Appendix C: Traffic Study

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KEA‘AU-PĀHOA ROAD IMPROVEMENTS
KEA‘AU TO PĀHOA
Project No. STP-0130(27)

TECHNICAL REPORT
Analysis of Preferred Alternative
For Kea‘au-Pāhoa Road
January 2011

Prepared for:

Department of Transportation
State of Hawai‘i

Prepared by:

SSFM INTERNATIONAL, Inc.,
with:
Roger Dyar, P.E.

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- That the project, study or investigation meets the Client's objectives.
- That the requirements of our Agreement with the Client have been met, and the Client has received the value of the fee to be paid.

The Preparation of This Report Was The Responsibility of and Completed By:

Heather Fourth — signature

2/1/11 — date

The Quality Review of This Report Was The Responsibility of and Completed By:

Roger D. Dyar — signature

2/1/11 — date

INTRODUCTION

The State of Hawai‘i, Department of Transportation (HDOT) is proposing the Kea‘au-Pāhoa Road Improvements Project, Project No. STP-0130(27). The project proposes to implement various improvements along approximately 9.5 miles of Kea‘au-Pāhoa Road (State Route 130), from the terminus of the existing four-lane Kea‘au Bypass to its intersection with Pāhoa-Kapoho Road. Kea‘au-Pāhoa Road is the only roadway that connects the study area with the Hilo area and is the primary conduit for emergency services to access local properties.

The project purpose is to improve highway safety, increase roadway capacity, and modernize Kea‘au-Pāhoa Road between Kea‘au and Pāhoa. Currently, the Kea‘au-Pāhoa Road is heavily congested during its peak hours of operation. Only about one fourth of the land in the study area is now developed, but it is expected that over the next 20 to 30 years, the population will double, exacerbating an already-congested situation if improvements are not made. Safety for both motorists and non-motorists is a paramount concern, as the roadway serves motor vehicles, the County of Hawaii's Hele-On bus routes, bicyclists, and pedestrians. Vehicle conflict points, at the intersections and numerous driveways along Kea‘au-Pāhoa Road, contribute to an accident rate much higher than the statewide average.

This report provides an analysis of the preferred alternative for Kea‘au-Pāhoa Road between Kea‘au and Pāhoa. This technical assessment was prepared by Roger Dyar, P.E. for SSFM International, Inc. in support of the Environmental Assessment (EA) for the project. Quality Control was completed by Heather Forester of SSFM International, Inc.

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CHAPTER 1: THE CORRIDOR

1.1 Corridor Description

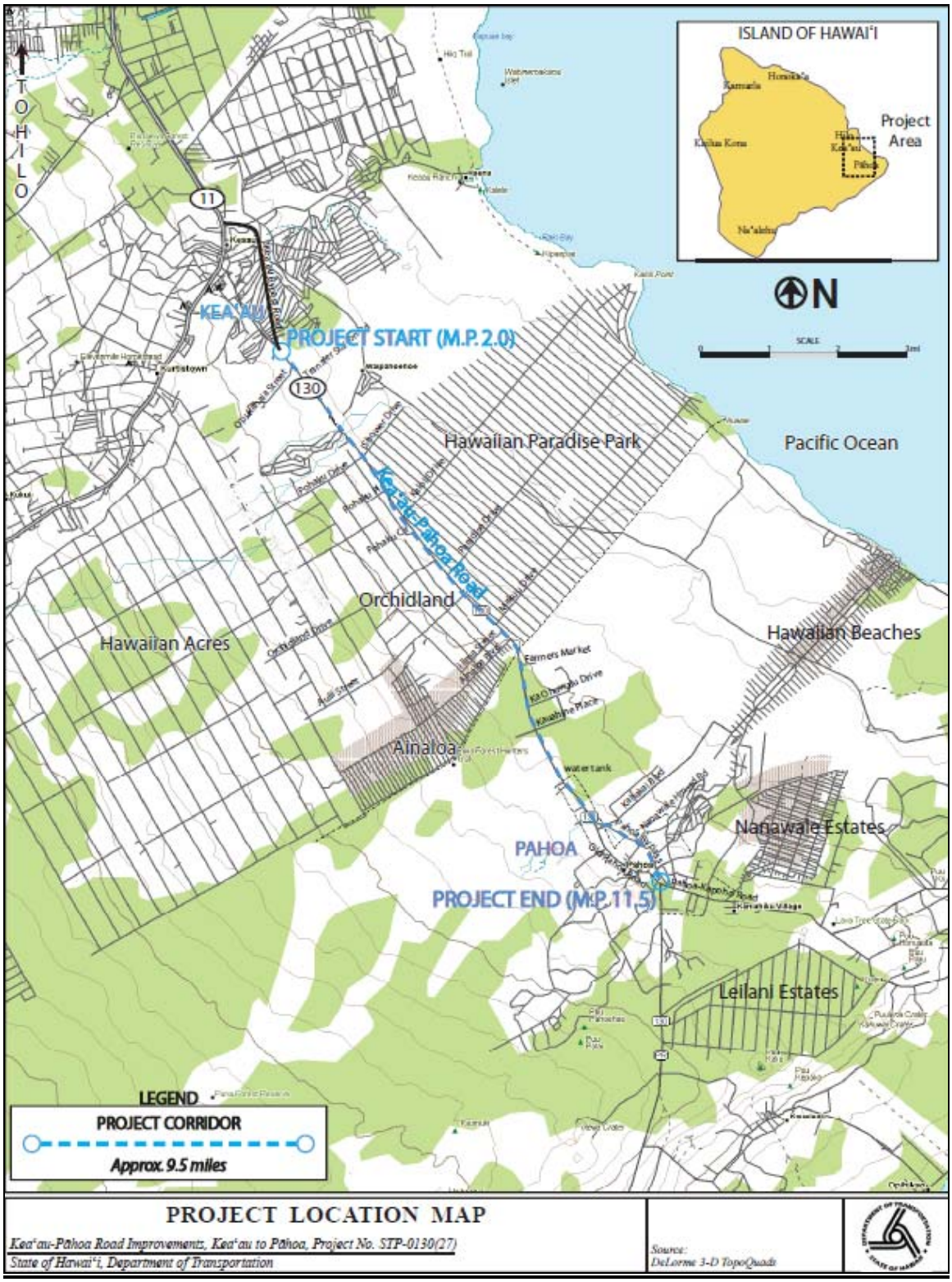
While Kea‘au-Pāhoa Road generally extends from the northwest to the southeast, for this traffic study, the primary directions along Kea‘au-Pāhoa Road will be listed as eastbound (towards Pāhoa) and westbound (towards Kea‘au) for consistency with earlier studies. The side streets will be referred to as running northbound (makai) or southbound (mauka).

The study corridor extends from milepost 2 at Kea‘au Bypass Road on the west to milepost 11.5 at Pāhoa-Kapoho Road (State Route 132) on the east, for a total distance of approximately 9.5 miles, as seen in Figure 1-1. The area slated for possible road improvements generally extends from the Kea‘au community at Opukahaia Street on the west end to Pāhoa-Kapoho Road on the east end in the community of Pāhoa.

Detailed traffic studies prepared earlier during the planning phase include intersection analysis and segmental levels of service by the SSFM International, Inc. Team and are available. These reports include the following:

- Forecast Report for Kea‘au-Pāhoa Road, by Wilbur Smith Associates, October 2008
- Forecast Methodology Report, by Wilbur Smith Associates, October 2008
- Turning Movement Report, by Wilbur Smith Associates, October 2008
- Kea‘au-Pāhoa Road Summary of Travel Time Study Results, by Roger D. Dyar, P.E., May 7, 2007
- Level of Service Study for Kea‘au-Pāhoa Road, by Roger D. Dyar, P.E., December 2, 2008
- Level of Service Study for Kea‘au-Pāhoa Road Widening Alternatives, by Roger D. Dyar, P.E., February 8, 2009
- A Study of Predicted Traffic Operations for Kea‘au-Pāhoa Road, by Roger D. Dyar, P.E., March 21, 2009
- TECHNICAL REPORT: Traffic Analysis for Kea‘au-Pāhoa Road, by Roger D. Dyar, P.E., January 2010

Figure 1-1: Kea'au-Pāhoa Road Study Corridor



1.2 Corridor Volumes

The traffic volumes for the existing year of data collection (2006) and the predicted future years are provided in Figures 1-2 through 1-6 which follow. The figures provide predicted A.M. and P.M. peak hour volumes for the years 2006, 2018, 2028 and 2038. The primary year used for analysis is the year 2038. Data is provided for the year 2028 as information.

1.3 Design Year and Design Speed

The design year is considered to be the year 2038 using both the A.M. and P.M. peak hours for determination of the need for left and right turns from Kea‘au-Pāhoa Road to the side streets. A second design year of 2018 was used for analysis of the Transportation Systems Management (TSM) Alternative, using volumes for the year 2018, to show the short term effects realized by the changes made in the alternative.

The design speed used is 60 mph (posted at 55 mph) for segments where the ultimate roadway cross-section will include two or more through lanes in each direction. A separate memorandum was prepared and used as the basis for establishment of the design speed.

Figure 1-2: Existing Year (2006) Peak Hour Traffic Volumes on Kea'au-Pāhoa Road

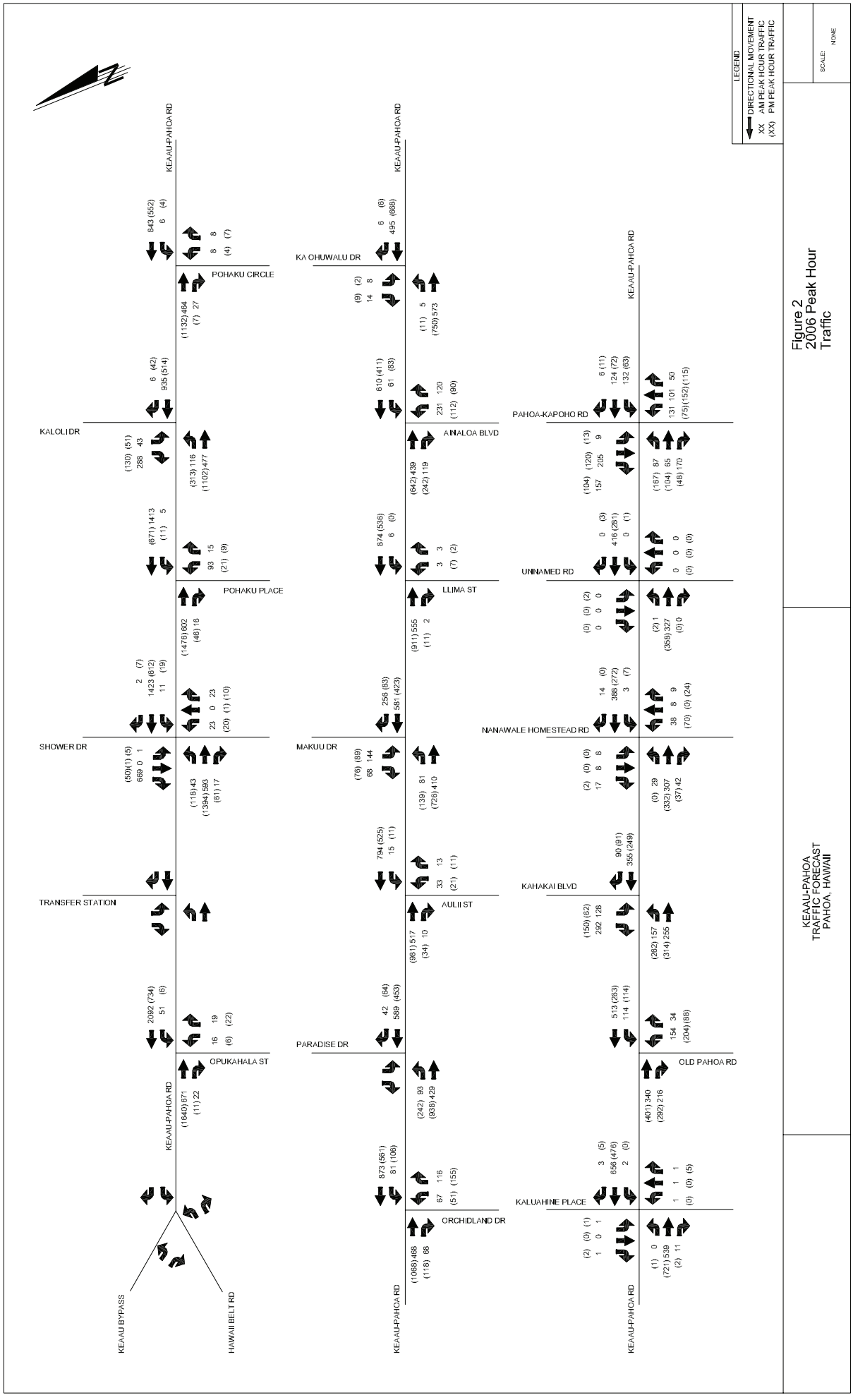


Figure 1-3: Future Year 2018 Peak Hour Traffic Volumes on Kea'au-Pāhoa Road

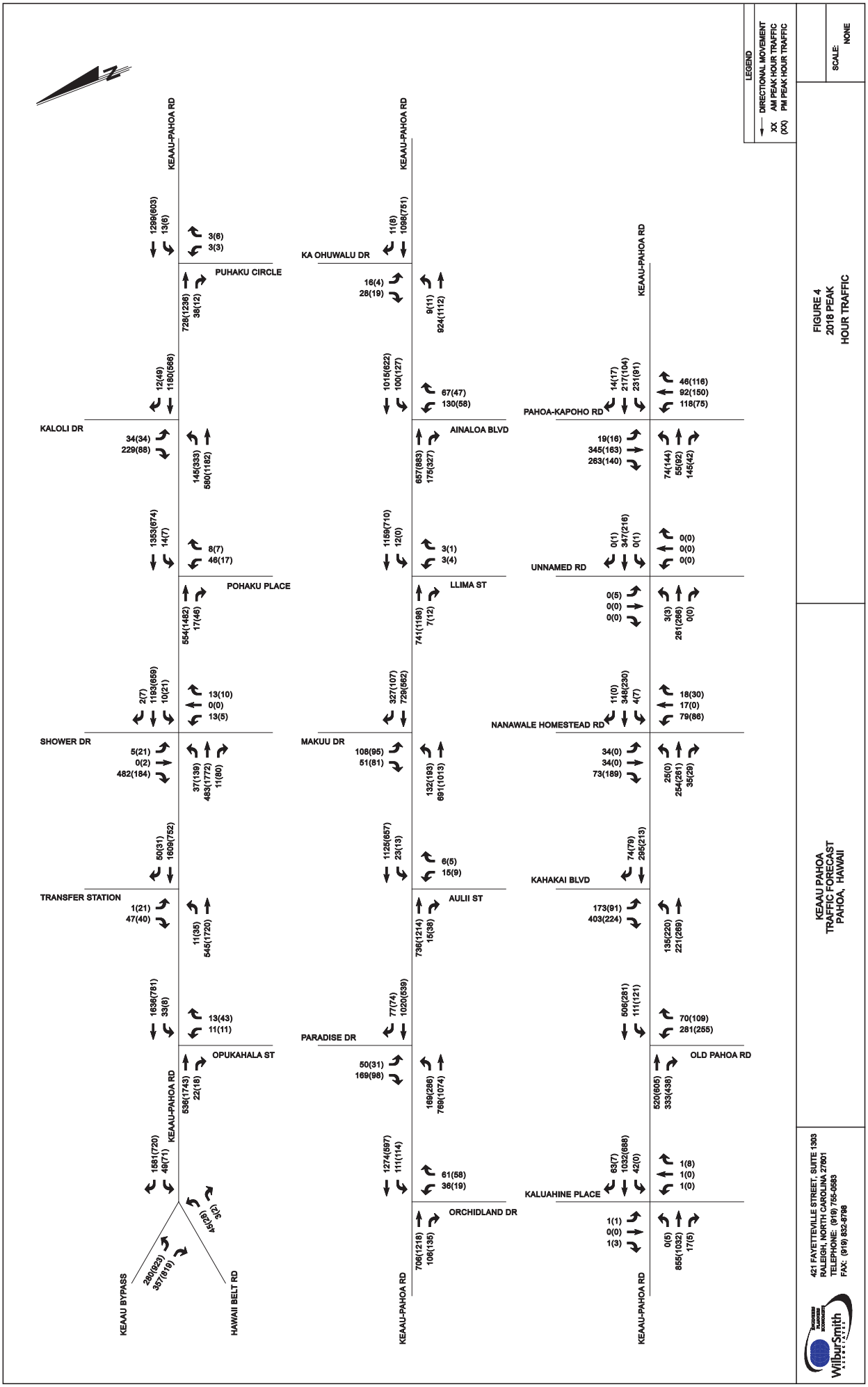


Figure 1-4: Future Year 2028 Peak Hour Traffic Volumes on Kea'au-Pāhoa Road

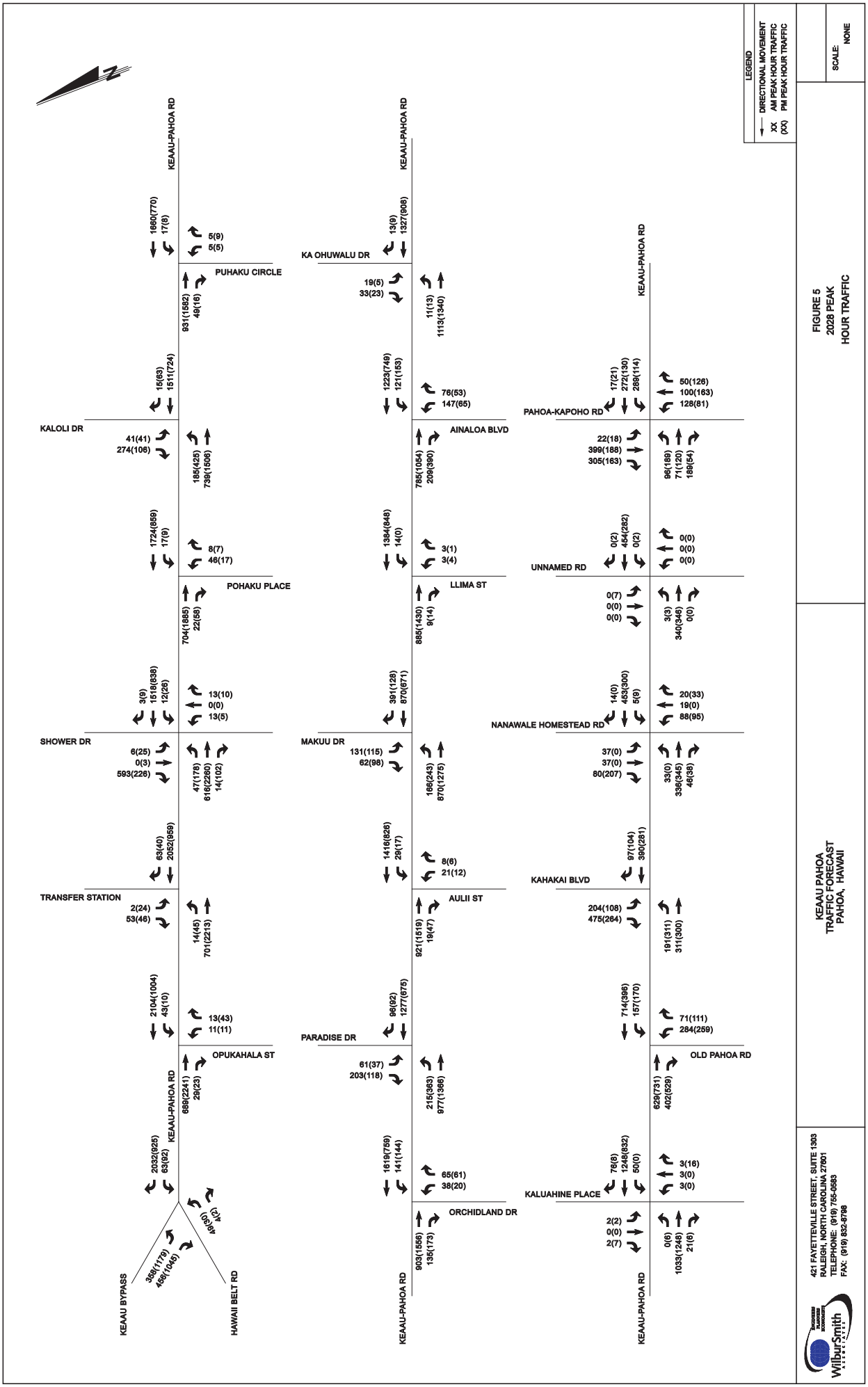


Figure 1-5: Future Year 2038 Peak Hour Traffic Volumes on Kea'au-Pāhoa Road

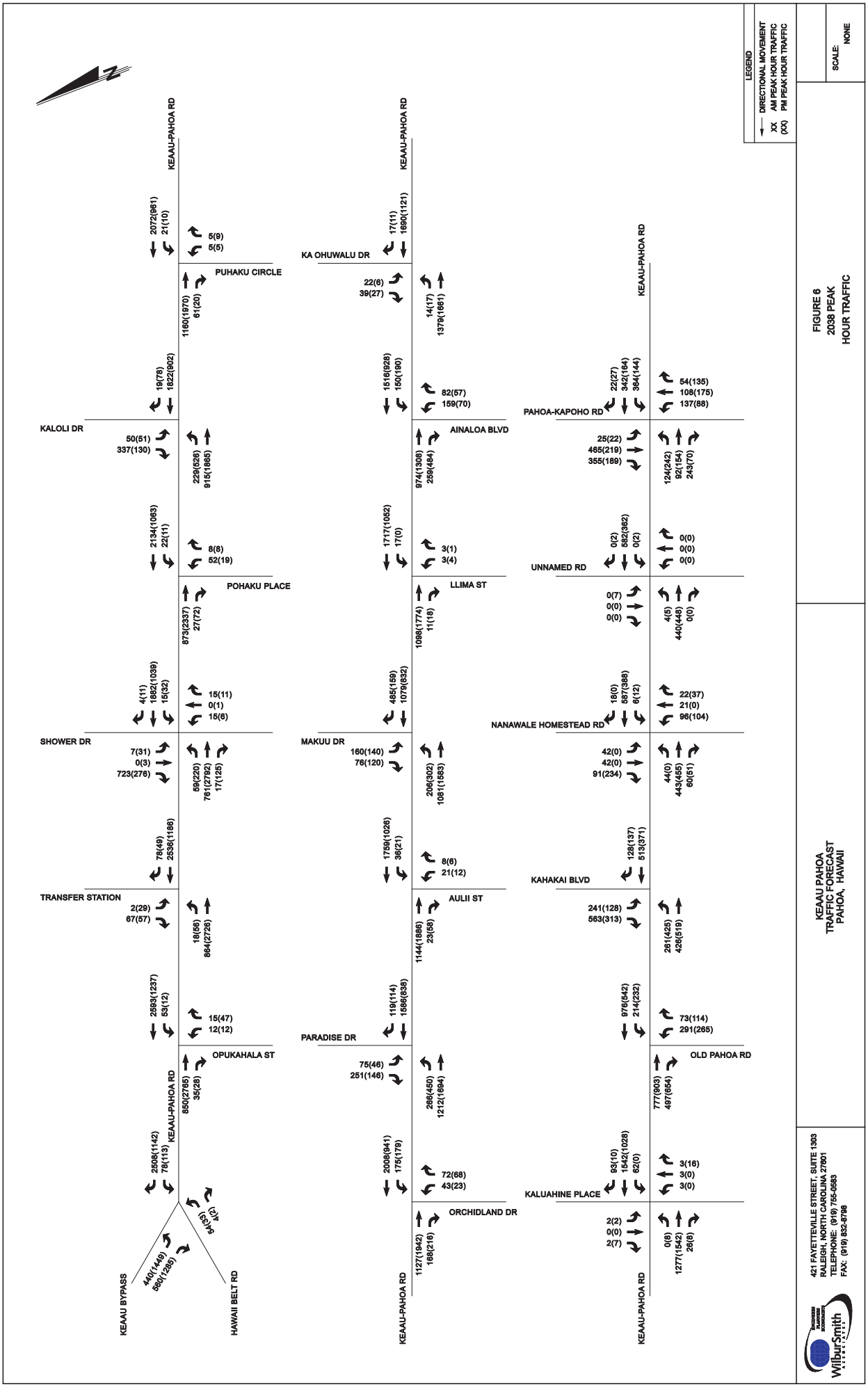
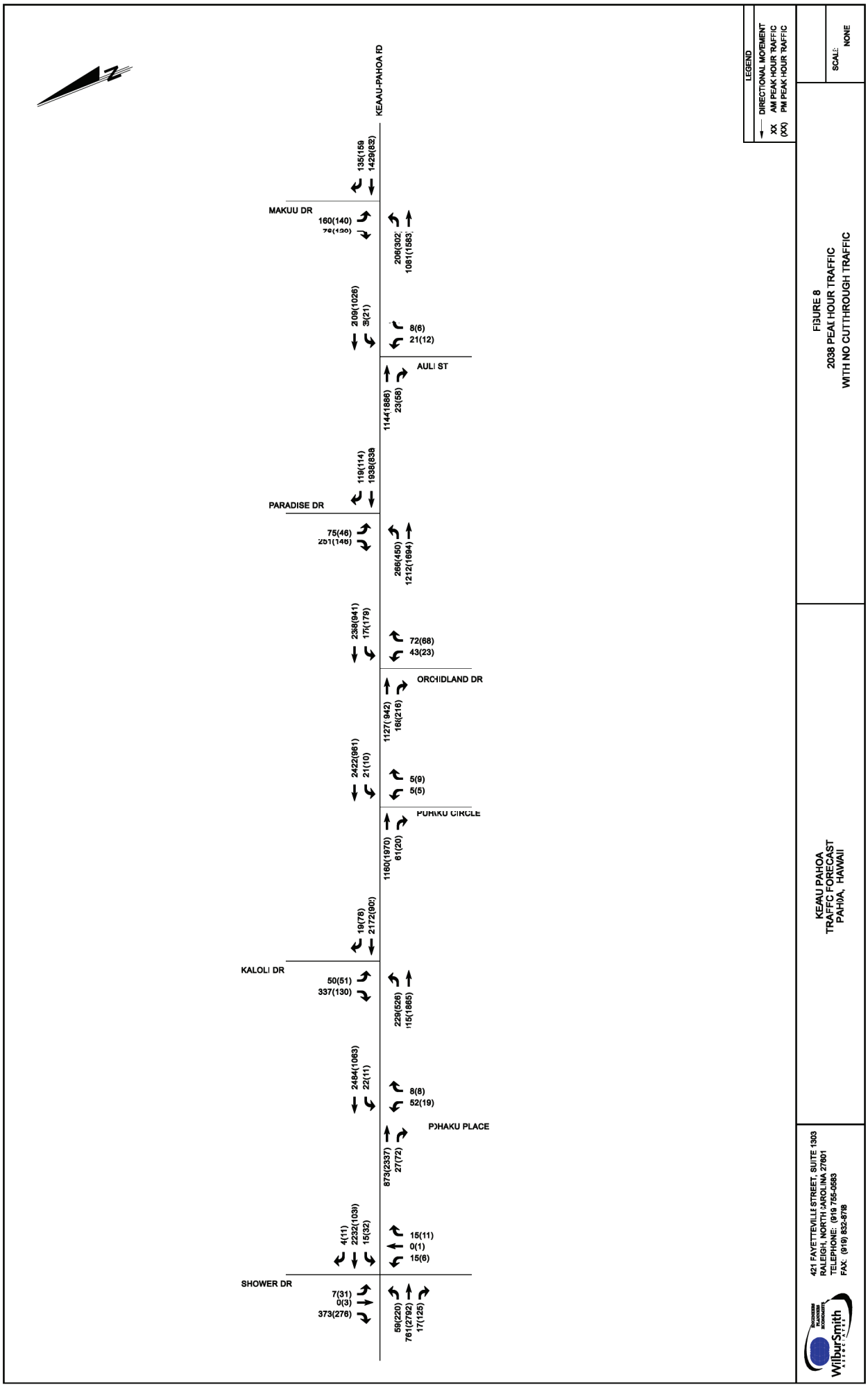


Figure 1-6: Future Year 2038 Peak Hour Traffic Volumes on Kea'au-Pāhoa Road with no Cut-through Traffic



1.4 Roadway Network for Preferred Alternative

The Preferred Alternative is a modification of Alternative 4. The Preferred Alternative will widen the highway so as to provide two through lanes in each direction (four lanes total) through the entire corridor, plus provide additional turning lanes where appropriate. In addition, access control measures will be applied, generally as described in Chapter 7 of TECHNICAL REPORT: Traffic Analysis for Kea'au-Pāhoa Road (January 2010).

The following Figure 1-7 shows the roadway network under for the Preferred Alternative. As seen in Figure 1-7, there would be two through lanes in each direction on Kea'au-Pāhoa Road. Roundabouts would be provided at Ainaloa Boulevard, Old Pāhoa Road and Kahakai Boulevard.

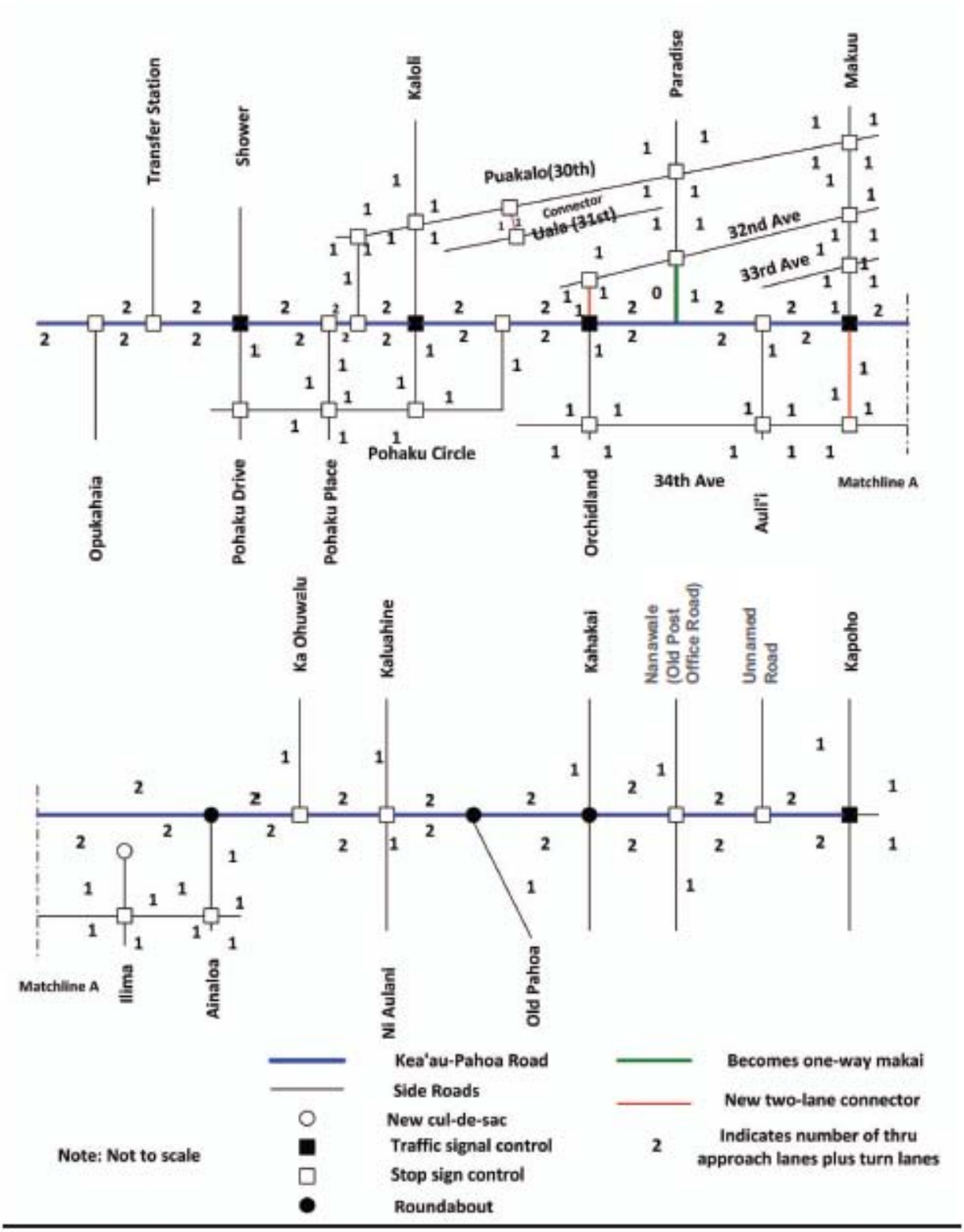
A new street segment would be provided at the Orchidland Drive intersection to connect to 32nd Avenue. This would make the intersection a four-way intersection and the new connection would provide for an alternate route for travel. The segment of Paradise Drive between Kea'au-Pāhoa Road and 32nd Avenue would be revised to allow only for one-way traffic away from Kea'au-Pāhoa Road towards 32nd Avenue.

A new street segment would be constructed opposite the approach of Maku'u Drive, making that intersection a four-way intersection. This provides for another means of circulation in the area. The intersection at Ilima Street would be closed, removing an access point and eliminating several points of traffic conflict at that location. There would be improvements made to 34th Avenue to accommodate the additional traffic that would use the street to circulate in the area and gain better connections to Kea'au-Pāhoa Road.

Traffic signals would be in place at Shower Drive, Kaloli Drive, Orchidland Drive, Maku'u Drive and Pāhoa-Kapoho Road.

A new connector would be built from 30th to 31st Avenue to allow for usage of the new connections to Kea'au-Pāhoa Road. There would be other numerous geometric improvements including addition of mainline auxiliary turning lanes for traffic leaving Kea'au-Pāhoa Road, as well as lengthening some of the existing auxiliary lanes.

Figure 1-7: Kea'au-Pāhoa Roadway Network for Preferred Alternative Year 2038



1.5 Detailed Description of Preferred Alternative

1.5.1 Description of Preferred Alternative - Full Widening to Four Lanes with Access Management Techniques Applied

The Preferred Alternative proposes full corridor widening to have two travel lanes in each direction from Opukahaia Street to the eastern terminus of the project at Pāhoa-Kapoho Road and adds intersection realignments and new connecting streets to implement access management and many of the features of Transportation Systems Management (TSM).

Some of the treatments described in the TSM Alternative will be combined with this alternative. Refer to Section "1.6.2 Description of Alternative 2 – Transportation System Management (TSM) Alternative" of TECHNICAL REPORT: Traffic Analysis for Kea'au-Pāhoa Road (January 2010) for a more detailed description. The following items are included in the Preferred Alternative:

- Access control measures including right-in/right-out and cul-de-sacs.

- Realignment of intersection approaches or addition of new access roadways, as seen in Figure 1-7, where necessary.

- Locations, storage lengths, and numbers of turn lanes on Kea'au-Pāhoa Road: A review of existing turn lanes and tapers and a review to see if there was a need to lengthen lanes and tapers were made. This analysis includes the traffic operations aspect as well as the safety aspect. Establishment of the turn lane lengths is based on future 2038 volumes and speeds and taper lengths are based on design speed and criteria of the American Association of State Highway and Transportation Officials (AASHTO) and the Hawai'i Department of Transportation (HDOT). In some cases, multiple turn lanes may be needed on the mainline of Kea'au-Pāhoa Road. This of course will have to be considered in conjunction with the installation of traffic signals and/or roundabouts.

- Locations, storage lengths, and numbers of turn lanes on cross streets: Analysis of the needs for storage lanes for side street approaches includes an assessment of the need for lanes and the length. This is both a traffic flow and a traffic safety determination.

- Locations of right turn taper areas: A review of right turn taper areas both for the mainline and for side streets was made. In some cases there can be operational and safety benefits from the use of right turn tapers on side streets, in lieu of construction of a full width turning lane. This option was reviewed in order to minimize roadway construction. Generally, tapers on the mainline of Kea'au-Pāhoa Road were determined by reviewing the design speed.

- Traffic control including signals and stop signs: The determination of the need for installation of stop signs, traffic signals and other traffic control devices were made by reviewing future design-year traffic volumes and applying criteria of the Manual on Uniform Traffic Control Devices (MUTCD). In the case of traffic signal warrant studies, the process used was an abbreviated one, since there are only two hours of traffic data available for the corridor for all future design years. The review to see if additional traffic control is needed, other than existing stop-sign control, concentrates on the future peak hour design volumes and Warrant 1 of the signal warrants from the MUTCD. This analysis was covered in the report "A Study of Predicted Traffic Operations for Kea'au-Pāhoa Road," by Roger D. Dyar, P.E., March 21, 2009.

- Use of roundabouts

- Bus pullouts

Table 1-1 shows the current anticipated design parameters for the side streets and for the anticipated traffic control for the Preferred Alternative.

Table 1-1: Intersection Side Street Design Parameters and Traffic Control for Kea'au-Pāhoa Road for Preferred Alternative

Intersection of Kea'au-Pāhoa Road at	Traffic Control		Side Street Approaches			
			Northbound (makai)		Southbound (mauka)	
	Exist.	**Pref Alt.**	*Exist.*	**Pref Alt.**	*Exist.*	**Pref Alt.**
Opukahaia St.	*Stop sign*	**Stop sign**	*LR*	**L/R**		
Transfer Station	*Stop sign*	**Stop sign**			*LR*	**LR**
Shower Drive	*Stop sign*	**Signal**	*LTR*	**LTR**	*LTR*	**LT/R**
Pohaku Place	*Stop sign*	**Stop sign**	*LR*	**R**		
Kaloli Drive	*Stop sign*	**Signal**		**LT/R**	*LR*	**L/R**
Pohaku Circle	*Stop sign*	**Stop sign**	*LR*	**R**		
Orchidland Dr.	*Stop sign*	**Signal**	*LR*	**LT/R**		**LT/R**
Paradise Drive	*Stop sign*	**None**			*LR*	**None. Make one-way northbound**
Auli'i Street	*Stop sign*	**Stop sign**	*LR*	**R**		
Maku'u Drive	*Stop sign*	**Signal**		**LT/R**	*LR*	**LT/R**
Ilima Street	*Stop sign*	**None**	*LR*	**None - Closed**		
Ainaloa Blvd.	*Stop sign*	**Roundabout**	*LR*	**L/R**		
Ka Ohuwalu Dr	*Stop sign*	**Stop sign**			*LR*	**L/R**
Kaluahine St.	*Stop sign*	**Stop sign**	*LTR*	**LTR**	*LTR*	**LTR**
Old Pāhoa Rd.	*Stop sign*	**Roundabout**	*LR*	**L/R**		
Kahakai Blvd.	*Stop sign*	**Roundabout**		**LT/R**	*LR*	**LT/R**
Nanawale (Post Office Road)	*Stop sign*	**Stop sign**	*LTR*	**LT/R**	*LTR*	**LT/R**
Unnamed Road	*Stop sign*	**Stop sign**			*LR*	**LR**
Kapoho Rd.	*Signal*	**Signal**	*L/TR*	**L/TR**	*L/TR*	**L/T/R**

Note: LTR indicates left, through and right turns all in a single lane. L/TR indicates a left turn lane and a second lane for through and right turns. LT/R indicates a lane for left turns and through traffic and a second lane for right turns. L/T/R indicates separate lanes for each movement.

Table 1-2 shows design criteria for the eastbound or Pāhoa-bound direction on Kea'au-Pāhoa Road for the Preferred Alternative. Turn lane lengths will be discussed and determined in the chapters which follow.

Table 1-2: Design Criteria for the Eastbound or Pāhoa-Bound Direction on Kea'au-Pāhoa Road for the Preferred Alternative

Intersection of Kea'au-Pāhoa Road at	Eastbound Lanes to Pāhoa								
	Through Lanes		Left Turn		Right Turn from Kea'au-Pāhoa		Right turn accel. onto Kea'au-Pāhoa		Proposed Bus Pullout
	Existing	**Pref. Alt**	*Existing*	**Pref. Alt**	*Existing*	**Pref. Alt**	*Existing*	**Pref. Alt**	
			w/o taper (ft.)		**w/o taper (ft.)**		**w/o taper (ft.)**		
Opukahaia St.	1	**2**			*none*	**none**	*none*	**none**	No
Transfer Station	1	**2**	*50*	**50**					No
Shower Drive	1	**2**	*465*	**465**	*none*	**250**	*none*	**none**	Yes
Pohaku Place	1	**2**			*none*	**none**	*none*	**none**	Yes
Kaloli Drive	1	**2**	*475*	**475**					Yes
Pohaku Circle	1	**2**			*none*	**250**			Yes
Orchidland Dr.	1	**2**			*410*	**410**	*none*	**none**	Yes
Paradise Drive	1	**2**	*522*	**522**	*none*	**none**	*none*	**none**	Yes
Auli'i Street	1	**2**			*385*	**385**	*none*	**none**	Yes
Maku'u Drive	1	**2**	*415*	**415**					Yes
Ilima Street	1	**2**			*none*	**none**	*none*	**none**	No
Ainaloa Blvd.	1	**2**			*365*	**400**	*none*	**none**	Yes
Ka Ohuwalu	1	**2**	*400*	**400**					Yes
Kaluahine St.	1	**2**	*140*	**400**	*95*	**95**	*none*	**none**	Yes
Old Pāhoa Rd.	1	**2**			*365*	**365**	*336*	**336**	No
Kahakai Blvd.	1	**2**	*285*	**425**					Yes
Nanawale (Post Office Road)	1	**2**	*none*	**200**	*none*	**none**	*none*	**none**	Yes
Unnamed Rd.	1	**2**	*none*	**150**	*none*	**none**	*none*	**none**	Yes
Pāhoa-Kapoho Road	1	**2**	*225*	**225**	*200*	**200**	*none*	**none**	Yes

Table 1-3 shows design criteria for the westbound or Kea'au-bound direction on Kea'au-Pāhoa Road for the Preferred Alternative. Turn lane lengths will be discussed and determined in the chapters which follow.

Table 1-3: Design Criteria for the Westbound or Kea'au-Bound Direction on Kea'au-Pāhoa Road for Preferred Alternative

Intersection of Kea'au-Pāhoa Road at	Westbound Lanes to Kea'au								
	Through Lanes		Left Turn		Right turn from Kea'au-Pāhoa		Right turn accel onto Kea'au-Pāhoa		Proposed
	Existing	**Pref Alt**	*Existing*	**Pref Alt**	*Existing*	**Pref Alt**	*Existing*	**Pref Alt**	Bus Pull-out
			w/o taper (ft.)		**w/o taper (ft.)**		**w/o taper (ft.)**		
Opukahaia St.	1	2	*50*	**50**					No
Transfer Station	1	2	*none*	**none**	*none*	**none**	*none*	**none**	No
Shower Drive	1	2	*400*	**400**	*none*	**none**	*none*	**1000**	Yes
Pohaku Place	1	2	*135*	**135**					Yes
Kaloli Drive	1	2			*none*	**none**	*none*	**510**	Yes
Pohaku Circle	1	2	*400*	**400**					Yes
Orchidland Dr.	1	2	*522*	**522**					Yes
Paradise Drive	1	2			*405*	**405**	*none*	**445**	Yes
Auli'i Street	1	2	*385*	**385**			*none*	**none**	Yes
Maku'u Drive	1	2			*370*	**370**	*none*	**620**	Yes
Ilima Street	1	2	*none*						No
Ainaloa Blvd.	1	2	*425*	**425**					Yes
Ka Ohuwalu	1	2			*Taper*	**Taper**	*none*	**none**	Yes
Kaluahine St.	1	2	*95*	**95**	*none*	**250**	*none*	**none**	Yes
Old Pāhoa Rd.	1	2	*150*						No
Kahakai Blvd.	1	2			*400*	**400**	*none*	**430**	Yes
Nanawale (Post Office Road)	1	2	*none*	**200**	*none*	**none**	*none*	**none**	Yes
Unnamed Rd.	1	2	*none*	**150**	*none*	**none**	*none*	**none**	Yes
Kapoho Rd.	1	1	*150*	**150**	*150*	**150**	*215*	**400**	Yes

Note: Taper indicates that there is no turn lane in place but that a taper is provided from the through lane connecting to the radius for right turns into the side street at the intersection. No storage is provided with this taper.

1.6 Analysis Methodology

1.6.1 Methods of LOS Analysis for Mainline Segments between Intersections

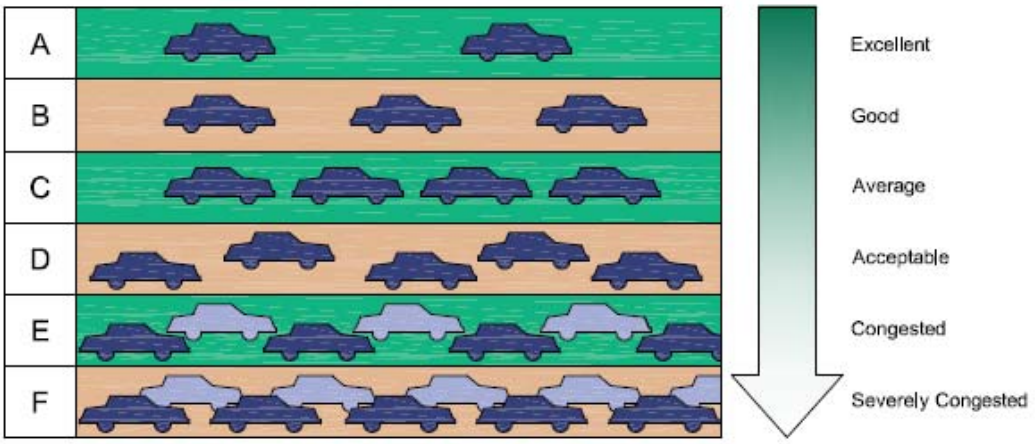
The only existing traffic signals on this corridor are at each of the termini on the east and west ends. Given its design and current functionality, the corridor operates more like an uninterrupted highway than it does as a typical suburban arterial. This is because of the limited amount of traffic control for the mainline and the presence of left turn lanes which generally allow higher travel speeds. This is demonstrated in the speed survey data which was gathered and analyzed in previous reports referenced earlier. In the future, the corridor will likely have several traffic signals and/or roundabouts. The spacing of these traffic control devices will be approximately one mile. Therefore, the corridor can be considered more like an uninterrupted highway than a suburban arterial and the analysis of its traffic operations will be made with this assumption.

The performance of traffic operations is reflected by the term Level of Service (LOS). LOS describes traffic operations on roadway segments and at intersections. The LOS represents the degree of traffic congestion, with a rating of A (best) to F (worst). For example, a LOS of A represents no traffic congestion and free flowing travel conditions. A LOS of F corresponds to extreme congestion, long delays, and forced flow conditions. For the Peak Hour conditions, LOS D is considered acceptable performance and LOS C is considered desirable. LOS E and LOS F are typically considered unacceptable. See Figure 1-8 on the following page for an illustration of LOS criteria for multi-lane highways.

Figure 1-8: Level of Service for Lanes

One-Way One-Lane Directional Volumes and Level of Service for Uninterrupted Highways

LOS	Capacity One-Way One Lane	V/C Ratio	Adjusted Capacity No Left Turn Lane	V/C Ratio
A	120	≤0.09	96	≤0.09
B	420	≤0.30	336	≤0.30
C	790	≤0.56	632	≤0.56
D	1120	≤0.79	896	≤0.79
E	1410	≤1.00	1128	≤1.00
F	1410	>1.00	1128	>1.00



Level of Service (LOS) for lanes, no adjustments

Kea'au-Pāhoa Road Improvements, Kea'au to Pāhoa, Project No. STP-0130(27)
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1.6.2 Criteria for LOS

LOS for two-lane highways is determined by the speeds that prevail as compared to the free-flow speed of the facility. A procedure developed by the Florida DOT was used to assess the LOS. The Florida DOT procedure is based on materials in the Highway Capacity Manual (HCM) and extensive research in the State of Florida. This procedure was used because it provides a simplified method that is very easy to apply and which has been used successfully elsewhere. The general concept of this method has been adopted by several other agencies including GRTA, the transportation planning agency for the greater Atlanta, Georgia, metropolitan area. The large size of the Florida DOT data base provides a great level of confidence in the overall procedure. Free-flow speeds were derived from travel time runs made in the early P.M. on Kea'au-Pāhoa Road. It was decided to use the average speeds for each direction of each segment as the free-flow speed for that segment. So, there is not a single free-flow speed for the entire corridor. Since free-flow speeds vary by location and direction of travel, the criteria for LOS also vary with each segment and with the two directions of travel.

The following Table 1-4 provides the criteria used for review of average travel speeds in the various segments of the corridor.

Table 1-4: LOS for Two-Lane Highways from Florida DOT Procedure

Level of Service (LOS)	% of Free-flow Speed Attained
A	> 91.7%
B	> 83.3%
C	> 75.0%
D	> 66.7%
E	> 58.3%
F	≤ 58.3%

For highways, the LOS is based on the volume to capacity (V/C) ratio as per the Florida DOT methodology. The Florida DOT criteria for LOS for highways are shown in Table 1-5.

Table 1-5: LOS for Multi-Lane Highways from Florida DOT Procedure

Level of Service (LOS)	V/C Ratio
A	≤ 0.09
B	≤ 0.30
C	≤ 0.56
D	≤ 0.79
E	≤ 1.0
F	> 1.0

In applying these criteria, the V/C ratio from the Synchro software was used for each intersection approach representing each segment of the roadway.

Florida DOT also provides criteria to assess LOS based on average travel speed on arterial streets. This table is taken from the HCM and it provides LOS based on observed or predicted speeds. Kea'au-Pāhoa Road is generally expected to be an arterial street with suburban and borderline urban characteristics in the design year of 2038. Table 1-6 was used in reviewing average speeds predicted by the SimTraffic model for the various alternatives studied.

Table 1-6: Level of Service Thresholds for Arterial Streets in Areas Transitioning into Urbanized Areas from Highway Capacity Manual

Level Of Service	Average Travel Speed
A	> 42 mph
B	> 34 mph
C	> 27 mph
D	> 21 mph
E	> 16 mph
F	≤ 16 mph

1.6.3 Detailed Description of Alternatives Methods of Intersection Analysis and Level of Service Criteria

Each intersection was analyzed using three different intersection analysis methods. The first technique analyzed the predicted intersection operations using Synchro LOS analysis as established in HCM. The second method utilized the SimTraffic simulation model to predict speeds that would be used to establish a LOS based on average traffic flow speeds. The third and final analysis method relies on a procedure developed by the Florida DOT. This method considers the volume to capacity ratio of each segment of a facility and assigns an LOS based on the calculated V/C ratio.

The methods of the HCM were used to analyze traffic flow at the area intersections. The Synchro software was used to apply the HCM methods since it provides a convenient way to store and summarize the data sets necessary for analysis. In addition, the criteria of the AASHTO were used to analyze the need for turning lanes. Other criteria, which are based on the AASHTO Green Book (2004), with materials taken from other state DOTs, were also used.

The overall approach was to consider each of the eleven major study intersections in each alternative model as individual, isolated locations and to review the traffic data for the A.M. and P.M. peak hours. These peak hours were studied using the HCM and AASHTO methods to determine the LOS for traffic operations and to recommend improvements to address any deficiencies. It was assumed that traffic volume should not exceed capacity for any movements and that the LOS should be "D" or better for all movements. The exception to this was to allow LOS E for minor side street or main-line turning movements.

The primary measure of traffic flow quality for the study used the concept of LOS as defined by the HCM. For intersections, the concept of LOS relates the quality of traffic flow to the delay time experienced by drivers. The HCM provides guidance on the use of the concept of LOS for streets and intersections. A tiered system has been established to describe traffic flow and congestion as related to observed and measured or predicted operational values. For intersections, the measure is stopped time delay. The LOS varies from A to F, with the quality of traffic service declining as the levels move from A towards F. With declining LOS, the ability to travel at the desired speed is inhibited by other vehicles either adjacent, opposite, or in front of a driver. Generally, in an urban area, it is expected that LOS D will be prevalent and be accepted in the A.M. and P.M. peak hours. So, any traffic movements with LOS E or worse would need to be reviewed closely to determine if any changes or improvements could be made to move the LOS to an acceptable level. Figure 1-9 on the following page illustrate LOS criteria at two-way stop-controlled intersections.

Figure 1-9: Representations of Levels of Service for Stop-Sign Controlled Intersections

Level Of Service	Flow Conditions	Technical Descriptions
A		Short Delays
B		Short Delays
C		Minimal Delays
D		Minimal Delays
E		Significant Delays
F		Considerable Delays

Level of Service	Signalized Intersections	Non-signalized Intersections	Roundabouts
	Vehicular Delay (Seconds)	Vehicular Delay (Seconds)	Vehicular Delay (Seconds)
A	< 10	<10	<10
B	10 – 20	10 - 15	10 - 15
C	20 – 35	15 - 25	15 - 25
D	35 – 55	25 - 35	25 - 35
E	55 – 80	35 - 50	35 - 50
F	> 80	> 50	> 50

Illustration Courtesy of California Department of Transportation

Level of Service (LOS)

Kea'au-Pāhoa Road Improvements, Kea'au to Pāhoa, Project No. STP-0130(27)
State of Hawai'i, Department of Transportation

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1.7 Development of Predicted Traffic Volumes with Preferred Alternative in Place in 2038

Traffic volumes were predicted for the year 2038 with the Preferred Alternative in place for the A.M. and P.M. peak hours. The volumes were calculated based on a review of the street system that would be in place, the predicted volumes for the year 2038 developed by Wilbur Smith Associates for this project, as shown in Figures 1-2 through 1-6, a review of existing development patterns and with consideration of the traffic control devices that would be in place. In general, the following guidelines were used to re-assign traffic to the new street network that would be in place with the Preferred Alternative:

- Traffic would use the new connectors where possible to utilize new traffic signals that would be in place in 2038.
- There would be conservation of traffic volumes from the 2038 data provided by Wilbur Smith Associates. In other words, no new traffic was added to the system or deleted from the system, compared to the predicted data.
- Estimates were made for several of the local street intersections which did not have traffic volumes available from counts made in 2006. These estimates maintained existing traffic volume totals and apportioned turning movements based on existing traffic patterns and the pattern of residential development on the local streets.
- Turning movements were developed based on the above general criteria and engineering judgment was applied in arriving at volume totals and distributions of trips.
- Other than the traffic signals and roundabouts, it was assumed that no other traffic control devices or modifications to speed limits would affect the distribution and assignment of trips.
- The origin and destination trip tables developed in the work done by Wilbur Smith Associates were used in some cases to apportion trips and assign them to the street network.
- Where multiple paths were possible, it was assumed that traffic was apportioned based on the upstream and downstream distributions that were available, taking into account the trip tables and the new traffic controls that would be in place in 2038.

The following Figure 1-10 shows the predicted A.M. and P.M. peak hour traffic volumes in the year 2038 with the Preferred Alternative in place for the portion of the study corridor from Pohaku Place to Pohaku Circle.

Figure 1-10: Predicted A.M. and P.M. Peak Hour Volumes in the Study Corridor from Pohaku Place to Pohaku Circle with the Preferred Alternative in Place in the Year 2038

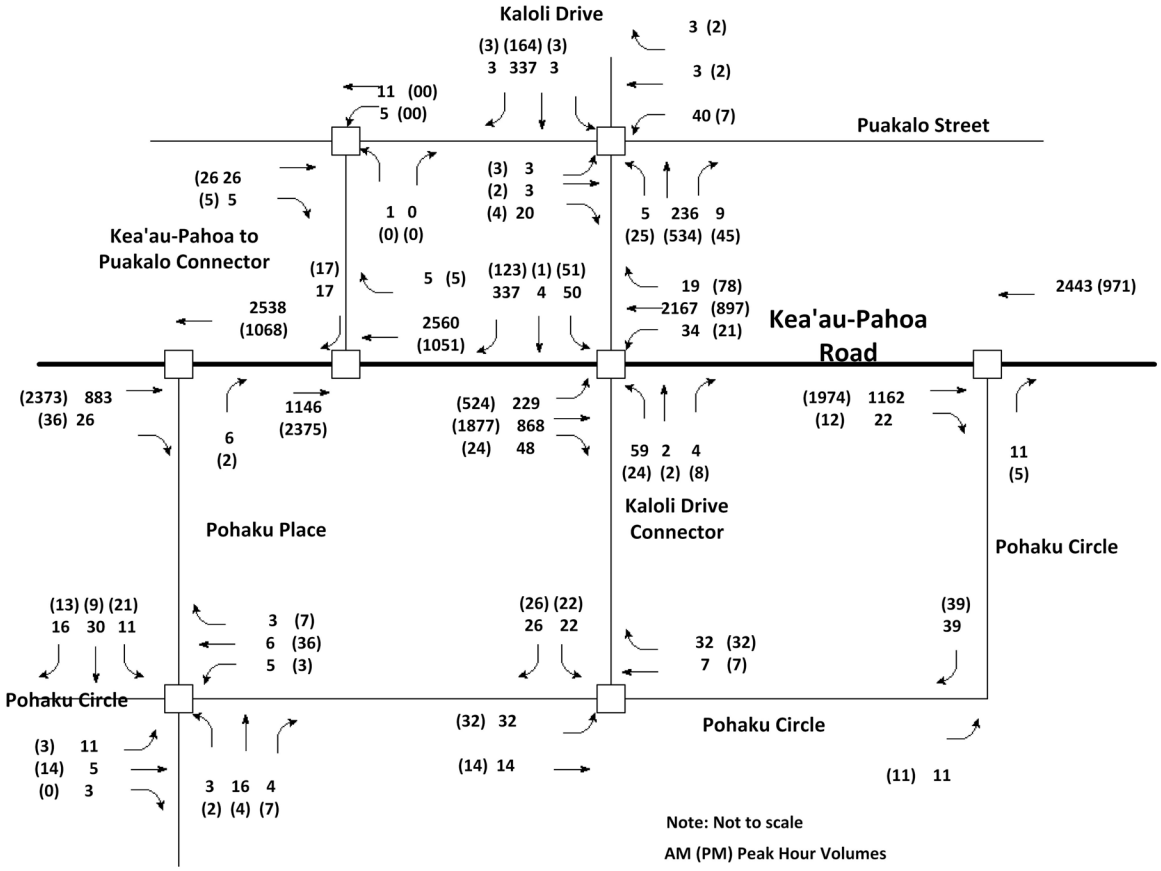
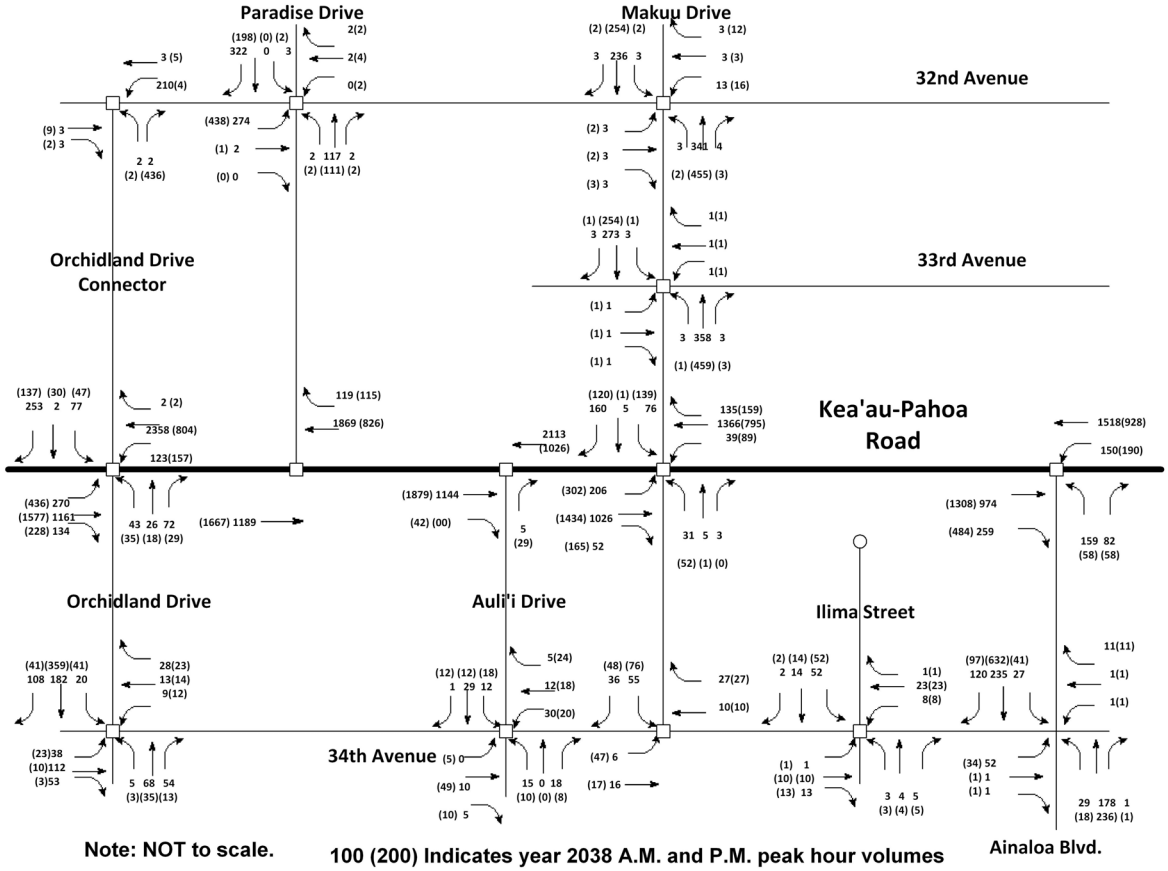


Figure 1-11 shows the A.M. and P.M. peak hour volumes predicted for the study corridor intersections in the year 2038 with the Preferred Alternative in place from about Orchidland Drive to about Ainaloa Boulevard.

Figure 1-11: Predicted A.M. and P.M. Peak Hour Volumes in the Study Corridor from Orchidland Dr. to Ainaloa Blvd. with the Preferred Alternative in Place in the Year 2038



The A.M. and P.M. peak hour volumes for the portions of the study corridor where there are no changes to the street system network as part of the Preferred Alternative are not changed and are the same as shown in Figure 1-7. These would include the intersections of Kea'au-Pāhoa Road at Opukahaia Street, at the Transfer Station, at Shower Drive, at Ka Ohuwalu Road, at Kahaluahine St., at Nanawale (Post Office Road), at the Unnamed Road and at Pāhoa-Kapoho Rd.

Figure 1-12 shows the A.M. and P.M. peak hour volumes predicted for the study corridor intersections in the year 2038 with the Preferred Alternative in place for the system that includes Old Pāhoa Road and Kahakai Blvd.

Figure 1-12: Predicted A.M. and P.M. Peak Hour Volumes in the Year 2038 with the Preferred Alternative in Place for the Old Pāhoa Road and Kahakai Blvd. System

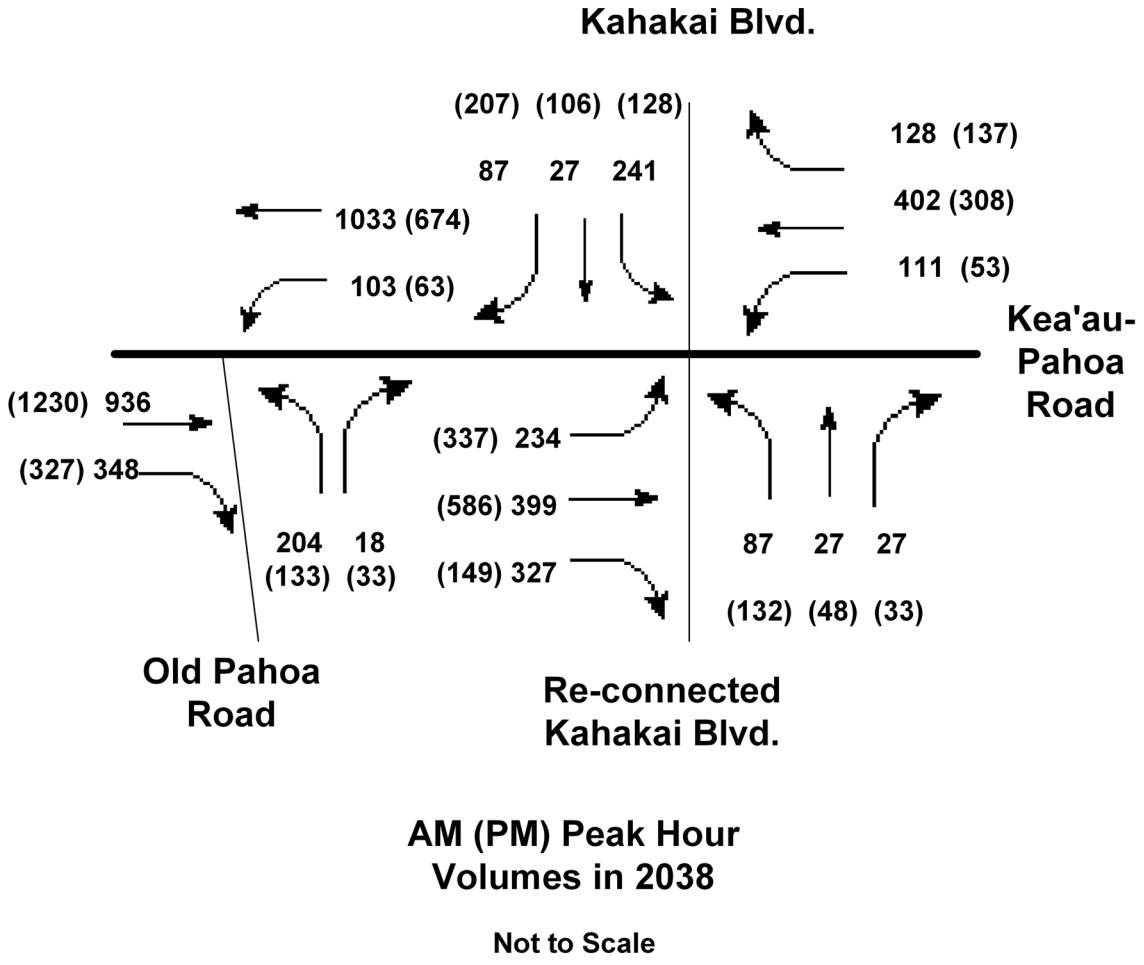


Figure 1-13 shows the predicted A.M. and P.M. peak hour volumes for the portion of the study corridor that includes 30th Avenue.

Figure 1-13: Predicted A.M. and P.M. Peak Hour Volumes in the Year 2038 with the Preferred Alternative in Place for the Portions of the Network Including 30th Avenue

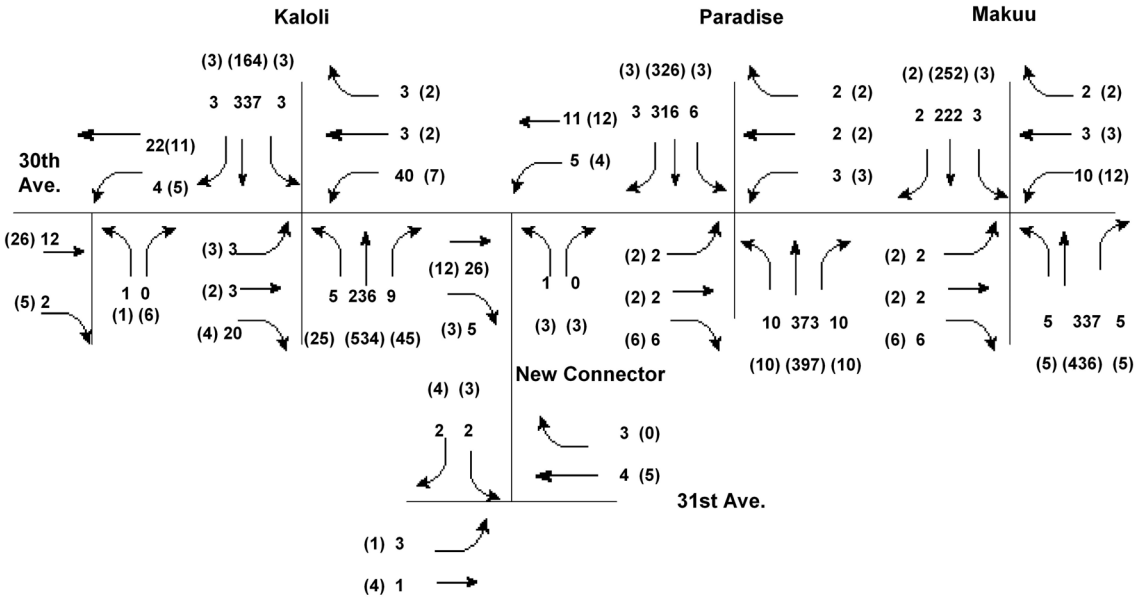


Figure 1-14 shows the predicted average daily traffic volumes (ADTs) for the study network streets for the year 2038 for the portion of the study corridor network that generally extends from Pohaku Place to Pohaku Circle.

Figure 1-15 shows the predicted ADTs for the study network streets for the year 2038 for the portion of the study corridor network that generally extends from Orchidland Drive to Ainaloa Blvd.

Figure 1-16 shows the predicted ADTs for the study network streets for the year 2038 for the portion of the study network that includes the Old Pāhoa Road and Kahakai Blvd. system.

Figure 1-14: Predicted ADTs for the Study Network Streets in the Year 2038 with the Preferred Alternative in Place from Near Pohaku Circle to Near Pohaku Place

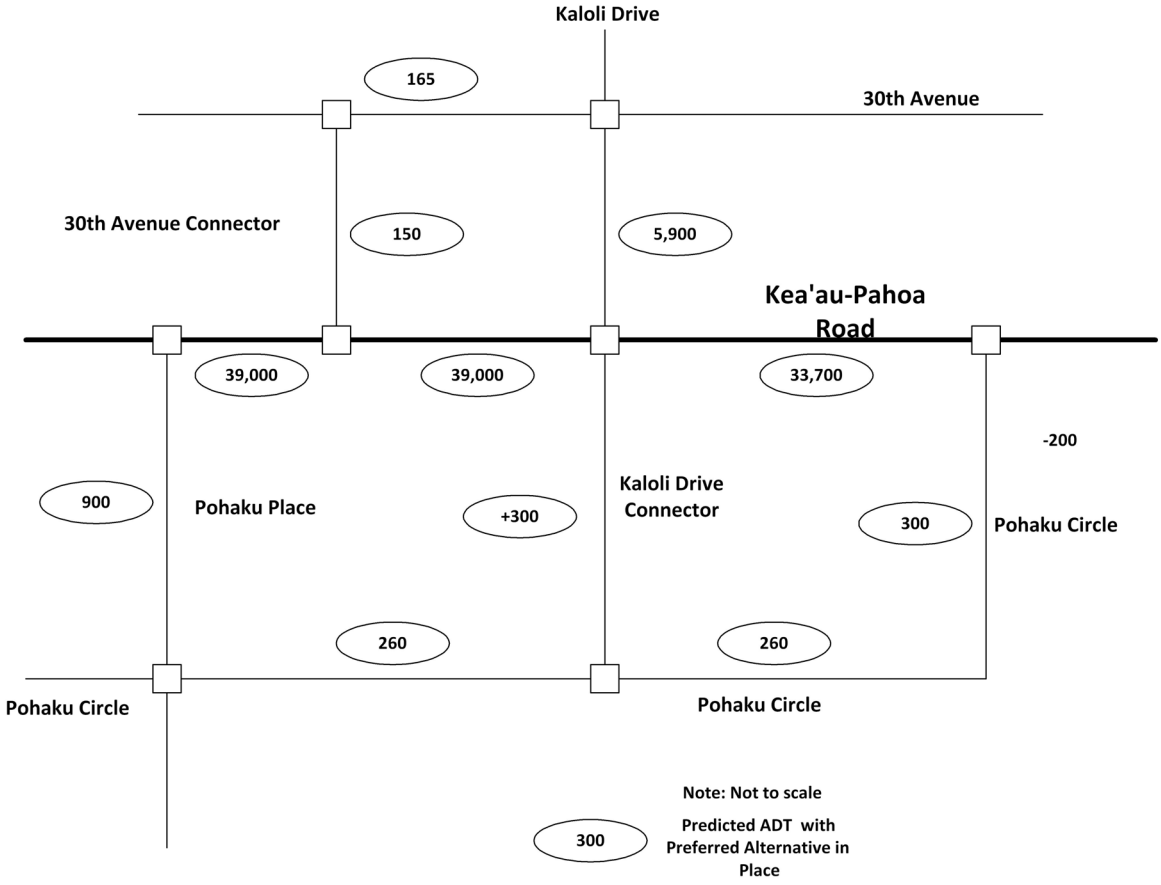


Figure 1-15: Predicted ADTs for the Study Network Streets in the Year 2038 with the Preferred Alternative in Place from Orchidland Dr. to Ainaloa Blvd.

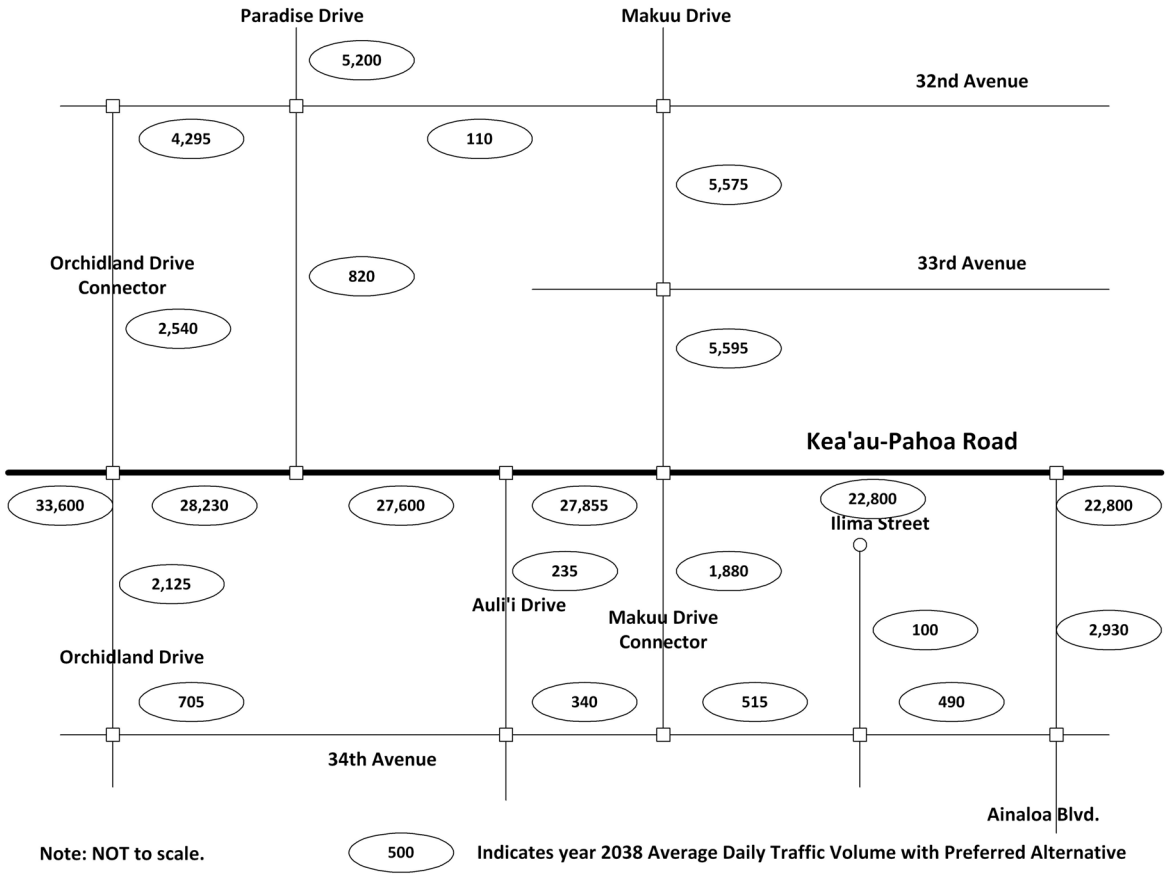
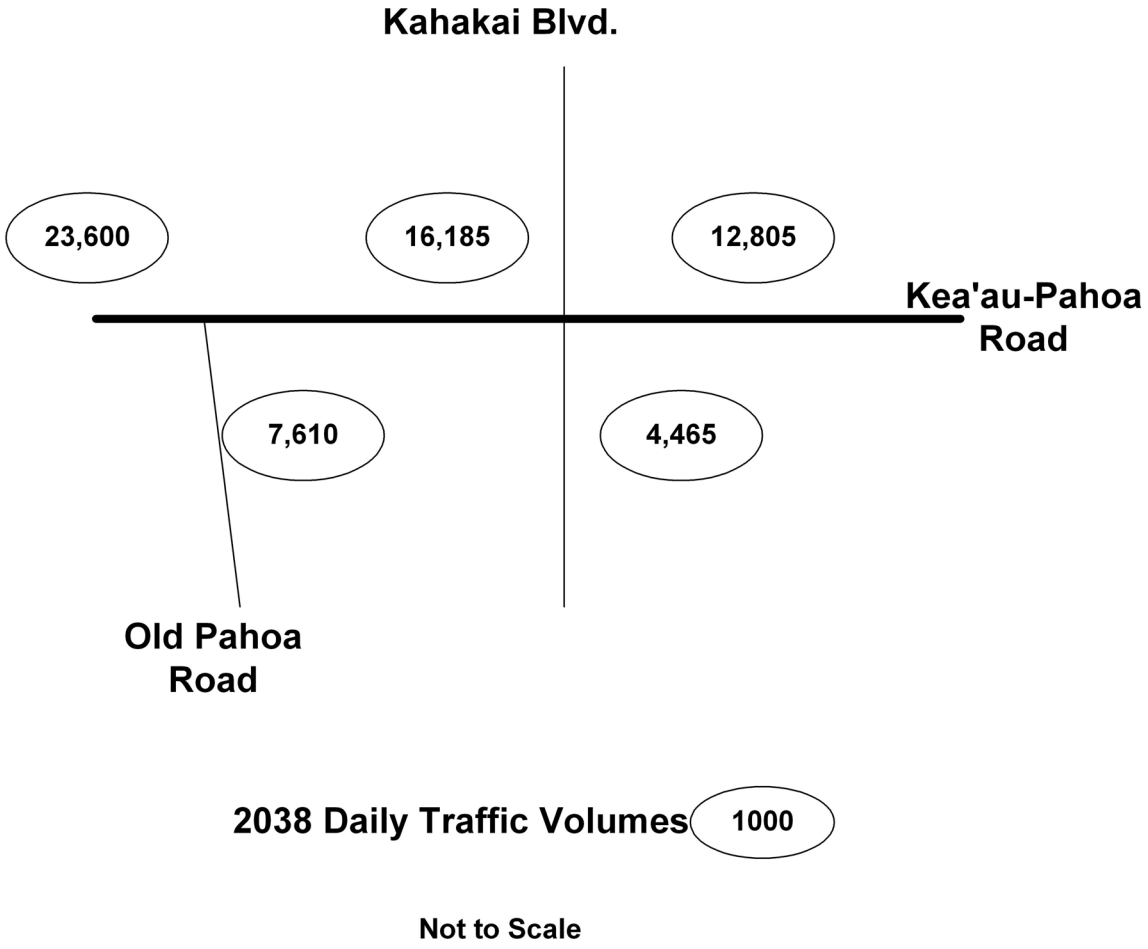


Figure 1-16: Predicted ADTs for the Study Network Streets in the Year 2038 with the Preferred Alternative in Place for the Old Pāhoa Road and Kahakai Blvd. System



CHAPTER 2: PREFERRED ALTERNATIVE ANALYSIS

2.1 Analysis

A detailed review was made of the Preferred Alternative using the methods of the HCM and the Florida DOT Quality/LOS Handbook, as discussed in Chapter 1. The Preferred Alternative includes a four-lane divided highway between the Kea'au Bypass and Pāhoa-Kapoho Road, with street system changes as shown in Figure 1-7. Traffic control devices would be as indicated in Table 1-1. There would be no changes to the posted speed limits currently in place. The analysis included traffic volumes, as predicted by Wilbur Smith Associates, for the year 2038.

Synchro software was used to assess the predicted traffic operations at each intersection in the study corridor. Tables 2-1, 2-2, 2-3 and 2-4 show the results of the Synchro runs for the A.M. and P.M. peak hours, respectively. Intersection LOS designations are as per Figure 1-9. Any movements worse than LOS D are highlighted. For the mainline through movements where an LOS is not calculated, any movements having volume to capacity (V/C) ratios over 0.85 are also highlighted in the tables.

As seen in Table 2-1, the westbound through movement has LOS C or better or V/C ratios under 0.85 in the A.M. peak hour except for at Orchidland Drive, Ainaloa Boulevard, and Old Pāhoa Road. In that same hour, the through movements in the eastbound direction towards Pāhoa have LOS B or better or V/C ratios under 0.49, with the exception of Ainaloa Boulevard, Old Pāhoa Road, and Kahakai Boulevard. Some of the side street movements do have LOS worse than D at some of the stop sign controlled intersections, reflecting the difficulty in making left turns across the heavy traffic volumes on Kea'au-Pāhoa Road. However, this is to be expected in areas that are urban or urbanizing, particularly in peak hours. All of the signalized intersections in the corridor show overall intersection LOS C or better in the A.M. peak hour. This table does show some congestion on Kea'au-Pāhoa Road at the three proposed roundabouts.

Table 2-2 shows excellent LOS and low levels of congestion for all intersections on the side streets in the study network off of Kea'au-Pāhoa Road. All LOS are shown to be C or better for the A.M. peak hour.

As seen in Table 2-3, the eastbound through movement generally has LOS B or better or acceptable V/C ratios in the P.M. peak hour. Exceptions include Shower Drive and the three proposed roundabout locations, which do show some congestion using the HCM methods. However, as will be seen later, the traffic simulation model shows much better traffic flow measures. In that same hour, the through movements in the westbound

direction towards Kea‘au have LOS C or better or V/C ratios under 0.78, with the exception of Ainaloa Boulevard. Some of the side street movements do have LOS worse than D at some of the non-signalized intersections, reflecting the difficulty in making left turns across the heavy traffic volumes on Kea‘au-Pāhoa Road. However, this is to be expected in areas that are urban or urbanizing, particularly during peak hours. All of the signalized intersections in the corridor show overall intersection LOS C or better in the P.M. peak hour, with the exception of Shower Drive.

As shown in Table 2-4, all the side street intersections in the study network show LOS C or better with low levels of congestion in the P.M. peak hour.

Table 2-1: Levels of Service and V/C Ratios for Kea'au-Pāhoa Road Intersections for the Preferred Alternative for Year 2038 for A.M. Peak Hour

Intersection of Kea'au-Pāhoa Road at	Int. LOS	Mainline						Side Street					
		Eastbound			Westbound			Northbound			Southbound		
		Left	Thru	Right	Left	Thru	Right	Left	Thru	Right	Left	Thru	Right
Opukahaia St.			NA 0.28		B	NA 0.83		C		C			
Transfer Sta.		E	NA 0.28			NA 0.84					F		F
Shower Dr. (TS)	A	C	A	A	A	B		E			E		A
Pohaku Place			NA 0.24			NA 0.81				B			
Connector To 30th Ave.			NA 0.37			NA 0.82							E
Kaloli Drive (TS)	C	F	A		A	B		E		E	E		A
Pohaku Circle			NA 0.37	NA 0.01		NA 0.78				B			
Orchidland Dr. (TS)	D	F	A	A	A	E		E		E	E		E
Paradise Dr.			A			B	A						
Auli'i Street			NA 0.37	NA 0.01		NA 0.71				B			
Maku'u Dr.(TS)	B	B	A		A	B	A	C		C	C		D
Ainaloa Blvd. (RD)		1.05			1.81			0.38					
Ka Ohuwalu		C	NA 0.44			NA 0.55					F		F
Kaluahine St.		A	NA 0.41	NA 0.02	B	NA 0.49	NA 0.49	F			F		
Old Pāhoa Rd. (RD)		0.95			1.28			0.46					
Kahakai Blvd. (RD)		0.91			0.66			0.25			0.58		
Nanawale (Post Office Road)		A	NA 0.19		A	NA 0.19		F		B	D		D
Unnamed Rd.		A	NA 0.14			NA 0.39					A		
Kapoho Rd. (TS)	C	C	C	C	C	D	C	B	B		C	C	C

(TS) – Indicates traffic signal in place. (RD) – Indicates roundabout in place. Values shown are v/c ratios.

Table 2-2: Levels of Service and V/C Ratios for Side Street Intersections in Study Corridor for the Preferred Alternative for Year 2038 for A.M. Peak Hour

Intersection	Int. LOS	Eastbound			Westbound			Northbound			Southbound		
		Left	Thru	Right	Left	Thru	Right	Left	Thru	Right	Left	Thru	Right
34th Ave. at Makuu Dr. Ext.		**NA** 0.00				**NA** **0.02**					**A**		**C**
34th Ave. at Auli'i St.		**A** 0.02			**B** 0.08			**A** 0.01			**A** **0.01**		
34th Ave. at Orchidland Dr.		**A** **0.03**			**A** **0.01**			**B** 0.21			**C** **0.49**		
34th Ave. at Ainaloa Blvd.		**C**			**B**			**A** 0.03			**A** 0.02		
34th Ave. at Ilima St.		**A**			**B**			**A** 0.00			**A** 0.00		
Pohaku Cir. at Pohaku Place		**A** **0.02**			**A** **0.06**			**A** **0.00**			**A** 0.01		
Pohaku Cir. at Kaloli Dr.			**A**			**NA** 0.02					**A**		**A**
Kaloli Dr. at 30th Ave.		**B**			**C**			**A**			**A**		
30th Ave. at Conn. to KP Rd.			**NA** **0.02**		**A** **0.00**			**A**		**A**			
30th Ave. at Conn. To 31st			**A**		**A**			**A**		**A**			
32nd at Conn. To KP Rd.			**A**		**A**			**A**		**A**			
Paradise Drive at 30th Ave.		**B** **0.02**			**C** **0.02**			**A** 0.01			**A** **0.00**		
Paradise Drive at 32nd Ave.		**C**			**B**			**A** 0.00			**A** 0.00		
Maku'u Drive at 30th Ave.		**B**			**B**			**A** 0.00			**A** 0.00		
Maku'u Drive at 32nd Ave.		**B**			**B**			**A** 0.00			**A** 0.00		
Maku'u Drive at 33rd Ave.		**B**			**B**			**A** 0.00			**A** 0.00		

Note: All intersections have stop sign control.

Table 2-3: Levels of Service and V/C Ratios for Kea'au-Pāhoa Road Intersections for Preferred Alternative for Year 2038 for P.M. Peak Hour

Intersection at	Int. LOS	Mainline						Side Street					
		Eastbound			Westbound			Northbound			Southbound		
		Left	Thru	Right	Left	Thru	Right	Left	Thru	Right	Left	Thru	Right
Opukahaia St.			NA 0.89		E	NA 0.40		F		F			
Transfer Sta.		B	NA 0.87			NA 0.39					F		F
Shower Dr. (TS)	F	B	F	A	D	B		D			E		A
Pohaku Place			NA 0.77			NA 0.34				D			
Connector To 30th Ave.			NA 0.76			NA 0.33							B
Kaloli Drive (TS)	B	D	A		B	B		C		C	C		A
Pohaku Circle			NA 0.63	NA 0.01		NA 0.31				C			
Orchidland Dr. (TS)	B	B	B	A	B	B		C		C	D		C
Paradise Dr.			NA 0.53			NA 0.26	NA 0.07						
Auli'i Street			NA 0.60	NA 0.03		NA 0.33				C			
Maku'u Dr.(TS)	B	A	A		C	B	A	C		C	D		C
Ainaloa Blvd. (RD)		1.46			1.10			0.19					
Ka Ohuwalu		B	NA 0.53			NA 0.37					D		D
Kaluahine St.		B	NA 0.49	NA 0.01	A	NA 0.33	NA 0.33	C			F		
Old Pāhoa Rd. (RD)		1.22			0.78			0.41					
Kahakai Blvd. (RD)		1.19			0.59			0.48			0.35		
Nanawale (Post Office Rd.)		A	NA 0.14		A	NA 0.12		F		B	F		F
Unnamed Rd.		A	NA 0.14			NA 0.12					A		
Kapoho Rd. (TS)	B	C	B	B	B	C	C	B	B		B	C	B

TS) – Indicates traffic signal in place. (RD) – Indicates roundabout in place. Values shown are v/c ratios.

Table 2-4: Levels of Service and V/C Ratios for Side Street Intersections in Study Corridor for the Preferred Alternative for Year 2038 for P.M. Peak Hour

Intersection	Int. LOS	Eastbound			Westbound			Northbound			Southbound		
		Left	Thru	Right	Left	Thru	Right	Left	Thru	Right	Left	Thru	Right
34th Ave. at Makuu Dr. Ext.		A 0.03				NA 0.02					A		A
34th Ave. at Auli'i St.		A 0.08			A 0.08			A 0.01			A 0.01		
34th Ave. at Orchidland Dr.		A 0.02			A 0.01			B 0.07			C 0.62		
34th Ave. at Ainaloa Blvd.		C			B			A 0.02			A 0.02		
34th Ave. at Ilima St.		A			B			A 0.00			A 0.03		
Pohaku Cir. at Pohaku Place		A 0.02			A 0.06			A 0.00			A 0.01		
Pohaku Cir. at Kaloli Dr.			A			A 0.00					A		A
Kaloli Dr. at 30th Ave.		B			C			A 0.02			A 0.00		
30th Ave. at Conn. to KP Rd.			NA 0.02		A 0.00			A		A			
30th Ave. at Conn. To 31st			NA 0.01		A 0.00			A		A			
31st at Conn. to 30th Ave.			NA 0.01		NA 0.01			A		A			
32nd at Conn. To KP Rd.			NA		A 0.14			B		B			
Paradise Drive at 30th Ave.		B 0.02			C 0.02			A 0.01			A 0.00		
Paradise Drive at 32nd Ave.		C			B			A 0.00			A 0.00		
Maku'u Drive at 30th Ave.		B			B			A 0.00			A 0.00		
Maku'u Drive at 32nd Ave.		B			C			A 0.00			A 0.00		
Maku'u Drive at 33rd Ave.		B			B			A 0.00			A 0.00		

Note: All intersections have stop sign control.

As a further detailed review, the SimTraffic module of Synchro was used to do microscopic modeling of the network for the A.M. and P.M. peak hours for Preferred Alternative for the year 2038. Tables 2-5, 2-6, 2-7, and 2-8 show the important measures from the SimTraffic analysis runs.

As seen in Table 2-5, speeds would generally vary from 2 to 56 mph in the westbound direction towards Kea‘au in the A.M. peak hour. The slower speeds are indicated on the approaches to the signalized intersections as would be expected. For the segments without traffic signals, speeds are predicted by SimTraffic to be above 26 mph, with the exception of the approach to the roundabouts at Ainaloa Boulevard, Kahakai Boulevard and Old Pāhoa Road. For the eastbound direction in the A.M. peak hour, the speeds would generally vary from 8 to 58 mph, again with the lower speeds on the approaches to signalized intersections. In segments approaching intersections with no traffic control the speeds generally range from 36 to 58 mph. All the signalized intersections have delays less than 75 seconds for the mainline through movements, except for the westbound approach at Orchidland Drive. This is also the case for the side street approaches, except for at Ka Ohuwalu in the southbound direction, which has a very low volume of traffic, and Kahakai Boulevard and Old Pāhoa Road, which have roundabouts.

As seen in Tables 2-5 and 2-6, the data indicates overall a very good picture of traffic operations in the corridor for the A.M. peak hour with Preferred Alternative in place in the year 2038.

As seen in Table 2-7, speeds would generally vary from 4 to 58 mph in the eastbound direction towards Pāhoa in the P.M. peak hour. The slower speeds are indicated on the approaches to the signalized intersections as would be expected. For the segments without traffic signals, speeds are predicted by SimTraffic to be above 39 mph. For the westbound direction in the P.M. peak hour, the speeds would generally vary from 6 to 57 mph, again with the lower speeds on the approaches to signalized intersections. In segments approaching intersections with no traffic control the speeds range from 21 to 58 mph. All the stop sign controlled intersections have less than 16 seconds of delay except for the northbound movement at Opukahaia Street and the southbound movement at the Transfer Station, both of which have a very low volume of traffic.

As seen in Tables 2-7 and 2-8, this data indicates overall a very good picture of traffic operations in the corridor for the P.M. peak hour with Preferred Alternative in place in the year 2038.

Table 2-5: Traffic Operational Measures from SimTraffic for Kea'au-Pāhoa Road for Preferred Alternative for Year 2038 for A.M. Peak Hour

Intersection	Eastbound			Westbound			Northbound			Southbound		
	Delay (sec)	Queue (ft)	Speed (mph)	Delay (sec)	Queue (ft)	Speed (mph)	Delay (sec)	Queue (ft)	Speed (mph)	Delay (sec)	Queue (ft)	Speed (mph)
Opukahaia	2.3	0	55	2.1	32	37	12.5	32	22	Movement does not exist		
Transfer Sta.	2.3	70	36	23.7	22	47	Movement does not exist			31.4	130	10
Shower Dr. (TS)	4.7	83	47	6.7	344	34	16.6	43	20	7.6	26	23
Pohaku Place	2.3	0	52	1.9	0	49	4.3	31	17	Movement does not exist		
Connector To 30th Ave.	1.1	0	50	3.5	523	48	Movement does not exist			42.0	70	4
Kaloli Drive (TS)	19.2	300	13	17.4	385	28	58.4	107	5	12.0	144	11
Pohaku Circle	2.2	0	51	12.1	0	42	0.8	27	24	Movement does not exist		
Orchidland Dr. (TS)	73.4	1345	17	200.7	587	13	44.2	125	10	71.4	244	2
Paradise Dr. (TS)	2.5	0	26	6.3	0	28	Movement does not exist			0.7	0	27
Auli'i Street	2.3	0	54	4.6	0	51	2.1	26	25	Movement does not exist		
Maku'u Dr.(TS)	10.3	202	22	13.2	397	12	30.4	71	12	10.6	91	11
Ainaloa Blvd. (RD)	12.8	172	26	16.6	238	24	9.7	119	20	Movement does not exist		
Ka Ohuwalu	2.4	24	58	3.9	0	56	Movement does not exist			186.4	228	4
Kaluahine	3.6	0	56	8.5	72	50	44.7	52	12	7.5	23	21
Old Pāhoa Rd. (RD)	18.7	184	46	10.4	139	15	113.8	476	3	Movement does not exist		
Kahakai Blvd. (RD)	13.7	271	13	9.1	116	24	24.9	202	8	318.8	1017	5
Nanawale (Post Office)	1.6	20	54	1.6	17	56	26.0	155	12	20.3	115	16
Unnamed Rd.	1.0	23	55	0.6	0	56	Movement does not exist			0	0	0
Kapoho Rd. (TS)	22.9	194	8	73.8	260	2	17.1	192	16	24.8	494	16

(TS) – Indicates traffic signal in place. (RD) – Indicates roundabout in place.
Speeds taken from SimTraffic runs for all side street and connector segments.

Table 2-6: Traffic Operational Measures from SimTraffic for Side Streets in Study Corridor for Preferred Alternative Year 2038 A.M. Peak Hour

Corridor Locations	Eastbound			Westbound			Northbound			Southbound		
	Delay (sec)	Queue (ft)	Speed (mph)	Delay (sec)	Queue (ft)	Speed (mph)	Delay (sec)	Queue (ft)	Speed (mph)	Delay (sec)	Queue (ft)	Speed (mph)
30th at KP Conn.	1.6	0	25	0.9	0	28	3.2	31	11	Movement does not exist.		
31st /Conn. 30th – 31st	2.0	0	26	4.2	32	23	Movement does not exist.			0.2	0	15
30th at/Conn. to 31st	1.4	0	24	1.9	0	29	1.1	31	16	Movement does not exist.		
Pohaku Pl./ Pohaku Cir.	6.2	32	22	6.2	51	25	2.9	0	23	2.1	0	19
Pohaku Cir. at Kaloli	2.6	0	28	4.0	21	23	Movement does not exist.			2.5	51	18
Kaloli at 30th	5.5	51	26	8.9	52	18	1.7	0	21	1.3		28
Orchidland at 32nd Ave	2.9	0	17	5.7	148	22	6.4	121	11	Movement does not exist.		
Orchidland at 34th Ave.	3.8	25	27	4.0	54	25	6.3	0	20	8.3	131	19
Paradise at 30th Ave.	2.5	30	26	6.3	30	28	0.9	47	25	0.7	0	27
Paradise at 32nd Ave.	10.3	127	20	2.0	31	30	0.5	0	20	5.6	0	15
Auli'i at 34th Ave.	2.2	32	27	7.2	52	27	1.2	0	25	0.8	0	26
Makuu at 30th Ave.	6.1	52	25	8.3	31	10	1.7	29	26	0.4	29	28
Makuu at 32nd Ave.	6.1	31	27	7.4	32	14	1.6	30	26	0.8	31	27
Makuu at 33rd Ave.	5.7	31	25	4.1	32	18	1.0	30	20	1.3	0	27
Makuu at 34th Ave.	1.9	0	28	2.9	0	18	Movement does not exist.			4.1	53	21
Ilima at 34th Ave.	3.1	31	15	1.1	31	23	1.2	0	25	1.3	0	24
Ainaloa at 34th Ave.	7.3	52	20	4.1	31	19	1.3	74	24	2.2	55	24

Notes: All intersections have stop sign control.
Speeds taken from SimTraffic runs for all side street and connector segments.

Table 2-7: Traffic Operational Measures from SimTraffic for Side Street Intersections in Study Corridor for Preferred Alternative for Year 2038 for P.M. Peak Hour

Intersection	Eastbound			Westbound			Northbound			Southbound		
	Delay (sec)	Queue (ft)	Speed (mph)	Delay (sec)	Queue (ft)	Speed (mph)	Delay (sec)	Queue (ft)	Speed (mph)	Delay (sec)	Queue (ft)	Speed (mph)
Opukahaia St.	12.1	0	46	4.0	103	21	>100	>500	1	Movement does not exist		
Transfer Sta.	1.8	52	39	19.5	22	49	Movement does not exist			>100	499	1
Shower Dr. (TS)	>100	1738	46	4.0	389	27	50.0	79	12	>100	>500	7
Pohaku Place	4.6	0	46	0.7	0	52	5.0	32	13	Movement does not exist		
Connector To 30th Ave.	2.5	0	46	1.8	523	53	Movement does not exist			9.0	50	9
Kaloli Drive (TS)	12.9	433	17	17.5	343	28	28.5	87	8	16.5	124	9
Pohaku Circle	4.9	0	46	5.6	0	49	1.6	27	23	Movement does not exist		
Orchidland Dr. (TS)	21.6	398	34	16.9	238	15	33.7	83	11	20.3	130	6
Paradise Dr. (TS)	1.2	0	51	3.3	0	50	Movement does not exist			0.0	0	0
Auli'i Street	4.4	0	50	2.9	0	54	13.5	47	16	Movement does not exist		
Maku'u Dr.(TS)	14.0	310	18	13.5	180	12	23.0	72	13	20.9	169	8
Ilima Street	Intersection does not exist.											
Ainaloa Blvd. (RD)	69.9	501	4	8.5	48	25	2.6	94	7	Movement does not exist		
Ka Ohuwalu	2.2	51	58	2.7	0	57	Movement does not exist			13.8	57	19
Kaluahine St.	3.7	24	56	1.1	0	57	11.0	52	20	8.4	23	21
Old Pāhoa Rd. (RD)	21.7	195	44	7.6	147	17	42.6	204	6	Movement does not exist		
Kahakai Blvd. (RD)	62.1	427	5	9.6	111	22	>100	432	1	18.4	182	7
Nanawale (Post Office)	1.5	0	55	2.1	19	55	15.1	116	15	12.3	97	20
Unnamed Rd.	0.9	0	56	0.7	0	57	Movement does not exist			9.0	52	20
Kapoho Rd. (TS)	23.2	234	8	21.6	233	6	15.4	156	16	16.9	157	18

(TS) – Indicates traffic signal in place. (RD) – Indicates roundabout in place.
Speeds taken from SimTraffic runs for all side street and connector segments.

Table 2-8: Traffic Operational Measures from SimTraffic for Kea'au- Road for Preferred Alternative for Year 2038 for P.M. Peak Hour

Corridor Locations	Eastbound			Westbound			Northbound			Southbound		
	Delay (sec)	Queue (ft)	Speed (mph)	Delay (sec)	Queue (ft)	Speed (mph)	Delay (sec)	Queue (ft)	Speed (mph)	Delay (sec)	Queue (ft)	Speed (mph)
30th at KP Conn.	1.6	0	25	0.9	29	28	3.2	0	11	Movement does not exist.		
31st /Conn. 30th – 31st	1.6	0	31	3.6	32	23	Movement does not exist.			1.8	31	13
30th /Conn. 30th -31st	0.3	0	28	1.6	0	29	2.9	31	11	Movement does not exist.		
Pohaku Pl./ Pohaku Cir.	5.5	32	20	1.3	32	27	4.0	0	21	1.4	0	19
Pohaku Cir. at Kaloli	2.0	0	28	4.4	0	24	Movement does not exist.			4.2	51	17
Kaloli at 30th	2.0	32	28	8.9	32	21	2.8	31	18	1.0	30	28
Orchidland at 32nd Ave	0.3	0	28	3.4	51	24	5.8	118	11	Movement does not exist.		
Orchidland at 34th Ave.	2.1	0	28	2.8	0	26	5.4	71	22	9.7	114	19
Paradise at 30th Ave.	2.5	30	26	6.3	52	28	0.9	49	25	0.7	28	27
Paradise at 32nd Ave.	9.5	127	21	5.4	31	29	0.9	30	19	3.3	2	18
Auli'i at 34th Ave.	7.1	93	26	6.0	52	25	3.1	0	20	3.0	20	22
Makuu at 30th Ave.	5.7	31	28	6.4	49	12	2.1	0	26	0.6	0	27
Makuu at 32nd Ave.	6.9	31	28	7.2	32	13	1.5	2	27	0.9	31	27
Makuu at 33rd Ave.	5.3	31	26	11.4	32	12	1.0	0	21	1.0	0	27
Makuu at 34th Ave.	5.2	73	28	3.7	0	16	Movement does not exist.			2.8	52	21
Ilima at 34th Ave.	3.4	52	14	1.6	54	22	0.4	0	25	1.4	31	23
Ainaloa at 34th Ave.	3.5	31	22	4.7	31	18	0.7	53	28	2.1	52	24

Notes: All intersections have stop sign control.
Speeds taken from SimTraffic runs for all side street and connector segments.

Tables 2-9 and 2-10 provide a summary of the analysis of the corridor’s expected traffic congestion and LOS based on the methods of the Florida DOT for the A.M. and P.M. peak hours, respectively. This analysis treats Kea‘au-Pāhoa Road as an uninterrupted facility with access control as per the Florida DOT LOS Manual.

As seen in Table 2-9, Preferred Alternative would provide LOS D or better for all segments of the corridor in both directions of travel in the A.M. peak hour, with the majority of the segments having LOS C or better. In the westbound direction the LOS would be D from Maku’u Drive westward. All the eastbound direction LOS would be C or better in the A.M. peak hour.

As seen in Table 2-10, Preferred Alternative would provide LOS D or better for all segments of the corridor in the P.M. hour except for the segments between Opukahaia Street and Shower Drive in the eastbound direction. Even these two segments would have V/C ratios of less than 1.0, indicating that there would be sufficient capacity for the total approach volume in the eastbound direction. In the westbound direction, all LOS would be B or C.

As seen in Tables 2-1 through 2-10, improvements are noted for virtually all of the segments of the corridor as well as many of the intersections. While there would still be some minor congestion issues at a few of the intersections and on some segments of roadway, the SimTraffic results indicate LOS D or better for all segments for both the A.M. and P.M. peak hours.

Table 2-9: Segmental LOS Using Florida DOT Methodology for Preferred Alternative for Year 2038 for A.M. Peak Hour

From	To	Lanes		Capacity		Volume		V/C Ratio		LOS	
		Ebd	Wbd	Ebd	Wbd	Ebd	Wbd	Ebd	Wbd	Ebd	Wbd
Opukahaia	Transfer	2	2	3390	3390	882	2646	0.26	0.78	B	D
Transfer	Shower	2	2	3390	3390	837	2614	0.25	0.77	B	D
Shower	Pōhaku Pl	2	2	3390	3390	909	2251	0.27	0.66	B	D
Pōhaku Pl	Puakalo Conn.	2	2	3390	3390	1146	2538	0.34	0.75	C	D
Puakalo Conn.	Kaloli	2	2	3390	3390	1145	2565	0.34	0.76	C	D
Kaloli	Pōhaku Cr	2	2	3390	3390	1184	2220	0.35	0.65	C	D
Pōhaku Cr	Orchidland	2	2	3390	3390	1565	2443	0.46	0.72	C	D
Orchidland	Paradise	2	2	3390	3390	1189	2483	0.35	0.73	C	D
Paradise	Auli'i	2	2	3390	3390	1144	1988	0.34	0.59	C	D
Auli'i	Maku'u	2	2	3390	3390	1284	2113	0.38	0.62	C	D
Maku'u	Ainaloa	2	2	3390	3390	1233	1540	0.35	0.45	C	C
Ainaloa	Ka Ohuwalu	2	2	3390	3390	1393	1668	0.38	0.50	C	C
Ka Ohuwalu	Kaluahine	2	2	3390	3390	1303	1697	0.38	0.50	C	C
Kaluahine	Old Pāhoa	2	2	3390	3390	1284	1166	0.23	0.34	B	C
Old Pāhoa	Kahakai	2	2	3390	3390	960	1136	0.16	0.19	B	B
Kahakai	Nanawale (Post Office)	2	2	3390	3390	547	641	0.13	0.18	B	B
Nanawale (Post Office)	Unnamed	2	2	3390	3390	444	582	0.14	0.17	B	B
Unnamed	Kapoho	2	2	3390	3390	459	582	0.26	0.17	B	B

Table 2-10: Segmental LOS Using Florida DOT Methodology for Preferred Alternative for Year 2038 for P.M. Peak Hour

From	To	Lanes		Capacity (1)		Volume(2)		V/C Ratio		LOS (3)	
		Ebd	Wbd	Ebd	Wbd	Ebd	Wbd	Ebd	Wbd	Ebd	Wbd
Opukahaia	Transfer	2	2	3390	3390	2782	1249	0.82	0.37	E	C
Transfer	Shower	2	2	3390	3390	3137	1235	0.93	0.36	E	C
Shower	Pōhaku Pl	2	2	3390	3390	2409	1082	0.71	0.32	D	C
Pōhaku Pl	Puakalo Conn.	2	2	3390	3390	2375	1068	0.70	0.32	D	C
Puakalo Conn.	Kaloli	2	2	3390	3390	2425	1056	0.72	0.31	D	C
Kaloli	Pōhaku Cr	2	2	3390	3390	1986	996	0.59	0.29	D	B
Pōhaku Cr	Orchidland	2	2	3390	3390	2241	971	0.66	0.29	D	B
Orchidland	Paradise	2	2	3390	3390	1667	963	0.49	0.28	C	B
Paradise	Auli'i	2	2	3390	3390	1921	941	0.57	0.28	D	B
Auli'i	Maku'u	2	2	3390	3390	1901	1026	0.56	0.30	D	C
Maku'u	Ainaloa	2	2	3390	3390	1792	1043	0.53	0.31	C	C
Ainaloa	Ka Ohuwalu	2	2	3390	3390	1678	1118	0.49	0.33	C	C
Ka Ohuwalu	Kaluahine	2	2	3390	3390	1558	1132	0.46	0.33	C	C
Kaluahine	Old Pāhoa	2	2	3390	3390	1557	1038	0.46	0.31	C	C
Old Pāhoa	Kahakai	2	2	3390	3390	1072	737	0.38	0.22	C	B
Kahakai	Nanawale (Post Office)	2	2	3390	3390	506	498	0.15	0.15	B	B
Nanawale (Post Office)	Unnamed	2	2	3390	3390	553	400	0.16	0.12	B	B
Unnamed	Kapoho	2	2	3390	3390	466	364	0.14	0.11	B	B

(1) See Chapter 1 of TECHNICAL REPORT Traffic Analysis For Kea'au-Pāhoa Road (January 2010) for lane capacities. (2) Total approach volume in peak hour. (3) See Chapter 1, Table 1-18 of TECHNICAL REPORT Traffic Analysis For Kea'au-Pāhoa Road (January 2010) for criteria.

2.2 Turn Lane Design Length

The following Table 2-11 provides the maximum queue lengths from the SimTraffic analysis for the Preferred Alternative. This table includes the maximum queues taken from the SimTraffic runs for both the A.M. and P.M. peak hours. These values can be used as a guide in establishing design turn lane storage lengths for this alternative. The values in the table do not include approach taper lengths for turn lanes. Both the storage lengths and the tapers should comply with HDOT and/or AASHTO Green Book criteria as appropriate.

Table 2-11: Maximum Queue Lengths from SimTraffic Analysis for Preferred Alternative

Intersection of Kea'au-Pāhoa Road at	East-bound	West-bound	North-bound	South-bound
Opukahaia St.		103	500	
Transfer Station	70	22		500
Shower	1738	389	99	500
Pohaku Place		0	32	
Kaloli Drive	433	385	107	74
Pohaku Circle		0	27	
Orchidland Dr.	1345	587	125	
Paradise Drive	365	0		244
Auli'i Street		0	47	
Maku'u Drive	310	397	72	169
Ainaloa Blvd.	501	298	119	
Ka Ohuwalu Dr	51		0	228
Kaluahine St.	26	0	52	23
Old Pāhoa Rd.	195	147	476	
Kahakai Blvd.	271	116	432	1017
Nanawale (Post Office Rd)	51	19	155	115
Unnamed Road	23	0	0	52
Pāhoa-Kapoho Road	244	260	192	494

2.3 Traffic Flow Conclusions for Preferred Alternative

The Preferred Alternative would provide significant improvements to the corridor although there are still some poor levels of service for a few intersection movements. Based on the review of the analysis of intersection levels of service using the HCM, the SimTraffic simulation analysis and the Florida DOT segmental analysis, the Preferred Alternative would achieve the objectives needed to fulfill the purpose and need of the proposed project.

REFERENCES

A Study of Predicted Traffic Operations for Kea‘au-Pāhoa Road, Roger D. Dyar, P.E., March 2009.

Highway Capacity Manual (HCM)

Institute of Transportation Engineers (ITE) Traffic Engineering Handbook

Manual on Uniform Traffic Control Devices (MUTCD)

Policy on Geometric Design of Highway and Streets, American Association of State Highway and Transportation Officials (AASHTO), 2004. Also known as "The AASHTO Green Book.”

TECHNICAL REPORT: Traffic Analysis for Kea‘au-Pāhoa Road, by Roger D. Dyar, P.E., January 2010