724	-3944	1145	35	-23	119	-597	1616	-36	-14	108	-727
	South	7875	152	-348	-95	-1086	820	140	-29	-48	203	1643	253	-151	-106	-290
	West	9100	1149	-658	-913	1102	722	166	-61	-116	602	1829	390	-169	-254	207
47th & University	East	9351	-445	-501	944	159	876	-39	-34	48	-48	1918	-106	-95	172	101
	North	1270	63	-92	48	15	86	-9	-7	0	1	277	7	-1	-12	7
	South	299	-24	-19	26	-8	9	1	-4	3	0	120	-22	-6	9	-1
	West	10330	680	-925	-775	-520	1262	111	-169	-77	-58	1985	175	-149	-332	-88
50th & Corporate	East	N/A	710	-1	-62	79	N/A	23	-3	2	-1	N/A	223	19	-34	33
	North	N/A	8341	-399	-24	467	N/A	1479	-47	22	5	N/A	1569	-85	-72	96
	South	N/A	7383	-386	-69	550	N/A	1188	-93	-4	60	N/A	1435	-107	12	119
	West	N/A	898	-72	10	-30	N/A	68	-4	5	-6	N/A	160	-14	-8	6
60th & University	East	10068	1698	-490	-1714	197	1476	195	-58	-234	41	2197	529	-126	-480	37
	North	4393	74	-26	886	-744	1030	26	-35	115	-138	857	19	4	135	-139
	South	5568	326	-78	-297	-47	759	100	-31	-53	-24	1257	189	-34	-164	-2
	West	8353	-155	-167	359	5	1470	-41	-32	1	-61	1651	-10	-72	59	46
128th & Sunset	East	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	North	4783	38	192	1619	N/A	1379	4	-2	378	N/A	886	-2	26	317	N/A
	South	4791	1987	-358	-1301	N/A	524	278	-25	-106	N/A	1405	795	-128	-432	N/A
	West	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
114th St Clive Cut-through	East	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	North	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	South	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	West	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
University & I-80 East Ramp	East	12742	-1771	82	3056	-1233	1377	-391	42	366	-113	2970	-771	-5	721	-270
	North	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	South	5335	409	-617	-331	26	1501	192	-146	-161	8	866	201	-163	-72	25
	West	15411	657	-860	-1456	1094	2501	-222	-157	-59	294	3196	-678	-205	-218	206
University & I-80 West Ramp	East	11213	1835	-1780	-908	14963	1795	736	-637	-92	2349	2118	700	-310	-257	2365
	North	9795	-625	1964	-1172	1344	2618	-856	693	-369	275	1688	-442	311	-213	185
	South	1093	82	351	-21	-77	178	-54	53	-1	-9	174	-37	36	6	-17
	West	14796	-1258	-572	1963	-322	1881	-102	-207	333	-137	2994	-527	-8	446	-22
I-35/ I-80 Sensor 29 NB	East	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	North	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
	South	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
	West	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
I-35/ I-80 Sensor 29 SB	East	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	North	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
	South	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
	West	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
I-35/ I-80 Sensor 30 NB	East	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	North	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	South	38274	-1644	-1360	4626	1499	6740	-159	-478	152	304	9177	-1406	49	1057	344
	West	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
I-35/ I-80 Sensor 30 SB	East	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	North	42489	-469	-291	1921	1075	8605	31	135	-212	202	8907	32	-221	300	151
	South	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	West	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

B.4 System-Wide Traffic-Volume Changes (Maps)



Des Moines Location File Names	Clive Sensor Names (Address)			Wavetronix Sensor Location	
1 60th and Univ	1	2001		1 Sensor located at:	
2 W Ramp and Univ	2	1900		41.607530, -93.776547	
3 E Ramp and Univ	3	1776			
4 50th and corporate	4	1601	used	http://boulter.com/gps/	
5 47th and Univ				Converted Bearing to Location	
6 Valley West Drive and Univ				http://boulter.com/gps/#41.607530%2C%20-93.776547	
7 22nd and Univ					

Legend

* The ending condition was used as the baseline because initial data was not available for the location

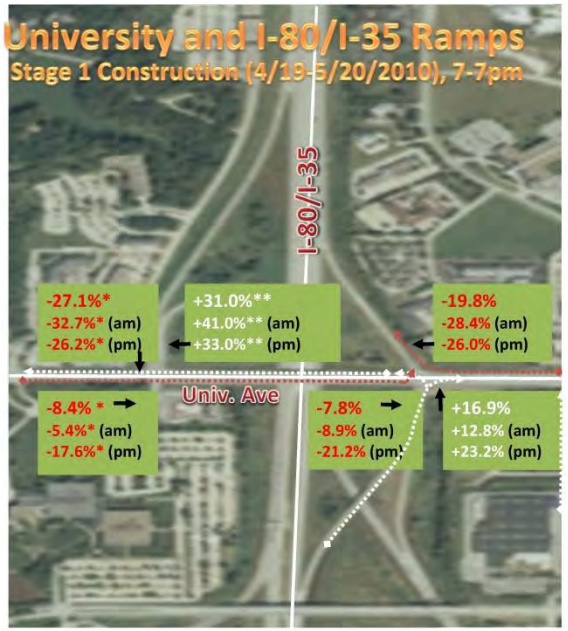
Volumes less than 1,000 Vehicles per 2 hours

7-7pm volumes

7-9am and 4-6pm volumes

7-9am and 4-6pm wavetronix volumes

N

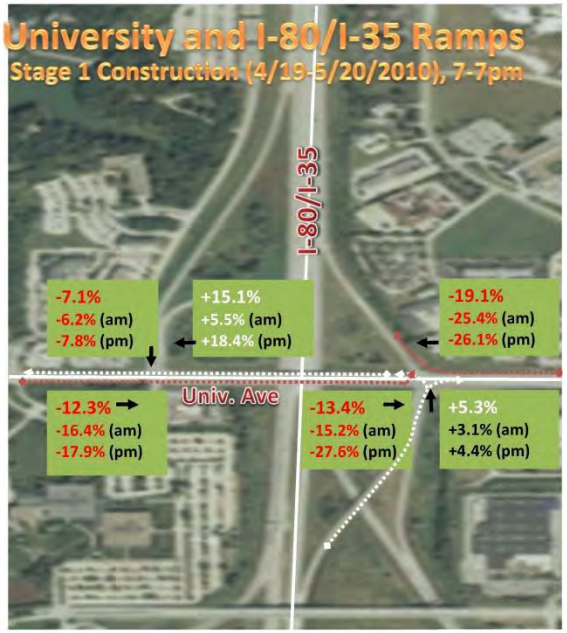


Des Moines Location File Names		Clive Sensor Names (Address)			Wavetronix Sensor Location	
1	60th and Univ	1	2001	1	Sensor located at:	
2	W Ramp and Univ	2	1900		41.607530, -93.776547	
3	E Ramp and Univ	3	1776			
4	50th and corporate	4	1601	used	http://boulter.com/gps/	
5	47th and Univ				Converted Bearing to Location	
6	Valley West Drive and Univ				http://boulter.com/gps/#41.607530%2C%20-93.776547	
7	22nd and Univ					

Legend

*	Does not decrease as much as shown, sensor failure occurred. The North leg did not decline during this time period
**	Does not increase as much as shown, sensor failure occurred.
###	Volumes decreased from the base condition (>5%)
###	Volumes increased from the base condition (>5%)
###	7-7pm volumes that were unchanged (<5%)
###	7-9am and 4-6pm pm volumes that were unchanged (<5%)

N



Des Moines Location File Names		Clive Sensor Names (Address)			Wavetronix Sensor Location	
1	60th and Univ	1	2001		1	Sensor located at:
2	W Ramp and Univ	2	1900			41.607530, -93.776547
3	E Ramp and Univ	3	1776			
4	50th and corporate	4	1601		used	http://boulter.com/gps/
5	47th and Univ					Converted Bearing to Location
6	Valley West Drive and Univ					http://boulter.com/gps/#41.607530%2C%20-93.776547
7	22nd and Univ					

Legend

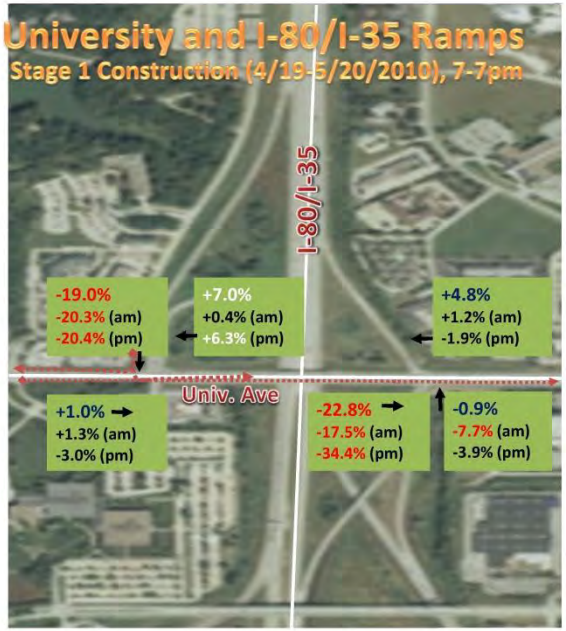
Volumes decreased from the base condition (>5%)

Volumes increased from the base condition (>5%)

7-7pm volumes that were unchanged (<5%)

7-9am and 4-6pm pm volumes that were unchanged (<5%)

N

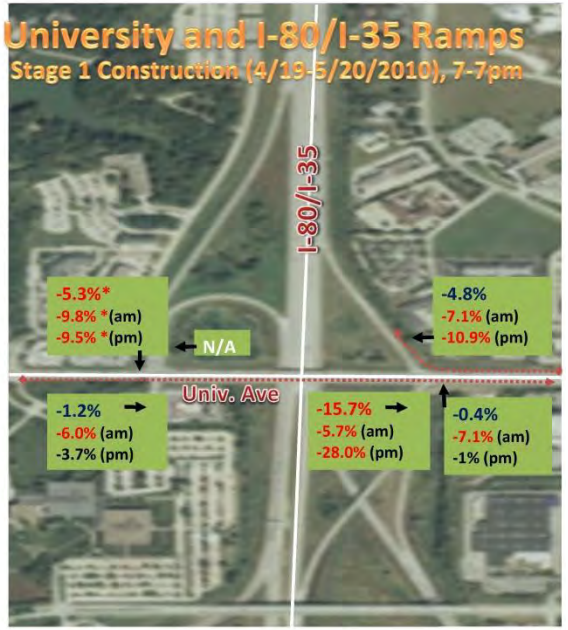


Des Moines Location File Names		Clive Sensor Names (Address)			Wavetronix Sensor Location	
1	60th and Univ	1	2001		1	Sensor located at:
2	W Ramp and Univ	2	1900			41.607530, -93.776547
3	E Ramp and Univ	3	1776			
4	50th and corporate	4	1601	used		http://boulter.com/gps/
5	47th and Univ					Converted Bearing to Location
6	Valley West Drive and Univ					http://boulter.com/gps/#41.607530%2C%20-93.776547
7	22nd and Univ					

Legend

- ### Volumes decreased from the base condition (>5%)
- ### Volumes increased from the base condition (>5%)
- ### 7-7pm volumes that were unchanged (<5%)
- ### 7-9am and 4-6pm pm volumes that were unchanged (<5%)

N

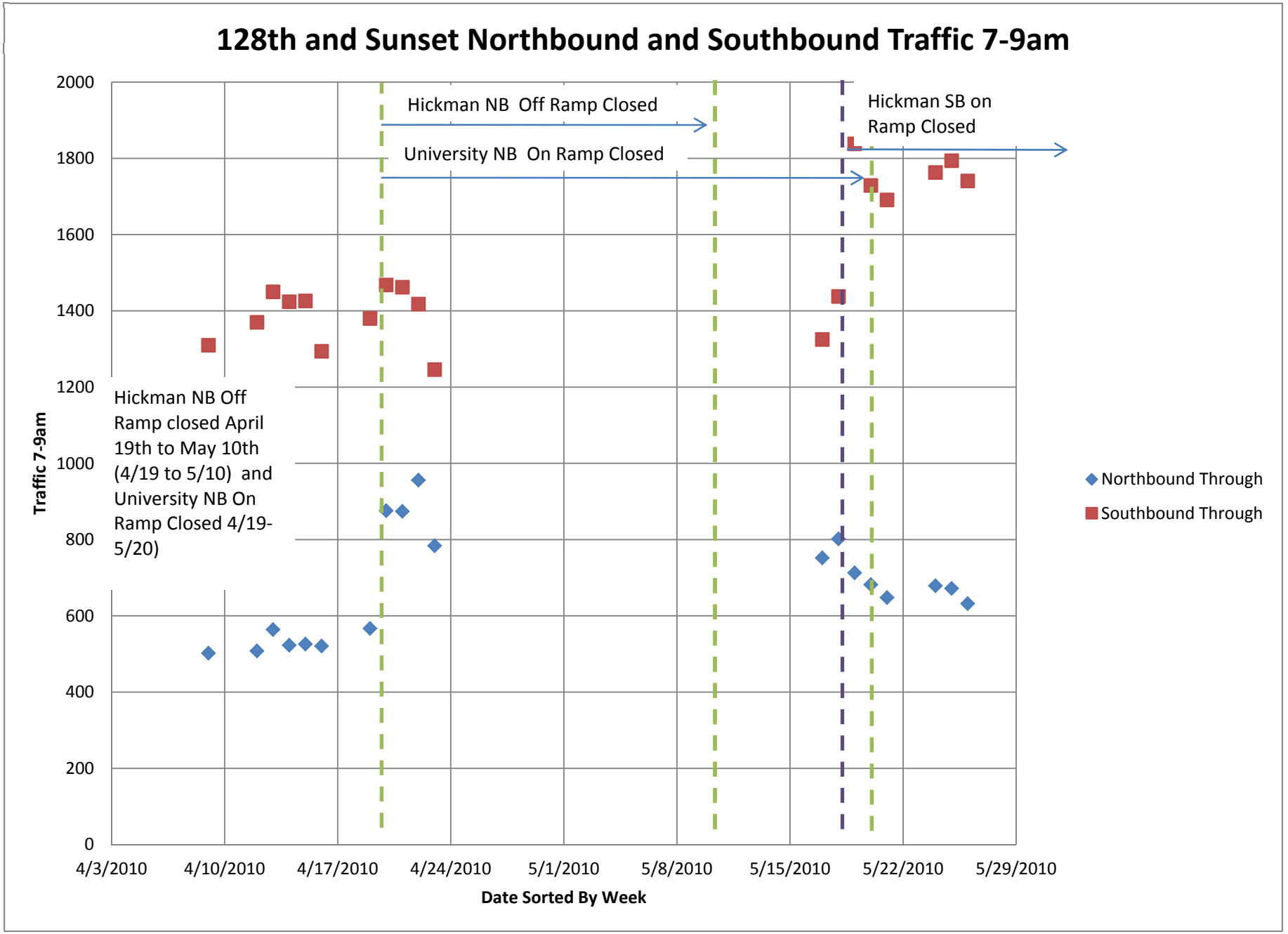


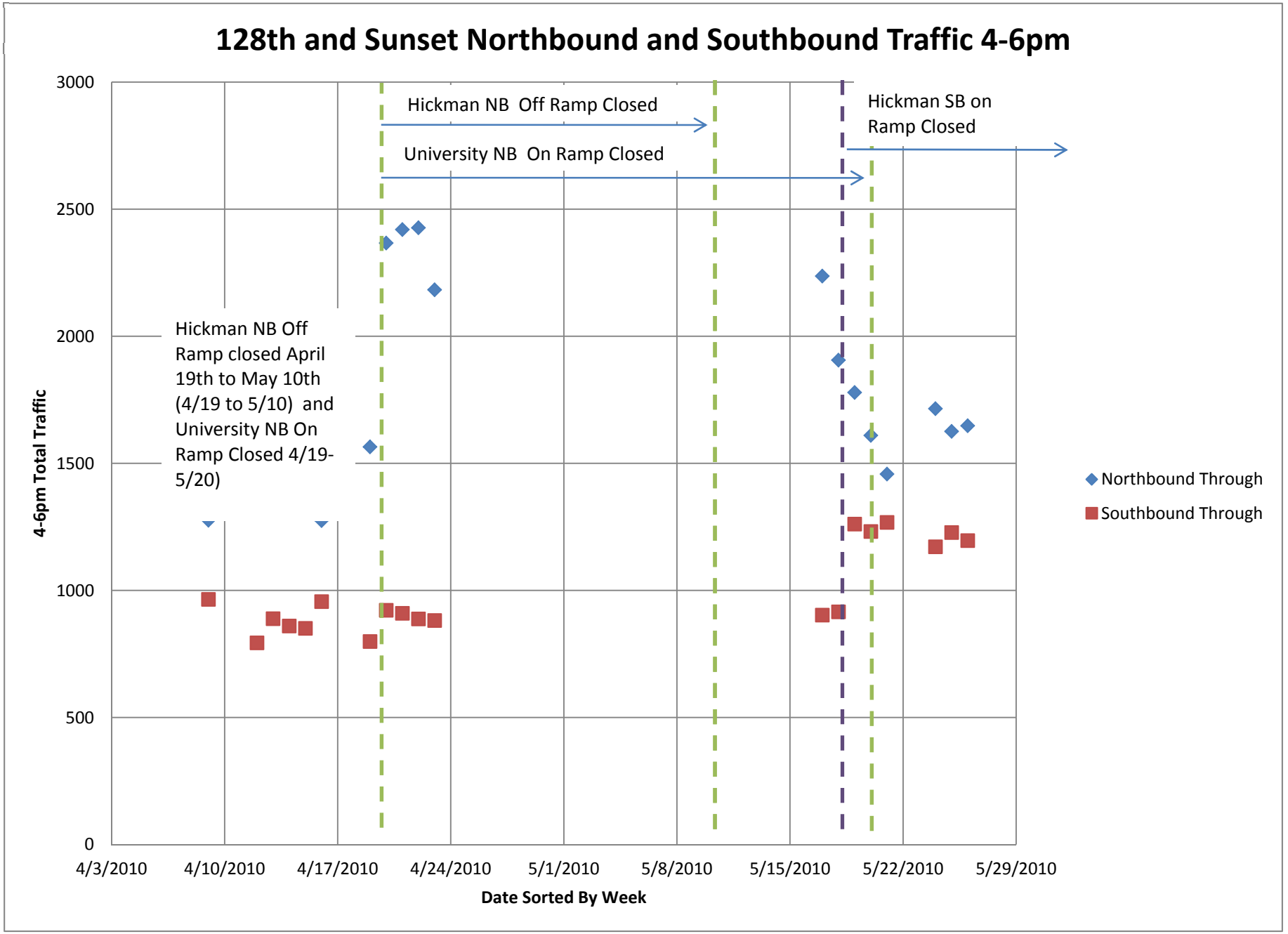
Des Moines Location File Names		Clive Sensor Names (Address)			Wavetronix Sensor Location	
1	60th and Univ	1	2001		1	Sensor located at:
2	W Ramp and Univ	2	1900			41.607530, -93.776547
3	E Ramp and Univ	3	1776			
4	50th and corporate	4	1601	used		http://boulter.com/gps/
5	47th and Univ					Converted Bearing to Location
6	Valley West Drive and Univ					http://boulter.com/gps/#41.607530%2C%20-93.776547
7	22nd and Univ					

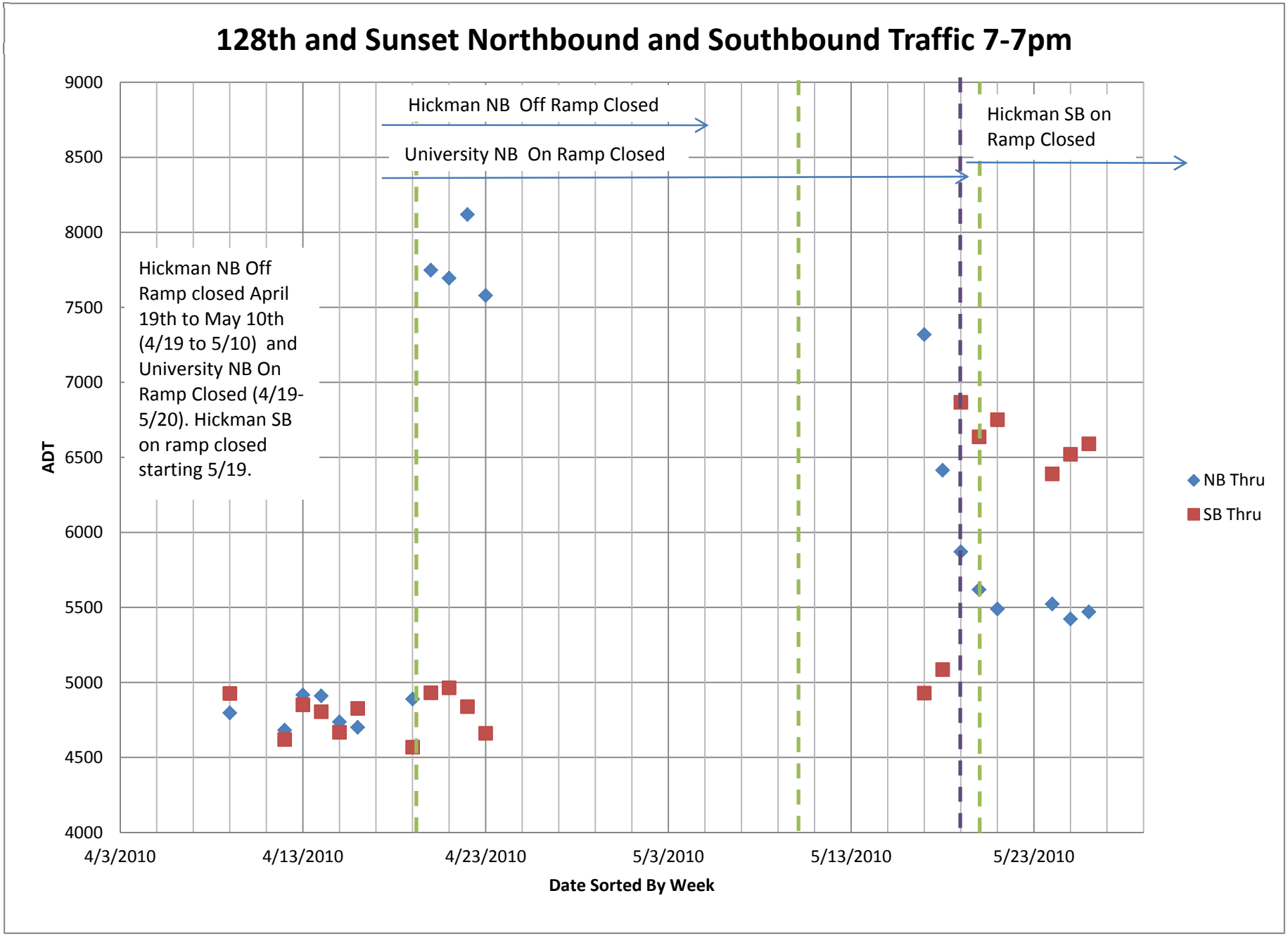
Legend		
	*	Volume not back to normal but increasing from the closure (lag)
	N/A	Sensor malfunction related to the east leg left turn
	N/A	Sensor malfunction create spike in volume
		If bad data is removed the sensors are similar to beginning condition
	###	Volumes decreased from the base condition (>5%)
	###	Volumes increased from the base condition (>5%)
	###	7-7pm volumes that were unchanged (<5%)
	###	7-9am and 4-6pm pm volumes that were unchanged (<5%)

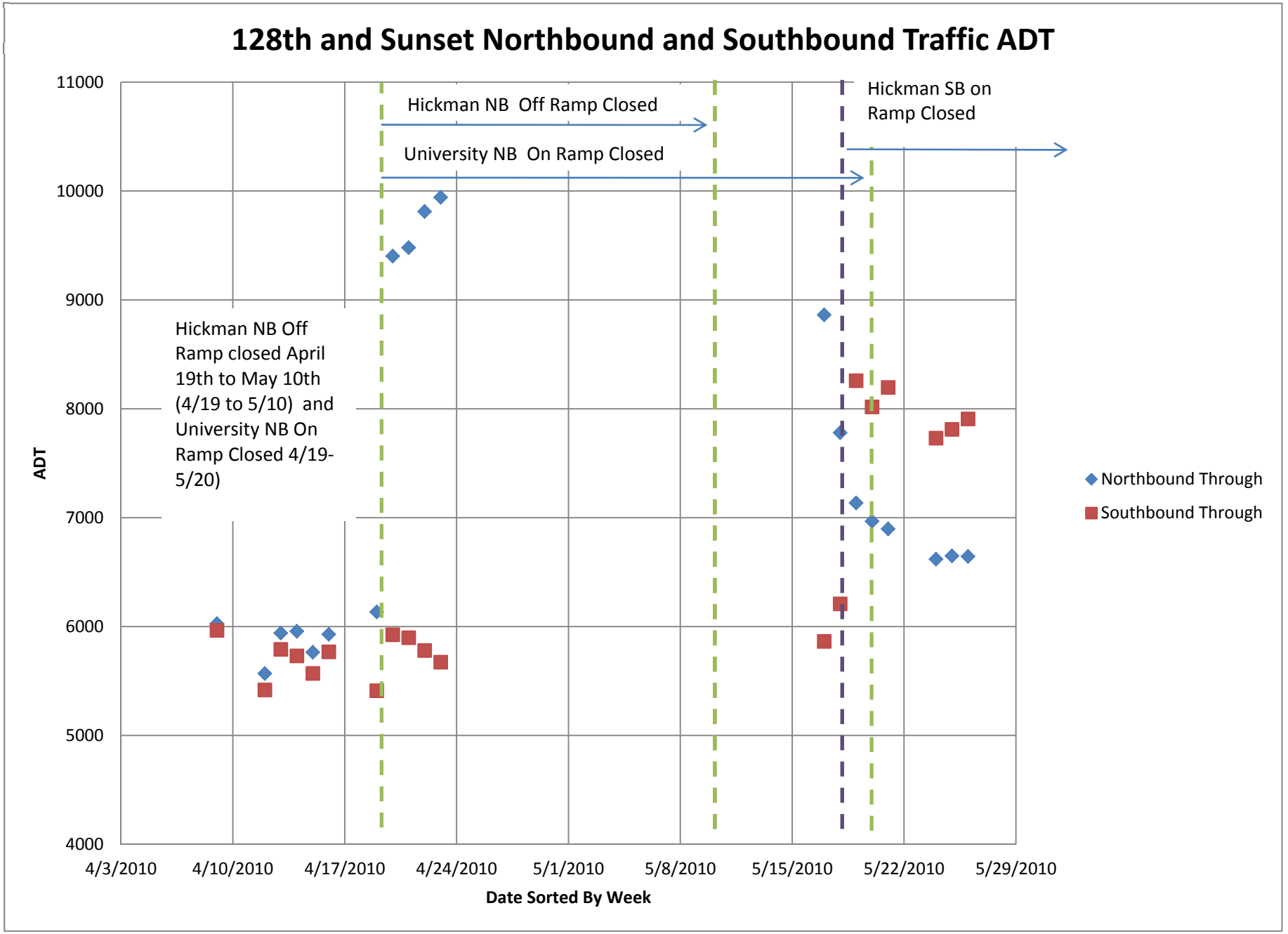
N

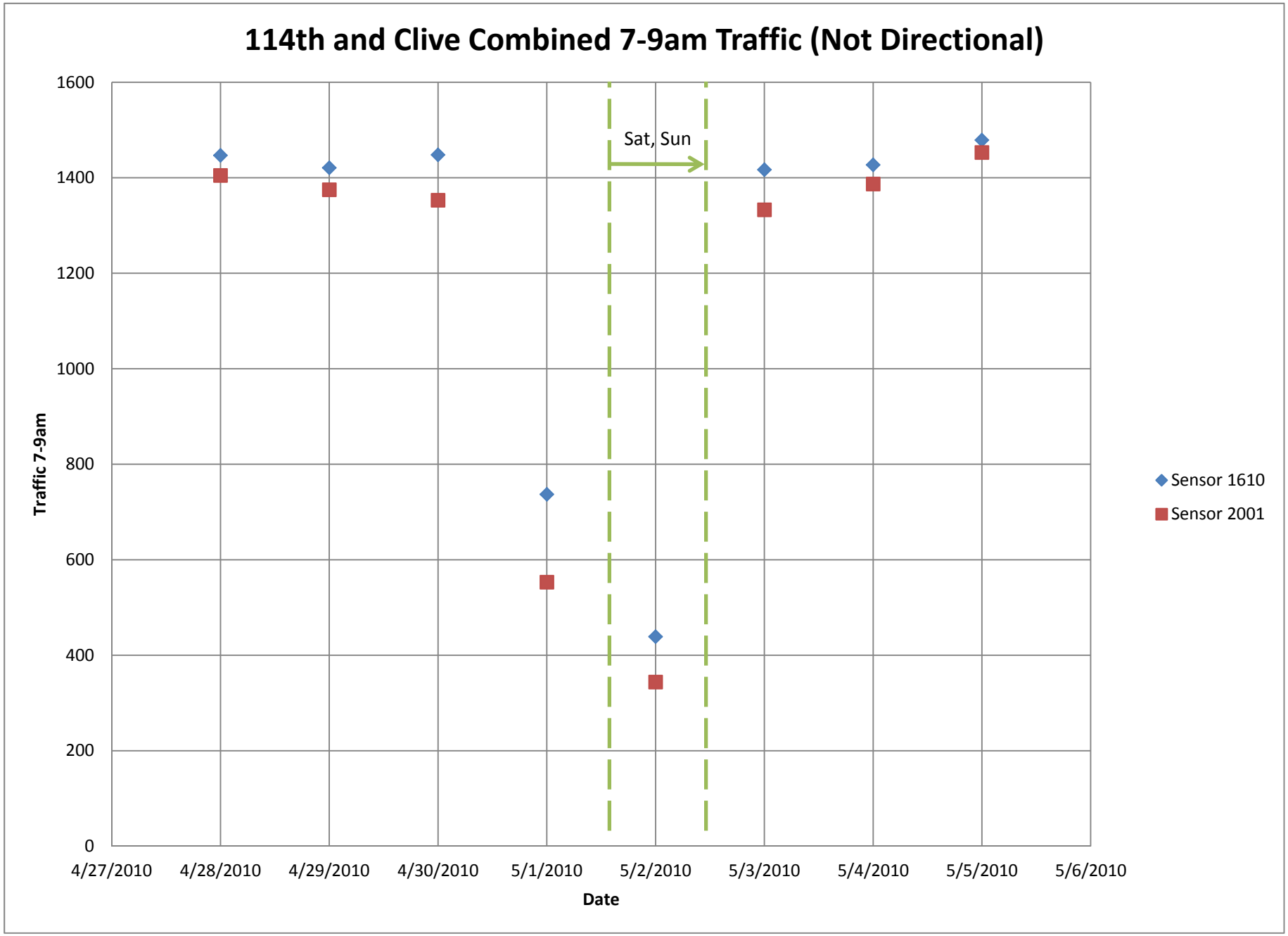
B.5 City of Clive Traffic-Volume Changes

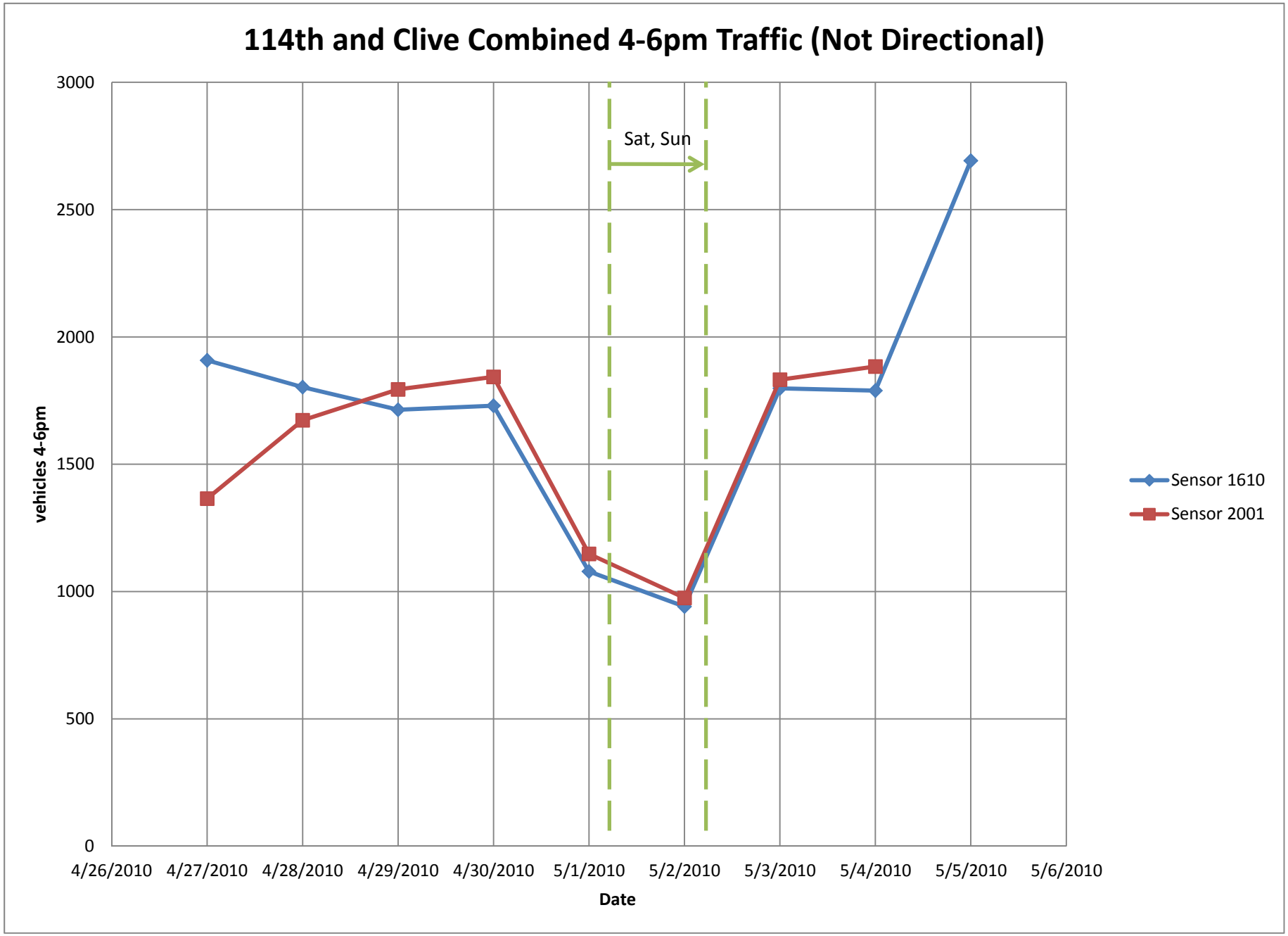

128th and Sunset Northbound and Southbound Traffic 7-9am
Hickman NB Off Ramp Closed
University NB On Ramp Closed
Hickman SB on Ramp Closed
Hickman NB Off Ramp closed April 19th to May 10th (4/19 to 5/10) and University NB On Ramp Closed 4/19-5/20)
Traffic 7-9am
2000
1800
1600
1400
1200
1000
800
600
400
200
0
4/3/2010
4/10/2010
4/17/2010
4/24/2010
5/1/2010
5/8/2010
5/15/2010
5/22/2010
5/29/2010
Date Sorted By Week
Northbound Through
Southbound Through

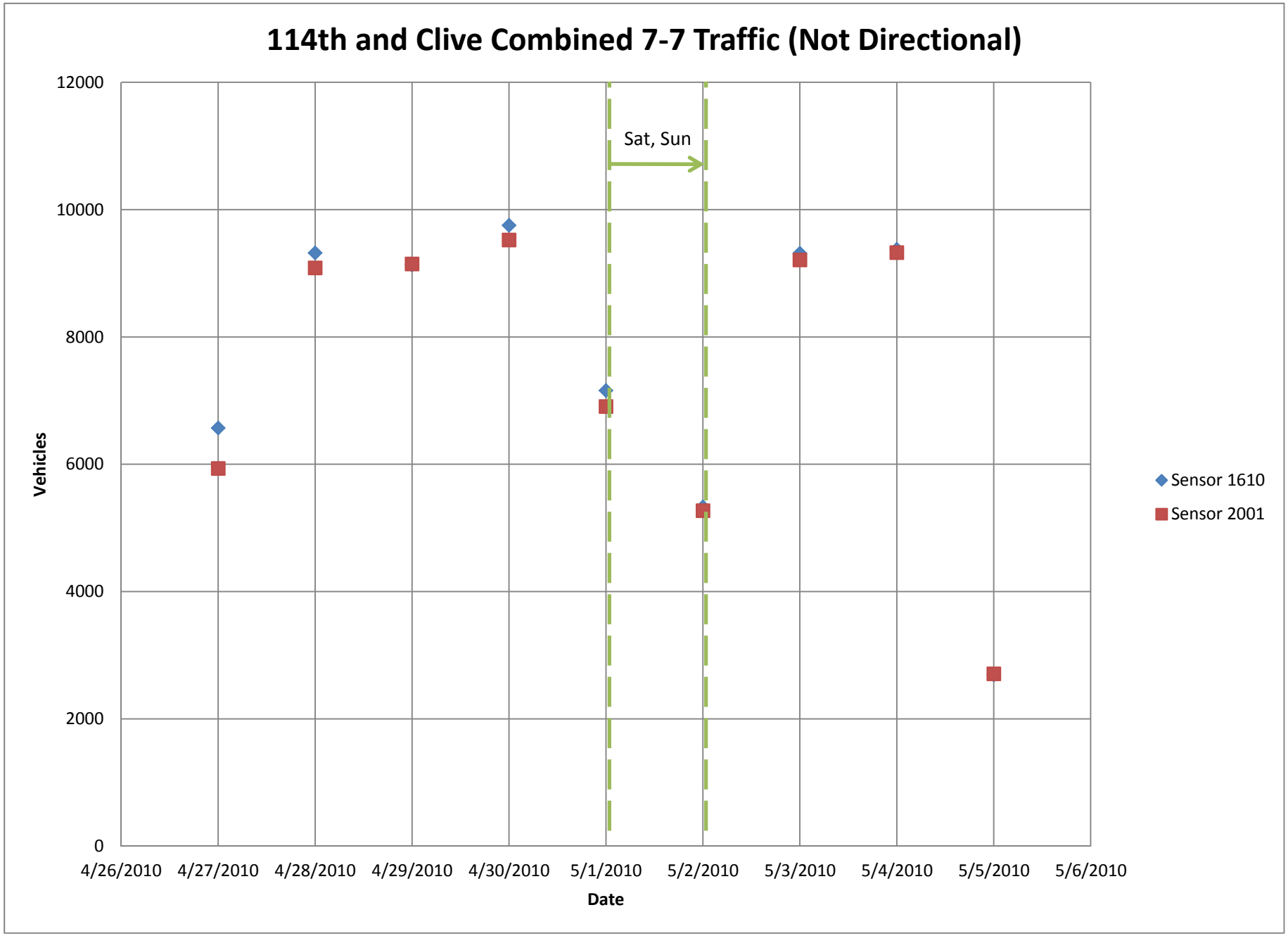

128th and Sunset Northbound and Southbound Traffic 4-6pm
Hickman NB Off Ramp Closed
University NB On Ramp Closed
Hickman SB on Ramp Closed
Hickman NB Off Ramp closed April 19th to May 10th (4/19 to 5/10) and University NB On Ramp Closed 4/19-5/20)
4-6pm Total Traffic
3000
2500
2000
1500
1000
500
0
4/3/2010
4/10/2010
4/17/2010
4/24/2010
5/1/2010
5/8/2010
5/15/2010
5/22/2010
5/29/2010
Date Sorted By Week
Northbound Through
Southbound Through

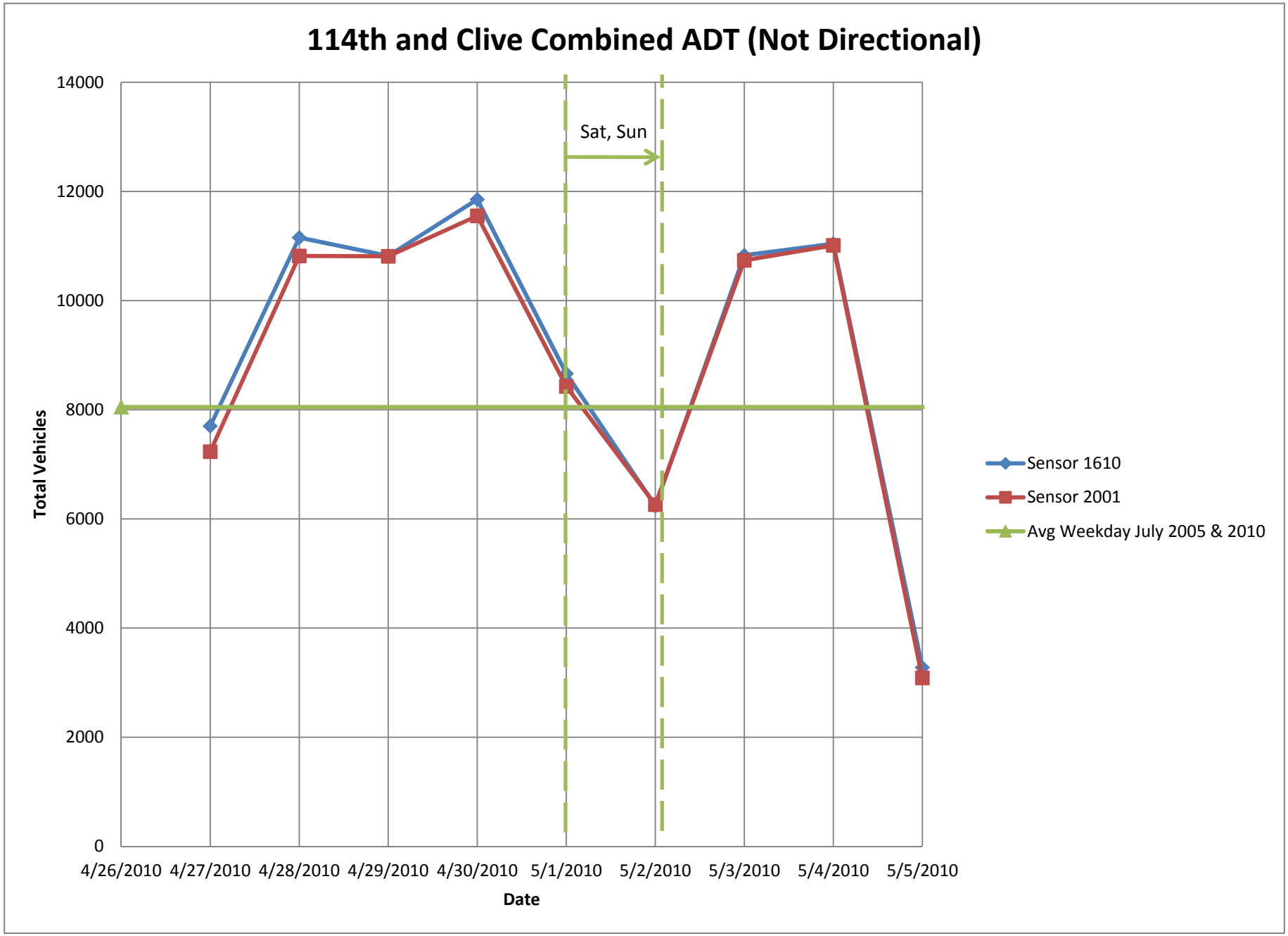

128th and Sunset Northbound and Southbound Traffic 7-7pm
9000
8500
8000
7500
7000
6500
6000
5500
5000
4500
4000
ADT
Hickman NB Off Ramp Closed
University NB On Ramp Closed
Hickman SB on Ramp Closed
Hickman NB Off Ramp closed April 19th to May 10th (4/19 to 5/10) and University NB On Ramp Closed (4/19-5/20). Hickman SB on ramp closed starting 5/19.
NB Thru
SB Thru
4/3/2010
4/13/2010
4/23/2010
5/3/2010
5/13/2010
5/23/2010
Date Sorted By Week


128th and Sunset Northbound and Southbound Traffic ADT
Hickman NB Off Ramp Closed
University NB On Ramp Closed
Hickman SB on Ramp Closed
Hickman NB Off Ramp closed April 19th to May 10th (4/19 to 5/10) and University NB On Ramp Closed 4/19-5/20)
ADT
11000
10000
9000
8000
7000
6000
5000
4000
4/3/2010
4/10/2010
4/17/2010
4/24/2010
5/1/2010
5/8/2010
5/15/2010
5/22/2010
5/29/2010
Date Sorted By Week
Northbound Through
Southbound Through


114th and Clive Combined 7-9am Traffic (Not Directional)
Traffic 7-9am
1600
1400
1200
1000
800
600
400
200
0
Sat, Sun
4/27/2010
4/28/2010
4/29/2010
4/30/2010
5/1/2010
5/2/2010
5/3/2010
5/4/2010
5/5/2010
5/6/2010
Date
Sensor 1610
Sensor 2001


114th and Clive Combined 4-6pm Traffic (Not Directional)
3000
2500
2000
1500
1000
500
0
vehicles 4-6pm
Sat, Sun
4/26/2010
4/27/2010
4/28/2010
4/29/2010
4/30/2010
5/1/2010
5/2/2010
5/3/2010
5/4/2010
5/5/2010
5/6/2010
Date
Sensor 1610
Sensor 2001


114th and Clive Combined 7-7 Traffic (Not Directional)
12000
10000
8000
6000
4000
2000
0
Vehicles
Sat, Sun
4/26/2010
4/27/2010
4/28/2010
4/29/2010
4/30/2010
5/1/2010
5/2/2010
5/3/2010
5/4/2010
5/5/2010
5/6/2010
Date
Sensor 1610
Sensor 2001


114th and Clive Combined ADT (Not Directional)
14000
12000
10000
8000
6000
4000
2000
0
Total Vehicles
Sat, Sun
4/26/2010
4/27/2010
4/28/2010
4/29/2010
4/30/2010
5/1/2010
5/2/2010
5/3/2010
5/4/2010
5/5/2010
Date
Sensor 1610
Sensor 2001
Avg Weekday July 2005 & 2010