MEMORANDUM

To: Mikaela Renz-Whitmore, City of Albuquerque Planning Department

From: Colin Burgett, Magnus Barber, Rick Chellman and Jeremy Nelson

Date: August 7, 2012

Subject: Volcano Heights Multi-modal Transportation Assessment

This memorandum describes the traffic forecast and circulation assessment conducted by Nelson\Nygaard of the proposed roadway network described in the Working Draft of the *Volcano Heights Sector Development Plan* (VHSDP) as of April 2012.

Purpose of the Sector Plan

The purpose of the VHSDP is to leverage the opportunity to create a major employment and activity center on the City's West Side in order to address the imbalance of jobs on the East Side and primarily housing on the West Side and relieve some congestion on river crossings caused by one-way commutes over time.

The Plan proposes a high-density, mixed-use development pattern that can encourage pedestrian, bicycle, and transit use for local trips without adversely impacting auto travel on the region's most important arterials – Paseo del Norte and Unser Boulevard, both of which are access-controlled by policy. This proposal has elicited several concerns by stakeholders and agency staff, including:

- Local impact of such intense development on surrounding neighborhoods and roadways;
- Regional impact of this development on the broader transportation network; and
- Potential effect of additional intersections on limited-access roadways.

Purpose of this Report

In order to assess the key concerns summarized above, Nelson\Nygaard was engaged by the Sector Plan consultant, Gateway Planning Group, as traffic engineering consultants to perform this traffic study.

The purpose of this assessment is to provide a conceptual, high-level analysis of the proposed roadway network. The analysis included conservative assumptions on various inputs in order to generate the worst-case scenario as a baseline for comparison between currently forecasted traffic volumes for 2035 and potential changes based on the proposed Plan.

- This study is not meant to provide the level of precision of a "near-term" Traffic Impact Analysis typically required to justify an access modification request for pending development applications on these limited-access roads.
- This report provides an "order-of-magnitude" trip generation comparison to assess the local impact of such intense development on surrounding neighborhoods and roadways.

- The circulation assessment focuses on potential operational concepts related to proposed quarter-mile spacing of intersections on the access-controlled Paseo del Norte and Unser Boulevard corridors within the Sector Plan boundary.

Report Overview

The traffic assessment is divided into the following three parts:

1. Traffic Forecast

Nelson\Nygaard prepared a forecast of motor vehicle traffic that would be generated by the land uses identified in the VHSDP and assessed the potential effect on the key regional roadways bordering the sector based on forecasted Year 2035 traffic volumes. The following steps were conducted:

- Review of VHSDP development assumptions including:
  - Land use buildout assumptions under the 2012 VHSDP and prior *Volcano Heights Conceptual Plan* prepared in 2006 that was used as the basis for growth assumptions put into the Mid-Region Council of Governments (MRCOG) traffic forecast to generate the 2035 Metropolitan Transportation Plan
  - Relevant VHSDP regulatory assumptions related to the planned design and long-term operation of the two key regional roadways that will provide access to the sector: Paseo Del Norte and Unser Boulevard
- Review of regional traffic forecast information relevant to site access focusing on:
  - Forecasted future traffic volumes on regional roadways that will serve the site, based on the MRCOG regional travel demand model forecast of Year 2035 traffic volumes
  - Confirmation of land use development assumptions for the Volcano Heights "sector" contained in the MRCOG Year 2035 traffic forecast, for purposes of assessing the potential change to Year 2035 traffic volumes resulting from land uses proposed in the 2012 VHSDP
- Preparation of preliminary Trip Generation forecast
  - Nelson\Nygaard prepared a preliminary forecast of Year 2035 trip generation for planning purposes, based on anticipated Year 2035 land uses under the proposed 2012 VHSDP
  - Nelson\Nygaard also provided a comparative trip generation for the site, based on the assumed Year 2035 land uses that are incorporated into the MRCOG Year 2035 model, for purposes of assessing the "net change" to Year 2035 traffic that would result from the VHDSP

2. Circulation Assessment

Incorporating the trip generation evaluation described in Part 1, Nelson\Nygaard provided input on the proposed street network as described in Part 2 of this report, focusing on review of:

- 2012 VHSDP site access characteristics focusing on proposed:
  - Circulation to and from adjacent sectors outside the boundaries of the VHDSP
  - Multi-modal access to the regional arterial and transit network
  - Site access capacity relative to trip generation forecast
- Proposed VHSDP internal street plan elements related to:
  - Block size and distance(s) between intersections
  - Network connectivity

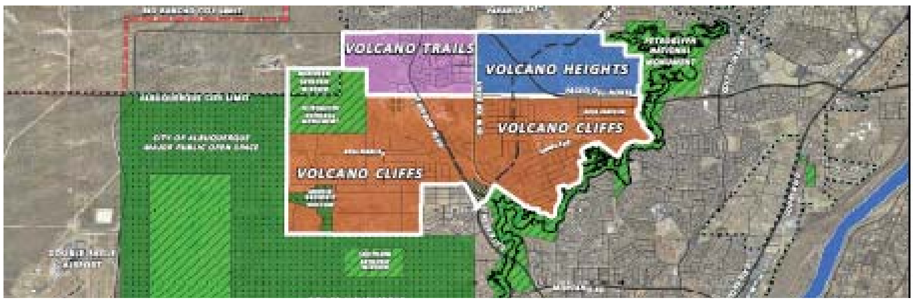
- Right-of-way widths (streets, sidewalks, and bicycle/pedestrian trails)
- Internal capacity relative to trip generation forecast

3. Relevant Case Studies

Based on the forecasted Year 2035 volumes on the two key regional arterials that will provide access to the sector, Paseo Del Norte and Unser Boulevard, Section 3 describes the general design and operational characteristics of several arterial streets in other cities for comparative purposes. In particular, the case studies provide examples of arterial streets that operate acceptably, carrying similar volumes of traffic as forecasted on Paseo Del Norte and Unser Boulevard, and include desired characteristics identified in the Sector Plan related to:

- Intersection spacing
- Narrower right-of-way configurations
- Multi-modal circulation elements

Figure 1-1. Local Context: Volcano Heights Sector & Adjacent Planning Areas



Source: City of Albuquerque Planning Department, Summary Sheet for *Volcano Heights Sector Development Plan*, March 27, 2012

Figure 1-2. Regional Context: Key Circulation Routes

Source: City of Albuquerque, *Volcano Heights Planning Study Report*, March 15, 2005

1. TRAFFIC ASSESSMENT

This section describes the steps taken to prepare a preliminary forecast of future traffic volumes that would be generated by the proposed land uses described in the VHSDP and an assessment of the resulting effect on the key regional circulation routes the provide access to the site.

VHSDP Development Assumptions

The traffic study did not include a comparison of existing zoning – Residential Developing (RD) Area Zone. RD is intended primarily as a holding zone until an area develops, allowing only single-family and townhouse development without an adopted sector development plan. The existing zoning, if unchanged, would result in exclusively residential development, most likely predominantly single-family houses with some townhouse development along major corridors. This development could result in up to 12,000 dwelling units, which would add another "bedroom community" on Albuquerque's West Side. The table below is included for informational purposes only to facilitate a high-level comparison.

In general, the amount of traffic generated based on the development scenarios below would be less than either the 2006 Conceptual Plan or the 2012 proposed Sector Plan, but it also would not include any services or employment for the surrounding area, which is a stated City policy for the Volcano Heights area. There would also be no reduction of vehicle trips from mixed-use scenarios or from compact development that can support transit service and encourage transit ridership. As shown on Figure 1-3, development of 2,848 single-family dwelling units, a development scenario that would be allowable under existing zoning, would generate over 26,000 daily vehicle trips (approximately 9.5 daily vehicle trips per dwelling unit) on adjacent roads, and approximately 2,800 vehicle trips during the PM peak hour (approximately one peak hour vehicle trip per unit).

Figure 1-3. Single-family Dwelling Units (DU) and Traffic Generation

Land Use	No. Units		Trip Generation Rate (see note 1)				Total Trips		
			Daily	AM Peak	PM Peak	Units	Daily	AM Peak	PM Peak
Scenario A: Residential Development with 1/2 Acre Lot Sizes (see note 2)									
Detached	924	(units)	9.57	0.77	1.02	/unit	8,843	711	942
Transit Trips (see note 5)			*0%*	*1%*	*1%*		*21*	*7*	*7*
Walk & Bicycle Trips (see note 6)			*0%*	*0%*	*0%*		*0*	*0*	*0*
Total Vehicle Trips Generated							8,821	704	935
Internal Vehicle Trips			*0%*	*0%*	*0%*		*0*	*0*	*0*
External Vehicle Trips (see note 6)			***100%***	***100%***	***100%***		***8,821***	***704***	***935***
Scenario B: Residential Development with 1/4 Acre Lot Sizes (see note 3)									
Detached	1,681	(units)	9.57	0.77	1.02	/unit	16,087	1,294	1,715
Transit Trips (see note 5)			*0%*	*2%*	*2%*		*78*	*26*	*26*
Walk & Bicycle Trips (see note 6)			*0%*	*0%*	*0%*		*0*	*0*	*0*
Total Vehicle Trips Generated							16,010	1,268	1,689
Internal Vehicle Trips			*0%*	*0%*	*0%*		*0*	*0*	*0*
External Vehicle Trips (see note 6)			***100%***	***100%***	***100%***		***16,010***	***1,268***	***1,689***
Scenario C: Residential Development with 1/8 Acre Lot Sizes (see note 4)									
Detached	2,848	(units)	9.57	0.77	1.02	/unit	27,255	2,193	2,905
Transit Trips (see note 5)			*1%*	*4%*	*3%*		*263*	*88*	*88*
Walk & Bicycle Trips (see note 6)			*3%*	*2%*	*1%*		*818*	*33*	*29*
Total Vehicle Trips Generated							26,175	2,072	2,788
Internal Vehicle Trips			*0%*	*0%*	*0%*		*0*	*0*	*0*
External Vehicle Trips (see note 6)			***100%***	***100%***	***100%***		***26,175***	***2,072***	***2,788***

Year 2035 Land Uses with Sector Plan

Unlike the existing zoning, the land use strategy in the 2012 VHSDP allows mixed-use development, with residences and services within walking or biking distance of each other. This development is intended to serve new residents, nearby residents, as well as regional markets. VHSDP development assumptions for Year 2035 were based on the allowable land uses, as described in the VHSDP, and a market assessment of future demand for office and retail space in the area within the specified timeframe. Based on that assessment, City Planning staff provided the following forecast of Year 2035 land uses:

- 2 million square feet of commercial space including:
  - 1.2 million square feet of office space
  - 800,000 square feet of retail space (mix of regional-serving, local-serving and specialty retail uses)
- 4,769 residential dwelling units consisting of:
  - 4,114 multi-family dwellings
  - 364 single-family detached dwellings
  - 291 single-family attached (rowhouse, townhouse, or duplex) dwellings

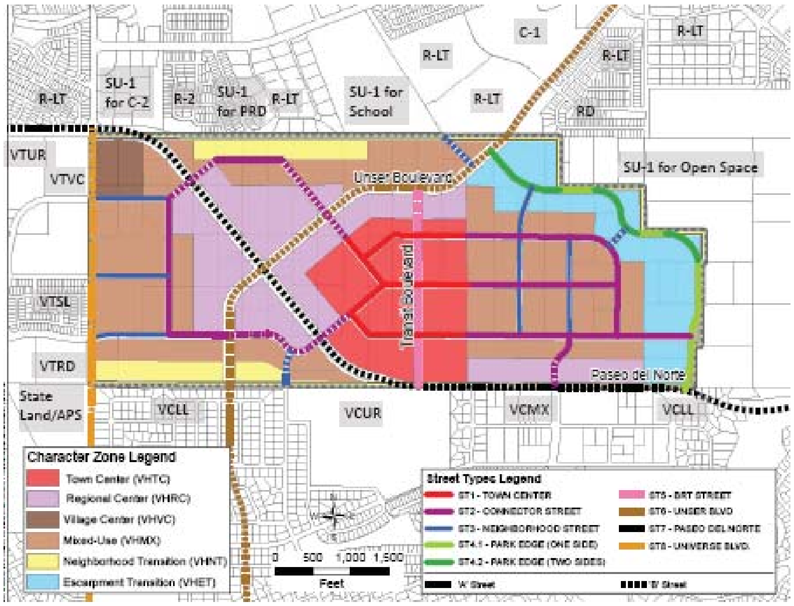
Figure 1-4 shows the proposed land use designations described in the VHSDP. Based on the distribution of allowable land uses within the sector, Gateway Planning provided a detailed spreadsheet describing the potential allocation of development on a block-by-block basis. Figure 1-5 shows a sketch version of the block layout utilized for conceptual forecasting purposes only.

Planned Arterial Street Network

The planned regional roadway network includes three key facilities that will provide direct access to Volcano Heights:

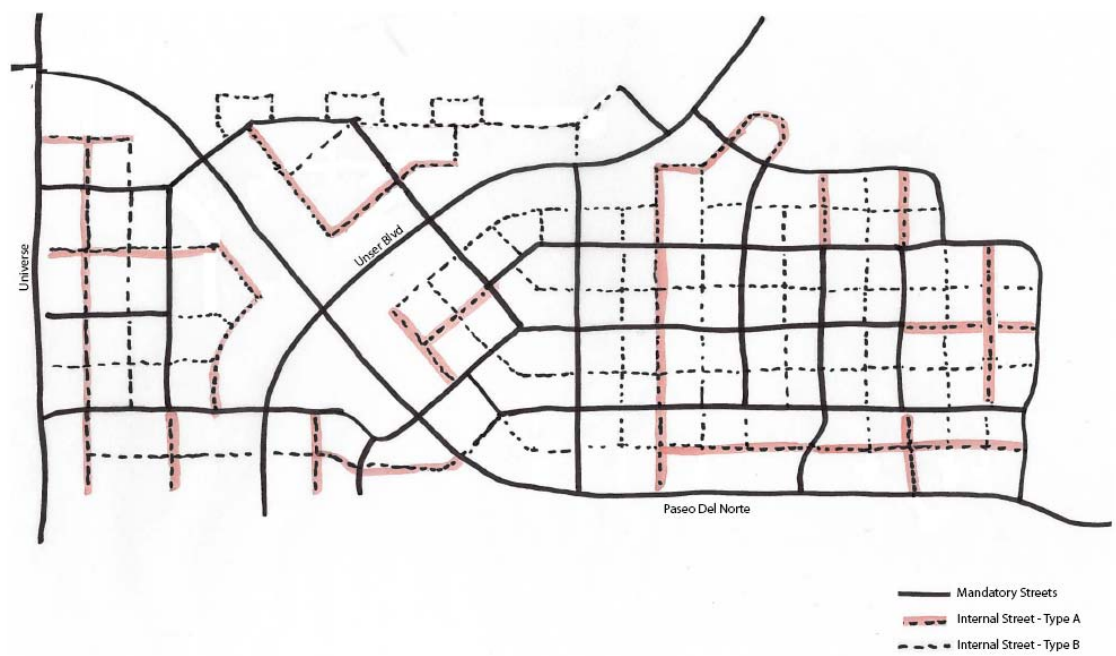
- Paseo del Norte, designated as a 6-lane limited-access facility with half-mile spacing between signalized intersections, including grade-separated crossings at several locations outside the sector and at-grade intersections planned within the study area,
- Unser Boulevard, designated as a 4-lane limited-access facility with half-mile spacing between signalized intersections and at-grade intersections planned within the study area, and
- Universe Boulevard, designated as a 4-lane major arterial.

Figure 1-4. VHSDP Proposed Character Zones & Street Types



Source: City of Albuquerque Planning Department, Summary Sheet for *Volcano Heights Sector Development Plan*, March 27, 2012

Figure 1-5. Conceptual Illustration of Possible Internal Streets & Block Layout

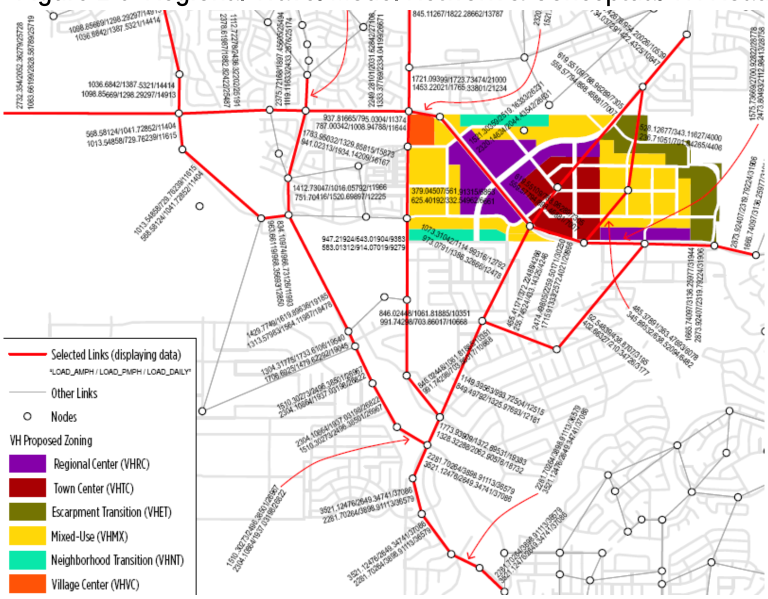


Source: Gateway Planning, Draft *Volcano Heights Internal Streets*, April 30, 2012 (For traffic modeling purposes only)

Regional Travel Model Assumptions

Future traffic volumes on the regional roadway network are forecasted by the MRCOG regional travel demand model.

Figure 1-6. Regional Travel Model Network & Conceptual VH Road Network



Year 2035 Land Uses without Sector Plan (Baseline Development Scenario)

The MRCOG model forecast of Year 2035 traffic volumes generated by development of the Volcano Heights sector is based on the proposed mix of land uses identified in the 2006 Volcano Heights Conceptual Plan. The anticipated level of development by Year 2035 would consist of 1,650 dwelling units and commercial development providing 9,500 jobs, representing approximately 3 million square feet of commercial development.

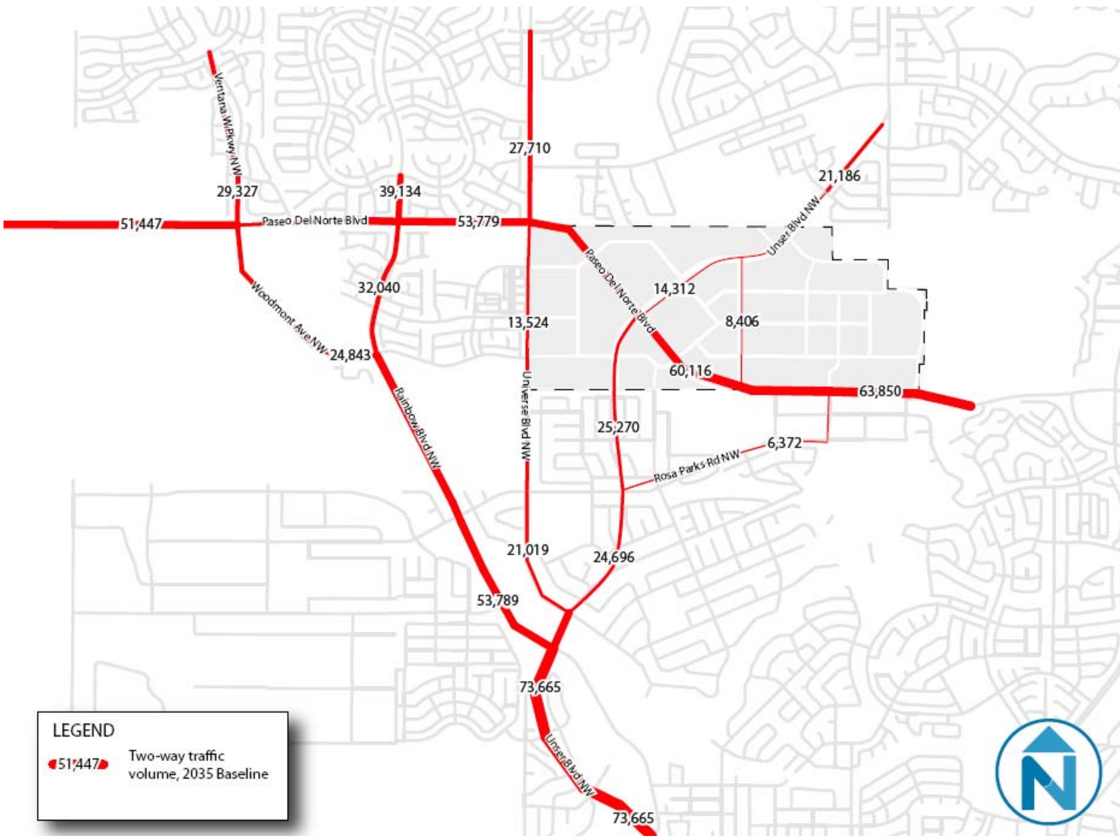
The Conceptual Plan envisioned a similar "village" core as the Sector Plan, but with several key differences:

- Outside of the "village" core area, the Conceptual Plan designated most of the site for office development, with a much smaller area designated for potential residential development.
  - The Conceptual Plan would allow over 1 million square feet of additional office space, compared to the Sector Plan, primarily with "office park" developments outside of the "village" core
- As a result, the number of residential units allowed under the Conceptual Plan is much lower than the Sector Plan
  - Under the Conceptual Plan, just 1,650 residential dwelling units are anticipated by Year 2035

  - Under the proposed Sector Plan, up to 4,800 residential dwelling units are anticipated by Year 2035
- Both plans would allow similar levels of retail development within the "village core" area. Therefore, since the Sector Plan forecast of Year 2035 commercial development is based on anticipated retail demand in the area, there is no difference anticipated in the mix of retail uses under Year 2035 conditions
- A key difference between the two plans is the proposed street layout, identified in the Sector Plan, which would extend the "village" grid concept to cover most of the VH sector, with smaller block sizes, narrower streets, and an increased emphasis on facilitating local connections at multiple intersections, with dispersal of traffic throughout the grid network. The mix of uses in close proximity is also intended to facilitate additional pedestrian and bicycle trips and help support transit service and encourage transit use.

Figure 1-7 shows the forecasted Year 2035 daily traffic volumes, including vehicle trips generated by VH Conceptual Plan land uses, on the regional roads providing access to the area. Peak hour traffic volumes are forecasted to be roughly 10 percent of daily traffic volumes.

Figure 1-7. Forecasted Year 2035 Traffic Volumes (with Baseline Land Uses from VH Conceptual Plan)



Source: Mid-Region Council of Governments, Year 2035 Daily Traffic Volume Forecast

As shown on Figure 1-7, forecasted daily volumes on the key regional roadways providing access to the Volcano Heights sector are as follows:

- East/West Circulation
  - Paseo del Norte: 60,000 daily vehicles within the VH core area
- North/South Circulation
  - Unser Boulevard: 14,000 daily vehicles within the VH core area
  - Universe Boulevard: 13,000 daily vehicles bordering the VH sector
  - Rainbow Boulevard, west of the VH sector: 50,000 daily vehicles by-passing the VH sector
  - South of the study area, north/south circulation will be funneled onto just one north/south connection to be provided by the lower segment of Unser Boulevard, projected to carry over 70,000 daily vehicles

Future Traffic Capacity

Planned roadway capacity and forecasted Year 2035 traffic volumes are summarized below in Figure 1-8. As shown, a significant amount of excess north-south capacity will be provided on both Unser and Universe Boulevards, while Paseo del Norte will operate at full capacity.

Figure 1-8 Future Traffic Volumes & Planned Capacity on Major Arterials within Volcano Heights

Planned Year 2035 Roadway Network Capacity & Forecasted Traffic Volumes								
	Through Lanes (Planned)		Intersection Turn Lanes (Planned)		Approximate Capacity* (Planned)		2035 Traffic Volume Forecast ***	
Regional Road	Total Lanes	Lanes per Direction	Left-turn lanes at signalized intersections	# of right-turn lanes at intersections	Peak Hour	Daily **	Daily	# of Through Lanes Needed to Accommodate Forecasted Volume
Paseo del Norte	6	3	2	1	6,000	60,000	60,116	6
Unser Blvd	4	2	2	1	4,000	40,000	14,312	2
Universe Blvd	4	2	1-2	0-1	3,500	35,000	13,524	2

*Assumes a balanced signal timing plan, with equal allocation of time to all approaches at major intersections.
**Daily capacity is typically estimated based on peak-hour capacity multiplied by ten.
***Forecasted traffic volume within the Volcano Heights core area based on Conceptual Plan land uses and street network.

Implications for Volcano Heights Roadway Network

Excess capacity on Unser and Universe Boulevards provides an opportunity to potentially consider narrower right-of-way allocations on those two facilities within and bordering the VH site. Given the grid street pattern, and potential traffic constraints on Paseo del Norte, it seems likely that future VH residents will generally prefer Unser and/or Universe for local access, especially during peak travel periods. (Also see Section 3 of this report that provides several examples of street configurations from other cities carrying similar traffic volumes).

Spacing of Signalized Intersections

A key factor relevant to the proposed internal VH circulation network relates to the desired spacing of signalized intersections on major arterials, particularly on Paseo del Norte. In walkable, mixed-use areas, typical block sizes of 300 to 400 feet allow for direct pedestrian travel between destinations. Where half-mile (2,620 feet) or quarter-mile (1,320 feet) distances are provided on major arterials, walking distances of over a half-mile can be required between land uses on opposite sides of the same street.

However, where traffic volumes are high relative to capacity, as will be the case on Paseo del Norte, it will be difficult to achieve 2-way synchronization of traffic signals at the desired regional travel speeds of 40 to 50 miles per hour (mph). Figure 1-9 provides examples of 2-way signal coordination options with varying travel speeds and varying distances between signalized intersections (half-mile, quarter-mile, and smaller).

Figure 1-9 Travel Speed & Intersection Spacing Considerations on Major Arterials

General Distance between Signalized Intersections for 2-way Signal Synchronization at Various Travel Speeds					
	2-way synchronization options				
Travel Speed (mph)	**Distance between signalized intersections**	**Signal off-set for 2-way coordination (seconds)**	**Signal cycle length (seconds)***	**Travel Time on Paseo del Norte through VH**	**Notes**
50	Half-mile	36	72	2.1	*Cycle lengths of less than 90 seconds likely infeasible at higher speeds with wide right-of-way & turn phases.*
45	Half-mile	40	80	2.3	
40	Half-mile	45	90	2.6	*Cycle length of 90 to 120 seconds likely required on Paseo del Norte to accommodate 120-ft pedestrian crossing distances and left-turn phases.*
36	Half-mile	50	100	2.9	
30	Half-mile	60	120	3.5	
30	Quarter-mile	30	60	3.5	*Cycle length of 60 to 90 seconds may be feasible with reduced travel speeds and shorter pedestrian crossing distances.*
25	Quarter-mile	36	72	4.2	
20	Quarter-mile	45	90	5.2	
18	660 ft	25	50	5.8	
15	660 ft	30	60	7.0	
10	400 ft	30	60	10.5	*Ideal travel speed for bicycle circulation.*
*Assumes a balanced signal timing plan, with equal allocation of time to all approaches at major intersections.					
** Length of Paseo del Norte = 1.75 miles through Volcano Heights sector.					

Sector Plan Traffic Generation

The steps undertaken to provide a preliminary vehicle trip forecast for proposed Year 2035 land uses under the VHDSP are described below.

Step 1: ITE Baseline Trip Generation

The baseline forecast of trips that would be generated by the Year 2035 land uses within the VHSDP boundaries was derived using trip generation rates for the key land use types provided by the Institute of Transportation Engineers (ITE) *Trip Generation* Manual, 8th edition.

ITE trip generation rates are based on studies of suburban locations, typically "single-use" developments. Such developments typically are located in areas with minimal public transit service and minimal provisions for pedestrian and bicycle circulation. Land uses selected for observation also generally provide separate, free parking facilities for each land use, and nearly all trips to and from such sites are made via private motor vehicle.

ITE chose to collect data at single-use suburban sites precisely to provide a "baseline" forecast of traffic generation that should be adjusted based on local characteristics and site-specific factors, such as:

- Rates of transit ridership and service
- Provisions for pedestrian and bicycle circulation
- Density and mix of land uses, particularly relevant to mixed-use developments, as envisioned in the VHSDP, in which a portion of trips will occur internally, between the various land uses within the sector

Since the baseline trip generation rates for individual land uses are based on data collected at low density development with separated land uses and minimal transit, walking, or biking, ITE cautions that trip generation analysis using ITE rates as a "baseline" must take into account land use and transportation alternatives from the local context in order to be accurate.

The methodology for applying site-specific trip generation factors based on the proposed mix of land uses and proposed street network configuration is described in Steps 2, 3, and 4.

Step 2: Baseline Trip Adjustment to Avoid Double-counting of Internal Trips

The model was adjusted to account for internal trips to/from retail uses that would otherwise be double-counted, based on ITE internal trip capture data for retail uses (to/from office, residential and other retail uses) in mixed-use developments.

Step 3: Baseline Trip Adjustment to Account for Retail Pass-by Trips

A significant portion of retail trips are "pass-by" trips (e.g. stopping at a store on your way home). In this example, the store itself did not generate the trip but rather benefits from its location on your route home. Pass-by trip rates are often between 20 and 50 percent of retail trips, generally higher for smaller retail establishments.

This forecast applied a PM Peak Hour pass-by rate of 25 percent for PM Peak derived from ITE logarithm for Shopping Centers applied to the anticipated size of regional retail sites within VH (determined at the block level). The daily pass-by rate was estimated conservatively at 15 percent.

Step 4: Bicycle & Walking Trips

The proposed development will have a relatively dense street network, a mix of land uses in close proximity, and street designs that incorporate facilities for bicycle, pedestrian and transit users. Residents and employees living and working in Volcano Heights will have some transportation choice; different modes may be more convenient at different times, depending on the trip.

Since the ITE average trip generation rates are based on observations made at single-use sites, the ITE average rates will not accurately predict the level of trip generation that would result from the proposed mix of uses at Volcano Heights. Therefore, consistent with the ITE recommended practice, the ITE average rates were adjusted based on local conditions, including the proposed mix of land use types.

To estimate the effect of the proposed mix-use development pattern on trip generation, Nelson\Nygaard used the URBEMIS methodology. URBEMIS is a program developed for the California Air Resources Board to calculate vehicle trips and resulting emissions resulting from new development.

URBEMIS was developed to more accurately reflect the level of vehicle trip generation resulting from new development by providing formulas based on specific site characteristics. The URBEMIS methodology is designed to offer a useful comparison of the difference in trip generation that can be expected when locating high density development in mixed-use, high-density areas with alternative transportation modes available and/or transportation demand management programs in place.

URBEMIS calculates trip generation rates starting with the ITE average trip generation rates as a base. The URBEMIS method employs standard methodologies but provides the opportunity to adjust ITE average rates to quantify the impact of a development's location, physical characteristics, and any demand management programs. In this way, it provides an opportunity to fairly evaluate developments that minimize their transportation impact, for example, through locating close to transit or providing high densities and a mix of uses.

Area Inputs

In addition to requiring the transportation modeler to input the basic land use components of the proposed project (i.e. the number of square feet of each land use), URBEMIS also factors in other area-specific characteristics to determine accurate trip rates. The number of trips generated by a development depends not only on the characteristics of the project itself, but also on the nature of the surrounding area. For example, neighborhood characteristics such as a good balance of housing and jobs, the presence of frequent transit service, and a highly-connected, walkable street network are strongly associated with lower vehicle trip rates. High-density housing added to an existing central city neighborhood, where many shops, services, and transit already exist, will normally generate fewer trips than the same housing located close to a freeway interchange and surrounded by only low-density housing subdivisions. For this reason, URBEMIS requires data about the area within approximately a half-mile radius from the center of the project, or for the entire project area, whichever is larger. Figure 1-10 shows the key project area characteristics applicable to the URBEMIS methodology.

Figure 1-10 Area Characteristics Input to URBEMIS Model

Factors
Number of housing units within ½ mile radius
Number of jobs located within ½ mile radius
Local serving retail within ½ mile radius
Transit service
Intersection density within ½ mile radius*
Sidewalk completeness within ½ mile radius
Bike lane completeness within ½ mile radius

Note: * Calculated from proposed street network, based on the number line segment terminations, or each “valence.” Intersections have a valence of 3 or higher: a valence of 3 is a “T” intersection, 4 is a four-way intersection, etc.

It is important to note that the above characteristics do not incorporate any transportation demand management (TDM) measures, such as specific programs, incentives, or strategies to reduce trip generation. Rather, they are based entirely on the mix and density of land uses and the proposed design of the road network.

Step 5: Transit Trip Forecast

For planning purposes, a preliminary "back-of-the-envelope" estimate of potential transit ridership was incorporated into this forecast, which assumed a relatively modest level of transit ridership, 5% of home to work trips for both residential and non-residential land uses, plus daily "non-work" transit trips estimated at 50% of daily work trips by transit. Higher levels of transit ridership are ultimately feasible depending on the ultimate level of transit service and transit incentives.

Step 6: Vehicle Trip Forecast

The resulting vehicle trip forecast is shown on Figure 1-11 for Volcano Heights, while a comparative trip generation forecast based on Conceptual Plan land uses, based on the same methodology, is shown on Figure 1-12.

Figure 1-11 Preliminary Trip Generation Forecast: Volcano Heights *Sector Development Plan* (Year 2035)

Land Use	No. Units		Trip Generation Rate (see note 1)				Total Trips		
			Daily	AM Peak	PM Peak	Units	Daily	AM Peak	PM Peak
Residential									
Detached	364	(units)	9.57	0.77	1.02	/unit	3,483	280	504
Attached	291	(units)	5.81	0.44	0.52	/unit	1,691	128	151
Multifamily	4,114	(units)	6.65	0.51	0.62	/unit	27,360	2,098	2,551
Hotel	53,600	(ft2)	8.92	0.64	0.74	/occupied room	797	57	66
Office	1,180,135	(ft2)	11.01	1.55	1.49	/1,000 ft2	12,993	1,829	1,758
Retail									
Regional Retail	326,700	(ft2)	42.94	1.95	7.70	/1,000 ft2	14,028	638	2,515
Specialty Retail	322,198	(ft2)	44.32	6.84	5.02	/1,000 ft2	14,280	2,204	1,617
Local Retail	170,600	(ft2)	42.94	3.72	12.92	/1,000 ft2	7,326	635	2,205
Internal Trip Adjustment (see note			*-19%*	*-15%*	*-20%*		*-15,679*	*-1,181*	*-2,218*
Retail Pass-by Trips (see note 3)			*-15%*	*-15%*	*-25%*		*-5,345*	*-522*	*-1,584*
Base Trip Subtotal (VH Sector Development Plan)							60,935	6,168	7,565
Walk & Bicycle Trips (see note 4)			*15%*	*14%*	*20%*		*9,070*	*836*	*1,550*
Transit Trips (see note 5)			*3%*	*5%*	*4%*		*2,000*	*300*	*300*
Total Vehicle Trips Generated							49,865	5,032	5,715
Internal Vehicle Trips (see note 6)			*13%*	*7%*	*11%*		*6,509*	*330*	*653*
External Vehicle Trips (see note 7)			*87%*	*93%*	*89%*		43,356	4,702	5,062

Notes:

(1) Base trip rates from ITE Trip Generation, 8th Edition. Peak hour trips rates shown for Regional Retail and Local Retail based on fitted curve logarathim applied at block level.

(2) Adjustment to account for internal trips to/from retail uses that would otherwise be double-counted, based on ITE internal trip capture data for retail uses (to/from office, residential and other retail uses) in mixed-use developments.

(3) Pass-by rate of 25 percent for PM Peak derived from ITE logarithim for Shopping Centers (while local and specialty retail uses often have higher pass-by rates). Daily pass-by rate conservatively estimated at 15 percent.

(4) Mode shift for internal trips based on proposed density, mix of uses, block layout, bicycle and pedestrian facilities

(5) Based on preliminary "back-of-the-envelope" estimate of potential transit ridership. Assumed 5% of home to work trips for both residential and non-residential land uses would occur via transit plus estimated "non-work" transit trips at 50% of

(6) Total Vehicle Trips derived by subtracting walk & bicycle trips (see note 4) and transit trips (see note 5) from Base Trip Subtotal.

(7) Derived from estimated internal trips (see note 2), subtracting internal walk & bicycle trips (see note 4) and internal transit trips (estimated at 5% of transit ridership).

(8) Net vehicle trips derived by subtracting internal vehicle trips (see note 6) from total vehicle trips generated.

Figure 1-12 Baseline Trip Generation Forecast: Volcano Heights *Conceptual Plan* Land Uses (Year 2035)

Land Use	No. Units		Trip Generation Rate (see note 1)				Total Trips		
			Daily	AM Peak	PM Peak	Units	Daily	AM Peak	PM Peak
Residential									
Detached	490	(units)	9.57	0.77	1.02	/unit	4,689	377	500
Attached	0	(units)	5.81	0.44	0.52	/unit	0	0	0
Multifamily	1,160	(units)	6.65	0.51	0.62	/unit	7,714	592	719
Office Park	1,900,000	(ft2)	11.42	1.72	1.50	/occupied room	21,698	3,268	2,850
Office (Town	280,502	(ft2)	11.01	1.55	1.49	/1,000 ft2	3,088	435	418
Retail (Town									
Regional Retail	326,700	(ft2)	42.94	1.95	7.70	/1,000 ft2	14,028	638	2,515
Specialty Retail	322,198	(ft2)	44.32	6.84	5.02	/1,000 ft2	14,280	2,204	1,617
Local Retail	170,600	(ft2)	42.94	3.72	12.92	/1,000 ft2	7,326	635	2,205
Internal Trip Adjustment (see note			*-22%*	*-15%*	*-19%*		*-15,679*	*-771*	*-2,010*
Retail Pass-by Trips (see note 3)			*-15%*	*-15%*	*-25%*		*-5,345*	*-522*	*-1,584*
Base Trip Subtotal (2006 VH Conceptual Plan Land Uses)							51,800	6,856	7,230
Walk & Bicycle Trips (see note 4)			*8%*	*9%*	*9%*		*4,271*	*592*	*652*
Transit Trips (see note 5)			*3%*	*3%*	*3%*		*1,500*	*225*	*225*
Total Vehicle Trips Generated							46,028	6,039	6,353
Internal Vehicle Trips (see note 6)			*25%*	*3%*	*21%*		*11,333*	*168*	*1,347*
External Vehicle Trips (see note 7)			*75%*	*97%*	*79%*		34,696	5,871	5,007

Notes:

(1) Base trip rates from ITE Trip Generation, 8th Edition. Peak hour trips rates shown for Regional Retail and Local Retail based on fitted curve logarathim applied at block level.

(2) Adjustment to account for internal trips to/from retail uses that would otherwise be double-counted, based on ITE internal trip capture data for retail uses (to/from office, residential and other retail uses) in mixed-use developments.

(3) Pass-by rate of 25 percent for PM Peak derived from ITE logarithim for Shopping Centers (while local and specialty retail uses often have higher pass-by rates). Daily pass-by rate conservatively estimated at 15 percent.

(4) Mode shift for internal trips based on proposed density, mix of uses, block layout, bicycle and pedestrian facilities

(5) Based on preliminary "back-of-the-envelope" estimate of potential transit ridership. Assumed 5% of home to work trips for both residential and non-residential land uses would occur via transit plus estimated "non-work" transit trips at 25% of

(6) Total Vehicle Trips derived by subtracting walk & bicycle trips (see note 4) and transit trips (see note 5) from Base Trip Subtotal.

(7) Derived from estimated internal trips (see note 2), subtracting internal walk & bicycle trips (see note 4) and internal transit trips (estimated at 5% of transit ridership).

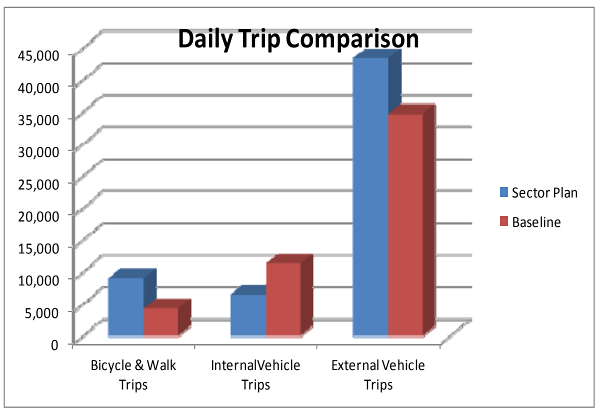
(8) Net vehicle trips derived by subtracting internal vehicle trips (see note 6) from total vehicle trips generated.

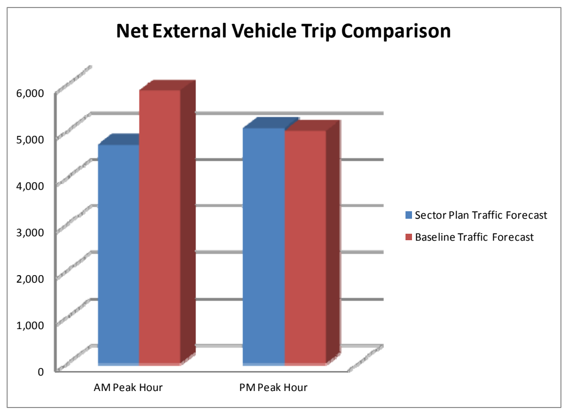
Findings

Figure 1-13 provides a comparison of the net change in trips resulting from the Sector Plan as shown in Figure 1-11, in comparison with the Baseline scenario represented by the Conceptual Plan trip generation forecast summarized on Figure 1-12. Key findings for traffic operations purposes relate to peak hour traffic volumes. While the development proposed by the Sector Plan does increase external daily vehicle trips, it reduces the A.M. peak hour trips and does not significantly increase P.M. peak hour trips, when traffic congestion is anticipated to be the heaviest. The key findings are summarized as follows:

- No increase in peak hour traffic volumes compared to the baseline scenario,
- Increased bicycle and walking trips and fewer internal vehicle trips compared to the baseline scenario, and
- Adequate traffic grid and street cross sections to accommodate increased internal and external trips compared to the baseline scenario.

Figure 1-13 Daily & Peak Hour Trip Comparison





2. CIRCULATION ASSESSMENT

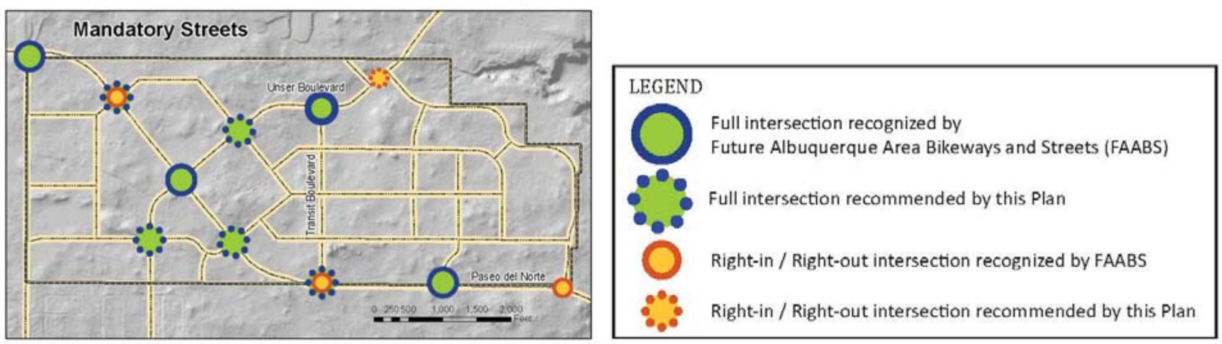
This section provides an assessment of the proposed street network focusing on traffic operations at planned and proposed signalized intersections.

Proposed Site Access

Arterial Access Concept

Figures 2-1 describes the primary access concept described in the 2012 VHSDP. As shown, signalized intersections on Paseo del Norte and Unser Boulevard would be provided at approximately quarter-mile intervals.

Figure 2-1 VHDSP Access Concept



Figures 2-2 and 2-3 provide conceptual cross-section drawings showing the potential lane configurations on Paseo del Norte and Unser Boulevard, as well as potential proximity to adjacent land uses.

Figure 2-2 Paseo del Norte (Conceptual Cross Section)

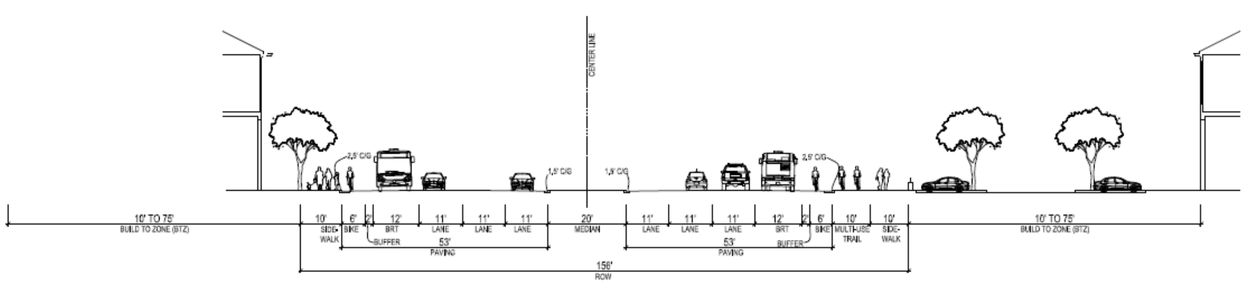
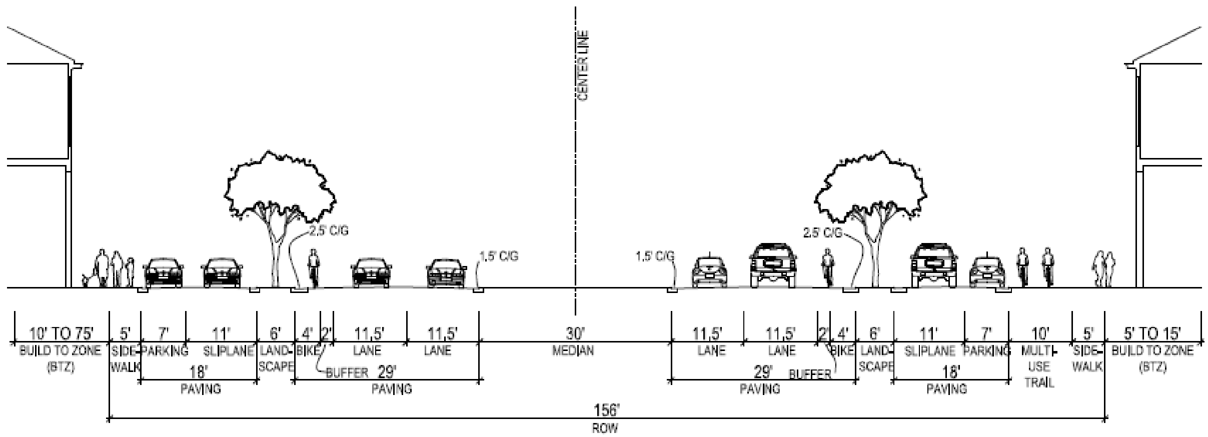


Figure 2-3 Unser Boulevard (Conceptual Cross Section)



Access to Internal Streets & Land Uses

Access to the internal street network and future land uses would primarily be provided by seven internal streets:

- Five internal "connector" streets would circulate between Paseo del Norte and Unser Boulevard, connecting with the internal street grid.
  - The connector streets would intersect the arterials at three proposed signalized intersection locations on Paseo del Norte and two proposed signalized intersection locations on Unser Boulevard.
  - The proposed "connector" streets between Paseo del Norte and Unser Boulevard are designated as NE Connector, NW Connector, SW Connector, SE Connector for purposes of this assessment.
  - The proposed "connector" street approximately one-fourth of a mile west of the eastern border of the sector is designated as East Connector for purposes of this assessment.
  - Figure 2-4 provides a conceptual illustration showing the potential lane and sidewalk configuration.
- **Park Edge Street** would circulate between Paseo del Norte and Unser Boulevard via "right-in/right-out" access to the arterials. Figure 2-6 provides a conceptual illustration of the proposed design options for the "Park Edge Street."
- **Transit Boulevard** would circulate between Paseo del Norte and Unser Boulevard via "right-in/right-out" access to the arterials. Figure 2-5 provides a conceptual illustration showing the potential lane and sidewalk configuration.

Figure 2-4 Connector Streets (Conceptual Cross Section)

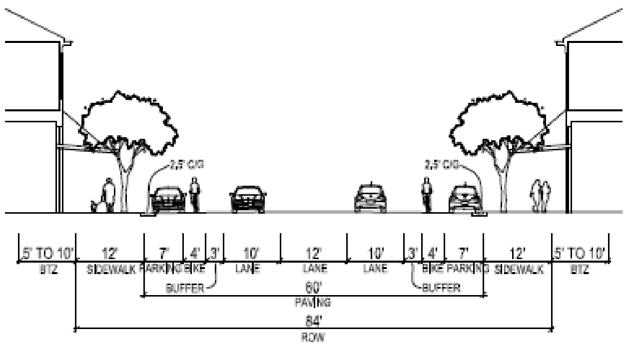


Figure 2-5 Transit Boulevard (Conceptual Cross Section)

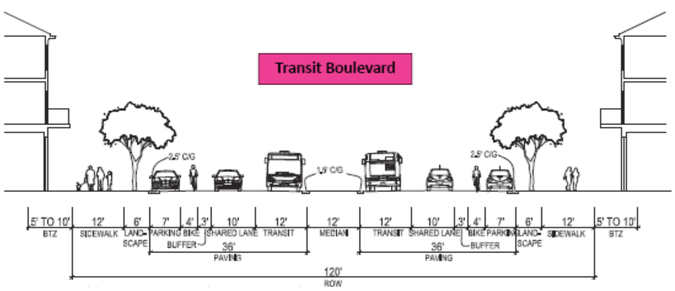
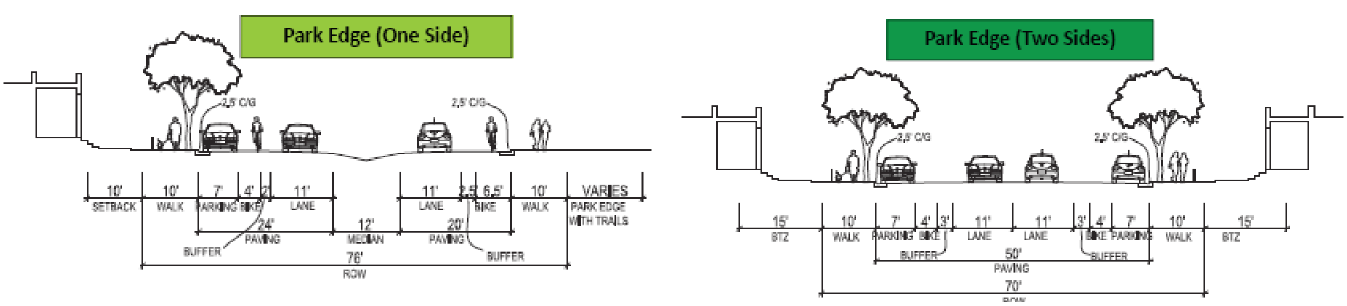


Figure 2-6 Park Edge Street (Conceptual Cross Sections)



Traffic Assessment

This section summarizes the potential effect of the three (3) proposed additional signalized intersections on Paseo del Norte (PDN) as described in the 2012 VHSDP.

Baseline Traffic Conditions

The segment of PDN that passes through the VH sector is approximately 1.75 miles long. Two signalized intersections are currently planned within the VH sector, while a third signalized intersection is located at the intersection of PDN.

Year 2035 Peak Hour Traffic Volumes

Peak-hour traffic volumes, based on the MRCOG model, would occur during the PM Peak Hour:

- 4,500 to 5,000 through vehicles on Paseo del Norte
- 1,500 to 2,000 through vehicles on Unser Boulevard

Baseline Level of Service Forecast

Nelson\Nygaard prepared level of service (LOS) reports for each of the proposed intersections based on forecast Year 2035 "through" volumes, and a conservative estimate of potential turning movements. (See Appendix A, Level of Service Reports).

- Average vehicle delay at arterial intersections on PDN is likely to average 40 to 50 seconds per vehicle, representing acceptable LOS D conditions.
- Average vehicle delay at non-arterial intersections on PDN is likely average 20 to 45 seconds, representing acceptable LOS C or D conditions.
- *Note: With a coordinated signal timing plan, and based on the traffic volumes forecasted for Year 2035, motorists would not be delayed at each intersection. Therefore, the "net" delay of passing through all three signalized intersection on Paseo del Norte would be less than the sum of the average delay at each individual intersection.*

Baseline Travel Time Forecast (Paseo del Norte)

For purposes of this analysis, the Year 2035 average net peak-hour travel time for east/west motorists traveling through the VH sector on Paseo del Norte is estimated to range from 150 to 200 seconds (2.5 to 3.3 minutes) based on an average travel speed of 42 miles per hour, which would allow for a 150-second travel time and would allow for 2-way signal coordination between Universe Boulevard and the planned East Connector (one-half mile east of Unser Boulevard).

- *With a coordinated 2-way signal coordination plan, delay to most east/west motorists could feasibly be limited to just one intersection, with up to 50 seconds of delay.*

<u>Travel Speed Assumptions</u>

The assumptions behind the baseline travel speed estimate are described in more detail below.

Based on the planned "freeway-like" characteristics of PDN, "baseline" conditions for traffic operations on PDN would be as follows:

- Travel speeds of 40 to 50 mph are anticipated during most time periods through 2035; however, delays at key intersections would likely reduce “net” travel time through the corridor, particularly during peak travel periods.
- Estimated net travel time through the corridor would range from approximately 120 to 240 seconds (2 to 4 minutes) based on the following:
  - Potential travel time through the corridor would be:
    - 120 seconds based on 52.5 mph travel speeds.
    - 140 seconds based on 45 mph travel speeds.
    - 150 seconds based on 42 mph travel speeds.
  - Average vehicle delay at the two arterial intersections during peak hours is likely to reach 40 to 50 seconds (average for all vehicles entering the intersection) at both intersections during Year 2035 conditions, based on the signal timing plan that would likely be needed to accommodate a significant volume of turning movements at each of those intersections.
  - Average vehicle at the third planned intersection, with East Connector, would be much less given the lower volume of turning movements at that intersection. With a signal plan that prioritizes east/west traffic at that intersection, average delay to east/west motorist of 10 to 20 seconds may be likely.
  - With a coordinated signal timing plan, potential delay to east/west through movements could be mitigated such that motorists would not be delayed at all three intersections. Rather, a portion of motorists would avoid delay at all three intersections, while many motorists would be delayed at one of the three intersections.
  - Given the width of Paseo del Norte, Unser Boulevard, and Universe Boulevard, 120-second signal cycles are likely to be necessary to accommodate Year 2035 traffic volumes and pedestrian crossings.
    - Based on that cycle length, a travel speed of 42 miles per hour would allow for 2-way signal coordination between Universe Boulevard and the planned East Connector signal location (one-half east of Unser Boulevard). This would result in a 150-second travel time for many motorists, while a portion of motorists would experience delay at signalized intersections, particularly where arterial streets intersect.
    - With a synchronized signal plan, delay to east/west motorist could potentially be reduced such that approximately half of east/west motorists could pass through all three intersections without delay, while the remaining half would likely be delayed at just one intersection. Based on this assumption, the total delay to east/west motorists passing through the 1.75 mile corridor would range from approximately 25 to 50 seconds.

Traffic Assessment: Key Assumptions

Based on the travel speed and initial signal timing assumptions described above, the proposed provision of three additional signalized intersections on Paseo del Norte was evaluated.

Traffic Volume & Turning Movement Assumptions

Nelson\Nygaard assessed the proposed arterial intersection configurations based on the Year 2035 traffic volume forecast described in the MRCOG model.

- **Through movements** at intersection on Paseo del Norte and Unser Boulevard were based directly on the model forecast. This provides a "conservative" assessment, since the actual volume of through movements should ultimately be reduced given the many turning movement options proposed within the VHSDP sector.
- **Turning movement volumes** were estimated based on the forecast of 5,000 external peak hour vehicle trips that would be generated by the VHDSP land uses, as well as a reasonable assumption of the ratio of turning movements to through movements to/from Paseo del Norte.
  - In addition, some assumptions regarding the potential use of the NE and SE Connector streets as "cut-through" routes were also incorporated into the turning movement estimates.

Traffic Signal Assumptions on Paseo Del Norte

Nelson\Nygaard developed a site-specific traffic operations model for the site using Synchro software. The following signal-timing assumptions were incorporated into the assessment:

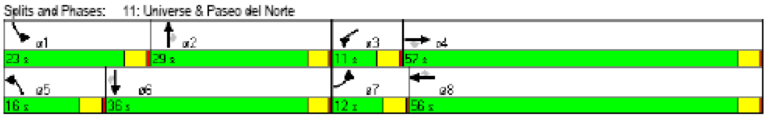
- Based on the desired travel speeds on Paseo del Norte, the conceptual signal timing plan is based on signal off-sets of 22.5 seconds between signalized intersections at quarter-mile intervals, with a longer off-set of 30 seconds between Unser Boulevard and the proposed NW Connector Street intersection to the west, thus allowing a travel speed of approximately 42 miles per hour (mph).
- Since 22-second off-sets would not allow for 2-way signal coordination at all signalized intersection, a partial "split-phase" signal plan could accommodate the differing arrival times of eastbound and westbound traffic flows at some intersections.
  - *Note: The intersection with Unser Boulevard would have a slight off-set between eastbound and westbound traffic flows, since the eastbound traffic platoon, released by the upstream green-light for eastbound through movements at Universe Boulevard, would arrive approximately 16 seconds earlier than the westbound traffic platoon. This off-set can be accommodated by allowing eastbound left-turns to occur during the initial portion of the cycle (prior to the arrival of most westbound vehicles) while the westbound left-turns would be accommodated with a "lagging" left-turn phase.*

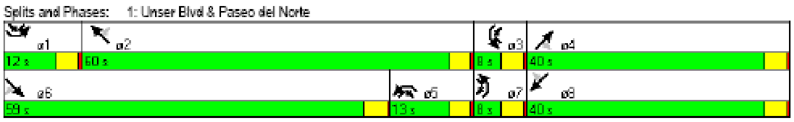
Based on this signal timing concept, the following two types of signal phasing options are included in the Synchro assessment:

- Signal Plan A would allocate 80 seconds to east/west traffic on Paseo del Norte, and 40 seconds to north/south traffic at the two planned intersections with Unser Boulevard and the East Connector Street
  - This signal plan will allow pedestrians to cross Paseo del Norte in a single phase, since 40 seconds would be the minimum pedestrian clearance time (including yellow and red-clearance periods) based on the proposed crossing distance of 120 feet.

- Signal Plan B would allocate 100 seconds to east/west traffic on Paseo del Norte, and 20 seconds to north/south traffic at <u>three proposed signalized intersections</u>, with Transit Boulevard, NE/NW Connector, and SE/SW Connector.
  - This signal plan would require pedestrians to cross Paseo del Norte in two separate crossing phases, since 40 seconds would be the minimum pedestrian clearance time (including yellow and red-clearance periods) for a single-phase based on the proposed crossing distance of 120 feet.
    - Therefore, with this configuration, pedestrians would cross one-half of Paseo del Norte during the north/south traffic phase, and then cross the second half during a separate 20-seccond pedestrian phase that that could be timed to occur concurrent with non-conflicting eastbound and westbound left-turn movements.
  - Left-turn treatments would potentially vary under Signal Plan B:
    - <u>Side-street approaches:</u> Given the limited time allocated to side-street approaches with this phase, it may be necessary to prohibit left-turn movements on some of the side-street approaches from the Connector Streets. No such left-turn prohibition would be necessary where "T" intersections are proposed, such as the proposed Transit Boulevard.
    - <u>Left-turns from Paseo del Norte</u>: Since eastbound and westbound traffic flows would not be "off-set" at Signal Plan B locations, this provides an opportunity for increased left-turn capacity, from Paseo del Norte to VH at these locations. This will be possible because left-turn movements will be able to occur concurrently with through movements, in one direction at a time, for 20 to 40 seconds during each signal cycle. During such periods, left-turns can effectively be made during gaps in opposing travel flows.

Figure 2-7 Signal Timing Concept: Planned Intersections





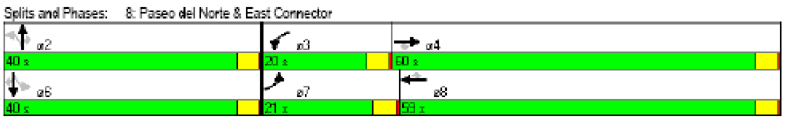
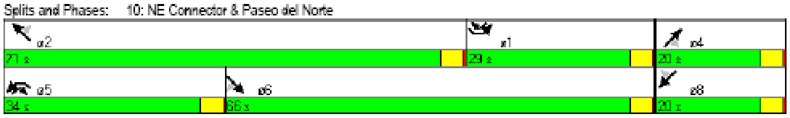
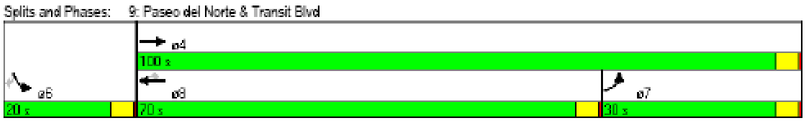


Figure 2-8 Signal Timing Concept: Proposed Additional VHSDP Intersections on Paseo del Norte





Traffic Assessment Findings

Based on the signal timing assumption described above, three of the proposed additional signalized intersections can be accommodated without significantly affecting traffic operations, and these intersections could ultimately significantly reduce delay at the adjacent intersections if the turning movements at those locations are reduced appropriately.

- Signal coordination on the 1.75-mile segment of Paseo del Norte within the VH sector can be provided with the additional intersections described in the VHSDP, with signal timing off-sets based on 42 mph travel speeds and 120-second signal cycles.
    - This signal coordination would synchronize the intersections of Paseo del Norte with Universe Boulevard and the East Connector (planned intersection one-half mile east of Unser Boulevard) in both directions with a 120-second off-set travel time between those 2 intersections, approximately 1.4 miles apart.

- Site access (inbound to VH from Paseo del Norte) would be enhanced with the additional intersections proposed, particularly if additional time is provided for left-turn movements entering the VH sector from Paseo del Norte at the proposed additional intersections.
    - This site access would <u>reduce left-turn movements</u> at the two currently planned intersections with Unser Boulevard and the East Connector Street.
    - Traffic operations at the intersection with Universe Boulevard is unlikely to be affected.
- Each signalized intersection would operate at an acceptable level of service (LOS) of D or better.

Net Effect on Travel Time

Based on this analysis, the estimated travel time range for east/west motorists traveling through the VH sector on Paseo del Norte is estimated to range from 150 to 230 seconds (2.5 to 3.3 minutes) based on an average travel speed of 42 miles per hour, which would allow for a 150-second travel time and would allow for 2-way signal coordination between Universe Boulevard and the planned East Connector (one-half mile east of Unser Boulevard).

- With a coordinated 2-way signal coordination plan, delay to most east/west motorists could feasibly be limited to just one intersection, with up to 50 seconds of delay.
- With the introduction of three additional intersections, a portion of east/west motorists would be delayed at a second intersection. Average delay at the three additional intersections would be approximately 30 seconds for the eastbound and westbound approaches.

<u>Net Change Resulting from Three Additional Proposed Intersections</u>

Based on this analysis:

- Net travel time would not change for most motorists.
- Some motorists could be delayed by up to 30 seconds at one of the additional three proposed intersections.
- Potential delays could be off-set by reductions in delay at the currently planned arterial intersections, particularly if left-turn volumes at the Unser Boulevard intersection are reduced by the greater dispersal of left-turn movements proposed by the VHSDP street network.

Proposed VHSDP Internal Street Network

The proposed internal circulation network would accommodate most trips to/from VH via the following seven internal streets:

- Four connector street segments with direct connections to both Paseo del Norte and Unser
- Transit Boulevard
- East Connector Street
- Park Edge

In addition to the seven primary access streets, additional internal circulation would be provided by "Town Center Streets," as shown conceptually on Figure 2-9, as well as a network of local internal blocks with small block sizes.

Figure 2-9 Town Center Street (Conceptual Cross Section)

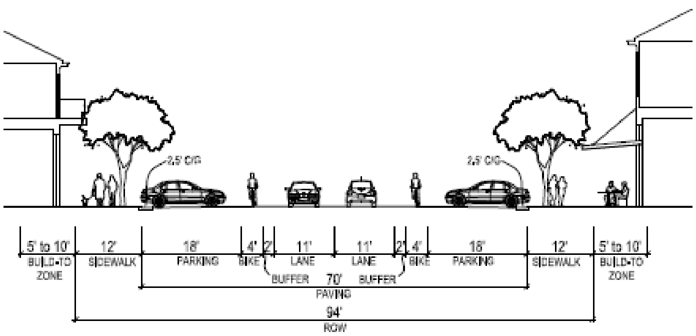
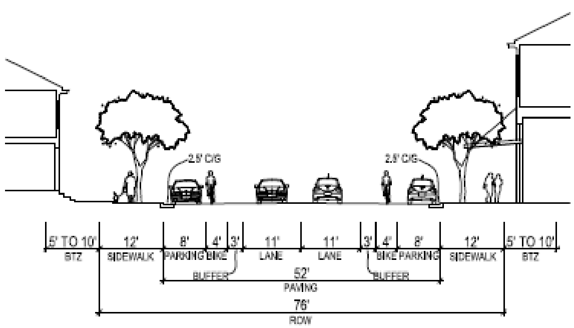


Figure 2-10 Neighborhood Street (Conceptual Cross Section)



Internal Traffic Capacity

Each of the seven primary internal streets, as well as three internal "Town Center Streets," would have at least two motor vehicle lanes, bicycle lanes, and sidewalks, and most would accommodate on-street parking.

Therefore, each of the internal streets would provide the capacity to accommodate 13,000 or more daily vehicles on <u>each</u> internal street, via multiple entrance and exit paths. Based on the potential dispersal of traffic that would be allowed with multiple entrance and exit points, traffic volumes would be less than 10,000 vehicles per day on any single internal street.

Therefore:

- The proposed internal street network is more than adequate to accommodate the forecasted volume of traffic that be generated by the VHDSP land uses <u>provided that such traffic is dispersed among multiple entrance and exit points</u> (i.e. intersections with Paseo del Norte and/or Unser Boulevard, as proposed in the 2012 VHSDP).
- If the number of entrance and exit points were to be limited to just two or three entrance/exit point, then the volume on those few entrance/exit points would likely require additional travel lanes.

Potential Internal Circulation Constraints

<u>Access to/from Regional Commercial Sites</u>

As described in the 2012 VHSDP, much of the site would be developed with a grid of streets that would maximize internal circulation by providing multiple travel route options and reducing travel distances, particularly by providing small block sizes and a mix of land uses.

However, the portion of the VHSDP sector that borders the intersection of Paseo del Norte and Unser Boulevard would not be developed with the same pattern of internal blocks, due to proximity to the Paseo del Norte and Unser Boulevard, which require much longer spacing between intersections.

- Access to the regional commercial sites along Paseo del Norte and Unser Boulevard from elsewhere in the VH sector will require longer walking distances from within the site to reach a signalized intersection in order to cross these high-traffic volume, multi-lane streets, potentially discouraging those internal trips.
- Circulation <u>between</u> regional commercial sites will be limited, particularly for sites on opposite sides of Paseo del Norte.
- Additional direct multi-modal connections across Paseo del Norte and Unser Boulevard would be a significant safety improvement and benefit to uses on opposite sides of the roadway. As shown on Figure 2-11, such additional multi-modal connections could be provided via grade-separated crossings.

Figure 2-11 Grade-Separated Undercrossing (Example)

3. RELEVANT CASE STUDIES

Based on the forecasted Year 2035 volumes on the two key regional arterials that will provide access to the sector, Paseo del Norte and Unser Boulevard, this section describes the general design and operational characteristics of several arterial streets in other cities for comparative purposes. In particular, the “case studies” cited below are of arterial streets that operate with acceptable levels of service, carrying similar volumes of motor vehicle traffic as forecasted on Paseo del Norte and Unser Boulevard, and include desired characteristics identified in the Sector Plan related to:

- Intersection spacing
- Narrower right-of-way configurations
- Multi-modal circulation elements

Paseo Del Norte Comparison: Lawrence Expressway

The Lawrence Expressway is a regional route through a portion of “Silicon Valley” in the San Francisco Bay Area, running approximately 8 miles from Saratoga Avenue (Saratoga) to US 237 (Sunnyvale) in Santa Clara County. The current and projected daily traffic volumes are similar to those projected for Paseo del Norte, as shown on Figure 3-1.

- Throughout its length the street has three mixed-flow traffic lanes in each direction, plus one high-occupancy vehicle (HOV) lane reserved for use by buses and carpools during peak periods.
- Most intersections are signalized at grade. Where it crosses regional freeways and some major regional streets, it has grade-separated intersections.
- The character of the surrounding area varies – in places sound walls separate the street from residential developments, while the northern half has office developments and large institutions such as hospitals fronting the street.

Figure 3-1 Current and Projected Average Daily Traffic Volumes on Lawrence Expressway

Roadway Segment	Existing (2008)		Future (2035)	
	ADT	LOS	ADT	LOS
Lawrence Expressway between US -101 Central Expressway	79,010	D	93,030	D
Lawrence Expressway between Central Expressway- Kifer Road	63,970	D	80,790	D
Lawrence Expressway between Kifer Road-Monroe Street	67,960	D	83,090	D
Lawrence Expressway between Monroe Street-Cabrillo Avenue	52,890	C	64,760	D
Lawrence Expressway between Cabrillo Avenue-El Camino Real	63,490	D	78,680	D
Lawrence Expressway between El Camino Real-Benton Street	58,230	D	70,840	D
Lawrence Expressway between Benton Street-Homestead Road	65,410	D	66,990	D
Lawrence Expressway between Homestead Road-Pruneridge Avenue	66,600	D	73,220	D
Lawrence Expressway between Pruneridge Avenue-Stevens Creek	62,890	D	68,990	D
Lawrence Expressway between El Camino Real and Reed	71,000	2008-2010 values from City of Sunnyvale 2010 LUTE Update existing conditions analysis		
Lawrence Expressway between Arques Ave and US 101	67,000			

Source: Santa Clara Public Hearing Draft General Plan, Appendix 8.7 Transportation and Mobility Assumptions, except where noted.

Level of Service

Traffic operations on the Lawrence Expressway are projected to remain at level of service D through the horizon year of 2035. While AASHTO defines LOS D as “approaching unstable flow,” in practice this is a fairly reasonable condition that many cities aspire to at peak times, with only slight reductions in vehicle speed and driver comfort. This LOS corresponds with the likely operation of Paseo del Norte at peak capacity.

Intersection Spacing

The distance between signalized intersections along the Lawrence Expressway varies. The table in Figure 3-2 summarizes the distance between the intersections in the segment shown in

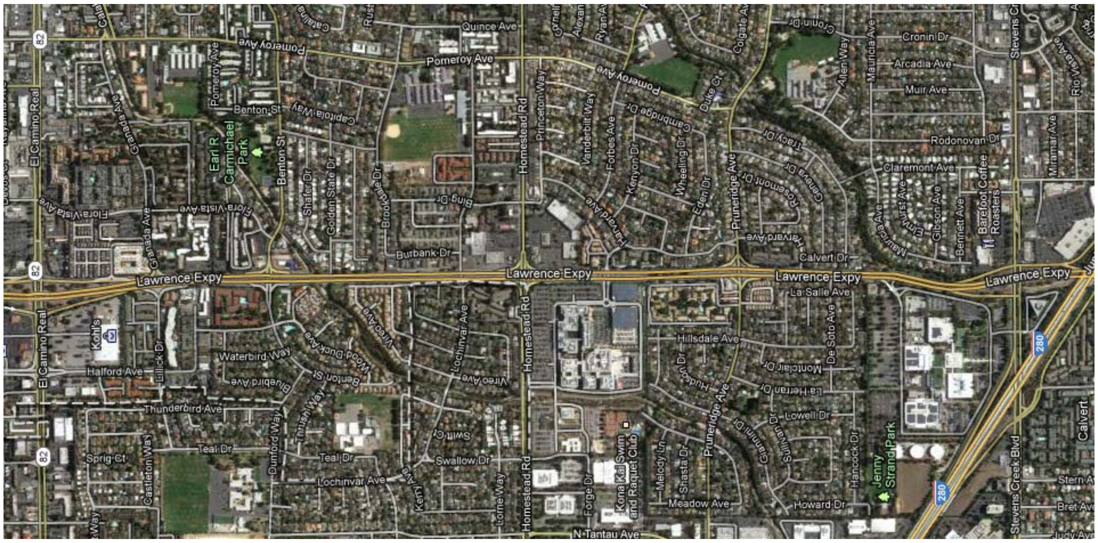
Figure 3-3. For this particular segment the distances are very short, between 0.1 and 0.4 miles. While some sections of Lawrence do have greater distances between signalized intersections, the short distances in this segment are fairly typical.

Figure 3-2 Distance Between Signalized Intersections (Example Segment)

Pruneridge Ave and Lehigh Dr	1,455 feet (0.27 mile)
Lehigh Dr and Homestead Rd	905 feet (0.17 mile)
Homestead Rd and Lochinvar Ave	672 feet (0.13 mile)
Lochinvar Ave and Benton St	2,098 feet (0.39 mile)

Lawrence Expressway carries a similar volume of traffic as forecasted for Paseo del Norte <u>and</u> with less than one-fourth mile between signalized intersections on some segments.

Figure 3-3 Aerial View of Lawrence Expressway



Lawrence Expressway between Junipero Serra (Interstate 280) and El Camino Real (State Route 82)

Source: Google Maps, © Google 2012

General Characteristics

The following images captured from Google Streetview provide an indication of the general nature of the Lawrence Expressway. It is clearly very much an auto-dominated streetscape, with narrow bike lanes and relatively narrow sidewalks with no planted strip separation from the street. In its favor, signalized intersections with crosswalks are closely spaced, which makes for an easier walking experience than if the street had ½ mile spacing between intersections. Newer developments have improved the street by adding planted berms and trees facing the street, as can be seen outside the Kaiser Hospital (below).

Figure 3-4 General Characteristics of Lawrence Expressway (Photo Examples)

Lawrence Expressway at Bollinger Road

Source: Google Maps Streetview, © Google 2012

Lawrence Expressway at Lehigh Drive (Kaiser Permanente)

Source: Google Maps Streetview, © Google 2012

Lawrence Expressway at Miraloma Way

Source: Google Maps Streetview, © Google 2012

Lawrence Expressway at Prospect Road

Source: Google Maps Streetview, © Google 2012

Unser Boulevard, Comparison 1: Valencia Street

As noted earlier in this report, the forecasted Year 2035 traffic volume on Unser Boulevard is less than 15,000 daily vehicles. The planned roadway configuration includes four travel lanes and a generous median within a 156-foot right-of-way.

In comparison: Valencia Street in San Francisco carries 20,000 daily vehicles and 5,000 daily bicyclists, as well as a very high volumes of pedestrians, with just 2 motor vehicle lanes within a 62.5 foot right-of-way.

- A key advantage of the narrower right-of-way is that relatively short 60-second signal cycles can efficiently accommodate vehicle and pedestrian movements.
- Wider streets, by contrast, require lengthier 90 to 120 second cycles, resulting in lengthier vehicle queues and extended delays, including longer waits for pedestrians between "WALK" intervals.

Figure 3-5 Valencia Street (Photo)

Source: Google Maps Streetview, © Google 2012

Unser Boulevard Comparison 2: Octavia Boulevard

As noted earlier, the forecasted Year 2035 traffic volume on Unser Boulevard is less than 15,000 daily vehicles. The planned roadway configuration includes four travel lanes and a generous median within a 156-foot right-of-way.

In comparison: Octavia Boulevard in San Francisco carries 45,000 daily vehicles with the same number of travel lanes as planned for Unser Boulevard, within a 133-foot wide right-of-way that also accommodates on-street parking within a "boulevard configuration." The cross-section for Octavia Boulevard, shown in Figure 3-6, has the same components as the cross section proposed for Unser Boulevard within Volcano Heights.

Figure 3-6 Octavia Boulevard Cross Section

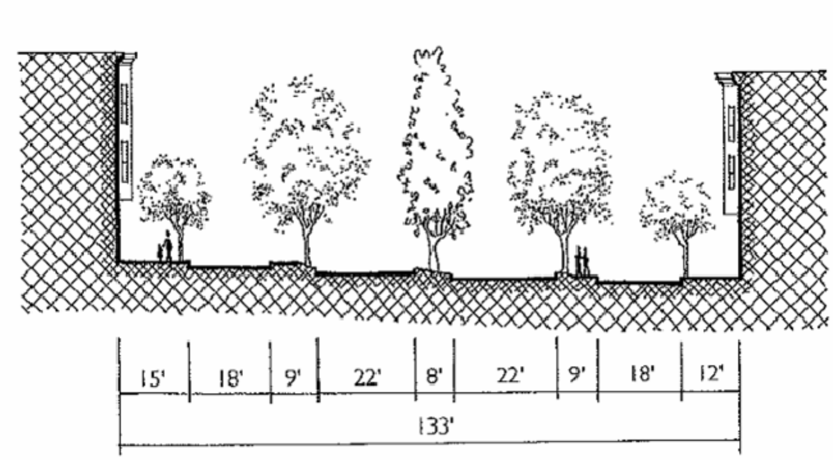


Figure 3-7 Octavia Boulevard Characteristics (Photo Examples)

Appendix A Signal Timing & Level of Service Reports

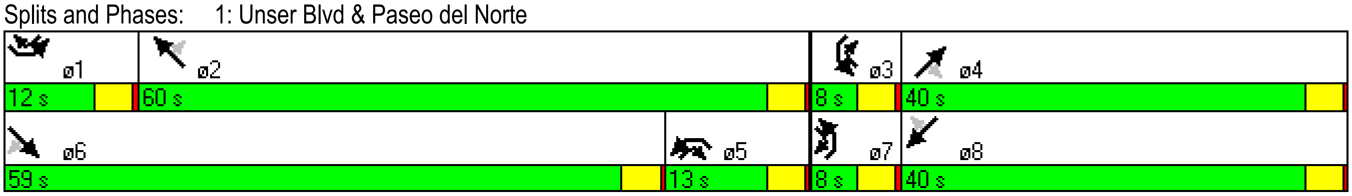
Note: see Pages 22-24 for overview of turning movement and signal phasing assumptions.

Lane Group	SEL	SET	SER	NWL	NWT	NWR	NEL	NET	NER	SWL	SWT	SWR
Lane Configurations												
Volume (vph)	200	2032	200	200	2498	200	100	916	100	100	822	100
Turn Type	Prot	NA	pm+ov	Prot	NA	pm+ov	Prot	NA	pm+ov	Prot	NA	pm+ov
Protected Phases	1	6	7	5	2	3	7	4	5	3	8	1
Permitted Phases			6			2			4			8
Detector Phase	1	6	7	5	2	3	7	4	5	3	8	1
Switch Phase												
Minimum Initial (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
Minimum Split (s)	8.0	40.0	8.0	8.0	40.0	8.0	8.0	40.0	8.0	8.0	40.0	8.0
Total Split (s)	12.0	59.0	8.0	13.0	60.0	8.0	8.0	40.0	13.0	8.0	40.0	12.0
Total Split (%)	10.0%	49.2%	6.7%	10.8%	50.0%	6.7%	6.7%	33.3%	10.8%	6.7%	33.3%	10.0%
Yellow Time (s)	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5
All-Red Time (s)	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5
Lost Time Adjust (s)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
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
Lead/Lag	Lead	Lead	Lead	Lag	Lag	Lead	Lead	Lag	Lag	Lead	Lag	Lead
Lead-Lag Optimize?	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Recall Mode	None	C-Max	None	None	C-Max	None	None	None	None	None	None	None
Act Effct Green (s)	8.5	55.9	59.9	9.0	56.4	64.4	4.0	35.1	44.1	4.0	35.1	47.6
Actuated g/C Ratio	0.07	0.47	0.50	0.08	0.47	0.54	0.03	0.29	0.37	0.03	0.29	0.40
v/c Ratio	0.85	0.89	0.26	0.80	1.08	0.24	0.90	0.92	0.18	0.90	0.82	0.16
Control Delay	78.8	24.0	4.5	76.3	79.8	21.3	116.4	41.4	21.0	99.9	33.0	15.5
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	78.8	24.0	4.5	76.3	79.8	21.3	116.4	41.4	21.0	99.9	33.0	15.5
LOS	E	C	A	E	E	C	F	D	C	F	C	B
Approach Delay		26.9			75.5			46.3			37.9	
Approach LOS		C			E			D			D	

Intersection Summary

Cycle Length: 120
Actuated Cycle Length: 120
Offset: 52 (43%), Referenced to phase 2:NWT and 6:SET, Start of Green
Natural Cycle: 120
Control Type: Actuated-Coordinated
Maximum v/c Ratio: 1.08
Intersection Signal Delay: 50.2 Intersection LOS: D
Intersection Capacity Utilization 96.0% ICU Level of Service F
Analysis Period (min) 15

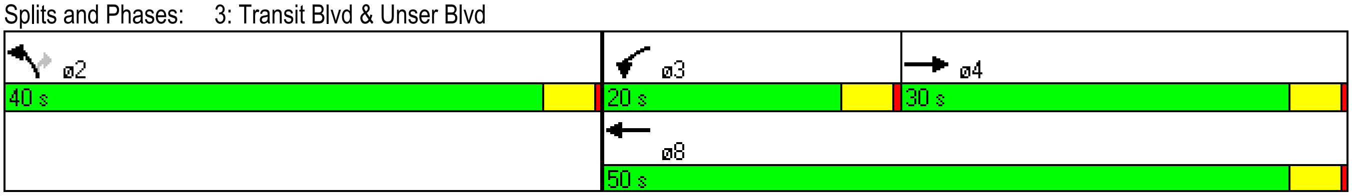
Splits and Phases: 1: Unser Blvd & Paseo del Norte



Lane Group	EBT	WBL	WBT	NBL	NBR
Lane Configurations					
Volume (vph)	992	300	1458	200	300
Turn Type	NA	Prot	NA	NA	Perm
Protected Phases	4	3	8	2	
Permitted Phases					2
Detector Phase	4	3	8	2	2
Switch Phase					
Minimum Initial (s)	4.0	4.0	4.0	4.0	4.0
Minimum Split (s)	20.0	8.0	20.0	40.0	40.0
Total Split (s)	30.0	20.0	50.0	40.0	40.0
Total Split (%)	33.3%	22.2%	55.6%	44.4%	44.4%
Yellow Time (s)	3.5	3.5	3.5	3.5	3.5
All-Red Time (s)	0.5	0.5	0.5	0.5	0.5
Lost Time Adjust (s)	0.0	0.0	0.0	0.0	0.0
Total Lost Time (s)	4.0	4.0	4.0	4.0	4.0
Lead/Lag	Lag	Lead			
Lead-Lag Optimize?	Yes	Yes			
Recall Mode	None	None	None	C-Max	C-Max
Act Effct Green (s)	26.0	16.0	46.0	36.0	36.0
Actuated g/C Ratio	0.29	0.18	0.51	0.40	0.40
v/c Ratio	0.97	0.95	0.81	0.28	0.37
Control Delay	54.7	78.8	22.7	19.6	3.6
Queue Delay	0.0	0.0	0.0	0.0	0.0
Total Delay	54.7	78.8	22.7	19.6	3.6
LOS	D	E	C	B	A
Approach Delay	54.7		32.3	10.0	
Approach LOS	D		C	B	

Intersection Summary	
Cycle Length: 90	
Actuated Cycle Length: 90	
Offset: 0 (0%), Referenced to phase 2:NBL and 6:, Start of Green	
Natural Cycle: 90	
Control Type: Actuated-Coordinated	
Maximum v/c Ratio: 0.97	
Intersection Signal Delay: 35.7	Intersection LOS: D
Intersection Capacity Utilization 65.1%	ICU Level of Service C
Analysis Period (min) 15	

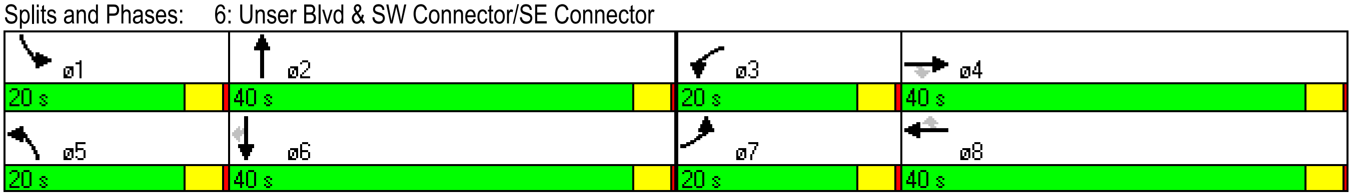
Splits and Phases: 3: Transit Blvd & Unser Blvd



Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	SBL	SBT	SBR
Lane Configurations											
Volume (vph)	100	300	100	100	300	100	100	1325	100	993	100
Turn Type	Prot	NA	Perm	Prot	NA	Perm	Prot	NA	Prot	NA	Perm
Protected Phases	7	4		3	8		5	2	1	6	
Permitted Phases			4			8					6
Detector Phase	7	4	4	3	8	8	5	2	1	6	6
Switch Phase											
Minimum Initial (s)	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
Minimum Split (s)	8.0	40.0	40.0	8.0	40.0	40.0	8.0	20.0	8.0	20.0	20.0
Total Split (s)	20.0	40.0	40.0	20.0	40.0	40.0	20.0	40.0	20.0	40.0	40.0
Total Split (%)	16.7%	33.3%	33.3%	16.7%	33.3%	33.3%	16.7%	33.3%	16.7%	33.3%	33.3%
Yellow Time (s)	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5
All-Red Time (s)	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5
Lost Time Adjust (s)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
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
Lead/Lag	Lead	Lag	Lag	Lead	Lag	Lag	Lead	Lag	Lead	Lag	Lag
Lead-Lag Optimize?	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Recall Mode	None	None	None	None	None	None	None	C-Max	None	C-Max	C-Max
Act Effct Green (s)	11.9	24.9	24.9	11.9	24.9	24.9	12.3	55.0	12.1	54.8	54.8
Actuated g/C Ratio	0.10	0.21	0.21	0.10	0.21	0.21	0.10	0.46	0.10	0.46	0.46
v/c Ratio	0.57	0.78	0.26	0.57	0.78	0.25	0.57	0.92	0.56	0.64	0.14
Control Delay	63.5	58.1	14.7	64.9	86.1	36.2	63.3	42.2	69.6	26.2	10.7
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	63.5	58.1	14.7	64.9	86.1	36.2	63.3	42.2	69.6	26.2	10.7
LOS	E	E	B	E	F	D	E	D	E	C	B
Approach Delay		50.5			71.9			43.6		28.5	
Approach LOS		D			E			D		C	

Intersection Summary	
Cycle Length: 120	
Actuated Cycle Length: 120	
Offset: 0 (0%), Referenced to phase 2:NBT and 6:SBT, Start of Green	
Natural Cycle: 110	
Control Type: Actuated-Coordinated	
Maximum v/c Ratio: 0.92	
Intersection Signal Delay: 43.5	Intersection LOS: D
Intersection Capacity Utilization 80.0%	ICU Level of Service D
Analysis Period (min) 15	

Splits and Phases: 6: Unser Blvd & SW Connector/SE Connector

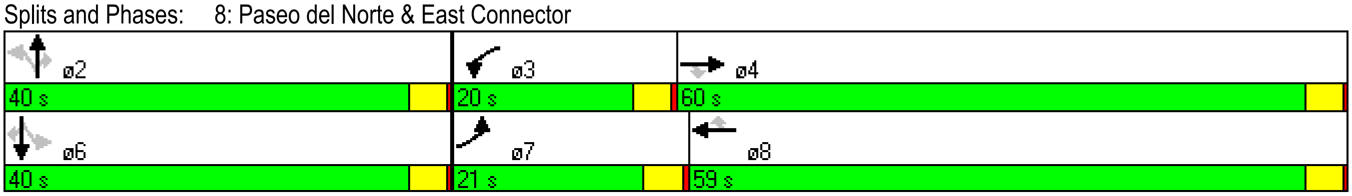


Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	200	2409	200	100	2038	200	200	200	200	200	200	200
Turn Type	Prot	NA	Perm	Prot	NA	Perm	Perm	NA	Perm	Perm	NA	Perm
Protected Phases	7	4		3	8			2			6	
Permitted Phases			4			8	2		2	6		6
Detector Phase	7	4	4	3	8	8	2	2	2	6	6	6
Switch Phase												
Minimum Initial (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
Minimum Split (s)	8.0	20.0	20.0	8.0	20.0	20.0	40.0	40.0	40.0	20.0	20.0	20.0
Total Split (s)	21.0	60.0	60.0	20.0	59.0	59.0	40.0	40.0	40.0	40.0	40.0	40.0
Total Split (%)	17.5%	50.0%	50.0%	16.7%	49.2%	49.2%	33.3%	33.3%	33.3%	33.3%	33.3%	33.3%
Yellow Time (s)	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5
All-Red Time (s)	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5
Lost Time Adjust (s)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
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
Lead/Lag	Lead	Lag	Lag	Lead	Lag	Lag						
Lead-Lag Optimize?	Yes											
Recall Mode	None	Max	Max	None	Max	Max	C-Min	C-Min	C-Min	C-Max	C-Max	C-Max
Act Effct Green (s)	12.3	59.9	59.9	12.1	59.7	59.7	36.0	36.0	36.0	36.0	36.0	36.0
Actuated g/C Ratio	0.10	0.50	0.50	0.10	0.50	0.50	0.30	0.30	0.30	0.30	0.30	0.30
v/c Ratio	0.57	0.98	0.23	0.58	0.83	0.23	0.69	0.36	0.33	0.69	0.36	0.33
Control Delay	57.7	46.8	3.4	64.4	30.1	3.1	51.1	35.2	5.8	51.1	35.2	5.8
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	57.7	46.8	3.4	64.4	30.1	3.1	51.1	35.2	5.8	51.1	35.2	5.8
LOS	E	D	A	E	C	A	D	D	A	D	D	A
Approach Delay		44.5			29.3			30.7			30.7	
Approach LOS		D			C			C			C	

Intersection Summary

Cycle Length: 120
Actuated Cycle Length: 120
Offset: 118 (98%), Referenced to phase 2:NBTL and 6:SBTL, Start of Green
Natural Cycle: 100
Control Type: Actuated-Coordinated
Maximum v/c Ratio: 0.98
Intersection Signal Delay: 36.3 Intersection LOS: D
Intersection Capacity Utilization 87.0% ICU Level of Service E
Analysis Period (min) 15

Splits and Phases: 8: Paseo del Norte & East Connector



Lane Group	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Volume (vph)	250	2000	2500	250	250	250
Turn Type	Prot	NA	NA	Perm	NA	Perm
Protected Phases	7	4	8		6	
Permitted Phases				8		6
Detector Phase	7	4	8	8	6	6
Switch Phase						
Minimum Initial (s)	4.0	4.0	4.0	4.0	4.0	4.0
Minimum Split (s)	8.0	20.0	20.0	20.0	20.0	20.0
Total Split (s)	30.0	100.0	70.0	70.0	20.0	20.0
Total Split (%)	25.0%	83.3%	58.3%	58.3%	16.7%	16.7%
Yellow Time (s)	3.5	3.5	3.5	3.5	3.5	3.5
All-Red Time (s)	0.5	0.5	0.5	0.5	0.5	0.5
Lost Time Adjust (s)	0.0	0.0	0.0	0.0	0.0	0.0
Total Lost Time (s)	4.0	4.0	4.0	4.0	4.0	4.0
Lead/Lag	Lag		Lead	Lead		
Lead-Lag Optimize?						
Recall Mode	None	C-Max	C-Max	C-Max	Max	Max
Act Effct Green (s)	26.0	96.0	66.0	66.0	16.0	16.0
Actuated g/C Ratio	0.22	0.80	0.55	0.55	0.13	0.13
v/c Ratio	0.65	0.49	0.89	0.26	1.06	0.58
Control Delay	35.2	1.7	27.5	3.6	124.9	11.8
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	35.2	1.7	27.5	3.6	124.9	11.8
LOS	D	A	C	A	F	B
Approach Delay		5.4	25.3		68.3	
Approach LOS		A	C		E	

Intersection Summary

Cycle Length: 120
Actuated Cycle Length: 120
Offset: 96 (80%), Referenced to phase 4:EBT and 8:WBT, Start of Green
Natural Cycle: 80
Control Type: Actuated-Coordinated
Maximum v/c Ratio: 1.06
Intersection Signal Delay: 21.1 Intersection LOS: C
Intersection Capacity Utilization 86.0% ICU Level of Service E
Analysis Period (min) 15

Splits and Phases: 9: Paseo del Norte & Transit Blvd

Lane Group	SEL	SET	SER	NWL	NWT	NWR	NET	NER	SWT	SWR
Lane Configurations										
Volume (vph)	200	2032	100	300	2498	100	250	500	250	200
Turn Type	Prot	NA	Perm	Prot	NA	Perm	NA	pm+ov	NA	pm+ov
Protected Phases	1	6		5	2		4	5	8	1
Permitted Phases			6			2		4	8	8
Detector Phase	1	6	6	5	2	2	4	5	8	1
Switch Phase										
Minimum Initial (s)	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
Minimum Split (s)	8.0	26.0	26.0	20.0	26.0	26.0	20.0	20.0	20.0	8.0
Total Split (s)	29.0	66.0	66.0	34.0	71.0	71.0	20.0	34.0	20.0	29.0
Total Split (%)	24.2%	55.0%	55.0%	28.3%	59.2%	59.2%	16.7%	28.3%	16.7%	24.2%
Yellow Time (s)	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5
All-Red Time (s)	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5
Lost Time Adjust (s)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Lost Time (s)	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
Lead/Lag	Lag	Lag	Lag	Lead	Lead	Lead		Lead		Lag
Lead-Lag Optimize?	Yes	Yes	Yes	Yes	Yes	Yes		Yes		Yes
Recall Mode	None	Max	Max	Max	C-Max	C-Max	None	Max	None	None
Act Effct Green (s)	25.0	62.0	62.0	32.0	69.0	69.0	14.0	50.0	14.0	43.0
Actuated g/C Ratio	0.21	0.52	0.52	0.27	0.58	0.58	0.12	0.42	0.12	0.36
v/c Ratio	0.62	0.89	0.13	0.38	0.98	0.12	0.67	0.84	0.67	0.39
Control Delay	70.6	51.4	16.6	53.4	39.3	8.4	66.6	45.2	60.8	32.6
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	70.6	51.4	16.6	53.4	39.3	8.4	66.6	45.2	60.8	32.6
LOS	E	D	B	D	D	A	E	D	E	C
Approach Delay		51.5			39.7		52.3		48.3	
Approach LOS		D			D		D		D	

Intersection Summary	
Cycle Length: 120	
Actuated Cycle Length: 120	
Offset: 75 (63%), Referenced to phase 2:NWT, Start of Green	
Natural Cycle: 90	
Control Type: Actuated-Coordinated	
Maximum v/c Ratio: 0.98	
Intersection Signal Delay: 46.1	Intersection LOS: D
Intersection Capacity Utilization 84.7%	ICU Level of Service E
Analysis Period (min) 15	

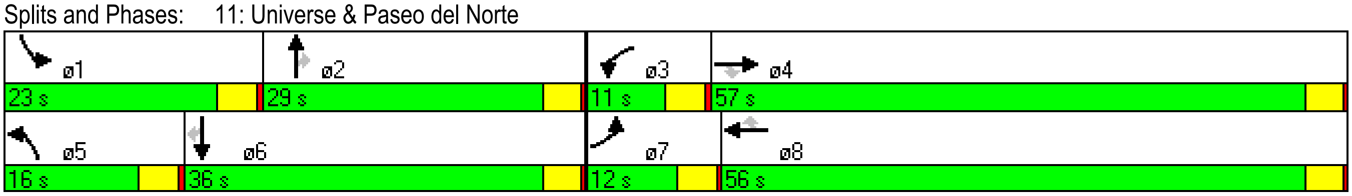
Splits and Phases: 10: NE Connector & Paseo del Norte

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	200	1632	200	100	2051	300	200	600	100	500	600	200
Turn Type	Prot	NA	Perm	Prot	NA	Perm	Prot	NA	Perm	Prot	NA	Perm
Protected Phases	7	4		3	8		5	2		1	6	
Permitted Phases			4			8			2			6
Detector Phase	7	4	4	3	8	8	5	2	2	1	6	6
Switch Phase												
Minimum Initial (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
Minimum Split (s)	8.0	20.0	20.0	8.0	20.0	20.0	8.0	20.0	20.0	8.0	20.0	20.0
Total Split (s)	12.0	57.0	57.0	11.0	56.0	56.0	16.0	29.0	29.0	23.0	36.0	36.0
Total Split (%)	10.0%	47.5%	47.5%	9.2%	46.7%	46.7%	13.3%	24.2%	24.2%	19.2%	30.0%	30.0%
Yellow Time (s)	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5
All-Red Time (s)	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5
Lost Time Adjust (s)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
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
Lead/Lag	Lead	Lag	Lag	Lead	Lag	Lag	Lead	Lag	Lag	Lead	Lag	Lag
Lead-Lag Optimize?	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Recall Mode	None	None	None	None	None	None	None	C-Max	C-Max	None	C-Max	C-Max
Act Effct Green (s)	8.0	53.1	53.1	6.9	52.0	52.0	11.2	25.0	25.0	19.0	32.8	32.8
Actuated g/C Ratio	0.07	0.44	0.44	0.06	0.43	0.43	0.09	0.21	0.21	0.16	0.27	0.27
v/c Ratio	0.90	0.75	0.26	0.52	0.96	0.39	0.65	0.84	0.25	0.95	0.64	0.40
Control Delay	96.0	30.6	6.0	57.6	47.6	10.1	62.4	57.6	9.3	79.1	42.4	17.0
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	96.0	30.6	6.0	57.6	47.6	10.1	62.4	57.6	9.3	79.1	42.4	17.0
LOS	F	C	A	E	D	B	E	E	A	E	D	B
Approach Delay		34.6			43.4			53.3			52.6	
Approach LOS		C			D			D			D	

Intersection Summary

Cycle Length: 120
Actuated Cycle Length: 120
Offset: 0 (0%), Referenced to phase 2:NBT and 6:SBT, Start of Green, Master Intersection
Natural Cycle: 90
Control Type: Actuated-Coordinated
Maximum v/c Ratio: 0.96
Intersection Signal Delay: 43.9 Intersection LOS: D
Intersection Capacity Utilization 89.5% ICU Level of Service E
Analysis Period (min) 15

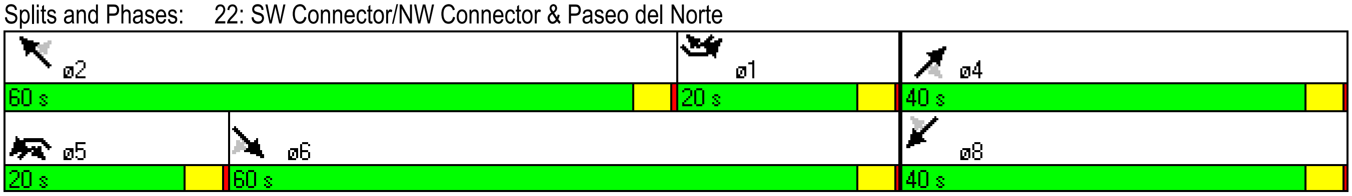
Splits and Phases: 11: Universe & Paseo del Norte



Lane Group	SEL	SET	SER	NWL	NWT	NWR	NET	NER	SWT	SWR
Lane Configurations										
Volume (vph)	500	2451	250	200	2032	200	300	200	300	500
Turn Type	Prot	NA	Perm	Prot	NA	Perm	NA	pm+ov	NA	pm+ov
Protected Phases	1	6		5	2		4	5	8	1
Permitted Phases			6			2	4	4		8
Detector Phase	1	6	6	5	2	2	4	5	8	1
Switch Phase										
Minimum Initial (s)	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
Minimum Split (s)	8.0	40.0	40.0	8.0	22.0	22.0	40.0	8.0	22.0	8.0
Total Split (s)	20.0	60.0	60.0	20.0	60.0	60.0	40.0	20.0	40.0	20.0
Total Split (%)	16.7%	50.0%	50.0%	16.7%	50.0%	50.0%	33.3%	16.7%	33.3%	16.7%
Yellow Time (s)	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5
All-Red Time (s)	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5
Lost Time Adjust (s)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Lost Time (s)	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
Lead/Lag	Lag	Lag	Lag	Lead	Lead	Lead		Lead		Lag
Lead-Lag Optimize?	Yes	Yes	Yes	Yes	Yes	Yes		Yes		Yes
Recall Mode	None	C-Max	C-Max	None	C-Max	C-Max	None	None	None	None
Act Effct Green (s)	16.0	76.7	76.7	12.5	73.2	73.2	18.8	35.3	18.8	38.8
Actuated g/C Ratio	0.13	0.64	0.64	0.10	0.61	0.61	0.16	0.29	0.16	0.32
v/c Ratio	1.13	0.78	0.24	0.58	0.68	0.20	0.54	0.43	0.54	0.97
Control Delay	129.4	25.0	10.6	37.1	26.8	9.8	49.0	35.0	51.5	73.8
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	129.4	25.0	10.6	37.1	26.8	9.8	49.0	35.0	51.5	73.8
LOS	F	C	B	D	C	A	D	D	D	E
Approach Delay		40.2			26.2		43.4		65.4	
Approach LOS		D			C		D		E	

Intersection Summary	
Cycle Length: 120	
Actuated Cycle Length: 120	
Offset: 22 (18%), Referenced to phase 2:NWT and 6:SET, Start of Green	
Natural Cycle: 100	
Control Type: Actuated-Coordinated	
Maximum v/c Ratio: 1.13	
Intersection Signal Delay: 38.4	Intersection LOS: D
Intersection Capacity Utilization 76.9%	ICU Level of Service D
Analysis Period (min) 15	

Splits and Phases: 22: SW Connector/NW Connector & Paseo del Norte



Lane Group	SEL	SET	NWL	NWT	NEL	NET	NER	SWL	SWT	SWR
Lane Configurations										
Volume (vph)	400	300	200	300	200	800	200	200	900	200
Turn Type	Prot	NA	Prot	NA	Prot	NA	Perm	Prot	NA	Perm
Protected Phases	1	6	5	2	7	4		3	8	
Permitted Phases							4			8
Detector Phase	1	6	5	2	7	4	4	3	8	8
Switch Phase										
Minimum Initial (s)	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
Minimum Split (s)	20.0	20.0	8.0	20.0	8.0	20.0	20.0	8.0	20.0	20.0
Total Split (s)	20.0	40.0	20.0	40.0	20.0	40.0	40.0	20.0	40.0	40.0
Total Split (%)	16.7%	33.3%	16.7%	33.3%	16.7%	33.3%	33.3%	16.7%	33.3%	33.3%
Yellow Time (s)	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5
All-Red Time (s)	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5
Lost Time Adjust (s)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Lost Time (s)	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
Lead/Lag	Lead	Lead	Lag	Lag	Lead	Lag	Lag	Lead	Lag	Lag
Lead-Lag Optimize?	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Recall Mode	Max	C-Max	None	None	None	None	None	None	None	None
Act Effct Green (s)	17.9	37.9	15.5	35.5	15.5	35.1	35.1	15.5	35.1	35.1
Actuated g/C Ratio	0.15	0.32	0.13	0.30	0.13	0.29	0.29	0.13	0.29	0.29
v/c Ratio	0.78	0.87	0.87	0.46	0.87	0.77	0.37	0.87	0.87	0.38
Control Delay	55.8	29.9	85.5	26.0	56.0	51.4	29.4	85.5	50.5	20.1
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	55.8	29.9	85.5	26.0	56.0	51.4	29.4	85.5	50.5	20.1
LOS	E	C	F	C	E	D	C	F	D	C
Approach Delay		41.4		43.0		48.5			51.2	
Approach LOS		D		D		D			D	

Intersection Summary

Cycle Length: 120
Actuated Cycle Length: 120
Offset: 0 (0%), Referenced to phase 6:SET, Start of Green
Natural Cycle: 80
Control Type: Actuated-Coordinated
Maximum v/c Ratio: 0.87
Intersection Signal Delay: 46.9 Intersection LOS: D
Intersection Capacity Utilization 88.4% ICU Level of Service E
Analysis Period (min) 15

Splits and Phases: 53: Unser Blvd & NE Connector/NW Connector