Traffic Assessment

Montaño Rail Runner Station

Prepared For:

Mid-Region Council of Governments

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Acronyms

AASHTO	American Association of State Highway and Transportation Officials
AADT	Annual Average Daily Traffic
AAWDT	Annual Average Weekday Traffic
AAWET	Annual Average Weekend Traffic
g/C	Green time per signal Cycle length
HCM	Highway Capacity Manual
HCS	Highway Capacity Software
HTG	Harwick Transportation Group
ITE	Institute of Transportation Engineers
LOS	Level of Service
MRCOG	Mid-Region Council of Governments
mph	Miles per Hour
MTP	Metropolitan Transportation Plan (current document for year 2025)
MUTCD	Manual on Uniform Traffic Control Devices
NMDOT	New Mexico Department of Transportation
pcphpl	Passenger cars per hour per lane
PHF	Peak Hour Factor
STIP	Statewide Transportation Improvement Plan
v/c	Volume to Capacity ratio
vpd	Vehicles per Day
vph	Vehicles per Hour

1.0 INTRODUCTION

This traffic assessment has been prepared for the proposed Montaño Rd Rail Runner station in Albuquerque, NM. The commuter rail station will be located to serve both the northeast heights and the Taylor Ranch area in northwest Albuquerque. It is anticipated that access to the site will be via bus transit, passenger vehicle, and bicycle. All three modes are currently served on Montaño Rd. The proposed rail station is to be located along the south side of Montaño Rd between 2nd St and Edith Blvd. The site has an existing median opening and driveway which are proposed for use by the site. A vicinity map and aerial based site plans are included in Appendix A.

The report details the existing operations on Montaño Rd in the vicinity of the proposed site, and describes three alternative design scenarios. Operations were verified at each of the adjacent signalized intersections, 2nd St and Edith Blvd, and a gap study was conducted at the site access to determine if adequate gaps should be available for unsignalized operations. Trip generation, distribution and assignment were prepared for new site trips, and traffic operations were evaluated for the existing condition and each alternative scenario. The results, findings, and recommendations are detailed herein.

1.1 ROADWAY NETWORK

Montaño Rd is a 4/5 and 6/7 lane principal arterial that includes a Rio Grande crossing west of the site. This roadway has 3-through lanes in each travel direction at the site access and is reduced to 2 through lanes at the 2nd St intersection (approximately 1000' west of the site access). Montaño Rd has a posted speed limit of 45 mph with bicycle lanes and sidewalks on each side of the road. A raised median manages access along this road.

2.0 TRAFFIC ANALYSIS METHODOLOGY

The *Highway Capacity Manual* (HCM 2000) defines operational measures of effectiveness for all types of roadways and junctions in terms of qualitative levels of service. This study is concerned with levels of service for both signalized and unsignalized intersections, and the barometer for each intersection type is measured in terms of average vehicle delay. Signalized intersections consider the average control delay for each approaching vehicle. Control delay is the sum of the deceleration, queue, stop, and acceleration delay, computed for each approach movement. The signalized intersection level of service criteria and a brief definition are contained in Table 1.

Table 1
Signalized Intersection Levels of Service

Level of Service	Average Control Delay per Vehicle	Definition
A	≤ 10.0 sec	Very low delay - Free flow
B	10.1 sec to 20.0 sec	Minimal stops, good progression
C	20.1 sec to 35.0 sec	Moderate number of stops
D	35.1 sec to 55.0 sec	Significant stops, some cycle failures
E	55.1 sec to 80.0 sec	High delay, approaching capacity
F	> 80.0 sec	Approach over saturation, excessive delay

The signalized intersection analyses were calculated using Synchro 7.0. This software calculates the level of service for each approach, and may provide optimization for each individual movement. It also provides excellent analyses for signal progression, where required. Synchro 7.0 can produce reports in either Synchro format or *Highway Capacity Manual* (HCM) format. Synchro's standard operational analyses for signalized intersections deviates slightly from the *Highway Capacity Manual* methodology, however, only for very congested intersections do the results diverge. Synchro can calculate both algorithms; and for this project the Synchro signalized level of service worksheets were used.

Unsignalized intersections also utilize control delay; however, its definition differs because of the type of traffic control. Stop controlled intersections may be two-way stop controlled, all-way stop controlled, or roundabouts (yield controlled). Each unsignalized intersection considered herein was two-way stop control, meaning that main street through-movements are not considered in the analyses because they should experience no intersection related delay. Unsignalized intersection levels of service are a function of the side street approaches and main street turn levels of service. For this reason, an overall intersection level of service is not calculated such as it is for signalized intersections, and the intersection level of service is typically considered that level of service experienced by the poorest approach LOS. Table 2 contains brief definitions of unsignalized intersection LOS and the control delay values.

Table 2
Unsignalized Intersection Levels of Service

Level of Service	Average Control Delay per Vehicle	Definition
A	≤ 10.0 sec	Little or no delay
B	10.1 sec to 15.0 sec	Short traffic delays
C	15.1 sec to 25.0 sec	Average traffic delays
D	25.1 sec to 35.0 sec	Long traffic delays
E	35.1 sec to 50.0 sec	Very long traffic delays, approaching capacity
F	> 50.0 sec	Over capacity, excessive delay

The unsignalized intersection analyses were evaluated using Synchro 7.0. While this program is primarily a signalized intersection tool, it also performs unsignalized intersection analyses that are consistent with the *Highway Capacity Manual* methodology and the output results are identical to those produced by the McTrans Highway Capacity Software.

Urban areas typically assign an overall level of service (LOS) D as the desirable base condition for signalized intersections. LOS E may be acceptable for certain low volume approaches or movements, especially where a higher level of service may significantly degrade a major movement or where the default is LOS E based upon the intersection cycle length or low approach volumes. LOS D is also the desired approach level of service for urban unsignalized intersections; however, lower service levels may be acceptable for very low volume approaches.

A series of assumptions must be made for all level of service analyses. For this study, the following analysis assumptions were made, and they apply to existing and forecast analyses:

- Lane Width - Nominally 12 feet
- Truck Percentage - Assumed 2% (actual percentages mostly lower)
- Existing Peak Hour Factors - Measured in field, applied by approach average
- Forecast Peak Hour Factors – Based upon existing PHFs and a 0.25 PHF for site movements
- Saturation Flow Rate - 1900 pcphpl
- Roadway Grades - All analyses assume flat grades
- Change Intervals - 4 seconds amber, 1.5 second all red
- Cycle Lengths - Existing cycles, maximum 120 seconds AM and PM.
- Signalized Operations - Actuated-Coordinated is assumed
- Arrival Type - Random on each roadway
- Right-turn-on-Red - Estimated
- Conflicting Pedestrians - Minimal
- Area Type - Non CBD

3.0 TRAFFIC VOLUMES

Turning movement counts were collected by HTG for the intersections of Montaño Rd at 2nd St and Edith Blvd during the AM and PM peak hours. The data was collected on November 4 and 5, 2009. The turning movement volumes are contained in Table 3. Daily traffic volumes were obtained from the MRCOG 2008 Traffic Flow Map for Montaño Rd, and the average daily traffic in 2008 for the roadway segment at the site access was 28,700 vehicles per day (vpd).

Table 3
Existing AM and PM Peak Hour Baseline Turning Movement Volumes

Intersection	Eastbound			Westbound			Northbound			Southbound		
	LT	Th	RT	LT	Th	RT	LT	Th	RT	LT	Th	RT
AM Peak Hour												
Montaño Rd @ 2nd St	116	1342	272	108	459	116	79	467	147	310	932	106
Montaño Rd @ Site Access		1799			729							
Montaño Rd @ Edith Blvd	155	1487	169	77	585	195	74	275	101	262	403	70
PM Peak Hour												
Montaño Rd @ 2nd St	100	643	142	159	1212	325	298	987	167	108	574	173
Montaño Rd @ Site Access		918			1704							
Montaño Rd @ Edith Blvd	128	884	64	99	1358	175	211	618	118	176	299	135

The summary traffic volumes and turning movement count sheets are contained in Appendix B and the Baseline and Build volumes are shown graphically on Figures B-1 through B-8.

A series of three Build alternatives were developed for the site. The site traffic volumes are based upon the development of 100, 200, and 250 parking spaces at the park and ride lot. The Build volumes for each alternative are contained in Tables 4 through 6. The site trip generation information is described in Section 4.

Table 4
100 Space Build AM and PM Peak Hour Turning Movement Volumes

Intersection	Eastbound			Westbound			Northbound			Southbound		
	LT	Th	RT	LT	Th	RT	LT	Th	RT	LT	Th	RT
AM Peak Hour												
Montaño Rd @ 2nd St	116	1352	272	108	461	116	79	467	147	310	932	106
Montaño Rd @ Site Access	0	1799	10	22	729	0	3	0	5	0	0	0
Montaño Rd @ Edith Blvd	155	1492	169	77	605	195	76	275	101	262	403	70
PM Peak Hour												
Montaño Rd @ 2nd St	100	647	142	159	1225	325	298	987	167	108	574	173
Montaño Rd @ Site Access	0	918	4	9	1704	0	14	0	30	0	0	0
Montaño Rd @ Edith Blvd	128	911	67	99	1366	175	212	618	118	176	299	135

Table 5
200 Space Build AM and PM Peak Hour Turning Movement Volumes

Intersection	Eastbound			Westbound			Northbound			Southbound		
	LT	Th	RT	LT	Th	RT	LT	Th	RT	LT	Th	RT
AM Peak Hour												
Montaño Rd @ 2nd St	116	1372	272	108	466	116	79	467	148	311	932	106
Montaño Rd @ Site Access	0	1799	32	68	729	0	7	0	16	0	0	0
Montaño Rd @ Edith Blvd	155	1501	170	77	646	195	80	275	101	262	403	71
PM Peak Hour												
Montaño Rd @ 2nd St	100	651	142	160	1240	326	298	987	167	108	574	173
Montaño Rd @ Site Access	0	918	9	19	1704	0	29	0	63	0	0	0
Montaño Rd @ Edith Blvd	129	940	70	99	1375	175	213	618	118	176	299	135

Table 6
250 Space Build AM and PM Peak Hour Turning Movement Volumes

Intersection	Eastbound			Westbound			Northbound			Southbound		
	LT	Th	RT	LT	Th	RT	LT	Th	RT	LT	Th	RT
AM Peak Hour												
Montaño Rd @ 2nd St	116	1382	272	108	468	116	79	467	148	311	932	106
Montaño Rd @ Site Access	0	1799	43	90	729	0	10	0	21	0	0	0
Montaño Rd @ Edith Blvd	155	1506	171	77	666	195	82	275	101	262	403	71
PM Peak Hour												
Montaño Rd @ 2nd St	100	654	142	160	1247	326	298	987	167	108	574	173
Montaño Rd @ Site Access	0	918	11	24	1704	0	37	0	80	0	0	0
Montaño Rd @ Edith Blvd	129	955	71	99	1379	175	213	618	118	176	299	135

4.0 TRIP GENERATION, DISTRIBUTION AND ASSIGNMENT

4.1 TRIP GENERATION

Project trips were generated using the Institute of Transportation Engineers (ITE) *Trip Generation*, 8th Edition. The land use selected was #90, Park and Ride Lot with Bus Service. The ITE publication includes two park and ride facilities, for buses and for light rail. Neither of these land uses exactly match the land use for this site because commuter rail service differs slightly; however, the bus service land use was selected because of a larger data sample size and because the peak period at the station will likely occur outside of the peak hour for the adjacent street traffic. The resultant values from the trip generation should be representative of the peak hour site trips. Table 7 contains a summary of the site trip generation for each scenario. The trip generation data sheets are contained in Appendix C.

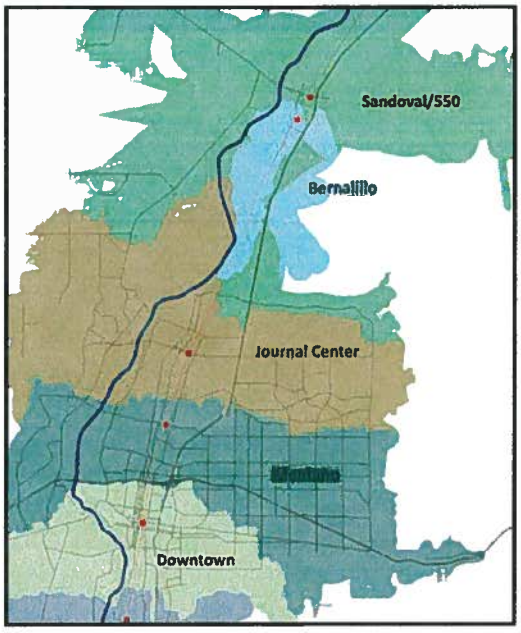
Table 7
Trip Generation

Alternative	Development	Parking Spaces	Daily	AM Enter	AM Exit	PM Enter	PM Exit
1	Commuter Rail Station	100	521	32	8	13	44
2	Commuter Rail Station	200	925	100	23	28	92
3	Commuter Rail Station	250	1127	133	31	35	117

No pass-by trips are assumed for the analyses. There will likely be pass-by or diverted link trips associated with "Kiss and Ride" trips to the station. The zero pass-by assumption was used to keep the results conservative.

4.2 TRIP DISTRIBUTION

The trip distribution for the site was generated using the Mid-Region Council of Governments (MRCOG) approved 2030 model year databank and based upon market station areas identified by MRCOG. The market service area is between the Downtown and Journal Center station service areas, and is shown at the right. An origin-destination trip assignment was prepared between the site data analysis subzones (DASZ) and eight subareas evaluated within the Montaño service area (see Appendix C). These subarea percentages were aggregated to the logical routes serving the site, and based upon the roadway network, six (6) contributing subareas/routes were developed. Table 8 contains the descriptions and contributing percentages from these subareas for each analysis year. These percentages were applied to develop the turning movements for the site



driveway and the two study area intersections.

Table 8
Trip Distribution Subarea Percentages

No.	Description	Percent
1	West of 2nd St via Montaño Rd	30%
2	North of Montaño Rd via 2nd St	1%
3	South of Montaño Rd via 2nd St	1%
4	East of Edith Blvd via Montaño Rd	61%
5	North of Montaño Rd via Edith Blvd	1%
6	South of Montaño Rd via Edith Blvd	6%

4.3 TRIP ASSIGNMENT

The trip assignment was based upon the contributing percentages from Table 8 and the values are shown in Table 9 below.

Table 9
Trip Assignments – 3 Alternatives

Intersection	Eastbound			Westbound			Northbound			Southbound		
	LT	Th	RT	LT	Th	RT	LT	Th	RT	LT	Th	RT
100 Parking Spaces												
AM Peak Hour												
Montaño Rd @ 2nd St		10		0	2	0			0	0		
Montaño Rd @ Site Access			10	22			3		5			
Montaño Rd @ Edith Blvd	0	5	0		20		2					0
PM Peak Hour												
Montaño Rd @ 2nd St		4		0	13	0			0	0		
Montaño Rd @ Site Access			4	9			14		30			
Montaño Rd @ Edith Blvd	0	27	3		8		1					0
200 Parking Spaces												
AM Peak Hour												
Montaño Rd @ 2nd St		30		0	7	0			1	1		
Montaño Rd @ Site Access			32	68			7		16			
Montaño Rd @ Edith Blvd	0	14	1		61		6					1
PM Peak Hour												
Montaño Rd @ 2nd St		8		1	28	1			0	0		
Montaño Rd @ Site Access			9	19			29		63			
Montaño Rd @ Edith Blvd	1	56	6		17		2					0
250 Parking Spaces												
AM Peak Hour												
Montaño Rd @ 2nd St		40		0	9	0			1	1		
Montaño Rd @ Site Access			43	90			10		21			
Montaño Rd @ Edith Blvd	0	19	2		81		8					1
PM Peak Hour												
Montaño Rd @ 2nd St		11		1	35	1			0	0		
Montaño Rd @ Site Access			11	24			37		80			
Montaño Rd @ Edith Blvd	1	71	7		21		2					0

5.0 TRAFFIC ANALYSES

Traffic analyses were performed for the existing Baseline and each of the three Build scenarios. The analyses for the site intersection were initially conducted assuming that a traffic signal would be installed. Because traffic signal warrants will not be satisfied based upon the MUTCD warrants, a series of analyses were also conducted for an unsignalized site access. The Baseline traffic analysis worksheets may be found in Appendix D, Alternative 1 in Appendix E, Alternative 2 in Appendix F, and the Alternative 3 worksheets in Appendix G. The unsignalized analysis worksheets follow the signalized analysis worksheets for each alternative.

5.1 SIGNALIZED INTERSECTION ANALYSIS

The signalized intersection traffic operations analysis results were summarized and combined to show the results comparatively. Each signalized intersection was evaluated using a 120 second cycle, representative of the existing conditions. Each intersection had the splits optimized, and that optimization included east-west coordination along Montaño Rd. As stated in Section 2, all analyses were conducted using Synchro 7.0 and the results produced using the *Highway Capacity Manual* methodology. Table 10 contains the signalized intersection measures of effectiveness (MOEs) including the intersection level of service [LOS], average control delay [Delay], and the average intersection volume to capacity (v/c) ratio [Ave v/c]. Note that all site turning movements were assigned a peak hour factor of 0.25, the lowest value allowable by Synchro, because only one northbound and one southbound train arrives during each peak hour, limiting the time period that vehicles should enter and exit the site.

Table 10
Montaño Rd Signalized Intersection Measures of Effectiveness

Intersection/Approach	AM Peak Hour			PM Peak Hour		
	LOS	Delay	Ave v/c	LOS	Delay	Ave v/c
2nd St						
Existing Condition	D	39 s	0.87	C	34 s	0.84
Alternative 1	D	39 s	0.89	C	34 s	0.82
Alternative 2	D	40 s	0.89	C	33 s	0.82
Alternative 3	D	40 s	0.90	C	35 s	0.82
Site Access						
Existing Condition	-	-	-	-	-	-
Alternative 1	A	8 s	0.47	A	9 s	0.41
Alternative 2	A	10 s	0.62	B	11 s	0.45
Alternative 3	B	12 s	0.71	B	11 s	0.50
Edith Blvd						
Existing Condition	C	24 s	0.66	C	31 s	0.71
Alternative 1	C	26 s	0.66	C	33 s	0.71
Alternative 2	C	24 s	0.67	C	32 s	0.69
Alternative 3	C	23 s	0.67	C	33 s	0.69

Table 10 indicates that acceptable operations should occur for each study area intersection, with or without the Rail Runner station. The presence of the station should not significantly impact operations within the Montaño Rd corridor, though it must be noted that intersection offsets must be established that provide optimal progression between 2nd St and Edith Blvd. The station driveway will have green time on the Montaño Rd approaches of up to 58% during the AM peak hour and 71% during the PM peak hour. A signalized Rail Runner station access should not impede traffic flow along Montaño Rd

The signal progression band widths were examined in Synchro to determine the optimal two way progression that may be achieved between 2nd St and Edith Blvd, including the Rail Runner station access. The results were manually adjusted to provide a greater peak hour directional progression because the Montaño Rd traffic volumes at 2nd St are approximately 2:1 higher in the peak direction. It would be possible to develop intersection offsets (or yield points) that would provide equal progression in each travel direction. The results of the progression analysis including a signalized site access are in Table 11.

Table 11
Progression Analyses Results

Alternative	Cycle Length	2nd St Green%	Edith Green%	Eastbound		Westbound	
				Green Band	Green Band %	Green Band	Green Band %
AM Peak Hour							
Existing	120 s	46%	41%	50 s	42%	37 s	31%
Alternative 1	120 s	46%	40%	52 s	43%	39 s	33%
Alternative 2	120 s	46%	40%	52 s	43%	39 s	33%
Alternative 3	120 s	46%	40%	52 s	43%	39 s	33%
PM Peak Hour							
Existing	120 s	41%	39%	34 s	28%	44 s	37%
Alternative 1	120 s	41%	39%	34 s	28%	44 s	37%
Alternative 2	120 s	42%	39%	35 s	29%	44 s	37%
Alternative 3	120 s	42%	39%	35 s	29%	44 s	37%

The progression analysis yields very good results for this limited corridor. Traffic should be coordinated through the adjoining signals in the peak direction near the maximum effective green times for those signals. The table also indicates that when comparing the existing progression with each of the alternatives, no degradation is anticipated by adding the Rail Runner station signal. Signalization of the site access will not affect operations within the Montaño Rd corridor so long as progression optimization is applied.

5.2 UNSIGNALIZED INTERSECTION ANALYSIS

Signalization of the site access is not guaranteed because, based upon the site access volumes, no Manual on Uniform Traffic Control Devices (MUTCD) traffic signal volume warrants will be satisfied. For this reason, unsignalized intersection analyses were performed, and a gap study was conducted at the site access during the AM and PM peak hours. Table 12 contains the unsignalized intersection analyses for each alternative. The unsignalized site access had the critical approaches assessed for level of service [LOS], average control delay [Delay], and the

estimated 95th percentile queue length [Queue]. The queue calculation is based upon the Highway Capacity Manual methodology described in Chapter 17, pages 17-22 through 17-24. Note that average delays in excess of 120 seconds are listed as greater than 120 seconds because the actual delay calculations on these approaches are unreliable. The appendices contain the calculated delay results on the level of service worksheets for reference.

Table 12
Site Access Unsignalized Intersection Levels of Service

Intersection	AM Peak			PM Peak		
	LOS	Delay	Queue	LOS	Delay	Queue
Site Driveway – Alternative 1						
WB LT	B	14 s	25'	A	10 s	25'
NB LT	F	77 s	25'	F	77 s	75'
NB RT	A	10 s	25'	A	10 s	25'
Site Driveway – Alternative 2						
WB LT	D	26 s	100'	B	10 s	25'
NB LT	F	> 120 s	125'	F	> 120 s	225'
NB RT	B	10 s	25'	B	11 s	50'
Site Driveway – Alternative 3						
WB LT	F	55 s	250'	B	11 s	25'
NB LT	F	> 120 s	NC	F	> 120 s	350'
NB RT	B	10 s	25'	B	12 s	50'

NC – Not Calculable

The unsignalized intersection analysis yields poor results for Alternative 1 and failing results for Alternatives 2 and 3. Level of service F is projected for the site access left-turn egress with each alternative, and the left-turn entry is calculated to be LOS F for a 250 space parking area. While the delay and level of service is of concern, the greater concern is for the projected vehicle queuing, both within the site and on westbound Montaño Rd.

The queues in Table 12 reflect design queues based upon random arrival rates. It is estimated that the arrival and departure patterns at the park and ride lot will be concentrated around the times that trains are scheduled, ingress starting approximately 10 minutes before and egress up to 10 minutes after. To account for this, the analysis utilized the lowest allowable peak hour factor (0.25) to increase the hourly flow rate. If the trips are concentrated in a 10 minute window, as assumed, the actual site access design queues will likely be up to 50% greater than shown in Table 12. This would result in a significant westbound left-turn queue deficiency for Alternatives 2 and 3.

Vehicle queuing at the site access may be problematic for both exiting vehicles and entering westbound vehicles. Traffic exiting to westbound Montaño Rd will be delayed by the heavy directional volumes, especially during the PM peak hour. The westbound queue at 2nd St periodically extends beyond the railroad crossing, which would eliminate available gaps for left turns exiting from the park and ride lot. Because of this existing Montaño Rd queuing, a gap study of existing traffic was conducted at the site access.

The gap study was conducted on January 11 and 12, 2010 at the proposed site entrance. The study was conducted for the peak hours identified by the intersection turning movement counts, 7:15 to 8:15 a.m. and 4:45 to 5:45 p.m. All vehicles in each travel direction were counted with a time stamp representing the time they passed the west return of the site access. During the count, flow was continuous except for westbound queue delay from the 2nd St intersection during the PM peak hour. When queue blocking of the site access occurred, vehicles were counted at approximately 2 second intervals to the end of the queue to represent egress blockage.

The results of the queue study were mixed. Observation during the study indicates that the signal system provides good vehicle platooning, resulting in numerous available gaps at the site access. A summary of the gap data is contained in Table 13 and additional information contained in Appendix H.

Table 13
Montaño Rd Site Access Gap Study Summary

	AM Peak Hour		PM Peak Hour	
	Eastbound	**Westbound**	**Eastbound**	**Westbound**
Vehicle Totals	**1712**	**717**	**866**	**1702**
Gaps of 10+ Seconds	75	99	103	42
Gaps of 15+ Seconds	41	68	61	26
Gaps of 20+ Seconds	18	51	41	16

The gap of concern is for vehicles turning left from the site access to westbound Montaño Rd. Gaps for right-turning vehicles are not considered significant because these gaps are created by the signal at 2nd St, and the remainder of this discussion refers to left-turn gaps. The Highway Capacity Manual (HCM) indicates in Table 17-5 that the critical gap for a left-turn egress movement from a minor street requires a critical gap of 7.5 seconds for a 4-lane or 6-lane major street. Given the median in Montaño Rd, it is estimated that a 10 second gap should be required for left-turn egress movements. The HCM also asserts that the 'follow-up time' should be at least 3.5 seconds for each subsequent vehicle. Based upon the median crossing, the follow-up time is conservatively assumed to be 5.0 seconds. It is assumed therefore, that a 10 second gap will serve one vehicle, 15 seconds will serve two vehicles, and 20 seconds will serve three vehicles.

Plots of the gaps were generated to observe the gap patterns that occurred during the peak hours. The longer gaps indicate that the signal actuations at 2nd St and Edith Blvd are instrumental in creating sizeable gaps for roadside access. The most significant concern from the plotted data is the lack of 15 second peak-direction gaps that occurred during the peak hours. For instance, the AM peak hour had a period of 5:27 during which no 15 second gap occurred. The PM peak period lacked a 15 second gap for 16:58, with the largest gap during that time being 8.6 seconds. The lack of gaps which will permit turning movements for such extended periods of time will influence driver behavior and route selection.

Long periods of gap restriction will lead to erratic behavior at an unsignalized site access. Lower gap acceptance would be anticipated during the AM peak hour when the eastbound traffic is heavy. This could lead to an increase in right-angle crashes at the site driveway. During the PM peak hour, the concern is for multiple left-turns queuing within the median to make two-stage left turns. One vehicle at a time making this movement would not be a concern, except that gaps to enter the westbound travel stream may not be available for minutes at a time. Should multiple vehicles try to queue within the opening, and this has been observed elsewhere in the corridor, a more unsafe condition will be created depending upon driver aggressiveness. Given that the left-turn egress demand will be concentrated based around the train schedule, the PM peak period gaps are considered inadequate to serve an unsignalized intersection.

In conjunction with potential erratic movements at the site access, the lack of available gaps will likely induce drivers to turn right and make a U-turn east of the site. There are two median openings between the site access and Edith Blvd, and it would be anticipated that the first of these openings would be utilized for site egress to westbound Montaño Rd. Montaño Rd has three travel lanes in each direction, and the 40' of pavement width would accommodate most passenger vehicle U-turns. The concern occurs during the PM peak hour when the backup from 2nd St extends east of the railroad tracks. This could block the U-turn location as well, though likely not for an extended time. Another concern for U-turns is storage availability after a train has arrived. If the 200 or 250 space lot is constructed, there could be demand for 29 to 37 left-turns. If 80% decide to make U-turns, there may be storage demand for 6 to 8 vehicles waiting for the U-turn. If the site access is to be unsignalized, a formal U-turn location should be established along Montaño Rd to ensure that U-turn vehicles do not queue within the left through lane.

6.0 FINDINGS AND RECOMMENDATIONS

6.1 FINDINGS AND CONSIDERATIONS

The findings of the traffic assessment indicate that the proposed Rail Runner station will not impact traffic operations within the Montaño Rd corridor if the site access is signalized. The site intersection will operate poor to failing as an unsignalized intersection, depending upon the size of park and ride lot developed. Montaño Rd has excellent progression with good vehicle platooning, and a moderate number of gaps are provided to serve left-turn egress movements, however, the gaps would be insufficient to serve the site traffic with unsignalized traffic control.

The projected traffic volumes were checked against the MUTCD signalization volume warrants, and under each of the three scenarios, the volumes will be significantly below the required threshold. Non-volume MUTCD warrants are not applicable at this intersection. The projected operations required that additional investigations be performed to ensure acceptable operations, and a gap study was performed to determine if the access would have adequate vehicle gaps to serve the site traffic. The study revealed that inadequate gaps occurred continuously for approximately 5½ minutes during the AM peak hour and 17 minutes during the PM peak. Should these durations occur once the station is constructed, an unsignalized intersection will fail.

If an unsignalized intersection is constructed, it is likely that drivers will occasionally exhibit erratic behavior when attempting to make a left-turn egress movement. These erratic movements may result in right-angle collisions or multiple vehicles queued in the median to make two-stage left turns. It is also anticipated that many drivers will abandon the site access left-turn movement and proceed east of the railroad tracks to make a U-turn from eastbound to westbound Montaño Rd. While there is adequate roadway width to negotiate the U-turn movement, it is likely that a number of vehicles will either queue within the eastbound lanes awaiting an opportunity to make the U-turn, or stack within the existing continuous two-way left-turn lane, possibly making multiple U-turns simultaneously. If an unsignalized intersection is provided at the site access, formal channelization for the storage of U-turning vehicles should be required.

Another consideration for an unsignalized intersection is the accommodation of pedestrians. Currently, there is transit service eastbound and westbound on Montaño Rd, and it will serve the Rail Runner station. If the intersection is unsignalized, westbound bus transit serving the site should be required to pull into the site for patrons to safely board or alight the buses. If the westbound bus stops along Montaño Rd (the existing condition), a pedestrian would be required to cross three travel lanes and a bicycle lane in each direction (40'), as well as traverse the 14' median area. The eastbound direction will likely require a right-turn deceleration taper, adding at least 12' of addition crossing width on the west side of the intersection. The resultant crossing times for each half of the road are at least 11.4 seconds and 26.8 seconds for the entire road (94'), resulting in extensive pedestrian exposure. Given that the gap study demonstrated that no gap greater than 8.6 seconds occurred during a 17 minute period in the PM peak hour, an unsignalized crossing would not permit safe crossing of the westbound lanes. This could be

mitigated by requiring westbound transit buses to enter the site for pickup and drop-off. The difficulty will then be for the buses to safely exit the site.

6.2 RECOMMENDATIONS

The recommendations for the site access are as follows:

1. The access should be signalized to provide good operations and safety for each of the three park and ride lot alternatives. While the MUTCD warrants are not satisfied at this access, pedestrian safety and operations indicate that an alternative to an unsignalized access is required. A traffic signal will best meet that need. It is also assumed that the signal will not be actuated frequently, primarily for short periods before and after trains arrive.

   Some considerations of the signalization should include:

   a. A westbound protected-permitted left-turn should be provided. The protected only phase should be programmed such that it provides protected only movements 15 minutes prior to each train arrival. Other times of the day this should be served as permitted only.

   b. The site access shall have two egress lanes, one for left turns and one for right turns. Signal actuation should be presence detection for each lane and the right-turn lane detection should be designed such that a single vehicle will not actuate the signal.

   c. The site access signal shall be coordinated with the signals at 2nd St and Edith Blvd to optimize progression within this section of Montaño Rd. Yield points (offsets) should be determined to ensure that the site access intersection does not impact Montaño Rd operations.

   d. The signal at the site access and at 2nd St shall be coordinated with the railroad signal actuation. This shall be coordinated to ensure that drivers can clear the railroad tracks prior to a train arrival. Supplemental signing and markings may also be required to ensure that motorists do not stop or get trapped on the tracks.

2. Bus service serving westbound Montaño Rd should enter the station site. If service is not provided into the site, the westbound bus stop should be located west of the site access. The external stop location should be designed such that a pedestrian would have to pass by the signalized pedestrian crossing rather than be enticed to jaywalk east of the site access because it is a shorter path to the station.

3. A 150' right-turn deceleration taper shall be constructed at the site access if Alternative 3 is selected. Alternatives 1 and 2 should generate less than the City of Albuquerque threshold of 40 vehicles per hour to require the taper.

4. The westbound left-turn lane from Montaño Rd to the site access should be extended to at least 250'. It is anticipated that the design queue (95th percentile) for this access could extend up to 450'. Because of the location of the railroad tracks, it is infeasible to accommodate the design left turn queue between the access and the tracks. The left turn

design period is the AM peak hour, and the low westbound volumes (approximately 700 vehicle in three lanes) should be able to accommodate periodic vehicles queued in the left lane. Warning signs conveying this condition should be developed and installed prior to site operation.

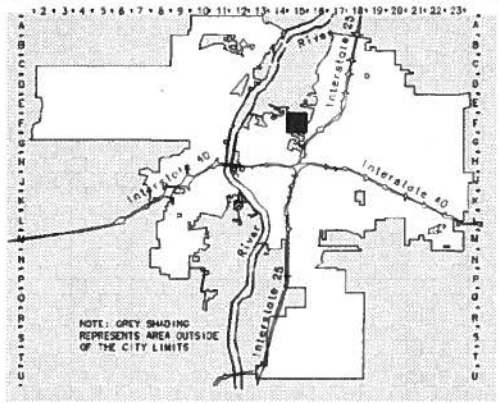
5. The Rail Runner train should be required to stop outside of the Montaño Rd right-of-way, such that the railroad gates may be raised after it passes (southbound), and during its dwell time in the station (northbound). If the train blocks Montaño Rd during a station stop, the roadway operations will be negatively impacted during each stop.

Appendices

Appendix A	Vicinity and Site Maps
Appendix B	Traffic Volume Summary
Appendix C	Trip Generation, Distribution and Assignment
Appendix D	Existing Level of Service Analyses
Appendix E	Alternative 1 Level of Service Analyses
Appendix F	Alternative 2 Level of Service Analyses
Appendix G	Alternative 3 Level of Service Analyses
Appendix H	Gap Study Summary

Appendix A

Vicinity and Site Maps



CITY OF ALBUQUERQUE · NEW MEXICO · 1706

GRAPHIC SCALE IN FEET

250 0 750 1000

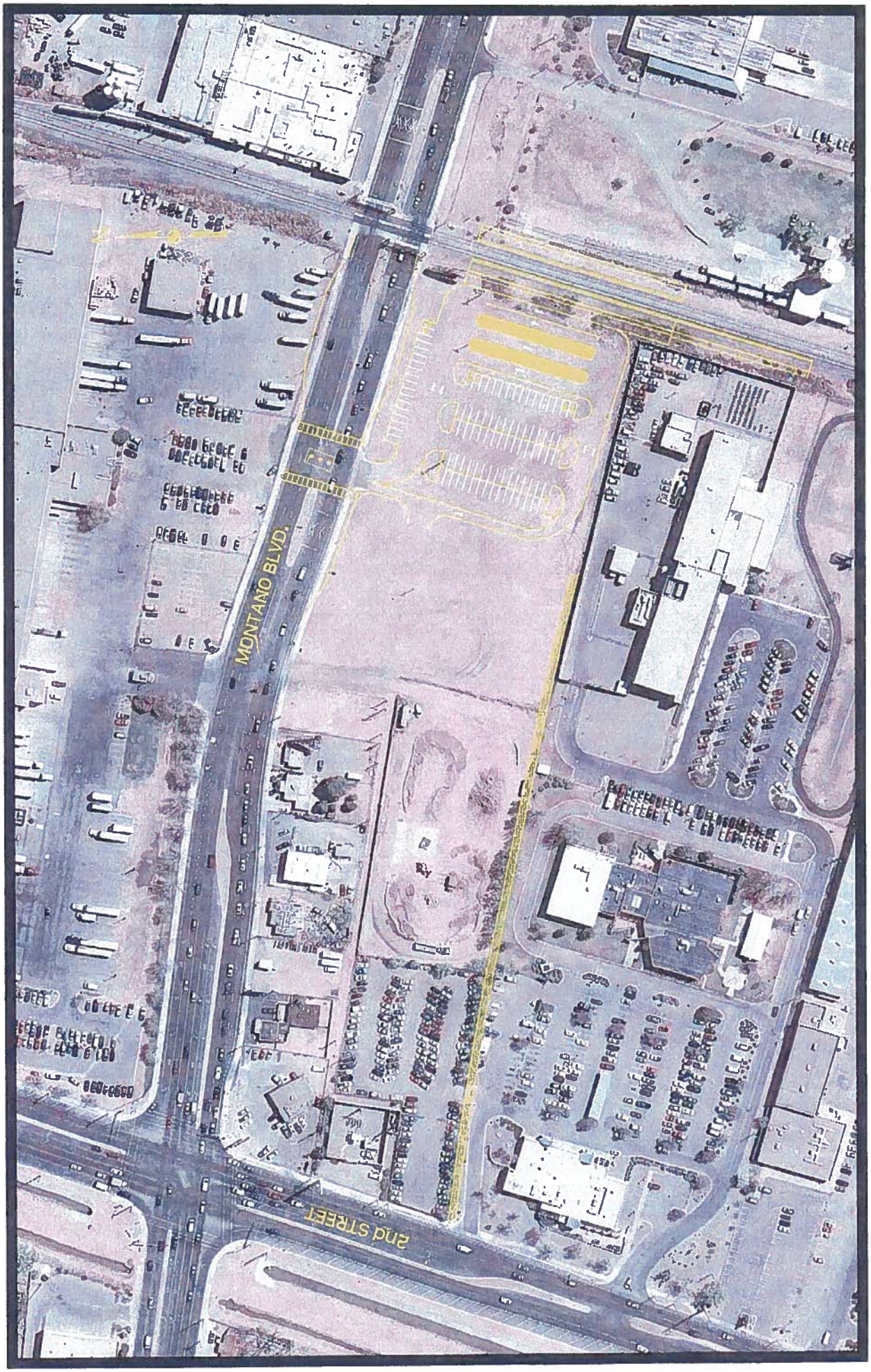
Zone Atlas Page

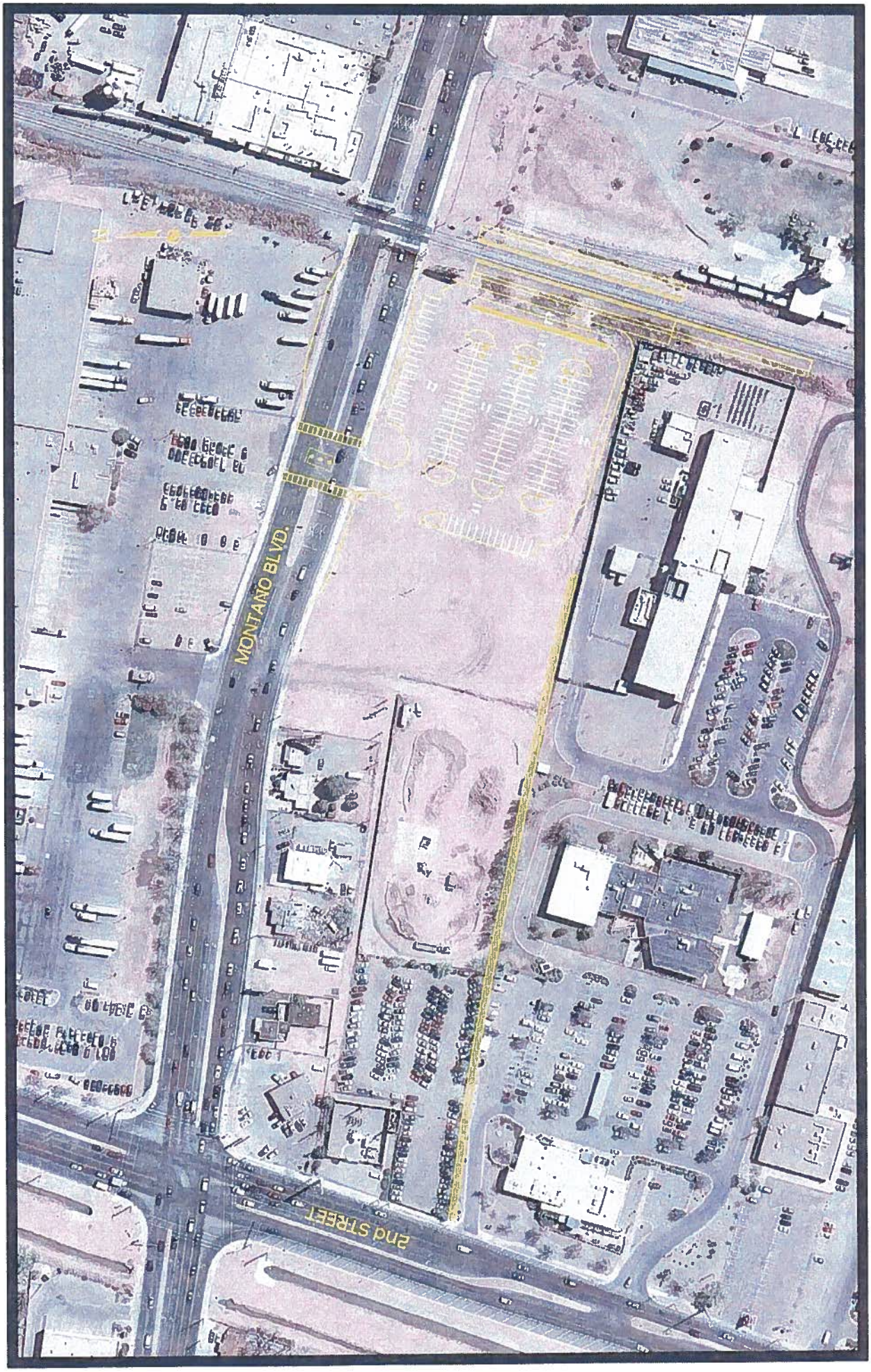
F-15-Z

Map Amended through November 01, 2003

Albuquerque Geographic Information System

PLANNING DEPARTMENT


MONTAÑO BLVD.
2nd STREET


MONTANO BLVD.
2nd STREET

Appendix B

Traffic Volume Summary

Harwick Transportation Group
1440 Camino Cerrito SE
Albuquerque, NM 87123
505.323.5060

Counter: NKH

File Name : Mont2ndSt
Site Code : 00000000
Start Date : 11/4/2009
Page No : 1

Groups Printed- Cars - Trucks - Buses

	MONTANO Eastbound				MONTANO Westbound				2ND ST Northbound				2ND ST Southbound				
Start Time	Left	Thru	Right	App. Total	Left	Thru	Right	App. Total	Left	Thru	Right	App. Total	Left	Thru	Right	App. Total	Int. Total
07:00 AM	18	311	73	402	19	66	12	97	9	91	28	128	63	211	25	299	926
07:15 AM	30	335	57	422	26	84	29	139	10	96	28	134	73	232	26	331	1026
07:30 AM	21	350	67	438	25	119	29	173	25	136	46	207	80	215	21	316	1134
07:45 AM	29	373	70	472	26	129	25	180	22	128	46	196	85	248	28	361	1209
Total	98	1369	267	1734	96	398	95	589	66	451	148	665	301	906	100	1307	4295
08:00 AM	36	284	78	398	31	127	33	191	22	107	27	156	72	237	31	340	1085
08:15 AM	32	290	52	374	25	126	20	171	21	88	21	130	63	222	25	310	985
08:30 AM	22	219	56	297	23	144	21	188	11	73	50	134	51	178	18	247	866
08:45 AM	21	232	47	300	20	117	29	166	17	85	29	131	46	154	19	219	816
Total	111	1025	233	1369	99	514	103	716	71	353	127	551	232	791	93	1116	3752
*** BREAK ***																	
04:00 PM	24	173	35	232	43	296	50	389	92	187	37	316	43	162	32	237	1174
04:15 PM	24	150	26	200	32	263	56	351	72	202	45	319	35	170	33	238	1108
04:30 PM	21	147	27	195	40	315	64	419	67	203	33	303	43	157	46	246	1163
04:45 PM	33	163	30	226	56	289	66	411	76	245	42	363	26	151	33	210	1210
Total	102	633	118	853	171	1163	236	1570	307	837	157	1301	147	640	144	931	4655
05:00 PM	16	154	30	200	37	325	84	446	83	261	41	385	29	152	50	231	1262
05:15 PM	26	170	45	241	28	289	88	405	66	295	29	390	25	142	48	215	1251
05:30 PM	25	156	37	218	38	309	87	434	73	186	55	314	28	129	42	199	1165
05:45 PM	28	145	29	202	36	274	58	368	70	191	28	289	28	131	34	193	1052
Total	95	625	141	861	139	1197	317	1653	292	933	153	1378	110	554	174	838	4730
Grand Total	406	3652	759	4817	505	3272	751	4528	736	2574	585	3895	790	2891	511	4192	17432
Apprch %	8.4	75.8	15.8		11.2	72.3	16.6		18.9	66.1	15		18.8	69	12.2		
Total %	2.3	20.9	4.4	27.6	2.9	18.8	4.3	26	4.2	14.8	3.4	22.3	4.5	16.6	2.9	24	
Cars	399	3631	756	4786	493	3243	736	4472	734	2540	572	3846	776	2858	509	4143	17247
% Cars	98.3	99.4	99.6	99.4	97.6	99.1	98	98.8	99.7	98.7	97.8	98.7	98.2	98.9	99.6	98.8	98.9
Trucks	4	15	3	22	11	19	13	43	1	22	11	34	11	29	2	42	141
% Trucks	1	0.4	0.4	0.5	2.2	0.6	1.7	0.9	0.1	0.9	1.9	0.9	1.4	1	0.4	1	0.8
Buses	3	6	0	9	1	10	2	13	1	12	2	15	3	4	0	7	44
% Buses	0.7	0.2	0	0.2	0.2	0.3	0.3	0.3	0.1	0.5	0.3	0.4	0.4	0.1	0	0.2	0.3

Harwick Transportation Group
1440 Camino Cerrito SE
Albuquerque, NM 87123
505.323.5060

Counter: NKH

File Name : Mont2ndSt
Site Code : 00000000
Start Date : 11/4/2009
Page No : 2

	MONTANO Eastbound				MONTANO Westbound				2ND ST Northbound				2ND ST Southbound				
Start Time	Left	Thru	Right	App. Total	Left	Thru	Right	App. Total	Left	Thru	Right	App. Total	Left	Thru	Right	App. Total	Int. Total
Peak Hour Analysis From 07:00 AM to 11:45 AM - Peak 1 of 1																	
Peak Hour for Entire Intersection Begins at 07:15 AM																	
07:15 AM	30	335	57	422	26	84	29	139	10	96	28	134	73	232	26	331	1026
07:30 AM	21	350	67	438	25	119	29	173	25	136	46	207	80	215	21	316	1134
07:45 AM	29	373	70	472	26	129	25	180	22	128	46	196	85	248	28	361	1209
08:00 AM	36	284	78	398	31	127	33	191	22	107	27	156	72	237	31	340	1085
Total Volume	116	1342	272	1730	108	459	116	683	79	467	147	693	310	932	106	1348	4454
% App. Total	6.7	77.6	15.7		15.8	67.2	17		11.4	67.4	21.2		23	69.1	7.9		
PHF	.806	.899	.872	.916	.871	.890	.879	.894	.790	.858	.799	.837	.912	.940	.855	.934	.921
Cars	115	1334	270	1719	105	450	108	663	79	452	140	671	308	927	105	1340	4393
% Cars	99.1	99.4	99.3	99.4	97.2	98.0	93.1	97.1	100	96.8	95.2	96.8	99.4	99.5	99.1	99.4	98.6
Trucks	0	6	2	8	2	7	7	16	0	8	6	14	2	4	1	7	45
% Trucks	0	0.4	0.7	0.5	1.9	1.5	6.0	2.3	0	1.7	4.1	2.0	0.6	0.4	0.9	0.5	1.0
Buses	1	2	0	3	1	2	1	4	0	7	1	8	0	1	0	1	16
% Buses	0.9	0.1	0	0.2	0.9	0.4	0.9	0.6	0	1.5	0.7	1.2	0	0.1	0	0.1	0.4
Peak Hour Analysis From 12:00 PM to 05:45 PM - Peak 1 of 1																	
Peak Hour for Entire Intersection Begins at 04:45 PM																	
04:45 PM	33	163	30	226	56	289	66	411	76	245	42	363	26	151	33	210	1210
05:00 PM	16	154	30	200	37	325	84	446	83	261	41	385	29	152	50	231	1262
05:15 PM	26	170	45	241	28	289	88	405	66	295	29	390	25	142	48	215	1251
05:30 PM	25	156	37	218	38	309	87	434	73	186	55	314	28	129	42	199	1165
Total Volume	100	643	142	885	159	1212	325	1696	298	987	167	1452	108	574	173	855	4888
% App. Total	11.3	72.7	16		9.4	71.5	19.2		20.5	68	11.5		12.6	67.1	20.2		
PHF	.758	.946	.789	.918	.710	.932	.923	.951	.898	.836	.759	.931	.931	.944	.865	.925	.968
Cars	100	639	142	881	158	1209	325	1692	298	981	166	1445	106	569	173	848	4866
% Cars	100	99.4	100	99.5	99.4	99.8	100	99.8	100	99.4	99.4	99.5	98.1	99.1	100	99.2	99.5
Trucks	0	3	0	3	1	1	0	2	0	5	1	6	2	5	0	7	18
% Trucks	0	0.5	0	0.3	0.6	0.1	0	0.1	0	0.5	0.6	0.4	1.9	0.9	0	0.8	0.4
Buses	0	1	0	1	0	2	0	2	0	1	0	1	0	0	0	0	4
% Buses	0	0.2	0	0.1	0	0.2	0	0.1	0	0.1	0	0.1	0	0	0	0	0.1

Harwick Transportation Group
1440 Camino Cerrito SE
Albuquerque, NM 87123
505.323.5060

Counter: NKH
Project: Montaño Station

File Name : MontanoEdith
Site Code : 00000000
Start Date : 11/5/2009
Page No : 1

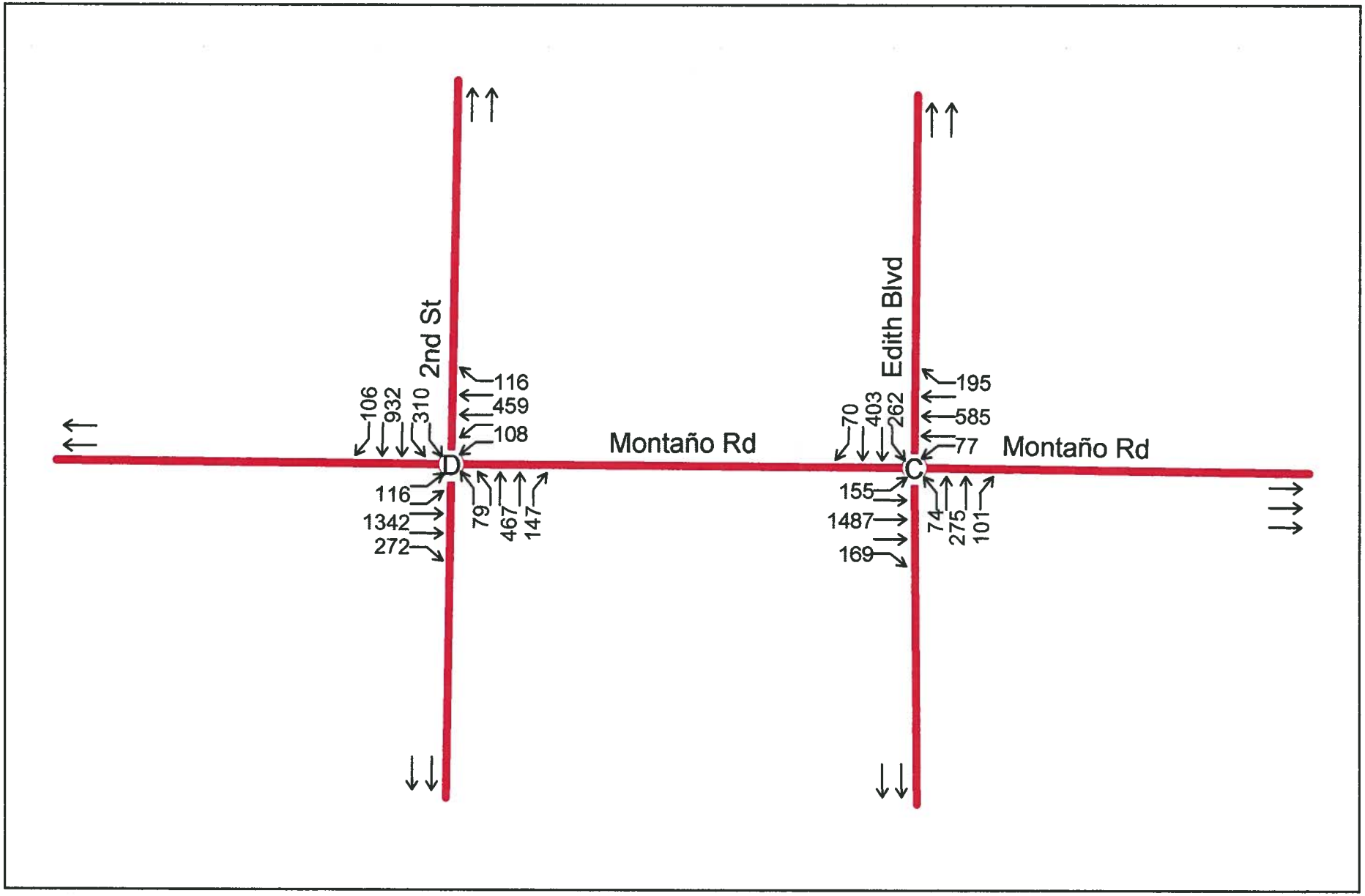
Groups Printed- Cars - Trucks - Buses

	Montaño Eastbound				Montaño Westbound				Edith Northbound				Edith Southbound				
Start Time	Left	Thru	Right	App. Total	Left	Thru	Right	App. Total	Left	Thru	Right	App. Total	Left	Thru	Right	App. Total	Int. Total
07:00 AM	39	275	41	355	9	79	52	140	10	66	14	90	57	75	14	146	731
07:15 AM	39	345	42	426	13	138	40	191	14	74	19	107	40	72	15	127	851
07:30 AM	35	388	55	478	20	158	65	243	20	64	34	118	71	105	18	194	1033
07:45 AM	41	392	39	472	32	148	61	241	26	86	23	135	74	130	19	223	1071
Total	154	1400	177	1731	74	523	218	815	70	290	90	450	242	382	66	690	3686
08:00 AM	40	362	33	435	12	141	29	182	14	51	25	90	77	96	18	191	898
08:15 AM	27	323	21	371	23	140	24	187	18	75	18	111	42	77	15	134	803
*** BREAK ***																	
Total	67	685	54	806	35	281	53	369	32	126	43	201	119	173	33	325	1701
*** BREAK ***																	
04:00 PM	30	220	15	265	26	272	40	338	67	147	32	246	63	106	39	208	1057
04:15 PM	28	237	14	279	28	314	36	378	49	122	36	207	55	82	32	169	1033
04:30 PM	25	199	13	237	35	295	45	375	47	156	25	228	48	77	33	158	998
04:45 PM	34	238	16	288	18	342	53	413	38	140	27	205	37	69	31	137	1043
Total	117	894	58	1069	107	1223	174	1504	201	565	120	886	203	334	135	672	4131
05:00 PM	30	211	11	252	25	344	44	413	67	169	29	265	49	81	44	174	1104
05:15 PM	39	236	24	299	21	377	33	431	59	153	37	249	42	72	27	141	1120
05:30 PM	22	160	9	191	26	270	33	329	38	136	17	191	36	63	32	131	842
05:45 PM	15	194	8	217	15	277	31	323	33	110	12	155	21	33	20	74	769
Total	106	801	52	959	87	1268	141	1496	197	568	95	860	148	249	123	520	3835
Grand Total	444	3780	341	4565	303	3295	586	4184	500	1549	348	2397	712	1138	357	2207	13353
Apprch %	9.7	82.8	7.5		7.2	78.8	14		20.9	64.6	14.5		32.3	51.6	16.2		
Total %	3.3	28.3	2.6	34.2	2.3	24.7	4.4	31.3	3.7	11.6	2.6	18	5.3	8.5	2.7	16.5	
Cars	441	3744	331	4516	292	3265	575	4132	484	1504	335	2323	699	1113	351	2163	13134
% Cars	99.3	99	97.1	98.9	96.4	99.1	98.1	98.8	96.8	97.1	96.3	96.9	98.2	97.8	98.3	98	98.4
Trucks	2	28	8	38	10	18	9	37	15	42	12	69	13	23	5	41	185
% Trucks	0.5	0.7	2.3	0.8	3.3	0.5	1.5	0.9	3	2.7	3.4	2.9	1.8	2	1.4	1.9	1.4
Buses	1	8	2	11	1	12	2	15	1	3	1	5	0	2	1	3	34
% Buses	0.2	0.2	0.6	0.2	0.3	0.4	0.3	0.4	0.2	0.2	0.3	0.2	0	0.2	0.3	0.1	0.3

Harwick Transportation Group
1440 Camino Cerrito SE
Albuquerque, NM 87123
505.323.5060

File Name : MontanoEdith
Site Code : 00000000
Start Date : 11/5/2009

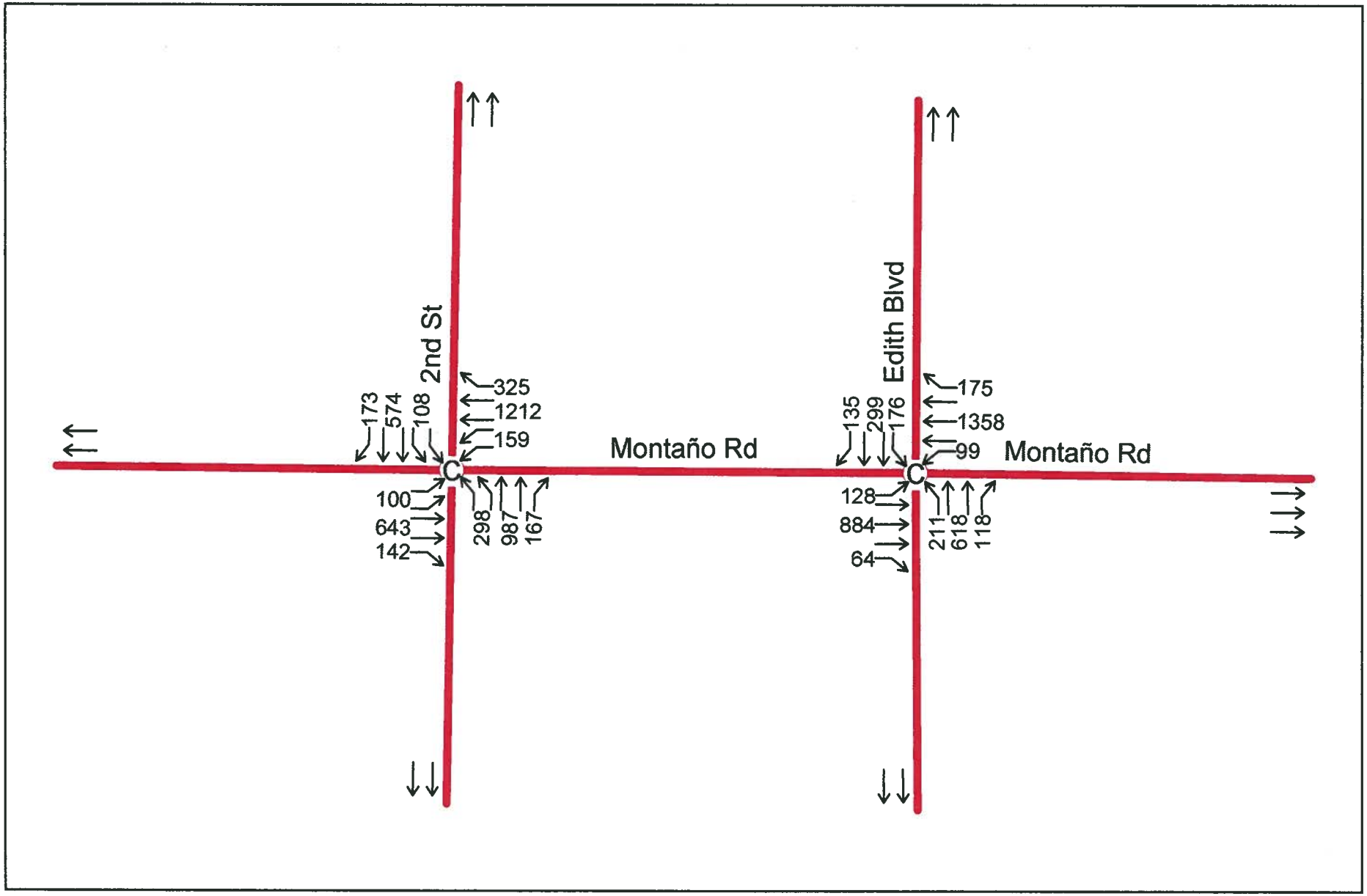
	Montaño Eastbound				Montaño Westbound				Edith Northbound				Edith Southbound				
Start Time	Left	Thru	Right	App. Total	Left	Thru	Right	App. Total	Left	Thru	Right	App. Total	Left	Thru	Right	App. Total	Int. Total
Peak Hour Analysis From 07:00 AM to 11:45 AM - Peak 1 of 1																	
Peak Hour for Entire Intersection Begins at 07:15 AM																	
07:15 AM	39	345	42	426	13	138	40	191	14	74	19	107	40	72	15	127	851
07:30 AM	35	388	55	478	20	158	65	243	20	64	34	118	71	105	18	194	1033
07:45 AM	41	392	39	472	32	148	61	241	26	86	23	135	74	130	19	223	1071
08:00 AM	40	362	33	435	12	141	29	182	14	51	25	90	77	96	18	191	898
Total Volume	155	1487	169	1811	77	585	195	857	74	275	101	450	262	403	70	735	3853
% App. Total	8.6	82.1	9.3		9	68.3	22.8		16.4	61.1	22.4		35.6	54.8	9.5		
PHF	.945	.948	.768	.947	.602	.926	.750	.882	.712	.799	.743	.833	.851	.775	.921	.824	.899
Cars	153	1476	167	1796	72	574	193	839	66	263	93	422	257	393	66	716	3773
% Cars	98.7	99.3	98.8	99.2	93.5	98.1	99.0	97.9	89.2	95.6	92.1	93.8	98.1	97.5	94.3	97.4	97.9
Trucks	1	8	1	10	4	7	2	13	7	11	7	25	5	9	3	17	65
% Trucks	0.6	0.5	0.6	0.6	5.2	1.2	1.0	1.5	9.5	4.0	6.9	5.6	1.9	2.2	4.3	2.3	1.7
Buses	1	3	1	5	1	4	0	5	1	1	1	3	0	1	1	2	15
% Buses	0.6	0.2	0.6	0.3	1.3	0.7	0	0.6	1.4	0.4	1.0	0.7	0	0.2	1.4	0.3	0.4
Peak Hour Analysis From 12:00 PM to 05:45 PM - Peak 1 of 1																	
Peak Hour for Entire Intersection Begins at 04:30 PM																	
04:30 PM	25	199	13	237	35	295	45	375	47	156	25	228	48	77	33	158	998
04:45 PM	34	238	16	288	18	342	53	413	38	140	27	205	37	69	31	137	1043
05:00 PM	30	211	11	252	25	344	44	413	67	169	29	265	49	81	44	174	1104
05:15 PM	39	236	24	299	21	377	33	431	59	153	37	249	42	72	27	141	1120
Total Volume	128	884	64	1076	99	1358	175	1632	211	618	118	947	176	299	135	610	4265
% App. Total	11.9	82.2	5.9		6.1	83.2	10.7		22.3	65.3	12.5		28.9	49	22.1		
PHF	.821	.929	.667	.900	.707	.901	.825	.947	.787	.914	.797	.893	.898	.923	.767	.876	.952
Cars	127	876	61	1064	96	1352	171	1619	207	605	116	928	172	292	135	599	4210
% Cars	99.2	99.1	95.3	98.9	97.0	99.6	97.7	99.2	98.1	97.9	98.3	98.0	97.7	97.7	100	98.2	98.7
Trucks	1	6	3	10	3	2	3	8	4	13	2	19	4	7	0	11	48
% Trucks	0.8	0.7	4.7	0.9	3.0	0.1	1.7	0.5	1.9	2.1	1.7	2.0	2.3	2.3	0	1.8	1.1
Buses	0	2	0	2	0	4	1	5	0	0	0	0	0	0	0	0	7
% Buses	0	0.2	0	0.2	0	0.3	0.6	0.3	0	0	0	0	0	0	0	0	0.2



Montaño Station AM Peak - Existing

P:\Montano Sta\Analysis\Ex-AM.sy7

Figure B-1



Montaño Station PM Peak - Existing

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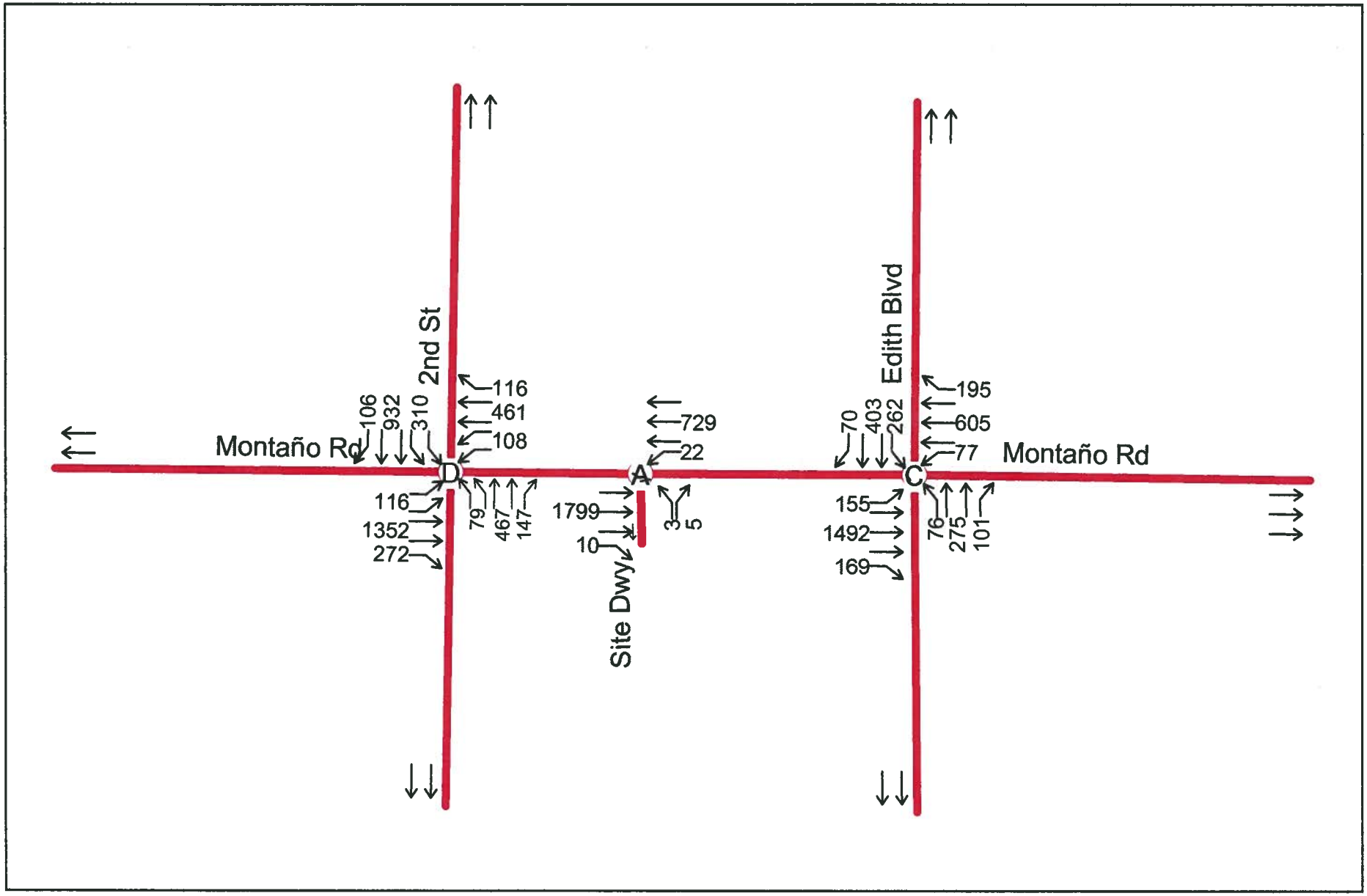
Figure B-2



Montaño Station AM Peak - Build 100 Spaces

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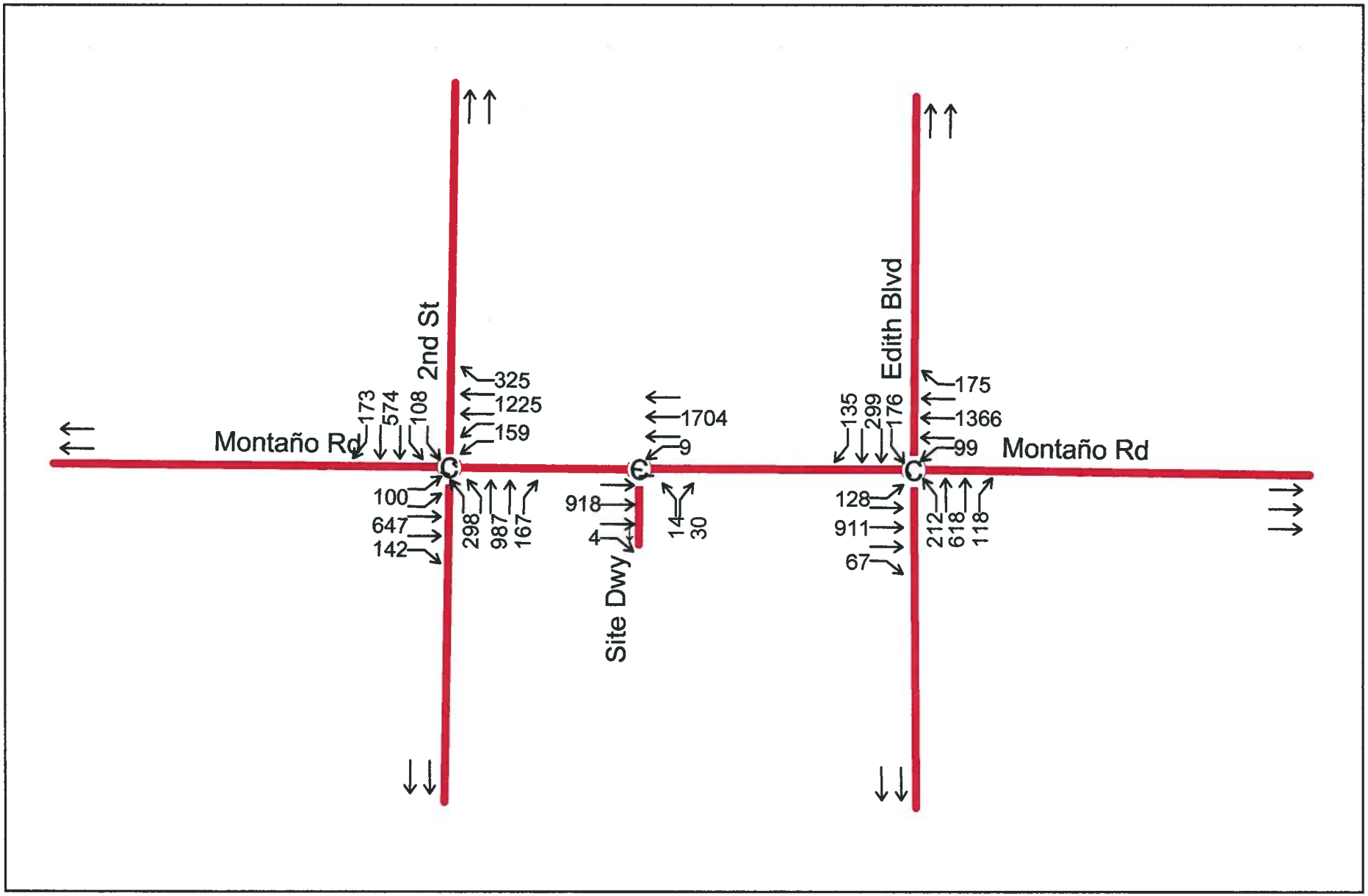
Figure B-3



Montaño Station PM Peak - Build 100 Spaces

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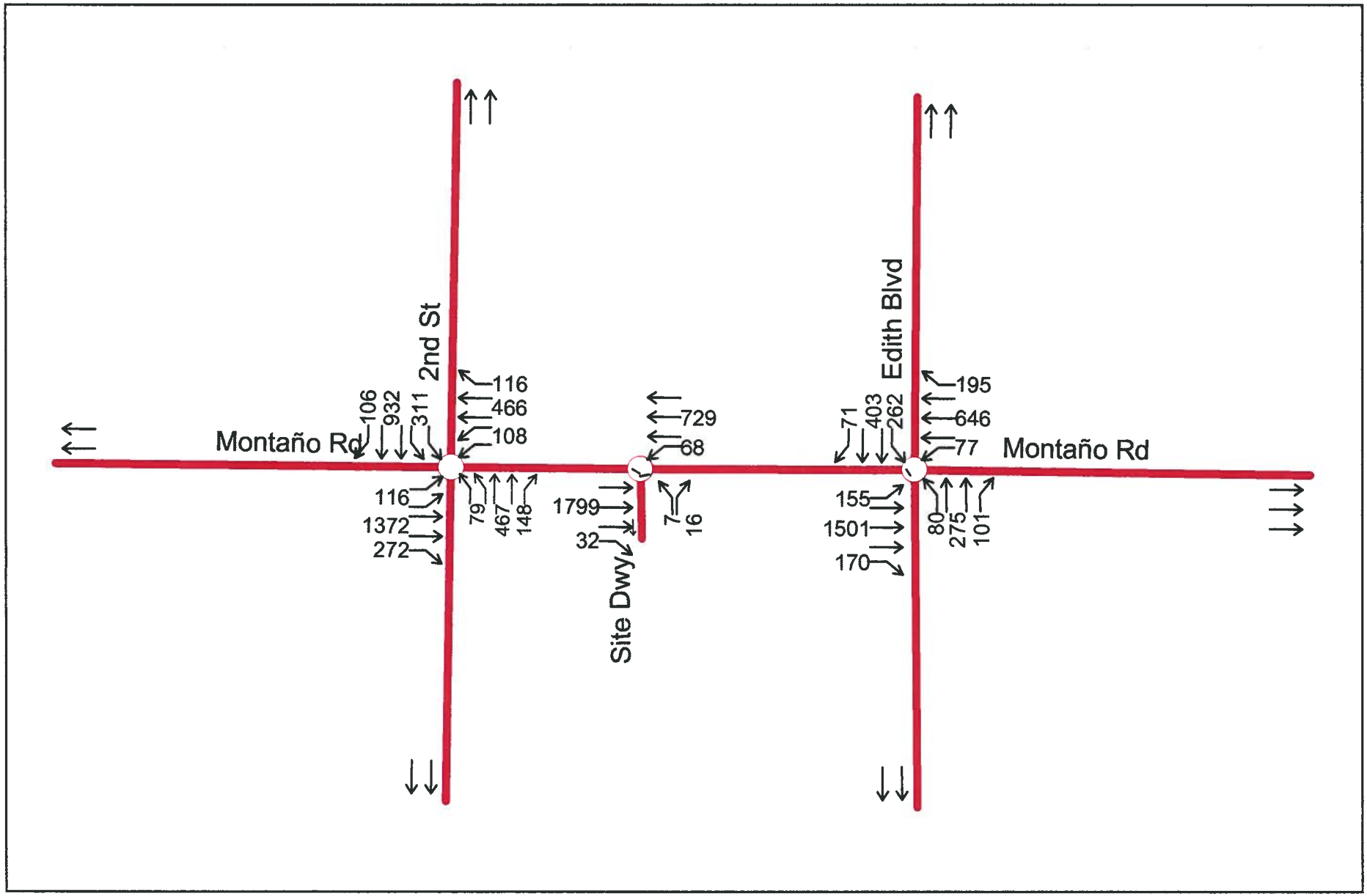
Figure B-4



Montaño Station AM Peak - Build 200 Spaces

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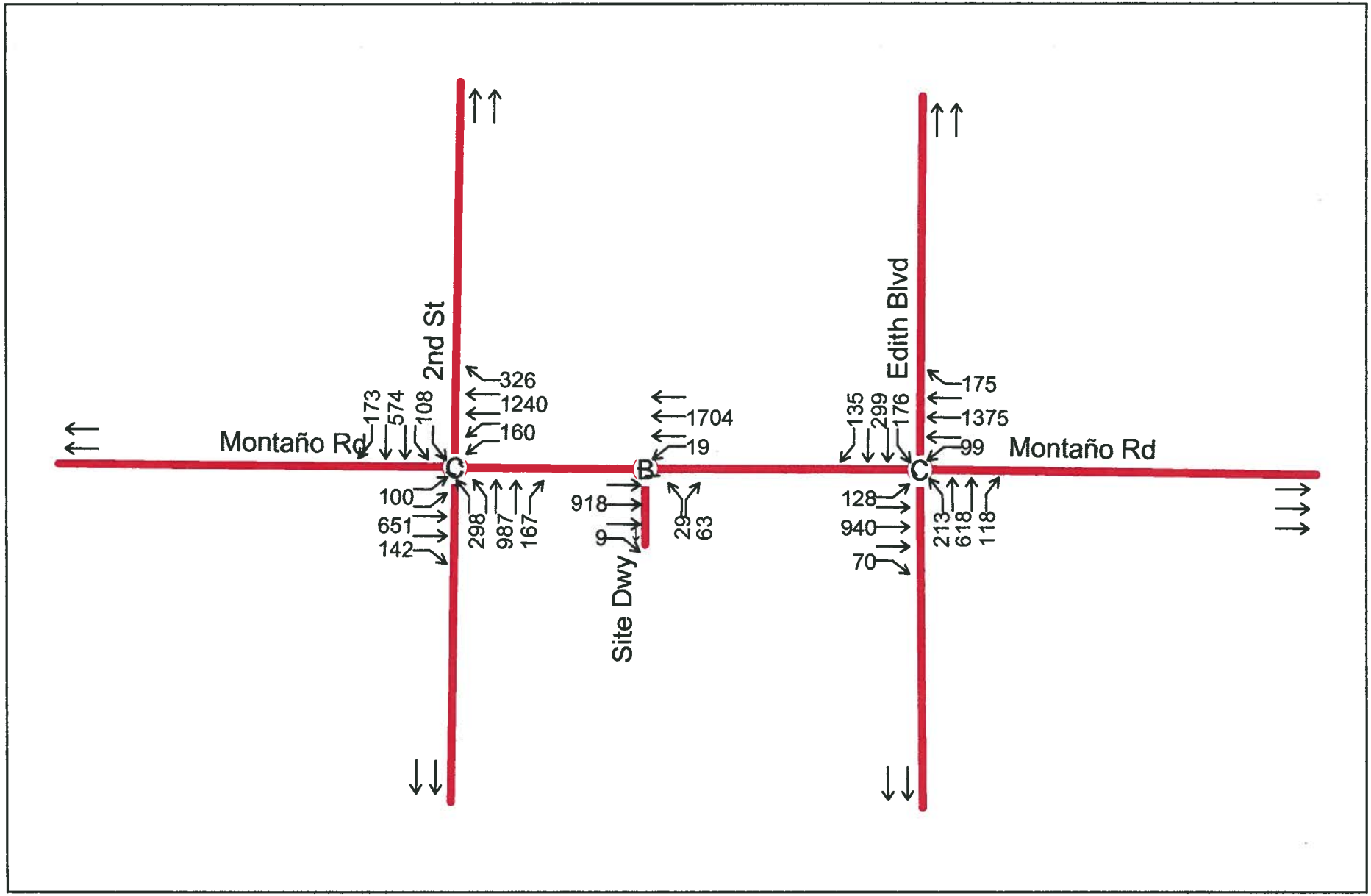
Figure B-5



Montaño Station PM Peak - Build 200 Spaces

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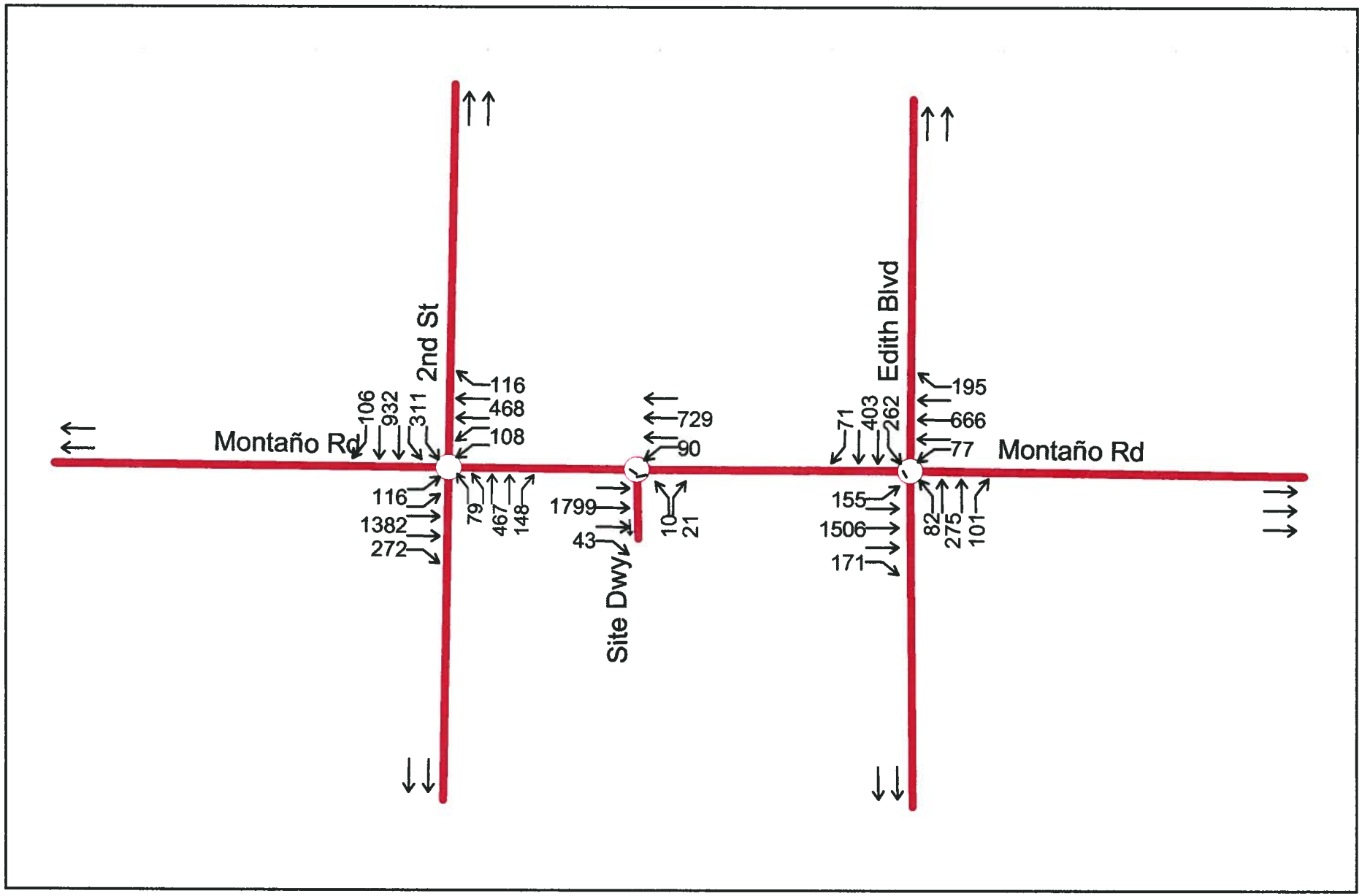
Figure B-6



Montaño Station AM Peak - Build 250 Spaces

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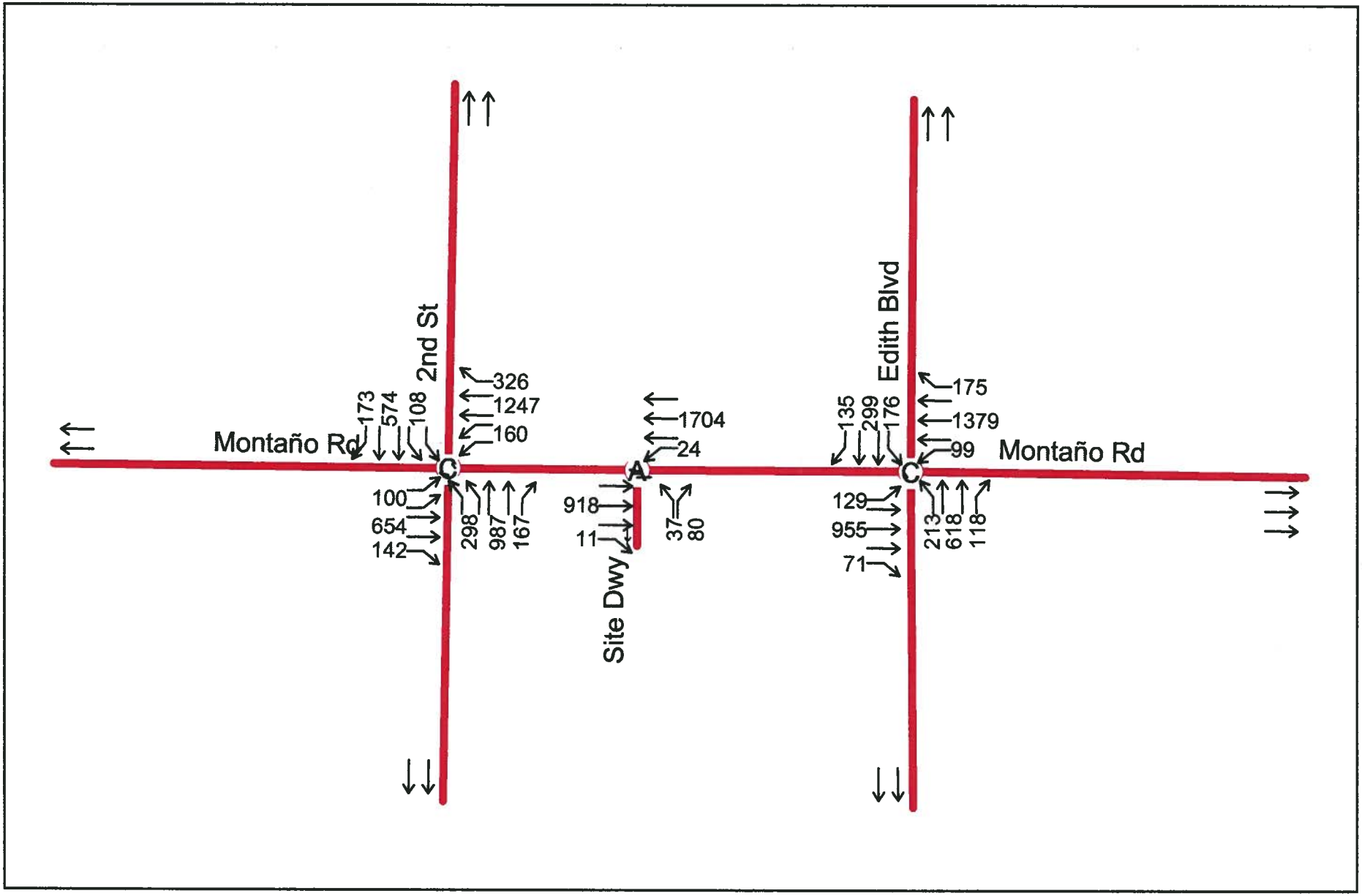
Figure B-7



Montaño Station PM Peak - Build 250 Spaces

P:\Montano Sta\Analysis\Ex-PM-Build-250.sy7

Figure B-8

Appendix C

Trip Generation, Distribution and Assignment

Trip Generation Worksheet

Land Use:	**Park and Ride Lot with Bus Service**	**90**	
Trip Generation Units:		1	Space
	Project Units:	100	

Trip Generation Equations:

Average Vehicle Trip End on a Weekday

T = 4.04(X) + 117.33	
Enter	50%
Exit	50%

Peak Hour of Adjacent St, Traffic 7 to 9 AM

T = 0.83(X) - 43.40	
Enter	81%
Exit	19%

Peak Hour of Adjacent St Traffic, 4 to 6 PM

T = 0.63(X) - 5.94	
Enter	23%
Exit	77%

Daily Trips		**521**
	Enter	261
	Exit	260
AM Peak Trips		**40**
	Enter	32
	Exit	8
PM Peak Trips		**57**
	Enter	13
	Exit	44

Trip Generation based upon ITE *Trip Generation*, 8th Edition.

Distribution-Assignment

Distribution

AM Peak Hour	Eastbound			Westbound			Northbound			Southbound			
Intersection	LT	TH	RT	LT	TH	RT	LT	TH	RT	LT	TH	RT	Sum
Montaño @ 2nd St		**0.3**		0.01	0.3	0.01			**0.01**	**0.01**			
Montaño @ Site Access			**0.32**	**0.68**			0.32		0.68				
Montaño @ Edith Blvd	0.01	0.61	0.06		**0.61**		**0.06**					**0.01**	

PM Peak Hour	Eastbound			Westbound			Northbound			Southbound			
Intersection	LT	TH	RT	LT	TH	RT	LT	TH	RT	LT	TH	RT	Sum
Montaño @ 2nd St		**0.3**		0.01	0.3	0.01			**0.01**	**0.01**			
Montaño @ Site Access			**0.32**	**0.68**			0.32		0.68				
Montaño @ Edith Blvd	0.01	0.61	0.06		**0.61**		**0.06**					**0.01**	

Assignment

AM Peak Hour	Eastbound			Westbound			Northbound			Southbound					
Intersection	LT	TH	RT	LT	TH	RT	LT	TH	RT	LT	TH	RT	Sum		
Montaño @ 2nd St		**10**		0	2	0			**0**	**0**			12	In	Out
Montaño @ Site Access			**10**	**22**			3		5				40	32	8
Montaño @ Edith Blvd	0	5	0		**20**		**2**					**0**	27		

PM Peak Hour	Eastbound			Westbound			Northbound			Southbound					
Intersection	LT	TH	RT	LT	TH	RT	LT	TH	RT	LT	TH	RT	Sum		
Montaño @ 2nd St		**4**		0	13	0			**0**	**0**			17	In	Out
Montaño @ Site Access			**4**	**9**			14		30				57	13	44
Montaño @ Edith Blvd	0	27	3		**8**		**1**					**0**	39		

Bold - Entering Traffic

Subarea Summaries

	Trips	1	2	3	4	5	6	7	8	SUM
Population		66688	18494	2846	3123	1603	15705	103343	72229	**284031**
Population %		23%	7%	1%	1%	1%	6%	36%	25%	**100%**
AM Enter	32	8	2	0	0	0	2	12	8	**32**
AM Exit	8	2	1	0	0	0	0	3	2	**8**
PM Enter	13	3	1	0	0	0	1	5	3	**13**
PM Exit	44	10	3	0	0	0	2	16	11	**42**
Daily Enter	261	61	17	3	3	1	14	95	66	**260**
Daily Exit	261	61	17	3	3	1	14	95	66	**260**

Subareas:	Via:
1	Westside via Montaño
2	East of river via Montaño
3	North of Montaño via 2nd St
4	South of Montaño via 2nd St
5	North of Montaño via Edith
6	South of Montaño via Edith
7	Via I-40 and Montaño
8	Via Montaño/Montgomery

Percentages	EB In	WB Out	WB In	EB Out
Directional	32%	32%	68%	68%

Trips	EB In	WB Out	WB In	EB Out
AM	10	3	22	5
PM	4	13	9	29
Daily	84	84	176	176

Trip Generation Worksheet

Land Use:	**Park and Ride Lot with Bus Service**	**90**

Trip Generation Units:	1	Space
Project Units:	200	

Trip Generation Equations:

Average Vehicle Trip End on a Weekday

T = 4.04(X) + 117.33

Enter	50%
Exit	50%

Peak Hour of Adjacent St, Traffic 7 to 9 AM

T = 0.83(X) - 43.40

Enter	81%
Exit	19%

Peak Hour of Adjacent St Traffic, 4 to 6 PM

T = 0.63(X) - 5.94

Enter	23%
Exit	77%

Daily Trips		**925**
	Enter	463
	Exit	462
AM Peak Trips		**123**
	Enter	100
	Exit	23
PM Peak Trips		**120**
	Enter	28
	Exit	92

Trip Generation based upon ITE *Trip Generation*, 8th Edition.

Distribution-Assignment

Distribution

AM Peak Hour	Eastbound			Westbound			Northbound			Southbound			
Intersection	LT	TH	RT	LT	TH	RT	LT	TH	RT	LT	TH	RT	Sum
Montaño @ 2nd St		**0.3**		0.01	0.3	0.01			**0.01**	**0.01**			
Montaño @ Site Access			**0.32**	**0.68**			0.32		0.68				
Montaño @ Edith Blvd	0.01	0.61	0.06		**0.61**		**0.06**					**0.01**	

PM Peak Hour	Eastbound			Westbound			Northbound			Southbound			
Intersection	LT	TH	RT	LT	TH	RT	LT	TH	RT	LT	TH	RT	Sum
Montaño @ 2nd St		**0.3**		0.01	0.3	0.01			**0.01**	**0.01**			
Montaño @ Site Access			**0.32**	**0.68**			0.32		0.68				
Montaño @ Edith Blvd	0.01	0.61	0.06		**0.61**		**0.06**					**0.01**	

Assignment

AM Peak Hour	Eastbound			Westbound			Northbound			Southbound					
Intersection	LT	TH	RT	LT	TH	RT	LT	TH	RT	LT	TH	RT	Sum		
Montaño @ 2nd St		**30**		0	7	0			**1**	**1**			39	In	Out
Montaño @ Site Access			**32**	**68**			7		16				123	100	23
Montaño @ Edith Blvd	0	14	1		**61**		**6**					**1**	83		

PM Peak Hour	Eastbound			Westbound			Northbound			Southbound					
Intersection	LT	TH	RT	LT	TH	RT	LT	TH	RT	LT	TH	RT	Sum		
Montaño @ 2nd St		**8**		1	28	1			**0**	**0**			38	In	Out
Montaño @ Site Access			**9**	**19**			29		63				120	28	92
Montaño @ Edith Blvd	1	56	6		**17**		**2**					**0**	82		

Bold - Entering Traffic

Subarea Summaries

	Trips	1	2	3	4	5	6	7	8	SUM
Population		66688	18494	2846	3123	1603	15705	103343	72229	**284031**
Population %		23%	7%	1%	1%	1%	6%	36%	25%	**100%**
AM Enter	100	23	7	1	1	1	6	36	25	**100**
AM Exit	23	5	1	0	0	0	1	8	6	**21**
PM Enter	28	7	2	0	0	0	2	10	7	**28**
PM Exit	92	22	6	1	1	1	5	33	23	**92**
Daily Enter	463	109	30	5	5	3	26	168	118	**464**
Daily Exit	463	109	30	5	5	3	26	168	118	**464**

Subareas:	Via:
1	Westside via Montaño
2	East of river via Montaño
3	North of Montaño via 2nd St
4	South of Montaño via 2nd St
5	North of Montaño via Edith
6	South of Montaño via Edith
7	Via I-40 and Montaño
8	Via Montaño/Montgomery

Percentages	EB In	WB Out	WB In	EB Out
Directional	32%	32%	68%	68%

Trips	EB In	WB Out	WB In	EB Out
AM	32	6	68	15
PM	9	30	19	62
Daily	149	149	315	315

Trip Generation Worksheet

Land Use:	**Park and Ride Lot with Bus Service**	**90**	
Trip Generation Units:		1	Space
	Project Units:	250	

Trip Generation Equations:

Average Vehicle Trip End on a Weekday

T = 4.04(X) + 117.33	
Enter	50%
Exit	50%

Peak Hour of Adjacent St, Traffic 7 to 9 AM

T = 0.83(X) - 43.40	
Enter	81%
Exit	19%

Peak Hour of Adjacent St Traffic, 4 to 6 PM

T = 0.63(X) - 5.94	
Enter	23%
Exit	77%

Daily Trips		**1127**
	Enter	564
	Exit	563
AM Peak Trips		**164**
	Enter	133
	Exit	31
PM Peak Trips		**152**
	Enter	35
	Exit	117

Trip Generation based upon ITE *Trip Generation*, 8th Edition.

Distribution-Assignment

Distribution

AM Peak Hour	Eastbound			Westbound			Northbound			Southbound			
Intersection	LT	TH	RT	LT	TH	RT	LT	TH	RT	LT	TH	RT	Sum
Montaño @ 2nd St		**0.3**		0.01	0.3	0.01			**0.01**	**0.01**			
Montaño @ Site Access			**0.32**	**0.68**			0.32		0.68				
Montaño @ Edith Blvd	0.01	0.61	0.06		**0.61**		**0.06**					**0.01**	

PM Peak Hour	Eastbound			Westbound			Northbound			Southbound			
Intersection	LT	TH	RT	LT	TH	RT	LT	TH	RT	LT	TH	RT	Sum
Montaño @ 2nd St		**0.3**		0.01	0.3	0.01			**0.01**	**0.01**			
Montaño @ Site Access			**0.32**	**0.68**			0.32		0.68				
Montaño @ Edith Blvd	0.01	0.61	0.06		**0.61**		**0.06**					**0.01**	

Assignment

AM Peak Hour	Eastbound			Westbound			Northbound			Southbound					
Intersection	LT	TH	RT	LT	TH	RT	LT	TH	RT	LT	TH	RT	Sum		
Montaño @ 2nd St		**40**		0	9	0			**1**	**1**			51	In	Out
Montaño @ Site Access			**43**	**90**			10		21				164	133	31
Montaño @ Edith Blvd	0	19	2		**81**		**8**					**1**	111		

PM Peak Hour	Eastbound			Westbound			Northbound			Southbound					
Intersection	LT	TH	RT	LT	TH	RT	LT	TH	RT	LT	TH	RT	Sum		
Montaño @ 2nd St		**11**		1	35	1			**0**	**0**			48	In	Out
Montaño @ Site Access			**11**	**24**			37		80				152	35	117
Montaño @ Edith Blvd	1	71	7		**21**		**2**					**0**	102		

Bold - Entering Traffic

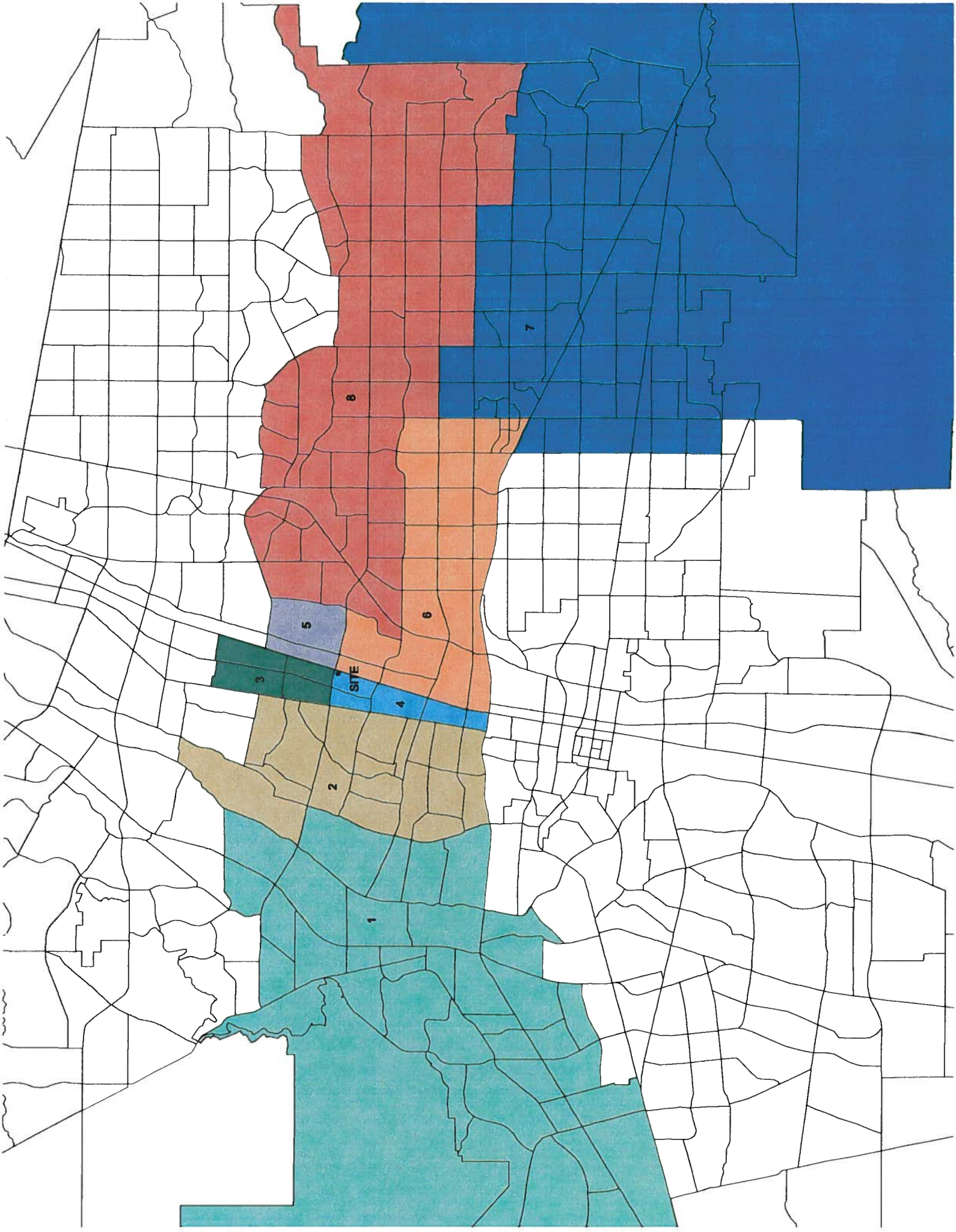
Subarea Summaries

	Trips	1	2	3	4	5	6	7	8	SUM
Population		66688	18494	2846	3123	1603	15705	103343	72229	**284031**
Population %		23%	7%	1%	1%	1%	6%	36%	25%	**100%**
AM Enter	133	31	9	1	1	1	7	48	34	**132**
AM Exit	31	7	2	0	0	0	2	11	8	**30**
PM Enter	35	8	2	0	0	0	2	13	9	**34**
PM Exit	117	27	8	1	1	1	6	43	30	**117**
Daily Enter	564	132	37	6	6	3	31	205	143	**563**
Daily Exit	564	132	37	6	6	3	31	205	143	**563**

Subareas:	Via:
1	Westside via Montaño
2	East of river via Montaño
3	North of Montaño via 2nd St
4	South of Montaño via 2nd St
5	North of Montaño via Edith
6	South of Montaño via Edith
7	Via I-40 and Montaño
8	Via Montaño/Montgomery

Percentages	EB In	WB Out	WB In	EB Out
Directional	32%	32%	68%	68%

Trips	EB In	WB Out	WB In	EB Out
AM	42	9	90	21
PM	10	37	24	80
Daily	181	181	382	382


1
2
3
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8
SITE

Appendix D

Existing Level of Service Analyses

HCM Signalized Intersection Capacity Analysis
1: Montaño Rd & 2nd St

1/11/2010

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	116	1342	272	108	459	116	79	467	147	310	932	106
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
Lane Util. Factor	0.97	0.95	1.00	0.97	0.95	1.00	0.97	0.95	1.00	0.97	0.95	1.00
Frt	1.00	1.00	0.85	1.00	1.00	0.85	1.00	1.00	0.85	1.00	1.00	0.85
Flt Protected	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00
Satd. Flow (prot)	3433	3539	1583	3433	3539	1583	3433	3539	1583	3433	3539	1583
Flt Permitted	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00
Satd. Flow (perm)	3433	3539	1583	3433	3539	1583	3433	3539	1583	3433	3539	1583
Peak-hour factor, PHF	0.92	0.92	0.92	0.89	0.89	0.89	0.84	0.84	0.84	0.93	0.93	0.93
Adj. Flow (vph)	126	1459	296	121	516	130	94	556	175	333	1002	114
RTOR Reduction (vph)	0	0	8	0	0	27	0	0	11	0	0	70
Lane Group Flow (vph)	126	1459	288	121	516	103	94	556	164	333	1002	44
Turn Type	Prot		pm+ov	Prot		pm+ov	Prot		pm+ov	Prot		pm+ov
Protected Phases	5	2	3	1	6	7	3	8	1	7	4	5
Permitted Phases			2			6			8			4
Actuated Green, G (s)	7.3	53.5	58.0	4.5	50.7	63.9	4.5	26.8	31.3	13.2	35.5	42.8
Effective Green, g (s)	8.8	55.0	61.0	6.0	52.2	66.9	6.0	28.3	34.3	14.7	37.0	45.8
Actuated g/C Ratio	0.07	0.46	0.51	0.05	0.44	0.56	0.05	0.24	0.29	0.12	0.31	0.38
Clearance Time (s)	5.5	5.5	5.5	5.5	5.5	5.5	5.5	5.5	5.5	5.5	5.5	5.5
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0
Lane Grp Cap (vph)	252	1622	805	172	1539	935	172	835	452	421	1091	657
v/s Ratio Prot	0.04	c0.41	0.02	c0.04	0.15	0.01	0.03	0.16	0.02	c0.10	c0.28	0.00
v/s Ratio Perm			0.16			0.05			0.09			0.02
v/c Ratio	0.50	0.90	0.36	0.70	0.34	0.11	0.55	0.67	0.36	0.79	0.92	0.07
Uniform Delay, d1	53.5	30.0	17.7	56.1	22.4	12.5	55.7	41.6	34.1	51.2	40.0	23.5
Progression Factor	1.00	1.00	1.00	0.67	0.44	0.03	1.00	1.00	1.00	1.00	1.00	1.00
Incremental Delay, d2	1.6	8.4	0.3	11.9	0.6	0.1	3.5	4.2	0.5	9.8	13.6	0.0
Delay (s)	55.0	38.3	18.0	49.2	10.4	0.4	59.2	45.7	34.6	60.9	53.6	23.6
Level of Service	E	D	B	D	B	A	E	D	C	E	D	C
Approach Delay (s)		36.3			14.8			44.9			52.9	
Approach LOS		D			B			D			D	

Intersection Summary			
HCM Average Control Delay	39.3	HCM Level of Service	D
HCM Volume to Capacity ratio	0.87		
Actuated Cycle Length (s)	120.0	Sum of lost time (s)	12.0
Intersection Capacity Utilization	82.9%	ICU Level of Service	E
Analysis Period (min)	15		

c Critical Lane Group

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	155	1487	169	77	585	195	74	275	101	262	403	70
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
Lane Util. Factor	1.00	0.91	1.00	1.00	0.91	1.00	1.00	0.95	1.00	1.00	0.95	1.00
Frt	1.00	1.00	0.85	1.00	1.00	0.85	1.00	1.00	0.85	1.00	1.00	0.85
Flt Protected	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00
Satd. Flow (prot)	1770	5085	1583	1770	5085	1583	1770	3539	1583	1770	3539	1583
Flt Permitted	0.33	1.00	1.00	0.08	1.00	1.00	0.47	1.00	1.00	0.35	1.00	1.00
Satd. Flow (perm)	611	5085	1583	154	5085	1583	881	3539	1583	643	3539	1583
Peak-hour factor, PHF	0.95	0.95	0.95	0.88	0.88	0.88	0.83	0.83	0.83	0.82	0.82	0.82
Adj. Flow (vph)	163	1565	178	88	665	222	89	331	122	320	491	85
RTOR Reduction (vph)	0	0	59	0	0	71	0	0	65	0	0	51
Lane Group Flow (vph)	163	1565	119	88	665	151	89	331	57	320	491	34
Turn Type	pm+pt		pm+ov	pm+pt		pm+ov	pm+pt		pm+ov	pm+pt		pm+ov
Protected Phases	5	2	3	1	6	7	3	8	1	7	4	5
Permitted Phases	2		2	6		6	8		8	4		4
Actuated Green, G (s)	55.2	47.2	52.7	54.6	46.9	67.9	27.6	22.1	29.8	48.6	37.6	45.6
Effective Green, g (s)	58.2	48.7	55.7	57.6	48.4	70.9	30.6	23.6	32.8	50.1	39.1	48.6
Actuated g/C Ratio	0.49	0.41	0.46	0.48	0.40	0.59	0.26	0.20	0.27	0.42	0.33	0.41
Clearance Time (s)	5.5	5.5	5.5	5.5	5.5	5.5	5.5	5.5	5.5	5.5	5.5	5.5
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0
Lane Grp Cap (vph)	388	2064	788	198	2051	988	277	696	485	480	1153	694
v/s Ratio Prot	0.03	c0.31	0.01	c0.03	0.13	0.03	0.02	0.09	0.01	c0.13	0.14	0.00
v/s Ratio Perm	0.17		0.07	0.18		0.07	0.06		0.03	c0.15		0.02
v/c Ratio	0.42	0.76	0.15	0.44	0.32	0.15	0.32	0.48	0.12	0.67	0.43	0.05
Uniform Delay, d1	17.8	30.6	18.5	21.6	24.6	11.0	35.1	42.7	32.7	25.5	31.7	21.7
Progression Factor	0.44	0.61	0.60	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Incremental Delay, d2	0.4	1.4	0.0	1.6	0.4	0.1	0.7	2.3	0.1	3.5	1.2	0.0
Delay (s)	8.2	20.0	11.1	23.2	25.0	11.1	35.7	45.0	32.8	29.0	32.8	21.7
Level of Service	A	C	B	C	C	B	D	D	C	C	C	C
Approach Delay (s)		18.2			21.7			40.8			30.4	
Approach LOS		B			C			D			C	

Intersection Summary			
HCM Average Control Delay	24.3	HCM Level of Service	C
HCM Volume to Capacity ratio	0.66		
Actuated Cycle Length (s)	120.0	Sum of lost time (s)	8.0
Intersection Capacity Utilization	68.4%	ICU Level of Service	C
Analysis Period (min)	15		

c Critical Lane Group

HCM Signalized Intersection Capacity Analysis
1: Montaño Rd & 2nd St

1/11/2010

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	100	643	142	159	1212	325	298	987	167	108	574	173
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
Lane Util. Factor	0.97	0.95	1.00	0.97	0.95	1.00	0.97	0.95	1.00	0.97	0.95	1.00
Frt	1.00	1.00	0.85	1.00	1.00	0.85	1.00	1.00	0.85	1.00	1.00	0.85
Flt Protected	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00
Satd. Flow (prot)	3433	3539	1583	3433	3539	1583	3433	3539	1583	3433	3539	1583
Flt Permitted	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00
Satd. Flow (perm)	3433	3539	1583	3433	3539	1583	3433	3539	1583	3433	3539	1583
Peak-hour factor, PHF	0.92	0.92	0.92	0.95	0.95	0.95	0.93	0.93	0.93	0.93	0.93	0.93
Adj. Flow (vph)	109	699	154	167	1276	342	320	1061	180	116	617	186
RTOR Reduction (vph)	0	0	26	0	0	11	0	0	53	0	0	16
Lane Group Flow (vph)	109	699	128	167	1276	331	320	1061	127	116	617	170
Turn Type	Prot		pm+ov	Prot		pm+ov	Prot		pm+ov	Prot		pm+ov
Protected Phases	5	2	3	1	6	7	3	8	1	7	4	5
Permitted Phases			2			6			8			4
Actuated Green, G (s)	4.6	42.5	57.6	9.4	47.3	54.3	15.1	39.1	48.5	7.0	31.0	35.6
Effective Green, g (s)	6.1	44.0	60.6	10.9	48.8	57.3	16.6	40.6	51.5	8.5	32.5	38.6
Actuated g/C Ratio	0.05	0.37	0.51	0.09	0.41	0.48	0.14	0.34	0.43	0.07	0.27	0.32
Clearance Time (s)	5.5	5.5	5.5	5.5	5.5	5.5	5.5	5.5	5.5	5.5	5.5	5.5
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0
Lane Grp Cap (vph)	175	1298	799	312	1439	756	475	1197	679	243	958	509
v/s Ratio Prot	0.03	0.20	0.02	c0.05	c0.36	0.03	c0.09	c0.30	0.02	0.03	0.17	0.02
v/s Ratio Perm			0.06			0.18			0.06			0.09
v/c Ratio	0.62	0.54	0.16	0.54	0.89	0.44	0.67	0.89	0.19	0.48	0.64	0.33
Uniform Delay, d1	55.8	30.0	16.0	52.1	33.0	20.7	49.1	37.5	21.3	53.6	38.6	30.9
Progression Factor	1.00	1.00	1.00	0.81	0.50	0.29	1.00	1.00	1.00	1.00	1.00	1.00
Incremental Delay, d2	6.7	1.6	0.1	1.3	6.2	0.3	3.8	9.8	0.1	1.5	3.3	0.4
Delay (s)	62.6	31.6	16.1	43.6	22.9	6.4	52.9	47.4	21.4	55.1	42.0	31.3
Level of Service	E	C	B	D	C	A	D	D	C	E	D	C
Approach Delay (s)		32.6			21.6			45.5			41.5	
Approach LOS		C			C			D			D	

Intersection Summary			
HCM Average Control Delay	34.3	HCM Level of Service	C
HCM Volume to Capacity ratio	0.84		
Actuated Cycle Length (s)	120.0	Sum of lost time (s)	12.0
Intersection Capacity Utilization	80.8%	ICU Level of Service	D
Analysis Period (min)	15		

c Critical Lane Group

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	128	884	64	99	1358	175	211	618	118	176	299	135
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
Lane Util. Factor	1.00	0.91	1.00	1.00	0.91	1.00	1.00	0.95	1.00	1.00	0.95	1.00
Frt	1.00	1.00	0.85	1.00	1.00	0.85	1.00	1.00	0.85	1.00	1.00	0.85
Flt Protected	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00
Satd. Flow (prot)	1770	5085	1583	1770	5085	1583	1770	3539	1583	1770	3539	1583
Flt Permitted	0.11	1.00	1.00	0.28	1.00	1.00	0.45	1.00	1.00	0.18	1.00	1.00
Satd. Flow (perm)	212	5085	1583	521	5085	1583	847	3539	1583	327	3539	1583
Peak-hour factor, PHF	0.90	0.90	0.90	0.95	0.95	0.95	0.89	0.89	0.89	0.88	0.88	0.88
Adj. Flow (vph)	142	982	71	104	1429	184	237	694	133	200	340	153
RTOR Reduction (vph)	0	0	34	0	0	53	0	0	43	0	0	59
Lane Group Flow (vph)	142	982	37	104	1429	131	237	694	90	200	340	94
Turn Type	pm+pt		pm+ov	pm+pt		pm+ov	pm+pt		pm+ov	pm+pt		pm+ov
Protected Phases	5	2	3	1	6	7	3	8	1	7	4	5
Permitted Phases	2		2	6		6	8		8	4		4
Actuated Green, G (s)	45.6	45.6	59.0	42.5	42.5	55.9	45.0	31.6	39.0	45.0	31.6	42.1
Effective Green, g (s)	47.1	47.1	62.0	44.0	44.0	58.9	48.0	33.1	42.0	48.0	33.1	45.1
Actuated g/C Ratio	0.39	0.39	0.52	0.37	0.37	0.49	0.40	0.28	0.35	0.40	0.28	0.38
Clearance Time (s)	5.5	5.5	5.5	5.5	5.5	5.5	5.5	5.5	5.5	5.5	5.5	5.5
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0
Lane Grp Cap (vph)	239	1996	818	284	1865	830	453	976	554	310	976	648
v/s Ratio Prot	c0.06	0.19	0.01	0.03	c0.28	0.02	0.06	c0.20	0.01	c0.08	0.10	0.01
v/s Ratio Perm	0.17		0.02	0.11		0.06	0.14		0.04	0.18		0.04
v/c Ratio	0.59	0.49	0.04	0.37	0.77	0.16	0.52	0.71	0.16	0.65	0.35	0.14
Uniform Delay, d1	28.4	27.4	14.3	30.1	33.5	16.9	25.1	39.1	26.9	26.2	34.8	24.7
Progression Factor	0.65	0.71	0.57	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Incremental Delay, d2	3.7	0.8	0.0	0.8	3.1	0.1	1.1	4.4	0.1	4.6	1.0	0.1
Delay (s)	22.2	20.2	8.3	30.9	36.5	16.9	26.2	43.5	27.0	30.8	35.8	24.8
Level of Service	C	C	A	C	D	B	C	D	C	C	D	C
Approach Delay (s)		19.7			34.1			37.6			31.9	
Approach LOS		B			C			D			C	

Intersection Summary			
HCM Average Control Delay	30.9	HCM Level of Service	C
HCM Volume to Capacity ratio	0.71		
Actuated Cycle Length (s)	120.0	Sum of lost time (s)	16.0
Intersection Capacity Utilization	73.5%	ICU Level of Service	D
Analysis Period (min)	15		

c Critical Lane Group

Appendix E

Alternative 1 Level of Service Analyses

Level of Service Analysis	Pages
Alternative 1 AM - Signalized	3
Alternative 1 PM - Signalized	3
Alternative 1 AM - Unsignalized	1
Alternative 1 PM - Unsignalized	1

HCM Signalized Intersection Capacity Analysis
1: Montaño Rd & 2nd St

1/11/2010

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	116	1352	272	108	461	116	79	467	147	310	932	106
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
Lane Util. Factor	0.97	0.95	1.00	0.97	0.95	1.00	0.97	0.95	1.00	0.97	0.95	1.00
Frt	1.00	1.00	0.85	1.00	1.00	0.85	1.00	1.00	0.85	1.00	1.00	0.85
Flt Protected	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00
Satd. Flow (prot)	3433	3539	1583	3433	3539	1583	3433	3539	1583	3433	3539	1583
Flt Permitted	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00
Satd. Flow (perm)	3433	3539	1583	3433	3539	1583	3433	3539	1583	3433	3539	1583
Peak-hour factor, PHF	0.92	0.92	0.92	0.89	0.89	0.89	0.84	0.84	0.84	0.93	0.93	0.93
Adj. Flow (vph)	126	1470	296	121	518	130	94	556	175	333	1002	114
RTOR Reduction (vph)	0	0	8	0	0	26	0	0	11	0	0	70
Lane Group Flow (vph)	126	1470	288	121	518	104	94	556	164	333	1002	44
Turn Type	Prot		pm+ov	Prot		pm+ov	Prot		pm+ov	Prot		pm+ov
Protected Phases	5	2	3	1	6	7	3	8	1	7	4	5
Permitted Phases			2			6			8			4
Actuated Green, G (s)	7.3	53.5	58.0	4.5	50.7	63.9	4.5	26.8	31.3	13.2	35.5	42.8
Effective Green, g (s)	8.8	55.0	61.0	6.0	52.2	66.9	6.0	28.3	34.3	14.7	37.0	45.8
Actuated g/C Ratio	0.07	0.46	0.51	0.05	0.44	0.56	0.05	0.24	0.29	0.12	0.31	0.38
Clearance Time (s)	5.5	5.5	5.5	5.5	5.5	5.5	5.5	5.5	5.5	5.5	5.5	5.5
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0
Lane Grp Cap (vph)	252	1622	805	172	1539	935	172	835	505	421	1091	604
v/s Ratio Prot	c0.04	c0.42	0.02	0.04	0.15	0.01	0.03	c0.16	0.02	0.10	c0.28	0.01
v/s Ratio Perm			0.16			0.05			0.09			0.02
v/c Ratio	0.50	0.91	0.36	0.70	0.34	0.11	0.55	0.67	0.32	0.79	0.92	0.07
Uniform Delay, d1	53.5	30.1	17.7	56.1	22.4	12.5	55.7	41.6	33.7	51.2	40.0	23.6
Progression Factor	1.00	1.00	1.00	0.89	0.21	0.03	1.00	1.00	1.00	1.00	1.00	1.00
Incremental Delay, d2	1.6	8.9	0.3	12.2	0.6	0.1	3.5	4.2	0.4	9.8	13.6	0.1
Delay (s)	55.0	39.0	18.0	62.1	5.4	0.5	59.2	45.7	34.1	60.9	53.6	23.6
Level of Service	E	D	B	E	A	A	E	D	C	E	D	C
Approach Delay (s)		36.8			13.5			44.8			52.9	
Approach LOS		D			B			D			D	

Intersection Summary			
HCM Average Control Delay	39.2	HCM Level of Service	D
HCM Volume to Capacity ratio	0.89		
Actuated Cycle Length (s)	120.0	Sum of lost time (s)	16.0
Intersection Capacity Utilization	83.1%	ICU Level of Service	E
Analysis Period (min)	15		

c Critical Lane Group

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	155	1492	169	77	605	195	76	275	101	262	403	70
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
Lane Util. Factor	1.00	0.91	1.00	1.00	0.91	1.00	1.00	0.95	1.00	1.00	0.95	1.00
Frt	1.00	1.00	0.85	1.00	1.00	0.85	1.00	1.00	0.85	1.00	1.00	0.85
Flt Protected	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00
Satd. Flow (prot)	1770	5085	1583	1770	5085	1583	1770	3539	1583	1770	3539	1583
Flt Permitted	0.25	1.00	1.00	0.11	1.00	1.00	0.47	1.00	1.00	0.35	1.00	1.00
Satd. Flow (perm)	467	5085	1583	208	5085	1583	881	3539	1583	643	3539	1583
Peak-hour factor, PHF	0.95	0.95	0.95	0.88	0.88	0.88	0.83	0.83	0.83	0.82	0.82	0.82
Adj. Flow (vph)	163	1571	178	88	688	222	92	331	122	320	491	85
RTOR Reduction (vph)	0	0	56	0	0	77	0	0	71	0	0	50
Lane Group Flow (vph)	163	1571	122	88	688	145	92	331	51	320	491	35
Turn Type	pm+pt		pm+ov	pm+pt		pm+ov	pm+pt		pm+ov	pm+pt		pm+ov
Protected Phases	5	2	3	1	6	7	3	8	1	7	4	5
Permitted Phases	2		2	6		6	8		8	4		4
Actuated Green, G (s)	46.7	46.7	53.7	44.1	44.1	65.1	29.1	22.1	30.3	48.6	36.1	46.9
Effective Green, g (s)	48.2	48.2	56.7	45.6	45.6	68.1	32.1	23.6	33.3	50.1	37.6	49.9
Actuated g/C Ratio	0.40	0.40	0.47	0.38	0.38	0.57	0.27	0.20	0.28	0.42	0.31	0.42
Clearance Time (s)	5.5	5.5	5.5	5.5	5.5	5.5	5.5	5.5	5.5	5.5	5.5	5.5
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0
Lane Grp Cap (vph)	321	2042	748	205	1932	951	299	696	439	480	1109	711
v/s Ratio Prot	0.05	c0.31	0.01	0.03	c0.14	0.03	0.02	0.09	0.01	c0.13	0.14	0.01
v/s Ratio Perm	0.15		0.07	0.13		0.06	0.06		0.02	c0.15		0.02
v/c Ratio	0.51	0.77	0.16	0.43	0.36	0.15	0.31	0.48	0.12	0.67	0.44	0.05
Uniform Delay, d1	24.5	31.1	18.1	40.6	26.7	12.3	34.0	42.7	32.4	25.5	32.8	20.9
Progression Factor	0.43	0.58	1.46	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Incremental Delay, d2	1.1	2.4	0.1	1.4	0.5	0.1	0.6	2.3	0.1	3.5	1.3	0.0
Delay (s)	11.7	20.5	26.5	42.1	27.2	12.4	34.5	45.0	32.5	29.0	34.1	20.9
Level of Service	B	C	C	D	C	B	C	D	C	C	C	C
Approach Delay (s)		20.4			25.2			40.5			31.0	
Approach LOS		C			C			D			C	

Intersection Summary			
HCM Average Control Delay	26.2	HCM Level of Service	C
HCM Volume to Capacity ratio	0.66		
Actuated Cycle Length (s)	120.0	Sum of lost time (s)	8.0
Intersection Capacity Utilization	68.5%	ICU Level of Service	C
Analysis Period (min)	15		
c Critical Lane Group			

Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations	↑↑↑	↱	↰	↑↑↑	↰	↱
Volume (vph)	1799	10	22	729	3	5
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0	4.0	4.0	4.0	4.0
Lane Util. Factor	0.91	1.00	1.00	0.91	1.00	1.00
Frt	1.00	0.85	1.00	1.00	1.00	0.85
Flt Protected	1.00	1.00	0.95	1.00	0.95	1.00
Satd. Flow (prot)	5085	1583	1770	5085	1770	1583
Flt Permitted	1.00	1.00	0.06	1.00	0.95	1.00
Satd. Flow (perm)	5085	1583	103	5085	1770	1583
Peak-hour factor, PHF	0.92	0.25	0.25	0.89	0.25	0.25
Adj. Flow (vph)	1955	40	88	819	12	20
RTOR Reduction (vph)	0	17	0	0	0	14
Lane Group Flow (vph)	1955	23	88	819	12	6
Turn Type		Perm	pm+pt			Perm
Protected Phases	4		3	8	2	
Permitted Phases		4	8			2
Actuated Green, G (s)	66.8	66.8	77.3	77.3	31.7	31.7
Effective Green, g (s)	68.3	68.3	78.8	78.8	33.2	33.2
Actuated g/C Ratio	0.57	0.57	0.66	0.66	0.28	0.28
Clearance Time (s)	5.5	5.5	5.5	5.5	5.5	5.5
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0	3.0
Lane Grp Cap (vph)	2894	901	158	3339	490	438
v/s Ratio Prot	c0.38		c0.03	0.16	c0.01	
v/s Ratio Perm		0.01	0.34			0.00
v/c Ratio	0.68	0.03	0.56	0.25	0.02	0.01
Uniform Delay, d1	18.1	11.3	16.3	8.4	31.6	31.5
Progression Factor	0.44	0.14	0.35	0.78	1.00	1.00
Incremental Delay, d2	0.3	0.0	4.1	0.0	0.1	0.1
Delay (s)	8.4	1.6	9.8	6.6	31.7	31.6
Level of Service	A	A	A	A	C	C
Approach Delay (s)	8.2			7.0	31.6	
Approach LOS	A			A	C	

Intersection Summary			
HCM Average Control Delay	8.1	HCM Level of Service	A
HCM Volume to Capacity ratio	0.47		
Actuated Cycle Length (s)	120.0	Sum of lost time (s)	12.0
Intersection Capacity Utilization	44.8%	ICU Level of Service	A
Analysis Period (min)	15		
c Critical Lane Group			

HCM Signalized Intersection Capacity Analysis
1: Montaño Rd & 2nd St

1/11/2010

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	100	647	142	159	1225	325	298	987	167	108	574	173
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
Lane Util. Factor	0.97	0.95	1.00	0.97	0.95	1.00	0.97	0.95	1.00	0.97	0.95	1.00
Frt	1.00	1.00	0.85	1.00	1.00	0.85	1.00	1.00	0.85	1.00	1.00	0.85
Flt Protected	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00
Satd. Flow (prot)	3433	3539	1583	3433	3539	1583	3433	3539	1583	3433	3539	1583
Flt Permitted	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00
Satd. Flow (perm)	3433	3539	1583	3433	3539	1583	3433	3539	1583	3433	3539	1583
Peak-hour factor, PHF	0.92	0.92	0.92	0.95	0.95	0.95	0.93	0.93	0.93	0.93	0.93	0.93
Adj. Flow (vph)	109	703	154	167	1289	342	320	1061	180	116	617	186
RTOR Reduction (vph)	0	0	27	0	0	11	0	0	52	0	0	18
Lane Group Flow (vph)	109	703	127	167	1289	331	320	1061	128	116	617	168
Turn Type	Prot		pm+ov	Prot		pm+ov	Prot		pm+ov	Prot		pm+ov
Protected Phases	5	2	3	1	6	7	3	8	1	7	4	5
Permitted Phases			2			6			8			4
Actuated Green, G (s)	4.6	42.5	57.6	9.4	47.3	54.3	15.1	39.1	48.5	7.0	31.0	35.6
Effective Green, g (s)	6.1	44.0	60.6	10.9	48.8	57.3	16.6	40.6	51.5	8.5	32.5	38.6
Actuated g/C Ratio	0.05	0.37	0.51	0.09	0.41	0.48	0.14	0.34	0.43	0.07	0.27	0.32
Clearance Time (s)	5.5	5.5	5.5	5.5	5.5	5.5	5.5	5.5	5.5	5.5	5.5	5.5
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0
Lane Grp Cap (vph)	175	1298	799	312	1439	809	475	1197	732	243	958	509
v/s Ratio Prot	0.03	0.20	0.02	c0.05	c0.36	0.03	0.09	c0.30	0.02	0.03	c0.17	0.02
v/s Ratio Perm			0.06			0.18			0.06			0.09
v/c Ratio	0.62	0.54	0.16	0.54	0.90	0.41	0.67	0.89	0.17	0.48	0.64	0.33
Uniform Delay, d1	55.8	30.0	16.0	52.1	33.2	20.4	49.1	37.5	21.1	53.6	38.6	30.9
Progression Factor	1.00	1.00	1.00	0.76	0.41	0.14	1.00	1.00	1.00	1.00	1.00	1.00
Incremental Delay, d2	6.7	1.6	0.1	1.6	8.4	0.3	3.8	9.8	0.1	1.5	3.3	0.4
Delay (s)	62.6	31.7	16.1	41.2	21.9	3.1	52.9	47.4	21.3	55.1	42.0	31.3
Level of Service	E	C	B	D	C	A	D	D	C	E	D	C
Approach Delay (s)		32.7			20.2			45.5			41.5	
Approach LOS		C			C			D			D	

Intersection Summary			
HCM Average Control Delay	33.7	HCM Level of Service	C
HCM Volume to Capacity ratio	0.82		
Actuated Cycle Length (s)	120.0	Sum of lost time (s)	8.0
Intersection Capacity Utilization	81.1%	ICU Level of Service	D
Analysis Period (min)	15		

c Critical Lane Group

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	128	911	67	99	1366	175	212	618	118	176	299	135
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
Lane Util. Factor	1.00	0.91	1.00	1.00	0.91	1.00	1.00	0.95	1.00	1.00	0.95	1.00
Frt	1.00	1.00	0.85	1.00	1.00	0.85	1.00	1.00	0.85	1.00	1.00	0.85
Flt Protected	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00
Satd. Flow (prot)	1770	5085	1583	1770	5085	1583	1770	3539	1583	1770	3539	1583
Flt Permitted	0.11	1.00	1.00	0.27	1.00	1.00	0.45	1.00	1.00	0.18	1.00	1.00
Satd. Flow (perm)	212	5085	1583	505	5085	1583	847	3539	1583	327	3539	1583
Peak-hour factor, PHF	0.90	0.90	0.90	0.95	0.95	0.95	0.89	0.89	0.89	0.88	0.88	0.88
Adj. Flow (vph)	142	1012	74	104	1438	184	238	694	133	200	340	153
RTOR Reduction (vph)	0	0	36	0	0	53	0	0	43	0	0	59
Lane Group Flow (vph)	142	1012	38	104	1438	131	238	694	90	200	340	94
Turn Type	pm+pt		pm+ov	pm+pt		pm+ov	pm+pt		pm+ov	pm+pt		pm+ov
Protected Phases	5	2	3	1	6	7	3	8	1	7	4	5
Permitted Phases	2		2	6		6	8		8	4		4
Actuated Green, G (s)	45.6	45.6	59.0	42.5	42.5	55.9	45.0	31.6	39.0	45.0	31.6	42.1
Effective Green, g (s)	47.1	47.1	62.0	44.0	44.0	58.9	48.0	33.1	42.0	48.0	33.1	45.1
Actuated g/C Ratio	0.39	0.39	0.52	0.37	0.37	0.49	0.40	0.28	0.35	0.40	0.28	0.38
Clearance Time (s)	5.5	5.5	5.5	5.5	5.5	5.5	5.5	5.5	5.5	5.5	5.5	5.5
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0
Lane Grp Cap (vph)	239	1996	818	279	1865	830	453	976	554	310	976	648
v/s Ratio Prot	c0.06	0.20	0.01	0.03	c0.28	0.02	0.07	c0.20	0.01	c0.08	0.10	0.01
v/s Ratio Perm	0.17		0.02	0.11		0.06	0.14		0.04	0.18		0.05
v/c Ratio	0.59	0.51	0.05	0.37	0.77	0.16	0.53	0.71	0.16	0.65	0.35	0.15
Uniform Delay, d1	28.4	27.6	14.4	30.3	33.6	16.9	25.1	39.1	26.9	26.2	34.8	24.7
Progression Factor	0.75	0.93	3.01	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Incremental Delay, d2	3.9	0.9	0.0	0.8	3.2	0.1	1.1	4.4	0.1	4.6	1.0	0.1
Delay (s)	25.3	26.5	43.3	31.2	36.7	16.9	26.2	43.5	27.0	30.8	35.8	24.8
Level of Service	C	C	D	C	D	B	C	D	C	C	D	C
Approach Delay (s)		27.4			34.3			37.6			31.9	
Approach LOS		C			C			D			C	

Intersection Summary			
HCM Average Control Delay	32.9	HCM Level of Service	C
HCM Volume to Capacity ratio	0.71		
Actuated Cycle Length (s)	120.0	Sum of lost time (s)	16.0
Intersection Capacity Utilization	73.7%	ICU Level of Service	D
Analysis Period (min)	15		

c Critical Lane Group

Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations	↑↑↑	↱	↰	↑↑↑	↰	↱
Volume (vph)	918	4	9	1704	14	30
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0	4.0	4.0	4.0	4.0
Lane Util. Factor	0.91	1.00	1.00	0.91	1.00	1.00
Frt	1.00	0.85	1.00	1.00	1.00	0.85
Flt Protected	1.00	1.00	0.95	1.00	0.95	1.00
Satd. Flow (prot)	5085	1583	1770	5085	1770	1583
Flt Permitted	1.00	1.00	0.21	1.00	0.95	1.00
Satd. Flow (perm)	5085	1583	382	5085	1770	1583
Peak-hour factor, PHF	0.92	0.25	0.25	0.95	0.25	0.25
Adj. Flow (vph)	998	16	36	1794	56	120
RTOR Reduction (vph)	0	8	0	0	0	76
Lane Group Flow (vph)	998	8	36	1794	56	44
Turn Type		Perm	pm+pt			Perm
Protected Phases	4		3	8	2	
Permitted Phases		4	8			2
Actuated Green, G (s)	56.7	56.7	66.4	66.4	42.6	42.6
Effective Green, g (s)	58.2	58.2	67.9	67.9	44.1	44.1
Actuated g/C Ratio	0.49	0.49	0.57	0.57	0.37	0.37
Clearance Time (s)	5.5	5.5	5.5	5.5	5.5	5.5
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0	3.0
Lane Grp Cap (vph)	2466	768	282	2877	650	582
v/s Ratio Prot	0.20		0.01	c0.35	c0.03	
v/s Ratio Perm		0.00	0.07			0.03
v/c Ratio	0.40	0.01	0.13	0.62	0.09	0.08
Uniform Delay, d1	19.8	16.0	12.7	17.5	24.8	24.7
Progression Factor	0.63	0.26	0.23	0.27	1.00	1.00
Incremental Delay, d2	0.1	0.0	0.1	0.3	0.3	0.3
Delay (s)	12.5	4.1	3.0	5.0	25.0	24.9
Level of Service	B	A	A	A	C	C
Approach Delay (s)	12.4			5.0	25.0	
Approach LOS	B			A	C	

Intersection Summary			
HCM Average Control Delay	8.6	HCM Level of Service	A
HCM Volume to Capacity ratio	0.41		
Actuated Cycle Length (s)	120.0	Sum of lost time (s)	8.0
Intersection Capacity Utilization	42.9%	ICU Level of Service	A
Analysis Period (min)	15		
c Critical Lane Group			

Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations						
Volume (veh/h)	1799	10	22	729	3	5
Sign Control	Free			Free	Stop	
Grade	0%			0%	0%	
Peak Hour Factor	0.92	0.25	0.25	0.89	0.25	0.25
Hourly flow rate (vph)	1955	40	88	819	12	20
Pedestrians						
Lane Width (ft)						
Walking Speed (ft/s)						
Percent Blockage						
Right turn flare (veh)						
Median type	None			None		
Median storage veh)						
Upstream signal (ft)	1050					
pX, platoon unblocked			0.71		0.71	0.71
vC, conflicting volume			1995		2404	652
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol			966		1543	0
tC, single (s)			4.1		6.8	6.9
tC, 2 stage (s)						
tF (s)			2.2		3.5	3.3
p0 queue free %			82		81	97
cM capacity (veh/h)			502		62	769

Direction, Lane #	EB 1	EB 2	EB 3	EB 4	WB 1	WB 2	WB 3	WB 4	NB 1	NB 2
Volume Total	652	652	652	40	88	273	273	273	12	20
Volume Left	0	0	0	0	88	0	0	0	12	0
Volume Right	0	0	0	40	0	0	0	0	0	20
cSH	1700	1700	1700	1700	502	1700	1700	1700	62	769
Volume to Capacity	0.38	0.38	0.38	0.02	0.18	0.16	0.16	0.16	0.19	0.03
Queue Length 95th (ft)	0	0	0	0	16	0	0	0	16	2
Control Delay (s)	0.0	0.0	0.0	0.0	13.7	0.0	0.0	0.0	76.9	9.8
Lane LOS					B				F	A
Approach Delay (s)	0.0				1.3				35.0	
Approach LOS									D	

Intersection Summary			
Average Delay	0.8		
Intersection Capacity Utilization	44.8%	ICU Level of Service	A
Analysis Period (min)	15		

HCM Unsignalized Intersection Capacity Analysis
9: Montaño Rd & Site Dwy

1/11/2010

Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations						
Volume (veh/h)	918	4	9	1704	14	30
Sign Control	Free			Free	Stop	
Grade	0%			0%	0%	
Peak Hour Factor	0.92	0.25	0.25	0.95	0.25	0.25
Hourly flow rate (vph)	998	16	36	1794	56	120
Pedestrians						
Lane Width (ft)						
Walking Speed (ft/s)						
Percent Blockage						
Right turn flare (veh)						
Median type	None			None		
Median storage veh)						
Upstream signal (ft)	1050					
pX, platoon unblocked			0.94		0.94	0.94
vC, conflicting volume			1014		1668	333
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol			802		1496	80
tC, single (s)			4.1		6.8	6.9
tC, 2 stage (s)						
tF (s)			2.2		3.5	3.3
p0 queue free %			95		45	87
cM capacity (veh/h)			770		102	909

Direction, Lane #	EB 1	EB 2	EB 3	EB 4	WB 1	WB 2	WB 3	WB 4	NB 1	NB 2
Volume Total	333	333	333	16	36	598	598	598	56	120
Volume Left	0	0	0	0	36	0	0	0	56	0
Volume Right	0	0	0	16	0	0	0	0	0	120
cSH	1700	1700	1700	1700	770	1700	1700	1700	102	909
Volume to Capacity	0.20	0.20	0.20	0.01	0.05	0.35	0.35	0.35	0.55	0.13
Queue Length 95th (ft)	0	0	0	0	4	0	0	0	63	11
Control Delay (s)	0.0	0.0	0.0	0.0	9.9	0.0	0.0	0.0	76.7	9.6
Lane LOS					A				F	A
Approach Delay (s)	0.0				0.2				30.9	
Approach LOS									D	

Intersection Summary			
Average Delay	1.9		
Intersection Capacity Utilization	42.9%	ICU Level of Service	A
Analysis Period (min)	15		

Appendix F

Alternative 2 Level of Service Analyses

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	116	1372	272	108	466	116	79	467	148	311	932	106
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
Lane Util. Factor	0.97	0.95	1.00	0.97	0.95	1.00	0.97	0.95	1.00	0.97	0.95	1.00
Frt	1.00	1.00	0.85	1.00	1.00	0.85	1.00	1.00	0.85	1.00	1.00	0.85
Flt Protected	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00
Satd. Flow (prot)	3433	3539	1583	3433	3539	1583	3433	3539	1583	3433	3539	1583
Flt Permitted	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00
Satd. Flow (perm)	3433	3539	1583	3433	3539	1583	3433	3539	1583	3433	3539	1583
Peak-hour factor, PHF	0.92	0.92	0.92	0.89	0.89	0.89	0.84	0.84	0.84	0.93	0.93	0.93
Adj. Flow (vph)	126	1491	296	121	524	130	94	556	176	334	1002	114
RTOR Reduction (vph)	0	0	8	0	0	26	0	0	11	0	0	70
Lane Group Flow (vph)	126	1491	288	121	524	104	94	556	165	334	1002	44
Turn Type	Prot		pm+ov	Prot		pm+ov	Prot		pm+ov	Prot		pm+ov
Protected Phases	5	2	3	1	6	7	3	8	1	7	4	5
Permitted Phases			2			6			8			4
Actuated Green, G (s)	7.3	53.5	58.0	4.5	50.7	63.9	4.5	26.8	31.3	13.2	35.5	42.8
Effective Green, g (s)	8.8	55.0	61.0	6.0	52.2	66.9	6.0	28.3	34.3	14.7	37.0	45.8
Actuated g/C Ratio	0.07	0.46	0.51	0.05	0.44	0.56	0.05	0.24	0.29	0.12	0.31	0.38
Clearance Time (s)	5.5	5.5	5.5	5.5	5.5	5.5	5.5	5.5	5.5	5.5	5.5	5.5
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0
Lane Grp Cap (vph)	252	1622	805	172	1539	935	172	835	505	421	1091	604
v/s Ratio Prot	c0.04	c0.42	0.02	0.04	0.15	0.01	0.03	c0.16	0.02	0.10	c0.28	0.01
v/s Ratio Perm			0.16			0.05			0.09			0.02
v/c Ratio	0.50	0.92	0.36	0.70	0.34	0.11	0.55	0.67	0.33	0.79	0.92	0.07
Uniform Delay, d1	53.5	30.4	17.7	56.1	22.5	12.5	55.7	41.6	33.7	51.2	40.0	23.6
Progression Factor	1.00	1.00	1.00	0.90	0.30	0.07	1.00	1.00	1.00	1.00	1.00	1.00
Incremental Delay, d2	1.6	9.9	0.3	12.2	0.6	0.1	3.5	4.2	0.4	9.9	13.6	0.1
Delay (s)	55.0	40.3	18.0	63.0	7.4	1.0	59.2	45.7	34.1	61.1	53.6	23.6
Level of Service	E	D	B	E	A	A	E	D	C	E	D	C
Approach Delay (s)		37.9			15.0			44.8			53.0	
Approach LOS		D			B			D			D	

Intersection Summary			
HCM Average Control Delay	39.9	HCM Level of Service	D
HCM Volume to Capacity ratio	0.89		
Actuated Cycle Length (s)	120.0	Sum of lost time (s)	16.0
Intersection Capacity Utilization	83.7%	ICU Level of Service	E
Analysis Period (min)	15		

c Critical Lane Group

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	155	1501	170	77	646	195	80	275	101	262	403	71
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
Lane Util. Factor	1.00	0.91	1.00	1.00	0.91	1.00	1.00	0.95	1.00	1.00	0.95	1.00
Frt	1.00	1.00	0.85	1.00	1.00	0.85	1.00	1.00	0.85	1.00	1.00	0.85
Flt Protected	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00
Satd. Flow (prot)	1770	5085	1583	1770	5085	1583	1770	3539	1583	1770	3539	1583
Flt Permitted	0.22	1.00	1.00	0.11	1.00	1.00	0.47	1.00	1.00	0.35	1.00	1.00
Satd. Flow (perm)	419	5085	1583	213	5085	1583	881	3539	1583	643	3539	1583
Peak-hour factor, PHF	0.95	0.95	0.95	0.88	0.88	0.88	0.83	0.83	0.83	0.82	0.82	0.82
Adj. Flow (vph)	163	1580	179	88	734	222	96	331	122	320	491	87
RTOR Reduction (vph)	0	0	56	0	0	84	0	0	71	0	0	50
Lane Group Flow (vph)	163	1580	123	88	734	138	96	331	51	320	491	37
Turn Type	pm+pt		pm+ov	pm+pt		pm+ov	pm+pt		pm+ov	pm+pt		pm+ov
Protected Phases	5	2	3	1	6	7	3	8	1	7	4	5
Permitted Phases	2		2	6		6	8		8	4		4
Actuated Green, G (s)	46.7	46.7	53.8	43.2	43.2	64.2	29.2	22.1	30.3	48.6	36.0	47.7
Effective Green, g (s)	48.2	48.2	56.8	44.7	44.7	67.2	32.2	23.6	33.3	50.1	37.5	50.7
Actuated g/C Ratio	0.40	0.40	0.47	0.37	0.37	0.56	0.27	0.20	0.28	0.42	0.31	0.42
Clearance Time (s)	5.5	5.5	5.5	5.5	5.5	5.5	5.5	5.5	5.5	5.5	5.5	5.5
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0
Lane Grp Cap (vph)	317	2042	749	205	1894	939	300	696	439	480	1106	722
v/s Ratio Prot	0.06	c0.31	0.01	0.03	c0.14	0.03	0.02	0.09	0.01	c0.13	0.14	0.01
v/s Ratio Perm	0.15		0.07	0.13		0.06	0.06		0.02	c0.15		0.02
v/c Ratio	0.51	0.77	0.16	0.43	0.39	0.15	0.32	0.48	0.12	0.67	0.44	0.05
Uniform Delay, d1	24.6	31.2	18.0	40.7	27.6	12.7	34.0	42.7	32.4	25.5	32.9	20.5
Progression Factor	0.27	0.41	0.88	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Incremental Delay, d2	1.1	2.3	0.1	1.4	0.6	0.1	0.6	2.3	0.1	3.5	1.3	0.0
Delay (s)	7.7	15.0	16.0	42.2	28.2	12.7	34.6	45.0	32.5	29.0	34.2	20.5
Level of Service	A	B	B	D	C	B	C	D	C	C	C	C
Approach Delay (s)		14.5			26.1			40.4			31.0	
Approach LOS		B			C			D			C	

Intersection Summary			
HCM Average Control Delay	23.8	HCM Level of Service	C
HCM Volume to Capacity ratio	0.67		
Actuated Cycle Length (s)	120.0	Sum of lost time (s)	8.0
Intersection Capacity Utilization	68.7%	ICU Level of Service	C
Analysis Period (min)	15		

c Critical Lane Group

Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations						
Volume (vph)	1799	32	68	729	7	16
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0	4.0	4.0	4.0	4.0
Lane Util. Factor	0.91	1.00	1.00	0.91	1.00	1.00
Frt	1.00	0.85	1.00	1.00	1.00	0.85
Flt Protected	1.00	1.00	0.95	1.00	0.95	1.00
Satd. Flow (prot)	5085	1583	1770	5085	1770	1583
Flt Permitted	1.00	1.00	0.06	1.00	0.95	1.00
Satd. Flow (perm)	5085	1583	111	5085	1770	1583
Peak-hour factor, PHF	0.92	0.25	0.25	0.89	0.25	0.25
Adj. Flow (vph)	1955	128	272	819	28	64
RTOR Reduction (vph)	0	55	0	0	0	50
Lane Group Flow (vph)	1955	73	272	819	28	14
Turn Type		Perm	pm+pt			Perm
Protected Phases	4		3	8	2	
Permitted Phases		4	8			2
Actuated Green, G (s)	61.6	61.6	84.5	84.5	24.5	24.5
Effective Green, g (s)	63.1	63.1	86.0	86.0	26.0	26.0
Actuated g/C Ratio	0.53	0.53	0.72	0.72	0.22	0.22
Clearance Time (s)	5.5	5.5	5.5	5.5	5.5	5.5
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0	3.0
Lane Grp Cap (vph)	2674	832	341	3644	384	343
v/s Ratio Prot	0.38		c0.13	0.16	c0.02	
v/s Ratio Perm		0.05	c0.45			0.01
v/c Ratio	0.73	0.09	0.80	0.22	0.07	0.04
Uniform Delay, d1	21.9	14.1	35.6	5.7	37.4	37.1
Progression Factor	0.34	0.06	0.47	0.85	1.00	1.00
Incremental Delay, d2	0.6	0.0	11.9	0.0	0.4	0.2
Delay (s)	8.0	0.9	28.5	4.9	37.8	37.4
Level of Service	A	A	C	A	D	D
Approach Delay (s)	7.5			10.8	37.5	
Approach LOS	A			B	D	

Intersection Summary			
HCM Average Control Delay	9.5	HCM Level of Service	A
HCM Volume to Capacity ratio	0.62		
Actuated Cycle Length (s)	120.0	Sum of lost time (s)	8.0
Intersection Capacity Utilization	51.9%	ICU Level of Service	A
Analysis Period (min)	15		
c Critical Lane Group			

HCM Signalized Intersection Capacity Analysis
1: Montaño Rd & 2nd St

1/11/2010

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	100	651	142	160	1240	326	298	987	167	108	574	173
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
Lane Util. Factor	0.97	0.95	1.00	0.97	0.95	1.00	0.97	0.95	1.00	0.97	0.95	1.00
Frt	1.00	1.00	0.85	1.00	1.00	0.85	1.00	1.00	0.85	1.00	1.00	0.85
Flt Protected	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00
Satd. Flow (prot)	3433	3539	1583	3433	3539	1583	3433	3539	1583	3433	3539	1583
Flt Permitted	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00
Satd. Flow (perm)	3433	3539	1583	3433	3539	1583	3433	3539	1583	3433	3539	1583
Peak-hour factor, PHF	0.92	0.92	0.92	0.95	0.95	0.95	0.93	0.93	0.93	0.93	0.93	0.93
Adj. Flow (vph)	109	708	154	168	1305	343	320	1061	180	116	617	186
RTOR Reduction (vph)	0	0	24	0	0	10	0	0	53	0	0	19
Lane Group Flow (vph)	109	708	130	168	1305	333	320	1061	127	116	617	167
Turn Type	Prot		pm+ov	Prot		pm+ov	Prot		pm+ov	Prot		pm+ov
Protected Phases	5	2	3	1	6	7	3	8	1	7	4	5
Permitted Phases			2			6			8			4
Actuated Green, G (s)	4.5	43.6	58.7	9.4	48.5	55.0	15.1	38.5	47.9	6.5	29.9	34.4
Effective Green, g (s)	6.0	45.1	61.7	10.9	50.0	58.0	16.6	40.0	50.9	8.0	31.4	37.4
Actuated g/C Ratio	0.05	0.38	0.51	0.09	0.42	0.48	0.14	0.33	0.42	0.07	0.26	0.31
Clearance Time (s)	5.5	5.5	5.5	5.5	5.5	5.5	5.5	5.5	5.5	5.5	5.5	5.5
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0
Lane Grp Cap (vph)	172	1330	814	312	1475	818	475	1180	724	229	926	493
v/s Ratio Prot	0.03	0.20	0.02	c0.05	c0.37	0.03	0.09	c0.30	0.02	0.03	c0.17	0.02
v/s Ratio Perm			0.06			0.18			0.06			0.09
v/c Ratio	0.63	0.53	0.16	0.54	0.88	0.41	0.67	0.90	0.18	0.51	0.67	0.34
Uniform Delay, d1	55.9	29.2	15.4	52.1	32.3	19.9	49.1	38.1	21.5	54.1	39.6	31.8
Progression Factor	1.00	1.00	1.00	0.72	0.34	0.22	1.00	1.00	1.00	1.00	1.00	1.00
Incremental Delay, d2	7.4	1.5	0.1	1.6	7.5	0.3	3.8	11.0	0.1	1.8	3.8	0.4
Delay (s)	63.3	30.8	15.5	39.4	18.4	4.7	52.9	49.0	21.6	55.9	43.4	32.2
Level of Service	E	C	B	D	B	A	D	D	C	E	D	C
Approach Delay (s)		32.0			17.7			46.7			42.7	
Approach LOS		C			B			D			D	

Intersection Summary			
HCM Average Control Delay	33.3	HCM Level of Service	C
HCM Volume to Capacity ratio	0.82		
Actuated Cycle Length (s)	120.0	Sum of lost time (s)	8.0
Intersection Capacity Utilization	81.6%	ICU Level of Service	D
Analysis Period (min)	15		

c Critical Lane Group

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	128	940	70	99	1375	175	213	618	118	176	299	135
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
Lane Util. Factor	1.00	0.91	1.00	1.00	0.91	1.00	1.00	0.95	1.00	1.00	0.95	1.00
Frt	1.00	1.00	0.85	1.00	1.00	0.85	1.00	1.00	0.85	1.00	1.00	0.85
Flt Protected	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00
Satd. Flow (prot)	1770	5085	1583	1770	5085	1583	1770	3539	1583	1770	3539	1583
Flt Permitted	0.11	1.00	1.00	0.26	1.00	1.00	0.45	1.00	1.00	0.18	1.00	1.00
Satd. Flow (perm)	212	5085	1583	488	5085	1583	844	3539	1583	328	3539	1583
Peak-hour factor, PHF	0.90	0.90	0.90	0.95	0.95	0.95	0.89	0.89	0.89	0.88	0.88	0.88
Adj. Flow (vph)	142	1044	78	104	1447	184	239	694	133	200	340	153
RTOR Reduction (vph)	0	0	37	0	0	53	0	0	43	0	0	59
Lane Group Flow (vph)	142	1044	41	104	1447	131	239	694	90	200	340	94
Turn Type	pm+pt		pm+ov	pm+pt		pm+ov	pm+pt		pm+ov	pm+pt		pm+ov
Protected Phases	5	2	3	1	6	7	3	8	1	7	4	5
Permitted Phases	2		2	6		6	8		8	4		4
Actuated Green, G (s)	45.6	45.6	59.1	42.5	42.5	55.9	45.1	31.6	39.0	44.9	31.5	42.0
Effective Green, g (s)	47.1	47.1	62.1	44.0	44.0	58.9	48.1	33.1	42.0	47.9	33.0	45.0
Actuated g/C Ratio	0.39	0.39	0.52	0.37	0.37	0.49	0.40	0.28	0.35	0.40	0.28	0.38
Clearance Time (s)	5.5	5.5	5.5	5.5	5.5	5.5	5.5	5.5	5.5	5.5	5.5	5.5
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0
Lane Grp Cap (vph)	239	1996	819	274	1865	830	454	976	554	310	973	646
v/s Ratio Prot	c0.06	0.21	0.01	0.03	c0.28	0.02	0.07	c0.20	0.01	c0.08	0.10	0.01
v/s Ratio Perm	0.17		0.02	0.11		0.06	0.15		0.04	0.18		0.04
v/c Ratio	0.59	0.52	0.05	0.38	0.78	0.16	0.53	0.71	0.16	0.65	0.35	0.15
Uniform Delay, d1	28.4	27.9	14.3	30.6	33.6	16.9	25.1	39.1	26.9	26.3	34.9	24.8
Progression Factor	0.64	0.80	2.81	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Incremental Delay, d2	3.8	1.0	0.0	0.9	3.2	0.1	1.1	4.4	0.1	4.6	1.0	0.1
Delay (s)	21.9	23.2	40.4	31.5	36.9	16.9	26.2	43.5	27.0	30.8	35.9	24.9
Level of Service	C	C	D	C	D	B	C	D	C	C	D	C
Approach Delay (s)		24.1			34.4			37.6			32.0	
Approach LOS		C			C			D			C	

Intersection Summary			
HCM Average Control Delay	32.0	HCM Level of Service	C
HCM Volume to Capacity ratio	0.69		
Actuated Cycle Length (s)	120.0	Sum of lost time (s)	12.0
Intersection Capacity Utilization	73.8%	ICU Level of Service	D
Analysis Period (min)	15		

c Critical Lane Group

Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations						
Volume (vph)	918	9	19	1704	29	63
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0	4.0	4.0	4.0	4.0
Lane Util. Factor	0.91	1.00	1.00	0.91	1.00	1.00
Frt	1.00	0.85	1.00	1.00	1.00	0.85
Flt Protected	1.00	1.00	0.95	1.00	0.95	1.00
Satd. Flow (prot)	5085	1583	1770	5085	1770	1583
Flt Permitted	1.00	1.00	0.20	1.00	0.95	1.00
Satd. Flow (perm)	5085	1583	371	5085	1770	1583
Peak-hour factor, PHF	0.92	0.25	0.25	0.95	0.25	0.25
Adj. Flow (vph)	998	36	76	1794	116	252
RTOR Reduction (vph)	0	19	0	0	0	146
Lane Group Flow (vph)	998	17	76	1794	116	106
Turn Type		Perm	pm+pt			Perm
Protected Phases	4		3	8	2	
Permitted Phases		4	8			2
Actuated Green, G (s)	54.1	54.1	65.2	65.2	43.8	43.8
Effective Green, g (s)	55.6	55.6	66.7	66.7	45.3	45.3
Actuated g/C Ratio	0.46	0.46	0.56	0.56	0.38	0.38
Clearance Time (s)	5.5	5.5	5.5	5.5	5.5	5.5
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0	3.0
Lane Grp Cap (vph)	2356	733	289	2826	668	598
v/s Ratio Prot	0.20		0.02	c0.35	0.07	
v/s Ratio Perm		0.01	0.13			c0.07
v/c Ratio	0.42	0.02	0.26	0.63	0.17	0.18
Uniform Delay, d1	21.5	17.5	13.7	18.3	24.9	24.9
Progression Factor	0.49	0.09	0.22	0.46	1.00	1.00
Incremental Delay, d2	0.1	0.0	0.4	0.3	0.6	0.6
Delay (s)	10.6	1.5	3.4	8.8	25.4	25.6
Level of Service	B	A	A	A	C	C
Approach Delay (s)	10.3			8.6	25.5	
Approach LOS	B			A	C	

Intersection Summary			
HCM Average Control Delay	11.0	HCM Level of Service	B
HCM Volume to Capacity ratio	0.45		
Actuated Cycle Length (s)	120.0	Sum of lost time (s)	8.0
Intersection Capacity Utilization	42.9%	ICU Level of Service	A
Analysis Period (min)	15		
c Critical Lane Group			

HCM Unsignalized Intersection Capacity Analysis
9: Montaño Rd & Site Dwy

1/11/2010

Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations						
Volume (veh/h)	1799	32	68	729	7	16
Sign Control	Free			Free	Stop	
Grade	0%			0%	0%	
Peak Hour Factor	0.92	0.25	0.25	0.89	0.25	0.25
Hourly flow rate (vph)	1955	128	272	819	28	64
Pedestrians						
Lane Width (ft)						
Walking Speed (ft/s)						
Percent Blockage						
Right turn flare (veh)						
Median type	None			None		
Median storage veh)						
Upstream signal (ft)	1050					
pX, platoon unblocked			0.72		0.72	0.72
vC, conflicting volume			2083		2772	652
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol			1150		2105	0
tC, single (s)			4.1		6.8	6.9
tC, 2 stage (s)						
tF (s)			2.2		3.5	3.3
p0 queue free %			37		0	92
cM capacity (veh/h)			435		12	782

Direction, Lane #	EB 1	EB 2	EB 3	EB 4	WB 1	WB 2	WB 3	WB 4	NB 1	NB 2
Volume Total	652	652	652	128	272	273	273	273	28	64
Volume Left	0	0	0	0	272	0	0	0	28	0
Volume Right	0	0	0	128	0	0	0	0	0	64
cSH	1700	1700	1700	1700	435	1700	1700	1700	12	782
Volume to Capacity	0.38	0.38	0.38	0.08	0.63	0.16	0.16	0.16	2.34	0.08
Queue Length 95th (ft)	0	0	0	0	104	0	0	0	110	7
Control Delay (s)	0.0	0.0	0.0	0.0	26.1	0.0	0.0	0.0	1248.0	10.0
Lane LOS					D				F	B
Approach Delay (s)	0.0				6.5				386.8	
Approach LOS									F	

Intersection Summary			
Average Delay	13.1		
Intersection Capacity Utilization	51.9%	ICU Level of Service	A
Analysis Period (min)	15		

Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations						
Volume (veh/h)	918	9	19	1704	29	63
Sign Control	Free			Free	Stop	
Grade	0%			0%	0%	
Peak Hour Factor	0.92	0.25	0.25	0.95	0.25	0.25
Hourly flow rate (vph)	998	36	76	1794	116	252
Pedestrians						
Lane Width (ft)						
Walking Speed (ft/s)						
Percent Blockage						
Right turn flare (veh)						
Median type	None			None		
Median storage veh)						
Upstream signal (ft)	1050					
pX, platoon unblocked			0.95		0.95	0.95
vC, conflicting volume			1034		1748	333
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol			860		1609	123
tC, single (s)			4.1		6.8	6.9
tC, 2 stage (s)						
tF (s)			2.2		3.5	3.3
p0 queue free %			90		0	71
cM capacity (veh/h)			740		82	861

Direction, Lane #	EB 1	EB 2	EB 3	EB 4	WB 1	WB 2	WB 3	WB 4	NB 1	NB 2
Volume Total	333	333	333	36	76	598	598	598	116	252
Volume Left	0	0	0	0	76	0	0	0	116	0
Volume Right	0	0	0	36	0	0	0	0	0	252
cSH	1700	1700	1700	1700	740	1700	1700	1700	82	861
Volume to Capacity	0.20	0.20	0.20	0.02	0.10	0.35	0.35	0.35	1.42	0.29
Queue Length 95th (ft)	0	0	0	0	9	0	0	0	227	31
Control Delay (s)	0.0	0.0	0.0	0.0	10.4	0.0	0.0	0.0	337.6	10.9
Lane LOS					B				F	B
Approach Delay (s)	0.0				0.4				113.9	
Approach LOS									F	

Intersection Summary			
Average Delay	13.1		
Intersection Capacity Utilization	42.9%	ICU Level of Service	A
Analysis Period (min)	15		

Appendix G

Alternative 3 Level of Service Analyses

HCM Signalized Intersection Capacity Analysis
1: Montaño Rd & 2nd St

1/11/2010

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	116	1382	272	108	468	116	79	467	148	311	932	106
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
Lane Util. Factor	0.97	0.95	1.00	0.97	0.95	1.00	0.97	0.95	1.00	0.97	0.95	1.00
Frt	1.00	1.00	0.85	1.00	1.00	0.85	1.00	1.00	0.85	1.00	1.00	0.85
Flt Protected	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00
Satd. Flow (prot)	3433	3539	1583	3433	3539	1583	3433	3539	1583	3433	3539	1583
Flt Permitted	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00
Satd. Flow (perm)	3433	3539	1583	3433	3539	1583	3433	3539	1583	3433	3539	1583
Peak-hour factor, PHF	0.92	0.92	0.92	0.89	0.89	0.89	0.84	0.84	0.84	0.93	0.93	0.93
Adj. Flow (vph)	126	1502	296	121	526	130	94	556	176	334	1002	114
RTOR Reduction (vph)	0	0	8	0	0	26	0	0	11	0	0	70
Lane Group Flow (vph)	126	1502	288	121	526	104	94	556	165	334	1002	44
Turn Type	Prot		pm+ov	Prot		pm+ov	Prot		pm+ov	Prot		pm+ov
Protected Phases	5	2	3	1	6	7	3	8	1	7	4	5
Permitted Phases			2			6			8			4
Actuated Green, G (s)	7.3	53.5	58.0	4.5	50.7	63.9	4.5	26.8	31.3	13.2	35.5	42.8
Effective Green, g (s)	8.8	55.0	61.0	6.0	52.2	66.9	6.0	28.3	34.3	14.7	37.0	45.8
Actuated g/C Ratio	0.07	0.46	0.51	0.05	0.44	0.56	0.05	0.24	0.29	0.12	0.31	0.38
Clearance Time (s)	5.5	5.5	5.5	5.5	5.5	5.5	5.5	5.5	5.5	5.5	5.5	5.5
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0
Lane Grp Cap (vph)	252	1622	805	172	1539	935	172	835	505	421	1091	604
v/s Ratio Prot	c0.04	c0.42	0.02	0.04	0.15	0.01	0.03	c0.16	0.02	0.10	c0.28	0.01
v/s Ratio Perm			0.16			0.05			0.09			0.02
v/c Ratio	0.50	0.93	0.36	0.70	0.34	0.11	0.55	0.67	0.33	0.79	0.92	0.07
Uniform Delay, d1	53.5	30.6	17.7	56.1	22.5	12.5	55.7	41.6	33.8	51.2	40.0	23.6
Progression Factor	1.00	1.00	1.00	0.92	0.35	0.09	1.00	1.00	1.00	1.00	1.00	1.00
Incremental Delay, d2	1.6	10.5	0.3	12.2	0.6	0.1	3.5	4.2	0.4	9.9	13.6	·0.1
Delay (s)	55.0	41.1	18.0	63.6	8.4	1.2	59.2	45.7	34.1	61.1	53.6	23.6
Level of Service	E	D	B	E	A	A	E	D	C	E	D	C
Approach Delay (s)		38.5			15.8			44.8			53.0	
Approach LOS		D			B			D			D	

Intersection Summary			
HCM Average Control Delay	40.2	HCM Level of Service	D
HCM Volume to Capacity ratio	0.90		
Actuated Cycle Length (s)	120.0	Sum of lost time (s)	16.0
Intersection Capacity Utilization	84.0%	ICU Level of Service	E
Analysis Period (min)	15		

c Critical Lane Group

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	155	1506	171	77	666	195	82	275	101	262	403	71
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
Lane Util. Factor	1.00	0.91	1.00	1.00	0.91	1.00	1.00	0.95	1.00	1.00	0.95	1.00
Frt	1.00	1.00	0.85	1.00	1.00	0.85	1.00	1.00	0.85	1.00	1.00	0.85
Flt Protected	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00
Satd. Flow (prot)	1770	5085	1583	1770	5085	1583	1770	3539	1583	1770	3539	1583
Flt Permitted	0.21	1.00	1.00	0.11	1.00	1.00	0.47	1.00	1.00	0.35	1.00	1.00
Satd. Flow (perm)	399	5085	1583	213	5085	1583	881	3539	1583	643	3539	1583
Peak-hour factor, PHF	0.95	0.95	0.95	0.88	0.88	0.88	0.83	0.83	0.83	0.82	0.82	0.82
Adj. Flow (vph)	163	1585	180	88	757	222	99	331	122	320	491	87
RTOR Reduction (vph)	0	0	56	0	0	83	0	0	71	0	0	50
Lane Group Flow (vph)	163	1585	124	88	757	139	99	331	51	320	491	37
Turn Type	pm+pt		pm+ov	pm+pt		pm+ov	pm+pt		pm+ov	pm+pt		pm+ov
Protected Phases	5	2	3	1	6	7	3	8	1	7	4	5
Permitted Phases	2		2	6		6	8		8	4		4
Actuated Green, G (s)	46.7	46.7	53.9	43.1	43.1	64.1	29.3	22.1	30.3	48.6	35.9	47.7
Effective Green, g (s)	48.2	48.2	56.9	44.6	44.6	67.1	32.3	23.6	33.3	50.1	37.4	50.7
Actuated g/C Ratio	0.40	0.40	0.47	0.37	0.37	0.56	0.27	0.20	0.28	0.42	0.31	0.42
Clearance Time (s)	5.5	5.5	5.5	5.5	5.5	5.5	5.5	5.5	5.5	5.5	5.5	5.5
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0
Lane Grp Cap (vph)	312	2042	751	205	1890	938	302	696	439	480	1103	722
v/s Ratio Prot	0.06	c0.31	0.01	0.03	c0.15	0.03	0.02	0.09	0.01	c0.13	0.14	0.01
v/s Ratio Perm	0.15		0.07	0.12		0.06	0.06		0.02	c0.15		0.02
v/c Ratio	0.52	0.78	0.17	0.43	0.40	0.15	0.33	0.48	0.12	0.67	0.45	0.05
Uniform Delay, d1	24.7	31.2	18.0	40.8	27.8	12.7	33.9	42.7	32.4	25.5	33.0	20.5
Progression Factor	0.20	0.34	0.55	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Incremental Delay, d2	1.1	2.2	0.1	1.4	0.6	0.1	0.6	2.3	0.1	3.5	1.3	0.0
Delay (s)	6.0	12.6	10.0	42.3	28.5	12.8	34.6	45.0	32.5	29.0	34.3	20.5
Level of Service	A	B	B	D	C	B	C	D	C	C	C	C
Approach Delay (s)		11.8			26.3			40.4			31.1	
Approach LOS		B			C			D			C	

Intersection Summary			
HCM Average Control Delay	22.8	HCM Level of Service	C
HCM Volume to Capacity ratio	0.67		
Actuated Cycle Length (s)	120.0	Sum of lost time (s)	8.0
Intersection Capacity Utilization	68.8%	ICU Level of Service	C
Analysis Period (min)	15		
c Critical Lane Group			

Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations	↑↑↑	↱	↰	↑↑↑	↰	↱
Volume (vph)	1799	43	90	729	10	21
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0	4.0	4.0	4.0	4.0
Lane Util. Factor	0.91	1.00	1.00	0.91	1.00	1.00
Frt	1.00	0.85	1.00	1.00	1.00	0.85
Flt Protected	1.00	1.00	0.95	1.00	0.95	1.00
Satd. Flow (prot)	5085	1583	1770	5085	1770	1583
Flt Permitted	1.00	1.00	0.06	1.00	0.95	1.00
Satd. Flow (perm)	5085	1583	114	5085	1770	1583
Peak-hour factor, PHF	0.92	0.25	0.25	0.89	0.25	0.25
Adj. Flow (vph)	1955	172	360	819	40	84
RTOR Reduction (vph)	0	71	0	0	0	68
Lane Group Flow (vph)	1955	101	360	819	40	16
Turn Type		Perm	pm+pt			Perm
Protected Phases	4		3	8	2	
Permitted Phases		4	8			2
Actuated Green, G (s)	59.6	59.6	87.3	87.3	21.7	21.7
Effective Green, g (s)	61.1	61.1	88.8	88.8	23.2	23.2
Actuated g/C Ratio	0.51	0.51	0.74	0.74	0.19	0.19
Clearance Time (s)	5.5	5.5	5.5	5.5	5.5	5.5
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0	3.0
Lane Grp Cap (vph)	2589	806	411	3763	342	306
v/s Ratio Prot	0.38		c0.17	0.16	c0.02	
v/s Ratio Perm		0.06	c0.47			0.01
v/c Ratio	0.76	0.13	0.88	0.22	0.12	0.05
Uniform Delay, d1	23.5	15.4	37.1	4.8	39.9	39.4
Progression Factor	0.36	0.15	0.53	0.93	1.00	1.00
Incremental Delay, d2	0.7	0.0	18.0	0.0	0.7	0.3
Delay (s)	9.3	2.3	37.8	4.5	40.6	39.8
Level of Service	A	A	D	A	D	D
Approach Delay (s)	8.7			14.7	40.1	
Approach LOS	A			B	D	

Intersection Summary			
HCM Average Control Delay	11.9	HCM Level of Service	B
HCM Volume to Capacity ratio	0.71		
Actuated Cycle Length (s)	120.0	Sum of lost time (s)	8.0
Intersection Capacity Utilization	53.1%	ICU Level of Service	A
Analysis Period (min)	15		
c Critical Lane Group			

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	100	654	142	160	1247	326	298	987	167	108	574	173
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
Lane Util. Factor	0.97	0.95	1.00	0.97	0.95	1.00	0.97	0.95	1.00	0.97	0.95	1.00
Frt	1.00	1.00	0.85	1.00	1.00	0.85	1.00	1.00	0.85	1.00	1.00	0.85
Flt Protected	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00
Satd. Flow (prot)	3433	3539	1583	3433	3539	1583	3433	3539	1583	3433	3539	1583
Flt Permitted	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00
Satd. Flow (perm)	3433	3539	1583	3433	3539	1583	3433	3539	1583	3433	3539	1583
Peak-hour factor, PHF	0.92	0.92	0.92	0.95	0.95	0.95	0.93	0.93	0.93	0.93	0.93	0.93
Adj. Flow (vph)	109	711	154	168	1313	343	320	1061	180	116	617	186
RTOR Reduction (vph)	0	0	24	0	0	10	0	0	52	0	0	19
Lane Group Flow (vph)	109	711	130	168	1313	333	320	1061	128	116	617	167
Turn Type	Prot		pm+ov	Prot		pm+ov	Prot		pm+ov	Prot		pm+ov
Protected Phases	5	2	3	1	6	7	3	8	1	7	4	5
Permitted Phases			2			6			8			4
Actuated Green, G (s)	4.5	43.6	58.7	9.4	48.5	55.0	15.1	38.5	47.9	6.5	29.9	34.4
Effective Green, g (s)	6.0	45.1	61.7	10.9	50.0	58.0	16.6	40.0	50.9	8.0	31.4	37.4
Actuated g/C Ratio	0.05	0.38	0.51	0.09	0.42	0.48	0.14	0.33	0.42	0.07	0.26	0.31
Clearance Time (s)	5.5	5.5	5.5	5.5	5.5	5.5	5.5	5.5	5.5	5.5	5.5	5.5
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0
Lane Grp Cap (vph)	172	1330	814	312	1475	818	475	1180	724	229	926	493
v/s Ratio Prot	0.03	0.20	0.02	c0.05	c0.37	0.03	0.09	c0.30	0.02	0.03	c0.17	0.02
v/s Ratio Perm			0.06			0.18			0.06			0.09
v/c Ratio	0.63	0.53	0.16	0.54	0.89	0.41	0.67	0.90	0.18	0.51	0.67	0.34
Uniform Delay, d1	55.9	29.3	15.4	52.1	32.5	19.9	49.1	38.1	21.5	54.1	39.6	31.8
Progression Factor	1.00	1.00	1.00	0.76	0.48	0.28	1.00	1.00	1.00	1.00	1.00	1.00
Incremental Delay, d2	7.4	1.5	0.1	1.6	7.8	0.3	3.8	11.0	0.1	1.8	3.8	0.4
Delay (s)	63.3	30.8	15.5	41.0	23.3	5.8	52.9	49.0	21.6	55.9	43.4	32.2
Level of Service	E	C	B	D	C	A	D	D	C	E	D	C
Approach Delay (s)		32.0			21.7			46.7			42.7	
Approach LOS		C			C			D			D	

Intersection Summary			
HCM Average Control Delay	34.6	HCM Level of Service	C
HCM Volume to Capacity ratio	0.82		
Actuated Cycle Length (s)	120.0	Sum of lost time (s)	8.0
Intersection Capacity Utilization	81.8%	ICU Level of Service	D
Analysis Period (min)	15		

c Critical Lane Group

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	129	955	71	99	1379	175	213	618	118	176	299	135
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
Lane Util. Factor	1.00	0.91	1.00	1.00	0.91	1.00	1.00	0.95	1.00	1.00	0.95	1.00
Frt	1.00	1.00	0.85	1.00	1.00	0.85	1.00	1.00	0.85	1.00	1.00	0.85
Flt Protected	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00
Satd. Flow (prot)	1770	5085	1583	1770	5085	1583	1770	3539	1583	1770	3539	1583
Flt Permitted	0.12	1.00	1.00	0.26	1.00	1.00	0.45	1.00	1.00	0.18	1.00	1.00
Satd. Flow (perm)	215	5085	1583	479	5085	1583	844	3539	1583	328	3539	1583
Peak-hour factor, PHF	0.90	0.90	0.90	0.95	0.95	0.95	0.89	0.89	0.89	0.88	0.88	0.88
Adj. Flow (vph)	143	1061	79	104	1452	184	239	694	133	200	340	153
RTOR Reduction (vph)	0	0	37	0	0	53	0	0	43	0	0	59
Lane Group Flow (vph)	143	1061	42	104	1452	131	239	694	90	200	340	94
Turn Type	pm+pt		pm+ov	pm+pt		pm+ov	pm+pt		pm+ov	pm+pt		pm+ov
Protected Phases	5	2	3	1	6	7	3	8	1	7	4	5
Permitted Phases	2		2	6		6	8		8	4		4
Actuated Green, G (s)	45.3	45.3	58.8	42.4	42.4	55.8	45.1	31.6	39.3	44.9	31.5	42.1
Effective Green, g (s)	46.8	46.8	61.8	43.9	43.9	58.8	48.1	33.1	42.3	47.9	33.0	45.1
Actuated g/C Ratio	0.39	0.39	0.51	0.37	0.37	0.49	0.40	0.28	0.35	0.40	0.28	0.38
Clearance Time (s)	5.5	5.5	5.5	5.5	5.5	5.5	5.5	5.5	5.5	5.5	5.5	5.5
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0
Lane Grp Cap (vph)	241	1983	815	274	1860	828	454	976	558	310	973	648
v/s Ratio Prot	c0.06	0.21	0.01	0.03	c0.29	0.02	0.07	c0.20	0.01	c0.08	0.10	0.01
v/s Ratio Perm	0.17		0.02	0.11		0.06	0.15		0.04	0.18		0.04
v/c Ratio	0.59	0.54	0.05	0.38	0.78	0.16	0.53	0.71	0.16	0.65	0.35	0.15
Uniform Delay, d1	28.5	28.2	14.5	30.9	33.8	16.9	25.1	39.1	26.7	26.3	34.9	24.7
Progression Factor	0.78	0.93	2.42	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Incremental Delay, d2	3.7	1.0	0.0	0.9	3.3	0.1	1.1	4.4	0.1	4.6	1.0	0.1
Delay (s)	25.9	27.1	35.2	31.7	37.1	17.0	26.2	43.5	26.8	30.8	35.9	24.8
Level of Service	C	C	D	C	D	B	C	D	C	C	D	C
Approach Delay (s)		27.5			34.7			37.6			32.0	
Approach LOS		C			C			D			C	

Intersection Summary			
HCM Average Control Delay	33.0	HCM Level of Service	C
HCM Volume to Capacity ratio	0.69		
Actuated Cycle Length (s)	120.0	Sum of lost time (s)	12.0
Intersection Capacity Utilization	74.0%	ICU Level of Service	D
Analysis Period (min)	15		

c Critical Lane Group

Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations						
Volume (vph)	918	11	24	1704	37	80
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0	4.0	4.0	4.0	4.0
Lane Util. Factor	0.91	1.00	1.00	0.91	1.00	1.00
Frt	1.00	0.85	1.00	1.00	1.00	0.85
Flt Protected	1.00	1.00	0.95	1.00	0.95	1.00
Satd. Flow (prot)	5085	1583	1770	5085	1770	1583
Flt Permitted	1.00	1.00	0.19	1.00	0.95	1.00
Satd. Flow (perm)	5085	1583	358	5085	1770	1583
Peak-hour factor, PHF	0.92	0.25	0.25	0.95	0.25	0.25
Adj. Flow (vph)	998	44	96	1794	148	320
RTOR Reduction (vph)	0	25	0	0	0	144
Lane Group Flow (vph)	998	19	96	1794	148	176
Turn Type		Perm	pm+pt			Perm
Protected Phases	4		3	8	2	
Permitted Phases		4	8			2
Actuated Green, G (s)	51.3	51.3	63.8	63.8	45.2	45.2
Effective Green, g (s)	52.8	52.8	65.3	65.3	46.7	46.7
Actuated g/C Ratio	0.44	0.44	0.54	0.54	0.39	0.39
Clearance Time (s)	5.5	5.5	5.5	5.5	5.5	5.5
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0	3.0
Lane Grp Cap (vph)	2237	697	295	2767	689	616
v/s Ratio Prot	0.20		0.02	c0.35	0.08	
v/s Ratio Perm		0.01	0.15			c0.11
v/c Ratio	0.45	0.03	0.33	0.65	0.21	0.29
Uniform Delay, d1	23.4	19.0	14.7	19.3	24.4	25.2
Progression Factor	0.57	0.12	0.29	0.26	1.00	1.00
Incremental Delay, d2	0.1	0.0	0.5	0.4	0.7	1.2
Delay (s)	13.4	2.3	4.7	5.5	25.1	26.4
Level of Service	B	A	A	A	C	C
Approach Delay (s)	12.9			5.4	26.0	
Approach LOS	B			A	C	

Intersection Summary			
HCM Average Control Delay	10.6	HCM Level of Service	B
HCM Volume to Capacity ratio	0.50		
Actuated Cycle Length (s)	120.0	Sum of lost time (s)	8.0
Intersection Capacity Utilization	42.9%	ICU Level of Service	A
Analysis Period (min)	15		
c Critical Lane Group			

Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations						
Volume (veh/h)	1799	43	90	729	10	21
Sign Control	Free			Free	Stop	
Grade	0%			0%	0%	
Peak Hour Factor	0.92	0.25	0.25	0.89	0.25	0.25
Hourly flow rate (vph)	1955	172	360	819	40	84
Pedestrians						
Lane Width (ft)						
Walking Speed (ft/s)						
Percent Blockage						
Right turn flare (veh)						
Median type	None			None		
Median storage veh)						
Upstream signal (ft)	1050					
pX, platoon unblocked			0.73		0.73	0.73
vC, conflicting volume			2127		2948	652
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol			1251		2375	0
tC, single (s)			4.1		6.8	6.9
tC, 2 stage (s)						
tF (s)			2.2		3.5	3.3
p0 queue free %			11		0	89
cM capacity (veh/h)			403		2	792

Direction, Lane #	EB 1	EB 2	EB 3	EB 4	WB 1	WB 2	WB 3	WB 4	NB 1	NB 2
Volume Total	652	652	652	172	360	273	273	273	40	84
Volume Left	0	0	0	0	360	0	0	0	40	0
Volume Right	0	0	0	172	0	0	0	0	0	84
cSH	1700	1700	1700	1700	403	1700	1700	1700	2	792
Volume to Capacity	0.38	0.38	0.38	0.10	0.89	0.16	0.16	0.16	17.76	0.11
Queue Length 95th (ft)	0	0	0	0	231	0	0	0	Err	9
Control Delay (s)	0.0	0.0	0.0	0.0	54.5	0.0	0.0	0.0	Err	10.1
Lane LOS					F				F	B
Approach Delay (s)	0.0				16.6				3232.3	
Approach LOS									F	

Intersection Summary			
Average Delay	122.5		
Intersection Capacity Utilization	53.1%	ICU Level of Service	A
Analysis Period (min)	15		

Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations						
Volume (veh/h)	918	11	24	1704	37	80
Sign Control	Free			Free	Stop	
Grade	0%			0%	0%	
Peak Hour Factor	0.92	0.25	0.25	0.95	0.25	0.25
Hourly flow rate (vph)	998	44	96	1794	148	320
Pedestrians						
Lane Width (ft)						
Walking Speed (ft/s)						
Percent Blockage						
Right turn flare (veh)						
Median type	None			None		
Median storage veh)						
Upstream signal (ft)	1050					
pX, platoon unblocked			0.95		0.95	0.95
vC, conflicting volume			1042		1788	333
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol			878		1660	136
tC, single (s)			4.1		6.8	6.9
tC, 2 stage (s)						
tF (s)			2.2		3.5	3.3
p0 queue free %			87		0	62
cM capacity (veh/h)			730		73	848

Direction, Lane #	EB 1	EB 2	EB 3	EB 4	WB 1	WB 2	WB 3	WB 4	NB 1	NB 2
Volume Total	333	333	333	44	96	598	598	598	148	320
Volume Left	0	0	0	0	96	0	0	0	148	0
Volume Right	0	0	0	44	0	0	0	0	0	320
cSH	1700	1700	1700	1700	730	1700	1700	1700	73	848
Volume to Capacity	0.20	0.20	0.20	0.03	0.13	0.35	0.35	0.35	2.02	0.38
Queue Length 95th (ft)	0	0	0	0	11	0	0	0	337	44
Control Delay (s)	0.0	0.0	0.0	0.0	10.7	0.0	0.0	0.0	595.8	11.8
Lane LOS					B				F	B
Approach Delay (s)	0.0				0.5				196.5	
Approach LOS									F	

Intersection Summary			
Average Delay	27.4		
Intersection Capacity Utilization	42.9%	ICU Level of Service	A
Analysis Period (min)	15		

Appendix H

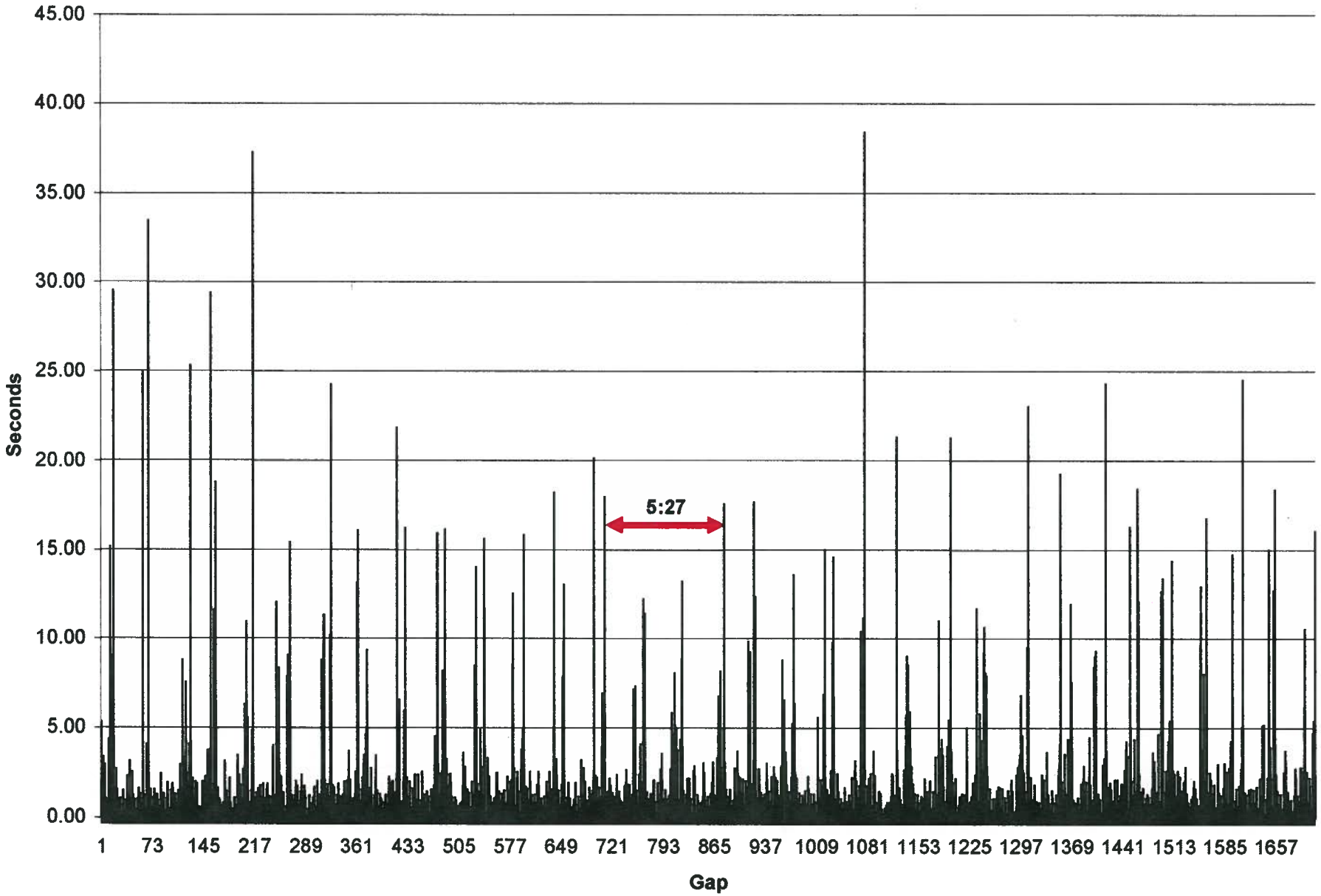
Gap Study Summary

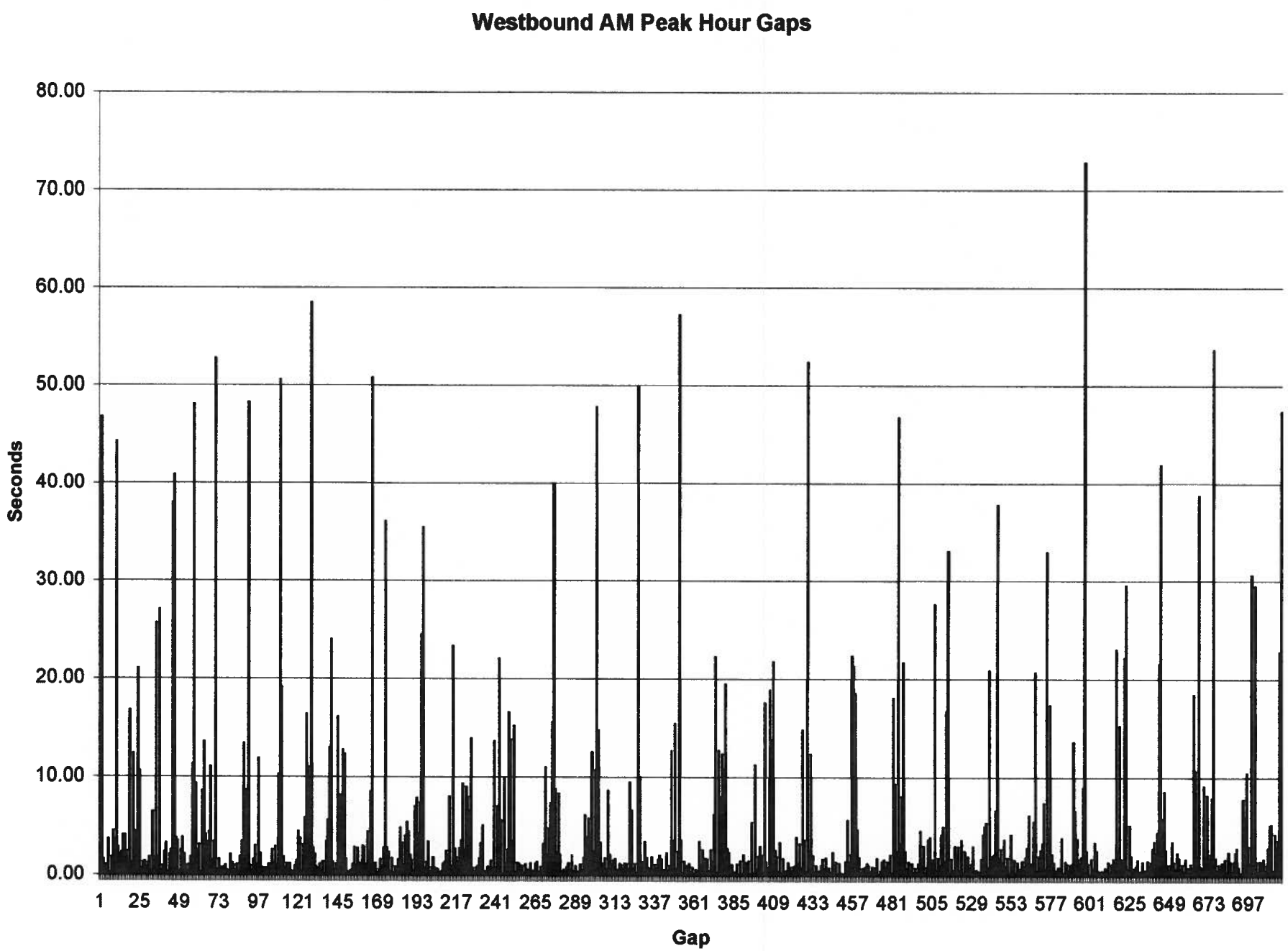
Peak Hour Delay Data Summary

Gaps (seconds)	AM Eastbound	AM Westbound	PM Eastbound	PM Westbound
0	2	0	2	5
0.5	410	124	140	293
1	388	112	165	376
1.5	322	116	120	304
2	160	67	90	238
2.5	114	39	58	148
3	73	38	35	104
3.5	31	24	29	57
4	36	19	26	32
4.5	26	18	16	28
5	12	7	16	17
5.5	13	8	11	12
6	11	8	9	10
6.5	4	5	8	10
7	5	5	5	8
7.5	2	3	6	3
8	5	6	11	2
8.5	7	6	4	5
9	8	8	10	4
9.5	8	5	2	4
10	6	2	11	4
10.5	2	3	6	1
11	3	7	7	1
11.5	4	2	3	3
12	4	1	3	2
12.5	4	5	1	0
13	4	4	3	1
13.5	4	1	1	1
14	1	6	5	2
14.5	2	0	2	1
15	3	2	2	3
16	7	4	6	1
17	6	5	3	5
18	3	2	7	0
19	4	4	2	1
20	1	2	2	2
25	9	16	11	7
30	2	4	12	5
35	1	3	6	0
40	2	6	4	2
40+	3	20	6	0
	0	0	0	0
Count Totals	**1712**	**717**	**866**	**1702**
Gaps 10+ Seconds	75	99	103	42
Gaps 15+ Seconds	41	68	61	26
Gaps 20+ Seconds	18	51	41	16

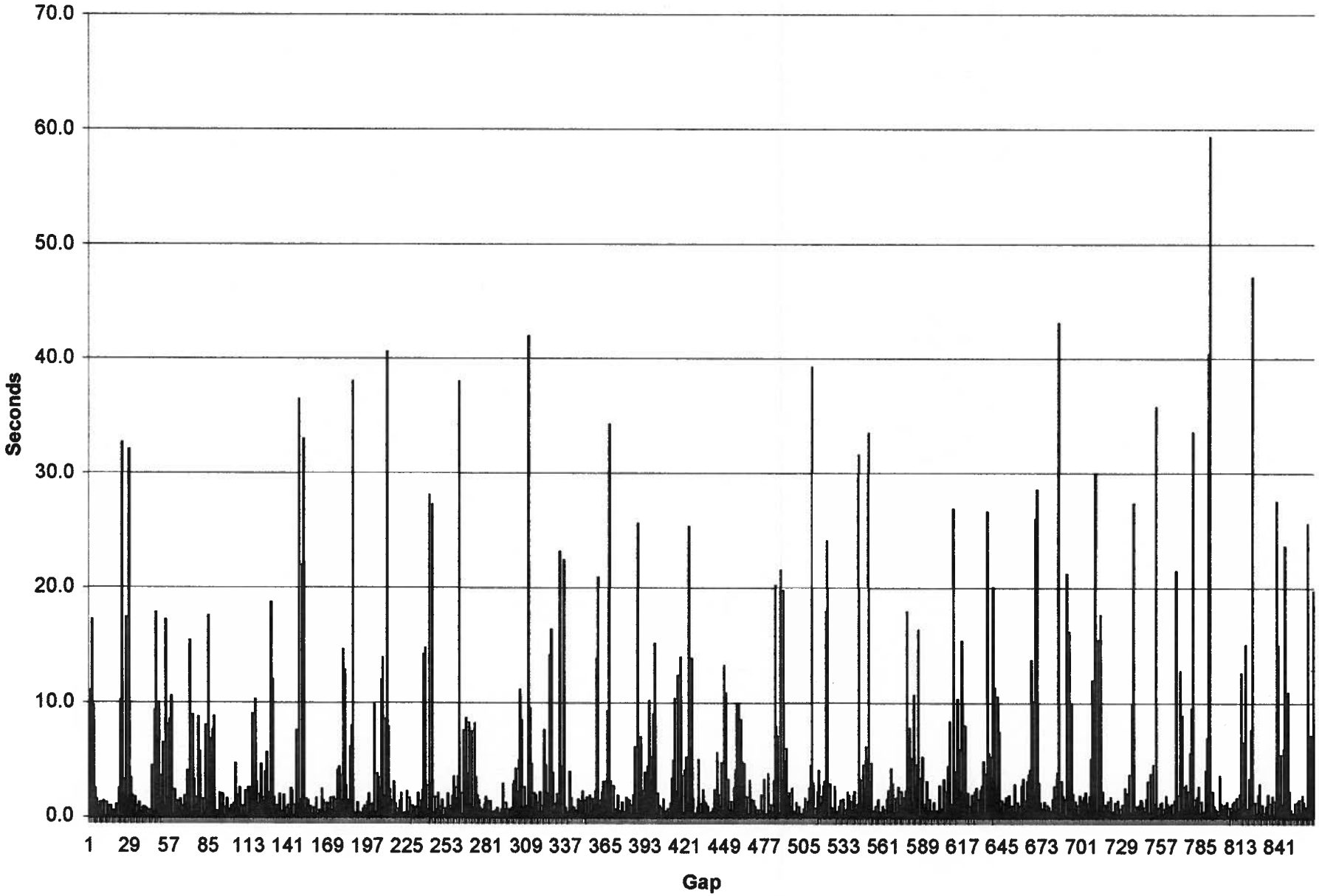
Counts collected January 11 and 12, 2010.

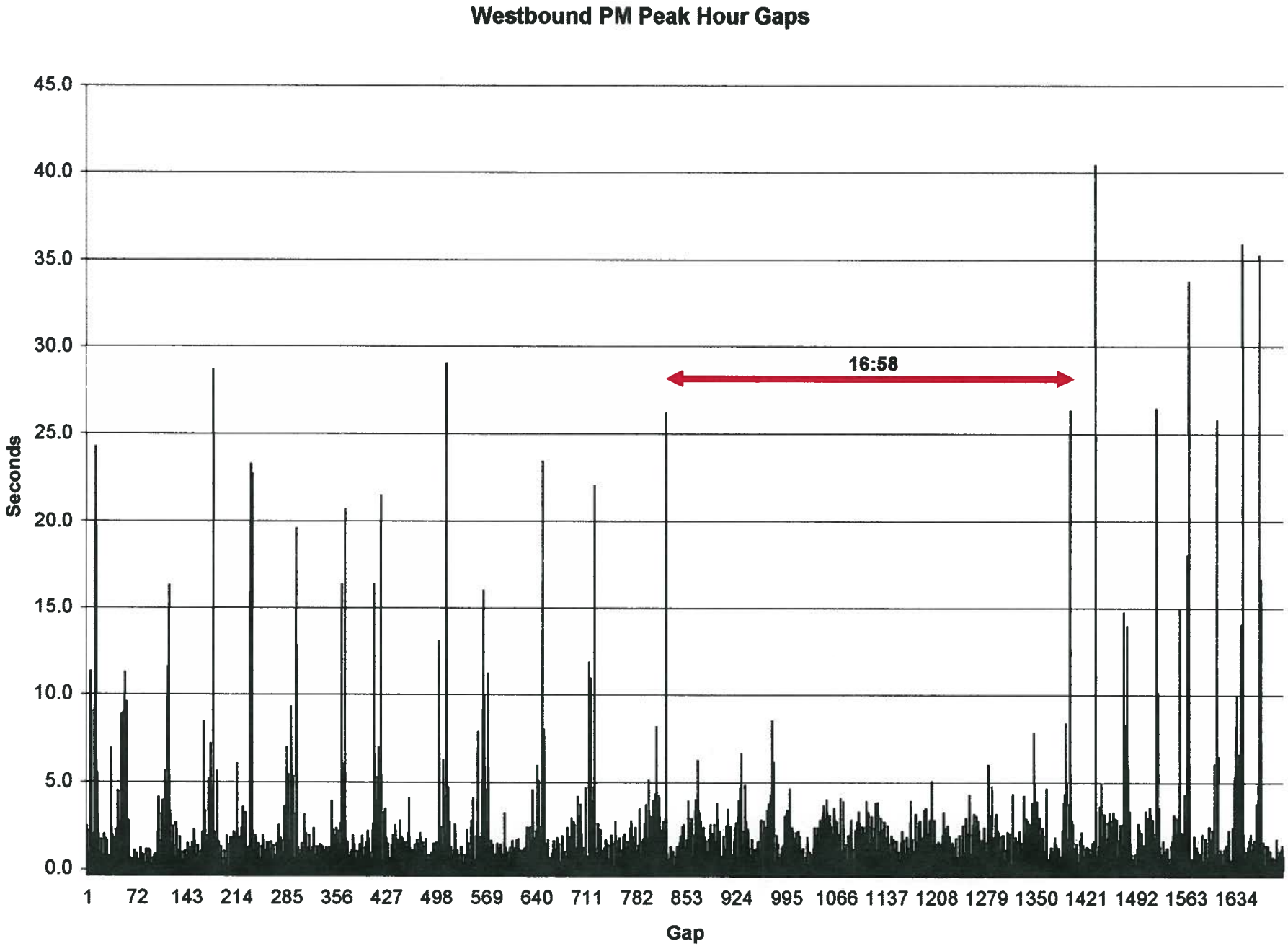
Eastbound AM Peak Hour Gaps




Westbound AM Peak Hour Gaps
80.00
70.00
60.00
50.00
40.00
30.00
20.00
10.00
0.00
Seconds
1 25 49 73 97 121 145 169 193 217 241 265 289 313 337 361 385 409 433 457 481 505 529 553 577 601 625 649 673 697
Gap

Eastbound PM Peak Hour Gaps




Westbound PM Peak Hour Gaps
45.0
40.0
35.0
30.0
25.0
20.0
15.0
10.0
5.0
0.0
Seconds
16:58
1
72
143
214
285
356
427
498
569
640
711
782
853
924
995
1066
1137
1208
1279
1350
1421
1492
1563
1634
Gap


2nd STREET
MONTANO BLVD.