Appendix I:

The Project Traffic Impact Study report by TJKM Transportation Consultants

TJKM
Transportation
Consultants

Vision That Moves Your Community

Draft Report

Traffic Impact Study for the Residential Development at 4659 Proctor Road

In the County of Alameda

November 3, 2010

Pleasanton
Fresno
Sacramento
Santa Rosa

www.tjkm.com

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Traffic Impact Study for the Residential Development at 4659 Proctor Road

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TJKM

www.tjkm.com

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Introduction and Summary

Introduction

This report presents the results of TJKM's traffic impact study for the proposed residential development at 4659 Proctor Road in the unincorporated City of Castro Valley, in the County of Alameda. The proposed development is located on the south side of Proctor Road, east of Walnut Road and west of Redwood Road.

The developer of 4659 Proctor Road is proposing to build approximately 24 single-family homes that would have access to Proctor Road by a proposed driveway. The development site and its vicinity are shown in Figure 1. The site plan for the proposed development is shown in Figure 2. The project driveway is proposed to be stop sign controlled for vehicles exiting the proposed development and maintain free movement for the existing traffic movements on Proctor Road.

The purpose of this traffic study is to evaluate the potential traffic impacts on the adjacent roadway network resulting from the proposed residential development at 4659 Proctor Road and to determine potential improvement measures.

Traffic operations were evaluated for the following two existing and one proposed study intersections that may potentially be impacted by the proposed project:

1. Proctor Road and Redwood Road (Existing)
2. Proctor Road and Walnut Road and Ewing Road (Existing)
3. Proctor Road and the Project Driveway (Proposed)

An intersection level of service (LOS) analysis was performed for the study intersections for the following three scenarios:

1. Existing Conditions (Scenario 1)
    - This scenario evaluates the existing study intersections based on the existing traffic counts and field surveys.
2. Future Near-term Conditions (Scenario 2)
    - This scenario is similar to *Existing Conditions* scenario, with the addition of traffic expected from approved developments in the surrounding area of the proposed project.
3. Future Near-term Plus Proposed Project Conditions (Scenario 3)
    - This scenario is similar to *Future Near-term Conditions* scenario, with the addition of traffic from the proposed residential development at 4659 Proctor Road.

In addition to the LOS analysis, on-site traffic circulation was evaluated for the proposed development, including parking space requirements, the layout of driveways, and the feasibility of vehicle turn-around.

Summary

Under *Existing Conditions (Scenario 1)*, the two existing study intersections operate at acceptable levels of service.

Under *Future Near-term Conditions (Scenario 2)*, the two existing study intersections continue to operate at acceptable levels of service.

The proposed residential development at 4659 Proctor Road is expected to generate 18 trips (4 inbound and 14 outbound) during the a.m. peak hour and 25 trips (16 inbound and 9 outbound) during the p.m. peak hour.

Under *Future Near-term Plus Project Conditions (Scenario 3)*, the three study intersections operate at acceptable levels of service.

TJKM reviewed the project site plan to evaluate on-site traffic circulation and access. Internal traffic circulation within the proposed project site is expected to be adequate and meet County's parking requirements and design standards.

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Vicinity Map, Intersection Lane Geometry, Traffic Control, and Existing Conditions (Scenario 1) Volumes

Figure 1

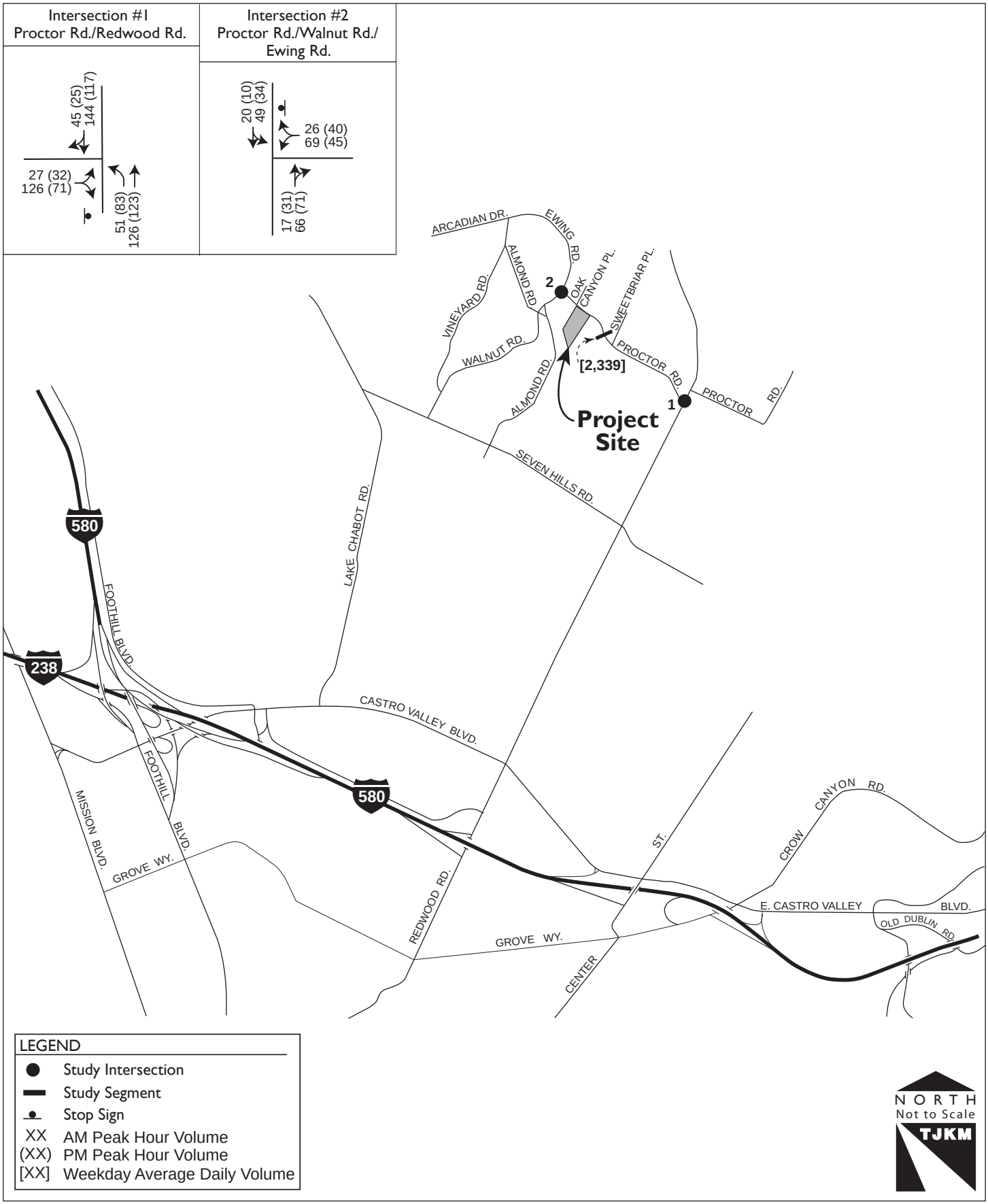

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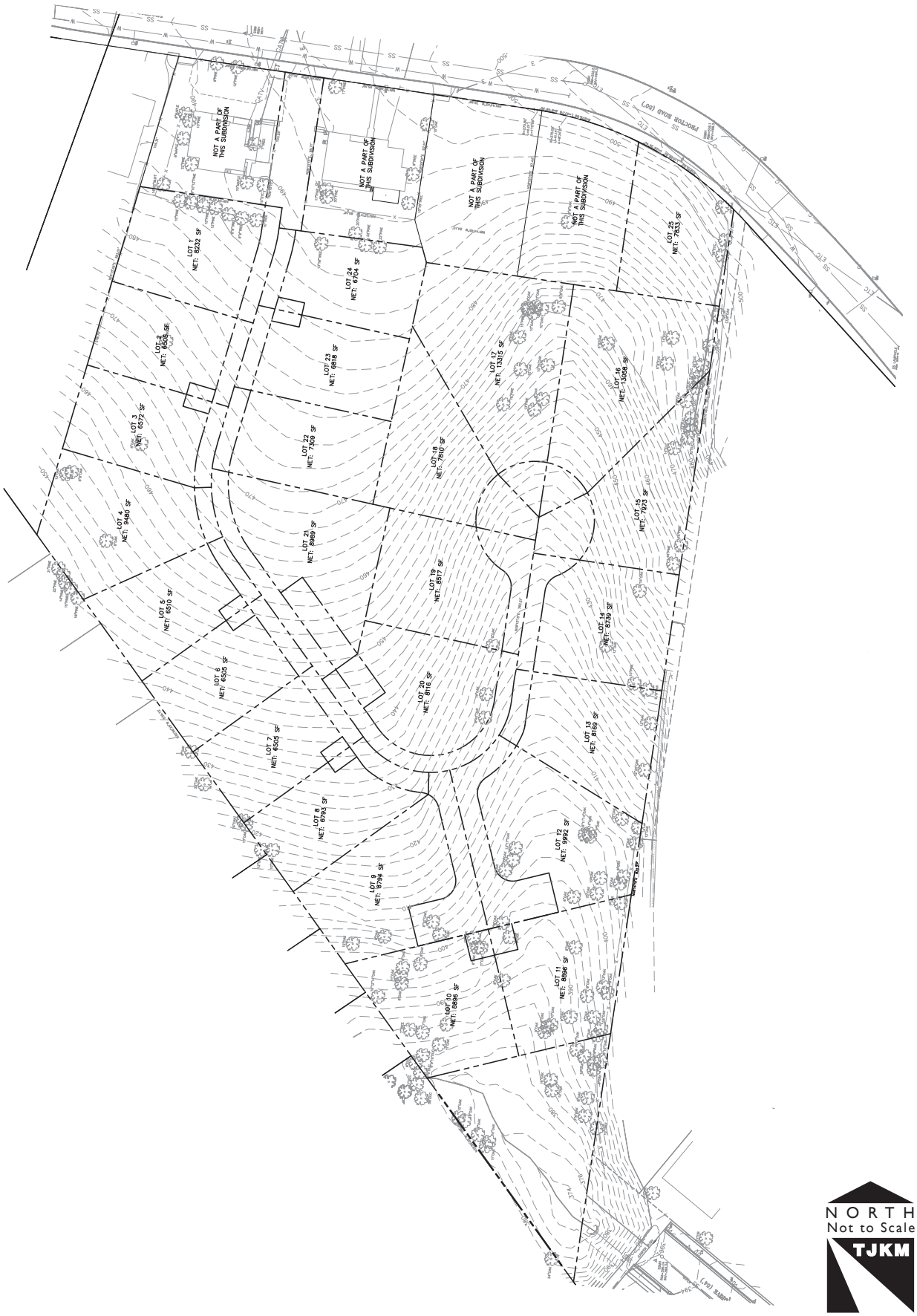
Figure 2

Proposed Site Plan for 4659 Proctor Road



Analysis Methodology

Level of Service Analysis Methodology

LOS ratings are qualitative descriptions of intersection operations and are reported using an 'A' through 'F' letter rating system to describe travel delay and congestion. LOS A indicates free flow conditions with little or no delay and LOS F indicates jammed conditions with excessive delays and long back-ups. The LOS methodology is described in detail in Appendix A.

Peak hour conditions at the study intersections are reports in terms of average delay (second/vehicle) with corresponding levels of service. The operating conditions at the study intersections were evaluated using the *2000 Highway Capacity Manual* (HCM 2000) Operations methodology contained in the SYNCHRO software package. The HCM 2000 methodology provides an average delay and LOS rating for each intersection approach and also for the overall intersection performance.

The intersections analyzed as part of this study each have one minor approach and stop sign control at this approach with free movement for the major approaches. As a result, for this study, the delay and LOS were reported for the minor approach.

LOS Standards

According to the County of Alameda Public Works Agency, the LOS standard for roadway systems is LOS D for intersections. Therefore, this report uses Level of Service (LOS) D as the minimum acceptable LOS threshold for the study intersections.

Existing Conditions (Scenario 1)

Roadway Network

Redwood Road is a north-south arterial that extends southward from California State Route 13 at 35th Avenue in the City of Oakland through unincorporated areas of the County of Alameda, including the City of Castro Valley. Redwood Road continues as 'A' Street south of Interstate 580 and Grove Way in the City of Hayward. At Proctor Road and near the proposed project site, Redwood Road is a two-way street with three lanes including a two-way-left-turn lane.

Proctor Road is an east-west local street in the unincorporated City of Castro Valley, in the County of Alameda, that extends eastward from Walnut Road and Ewing Road to an off-set intersection at Redwood Road. From the off-set intersection at Redwood Road, Proctor Road continues westward and then northward as a local street. Proctor Road is a two-lane two-way street.

Walnut Road and Ewing Road meet at Proctor Road in the unincorporated City of Castro Valley in the County of Alameda. Ewing Road is a local street that continues from Proctor Road to the north and then the west as a two-lane two-way street. From Proctor Road, Walnut Road continues southwestward towards Seven Hills Road, also in the City of Castro Valley, as a two-lane two-way street.

Intersection Geometrics and Traffic Control

The intersection of Redwood Road and Proctor Road is an unsignalized off-set intersection with four approaches. Approximately 100 feet, center-to-center, separate the northern and southern Proctor Road approaches. For this study, the intersection of the southern Proctor Road approach and Redwood Road is considered the study intersection and is analyzed as an intersection with three approaches. The intersection of the northern Proctor Road approach and Redwood Road is not included in this traffic impact analysis because the trips generated by the proposed project are not expected to cross the Redwood Road arterial and continue eastward on Proctor Road through the residential neighborhood.

For the study intersection of Redwood Road and Proctor Road, the eastbound minor street approach has stop sign control and consists of one lane in each direction. The major approaches of Redwood Road are uncontrolled, with the southbound approach consisting of one lane and the northbound approach consisting of one through lane and one two-way-left-turn lane. The two-way-left-turn lane ends at the intersection.

The intersection of Walnut Road, Ewing Road, and Proctor Road is an unsignalized intersection with three approaches. The minor street approach, or the westbound approach on Proctor Road, has stop sign control and consists of one lane in each direction. The north- and southbound approaches are uncontrolled and consist of one lane in each direction.

The proposed intersection of Proctor Road and the project driveway is proposed to be an unsignalized intersection with three approaches. The minor street approach, or the northbound approaching project driveway will have stop sign control and consist of one lane in each direction. The east- and westbound approaches will continue to be uncontrolled and consist of one lane in each direction.

The lane geometry and traffic control for the existing study intersections are shown in Figure 1. The lane geometry and traffic control for the proposed study intersection is shown in Figure 4.

Traffic Volumes

National Data & Surveying Services (NDS) collected traffic volumes at the existing study intersections during the typical a.m. peak period, between 7:00 a.m. and 9:00 a.m., and during the typical p.m. peak period, between 4:00 p.m. and 6:00 p.m. NDS also collected the 24-hour period traffic volumes on Proctor Road, west of Sweetbriar Place, near the proposed project site. The peak hour and 24-hour traffic volume data were collected on Thursday, October 14, 2010 and are included in Appendix B and summarized in Figure 1.

Level of Service Analysis

Table 1 presents a summary of the peak hour level of service analysis for each of the existing study intersections for *Existing Conditions* (Scenario 1). Level of service worksheets are provided in Appendix C.

Table I: Peak Hour Intersection Delay and Levels of Service – Scenario 1

ID	*Intersection*	*Control*	*A.M. Peak Hour*		*P.M. Peak Hour*	
			Delay	*LOS*	*Delay*	*LOS*
1	Proctor Road / Redwood Road	Minor Street Approach Stop	12.2	B	11.3	B
2	Proctor Road / Walnut Road / Ewing Road	Minor Street Approach Stop	11.0	B	9.8	A

Note: Delay = Average Delay in seconds per vehicle
LOS = Level of Service
The delay and LOS at intersections with stop or yield control on the minor approach are for the worst-case minor approach.

For *Existing Conditions* (Scenario 1), the two existing study intersections operate at acceptable levels of service of LOS B or better.

Future Near-term Conditions (Scenario 2)

This scenario is based on the future near-term conditions in the region surrounding the proposed project site. To approximate these conditions, a five-year incremental traffic growth was added to existing volumes. The average annual growth rate was estimated to be two percent based on similar studies conducted in this area. This growth rate was applied to each of the study intersection turning movement volumes. Figure 3 summarizes the turning movement volumes for this scenario.

Level of Service Analysis

Table 11 presents a summary of the peak hour level of service analysis for each of the existing study intersections for the *Future Near-term Conditions (Scenario 2)*. Level of service worksheets are provided in Appendix D.

Table II: Peak Hour Intersection Delay and Levels of Service – Scenario 2

ID	*Intersection*	*Control*	*A.M. Peak Hour*		*P.M. Peak Hour*	
			Delay	*LOS*	*Delay*	*LOS*
1	Proctor Road / Redwood Road	Minor Street Approach Stop	13.1	B	12.0	B
2	Proctor Road / Walnut Road / Ewing Road	Minor Street Approach Stop	11.5	B	10.0	B

Note: Delay = Average Delay in seconds per vehicle
LOS = Level of Service
The delay and LOS at intersections with stop or yield control on the minor approach are for the worst-case minor approach.

For *Future Near-term Conditions (Scenario 2)*, the two existing study intersections continue to operate at acceptable levels of service.

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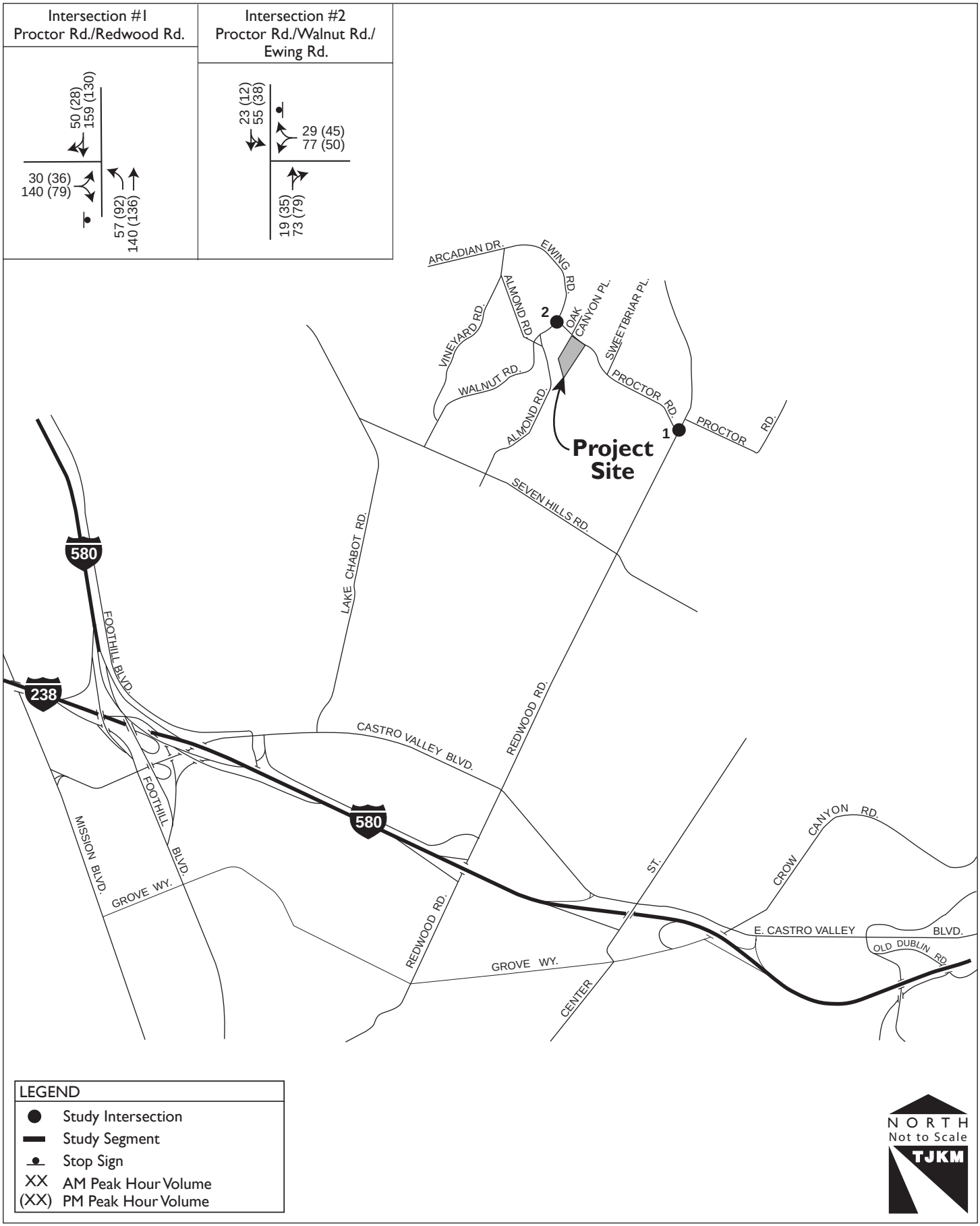
Figure 3

Future Near-term Conditions (Scenario 2) Volumes



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Future Near-term plus Project Conditions (Scenario 3)

This scenario is based on the future near-term conditions in the region surrounding the proposed project site plus the trips generated by the proposed project. Figure 5 summarizes the turning movement volumes for this scenario.

Proposed Project Location and Description
The proposed residential development at 4659 Proctor Road consists of 24 single-family homes. The proposed development is located on the south side of Proctor Road, east of Walnut Road and west of Redwood Road, in the unincorporated City of Castro Valley, in the County of Alameda. The development vicinity and proposed site plan are shown in Figures 1 and 2, respectively.

Access to the proposed development will be through a proposed driveway on Proctor Road approximately 630 feet east of Walnut Road. The proposed access driveway will be will be stop-sign-controlled for vehicles exiting the proposed project site. The east- and westbound approaches on Proctor Road will remain uncontrolled.

Two photographs taken in October 2010 at the proposed project driveway on Proctor Road are included below. The first photograph shows the westward view from the proposed project driveway. The second photograph shows the eastward view from the proposed project driveway. Both photographs indicate no horizontal curves or physical obstructions that will limit sight distance from the project driveway.

Proctor Road and Project Driveway – Westward View

Proctor Road and Project Driveway – Eastward View

Project Trip Generation

Trip generation for the proposed developments was determined using "trip generation per dwelling unit" rates obtained from *Trip Generation*, 8th Edition, published by the Institute of Transportation Engineers (ITE). The proposed development at 4659 Proctor Road is expected to generate approximately 18 trips during the a.m. peak hour and 25 trips during the p.m. peak hour. Trip generation for the proposed development during the peak hours is summarized in Table III.

Table III: Peak Hour Trip Generation for Proposed Development

Project	*Land Use (ITE Code)*	*Size*	*A.M. Peak Hour*					*P.M. Peak Hour*				
			Rate	*In: Out*	*In*	*Out*	*Total*	*Rate*	*In: Out*	*In*	*Out*	*Total*
4659 Proctor Road	Single-Family Detached Housing (210)	24 Units	0.75	25:75	4	14	18	1.01	63:37	16	9	25

Project Trip Distribution and Trip Assignment

Trip distribution determines the proportions of the total vehicles generated by a project that are expected to travel between the project site and various destinations outside the project area. Trip assignment determines the various routes that vehicles are expected to take while travelling between the project site and each destination. For the proposed development, the trip distribution and assignment were determined based on existing turning movements and TJKM's knowledge of the study area. The trip distribution and assignment for the proposed development are shown in Figure 4.

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Proposed Project Trip Distribution and Assignment

Figure 4

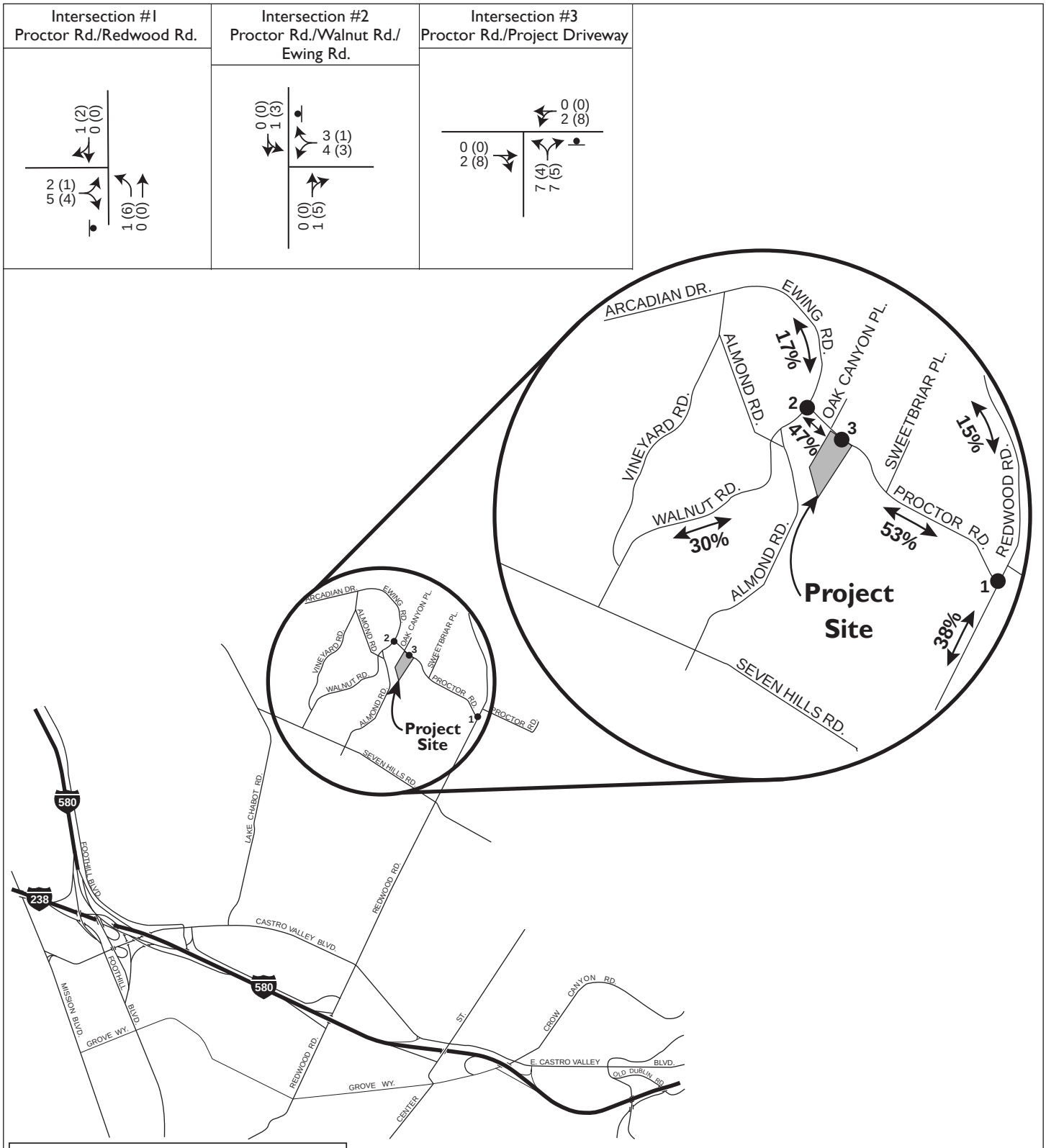

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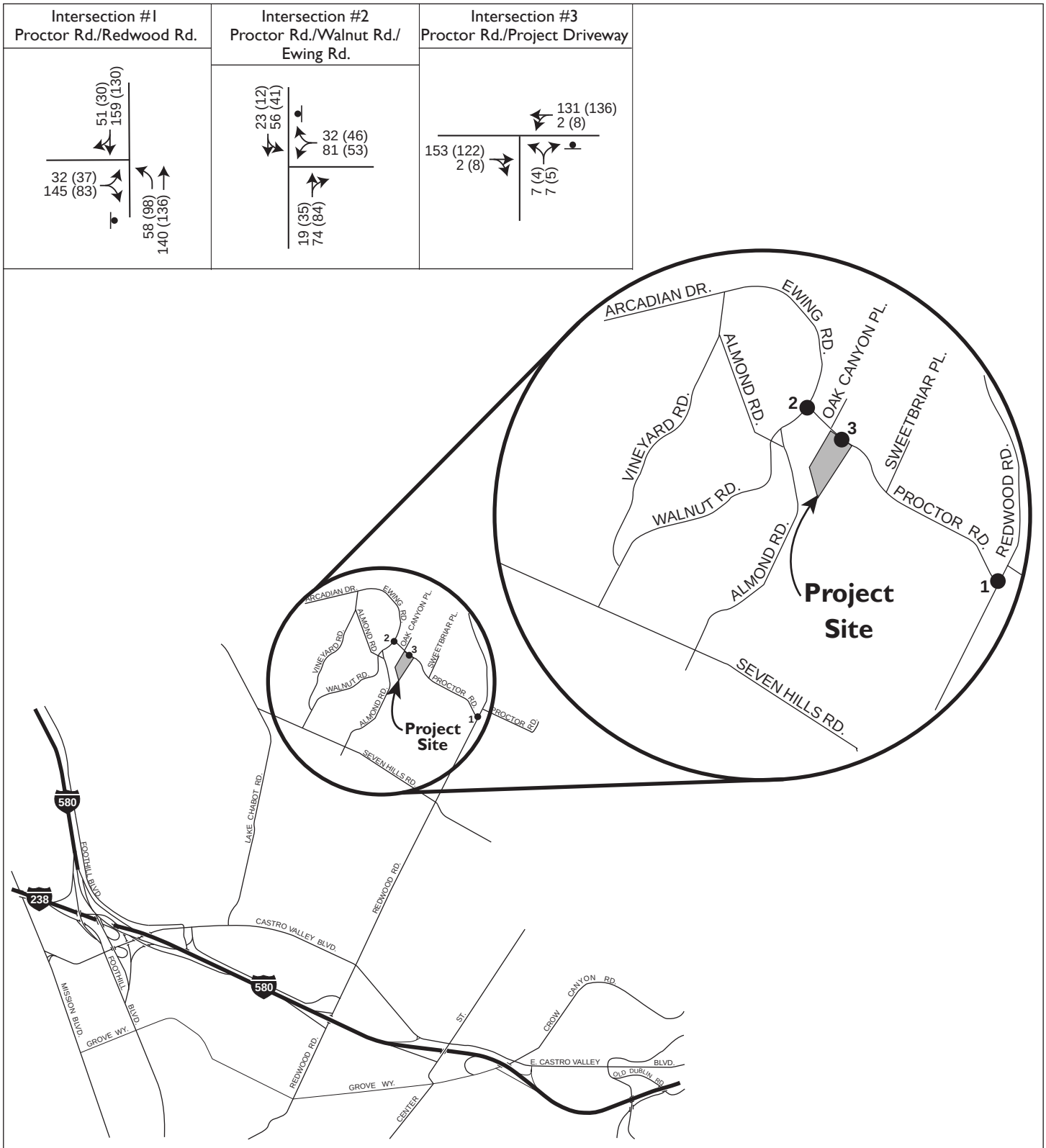
Figure 5

Future Near-term Plus Project Conditions (Scenario 3) Volumes



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Level of Service Analysis
Table IV presents a summary of the peak hour level of service analysis for each of the study intersections for the *Future Near-term plus Project Conditions (Scenario 3)*. Level of service worksheets are provided in Appendix E.

Table IV: Peak Hour Intersection Delay and Levels of Service – Scenario 3

ID	*Intersection*	*Control*	*A.M. Peak Hour*		*P.M. Peak Hour*	
			Delay	*LOS*	*Delay*	*LOS*
1	Proctor Road / Redwood Road	Minor Street Approach Stop	13.4	B	12.2	B
2	Proctor Road / Walnut Road / Ewing Road	Minor Street Approach Stop	11.7	B	10.1	B
3	Proctor Road / Project Driveway	Minor Street Approach Stop	9.8	A	9.6	A

Note: Delay = Average Delay in seconds per vehicle
LOS = Level of Service
The delay and LOS at intersections with stop or yield control on the minor approach are for the worst-case minor approach.

For *Future Near-term plus Project Conditions (Scenario 3)*, the two existing and one proposed study intersections operate at acceptable levels of service.

Project Site Circulation and Access
TJKM reviewed the project site plan to evaluate on-site circulation and access. As shown in Figure 2, the proposed project will have one primary access point on Proctor Road approximately 630 feet east of the Walnut Road. TJKM recommends installing flares at the edges of the project driveway to achieve a minimum width of 26 feet at the point where the driveway meets Proctor Road. This installation will help prevent the need for vehicles turning into the project driveway from having to slow down significantly before entering the development.

The proposed project driveway will terminate at a cul-de-sac and a Tee turnaround (or hammerhead) to provide turn around areas for vehicles within the project site. These turn-around areas are shown on the proposed site plan in Figure 2. Per AASHTO guidelines, a local street open at only one end shall provide a special turning area at the closed end, preferably circular. The minimum outside radius of the special turning area is specified to be 30 feet in residential areas. The cul-de-sac at the closed end of the project driveway will be approximately 45 feet and thus satisfies the AASHTO minimum radius requirement.

Both the cul-de-sac and Tee turnaround were analyzed using AutoTURN, an AutoCAD-based turning radius software. The site was determined to satisfactorily provide adequate turning area for a single-unit truck and a fire truck to circulate within the project site. AutoTURN analysis figures illustrating the turning movements for single-unit trucks and fire trucks are included in Appendix F.

On-Site Parking Requirements
The proposed project will provide two off-street parking spaces and approximately one on-street guest parking space for each single family home. The Alameda County Zoning Ordinance states that two parking spaces must be provided for every single-family residential dwelling. The proposed project therefore satisfies the parking requirements for the proposed development type.

Conclusions

TJKM has reached the following conclusions regarding the proposed residential development at 4659 Proctor Road:

- Under Scenario 1, the two existing study intersections operate at acceptable levels of service.
- Under Scenario 2, the two existing study intersections operate at acceptable levels of service.
- Under Scenario 3, all three study intersections operate at acceptable levels of service.
- TJKM reviewed the project site plan to evaluate on-site traffic circulation and access. Internal traffic circulation within the proposed project site is expected to be adequate and meet County's parking requirements and design standards.

Study Participants

TJKM Transportation Consultants

Joy Bhattacharya, P.E., P.T.O.E.	Project Manager
Travis Richards, P.E.	Project Engineer
Dan Harrison	Graphics
Margie Pfaff	Word Processing

References

Trip Generation, 8th Edition, Institute of Transportation Engineers, 2008.

A Policy on Geometric Design of Highways and Streets, 5th Edition, American Association of State Highway and Transportation Officials (AASHTO), 2004.

The Alameda County, California Municipal Code, Book Publishing Company, Ordinance 2010-31, passed June 29, 2010.

Appendix A – Level of Service Methodology

APPENDIX A
LEVEL OF SERVICE

The description and procedures for calculating capacity and level of service (LOS) are found in Transportation Research Board, *Highway Capacity Manual 2000*. *Highway Capacity Manual 2000* represents the latest research on capacity and quality of service for transportation facilities.

Quality of service requires quantitative measures to characterize operational conditions within a traffic stream. LOS is a quality measure describing operational conditions within a traffic stream, generally in terms of such service measures as speed and travel time, freedom to maneuver, traffic interruptions, and comfort and convenience.

Six levels of service are defined for each type of facility that has analysis procedures available. Letters designate each level, from A to F, with LOS A representing the best operating conditions and LOS F the worst. Each LOS represents a range of operating conditions and the driver's perception of these conditions. Safety is not included in the measures that establish service levels.

A general description of service levels for various types of facilities is shown in Table A-I

Table A-I: Level of Service Description

Facility Type	***Uninterrupted Flow***	***Interrupted Flow***
	Freeways Multi-lane Highways Two-lane Highways Urban Streets	Signalized Intersections Unsignalized Intersections Two-way Stop Control All-way Stop Control
LOS		
A	Free-flow	Very low delay.
B	Stable flow. Presence of other users noticeable.	Low delay.
C	Stable flow. Comfort and convenience starts to decline.	Acceptable delay.
D	High-density stable flow.	Tolerable delay.
E	Unstable flow.	Limit of acceptable delay.
F	Forced or breakdown flow.	Unacceptable delay

Source: *Highway Capacity Manual 2000*

Urban Streets

The term "urban streets" refers to urban arterials and collectors, including those in downtown areas.

Arterial streets are roads that primarily serve longer through trips. However, providing access to abutting commercial and residential land uses is also an important function of arterials.
Collector streets provide both land access and traffic circulation within residential, commercial and industrial areas. Their access function is more important than that of arterials, and unlike arterials their operation is not always dominated by traffic signals.

Downtown streets are signalized facilities that often resemble arterials. They not only move through traffic but also provide access to local businesses for passenger cars, transit buses, and trucks.

Pedestrian conflicts and lane obstructions created by stopping or standing buses, trucks and parking vehicles that cause turbulence in the traffic flow are typical of downtown streets.

The speed of vehicles on urban streets is influenced by three main factors, street environment, interaction among vehicles and traffic control. As a result, these factors also affect quality of service.

The street environment includes the geometric characteristics of the facility, the character of roadside activity and adjacent land uses. Thus, the environment reflects the number and width of lanes, type of median, driveway density, spacing between signalized intersections, existence of parking, level of pedestrian activity and speed limit.

The interaction among vehicles is determined by traffic density, the proportion of trucks and buses, and turning movements. This interaction affects the operation of vehicles at intersections and, to a lesser extent, between signals.

Traffic control (including signals and signs) forces a portion of all vehicles to slow or stop. The delays and speed changes caused by traffic control devices reduce vehicle speeds, however, such controls are needed to establish right-of-way.

The average travel speed for through vehicles along an urban street is the determinant of the operating LOS. The travel speed along a segment, section or entire length of an urban street is dependent on the running speed between signalized intersections and the amount of control delay incurred at signalized intersections.

LOS A describes primarily free-flow operations. Vehicles are completely unimpeded in their ability to maneuver within the traffic stream. Control delay at signalized intersections is minimal.

LOS B describes reasonably unimpeded operations. The ability to maneuver within the traffic stream is only slightly restricted, and control delays at signalized intersections are not significant.

LOS C describes stable operations, however, ability to maneuver and change lanes in midblock location may be more restricted than at LOS B. Longer queues, adverse signal coordination, or both may contribute to lower travel speeds.

LOS D borders on a range in which in which small increases in flow may cause substantial increases in delay and decreases in travel speed. LOS D may be due to adverse signal progression, inappropriate signal timing, high volumes, or a combination of these factors.

LOS E is characterized by significant delays and lower travel speeds. Such operations are caused by a combination of adverse progression, high signal density, high volumes, extensive delays at critical intersections, and inappropriate signal timing.

LOS F is characterized by urban street flow at extremely low speeds. Intersection congestion is likely at critical signalized locations, with high delays, high volumes, and extensive queuing.

The methodology to determine LOS stratifies urban streets into four classifications. The classifications are complex, and are related to functional and design categories. Table A-II describes the functional and design categories, while Table A-III relates these to the urban street classification.

Once classified, the urban street is divided into segments for analysis. An urban street segment is a one-way section of street encompassing a series of blocks or links terminating at a signalized intersection. Adjacent segments of urban streets may be combined to form larger street sections, provided that the segments have similar demand flows and characteristics.

Levels of service are related to the average travel speed of vehicles along the urban street segment or section.

Travel times for existing conditions are obtained by field measurements. The maximum-car technique is used. The vehicle is driven at the posted speed limit unless impeded by actual traffic conditions. In the maximum-car technique, a safe level of vehicular operation is maintained by observing proper following distances and by changing speeds at reasonable rates of acceleration and deceleration. The maximum-car technique provides the best base for measuring traffic performance.

An observer records the travel time and locations and duration of delay. The beginning and ending points are the centers of intersections. Delays include times waiting in queues at signalized intersections. The travel speed is determined by dividing the length of the segment by the travel time. Once the travel speed on the arterial is determined, the LOS is found by comparing the speed to the criteria in Table A-IV. LOS criteria vary for the different classifications of urban street, reflecting differences in driver expectations.

Table A-II: Functional and Design Categories for Urban Streets

Criterion	***Functional Category***			
	Principal Arterial		***Minor Arterial***	
Mobility function	Very important		Important	
Access function	Very minor		Substantial	
Points connected	Freeways, important activity centers, major traffic generators		Principal arterials	
Predominant trips served	Relatively long trips between major points and through trips entering, leaving, and passing through city		Trips of moderate length within relatively small geographical areas	
Criterion	***Design Category***			
	High-Speed	***Suburban***	***Intermediate***	***Urban***
Driveway access density	Very low density	Low density	Moderate density	High density
Arterial type	Multilane divided; undivided or two-lane with shoulders	Multilane divided: undivided or two-lane with shoulders	Multilane divided or undivided; one way, two lane	Undivided one way; two way, two or more lanes
Parking	No	No	Some	Usually
Separate left-turn lanes	Yes	Yes	Usually	Some
Signals per mile	0.5 to 2	1 to 5	4 to 10	6 to 12
Speed limits	45 to 55 mph	40 to 45 mph	30 to 40 mph	25 to 35 mph
Pedestrian activity	Very little	Little	Some	Usually
Roadside development	Low density	Low to medium density	Medium to moderate density	High density

Source: *Highway Capacity Manual 2000*

Table A-III: Urban Street Class based on Function and Design Categories

Design Category	*Functional Category*	
	Principal Arterial	***Minor Arterial***
High-Speed	I	Not applicable
Suburban	II	II
Intermediate	II	III or IV
Urban	III or IV	IV

Source: *Highway Capacity Manual 2000*

Table A-IV: Urban Street Levels of Service by Class

Urban Street Class	***I***	***II***	***III***	***IV***
Range of Free Flow Speeds (mph)	45 to 55	35 to 45	30 to 35	25 to 35
Typical Free Flow Speed (mph)	50	40	33	30
LOS	***Average Travel Speed (mph)***			
A	>42	>35	>30	>25
B	>34	>28	>24	>19
C	>27	>22	>18	>13
D	>21	>17	>14	>9
E	>16	>13	>10	>7
F	≤16	≤13	≤10	≤7

Source: *Highway Capacity Manual 2000*

Interrupted Flow

One of the more important elements limiting, and often interrupting the flow of traffic on a highway is the intersection. Flow on an interrupted facility is usually dominated by points of fixed operation such as traffic signals, stop and yield signs. These all operate quite differently and have differing impacts on overall flow.

Unsignalized Intersections

The current procedures on unsignalized intersections were first introduced in the 1997 update to the *Highway Capacity Manual* and represent a revision of the methodology published in the 1994 update to the 1985 *Highway Capacity Manual*. The revised procedures use control delay as a measure of effectiveness to determine LOS. Delay is a measure of driver discomfort, frustration, fuel consumption, and increased travel time. The delay experienced by a motorist is made up of a number of factors that relate to control, traffic and incidents. Total delay is the difference between the travel time actually experienced and the reference travel time that would result during base conditions, *i. e.,* in the absence of traffic control, geometric delay, any incidents, and any other vehicles. Control delay is the increased time of travel for a vehicle approaching and passing through an unsignalized intersection, compared with a free-flow vehicle if it were not required to slow or stop at the intersection.

Two-Way Stop Controlled Intersections

Two-way stop controlled intersections in which stop signs are used to assign the right-of-way, are the most prevalent type of intersection in the United States. At two-way stop-controlled intersections the stop-controlled approaches are referred as the minor street approaches and can be either public streets or private driveways. The approaches that are not controlled by stop signs are referred to as the major street approaches.

The capacity of movements subject to delay are determined using the "critical gap" method of capacity analysis. Expected average control delay based on movement volume and movement capacity is calculated. A LOS designation is given to the expected control delay for each minor movement. LOS is not defined for the intersection as a whole. Control delay is the increased time of travel for a vehicle approaching and passing through a stop-controlled intersection, compared with a free-flow vehicle if it were not required to slow or stop at the intersection. A description of levels of service for two-way stop-controlled intersections is found in Table A-VI.

Table A-VI: Description of Level of Service for Two-Way Stop Controlled Intersections

LOS	*Description*
A	Very low control delay less than 10 seconds per vehicle for each movement subject to delay.
B	Low control delay greater than 10 and up to 15 seconds per vehicle for each movement subject to delay.
C	Acceptable control delay greater than 15 and up to 25 seconds per vehicle for each movement subject to delay.
D	Tolerable control delay greater than 25 and up to 35 seconds per vehicle for each movement subject to delay.
E	Limit of tolerable control delay greater than 35 and up to 50 seconds per vehicle for each movement subject to delay.
F	Unacceptable control delay in excess of 50 seconds per vehicle for each movement subject to delay.

Source: *Highway Capacity Manual 2000*

Appendix B – Existing Traffic Counts

Intersection Turning Movement

Prepared by:

National Data & Surveying Services

N-S STREET: Redwood Rd DATE: 10/14/2010 LOCATION: City of Castro Valley

E-W STREET: Proctor Rd DAY: THURSDAY PROJECT# 10-7394-001

	NORTHBOUND			SOUTHBOUND			EASTBOUND			WESTBOUND			
LANES:	NL	NT	NR	SL	ST	SR	EL	ET	ER	WL	WT	WR	TOTAL
7:00 AM	5	14	0	1	13	2	1	1	11	9	1	1	59
7:15 AM	7	9	1	0	10	2	0	0	20	11	2	1	63
7:30 AM	6	10	4	0	21	0	2	0	17	14	4	1	79
7:45 AM	11	29	9	6	24	2	1	6	48	23	13	6	178
8:00 AM	22	25	21	3	13	0	4	12	39	20	12	4	175
8:15 AM	12	24	4	2	16	4	2	0	22	13	10	5	114
8:30 AM	7	20	2	1	13	1	2	1	15	7	4	0	73
8:45 AM	3	10	2	1	21	0	2	2	18	8	3	0	70
TOTAL VOLUMES =	NL 73	NT 141	NR 43	SL 14	ST 131	SR 11	EL 14	ET 22	ER 190	WL 105	WT 49	WR 18	TOTAL 811

AM Peak Hr Begins at: 730 AM

PEAK VOLUMES =	51	88	38	11	74	6	9	18	126	70	39	16	546
PEAK HR. FACTOR:		0.651			0.711			0.695			0.744		0.767

CONTROL:

Intersection Turning Movement

Prepared by:

National Data & Surveying Services

N-S STREET: Redwood Rd DATE: 10/14/2010 LOCATION: City of Castro Valley

E-W STREET: Proctor Rd DAY: THURSDAY PROJECT# 10-7394-001

	NORTHBOUND			SOUTHBOUND			EASTBOUND			WESTBOUND			
LANES:	NL	NT	NR	SL	ST	SR	EL	ET	ER	WL	WT	WR	TOTAL
4:00 PM	18	21	7	0	19	1	3	2	12	5	2	0	90
4:15 PM	23	18	13	2	15	0	3	0	14	4	3	1	96
4:30 PM	19	25	16	1	16	2	4	4	11	5	3	2	108
4:45 PM	17	23	19	0	14	2	0	3	16	1	1	2	98
5:00 PM	19	18	11	0	21	2	2	3	13	10	4	2	105
5:15 PM	20	17	14	1	15	1	2	7	17	5	4	1	104
5:30 PM	25	24	13	1	20	8	1	2	18	10	2	2	126
5:45 PM	19	16	10	0	28	3	6	9	23	8	1	1	124
TOTAL VOLUMES =	NL 160	NT 162	NR 103	SL 5	ST 148	SR 19	EL 21	ET 30	ER 124	WL 48	WT 20	WR 11	TOTAL 851

PM Peak Hr Begins at: 500 PM

PEAK VOLUMES =	83	75	48	2	84	14	11	21	71	33	11	6	459
PEAK HR. FACTOR:		0.831			0.806			0.678			0.781		0.911

CONTROL:

Intersection Turning Movement

Prepared by:

National Data & Surveying Services

N-S STREET: Walnut Rd/Ewing Rd DATE: 10/14/2010 LOCATION: City of Castro Valley

E-W STREET: Proctor Rd DAY: THURSDAY PROJECT# 10-7394-002

	NORTHBOUND			SOUTHBOUND			EASTBOUND			WESTBOUND			
LANES:	NL	NT	NR	SL	ST	SR	EL	ET	ER	WL	WT	WR	TOTAL
7:00 AM		1	3	5	1					10		1	21
7:15 AM		1	5	11	2					7		6	32
7:30 AM		2	7	9	3					10		6	37
7:45 AM		3	26	21	9					20		3	82
8:00 AM		9	21	10	4					26		9	79
8:15 AM		3	12	9	4					13		8	49
8:30 AM		3	4	8	2					9		5	31
8:45 AM		1	9	3	2					6		3	24

TOTAL VOLUMES =	NL	NT	NR	SL	ST	SR	EL	ET	ER	WL	WT	WR	TOTAL
	0	23	87	76	27	0	0	0	0	101	0	41	355

AM Peak Hr Begins at: 730 AM

PEAK VOLUMES =													
	0	17	66	49	20	0	0	0	0	69	0	26	247
PEAK HR. FACTOR:		0.692			0.575			0.000			0.679		0.753

CONTROL:

Intersection Turning Movement

Prepared by:

National Data & Surveying Services

N-S STREET: Walnut Rd/Ewing Rd DATE: 10/14/2010 LOCATION: City of Castro Valley

E-W STREET: Proctor Rd DAY: THURSDAY PROJECT# 10-7394-002

	NORTHBOUND			SOUTHBOUND			EASTBOUND			WESTBOUND			
LANES:	NL	NT	NR	SL	ST	SR	EL	ET	ER	WL	WT	WR	TOTAL
4:00 PM		5	11	4	4					7		12	43
4:15 PM		5	11	6	2					13		3	40
4:30 PM		9	18	7	4					6		9	53
4:45 PM		5	15	6	1					12		11	50
5:00 PM		5	13	4	1					14		6	43
5:15 PM		12	20	7	5					12		9	65
5:30 PM		6	17	10	0					11		13	57
5:45 PM		8	21	13	4					8		12	66

TOTAL	NL	NT	NR	SL	ST	SR	EL	ET	ER	WL	WT	WR	TOTAL
VOLUMES =	0	55	126	57	21	0	0	0	0	83	0	75	417

PM Peak Hr Begins at: 500 PM

PEAK VOLUMES =	0	31	71	34	10	0	0	0	0	45	0	40	231
PEAK HR. FACTOR:		0.797			0.647			0.000			0.885		0.875

CONTROL:

Prepared by NDS/ATD

Volumes for: Thursday, October 14, 2010	City:	Castro Valley	Daily Totals NB	SB	EB	WB	Total
Location: Proctor Rd W/o Sweetbriar Place	Project:	10-7395-001	0	0	1,094	1,245	2,339

AM Period	NB	SB	EB		WB			PM Period	NB	SB	EB		WB		
00:00			2		2			12:00			12		13		
00:15			0		1			12:15			12		13		
00:30			1		0			12:30			17		27		
00:45			2	5	2	5	10	12:45			9	50	6	59	109
01:00			0		0			13:00			12		21		
01:15			0		0			13:15			10		20		
01:30			0		0			13:30			14		11		
01:45			1	1	2	2	3	13:45			16	52	15	67	119
02:00			0		0			14:00			14		14		
02:15			0		1			14:15			12		10		
02:30			0		0			14:30			29		24		
02:45			0		0	1	1	14:45			27	82	15	63	145
03:00			0		1			15:00			22		44		
03:15			1		0			15:15			28		33		
03:30			0		0			15:30			30		15		
03:45			0	1	0	1	2	15:45			19	99	22	114	213
04:00			0		0			16:00			16		34		
04:15			1		0			16:15			22		23		
04:30			0		3			16:30			23		21		
04:45			0	1	0	3	4	16:45			21	82	26	104	186
05:00			3		1			17:00			19		35		
05:15			1		2			17:15			29		26		
05:30			2		1			17:30			25		28		
05:45			1	7	2	6	13	17:45			37	110	34	123	233
06:00			4		5			18:00			33		28		
06:15			1		8			18:15			23		23		
06:30			6		9			18:30			22		33		
06:45			12	23	4	26	49	18:45			16	94	25	109	203
07:00			9		8			19:00			15		16		
07:15			17		17			19:15			12		20		
07:30			19		10			19:30			9		14		
07:45			57	102	20	55	157	19:45			12	48	8	58	106
08:00			44		43			20:00			10		11		
08:15			24		38			20:15			9		12		
08:30			13		17			20:30			4		13		
08:45			17	98	15	113	211	20:45			10	33	18	54	87
09:00			14		9			21:00			10		12		
09:15			11		16			21:15			7		14		
09:30			16		10			21:30			12		25		
09:45			9	50	17	52	102	21:45			5	34	21	72	106
10:00			13		20			22:00			2		3		
10:15			14		12			22:15			3		3		
10:30			8		10			22:30			5		2		
10:45			16	51	21	63	114	22:45			1	11	7	15	26
11:00			13		22			23:00			2		5		
11:15			15		9			23:15			2		2		
11:30			13		18			23:30			1		7		
11:45			13	54	17	66	120	23:45			1	6	0	14	20
Total Vol.			393		393		**786**				701		852		**1553**

	NB	SB	EB	WB	Total
Daily Totals :	0	0	1,094	1,245	2,339

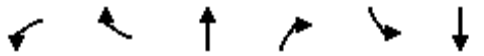
	AM			PM		
Split %	50.0%	50.0%	**33.6%**	45.1%	54.9%	**66.4%**
AM				**PM**		
Peak Hr.	07:30	07:45	**07:45**	**Peak Hr.**	17:15	17:00	**17:15**
Volume	144	118	**256**	**Volume**	124	123	**240**
P.H.F.	0.632	0.686	**0.736**	**P.H.F.**	0.838	0.879	**0.845**
7 - 9 Vol.	200	168	**368**	**4 - 6 Vol.**	192	227	**419**
Peak Hr.	07:30	07:45	**07:45**	**Peak Hr.**	17:00	17:00	**17:00**
Volume	144	118	**256**	**Volume**	110	123	**233**
P.H.F.	0.632	0.686	**0.736**	**P.H.F.**	0.743	0.879	**0.820**

Appendix C – Level of Service Worksheets: Existing Conditions (Scenario 1)

Movement	NBL	NBT	SBT	SBR	SEL	SER
Lane Configurations						
Sign Control		Free	Free		Stop	
Grade		0%	0%		0%	
Volume (veh/h)	51	126	144	45	27	126
Peak Hour Factor	0.65	0.65	0.76	0.76	0.70	0.70
Hourly flow rate (vph)	78	194	189	59	39	180
Pedestrians						
Lane Width (ft)						
Walking Speed (ft/s)						
Percent Blockage						
Right turn flare (veh)						
Median type					None	
Median storage veh)						
Upstream signal (ft)						
pX, platoon unblocked						
vC, conflicting volume	249				570	219
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	249				570	219
tC, single (s)	4.1				6.4	6.2
tC, 2 stage (s)						
tF (s)	2.2				3.5	3.3
p0 queue free %	94				92	78
cM capacity (veh/h)	1317				454	821

Direction, Lane #	NB 1	NB 2	SB 1	SE 1
Volume Total	78	194	249	219
Volume Left	78	0	0	39
Volume Right	0	0	59	180
cSH	1317	1700	1700	718
Volume to Capacity	0.06	0.11	0.15	0.30
Queue Length 95th (ft)	5	0	0	32
Control Delay (s)	7.9	0.0	0.0	12.2
Lane LOS	A			B
Approach Delay (s)	2.3		0.0	12.2
Approach LOS				B

Intersection Summary			
Average Delay	4.4		
Intersection Capacity Utilization	32.9%	ICU Level of Service	A
Analysis Period (min)	15		



Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Sign Control	Stop		Free			Free
Grade	0%		0%			0%
Volume (veh/h)	69	26	17	66	49	20
Peak Hour Factor	0.68	0.68	0.69	0.69	0.58	0.58
Hourly flow rate (vph)	101	38	25	96	84	34
Pedestrians						
Lane Width (ft)						
Walking Speed (ft/s)						
Percent Blockage						
Right turn flare (veh)						
Median type	None					
Median storage veh)						
Upstream signal (ft)						
pX, platoon unblocked						
vC, conflicting volume	276	72			120	
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	276	72			120	
tC, single (s)	6.4	6.2			4.1	
tC, 2 stage (s)						
tF (s)	3.5	3.3			2.2	
p0 queue free %	85	96			94	
cM capacity (veh/h)	673	990			1467	

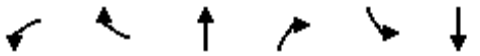
Direction, Lane #	WB 1	NB 1	SB 1
Volume Total	140	120	119
Volume Left	101	0	84
Volume Right	38	96	0
cSH	737	1700	1467
Volume to Capacity	0.19	0.07	0.06
Queue Length 95th (ft)	17	0	5
Control Delay (s)	11.0	0.0	5.5
Lane LOS	B		A
Approach Delay (s)	11.0	0.0	5.5
Approach LOS	B		

Intersection Summary			
Average Delay		5.8	
Intersection Capacity Utilization		22.5%	ICU Level of Service A
Analysis Period (min)		15	

Movement	NBL	NBT	SBT	SBR	SEL	SER
Lane Configurations						
Sign Control		Free	Free		Stop	
Grade		0%	0%		0%	
Volume (veh/h)	83	123	117	25	32	71
Peak Hour Factor	0.83	0.83	0.89	0.89	0.68	0.68
Hourly flow rate (vph)	100	148	131	28	47	104
Pedestrians						
Lane Width (ft)						
Walking Speed (ft/s)						
Percent Blockage						
Right turn flare (veh)						
Median type					None	
Median storage veh)						
Upstream signal (ft)						
pX, platoon unblocked						
vC, conflicting volume	160				494	146
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	160				494	146
tC, single (s)	4.1				6.4	6.2
tC, 2 stage (s)						
tF (s)	2.2				3.5	3.3
p0 queue free %	93				91	88
cM capacity (veh/h)	1420				497	902

Direction, Lane #	NB 1	NB 2	SB 1	SE 1
Volume Total	100	148	160	151
Volume Left	100	0	0	47
Volume Right	0	0	28	104
cSH	1420	1700	1700	720
Volume to Capacity	0.07	0.09	0.09	0.21
Queue Length 95th (ft)	6	0	0	20
Control Delay (s)	7.7	0.0	0.0	11.3
Lane LOS	A			B
Approach Delay (s)	3.1		0.0	11.3
Approach LOS				B

Intersection Summary			
Average Delay	4.5		
Intersection Capacity Utilization	28.4%	ICU Level of Service	A
Analysis Period (min)	15		



Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Sign Control	Stop		Free			Free
Grade	0%		0%			0%
Volume (veh/h)	45	40	31	71	34	10
Peak Hour Factor	0.89	0.89	0.80	0.80	0.65	0.65
Hourly flow rate (vph)	51	45	39	89	52	15
Pedestrians						
Lane Width (ft)						
Walking Speed (ft/s)						
Percent Blockage						
Right turn flare (veh)						
Median type	None					
Median storage veh)						
Upstream signal (ft)						
pX, platoon unblocked						
vC, conflicting volume	203	83			128	
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	203	83			128	
tC, single (s)	6.4	6.2			4.1	
tC, 2 stage (s)						
tF (s)	3.5	3.3			2.2	
p0 queue free %	93	95			96	
cM capacity (veh/h)	757	976			1459	

Direction, Lane #	WB 1	NB 1	SB 1
Volume Total	96	128	68
Volume Left	51	0	52
Volume Right	45	89	0
cSH	847	1700	1459
Volume to Capacity	0.11	0.07	0.04
Queue Length 95th (ft)	9	0	3
Control Delay (s)	9.8	0.0	5.9
Lane LOS	A		A
Approach Delay (s)	9.8	0.0	5.9
Approach LOS	A		

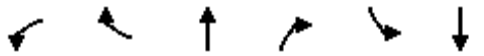
Intersection Summary			
Average Delay	4.6		
Intersection Capacity Utilization	20.7%	ICU Level of Service	A
Analysis Period (min)	15		

Appendix D – Level of Service Worksheets: Future Near-term Conditions (Scenario 2)

Movement	NBL	NBT	SBT	SBR	SEL	SER
Lane Configurations						
Sign Control		Free	Free		Stop	
Grade		0%	0%		0%	
Volume (veh/h)	57	140	159	50	30	140
Peak Hour Factor	0.65	0.65	0.76	0.76	0.70	0.70
Hourly flow rate (vph)	88	215	209	66	43	200
Pedestrians						
Lane Width (ft)						
Walking Speed (ft/s)						
Percent Blockage						
Right turn flare (veh)						
Median type					None	
Median storage veh)						
Upstream signal (ft)						
pX, platoon unblocked						
vC, conflicting volume	275				633	242
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	275				633	242
tC, single (s)	4.1				6.4	6.2
tC, 2 stage (s)						
tF (s)	2.2				3.5	3.3
p0 queue free %	93				90	75
cM capacity (veh/h)	1288				414	797

Direction, Lane #	NB 1	NB 2	SB 1	SE 1
Volume Total	88	215	275	243
Volume Left	88	0	0	43
Volume Right	0	0	66	200
cSH	1288	1700	1700	685
Volume to Capacity	0.07	0.13	0.16	0.35
Queue Length 95th (ft)	5	0	0	40
Control Delay (s)	8.0	0.0	0.0	13.1
Lane LOS	A			B
Approach Delay (s)	2.3		0.0	13.1
Approach LOS				B

Intersection Summary			
Average Delay	4.7		
Intersection Capacity Utilization	35.0%	ICU Level of Service	A
Analysis Period (min)	15		



Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Sign Control	Stop		Free			Free
Grade	0%		0%			0%
Volume (veh/h)	77	29	19	73	55	23
Peak Hour Factor	0.68	0.68	0.69	0.69	0.58	0.58
Hourly flow rate (vph)	113	43	28	106	95	40
Pedestrians						
Lane Width (ft)						
Walking Speed (ft/s)						
Percent Blockage						
Right turn flare (veh)						
Median type	None					
Median storage veh)						
Upstream signal (ft)						
pX, platoon unblocked						
vC, conflicting volume	310	80			133	
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	310	80			133	
tC, single (s)	6.4	6.2			4.1	
tC, 2 stage (s)						
tF (s)	3.5	3.3			2.2	
p0 queue free %	82	96			93	
cM capacity (veh/h)	638	980			1451	

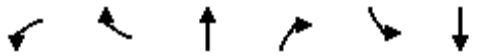
Direction, Lane #	WB 1	NB 1	SB 1
Volume Total	156	133	134
Volume Left	113	0	95
Volume Right	43	106	0
cSH	705	1700	1451
Volume to Capacity	0.22	0.08	0.07
Queue Length 95th (ft)	21	0	5
Control Delay (s)	11.5	0.0	5.5
Lane LOS	B		A
Approach Delay (s)	11.5	0.0	5.5
Approach LOS	B		

Intersection Summary			
Average Delay	6.0		
Intersection Capacity Utilization	23.6%	ICU Level of Service	A
Analysis Period (min)	15		

Movement	NBL	NBT	SBT	SBR	SEL	SER
Lane Configurations						
Sign Control		Free	Free		Stop	
Grade		0%	0%		0%	
Volume (veh/h)	92	136	130	28	36	79
Peak Hour Factor	0.83	0.83	0.89	0.89	0.68	0.68
Hourly flow rate (vph)	111	164	146	31	53	116
Pedestrians						
Lane Width (ft)						
Walking Speed (ft/s)						
Percent Blockage						
Right turn flare (veh)						
Median type					None	
Median storage veh)						
Upstream signal (ft)						
pX, platoon unblocked						
vC, conflicting volume	178				547	162
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	178				547	162
tC, single (s)	4.1				6.4	6.2
tC, 2 stage (s)						
tF (s)	2.2				3.5	3.3
p0 queue free %	92				88	87
cM capacity (veh/h)	1398				458	883

Direction, Lane #	NB 1	NB 2	SB 1	SE 1
Volume Total	111	164	178	169
Volume Left	111	0	0	53
Volume Right	0	0	31	116
cSH	1398	1700	1700	685
Volume to Capacity	0.08	0.10	0.10	0.25
Queue Length 95th (ft)	6	0	0	24
Control Delay (s)	7.8	0.0	0.0	12.0
Lane LOS	A			B
Approach Delay (s)	3.1		0.0	12.0
Approach LOS				B

Intersection Summary			
Average Delay	4.7		
Intersection Capacity Utilization	30.5%	ICU Level of Service	A
Analysis Period (min)	15		



Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Sign Control	Stop		Free			Free
Grade	0%		0%			0%
Volume (veh/h)	50	45	35	79	38	12
Peak Hour Factor	0.89	0.89	0.80	0.80	0.65	0.65
Hourly flow rate (vph)	56	51	44	99	58	18
Pedestrians						
Lane Width (ft)						
Walking Speed (ft/s)						
Percent Blockage						
Right turn flare (veh)						
Median type	None					
Median storage veh)						
Upstream signal (ft)						
pX, platoon unblocked						
vC, conflicting volume	229	93			142	
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	229	93			142	
tC, single (s)	6.4	6.2			4.1	
tC, 2 stage (s)						
tF (s)	3.5	3.3			2.2	
p0 queue free %	92	95			96	
cM capacity (veh/h)	729	964			1440	

Direction, Lane #	WB 1	NB 1	SB 1
Volume Total	107	142	77
Volume Left	56	0	58
Volume Right	51	99	0
cSH	824	1700	1440
Volume to Capacity	0.13	0.08	0.04
Queue Length 95th (ft)	11	0	3
Control Delay (s)	10.0	0.0	5.9
Lane LOS	B		A
Approach Delay (s)	10.0	0.0	5.9
Approach LOS	B		

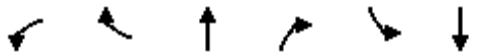
Intersection Summary			
Average Delay	4.7		
Intersection Capacity Utilization	21.6%	ICU Level of Service	A
Analysis Period (min)	15		

Appendix E – Level of Service Worksheets: Future Near-term Plus Project Conditions (Scenario 3)

Movement	NBL	NBT	SBT	SBR	SEL	SER
Lane Configurations						
Sign Control		Free	Free		Stop	
Grade		0%	0%		0%	
Volume (veh/h)	58	140	159	51	32	145
Peak Hour Factor	0.65	0.65	0.76	0.76	0.70	0.70
Hourly flow rate (vph)	89	215	209	67	46	207
Pedestrians						
Lane Width (ft)						
Walking Speed (ft/s)						
Percent Blockage						
Right turn flare (veh)						
Median type					None	
Median storage veh)						
Upstream signal (ft)						
pX, platoon unblocked						
vC, conflicting volume	276				637	243
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	276				637	243
tC, single (s)	4.1				6.4	6.2
tC, 2 stage (s)						
tF (s)	2.2				3.5	3.3
p0 queue free %	93				89	74
cM capacity (veh/h)	1287				411	796

Direction, Lane #	NB 1	NB 2	SB 1	SE 1
Volume Total	89	215	276	253
Volume Left	89	0	0	46
Volume Right	0	0	67	207
cSH	1287	1700	1700	681
Volume to Capacity	0.07	0.13	0.16	0.37
Queue Length 95th (ft)	6	0	0	43
Control Delay (s)	8.0	0.0	0.0	13.4
Lane LOS	A			B
Approach Delay (s)	2.3		0.0	13.4
Approach LOS				B

Intersection Summary			
Average Delay	4.9		
Intersection Capacity Utilization	35.5%	ICU Level of Service	A
Analysis Period (min)	15		



Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Sign Control	Stop		Free			Free
Grade	0%		0%			0%
Volume (veh/h)	81	32	19	74	56	23
Peak Hour Factor	0.68	0.68	0.69	0.69	0.58	0.58
Hourly flow rate (vph)	119	47	28	107	97	40
Pedestrians						
Lane Width (ft)						
Walking Speed (ft/s)						
Percent Blockage						
Right turn flare (veh)						
Median type	None					
Median storage veh)						
Upstream signal (ft)						
pX, platoon unblocked						
vC, conflicting volume	314	81			135	
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	314	81			135	
tC, single (s)	6.4	6.2			4.1	
tC, 2 stage (s)						
tF (s)	3.5	3.3			2.2	
p0 queue free %	81	95			93	
cM capacity (veh/h)	634	979			1450	

Direction, Lane #	WB 1	NB 1	SB 1
Volume Total	166	135	136
Volume Left	119	0	97
Volume Right	47	107	0
cSH	704	1700	1450
Volume to Capacity	0.24	0.08	0.07
Queue Length 95th (ft)	23	0	5
Control Delay (s)	11.7	0.0	5.6
Lane LOS	B		A
Approach Delay (s)	11.7	0.0	5.6
Approach LOS	B		

Intersection Summary			
Average Delay	6.2		
Intersection Capacity Utilization	24.1%	ICU Level of Service	A
Analysis Period (min)	15		

Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations						
Sign Control	Free			Free	Stop	
Grade	0%			0%	0%	
Volume (veh/h)	153	2	2	131	7	7
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	166	2	2	142	8	8
Pedestrians						
Lane Width (ft)						
Walking Speed (ft/s)						
Percent Blockage						
Right turn flare (veh)						
Median type					None	
Median storage veh)						
Upstream signal (ft)						
pX, platoon unblocked						
vC, conflicting volume			168		314	167
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol			168		314	167
tC, single (s)			4.1		6.4	6.2
tC, 2 stage (s)						
tF (s)			2.2		3.5	3.3
p0 queue free %			100		99	99
cM capacity (veh/h)			1409		678	877

Direction, Lane #	EB 1	WB 1	NB 1
Volume Total	168	145	15
Volume Left	0	2	8
Volume Right	2	0	8
cSH	1700	1409	764
Volume to Capacity	0.10	0.00	0.02
Queue Length 95th (ft)	0	0	2
Control Delay (s)	0.0	0.1	9.8
Lane LOS		A	A
Approach Delay (s)	0.0	0.1	9.8
Approach LOS			A

Intersection Summary			
Average Delay	0.5		
Intersection Capacity Utilization	18.5%	ICU Level of Service	A
Analysis Period (min)	15		

Movement	NBL	NBT	SBT	SBR	SEL	SER
Lane Configurations						
Sign Control		Free	Free		Stop	
Grade		0%	0%		0%	
Volume (veh/h)	98	136	130	30	37	83
Peak Hour Factor	0.83	0.83	0.89	0.89	0.68	0.68
Hourly flow rate (vph)	118	164	146	34	54	122
Pedestrians						
Lane Width (ft)						
Walking Speed (ft/s)						
Percent Blockage						
Right turn flare (veh)						
Median type					None	
Median storage veh)						
Upstream signal (ft)						
pX, platoon unblocked						
vC, conflicting volume	180				563	163
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	180				563	163
tC, single (s)	4.1				6.4	6.2
tC, 2 stage (s)						
tF (s)	2.2				3.5	3.3
p0 queue free %	92				88	86
cM capacity (veh/h)	1396				446	882

Direction, Lane #	NB 1	NB 2	SB 1	SE 1
Volume Total	118	164	180	176
Volume Left	118	0	0	54
Volume Right	0	0	34	122
cSH	1396	1700	1700	678
Volume to Capacity	0.08	0.10	0.11	0.26
Queue Length 95th (ft)	7	0	0	26
Control Delay (s)	7.8	0.0	0.0	12.2
Lane LOS	A			B
Approach Delay (s)	3.3		0.0	12.2
Approach LOS				B

Intersection Summary			
Average Delay	4.8		
Intersection Capacity Utilization	31.3%	ICU Level of Service	A
Analysis Period (min)	15		

Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Sign Control	Stop		Free			Free
Grade	0%		0%			0%
Volume (veh/h)	53	46	35	84	41	12
Peak Hour Factor	0.89	0.89	0.80	0.80	0.65	0.65
Hourly flow rate (vph)	60	52	44	105	63	18
Pedestrians						
Lane Width (ft)						
Walking Speed (ft/s)						
Percent Blockage						
Right turn flare (veh)						
Median type	None					
Median storage veh)						
Upstream signal (ft)						
pX, platoon unblocked						
vC, conflicting volume	241	96			149	
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	241	96			149	
tC, single (s)	6.4	6.2			4.1	
tC, 2 stage (s)						
tF (s)	3.5	3.3			2.2	
p0 queue free %	92	95			96	
cM capacity (veh/h)	715	960			1433	

Direction, Lane #	WB 1	NB 1	SB 1
Volume Total	111	149	82
Volume Left	60	0	63
Volume Right	52	105	0
cSH	811	1700	1433
Volume to Capacity	0.14	0.09	0.04
Queue Length 95th (ft)	12	0	3
Control Delay (s)	10.1	0.0	6.0
Lane LOS	B		A
Approach Delay (s)	10.1	0.0	6.0
Approach LOS	B		

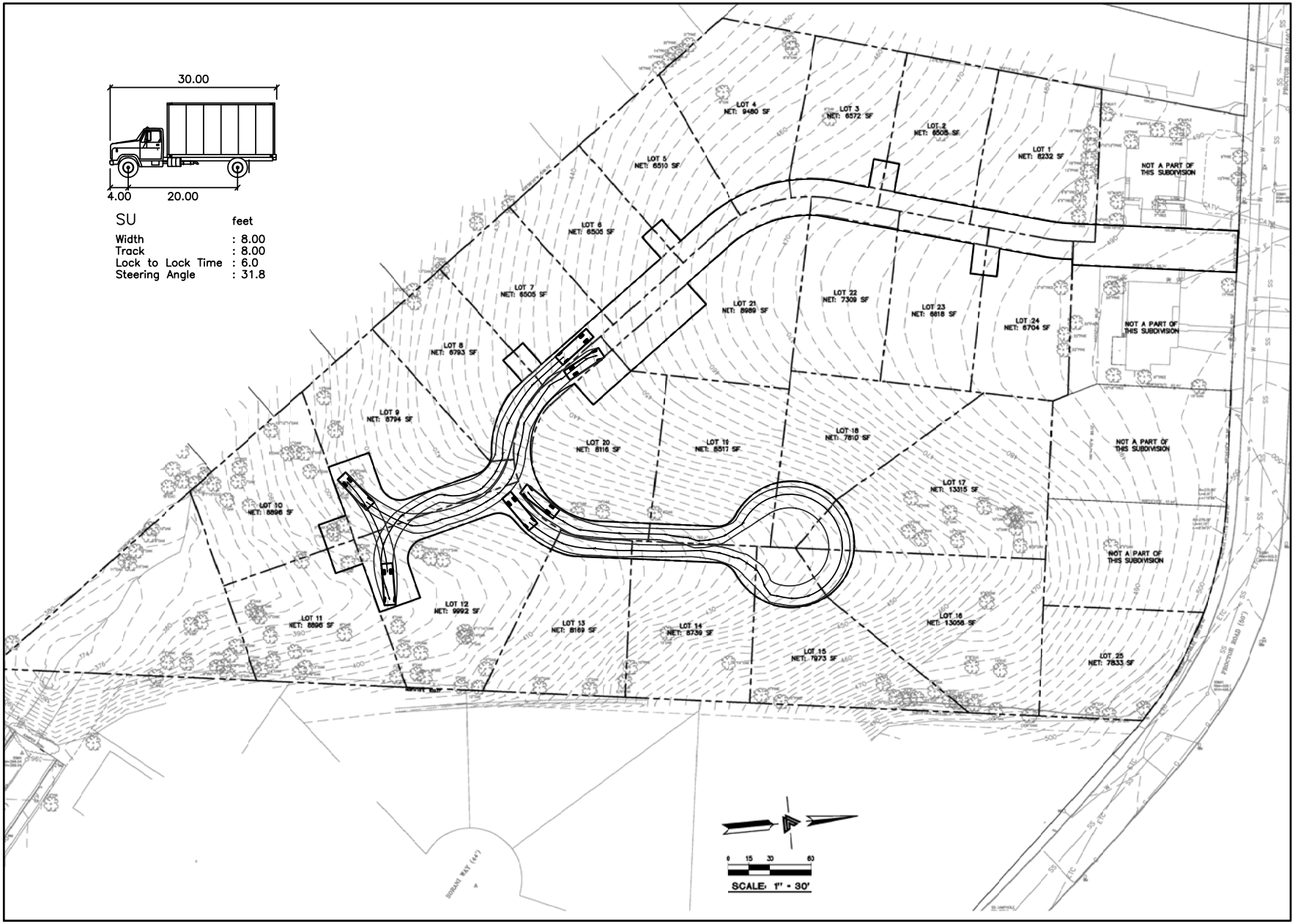
Intersection Summary			
Average Delay	4.7		
Intersection Capacity Utilization	22.0%	ICU Level of Service	A
Analysis Period (min)	15		

Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations						
Sign Control	Free			Free	Stop	
Grade	0%			0%	0%	
Volume (veh/h)	122	8	8	136	4	5
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	133	9	9	148	4	5
Pedestrians						
Lane Width (ft)						
Walking Speed (ft/s)						
Percent Blockage						
Right turn flare (veh)						
Median type					None	
Median storage veh)						
Upstream signal (ft)						
pX, platoon unblocked						
vC, conflicting volume			141		302	137
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol			141		302	137
tC, single (s)			4.1		6.4	6.2
tC, 2 stage (s)						
tF (s)			2.2		3.5	3.3
p0 queue free %			99		99	99
cM capacity (veh/h)			1442		685	912

Direction, Lane #	EB 1	WB 1	NB 1
Volume Total	141	157	10
Volume Left	0	9	4
Volume Right	9	0	5
cSH	1700	1442	795
Volume to Capacity	0.08	0.01	0.01
Queue Length 95th (ft)	0	0	1
Control Delay (s)	0.0	0.5	9.6
Lane LOS		A	A
Approach Delay (s)	0.0	0.5	9.6
Approach LOS			A

Intersection Summary			
Average Delay	0.5		
Intersection Capacity Utilization	23.7%	ICU Level of Service	A
Analysis Period (min)	15		

Appendix F – On-Site Circulation: AutoTURN Figures



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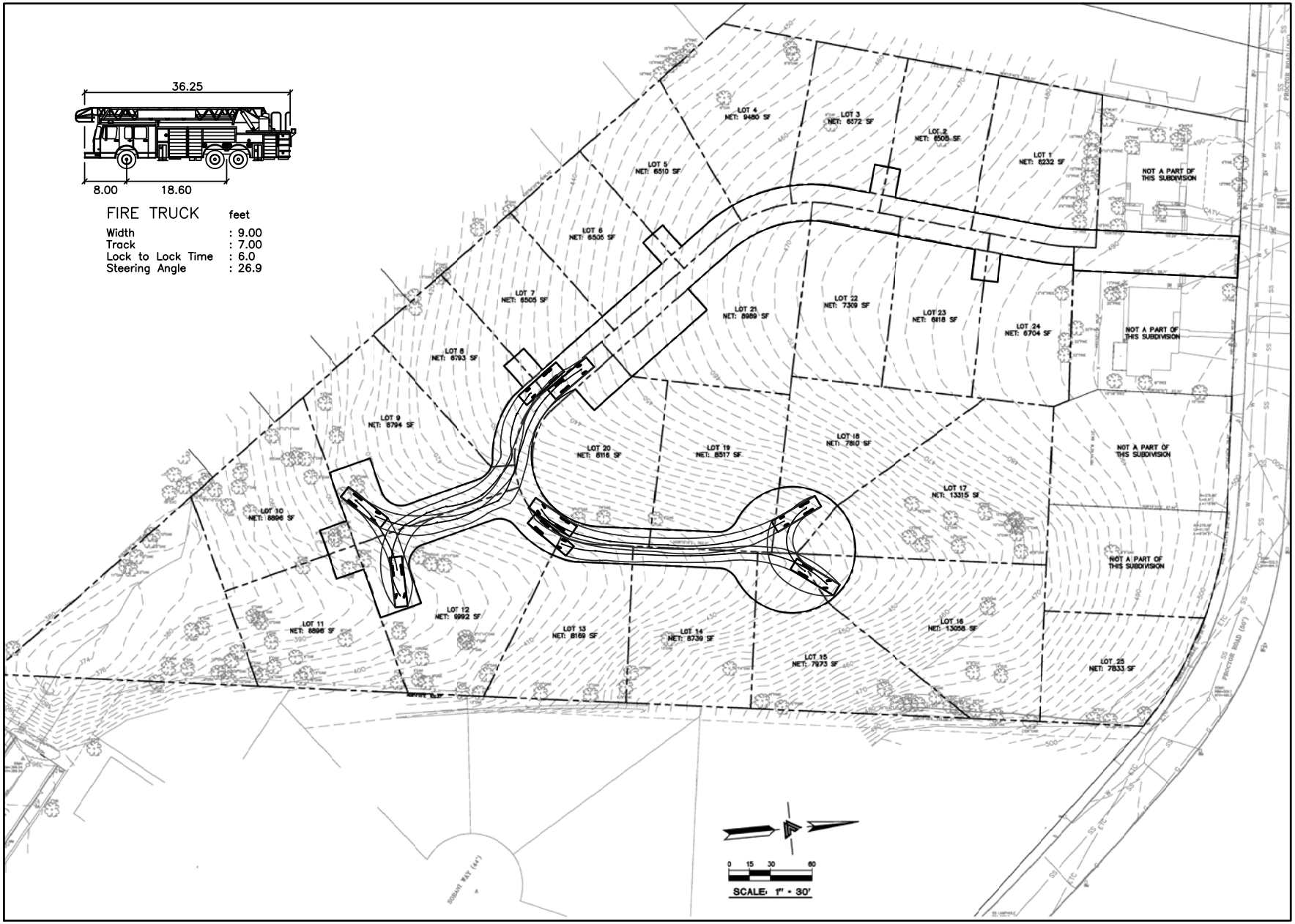

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